United States
International Trade Commission

Aluminum: Competitive Conditions Affecting the U.S. Industry

June 2017
Publication Number: 4703
Investigation Number: 332-557

United States International Trade Commission

Commissioners

Rhonda K. Schmidtlein, Chairman

David S. Johanson, Vice Chairman

Irving A. Williamson

Meredith M. Broadbent

Catherine DeFilippo
Director, Office of Operations

Jonathan Coleman
Director, Office of Industries

Address all communications to
Secretary to the Commission
United States International Trade Commission
Washington, DC 20436

United States International Trade Commission

Aluminum: Competitive Conditions Affecting the U.S. Industry

June 2017
Publication Number: 4703
Investigation Number: 332-557

United States International Trade Commission

This report was prepared principally by

Co-Project Leaders
Karl Tsuji, karl.tsuji@usitc.gov
Mihir Torsekar, mihir.torsekar@usitc.gov

Office of Industries
Renee Berry, Mark Brininstool, Logan Cobb, Brian Daigle, Andrew David, Diana Friedman, David Guberman, Vincent Honnold, Mahnaz Khan, Gregory LaRocca, Kathryn Lundquist, Daniel Matthews, Deborah McNay, Jessica Pugliese, Mitchell Semanik, and Marin Weaver

Office of Economics
Andre Barbe, Alan Fox, and Ravinder Ubee

Office of Analysis and Research
Robert Bauchspies, Maureen Letostak, David Lundy, Laura Thayn, and Wendy Willis

Office of Tariff Affairs and Trade Agreements
Janet Freas

Office of the General Counsel
William Gearhart

Content Reviewers
John Fry and Wen Jin Yuan

Statistical Reviewer
Jeremy Wise

Editorial Reviewer
Judy Edelhoff and Peg Hausman

Administrative Support
Jaime Bruckman, Cynthia Payne, Monica Sanders, and Blair Williams

Special Assistance
Robert Feinberg

Interns
Jared Angle, Renato Barredo, Robert Casanova, Sharifa Crawford, Pamela Davis, Celia Feldpausch, Maeryn Goldman, Fernando Gracia, Matthew Hoff, Christopher Mitchell, KaDeadra McNealy, Thomas Ponikowski, Mary Roop, and Amanda Ryan

Office of the Chief Information Officer
Phyllis Boone and Shala Ewing

Help Desk and Customer Service Division

Under the direction of
Robert Carr, Chief
Natural Resources and Energy Division
Office of Industries

Table of Contents

Boxes

Figures

Tables

Abbreviations and Acronyms

Abbreviation or acronym	Term
1xxx	pure (nonalloyed) aluminum
AAC	Aluminium Association of Canada
AAC	Australian Aluminium Council
AD	antidumping
AEC	Aluminum Extruders Council
AEFTC	Aluminum Extruders Fair Trade Committee
Alba	Aluminium Bahrain
AluNorf	Aluminum Norf GmbH
Alupco	Aluminium Products Co. (Saudi Arabia)
ASM	*Annual Survey of Manufacturers*
ASM	American Society for Metals International
AUV	average unit value
AVE	ad valorem equivalent
Balexco	Bahrain Aluminium Extrusion Co.
Befesa	Befesa Aluminium Germany GmbH
BEMO	Boguchanskoye Energy and Metals Complex
BLS & Co.	Biggins Lacy Shapiro and Co. LLC
CAFE	Corporate Average Fuel Economy (standard)
CAPEX	capital expenditure(s)
CASH	continuous heat-treated annealing
CBSA	Canada Border Services Agency
CCA	capital cost allowance
Chalco	Aluminum Corporation of China
Chalieco	China Aluminum International Engineering Corporation Ltd.
CIS	Commonwealth of Independent States
CITT	Canadian International Trade Tribunal
CME	Canadian Manufacturers and Exporters
CMRA	China Nonferrous Metals Industry Association Recycling Metal Branch
CNIA	China Nonferrous Metals Industry Association
Commerce	U.S. Department of Commerce
Committee	U.S. House of Representatives Committee on Ways and Means
Commission	U.S. International Trade Commission
Constellium	Constellium Rolled Products Ravenswood LLC
CO_2	carbon dioxide
COP	cost of production
CPES	Centre for European Policy Studies
CVD	countervailing duty
DAI	Dubal America Inc.
DEC	Department of Environmental Conservation (New York State)
EC	European Commission
EDIS	Electronic Docket Information System (USITC)
EDF	Environmental Defense Fund

Abbreviation or acronym	Term
EEA	European Economic Area
EFTA	European Free Trade Association
EGA	Emirates Global Aluminium
EHC	Electric Holding Co. (Oman)
EIA	U.S. Energy Information Agency
ELV	End-of-Life Vehicles Directive (EU)
EPA	U.S. Environmental Protection Agency
ESE	EuroSibEnergo
ETS	Emissions Trading System (EU)
EU	European Union
FEC	fin evaporator coil
FRPs	flat-rolled products
GAC	Guinea Aluminum Corp.
Garmco	Gulf Aluminum Rolling Mill Co.
GBR	Global Business Reports
GCC	[Persian] Gulf Cooperation Council
GDA	Gesamtverband der Aluminiumindustrie e.V. (Aluminum Industry General Association, Germany)
GHG	greenhouse gas
GOIC	Gulf Organization for Industrial Consulting
GTA	Global Trade Atlas (database)
GTAP	Global Trade and Analysis Project (model)
Gulf States	Gulf Cooperation Council (GCC) countries
GVA	Global Vietnam Aluminium Co. Ltd.
HG	high-grade
hr	hour
HS	Harmonized Commodity Description and Coding System (Harmonized System) (WCO)
HTS	Harmonized Tariff Schedule of the United States
HVAC	heating, ventilation, and cooling
Hydro	Norsk Hydro ASA
IAI	International Aluminium Institute
ICSG	International Copper Study Group
IEA	International Energy Agency
IED	Industrial Emissions Directive (EU)
IETA	International Emissions Trading Association
IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
ISO	International Standards Organization
ISRI	Institute of Scrap Recycling Industries
kA	kiloampere
kg	kilogram
kWh	kilowatt-hour
LIBS	laser-induced breakdown spectroscopy
LCOE	levelized cost of energy
LME	London Metal Exchange
MA	Ma'aden Aluminium (Saudi Arabia)

Abbreviation or acronym	Term
MIIT	Ministry of Industry and Information Technology (China)
MMBtu	million British thermal units
MSCI	Metals Service Center Institute
mt	metric ton
Mmt	Million metric tons
MW	Metals Week (U.S. Aluminum Transaction)
MWh	megawatt-hour
NAICS	North American Industrial Classification System
NAPCO	National Aluminium Products Co. (Oman)
NASDAQ	National Association of Securities Dealers Automated Quotations Inc.
NBS	National Bureau of Statistics of China
nec	not elsewhere classified
nesoi	not elsewhere specified or included
NFM	nonferrous metals
NHTSA	National Highway Transportation Safety Administration
Noranda	Noranda Aluminium Holding Corp.
OARC	Oman Aluminum Rolling Co.
OECD	Organisation for Economic Co-operation and Development
OEM	original equipment manufacturer
OICA	Organisation Internationale des Constructeurs d'Automobiles (International Organization of Motor Vehicle Manufacturers)
PBOC	People's Bank of China
Aalex	Qatar Aluminium Extrusion Co.
R&D	research and development
REACH	European Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals
RMB	renminbi (China)
Rusal	*See* UC Rusal
SEZ	special economic zone
SHFE	Shanghai Futures Exchange
SMM	Shanghai Metals Market
SOE	state-owned enterprise
SUAL	Siberian-Urals Aluminium Co.
Trimet	Trimet Aluminium SE (Germany)
UAE	United Arab Emirates
UBCs	used beverage cans
UC Rusal	United Company Rusal (Russia)
UK	the United Kingdom
UNDESA	United Nations Department of Economic and Social Affairs
USCBP	U.S. Customs and Border Protection
USCC	U.S.-China Economic and Security Review Commission
USDOC	U.S. Department of Commerce
USGS	U.S. Geological Survey
USITC	U.S. International Trade Commission
USTR	U.S. Trade Representative; Office of the U.S. Trade Representative
USW	United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and

Abbreviation or acronym	Term
	Service Workers International Union
VAP	value-added product
VAT	value-added tax
WBMS	World Bureau of Metal Statistics
WEC	World Energy Council
WEF	World Economic Forum
WFD	Waste Framework Directive (EU)
WMW	*Waste Management World*
WSA	World Steel Association
WTO	World Trade Organization

Glossary

Term	Definition
1xxx sheet	Pure (unalloyed) aluminum sheet.
Aluminum, alloyed	Aluminum that is alloyed with various nonferrous metals to enhance certain physical characteristics.
Aluminum, unalloyed	Pure aluminum containing at least 99 percent aluminum by weight.
Alumina	Refined aluminum oxide extracted from bauxite for electrolytic smelting into aluminum metal.
Average business cost	CRU Group's term for the business costs across smelters or rolling mills in a country, compiled from the weighted average (by volume of production) of individual component costs of the cost profile. This approach makes it possible to compare costs across countries on a consistent basis.
Bar	A wrought product with a solid cross section having a number of flat sides.
Bauxite	The mined ore source for aluminum, which must be refined into alumina before undergoing electrolytic smelting to produce aluminum metal.
Billet or extrusion billet	An unwrought aluminum product that is the input to the extrusion process. It may be solid or hollow, but commonly has a cylindrical cross-section. Usually a cast product, billets also can be wrought from ingots or sintered from compacted aluminum powder.
Business cost	CRU Group's term for the sum of site costs (incurred at the production site) and net realization costs (of marketing, delivery, and financing; and various premiums or discounts received; for "bringing a product to market and receiving a fair market price"). This approach makes it possible to compare costs across smelters or rolling mills on a consistent basis.
Captive producer	A facility or operation that provides secondary unwrought aluminum directly to the wrought aluminum production operations of the firm that owns the captive producer.
Cast products	Non-mechanical (non-wrought) products, formed by pouring molten aluminum into a mold or injecting it into a steel die, and then cooling it to solidify the aluminum. Not covered by this investigation.
Castings	The solid, finished, or near-finished aluminum shapes resulting from the foundry or die-casting processes. Not covered by this investigation.
Casthouse cost	CRU Group's term for the costs incurred at a primary aluminum's casthouse, where liquid aluminum is processed into a variety of solid unwrought shapes of differing unit values, such as ingots, slabs, billets, etc.
Closed-loop (scrap) system	A production system that uses scrap, waste, or byproducts of one manufacturing process to produce another product. In the aluminum industry, the secondary production process uses new and old sources of aluminum scrap metal to produce secondary unwrought aluminum.
Closure	Complete and permanent shutdown of a facility or a production line within a facility.
Continuously cast (cc) strip	An unwrought aluminum product, usually between 3–20 mm in thickness. It is produced using a continuous casting process during which molten aluminum is fed into casting nozzles of the casting unit, flows between water-cooled rollers, and emerges as a solid strip of aluminum. It is an input for certain flat-rolled products.
Curtailment	Taking production capacity out of active production but keeping it fully operational so it can be quickly restarted.
Drawn products	Aluminum that is mechanically shaped by being pulled through the opening of a steel die. Wire is produced by drawing unwrought wire rod. Extruded bars, rods, tubes, and pipes may also subsequently be drawn to improve surface finishes or achieve final outer dimensions.

Term	Definition
Extruded products or extrusions	Aluminum profiles, bars, rods, tubes, and pipes mechanically shaped from a preheated aluminum billet by pushing it under pressure in a hydraulic extrusion press through the opening of a steel die.
Fake semis	A short-form term for bogus semifabricated products. These are unwrought aluminum products that have undergone minimal processing to look like wrought forms but that are suitable only to be melted down and reprocessed, as they lack the proper alloy contents or physical dimensions needed for use as a wrought product.
Fabricated products	Wrought or cast aluminum products subject to further mechanical working into a finished form by machining, forming, joining, etc.
Flat-rolled products	Plates, sheets, strip, or foil produced by reducing a preheated aluminum slab via successive passes between paired, flat-surfaced steel rolls to attain the desired final thickness.
Foil	Flat-rolled aluminum of thickness not exceeding 0.2 millimeters.
Forged products (forgings)	Mechanical (wrought) products formed by applying pressure to shape unwrought aluminum using either open or closed dies—not covered by this investigation because many forgings are classified as downstream finished components or finished products in international trade statistics.
Foundry alloy	Aluminum alloyed with other base metals used in the production of aluminum castings.
High-purity aluminum	Pure aluminum containing at least 99.5 percent aluminum by weight.
Idle capacity	The portion of a facility's production capacity that is curtailed while the remaining capacity is still actively in production.
Ingot	A cast product intended and suitable for remelting or forming by hot or cold mechanical working.
Liquid (molten) aluminum	Melted, pourable unwrought aluminum, of either primary or secondary origin, that can be directly consumed by downstream wrought, foundry, and die-casting facilities without being remelted.
Liquid metal cost	CRU Group's term for the cost of producing molten aluminum at a primary smelter.
Merchant producer	A facility or firm that produces secondary unwrought aluminum for sale to wrought or cast product firms.
Mill products	An alternative term for wrought (semifabricated) aluminum products.
Nameplate capacity	The level of installed production capacity or output a manufacturing facility is intended to operate.
Net realization cost	CRU Group's term for the costs of marketing, delivery (transportation), and financing; along with various premiums or discounts received; which together make up the costs of "bringing a product to market and receiving a fair market price."
New (process) scrap	Aluminum remaining (e.g., as cut-off ends, surface shavings, edge trimmings, etc.) from production of unwrought, wrought, and cast aluminum, which is either remelted on-site or sold into the secondary aluminum market.
Old (post-consumer) scrap	Recycled aluminum recovered from discarded durable and nondurable industrial and consumer products, such as used beverage cans.
Pig	Small ingots for remelting, weighing less than 25 kilograms.
Pipe	A tube with standardized outside diameter and wall thicknesses.
Plate	Flat-rolled aluminum of thickness at least 6 millimeters thick (6.3 millimeters in the United States).
Potline	Several electrolytic cells (pots) that are electrically connected in a series in a primary smelting facility.
Potroom	A large building that contains electrolytic cells and potlines used during the electrolytic smelting of alumina into molten aluminum.
Powder and flakes	Non-mechanical (non-wrought) products formed by spraying gasified molten aluminum under high pressure through a nozzle (a process called atomization) and allowing the

Term	Definition
	sprayed aluminum to solidify through contact with the air into fine particles. Not covered by this investigation.
Primary unwrought aluminum	Aluminum (either pure or subsequently alloyed) produced directly from electrolytic smelting of alumina, typically at a primary smelter.
Profiles, sections, or shapes	A wrought product having cross-sectional shares other than those of other wrought products.
Pure aluminum	Unalloyed aluminum containing at least 99 percent aluminum by weight.
Remelt ingot	Ingot intended and suitable for remelting, considered a low value-added product.
Rod	A wrought product with a solid circular cross section.
Secondary refiner	A refiner that produces aluminum casting alloys by melting blended aluminum scrap, adding alloying metals, and removing contaminants to meet customer specifications.
Secondary remelter	A remelter that produces aluminum wrought alloys from aluminum scrap, in unwrought forms of billets and slabs.
Secondary unwrought aluminum	Aluminum (usually alloyed) produced by melting down aluminum scrap along with some primary aluminum and alloying metals.
Semifabricated products	An alternative term for wrought aluminum products.
Semifinished products	Product that has undergone some processing and is supplied for further processing before it is ready for use. Semifinished products include both wrought products and castings.
Semis	A short-form term for semifabricated or wrought aluminum products.
Sheet	A flat-rolled product between 0.20 millimeters to under 6.3 mm thick (0.15 millimeters to under 6.3 millimeters in the United States).
Sheet ingot	A large unwrought slab of aluminum that can weigh more than 20 metric tons and is approximately 6 feet wide, 20 feet long, and more than 2 feet thick. Sheet ingot is reduced in thickness to produce flat-rolled products such as sheet, plate, and foil.
Site cost	CRU Group’s term for the cost of producing solid unwrought aluminum at a primary smelter; this equals the sum of the (1) liquid metal cost and (2) casthouse cost. In the case of a rolling mill, this is the cost of producing the flat-rolled product.
Slab	Often called a reroll plate, an unwrought product that is rectangular in cross section and with a thickness not less than 6 mm with sheared or sawn edges, suitable and intended for further rolling.
Sow	Large ingots for remelting, typically weighing about 500 kilograms.
T-ingot or t-slab	Ingots and slabs suitable for remelting, distinguished by their t-shaped cross section that enables the product to be lifted and transported using an industrial forklift or crane.
Tube	A hollow wrought product with uniform wall thicknesses along their length.
Unwrought aluminum	Ingots, slabs, blocks, billets, sows, etc., produced by casting molten aluminum of either primary or secondary origin, but not further machined or processed, other than by simple trimming, scalping, or descaling. Unwrought aluminum is intended for downstream wrought processing or remelting for casting or atomization.
Wire	Wire is produced by drawing unwrought wire rod through one or more steel dies to attain the desired final outside dimensions. Wires do not exceed 10 mm in maximum diameter.
Wire rod	A solid wrought product of circular cross section that is long in relation to its diameter. Wire rod is a raw material used to produce aluminum wire, strand, and cable.
Wrought aluminum products	Rolled, drawn, extruded, forged, or otherwise mechanically worked (formed) aluminum products. Also referred to as “semifabricated,” “semis,” or “mill products.”

Executive Summary

The purpose of this study is to provide information on factors affecting the global competitiveness of the U.S. aluminum industry. Specifically, it examines production, consumption, trade, investment, and competitiveness factors affecting unwrought (primary and secondary) and wrought aluminum during 2011–15.

This report was prepared by the U.S. International Trade Commission (Commission) at the request of the U.S. House Committee on Ways and Means. The Commission used three complementary approaches to evaluate competitiveness trends in the global aluminum industry: (1) qualitative research, including a hearing and fieldwork (domestic and foreign); (2) a survey of U.S. aluminum producers; and (3) a quantitative analysis of the effects of various foreign government policies.

Highlights

The global aluminum industry is widely affected by government intervention through policies and programs that principally impact primary aluminum production costs.

The chief determinants of competitiveness vary among industry segments. For primary aluminum, it is electricity costs; for secondary aluminum, it is access to cheap and reliable scrap supplies; and for wrought aluminum, it is proximity to end markets.

As of 2015, China was the world's largest aluminum producer and consumer, accounting for over half the world's production and consumption of both primary unwrought and wrought aluminum. It also ranked second (after the United States) among all secondary unwrought producers.

The competitiveness of the U.S. industry varied across segments. The primary unwrought sector was disadvantaged in 2011–15 by relatively high electricity costs and limited investments in smelting technologies during a period of declining prices. In contrast, the secondary and wrought industries remained very competitive. Secondary aluminum benefited from abundant low-cost scrap; wrought aluminum, from proximity to and close collaboration with consumers in the large U.S. market.

The global aluminum market experienced price declines of roughly 30 percent during 2011–15 due to oversupply—as measured by growing global inventories, or stocks, of primary aluminum—and falling production costs. The declining price of aluminum during this time impacted primary producers differently.

The Request

On February 24, 2016, the Committee on Ways and Means (Committee) of the U.S. House of Representatives asked the U.S. International Trade Commission (Commission or USITC) to conduct an investigation[1] and provide a report on factors affecting the global competitiveness of the U.S. aluminum industry, which includes both unwrought (primary and secondary) and wrought (semi-finished) aluminum products. (Primary aluminum derives from refined ore, while secondary aluminum comes from recycled aluminum.) The Committee requested that the report focus primarily on the period 2011–15, with discussions of longer-term trends since 2001 as appropriate. The Commission's report provides, to the extent that information is available:

- An overview of the aluminum industry in the United States and other major global producing and exporting countries, including production, production capacity, capacity utilization, employment, wages, inventories, supply chains, domestic demand, and exports;
- Information on recent trade trends and developments in the global market for aluminum, including U.S. and other major foreign producer imports and exports, and trade flows through third countries for further processing and subsequent exports;
- A comparison of the competitive strengths and weaknesses of aluminum production and exports in the United States and other major producing and exporting countries. The comparison covers such factors as producer revenue and production costs, industry structure, input prices and availability, energy costs and sources, production technology, product innovation, exchange rates, and pricing, as well as government policies and programs that directly or indirectly affect aluminum production and exporting in these countries;
- In countries where unwrought aluminum capacity has significantly increased, identification of factors driving that capacity growth and related production changes; and
- A qualitative and, to the extent possible, quantitative assessment of the impact of government policies and programs in major foreign aluminum-producing and -exporting countries on their aluminum production, exports, consumption, and domestic prices, as well as on the U.S. aluminum industry and on aluminum markets worldwide.

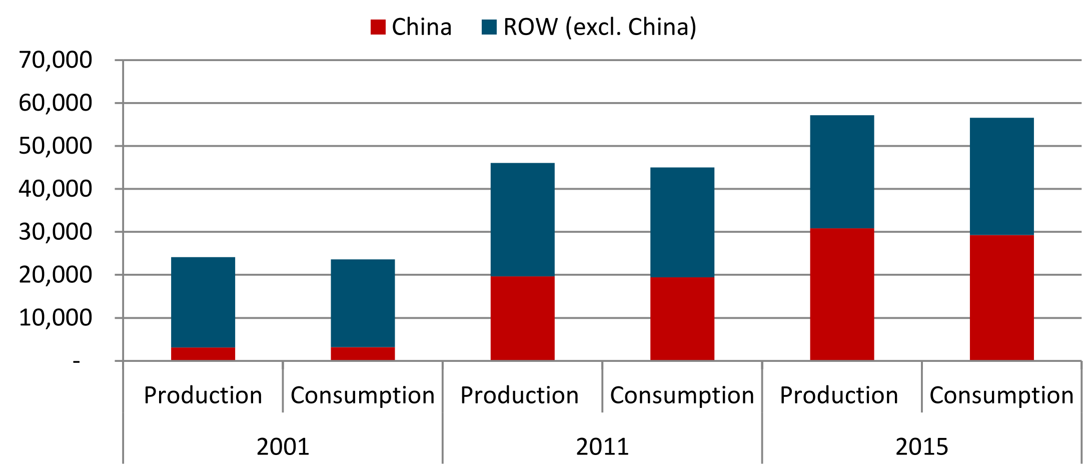
[1] The offices of Commissioner Kieff and former Commissioner Pinkert did not participate in this investigation.

Key Findings

Global aluminum production and consumption growth during 2011–15 was principally driven by China.

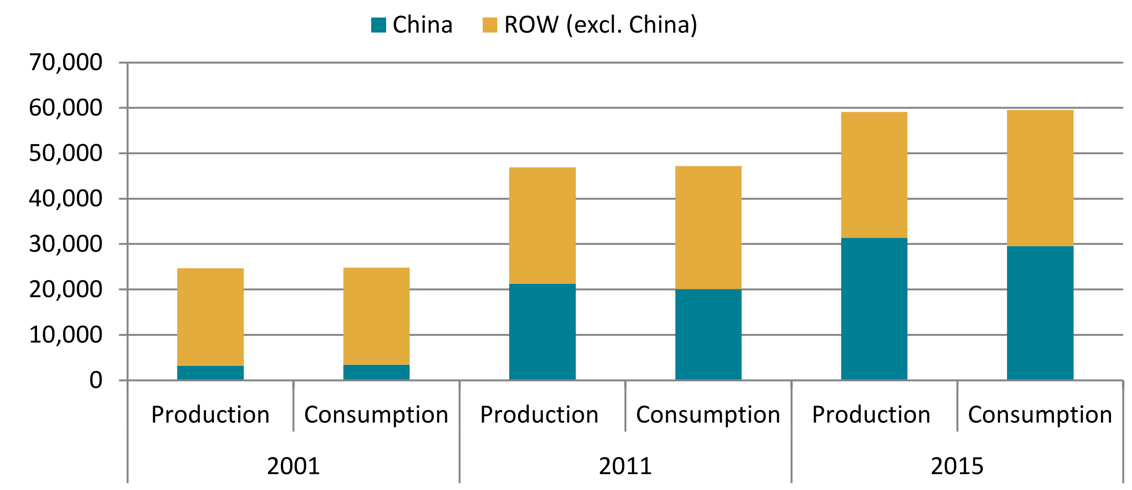
As of 2015, China was the world's largest aluminum producer and consumer, accounting for more than half of the world's production and consumption of both primary unwrought and wrought aluminum (figure ES.1 and 2). Further, the country ranked second after the United States among global secondary unwrought producers. Though the vast majority of China's aluminum production serves its rapidly expanding domestic market, the country has become the world's largest exporter of wrought products. These trends reflect a combination of factors, including a robust market for infrastructure projects; the recent emergence of highly efficient producers; and government policies that facilitated the growth of China's aluminum industry, while limiting the export of primary aluminum and encouraging the export of wrought products.

Figure ES.1: Production and consumption of primary aluminum in China compared to the rest of the world (excluding China), 2001, 2011, and 2015 (thousand mt)



Source: Compiled by USITC staff from CRU Group.
Note: Corresponds to appendix table L.1.

Figure ES.2: Production and consumption of wrought aluminum in China compared to the rest of the world (excluding China), 2001, 2011, and 2015 (thousand mt)

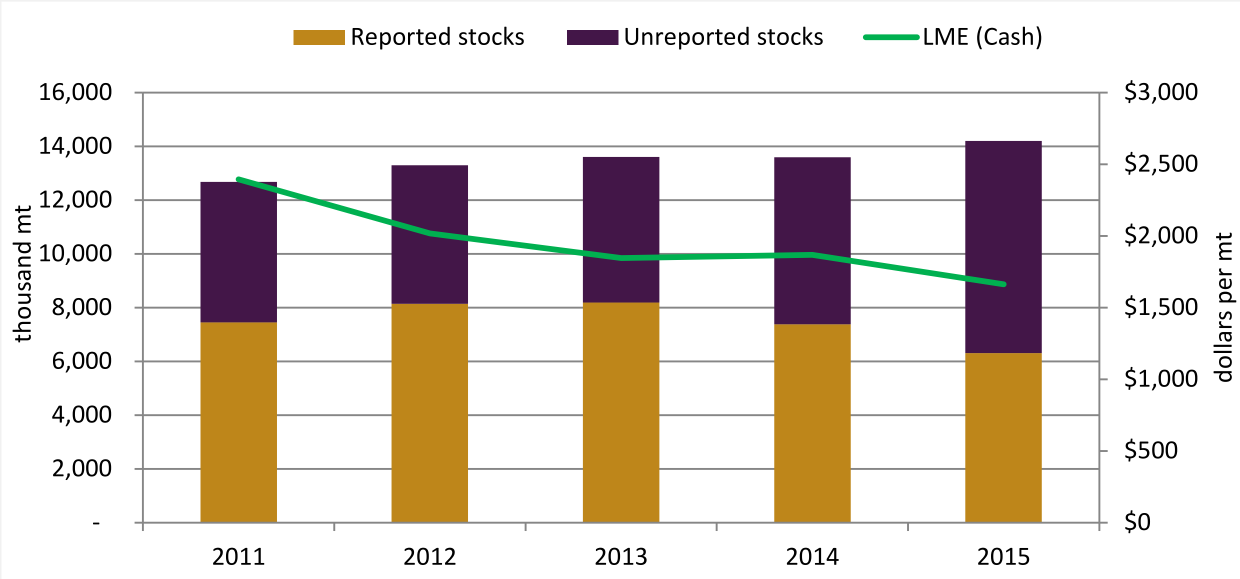


Source: Compiled by USITC staff from CRU Group.
Note: Corresponds to appendix table L.2.

The global aluminum market experienced severe price declines during 2011–15, due to oversupply and falling production costs, which produced divergent responses from primary producers.

The global aluminum industry during 2011–15 was characterized by declining prices, which fell by roughly 30 percent over this period. These price declines were primarily driven by (1) an oversupply of primary aluminum and (2) falling production costs. The oversupply is evident from the growth of global inventories, or world stocks, of primary unwrought aluminum (figure ES.3). Much of these stocks are believed to have originated from Eastern and Central Europe, though China accounted for most of the growth during 2011–15.

Figure ES.3: Total world stocks of primary unwrought aluminum and global aluminum prices, 2011–15



Source: CRU Group.
Note: Reported Stocks reflect only official statistics, while unreported stocks reflect CRU Group's calculation of the additional residual once consumption is subtracted from production. Corresponds to appendix table L.3.

Primary aluminum producers reacted to declining prices in different ways. For example, the United States reduced primary aluminum capacity by 19 percent during 2011–15 (and by an additional 39 percent in 2016) while Europe lost 11 percent over this period. In sharp contrast, China and the Gulf Cooperation Council (GCC)[2] countries each expanded primary unwrought aluminum production capacity more than 40 percent, driven by government intervention and investments in cost-efficient technologies, despite the declining global prices over this period.

Government intervention in the global aluminum industry is pervasive.

Government policies intended to encourage the aluminum industry are widespread in leading aluminum-producing countries. Governments employ a number of different tools to achieve their policies, including incentivizing production through cash grants and low cost electricity (e.g., in the GCC countries); keeping a domestic supply of primary aluminum via export tariffs to aid in production of downstream value-added goods (e.g., China for primary aluminum); and offering rebates on value-added taxes (VATs) to encourage exports (e.g., China for wrought aluminum). The type and size of the government policies vary by country—quantitative estimates of the impacts of certain selected policies appear later in the executive summary. The Commission has identified a number of policies affecting the global aluminum industry and

[2] The GCC is a regional economic and political organization in the Middle East consisting of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE). The UAE is the leading aluminum producer and exporter in the GCC.

provided a qualitative analysis of the effect of these policies. For certain of these policies, the Commission was able to provide a quantitative analysis of these effects (table ES.1).

Table ES.1: Government policies across the selected countries and regions identified in this report, and whether the effect is estimated by the model

Policy	Qualitative effect of the policy	Does the model estimate the effect of this policy?
Canada		
Low-cost electricity	Lowers production costs, especially for primary unwrought	No
Low-cost financing	Lowers production costs	No
Accelerated depreciation schedules for machinery and equipment	Lowers production costs	No
Government procurement	Increases demand for aluminum	No
China		
Export tariffs on primary, secondary, and wrought	Discourages exports, lowers input costs for wrought	Yes, under Chinese trade policies
VAT and export tariffs on aluminum scrap	Discourages exports of scrap, lowers production costs for secondary	No
VAT on exports and partial rebate	Discourages exports, especially for primary wrought	Yes, under Chinese trade policies
Reduced electricity prices	Lowers production costs, especially for primary unwrought	Yes, under Chinese domestic policies
Higher electricity prices for inefficient smelters	Increases production costs for inefficient primary smelters	Yes, under Chinese domestic policies
Minimum energy-efficiency thresholds	Increases production costs for inefficient primary smelters	No
Environmental policies	Increases production costs	No
Overcapacity policies	Lowers production capacity	No
Low-cost financing	Lowers production costs	Yes, under China domestic policies
Tax benefits for facilities that are new or in Western China	Lowers production costs	No
VAT rebates for secondary and wrought	Lowers production costs	Yes, under Chinese domestic policies
Grants	Lowers production costs	Yes, under Chinese domestic policies
Discounted land use fees	Lowers production costs	No
Government stockpiling	Increases prices for aluminum	No
Wrought policies named in antidumping cases	Lowers production costs	Yes, under Chinese domestic policies
Gulf Cooperation Council (GCC) Countries		
Low-cost electricity	Lowers production costs	Yes, under GCC energy policies
Low-cost natural gas	Lowers production costs	Yes, under GCC energy policies
Corporate ownership policies	Increases production costs	No
Low-cost financing	Lowers production costs	No
Tax benefits	Lowers production costs	No
Low rents, land grants, and investment programs	Lowers production costs	No
Investment promotion	Lowers production costs	No
Labor policies and hiring preferences	Increases production costs	No
Russia		

Policy	Qualitative effect of the policy	Does the model estimate the effect of this policy?
Export tariffs on unwrought aluminum	Discourages exports of unwrought and reduces production costs for wrought	Yes, see appendix K
Export tariffs on aluminum scrap	Discourages exports of aluminum scrap and reduces production costs for secondary	No
Export licenses for bauxite	Discourages exports of bauxite, reduces production costs for primary	No
State aluminum reserve	Increases demand for aluminum	No
"Aluminum Valley" (Siberia) special economic zones	Increases aluminum production and consumption	No
Development plans	Increases demand for aluminum	No
Direct government investment	Lowers production costs	No
Western Europe		
“Energy transition” in Germany	Increases production costs, especially for primary unwrought	No
Environmental policies	Increases production costs	No

Source: Compiled by USITC staff from the “Government Policies and Programs” sections of chapters 5–9.

The chief determinant of competitiveness for primary aluminum producers is low electricity costs; for secondary and wrought producers, the determinants are reliable scrap supplies and proximity to end markets. . .

Production costs—especially electricity costs—are a leading determinant of competitiveness in the global primary aluminum industry. Three of the leading producers of primary unwrought aluminum (Russia, Canada, and the GCC) during 2011–15 had access to energy supplies that were both low-cost and abundant.

Competitiveness in secondary unwrought production is largely influenced by the price and reliability of supply of recycled aluminum (scrap), while wrought aluminum production benefits from proximity to and coordination with developed end markets, such as aerospace and automotive parts suppliers. Developed economies, led by the United States and Germany, are the world’s leading secondary producers, by virtue of their sizable markets, well-developed infrastructure for collecting scrap, and a consumer culture encouraging recycling. Leading wrought producers, such as Germany and the United States, enjoy both geographic closeness to and synergistic working relationships with many of their end markets. The Commission’s competitiveness profiles for each of the countries and regions discussed in this report can be found in table ES.2.

Table ES.2: Competitiveness profile of selected countries and regions

Country/region	
Canada	Competitiveness in primary unwrought aluminum is driven by low energy costs (hydropower); updated smelting technologies; and proximity to the large U.S. market. Production of secondary unwrought and wrought aluminum is limited.
China	Competitiveness improved in 2011–15, with high electricity and other costs lowered by new smelters in regions with low-cost electricity; captive power; vertical integration; low capital expenditure and low labor costs; and new technology. Export tariffs /VAT limit exports.
GCC Countries	Competitiveness in primary unwrought aluminum is driven by low electricity costs (natural gas); investments in bauxite mines, alumina refineries, and advanced smelting technologies. Production of secondary unwrought and wrought aluminum is limited.
Europe	Competitiveness in primary unwrought aluminum is driven by low energy costs (hydropower) in Norway and Iceland and investments in technology. Secondary and wrought production is led by Germany, whose industries benefit from access to large volumes of domestic scrap and are located in close proximity to end markets.
Russia	Competitiveness in primary unwrought aluminum is driven by low energy costs (hydropower) and investment in upstream raw material supply and production technology which help to offset high transportation costs. Production of secondary unwrought and wrought aluminum is limited.
United States	Primary unwrought sector has been disadvantaged during 2011–15 due to the relatively high cost of mostly grid-sourced electricity, limited investments in smelting technologies, and a strong currency. The secondary sector is highly competitive due to an abundance of scrap generated from mature end–markets. Wrought sector competitiveness is characterized by relative proximity to end markets, and relatively high–value-added production.

Source: Compiled by Commission staff.

. . . but China is a major exception.

Despite having a fairly new aluminum industry, relatively high electricity costs in many regions, and a less developed consumer economy than many other countries where the industry is important, China is the world's leading aluminum producer. China's competitiveness in primary unwrought and wrought aluminum improved during 2011–15, with the addition of new smelters fueled by low-cost energy (coal-fired in Northwestern provinces) from captive power sources; vertical integration; low costs for capital expenditures; low labor costs; use of advanced smelting technology; and increased usage of molten (liquid) primary aluminum to make wrought goods. Older smelters built before 2010, however, face much higher energy costs and raise the Chinese aluminum industry's overall average business costs.[3] Secondary unwrought production has also grown, fueled by high scrap imports, increased domestic collection of recycled aluminum (scrap), and the effects of favorable government policies.

[3] For a full definition of business cost, please refer to the Glossary of this report.

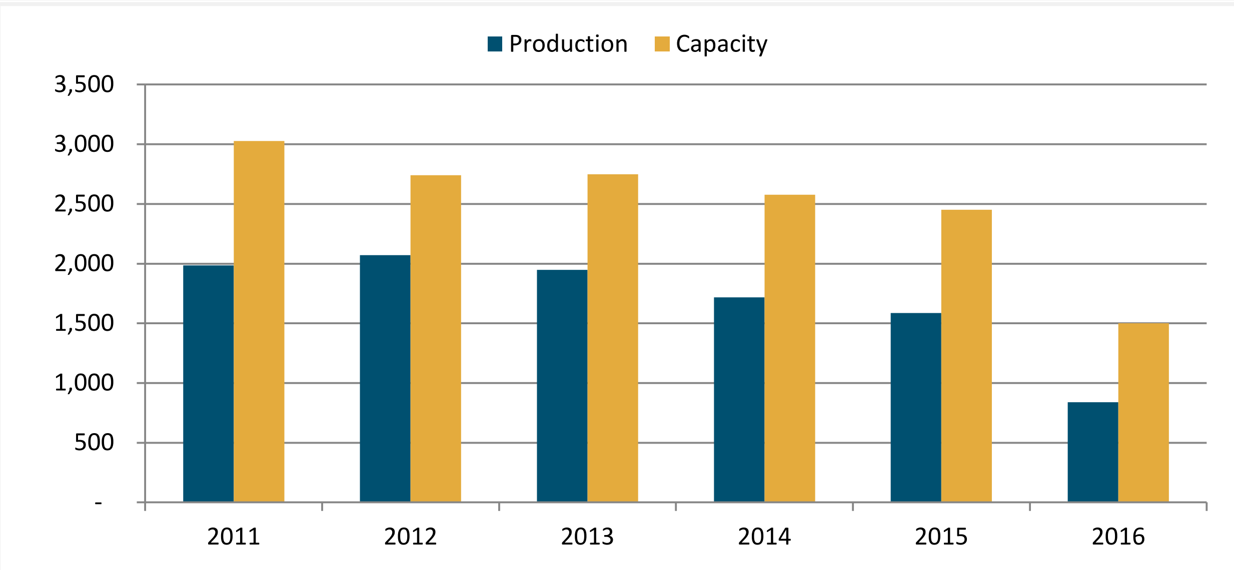
Selected Country Discussions

The United States

U.S. primary production capacity shrank more than in any other large producing country . . .

U.S. primary aluminum capacity fell by 19 percent during 2011–15 and, by an additional 39 percent in 2016 (figures ES.4). Despite a 25 percent reduction in primary aluminum production costs, the country remained one of the world's highest-cost producers during this period. A combination of factors, including relatively high electricity rates; limited investments in new technologies; and currency appreciation have all contributed to the United States' loss of competitiveness in this segment in recent years.

Figure ES.4: U.S. primary aluminum production and capacity, 2011–16 (thousand mt)



Source: CRU Group, 2011–15.
Note: U.S. Geological Survey, (2016). Corresponds to appendix table L.4.

. . . while the Commission's survey revealed expansions in both secondary and wrought capacity.

In contrast to its primary aluminum industry, the United States slightly expanded its secondary and wrought capacity over this period, according to the Commission's survey. The United States is the world's largest secondary aluminum producer, owing to its robust and mature end markets and its scrap collection infrastructure; these strengths were reflected in capacity expansions between 2011 and 2015.

Growth in the capacity for wrought production during this time reflected the U.S. industry's transition away from commodified production of flat-rolled products (FRPs) towards higher-value-added auto sheet production; carmakers in the United States are becoming more and more reliant on aluminum and other lightweight materials in their efforts to improve energy efficiency. At the same time, China is increasingly supplying the U.S. market with low-value-added FRPs such as foil; U.S. foil imports from China nearly doubled during 2012–15.

Canada

Trade flows with the United States reflect a highly integrated regional supply chain.

Canada is the leading supplier of the U.S. market for primary unwrought aluminum, while serving as the leading export market for U.S.-produced wrought aluminum. These trade flows reflect the competitive advantages each country has within segments of the aluminum industry. Canada's low-cost hydroelectric power drives its status as the world's third-largest producer and second leading exporter of primary aluminum. At the same time, the U.S. wrought industry is one of the most competitive in the world, owing to its access to large volumes of scrap and its strong ties to domestic automotive and aerospace industries.

China

China exports relatively little primary unwrought aluminum, but is the world's largest exporter of wrought aluminum.

China's primary aluminum exports are restricted by government policies, mostly by export tariffs and a VAT. These policies have incentivized the retention of primary unwrought aluminum for use in domestic wrought production. In sharp contrast, China is the world's largest exporter of wrought aluminum, selling roughly 10 percent of the country's wrought production abroad. The majority of China's wrought exports are lower-value-added products, such as commodified foil.

Many Chinese unwrought and wrought aluminum producers benefit from government policies affecting energy costs, land-use costs, and other factors of production. However, these benefits are spread unevenly across the industry, and state-owned enterprises tend to receive the most support. The Chinese government's aluminum trade policies generally reduce barriers to raw material imports and discourage the export of primary unwrought aluminum, while stimulating the production and export of most forms of wrought aluminum.

During 2011–15, China's capacity to produce primary unwrought and wrought aluminum expanded more than that of any other country, but utilization rates were low compared to other leading producers.

During 2011–15, China's capacity expansions for both primary and wrought production exceeded that of any other country or region discussed in this report. China's primary unwrought production capacity increased by more than 60 percent, while wrought production capacity—as measured by FRP capacity—grew by nearly 90 percent during this time.

However, capacity utilization rates for primary and FRP production were low relative to other leading producers. On the primary aluminum side, China's overall capacity utilization rate of 81 percent was lower than those of other major producers, including Canada (90 percent), GCC members (99 percent), Norway (92 percent), and Russia (86 percent) in 2015. China's capacity utilization rates for FRP were also lower than the global average during 2015, having declined from 77 percent in 2011 to 62 percent in 2015.

China's underused capacity in both the primary and the FRP segments suggests substantial potential to expand production that could eventually translate into significant increases in exports, especially on the wrought side.

Gulf Cooperation Council (GCC) Countries'

Rapid growth in the GCC countries' primary industry was largely due to the availability of low-cost natural gas, facilitated by government policies.

The GCC aluminum producers have several key competitive advantages in the production of primary aluminum, including low-cost energy due to extensive low-cost natural gas reserves; reduced electricity prices through government programs; and technological improvements and investments in upstream and downstream production. Further, the GCC countries have integrated their aluminum supply chain by investing in upstream production in order to gain greater control over their raw material prices. Upstream investments have included purchasing bauxite mines abroad and creating alumina refineries abroad and domestically.

Russia

Russia's status as a leading producer and exporter of primary aluminum reflects low-cost electricity and investments in efficient smelter technologies.

Russia is the world's largest exporter of unwrought aluminum and the second-largest producer of that commodity. Although Russia's production of primary aluminum declined during 2011–15 with the closing of less efficient, obsolete smelting capacity during a period of declining aluminum prices, Russian competitiveness benefitted from a roughly 40 percent depreciation of the ruble relative to the dollar. The country's primary aluminum industry, which is consolidated under the firm United Company Rusal, profits heavily from its access to low-cost hydroelectric power. Further, Rusal has been active in recent years in upgrading the manufacturing technology at its smelters, further improving their cost efficiencies. Given its relatively small domestic market, Russia's secondary and wrought aluminum industries are limited. Moreover, Russia's lack of a recycling culture and infrastructure poses a continued challenge to the development of a significant secondary aluminum industry.

Europe

Norway (primary aluminum) and Germany (secondary and wrought) are leading representatives of Europe's global competitiveness.

During 2011–15, Norway's abundance of cheap hydropower helped to assure its status as Europe's leading primary aluminum producer, while Germany's industrial clusters and central location in Europe contributed to its position as the region's largest secondary and wrought producer. The growth of European aluminum consumption during 2011–15 was principally driven by demand from the region's transportation sector. In particular, demand from Germany's automobile sector has increased for FRPs. European aluminum trade remained principally intraregional, with Norway serving as the largest exporter of unwrought aluminum and Germany as the region's largest supplier of wrought products.

Key Findings from the Commission's Quantitative Analysis

To capture the effects of certain government policies on the global aluminum industry, and especially on the U.S. industry, the Commission employed the Global Trade Analysis Project (GTAP) model—a computable general equilibrium model of the world economy.[4] The Commission's analysis estimates the effects of the aluminum-specific policies whose existence could be confirmed by the Commission and for which an ad valorem equivalent could be calculated, by comparing what aluminum markets look like under different policy scenarios. The

[4] The GTAP model is a global trade model that takes into account the linkages between all industries in each country and the pattern of trade flows across borders. As such, the model affords quantification of the indirect effects that policies in one country or sector have on other countries and sectors. For this investigation, the GTAP model was revised to incorporate more detailed information about the aluminum industry.

baseline "no-policy" scenario is what the 2011 world economy would hypothetically have looked like if none of the quantified aluminum policies had been in place.[5]

The findings presented in this report are for a selected subset of foreign government policies.[6] These policies were grouped into three categories: Chinese trade policies, Chinese domestic policies, and GCC countries energy policies. Notably, although the model included changes in prices, production, imports, and exports, the impacts of these selected policies on production and exports were the most significant. These policies are discussed below and shown in table ES.3.

Table ES.3: Effect of selected Chinese domestic and trade policies and GCC countries' energy policies on U.S. aluminum production and exports, 2015

	Commodity					
	Primary unwrought		**Secondary unwrought**		**Wrought**	
	Domestic policies in China					
Change in U.S.	Percent	Million $	Percent	Million $	Percent	Million $
Production	-0.9	-47	-0.4	-23	-4.6	-1,088
Exports	-4.9	-31	-1.0	-6	-15.8	-771
	Trade policies in China					
Change in U.S.	Percent	Million $	Percent	Million $	Percent	Million $
Production	2.2	112	0.1	6	0.9	207
Exports	16.3	102	0.3	2	2.8	138
	Energy policies in GCC countries					
Change in U.S.	Percent	Million $	Percent	Million $	Percent	Million $
Production	-0.9	-46	0.0	0	-0.1	-13
Exports	-0.8	-5	0.0	0	-0.2	-11

Source: USITC staff calculations.
Note: The selected Chinese domestic policies are limited to energy policies, financing, VAT rebates, grants, and fees. The effect of these policies is the difference between the no-policy scenario (baseline) and the scenario where the selected Chinese domestic policies exist.

The U.S. industry was negatively impacted by the selected domestic aluminum policies in China . . .

China's aluminum policies lower the cost of domestic production (e.g., government support for unwrought and wrought aluminum production and purchases of capital equipment for primary aluminum). They thus encourage domestic production of aluminum products, with the largest impact in the wrought sector. In 2011–15, these policies negatively impacted the U.S. wrought industry in particular, reducing U.S. production by 4.6 percent and exports by 15.8 percent,

[5] Note that the baseline is not the actual world economy in 2011, as these aluminum policies did exist in 2011. The baseline is what 2011 would have looked like if the policies had not existed. See appendix E for more details.
[6] For many policies, either there was too little information to verify that the policy existed or else the policy was not specific to the aluminum sector. In both of these cases, no meaningful ad valorem rate for the policy could be calculated, so they were excluded from the quantitative assessment.

reflecting increased competition from Chinese wrought production and exports, as noted in table ES.3.

…but, to a much lesser degree, was positively impacted by the selected trade policies in China.

Of the policies listed earlier that were included in the Commission's model, China's trade policies (for example, export tariffs on unwrought aluminum and limited VAT rebates on all exported aluminum) benefited all three segments of U.S. aluminum production and exports. These trade policies discouraged Chinese production and exports of unwrought and wrought aluminum and likely reduced the competition faced by U.S. aluminum producers.

Energy policies in the GCC countries had a slightly negative effect on the U.S. primary industry.

The selected GCC energy policies that were modeled reduced the amount that GCC firms pay for electricity or natural gas. Because primary aluminum production is highly energy intensive, these policies uniquely affected this segment of production. The U.S. aluminum industry was negatively impacted by the increased competition, which resulted in a 0.9 percent and 0.8 percent loss of production and exports, respectively, for primary unwrought aluminum, as noted in table ES.3.

Chapter 1 Introduction

Overview

Aluminum is the world's second most consumed metal[7] and is used in numerous end-use sectors, including aerospace equipment, energy-efficient motor vehicles, sustainable buildings, electrical transmission equipment, packaging, and consumer products, among others.[8] The metal is valued for its unique combination of physical properties—its light weight, strength, ductility and ready formability, high reflectance, electrical and heat conductivity, and corrosion resistance. These properties can be selectively augmented by alloying aluminum with other nonferrous base metals.[9] Aluminum is also among the most recyclable of materials, —an estimated 70–75 percent of all aluminum ever produced still being in use.[10] Further, remelting recovered aluminum scrap saves more than 90 percent of the energy required to produce the metal from its ore.[11]

Since the late 1990s, global aluminum production has shifted from long-established producers in North America, East Asia, and Europe to emerging ones, particularly in China, the Middle East, and Russia. These emerging producers benefited from combinations of access to abundant and cheap electric power, favorable government policies and programs, and expanding domestic and foreign markets. Although the United States was the world's largest primary unwrought aluminum producer through the year 2000,[12] ongoing smelting capacity cutbacks and closures, along with rapidly growing global smelting capacity, has diminished the role of the U.S. primary segment. By contrast, both the scrap-based secondary unwrought

[7] Global consumption of metals in 2014 is estimated at roughly 77 million metric tons (mt) of aluminum wrought and cast products, compared to 23 million mt of refined copper, but 1.5 billion mt of finished steel products. IAI, "Regional and Worldwide Product Net Shipments, 2014" (accessed February 26, 2017); ICSG, "World Refined Copper Usage," 2016; WSA, "Table 41: Apparent Steel Use, Finished Steel Products," October 2016.
[8] For more details, see Aluminum Association, "History of Aluminum" (accessed January 12, 2017); "Product Markets" (accessed July 25, 2016).
[9] Aluminum Association, "Aluminum 101;" "Aluminum Alloys 101" (both accessed January 12, 2017).
[10] Aluminum Association, "Aluminum 101" (accessed January 12, 2017); "Recycling"; "The Economic Impact of Aluminum" (both accessed July 25, 2016).
[11] Aluminum Association, "Recycling" (accessed February 13, 2017); "Secondary Production," 2016; and "Primary Production" (both accessed July 25, 2016).
[12] In the year 2000, China overtook the United States as the world's largest producer of primary unwrought aluminum. USGS, "Aluminum, Primary, World Production by Country," 2015.

segment and the wrought products segment of the U.S. aluminum industry continued to grow steadily after 2000.[13]

Scope

This report is provided in response to a letter sent by the U.S. House of Representatives Committee on Ways and Means (Committee)[14] to the U.S. International Trade Commission (USITC or Commission) on February 24, 2016. To better assess the current market conditions confronting the U.S. aluminum industry, the Committee requested that the Commission conduct an investigation[15] and provide a report under section 332(g) of the Tariff Act of 1930 (19 U.S.C. §1332(g)) to examine the factors affecting the global competitiveness of the U.S. aluminum industry. The Committee asked that the report be delivered no later than 16 months following receipt of the request (i.e., by June 24, 2017), and that it not contain any confidential business information, as the Committee expressed its intent to make the Commission's report available to the public in its entirety. The Commission's fact-finding investigation coincided with several other U.S. trade investigations of aluminum (box 1.1).

Box 1.1: Recent U.S. Trade Actions Relating to Imports of Aluminum, 2011–17

Actions under U.S. countervailing duty (CVD) and antidumping duty (AD) laws. On May 26, 2011, the U.S. Department of Commerce (Commerce) issued CVD and AD orders on imports of certain aluminum extrusions other than finished heat sinks from China.[a] Commerce issued the orders after determining that imports of this product are subsidized and are being sold in the United States at less than fair value, and the U.S. International Trade Commission (Commission or USITC) determined that a U.S. industry is materially injured by reason of such imports (Commission investigation nos. 701-TA-475 and 731-TA-1177). In 2016, Commerce and the Commission initiated five-year "sunset" reviews of these orders.[b] Both agencies made affirmative determinations in their respective investigations on whether revoking the orders would be likely to lead to continuation or recurrence of subsidies and dumping (Commerce) and of material injury to a U.S. industry (the Commission) within a reasonably foreseeable time.[c] On April 25, 2017, Commerce published a notice continuing these orders.[d]

On March 9, 2017, the Aluminum Association Trade Enforcement Working Group filed a petition with the Commission and Commerce under the U.S. CVD and AD laws alleging that imports of aluminum foil from China are being subsidized and sold in the United States at less than fair value and that a U.S. industry is materially injured or threatened with material injury by reason of such imports from China.[e] On April 21, 2017, the Commission made affirmative determinations in the preliminary phase of its investigations (Commission investigation nos. 701-TA-570 and 731-TA-1346), finding that there is a reasonable indication that a U.S. industry is materially injured by reason of imports of this product from

[13] For more details, see chapters 3 and 4.
[14] See appendix A for the Committee's request letter and appendix B for the *Federal Register* notices.
[15] The offices of Commissioner Kieff and former Commissioner Pinkert did not participate in this investigation. F. Scott Kieff, memorandum no. CO85-OO-012, September 28, 2016; Dean. A Pinkert, memorandum no. CO82-OO-012, December 23, 2016. Available online in the Commission's Electronic Docket Information System (EDIS) at http://edis.usitc.gov.

China that are allegedly subsidized and sold in the United States at less than fair value. As a result of the Commission's affirmative determinations, Commerce will continue to conduct its investigations.[f] If both agencies make affirmative final determinations in their respective investigations, Commerce will issue CVD and AD orders on imports of the product from China that are the subject of those affirmative determinations.

Safeguard petition. On April 18, 2016, the United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union, AFL-CIO, CLC (USW), filed a petition with the Commission under section 202 of the Trade Act of 1974 (19 U.S.C. § 2252), the U.S. global safeguard law, alleging that primary unwrought aluminum is being imported into the United States in such increased quantities as to be a substantial cause of serious injury or the threat of serious injury to the domestic industry producing primary unwrought aluminum.[g] The USW withdrew the petition four days later on April 22, 2016;[h] as a result, the Commission did not conduct an investigation or make a determination.

WTO Dispute Settlement Complaint. On January 12, 2017, the United States filed a request with the World Trade Organization (WTO) for consultations with China under the WTO dispute settlement mechanism concerning alleged subsidies that China provides to its producers of primary aluminum. The United States claimed that the measures appear to be inconsistent with Articles 5(c), 6.3(a), 6.3(b), 6.3(c), and 6.3(d) of the Subsidies and Countervailing Measures Agreement, and Article XVI:1 of the General Agreement on Tariffs and Trade 1994. As of early May 2017, the matter was still in consultations.[i] In a press release issued at the time the request for consultations was filed, the Office of the United States Trade Representative (USTR) said that "China appears to provide subsidies through artificially cheap loans from banks and through artificially low-priced inputs for aluminum production, such as coal, electricity, and alumina."[j]

Commerce national security investigation. On April 26, 2017, the Secretary of Commerce (Secretary) initiated an investigation under section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. 1862), to determine the effects on the national security of imports of aluminum. Commerce scheduled a public hearing for this investigation on June 22, 2017. On April 27, 2017, the President signed a memorandum directing the Secretary "to proceed expeditiously in conducting his investigation and submit a report on his finding to the President. The President further directed that if the Secretary finds that aluminum is being imported into the United States in such quantities or under such circumstances as to threaten to impair the national security, the Secretary {is to} recommend actions and steps that should be taken to adjust aluminum imports so that they will not threaten to impair the national security."[K]

[a] 76 Fed. Reg. 30650 (May 6, 2011).
[b] For initiation of the Commission reviews, see 81 Fed. Reg. 18884 (April 1, 2016).
[c] 82 Fed. Reg. 15716 (March 30, 2017) (notice of the Commission's determinations); USITC, *Certain Aluminum Extrusions from China*, March 2017, 3. See also USITC, "USITC Makes Determinations in Five-Year (Sunset) Reviews Concerning Certain Aluminum Extrusions from China," March 10, 2017.
[d] 82 Fed. Reg. 19025 (April 25, 2017).
[e] Herrmann et al., *Certain Aluminum Foil from the People's Republic of China*, March 9, 2017. This and other documents submitted to the Commission for this investigation are available on EDIS at http://edis.usitc.gov.
[f] 82 Fed. Reg. 13853 (March 15, 2017); 82 Fed. Reg. 19751 (April 28, 2017); USITC, *Aluminum Foil from China*, May 2017, 1. See also USITC, "USITC Votes to Continue Investigations on Aluminum Foil from China," April 21, 2017.
[g] Stewart et al., *Petition for Relief Pursuant to Section 201 of the Trade Act of 1974*, April 18, 2016. This and other documents submitted to the Commission for this investigation are available on EDIS at http://edis.usitc.gov.
[h] Stewart et al., *Withdrawal of Petition Filed on April 18, 2016*, April 22, 2016.
[i] WTO, "Dispute Settlement: DS519; China—Subsidies to Producers of Primary Aluminum" (accessed May 10, 2017).
[j] USTR, "Obama Administration Files WTO Complaint on China's Subsidies to Aluminum Producers," January 12, 2017.

[K] 82 Fed. Reg. 21509, 21510 (May 9, 2017). See also Executive Office of the President, Office of the Press Secretary. "Presidential Memorandum for the Secretary of Commerce: Aluminum Imports," April 27, 2017; Swanson, "This Remote Factory," May 29, 2017.

As requested by the Committee, this investigation covers both unwrought (primary and secondary) and wrought (e.g., semi-finished) aluminum products. This report focuses on the 2011–15 time period, but also examines longer-term trends since 2001 as necessary for broader context. The Commission's report, to the extent that information is available provides:

- An overview of the aluminum industry in the United States and other major global producing and exporting countries, including production, production capacity, capacity utilization, employment, wages, inventories, supply chains, domestic demand, and exports;
- Information on recent trade trends and developments in the global market for aluminum, including U.S. and other major foreign producer imports and exports, and trade flows through third countries for further processing and subsequent exports;
- A comparison of the competitive strengths and weaknesses of aluminum production and exports in the United States and other major producing and exporting countries, including such factors as producer revenue and production costs, industry structure, input prices and availability, energy costs and sources, production technology, product innovation, exchange rates, and pricing, as well as government policies and programs that directly or indirectly affect aluminum production and exporting in these countries;
- In countries where unwrought aluminum capacity has significantly increased, identification of factors driving those capacity and related production changes; and
- A qualitative and, to the extent possible, quantitative assessment of the impact of government policies and programs in major foreign aluminum-producing and -exporting countries on their aluminum production, exports, consumption, and domestic prices, as well as on the U.S. aluminum industry and on aluminum markets worldwide.

Approach

As requested by the Committee, this investigation relied on both qualitative and quantitative methods to provide (1) cross-country comparisons of the competitive strengths and weaknesses of the aluminum industries in the United States and in other major producing countries, and (2) detailed profiles of major aluminum-producing countries of the world. Qualitative information was gathered from published industry literature and statistics, and from interviews of sources knowledgeable about the aluminum industry, including representatives of industry associations, domestic producers, government agencies, and consultancy firms.[16] Commission staff traveled both within the United States and abroad to China and Vietnam to confer with industry associations, producers, and government officials. Information was also provided to the Commission at a public hearing, held on September 29, 2016,[17] and by written submissions provided by interested parties.[18]

Quantitative analysis (modeling) was conducted to assess the impact of selected government policies and programs in major foreign aluminum-producing and -exporting countries on their own industries, as well as on the U.S. and global aluminum markets. This analysis used the Global Trade Analysis Project (GTAP), a widely used computable general equilibrium model of the world economy, to quantify the impact of policies on international trade.[19] For this investigation, the standard GTAP model was expanded to include additional sectors more specific to the aluminum industry. The Commission used a two-step process to (1) identify the relevant policies and programs and quantify certain trade and domestic policies that impact the aluminum industry into value (ad valorem) equivalents suitable for inclusion in the model, and then (2) compare the actual aluminum markets in 2015 with these policies in place to a counterfactual scenario without these policies.

Information Sources

To augment the industry information gathered from the sources mentioned above, the Commission purchased global aluminum industry statistics from CRU Group, a London-based international consultancy specializing in the global mining, metals, and fertilizer industries.[20] CRU Group's categories for wrought aluminum products (flat-rolled products (FRPs), extruded products, and wire and cable), which are covered in chapters 2–9, are shown in table 1.1. The Commission also purchased access to an import-export transactions database from Datamyne, Inc., a Miami, FL-based compiler of international shipping transactions documents filed with customs authorities worldwide.[21]

---

[16] For example, industry statistics for the Russian primary and secondary aluminum industry in chapter 8 include information provided by United Company Rusal, Russia's sole primary aluminum producer, through written submissions to the USITC as well as company annual reports.
[17] The Commission's hearing was scheduled for September to coincide with the aluminum industry association meetings held in Washington, DC, to facilitate industry participation in the hearing. See appendix C for the list of hearing witnesses.
[18] See appendix D for the views of interested parties.
[19] The Commission recently used this model in several other section 332 investigation reports, including USITC, *Trans-Pacific Partnership Agreement*, May 2016; *Trade, Investment, and Industrial Policies in India*, December 2014; *U.S.-Korea Free Trade Agreement: Passenger Vehicle Sector Update*, March 2011.
[20] CRU Group.
[21] Datamyne Inc., Datamyne database.

Table 1.1: Correspondence of CRU Group product categories with wrought aluminum products and with 4-digit headings of the global Harmonized Commodity Description and Coding System (HS)

Group categories and corresponding wrought products	HS heading
Flat-rolled products	
Plates, sheets, and strip	7606
Foils	7607
Extruded products	
Bars, rods, and profiles	7604
Tubes and pipes	7608
Wire and cable	
Wire	7605

Source: Compiled by USITC staff.

The Commission issued a survey to collect information from domestic aluminum producers about the domestic industry and market.[22] The survey was principally intended to gather information on the U.S. secondary unwrought aluminum industry, for which only limited public data are available, and to augment information on the U.S. wrought products industry. The survey solicited much less information about the U.S. primary industry, because data on that industry segment are available from other sources and because the limited number of U.S. firms would not allow for the publication of the survey results.[23] Otherwise, unless confidentiality concerns arise, the survey results are provided to the degree of disaggregation specified in the original survey questions.

The principal source of international trade data used in the report was Global Trade Atlas (GTA).[24] GTA export data for all countries, including the United States, in this report are “mirror data” (i.e., data based on imports from reporting countries) due to several discrepancies found in the reported export data. These discrepancies include reporting issues stemming from misclassifications between wrought and unwrought aluminum, a lack of reporting from several smaller aluminum-trading countries, and distortions due to certain countries acting as large transshipment points for aluminum. However, an exception was made in that the report makes use of official Chinese trade statistics.[25] With the exception of the Chinese data, all other trade data for unwrought aluminum combine both primary and secondary products. This is because the global Harmonized Commodity Description and Coding System (HS), which classifies goods for tariff purposes, combines the products at a single 6-digit level (the HS-6 level), and therefore the data are commingled.[26] For this report, trade and industry data will principally be

[22] See appendix B for the *Federal Register* notices, and appendix F for the survey questionnaire, appendix G for a description of the survey methodology, and appendix H for the survey results.
[23] See the first footnote in appendix H for the Commission's criteria for combining or suppressing responses to avoid revealing the operations of any particular respondent to a question.
[24] IHS Markit, GTA database.
[25] The Chinese data allow the separation of China’s primary and secondary exports, as well as an examination of trends in wrought exports both including and excluding remelt products. See the “Trade” section of chapter 6.
[26] See appendix E for HS classifications of unwrought and wrought aluminum products.

presented on the basis of quantity rather than value, usually in terms of metric tons (mt). Quantity is the measure used by the aluminum industry itself, and the presentation of quantity data, rather than value data, avoids distortions resulting from the price volatility experienced by the global aluminum industry.

Organization of the Report

The rest of this chapter presents overviews of aluminum production processes and end uses as technical background for the analysis presented in the subsequent chapters.[27] Chapter 2 addresses the Committee's first and second requests, giving overviews of the global aluminum industry; global trade flows, including trade flows through third countries;[28] and global prices, stocks, and cost of production. Chapter 3 presents cross-country comparisons of relevant competitive factors for both unwrought and wrought aluminum, which principally addresses the Committee's third request. Chapters 4–9 examine the aluminum industries of the United States, Canada, China, the Gulf Cooperation Council (GCC) countries, Russia, and Europe. Chapter 4 covers the U.S. industry and includes selected results of the Commission's survey of the domestic aluminum industry.[29] Chapters 5–9 focus on specific foreign countries or regions, including policies and programs that impact the aluminum industries in their respective countries and regions. The analysis presented in these chapters responds to the Committee's first, third, and fourth requests. Chapter 10, in response to the Committee's fifth request, presents a quantitative analysis of the impact of certain foreign government policies and programs described in chapters 5–9. It focuses on their effect on the U.S. aluminum industry, foreign aluminum industries, and global aluminum markets.[30]

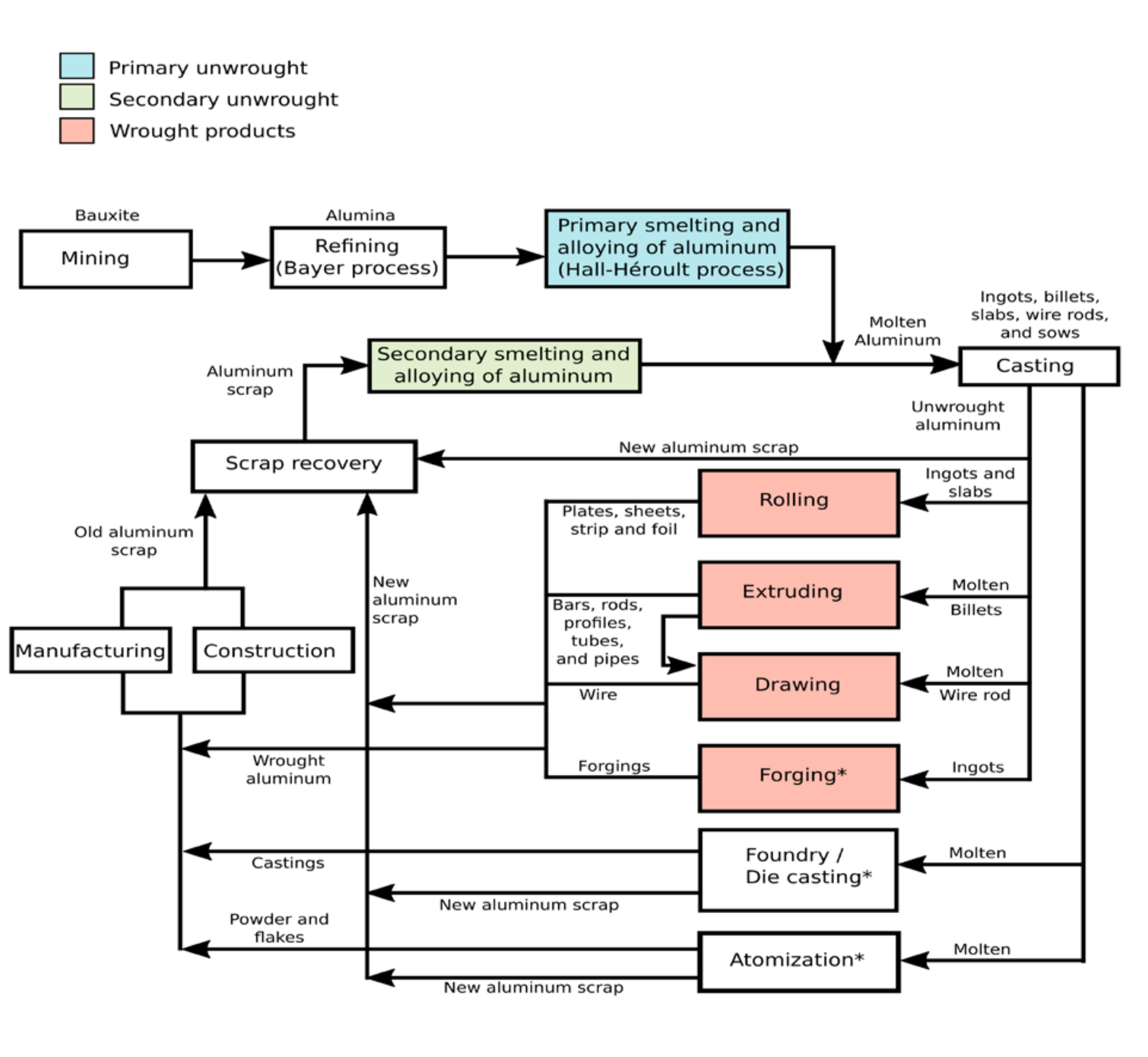
Overview of Aluminum Production Processes and Products

This investigation covers three segments of the aluminum industry: primary unwrought, secondary unwrought and wrought products (figure 1.1). Primary unwrought aluminum is produced by mining and refining bauxite ore and smelting aluminum oxide (alumina), while secondary unwrought aluminum is produced by recycling and remelting aluminum scrap. Unwrought aluminum, whether of primary or secondary origin, is converted into wrought

[27] See appendix I for additional tables and figures that provide more technical details about aluminum trade classifications, products, and production processes.
[28] See appendix J for international trade and processing of unwrought aluminum through third countries.
[29] See appendix H for the survey results.
[30] Also see appendix K for a more technical discussion of the Commission's economic modeling.

aluminum products[31] via mechanical processes,[32] including rolling, extruding, drawing, and forging.[33]

Figure 1.1: Aluminum industry supply chain and production processes



Source: Aluminum Association, "Processing," 2017.
Note: *Not covered in this investigation.

[31] Throughout this report, wrought aluminum products are also referred to as "semi-finished" or "mill" products.
[32] Alternatively, molten aluminum can be converted into aluminum products via (1) non-mechanical processes, including foundry and die-casting operations that produce aluminum castings, and (2) spraying (atomization) operations that produce aluminum powders and flakes. Not being wrought products, aluminum castings, powders, and flakes are excluded from this investigation.
[33] Aluminum forgings are not included in this investigation because they are often classified as downstream components or even finished goods for purposes of international trade.

Primary Unwrought Aluminum

Primary unwrought aluminum originates with the mining of bauxite ore and its subsequent refining into alumina through the Bayer process. The process continues with the electrolytic smelting of alumina into molten aluminum metal.[34] Primary aluminum producers use the Hall-Héroult electrolytic process[35] to smelt alumina in pots (electrolytic cells) connected in a potline (a series of electrolytic cells). This process produces molten aluminum that is either sold directly to customers or transported to a facility known as a casthouse, where it can be alloyed with other metals and cast into various unwrought products. Typically, molten aluminum can only be shipped short distances to customers, whereas ingots, billets, and other solid forms can easily be transported over long distances.[36] Forms of unwrought aluminum mentioned in this report include:[37]

- Billet or extrusion billet: As inputs into the extrusion process, billets are either solid or hollow, but each commonly has a cylindrical cross-section.
- Continuously cast (cc) strip: As an input for rolling certain flat-rolled products (FRPs), cc strip is usually 3–20 millimeters (mm) thick. It is produced from molten aluminum fed via nozzles into a continuous caster, which solidifies as it flows between water-cooled rollers and emerges as a solid strip of aluminum.
- Foundry alloy: Aluminum alloyed with other base metals used in the production of aluminum castings.
- Ingot: A cast product suitable for remelting or for forming by hot or cold mechanical working.
- Pig: Small ingots for remelting, typically weighing less than 25 kilograms.
- Remelt ingot: An ingot suitable for remelting, considered a low-value-added product.
- Sheet ingot: A large slab that can weigh more than 20 mt, for rolling into FRPs.
- Slab: Often called a “reroll plate,” having a rectangular cross section, a thickness not less than 6 mm , and sheared or sawn edges; it is suitable for further rolling.
- Sow: Large ingots for remelting, typically weighing about 500 kilograms.
- T-ingot or t-slab: Ingots and slabs suitable for remelting characterized by a t-shape cross-section, which allows this unwrought product to be lifted and transported using an industrial forklift or crane.
- Wire rod: Coiled rod suitable for drawing into wire.

---

[34] For further technical background on the primary smelting process, see appendix I.
[35] See appendix figure I.2.
[36] For more information about how molten aluminum is transported, see the “Primary Unwrought Aluminum” section of appendix I.
[37] Based on definition 2.4, “Unwrought Products, except Castings,” in Aluminum Association, *GAG Guidance Document 001: Terms and Definitions*, March 2009, 6. See also appendix figure I.3.

Primary aluminum smelters are highly capital-intensive operations, with high fixed costs and continuous (i.e., 24 hours a day, 7 days a week) production cycles. As a result, during periods of weak demand or low aluminum prices, firms may select individual potlines to either operate at near capacity or shut down completely, rather than run them at reduced capacity.[38] The principal input costs for primary smelters are electricity, alumina, carbon anodes, and labor. Capital costs, including construction and equipment, for a new (greenfield) smelter are estimated at $4.5 billion.[39]

Secondary Unwrought Aluminum

Secondary unwrought aluminum is produced by melting recycled aluminum scrap, recovered from both the manufacturing process (new scrap) and post-consumer sources (old scrap) (figure 1.1). To reduce raw-materials costs, secondary producers select a mix of aluminum alloy scrap for the melting furnace to achieve the desired alloy content in the molten aluminum, after dilution with added primary unwrought aluminum. In this way, they minimize the need for additional nonferrous metal.[40] As with primary aluminum, the secondary molten aluminum can be sold in its liquid state, or cast into various unwrought products.[41] A key advantage is that secondary unwrought aluminum production consumes 90 percent less energy than primary unwrought aluminum[42] because it avoids the two steps of refining bauxite into alumina and the subsequent electrolytic smelting into pure aluminum.[43]

A fully developed aluminum recycling industry includes both refiners and remelters. Refiners produce casting alloys from various types of scrap, with the addition of primary aluminum and alloying elements and the removal of unwanted elements. Remelters produce wrought alloys largely from aluminum alloy scrap that is cleaned and sorted.[44] Aluminum scrap is valued differently depending on whether it consists of a single alloy (highest value), has a mixture of alloys, or is mixed with other materials (lower value). With the development of new technologies, such as automated color sorting[45] and laser-induced breakdown spectroscopy (LIBS),[46] separating scrap (based on its quality content) and removing contaminants has become more cost effective, thereby increasing the value of recycled aluminum. Once collected

[38] A facility is described as having “curtailed” production if it shuts down one or more potlines. Reportedly, as long as a smelter continues to cover its cash costs, it will continue to operate. Industry representative, interview by USITC staff, December 16, 2016.
[39] Industry representatives, interviews by USITC staff, February 15, 2016.
[40] Industry representative, interview by USITC staff, October 5, 2016.
[41] See appendix figure I.3.
[42] EIA, “Energy Needed to Produce Aluminum,” August 12, 2016.
[43] Aluminum Association, “Secondary Production” (accessed July 25, 2016).
[44] IAI, “Industry Structure” (accessed January 24, 2017).
[45] Color sorting is an automated process in which computers are used to sort metals by their color/appearance.
[46] LIBS analyzes the chemical makeup of recycled metals in order to identify them and sort them by element.

and sorted, recycled aluminum is then shredded and decoated[47] to remove plastics, oils, paints, inks, and other coatings from its surface.[48]

Although secondary aluminum production dates back to the early 20th century, it was not until the 1960s, when consumers began recycling used beverage cans (UBCs), that scrap aluminum became a major source of raw materials for the industry. Other post-consumer aluminum-containing products that are commonly recycled include motor vehicle parts, appliances, and architectural components, but UBCs remain one of the top recyclable products by weight in the U.S. secondary aluminum market.[49]

The principal operating costs for secondary producers include purchasing aluminum scrap, energy (e.g., natural gas to fuel furnaces and electricity to power equipment), and labor. Secondary facilities are less capital intensive than primary smelters, and have lower fixed costs.[50] Factors affecting the viability of secondary aluminum production include the availability of sufficient affordable scrap aluminum close to secondary producers;[51] furnace technology;[52] and scrap sorting and processing efficiency.[53]

Alloyed and Unalloyed Aluminum

Depending on the final end-use requirements, aluminum is often alloyed with other nonferrous metals to elicit certain characteristics, such as improved strength, corrosion resistance, electrical and thermal conductivity, malleability, and other physical properties. Copper, manganese, silicon, magnesium, and zinc are the most common alloying metals in the aluminum industry, with their numerous wrought alloy compositions being classified within designated alloy series 2xxx–7xxx according to the predominant alloying metal(s).[54] Unalloyed (pure) aluminum (alloy series 1xxx) contains 99 percent or more of aluminum by weight.[55] Unalloyed aluminum containing at least 99.8 percent aluminum is referred to as "high-purity

---

[47] Aluminum Association, "Secondary Production" (accessed July 25, 2016).
[48] Evans and Guest, *The Aluminum Decoating Handbook*, June 2000, 6.
[49] USGS, Aluminum Statistics and Information database (accessed July 22, 2016).
[50] Industry representatives, interviews by USITC staff, December 16, 2016.
[51] Given that transportation can be a major cost factor, secondary producers tend to locate close to urban centers where scrap is readily available. Countries with higher urbanization levels, large working-age populations, and an aluminum industry that developed over decades tend to be larger generators of scrap. Industry representatives, interviews by USITC staff, December 16, 2016.
[52] Older furnaces tend to be less energy efficient and incur higher production costs than greenfield or upgraded furnaces. Industry representatives, interviews by USITC staff, December 16, 2016.
[53] Secondary aluminum production also relies on a robust local recycling system and the ability to draw upon and process both old and new scrap. Industry representatives, interviews by USITC staff, December 16, 2016.
[54] See appendix table I.1 for the series classifications, properties, and major end uses of various wrought aluminum alloys.
[55] Aluminum Association, "Aluminum Alloys 101" (accessed January 12, 2017).

aluminum."[56] Aluminum alloys are further distinguished by how they can be strengthened and hardened—either by heat-treating and precipitation-hardening (aging) or by mechanical cold-working.[57]

Wrought Aluminum

Wrought aluminum (also called "semi-finished," "semis," or "mill products"), included in this investigation, is produced from primary or secondary unwrought aluminum that is mechanically worked by rolling, extruding, or drawing[58] into various forms.[59] Wrought products comprise a very broad group of goods, from highly engineered and differentiated products that compete based on their physical and performance characteristics, to more standardized (commodity) products that compete largely on the basis of price.

Flat-rolled Products

Aluminum plates, sheets, strip, and foil are produced by passing an aluminum ingot or slab between large steel rollers until it reaches the desired thickness. Some of these products are also rolled from slab produced from molten aluminum by the continuous casting process. Because the rolls are flat-surfaced, these FRPs must be slit (trimmed) to width. Plates are at least 6 mm thick (at least 6.3 mm in the United States) and are usually cut to length. Sheets are rolled down to a thickness of between 0.20 mm and less than 6.3 mm (0.15 mm to less than 6.3 mm in the United States),[60] while foil is rolled to a maximum thickness of 0.20 mm.[61] Both sheet and foil are wound into coils. Strip is slit from coiled aluminum into narrower widths than the original coil. Aluminum plate is used in heavy-duty applications, for which it is often machined to shape, e.g., as structural sections for ships, armor for military vehicles and storage tanks. Sheet is considered the most widely used form of wrought aluminum in major end-use sectors, e.g., as aircraft wing and body panels, auto body sheet, packaging, and building facades and components.[62]

---

[56] Definition 2A, "High-purity aluminum," in appendix H: Survey Questionnaire, 4.
[57] For further technical background on alloyed versus unalloyed aluminum, see appendix I.
[58] For more details about wrought processes, see appendix I.
[59] For the relevant HS classifications of aluminum wrought products, see table E.1 in appendix E.
[60] Definition 2.6. Sheet and plate, in: Aluminum Association, *GAG Guidance Document 001, Terms and Definitions*, March 2009, 7.
[61] In the United States, there is an overlap in the specifications for the thickness range of 0.15–0.20 mm for foil and sheet aluminum. Foil products in the upper thickness range are made to foil product specifications. Definition 2.7 Foil in: Aluminum Association, *GAG Guidance Document 001, Terms and Definitions*, March 2009, 9.
[62] Aluminum Association, "Plate and Sheet" (accessed July 11, 2016).

Extruded Products

Aluminum bars, rods, profiles, tubes, and pipes are principally produced from extruded billets, but can also be produced by rolling or by drawing from molten aluminum. Aluminum rods have a solid circular cross-section, but bars can have a number of flat sides.[63] Rods and bars are machined into shapes suitable for equipment components, fasteners, etc. Profiles (also referred to as "shapes" or "sections"), which have various cross-sectional shapes that differ from those of other wrought products,[64] are cut to length for construction and manufacturing applications.[65] Aluminum tubes and pipes are hollow products with uniform wall thickness; pipes are distinguished from tubes by their combinations of standardized outside diameters and wall thicknesses.[66] Tubes and pipes are used for transporting liquids and gases in heat exchangers, processing equipment, and numerous other industrial applications.[67]

Wire

Aluminum wire is produced principally by drawing wire rod through a series of steel dies, but can also be drawn directly from molten aluminum, to a final diameter less than 10.00 mm.[68] Aluminum wire can be stranded together or laid into cable for its principal end use as electrical conductors, although wire is also used in numerous other products including fasteners, fencing, and more.[69]

With lower fixed costs, wrought product mills are less capital intensive than primary smelters. The leading operating costs for wrought facilities include expenditures for unwrought aluminum, aluminum scrap, or both; labor; transportation; and electricity. Factors shaping a wrought product mill's competitiveness include its production capacity (to gain economies of scale); breadth of product mix (as narrower product lines allow for improved efficiencies); manufacturing technology and equipment; and proximity to customers.[70]

---

[63] Definitions 2.9.1. rod and 2.9.2. bar, in: Aluminum Association, *GAG Guidance Document 001, Terms and Definitions*, March 2009, 11.
[64] Definition 2.8.1. profile, in: Aluminum Association, *GAG Guidance Document 001, Terms and Definitions*, March 2009, 9.
[65] Aluminum Association, "Rod and Bar" (accessed July 25, 2016).
[66] Definitions 2.8.12. tube and 2.8.24. pipe, in Aluminum Association, *GAG Guidance Document 001: Terms and Definitions*, March 2009, 10–11.
[67] Aluminum Association, "Processing: Rod and Bar" (accessed July 25, 2016).
[68] Definition 2.9.16. wire, in Aluminum Association, *GAG Guidance Document 001: Terms and Definitions*, March 2009, 12.
[69] Aluminum Association, "Processing: Rod and Bar" (accessed July 25, 2016).
[70] Proximity to customers reportedly is more important for extrusions than for FRPs, as extrusions tend to be lower-cost items. Industry representatives, interviews by USITC staff, December 16, 2016.

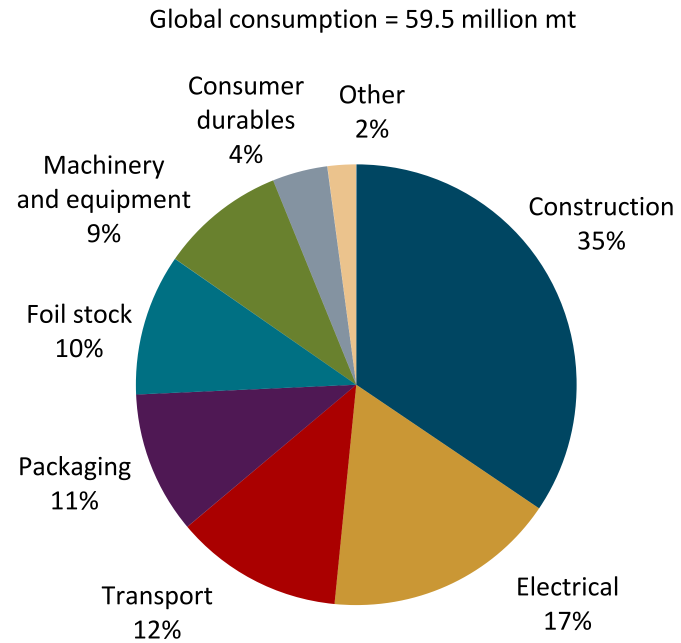
Overview of Aluminum End Uses

Aluminum's physical and chemical properties make it increasingly important in the production of various value-added products. These properties include malleability; relative weight compared to steel and copper (approximately one-third the weight of both metals); ability to be drawn out into wire or thread (ductility); ability to be easily machined and cast; durability; and resistance to corrosion.[71] Despite its success in many end-use applications, aluminum faces strong competition from other materials. For example, steel continues to be used as a major input in many end markets due to the higher raw-material, conversion, and assembly costs for aluminum. WorldAutoSteel, the automotive group of the World Steel Association, estimates that raw-material costs for aluminum are three times those of steel and that aluminum's conversion costs are twice those of steel, while assembly costs are 20–30 percent higher than for steel.[72] In addition, plastic and glass have made significant inroads into packaging markets, especially for beverage containers.

The largest end-user sector is construction, followed by the electrical and transportation sectors; together, these three sectors used almost two-thirds (64 percent) of all wrought aluminum products consumed worldwide in 2015 (figure 1.2).

[71] USGS, Aluminum Statistics and Information database (accessed July 22, 2015).
[72] WSA, “Cost: Facing the Challenge” (accessed January 27, 2017).

Figure 1.2: World: Consumption of aluminum wrought products by major end-use sectors, 2015



Source: CRU Group.
Note: Corresponds to appendix table L.5.

Construction

Aluminum is used in various building materials in the construction industry, including window frames, air-conditioning systems, doors, architectural frames, siding, roofing, and solar protection. Aluminum is able to withstand a wide temperature range and becomes stronger in lower temperatures, which makes it particularly useful for construction in colder climates. The use of aluminum extrusions in high-rise buildings and skyscrapers has increased in recent years due to the metal's lower weight relative to steel in similar applications.[73]

Electrical

In the electric power industry, aluminum is the predominant material in wire cables for medium- and high-voltage overhead power lines due to its light weight and lower cost relative to copper. The National Electric Code in the United States now stipulates aluminum alloy wiring in the construction of new buildings.[74] Aluminum is also used in components of electric equipment and machinery.

[73] UC Rusal, "Aluminum in Construction" (accessed July 25, 2016).
[74] UC Rusal, "Aluminum in Power Engineering" (accessed July 25, 2016).

Transport

Aircraft and Aerospace

Various aluminum alloys are used to produce aerospace parts and body frames for airplanes and spacecraft.[75] Given its light weight, many components in aircraft, including frames, engine turbines, cockpit instrumentation, seats, exhaust pipes, and wing panels, are composed primarily of aluminum. Estimates from the aerospace industry indicate that aluminum makes up about 80 percent of the total weight, including interior components and main body frame, of aircraft such as Boeing's 737. Aluminum alloys are also used in space exploration, comprising 50–90 percent of the weight of modern spacecraft.[76]

Automotive

The physical and chemical properties of aluminum enable automakers to reduce motor vehicle weight without compromising strength and safety. Aluminum can reduce vehicle body weight by up to 50 percent and can absorb twice the crash energy of steel on a pound-for-pound basis. Many automakers are increasing their use of aluminum in producing various automotive parts to reduce vehicle weight and improve overall fuel economy in order to meet the Corporate Average Fuel Efficiency (CAFE) standards.[77] For example, Ford Motor Company has transitioned to an all-aluminum body for the F-150 pickup truck, in addition to using various other automotive parts of aluminum, to reduce total body weight by about 700 pounds.[78]

Railway Transport

The use of aluminum in the construction of railway freight cars has increased in recent years as railroads have sought to reduce overall weight and improve locomotive fuel efficiency. Aluminum-sided hopper cars transport coal, grain, and various industrial minerals, while aluminum tank cars transport chemicals. Aluminum's corrosive-resistant abilities ensure longer lifespans and preserve the value of such railway cars over time. The development of high-speed rail has made it possible for aluminum to provide additional benefits; aluminum can reduce bends in rails that add to friction resistance while enabling manufacturers to produce trains and railway cars that are more aerodynamic and lighter than previous models.[79]

---

[75] See appendix table I.1.
[76] Metal Supermarkets, "History of Aluminum in the Aerospace Industry," February 8, 2016.
[77] Regulations set by the U.S. Environmental Protection Agency and the National Highway Transportation Safety Administration that set fuel efficiency requirements for lightweight and heavyweight vehicles. For more information see the "Consumption" section in chapter 4.
[78] Aluminum Association, "Automotive," 2016.
[79] UC Rusal, "Transport" (accessed July 25, 2016).

Shipping

The shipping industry relies on various aluminum alloy flat-rolled and extruded products (referred as "marine aluminum") to produce ships and shipping containers that are up to 100 times less corrosion-prone than those of steel. The use of marine aluminum in shipping has enabled the industry to reduce both weight and fuel costs while increasing speed and cargo-carrying capacity.[80]

Packaging and Foil Stock

Aluminum's physical and chemical properties enable the food and beverage processing industry to protect food from light, liquids, and bacteria. Aluminum foil and containers are also used to maintain the temperature of food and beverages. Aluminum has allowed beverage-processing companies to reduce greenhouse gas emissions as well. Recent studies indicate that emissions associated with transporting and cooling beverages in aluminum cans are 7–21 percent lower than those for plastic and 35–49 percent lower than for glass.[81]

Machinery and Equipment, Consumer Durables, and Other Products

Aluminum has been used for several decades in producing various kitchen appliances and consumer electronics, including washing machines, dryers, and refrigerators, due to its light weight, strength, and thermal characteristics.[82] Advanced-technology producers of consumer electronics, such as Apple Inc., have increased their reliance on aluminum in recent years in order to improve recycling uptake and to produce lighter-weight products.[83]

---

[80] Djukanovic, "Aluminum Alloys in Shipbuilding," June 13, 2016.
[81] Aluminum Association, "Aluminum Cans Carry Lower Carbon Footprint," August 3, 2016.
[82] Aluminum Association, "Electronics and Appliances" (accessed July 25, 2016).
[83] See, e.g., Apple Inc., "Apple's Patent Pending 7000 Series Aluminum Invention," December 13, 2015; "Environment: Resources" (accessed July 25, 2016).

Bibliography

Aluminum Association. “Aluminum 101.” http://www.aluminum.org/aluminum-advantage/aluminum-101 (accessed January 12, 2017).

———. “Aluminum Cans Carry Lower Carbon Footprint than Glass or Plastic Equivalents in Beverage Transportation and Refrigeration, Finds New Study.” News release, August 3, 2016. http://www.aluminum.org/news/aluminum-cans-carry-lower-carbon-footprint-glass-or-plastic-equivalents-beverage-transportation.

———. *GAG Guidance Document 001: Terms and Definitions*. Edition 2009–01. Arlington, VA: Aluminum Association, March 2009. http://www.aluminum.org/sites/default/files/GAG_Terms_and_Definitions_-Edition_2009-01_-March_2009.pdf.

———. “History of Aluminum.” http://www.aluminum.org/aluminum-advantage/history-aluminum (accessed February 13, 2017).

———. “Industry Standards: Aluminum Alloys 101.” http://www.aluminum.org/resources/industry-standards/aluminum-alloys-101 (accessed January 12, 2017).

———. “Processing.” http://www.aluminum.org/industries/processing (accessed January 10, 2017).

———. “Processing: Plate and Sheet.” http://www.aluminum.org/industries/processing/sheet-plate (accessed July 11, 2016).

———. “Processing: Rod and Bar.” http://www.aluminum.org/industries/processing/rod-bar#sthash.a8yvSebO.dpuf (accessed July 25, 2016).

———. “Product Markets.” http://www.aluminum.org/product-markets (accessed February 13, 2017).

———. “Product Markets: Automotive.” http://www.aluminum.org/product-markets/automotive (accessed July 25, 2016).

Aluminum Association. “Product Markets: Electronics and Appliances.” http://www.aluminum.org/product-markets/electronics-appliances (accessed July 25, 2016).

———. "Production: Primary Production." http://www.aluminum.org/industries/production/primary-production (accessed July 25, 2016).

———. "Production: Recycling." http://www.aluminum.org/industries/production/recycling (accessed February 13, 2017).

———. "Production: Secondary Production." http://www.aluminum.org/industries/production/secondary-production (accessed July 25, 2016).

———. "The Economic Impact of Aluminum." http://www.aluminum.org/aluminum-advantage/economic-impact-aluminum (accessed February 13, 2017).

American Society for Metals (ASM) International. "Subject Guide: Aluminum and Aluminum Alloys." http://www.asminternational.org/web/guest/aluminum/subject-guide (accessed January 13, 2017).

Apple Inc. "Apple's Patent Pending 7000 Series Aluminum Invention Used in the New iPhone 6s Comes to Light," December 13, 2015. http://www.patentlyapple.com/patently-apple/2015/12/apples-patent-pending-7000-series-aluminum-invention-used-in-the-new-iphone-6s-comes-to-light.html.

———. "Environment: Resources." http://www.apple.com/environment/resources/ (accessed July 25, 2016).

Datamyne Inc. Datamyne database. http://www.datamyne.com/ (accessed various dates).

Djukanovic, Goran. "Aluminum Alloys in Shipbuilding—A Fast Growing Trend." Aluminium Insider, June 13, 2016. http://aluminiuminsider.com/aluminium-alloys-in-shipbuilding-a-fast-growing-trend/.

Evans, Richard, and Graham Guest. *The Aluminum Decoating Handbook*. Wolverhampton, UK: Stein Atkinson Stordy Ltd., June 2000. http://infohouse.p2ric.org/ref/26/25275.pdf.

Executive Office of the President. Office of the Press Secretary. *Presidential Memorandum for the Secretary of Commerce: Aluminum Imports and Threats to National Security*, April 27, 2017. https://www.whitehouse.gov/the-press-office/2017/04/27/presidential-memorandum-secretary-commerce.

———. "Presidential Memorandum for the Secretary of Commerce: Aluminum Imports and Threats to National Security," April 27, 2017. https://www.whitehouse.gov/the-press-office/2017/04/27/presidential-memorandum-secretary-commerce.

IHS Markit. Global Trade Atlas (GTA) database. https://www.ihs.com/products/maritime-global-trade-atlas.html (accessed various dates).

International Aluminium Institute (IAI). "Industry Structure." http://recycling.world-aluminium.org/review/industry-structure.html (accessed January 24, 2017).

———. "Regional and Worldwide Product Net Shipments." Global Mass Flow Model—2014 (2015 draft). http://www.world-aluminium.org/media/filer_public/2016/12/20/regions.xlsx (accessed February 26, 2017).

International Copper Study Group (ICSG). "World Refined Copper Usage, 1900–2015." *The World Copper Factbook 2016*. Lisbon: ICSG, 2016, 39. http://www.icsg.org/index.php/component/jdownloads/finish/170/2202.

Kelley Drye & Warren LLP. *Certain Aluminum Foil from the People's Republic of China—Petitions for the Imposition of Antidumping and Countervailing Duties*, March 9, 2017. http://www.aluminum.org/sites/default/files/Case%20Cover%20Letter.pdf.

Metal Supermarkets. "History of Aluminum in the Aerospace Industry," February 8, 2016. https://www.metalsupermarkets.com/history-of-aluminum-in-the-aerospace-industry.

Stewart and Stewart. *Petition for Relief Pursuant to Section 201 of the Trade Act of 1974, on Behalf of the United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union, AFL-CIO, CLC*, April 18, 2016. http://www.usw.org/news/pdfs/Primary-Unwrought-Aluminum-201-Petition-Narrative-CIRCULATE-1.pdf.

———. *Withdrawal of Petition Filed on April 18, 2016*, April 22, 2016. http://www.usw.org/news/media-center/articles/2016/usw-announces-suspension-of-section-201-petition-on-primary-unwrought-aluminum-government-discussions-scheduled.

Swanson, Ana. "This Remote Factory is Where Trump May Finally Draw the Line on Trade" (Print edition title: "Ky. Town in Trade Policy's Cauldron"). The Washington Post, May 29, 2017. https://www.washingtonpost.com/news/wonk/wp/2017/06/29/this-remote-factory-is-where-trump-may-finally-draw-the-line-on-trade/?utm_term=.1d7b7f5e1843.

UC Rusal. “Aluminum in Construction.” http://aluminiumleader.com/application/construction/ (accessed July 25, 2016).

———. “Aluminum in Power Engineering.” http://aluminiumleader.com/application/electrical_engineering/ (accessed July 25, 2016).

———. “Transport.” http://www.aluminiumleader.com/application/transport/ (accessed July 27, 2016).

U.S. Energy Information Agency (EIA). “Energy Needed to Produce Aluminum.” *Today in Energy*, August 16, 2012. http://www.eia.gov/todayinenergy/detail.cfm?id=7570.

U.S. Geological Survey (USGS). “Aluminum, Primary, World Production by Country,” 2015. In Matos, G.R., comp., *Historical Global Statistics for Mineral and Material Commodities* (2015 version). USGS Data Series 896. Reston, VA: USGS, 2015. http://dx.doi.org/10.3133/ds896 (accessed February 26, 2017).

———. Aluminum Statistics and Information database. http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/ (accessed July 22, 2015).

U.S. International Trade Commission (USITC). Aluminum Foil from China. Inv. no. 701-TA-570 and 731-TA-1346 (Preliminary). Publication 4684. Washington, DC: USITC, May 2017. https://www.usitc.gov/publications/701_731/pub4684.pdf.

———. Certain Aluminum Extrusions from China. Inv. nos. 701-TA-475 and 731-TA-1177 (Review). Publication 4677. Washington, DC: USITC, March 2017. https://www.usitc.gov/publications/701_731/pub4677.pdf.

———. *Trade, Investment, and Industrial Policies in India: Effects on the U. S. Economy*. USITC Publication No. 4501. Washington, DC: USITC, December 2014. https://www.usitc.gov/publications/332/pub4501.pdf.

———. *Trans-Pacific Partnership Agreement: Likely Impact on the U.S. Economy and on Specific Industry Sectors*. USITC Publication 4607. Washington, DC: USITC, May 2016. https://www.usitc.gov/publications/332/pub4607_new_0.pdf.

———. “USITC Makes Determinations in Five-Year (Sunset) Reviews Concerning Certain Aluminum Extrusions from China.” News release 17-038, March 10, 2017. https://www.usitc.gov/press_room/news_release/2017/er0310ll739.htm.

———. "USITC Votes to Continue Investigations on Aluminum Foil from China." News release 17-056, April 21, 2017. https://www.usitc.gov/press_room/news_release/2017/er0421ll755.htm.

———. *U.S.-Korea Free Trade Agreement: Passenger Vehicle Sector Update*. USITC Publication 4220. Washington, DC: USITC, March 2011. https://www.usitc.gov/publications/332/pub4220.pdf.

U.S. Trade Representative (USTR). "Obama Administration Files WTO Complaint on China's Subsidies to Aluminum Producers." Press release, January 12, 2017. https://uschinatradewar.com/files/2017/01/Obama-Administration-Files-WTO-Complaint-on-China%E2%80%99s-Subsidies-to-Aluminum-Produ.pdf.

World Steel Association (WSA). "Table 41: Apparent Steel Use, Finished Steel Products." In *Steel Statistical Yearbook 2016*, 85–87. Brussels: WSA, October 2016. https://www.worldsteel.org/en/dam/jcr:37ad1117-fefc-4df3-b84f-6295478ae460/Steel+Statistical+Yearbook+2016.pdf.

———. WorldAutoSteel. "Cost: Facing the Challenge." http://www.worldautosteel.org/why-steel/cost (accessed January 27, 2017).

World Trade Organization (WTO). *China—Subsidies to Producers of Primary Aluminum: Request for Consultations by the United States*. WT/DSS19/1, G/SCM/D113/1, G/L/1173, Document no. 17-0301, January 17, 2017. https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S006.aspx?Query=(%20@Symbol=%20(wt/ds519/1%20))&Language=ENGLISH&Context=FomerScriptedSearch&languageUIChanged=true#.

Chapter 2
Global Overview

The global aluminum industry comprises three distinct major segments—primary unwrought aluminum, secondary unwrought aluminum, and wrought aluminum. These segments have somewhat different production and consumption patterns and are subject to different competitive conditions. The global industry can broadly be divided into two groups of countries. The first group consists of countries with a competitive advantage in producing primary unwrought aluminum—for example, Canada, Norway, Russia, and the Gulf Cooperation Council (GCC)[84] countries. For this group, this advantage is due in large part to low-cost sources of electricity, a leading cost of production. The second group includes countries with a longstanding competitive advantage in producing secondary unwrought and wrought aluminum—for example, Germany and the United States. China does not fit in either group, since it has relatively high electricity rates and its wrought aluminum industry is not as mature as those of its competitors. Despite this, China claims more than half of the world's production of primary and wrought aluminum, and ranks among the world leaders in secondary aluminum manufacturing.[85]

During 2001–15, the dominant trend in the primary unwrought segment of the global aluminum industry was the rapid growth of China's production, which grew nearly 10-fold by volume. While no producer grew as quickly as China, others, such as the GCC countries, India, and Iceland, also expanded rapidly. Overall, global production of primary unwrought aluminum more than doubled during the period. The gains in these emerging aluminum-producing countries more than offset losses in other, more established producing countries. Production contracted most quickly in the United States, but also fell in other major producing countries, such as Australia and Brazil. Meanwhile, established producers with reliable access to low-cost electricity, such as Canada and Russia, generally experienced steady production levels during the period.

In the wrought aluminum segment, global production more than doubled as well. China again led this expansion, and its wrought production grew at a pace similar to its primary unwrought production, expanding nearly 10-fold between 2001 and 2015. Global demand for wrought

---

[84] The GCC is a regional economic and political organization consisting of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE).

[85] The country's standing as the world's predominant aluminum producer reflects a combination of factors, including a burgeoning domestic market, the emergence of highly efficient producers, and government policies that facilitate the growth of the industry. See chapters 3 and 6 for additional details.

aluminum grew consistently throughout 2011–15, which provided opportunities for most producing countries, including the United States, Germany, and India, to either maintain or expand production.

Consumption of primary and secondary unwrought aluminum is driven by demand from wrought producers, while consumption of wrought aluminum is driven by demand from downstream industries (such as construction and transportation) that use aluminum products. As a result, unwrought aluminum is consumed mostly by the countries with large wrought industries, while wrought aluminum is consumed by a broader range of countries with industries that use wrought products. During 2001–15, both wrought and unwrought aluminum consumption grew more than eightfold in China and more than tripled in India. This growth was largely due to (1) an increasing capacity to produce wrought products from unwrought aluminum in these countries, and (2) investments in infrastructure that generated demand for aluminum for construction and transportation uses. Much of the demand within these countries was supplied by domestic production. Consumption of wrought aluminum also grew quickly in other developing countries, including Brazil, Indonesia, and Thailand, where growth ranged from 80 percent to 150 percent in each of these countries during 2001–15. Consumption in developed countries, such the United States, grew more slowly.

Because relatively few countries produce primary unwrought aluminum and because many countries require aluminum and its downstream products, the commodity is heavily traded. The world's largest primary aluminum exporters were Russia, the GCC countries, and Canada—countries with limited domestic markets. The leading primary unwrought importers were the United States, Japan, and Germany, countries with established wrought aluminum industries and large end-use markets. Notably, China's exports of primary aluminum are very small compared to its domestic production, due in large part to significant export restraints on primary unwrought aluminum. On the other hand, China has no restrictions on its exports of unwrought aluminum and is a global leader in these exports.

The global primary aluminum segment during 2011–15 was characterized by declining prices. There were two important drivers of this price decline: an oversupply of primary aluminum and falling production costs. The effects of price declines varied among countries producing primary unwrought. In the United States, Western Europe, and South America, capacity contracted, whereas in other locations price declines reduced firm profits. Despite declining prices, the GCC countries and China substantially expanded capacity expansions. Capacity growth in these latter countries involved investments in new technology and scale production.

Overview of Global Production[86]

Primary Unwrought Aluminum

From 2001 to 2015, trends in primary unwrought aluminum production and capacity varied greatly by country (table 2.1), though total global production grew by 137 percent and global capacity by 162 percent. The rapid growth of the primary aluminum sector in some countries, such as China, the GCC countries, and India, more than offset its contraction in other countries, most notably the United States, leading to overall global growth in production. In several other established producing countries, including Russia, Canada, and Norway, production increased only slightly. The result of these changes was an increase in the concentration of primary aluminum production. The top five producing countries in 2001 accounted for 56 percent of global production. By 2015, that year's top 5 producers accounted for 78 percent of production.

During the period, capacity utilization rates[87] in major producing regions and countries generally declined due to periodic fluctuations in global demand and to global oversupply and associated reductions in aluminum prices. Globally, capacity utilization fell from 89 percent in 2001 to 84 percent in 2011 and to 80 percent in 2015.

Table 2.1: World: Production, capacity, and capacity utilization of primary unwrought aluminum, by producer, 2001, 2006, and 2011–15

Producer	2001	2006	2011	2012	2013	2014	2015
Production (1,000 mt)							
China	3,124	9,362	19,623	22,204	24,884	28,303	30,839
GCC countries	1,052	1,641	3,482	3,662	3,888	4,864	5,110
Russia	3,300	3,738	3,990	4,024	3,690	3,480	3,550
Canada	2,585	3,052	2,984	2,781	2,969	2,858	2,880
India	620	1,116	1,660	1,714	1,685	1,922	2,352
Australia	1,800	1,937	1,949	1,862	1,780	1,715	1,662
United States	2,637	2,281	1,986	2,070	1,948	1,718	1,587
Norway	1,037	1,382	1,126	1,138	1,160	1,173	1,213
Iceland	239	324	805	816	838	848	855
Brazil	1,138	1,604	1,437	1,436	1,304	962	772
All other	6,635	7,505	7,000	6,238	6,470	6,363	6,347
Total	24,167	33,942	46,042	47,945	50,616	54,206	57,167
Capacity (1,000 mt)							
China	3,446	11,571	23,210	26,140	29,470	34,288	38,061

[86] This section provides an overview of trends during the broader 2001–15 period before turning to an examination of more recent developments during 2011–15. Because trends are significantly different among the primary unwrought, secondary unwrought and wrought aluminum segments, the three segments are treated separately. Global CRU Group and WMBS data are used for the analysis of the primary, secondary, and wrought aluminum sectors in this chapter to ensure data comparability across multiple countries and industry indicators.
[87] Because of the high capital and fixed costs associated with primary unwrought aluminum production, cost competitiveness for producers can be affected by capacity utilization rates.

Producer	2001	2006	2011	2012	2013	2014	2015
GCC countries	1,050	1,642	3,628	3,816	4,533	5,050	5,154
Russia	3,287	3,836	4,199	4,210	4,287	4,259	4,137
Canada	2,656	3,119	3,036	3,035	3,075	2,968	3,194
India	659	1,136	2,641	3,251	3,475	3,912	4,143
Australia	1,810	1,956	2,015	2,015	2,036	2,060	1,691
United States	4,383	3,614	3,028	2,740	2,748	2,577	2,452
Norway	1,035	1,394	1,305	1,318	1,318	1,318	1,318
Iceland	245	336	812	823	847	849	864
Brazil	1,281	1,604	1,684	1,684	1,684	1,684	1,588
All other	7,425	8,326	9,007	8,987	9,130	8,992	8,988
Total	27,277	38,534	54,565	58,019	62,603	67,957	71,590
Capacity utilization (%)							
China	91	81	85	85	84	83	81
GCC countries	100	100	96	96	86	96	99
Russia	100	97	95	96	86	82	86
Canada	97	98	98	92	97	96	90
India	94	98	63	53	48	49	57
Australia	99	99	97	92	87	83	98
United States	60	63	66	76	71	67	65
Norway	100	99	86	86	88	89	92
Iceland	98	96	99	99	99	100	99
Brazil	89	100	85	85	77	57	49
All other	89	90	78	69	71	71	71
Total	89	88	84	83	81	80	80

Source: CRU Group.

The dominant trend throughout 2001–15 was the rapid expansion of China's primary aluminum production, which reflected annual growth of 18 percent on average. Most of this growth in China occurred before 2011, though steady growth continued after that. During the narrower 2011–15 period, China's production increased by 57 percent (12 percent per year on average) and capacity grew by 64 percent. China's production and capacity growth reflected rapidly growing domestic demand within China, which led to unprecedented construction of greenfield smelters and to expansions to existing smelters (see chapter 6).[88] China also made substantial investments in advanced technology during the period. For instance, the Chinese government encouraged the growth of smelters with high cell amperages, which are associated with improved energy efficiencies and yield substantial cost savings.[89] The addition of new, often state-of-the-art, capacity allowed China to improve its economies of scale and to move from being one of the highest-cost producers to being one close to the world average.[90] These

---

[88] Zhou, "Will Smelters in Xinjiang Continue to Expand Capacity?" July 9, 2015; Home, "China, the Aluminum Giant," July 20, 2015.
[89] See chapter 3 for more information about the competitive factors affecting primary unwrought aluminum producers.
[90] Jorge Vazquez, written testimony to the USITC, September 29, 2016, 3. See chapter 6 for additional details on the industry in China.

improvements to smelters in China led to considerable variation in capacity utilization rates, generally based on both the relative age and size of the smelter. For example, smelters built during 2011–15, which are larger and have more advanced production technology, were operating at an 88 percent utilization rate, while older smelters, which are smaller in size, were operating at just 75 percent.[91] Overall, China's capacity utilization rate of 81 percent in 2015 was near the global average of 80 percent.

Primary aluminum production and capacity also expanded quickly in the GCC countries and in India. During 2011–15, production in the GCC countries grew by 47 percent and capacity by 42 percent. The GCC countries benefited from low electricity costs due to abundant natural gas and were characterized by their substantial investments in advanced technology during the period. In these countries, joint ventures with multinational aluminum companies resulted in access to leading technology and the construction of highly efficient smelters.[92] Throughout most of 2001–15, GCC countries operated at nearly full capacity in an effort to meet growing global demand.[93] In India, growth over the period was 42 percent for production and 57 percent for capacity. India's capacity expansion outpaced growth in production, leading to a sharp decline in its capacity utilization rate, from 94 percent in 2001 to 57 percent in 2015.

During the 2011–15 period, price declines for primary aluminum resulted in major production and capacity contractions in some countries with long-established industries. For example, during this time smelters in the United States and Western Europe closed 19 percent and 11 percent of their capacity, respectively. In the European Union (EU), production became more concentrated in the largest-producing countries. Smelter closures in the United Kingdom (UK), Italy, and the Netherlands brought primary unwrought aluminum production in these three countries virtually to a halt.[94] Meanwhile, production volumes grew by about 25 percent during 2011–15 in both Germany and France, the largest EU producers, but were still below 2001 levels in both countries. Smelters in Germany and France tended to have lower average business costs during the period than those in other EU countries, particularly Italy and the Netherlands.[95]

---

[91] CRU Group.
[92] U.S.-headquartered Alcoa, for example, formed a joint venture in 2009 with Ma'aden, the Saudi Arabian Mining Co., creating the largest, lowest-cost fully integrated aluminum smelter in the world. The project connects a bauxite mine in central Saudi Arabia by rail to the facility where alumina refining, smelting, and casthouse production occurs, and also includes a rolling mill. Alcoa. website, "Saudi Arabia," http://www.alcoa.com/saudi-arabia/en/default.asp (accessed March 12, 2017).
[93] Reed Exhibitions, "Middle East Aluminum Industry," April 14, 2015. Further, according to the Emirates Global Aluminum Association (EGA), regional consortium operates at or near full production capacity; EGA is the largest GCC primary aluminum producer (EGA, written submission to the USITC, January 23, 2017).
[94] See chapter 9 for additional information.
[95] CRU Group.

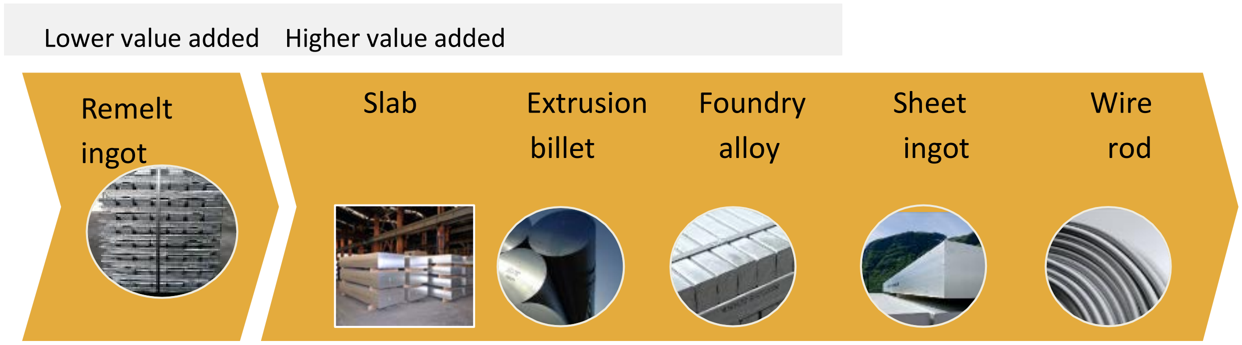
The United States was also a relatively high-cost producer, despite a 25 percent reduction in production costs over this period.[96] As a result, 2015 production levels in the United States were down 20 percent compared to 2011, and 40 percent compared to 2001. During 2011–15, the United States also had by far the lowest capacity utilization rates of all the major producing countries and regions discussed in later chapters of this report. As detailed in chapter 3, U.S. smelters paid high electricity rates and made fewer capital investments in various cost-saving technologies than did other countries.

Countries that were better able to weather global price declines during 2011–15 tended to be those with access to low-cost sources of electricity. Because primary aluminum production is highly energy intensive, the world's leading producers, with the exception of China, are also generally the countries with the lowest energy costs. Norway, Canada, and Russia all have abundant, low-cost hydroelectric power sources, and all three largely maintained their production levels during 2011–15.[97] In Russia and Canada, 2015 production was slightly lower than in 2011, but higher than in 2001. In Norway, production was mostly steady throughout 2011–15. Increasing production of electricity from hydroelectric and geothermal sources in Iceland also enabled that country to become the second-largest producer of primary aluminum in Europe.

While this report generally treats primary unwrought aluminum as a single industry segment, there are several major product groups within this segment that experienced somewhat different trends over the period. The simplest and most commonly produced form of primary unwrought aluminum is remelt ingot for foundry castings, which represented 44 percent of global primary output during 2015, down from 51 percent in 2011. There are also higher value-added forms of primary unwrought aluminum, as shown in figure 2.1. Prices for these products may diverge from the remelt ingot price, as various value-added premiums and conversion charges are included to cover the additional costs of further processing.

[96] Nevertheless, U.S. average business costs were still in the highest 25 percent among global primary unwrought aluminum producers during 2011–15; CRU Group. China has similarly high production costs; however, unlike China, the United States faced cash costs that were much higher than the world average during 2015. CRU Group.
[97] Since 2010, Canada has been one of the world's lowest cost producers of primary aluminum, with average business costs falling within the bottom 25 percent. CRU Group.

Figure 2.1: World: Primary unwrought aluminum products



Source: Industry representatives, interviews by USITC staff, June 5, 2016, and January 24, 2017; Hydro Aluminum Metals USA, "Pricing of Aluminum Products," January 17, 2017.

The most notable change in global production patterns from 2011 to 2015 was the growth of molten aluminum shipments (not shown in figure 2.1), which grew from 11 percent to 22 percent of total primary aluminum shipments (table 2.2). These gains were almost entirely driven by China, where molten aluminum grew from 21 percent of primary aluminum production in 2011 to 37 percent in 2015. When China is excluded from the world totals, global molten aluminum shipments increased only slightly, from 4 to 5 percent of total shipments. As detailed in chapter 6, China has increasingly relied on molten aluminum as a lower-cost input in the production of wrought aluminum. The growth of vertically integrated smelters within the country is closely associated with this trend. When primary and wrought aluminum producers are close to each other geographically, the costs of transporting molten aluminum are considerably reduced, and producers can avoid the higher energy costs and material loss associated with remelting.[98]

Table 2.2: World: Primary unwrought aluminum production volumes (thousand mt) and shares of total (percent), by product, 2011–15

	2011	2012	2013	2014	2015
Remelt ingot	23,481	24,452	25,308	24,935	25,153
Share of total	51%	51%	50%	46%	44%
Liquid molten metal[a]	5,065	6,233	7,592	10,299	12,577
Share of total	11%	13%	15%	19%	22%
Extrusion billet	6,446	6,712	6,580	7,589	7,432
Share of total	14%	14%	13%	14%	13%
Slab	5,065	4,795	4,555	4,336	4,573
Share of total	11%	10%	9%	8%	8%
Foundry alloy	2,763	3,356	3,037	3,252	3,430
Share of total	6%	7%	6%	6%	6%
Wire rod	1,842	1,918	2,531	2,168	2,858
Share of total	4%	4%	5%	4%	5%

[98] For more information about how molten aluminum is transported, see the "Primary Unwrought Aluminum" section of appendix I.

	2011	2012	2013	2014	2015
Continuously cast strip[a]	921	959	1,012	1,084	572
Share of total	2%	2%	2%	2%	1%
Total[b]	46,042	47,945	50,616	54,206	57,167

Source: CRU Group.
[a] Not included in figure 2.1.
[b] Because of rounding, total may not equal sum of line items.

Secondary Unwrought Aluminum

Secondary unwrought aluminum is produced through the recycling and remelting of scrap aluminum.[99] As a result, its production is principally dependent on the supply of scrap, which is generated at the end of the lifecycle of various products.[100] Secondary aluminum is used as an input to downstream wrought production, and the world's largest secondary producers tend to be substantial wrought producers as well. The United States, China, and Europe were the leading producers of secondary aluminum during 2011–15 (table 2.3).[101]

Table 2.3: World: Secondary unwrought aluminum production, 2011–15 (thousand mt)

Country/region	2011	2012	2013	2014	2015
United States	3,044	3,431	3,482	3,637	3,738
China	2,148	2,073	2,004	2,003	2,003
Europe	2,587	2,538	2,543	2,634	2,672
All other	1,905	1,924	1,973	1,947	1,831
Total	9,684	9,966	10,002	10,221	10,244

Source: WBMS, "Aluminum: Secondary Production," 2016, 13.
Note: WBMS secondary aluminum ingot production statistics are not comprehensive, with uncertain coverage (stand-alone versus captive production facilities), depending on the reporting country.

The availability of scrap can be influenced by several factors, including the age of the domestic aluminum industry and its scrap recycling infrastructure; the relative development of a country's economy; and the size of the working-age population within a country.[102] The United States' favorable position on all of these measures has helped make it both the world's largest producer of aluminum scrap, representing nearly 40 percent of the global total during 2011–15, and the world's leading aluminum scrap exporter.[103] Between 2011 and 2013, about 70 percent of U.S. scrap exports were sent to China. However, the share sent to China declined to

[99] The production of secondary aluminum often includes the use of primary aluminum as an input.
[100] Products generate scrap at the end of their lifecycle. Buildings and infrastructure projects have the longest lifecycle, reaching beyond 50 years in some cases, while transportation equipment may have a lifecycle of 20–30 years. Industry representative, interview by USITC staff, Chicago, IL, June 5, 2016.
[101] Production, capacity, and capacity utilization data are not available for secondary aluminum.
[102] Industry representative, interview by USITC staff, Washington, DC, December 16, 2016.
[103] Ibid., Chicago, IL, June 5, 2016.

56 percent by 2015 as China's domestic scrap collection capabilities increased and its costs of primary aluminum production decreased.[104]

Wrought Aluminum

Global production of wrought aluminum expanded at about the same pace as production of primary aluminum during 2001–15, growing by 139 percent over the period and led by rapid growth in China (table 2.4). Worldwide, wrought production and capacity changes during 2011–15 generally reflected robust global end-market demand and were not strongly affected by the price declines that drove trends in the unwrought aluminum sector. Wrought consumption, described in greater detail later in this chapter, increased in nearly every major market, including the United States, Germany, and China. This led to steady or increasing production levels in most major producing countries, including the United States.

Table 2.4: World: Production of wrought aluminum, by producer and product, 2001, 2006, and 2011–15 (thousand mt)

Producer	2001	2006	2011	2012	2013	2014	2015
China	3,195	8,263	21,275	24,227	27,218	29,735	31,403
United States	6,186	6,749	5,739	5,930	5,975	6,116	6,224
Germany	1,985	2,546	2,459	2,430	2,512	2,567	2,507
Japan	2,356	2,403	2,021	2,012	1,988	2,077	2,054
India	613	1,034	1,608	1,621	1,635	1,701	1,791
Italy	869	943	943	853	832	849	822
Russia	506	684	749	790	828	798	779
France	766	770	742	734	727	740	738
Canada	799	944	617	710	693	704	707
Mexico	106	168	204	241	250	291	289
All other	7,286	9,851	10,541	10,737	11,048	11,579	11,762
Total	24,667	34,355	46,898	50,285	53,706	57,157	59,076
Product							
Flat-rolled products	12,725	16,321	19,701	20,401	21,615	23,061	23,784
Extrusions	9,323	13,965	20,818	22,566	24,455	26,022	26,931
Wire and cable	2,620	4,069	6,379	7,318	7,636	8,074	8,361
Total	24,667	34,355	46,898	50,285	53,706	57,157	59,076

Source: CRU Group.

China and the United States are the world's largest producers of wrought aluminum products. Production showed divergent trends in these two leading countries during 2001–15. In China, the period was characterized by consistent, rapid growth in production, although this growth was slower during 2011–15 than it was during 2001–11. In the United States, production grew between 2001 and 2006, fell between 2006 and 2011, and then recovered somewhat during the 2011–15 period. Because China's growth was consistent across the period, China emerged

[104] In 2015, Canada, South Korea, and Mexico accounted for the remaining 30 percent of U.S. scrap exports.

as the world's leading producer of wrought aluminum products and displaced the United States.

Production of wrought aluminum products comprises three major categories: (1) flat-rolled products (FRPs), (2) extrusions, and (3) wire and cable. In 2015, extrusions accounted for the largest share (over 45 percent) of global production of these three categories (table 2.4). However, extrusion production was highly concentrated in China, which accounted for 64 percent of the global total. Extrusions made up the majority of Chinese wrought aluminum production, and China's overall growth in wrought production mostly reflected strong domestic demand for extrusions. Chinese demand for extrusions was driven principally by its infrastructure projects, but also by its emergence as the world's leading supplier of transportation equipment.[105] However, while extrusion production was almost twice as large as FRP production in China in 2015, FRP production also grew rapidly in 2011–15, reflecting the country's emergence as the world's leading producer of foil and other commodified FRP products. In most developed countries that produce wrought aluminum, including the United States, Germany, and Japan, FRPs account for the majority of production, since wrought aluminum use is tied more to industries such as automotive and packaging and less to infrastructure projects and construction.

Flat-rolled Products

FRPs have a wide range of applications, from transportation and construction to beverage cans and packaging, making them the second-largest wrought product category in the world after extrusions and the largest outside of China. Between 2011 and 2015, global production of FRPs grew by just over 20 percent (table 2.5). Production and capacity were steady to increasing in all of the major producing countries over this period; none experienced a contraction of the industry. Still, China drove much of this expansion, as production in the next three largest-producing countries—the United States, Germany, and Japan—increased only slightly. In addition, the growth in production during 2011–15 did not bring production levels back to their 2006 highs in any of those three countries. For example, in the United States, FRP production expanded by 5 percent and capacity expanded by 6 percent during 2011–15, but this only partially offset the 6 percent loss in production and the 9 percent loss in capacity incurred between 2001 and 2011.

FRP capacity utilization is lower in China than in other leading FRP-producing countries and declined during 2011–15, reflecting the fact that capacity in this segment expanded faster than production in China during this period. It is likely that aluminum producers anticipate greater

[105] Industry representative, interview by USITC staff, January 24, 2017. China's transportation sector consumed 2 million mt of aluminum in 2015, the highest of any other country reported worldwide. CRU Group.

demand for FRPs in China in the future, as the economy continues to develop, and have invested in additional capacity to meet that demand.[106] During the period, capacity utilization averaged 69 percent in China, compared to 70 percent in the United States, 87 percent in Germany, and 73 percent in Japan.[107]

Table 2.5: World: Production, capacity, and capacity utilization of aluminum flat-rolled products, by producer, 2001, 2006, and 2011–15

Producer	2001	2006	2011	2012	2013	2014	2015
Production (1,000 mt)							
China	747	2,004	6,073	6,643	7,636	8,600	9,200
United States	4,269	4,626	3,992	4,088	4,070	4,130	4,186
Germany	1,504	1,922	1,835	1,854	1,933	1,952	1,899
Japan	1,289	1,340	1,195	1,167	1,147	1,224	1,264
France	486	529	541	540	530	543	539
Italy	388	406	451	481	472	481	491
India	200	270	390	386	429	454	464
Russia	237	353	367	378	388	388	401
Canada	210	229	140	140	140	140	140
United Kingdom	303	276	109	111	124	124	133
All other	3,092	4,366	4,608	4,613	4,746	5,025	5,067
Total	12,725	16,321	19,701	20,401	21,615	23,061	23,784
Capacity (1,000 mt)							
China	1,319	3,130	7,901	9,516	11,162	13,035	14,753
United States	6,295	5,528	5,742	5,752	5,772	5,913	6,094
Germany	1,948	2,063	2,158	2,188	2,188	2,188	2,208
Japan	1,578	1,597	1,666	1,686	1,626	1,626	1,626
France	638	638	608	628	633	648	658
Italy	567	725	777	752	752	732	707
India	302	342	499	604	667	728	738
Russia	716	818	1,028	1,035	1,038	1,038	1,038
Canada	267	267	185	185	185	185	186
United Kingdom	345	318	116	116	146	146	146
All other	4,699	5,611	6,571	6,848	7,109	7,598	7,944
Total	18,674	21,037	27,251	29,310	31,278	33,837	36,098
Capacity utilization (%)							
China	57	64	77	70	68	66	62
United States	68	84	70	71	71	70	69
Germany	77	93	85	85	88	89	86
Japan	82	84	72	69	71	75	78
France	76	83	89	86	84	84	82
Italy	68	56	58	64	63	66	69
India	66	79	78	64	64	62	63
Russia	33	43	36	37	37	37	39

[106] Industry representative, telephone interview by USITC staff, April 17, 2017.
[107] USITC staff calculations based on CRU Group. Results of the USITC survey of domestic producers suggest a higher U.S. capacity utilization rate of between 87 and 99 percent. Appendix table H.7: Survey questions 4.2 and 4.3 in appendix H: Survey Results.

Producer	2001	2006	2011	2012	2013	2014	2015
Canada	79	86	76	76	76	76	75
United Kingdom	88	87	94	96	85	85	91
All other	66	78	70	67	67	66	64
Total	68	78	72	70	69	68	66

Source: CRU Group.

In the United States and Germany, FRPs are mostly used in automotive, aerospace, and packaging end-use markets. Both countries have large automobile and aerospace manufacturing industries. The importance of these industries to FRP production in more mature producing countries reflects a transition away from commodified FRPs, such as can sheet and foil, in favor of higher-value-added automotive sheet production.[108] This is particularly true in the United States, where automakers are becoming increasingly reliant on aluminum and other lightweight materials to improve energy efficiencies in accordance with the Corporate Average Fuel Economy (CAFE) standards.[109] Consistent with this trend, according to the results of the Commission's survey, U.S. wrought producers doubled their capital investments during this five-year period, with 78 percent of investments directed to upgrading equipment in rolling mills that produce FRPs (appendix table H.15).[110]

Extrusions

Aluminum extrusions are principally used in building and construction applications, and to a lesser extent by the transportation sector. As a result, countries undergoing substantial infrastructure development, such as China and India, specialize much of their production in this wrought product category.[111] For example, production of extrusions in 2015 grew nearly threefold from 2001 levels in India and more than 10-fold in China. However, other countries with competitive wrought segments, including the United States, Japan, and Germany, are also major producers. During the narrower 2011–15 period, production of aluminum extrusions grew 29 percent worldwide. Over this period, extrusions production grew 44 percent in China and 21 percent in the United States, the largest- and second-largest- producing countries,

[108] For example, both Novelis and Alcoa exited the foil production market in large part due to the challenges of competing against lower-priced Chinese FRPs. Miller, "China Crinkles," August 21, 2016; Vazquez, USITC written testimony, September 29, 2016. The U.S. automotive industry has increasingly resorted to aluminum in an effort to comply with national energy efficiency standards. Recent technological advancements in the form of new alloys have improved the strength of aluminum. Combined with its lightweight properties, this strength has made it more attractive than steel in automotive production. Kayakiran, "Auto Industry Drives Comeback," January 28, 2015. FRP mills in the United States were largely designed to produce can sheet. Vazquez, written testimony to the USITC, September 28, 2016.
[109] Industry representative, interview by USITC staff, September 23, 2016.
[110] USITC, survey of U.S. aluminum producers, September 30, 2016. These investments also reflect the greater costs associated with rolling-mill equipment compared to the equipment used for other wrought products, such as extrusions. U.S. industry representative, interview by USITC staff, December 16, 2016.
[111] Industry representative, interview by USITC staff, Washington, DC, January 24, 2017.

respectively (table 2.6).[112] While China and the United States expanded production of extrusions, production in Japan and Germany, the next-largest producers, fell by 5 percent and 3 percent, respectively.

Table 2.6: World: Production of aluminum extrusions, by producer, 2001, 2006, and 2011–15 (thousand mt)

Producer	2001	2006	2011	2012	2013	2014	2015
China	1,720	4,742	11,988	13,520	15,202	16,357	17,215
United States	1,706	1,934	1,571	1,673	1,728	1,853	1,908
Japan	1,018	1,029	794	812	810	820	757
Germany	451	584	603	552	556	591	587
India	124	206	313	306	329	369	366
Canada	443	488	285	344	332	351	362
Italy	454	507	465	352	345	355	321
Mexico	59	108	133	161	172	210	206
Russia	168	181	197	213	234	219	204
France	192	153	119	111	113	114	116
All other	2,988	4,033	4,350	4,522	4,634	4,783	4,889
Total	9,323	13,965	20,818	22,566	24,455	26,022	26,931

Source: CRU Group.

Wire and Cable

Aluminum wire and cable was the smallest category of wrought aluminum production between 2011 and 2015, accounting for only 14 percent of the world total. Global production grew by 31 percent over this period. Production trends mirrored those observed for extrusions, since wire and cable production is similarly associated with infrastructure and construction projects and the associated increased need for electricity transmission and distribution systems. With the majority of such infrastructure projects occurring in Asia during this period, China and India have accounted for a large majority of wire and cable production.[113] As with other wrought products, China's production grew rapidly, expanding by 55 percent between 2011 and 2015 (table 2.7). After China, India was the largest wire and cable producer and accounted for 11 percent of global production in 2015.

[112] U.S. extrusions firms have responded to growing demand in the building and construction segment, in particular, with capacity expansions, facility upgrades, and acquisitions. In addition, after the 2010 imposition of antidumping and countervailing duty orders on U.S. imports from China, those imports fell significantly; the 2011–15 rise in U.S. extrusion production followed the import decline.
[113] Industry representative, interview by USITC staff, Chicago, IL, June 6, 2016.

Table 2.7: World: Production of aluminum wire and cable, by producer, 2001, 2006, and 2011–15 (thousand mt)

Producer	2001	2006	2011	2012	2013	2014	2015
China	728	1,517	3,215	4,064	4,379	4,779	4,989
India	290	558	904	929	876	879	961
Canada	146	227	192	227	222	212	205
Russia	101	150	184	199	206	191	174
United States	210	189	175	168	177	134	129
France	87	88	83	83	83	83	83
Mexico	24	35	47	49	48	51	51
Japan	48	33	32	33	32	32	33
Germany	30	41	21	23	23	23	21
Italy	27	30	27	20	15	13	10
All other	929	1,201	1,499	1,523	1,575	1,677	1,705
Total	2,620	4,069	6,379	7,318	7,636	8,074	8,361

Source: CRU Group.

Overview of Global Consumption

Global consumption of primary unwrought and wrought aluminum during 2001–15 was characterized by a shift from developed economies in North America and Europe to developing regions, especially China. By 2015, China's consumption of each type had grown more than eightfold, accounting for 52 percent of global primary consumption and nearly 50 percent of wrought consumption.[114]

Primary Unwrought Aluminum

In general, consumption trends for primary unwrought aluminum are closely linked to production trends for wrought products, since primary unwrought aluminum is mostly consumed by wrought producers. Between 2011 and 2015, consumption of primary unwrought aluminum grew not only in China, but also in other countries that expanded their production of wrought products (table 2.8). In developing-country markets, such as India and Turkey, the strong growth in primary aluminum consumption reflected a continuation of the trend that occurred throughout the broader 2001–15 period. Growth in consumption of primary aluminum in these developing countries reflects their expanding production capacity in wrought aluminum products. The United States and Germany, despite being more established producers of wrought products, also expanded consumption of primary unwrought aluminum between 2011 and 2015 (by 17 percent and 7 percent, respectively) as their production of wrought products increased. Consumption of primary aluminum declined slightly in Japan,

[114] Although comprehensive statistics on secondary aluminum consumption are not readily available, limited statistical and anecdotal information suggests that China is among the world's leading consumers in this segment as well (industry representative, interview by USITC staff, Chicago, IL, June 6, 2016).

which is consistent with its flat level of production of FRPs and declining production of extrusions.

Table 2.8: World: Consumption of primary unwrought aluminum, by consumer, 2001, 2006, and 2011–15 (thousand mt)

Consumer	2001	2006	2011	2012	2013	2014	2015
China	3,212	8,790	19,417	21,345	24,274	27,292	29,267
United States	5,248	6,172	4,539	4,865	4,980	5,196	5,328
Germany	1,544	1,976	2,077	2,063	2,073	2,188	2,215
Japan	2,241	2,480	2,088	2,116	1,950	2,058	1,964
India	585	1,106	1,673	1,773	1,701	1,698	1,887
South Korea	850	1,148	1,327	1,301	1,235	1,326	1,398
Turkey	176	433	869	938	971	1,061	1,103
Italy	755	1,016	891	776	784	837	881
Russia	595	770	858	916	933	874	828
Brazil	559	773	1,057	1,033	1,013	992	803
All other	7,833	9,793	10,194	10,194	10,400	10,694	10,883
Total	23,598	34,457	44,990	47,320	50,314	54,216	56,557

Source: CRU Group.

Wrought Aluminum

Consumption of wrought products increased between 2011 and 2015 in all of the top 10 consuming countries except Brazil and Russia, leading to an overall 26 percent increase in global consumption during the period (table 2.9). This growth was the fastest in China, where consumption of wrought products increased by 47 percent to nearly 30 million mt, making the China market more than four times larger than the second-largest market, the United States, in 2015. Consumption of wrought aluminum also grew rapidly in the GCC countries, rising by 35 percent over the period, due chiefly to the region's growing demand for construction materials.

Table 2.9: World: Consumption of wrought aluminum, by consumer, 2001, 2006, and 2011–15 (thousand mt)

Consumer	2001	2006	2011	2012	2013	2014	2015
China	3,440	7,918	20,113	23,087	25,797	27,998	29,505
United States	6,278	7,242	5,793	6,015	6,196	6,425	6,642
Germany	1,828	2,466	2,594	2,464	2,444	2,530	2,613
Japan	2,165	2,275	1,902	1,932	1,951	1,969	1,991
India	610	1,056	1,655	1,701	1,672	1,712	1,848
Brazil	602	688	1,140	1,133	1,193	1,170	1,085
South Korea	509	712	862	863	882	913	936
Russia	426	566	677	741	752	698	648
Indonesia	225	321	433	460	483	493	511
Thailand	201	303	383	440	454	471	509
All other	8,559	10,996	11,612	11,784	12,239	12,934	13,234
Total	24,843	34,543	47,164	50,620	54,063	57,313	59,522

Source: CRU Group.
Note: GCC countries' consumption of wrought aluminum rose from 690,000 mt to 940,000 mt during 2011–15.

The United States, Germany, and Japan are more established markets for wrought products and thus experienced slower growth in consumption. These countries have large wrought-consuming industries due in large part to the presence of major construction and transportation equipment firms. In particular, robust demand from the automotive and aerospace sectors drove consumption trends within these countries during the period. Demand from the packaging industry also tended to be steady in developed markets during this time.[115]

Data are also available for global consumption of wrought aluminum by end use. During 2011–15, construction was the largest consuming end-use market for aluminum, accounting for roughly one-third of global consumption across each of the five years of this period. Electrical industries were the second-largest consuming end-use market, followed by transportation; collectively, these two industries represented 30 percent of global demand between 2011 and 2015 (table 2.10).

[115] CRU Group.

Table 2.10: World: Consumption of wrought aluminum by end use, 2011–15 (thousand mt)

End-use sector	2011	2012	2013	2014	2015
Construction	16,064	17,494	18,829	19,830	20,515
Electrical	7,939	8,855	9,336	9,859	10,185
Transportation	5,613	5,936	6,312	6,829	7,318
Packaging	5,376	5,559	5,800	6,011	6,200
Foil stock	4,707	4,921	5,466	5,967	6,172
Machinery and equipment	4,361	4,646	4,934	5,270	5,475
Consumer durables	2,036	2,092	2,195	2,303	2,404
Other	1,067	1,118	1,192	1,246	1,252
Total	47,164	50,620	54,063	57,313	59,522

Source: CRU Group.
Note: Aluminum consumption amounts by end use are not limited to primary aluminum, so comparisons to previous primary aluminum consumption numbers will differ.

Much of the international expansion of these three leading end-use markets was driven by rising demand in China and other emerging economies during 2011–15. Developing economies often build infrastructure more rapidly, which generates demand for aluminum by the construction and electrical industries in particular. Notably, China has also emerged as the world’s largest market for aluminum in the transportation sector, reflecting the country’s increasing involvement in the manufacture of more complex products. Developed economies, led by Canada, the United States, and Germany, also feature large transportation sectors, which consume wrought aluminum products in producing motor vehicles and aircraft.

Overview of Global Trade

International trade in aluminum tends to flow from countries that are principally engaged in unwrought production to those with substantial wrought industries. For instance, the leading exporters of unwrought aluminum during 2011–15 included Russia, Canada, the GCC countries, and Norway—all countries with small wrought industries. Likewise, the largest importers of unwrought aluminum were countries that have sizable wrought-producing industries. The three largest importers of unwrought aluminum in 2015 were the United States, Germany, and Japan—three of the world’s four largest wrought producers. These trends reflect the substantial link between unwrought aluminum supplies and wrought aluminum production. The largest wrought exporting countries were those with the largest wrought-producing industries, led by China, Germany, and the United States. These exports were primarily sent to developed countries; Germany, the United States, the UK, and France were the top importers in 2015. These countries require wrought aluminum products for a wide range of end uses and cannot always fill this demand through domestic production.

Unwrought Aluminum

Exports

Unwrought aluminum exports between 2011 and 2015 were concentrated among the top six exporting countries: Russia, Canada, Netherlands, the United Arab Emirates (UAE), Australia, and Norway (table 2.11). [116] These countries accounted for over one-half of global unwrought aluminum exports in 2015. As shown on the map (figure 2.2), the largest bilateral trade flow was the export of unwrought aluminum from Canada to the United States. European markets were largely served by exports from Norway, which was the second-largest trade flow. Russia was less reliant on a single export market than were Canada or Norway: the top three export destinations for Russia were Japan, the UK, and Turkey, all representing nearly equal export volumes. The UAE also exported to a wide variety of destinations, while Australia primarily exported to Asia.

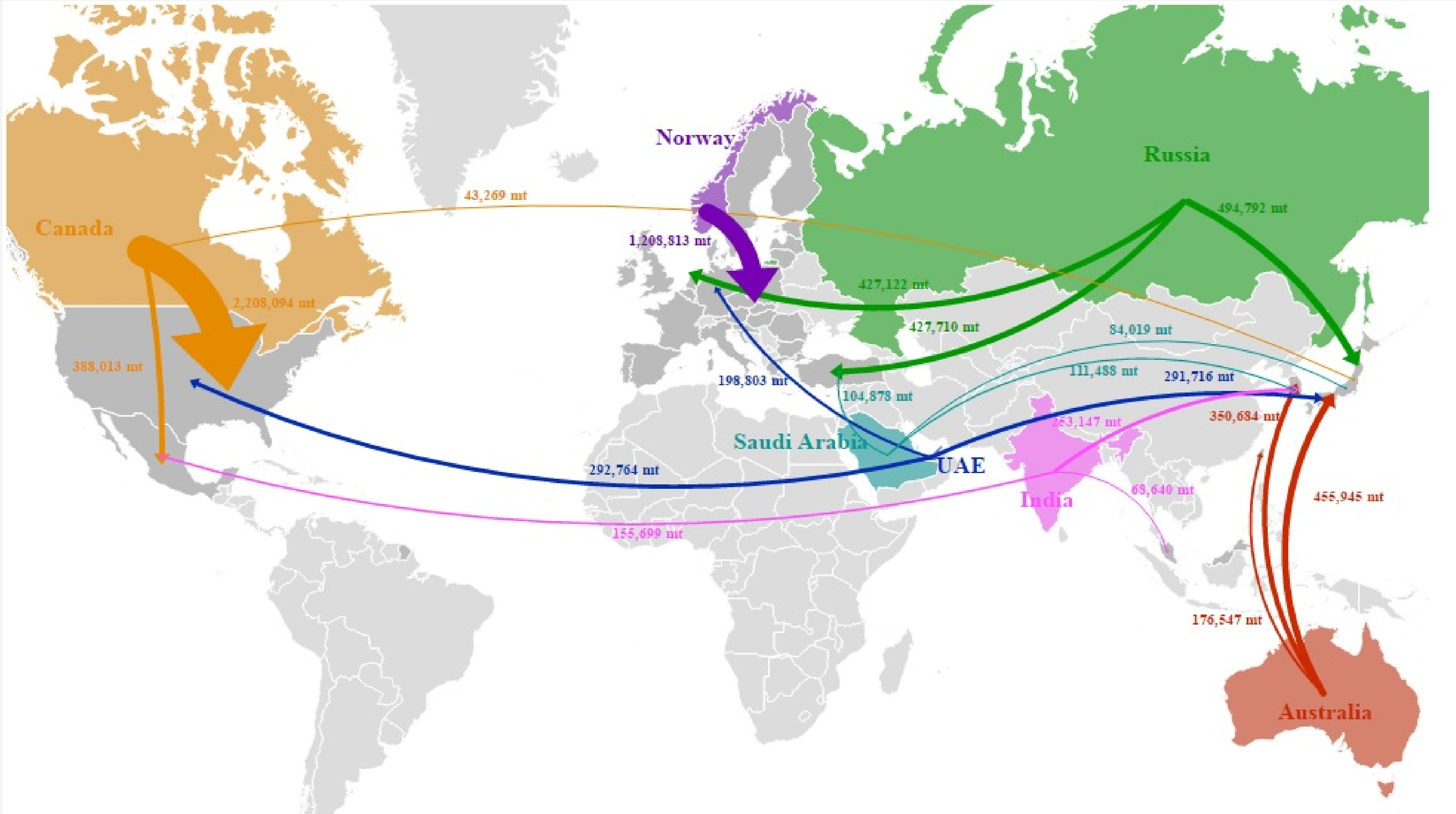
Table 2.11: World: Exports of unwrought aluminum (HS 7601), by leading exporters and the United States, 2001, 2006, and 2011–15 (thousand mt)

Exporter	2001	2006	2011	2012	2013	2014	2015
Russia	2,721	3,427	2,916	2,919	2,588	3,771	3,265
Canada	2,047	2,361	2,467	2,419	2,650	2,642	2,876
United Arab Emirates	523	852	1,625	1,720	1,767	2,060	2,128
Netherlands	991	1,501	2,140	1,744	1,725	1,999	1,873
Australia	3,293	1,650	1,709	1,652	1,538	1,406	1,367
Norway	1,078	1,591	1,432	1,362	1,298	1,320	1,252
India	118	192	325	271	352	464	824
Saudi Arabia	11	14	6	13	146	395	615
China	442	1,257	747	609	516	619	582
United States	370	421	406	410	389	397	392
All other	6,146	8,751	9,434	9,065	9,380	9,203	8,856
Total	17,740	22,017	23,206	22,184	22,349	24,275	24,030

Source: IHS Markit, GTA database (accessed September 22, 2016 and April 4, 2017).
Note: "HS" is the global Harmonized Commodity Description and Coding System, which classifies traded products. Export figures are based on "mirror data," which derives export statistics from partner countries' import data. The table shows exports of the world's nine largest wrought exporters as well as the United States.

[116] Most exports from the Netherlands likely originated from Norway or Germany. The Netherlands has little unwrought aluminum production. It appears prominently in trade statistics for aluminum because of its role as a principal exporting port for much of Western Europe. For example, unwrought aluminum produced in Norway and Germany may be exported out of Rotterdam and thereby attributed to the Netherlands in global trade statistics.

Figure 2.2: World: Major trade flows of unwrought aluminum (thousand mt)



Source: IHS Markit, GTA database (accessed September 22, 2016, and April 4, 2017).

These top primary unwrought exporting countries share two main commonalities. First, because primary aluminum production is especially energy intensive, the largest producers are also those with the lowest electricity costs.[117] The second commonality among these producers is that each has only a small domestic market for unwrought aluminum and exports nearly all of its production. Between 2011 and 2015, unwrought aluminum exports from the UAE expanded the most rapidly among the top six exporters, growing by 31 percent, followed by Canada (17 percent) and Russia (12 percent). The UAE's export growth was due to its added production capacity during the period. Canadian exports filled a gap created by declining U.S. primary production, while Russia's exports benefited from a significant devaluation of the ruble. By contrast, Australian, Norwegian, and Dutch exports all fell between 2011 and 2015. Outside of these countries, exports from India and Saudi Arabia also increased significantly during the period.

Imports

For every year during 2011–15, more than one-half of global unwrought aluminum exports were sent to five importing countries: the United States, Japan, Germany, the Netherlands, and South Korea. With the exception of the Netherlands, which is a trade hub for Western Europe, the large importers of unwrought aluminum were also among the world's largest wrought producers. Of particular note is the United States, which recorded a 24 percent increase in unwrought imports during 2011–15. This growth reflected declining U.S. primary production resulting from idled capacity and several smelter closures, as well as rising domestic demand. The other four leading countries imported relatively consistent volumes of primary unwrought aluminum between 2011 and 2015 (table 2.12). Mexico experienced the largest growth among the top 10 importers, with imports rising by 84 percent over the period. Mexico has one of the world's fastest-growing aluminum industries, and imported unwrought aluminum is a critical input into its burgeoning wrought production.

Table 2.12: World: Leading importers of unwrought aluminum (HS 7601), 2001, 2006, and 2011–15 (thousand mt)

Importer	2001	2006	2011	2012	2013	2014	2015
United States	2,678	3,465	2,696	2,855	2,897	3,060	3,330
Japan	2,611	3,036	2,693	2,752	2,480	2,824	2,529
Germany	1,659	2,203	2,536	2,443	2,414	2,591	2,526
Netherlands	969	1,756	2,145	1,959	2,062	2,514	2,199
South Korea	881	1,206	1,318	1,429	1,430	1,491	1,512
Italy	683	990	1,047	845	993	1,116	1,132
Turkey	127	464	885	934	990	1,094	1,131
Mexico	421	439	554	637	609	689	1,021
Taiwan	417	540	564	553	591	662	645

[117] See chapter 3 for additional details.

Importer	2001	2006	2011	2012	2013	2014	2015
France	509	596	540	412	473	562	539
All other	6,785	7,322	8,229	7,366	7,409	7,671	7,466
Total	17,740	22,017	23,206	22,184	22,349	24,275	24,030

Source: IHS Markit, GTA database (accessed September 22, 2016, and April 4, 2017).

Wrought Aluminum

Exports

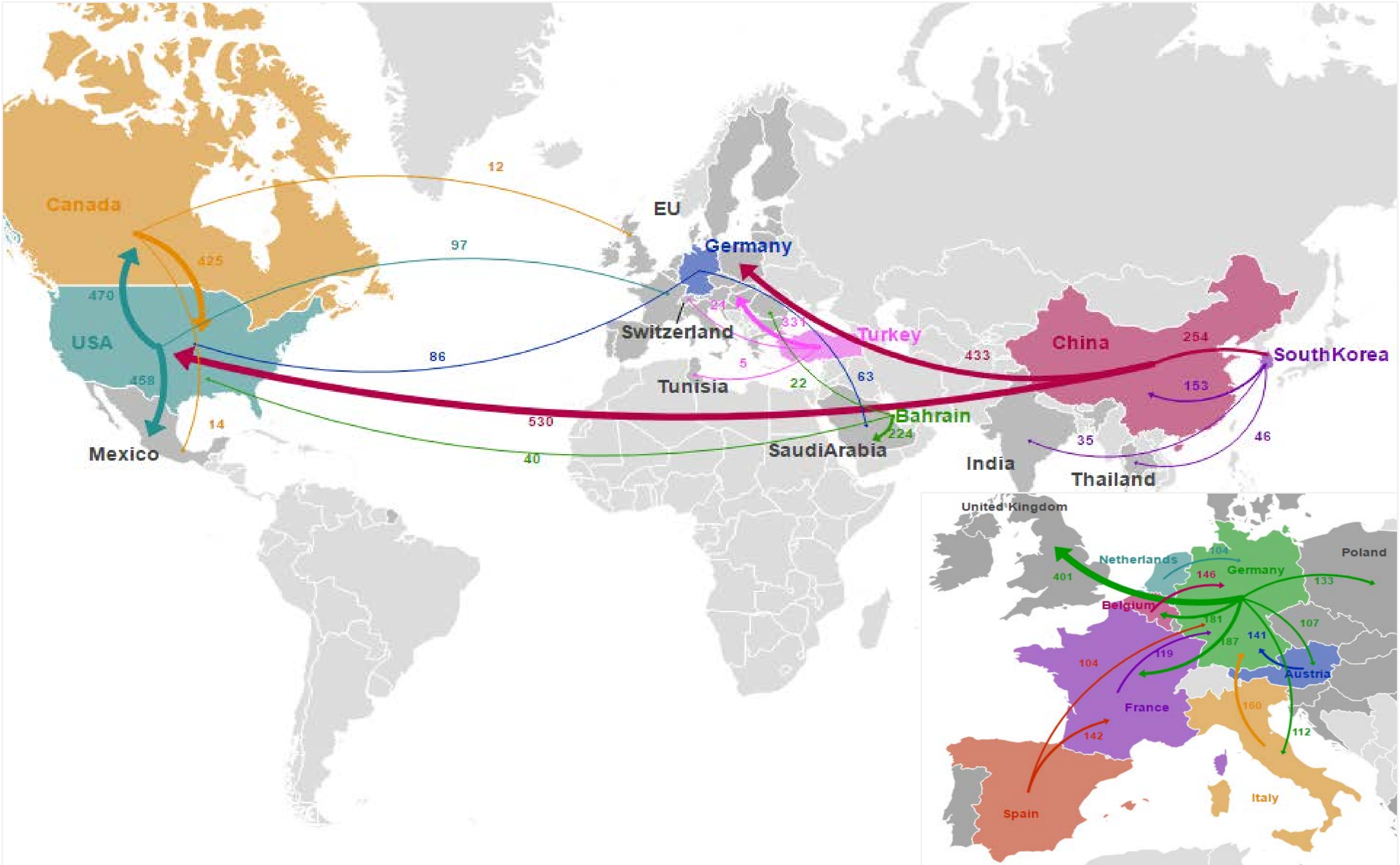
The three largest exporters of wrought aluminum during 2011–15 were also the world's leading producers. Collectively, China, Germany, and the United States represented 40 percent of global exports in 2015 (table 2.13). Unlike unwrought aluminum exports, the majority of which go to a relatively small group of countries with wrought industries, wrought exports are sent to a wide range of countries with manufacturing and construction industries that generate demand for wrought products (figure 2.3). The map also indicates that the major wrought exporters also import wrought products from the other major producing countries. For example, there is a significant bilateral trade flow in wrought aluminum between the United States and Germany. Also, the United States imports a large volume of wrought aluminum from China, despite being a major producer. These patterns reflect the major producers' specialization in particular segments of the wrought aluminum market. For instance, as previously described, the United States tends to import lower-value FRPs, such as foil, and export higher-value FRPs, such as automotive sheet.

Table 2.13: World: Leading exporters of wrought aluminum (HS 7604–7608), 2001, 2006, and 2011–15 (thousand mt)

Exporter	2001	2006	2011	2012	2013	2014	2015
China	110	924	2,595	2,305	2,686	2,904	2,934
Germany	1,296	1,725	1,838	1,815	1,804	1,862	2,059
United States	1,062	1,200	1,144	1,298	1,297	1,246	1,204
Italy	347	516	607	552	611	628	635
France	537	683	665	638	599	600	582
South Korea	207	428	504	413	501	563	474
Canada	547	794	516	489	432	446	463
Spain	208	338	376	383	403	434	449
Turkey	71	184	329	347	350	347	395
Bahrain	175	388	354	369	435	240	375
All other	3,776	5,575	5,728	5,614	5,817	5,944	5,838
Total	8,338	12,757	14,656	14,224	14,934	15,215	15,408

Source: IHS Markit, GTA database (accessed September 22, 2016 and April 4, 2017).
Note: Export figures are based on "mirror data," which derives export statistics from partner countries' import data.

Figure 2.3: World: Major trade flows of wrought aluminum (thousand mt)



Source: IHS Markit, GTA database (accessed September 22, 2016, and April 4, 2017).

Growth in global exports during this period largely stemmed from increased demand for FRPs. Collectively, FRPs represented 67 percent of total global wrought exports from 2011 to 2015 (table 2.14). As previously noted, FRPs are commonly used in the automotive, aerospace, consumer electronics, and packaging industries. The United States and other established aluminum producers have an advantage in producing for higher-value transportation markets due to their various certifications from original equipment manufacturers (OEMs) within these consuming industries.[118] As established producers have prioritized higher-value-added wrought production, they have become large importers of lower value-added FRPs. For instance, the United States nearly doubled its imports of foil and other lower-value-added FRPs from China during 2011–15.

Table 2.14: World: Exports of wrought aluminum, by product form, 2001, 2006, and 2011–15 (thousand mt)

Product form	2001	2006	2011	2012	2013	2014	2015
Flat-rolled products	5,883	8,469	9,639	9,265	10,006	10,280	10,554
Plates, sheets, and strip (HS 7606)	4,575	6,521	7,530	7,152	7,673	7,917	8,200
Foil (HS 7607)	1,308	1,949	2,109	2,113	2,333	2,364	2,354
Extrusions	1,866	3,253	3,867	3,751	3,696	3,719	3,564
Bars, rods, and profiles (HS 7604)	1,621	2,868	3,309	3,336	3,251	3,222	3,133
Tubes and pipes (HS 7608)	244	385	558	415	445	497	430
Wire and cable	589	1,035	1,150	1,207	1,231	1,215	1,291
Wire (HS 7605)	589	1,035	1,150	1,207	1,231	1,215	1,291
Total	8,338	12,757	14,656	14,224	14,934	15,215	15,408

Source: IHS Markit, GTA database (accessed September 22, 2016, and April 4, 2017).
Note: Export figures are based on "mirror data," which derives export statistics from partner countries' import data.

Imports

Wrought imports during 2011–15 were relatively evenly distributed among the top 10 importing countries (table 2.15). For example, outside of Germany and the United States, which together accounted for 21 percent of the total in 2015, the combined share of the next 8 countries was just 32 percent. For both the United States and Germany, FRPs represented the largest import categories of wrought goods, a pattern which mostly stems from the large transportation equipment manufacturing presence in these countries. In some developing countries, such as Mexico and China, imports of wrought aluminum fell during the period as more of the demand for these products was met by their growing domestic wrought industries.

[118] Industry representative, interview by USITC staff, Washington, DC, December 16, 2016.

Table 2.15: World: Imports of wrought aluminum, by importer, 2001, 2006, and 2011–15 (thousand mt)

Importer	2001	2006	2011	2012	2013	2014	2015
Germany	927	1,297	1,613	1,499	1,449	1,559	1,702
United States	868	1,554	1,194	1,237	1,238	1,409	1,585
United Kingdom	506	687	711	695	720	802	863
France	561	748	764	769	777	782	808
Canada	555	660	506	563	574	593	623
Mexico	321	441	890	966	639	651	600
Netherlands	358	509	525	466	456	494	544
Saudi Arabia	128	322	430	514	571	([a])	539
Italy	502	556	569	493	510	498	515
China	400	681	574	527	478	496	469
All other	3,211	5,301	6,881	6,494	7,522	7,931	7,161
Total	8,338	12,757	14,656	14,224	14,934	15,215	15,408

Source: IHS Markit, GTA database (accessed September 22, 2016, and April 4, 2017).
[a] Not reported.

Trade Flows through Third Countries

The Commission identified several trade flows through third countries, such as through warehouses in the Netherlands and other countries that are major regional shipping hubs, although most of these flows do not involve further processing of aluminum. The only major flows identified by the Commission that could potentially involve further processing are from China through Mexico, Malaysia, and Vietnam, although to date, most of this aluminum has not been further processed, as described below.[119]

During 2011–15, spikes in Chinese exports of certain aluminum products to third countries led to concern among global industry representatives about the classification of these goods and the potential for Chinese exporters to avoid China's export restraints and U.S. trade remedies by shipping these products through third countries. They fear that such shipments depress the global aluminum price, harming most global—including U.S.—producers. (box 2.1).[120] In particular, industry representatives have stated that a portion of purported exports of bars, rods, and profiles from China have been purposely misclassified to avoid Chinese export restraints, and are actually primary unwrought aluminum for remelting ("remelt semis").[121] Remelt semis are aluminum metal that is minimally manufactured, or semifinished, to appear as a semi-manufactured (wrought) product.[122] However, remelt semis do not have the alloy

[119] For more information about trade flows through third countries, see appendix J.
[120] USITC, hearing transcript, September 29, 2016, 28–29 (testimony of Garney B. Scott III, Scepter Industries and Aluminum Association chairman); industry representatives, interviews by USITC staff, Nanning, China, October 27, 2016; Clemence, "Illicit Trade in China's Semis," December 16, 2015.
[121] Ibid.
[122] USITC, hearing transcript, September 29, 2016, 28–29 (testimony of Garney B. Scott III, Scepter Industries and Aluminum Association chairman).

content required for many end uses, and purchasers must melt them down to start over with the manufacture of new unwrought products.

Box 2.1: Trade Policies Affecting Chinese Exports of Remelt Semis

During the period of investigation, China's government policies discouraged exports of primary unwrought aluminum. This was achieved by imposing a 15 percent export tax and by withholding rebates on the 17 percent value-added tax (VAT). At the same time, China encouraged the export of wrought products through a VAT rebate that ranged between 13 and 15 percent during 2011–15. Some U.S. industry representatives state that these policies incentivize Chinese aluminum producers to disguise primary aluminum metal as extrusions, or other wrought projects (i.e., "remelt semis"), both to avoid the export tariff and to take advantage of VAT rebates.

In addition, the United States has applied antidumping (AD) and countervailing duty (CVD) measures to Chinese extrusions since 2011. This may create incentives for transshipment of products covered by the AD/CVD orders.

[a] Incentives for exporting remelt semis changed over time for certain HS categories as Chinese policies changed. For example, in 2008, Chinese authorities noticed that exports of primary aluminum were apparently misclassified under HS 7604.29 (aluminum alloy bars, rods and non-hollow profiles); China responded by removing the VAT rebate and adding a 5–15 percent export tariff on tariff line 7604.2910 (with the tariff rate varying with the cross-section perimeter of the product). Jun, "Nonferrous Industry Body Refutes Claim," September 12, 2016.
[b] USITC, hearing transcript, September 29, 2016, 35–36 (testimony of Tim Reyes, Alcoa Cast Products, and witness for Alcoa, Inc.); industry representatives, interview by USITC staff, July 21, 2016.
[c] For more information, see: USITC, *Certain Aluminum Extrusions from China*, April 2017.

Chinese exports of remelt semis are largely believed to have been classified as bars, rods, and profiles (HS 7604) and shipped from bonded warehouses.[123] Such exports to Mexico, Malaysia, and Vietnam reached a total of about 1.4 million mt during 2011–15. This volume of exports roughly corresponds to industry estimates of total stocks of Chinese aluminum products held outside of China, and represented about 10 percent of total global inventories of primary aluminum during 2011–15 (table 2.16).[124] Total global primary aluminum production (and consumption) was roughly 57 million mt in 2015, so inventories of 1.4 million mt are roughly 2 to 3 percent of global consumption.

[123] Such exports were identified by industry representatives as the most likely to flow through third countries for further processing and re-export. See appendix J for more details.
[124] USITC, hearing transcript, September 29, 2016, 220 (testimony of Jorge Vazquez, founder, Harbor Aluminum).

Table 2.16: Chinese exports of aluminum bars, rods, and profiles (HS 7604) from bonded warehouses to Mexico, Malaysia, and Vietnam, total global stock, and global unwrought and extrusions production, 2011–15 (thousand mt)

Destination/attribute	2011	2012	2013	2014	2015	Total
Vietnam	0	1	1	34	441	477
Malaysia	0	0	0	176	24	200
Mexico	338	330	43	1	1	713
Total exports to Mexico, Malaysia, and Vietnam	338	331	43	211	467	1,390
Total Global Stocks	12,671	13,297	13,599	13,589	14,200	--
Global unwrought production	46,042	47,945	50,616	54,206	57,167	--
Global extrusion production	20,818	22,566	24,455	26,022	26,931	--

Source: IHS Markit, GTA database (accessed September 22, 2016); CRU Group.
Note: Export figures are based on "mirror data," which derives export statistics from partner countries' import data.

The pattern of trade in potential remelt semis has shifted among Mexico, Malaysia, and Vietnam in three distinct periods. During 2011–13, Mexico was the principal destination for these products; over the next year, these exports appeared to have been sent to Malaysia, and then shifted to Vietnam by 2015.[125] Industry representatives have noted that Vietnam charges lower storage rates for bonded warehouses than do other countries, which might make Vietnam an attractive warehousing destination.[126] In 2016, a majority of the products held in Mexico were shipped to Vietnam, and some Chinese-origin products stockpiled in the United States before 2011 may have been shipped to Vietnam as well.[127]

A review of available data indicates that remelt semis are likely moving from warehouses in China to storage facilities in other countries, largely without further processing. Most of the potential remelt products exported by China appear to have remained in inventory in Malaysia and Vietnam, with the largest volume currently in Vietnam.[128] While most of these goods remain in storage and have likely not been further processed, there does appear to be a small volume of products that has been shipped from Malaysia and Vietnam for processing. For example, semis appear to have been remelted into primary billets (classified under HS 7601) in

[125] Based on Chinese exports in two trade regimes: (1) storage and transit goods in bonded warehouses; and (2) inbound/outbound goods in bonded warehouses. IHS Markit, GTA database (accessed various dates June 2016–March 2017).
[126] Industry representative, interview by USITC staff, Ho Chi Minh City, Vietnam, October 19, 2016.
[127] Mexico exported no aluminum extrusions under HS 7604 to Vietnam during 2011–15, then exported 497,000 mt in 2016. See appendix J for additional information about these exports from Mexico to Vietnam. Total U.S. exports to Vietnam, which were less than 1,000 mt annually during 2011–14 and only 11,000 mt in 2015, totaled 387,000 mt in 2016 (of which 234,000 mt were listed as U.S. domestic exports). Trade Data Information Services, Import Genius database (accessed November 2016); industry representative, telephone interview by USITC staff, November 16, 2016; USITC, hearing transcript, September 29, 2016, 220 (hearing testimony of Jorge Vazquez, founder, Harbor Aluminum); IHS Markit, GTA database (accessed March 7, 2017).
[128] Clemence, "Evidence Points to Much Larger Fake Semi Trade," October 21, 2016; USITC, hearing transcript, September 29, 2016, 219 (Jorge Vazquez, Harbor Aluminum).

Vietnam and exported to Brazil.[129] In 2016, Vietnam also shipped small amounts of such billets (6063 alloy billet) to the United States and India.[130] It is also possible that a small volume was shipped from Malaysia without additional transformation: re-exports from Malaysia to the rest of the world increased by 4,500 mt during 2012–15, including a 3,300-mt increase in re-exports to Vietnam.[131]

Overview of Global Prices, Stocks, and Cost of Production

This section describes the relationship between prices, stocks, and the cost of production in the global aluminum industry. In particular, it examines the decline in global aluminum prices during 2011–15 associated with global oversupply (as measured by increasing global stocks) and falling costs of production. These interrelated trends significantly affected the period's production and trade patterns as described above, particularly for primary aluminum.

Prices

Aluminum is a globally traded commodity, and prices are largely set via global and regional exchanges for primary unwrought aluminum (box 2.2). Prices also carry regional premiums, which vary somewhat by region, and include transaction and transportation costs. Remelt ingot is the most basic, commodified primary aluminum product, and its prices are based on the London Metal Exchange (LME) price, plus a small ingot premium. Primary aluminum value-added products (VAPs), such as slab and wire rod, receive a VAP "upcharge" in addition to the ingot premium.

---

[129] From 2011 to 2014, Brazil did not receive any imports under HS 7601 from Vietnam. In 2015, 25 mt of 6063-alloy billet arrived in Brazil from Vietnam, while another 2,045 mt arrived in 2016. Clemence, "New Numbers Show China's Continuing Trade in Fake Semis," April 6, 2016; IHS Markit, GTA database, (accessed September 22, 2016); Datamyne, Datamyne database (accessed September 22, 2016).

[130] Import Genius international trade database (accessed September 22, 2016).

[131] A greater volume of remelt products in HS 7606 may have been re-exported from Malaysia. Malaysian trade data indicate that re-exports of goods in this heading increased from 6,000 mt in 2012 to 37,000 mt in 2014, before declining again to 13,000 mt in 2015. IHS Markit, GTA database (accessed March 7, 2017).

Box 2.2: Commodity Exchanges

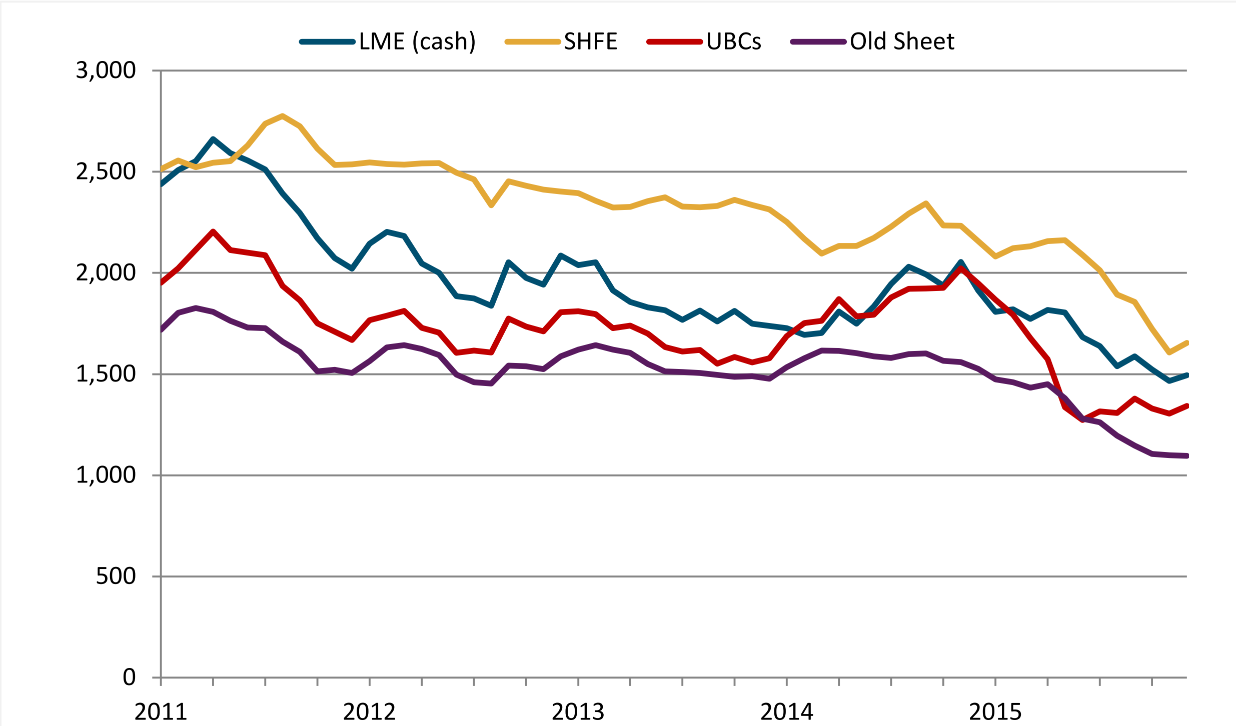
The London Metal Exchange (LME) is the predominant international exchange for high-grade unwrought aluminum, as well as for aluminum alloy contracts.[a] The LME's official price for high-grade unwrought aluminum and aluminum alloy is quoted in U.S. dollars, with the official daily price being the last bid and offer price that is quoted during the second (afternoon) Ring session.[b] The Shanghai Futures Exchange (SHFE) is a major commodity exchange for unwrought aluminum contracts in Asia.[c] Aluminum contracts for the United States and Europe are traded on the LME, while contracts for Asia are traded on both the LME and the SHFE.[d] Aluminum prices in China are set on the SHFE. Exchange-registered warehouses hold primary unwrought aluminum for delivery on exchange-traded contracts, and these warehouses are an important source of aluminum held in inventory (see the "Stocks" section below).

[a] High-grade primary aluminum is traded on the LME as physical, futures, and options contracts in lots of 25 mt. The LME aluminum physical contract is for delivery of ingots, t-bars, and sows, which must meet the chemical purity levels of either the North American and International Registration Record standard P1020A or the Chinese GB/T 1196-2008 National Standard Al99.70. The LME aluminum futures contract has prompt delivery dates scheduled daily out to 3 months, weekly from 3 to 6 months, and monthly from 7 to 123 months. The LME aluminum options contract (to buy or sell the underlying futures contract) has prompt dates scheduled monthly out to 63 months. LME, "LME Aluminium Contract Specifications, Physical Specifications," 2017; "Futures Contract Specifications," 2017; "Traded Options Contract Specifications," 2017.
[b] The Ring is the trading floor for the LME, with two trading sessions each trading day. The official daily price of aluminum is determined at the end of the second session.
[c] Aluminum is traded on the SHFE as physical contracts, for delivery of ingots, in lots of 5 mt. Grade and quality specifications for standard products are "aluminum ingot prescribed in the National Standard of GB/T 1196-2008, AL99.70, with aluminum content no less than 99.7 percent." Substitutions include "aluminum ingot as prescribed in the National Standard of GB/T1196-2008 AL99.85, AL99.90. 2," as well as "aluminum ingot as prescribed in P1020A standard." SHFE, "Aluminum Contract Specifications," 2017.
[d] Hydro Aluminum Metals USA, "Pricing of Aluminum Products," January 17, 2017.

During 2011–15, global primary aluminum prices, as measured by the LME,[132] dropped by roughly 30 percent. Prices also declined by a similar amount on the SHFE and in the secondary (scrap) aluminum market (figure 2.4). Scrap aluminum trades at a discount relative to the LME price, and is shown in the figure as prices for used beverage cans and old sheet.[133] The price is assessed biweekly through a survey of secondary aluminum smelters and scrap dealers, and contracts are sold on various commodity exchanges.[134]

[132] Based on three-month LME prices.
[133] Used beverage cans are one of the largest recycled aluminum products and are sold in large bales. U.S. old sheet is defined as non-cast aluminum items for consumption by secondary aluminum smelters to meet Institute of Scrap Recycling Industries' (ISRI) "taint/tabor" specifications. ISRI, "Scrap Specification Circular," January 1, 2016.
[134] S&P Global Platts, "Methodology and Specifications Guide: Nonferrous," August 2016.

Figure 2.4: Global primary and secondary aluminum prices, 2011–15 (dollars per mt)



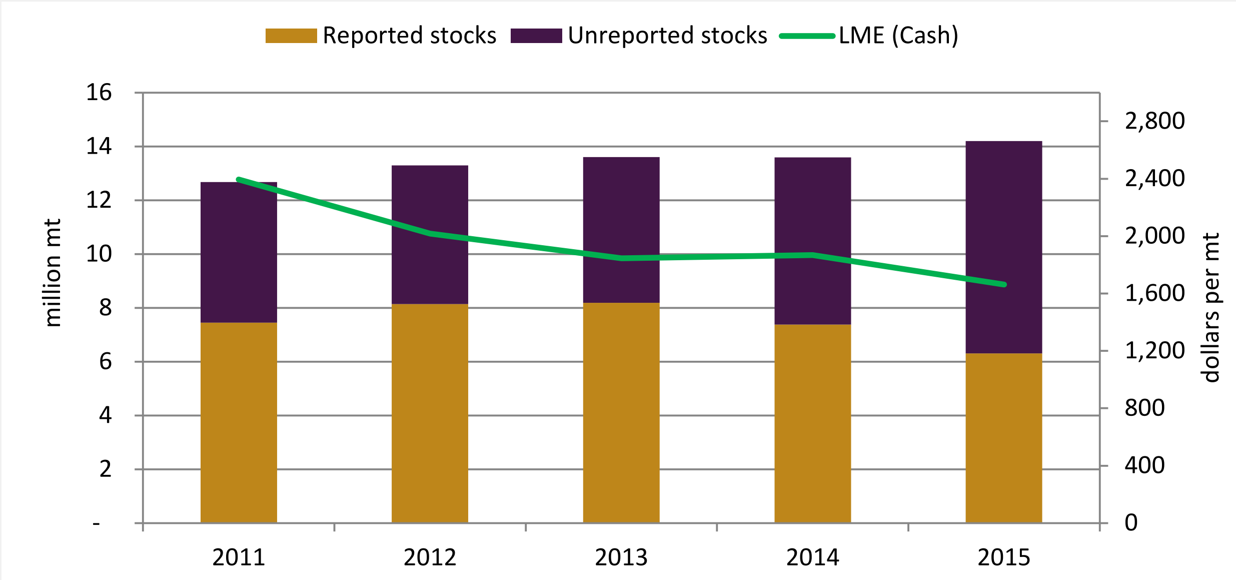
Source: Metal Bulletin, S&P Global Platts Metals Week Price Notification Monthly Reports, January 2011 – December 2015 (accessed various dates).
Note: Corresponds to appendix table L.6.

Stocks

Global stocks of primary aluminum have grown rapidly since the early 2000s, more than tripling from 4.3 million mt in 2001 to 14.2 million mt by the end of 2015, according to CRU Group estimates.[135] This growth in stocks reflects global supply of primary aluminum throughout this period, and was a principal driver of declining aluminum prices during 2011–15 (figure 2.5).[136] While total stocks are difficult to determine, the Commission received multiple estimates of stock levels from industry sources, which consistently showed that stock levels increased during 2011–15 and which agreed that rising stocks had contributed to the price declines during the period. Stocks reported by the CRU Group are of two types: reported stocks, which reflect only official statistics; and unreported stocks, which reflect CRU Group's calculation of the additional residual once consumption is subtracted from production. Unreported stocks increased during 2011–15, more than offsetting declines in reported stocks.

[135] CRU Group.
[136] The ratio of reported world stocks of primary aluminum to consumption has a strongly negative correlation to global prices during 2011–15. The correlation coefficient was -0.88, suggesting a strong association between growing global inventories and price declines.

Figure 2.5: World: Primary aluminum stocks and prices, 2011–15



Source: CRU Group.
Note: Reported stocks reflect only official statistics, while unreported stocks reflect CRU Group's calculation of the additional residual once consumption is subtracted from production. Corresponds to appendix table L.7.

Primary aluminum stocks appear to have originated from a number of different countries. One estimate is that 60 percent of global stocks originated in Eastern and Central Europe (mostly Russia), 17 percent in North America, 10 percent in China, and 13 percent in other regions.[137] The majority of reported stocks are held in warehouses approved by the major aluminum exchanges (box 2.3). LME warehouse holdings accounted for the largest shares of all reported primary-aluminum inventories worldwide, though this share fell from 67 percent in 2011 to 46 percent in 2015. SHFE inventories accounted for only 2.2–5.4 percent of worldwide reported inventories over this same five-year period.[138]

---

[137] Vazquez, USITC written hearing testimony, September 29, 2016, 3; industry official, telephone interview by USITC staff, December 21, 2016.
[138] CRU Group.

Box 2.3: Commodity Exchange Warehouses

Worldwide, the London Metal Exchange (LME) has approved over 600 warehouses and storage facilities for holding nonferrous metals (including primary aluminum) on behalf of the exchange participants. These facilities are located in the United States; Western Europe (Belgium, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom); the Middle East (the United Arab Emirates); and East/Southeast Asia (Japan, South Korea, Malaysia, Singapore, and Taiwan).[a] The LME does not own or operate these warehouses, nor does it own the aluminum contained in them. Rather, it authorizes warehouse companies to store LME-approved brands of aluminum and issues LME warrants (claims) for aluminum to be delivered into or removed from approved warehouses in order to fulfill contract terms for exchange-traded aluminum (physical or future delivery).[b]

The Shanghai Futures Exchange (SHFE) also authorizes warehouses. All 15 warehouses for holding aluminum traded on the SHFE are located in China, in the City of Shanghai and in various cities in the eastern Chinese provinces of Jiangsu, Zhejiang, and Guangdong.[c]

[a] LME, "Warehouse Locations," 2017.
[b] LME, "Approved Warehouses," 2017.
[c] SHFE, "The SHFE Approved Warehouses for Delivery of Aluminum Contract," 2017.

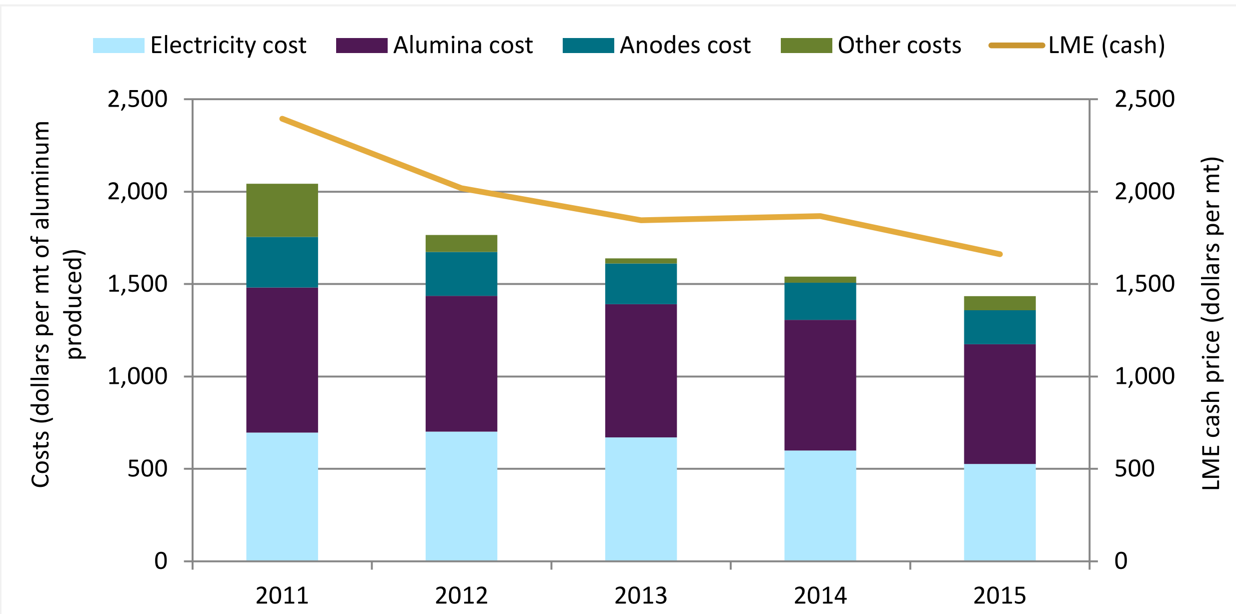
Several witnesses at the Commission hearing attributed the increase in global stocks principally to overproduction in China during the period.[139] As China's primary aluminum production has expanded rapidly, its relative contribution to global inventories has also increased.[140] Estimates of China's share of global stocks in 2015 were between 18 and 30 percent; up from 9 to 15 percent in 2011 (these figures include Chinese domestic stocks held in China).[141] However, available information also suggests that much of the expanded production was consumed domestically in China, and that the country's share of stocks is small relative to its share of global production. Even if the high estimate that 30 percent of stocks are of Chinese origin is correct, this is much smaller than its 55 percent share of global production. China's main contribution to global inventories outside China is believed to largely be "remelt semis," as described in the trade section above.[142] Nevertheless, most of the growth in world stocks during 2011–15 is attributable to China.

[139] USITC, hearing transcript, September 29, 2016, 46 (testimony of Michael Bless); USITC, hearing transcript, September 29, 2016, 56 (testimony of Matt Aboud, Hydro Aluminum Metals USA); USITC, hearing transcript, September 29, 2016, 69 (testimony of Paul-Henri Chevalier, Jupiter Aluminum Corp.).
[140] CRU Group.
[141] Ibid.
[142] USITC, hearing transcript, September 29, 2016, 28–29 (testimony of Garney B. Scott III, Scepter Industries and Aluminum Association chairman); industry representatives, interviews by USITC staff, Nanning, China, October 27, 2016; Clemence, "Illicit Trade in China's Semis Is a Full-Blown Problem," December 16, 2015.

Costs of Production

In addition to persistently high and rising inventories, falling production costs for primary aluminum have also been an important driver of decreasing aluminum prices. There is a particularly strong correlation between production costs and global prices for primary aluminum.[143] As shown in figure 2.6, 2015 prices were 31 percent lower than they had been in 2011, and global costs of production moved mostly in tandem over the period, falling by 30 percent.[144] More generally, falling global production costs have been driven by the declining costs of the three most critical primary aluminum smelting inputs:[145] energy (down by 24 percent), alumina (down by 18 percent), and anodes (down by 32 percent) across this five-year period.

Figure 2.6: World: Price and input costs for production of primary unwrought aluminum, 2011–15



Source: CRU Group.
Note: Global aluminum prices are based on the LME cash price as reported by CRU Group; electricity cost is based on potroom power costs. Other/adjustments include the costs associated with labor, pot relining, casthouse, and site activities. It also includes net realizations adjustments (or credits) to reflect variances in product mix and quality. Corresponds to appendix table L.8.

[143] Vazquez, written testimony to the USITC, September 29, 2016; USITC staff calculations.
[144] Global primary alumina costs were 42 percent of total business costs, followed by energy costs (as measured by total potroom power costs) at 34 percent of total business costs, followed by 15 percent for anodes costs; 9 percent of costs were attributed to a combination of inputs, including transportation and labor costs. CRU Group. See chapter 3 for cross-country comparisons of cost declines.
[145] Vazquez, written testimony to the USITC, September 29, 2016. China's average business costs fell by 31 percent during this time. CRU Group.

Bibliography

Aluminum Extruders Council (AEC). "AEC Files Scope Clarification and Circumvention Case against China Zhongwang Holdings Ltd." Blog, October 23, 2015. http://aluminumextruderscouncil.blogspot.com/2015/10/aec-files-scope-clarification-and.html.

Bloomberg. "China's Aluminum Set to Worsen Glut as Taxes Removed." In *Jakarta Post*, April 24, 2015. http://www.pressreader.com/indonesia/the-jakarta-post/20150424/282050505607907/TextView.

BBC News. "Fresh Data Confirms Chinese Economic Slowdown," March 1, 2016. http://www.bbc.com/news/business-35693794.

China Nonferrous Metals Industry Association (CNIA). Post-hearing statement to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, October 17, 2016.

Clark, Al. "China's Aluminum Value Chain." CM Group, PowerPoint presentation to USITC staff, September 27, 2016.

Clemence, Christopher. "Evidence Points to Much Larger Fake Semi Trade Relocating to Vietnam." Aluminium Insider, October 21, 2016. http://aluminiuminsider.com/exclusive-evidence-points-to-much-larger-fake-semi-trade-relocating-to-vietnam/.

———. "Illicit Trade in China's Semis Is a Full-Blown Problem." Aluminium Insider, December 16, 2015. http://aluminiuminsider.com/illicit-trade-in-chinas-semis-is-a-full-blown-problem/.

———. "New Numbers Show China's Continuing Trade in Fake Semis." Aluminium Insider, April 6, 2016. http://aluminiuminsider.com/exclusive-new-numbers-show-chinas-continuing-trade-in-fake-semis/.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Datamyne Inc. Datamyne database. http://www.datamyne.com/ (accessed various dates).

Deaux, Joe. “Aluminum Is a Poor Man’s Steel When It Comes to Fighting China.” Bloomberg, August 4, 2016. https://www.bloomberg.com/news/articles/2016-08-04/aluminum-is-a-poor-man-s-steel-when-it-comes-to-fighting-china.

Emirates Global Aluminium Association (EGA). Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, January 23, 2017.

Government of Mexico. Ministry of Economy. “Manufacturing, Maquila and Export Service Industry.” Economic Secretary of Mexico (SE) IMMEX, 2010. http://www.2006-2012.economia.gob.mx/industry/foreign-trade-instruments/immex.

Hall, Andrew. “Aluminum Grows in Southeast Asia.” *Metal Bulletin*, September 2016 (fee required).

Home, Andy. “Alcoa Shines a Light on China’s ‘Fake Semis’ Trade.” Reuters, July 13, 2015. http://www.reuters.com/article/us-china-aluminium-ahome-idUSKCN0PO03C20150714.

———. “China, the Aluminum Giant That’s Still Growing.” Reuters, July 20, 2015. http://www.reuters.com/article/us-aluminium-production-ahome-idUSKCN0PU21C20150720.

Hydro Aluminum Metals USA. “Pricing of Aluminum Products.” In “World Markets for Aluminum.” *Platts Aluminum Symposium*, Paradise Valley, AZ, January 17, 2017.

IHS Markit. Global Trade Atlas (GTA) database. https://www.ihs.com/products/maritime-global-trade-atlas.html (accessed various dates).

Import Genius. International Trade Databases for Import-Export Data. https://www.importgenius.com/ (accessed various dates).

Institute of Scrap Recycling Indusgtries (ISRI). “Scrap Specification Circular.” January 1, 2016. http://www.isri.org/specs.

Kayakiran, Firat. “Auto Industry Drives Comeback in Aluminum Prices: Analyst: Usage in Cars Will Have ‘Explosive Period of Growth from 2015 to 2025.’” *Automotive News*, January 28, 2015. http://www.autonews.com/article/20150128/OEM10/150129811/auto-industry-drives-comeback-in-aluminum-prices.

London Metal Exchange (LME). “Approved Warehouses.” https://www.lme.com/trading/warehousing-and-brands/warehousing/approved-warehouses (accessed April 11, 2017).

———. “LME Aluminium Contract Specifications, Physical Specifications.” http://www.lme.com/en-gb/metals/non-ferrous/aluminium/contract-specifications/physical (accessed February 16, 2017).

———. “LME Aluminium Contract Specifications, Futures Contract Specifications.” http://www.lme.com/en-gb/metals/non-ferrous/aluminium/contract-specifications/futures (accessed February 16, 2017).

———. “LME Aluminium Contract Specifications, Traded Options Contract Specifications.” http://www.lme.com/en-gb/metals/non-ferrous/aluminium/contract-specifications/options (accessed February 16, 2017).

———. “Warehouse Locations.” https://www.lme.com/trading/warehousing-and-brands/warehousing/warehouse-locations (accessed April 11, 2017).

Jun, Xie. “Nonferrous Industry Body Refutes Claim That Chinese Company Is Evading US Tariffs.” *Global Times*, September 12, 2016. http://www.globaltimes.cn/content/1006123.shtml.

Miller, John W. “China Crinkles.” *Wall Street Journal*, August 21, 2016. https://www.wsj.com/articles/china-crinkles-aluminum-foil-makers-1471836740

Patterson, Scott, John W. Miller, and Chuin-Wei Yap. “Chinese Billionaire Linked to Giant Aluminum Stockpile in Mexican Desert.” *Wall Street Journal*, September 9, 2016. https://www.wsj.com/articles/chinese-billionaire-linked-to-giant-aluminum-stockpile-in-mexican-desert-1473356054.

Patterson, Scott, Biman Mukherji, and Vu Trong Khanh. “Giant Aluminum Stockpile Was Shipped From Mexico to Vietnam.” *Wall Street Journal*, December 1, 2016. https://www.wsj.com/articles/giant-aluminum-stockpile-was-shipped-from-mexico-to-vietnam-1480588228.

Pei, Minxin. “China’s Slowing Economy: The Worst Has Yet to Come.” *Fortune*, January 21, 2015. http://fortune.com/2015/01/21/china-economy-growth-slowdown/.

PT Indonesia Asahan Aluminum (INALUM). “Meeting the Aluminium Needs of Southeast Asia.” Metal Bulletin, 2013 http://www.metalbulletin.com/events/download.ashx/document/speaker/6588/a0ID000000X0jhIMAR/Presentation.

Reed Exhibitions. "Middle East Aluminum Industry under Global Spotlight," April 14, 2015. http://www.reedexpo.com/es/Comunicados-de-prensa/2015/Middle-East-aluminium-industry-under-global-spotlight-as-ALUMINIUM-MIDDLE-EAST-2015-opens-in-Dubai-/ (accessed April 14, 2015).

S&P Global Platts. "Methodology and Specifications Guide: Nonferrous," August 2016. http://www.platts.com/elqNow/elqNotAuthRedir.htm?ref=/IM.Platts.Content/MethodologyReferences/MethodologySpecs/nonferrous.pdf.

Shanghai Futures Exchange (SHFE). "Aluminum Contract Specifications." http://www.shfe.com.cn/en/products/Aluminum/ (accessed March 3, 2017).

———. "The SHFE Approved Warehouses for Delivery of Aluminum Contract." http://www.shfe.com.cn/upload/dir_20111215/30308_20111215.htm (accessed April 11, 2017).

Trade Data Services. "ImportGenius trade database." https://www.importgenius.com/ (accessed various dates) (fee required).

Trefis Team. "Higher Aluminum Prices and Value-Added Businesses to Boost Alcoa's Q1 Results." *Forbes*, April 7, 2015. https://www.forbes.com/sites/greatspeculations/2015/04/07/higher-aluminum-prices-and-value-added-businesses-to-boost-alcoas-q1-results/#56efc84f50f4.

U.S. Customs and Border Protection (USCBP). NY 897469. Customs Rulings Online Search System, May 19, 1994. https://rulings.cbp.gov/.

U.S. Department of Commerce (USDOC). International Trade Administration (ITA). "Fact Sheet: Commerce Finds Dumping and Subsidization of Aluminum Extrusions from the People's Republic of China," March 29, 2011. http://ia.ita.doc.gov/download/factsheets/factsheet-prc-alum-ext-adcvd-final-032911.pdf.

U.S. International Trade Commission (USITC). Hearing transcript in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

———. *Certain Aluminum Extrusions from China.* Investigation nos. 701-TA-475 and 731-TA-1177 (review). USITC Publication 4481. Washington, DC: USITC, March 2017.

Vazquez, Jorge. Post-hearing statement to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, October 7, 2016.

———. Hearing testimony to the U.S. International Trade Commission in connection with investigation no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

Valdimarsson, Omar. “Aluminum Island Offers Cheap Power Oasis amid Commodities Tumble.” Bloomberg, February 14, 2016. https://www.bloomberg.com/news/articles/2016-02-15/aluminum-island-offers-cheap-power-oasis-amid-commodities-tumble.

World Bureau of Metal Statistics (WBMS). *World Metal Statistics, 2016 Yearbook*. Ware, Herts, United Kingdom: WBMS, 2016.

Yoders, Jeff. “Reclassification as an Answer for Fake Chinese Aluminum Semis?” MetalMiner, August 17, 2016. http://agmetalminer.com/2016/08/17/reclassification-an-answer-for-fake-chinese-aluminum-semis/.

Zhou, Rebecca. “Will Smelters in Xinjiang Continue to Expand Capacity?” CRU Group, July 9, 2015. http://www.crugroup.com/about-cru/cruinsight/Will_smelters_in_Xinjiang_continue_to_expand_capacity.

Chapter 3
Cross-Country Comparison of Industry Competitiveness in Major Aluminum Producing Countries

Overview of Key Competitive Factors

Drawing upon information gained from interviews with industry representatives, its public hearing, industry and trade data,[146] and qualitative analysis, the Commission identified the most critical competitive factors for the three aluminum industry segments—primary, secondary, and wrought (table 3.1). Although several factors were identified for all three segments, for primary producers, one critical competitive driver stands out: access to low-cost electricity. For secondary producers it is the availability and cost of scrap, while for wrought producers it is proximity to market.

Table 3.1: Summary of key factors that affect aluminum industry competitiveness

Primary	Secondary and wrought
Production costs	Availability and cost of aluminum scrap (secondary)
Upstream vertical integration	Availability and cost of unwrought aluminum (wrought)
Economies of scale	Proximity to market (wrought)
Capital expenditures	High-value-added production capability (wrought)
Transportation costs	Labor costs (wrought)
Government policies	

Source: Compiled by USITC staff.

[146] For more information on the datasets used in this report, see chapter 1.

Primary Unwrought Aluminum

Production costs[147] are a leading determinant of competitiveness in the global primary aluminum industry. They are made up mostly of expenditures on electricity, alumina, anodes, and labor.[148] The most significant cost differences among aluminum-producing countries are for electricity,[149] which can represent up to 40 percent or more of total production costs; other costs of production are relatively more consistent across the major aluminum-producing countries.

Electricity costs are a function of two factors—electricity rates (i.e., the price paid per unit of purchased electricity, or the cost to self-generate for internal consumption) and the efficiency of electricity use (i.e., the number of units of electricity required to produce a ton of aluminum). Electricity rates depend on the cost of producing electricity (closely related to the electricity source used, such as hydroelectric, natural gas, and coal); the contract terms (e.g., some firms are able to enter into long-term contracts with electricity prices linked to the London Metal Exchange (LME) aluminum price); whether firms generate their own electricity (via captive power plants, which often provide a cost advantage); and, in some countries/regions, government policies. According to industry representatives, access to low-cost electricity is the single most important determinant in decisions on where to construct new smelters.[150] Efficiency is also a critical variable. More efficient smelters generally use potline cell technologies with higher-amperage cells that use less electricity per metric ton (mt) of primary aluminum production.[151]

---

[147] Throughout this report, "production cost" is the generic term for the cost of producing aluminum at a primary smelter, secondary facility, or wrought-product mill. "Business cost" (also used throughout this report) is CRU Group's more specific term for the cost of producing aluminum at a smelter or rolling mill (i.e., the "site cost") plus costs of marketing, delivery (transportation), and financing, and various premiums or discounts received, which reflect the costs of "bringing a product to market and receiving a fair market price" (i.e., the "net realization cost"). This approach makes it possible to compare costs across smelters or rolling mills on a consistent basis. CRU Group's "average business cost" is the weighted average (by volume of production) of individual component costs for individual smelters or rolling mills in a country, which makes it possible to compare costs across countries on a consistent basis. Source: CRU Group representative, email message to USITC staff, June 9, 2017.
[148] Global primary alumina costs were 42 percent of average business costs, followed by energy costs (as measured by total potroom power costs) at 34 percent, anode costs at 15 percent, and other costs (e.g., transportation and labor costs) at 10 percent. CRU Group.
[149] USITC, hearing transcript, September 29, 2016, 220 (testimony of Jorge Vazquez, Harbor Aluminum); Nappi, *The Global Aluminium Industry: 40 Years Since 1972*, February 25, 2013, 18–19.
[150] Industry representatives, interviews by USITC stafff, December 16, 2016, and February 15, 2017.
[151] Every increase of 100 kiloamperes (kA) can reduce power consumption by 0.5 megawatt hours (MWh). Industry representative, telephone interview by USITC staff, February 15, 2017; AME, "Aluminum Smelter Electricity Costs," http://www.amegroup.com/Website/FeatureArticleDetail.aspx?faId=73 (accessed February 12, 2017); Fickling, "China Isn't the Reason," October 10, 2016.

The structure of a country's aluminum industry can affect its competitive position. In particular, vertical integration upstream into bauxite and alumina production can yield substantial cost efficiencies. In addition, large-capacity smelters can provide economies of scale, which further reduce production costs. The capital expenditure (CAPEX) costs of building a new smelter can likewise have a significant impact on long-term competitiveness. There is wide variation in CAPEX costs worldwide, particularly between producers inside and outside of China.

Transportation costs commonly comprise less than 10 percent of estimated global primary production costs, but can nevertheless also affect competitiveness, depending on the destination market. In particular, export-oriented primary producers can incur substantial transportation costs if their smelters are located far from shipping ports.

Although government policies affect competitiveness across all three segments of the global aluminum supply chain, they are believed to impact primary aluminum more than other segments by lowering production costs. For example, government programs have lowered electricity rates in each of the leading primary producing countries discussed in this report.

Secondary Unwrought and Wrought Aluminum

In the secondary aluminum industry, the availability and cost (including freight cost) of aluminum scrap is the most critical component of competitiveness.[152] Scrap is the main input into secondary aluminum production and accounts for a large share of the value of production.[153] The availability of scrap within a country is determined by several factors, including the age of the domestic aluminum industry, the level of economic development, the culture of recycling, and the infrastructure that facilitates scrap collection.[154] Developing economies tend to generate less scrap due to the relative infancy of various aluminum end markets and are more reliant on primary aluminum for wrought production.[155]

In the wrought aluminum industry, the availability and cost of unwrought aluminum (both primary and secondary) is a key driver of a country's competitiveness.[156] Because secondary aluminum is often a lower-cost input into wrought production than primary aluminum is,

---

[152] Industry representative, telephone interview by USITC staff, December 16, 2016.
[153] For example, Ye Chiu (a major Asian producer) reported in 2015 that aluminum scrap accounts for about 80 percent of the costs of secondary aluminum production. Ye Chiu Group, *2015 Annual Report*, n.d., 17 (accessed March 18, 2017).
[154] Industry representative, interview by USITC staff, December 22, 2016; industry representative, interview by USITC staff, Chicago, IL, June 5, 2016.
[155] Products generate scrap at the end of their lifecycle. Buildings and infrastructure projects have the longest lifecycle, reaching beyond 50 years in some cases, while transportation equipment may have a lifecycle of 20 to 30 years. Industry representative, interview by USITC staff, Chicago, IL, June 5, 2016.
[156] Industry representative, telephone interview by USITC staff, December 16, 2016; industry representative, interview by USITC staff, February 27, 2017.

wrought aluminum manufacturers benefit if they have access to an abundant supply of secondary aluminum.[157] At the same time, access to a domestic primary aluminum supply is also important. A domestic supply chain provides a more stable supply, reducing the amount of inventory that firms need to carry, and facilitates the development of new alloys and products.[158] The ability of wrought producers to source aluminum in liquid (molten) form directly from smelters can also reduce production costs by eliminating the need to cast and remelt aluminum (which results in additional energy costs and some loss of material).[159]

Unwrought aluminum is the largest component of wrought aluminum production costs. For example, among rolled products, unwrought aluminum accounted for between 75 and 86 percent of average business costs for 1xxx sheet, building sheet, and foil stock in 2015 (figure 3.1).[160] Similarly, unwrought aluminum made up more than two-thirds of costs for U.S. extrusion producers, about 70 percent for the European Union (EU) extruders, and between 80 and 87 percent for publicly traded aluminum extruders in China.[161]

[157] Developed countries typically generate more scrap and, as a result, nearly half of the semis produced in these economies are made of this input. In contrast, the semis produced in developing economies are typically produced from less than 25 percent scrap. For example, the estimated ratio of scrap to primary aluminum for semis production in China is 10:90, while in the United States it is relatively evenly divided. Industry representative, telephone interview by USITC staff, December 16, 2016; industry representative, interview by USITC staff, February 27, 2017; industry representative, interview by USITC staff, Chicago, IL, June 6, 2016; industry representative, interview by USITC staff, December 22, 2016; USITC, hearing transcript, September 29, 2016, 161 (Ganesh Paneer, Novelis Corp.).

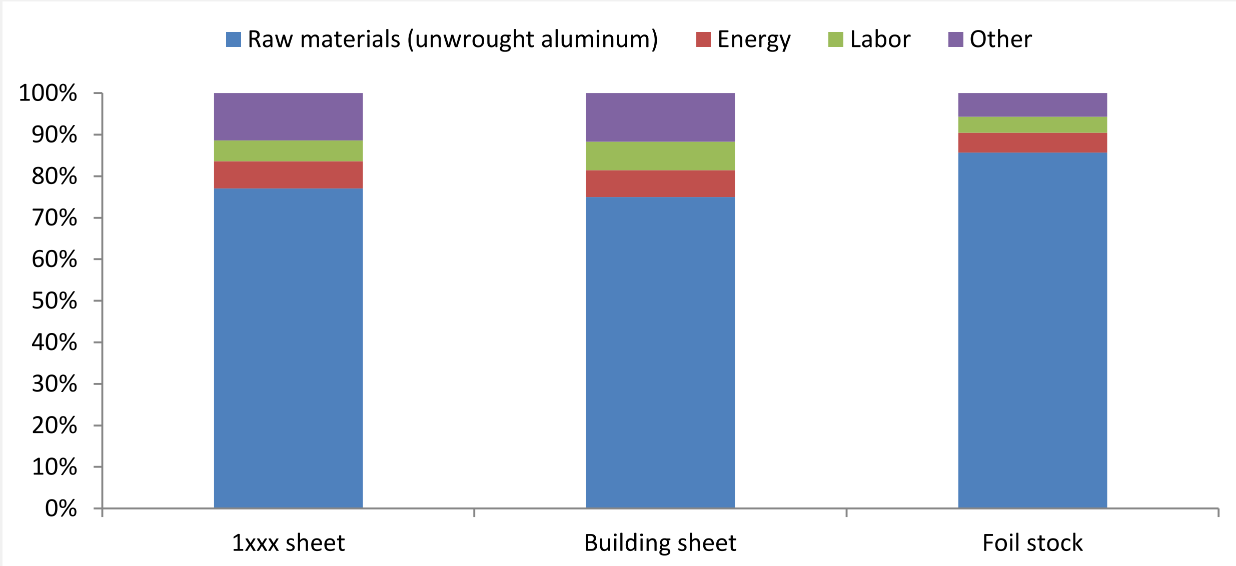
[158] USITC, hearing transcript, September 29, 2016, 54 (testimony of Matt Aboud, Hydro Aluminum Metals USA); 197, 232 (testimony of Brook Hamilton, Bonnell Aluminum).

[159] This material loss is referred to as "melt loss." Industry representatives, telephone interviews by USITC staff, December 16, 2016, and February 17, 2017; industry representative, interview by USITC staff, October 4, 2016.

[160] CRU Group.

[161] Percentages in different countries/regions may not be directly comparable due to differences in how the share was calculated and the extent of industry coverage. For the United States, based on NAICS 331318: Other aluminum rolling, drawing, and extruding; U.S. Census Bureau, "2015 Annual Survey of Manufactures," available via the American Fact Finder database, https://factfinder.census.gov (accessed April 14, 2017); Centro di Ricerca di Economia Industriale e Finanza, "Executive Summary," January 2015, 34; Chinese data compiled from financial reports of publicly traded aluminum extrusion producers.

Figure 3.1: Share of average business costs for selected rolled products accounted for by input, 2015, (share of average business costs)



Source: CRU Group.
Note: Corresponds to appendix table L.9.

Proximity to the market is also an important factor of competition in the wrought aluminum sector.[162] Physical nearness to principal consumers enables wrought aluminum firms to develop the close relationships necessary to boost innovation and create new aluminum products and alloys, speed communication, and reduce the cost of exchanging knowledge and information.[163]

The capability to produce high-value-added, differentiated products is an important competitive factor for countries producing wrought aluminum.[164] Wrought producers can serve customers demanding these products most effectively by developing specific alloys that elicit various characteristics (e.g., heat resistance, flexibility, strength) and producing various shapes requested by customers in these end markets through specialized equipment like wide rolling lines and large stretchers.[165]

Although labor costs typically account for a relatively small share of the total cost of producing wrought aluminum, differences in labor costs among major producing countries can be important to their competitiveness.[166] For example, even though labor accounts for only

[162] Industry representative, telephone interview by USITC staff, December 16, 2016.
[163] USITC hearing transcript, September 29, 2016, 54 (testimony of Matt Aboud, Hydro Aluminum Metals USA).
[164] The Commission was only able to obtain data for the end-use markets supplied by certain wrought products, which will serve as the basis for value-added comparisons across countries. Industry representative, email correspondence with USITC staff, February 15, 2017.
[165] Industry representative, interview by USITC staff, October 4, 2016; Saha, *Aerospace Manufacturing Processes,* 2017, 273.
[166] Industry representative, telephone interview by USITC staff, February 17, 2017.

7 percent of the global average business costs for building sheet, the difference in labor costs between Germany and China is almost $194/mt.[167]

Cross-Country Comparison of Competitive Factors

Most of the leading primary unwrought aluminum producers during 2011–15, including Canada, Norway, Russia, and the Gulf Cooperation Council (GCC) countries, are endowed with low-cost and abundant energy supplies (table 3.2). China is an exception, with energy costs among the world's highest. Its competitiveness, however, has been enhanced by the construction of new, modern smelters during 2011–15 in provinces boasting abundant low-cost coal; an industry structure that affords economies of scale, captive power supplies, and low capital expenditure costs; advanced technology; and the lowest labor costs of all major producing countries.

Table 3.2: The competitive profile among selected primary aluminum producing countries/regions

Country/region	Competitive profile
Canada	Competitive advantage in low electricity costs (hydro), updated smelting technologies, and proximity to the large U.S. market.
China	Competitiveness improved in 2011–15, with high energy and other costs lowered by new smelters in regions with low-cost inputs; captive power; vertical integration; low capital expenditure and low (but rising) labor costs; new smelting technology. Export taxes/value-added tax (VAT) limit exports by raising prices.
GCC countries	Competitiveness in primary unwrought aluminum is driven by low electricity costs (natural gas); investments in bauxite mines, alumina refineries, and advanced smelting technologies.
Norway	Advantage in low electricity costs (hydro) and investments in smelter technologies.
Russia	Advantage in low electricity costs (hydro).
United States	Competitiveness limited by high cost, mostly grid-sourced, electricity; relatively older production technologies; and a strong currency.

Source: Compiled by USITC staff.

Developed economies, led by the United States and Germany, were the world's leading secondary producers during 2011–15, by virtue of their mature end markets, sophisticated infrastructure for collecting scrap, and culture of recycling. In contrast, China has rapidly advanced its secondary industry through substantial imports of scrap (principally supplied by the United States) and government policies that encourage the retention of scrap within its borders.

The proximity of wrought aluminum producers to large end markets strongly influenced their cost competitiveness: the countries with the most competitive wrought industries (China, the United States, and Germany) all have sizable domestic end markets. Recently, growth in the

[167] CRU Group.

high-value-added automotive market has translated into increased U.S. investments in the production of flat-rolled products (FRPs). At the same time, U.S. output of more commodified wrought products (such as foil) has declined amid rising supply from China. Similarly, growth in the European automobile market has led to increased production of FRPs in Europe. The wrought industries in the United States and Europe benefit from close collaboration between producers and customers in the automotive sector, in particular (table 3.3).

Table 3.3: The competitive profile of selected countries producing secondary unwrought and wrought aluminum

Country	Secondary	Wrought
China	Competitiveness due to scrap imports and increased domestic scrap collection.	Competitiveness improved, particularly during 2014–15, due to raw material cost advantages. High-value-added production capability increased, but is still limited for certain product types.
Germany	Competitive due to an abundance of scrap generated from mature end markets.	Competitiveness due to availability of inputs, proximity to customers, and strong high-value-added production capabilities, which help to offset relatively high labor costs.
United States	Competitive due to an abundance of scrap generated from mature end markets.	Competitive producer due to economies of scale for FRPs, proximity to end markets, and robust high–value-added production, which help to offset relatively high labor costs.

Source: Compiled by USITC staff.

Primary Unwrought Aluminum

Production Costs

Among the countries covered in this report, the lowest-cost producers of primary aluminum in 2015 were Canada, the GCC countries, Russia, and Norway, with average business costs 11 to 16 percent below the global average (table 3.4 and figure 3.2). Although alumina costs account for a larger share of the global average cost of production than electricity does (40 percent to 32 percent), there is much more variability in costs for electricity than for alumina across suppliers. For example, the difference between the suppliers in table 3.4 with the highest and lowest alumina costs was $190/mt, while the difference for electricity was $362/mt. As a result, electricity costs play a much more important role in determining cost competitiveness.[168]

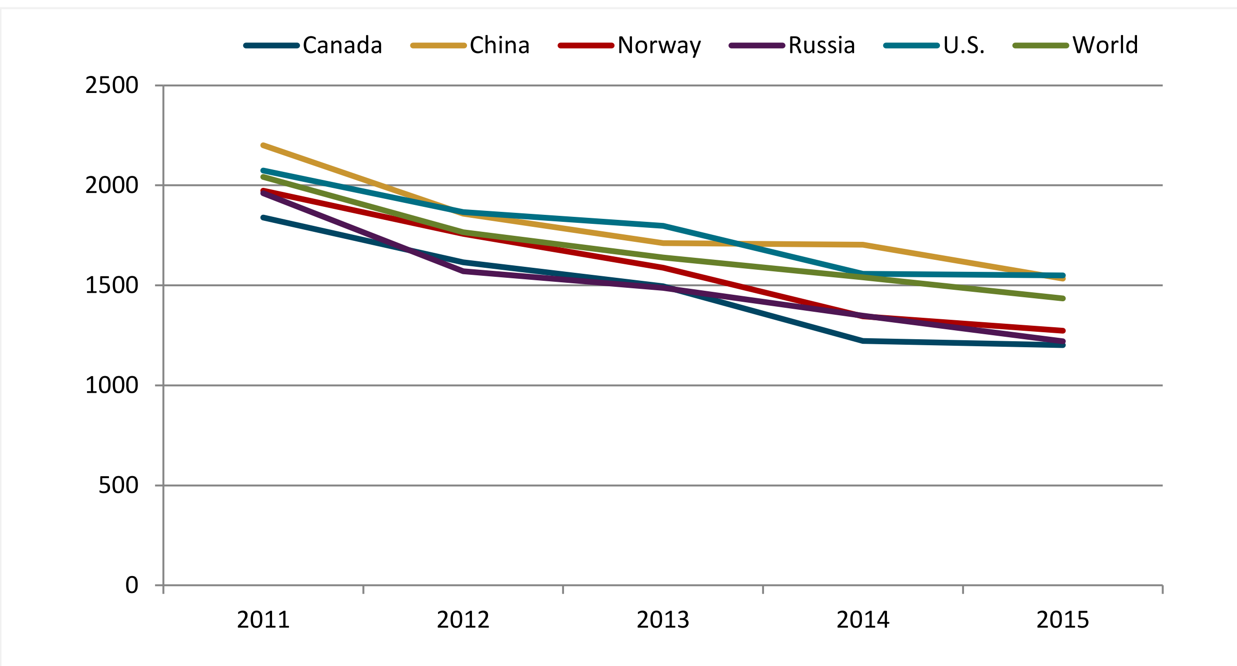
[168] Nappi, *The Global Aluminium Industry: 40 Years since 1972*, February 25, 2013, 18–19.

Table 3.4: Selected production cost items and average business costs for primary unwrought aluminum, by selected countries and regions, 2015 (dollars per mt)

Production cost item	Canada	China	GCC countries	Norway	Russia	United States	Global average	Global average, excl. China
Alumina	588	709	519	614	604	597	647	575
Anodes	181	186	159	247	139	175	185	184
Electricity	252	614	333	390	408	532	527	424
Labor	167	52	180	126	59	246	94	145
Other	214	136	158	210	168	279	171	211
Liquid metal costs	1,402	1,697	1,440	1,587	1,378	1,830	1,624	1,538
Average business cost	1,202	1,534	1,201	1,274	1,220	1,550	1,435	1,304

Source: CRU Group.
Note: Energy costs refer to the total potroom power costs for smelters operating within each country or region. Other costs include total pot relining costs, casthouse costs, and various site costs. Average business costs are lower than liquid metal costs due to the inclusion of net realizations. CRU Group uses net realization cost adjustments to account for variances in product quality impacting production costs, but these data do not include overhead costs in overall corporate cost.

Figure 3.2: Average business costs of production for selected primary aluminum producing countries, 2011–15 (dollars per mt)



Source: CRU Group.
Note: Corresponds to appendix table L.10.

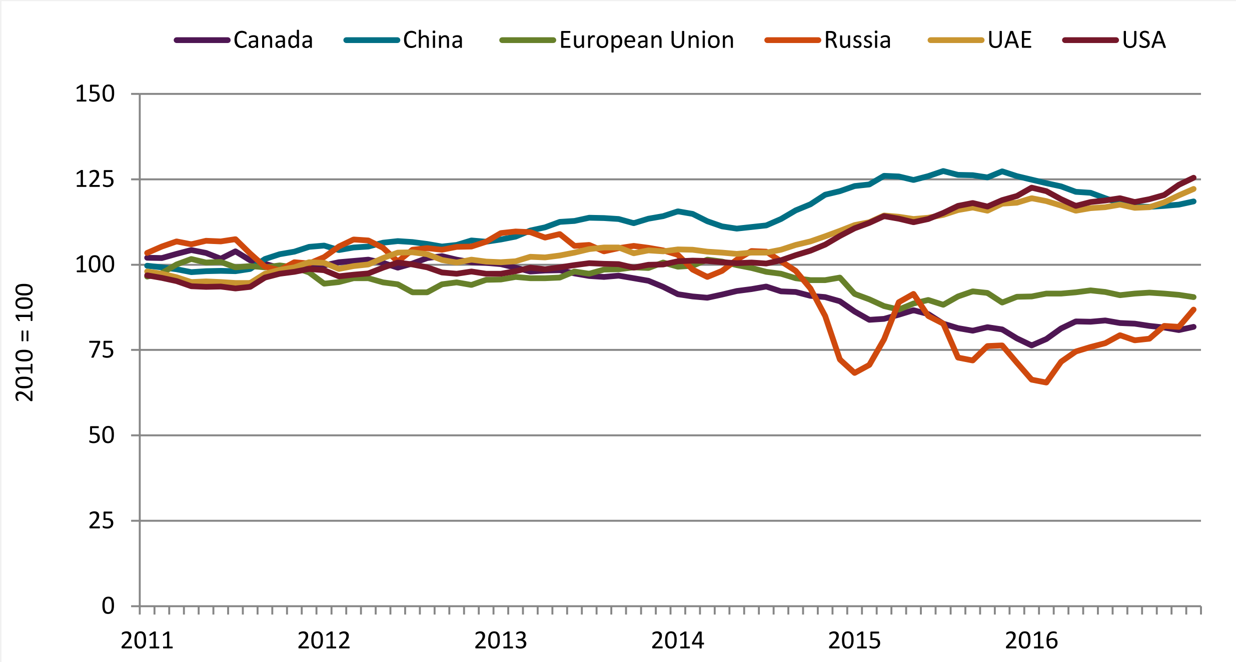
Canada has low electricity prices due to the availability of low-cost hydroelectric power, while the GCC countries benefit from ample natural-gas reserves for electricity generation, captive power plants in some instances, and government support programs.[169] Companies in these countries also benefit from investments in newer smelter technology that reduce energy consumption per metric ton of primary aluminum produced. In Canada, this is primarily the result of upgrades to existing plants, while in the GCC countries, it is due to the construction of new smelters or expansion of existing ones using advanced technology.[170]

Russia and Norway also benefit from the availability of low-cost hydroelectric power and favorable rates (including electricity rates in Russia that are linked to the LME price).[171] However, their electricity rates were slightly higher than in Canada and the GCC countries overall. Moreover, Russia's plants are somewhat less energy efficient, so that its overall electricity costs were close to the world average, excluding China.[172] Russia and Norway's production costs (when converted to U.S. dollars) also benefited from depreciating currencies during 2011–15 (box 3.1).

Box 3.1: Exchange Rates Can Impact Competitiveness

Changes in exchange rates affect the competitiveness of global aluminum producers across all industry segments, and tend to depress the volume of exports from countries with appreciating currencies. Exchange rates also play a role in determining the price of aluminum on global markets. Many foreign producers of aluminum earn revenues in U.S. dollars and euros, while paying labor and other operating costs (e.g., electricity) in their domestic currencies. When the U.S. dollar appreciates against other major currencies, this enhances the competitiveness of foreign producers relative to U.S. producers. Similarly, a depreciation of the U.S. dollar against other major currencies tends to enhance the competitiveness of American aluminum producers.[a] The figure below shows the effective exchange rates for major aluminum-producing countries during 2011–16. The Chinese yuan, the Emirati dhirma, and the U.S. dollar all appreciated relative to a basket of major currencies, while the Canadian dollar, the euro, and the Russian ruble depreciated.

[169] See the "Competitive Factors" sections of chapters 5 and 7, respectively.
[170] Canadian industry efficiency overall has also increased due to the shutdown of older, less efficient plants. Industry consultant, telephone interview with USITC staff, February 16, 2017; EGA, written submission to the USITC, January 23, 2017; Starta, Poddar, and Alberich, *How GCC Smelters Can Continue Growing Profitably*, February 2013; Arabian Businness.com, "Gulf Aluminum Industry: Bright Future," February 18, 2012.
[171] USITC, hearing transcript, September 29, 2016, 53 (testimony of Matt Aboud, Hydro Aluminum Metals USA); En+ Group company website, "Our History," http://eng.enplus.ru/about/history/ (accessed 2017).
[172] CRU Group.



Source: Bank for International Settlements, via Federal Reserve Bank of St. Louis (accessed February 15, 2017).
Note: UAE = United Arab Emirates. The Emirati dhirma is pegged to the U.S. dollar. Corresponds to appendix table L.11.
[a] De Frutos, "3-Month LME Aluminum Price Hits a 1-Year High," August 18, 2016; Nappi, *The Global Aluminium Industry: 40 Years since 1972*, February 25, 2013, 18–19.

In contrast, China and the United States were above the world average cost in 2015, due to their relatively high electricity costs. For U.S. smelters, high electricity costs have been a long-term competitive challenge. In 2015, these costs were $38 per megawatt-hours (MWh), nearly double the rate of other leading producing countries. Also, several remaining U.S. smelters are more than 50 years old; they tend to be less energy efficient.[173] The stronger the electric current— commonly measured in terms of kiloamperes (kA)— flowing through the individual pots, the greater the energy efficiency of the smelter. Many U.S. smelters operate at 300 kA or less, while several competitor countries have smelters that operate at 400 kA or higher.[174] The U.S. primary sector continued to shrink in 2016, although its electricity costs fell that year, reportedly due to favorable U.S. wholesale energy markets and improved negotiated utility rates.[175]

For China, countrywide production data mask the diversity that exists within the primary aluminum industry owing to its size (China accounted for half of all global aluminum smelters in 2015), regional dispersion, and disparity in smelter ages. For example, production costs of some

[173] The most recent smelter in the United States was built 26 years ago. Vazquez, written testimony for USITC hearing, September 29, 2016.
[174] Industry representative, interview by USITC staff, Chicago, IL, June 5, 2016; Fickling, "China Isn't the Reason," October 10, 2016. Industry consultant, telephone interview by USITC staff, February 15–16, 2017
[175] Industry representative, interview by USITC staff, October 2016.

of China's smelters built during 2011–16 are estimated to be significantly below average global production costs, while its older smelters are among the world's costliest producers of aluminum.[176]

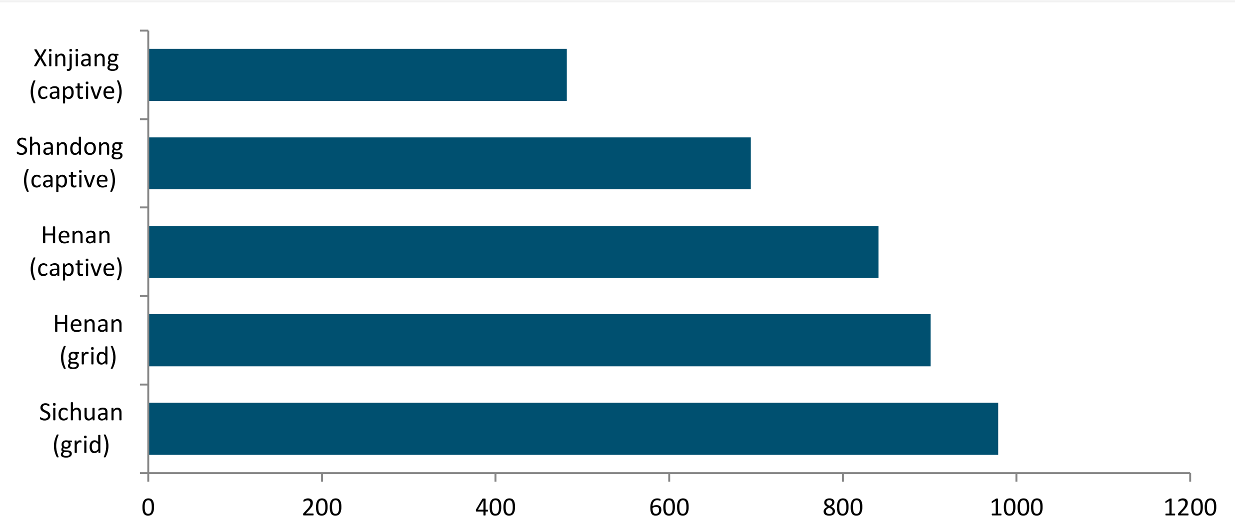
China's average production costs declined substantially during 2011–15, and fell even further during 2016.[177] These shifts were driven, in part, by electricity costs that fell by 34 percent in 2011–15 (and even further through the first three quarters of 2016), narrowing the gap with producers in the rest of the world and increasing the cost competitiveness of Chinese production.[178] Falling electricity costs in China reflected a decline in electricity rates due to lower coal prices, electricity reforms, and local governments offering lower rates to a number of producers, particularly in response to the fall in aluminum prices in 2015.[179]

China's shift in production to regions with access to low-cost coal and its construction of captive power plants also significantly contributed to the decline in China producers' electricity costs (figure 3.3). Electricity costs for China's new capacity, most of which uses captive power, averaged 1.5 cents per kilowatt-hour (kWh) in 2016, compared to an average cost of 3 cents per kWh for the Chinese industry as a whole. Most of the smelters with captive power are vertically integrated upstream into coal production or have access to low-cost coal supplies. Combined with the ability to pay only the production costs and to avoid transmission and distribution fees, such supplies can significantly lower electricity costs.[180] Finally, Chinese smelters have invested in larger-scale cell technologies that are more energy-efficient, with more than half operating at 400 kA or above and some exceeding 600 kA. As a result, Chinese aluminum producers are

[176] USITC, hearing transcript, September 29, 2016, 221 (testimony of Jorge Vazquez, Harbor Aluminum); industry representative, telephone interview by USITC staff, February 27, 2017.
[177] With the additional significant declines in Chinese production costs in early 2016, China's cash cost of production for molten aluminum (prior to casting) reportedly had declined to 1 percent above the average cost for the rest of the world outside of China and the United States. Jorge Vazquez, USITC hearing exhibits, September 29, 2016, 3.
[178] CRU Group.
[179] *Metal Bulletin Daily Alerts*, "China's Henan Issues Action Plan," September 14, 2012; *Metal Bulletin*, "China Aluminum Smelters Offered Extra Subsidies," June 1, 2012; Mok, "China Aluminum Smelters Seek Government Subsidies on Power, " November 3, 2015; CM Group, Washington, DC, PowerPoint presentation, September 27, 2016; industry representative, interview by USITC staff, Chicago, IL, June 5, 2016; BLS & Co. and Tractus Asia, "A Comparison of U.S. and China Electricity Costs," 2016, 5; Moody's, "Moody's: China's On-grid Tariff," January 4, 2016.
[180] Jorge Vazquez, hearing exhibits, September 29, 2016, 6, 8; industry representative, telephone interview by USITC staff, February 15, 2017.

more energy efficient than the rest of the world, where less than 5 percent of producers use kA technologies exceeding 400 kA.[181]

Figure 3.3: China: Selected provincial grid or captive power electricity costs for primary aluminum production at smelters, 2014 (dollars per mt)



Source: Mukhamedshin, "Energy Costs and Considerations," September 2014, 10.
Note: The plant in Xinjiang is a Xinfa aluminum smelter, the one in Shandong a China Hongqiao smelter, the captive plant in Henan an Aluminum Corp. of China (Chalco) smelter, the grid-connected plant in Henan a Zhongfu smelter, and the plant in Sichuan a Sichuan Qiya smelter. Corresponds to appendix table L.12.

Upstream Vertical Integration

Upstream vertical integration into bauxite mining and alumina refining improves the competitiveness of many primary aluminum producers by helping them better manage the availability and cost of major inputs. Primary aluminum producers in China, the GCC countries, Russia, and Norway all benefit from upstream vertically integrated operations. For example, because Russia has too few high-quality, low-cost domestic bauxite resources for refining into alumina,[182] its aluminum monopoly, Rusal, has invested in numerous bauxite mines and alumina refineries around the world. This ensures Russia has a sufficient bauxite supply and allows it to benefit from bauxite sales when market conditions are favorable.[183] Similarly, during 2011–15, the GCC countries increased their competitiveness in aluminum production by

[181] CM Group, PowerPoint presentation, September 27, 2016; Wen, "Aluminum Industry in China and International Trade," October 27, 2016, 6–7; Adkins, "Out with the Old Thinking," July/August 2016; Fickling, "It's Not China's Fault," October 10, 2016; Chalieco, "Electrolytic Aluminum Technology," February 8, 2014; Wookey, "China Is Most Efficient," October 31, 2016.
[182] The quality of Russian bauxite is reportedly inferior to that of many other leading bauxite sources. UC Rusal, *Driven by Green Power*, May 5, 2016, 25.
[183] UC Rusal, written testimony to the USITC, September 12, 2016, 5; UC Rusal, *Driven by Green Power*, May 5, 2016, 8.

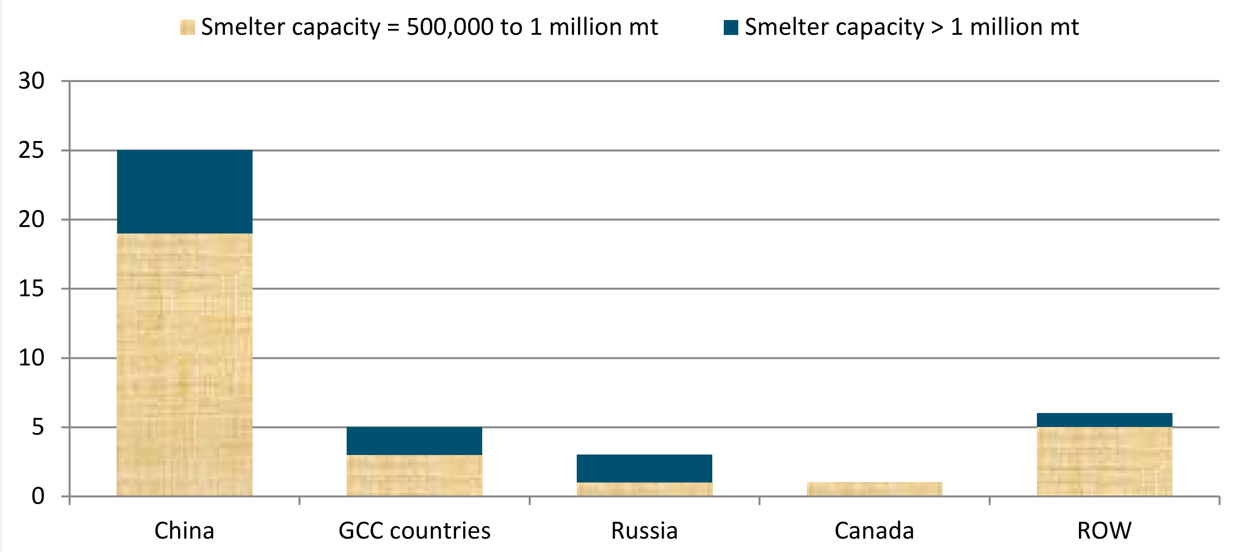
gaining control over raw materials and mitigating price volatility through upstream investments in global bauxite mines and alumina refineries. The Chinese industry is characterized by extensive vertical integration, both upstream into bauxite and alumina operations and downstream into the production of high-value wrought aluminum products.[184]

Economies of Scale

In the production of primary aluminum, smelters with large production capacity typically have lower input costs per unit of output as a result of economies of scale. The construction of new, large-scale smelters in China and the GCC countries during 2011–15 significantly increased the global competitiveness of primary aluminum producers in these regions. In 2015, the GCC countries had the highest average annual smelter production capacity in the world at more than 850,000 mt. Five smelters in the GCC countries had at least 500,000 mt in annual production capacity, and two had more than 1 million mt (figure 3.4). In China, there were 25 smelters with more than 500,000 mt in capacity and 6 smelters with more than 1 million mt, though the country average was only 370,000 mt due to the continued operation in China of a large number of small-scale, older smelters. Russia also had several large smelters, including two smelters with more than 1 million mt of capacity and an average capacity of 376,000 mt.[185] In contrast, in 2015 there were no smelters with more than 500,000 mt of capacity in the United States and Norway, and only one in Canada.[186]

[184] One industry representative at the Commission's hearing noted that China is "fully integrated all the way from the coal mine and, in some cases, all the way to the extrusion plant or to the flat rolled products plant"—a structure that yields significant benefits. USITC, hearing transcript, September 29, 2016, 221 (testimony of Jorge Vazquez, Harbor Aluminum).
[185] CRU Group.
[186] Ibid.

Figure 3.4: Number of smelters with at least 500,000 metric tons in annual capacity, 2015



Source: CRU Group.
Note: ROW = rest of the world. India is the only country in the rest of the world with more than one smelter that has at least 500,000 mt of capacity per year. Corresponds to appendix table L.13.

Capital Expenditure (CAPEX) Costs

A significant competitive advantage of China in the production of primary aluminum compared with other global suppliers is its low capital cost for constructing new smelters. For example, CAPEX costs for aluminum smelters in China are estimated to be $3,000/mt or less, compared with CAPEX costs in the Middle East and Russia of about $6,000/mt, and about $7,000/mt in Norway. A number of factors contribute to China's low capital costs, including low cost labor inputs into capital goods; short time frames for permitting (particularly for brownfield projects) and construction; the use of higher-amperage cells, which require smaller footprints and have lower capital costs; and supportive government policies.[187]

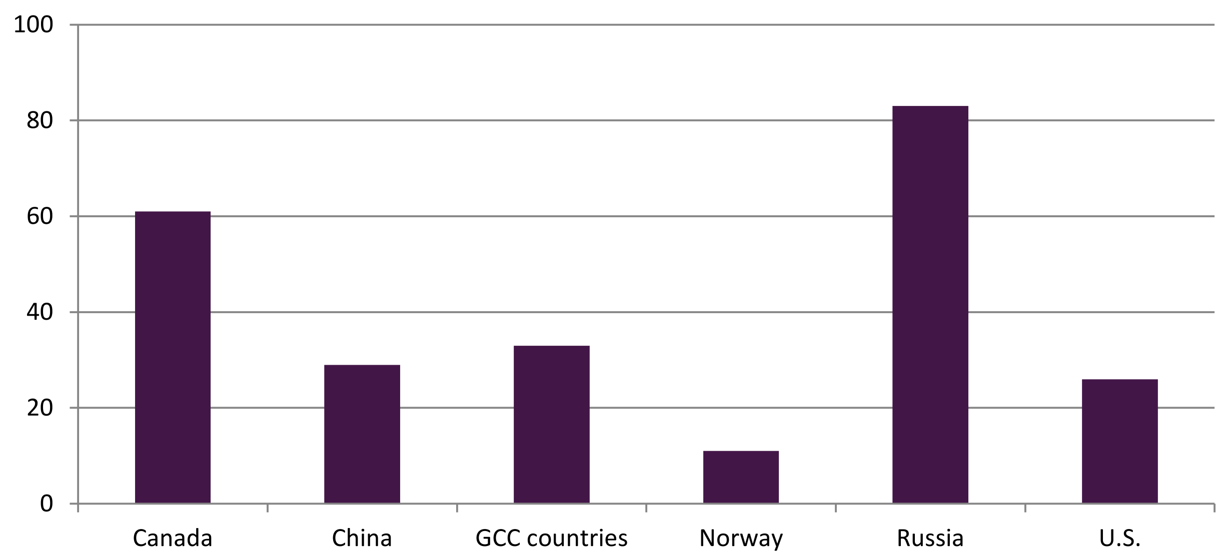
Transportation Costs

Transportation costs are part of the cost of delivering a final product to a customer, and can significantly affect the ability of countries to compete in the global primary aluminum market. For example, the high transportation costs incurred by Russia's primary aluminum sector weaken its competitiveness because most production occurs in Siberia—which is far from the country's shipping ports—while its leading customers are in foreign markets, such as Europe

[187] Industry representative, telephone interview by USITC staff, December 16, 2016; Andrew Wood, "Keeping the Bauxite and Alumina Industry Profitable," February 25, 2014, 7; CNIA, posthearing brief, October 17, 2016, 36; JCP Investment Partners, *The Aluminum Market Outlook*, August 2012, 2; industry representative, interview by USITC staff, February 16, 2017; Wen XIanjun, "Aluminum Industry," October 2, 2016, 6–7.

and the United States (figure 3.5).[188] In 2015, Russia's transportation costs were $83/mt, the highest of all countries for which data were available.[189] Notably, despite Canada's geographic proximity to the United States—Canada's largest market—the distance between Canadian smelters (most of which are located in northern Quebec) and the majority of U.S. customers (most of which are in the Midwest) is substantial, as reflected in Canada's relatively high transportation costs.[190] In contrast, the transportation costs for Norway are relatively low, since its smelters are located close to ports and Norway is close to the European market.

Figure 3.5: Primary aluminum delivery costs, 2015 (dollars per mt)



Source: CRU Group.
Note: Based on delivered costs to customers per metric ton of aluminum. This metric is influenced by the proximity of supplying countries to their main markets and can reflect regional premiums. It does not reflect a per-mile transportation cost. Corresponds to appendix table L.14.

Government Policies

Government policies can also impact the competitiveness of countries producing primary aluminum, mostly through lowering overall production costs.[191] For example, producers in the GCC countries have benefited from government support to lower electricity costs,[192] while in China, local governments have charged lower electricity rates during times of low aluminum

[188] USITC, hearing transcript, September 29, 2016, 348 (testimony of Anton Bazulev, UC Rusal).
[189] CRU Group.
[190] Industry representative, email correspondence with USITC staff, May 5, 2017.
[191] Jorge Vazquez, written testimony, USITC hearing, September 29, 2016. In its post-hearing submission to the Commission, the CNIA denied allegations of "material government subsidies provided to the aluminum industry." CNIA, post-hearing submission to the USITC, October 17, 2016, 6.
[192] See, e.g., IMF, *Economic Prospects and Policy Challenges for the GCC Countries*, October 5, 2013, 22.

prices.[193] Likewise, in Canada, both the federal government and the Quebec provincial government have imposed tax and tariff policies that facilitate the purchase and use of large-scale machinery, which can translate into lower production costs.

Secondary Unwrought and Wrought Aluminum

Availability and Cost of Aluminum Scrap

In the production of secondary aluminum, an abundance of low-cost aluminum scrap is the key reason that the United States and Europe (both major producers of aluminum scrap) are among the leading global suppliers.[194] In its secondary production, China is increasingly using domestic scrap, which accounted for around two-thirds of the Chinese scrap supply in 2015.[195] The availability of scrap in China is supported by government policies, which include a 15 percent export tax and 17 percent value-added tax on aluminum scrap exports ensuring domestic scrap remains within the country.[196] China imports the remaining one-third of its scrap needs, purchased at among the lowest prices in the world.[197]

Availability and Cost of Unwrought Aluminum

In the production of wrought aluminum, the availability and cost of both primary and secondary aluminum are important determinants of competitiveness. Because secondary is less energy intensive than primary aluminum, it tends to be less expensive and preferred as an input by producers of wrought aluminum. Although many countries with mature wrought aluminum industries, such as the United States and Germany, are not substantial primary aluminum

---

[193] *Metal Bulletin Daily Alerts*, "China's Henan Issues Action Plan," September 14, 2012; *Metal Bulletin Daily Alerts*, "China Aluminum Smelters Offered Extra Subsidies," June 1, 2012; *Platts Metals Daily*, "China Aluminum Smelters Seek Government Subsidies," November 3, 2015.

[194] Industry representative, interview by USITC staff, Chicago, IL, June 5, 2016; European Aluminum, *Recycling*, March 23, 2016, 10.

[195] Total scrap collection of 4.2 million mt in 2015 is a projection by China's Nonferrous Metal Industry Association's Metal Recycling Branch (Beijing) (CMRA) in November 2015. Minter, "CMRA Conference Report: Reversal of Fortune," January/February 2016; Minter, "Report: CMRA Conference," January/February 2013; HIS Markit, GTA database (accessed August 23, 2016).

[196] USITC hearing transcript, September 29, 2016, 98–99 (testimony of Ganesh Paneer, Novelis Corp.); 99 (testimony of Alan Price, Counsel to Century Aluminum); China Customs, "2016 Customs Import and Export Tariff," 2016.

[197] China's 2015 import average unit value (AUV) for aluminum scrap was 7 percent below the AUV for the rest of the world. HIS Markit, GTA database (accessed March 30, 2017). Among the factors contributing to low prices for Chinese imports are low shipping costs. According to a witness at the USITC hearing, "it is cheaper to export scrap to China from the U.S. West Coast than it is to ship to the Midwest, where most of the U.S. aluminum remelt facilities are based." Vazquez, USITC written statement, September 29, 2016. Chinese firms also have invested in the United States and Europe in order to have more direct control over their supply chains, as discussed in chapter 6.

producers, both have access to substantial amounts of secondary aluminum that makes them globally competitive.

Certain representatives of the U.S. wrought aluminum sector have expressed concerns over the declining availability of domestic primary aluminum supply amid increasing plant closures and idled capacity,[198] as well as over the higher cost of transporting primary aluminum as the country has become more reliant on imports in recent years.[199] As the dependence on imports has risen, so have U.S. wrought producers' concerns over potential supply disruptions. In response, many firms are carrying larger inventories at higher cost in order to maintain reliability in serving their customers.[200] In addition, U.S. smelter closures mean that some wrought producers have lost their source of liquid aluminum, which has raised their costs of production.[201] Certain U.S. producers also consider a domestic primary aluminum supply is necessary to meet some of the technical requirements, such as purity, required by their end-use markets and for collaboration in the development of new alloys.[202]

Chinese wrought aluminum producers, on the other hand, benefit from an ample supply of unwrought domestically produced aluminum, declining production costs, and the increasing availability of liquid aluminum as wrought producers locate close to smelters. China has increasingly located production close to primary smelters and used liquid aluminum in an effort to further reduce costs during 2011–15. Liquid aluminum as a share of Chinese primary shipments increased, from 21 percent in 2011 to 37 percent in 2015.[203] During this time period, China's liquid metal costs have fallen by 25 percent and nearly converged with the global average.[204]

Proximity to Market

For wrought aluminum producers, proximity to markets is essential for global competitiveness. The countries with the largest consumption of wrought aluminum outside of China are the United States and Germany, where the major customers are industries serving the transportation sector (mostly automotive and aerospace); these industries demand highly specialized, value-added products. The location of wrought aluminum producers close to these

[198] AEFTC, written submission to the USITC, October 11, 2016, 3–4.
[199] USITC, hearing transcript, September 29, 2016, 197 (testimony of Brook Hamilton, Bonnell Aluminum).
[200] USITC, hearing transcript, September 29, 2016, 232 (testimony of Brock Hamilton, Bonnell Aluminum).
[201] Industry representative, interview by USITC staff, October 4, 2016.
[202] Industry consultant, interview by USITC staff, December 16, 2016; USITC, hearing transcript, September 29, 2016, 108–9 (testimony of Stephanie Hickman Boyse, Brazeway Inc.); 113 (testimony of Lloyd A. Stemple, Constellium Rolled Products Ravenswood LLC); 54–55 (testimony of Matt Aboud, Hydro Aluminum Metals USA); 107 (testimony of Michael A. Bless, Century Aluminum).
[203] CRU Group.
[204] During 2011–15, liquid aluminum costs for China fell from $2,275/mt to $1,697/mt, while the costs for the rest of the world fell from $2,142/mt to $1,631/mt. CRU Group.

customers has been a source of their global competitiveness. In the United States, wrought aluminum producers have invested in facilities close to centers of automotive and aerospace production, making it easier to cooperate in developing innovative solutions that meet their customers' performance and end-use requirements.[205] For example, Novellis operates a facility in Michigan that provides technical support for automotive manufacturers, and during the past five years has installed three automotive finishing lines at its production facility in New York.[206] Likewise, Constellium is opening an R&D center in Plymouth, MI, to serve the automotive end market.[207]

In Germany, wrought producers typically develop products jointly with customers, a process that is enhanced by proximity.[208] For example, Norsk Hydro ASA, Europe's third-largest aluminum producer, announced plans in 2015 to invest $147 million, in order to increase its aluminum automotive sheet production after a record volume of shipments.[209] Moreover, the company has collaborated with a leading regional automobile producer, Mercedes Benz, to develop welding techniques that reduce assembly costs.[210]

High-Value-Added Production Capabilities

Much of the global competitiveness of German and U.S. firms in wrought aluminum production stems from an ability to supply high-value-added products resulting from their investment in R&D and advanced manufacturing equipment. In the United States, for example, producers have introduced new alloys and technologies to meet customer requirements in the automotive and aerospace markets.[211] Firms have also invested in equipment to supply high-value-added applications. For example, the rolling mill at Constellium's operation at Ravenswood, WV, is one of the widest in the world and is capable of producing a broad range of widths and thicknesses for transportation and marine applications. The firm also has the world's largest stretcher, which contributes to its ability to manufacture unique products for

---

[205] USITC, hearing transcript, September 29, 2016, 54 (testimony of Matt Aboud, Hydro Aluminum Metals USA); AEFTC, written submission to the USITC (post-hearing brief), October 11, 2016, 1.
[206] USITC, hearing transcript, September 29, 2016, 62 (Ganesh Paneer, Novelis Corp.); Jorge Vazquez, written testimony submitted to the USITC, September 29, 2016; Kayakiran, "Auto Industry Drives Comeback," January 28, 2015.
[207] USITC, hearing transcript, September 29, 2016, 74 (testimony of Lloyd Stemple, Constellium Rolled Products Ravenswood LLC).
[208] Industry representative, telephone interview by USITC staff, February 28, 2017; ECORYS, *Competitiveness*, 2011, 13; Novelis, Automotive Aluminum, http://novelis.com/markets-we-serve/automotive/ (accessed February 22, 2017); Aleris, Research and Development, https://www.aleris.com/company/research-development/ (accessed February 22, 2017); Grave et al., *Electricity Costs of Energy Intensive Industries*, July 2015, 53.
[209] Kayakiran, "Auto Industry Drives Comeback," January 28, 2015.
[210] Ibid.
[211] Summe, "Insider's Look: 7000-series Aluminum Alloy Innovation," August 19, 2015; Constellium, "AIRWARE®: Low Density Alloy for Lighter Aircraft," October 17, 2013; Arconic, "Global Rolled Products," 2017.

the aerospace market.[212] Similarly, German producers have invested in technology, equipment, and R&D to serve the auto and aerospace markets.[213] For example, a small number of specialized German companies are tied to the Airbus supply chain and have invested in advanced technology to supply products to this market.[214]

The major customer of China's wrought aluminum industry is the construction sector, which mostly requires standard, lower-value-added products. However, recently the country has made inroads into certain high-value-added end markets—a development that has become a concern for U.S. producers. For instance, China is expanding production of aluminum for the aerospace sector, with both foreign-invested and Chinese-headquartered firms becoming qualified to supply FRPs to major Western aircraft producers.[215] However, currently China is not a major producer of aluminum sheet for the auto industry.[216]

Labor Costs

The cost of labor in producing wrought aluminum products is another important factor of global competitiveness. While data are not available for most products, labor costs for FRPs are illustrative of significant differences among major suppliers (figure 3.6). Compared with the United States and Germany, China has the lowest FRP labor costs, giving it a substantial competitive advantage. For example, Chinese labor costs for producing 1xxx sheet were $140/mt less than those of the United States in 2015. In the production of building sheet, labor

---

[212] Constellium, "Ravenswood Aluminium Plant, USA," September 24, 2015.

[213] Minter, "How Aleris Recycled Itself," February 28, 2014; Truett, "Aluminum Gains Automotive Momentum," April 21, 2014; Constellium, "Singen Aluminum Plant, Germany," http://www.constellium.com/Aluminum-company/manufacturing-recycling-plants/singen-germany (accessed February 22, 2017); Hydro, "Germany," http://www.hydro.com/en/about-hydro/hydro-worldwide/germany/ (accessed October 5, 2016); Novelis, "Geographic Locations," Europe, http://novelis.com/about-us/locations/ (accessed January 9, 2017); industry representative, telephone interview by USITC staff, February 28, 2017; Aleris, "Rolled Products Germany GmbH," https://www.aleris.com/locations/aeris-rolled-products-germany-gmbh/ (accessed February 22, 2017); Airbus Group, Procurement Organisation & Major Suppliers, June 5, 2015; Otto Fuchs, "Aerospace Industry," http://www.otto-fuchs.com/en/business-areas/aerospace-industry.html (accessed February 22, 2017); Aleris, Aerospace, https://www.aleris.com/industries/aerospace/ (accessed March 2, 2017).

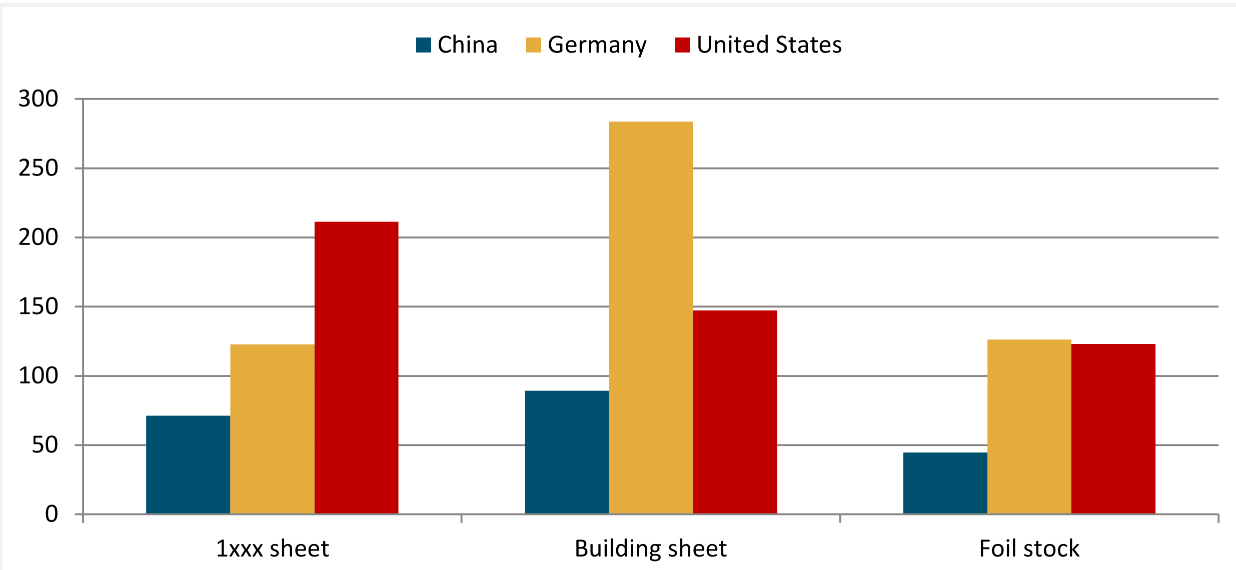
[214] Producers can also supply other aerospace manufacturers. Aleris, Rolled Products Germany GmbH, https://www.aleris.com/locations/aeris-rolled-products-germany-gmbh/ (accessed February 22, 2017); Airbus Group, Procurement Organisation & Major Suppliers, June 5, 2015; Otto Fuchs, "Aerospace Industry," http://www.otto-fuchs.com/en/business-areas/aerospace-industry.html (accessed February 22, 2017); Aleris, Aerospace, https://www.aleris.com/industries/aerospace/ (accessed March 2, 2017).

[215] Perrett, "Nanshan Aluminum," November 8, 2016; Perrett, "Aleris's Chinese Mill," October 31, 2016; Aleris, "Aleris Attains," September 29, 2014; China Aluminum Network, "Northeast Light Alloy Co., Ltd Praised," September 4, 2012; China Zhongwang, "Industry Certification," June 19, 2014; Arconic website, http://www.arconic.com/global/en/contact/locations.asp?country=China (accessed February 21, 2017). The certification requirements to sell aluminum to various transportation end markets can be rigorous, which creates a competitive advantage for those producers who have received it.

[216] Industry representative, interview by USITC staff, February 27, 2017; CNIA, written submission to the USITC, February 21, 2017, 13–14.

costs put Germany at a competitive disadvantage, with costs per metric ton roughly double those in the United States and three times those in China. At the same time, in the production of foil stock, Chinese labor costs were less than one-half those in both the United States and Germany. Nonetheless, while China has maintained a labor cost advantage, it generally declined during 2011–15 as average hourly wages for producers of FRPs almost doubled, being only partially offset by a 17 percent increase in productivity.[217] Similarly, in China's aluminum extrusion sector, increasing efficiency has been offset by rising wages, and the labor cost portion of non-material costs has substantially increased.[218]

Figure 3.6: Labor costs for select flat-rolled products, 2015 (dollars per mt)



Source: CRU Group.
Note: Corresponds to appendix table L.15.

[217] CRU Group.
[218] Based on annual reports of publicly traded aluminum extrusion producers.

Bibliography

Adkins, Paul. "Out with the Old Thinking." *Aluminium International Today*, July/August 2016, 10. https://issuu.com/quartzmetals/docs/aluminium_international_today_july.

Airbus Group. "Procurement Organisation & Major Suppliers," June 2015. http://www.airbus.com/fileadmin/media_gallery/files/supply_world/Airbus-Procurement-Organisation-Major-Suppliers-June2015.pdf.

Aluminum Extrusions Fair Trade Committee (AEFTC). Posthearing brief to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, October 11, 2016.

Aluminum-Production.com. "Prebake and Soderberg," n.d. http://www.aluminum-production.com/prebake_soderberg.html.

AME Group. "Aluminum Smelter Electricity Costs in China," n.d. http://www.amegroup.com/Website/FeatureArticleDetail.aspx?faId=73.

Arabian Business.com. "Gulf Aluminum Industry: Bright Future," February 18, 2012. http://www.arabianbusiness.com/gulf-aluminium-industry-bright-future-445723.html.

Biggins Lacy Shapiro & Co. LLC (BLS & Co.) and Tractus Asia Ltd. (Tractus), "A Comparison of U.S. and China Electricity Costs," 2016. http://blsstrategies.com/docs/news/News_181.pdf.

Boersma, Tim, and Steve Griffiths. "Reforming Energy Subsidies: Initial Lessons from the United Arab Emirates." January 19, 2016. https://www.brookings.edu/research/reforming-energy-subsidies-initial-lessons-from-the-united-arab-emirates/.

Centro di Ricerca di Economia Industriale e Finanza. "Executive Summary." *The Impact of EU Policies on the Competitiveness of the EU Aluminium Industry: A Focus on Non-integrated Downstream Users*. Rome, Italy: Centro di Ricerca di Economia Industriale e Finanza "Fabio Gobbo" (Fabio Gobbo Research Center for Industrial Economy and Finance), Libera Università Internazionale degli Studia Sociali "Guido Carli" (Guido Carli Free International University of Social Studies), January 2015. http://www.aluplanet.com/documenti/InfoAlluminio/Executive_Summary_impactEU.pdf.

China Aluminum International Engineering Corp. Ltd. (Chalieco). "Electrolytic Aluminum Technology," February 8, 2014. http://www.chalieco.com.cn/en/index.php/news/company_content/199.html.

China Nonferrous Metals Industry Association (CNIA). Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, February 21, 2017.

CM Group. PowerPoint presentation to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, September 27, 2016

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

De Frutos, Raul. "3-Month LME Aluminum Price Hits a 1-year High," August 18, 2016. https://agmetalminer.com/2016/08/18/3-month-lme-aluminum-price-hits-a-1-year-high/.

Elliot, Douglas J., and Kai Yan. "The Chinese Financial System: An Introduction and Overview," July 1, 2013. https://www.brookings.edu/research/the-chinese-financial-system-an-introduction-and-overview/.

Emirates Global Aluminium Association (EGA). Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, January 23, 2017.

Fickling, David. "China Isn't the Reason U.S. Aluminum is Suffering." Bloomberg, October 10, 2016, https://www.bloomberg.com/gadfly/articles/2016-10-10/china-isn-t-the-reason-u-s-aluminum-is-suffering.

Hong, Shen. "China's Small Businesses Lose Out on Cheaper Loans," April 1, 2015. https://www.wsj.com/articles/chinas-small-businesses-lose-out-on-cheaper-loans-1427860298.

IHS Markit. GTA database, https://www.gtis.com (accessed various dates).

International Aluminium Institute (IAI) statistics. http://www.world-aluminium.org/statistics/ (accessed various dates).

International Monetary Fund (IMF). *Economic Prospects and Policy Challenges for the GCC Countries." Annual Meeting of Ministers of Finance and Central Bank Governors*. Washington, DC: IMF, October 5, 2013. https://www.imf.org/external/np/pp/eng/2013/100513b.pdf.

Kayakiran, Firat. “Auto Industry Drives Comeback in Aluminum Prices.” *Automotive News*, January 28, 2015. http://www.autonews.com/article/20150128/OEM10/150129811/auto-industry-drives-comeback-in-aluminum-prices.

Metal Bulletin. “China Aluminium Smelters Offered Extra Subsidies to Keep Producing,” June 1, 2012. https://www.lexisnexis.com (fee required).

Metal Bulletin Daily Alerts. “China’s Henan Issues Action Plan to Hasten Development of Aluminium Industry,” September 14, 2012. https://www.lexisnexis.com (fee required).

Minter, Adam. CMRA Conference Report: Reversal of Fortune, *Scrap Magazine*, January/February 2016, http://www.isri.org/news-publications/scrap-magazine/scrap-articles/cmra-conference-report-reversal-of-fortune#.V7zWJfkrJ-A.

———. Report: CMRA Conference—The Winds of Change, *Scrap Magazine*, January/February 2013, http://www.isri.org/news-publications/scrap-magazine/scrap-articles/report-cmra-conference-the-winds-of-change#.V7zWMPkrJ-A.

Mok, Yuencheng. “China Aluminum Smelters Seek Government Subsidies on Power While Mulling Capacity Cuts.” *Platts Metals Daily*, November 3, 2015. https://www.lexisnexis.com (fee required).

Moody’s Corp. “Moody’s: China’s On-grid Tariff Cut Is Credit Negative for Coal-fired Power Generators,” January 4, 2016. https://www.moodys.com/research/Moodys-Chinas-on-grid-tariff-cut-is-credit-negative-for--PR_341859.

Mukhamedshin, Oleg. “Energy Costs and Considerations in Primary Smelting and the China Factor.” Metal Bulletin Event, 29th International Aluminium Conference, September 23, 2014. http://www.metalbulletin.com/events/download.ashx/document/speaker/7043/a0ID000000X0juBMAR/Presentation.

Nappi, Carmine. *The Global Aluminium Industry: 40 Years Since 1972*. London, United Kingdom: World Aluminium, February 25, 2013. http://www.world-aluminium.org/media/filer_public/2013/02/25/an_outlook_of_the_global_aluminium_industry_1972_-_present_day.pdf.

Nicola, Stefan. “Fossil Fuel Subsidies Fall in Gain for Renewables.” Bloomberg, January 30, 2015. https://www.bloomberg.com/news/articles/2015-01-30/fossil-fuel-subsidies-fall-in-gain-for-renewables.

Ling, Wan. "Chinese Labor Rates Continue to Rise." CRU Group, April 7, 2016. http://www.crugroup.com/about-cru/cruinsight/Chinese_labour_rates_continue_to_rise.

Platts. "The Price of Aluminum: Metals Price Assessments," n.d. http://www.platts.com/price-assessments/metals/aluminum-transaction.

Shanghai Daily. "China Lowers Electricity Price for Grid, Enterprise Users," April 19, 2015. http://www.shanghaidaily.com/business/economy/China-lowers-electricity-price-for-grid-enterprise-users/shdaily.shtml.

Starta, Daniel, Abhishet Poddar, and Jose Alberich. *How GCC Smelters Can Continue Growing Profitably*. Chicago, IL: A.T. Kearney Inc., February 2013. https://www.atkearney.com/documents/10192/1386420/How+GCC+Smelters+Can+Continue+Growing+Profitably.pdf/b8ccbe8b-d563-488c-950e-887f2fccb285.

UC Rusal. Written testimony submitted to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, September 12, 2016.

U.S. International Trade Commission (USITC). Hearing transcript in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, September 29, 2016.

Vazquez, Jorge. Harbor Aluminum. Hearing exhibits submitted to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

Vazquez, Jorge. Harbor Aluminum Intelligence Unit LLC (Harbor Aluminum). Written testimony submitted to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, September 29, 2016.

Wen, Xianjun. "Aluminum Industry in China and International Trade." Presentation at China Aluminum Week Conference, Nanning, China, October 27, 2016.

Wood, Andrew. "Keeping the Bauxite and Alumina Industry Profitable–Challenges and Opportunities," *Metal Bulletin* 20th Bauxite & Alumina Conference, 25 February 2014, 7. http://www.metalbulletinstore.com/images/covers/20th%20Bauxite%20and%20Alumina%20Conference/lb_Bauxite-Alumina_2014_WEB_1.pdf.

Wookey, Jethro. "China Is Most Efficient Aluminum Producer Nation." October 31, 2016. https://www.fastmarkets.com/base-metals-news/aluminium/lme-week-2016-china-is-most-efficient-aluminium-producer-nation-123097/.

Chapter 4 United States[219]

Overview

During 2011–15, the U.S. primary aluminum industry recorded major declines in principal performance indicators. Low prices on the London Metal Exchange (LME), global oversupply, and relatively high production costs triggered large capacity cutbacks that led to employment and production declines (table 4.1). Several domestic producers of primary unwrought aluminum exited the industry, while others either fully curtailed output at certain smelters or operated them with some idled capacity.[220] In 2016, U.S. primary aluminum production and capacity continued to drop and reached period lows.[221]

In contrast, the U.S. producers of secondary unwrought and wrought aluminum increased their capacity, production, and employment during this period. The secondary unwrought industry captured a larger share of the U.S. unwrought aluminum market to help meet rising demand from the wrought sector, which continued to see growth in most leading end-use markets, particularly automotive and construction. In 2015, the United States was the world's ninth-largest producer of primary unwrought aluminum, its largest producer of secondary unwrought aluminum, and its second-largest producer of wrought aluminum products.

[219] The statistical information presented in this chapter is taken from publicly available and purchased sources and responses from the Commission's survey of domestic aluminum producers. (The responses are summarized in appendix G; the survey itself appears in appendix F.) The survey results are presented using the lowest level of aggregation that does not reveal confidential business information. Hence, the degree of disaggregation varies among tables, particularly for secondary unwrought and wrought aluminum products. Moreover, due to the limited number of respondents from the primary unwrought segment and the small size of that segment's shares, the survey results from primary unwrought producers are not presented in this chapter; rather, the Commission relied on publicly available and purchased sources of information about the primary unwrought segment. Conversely, a lack of readily available statistics about the secondary unwrought segment was a major reason that the Commission chose to survey both (1) secondary unwrought producers that sell to downstream wrought aluminum and foundry customers, and (2) wrought aluminum product firms with captive scrap-remelting capabilities. Finally, any differences between the survey results and similar statistics available from other sources are not reconciled in this study beyond mentioning potential reasons based on readily available information.

[220] "Curtailed capacity" is a production capacity taken out of active production, but kept operational so it can be quickly restarted. By contrast, "idled capacity" is the portion of a facility's production capacity that is curtailed while the remaining capacity is still actively in production. Finally, "closure" is the complete and permanent shutdown of a facility or a production line within a facility.

[221] In 2016, primary unwrought aluminum production declined 47 percent from the 2015 level, and capacity dropped 39 percent. Limited data are available for the primary unwrought aluminum industry in 2016. Where appropriate, the 2016 data for production and capacity are referenced.

Table 4.1: United States: Primary unwrought, secondary unwrought, and wrought aluminum industry segment performance, 2011–15 (percentage change)

Industry segment	Capacity	Production	Employment
Primary unwrought	-19.0	-20.1	-26.8
Secondary unwrought	5.6	13.4	10.2
Wrought	5.7	12.8	12.7

Sources: CRU Group; USITC survey of U.S. aluminum producers, September 30, 2016, questions 3.2, 3.3, 4.2 and 4.3.
Note: Limited data for 2016 are available for the primary unwrought aluminum industry. In that year, primary unwrought aluminum production declined 47 percent from the 2015 level, and capacity dropped 39 percent.

Even though U.S. secondary unwrought aluminum producers increased their output over the period, U.S. imports of unwrought aluminum also captured a larger share of the U.S. market to help meet the growing demand of the wrought products segment. The United States was the world's largest net importer of unwrought aluminum in 2015, as U.S. wrought producers increasingly relied on Canada for their unwrought aluminum needs. The United States was also a net importer of wrought products, with China overtaking Canada as the leading source of these imports in 2015. Plate, sheet, strip, and foil accounted for 98 percent of the imports from China. The United States was the world's third-largest exporter of wrought aluminum products, with Mexico and Canada the leading markets, reflecting the high degree of integration of the North American automotive and aerospace industries.

Although the U.S. aluminum industry benefited from certain U.S. government policies and programs, such as direct grants for developing technologies and state and local government tax rebates and electricity contracts, the U.S. primary aluminum industry remains among the world's highest cost-producers. The strategic efforts of domestic primary aluminum producers to enhance their cost competitiveness by shedding high-cost smelters and lowering raw material costs have not been sufficient to improve their position relative to global competitors. As a result, the U.S. secondary aluminum industry has made inroads in the U.S. unwrought market, taking advantage of its ready access to the world's most abundant supplies of aluminum scrap, generated by the U.S. economy.

The U.S. wrought products segment continued to expand during the period, benefiting from access to large end-use markets, a robust supply chain, a broad product portfolio, and advanced research and development (R&D) and technical capabilities. Moreover, the segment produces certain flat-rolled sheet products at lower cost than its major foreign rivals, despite a narrowing cost advantage during 2011–15. However, some domestic producers of wrought products have expressed growing concerns about rising import competition, especially for lower-cost extruded and foil products.

Industry Structure

Restructuring of the overall U.S. aluminum industry during 2011–16 was most prominent in the U.S. primary aluminum sector, as the industry was reduced to only two firms after several smelters closed permanently and others were acquired. Primary aluminum sector employment also contracted, and certain planned investments in smelter upgrades were either postponed or cancelled.

In contrast, the U.S. secondary unwrought segment recorded a net increase in the number of firms, despite several acquisitions and closures of older facilities. At the same time, the wrought aluminum industry maintained its status as the largest segment of the U.S. aluminum industry. Employment in both the secondary and wrought aluminum sectors posted gains during the period. In 2015, investment in the secondary sector declined following the completion of a large investment in the "captive" sector (the vertically integrated wrought aluminum segment of the industry) in Lafayette, Indiana, by Shandong Nanshan Aluminum Co. Ltd. (China). The U.S. wrought aluminum sector, however, attracted domestic and foreign investment throughout the period. This was particularly true in the sheet, plate, strip, and foil (flat-rolled products) sector, which serves the fast-growing automotive and aerospace markets.

Primary Unwrought Aluminum

The U.S. primary aluminum industry, which is the world's ninth-largest producer, is the smallest segment of the U.S. aluminum industry.[222] The U.S. primary aluminum industry produces a wide range of casthouse products in many different alloys, including high-purity alloys, for its end-use customers. Due to the low supply of domestic bauxite resources,[223] the U.S. primary aluminum industry is almost entirely dependent on imports of bauxite, principally from Jamaica, for refining into alumina.

Number, Location, and Concentration

Since 2011, the U.S. primary aluminum industry has been reduced by half due to three smelter acquisitions, two corporate bankruptcies, and numerous capacity reductions, including seven permanent smelter and potline closures.[224] In 2011, five companies—Alcoa, Century Aluminum

[222] Yucel, *Aluminum Manufacturing in the US,* June 2016, 4.
[223] Bray, "Bauxite and Alumina," January 2016, 1.
[224] See table 4.2 for sources.

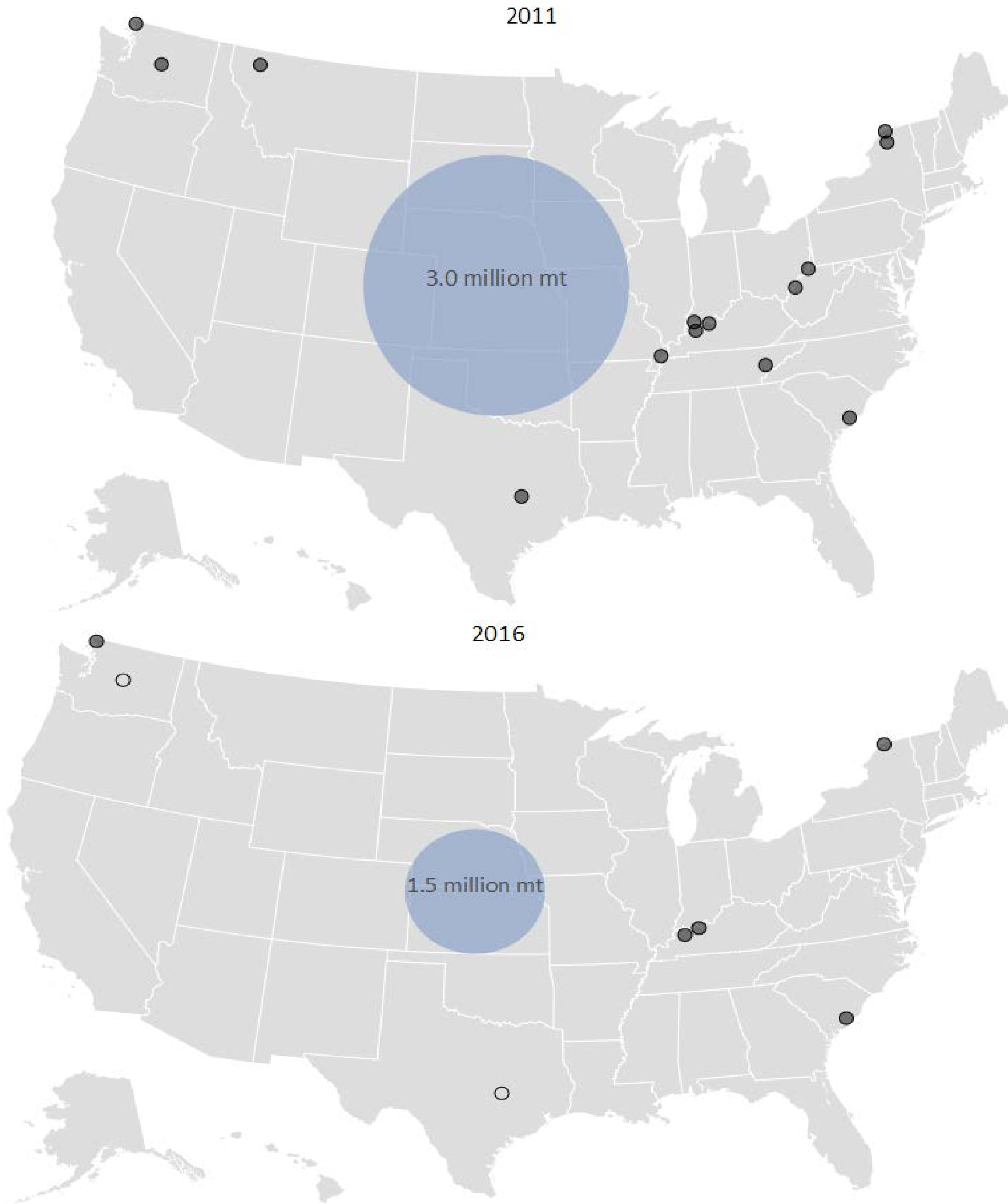
(Century), Noranda Aluminum Holding Corp. (Noranda),[225] Ormet Primary Aluminum Corp., and Rio Tinto Alcan—and one joint venture (Alcoa-Century Aluminum) operated 14 primary aluminum smelters across the United States (figure 4.1). However, by 2016, only Alcoa and Century Aluminum remained, operating a total of 7 smelters in Kentucky, New York, South Carolina, and Washington state. A combination of low aluminum prices,[226] the inability to obtain competitive electricity contracts,[227] and competition with more modern facilities abroad[228] have been cited as reasons for the capacity reductions. Moreover, the upstream supply chain for U.S. primary production has also reduced capacity. Of the four U.S. alumina refineries that operated in 2011, only the Gramercy, LA, refinery still produces metallurgical (smelter-grade) alumina.[229]

Alcoa currently has only one U.S. smelter, Massena West (NY) operating at full capacity (table 4.2). Massena West has the capability to produce value-added products, such as billet, bar, and rod.[230] Alcoa's other three smelters are curtailed indefinitely (Rockdale, TX, and Wenatchee, WA) or operating with partly idled capacity (Intalco Ferndale, WA).[231] Century has three U.S. smelters, with only one smelter (Sebree, located in Robards, KY) operating at full capacity. Its smelters at Hawesville, KY (which has four potlines configured to produce high-purity aluminum)[232] and Mt. Holly, SC, are operating with idled capacity.[233]

---

[225] Noranda completed Chapter 11 bankruptcy proceedings in February 2016. In March 2016, Noranda completely shut down its New Madrid, MO, smelter shortly after failing to negotiate a favorable electric-power supply contract from Ameren. GlobeNewswire, "Noranda Initiates Chapter 11 Process," February 8, 2016; Barker, "New Madrid Smelter to Shut Down Next Month," February 8, 2017.
[226] See, e.g., Alcoa Inc., "Alcoa to Close Warrick Smelter," January 7, 2016.
[227] See, e.g., Century Aluminum, "Century Aluminum Permanently Closing Ravenswood Smelter," July 27, 2015.
[228] See, e.g., Erickson, "Columbia Falls Aluminum Co. Announces Permanent Closure," March 3, 2015.
[229] The Burnside, LA, refinery, which was sold in February 2013 when Ormet Primary Aluminum Corp. declared bankruptcy, was retrofitted in December 2013 by the new owner to produce chemical-grade rather than smelter-grade alumina. The Point Comfort, TX, refinery was shut down in March 2016, followed by the Corpus Christi, TX, refinery in September 2016. Bray, "Bauxite and Alumina," January 2015 and January 2017, 1.
[230] Alcoa Corp., "Alcoa Massena Operations—West Plant Overview," https://www.alcoa.com/alcoacarriers/en/locations/overview.asp?loc=Massena_NY-_Massena_West (accessed April 11, 2017).
[231] Various news articles indicate that the Wenatchee smelter appears to have been fully curtailed; however, Alcoa's website reports that the plant is operating with idled capacity. Alcoa Corp., "What We Do: Aluminum," http://www.alcoa.com/global/en/what-we-do/aluminum/default.asp (accessed March 13, 2017); King, "Alcoa to Shut Down Ferndale and Wenatchee Aluminum Smelters," November 2, 2015; Banse, "Aluminum Smelting's Questionable Future in the Northwest," January 27, 2016.
[232] Century Aluminum, "Plants and Products: Hawesville," http://centuryaluminum.com/plants-products/hawesville/ (accessed March 4, 2017).
[233] For data on capacity utilization, refer to table 4.8.

Figure 4.1: United States: Locations of primary unwrought aluminum smelters and total capacity, 2011 and 2016 (million mt)



Sources: CRU Group; Alcoa, “What We Do: Aluminum,” http://www.alcoa.com/global/en/what-we-do/aluminum/default.asp (accessed March 13, 2017); King, “Alcoa To Shut Down Ferndale And Wenatchee Aluminum Smelters,” November 2, 2015; Banse, “Aluminum Smelting’s Questionable Future in the Northwest,” January 27, 2016; Century Aluminum, “Plants and Products,” http://centuryaluminum.com/plants-products/ (accessed March 4, 2017).
Note: mt = metric ton. Shaded dots = smelters with operating capacity in 2011 and 2016. Open dots = smelters with curtailed capacity in 2016.

Table 4.2: United States: Primary unwrought aluminum smelters, 2011–16

Smelter name/Location	Owner	Year established	Operational status	Capacity (thousand mt) 2011	2016
Alcoa, TN	Alcoa	1914	Permanently closed (January 2012)	215	-
Warrick (Evansville, IN)	Alcoa	1960	Permanently closed (March 2016)	269	-
Intalco (Ferndale, WA)*	Alcoa	1966	Operating (49,000 mt of idled capacity)	279	279
Massena East (Massena, NY)	Alcoa	1959	Permanently closed (November 2016)	125	-
Massena West (Massena, NY)*	Alcoa	1902	Operating	130	130
Rockdale, TX	Alcoa	1952	Curtailed (June 2008); permanently closed two potlines (January 2012)	267	191
Wenatchee Works (Wenatchee, WA)	Alcoa	1952	Curtailed (January 2016)	184	184
Hawesville, KY*	Century	1969	Operating (about 151,000 mt of idled capacity)	244	252
Ravenswood, WV	Century[a]	1957	Permanently closed (July 2015)	170	-
Mount Holly, SC*	Century[b]	1980	Operating (about 115,000 mt of idled capacity)	229	231
Sebree (Robards, KY)*	Century[c]	1973	Operating	196	218
Columbia Falls, MT	Columbia Falls Aluminum Co.[d]	1955	Permanently closed (March 2015)	168	-
New Madrid, MO	Noranda[e]	1971	Permanently closed (March 2016)	263	-
Hannibal, OH	Ormet Primary Aluminum Corp.[f]	1958	Permanently closed (July 2014)	271	-
Total capacity				3,010	1,485

Sources: Alcoa Corp., "What We Do: Aluminum," http://www.alcoa.com/global/en/what-we-do/aluminum/default.asp (accessed March 13, 2017); Alcoa Corp., "Who We Are: History," http://www.alcoa.com/global/en/who-we-are/history/default.asp (accessed May 11, 2017); Alcoa Corp., "Alcoa to Curtail Smelting and Refining Capacity," November 2, 2015; Alcoa Corp., "United States," http://www.alcoa.com/united-states/en/default.asp (accessed May 11, 2017); *Bellingham Herald*, "A History of Alcoa Intalco Works," http://www.bellinghamherald.com/news/business/article42346254.html (accessed April 6, 2017); Bray, "Aluminum," 2011-2017; Associated Press, "Alcoa's Aluminum Smelter Closes in Warrick County," March 25, 2016; Bray, "Aluminum (Advanced Release)," 2012–2015; Century Aluminum, "Plants and Products," http://centuryaluminum.com/plants-products/ (accessed March 4, 2017); Century Aluminum, "Century Aluminum Permanently Closing Ravenswood Smelter," July 27, 2015; Century Aluminum, "Century Announces Continued Operation of Two Potlines," September 30, 2015; Century Aluminum, "Century Announces Continued Operations of Its Sebree, KY Smelter," December 17, 2015; Century Aluminum, "Century Reaches New Market-Based Power Agreement," July 6, 2016; Century Aluminum Sebree, "Sebree, KY," http://www.centurysebree.com/ (accessed April 6, 2017); Lannom, "Century Gives up on Ravenswood Plant," July 28, 2015; Martin, "Alcoa Will Permanently Close Massena East," November 2, 2015; Ohara, "Washington Aluminum Plant Celebrates 60 Years," June 23, 2012; Overturf, "5 Years after Shuttering," November 7, 2013; Tabish, "The Rise and Fall of the Columbia Falls," September 14, 2016; EPA, "Superfund Site: Ormet Corp., Hannibal, OH" (accessed April 6, 2017); Wood Mackenzie, "New Madrid Aluminum Smelter," November 2016 ; Yakama Nation Fisheries Research Management, "Columbia Gorge Aluminum Plant: Fact Sheet," September 19, 2011.

Note: Smelters operating in 2017 are marked with *.

[a] Century Ravenswood had been curtailed since February 2009.

[b] Alcoa sold its 50.3 percent ownership share to Century Aluminum, its Mt. Holly joint-venture partner, in December 2014.

[c] Rio Tinto Alcan sold Sebree to Century Aluminum in June 2013.

[d] Columbia Falls Aluminum Co. had been curtailed since 2009.

[e] In January 2016, Noranda permanently shut down two potlines due to an electrical circuit failure. Then in February 2016, Noranda filed for Chapter 11 bankruptcy.

[f] Ormet closed two potlines in the summer of 2012, filed for Chapter 11 bankruptcy in February 2012, sold to Niagara Worldwide in June 2014, and permanently closed later that year.

Historically, U.S. smelters have based their location decisions primarily on whether the site is near affordable power sources, balanced with the need to have access to customers.[234] For example, Alcoa's Intalco, Wenatchee Works, and Massena West smelters are located near energy grids that use hydropower (the Bonneville Power Authority, the Chelan County Power Utility District, and the New York Power Authority).[235] The power grid for Alcoa Rockdale (now curtailed) relied on coal,[236] whereas Century's aluminum smelters are located near power grids that rely on natural gas and some nuclear energy for generating electric power.[237]

Alcoa and Century, both multinational firms, now focus solely on the upstream segment of the aluminum industry (i.e., primary aluminum and raw material inputs), which are largely situated outside of the United States (box 4.1). Alcoa split its long-time fully integrated business into Alcoa Corp. (upstream) and Arconic Inc. (downstream wrought production) in November 2016,[238] which allows the new Alcoa entity to focus on primary production efficiency using its global supply chain.[239] Besides its upstream operations, Alcoa Corp. encompasses energy-generation, casting, and certain rolling facilities at 64 sites worldwide that employ 17,000 workers.[240]

Century is pursuing a strategy that allows it to focus on primary aluminum production and growth opportunities in that sector, following the sale of its ownership shares in bauxite mining and alumina refining in 2009 to U.S. based Noranda Alumina.[241] Noranda (now owned by parent company Dada Holdings) supplies alumina to Century Aluminum's U.S. smelters from its Gramercy, LA, refinery.[242]

---

[234] Peck, "The United States: A Troubled Industry," 1988, 38.
[235] Alcoa Corp., "Alcoa Reaches Agreement with New York State," November 24, 2015; Craig, "Chelan PUD Discussing Future of Wenatchee Works," March 17, 2017; Gallagher, "Ferndale Intalco's Smelter to Stay Open," May 2, 2016.
[236] Cassell, "Energy Future Settles Issues with Alcoa," January 5, 2016; Luminant, "Sandow: Power Plant and Mine," n.d. (accessed April 5, 2017).
[237] Century Aluminum, "Fourth Quarter Earnings Call," February 23, 2017; Peck, "The United States: A Troubled Industry," 1988, 38.
[238] Alcoa Corp., "Alcoa Corporation Streamlines Company Structure," March 2, 2017.
[239] USITC, hearing transcript, September 29, 2016, 155–56 (testimony of Tim Reyes, Alcoa Cast Products).
[240] Alcoa Corp., "Alcoa Corporation Launches," November 1, 2016; Alcoa, "Alcoa Inc. Board of Directors Approves Separation," September 29, 2016; Alcoa Inc., "Alcoa Inc. Announces Filing of Initial Form," June 29, 2016; Alcoa Inc., "Alcoa to Separate Into Two," September 28, 2015.
[241] Century Aluminum, "Century Aluminum Divests Stakes," August 4, 2009.
[242] Aluminium Insider, "New Day Aluminum Acquires Noranda's Upstream Assets," October 22, 2016; Aluminium Insider, "Noranda Alumina to Fuel Century," January 6, 2017.

Box 4.1: United States: Overview of the U.S. Primary Aluminum Producers Still Operating

Alcoa Corp. (New York) is the larger of the two remaining U.S. producers, in terms of both U.S. and worldwide production capacity. During 2011–15, Alcoa ranked among the top 10 primary producers in the world.[a] Its foreign smelting operations are located in Australia, Brazil, Canada, Iceland, Norway, and Spain. Alcoa also holds a 25.1-percent share in the joint-venture Ma'aden smelter in Ras Al-Khair, Saudi Arabia.[b] The company is extensively integrated upstream and claims to be the world's largest bauxite miner, with four mines, as well as the largest alumina refiner,[c] with six refineries in Australia, Brazil, and Spain (total installed annual capacity of 17 million mt). Alcoa also has a 25 percent share in the refinery associated with the Ma'aden smelter.[d]

Century Aluminum Co. (Chicago, IL) operates three smelters in the United States, a new large-scale smelter in Grundartangi, Iceland, and a carbon-anode production facility in Vissingen, the Netherlands.[e] Century Aluminum's Hawesville, KY, smelter reportedly is the largest producer of high-purity aluminum in North America.[f] Other global producers of high-purity aluminum include Dubal, in Dubai, United Arab Emirates; Rusal in Russia; Norsk Hydro in Germany and Norway; and JoinWorld in China.[g]

[a] Statista, "Aluminum—Leading Companies Worldwide by Production Output 2015."
[b] Alcoa Corp., "What We Do: Aluminum," https://www.alcoa.com/global/en/what-we-do/aluminum/default.asp (accessed February 21, 2017).
[c] Alcoa Corp., "What We Do: Bauxite," http://www.alcoa.com/global/en/what-we-do/bauxite/default.asp (accessed February 21, 2017); Alcoa Corp., "What We Do: Alumina," http://www.alcoa.com/global/en/what-we-do/alumina/default.asp (accessed February 21, 2017); Alcoa Corp., "Alcoa Corporation Launches," November 1, 2016.
[d] Alcoa Corp., "What We Do: Alumina," http://www.alcoa.com/global/en/what-we-do/alumina/default.asp (accessed February 21, 2017).
[e] Century Aluminum, "Company at a Glance," http://centuryaluminum.com/company/ (accessed May 11, 2017).
[f] Century Aluminum, "Plants and Products: Hawesville," http://centuryaluminum.com/plants-products/hawesville/ (accessed March 4, 2017)..
[g] UC Rusal, "High Purity Aluminum," http://www.rusal.ru/en/clients/products/high-purity_aluminum/ (accessed March 4, 2017); Hydro, "High Purity," http://www.hydro.com/en/products/casthouse-products/High-purity/, October 11, 2016; Tabereaux, "World Primary Aluminum Production in Review," May 18, 2016.

Employment and Wages

Between 2011 and 2015, primary smelting employment fell by 27 percent as the segment contracted (table 4.3). Though the final data are not available, employment likely continued to fall in 2016, given the additional domestic capacity closures and curtailments that year. Industry wages followed the same increasing trend as that of average wages for production and nonsupervisory employees in the broader manufacturing sector in the United States.[243] Estimated worker productivity improved at roughly the same rate as average wages per hour over the period.

More stable industry employment may result from certain industry commitments. For example, the New York state government provided funding to Alcoa that is contingent on preserving jobs in upstate New York. As a result, Alcoa must keep 600 full-time equivalent employees on the

[243] FRED, "Average Hourly Earnings of Production and Nonsupervisory Employees: Manufacturing," https://fred.stlouisfed.org/series/CES3000000008 (accessed March 12, 2017).

payroll or face financial penalties; thus, as long as this policy is in place, employment is expected to remain stable at Massena West.[244]

Table 4.3: United States: Primary unwrought aluminum industry employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	6,509	6,544	6,020	5,167	4,767
Production (1,000 mt)	1,986	2,070	1,948	1,718	1,587
Productivity (workers/1,000 mt)	3.3	3.2	3.1	3.0	3.0
Average wages ($/hr)	41.89	42.24	44.16	45.14	45.26

Source: CRU Group.

Investment

During 2011–15, several U.S. firms planned upgrades of potline technology, but found themselves unable to follow through in many cases, citing poor market conditions and a lack of competitiveness. As a result, U.S. smelters tend to use older, less efficient potline technology than leading global competitors. In 2012, for example, Alcoa Corp. announced that it would replace three antiquated Söderberg potlines at Massena East with modern pre-bake technology.[245] By 2015, however, Alcoa cancelled the Massena East modernization after the firm deemed the entire facility uncompetitive.[246] Similarly, Noranda delayed a technology upgrade at its New Madrid, MO, smelter due to poor market conditions in 2015,[247] and permanently closed the smelter in March 2016. On the other hand, as noted above, New York state provided Alcoa with a grant to modernize the Massena West smelter late in 2015.[248]

Secondary Unwrought Aluminum[249]

The United States is the world's leading producer of secondary unwrought aluminum, largely owing to its high volume of scrap generation and long-established aluminum scrap recycling

[244] New York State, Office of the Governor, "Governor Cuomo and Senator Schumer Announce Deal," November 24, 2015.
[245] For further details, see the "Primary Unwrought Aluminum" section in chapter 1.
[246] Alcoa Corp., "Alcoa to Permanently Close Remaining Potlines," January 15, 2014; Beckstead, "Alcoa Decision to End Smelting Operations in Massena," November 3, 2015.
[247] O'Carroll, "The Decline of the US Aluminum Smelting Industry," April 6, 2016.
[248] For more information, see the "Government Policies and Programs" section in this chapter.
[249] Secondary aluminum production totals presented in this chapter are based on data collected through the Commission's survey and represent the total volume of output by U.S. secondary operations. This output reflects all inputs used, including scrap aluminum (whether purchased or transferred from downstream users), alloying metals, primary aluminum, and secondary aluminum. The Commission's production totals are therefore larger than totals published by other sources that principally report secondary production in terms of the volume of purchased scrap that was used/recovered.

industry.[250] Because scrap serves as the principal raw material input for the secondary industry, the manufacture of secondary aluminum is more energy efficient, requiring only 8 percent of the energy used to produce primary aluminum.[251] The two types of secondary unwrought aluminum producers—captive producers and merchant producers[252]—have different structures because they serve different geographic and end-use markets in the United States and abroad (box 4.2).[253]

Box 4.2: United States: Two Types of Secondary Producers: Captive and Merchant

Captive producers of secondary aluminum are wrought producers that are vertically integrated with their sources of raw material. They typically take advantage of economies of scale to service a global market. Captive producers rely on combinations of well-sorted old (post-consumer) scrap, new scrap left over from the production process (process scrap), and primary aluminum; adding the primary aluminum allows them to attain specific alloy contents, uniform surface finishes, or both.[a] Most captive producers are large global firms, but a number of small vertically integrated firms also produce secondary aluminum for their own use. These small captive firms principally produce extruded products and service local niche markets.

Merchant producers of secondary aluminum are typically small to medium-sized firms, with production volumes rarely exceeding 200,000 mt per year. These firms purchase and refine mostly old (post-consumer) scrap to produce specification ingot, as well as billet and slab, principally for foundries and die casters.[b] Merchant producers tend to produce these goods using different qualities of scrap than captive producers, and must rely on extensive technical and market knowledge to create the alloy combinations demanded by customers. In addition, they must have an extensive network of procurement contacts for scrap supplies.[c]

[a] USITC, hearing transcript, September 29, 2016, 248–49 (testimony of Jason Weber, Sapa Extrusions Inc.).
[b] IAI, "Industry Structure," http://recycling.world-aluminium.org/review/industry-structure.html (accessed February 22, 2017).
[c] Industry representative, telephone interview by USITC staff, February 16, 2017.

Number, Location, and Concentration

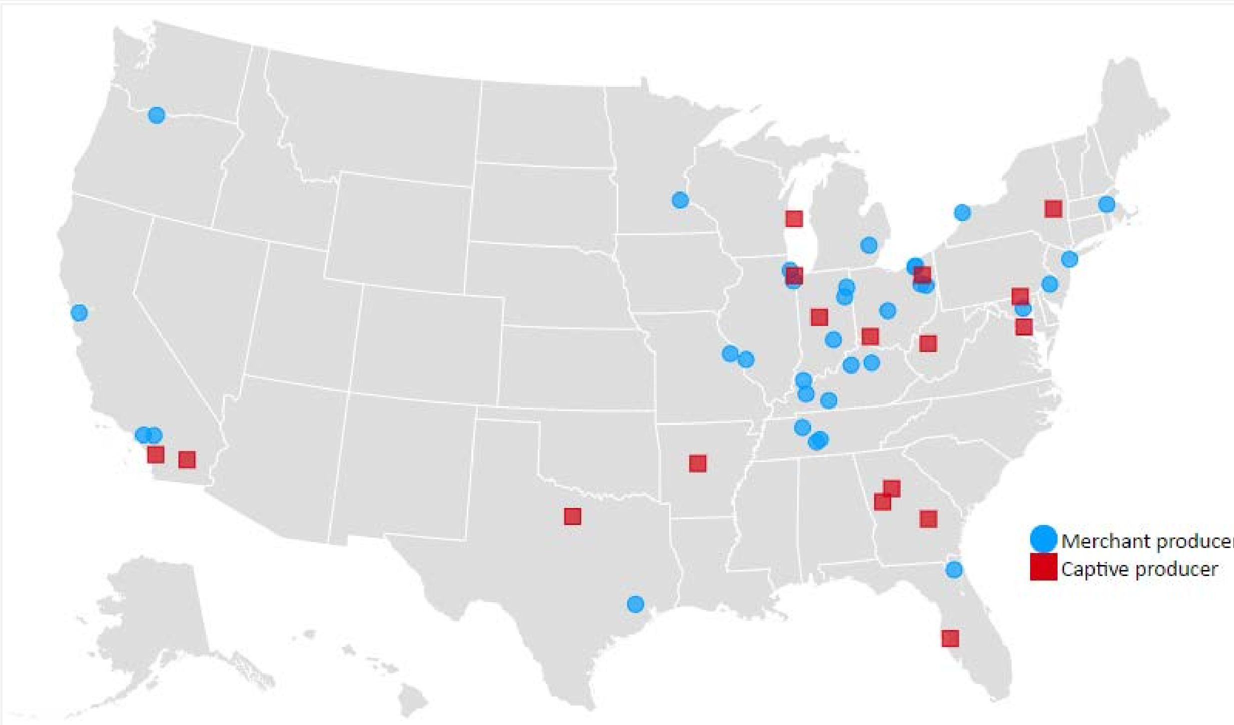
The U.S. secondary unwrought aluminum segment is relatively fragmented, consisting of at least 45 firms in 2015.[254] Most secondary facilities are located east of the Mississippi River, near

[250] WBMS, "Aluminum," 2016.
[251] Aluminum Association, "The Aluminum Can Advantage" (accessed August 16, 2016).
[252] IAI, "Industry Structure," http://recycling.world-aluminium.org/review/industry-structure.html (accessed February 22, 1017). See also the description of the secondary unwrought aluminum segment in the "Aluminum Production Processes" section in chapter 1. Some secondary producers also provide toll-processing services to other companies; these are production process services performed for a client using the clients' raw materials. USITC survey of U.S. aluminum producers, September 30, 2016, question 3.3.
[253] GARC, *Global Aluminum Recycling*, 2009, 10.
[254] USITC survey of aluminum producers, September 30, 2016, question 3.1. *Recycling Today* reports the existence of 60 firms operating 121 facilities, excluding primary smelters (listed in table 4.2) that melt down new aluminum scrap recovered from their casting operations. Taylor, "Secondary Aluminum Producers in North America," June 2, 2015, 100; Taylor, "Light Metal, Heavy Changes," June 2, 2015, 99.

industrial centers that provide both scrap supplies and potential markets (figure 4.2). Prominent secondary producers in 2015 included wrought producers with captive production such as Aleris Inc., Kaiser Aluminum Corp., Novelis Corp., and Sapa Extrusions Inc., and merchant producer Real Alloys (see box 4.3).

In that year, these leading producers together accounted for 60 percent of both total capacity and total production, as well as 46 percent of total employment, in the secondary unwrought aluminum segment.[255]

Figure 4.2: United States: Locations of secondary unwrought aluminum producers, 2015



Source: USITC survey of aluminum producers, September 30, 2016, question 3.1.

Although acquisitions helped to consolidate the U.S. secondary aluminum segment, the industry experienced a net increase in the number of firms, as closures were mostly of older facilities.[256] The most notable merger during this period was Signature Group Holding's

[255] Compiled by USITC staff from USITC survey of U.S. aluminum producers, September 30, 2016, question 3.2.
[256] Industry representatives, interviews by USITC staff, March 9, 2017; Taylor, "Light Metal, Heavy Changes," June 2, 2015.

acquisition of Aleris's specification ingot and alloy facilities in spring 2015, which led to the formation of Real Alloy.[257]

Box 4.3: United States: Overview of Leading Secondary Unwrought Aluminum Producers

Aleris Corp. (Cleveland, OH) is a multinational producer of flat-rolled aluminum products that reported consuming more than 2.4 million mt of aluminum scrap and other materials to produce secondary aluminum used in making its wrought products. Scrap accounted for 64 percent of its raw material inputs in 2013; the company intends to raise the share of scrap to 73 percent by 2020.[a]

Arconic Inc. (New York, NY) was created as a wrought aluminum producer from Alcoa Inc's. corporate split in November 2016. Arconic holds most of the former company's recycling operations; all of the extruding and forging operations; and all of the rolling operations not allocated to the new "upstream company," Alcoa Corp.[b]

Kaiser Aluminum Corp. (Foothill Ranch, CA) is a multinational producer of both unwrought (billet) and wrought (rolled, extruded, and drawn) aluminum products. Five of its 11 U.S. facilities have remelt operations that purchase various forms of aluminum scrap.[c]

Novelis Corp. (Atlanta, GA), a leading multinational producer of flat-rolled aluminum products, claims to have developed the world's largest aluminum recovery network. It states that its network reclaims 60 billion used beverage cans annually, along with a wide variety of other types of aluminum scrap. Approximately 53 percent of Novelis's raw material inputs are recycled aluminum scrap.[d]

Real Alloy (Cleveland, OH), a multinational producer of secondary aluminum, is considered the world's largest independent consumer of aluminum scrap[e] and a global leader in producing both wrought aluminum alloys and specification (foundry) aluminum alloys in unwrought forms of molten metal, ingots, and sows.[f] Real Alloy was established following Signature Group Holding's acquisition of Aleris's recycling and specification alloys operations in February 2015.[g] Among Real Alloy's 23 facilities operating in Europe and North America are 9 recycling facilities, 3 specification alloy facilities, and 3 specialty products facilities located in the United States.[h]

Sapa Extrusions Inc. (Rosemont, IL), the North American subsidiary of Oslo-based Sapa AS, claims to be the leading North American producer of extruded aluminum alloy products. The firm has stated that it is striving to expand its remelting capabilities, with aluminum scrap accounting for 50 percent of its raw materials input chain in 2015.[i]

[a] Aleris, *Beyond Aluminum: 2014 Sustainability Report*, n.d., 12 (accessed May 2, 2017).
[b] Alcoa Inc., "Alcoa to Separate Into Two Industry-Leading Public Companies," September 28, 2015; Arconic, "Alcoa Recycling Overview," https://www.arconic.com/carriers/en/locations/overview.asp?loc=Maryville_TN-_Recycling (accessed May 31, 2017); Arconic, "Who We Are: Global Rolled Products," https://www.arconic.com/global/en/who-we-are/global-rolled-products.asp (accessed January 26, 2017); Arconic, "What We Do," https://www.arconic.com/global/en/what-we-do/overview.asp (accessed April 12, 2017); Alcoa Corp., "Alcoa Corporation Launches as an Independent Industry Leader," November 1, 2016.
[c] Kaiser Aluminum, "Products," https://www.kaiseraluminum.com/customers/products/ (accessed March 14, 2017); Kaiser Aluminum, "Form 10-K: Annual Report," March 30, 2006, 8.
[d] Novelis, "Recycling," http://novelis.com/sustainability/recycling/ (accessed March 10, 2017).

[257] The formation of Real Alloy introduced a new type of firm, the "large refiner." But because Real Alloy's facilities operate relatively independently—as do the facilities of smaller refinery firms—it remains classified with smaller refineries. *Recycling Today*, "Signature Group Holdings Introduces Real Alloys," March 2, 2015.

[e] *Recycling Today*, “Signature Group Holdings Introduces Real Alloys,” March 2, 2015.
[f] Real Alloy, “Home,” https://www.realalloy.com/home/ (accessed May 2, 2017); Real Alloy, "Delivery Forms," https://www.realalloy.com/products/delivery-forms/ (accessed May 2, 2017).
[g] *Recycling Today*, “Signature Group Holdings Introduces Real Alloys,” March 2, 2015.
[h] Real Alloy, “Locations,” https://www.realalloy.com/company/locations/ (accessed May 1, 2017).
[i] Sapa Group, “About Us,” http://www.sapagroup.com/en/na/profiles/about (accessed March 10, 2017); Sapa Group, *Sustainability Report 2015*, 2015, 11.

Employment and Wages

Employment in the domestic secondary aluminum segment rose by 10 percent during the period to 7,524 workers in 2015, reflecting increased U.S. production and static labor productivity (table 4.4). Merchant producers accounted for the larger share of employees, with approximately 65 percent of the total over the period. Not only do merchant firms outnumber captive firms in the industry, but a majority of merchant firms produce for the foundry and die cast industries, which use old scrap that is more labor intensive to work with.[258] Although captive producers tend to be larger companies, their secondary production accounts for only a portion of their operations.

Table 4.4: United States: Secondary unwrought aluminum industry employment and productivity, 2011–15

Item	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)					
Captive producers	2,391	2,394	2,437	2,556	2,655
Merchant producers	4,437	4,611	4,463	4,680	4,869
Total	6,828	7,005	6,900	7,236	7,524
Production (1,000 mt)					
Captive producers	4,343	4,535	4,662	4,828	4,967
Merchant producers	3,230	3,397	3,407	3,466	3,620
Total	7,573	7,933	8,069	8,295	8,587
Labor productivity (workers/1,000 mt)					
Captive producers	0.6	0.5	0.5	0.5	0.5
Merchant producers	1.4	1.4	1.3	1.4	1.3

Source: USITC survey of U.S. aluminum producers, September 30, 2016, question 3.2.
Note: Because of rounding, total may not equal sum of line items.

Investment

The secondary industry reported investments in its facilities averaging around $291 million annually over this five-year period. Merchant producers accounted for more than three-fifths (61 percent) of the investments over this period (table 4.5). Increased investment in the captive segment during 2012–14 corresponds with the greenfield construction of Shandong Nanshan Aluminum Co. Ltd. (China) in Lafayette, IN. The facility includes an extrusion mill that also

[258] Industry representatives, interviews by USITC staff, March 9, 2017; IAI, “Industry Structure,” http://recycling.world-aluminium.org/review/industry-structure.html (accessed February 22, 1017).

features secondary unwrought production.[259] The secondary segment also attracted foreign direct investment from Toyota Tsusho America (Japan), a global trading company with established metals operations, which has expanded its holdings of secondary aluminum-producing companies.[260] Toyota Tsusho acquired Bermco Aluminum (a U.S.-based merchant producer) after Bermco significantly expanded its capacity in 2014.[261]

Table 4.5: United States: Secondary unwrought aluminum industry investment, 2011–15 (million dollars)

Item	2011	2012	2013	2014	2015
Captive producers	70.0	124.2	137.5	183.8	47.8
Merchant producers	186.8	195.8	155.5	173.1	180.1
Total	256.8	319.9	293.0	357.0	227.9

Source: USITC survey of U.S. aluminum producers, September 30, 2016, question 3.2.
Notes: Data cover capital expenditures related to secondary unwrought aluminum operations. Because of rounding, total may not equal sum of line items.

U.S. secondary producers have noted that they have not invested in or made use of state-of-the-art scrap-sorting technology,[262] which is one way to expand the availability of scrap. However, this lack of investment generally reflects the structure of the U.S. industry, as many U.S. secondary producers typically convert scrap aluminum directly into wrought products from pre-sorted aluminum scrap purchased from end-use consumers (new scrap), as well as scrap collectors and scrap yards (old scrap).[263] Consequently, these firms do not typically maintain a scrap yard that would support investment in the equipment needed to sort mixed scrap.[264]

Wrought Aluminum

The U.S. wrought aluminum products segment is the world’s second-largest producer of wrought goods (after China) and the largest segment of the combined U.S. aluminum industry.[265] The U.S. wrought segment produces a wide range of products in many different alloys, from large-volume, commodity-grade articles to high-value-added goods. Production of wrought aluminum is a capital-intensive process, requiring sophisticated manufacturing techniques, and the U.S. industry is considered to be one of the world’s best and most

---

[259] Zhang, “Nanshan Aluminum to Open US Plant,” May 12, 2011; Paulson Institute, “A Chinese Aluminum Company’s Learning Curve,” October 31, 2013.
[260] Toyota Tsusho also owns Most Inc., MO, and Kentucky Smelting Technology Inc., which are both U.S. merchant producers. Toyota Tsusho, “Associated Companies (Metals),” October 1, 2016, http://www.toyota-tsusho.com/english/company/group/metal.html.
[261] *Recycling Today*, “Toyota Tsusho America Buys Bermco Aluminum,” August 14, 2015; Toyota Tsusho, “Associated Companies (Metals),” October 1, 2016, http://www.toyota-tsusho.com/english/company/group/metal.html.
[262] Industry representatives, interviews by USITC staff, March 1, 2017.
[263] Ibid.
[264] Ibid.
[265] John Dunham & Associates, *2016 Economic Impact of the Aluminum Industry*, March 2016, an attachment to the Aluminum Association's written submission to the USITC, September 12, 2016, 3.

technically advanced producers.[266] Depending on the manufacturing and performance specifications for a particular wrought product, the principal raw material inputs may be primary, secondary, or both types of unwrought aluminum in various forms (e.g., ingot, billet). Some wrought producers (e.g., producers of sheet for beverage cans) remelt aluminum scrap to manufacture their own raw materials in-house (i.e., captive production).

Number, Location, and Concentration

The U.S. industry producing the principal wrought products covered by this investigation—plate, sheet, and strip; foil; wire; profiles, bars, and rods; and pipe and tube—encompasses approximately 150 firms.[267] At least 30–35 large rolling mills produce plate, sheet, strip, and foil in the United States, with the top five U.S. producers accounting for 82 percent of total U.S. output of flat-rolled products (FRPs) in 2015.[268] Novelis, with eight U.S. facilities among its global operations,[269] is the world's largest producer of aluminum sheet, accounting for 14 percent of the global supply.[270] Other leading U.S. producers include Aleris, Arconic Inc., Constellium Rolled Products Ravenswood LLC (Constellium), and Gränges AB (box 4.4).

Significant corporate restructuring has occurred in the wrought products segment, most notably in the FRP sub-segment. These changes are driven in part by the financial challenges in the primary smelting sector, which have led some vertically integrated aluminum firms to reduce their reliance on smelting or to seek opportunities in the more profitable downstream aluminum segment, or both. Also, the need to address demands of both the upstream and downstream segments of the industry has reportedly driven many vertically integrated firms to focus on their core competencies.[271] Increased wrought aluminum output by emerging foreign producers has also led U.S. firms to consolidate their wrought products operations to compete more effectively.[272] As a result, former vertically integrated players in this segment, such as Alcoa, Alcan, and Noranda, have spun off or sold off their FRP operations to other U.S. and foreign firms, thereby transforming the wrought segment and creating new multinational downstream aluminum players.[273]

---

[266] USITC, hearing transcript, September, 29, 2016, 66 (testimony of Ganesh Panneer, Novelis Corp.).
[267] Approximately 1,500 firms manufacture all types of wrought and cast aluminum products, and they employ 136,615 workers. Aluminum Association, written submission to the USITC, September 12, 2016, 3.
[268] Based on data collected for the USITC survey of U.S. aluminum producers, September 30, 2016.
[269] Novelis, "Geographic Locations," http://novelis.com/about-us/locations/ (accessed March 12, 2017).
[270] USITC, hearing transcript, September 29, 2016, 61 (testimony of Ganesh Panneer, Novelis Corp.).
[271] Ibid., 157 (testimony of Matt Aboud, Hydro Aluminum Metals USA).
[272] Whiteman, "Investors Flock to Alcoa," November 1, 2016.
[273] See the discussion on "Primary Unwrought Aluminum" in this chapter for more information these firms' remaining operations.

Box 4.4: United States: Overview of Leading Wrought Aluminum Producers

Aleris Corp. (Cleveland, OH), a multinational producer of flat-rolled aluminum products, was formed in 2004 through the merger of Commonwealth Industries and IMCO Recycling Inc. Aleris was subsequently purchased by Texas Pacific Group in 2006. After filing for Chapter 11 bankruptcy in 2009, Aleris emerged as a privately held company owned by the investment funds of Apollo Management, Oaktree Capital Management, and Sankaty Advisors.[a] In late August 2016, Aleris entered into a definitive agreement outlining the terms by which it would be acquired by Zhongwang USA LLC. Zhongwang USA is majority-owned by Liu Zhongtian, the founder of China Zhongwang Holdings Ltd.,[b] a leading Chinese aluminum producer. Citing national security concerns with the merger, the Committee on Foreign Investment in the United States (CFIUS) invited the two firms to withdraw and refile their merger notice to obtain more time to provide additional information, including possible measures to mitigate these concerns.[c] Aleris and Zhongwang USA withdrew their notice in February 2017 and refiled in May 2017, and agreed to extend the termination date of their proposed merger to the end of August 2017.[d]

Arconic Inc. (New York, NY) is a multinational producer of wrought (rolled and extruded) aluminum products.[e] As mentioned earlier, Arconic was created when Alcoa Inc. undertook its corporate split in November 2016. The new Arconic holds Alcoa Inc.'s extruding operations, along with rolling operations not allocated to the new Alcoa Corp. Alcoa Corp. retained the upstream operations (bauxite, alumina, and smelting), cast products, and rolling mills in Warrick, IN, and Saudi Arabia.[f]

Constellium Rolled Products Ravenswood LLC (Ravenswood, WV) is a multinational producer of rolled products, with aluminum rolling mills located in Ravenswood, WV, and Muscle Shoals, AL (the latter from acquisition of Wise Metals in October 2014). Constellium's mills principally service the packaging, automotive, and aerospace markets.[g] Constellium is the former Alcan Engineered Products business, which was divested from Rio Tinto in 2011 following its 2007 purchase of Alcan Inc. In 2011, Apollo Global Management acquired a 51 percent interest in Alcan Engineered Products, and FSI took 10 percent, with the remaining 39 percent retained by Rio Tinto.[h]

Gränges AB (Stockholm, Sweden) purchased Noranda Aluminum Holding Corp's U.S. rolling mill business in August 2016 as part of Noranda's Chapter 11 reorganization.[i] Gränges is a leading global supplier of rolled aluminum for producers of brazed aluminum heat exchangers.[j]

Novelis Corp. (Atlanta, GA), a leading multinational producer of flat-rolled aluminum products,[k] emerged as a spin-off of the rolled products business of Alcan (Canada) in 2005. In 2007, Novelis was acquired by Hindalco industries Ltd. (India).[l]

[a] Aleris, "Our History," https://www.aleris.com/company/our-history/ (accessed April 13, 2017).
[b] Aleris, "Aleris to Be Acquired by Zhongwang USA LLC," August 29, 2016.
[c] Aleris, "Aleris Reports First Quarter 2017 Results," May 4, 2017.
[d] Aleris, "Form 8-K," May 26, 2017.
[e] Arconic, "Who We Are: Global Rolled Products," https://www.arconic.com/global/en/who-we-are/global-rolled-products.asp (accessed January 26, 2017); Arconic, "What We Do," https://www.arconic.com/global/en/what-we-do/overview.asp (accessed April 12, 2017)..
[f] Alcoa corp., "Alcoa Corporation Launches as an Independent Industry Leader," November 1, 2016; Alcoa Inc., "Alcoa Inc. Board of Directors Approves Separation of Company," September 29, 2016; Alcoa Inc., "Alcoa Inc. Announces Filing of Initial Form 10 Registration Statement," June 29, 2016; Alcoa Inc., "Alcoa to Separate Into Two Industry-Leading Public Companies," September 28, 2015.
[g] Constelllium, "Ravenswood Aluminum Plant, USA," http://www.constellium.com/aluminium-company/manufacturing-recycling-plants/ravenswood-united-states (accessed April 13, 2017).
[h] Constelllium, "Who We Are: World Leader in Aluminum Manufacturing," http://www.constellium.com/aluminium-company/aluminium-manufacturing-leader (accessed April 13, 2017).

[i] GlobeNewswire, "Noranda Initiates Chapter 11 Process," February 8, 2016; Platts, "Noranda Agrees to Sell Magnesium Alloys," August 22, 2016; Gränges, "Gränges Completes US Acquisition," August 22, 2016.
[j] Gränges, "Gränges Completes US Acquisition," August 22, 2016.
[K] Novelis, "Who We Are, Novelis: An Aluminum Company," http://novelis.com/about-us/#1445023300734-76c899bc-c45c (accessed April 12, 2017).
[l] Novelis, "Our History," http://novelis.com/about-us/#1445023525125-635e2312-1c53 (accessed April 12, 2017).

More than 100 of the U.S. wrought producers are extruders, most of which are relatively small and service local markets.[274] The extrusions sub-segment is more fragmented than the flat-rolled sub-segment, with lower barriers to entry. As a result, the top five U.S. extruders accounted for a smaller share (52 percent) of U.S. output in 2015.[275] Sapa Extrusions Inc. (Sweden) is the largest aluminum extruder in the United States, with 18 facilities across the country.[276] Many U.S. extruders also manufacture seamless tube and pipe products; the leading five producers of tube and pipe products accounted for 74 percent of U.S. output in 2015.[277] Wire production is the most concentrated segment, with the top five U.S. producers accounting for 96 percent of U.S. output in 2015.[278]

U.S. extruders have responded to improved market demand with capacity increases, expansions, facility upgrades, and acquisitions. In addition, several firms, such as Bonnell Aluminum, Jordan Aluminum, and Kobe Steel USA, are currently pursuing planned expansions and adding new facilities.[279] This growth occurred subsequent to the imposition of antidumping and countervailing duty orders on U.S. imports of certain aluminum extrusions from China starting in May 2011.[280] These orders were continued as of April 2017.[281]

The U.S. foil sector has experienced considerable retrenchment in the face of increased imports, largely from China. Certain types of foil, such as household foil, continue to be produced by just a few U.S. firms.[282] JW Aluminum Co. (Goose Creek, SC) is one of the only remaining U.S. producers of ultra-thin-gauge foil after Alpha Aluminum Inc. closed its plant in North Carolina in July 2015, and Novelis idled its Terre Haute, IN, foil plant in April 2014.[283]

---

[274] AEFTC, written submission to the USITC, September 12, 2016, 3.
[275] Based on data collected for the USITC survey of U.S. aluminum producers, September 30, 2016.
[276] USITC, hearing transcript, September 29, 2016, 200 (testimony of Jason Weber, Sapa Extrusions).
[277] Based on data collected for the USITC survey of U.S. aluminum producers, September 30, 2016.
[278] Ibid.
[279] USITC, *Certain Aluminum Extrusions from China*, 2017, III-3.
[280] 76 Fed. Reg. 30650 (May 26, 2011) (antidumping duty order); 76 Fed. Reg. 30653 (May 26, 2011) (countervailing duty order).
[281] 82 Fed. Reg. 19025 (April 25, 2017).
[282] Miller, "China Crinkles Aluminum Foil Makers," August 21, 2016. Two U.S. producers, Reynolds and Trinidad Benham, account for almost all domestic production of household foil, for example. USITC, hearing transcript, *Aluminum Foil from China*, March 30, 2017, 130, 139 (testimony of Donna Walters, Trinidad Benham Corp.).
[283] USITC, hearing transcript, September 29, 2016, 64 (testimony of Ganesh Panneer, Novelis Corp.).

Manufacturers of wrought aluminum products tend to locate facilities near their markets, large population centers, and areas where labor and shipping networks are readily available.[284] In addition, rolling mills may locate near aluminum smelters, which provide molten aluminum directly to the mills.

Employment and Wages

According to U.S. Census Bureau statistics, U.S. producers of aluminum sheet, plate, and foil employed 17,521 employees in 2014, while U.S. producers performing other aluminum rolling, drawing, and extruding activities employed 24,447 workers. Ohio, California, Texas, Pennsylvania, and Indiana have the highest wrought segment employment levels within the United States.[285] Employment in U.S. rolling mills increased during 2011–15, with comparable growth in average wages (table 4.6). Employment also grew across the other wrought products segments, rising among all product categories during this period (appendix H, table H.14).

U.S. employment in the wrought products industry rose by nearly 13 percent during the period, with plate, sheet, and strip and profiles, bar, and rod products accounting for 68 percent of U.S. industry employment in 2015. Employment in the profiles, bars, and rod products sector posted the largest increase, both by number and percentage change. However, industry representatives noted that skilled workers are increasingly hard to find and retain in the industry, in part because of previous job losses that have eroded worker confidence in this industry segment.[286]

Table 4.6: United States: Aluminum rolling mill employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	11,625	11,754	11,961	12,124	12,664
Productivity (workers/1,000 mt)	2.9	2.9	2.9	2.9	2.9
Average wages ($/hr)	33.50	33.67	35.21	35.89	36.88

Source: CRU Group.

Investment

According to the Aluminum Association, announced and completed investment in the U.S. wrought aluminum manufacturing industry has totaled $2.8 billion since 2013.[287] U.S. firms' responses to the Commission's questionnaire indicate that annual capital spending in the wrought aluminum products industry rose 65 percent between 2011 and 2015 to $995.3 million

[284] Aluminum Association, written submission to the USITC, October 7, 2016.
[285] Ibid.
[286] USITC, hearing transcript, September 29, 2016, 72 (testimony of Paul-Henri Chevalier, Jupiter Aluminum Corp.); 239–40 (testimony of Robert Smith, USW Local 420-A).
[287] Aluminum Association, "Driving Modern Manufacturing."

(table 4.7). Investment in the FRP sector accounted for 65 percent of these expenditures in 2015. This share reflects not only the growth of downstream industries using FRPs but also the greater costs associated with the rolling mill equipment used to produce FRPs, compared to extrusion presses.[288] Industry observers note that the wrought segment is running close to capacity and will require additional expansions to meet anticipated market growth opportunities.[289] To meet this need, Novelis and Alcoa have already expanded facilities dedicated to serving the automotive industry. Braidy Industries recently announced plans to build the first greenfield rolling mill in the United States in over 30 years; it will produce automotive body and aerospace sheet and plate.[290] Additional U.S. capacity expansions in automotive sheet have been announced by Constellium, Aleris, and Kobe Steel.[291]

Table 4.7: United States: Wrought aluminum, capital expenditures at U.S. facilities, 2011–15 (thousand dollars)

Product group	2011	2012	2013	2014	2015
Plate, sheet, strip, foil products[a]					
Plate products	30,863	39,133	47,459	42,631	117,121
Sheet, strip, foil products	245,617	410,997	414,927	386,523	532,644
Subtotal	276,480	450,131	462,386	429,154	649,765
Plate, sheet, strip, foil products					
Non-heat treated	210,035	179,804	187,069	276,162	294,753
Heat treated	66,446	270,326	275,317	152,992	355,012
Subtotal	276,480	450,131	462,386	429,154	649,765
Wire products	40,014	104,689	53,331	110,212	71,862
Profile, bar, rod products	132,732	114,424	157,975	148,706	153,257
Tube or pipe products	20,081	24,559	33,645	70,778	36,129
Capital expenditures that cannot be attributed to only one product group	132,946	160,421	105,602	74,118	84,259
Total	602,254	854,223	812,939	832,968	995,271

Source: USITC survey of U.S. aluminum producers, September 30, 2016, question 4.11.
[a] Plate products were merged with sheet, strip, and foil products due to confidentiality concerns.

The wrought aluminum segment has become increasingly globalized, as foreign multinational producers sought growth opportunities in leading markets. Foreign direct investment has risen in many product segments. Examples in the FRP sub-segment include the acquisition of Novelis by Hindalco Industries Ltd. (India) in 2007 and the bankruptcy purchase of Noranda Aluminum's U.S. rolling mill operations by Gränges (Sweden) in August 2016. In addition, UACJ (Japan) is

[288] Industry consultant, interview by USITC staff, December 16, 2016.
[289] Aluminium Insider, "Automotive Sheet Aluminum Producers," August 9, 2016.
[290] Ibid., "Braidy Industries Announces Plan," May 4, 2017.
[291] Aluminum Association, written submission to the USITC, September 12, 2016.

increasing the rolling capacity at its Tri-Arrows Aluminum facility in Kentucky at a cost of $160 million.[292]

Foreign investment is also a significant element in the U.S. extrusions sub-segment. Sapa (Sweden), for example, is the largest U.S. extrusion manufacturer, having first entered the U.S. market with the acquisition of Anodizing Inc. in 2000.[293] Kobe Steel (Japan) recently announced plans to establish an extrusion mill in Kentucky to produce motor vehicle frames and bumpers.[294] Finally, Nanshan (China) invested $160 million in an extrusion mill in Indiana that opened in 2012, becoming the first greenfield facility launched in the United States by one of China's leading metal producers.[295]

More recently, Chinese firms are reportedly striving to enter into the more profitable automotive and aerospace markets, in part to capture global market share from leading rivals such as Alcoa and Constellium. Moreover, acquiring foreign firms enables Chinese aluminum firms to gain technical expertise and expand their global reach.[296] In the United States, Zhongwang USA LLC (China) announced plans in 2016 to acquire Cleveland, OH-based Aleris Corp. for $2.3 billion.[297] U.S. industry representatives expressed concern that this purchase will not only allow Zhongwang to acquire advanced production and product technologies, but also give it access to higher-end markets.[298]

Production

Primary Unwrought Aluminum

U.S. primary aluminum production dropped to a period low in 2016. The United States dropped in the rankings that year to become the world's ninth-largest producer of primary aluminum, falling from its position as the world's fourth-largest producer in 2011. Production by the two remaining U.S. primary aluminum producers in 2016 totaled 840,000 mt, representing a loss of over 1 million mt of production since 2011.[299] The decline in U.S. primary aluminum output coincided with a drop in the LME price combined with the appreciation of the U.S. dollar, which squeezed U.S. primary producers and placed U.S. smelters under significant competitive

[292] Aluminium Insider, "UACJ to Invest US$488 MM in US, Thailand," December 1, 2016.
[293] Sapa Group, "48 Years of Entrepreneurial Spirit," http://www.sapagroup.com/en/sapa-profili-srl/about-us/history/ (accessed February 17, 2017).
[294] Aluminium Insider, "Japanese Aluminum Companies Ramping Up," July 17, 2016.
[295] Paulson Institute, "A Chinese Aluminum Company's Learning Curve," October 31, 2013.
[296] Aluminium Insider, "Experts See Increasing In-Roads," October 18, 2016; industry representative, interview by USITC staff, October 4, 2016.
[297] Aluminium Insider, "Experts See Increasing In-Roads," October 18, 2016.
[298] Industry representative, interview by USITC staff, October 4, 2016.
[299] CRU Group.

pressure. As the LME price continued to fall, U.S. smelters were unable to keep pace despite declining production costs.

The production decline reflected cutbacks in U.S. primary smelting capacity, which fell by nearly one-fifth (19 percent) during 2011–15 (table 4.8) as part of a longer industry contraction continuing from 2001. Capacity further declined in 2016 to about 1.5 million mt, and capacity utilization fell to an estimated 57 percent.

Table 4.8: United States: Primary unwrought aluminum production, capacity, and capacity utilization, 2001, 2006, 2011–16

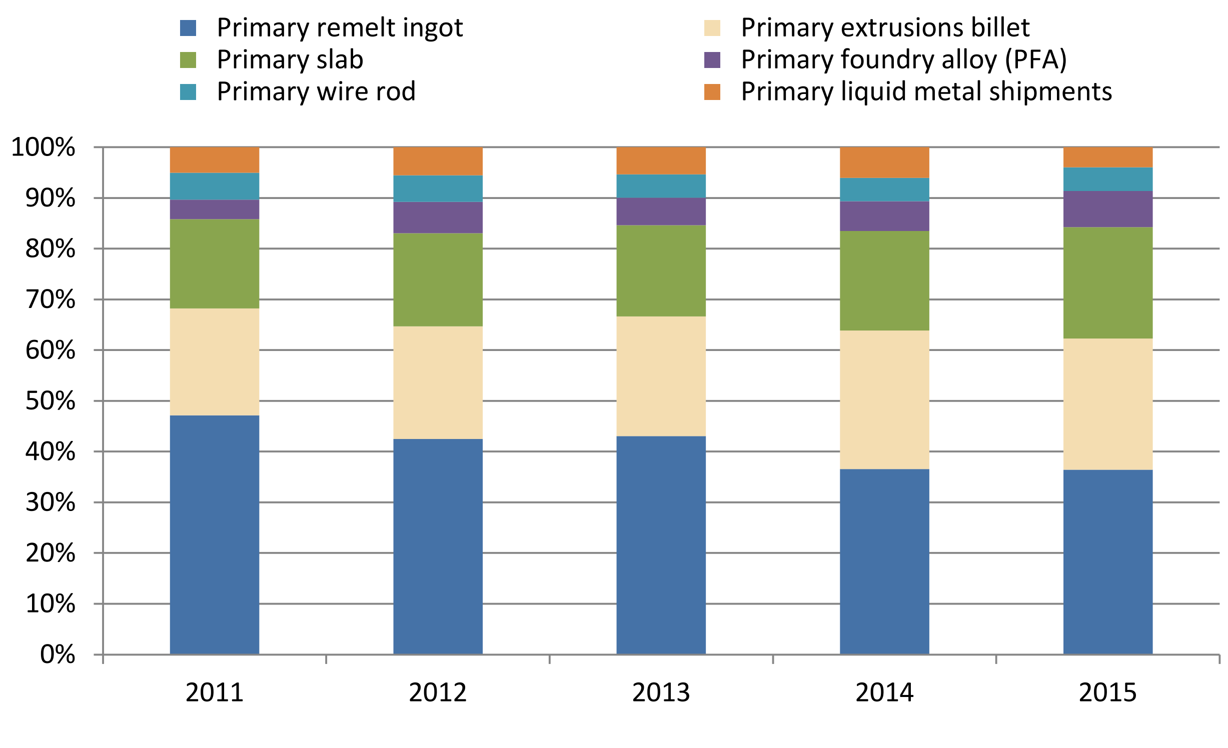
Attribute	2001	2006	2011	2012	2013	2014	2015	2016
Production (1,000 mt)	2,637	2,281	1,986	2,070	1,948	1,718	1,587	840
Capacity (1,000 mt)	4,383	3,614	3,028	2,740	2,748	2,577	2,452	1,485
Capacity utilization (%)	60	63	66	76	71	67	65	57

Source: CRU Group.

Over 2011–15, U.S. primary aluminum production increasingly shifted to value-added casthouse products (i.e., products other than primary remelt ingots). Value-added production increased from 53 percent to 64 percent of all casthouse output over the period (figure 4.3).[300] In particular, the shares of extrusion billets, slabs, and primary foundry alloys grew, reflecting a global trend of primary producers moving to higher-value-added casthouse production.[301] As noted previously, Alcoa's Massena West smelter is capable of producing value-added casthouse products.[302] Century's Hawesville, KY, facility is the largest producer of high-purity aluminum in North America, and it is strategically located near the U.S. defense and aerospace industries.[303] Although the Hawesville location is operating at 40 percent capacity, a primary focus of the remaining capacity is to produce high-purity aluminum.[304]

[300] Value-added products include billet, slab, rod, primary foundry alloy, and high-purity aluminum. CRU Group data for primary casthouse production do not include high-purity aluminum.
[301] CRU Group.
[302] Intalco also has value-added casthouse production. *Recycling Today*, "Alcoa to Decrease Aluminum Smelting and Refining Capacity," November 3, 2015.
[303] Century Aluminum Co., "Plants and Products: Hawesville," http://centuryaluminum.com/plants-products/hawesville/ (accessed March 14, 2017).
[304] Century Aluminum Co., "Century Announces Continued Operation of Two Potlines," September 30, 2015.

Figure 4.3: United States: Primary unwrought aluminum industry production, by casthouse products, 2011–15 (percent)



Source: CRU Group.
Note: Corresponds to appendix table L.16.

Secondary Unwrought Aluminum

In 2015, the United States was the world's leading producer of secondary aluminum, with annual secondary production exceeding that of primary unwrought due in large part to the contraction of domestic smelting capacity and output. Secondary unwrought production capacity grew by 6 percent over 2011–15 to nearly 10.0 million mt by 2015 (table 4.9). Estimated U.S. secondary production increased steadily, from 7.6 million mt in 2011 to 8.6 million mt in 2015.

Table 4.9: United States: Secondary unwrought aluminum industry capacity and production, by type of producer, 2011–15

Item	2011	2012	2013	2014	2015
Production (1,000 mt)					
Captive producers					
Large	3,883	4,033	4,095	4,171	4,222
Small	460	503	567	658	745
Total	4,343	4,535	4,662	4,828	4,967
Merchant producers	3,230	3,397	3,407	3,466	3,620
Total	7,573	7,933	8,069	8,295	8,587
Capacity (1,000 mt)					
Captive producers	5,198	5,206	5,270	5,529	5,549
Merchant producers	4,261	4,388	4,403	4,504	4,445
Total	9,459	9,595	9,673	10,033	9,993
Capacity utilization (%)					
Captive producers	84	87	89	87	90
Merchant producers	76	77	77	77	81
Average	80	82	83	82	86

Source: USITC survey of U.S. aluminum producers, September 30, 2016, question 3.2; calculation by USITC staff.
Note: Because of rounding, total may not equal sum of line items.

Among the various types of secondary unwrought producers, large captive producers led the segment in terms of volume, with growth of 9 percent to 4.2 million mt in 2015. Merchant producers outpaced them with 12 percent growth in output over the period, reaching 3.6 million mt in 2015. Production of the small captive producers increased by 62 percent during the period to total 745,000 mt in 2015, with this growth largely attributable to the servicing of niche markets.

Wrought Aluminum

During 2011–15, the United States was the world's second-largest single-country producer of wrought aluminum after China. In contrast to declining U.S. primary aluminum production, survey results indicate that total wrought aluminum output rose by nearly 13 percent over the period to 7.1 million mt in 2015 (table 4.10). Nearly two-thirds (4.4 million mt) of all wrought aluminum products manufactured in the United States in 2015 were FRPs. Extrusions made up another 32 percent (2.3 million mt) of U.S. production, with the remainder (6 percent) accounted for by wire and cable.

Table 4.10: United States: Wrought aluminum, production, capacity and capacity utilization, 2011–15

Item	2011	2012	2013	2014	2015
Production (1,000 mt)					
Plate products	215	236	250	258	268
Sheet, strip, foil products	3,925	3,990	4,016	4,103	4,125
Wire products	389	454	451	422	445
Profile, bar, rod products	1,473	1,597	1,682	1,764	1,835
Tube or pipe products	299	325	356	402	434
Total	6,302	6,603	6,754	6,948	7,107
Capacity (1,000 mt)					
Plate products	237	244	255	263	270
Sheet, strip, foil products	4,523	4,477	4,429	4,386	4,465
Wire products	699	741	745	720	718
Profile, bar, rod products	2,233	2,328	2,436	2,508	2,566
Tube or pipe products	888	959	994	1,049	1,049
Total	8,580	8,750	8,858	8,927	9,068
Capacity utilization (%)[a]					
Plate products	91	97	98	98	99
Sheet, strip, foil products	87	89	91	94	92
Wire products	56	61	61	59	62
Profile, bar, rod products	66	69	69	70	72
Tube or pipe products	34	34	36	38	41
Average	74	76	76	78	78

Source: USITC survey of U.S. aluminum producers, September 30, 2016, survey questions 4.2 and 4.3.
[a] USITC staff calculations.

FRP output rose by 6 percent during the period to 4.4 million mt in 2015, likely in response to increased demand from the transportation and packaging industries. The largest increase in output occurred for extrusions, production of which rose by 28 percent during the period. Industry representatives attribute such growth to sustained expansion of the U.S. construction market and to antidumping and countervailing duty orders on certain aluminum extruded products from China.[305] Output of wire and cable rose by 14 percent to 445,000 mt in 2015.

Survey results show that wrought aluminum production capacity expanded in successive years since 2011 to reach 9.1 million mt (6 percent growth over the period) by 2015. FRPs accounted for more than half (averaging 53 percent per year) of total wrought product capacity. The capacity utilization rate for wrought aluminum products averaged nearly 80 percent in 2015, with capacity utilization exceeding 90 percent for FRPs. Tube and pipe producers reported the lowest capacity utilization rate of less than 36 percent.

According to the Commission survey, U.S. production of sheet, strip, and foil products made of heat-treatable 6xxx series alloys was the fastest-growing category during 2011–15. Production of these products, which are typically used in the automotive industry, nearly tripled

[305] USITC, hearing transcript, September 29, 2016, 41 (testimony of Stephanie Hickman Boyse, Brazeway Inc.).

(table 4.11). Non-heat-treatable alloys (3xxx and 5xxx series), however, accounted for the largest share of U.S. production, with nearly 50 percent of the total. These alloys are typically used in beverage cans and building/construction components.

Table 4.11: United States: Wrought aluminum products, production by product groups, 2011–15 (thousand mt)

Product group	2011	2012	2013	2014	2015
Plate, sheet, strip, foil products					
Unalloyed, series 1XXX	144	147	140	145	124
Non-heat treatable (alloy series 3XXX, 5XXX)	3,220	3,268	3,322	3,313	3,261
Heat treatable (alloy series 2XXX, 7XXX)	188	218	236	236	265
Heat treatable (alloy series 6XXX)	139	149	157	229	369
All other plate and sheet products of series not specified above	450	444	411	438	373
Subtotal	4,141	4,227	4,266	4,361	4,392
Wire products	389	454	451	422	445
Profile/bar/rod products	1,473	1,597	1,682	1,764	1,835
Tube or pipe products	299	325	356	402	434
Total	6,302	6,603	6,754	6,948	7,107

Source: USITC survey of U.S. aluminum producers, September 30, 2016, question 4.3.
Note: Because of rounding, total may not equal sum of line items.

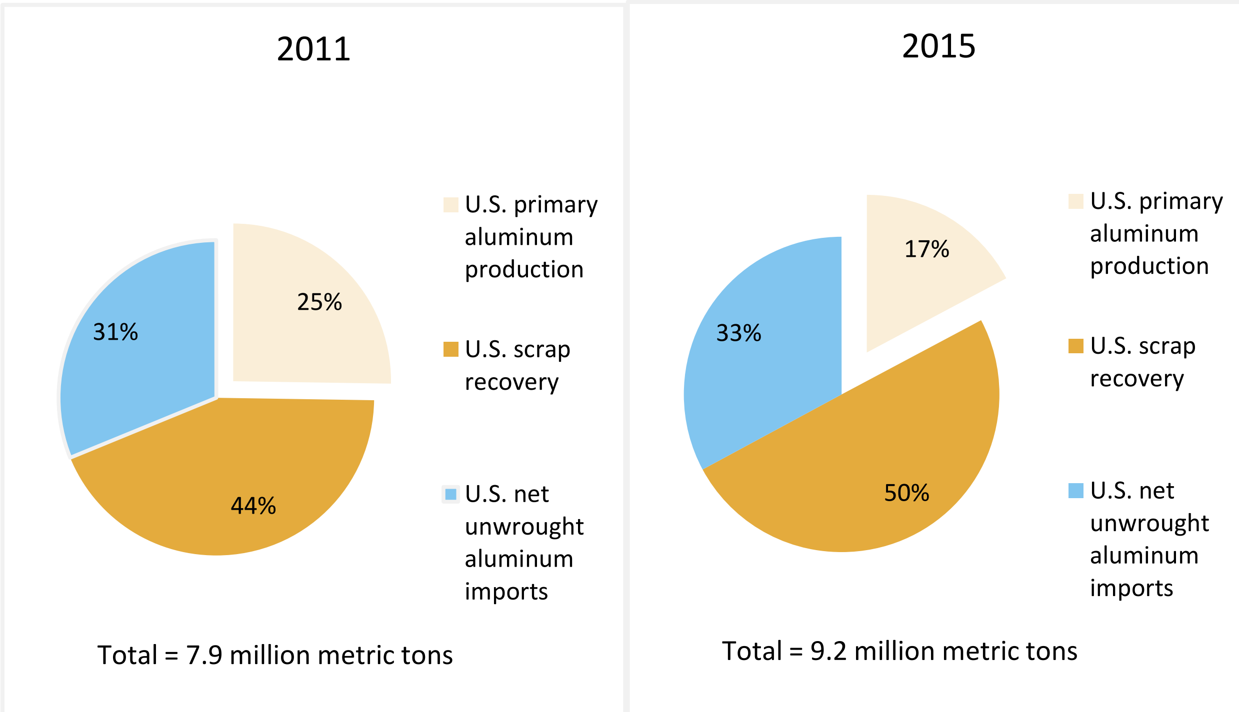
Consumption

Unwrought Aluminum

With the decline in U.S. primary aluminum production, U.S. secondary unwrought aluminum output and U.S. imports increased their shares of the growing U.S. market during 2011–15. In 2016, U.S. imports of unwrought aluminum captured an even larger share of the market, as U.S. primary aluminum production fell by nearly 750,000 mt from the 2015 level and imports rose by approximately 946,000 mt.

In 2015, U.S. consumption of aluminum from primary and secondary sources totaled 9.2 million mt, up from 7.9 million mt in 2011. The growth in U.S. consumption of unwrought aluminum was driven by the rising demand from U.S. wrought producers, largely to produce FRPs and extrusions for the transportation, packaging, and construction markets. Unlike many other world markets, a large and growing share of U.S. unwrought consumption is accounted for by secondary aluminum, which reached an estimated 50 percent of the market in 2015. As a share of unwrought aluminum consumption, U.S. imports increased more slowly, from 31 percent in 2011 to 33 percent in 2015 (figure 4.4).

Figure 4.4: United States: Unwrought aluminum consumption, 2011 and 2015



Source: Estimated by USITC staff from data collected from USITC survey results; from Bray, "Aluminum (Advanced Release)," 2012–15; and from official trade statistics of the USDOC presented on USITC's DataWeb (accessed April 6, 2017).
Note: Corresponds to appendix table L.17.

Wrought Aluminum

U.S. consumption of wrought aluminum products rose by 16 percent during the period to 7.4 million mt in 2015 (table 4.12). Although U.S. production increased during the period (up 13 percent), U.S. imports grew at a far faster pace (up 33 percent). As a result, U.S. imports of wrought aluminum products captured a growing share of the domestic market, accounting for 23 percent of consumption in 2015 compared to 19 percent in 2011. However, import penetration varied considerably by sector. U.S. imports accounted for approximately 24 percent of the U.S. FRP market, 39 percent of the wire products market, and 10 percent of the extrusions market in 2015.

Table 4.12: United States: Consumption of wrought aluminum by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions	1,679	1,760	1,844	1,996	2,106
Flat-rolled products	4,326	4,270	4,468	4,603	4,802
Wire and cable	410	527	535	543	510
Total	6,415	6,558	6,846	7,142	7,418

Source: Estimated by USITC staff from USITC survey results and official trade statistics of the USDOC presented on USITC's DataWeb (accessed April 6, 2017).

The growth in the consumption of both FRPs and extrusions during 2011–15 reflects trends in their end-use markets. FRPs accounted for about two-thirds (64–67 percent) of the wrought aluminum products consumed in the United States in 2011–15. They are typically used in the transport and packaging markets, which together represented over one-half of U.S. consumption by end market.[306] Most notably, the growth in the transportation sector—nearly 47 percent over the period—likely reflects not only increased U.S. motor vehicle production,[307] but also an increase in the aluminum intensity of automobiles, as carmakers shift to lighter-weight materials to improve fuel economy and meet corporate average fuel economy (CAFE) standards (box 4.5). Extrusions, which accounted for 26–28 percent of U.S. wrought aluminum consumption in 2011–15, are widely used in the transportation and construction industries. Since 2011, the gain in the construction market, although more modest than that in the transport sector, reflected year-on-year increases in total construction spending in the United States.[308]

According to survey results, U.S. wrought producers identified the beverage can, building and construction, and automotive industries as the three leading markets for domestic shipments in 2015. These markets accounted for nearly 50 percent of identified end-use markets that year, with the automotive market nearly tripling in size during the period and accounting for nearly all of the market growth (appendix H, table H.17).

The transportation sector (largely automotive) is anticipated to account for the majority of market growth in wrought aluminum over the next 10 years.[309] Aluminum content per vehicle is expected to increase to 500 pounds by 2025, up from 390 pounds in 2015[310] and 350 pounds in 2012.[311] This growth represents potential demand for aluminum automotive body sheet of 4 billion pounds (2 million mt) by 2025, up from 2012 consumption of less than 200 million pounds (100,000 mt).[312] As an example, the Aluminum Association indicates that capacity needs for 6000 alloy series heat-treatable sheet could reach 2.8 billiion pounds (1.4 million mt).[313]

---

[306] CRU Group.
[307] During 2011–15, U.S. motor vehicle production rose by 40 percent from 8.7 million units in 2011 to 12.1 million units in 2015. OICA, "2016 Production Statistics," 2017.
[308] Federal Reserve Bank of St. Louis, "Total Construction Spending" (accessed January 12, 2017).
[309] Aluminum Association, written submission to the USITC, September 12, 2016.
[310] Drive Aluminum, "Aluminum: The Growth Story."
[311] Sedgwick, "Aluminum's Per-vehicle Use Expected to Rise," July 21, 2014. Contributing to this growth was the shift from steel to aluminum by Ford's F-150 truck, which uses about 600 pounds of aluminum. Isidore, "Ford Gets Ready to Unveil the Aluminum F-150," January 2, 2014.
[312] Aluminum Association, written submission to the USITC, September 12, 2016, 1.
[313] Ibid.

Box 4.5: United States: Motor Vehicle Fuel Efficiency Standards

Corporate Average Fuel Economy (CAFE) standards for motor vehicles have prompted increased demand for aluminum. Consumption of wrought and cast aluminum in light vehicles increased by 28 percent during 2012–15[a] as automakers increasingly replaced steel with aluminum to lighten vehicle weights. CAFE regulations set by the U.S. Environmental Protection Agency and the National Highway Transportation Safety Administration (NHTSA) currently require lightweight vehicles[b] to attain fuel efficiency of 54.5 miles per gallon by 2025[c] and require medium- and heavy-duty trucks to increase fuel efficiency by 2027.[d]

[a] Djukanovic, "Aluminium Use in Automobiles to Increase Significantly," May 26, 2016.
[b] Aluminum is one of engineers' top choices of metals to use in achieving the lower weights required to raise vehicle fuel efficiency. Aluminum Channel, "Aluminum's Role in Achieving 2025 CAFE Standards," 2015; Aluminum Association, "New Truck Rule Recognizes Aluminum," August 17, 2016.
[c] NHTSA, "Obama Administration Finalizes Historic 54.5 mpg," August 28, 2012.
[d] NHTSA, "EPA and DOT Finalize Greenhouse Gas and Fuel Efficiency Standards," August 16, 2016.

The aerospace sector is also expected to be a source of continued strong demand for aluminum FRPs.[314] Demand for aluminum plate in the aerospace industry, for example, has grown in response to an increased backlog of orders for aircraft from Boeing and Airbus.[315] Packaging, on the other hand, is a stable RFP market that is more resilient across economic cycles.

Global demand for aluminum extrusions is predicted to exceed 22 million mt by 2020, driven, in large part, by greater use in the building and construction industry, where more sustainable building materials are valued. Aluminum extrusions also recorded gains in the automotive and marine industries, where their strength, lightness, and durability are reportedly finding increased application.[316]

Trade

U.S. trade flows for aluminum largely reflect the regional integration of aluminum manufacturing in North America, as the United States relies on imports of primary unwrought aluminum, principally from Canada, and exports wrought products to Canada and Mexico. The United States is the world's largest net importer of unwrought aluminum, and is also a net importer of wrought aluminum products.

[314] USITC, hearing transcript, September 29, 2016, 74–75 (testimony of Lloyd A. Stemple, Constellium Rolled Products Ravenswood LLC).
[315] USITC, hearing transcript, September 29, 2016, 164 (testimony of Lloyd A. Stemple, Constellium Rolled Products Ravenswood LLC). Boeing's backlog, for example, totaled 5,715 aircraft in 2016. Boeing, "Orders and Deliveries," http://www.boeing.com/commercial/#/orders-deliveries (accessed February 28, 2017).
[316] Taber Extrusions, "Global Aluminum Extrusion Market," March 29, 2016.

Unwrought Aluminum

Exports

The U.S. unwrought aluminum segment has traditionally focused on supplying the domestic market. During 2011–15, U.S. exports of unwrought aluminum hovered at around 400,000 mt per year. An average of 87 percent of these exports supplied the regional markets of Mexico and Canada (table 4.13). Although total U.S. exports were largely flat over this period, Mexico’s share of U.S. exports rose steadily to nearly two-thirds (64 percent) in 2015. This shift corresponds with Mexico’s increased demand for primary aluminum, reflecting Mexico’s growing wrought aluminum industry and its planned expansions over the next five years.[317]

Table 4.13: United States: Unwrought aluminum exports (HS 7601), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
Mexico	209	237	214	237	252
Canada	114	112	122	126	110
France	4	5	10	6	7
South Korea	2	1	1	4	4
Taiwan	3	3	4	5	4
All other	74	52	37	19	15
Total	406	410	389	397	392

Source: IHS Markit, GTA database (accessed March 10, 2017).
Note: Exports based on partner country imports. Because of rounding, total may not equal sum of line items. The table is sorted on 2015 data.

Imports

The U.S. aluminum market has become increasingly reliant on imports of unwrought aluminum as domestic primary smelting capacity contracted during 2011–16 (table 4.14). Canada remained the leading supplier, but its share of U.S. imports fell from a high of 71 percent in 2013 to a low of 54 percent in 2016. While imports from Canada grew incrementally, imports from the Gulf Cooperation Council (GCC) countries and Russia grew rapidly, particularly between 2013 and 2016. Among the Gulf States, the United Arab Emirates evolved into a top supplier starting in 2011, while U.S. imports from Qatar, Bahrain, and, to some extent, Saudi Arabia increased rapidly over this period. In 2016, Canada, the GCC countries, and Russia accounted for nearly 90 percent of U.S. unwrought imports. Because Canada, the GCC countries, and Russia have little secondary unwrought production, the vast majority of U.S. imports from these countries were likely primary unwrought aluminum.

[317] Villegas, “Mexico, the World's Fastest Growing Aluminum Market,” June 8, 2016.

Table 4.14: United States: Unwrought aluminum imports (HS 7601), by source, 2011–16 (thousand mt)

Source	2011	2012	2013	2014	2015	2016
Canada	1,838	1,839	2,061	2,002	2,208	2,294
GCC countries	310	414	375	421	530	822
Russia	224	290	187	321	287	705
Argentina	94	78	94	72	86	174
Venezuela	64	48	12	63	48	63
China	2	1	10	2	3	2
All other	164	186	157	179	168	216
Total	2,696	2,855	2,897	3,060	3,330	4,276

Source: IHS Markit, GTA database (accessed March 10, 2017).
Note: Because of rounding, total may not equal sum of line items. The GCC countries include Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

Wrought Aluminum

Exports

U.S. exports of wrought aluminum grew by 6 percent during 2011–15 to 1.2 million mt (table 4.15). Exports declined in four of six product categories in 2015, while exports of bars, rods, and profiles and plates, sheets, and strip increased. Plates, sheets, and strip remained the largest export category, accounting for 70 percent of the 2015 total (table 4.16). Canada and Mexico were the two leading U.S. export destinations for each product category, a reflection of the highly integrated nature of the North American market for two leading consuming industries—motor vehicles and aerospace.

Table 4.15: United States: Wrought aluminum exports (HS 7604–7608), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
Canada	409	437	446	445	470
Mexico	407	498	463	526	458
Germany	14	16	16	8	40
China	37	39	34	31	33
South Korea	17	20	24	27	30
All other	261	289	313	210	173
Total	1,144	1,298	1,297	1,246	1,204

Source: IHS Markit, GTA database (accessed March 10, 2017).
Note: Exports based on partner country imports. Because of rounding, total may not equal sum of line items. The table is sorted on 2015 data.

Table 4.16: United States: Wrought aluminum exports, by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions	178	206	228	275	217
Bars, rods, and profiles (HS 7604)	136	154	177	175	157
Tubes and pipes (HS 7608)	42	52	52	100	59
Flat-rolled products	932	1,066	1,031	931	948
Plates, sheets, and strip (HS 7606)	815	919	902	804	841
Foil (HS 7607)	117	137	129	127	107
Wire (HS 7605)	34	36	38	41	40
Total	1,144	1,298	1,297	1,246	1,204

Source: IHS Markit, GTA database (accessed March 10, 2017).
Note: Export figures are based on partner country imports. Because of rounding, total may not equal sum of line items. The table is sorted on 2015 data.

Imports

The United States was a net importer of wrought aluminum products in 2016, and is the world's second-largest importer of these products. U.S. imports rose by 41 percent during 2011–16 to nearly 1.7 million mt (table 4.17). Plate, sheet, and strip accounted for the majority of U.S. imports of wrought aluminum each year of the period under review, representing 55 percent of such imports in 2016 (table 4.18).

Table 4.17: United States: Wrought aluminum imports (HS 7604–7608), by source, 2011–16 (thousand mt)

Source	2011	2012	2013	2014	2015	2016
China	209	183	283	401	530	531
Canada	481	455	403	415	425	452
GCC countries	19	45	43	49	42	92
Germany	99	98	95	76	86	89
South Africa	53	60	59	57	47	61
All other	332	397	356	410	454	460
Total	1,194	1,237	1,238	1,409	1,585	1,686

Source: IHS Markit, GTA database (accessed March 10, 2017).
Note: Because of rounding, total may not equal sum of line items. The GCC countries include Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

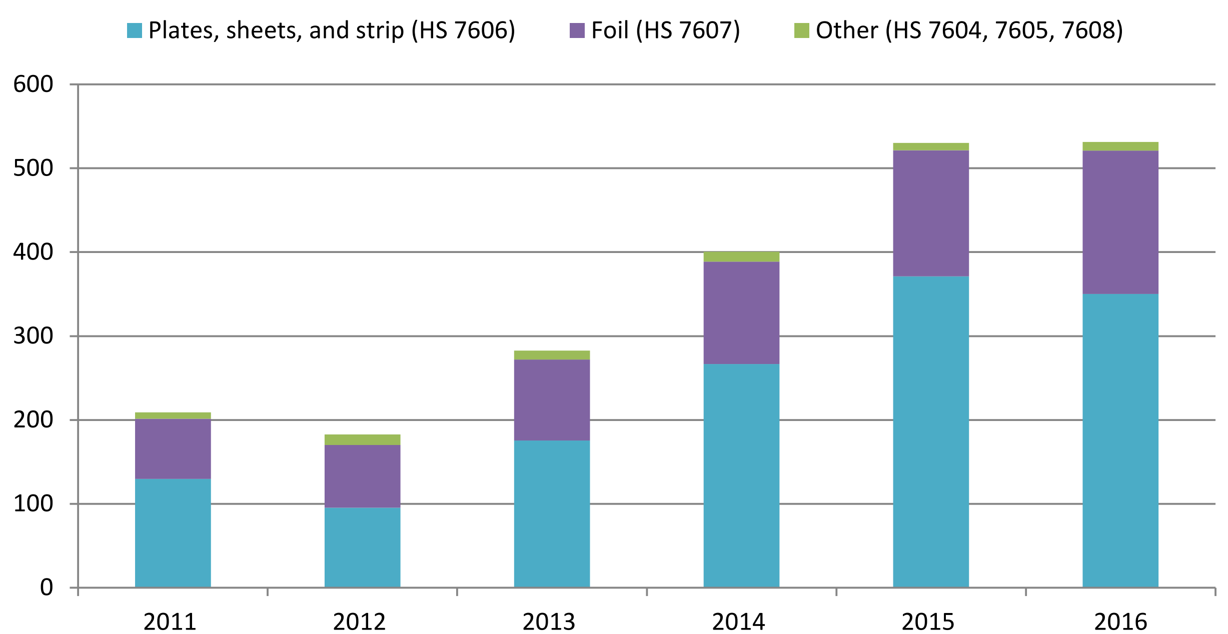
Table 4.18: United States: Wrought aluminum imports, by product form, 2011–16 (thousand mt)

Product form	2011	2012	2013	2014	2015	2016
Extrusions	134	170	178	199	218	227
Bars, rods, and profiles (HS 7604)	114	150	157	175	192	203
Tubes and pipes (HS 7608)	20	20	21	24	27	24
Flat-rolled products	894	835	835	985	1,166	1,189
Plates, sheets, and strip (HS 7606)	713	661	645	765	927	928
Foil (HS 7607)	181	174	190	220	239	261
Wire (HS 7605)	165	232	226	224	201	270
Total	1,194	1,237	1,238	1,409	1,585	1,686

Source: IHS Markit, GTA database (accessed March 10, 2017).
Note: Because of rounding, total may not equal sum of line items.

China overtook Canada to become the largest supplier of wrought aluminum to the United States in 2015, supplying 33 percent of U.S. imports by quantity.[318] Ninety-eight percent of U.S. imports from China fell under two HS headings: HS 7606 (plate, sheet, and strip) and HS 7607 (foil) (figure 4.5). China accounted for 38 percent (350,263 mt) of U.S. aluminum plate, sheet, and strip imports and 65 percent (170,803 mt) of U.S. imports of aluminum foil in 2016.

Figure 4.5: United States: Wrought aluminum imports from China, by product form, 2011–16 (thousand mt)



Source: IHS Markit, GTA database (accessed April 7, 2017).
Note: Corresponds to appendix table L.18.

[318] See chapter 1, "Introduction," for more information on recent countervailing duty and antidumping duty determinations on U.S. imports of certain aluminum extrusions and foil from China.

The increased imports from China are reportedly attributable in part to the growth in China's primary aluminum capacity, which has contributed to an expansion of wrought aluminum production.[319] In addition, one industry representative indicated that China has been able to make gains in the U.S. market not only because of its price competitiveness but also because U.S. rolling mills produce mostly value-added products, whereas imports from China are largely commodity products.[320]

U.S. producers have expressed concerns that these higher volumes of lower-priced imports from China compete directly with U.S. wrought aluminum production, and not only contribute to the closure of U.S. wrought aluminum facilities but also threaten the ability of U.S. firms to earn a "fair return" on their aluminum investments.[321] One industry official noted that the impact of these imports could limit the ability of U.S. firms to invest in R&D and improved technologies that "create the rolled aluminum products of the future"[322] demanded by end-use consumers.

Although not among the leading suppliers to the United States, Vietnam has sharply increased its extrusion exports to the United States. U.S. imports of extrusions[323] from Vietnam rose from 219 short tons in 2011 to 9,850 short tons in 2015. [324] According to the AEFTC, Vietnam has become a warehousing destination for extrusions from China since the industry in China increased its exports to Vietnam in 2015 and then shifted exports that it had previously sent to Mexico to Vietnam in 2016. [325]

Government Policies and Programs

During 2011–15, the U.S. aluminum industry likely benefited from certain aluminum-specific (direct) and broader (indirect) government policies and programs, at the federal, state, and local levels.

---

[319] USITC, hearing transcript, September 29, 2016, 205 (testimony of Holman Head, O'Neal Industries); 293 (testimony of Gerd Gotz, European Aluminum Association).
[320] U.S. industry consultant, interview by USITC staff, May 4, 2016.
[321] Novelis, written submission to the USITC, September 12, 2016, 2–3.
[322] Ibid., 10.
[323] These extrusions are classified under subheadings 7604.21, 7604.29, and 7608.20 in the Harmonized Tariff Schedule of the United States (HTS).
[324] A short ton equals 2,000 pounds.
[325] AEFTC, written submission to the USITC, October 11, 2016, 6–7. Warehouse trade is also discussed in appendix J, "Trade Flows through Third Countries."

Grants

Among the direct policies and programs, the federal government provided grants to two downstream aluminum producers, totaling more than $7.0 million, for R&D of advanced products and production processes. Constellium received more than $2 million from the U.S. Department of Defense for development of next-generation aluminum armor materials, and Alcoa received over $5 million from the U.S. Department of Energy for research that included a membrane purification cell for aluminum recycling and development of low-cost, high-strength automotive sheet.[326]

State governments provided more varied policies and programs. Between 2011 and 2015, state governments provided over $70 million in investments, grants, and workforce training to the aluminum industry.[327] Of this, the vast majority was the $68.8 million provided by the state of New York to Alcoa's Massena West smelter.[328] The agreement provided $30 million in electricity savings from the New York Power Authority and $38.8 million in capital and operating support over 3.5 years from the Empire State Development Agency.[329] In return, Alcoa must maintain at least 600 full-time-equivalent employees at the Massena West facility and could face penalties up to $40 million for breaching the agreement.

Electricity Contracts

Favorable state electric power contracts are especially valued by primary smelters, given the high share of energy in their production costs. In summer 2016, Century Aluminum signed an agreement with South Carolina's electric power utility, Santee Cooper, to receive 25 percent of the power for its Mt. Holly smelter at a reduced rate.[330] Nonetheless, until it can secure a more favorable, longer-term power supply contract, Century Aluminum reportedly will continue to operate this facility at only 50 percent capacity.[331]

---

[326] Good Jobs First, "Subsidy Tracker, Aluminum," 2015.
[327] Ibid.
[328] Good Jobs First, "Subsidy Tracker Individual Entry, Alcoa," 2015; Hotter, "Alcoa Will Keep Massena West Aluminum Smelter Open," November 24, 2015.
[329] The New York Power Authority provides low-cost hydropower indexed to the price of aluminum, but this means that as the price of aluminum increases, the cost of electricity also increases. New York State, Office of the Governor, "Governor Cuomo and Senator Schumer Announce Deal," November 24, 2015.
[330] Santee Cooper, "Santee Cooper Announces Deal," December 18, 2015.
[331] Century Aluminum Co., "Century Reaches New Market-Based Power Agreement," July 6, 2016.

State programs are not always sufficient to keep facilities' doors open. For instance, state tax credits and complex electric power rates tied to the LME price for aluminum did not prevent the permanent closure of Century Aluminum's smelter in Ravenswood, WV, in July 2015.[332]

Competitive Factors

An overarching strength for all segments of the U.S. aluminum industry is their proximity to the robust North American transportation and packaging end-use markets. Nevertheless, U.S. primary aluminum producers continue to experience major competitiveness challenges, largely due to electric power costs that are higher than those of leading foreign rivals, particularly Canada and most of the GCC countries. Meanwhile, the U.S. secondary unwrought segment has the advantage of access to the most abundant supplies of domestically generated aluminum scrap in the world. U.S. wrought firms are reportedly technologically advanced and work closely with their customers to create innovative product and alloy solutions to meet their end-use requirements (table 4.19).

[332] Ali, "Century Aluminum Permanently Closes Ravenswood, WV Plant," July 27, 2015; Ross, "Century: PSC Decision Not Enough," October 9, 2012.

Table 4.19: United States: Select competitive factors

Competitive factor	Segment	Impact on competitiveness
Expensive electric power	All three segments, but especially primary unwrought	U.S. aluminum producers purchase electricity from the grid or wholesale electric power markets, rather than owning captive electric power generators. U.S. producers' negotiated rates are higher than those of most global rivals.
Lower investment in production technology upgrades	Primary unwrought	Many U.S. primary smelters operate with older, less energy-efficient, and smaller-capacity potline technologies.
Ready availability of scrap	Secondary unwrought	The secondary unwrought segment has ready access to one of the leading sources of domestically generated aluminum scrap. However, domestic aluminum scrap supply tightened earlier in the period due to demand from China, and low aluminum prices have discouraged scrap dealers from selling onto the market.
Access to large, growing, diversified markets for high-value products	Wrought products	U.S. wrought product mills service large and growing domestic markets for a wide range of end-use applications.
Ability to produce a wide range of products and alloys to meet customer specifications	All three segments	U.S. producers are global leaders in supplying automotive- and aerospace-grade aluminum. The United States is one of the world’s two main suppliers of high-purity unwrought aluminum.
Product development collaboration with supply-chain partners	All three segments	Close collaboration throughout the supply chain fosters innovation and development of new products, alloys, and markets.
Environment conducive to research and development (R&D)	All three segments	Federal agencies, especially the U.S. Department of Energy, support R&D of energy-efficient potline cells for primary smelters and low-cost, high-strength automotive-grade aluminum sheet.
Declining global aluminum prices and appreciating U.S. currency	All three segments	The U.S. aluminum industry cannot offset declining U.S. dollar-denominated aluminum prices by reducing its own-currency production costs, as the U.S. dollar has appreciated against other major foreign currencies in recent years.

Source: Compiled by USITC staff.

Primary Unwrought Aluminum

Cost Overview

For U.S. primary unwrought producers, electric power is a principal driver of the costs of production. These costs depend largely on the energy type (e.g., hydropower versus fossil-fuel-fired) available to smelters, as well as rates negotiated with electric power suppliers. Labor costs also drive costs of production for U.S. smelters because they are typically higher than the global average.

Traditionally, the United States has been a high-cost producer of primary aluminum, with average business costs consistently in the top half of global cost distribution over 2001–15. There was little change in the country's relative position in recent years, even though production costs of primary unwrought aluminum in United States declined by 25 percent during 2011–15 (table 4.20), driven by falling raw material costs for alumina, lower electricity costs for U.S. smelters, and lower anode costs. (Other costs—e.g., for labor and for pot relining—also declined but do not account for a large percentage of business costs in the United States.) Nevertheless, the U.S. primary segment's cost competitiveness fell slightly relative to other large producers over this period, as U.S. primary production cost declines did not keep pace with the global average.

Table 4.20: United States: Primary unwrought aluminum average business costs, 2011–15 (dollars per mt)

Cost component	2011	2012	2013	2014	2015
Alumina	727	629	621	625	597
Electricity	585	606	616	605	532
Labor	257	248	253	248	246
Anode	292	254	223	190	175
Other[a]	328	312	307	306	277
Total liquid metal costs	2,188	2,048	2,020	1,973	1,830
Casthouse	97	93	93	99	106
Net realizations[b]	-211	-275	-317	-514	-386
Average business costs	2,074	1,867	1,797	1,559	1,550
Global average business costs	1,909	1,702	1,589	1,392	1,350
LME cash price	2,395	2,018	1,845	1,867	1,661

Source: CRU Group.
Note: Because of rounding, total may not equal sum of line items.
[a] "Other costs" covers bath material, pot relining, smelter fuel, maintenance and other supplies, sustaining capital, working capital on supplies.
[b] CRU Group uses net realization cost adjustments to account for variances in product quality impacting production costs, but does not include overhead costs in overall corporate costs.

High Electric Power Costs Hamper U.S. Industry Competitiveness

High electricity costs relative to those of global rivals have been a long-term competitive disadvantage for U.S. primary smelters. U.S. electricity costs of $38/megawatt-hour (MWh) in 2015 are nearly double those of other leading producers. However, current favorable U.S. wholesale energy markets and lower utility rates reportedly have improved the remaining U.S. primary producers' competitiveness. Century Aluminum is now operating most of its smelters with electricity purchased on wholesale electric power markets, and Alcoa negotiated more favorable rates with the Bonneville Power Administration and New York Power Authorities.[333] In light of their comparative disadvantage in terms of electric power costs, U.S. producers have in some cases moved away from long-term electric power contracts in favor of shorter-term

[333] Industry representative, interview by USITC staff, October 2016.

(three-year) contracts or purchases from the wholesale market at spot prices.[334] These new power arrangements increase these firms' exposure to risk, but also provide them with the flexibility they need to adapt to uncertain market conditions.

Limited Investment Has Forestalled Upgrading U.S. Smelter Technology

With respect to electricity costs, another competitive disadvantage for U.S. smelters is their use of older, less efficient potline technology. Because of unfavorable market and financial conditions, U.S. smelters have been limited in their ability to invest in newer, more efficient smelting technologies. As a result, they are running on 300-kiloamperes (kA) equipment, while some facilities abroad are running on equipment using 400, 500, and even 600 kA and deploying larger-capacity potlines.[335]

Secondary Unwrought Aluminum

U.S. Industry Benefits from Ready Access to Aluminum Scrap

The United States has a competitive advantage in terms of the availability of scrap for the production of secondary unwrought aluminum (box 4.6). The United States, a leading global generator of scrap, has a strong culture of recycling aluminum and a push for "green" recycled products.[336] In 2016, researchers found that the recycling rate for U.S. automotive aluminum was 91 percent,[337] whereas the consumer recycling rates for used aluminum beverage cans were 50–57 percent and U.S. industry average recycling rates for such cans ran at 58–66 percent from 2011 to 2014.[338] In 2013, Europe was found to have recycled more aluminum on a per capita basis, but North America recycled more than China.[339] The United States and

---

[334] Alcoa Corp., "Alcoa Reaches Agreement with New York State," November 24, 2015; Gallagher, "Ferndale Intalco's Smelter to Stay Open," May 2, 2016; Susman Godfrey L.L.P., "Luminant Defeats Alcoa in $500 Million Jury Trial," June 4, 2010; Century Aluminum Co., "Century Receives Positive Ruling on Hawesville Power," August 14, 2013; Century Aluminum Co., "Century Reaches New Market-Based Power Agreement," July 6, 2016; Santee Cooper, "Santee Cooper Announces Deal," December 18, 2015; Century Aluminum Co., "Century Receives Positive Ruling," January 30, 2014.
[335] New York State DEC, "Draft Permit For Alcoa Massena Plants Modernization," August 22, 2012; Alcoa Inc., "Alcoa to Permanently Close Remaining Potlines," January 15, 2014; Beckstead, "Alcoa Decision to End Smelting Operations in Massena," November 3, 2015; O'Carroll, "The Decline of the US Aluminum Smelting Industry," April 6, 2016.
[336] USITC, hearing transcript, September 29, 2016, 233 (testimony of Jason Weber).
[337] Kelly and Apelian, *Automotive Aluminum Recycling at End of Life*, 2016.
[338] Aluminum Association, "The Aluminum Can Advantage," June 2016, 4, 7.
[339] For more region/country recycling rate comparisons refer to chapter 9, "Western Europe."

Canada together recycle more than 5 million tons of aluminum each year, a majority of which the North American aluminum industry consumes.[340]

Box 4.6: United States: Aluminum Scrap Availability

USITC hearing testimony suggests that the domestic supply of post-consumer scrap has fallen in recent years for two main reasons. First, U.S. scrap collected in the Western United States is typically sold to Asia because it is more cost effective to transport it in containers already returning to Asia than to transport it to the Central and Eastern United States.[a] Although demand for scrap in China has slowed as its own scrap supply has grown,[b] China is still the largest market for U.S. scrap exports. The U.S. scrap supply has also tightened because of low LME prices for primary aluminum, which discourage scrap collectors and scrap yards from selling their scrap on the market.[c]

[a] Industry representatives, interviews by USITC staff, October 5, 2016.
[b] Industry representatives, interviews by USITC staff, March 1, 2017.
[c] Bray, "Aluminum," November 2016.

Wrought Aluminum

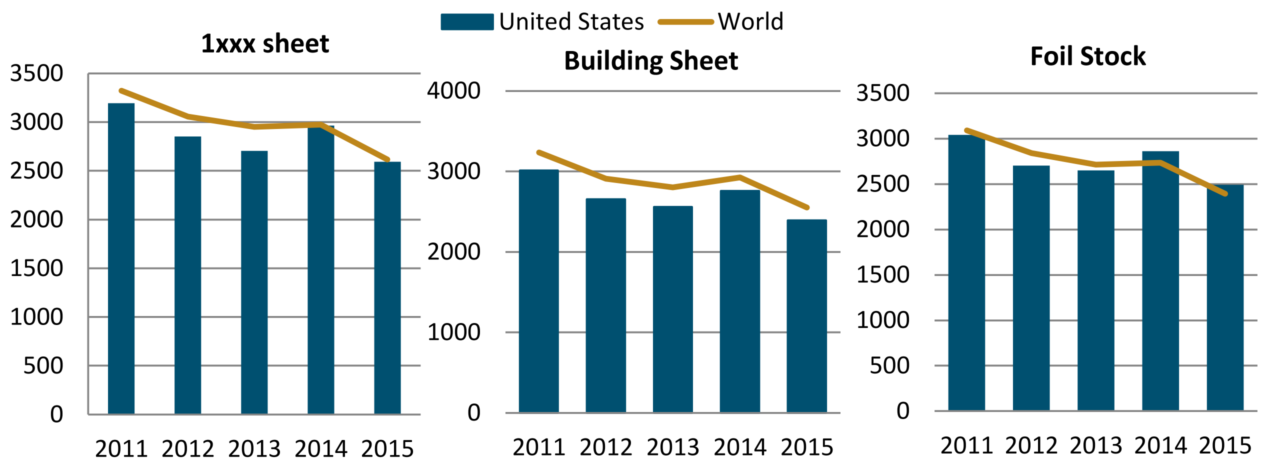
Cost Overview

Global prices for raw material inputs largely determine costs of production for U.S. wrought aluminum production. Beyond these major inputs, labor costs also drive costs of production for U.S. wrought aluminum producers because they are typically higher than the global average. However, the extent to which labor impacts costs of production varies by the wrought aluminum product.

From 2011 to 2015, U.S. wrought producers manufactured 1xxx sheet (of pure aluminum) and building sheet at costs below the world average (figure 4.6). U.S. foil stock producers' average business costs were also below the world average until 2014. Raw material costs were the largest share for U.S. producers of these three FRPs, accounting for a majority of their average business costs (table 4.21). In line with the declining global price of primary aluminum, U.S. raw material costs declined by 21 percent for 1xxx sheet, 24 percent for building sheet, and 20 percent for foil stock over this five-year period.

[340] Aluminum Association, "Aluminum Recycling" (accessed April 5, 2017).

Figure 4.6: United States: Certain aluminum flat-rolled products, average business costs, 2011–15 (dollars per mt)



Source: CRU Group.
Note: Corresponds to appendix table L.19.

The United States was a lower-cost producer of 1xxx sheet and building sheet than either China or Germany. However, the U.S. advantage in raw material cost declined over this period. In 2011, the United States' raw materials costs for 1xxx sheet and building sheet were 6 percent and 2 percent below corresponding world average costs, respectively. Both were only 1 percent below the world average by 2015. By 2014, U.S. raw materials costs for foil stock had climbed above that for China, while Germany had lower costs than the United States over this entire period.

Table 4.21: United States: Certain aluminum flat-rolled products, average business costs, 2011–15 (dollars per mt)

Product and costs	2011	2012	2013	2014	2015
1xxx sheet (pure aluminum)					
Energy	85	68	75	81	82
Labor	226	205	205	209	211
Delivery	70	69	70	70	67
Raw materials	2,521	2,255	2,112	2,347	2,000
Other	291	253	243	258	234
Total	3,194	2,851	2,705	2,963	2,594
Building sheet					
Energy	64	58	64	67	68
Labor	144	142	146	156	147
Delivery	78	80	81	81	77
Raw materials	2,502	2,157	2,055	2,230	1,897
Other	225	218	216	224	205
Total	3,013	2,654	2,561	2,757	2,394
Foil stock					
Energy	40	34	38	40	41
Labor	115	109	119	121	123
Delivery	16	16	16	17	16
Raw materials	2,716	2,403	2,333	2,534	2,171
Other	155	141	143	151	140
Total	3,041	2,703	2,649	2,862	2,491

Source: CRU Group.
Note: Because of rounding, total may not equal sum of line items.

By contrast with the primary segment, energy costs for U.S. FRP producers accounted for only a small proportion of average business costs—3 percent for 1xxx sheet and building sheet, and 1 percent for foil stock. Over 2011–15, energy and labor costs rose slightly for building sheet and foil stock, and these costs have also increased for 1xxx sheet since 2014. However, declines in delivery and raw materials costs partly offset increases in energy and labor costs. U.S. FRP producer costs for energy were very competitive, about 50–60 percent below the world average throughout the period.

U.S. Firms Are Able to Produce a Wide Range of Wrought Aluminum Products

A broad range of wrought aluminum products helps the U.S. wrought segment and individual firms to maximize the use of their large installed capacity and facilitates the growth of volumes and profits necessary to support their large fixed-cost investments.[341] Robust production volumes across segments are critical for firms to cover costs and investments across their

[341] USITC, hearing transcript, September 29, 2016, 77 (testimony of Lloyd A. Stemple, Constellium Rolled Products Ravenswood LLC).

various mills and production facilities and maintain their manufacturing sophistication.[342] One firm, for example, noted that its output is concentrated in higher-value markets, but that demand for these products is not sufficient to use all of its aluminum production, so the firm also produces commodity-grade products to spread its costs across a larger volume of output.[343]

U.S. Firms Benefit from Proximity to Supply-Chain Partners

Proximity to supply-chain partners, from smelter to end-use customer, facilitates collaboration and close cooperation in developing new alloys for use in new or improved products, taking them from the laboratory to full production.[344] Proximity fosters the close relationships needed to boost innovation and technology development and create new aluminum products and alloys that meet customers' performance and end-use requirements. [345] Proximity also speeds communication and reduces the cost of exchanging knowledge and information.[346]

U.S. wrought producers prefer to secure unwrought aluminum from domestic sources for several reasons. Two important factors are reliability and proximity of supply.[347] Imports expose U.S. producers to potential supply chain disruptions, which mean producers must carry larger inventories to maintain uninterrupted service to their customers.[348] In addition, U.S. smelter closures resulted in some producers losing their source of molten aluminum, which has hurt their production cost structure.[349]

A domestic primary aluminum supply is also considered necessary by some U.S. producers to meet some of the technical requirements[350] imposed by their end-use markets. For example, certain aluminum products for aerospace and military applications require high-purity aluminum alloys that are produced by only a few smelters in the world, one of which is Century Aluminum's Hawesville, KY, facility. Meeting these requirements is also particularly important

---

342 Novelis, written submission to the USITC, October 7, 2016, 2.
343 Industry representative, interview by USITC staff, October 4, 2016.
344 USITC, hearing transcript, September 29, 2016, 54–55 (testimony of Matt Aboud, Hydro Aluminum Metals USA); 107 (testimony of Michael A. Bless, Century Aluminum).
345 USITC, hearing transcript, September 29, 2016, 54 (testimony of Matt Aboud, Hydro Aluminum Metals USA); AEFTC, written submission to the USITC, October 11, 2016, 1.
346 AEFTC, written submission to the USITC, October 11, 2016, 1; USITC, hearing transcript, September 29, 2016, 54 (testimony of Matt Aboud, Hydro Aluminum Metals USA).
347 USITC, hearing transcript, September 29, 2016, 197 (testimony of Brook Hamilton, Bonnell Aluminum).
348 Ibid.
349 Industry representative, interview by USITC staff, October 4, 2016.
350 USITC, hearing transcript, September 29, 2016, 108–9 (testimony of Stephanie Hickman Boyse, Brazeway Inc.).

in the FRP segment, where the proper mix of alloys is a critical requirement for delivery to customers.[351]

U.S. Industry Leverages R&D and Advanced Manufacturing Capabilities

Many U.S. firms are leaders in their respective products and markets in part because of their advanced manufacturing and R&D capabilities. Novelis and Constellium, for example, noted that their R&D hubs serve the beverage can and automotive markets by collaborating with the end-use customers to test new products.[352] Novelis's Kennesaw, GA, facility, which is located near automotive and beverage can end users, pursues both short- and long-term R&D.[353] Novelis also has a Detroit research facility that carries out short-term R&D tailored to and sometimes in collaboration with automotive end users.[354] Likewise, Constellium is opening an R&D center in Plymouth, MI, to serve the automotive market.[355]

The technology developed at these R&D centers often relates to alloys specific to an end user. In the automotive and aerospace markets, for example, where lighter weight and improved strength are sought, U.S. producers have introduced new alloys and technologies to meet these customer requirements. Novelis developed its Advanz 7000-series aluminum alloy from its aerospace technology to compete with high-strength steels in the automotive industry.[356] For the aerospace industry, Constellium's Airware aluminum technology offers aluminum products that it states are lighter, easier to manufacture, and more environmentally benign.[357] Arconic claims to be one of the world's largest suppliers of aluminum sheet and plate to the aerospace industry. Arconic also reports that it is on the forefront of the shift to aluminum in the automotive industry with its Micromill technology, which it states yields a 30 percent improvement in aluminum sheet strength.[358]

The wrought industry offers a number of examples of factories that can be said to be world-class. Constellium's Ravenswood, WV, facility has one of the widest rolling mills in the world, capable of producing a large range of widths and thicknesses for transportation and marine applications. The firm also claims to have the world's largest stretcher, which contributes to its

[351] Industry consultant, interview by USITC staff, December 16, 2016.
[352] USITC, hearing transcript, September 29, 2016, 54 (testimony of Matt Aboud, Hydro), 62 (testimony of Ganesh Panneer, Novelis), and 75 (testimony of Lloyd "Buddy" Stemple, Constellium).
[353] Industry representatives, telephone interviews by USITC staff, March 6, 2017.
[354] Industry representative, telephone interview by USITC staff, March 6, 2017.
[355] USITC, hearing transcript, September 29, 2016, 74 (testimony of Lloyd "Buddy" Stemple, Constellium Rolled Products Ravenswood LLC).
[356] Summe, "Insider's Look: 7000-series Aluminum Alloy Innovation," August 19, 2015.
[357] Constellium, "AIRWARE®: Low Density Alloy for Lighter Aircraft," October 17, 2013.
[358] Arconic, "Who We Are: Global Rolled Products," https://www.arconic.com/global/en/who-we-are/global-rolled-products.asp (accessed January 26, 2017)

ability to manufacture unique products for the aerospace market.[359] Arconic has also installed a large aluminum plate stretcher at its Davenport, IA, facility to produce highly differentiated plate for the aerospace and industrial markets.[360] Finally, the Cressona, PA, plant of Sapa Extrusions, the world's leading producer of aluminum profiles, is the largest common-alloy extrusion facility in Sapa's global network.[361]

359 Constellium, "Ravenswood Aluminum Plant, USA," http://www.constellium.com/aluminium-company/manufacturing-recycling-plants/ravenswood-united-states (accessed April 13, 2017).
360 DeWitt, "Arconic Davenport Works Installs New Stretcher," April 11, 2017.
361 Sapa Group, "Sapa Cressona, PA," https://www.sapagroup.com/en-us/locations/north-america/united-states/offices/sapa-cressona-pa/ (accessed February 14, 2017).

Bibliography

Alcoa Corp. “Alcoa Corporation Launches as an Independent Industry Leader in Bauxite, Alumina and Aluminum Products.” Press release, November 1, 2016. http://news.alcoa.com/press-release/corporate/alcoa-corporation-launches-independent-industry-leader-bauxite-alumina-and.

———. “Alcoa Inc. Announces Filing of Initial Form 10 Registration Statement for Separation of Upstream Business, Alcoa Corporation.” Press release, June 29, 2016. http://news.alcoa.com/press-release/alcoa-inc-announces-filing-initial-form-10-registration-statement-separation-upstream.

———. “Alcoa Inc. Board of Directors Approves Separation of Company.” Press release, September 29, 2016. http://news.alcoa.com/press-release/alcoa-inc-board-directors-approves-separation-company.

———. “Alcoa Reaches Agreement with New York State to Increase Competitiveness of Massena West Smelter.” Press release, November 24, 2015. http://news.alcoa.com/press-release/alcoa-reaches-agreement-new-york-state-increase-competitiveness-massena-west%20.

———. “Alcoa to Close Warrick Smelter and Curtail Remaining Capacity at Pt. Comfort Refinery.” Press release, January 7, 2016. http://news.alcoa.com/press-release/alcoa-close-warrick-smelter-and-curtail-remaining-capacity-pt-comfort-refinery.

———. “Alcoa to Curtail Smelting and Refining Capacity to Further Drive Upstream Competitiveness.” Press release, November 2, 2015. http://news.alcoa.com/press-release/alcoa-curtail-smelting-and-refining-capacity-further-drive-upstream-competitiveness.

———. “Alcoa to Permanently Close Remaining Potlines at Massena East Smelter.” Press release, January 15, 2014. http://news.alcoa.com/press-release/alcoa-permanently-close-remaining-potlines-massena-east-smelter.

———. “Alcoa to Separate Into Two Industry-Leading Public Companies, Completing Successful Multi-Year Transformation.” Press release, September 28, 2015. http://news.alcoa.com/press-release/alcoa-separate-two-industry-leading-public-companies-completing-successful-multi-year.

Aleris Corp. “Aleris Reports First Quarter 2017 Results.” News release, May 4, 2017. http://investor.aleris.com/2017-05-04-Aleris-Reports-First-Quarter-2017-Results.

———. "Aleris to Be Acquired by Zhongwang USA LLC." News release, August 29, 2016. http://investor.aleris.com/2016-08-29-Aleris-To-Be-Acquired-By-Zhongwang-USA-LLC.

———. *Beyond Aluminum: 2014 Sustainability Report*. Cleveland, OH: Aleris, n.d. https://www.aleris.com/wp-content/uploads/2015/04/2014-CSR-Report_Update04-30-15.pdf (accessed March 10, 2017).

———. "Form 8-K," May 26, 2017. https://www.sec.gov/Archives/edgar/data/1518587/000151858717000024/otherevents-updatemay2017.htm.

Ali, Ann. "Century Aluminum Permanently Closes Ravenswood, WV Plant." *The State Journal*, July 27, 2015. http://www.theet.com/statejournal/news/century-aluminum-permanently-closes-ravenswood-wv-plant/article_67939584-1691-50be-a1b3\.

Aluminum Association. "Aluminum Recycling." http://www.aluminum.org/sustainability/aluminum-recycling (accessed April 5, 2017).\

———. "Driving Modern Manufacturing." http://www.aluminum.org/driving-modern-manufacturing (accessed March 12, 2017).

———. "New Truck Rule Recognizes Aluminum as Mass Reduction Solution to Boost Fleet Fuel Economy." PR Newswire, August 17, 2016. https://www.yahoo.com/news/aluminum-association-truck-rule-recognizes-aluminum-mass-reduction-170000622.html.

———. "The Aluminum Can Advantage." http://www.aluminum.org/aluminum-can-advantage (accessed April 5, 2017).

———. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry,* September 12, 2016.

———. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, October 7, 2016.

The Aluminum Channel. "Aluminum's Role in Achieving 2025 CAFE Standards," 2015. http://www.thealuminumchannel.com/videos/view/aluminums-role-in-achieving-2025-cafe-standards.

Aluminum Extruders Fair Trade Committee (AEFTC). Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 12, 2016.

———. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, October 11, 2016.

Aluminium Insider. "Automotive Sheet Aluminum Producers Fighting to Meet Increasing Demand: Boney," August 9, 2016. http://aluminiuminsider.com/automotive-sheet-aluminium-producers-fighting-to-meet-increasing-demand-boney/.

———. "Braidy Industries Announces Plans for U.S.'s First New Aluminium Rolling Mill in 30 Years," May 4, 2017. http://aluminiuminsider.com/braidy-industries-announces-plans-u-s-s-first-new-aluminium-rolling-mill-three-decades.

———. "Experts See Increasing In-Roads in Western Aluminium Industry by Chinese Firms," October 18, 2016. http://aluminiuminsider.com/experts-see-increasing-in-roads-in-western-aluminium-industry-by-chinese-firms/.

———. "Japanese Aluminium Companies Ramping Up to Capture Share in US Automotive Aluminium Market," July 17, 2016. http://aluminiuminsider.com/japanese-aluminium-companies-ramping-up-to-capture-share-in-us-automotive-aluminium-market/.

———. "New Day Aluminum Acquires Noranda's Upstream Assets for US$24.43 MM," October 22, 2016. http://aluminiuminsider.com/new-day-aluminum-acquires-norandas-upstream-assets-for-us24-43-mm (accessed March 5, 2017).

———. "Noranda Alumina to Fuel Century Aluminum's Kentucky Smelters," January 6, 2017. http://aluminiuminsider.com/noranda-alumina-fuel-century-aluminums-kentucky-smelters.

———. "UACJ to Invest US$488 MM in US, Thailand to Boost Rolled Aluminum Capacity," December 1, 2016. http://aluminiuminsider.com/uacj-invest-us488-mm-us-thailand-boost-rolled-aluminum-capacity/.

Associated Press. "Alcoa's Aluminum Smelter Closes in Warrick County," March 25, 2016.

Banse, Tom. "Aluminum Smelting's Questionable Future in the Northwest." NW News Network, January 27, 2016. http://nwnewsnetwork.org/post/aluminum-smeltings-questionable-future-northwest.

Barker, Jacob. “New Madrid Smelter to Shut Down Next Month After Noranda Files for Bankruptcy.” *St. Louis-Post Dispatch*, February 8, 2017. http://www.stltoday.com/business/local/new-madrid-smelter-to-shut-down-next-month-after-noranda/article_b386f8cc-73a9-590e-8f1b-ebfcff6c6003.html.

Beckstead, Bob. “Alcoa Decision to End Smelting Operations in Massena Will Slash Workforce by 487 Jobs.” *Watertown Daily Times*, November 3, 2015. http://www.watertowndailytimes.com/news05/alcoa-decision-to-end-smelting-operations-in-massena-will-slash-workforce-by-487-jobs-20151103.

Bray, E. Lee. “Aluminum (Advance Release).” *Minerals Yearbook*. Reston, VA: U.S. Geological Survey, 2012–15. https://minerals.usgs.gov/minerals/pubs/commodity/aluminum/index.html#myb.

———. “Aluminum.” *Mineral Commodity Summaries*. Reston, VA: U.S. Geological Survey, 2011–17. https://minerals.usgs.gov/minerals/pubs/commodity/aluminum/index.html#myb.

———. “Bauxite and Alumina.” *Mineral Commodity Summaries*. Reston, VA: U.S. Geological Survey, 2011–16. https://minerals.usgs.gov/minerals/pubs/commodity/aluminum/index.html#myb.

Cassell, Barry. “Energy Future Settles Issues with Alcoa over Coal-Fired Capacity,” January 5, 2016. https://www.hubs.com/power/explore/2016/01/energy-future-settles-issues-with-alcoa-over-coal-fired-capacity.

Century Aluminum Co. “Century Aluminum Divests Stakes in Bauxite and Alumina Assets.” Press release. Marketwired, August 4, 2009. http://www.marketwired.com/press-release/century-aluminum-divests-stakes-in-bauxite-and-alumina-assets-nasdaq-cenx-1213454.htm.

———. “Century Aluminum Permanently Closing Ravenswood Smelter.” Press release, July 27, 2015. http://investor.shareholder.com/cenx/releasedetail.cfm?ReleaseID=924061.

———. “Century Announces Continued Operations of Its Sebree, KY Smelter.” Press release, December 17, 2015. http://investor.shareholder.com/cenx/releasedetail.cfm?ReleaseID=947511.

———. “Century Announces Continued Operation of Two Potlines at Hawesville, KY Smelter—Remaining Operations to Focus on High-Purity Production.” Press release, September 30, 2015. http://investor.shareholder.com/cenx/releasedetail.cfm?ReleaseID=934415.

———. "Century Reaches New Market-Based Power Agreement for Mt. Holly Smelter." Press release, July 6, 2016. http://investor.shareholder.com/cenx/releasedetail.cfm?ReleaseID=978344.

———. "Century Receives Positive Ruling from Kentucky Public Service Commission on Market-Priced Power for Sebree, KY Smelter." Press release, January 30, 2014. http://investor.shareholder.com/cenx/releasedetail.cfm?ReleaseID=822255.

———. "Century Receives Positive Ruling on Hawesville Power." Press release, August 14, 2013. http://investor.shareholder.com/cenx/releasedetail.cfm?ReleaseID=785264.

———. "Fourth Quarter Earnings Call." Presentation, February 23, 2017. http://files.shareholder.com/downloads/CENX/4074176916x0x929665/E6ED0FD9-2690-493C-A5FC-89C8093A9152/CENXQ416_Earnings_Conference_Call.pdf.

Constellium. "AIRWARE®: Low Density Alloy for Lighter Aircraft," October 17, 2013. http://www.constellium.com/aluminium-products/aerospace-and-transportation/patents-and-brands/airware-technology.

Craig, Kimberlee. "Chelan PUD Discussing Future of Wenatchee Works with Alcoa Corporation." *Chelan County Power Utility District News*, March 17, 2017. http://www.chelanpud.org/about-us/media-room/news/2017/03/17/chelan-pud-discussing-future-of-wenatchee-works-with-alcoa-corporation.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

DeWitt, Jennifer. "Arconic Davenport Works Installs New Stretcher." *Quad City Times*, April 11, 2017. http://qctimes.com/business/arconic-davenport-works-installs-new-stretcher/article_26c4c291-f4f4-5d84-a218-d17924e3ca71.html.

Djukanovic, Goran. "Aluminium Use in Automobiles to Increase Significantly." Aluminium Insider, May 26, 2016. http://aluminiuminsider.com/aluminium-use-in-automobiles-to-increase-significantly.

Drive Aluminum. "Aluminum: The Growth Story." http://www.drivealuminum.org/aluminum-101/ (accessed January 25, 2017).

EPA. *See* U.S. Environmental Protection Agency.

Erickson, David. "Columbia Falls Aluminum Co. Announces Permanent Closure." *Missoulian*, March 3, 2015. http://missoulian.com/news/local/columbia-falls-aluminum-co-announces-permanent-closure/article_e47f5d93-ef0c-5ecc-9b02-daa17f22acb6.html accessed March 7, 2017).

Federal Reserve Bank of St. Louis. Total Construction Spending Table. FRED Economic Data. https://fred.stlouisfed.org/series/TTLCONS (accessed March 12, 2017).

Gallagher, Dave. "Ferndale Intalco's Smelter to Stay Open into 2018." *Bellingham Herald*, May 2, 2016. http://www.bellinghamherald.com/news/local/article75151737.html.

Global Aluminum Recycling Committee (GARC). *Global Aluminium Recycling: A Cornerstone of Sustainable Development*. International Aluminium Institute, 2009. http://www.world-aluminium.org/media/filer_public/2013/01/15/fl0000181.pdf.

GlobeNewswire. "Noranda Initiates Chapter 11 Process to Reposition Business Operations; Expects to Receive Up to $165 Million in New Financing to Enhance Liquidity." News release, February 8, 2016. http://inpublic.globenewswire.com/releaseDetails.faces?rId=1984249.

Good Jobs First. "Subsidy Tracker, Aluminum," 2015. http://www.goodjobsfirst.org/search/node?keys=Aluminum&=Search (accessed August 18, 2016).

———. "Subsidy Tracker Individual Entry," 2015. http://subsidytracker.goodjobsfirst.org/subsidy-tracker/ny-alcoa-0 (accessed August 18, 2016).

Gränges AB. "Gränges Completes US Acquisition." Press release, August 22, 2016. http://www.granges.com/media/press-releases/2016/granges-completes-us-acquisition.

Hotter, Andrea. "Alcoa Will Keep Massena West Aluminium Smelter Open." *Metal Bulletin*, November 24, 2015. https://www.metalbulletin.com/Article/3508875/Search-results/Alcoa-will-keep-Massena-West-aluminium-smelter-open.html?term=massena%20east&filters=%7B%22dates%22:%5B%2201-01-15%22,%2231-12-15%22%5D%7D&onlyCurrent.

IHS Markit. Global Trade Atlas (GTA) database. https://www.gtis.com/gta (accessed various dates).

International Organization for Automobile Manufacturers (OICA). "Production Statistics," 2017. http://www.oica.net/category/production-statistics/.

Isidore, Chris. "Ford Gets Ready to Unveil the Aluminum F-150." CNNMoney.com, January 2, 2014. http://money.cnn.com/2014/01/02/autos/aluminum-f150/.

John Dunham & Associates. *2016 Economic Impact of the Aluminum Industry: Methodology and Documentation*. Prepared for the Aluminum Association, Arlington, VA. Brooklyn, NY: John Dunham & Associates, March 2016. Attachment to Aluminum Association, written submission to the USITC in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 12, 2016.

Kaiser Aluminum Corp. "Form 10-K, Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934 for the Fiscal Year Ended December 31, 2005," March 30, 2006. http://investors.kaiseraluminum.com/secfiling.cfm?filingID=950129-06-3420.

Kelly, Sean, and Diran Apelian. *Automotive Aluminum Recycling at End of Life: A Grave-to-Gate Analysis.* Center for Resource Recovery and Recycling, Metal Processing Institute, Worcester Polytechnic Institute (WPI). Worcester, MA: WPI, 2016. http://www.aluminum.org/sustainability/sustainability-reports#sthash.qBtoMv3x.dpufhttp://www.aluminum.org/sustainability/sustainability-reports.

King, Anna. "Alcoa to Shut Down Ferndale and Wenatchee Aluminum Smelters." Oregon Public Broadcasting, November 2, 2015. http://www.opb.org/news/article/npr-alcoa-to-shut-down-ferndale-and-wenatchee-aluminum-smelters.

Lannom, Andrea. "Century Gives Up on Ravenswood Plant." *West Virginia Press*, July 28, 2015. http://wvpress.org/news/century-aluminum-gives-up-on-ravenswood-plant/.

Luminant. "Sandow: Power Plant and Mine," n.d. https://www.luminant.com/powering-texas/generation-capacity-and-energy-production/#.WOVR8vn1B1s (accessed May 11, 2017).

Martin, Ryne. "Alcoa Will Permanently Close Massena East, End Smelting at West Plant and Lay Off up to 500 Workers." *Watertown Daily News*, November 2, 2015. http://www.watertowndailytimes.com/news05/alcoa-will-permanently-close-massena-east-end-smelting-at-west-plant-and-lay-off-up-to-500-workers-20151102.

Miller, John W. "China Crinkles Aluminum Foil Makers." *Wall Street Journal*, August 21, 2016. https://www.wsj.com/articles/china-crinkles-aluminum-foil-makers-1471836740.

National Highway Traffic Safety Administration (NHTSA). "EPA and DOT Finalize Greenhouse Gas and Fuel Efficiency Standards for Heavy-Duty Trucks." News release, August 16, 2016. http://www.nhtsa.gov/About%20NHTSA/Press%20Releases/md-hd-cafe-final-rule-08162016.

———. "Obama Administration Finalizes Historic 54.5 mpg Fuel Efficiency Standards." News release, August 28, 2012. https://www.nhtsa.gov/press-releases/obama-administration-finalizes-historic-545-mpg-fuel-efficiency-standards.

New York State. Department of Environmental Conservation (DEC). "Draft Permit for Alcoa Massena Plants Modernization Now Available For Public Comment." Press release, August 22, 2012. http://www.dec.ny.gov/press/87854.html.

New York State. Office of the Governor. "Governor Cuomo and Senator Schumer Announce Deal to Preserve Hundreds of Jobs at Alcoa Facility in Massena." News release, November 24, 2015. https://www.governor.ny.gov/news/governor-cuomo-and-senator-schumer-announce-deal-preserve-hundreds-jobs-alcoa-facility-massena.

Novelis. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 12, 2016.

———. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, November 2, 2016.

O'Carroll, Lloyd. "The Decline of the US Aluminum Smelting Industry in the 21st Century: Causes and Consequences." CRU Insight, April 6, 2016. http://www.crugroup.com/about-cru/cruinsight/The_decline_of_the_US_aluminum_smelting_industry_in_the_21st_Century_causes_and_consequences.

Ohara, Dave. "Washington Aluminum Plant Celebrates 60 Years in Wenatchee." *Green Data Center Blog*, June 23, 2012. http://www.greenm3.com/gdcblog/2012/6/23/washington-aluminum-plant-celebrates-60-years-in-wenatchee.html.

Overturf, Jordan. "5 years after Shuttering, Fate of Alcoa, Workers Still Unclear." *The Eagle*, November 7, 2013. http://www.theeagle.com/news/local/years-after-shuttering-fate-of-alcoa-workers-still-unclear/article_e01d5395-516d-5743-b8db-78c82aa88008.html.

Paulson Institute. "A Chinese Aluminum Company's Learning Curve in the US Market," October 31, 2013. http://www.paulsoninstitute.org/wp-content/uploads/2017/01/Paulson-Paper-on-Investment_Nanshan_English_R.pdf.

Peck, Merton. "The United States: A Troubled Industry." In *The World Aluminum Industry in a Changing Energy Era*, edited by Merton J. Peck. New York: Routledge Revivals, 2016. Originally published by Resources for the Future in 1988.

Platts. "Noranda Agrees to Sell Magnesium Alloys from Missouri Operations," August 22, 2016.

Recycling Today. "Alcoa to Decrease Aluminum Smelting and Refining Capacity," November 3, 2015. http://www.recyclingtoday.com/article/alcoa-aluminum-production-curtailments/.

———. "Signature Group Holdings Introduces Real Alloys," March 2, 2015. http://www.recyclingtoday.com/article/aleris-aluminum-recycling-real-alloy/.

———. "Toyota Tsusho America Buys Bermco Aluminum," August 14, 2015. http://www.recyclingtoday.com/article/bermco-aluminum-acquired/.

Ross, Jim. "Century: PSC Decision Not Enough for Smelter's Restart." *State Journal*, October 9, 2012. http://www.theet.com/statejournal/news/century-psc-decision-not-enough-for-smelter-s-restart/article_cc40f240-1ddb-535c-b230-8941aa9e56ff.html.

Santee Cooper. "Santee Cooper Announces Deal in Principle with Century Aluminum." News release, December 18, 2015. https://www.santeecooper.com/about-santee-cooper/news-releases/news-items/santee-cooper-announces-deal-in-principle-with-century-aluminum.aspx.

Sapa Group. *Sustainability Report 2015*. Rosemont, IL: Sapa Group, 2015. http://www.sapagroup.com/upload/Sustainability/Sapa%20Sustainability%20Report%2020015%20Interactive.pdf.

Sedgwick, David. "Aluminum's Per-Vehicle Use Expected to Rise 56% from 2012 to 2025." *Automotive News*, July 21, 2014. http://www.autonews.com/article/20140721/OEM01/307219999/aluminums-per-vehicle-use-expected-to-rise-56-percent-from-2012-to.

Statista. "Aluminum—Leading Companies Worldwide by Production Output 2015." https://www.statista.com/statistics/280920/largest-aluminum-companies-worldwide. (accessed February 22, 2017).

Summe, Todd. “Insider’s Look: 7000-series Aluminum Alloy Innovation.” *Novelis Blog,* Novelis, August 19, 2015. http://novelis.com/7000-series-aluminum-alloy-innovation.

Susman Godfrey L.L.P. “Luminant Defeats Alcoa in $500 Million Jury Trial.” PR Newswire, June 4, 2010. http://www.prnewswire.com/news-releases/luminant-defeats-alcoa-in-500-million-jury-trial-95620919.html.

Taber Extrusions. “Global Aluminum Extrusion Market Predicted to Surpass 24 Million Tons by 2019.” News release, March 29, 2016. http://taberextrusions.com/global-aluminum-extrusion-market-predicted-to-surpass-24-million-tons-by-2019/.

Tabereaux, Alton. “World Primary Aluminum Production in Review—Part I.” *Light Metal Age Blog*, May 18, 2016. https://www.lightmetalage.com/news/blog/primary-aluminum-production-review/.

Tabish, Dillion. “The Rise and Fall of the Columbia Falls Aluminum Plant.” *Flathead Beacon*, September 14, 2016. http://flatheadbeacon.com/2016/09/14/rise-fall-columbia-falls-aluminum-plant.

Taylor, Brian. “Light Metal, Heavy Changes.” *Recycling Today*, June 2015. http://www.recyclingtoday.com/article/rt0615-secondary-aluminum-producers/ https://www.recyclingtoday.com/FileUploads/file/SecondaryAluminum.pdf.

———. “Secondary Aluminum Producers in North America.” *Recycling Today*, June 2015. https://www.recyclingtoday.com/FileUploads/file/SecondaryAluminum.pdf.

U.S. Environmental Protection Agency (EPA). “Superfund Site: Ormet Corp., Hannibal, OH.” https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0504223 (accessed April 12, 2017).

U.S. International Trade Commission (USITC). *Certain Aluminum Extrusions from China*. Inv. nos. 701-TA-475 and 731-TA-1177 (Review), USITC Publication 4677. Washington, DC: USITC, 2017.

———. Harmonized Tariff Schedule of the United States (HTS), 2017 Basic Edition. Washington, DC: USITC, February 2017. https://hts.usitc.gov/current.

———. Hearing transcript in connection with inv. nos. 701-TA-570 and 731-TA-1346 (Preliminary), *Aluminum Foil from China,* March 30, 2017.

———. Hearing transcript in connection with inv. nos. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

———. Interactive Tariff and Trade DataWeb (DataWeb)/U.S. Department of Commerce (USDOC). https://dataweb.usitc.gov (accessed various dates).

Villegas, Jesus. "Mexico, The World's Fastest Growing Aluminum Market: What, Who and How Much." Chicago, IL: Harbor's 9th Aluminum Outlook Conference, June 8, 2016.

Whiteman, Lou. "Investors Flock to Alcoa over Arconic Post-Split." *The Street*, November 1, 2016. https://www.thestreet.com/story/13875862/1/investors-flock-to-alcoa-over-arconic-post-split.html.

Wood Mackenzie. *New Madrid Aluminium Smelter: Asset Report*, November 2016. https://www.woodmac.com/reports/metals-new-madrid-aluminium-smelter-16041798.

World Bureau of Metal Statistics (WBMS). "Aluminum." World Metal Statistics, 2011–16.

Yakama Nation Fisheries Research Management. "Columbia Gorge Aluminum Plant: Fact Sheet," September 19, 2011. http://yakamafish-nsn.gov/sites/default/files/projects/Goldendale%20Fact%20Sheet%20110919.pdf.

Yucel, Ibrahim. *Aluminum Manufacturing in the US*. IBISWorld Industry Report 33131, June 2016.

Zhang, Qi. "Nanshan Aluminum to Open US plant." *China Daily*, May 12, 2011. http://usa.chinadaily.com.cn/us/2011-05/12/content_12495827.htm.

Chapter 5
Canada

Overview

Canada is the world's third-largest producer of primary unwrought aluminum, after China and Russia.[362] It is also one of the world's largest net exporters of aluminum. The Canadian aluminum industry derives a sizable competitive advantage from its access to abundant hydroelectric power (hydropower), largely along the Saint Lawrence River. It has therefore focused its resources and technical capabilities on the energy-intensive primary unwrought aluminum segment, while the United States has intensified its focus on secondary and wrought production in an increasingly integrated North American market.[363] Canada is not a major producer in the remaining market unwrought segment—secondary —since it has only a modest supply of domestic scrap and a relatively small domestic market.[364]

Close proximity to the United States gives Canada ready access to one of the world's largest aluminum markets, as well as lower costs for transporting primary unwrought aluminum from Canadian smelters to U.S. ports. The United States was Canada's largest trade partner throughout 2011–15 for Canadian aluminum exports (principally primary unwrought) and imports (principally wrought products). Likewise, Canada was the largest source of U.S. imports of unwrought aluminum and the largest export destination for U.S. wrought products during this five-year period.[365]

Very low energy costs from its hydropower resources form the cornerstone for the growth and profitability of Canada's primary unwrought aluminum segment. The industry has further benefited from having lowered production costs via corporate consolidations and smelter technology upgrades. The policy environment, both at the national and provincial levels, generally facilitates the efficient operation of the Canadian aluminum industry.

[362] CRU Group.
[363] For more detailed explanation of the U.S. domestic secondary and wrought aluminum production, see chapter 4.
[364] USITC, hearing transcript, September 29, 2016 (testimony of Jean Simard, Canadian Aluminum Association (CAA)).
[365] For more details about leading U.S. aluminum trade partners, see chapter 4.

Industry Structure

Canada's primary aluminum industry is concentrated among a few key smelting companies, with diverse patterns of upstream integration along the primary-aluminum value chain. By contrast, companies are much smaller and less concentrated in the Canadian secondary industry segments, both unwrought and wrought.

Primary Unwrought Aluminum

Number, Location, and Concentration of Firms

The Canadian primary aluminum industry is dominated by two multinational firms—U.S.-based Alcoa Corp. and Rio Tinto PLC,[366] based in the United Kingdom (UK)—that operate eight of Canada's nine aluminum smelters (table 5.1). The ninth smelter is a joint venture between Rio Tinto and Canadian-based Aluminerie Alouette. Rio Tinto owns and operates the majority of Canadian smelters, which together make up roughly 50 percent of the nation's smelting capacity. Alcoa represents approximately 31 percent of Canadian capacity, with Aluminerie Alouette accounting for the remainder. With the exception of the Kitimat smelter in British Columbia, the other eight are located in Quebec on or near the Saint Lawrence River and its tributaries (figure 5.1).

[366] Starting May 2015, "Alcan" was phased out from the corporate name of "Rio Tinto Alcan," dating back to Rio Tinto's acquisition of Montreal-based Alcan Ltd. in 2007. Van der Linde, "Rio Tinto Dropping Alcan Name," May 12, 2015.

Table 5.1: Canada: Primary unwrought aluminum smelters, 2016

Smelter	Primary ownership	Production capacity (mt)	Operations began	City	Province	Main products
Alma	Rio Tinto	466,000	2000	Alma	Quebec	Rod, T-ingot, pig ingot, molten aluminum
Arvida/AP60 Technology Centre	Rio Tinto	173,000	1954	Saguenay	Quebec	Billet, molten aluminum
Baie-Comeau	Alcoa	282,000	1958	Baie-Comeau	Quebec	T-ingot, slab
Bécancour	Alcoa/Rio Tinto	437,000	1986	Bécancour	Quebec	Billet, T-ingot, slab
Deschambault	Alcoa	260,000	1992	Deschambault-Grondines	Quebec	Ingot, liquid aluminum
Grande-Baie	Rio Tinto	221,000	1980	La Baie	Quebec	Rolling slabs, sows, high-purity sows, molten aluminum
Kitimat	Rio Tinto	420,000	1954	Kitimat	British Columbia	Ingot
Laterrière	Rio Tinto	235,000	1989	Laterrière	Quebec	Sheet ingot
Sept-Îles	Aluminerie Alouette/ Rio Tinto[a]	650,000	1992	Sept-Îles	Quebec	Ingot

Source: Rio Tinto, “Alma”; Rio Tinto, “Arvida/AP60 Technology Centre”; Rio Tinto, “Bécancour”; Rio Tinto “Grande-Baie”; Rio Tinto, “Kitimat” (all accessed November 15, 2016); Marowits, “Alcoa to Close Two Potlines in Quebec,” May 16, 2013; Alcoa, “Deschambault” (accessed November 15, 2016); Reuters, "Quebec Aluminum Smelter Hit by Power Failure,” July 7, 2010; Destination Sept-Îles, “Alouette Aluminum Plant” (accessed November 15, 2016). Note: mt=metric tons.

[a] Rio Tinto maintains a 40 percent ownership of the Aluminerie Alouette Sept-Îles facility.

In addition to easy access to cheap and abundant hydropower, these locations offer ready transportation for both alumina and other raw materials arriving at the smelters and for unwrought aluminum being sent to purchasers and traders in the United States.[367] This proximity significantly reduces U.S. import costs for Canadian aluminum, thereby enhancing Canada’s competitive position in the global primary aluminum market.[368] Primary aluminum production in Canada is principally focused on ingots, slabs and rods, with smaller production volumes of liquid aluminum, billet, and rolling slabs.

[367] USITC, hearing transcript, September 29, 2016 (testimony of Jean Simard, CAA).

[368] USITC DataWeb/USDOC, “HTS 7601: Aluminum, Unwrought, Charges, Insurance, and Freight for All Countries, U.S. Imports for Consumption” (accessed September 22, 2016).

Figure 5.1: Canada: Location of primary unwrought aluminum smelters, 2016

Source: AAC, "Aluminum: Over 100 Years of History in Canada" (accessed July 17, 2016).

Since 2001, the primary aluminum segment in Canada has undergone corporate consolidation and facility shutdowns. In October 2007, Rio Tinto finalized its $38.1 billion takeover of Canadian aluminum producer Alcan Ltd. (renamed "Rio Tinto Alcan"), which had already undergone a merger with Swiss-based Algroup in 2000.,[369] This takeover reduced the number of aluminum smelting companies operating in Canada to three.[370] In addition, Rio Tinto Alcan closed down its Beauharnois smelter in 2009[371] and its Shawinigan smelter in 2013[372] as part of a broader corporate strategy to consolidate its worldwide operations and reduce primary aluminum production costs.[373] Since the Shawinigan smelter was the oldest in Canada and the Beauharnois smelter dated back to 1943,[374] upgrading them would have been prohibitively expensive. Following the closure of its Beauharnois smelter, Rio Tinto Alcan cutback alumina production at its Vaudreuil refinery.

---

[369] AAC, "Aluminium: Over 100 Years of History in Canada" (accessed July 17, 2016).
[370] Goldstein and Mandaro, "Rio Tinto Makes $38.1 Billion Takeover Bid," July 12, 2007.
[371] AAC, "Aluminium: Over 100 Years of History in Canada," 2016.
[372] CBC News, "Rio Tinto Alcan to Close Shawinigan Smelter," August 7, 2013.
[373] Rio Tinto also reduced primary aluminum production at facilities in France, Norway, and the United Kingdom. (UK). *Canadian Mining Journal*, "Aluminium Production: Permanent Closure," January 25, 2009.
[374] *Canadian Encyclopedia*, "Aluminum," 2016.

Alumina

Canada's sole domestic source of alumina for its primary unwrought aluminum industry is the Vaudreuil refinery, located in Saguenay, Quebec. Owned and operated by Rio Tinto, this refinery produces approximately 1.5 million metric tons (mt) of alumina yearly for the company's Canadian smelters.[375] Bauxite for this refinery is principally sourced from Brazil and Guinea.[376] Canadian exports of alumina amounted to less than 36,000 mt, an indication that the vast majority of Rio Tinto's refinery output is consumed by its own smelters within Canada.[377] Since domestic alumina production fulfilled only 26–28 percent of the nation's overall consumption needs in each of the past five years,[378] Canada imported between 3.8 and 4.4 million mt of alumina annually, principally from Brazil, followed by the United States, Jamaica, and Suriname.[379] Canada's upstream value chain is diversified by sourcing alumina as an intercompany transfer between Alcoa and Rio Tinto, as well as from independent alumina producers.[380] Hence, with Alcoa and Rio Tinto both being global leaders in bauxite mining and alumina refining,[381] their Canadian smelters are likely to have continued access to reliable supplies of competitively priced alumina.

Investments

The Canadian aluminum industry has undertaken capital investments in several smelters to expand production capacity or upgrade production technology. In 2005, the Aluminerie Alouette smelter in Sept-Îles completed its capacity expansion project to increase production by over 50 percent.[382] In British Columbia, the Kitimat smelter was expanded and modernized in 2006 by Alcan and in 2015 by Rio Tinto Alcan.[383] In April 2016, Rio Tinto announced that it would expand its Laterrière operations with a $36.6-million project to increase annual production capacity by 15,000 mt.[384]

[375] Rio Tinto, "Vaudreuil" (accessed January 5, 2017). Also see USITC, hearing transcript, September 29, 2016, 333–334 (testimony of Jean Simard, CAA).
[376] IHS Markit, GTA database (accessed September 12, 2016).
[377] Ibid.
[378] Calculated by USITC staff as the ratio of domestic refinery output to apparent domestic consumption (production plus imports less exports).
[379] Ibid.
[380] Industry representative, interview by USITC staff, February 13, 2017.
[381] Bell, "World's Biggest Aluminum Producers," November 20, 2016.
[382] PR Newswire, "Can$1.45 Billion Expansion of Aluminerie Alouette," September 20, 2005.
[383] CBC News, "Kitimat Rio Tinto Aluminum Smelter Re-Opens," July 7, 2015.
[384] Rio Tinto, "Breaking Old Ground," July 7, 2016; *Journal de Québec*, "Rio Tinto Aluminium Investit" [Rio Tinto Aluminum Invests], April 27, 2016.

In addition, several smelters in Canada have undergone renovations to reduce emissions and to replace older Söderberg potlines with more advanced pre-bake anode technologies.[385] In 2013, two Söderberg potlines in Baie-Comeau were eliminated.[386] The Laterrière plant went through electrolytic cell-control upgrades in 2011,[387] and in 2014 the Arvida smelter added the AP60 Technological Centre to "permit further improvements in productivity and reductions in energy and environmental footprint."[388] Additionally, the Kitimat smelter updated technology and reduced emissions of greenhouse gases, including fluorides and hydrocarbons in 2015, while also increasing production.[389] According to a Canadian industry representative, such improvements helped maintain the competitiveness of the Canadian primary aluminum industry by improving production efficiency and by reducing the need for environmental remediation efforts.[390]

Upstream Integration in Energy

Typical for major primary aluminum-producing countries, Canada's aluminum smelters overwhelmingly use hydropower to provide the electricity necessary to power their electrolytic production processes. Primary aluminum smelters in Canada receive their electricity from two sources: through facilities operated by Hydro-Quebec, and through captured hydroelectric facilities operated by the aluminum smelters. Operating captured hydroelectric facilities improves logistics operations for smelters and reduces the costs of negotiating with public utilities.

Employment

The nine operating primary aluminum smelters in Canada directly employ more than 7,000 workers, with Alcoa employing at least 3,000,[391] Rio Tinto at least 3,500,[392] and Aluminerie Alouette more than 900. Additionally, Rio Tinto's Vaudreuil alumina refinery employs at least 540 workers.[393] Nonetheless, total Canadian smelter employment declined by 17 percent in 2011–15, from 8,549 to 7,082 (table 5.2). Since overall primary aluminum production remained relatively flat during this period, declining employment partly reflected efficiency improvements at some smelters. In addition, some updated smelters (particularly the

---

385 For more details, see the description of the electrolytic smelting process in "Primary Unwrought Aluminum" in chapter 1 as well as appendix I.
386 Marowits, "Alcoa to Close Two Potlines in Quebec," May 16, 2013.
387 CNW Group, "Rio Tinto Alcan Announces Can$36 Million Investment," May 17, 2011.
388 *Canadian Metalworking*, "Rio Tinto Alcan Inaugurates New AP60," January 17, 2014.
389 CBC News, "Kitimat Rio Tinto Aluminum Smelter Re-Opens," July 7, 2015.
390 USITC, hearing transcript, September 29, 2016 (testimony of Jean Simard, CAA).
391 Alcoa, "Outlook on Sustainability," 2015.
392 Rio Tinto Alcan, *Rio Tinto Alcan in North America*, June 14, 2016, 12–24.
393 Ibid.

Kitimat smelter) added jobs,[394] while some older, less efficient smelters (Beauharnois and Shawinigan). Overall, the Canadian aluminum industry benefited over 2011–15 from both rising labor productivity (fewer workers required per unit of output) and declining average hourly wages in U.S. dollar terms, attributable in part to the relative strength of the U.S. dollar to the Canadian dollar.[395]

Table 5.2: Canada: Primary unwrought aluminum industry employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment number, full-time equivalent	8,549	8,094	8,272	7,246	7,082
Production (1,000 mt)	2,984	2,781	2,969	2,858	2,880
Productivity (workers/1,000 mt)	2.9	2.9	2.8	2.5	2.5
Average wages ($/hr)	45.07	43.27	42.34	41.07	37.90

Source: CRU Group.

Secondary Unwrought Aluminum

In contrast to the more than 100 secondary unwrought aluminum facilities in the United States,[396] Canada has only 8 major secondary facilities, with all but 1 located in Ontario (table 5.3). In contrast to the primary segment, the structure of the secondary aluminum industry segment is less concentrated in terms of firm ownership. Most secondary aluminum in Canada is produced by U.S.-based firms. Secondary aluminum facilities in London, Mississauga, and Saguenay (all in Ontario) operate as affiliates of their U.S.-based parent companies, with the majority of their secondary production occurring in the United States.[397] In addition, the Windsor, Ontario, facility is the Canadian operation of Mexican-based Nemak S.A.[398]

[394] For further information, see the "Investments" section of this chapter.
[395] For more details about the impact of exchange rates, see chapter 3.
[396] *Recycling Today*, "Secondary Aluminum Producers," June 2, 2015.
[397] Kaiser Aluminum, "About Us: Facilities" (accessed February 13, 2016); Government of Canada, "Canadian Company Profiles," February 25, 2016. Sapa Group, "Canada"; Scepter Inc., "Saguenay, Quebec" (both accessed March 1, 2017).
[398] Nemak, "About Us" (accessed March 1, 2017).

Table 5.3: Canada: Secondary aluminum producers and their principal products (wrought and unwrought)

Plant Owner	City	Province	Product
Kaiser Aluminum	London	Ontario	Extruded products
Matalco	Brampton	Ontario	Billet
Nemak	Windsor	Ontario	Extruded car parts
Real Alloy	Mississauga	Ontario	Ingot, specification alloys, sows, molten metal
Rochester Aluminum Smelter of Canada	Concord	Ontario	Ingot
Sapa Extrusions	Toronto	Ontario	Billet, building and machine components
Signature Aluminum	Pickering	Ontario	Log, billet casting, extrusions, specification alloys
Scepter Industries	Saguenay	Quebec	Remelt scrap ingot

Source: Kaiser Aluminum, "About Us: Facilities"; Matalco, "Brampton, Ontario"; Nemak, "About Us"; Rochester Aluminum Smelting Canada, "Products"; Sapa Group, "About Sapa"; Signature Aluminum Canada, "Extrusion"; Scepter Inc., "Saguenay, Quebec"(all accessed January 25–February 17, 2016); Government of Canada, "Company Profiles: Canadian Company Capabilities; Real Alloy," February 25, 2016.

Three factors largely explain the inability of Canada's secondary aluminum segment to consolidate in order to gain the economies of scale attained by its primary aluminum industry. First, energy costs are much less critical to the competitiveness of secondary aluminum production,[399] so Canada's low energy costs are less effective in attracting the capital investment needed for expansion and consolidation. Second, unlike the United States, Canada's modest population (less than that of California)[400] does not generate enough domestic aluminum scrap to supply major secondary production.[401] Canada also does not import large amounts of aluminum scrap from the United States (between 88,000 and 119,000 mt annually during 2011–15). On the contrary, Canada exports more than three times those amounts to secondary unwrought aluminum facilities in the United States.[402]

Finally, the United States produces enough secondary aluminum to prevent the emergence of a substantial Canadian secondary aluminum industry that would feed into the U.S. market. In contrast to the 185,000 mt of secondary aluminum produced in Canada in 2015, the World Bureau of Metal Statistics estimates that the United States produced over 3.7 million mt of secondary aluminum (nearly 40 times as much) in 2015.

[399] Secondary production requires less than 10 percent of the energy required for primary smelting. Aluminum Association, "Secondary Production" (accessed March 1, 2017).
[400] Canada's 2016 national population is estimated to be 36.3 million. Government of Canada, Statistics Canada, "Population by Year, by Province and Territory," September 28, 2016. California's estimated 2016 population was 39.2 million. U.S. Census Bureau, "Quick Facts: California" (accessed February 10, 2017).
[401] Industry representative, telephone interview by USITC staff, February 16, 2017.
[402] IHS Markit, GTA database. HS 7602: Aluminum waste and scrap (accessed April 4, 2017).

Wrought Aluminum

Canada's wrought aluminum industry segment is similar in structure to that of its secondary industry segment. Some facilities are operated by foreign-owned firms, while others are single-location, domestic producers. There are about 17 major aluminum extruding mills in Canada,[403] with 10 concentrated in Ontario and the others in Quebec, British Columbia, and Alberta. There are a small number of aluminum rolling mills, and a few wire and cable producers. Among Canadian rolling mills, the number of employees declined from 224 to 195 during 2011–15 (table 5.4). Productivity increased and average wages declined (in U.S. dollar terms) for rolling-mill workers, reflecting competitive advantages for Canadian wrought aluminum production.

Table 5.4: Canada: Aluminum rolling mill employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	224	231	187	192	195
Productivity (workers/1,000 mt)	2.0	2.0	1.7	1.6	1.6
Average wages ($/hr)	52.22	46.92	45.88	43.99	43.44

Source: CRU Group.

Canadian aluminum extruders create an array of products. All but one major extruding mill produce profiles (shapes), while the majority also produces tubes and pipes. A smaller number produce bars and rods.[404] Most firms that operate wrought-product facilities in Canada are not directly connected to primary or secondary unwrought producers. Only 1 of these wrought facilities is operated by a major primary unwrought producer,[405] and 4 are connected to major firms that produce secondary unwrought products in Canada.[406] The remaining 12 facilities operate independently from the unwrought segments of the Canadian aluminum value chain.

Production

Canadian aluminum production is concentrated in primary unwrought aluminum, and Canada is among the world's leading primary producers. Canadian secondary unwrought and wrought aluminum output is low by comparison.

[403] Kaiser Aluminum, "About Us: Facilities," 2016; Matalco, "Brampton, Ontario," 2016; Nemak, "'About Us," 2016; Rochester Aluminum, "Products," 2016; Sapa Group, "Canada," 2016; Signature Aluminum Canada, "Extrusion," 2016; Scepter Inc., "Saguenay, Quebec," 2016 (all accessed from January 12 to March 1, 2017); Government of Canada, "Company Profiles," February 25, 2016.
[404] Aluminum Association, *North American Extrusion Press Directory*, 2014, 3.
[405] There is one Alcoa facility, in Lethbridge, Alberta, that produces extruded aluminum forms.
[406] Sapa has two facilities, one in Ontario and the other in Quebec; Signature has an aluminum facility in Ontario; and Kaiser has an aluminum facility in Ontario.

Primary Unwrought Aluminum

During 2011–15, Canada maintained its position as the world's third-largest producer of primary unwrought aluminum, significantly behind China and just behind Russia. The small domestic market limits the Canadian aluminum industry's ability to sell domestically, but the larger U.S. market provides Canada with enough demand to maintain annual production at or near 3 million mt through exports.[407] In 2015 over 85 percent of Canadian primary aluminum was exported.[408] Canada maintained relatively stable production levels between 2.8 million and 3.0 million mt over that five-year period (table 5.5). Canadian capacity utilization in producing primary aluminum fluctuated from year to year, between 90 and 98 percent.

Table 5.5: Canada: Primary unwrought aluminum production, capacity, and capacity utilization, 2011–15

Attribute	2011	2012	2013	2014	2015
Production (1,000 mt)	2,984	2,781	2,969	2,858	2,880
Capacity (1,000 mt)	3,036	3,035	3,075	2,968	3,194
Capacity Utilization (%)	98	92	97	96	90

Source: CRU Group.

The nine Canadian smelters produce a variety of primary aluminum products, but they principally make remelt ingots and slabs (together accounting for 66 percent of all casthouse output in 2015), followed by smaller volumes of foundry alloys, extrusion billets, molten aluminum, and wire rods.[409] Some smelters, such as Rio Tinto's Grande-Baie and Alma facilities, as well as Aluminerie Alouette's facility, specialize in smelting high-purity unwrought aluminum products.[410]

Secondary Unwrought Aluminum

Canada has limited secondary unwrought aluminum production, amounting to only about 185,000 mt annually in recent years.[411] This is far less than the nearly 3 million mt of primary unwrought aluminum produced annually by Canadian aluminum smelters; of the Canadian unwrought aluminum industry, 96 percent is devoted to the production of primary unwrought and 4 percent to secondary unwrought aluminum. As noted earlier, the disparity is largely attributable to the absence of a significant consumer base for secondary aluminum consumption and to the limited importance of low energy costs for the secondary industry segment. A number of Canadian secondary producers operate along North American value

[407] USITC, hearing transcript, September 29, 2016 (testimony of Jean Simard, CAA).
[408] For further details, see the "Trade" section of this chapter.
[409] CRU Group.
[410] RTA Public Sales, "Our Global Network," February 6, 2016. Many other aluminum smelters in the United States and Canada produce less-pure aluminum products that are more frequently substitutable.
[411] WBMS, "Aluminum, Secondary Ingot Production," November 2014.

chains.[412] Of the eight major secondary aluminum facilities in Canada, four predominantly or exclusively produce unwrought materials (e.g., billets, ingot, and billets), while the others are captive producers for wrought product mills that sell to aerospace, automotive parts,[413] and machine and building component manufacturers.[414]

Wrought Aluminum

Canada's wrought aluminum production is also low compared to its primary unwrought aluminum production. Established U.S. wrought producers provide most of Canada's consumption needs, thereby limiting the need for a substantial domestic wrought aluminum production base in Canada. After rising from 2011 to 2012, Canadian wrought production was stable at around 700,000 mt per year during 2013–15 (table 5.6). Production of Canadian wrought aluminum is concentrated in extruded products (approximately 50 percent of all wrought products), with lesser shares of wire and cable (30 percent) and flat-rolled products (20 percent). Over 65 percent of Canadian wrought production is exported and about 77 percent of Canadian wrought aluminum exports are sent to the United States.[415]

Table 5.6: Canada: Wrought aluminum production, capacity, and capacity utilization, 2011–15

Attribute	2011	2012	2013	2014	2015
Production (1,000 mt)					
Flat-rolled products	140	140	140	140	140
Extrusions	285	344	332	351	362
Wire and cable	192	227	222	212	205
Total	617	710	693	704	707
Capacity (1,000 mt)					
Flat-rolled products	185	185	185	185	186
Capacity utilization (%)					
Flat-rolled products	76	76	76	76	75

Source: CRU Group.

[412] Kaiser Aluminum, "About Us: Facilities" (accessed February 13, 2017); Government of Canada, "Canadian Company Profiles," February 25, 2016; Scepter Inc., "Saguenay, Quebec" (accessed February 12, 2017).
[413] Nemak, "About Us" (accessed September 17, 2016).
[414] Sapa Group, "Canada" (accessed September 17, 2016).
[415] For further information, see the "Trade" section of this chapter.

Consumption

Unwrought Aluminum

Canadian demand for primary aluminum is largely met by its domestic production. When imports are necessary, they are principally sourced from the United States. Canada consumed between 450,000 and 600,000 mt of primary aluminum annually during 2011–15[416]—a decline from its 2006 peak of 850,000 mt.[417] During 2011–15, Consumption peaked at 600,000 mt in 2011, but fell to slightly below 500,000 mt in 2015.This may be due to downstream aluminum-consuming industries increasingly relying on wrought products imported from the United States, rather than relying on Canadian wrought production, which then reduces demand for domestic primary unwrought aluminum.

Wrought Aluminum

Wrought aluminum consumption in Canada increased 17 percent during 2011–15 (table 5.7). FRPs predominated among all wrought product forms consumed, with the FRP share of consumption growing from 58 percent in 2011 to 63 percent in 2015. The use of wrought aluminum in Canada is moderately concentrated in the top two end-use sectors—construction and transport. Construction was the leading sector in 2011–15, accounting for almost one-third (31–33 percent) of annual consumption. Over the same five-year period, the transport sector grew from 22 percent to 28 percent of the nation’s annual wrought-product consumption.

[416] CRU Group.
[417] Ibid.

Table 5.7: Canada: Consumption of wrought aluminum by form and end use, 2011–15 (thousand mt)

Attribute	2011	2012	2013	2014	2015
By form					
Flat-rolled products	355	376	386	415	452
Extrusions	182	193	193	205	217
Wire and cable	79	66	66	57	52
Total	616	635	645	677	721
By end use					
Construction	193	202	207	222	230
Transport	137	150	156	177	199
Electrical	106	97	97	88	98
Foil stock	56	60	63	66	66
Packaging	68	69	65	64	63
Consumer durables	47	48	50	53	60
Other	9	9	8	7	5
Machinery and equipment	0	0	0	0	0
Total	616	635	645	677	720

Source: CRU Group.
Note: Because of rounding, total may not equal the sum of the line items.

Wrought aluminum has been used in many Canadian infrastructure projects, particularly in bridges. The world's first and largest all-aluminum bridge, in Saguenay, Quebec, was a starting point in promoting the use of aluminum for bridges and bridge components (e.g., bikeways, walkways, decks, and girders) across Canada.[418] Aluminum is particularly useful for construction in colder climates because it can withstand a wide temperature range and becomes stronger in lower temperatures, and it has been used increasingly in buildings to reduce weight and insulation costs.[419] In the automotive sector, Canadian manufacturers have likewise shifted to using more aluminum in motor vehicles to comply with stricter environmental standards. They are also using more aluminum in motor-vehicle parts, particularly to reduce weight while maintaining durability.[420]

Trade

Canada's international trade in both unwrought and wrought aluminum products is predominantly with the United States and Mexico, a reflection of an integrated North American market for aluminum.

[418] AAC, "Aluminium Infrastructure and Bridges," 2016.
[419] HomeTips.Com, "Pros and Cons of Metal Roofing" (accessed June 26, 2016).
[420] AAC, "Aluminum Transport: Context and Objective," 2016.

Unwrought Aluminum

Exports

Canada is the world's second-largest exporter of unwrought aluminum[421] and the largest supplier of primary aluminum products to the United States (table 5.8). Nearly 77 percent of Canadian unwrought aluminum exports were destined for the United States in 2015, up from 75 percent in 2011.[422] Lesser leading export destinations include Mexico, Europe, and Japan. Two major factors explain the rise in the U.S. share of Canadian unwrought aluminum exports (figure 5.2). One is that some other countries may have shifted away from Canadian-origin aluminum in favor of other third-country sources; this shift has expanded the proportion of Canadian aluminum available for export to the United States. The other factor is the decline in U.S. domestic production of primary unwrought aluminum, which has been partially replaced with Canadian-origin material.

Table 5.8: Canada: Unwrought aluminum exports (HS 7601), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
United States	1,838	1,839	2,061	2,002	2,208
Mexico	140	143	143	196	388
Japan	76	59	60	56	43
Norway	122	95	47	45	33
Switzerland	13	8	44	56	31
All other	280	275	295	287	173
Total	2,467	2,419	2,650	2,642	2,876

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Figures for exports are based on partner country imports. Because of rounding, total may not equal the sum of the line items.

Canadian exports of unwrought aluminum by weight to the United States rose by 20 percent to 2.2 million tons during 2011–15, even as the value of exports has remained relatively stable.

[421] IHS Markit, GTA database, (accessed September 22, 2016).
[422] Canadian exports of unwrought aluminum to the United States since 2011 rose 20 percent to 2.2 million mt in 2015.

Figure 5.2: Canada: Unwrought aluminum exports to global and U.S. markets, 2011–15 (thousand mt)

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Corresponds to appendix table L.20.

Imports

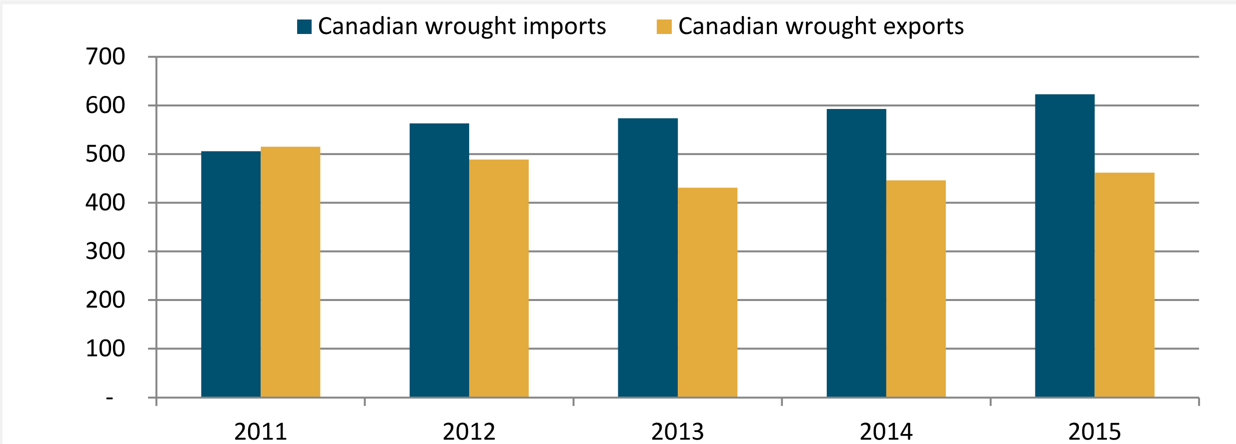
Canada imports only minimal quantities of unwrought aluminum compared to its exports. This is due to the substantial domestic production of primary aluminum, which fills much of the demand of downstream industries. Canada's unwrought imports came predominantly from the United States and remained relatively stable over 2011–15, though the imports from the United States declined slightly in 2015 with the growth of imports from Iceland.[423]

[423] IHS Markit, GTA database, "Canada Exports: 7601" (accessed September 22, 2016).

Wrought Aluminum

Though neither its exports nor its imports of wrought aluminum products are substantial, Canada is a net importer of these goods (figure 5.3). This trend reflects both smaller domestic consumption demand and lesser production capacity in this industry segment.[424]

Figure 5.3: Canada: Wrought aluminum imports and exports, 2011–15 (thousand mt)



Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Corresponds to appendix table L.21.

Exports

The United States was also the largest market for Canada's exports of wrought aluminum products during 2011–15. For some wrought products, the United States received over 98 percent of Canadian exports (table 5.9), due to a combination of proximity, established commercial sourcing relationships, and economically competitive production. Mexico was the next-largest export market, but a significantly smaller one. The United States remains a large, relatively stable, and consistent market for Canadian wrought production. Ready access from Quebec to U.S. markets and ports in the Great Lakes region facilitates cross-border trade with the United States, compared to long-distance transport by rail or road to domestic customers or by ship to clients overseas. Exports were evenly split during 2015 between wire (38 percent of all wrought products) and flat-rolled products (43 percent), with a smaller proportion of bars, rods, and profiles (18 percent).[425]

[424] See the "Consumption" section of this chapter.
[425] IHS Markit, GTA database, (accessed September 22, 2016).

Table 5.9: Canada: Wrought aluminum exports (HS 7604–7608), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
United States	481	455	403	415	425
Mexico	10	8	10	15	14
Germany	1	1	1	1	9
Ecuador	3	1	4	3	4
China	7	3	3	2	2
All other	13	21	11	11	9
Total	516	489	432	446	463

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner-country imports. Because of rounding, total may not equal the sum of the line items.

Imports

Canada's market for wrought aluminum imports is similar to its market for unwrought imports in that the United States supplies the vast majority of both—81 to 75 percent annually during 2011–15 (table 5.10). China, however, has become an increasingly important supplier: Canadian wrought imports from China increased by 122 percent in 2011–15, from 35,000 mt to 78,000 mt. Canada's wrought imports are almost entirely concentrated in foil, which accounted for about 85 percent of all wrought imports throughout the 2011–15 period.[426] Canada's trade balance in wrought aluminum products shifted from net exports in 2011 to net imports from 2012 through 2015 (compare tables 5.9 and 5.10). Of the large Canadian companies that consume significant amounts of wrought aluminum products, several import from the United States or other countries, rather than relying on domestic sources. For example, Bombardier Inc. announced in 2014 that it would source aluminum aerospace-grade plate from an Aleris-owned rolling mill in Zhenjiang, China.[427] Bombardier also expanded the use of aluminum in its CSeries jet airliners by employing aluminum alloys for the wings and fuselage,[428] but has increased its sourcing of aluminum products from Brazil.[429]

[426] IHS Markit, GTA database, (accessed September 22, 2016).
[427] Aleris, "Aleris Attains Qualification to Supply Bombardier," 2014.
[428] Brown, "An Inside Look at the New Bombardier," February 3, 2012.
[429] Bombardier, "Bombardier Inaugurates Advanced Monorail," April 13, 2012.

Table 5.10: Canada: Wrought aluminum imports (HS 7604–7608), by source, 2011–15 (thousand mt)

Source	2011	2012	2013	2014	2015
United States	409	437	446	445	470
China	35	43	52	69	78
Germany	13	12	19	19	21
Malaysia	5	6	6	6	6
Indonesia	7	9	7	7	5
All other	37	56	44	48	42
Total	506	563	574	593	623

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal the sum of the line items.

Import Injury Actions

The Canadian International Trade Tribunal in 2009 initiated trade-remedy actions against what it deemed anticompetitive behavior by aluminum extruders in China. Governed by the Special Import Measures Act,[430] the Canadian International Trade Tribunal issued antidumping (AD) and countervailing duty (CVD) orders on certain extruded aluminum products from China, acting through the Canada Border Services Agency. These orders were reviewed in 2014, and the AD and CVD orders were continued.[431] The AD duty for most subject products was set at 101 percent of the export price; other subject products were set at a CVD rate of 15.84 renminbi (approximately $2.30) per kilogram.[432]

Government Policies and Programs

Both the Quebec provincial government and the Canadian federal government have implemented policies to facilitate the development and maintenance of the aluminum industry in Canada. These measures include tax and tariff policies that have supported the purchase and use of large-scale machinery (including aluminum machinery), and Quebec provincial initiatives to promote increased production as well as encourage innovation in the aluminum industry. The Canadian government has also initiated trade enforcement measures against what it has judged to be anticompetitive behavior by Chinese aluminum producers.

[430] Inquiry No. NQ-2008-003. See Canadian International Trade Tribunal Aluminum Extrusions, Expiry Review RR-2013--003, http://www.gc.ca (accessed May 16, 2017).
[431] Inquiry No. NQ-2008-003R.
[432] Government of Canada, CITT, *Aluminum Extrusions*, March 17, 2014.

Quebec Provincial Policies

Responding to a 2006 report suggesting that an organization be created to coordinate and promote the aluminum processing industry in Quebec,[433] the Communauté Métropolitaine de Montréal created AluQuébec in 2012 to bring together the provincial government and the aluminum private sector. In 2015, the provincial government allocated Can$32.5 million to develop the province's aluminum industry,[434] including goals of doubling aluminum processing volumes in Quebec over a 10-year period, using government procurement policies to expand consumption of domestically processed aluminum, and encouraging expansion of aluminum smelters in Quebec.[435]

Although many of these programs began before 2011, the government of Quebec coordinated with aluminum smelters in the province during 2011–15 to encourage higher production and more collaboration along the aluminum value chain. The provincial government reportedly has typically provided both financial assistance and reduced electricity rates for aluminum smelters,[436] though the current trend has been toward working further down the value chain and supporting public-private partnerships. A 2011 initiative by the Canadian and Quebecois governments allocated over Can$200,000 to support the creation of the National Research Council Canada Aluminum Technology Centre in Chicoutimi. The center's tasks include studying the aluminum sector, helping small and medium-sized businesses to grow, and developing the scientific and technological processes for new end uses of aluminum.[437]

Tax and Tariff Policies

Canada's comparatively low taxation and tariff rates promote the growth of its aluminum industry without restricting domestic access to imports. The Canadian government has steadily reduced taxes to rates below those of other major worldwide economies. In 2015, the Canadian government noted that its effective business tax costs were the lowest of the G-7 member states and were 46 percent lower than U.S. businesses' taxes.[438] These measures reduced the Canadian aluminum industry tax burdens as it was trying to compete internationally, particularly with the United States.

From 2007 to 2015, the Canadian government also authorized the accelerated capital cost allowance (CCA) program, which allows companies to take accelerated depreciations for certain

[433] AluQuébec Aluminum Cluster, "The Role of AluQuébec," 2015.
[434] AluQuébec Aluminum Cluster, "AluQuébec Is Fully Committed," June 19, 2015.
[435] Government of Quebec, "The Future Is Taking Shape," 2006.
[436] *Globe and Mail*, "Quebec Needs to Move Beyond Simply Smelting," September 6, 2012.
[437] Marketwired, "Governments of Canada and Quebec," February 11, 2011.
[438] Government of Canada, "Supporting the Manufacturing Sector," April 21, 2015.

major capital investments. This program seeks to encourage investment in major machinery and equipment for production, which until 2015 provided a 50 percent depreciation rate for major capital purchases.[439] During 2011–15, more than 20,000 businesses took advantage of this incentive to reduce their production costs; the Latèrriere, Kitimat,[440] Baie-Comeau,[441] and Arvida smelters[442] underwent renovations that either expanded or contracted capacity, or that upgraded existing equipment and smelters.

Canadian import tariffs on aluminum, raw materials for aluminum, and related manufacturing equipment are low, with zero tariffs on primary aluminum products. Starting in 2009, the Canadian government also incrementally reduced or eliminated tariffs on some wrought and specialized aluminum products, including certain printed aluminum products, aluminum structures, and aluminum pipe.[443] The Canadian government also eliminated import tariffs for machinery, equipment, and manufacturing inputs, including bauxite and alumina.[444] The favorable tariff treatment, coupled with the lower-tax environment and CCA, has helped reduce operating costs for Canadian aluminum smelters and maintain or expand production throughout 2011–15.

Competitive Factors

The main reason cited for Canada's competitiveness in the primary unwrought aluminum sector is its low production costs.[445] Low energy costs, comparatively modern smelters (after the recent shutdowns of older aluminum smelters and new smelters coming online), and Canada's close proximity to the major U.S. aluminum market are the main drivers of Canada's aluminum production. Moreover, Canada's competitiveness in the U.S. market has grown with the reduction of U.S. primary capacity. The decline in the value of the Canadian dollar relative to the U.S. dollar in 2013–15 may have also supported Canadian aluminum exports (table 5.11). Given the relatively small sizes of Canada's secondary unwrought and wrought aluminum segments, this section will focus on the primary unwrought aluminum segment.

---

[439] Canada's revenue authority explains the benefit as follows: "Manufacturing and processing (M&P) machinery and equipment that would otherwise qualify for a 30% CCA (Class 43) will, for a limited time, qualify for an accelerated write-off. Eligible purchases acquired before 2016 will qualify for a 50% straight line accelerated CCA rate and will be placed in Class 29. Eligible purchases acquired after 2015 and before 2026 will qualify for a 50% declining balance accelerated CCA rate (new Class 53)." Government of Canada, Canada Revenue Agency, "How to Calculate the Deduction," January 3, 2017.
[440] *Journal de Québec*, "Rio Tinto Aluminum Investit" [Rio Tinto invests], April 27, 2016.
[441] Marowits, "Alcoa to Close Two Potlines in Quebec," May 16, 2013.
[442] SNC-Lavalin, "Arvida Aluminum Smelter" (accessed November 3, 2016).
[443] Government of Canada, CBSA, "Chapter 76-T2015 Aluminum," January 1, 2015.
[444] CME, "Canada Makes: Additive Manufacturing Forum," April 30, 2015.
[445] Industry representative, telephone interview by USITC staff, February 16, 2017.

Table 5.11: Canada: Selected competitive factors

Competitive factor	Segment	Impact on competitiveness
Inexpensive hydroelectric power	Primary unwrought	Canadian primary aluminum smelters purchase their energy either through Hydro-Québec or through the use of hydroelectric power plants operated for aluminum smelting facilities. The abundance of cheap, renewable hydroelectric energy substantially reduces Canada's aluminum production costs.
Updated smelter technology	Primary unwrought	Canadian smelters frequently undergo upgrades and refinements to existing smelter technology to maintain efficiency and cost competitiveness.
Proximity to U.S. market	All sectors	Canadian primary unwrought and wrought aluminum sectors have easy access to the U.S. market. The substantial size and consistent demand of the U.S. market has provided a consistent recipient for the majority of Canadian aluminum products.
Canadian currency exchange rate	Primary unwrought	Although the exchange rate between the Canadian dollar and U.S. dollar remained at relative parity during 2011–13, the decline in oil prices contributed to the fall in the value of the Canadian dollar from the end of 2014 to 2015. This likely decreased the relative costs for U.S. aluminum importers of Canadian aluminum, as Canadian inputs (such as wages) were distributed in Canadian dollars while aluminum is priced in U.S. dollars.

Source: Compiled by USITC staff.

Cost Overview

As noted earlier, Canada's low production cost for primary aluminum is generally cited as its main competitive strength. Canadian smelters benefit from low energy costs through their access to abundant and low-priced hydroelectric power. Transportation logistics are relatively simple given Canada's position as a feeder to U.S. markets (although actual transportation costs are not as competitive as those of most major primary aluminum producers and are lower only than Russia's).[446] Additionally, the Canadian industry's modern technology improves production efficiency (table 5.12). Other factors (e.g., declining alumina prices[447]) have also reduced operating costs, though to a lesser extent than the three factors highlighted above. In contrast, other traditional production cost components do not provide Canada with a competitive advantage. For example, wage rates for aluminum smelter jobs are comparable to those in the United States and Western Europe, higher than in Russia, and much higher than in China.[448] These higher rates are partially offset by relatively high labor productivity.

[446] CRU Groups' estimated total delivery cost for Canadian aluminum is $61 per mt. For the United States, this cost is $26 per mt, and for Russia it is $83 per mt (all dollar amounts are U.S. dollars). Metal delivered cost is defined as the cost for delivering the aluminum from the smelter to a pricing point, which is either the regional market, the nearest LME warehouse, or the nearest port. CRU Group.

[447] Alumina prices have declined in 2011–15 from an average price for Canadian smelters of $743 per mt to $588 per mt. However, this decline in alumina prices has also occurred for U.S. aluminum smelters, which suggests it does not increase Canada's relative competitiveness in primary aluminum production. CRU Group.

[448] CRU Group.

Table 5.12: Canada: Primary unwrought aluminum average business costs, 2011–15 (dollar per mt of primary aluminum)

Cost component	2011	2012	2013	2014	2015
Alumina	743	639	624	621	588
Electricity	341	335	310	301	252
Labor	236	230	216	190	167
Anode	263	232	213	197	181
Other[a]	297	289	274	251	214
Total liquid metal costs	1,881	1,725	1,636	1,558	1,402
Casthouse	104	92	92	91	87
Net realizations[b]	-146	-202	-234	-428	-287
Average business costs	1,839	1,615	1,495	1,222	1,202
Global average business costs	2,041	1,766	1,639	1,541	1,435
LME cash price	2,395	2,018	1,845	1,867	1,661

Source: CRU Group.
Note: Because of rounding, total may not equal the sum of the line items.
[a] Other costs covers bath material, pot relining, smelter fuel, maintenance and other supplies, sustaining capital, working capital on supplies.
[b] CRU Group uses the net realization cost adjustments to account for variances in product quality impacting production costs, but does not include overheard costs in overall corporate costs.
[c] LME=London Metal Exchange

Most production costs for Canadian primary aluminum smelters have fallen from 2011 to 2015. Although costs of certain production components (e.g., alumina) have declined both in Canada and in other major aluminum-producing nations, other production cost declines (e.g., potroom power costs) have been Canadian-specific.

Low Electric Power Costs Are the Key Competitive Advantage of Canadian Smelters

Canada is the third-largest hydropower producer in the world, after China and Brazil.[449] Industry observers noted that as a result, Canada has among the lowest energy costs of any global producer of primary aluminum.[450] Average potroom energy costs were $252 per mt of aluminum produced in Canada in 2015, compared to $532 per mt in the United States in 2015.[451]

[449] WEC, "Energy Resources: Hydropower," 2016.
[450] Industry representative, telephone interview by USITC staff, February 16, 2017.
[451] CRU Group.

Smelters in Quebec procure the majority of their hydropower from the province's public utility Hydro-Québec (since the 1960s[452]), along with some power from independent generators.[453] Outside Quebec, the Kitimat aluminum smelter in British Columbia relies on the hydropower station in nearby Kemano.[454] In 2013, Alcoa's smelters at Baie-Comeau, Deschaumbault, and Bécancour negotiated long-term limited rate increases from 2014 to at least 2030 (at least 2036 for Baie-Comeau), ranging from 2.8 cents to 3.3 Canadian cents (approximately 2.0–2.4 U.S. cents) per kilowatt-hour (kWh).[455] Rio Tinto also negotiated reduced energy prices in 2013 with Hydro-Québec.[456]

To illustrate the differences, a comparison of the energy costs between a typical Canadian primary aluminum smelter procuring its energy from Hydro-Québec and a recently closed U.S. primary aluminum smelter is provided in table 5.13. Quebec aluminum producers generally operate with prices around 3 Canadian cents per kWh; though negotiated price agreements vary slightly among smelters, they do not depart significantly from this price. By comparison, a 2015 agreement between the Missouri Public Service Commission and the New Madrid smelter, which has since closed, lowered energy prices to 3.8 cents per kWh.[457]

Table 5.13: Canada: Comparison of Canadian and U.S. primary smelter energy costs, 2010 and 2014

Item	Baie-Comeau (Canada)	New Madrid (United States)	Difference between Canadian and U.S. price
Aluminum energy cost	2.5 cents/kWh[a]	3.8 cents/kWh	34.2 percent
Local consumer energy cost	3.8 cents/kWh	8.8 cents/kWh[b]	56.8 percent

Source: CBC News, "Alcoa Aluminum Company Reaches Power Deal," February 25, 2014; *Saint Louis Today*, "Noranda's Pleas over Electric Rates Stir Worry," April 8, 2011.

[a] Converted from Canadian dollar price to U.S. dollar price using exchange rate US$1 = Can$1.3072; Can$0.033 = US$0.0254. Federal Reserve, "Historical Rates for the Canadian Dollar: June 2016," June 2016.

[b] Missouri Department of Energy, "Electricity Bill Fact Sheet," 2010.

[452] Hydroéléctricité, "The Nationalization of Electricity," 2010.
[453] Energie et Ressources Naturelles Québec, "Consommation d'Energie par Forme" [End-use consumption by energy type], 2015.
[454] Bechtel, "Kitimat Aluminum Smelter Modernization, British Columbia, Canada," 2015.
[455] CBC News, "Alcoa Aluminum Company Reaches Power Deal," February 25, 2014.
[456] *Globe and Mail* (Toronto), "Quebec Signs Deal with Rio Tinto Alcan," December 19, 2014.
[457] *American Metal Marke*t, "Power Rates Drive US Aluminum Industry's Future," March 31, 2016.

Continuous Upgrading of Potline Technology Enhances Canadian Smelting Efficiency

As a result of upgrades to existing plants and the shutdown of older, less efficient facilities, Canada's aluminum smelters are more energy efficient than those in most other producing countries.[458] In fact, energy efficiency (e.g., electricity consumed per mt of aluminum) for the Canadian aluminum industry has improved since 1990, while energy intensity (total electricity consumption) has been relatively stable throughout 2011–15.[459] Increased energy efficiency has been facilitated by new technology coming online in several smelters, particularly the Kitimat smelter in British Columbia, as well as the Arvida, Laterrière, and Alma smelters in Quebec. In addition, the closure of older aluminum smelters (including the Beauharnois and Shawinigan smelters) with less efficient technology has reduced the average operating costs of Canadian primary aluminum smelters.

Canadian Smelters Benefit from Proximity to Large U.S. Market

Canada's ready access to the United States, one of the largest aluminum markets in the world, both lowers transportation costs and provides a market to absorb Canadian production capacity. The United States has remained a stable destination for Canadian aluminum exports, which has allowed Canadian firms to expand operations with the expectation that the large U.S. market will absorb their increased production.

Additionally, due to the proximity to the United States, Canadian unwrought aluminum producers benefit from lower insurance rates and freight costs than other U.S. major trade partners. From 2011 to 2015, the average shipping cost for U.S. imports of Canadian unwrought aluminum for consumption was $16.35 per mt. In contrast, Russia's average cost for shipping unwrought aluminum to the United States in the same period was $53.38 per mt; in the case of the United Arab Emirates, it was $120 per mt.[460]

The concentration of aluminum smelters in Quebec provides relatively easy transportation options to the U.S. market. Most primary aluminum produced in Canada travels along rivers that run through Quebec; from there, it can then be transported to the ports for warehousing and purchase by U.S. buyers.[461] This simplifies logistics management for Canadian aluminum

[458] Industry representative, telephone interview by USITC staff, February 16, 2017.
[459] Hydro-Québec, *Annual Report*: *2014*.
[460] USITC, DataWeb database, "HTS 7601: Aluminum, Unwrought, Charges, Insurance, and Freight for All Countries, U.S. Imports for Consumption" (accessed September 22, 2016).
[461] USITC, hearing transcript, September 29, 2016 (testimony of Jean Simard,) (CAA).

smelters. Moreover, the Canadian smelting firms have longstanding commercial relationships with consuming industries in the United States. For example, Canadian primary production has a natural market in Alcoa’s large operations producing wrought aluminum in the United States.

Bibliography

Alcoa Corporation. "Deschambault." https://www.alcoa.com/alcoacarriers/en/locations/overview.asp?loc=Deschambault_QC-_Primary_Metals (accessed November 15, 2016).

———. *Outlook on Sustainability 2015*. Report, December 31, 2015. https://www.alcoa.com/canada/en/pdf/sustainability/rdd15_eng.pdf .

Aleris Inc. "Aleris Attains Qualification to Supply Bombardier from Zhenjiang, China." Press release, September 29, 2014. https://www.aleris.com/case-studies/aleris-attains-qualification-to-supply-bombardier-from-zhenjiang-china-2/.

Aluminum Association. *North American Extrusion Press Directory 2014,* December 18, 2014. http://www.aluminum.org/north-american-aluminum-press-directory-2014 (fee required).

———. "Secondary Production: Quick Read." http://www.aluminum.org/industries/production/secondary-production (accessed February 10, 2017).

Aluminium Association of Canada (AAC). "Aluminium Infrastructure and Bridges: Context and Objective." https://aluminium.ca/en/aluminium/infrastructure-and-bridges (accessed February 1, 2017).

———. "Aluminium: Over 100 Years of History in Canada," https://aluminium.ca/en/aluminium/history (accessed July 17, 2016).

———. "Aluminium Transport: Context and Objective." https://aluminium.ca/en/aluminium/transport (accessed February 6, 2017).

AluQuébec. "Aluquébec Is Fully Committed to the Success of Quebec's Aluminum Development Strategy." Press release, June 19, 2015. http://aluquebec.com/en/publications/press-releases/aluquebec-fully-committed-success-quebec-s-aluminum-development-strategy.

———. "The Role of AluQuébec." http://aluquebec.com/en/aluquebec/role-aluquebec (accessed January 10, 2017).

Brown, David Parker. “An Inside Look at the New Bombardier CSeries—Literally.” *Airline Reporter*, February 3, 2012. http://www.airlinereporter.com/2012/02/tour-of-the-bombardier-cseries-mock-up/.

Bechtel Corp. “Kitimat Aluminum Smelter Modernization, British Columbia, Canada.” http://www.bechtel.com/projects/kitimat-aluminum-smelter-modernization/ (accessed February 11, 2017).

Bell, Terence. “Commodities: The World’s Biggest Aluminum Producers.” The Balance, November 20, 2016. https://www.thebalance.com/the-10-biggest-aluminum-producers-2012-2339722.

Bombardier Inc. “Bombardier Inaugurates Advanced Monorail Vehicle Manufacturing Site in Brazil.” Press release, April 13, 2012. http://www.bombardier.com/en/media/newsList/details.34233-bombardier-inaugurates-advanced-monorail-vehicle-manufacturing-site-in-brazil.bombardiercom.html?filter-bu=transport.

Canadian Encyclopedia. “Aluminum,” March 4, 2015. http://www.thecanadianencyclopedia.ca/en/article/aluminum/.

Canadian Manufacturers and Exporters (CME). “Canada Makes: Additive Manufacturing Forum.” Forum schedule for meeting in Hamilton, Ontario, April 30, 2015. http://www.cme-mec.ca/?lid=E5ELR-JJPAC-EYBZZ&comaction=show&cid=RQRX9-7SRCF-QGHWX (accessed January 5, 2017).

Canadian Metalworking. “Metalworking: Rio Tinto Alcan Inaugurates New AP60 Aluminum Smelter in Quebec,” January 17, 2014. http://www.canadianmetalworking.com/news/metalworking/rio-tinto-alcan-inaugurates-new-ap60-aluminum-smelter-in-quebec.

Canadian Mining Journal. “Aluminum Production: Permanent Closure Planned for Beauharnois Smelter,” January 25, 2009. http://www.canadianminingjournal.com/news/aluminum-production-permanent-closure-planned-for-beauharnois-smelter/.

CBC News. “Alcoa Aluminum Company Reaches Power Deal with Quebec,” February 25, 2014. http://www.cbc.ca/news/canada/montreal/alcoa-aluminum-company-reaches-power-deal-with-quebec-1.2550681.

———. "Kitimat Rio Tinto Aluminum Smelter Re-opens," July 7, 2015. http://www.cbc.ca/news/canada/british-columbia/kitimat-rio-tinto-aluminum-smelter-re-opens-1.3141077.

———. "Rio Tinto Alcan to Close Shawinigan Smelter," August 7, 2013. http://www.cbc.ca/news/business/rio-tinto-alcan-to-close-shawinigan-que-smelter-1.1338873.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Destination Sept-Îles. "Alouette Aluminium Plant." https://destinationsept-iles.com/en/attractions/alouette-aluminium-plant (accessed December 1, 2016).

Globe and Mail (Toronto). "Quebec Signs Deal with Rio Tinto Alcan to Preserve 1,000 Jobs at Arvida Plant." Canadian Press, December 19, 2014. http://www.theglobeandmail.com/report-on-business/quebec-signs-deal-with-rio-tinto-alcan-to-preserve-1000-jobs-at-arvida-plant/article22167004/.

Goldstein, Steve, and Laura Mandaro. "Rio Tinto to Buy Alcan for $38 Billion." Market Watch, July 12, 2007. http://www.marketwatch.com/story/rio-tinto-agrees-to-acquire-alcan-for-381-billion-in-cash.

Government of Canada. Canada Border Services Agency (CBSA). *Customs Tariff—Schedule*. Chapter 76: "Aluminum and Articles Thereof," January 1, 2015. http://www.cbsa-asfc.gc.ca/trade-commerce/tariff-tarif/2015/01-99/ch76-2015-eng.pdf.

———. Canadian International Trade Tribunal (CITT). *Aluminum Extrusions: Expiry Review No. RR-2013-003*; *Anti-Dumping Injury Inquiries Expiry Reviews (section 76.03); Orders and Reasons Issued—Final*, March 28, 2014. http://www.citt.gc.ca/en/node/6412.

———. Canada Revenue Agency. "How to Calculate the Deduction for Capital Cost Allowance (CCA)," January 3, 2017. http://www.cra-arc.gc.ca/tx/bsnss/tpcs/slprtnr/rprtng/cptl/hw-eng.html.

———. Innovation, Science and Economic Development Canada. Industries and Business. "Company Profiles—Canadian Company Capabilities: Real Alloy," February 25, 2016. http://www.ic.gc.ca/app/ccc/srch/nvgt.do?lang=eng&prtl=1&estblmntNo=131240780000&profile=cmpltPrfl&profileId=2052&app=sold.

———. Statistics Canada. "Population by Year, by Province and Territory." Summary table, September 28, 2016. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/demo02a-eng.htm.

———. "Supporting the Manufacturing Sector and Investing in Advanced Research." Chapter 3.1, *Canadian National Budget: Budget 2015; Budget Plan*, April 21, 2015. http://www.budget.gc.ca/2015/docs/plan/ch3-1-eng.html.

Government of Québec. Énergie et Ressources Naturelles Québec. "Consommation d'énergie par forme (1988–2013)" [End-use consumption by energy type]. https://mern.gouv.qc.ca/energie/statistiques/statistiques-consommation-forme.jsp (accessed August 12, 2016).

———. Énergie et Ressources Naturelles Québec. *The Future is Taking Shape: The Québec Aluminium Development Strategy 2015–2025*. https://www.economie.gouv.qc.ca/fileadmin/contenu/publications/administratives/strategies/strategie_aluminium_en.pdf (accessed January 3, 2017).

———. Hydro-Québec. *Hydro-Québec Annual Report: 2014*, December 31, 2014, 7–20. http://www.hydroquebec.com/publications/en/docs/annual-report/annual-report-2014.pdf.

Grant Thornton LLP. "Section 1—Businesses: Calculating Depreciation." *Tax Planning Guide [Canada] 2016–2017*. http://www.taxplanningguide.ca/tax-planning-guide/section-1-businesses/calculating-depreciation (accessed April 29, 2017).

Hydroéléctricité. "The Nationalization of Electricity," 2010. http://www.hydroelectricite.ca/en/the-nationalization-of-electricity.php (accessed February 1, 2016).

IHS Markit. Global Trade Atlas (GTA) database. www.ihs.com (accessed April 4, 2017) (fee required).

Journal de Québec. "Rio Tinto Aluminium investit 36.6 millions $ à Laterrière" [Rio Tinto Aluminium invests Can$36.6 million in Laterrière], April 27, 2016. http://www.journaldequebec.com/2016/04/27/rio-tinto-aluminium-investit-366-millions--a-laterriere.

Kaiser Aluminum Corp. "About Us: Facilities," https://www.kaiseraluminum.com/about-us/facilities/ (accessed February 13, 2017).

Maltais, Kirk. "Power Rates Drive US Aluminum Industry's Future." *Metal Bulletin*, March 31, 2016. http://www.amm.com/Article/3541758/Power-rates-drive-US-aluminum-industrys-future.html.).

Marketwired (Nasdaq, Inc.). "Governments of Canada and Quebec Support Aluminium Industry in Chicoutimi." Press release, February 11, 2011. http://www.marketwired.com/press-release/governments-of-canada-and-quebec-support-aluminium-industry-in-chicoutimi-1394440.htm.

Marotte, Bertrand. "Quebec Needs to Move beyond Simply Smelting Aluminum." *Globe and Mail* (Toronto), September 6, 2012. http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/quebec-needs-to-move-beyond-simply-smelting-aluminum/article4200636/.

Marowits, Ross. "Alcoa to Close Two Potlines in Quebec, Eliminating about 500 Jobs." *Financial Post* (Postmedia Network Inc., Canada), May 16, 2013. http://business.financialpost.com/news/alcoa-to-close-two-potlines-in-quebec-eliminating-about-500-jobs.

Matalco Inc. "Contact Us: Head Office/Brampton Operations, Brampton, Ontario." http://www.matalco.com/contact.htm (accessed February 13, 2017).

Nemak. "About Us," http://www.nemak.com/about-us/?sc=0 (accessed May 1, 2017).

PR Newswire. "Can$1.45 Billion Expansion of Aluminerie Alouette Completed on Budget and Ahead of Schedule." News release, September 20, 2005. http://www.prnewswire.com/news-releases/can145-billion-expansion-of-aluminerie-alouette-completed-on-budget-and-ahead-of-schedule-55077557.html.

Recycling Today. "Secondary Aluminum Producers: Secondary Aluminum Producers in North America." List of producers by state and map, June 2, 2015. https://www.recyclingtoday.com/FileUploads/file/SecondaryAluminum-producers.pdf.

Reuters. "Quebec Aluminum Smelter Hit by Power Failure," July 7, 2010. http://uk.reuters.com/article/riotinto-quebec-idUKN0715368620100707.

Rio Tinto. "Alma," http://www.riotinto.com/aluminium/alma-4808.aspx (accessed July 5, 2016).

———. "Alouette," http://www.riotinto.com/aluminium/sept-iles-alouette-4811.aspx (accessed July 5, 2016).

———. "Arvida/AP60 Technology Centre," http://www.riotinto.com/aluminium/arvida-4813.aspx (accessed November 10, 2016).

———. "Bécancour," http://www.riotinto.com/aluminium/becancour-4814.aspx (accessed November 15, 2016).

———. "Breaking Old Ground: Launch of the Laterrière Smelter Expansion." Press release, July 7, 2016. http://www.riotinto.com/ourcommitment/spotlight-18130_18914.aspx.

———. "Grande-Baie," http://www.riotinto.com/aluminium/grande-baie-4816.aspx (accessed November 15, 2016).

———. "Kitimat," http://www.riotinto.com/canada/bcworks/kitimat-kemano-17841.aspx (accessed November 15, 2016).

———. "Vaudreuil," http://www.riotinto.com/aluminium/vaudreuil-4729.aspx (accessed January 5, 2017).

Rio Tinto Alcan. Public Sales. "Our Global Network: Americas," https://www.rtapublicsales.riotinto.com/En/OurGlobalNetwork/Americas/Pages/HomePage.aspx (accessed February 6, 2016).

———. "Rio Tinto Alcan Announces C$36 Million Investment at Its Laterrière Smelter in Quebec." News release, via CNW Telbec, May 17, 2011. http://www.newswire.ca/news-releases/rio-tinto-alcan-announces-c36-million-investment-at-its-laterriere-smelter-in-quebec-508241811.html.

———. *Rio Tinto Alcan in North America*. Montreal: Rio Tinto Alcan, June 14, 2016. http://www.riotinto.com/documents/140627_RioTinto_Alcan_site_visit_case_studies.pdf.

Rochester Aluminum Smelting Canada Ltd. (Rochester Aluminum). "Products: Rochester Aluminum and Greenway Industries Produce a Wide Range of Secondary Aluminum Products." http://www.rochesteraluminum.com/products/ (accessed January 30, 2017).

Sapa Group, "About Sapa," http://www.sapagroup.com/en/about-us/around-the-world-with-sapa/canada/ (accessed February 7, 2017).

Scepter, Inc. "Saguenay, Québec," http://www.scepterinc.com/locations-map/saguenay-queacutebec.647165 (accessed February 7, 2017).

Signature Aluminum Canada, Inc. “Services: Extrusion,” https://www.signaturealum.com/services_extrusion.cfm (accessed February 13, 2017).

SNC-Lavalin. “Arvida Aluminum Smelter, AP60 Technology Centre,” http://www.snclavalin.com/en/arvida-aluminium-smelter-ap60-technology-centre (accessed November 3, 2016).

State of Missouri. Missouri Department of Economic Development. Division of Energy. “Electricity Bill Fact Sheet,” 2010. https://energy.mo.gov/energy/docs/Electricitybillfactsheet.pdf.

Tomich, Jeffrey. “Business: Noranda’s Pleas over Electric Rates Stir Worry in Bootheel.” *Saint Louis Post-Dispatch*, April 8, 2011. http://www.stltoday.com/business/local/noranda-s-pleas-over-electric-rates-stir-worry-in-bootheel/article_9da4f143-90bd-57b9-a7ec-1b9a1ea73788.html.

U.S. Census Bureau. “Quick Facts: California.” http://www.census.gov/quickfacts/table/PST045216/06 (accessed February 10, 2017).

U.S. Federal Reserve. “Historical Rates for the Canadian Dollar: 2000–Present.” https://www.federalreserve.gov/releases/h10/hist/dat00_ca.htm (accessed February 5, 2017).

U.S. International Trade Commission (USITC)/U.S. Department of Commerce (USDOC). Interactive Tariff and Trade DataWeb database (DataWeb). https://dataweb.usitc.gov (accessed September 22, 2016).

———. Hearing transcript in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

Van der Linde, Damon. “Rio Tinto Dropping Alcan Name at New Montreal Headquarters." *Financial Post* (Toronto), May 12, 2015. http://business.financialpost.com/news/mining/rio-tinto-dropping-alcan-name-at-new-montreal-headquarters.

Vandervort, Don. “Pros and Cons of Metal Roofing.” Blog, HomeTips.com, June 24, 2016. https://www.hometips.com/buying-guides/metal-roofing-drawbacks.html (accessed February 1, 2017).

World Atlas. "Economics: Top Aluminum Producing Nations in the World," March 13, 2017. http://www.worldatlas.com/articles/top-aluminum-producing-nations-in-the-world.html.

World Bureau of Metal Statistics (WBMS). "Aluminum, Secondary Ingot Production." *World Metal Statistics* (accessed April 3, 2017) (fee required).

World Energy Council (WEC). "Data: Energy Resources; Hydropower." https://www.worldenergy.org/data/resources/resource/hydropower/ (accessed August 2, 2016).

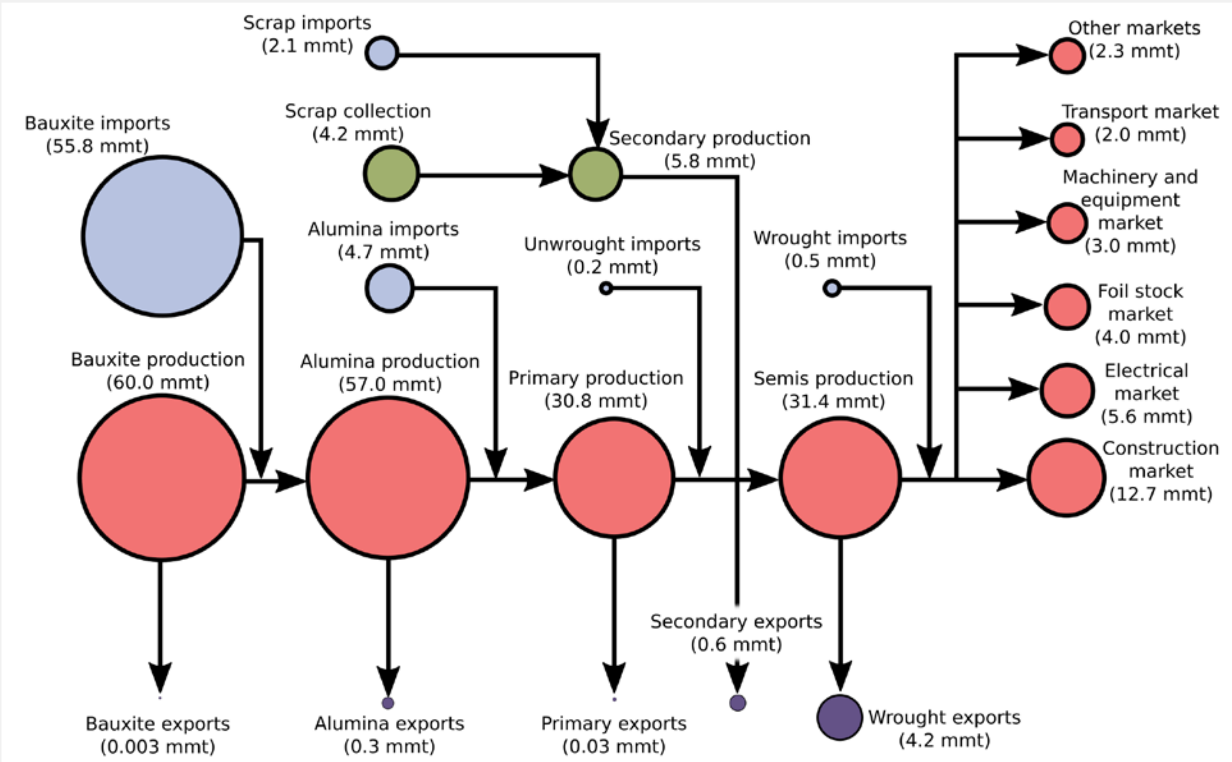
Chapter 6
China

Overview

China's aluminum industry and market grew rapidly during 2011–15. China is the largest global producer of both primary and wrought aluminum, and is a substantial producer of secondary aluminum (figure 6.1). China's primary aluminum industry—which mainly serves the domestic market—significantly improved its technology and reduced production costs after 2011. As a result of these improvements, government policies, and the idling of high-cost production capacity, China's average cash costs of production, which were substantially higher than those of the rest of the world in 2011, fell to within 1 percent of the rest of the world's costs by the third quarter of 2016.[462] The Chinese secondary industry continued to expand, but faced a number of challenges (including rising labor costs) that slowed growth. China's wrought aluminum industry lowered its production costs, increased exports of commodity products, and moved into certain higher-value-added goods, such as aerospace sheet. However, there are other high-value-added industry segments (e.g., automotive sheet) in which China has only limited production.

[462] Data for the rest of the world do not include the United States. Vazquez, hearing exhibits, September 29, 2016, 3. Cash costs are defined by Harbor Aluminum as the costs "before casting (molten metal). Does not include depreciation, interest payments or working capital; excludes applicable VAT of 17% that Chinese aluminum smelters pay on raw materials, energy and services." Consistent with the rest of this report, this chapter primarily uses data on average business costs. In some instances, particularly where 2016 data were used and in other instances where business cost data were not readily available at the time of writing, cash costs were used.

Figure 6.1: China: Aluminum production value chain, 2015



Source: CRU Group. IHS Markit, GTA database (accessed April 2016–September 2016); CNIA, post hearing brief to the USITC, October 17, 2016, exhibit 1, 20; USGS, "Bauxite and Alumina," 2016, 33.
Note: mmt = million metric tons. All items are to scale, except the symbol for bauxite exports, which if to scale would be slightly smaller. The figures for the wrought market and exports come from different sources and, when combined, slightly exceed the figure for total wrought production. This figure does not include the 0.8 mmt of net increase in primary aluminum inventories.

The extent of China's exports varies by industry segment. Exports by China's primary aluminum industry are limited by government policies—export tariffs and a value-added tax (VAT)—and China is a net importer of primary aluminum. The secondary industry is more export oriented, with firms importing aluminum scrap, processing it, and exporting the resulting secondary aluminum to markets in East Asia. The Chinese wrought industry substantially increased its global exports during 2011–15, and accounted for about one-third of 2015 global exports. Exports substantially increased across all three main product types—bars, rods, and profiles; plates, sheets, and strip; and foil. The United States was the largest export destination for wrought products.[463]

Many Chinese unwrought and wrought aluminum producers benefit from government policies, but these benefits are spread unevenly across the industry, and state-owned enterprises (SOEs) tend to receive the most support. The Chinese government generally orients aluminum trade policies in a way that reduces barriers to raw material imports, discourages the export of

[463] IHS Markit, GTA database (accessed April 4, 2017).

primary unwrought aluminum, and reduces barriers to the export of most forms of wrought aluminum. National energy policies have generally reduced electricity costs across all industries, while provincial governments have specifically assisted aluminum companies by offering lower electricity prices to local smelters. Finally, aluminum companies benefit from direct support such as financing, taxes, grants, and reduced land-use fees. Public information for 15 primary and wrought producers indicates that, for these companies, income from government grants totaled almost $500 million in 2015.[464]

Industry Structure

China's three industry segments—primary unwrought, secondary unwrought, and wrought aluminum—have distinct industry structures. The primary industry is the most concentrated. It includes large Chinese private firms and SOEs (and only limited foreign participation); tends to be vertically integrated; and is characterized by a trend toward building large, advanced technology plants in low-cost locations (though many smaller smelters continue to exist). The secondary industry, on the other hand, has extensive participation by foreign firms, less industry concentration, and limited downstream vertical integration. Like the primary industry, some firms are adopting more advanced technology in order to lower production costs. The wrought industry is also fragmented, with a large number of producers, though there are also large, advanced plants in China.

Some Chinese primary producers are vertically integrated downstream into wrought production. There are also a number of foreign-invested firms engaged in wrought production in China, often producing high-value-added products. Some wrought producers have followed primary producers to low-cost locations in Western China, but production remains concentrated in East and South Central China, as proximity to customers and ease of export remain important considerations in plant locations.

[464] These data are only for those 15 companies, and therefore the amount of grants received by all firms in the industry in 2015 was likely higher. In addition, for these companies, this total is only a portion of the benefits that firms receive from government policies, as it only applies to income recorded as government grants on financial statements. Companies may use different accounting methods and approaches to reporting government grants; therefore, there may be some differences in what is included. Further, the data on government grants presented here do not include deferred income. Compiled from financial reports of publicly traded Chinese aluminum companies.

Primary Unwrought Aluminum

Number, Location, and Concentration

The Chinese primary aluminum industry is composed of a mix that encompasses SOEs, including those owned by local governments; publicly traded firms, including some in which SOEs and individuals have large ownership stakes; and private companies (table 6.1). Foreign-invested enterprises account for a relatively small share of Chinese production in this segment. The two firms with the most production capacity in 2011 were both SOEs—Aluminum Corporation of China (Chalco) and State Power Investment Co.—but non-SOEs accounted for at least 60 percent of China's primary aluminum capacity additions[465] during 2011–15. A substantial portion of expansions in the non-SOE sector were driven by one firm: China Hongqiao Group, which accounted for 23 percent of all capacity additions in China during 2011–15. Other firms with capacity additions exceeding 1 million mt were three non-SOEs (Xinfa Group, Xinren Aluminum Holdings Ltd., and East Hope Group) and one SOE (Jiuquan Iron and Steel Group).[466]

Table 6.1: China: Leading primary unwrought aluminum producers (by majority ownership of plants), production location and capacities, and extent of vertical integration

Company	Smelter locations (2016)	Ownership structure: SOE or SOE subsidiary?	Production (thousand mt)		Share of 2015 production (percent)	Capacity in 2015 (thousand mt)	Capacity utilization in 2015 (percent)	Alumina refining?
			2011	2015				
China Hongqiao Group	Shandong	No	1,594	5,038	16.3	5,779	87	Yes
Aluminum Corp. of China (Chalco)	Gansu, Guangxi, Guizhou, Henan, Hunan, Inner Mongolia, Liaoning, Ningxia, Qinghai, Shandong, Shanxi, Xinjiang	Yes	3,474	3,291	10.7	3,905	84	Yes
Xinfa Group	Guangxi, Shandong, Xinjiang	No	1,350	2,751	8.9	3,235	85	Yes
State Power Investment Co.	Chongqing, Inner Mongolia, Ningxia, Qinghai, Sichuan	Yes	2,048	2,423	7.9	3,048	80	Yes
East Hope Group	Inner Mongolia, Xinjiang	No	675	1,775	5.8	1,876	95	Yes
Jiuquan Iron & Steel Group	Gansu	Yes	254	1,353	4.4	1,710	79	No
Shenhuo Coal and Power Co.	Henan, Xinjiang	Yes	565	1,173	3.8	1,500	78	Yes

[465] Defined as new smelter capacity brought online. Does not include smelters taken offline or where production capacity was reduced.
[466] CRU Group. Firm capacity expansion totals are for smelters in which firms have a majority ownership, as described in table 6.1 and with the exceptions noted in table 6.1.

Company	Smelter locations (2016)	Ownership structure: SOE or SOE subsidiary?	Production (thousand mt) 2011	Production (thousand mt) 2015	Share of 2015 production (percent)	Capacity in 2015 (thousand mt)	Capacity utilization in 2015 (percent)	Alumina refining?
Yunnan Metallurgical Group	Yunnan	Yes	501	1,157	3.8	1,205	96	Yes
Xinren Aluminum Holdings Ltd.	Guizhou, Xinjiang	No	138	1,060	3.4	1,276	83	No
Shandong Nanshan Aluminium Co. Ltd.	Shandong	No	503	848	2.8	856	99	Yes

Source: Production, capacity utilization, and smelter location data are from the CRU Group; alumina production information is from CM Group; all other data are compiled by USITC staff from company websites, financial reports, media reports, and interviews by industry representatives. Data for State Power Investment Co. include smelters for which the company has an ownership stake and operates the smelter, but is not the majority owner.
Note: Total capacity of smelters in which firm is the majority owner, unless otherwise noted.

Overall, the primary aluminum industry is becoming more concentrated over time, with the top 2 firms together accounting for more than one-quarter (27 percent), and the top 5 firms accounting for nearly one-half (49.5 percent), of Chinese production in 2015. During 2011–15, the top 10 firms combined accounted for 87 percent of the increase in primary aluminum production. However, there are still a large number of smaller producers in China—overall, more than 50 companies produced primary aluminum in China in 2015, with production taking place at about 100 smelters.[467]

Most of the major primary aluminum producers in China are vertically integrated upstream (e.g., into bauxite mining, alumina refining, and electric power generation), downstream (into wrought production), or both. The top five aluminum producers all have significant alumina capacity—some produce according to their internal demand, some produce only a portion of their internal demand and still others produce significant excess alumina for commercial sale.[468] Outside of the top five producers, there is significant variation in whether firms produce alumina, and in the extent to which they do so.[469] Substantial new alumina refining capacity is anticipated to come online in the near term, with 11.5 million mt per year of capacity under construction as of September 2016.[470]

Chinese smelters are also increasingly vertically integrated upstream in power generation. More and more companies are building their own electricity generation plants (captive power

[467] CRU Group. See the production section below for a discussion of differences in capacity utilization by smelter size.
[468] Industry representative, interview by USITC staff, Washington, DC, September 27, 2016.
[469] Ibid.
[470] Al Clark, hearing exhibits to the USITC, September 29, 2016, 9.

plants), and they often have their own coal mines, which results in lower power prices than if they were purchasing power from the electric grid.[471] In 2015, 63 percent of the electricity used in aluminum production was generated by captive power plants, rather than purchased from a supplier. This is up from 2011, when only one-half of the power used was self-generated.[472] The share of primary aluminum smelting with captive power plants is continuing to grow: of the new aluminum smelter projects announced during 2011–15, 79 percent were planned with captive power plants.[473] And of these new projects with captive power plants, 71 percent had their own coal mine.[474]

Chinese companies are building smelters in Northwest China and Inner Mongolia, which have lower production costs because they are near low-cost coal resources, among other factors.[475] The share of Chinese production capacity sited in these areas increased from 33 percent in 2011 to 47 percent in 2015, and the number of smelters there more than doubled to 37 (table 6.2 and figure 6.2). Capacity expansions by China Hongqiao—China's largest producer—in Shandong have driven the growth in capacity in East China, the second fastest growing region in terms of the volume of capacity additions, while expansions by Yunnan Aluminum have driven the growth in production capacity in Southwest China.[476]

Table 6.2: China: Primary unwrought aluminum production, capacity, capacity utilization, and number of smelters, by region and select provinces within each region, 2006, 2011, and 2015

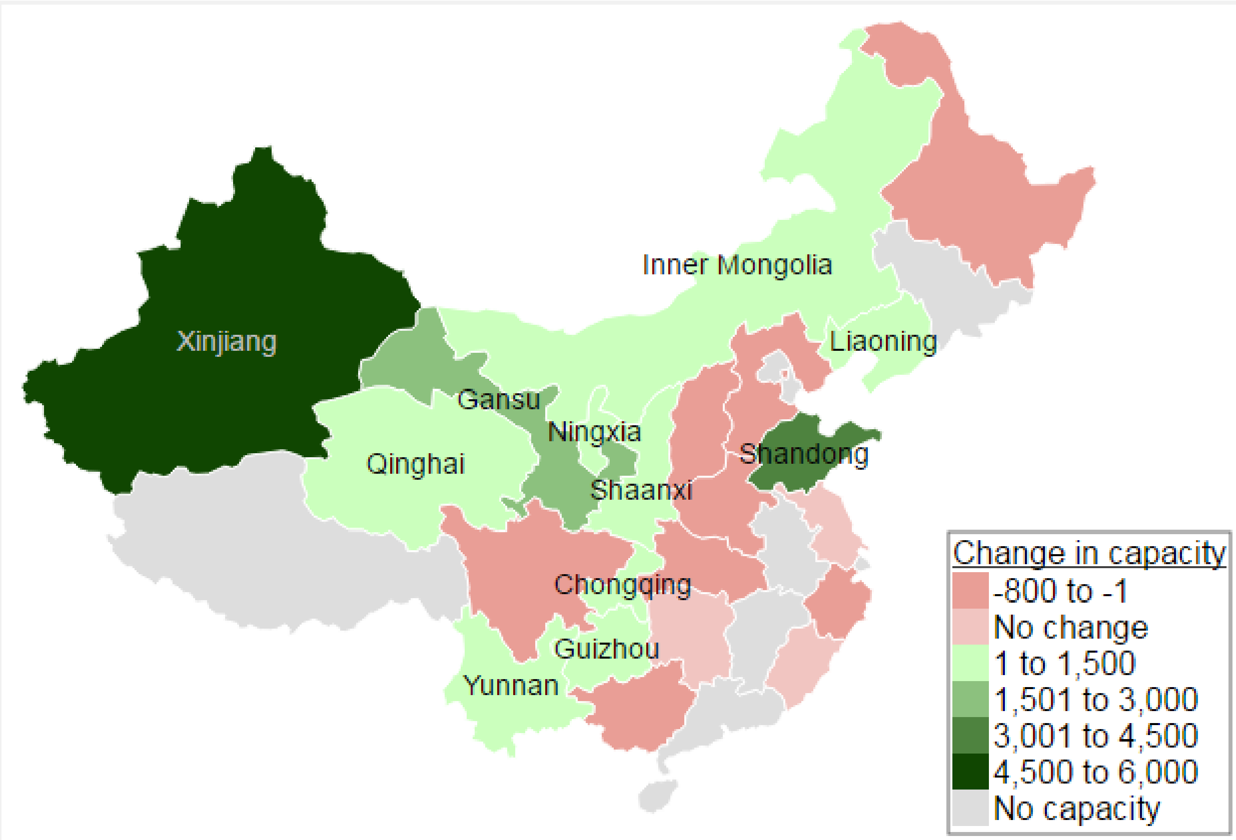
	Production (million mt)			Capacity (million mt)			Capacity utilization (%)			Number of smelters		
	2006	2011	2015	2006	2011	2015	2006	2011	2015	2006	2011	2015
Northwest China and Inner Mongolia	2.9	6.7	15.2	3.4	7.6	18.1	86	88	84	18	31	37
Xinjiang	0.05	0.4	5.6	0.1	0.6	6.4	62	68	88	2	6	8
Inner Mongolia	0.7	1.8	3.1	0.9	2.0	3.3	77	92	93	4	6	7
Gansu	0.6	1.2	2.5	0.7	1.3	3.0	93	89	82	5	5	6
East China	1.1	4.0	7.6	1.4	4.6	8.7	81	86	88	14	14	14
Shandong	0.9	3.6	7.5	1.2	4.2	8.4	80	86	89	11	11	13
South Central China	2.7	5.2	3.9	3.3	6.3	5.4	82	82	72	28	27	19
Henan	2.0	3.9	3.0	2.4	4.7	3.9	84	84	76	18	18	11
Southwest China	1.6	2.7	3.0	2.0	3.2	4.2	82	84	73	16	15	18

[471] *South China Morning Post*, "China Hongqiao Builds," June 14, 2015; CNIA, post hearing brief to the USITC, October 17, 2016, exhibit 1, 2; Vazquez, hearing exhibits, September 29, 2016, 6.
[472] IAI, IAI Statistics database (accessed December 19, 2016).
[473] Vazquez, hearing exhibits, September 29, 2016, 6.
[474] Vazquez, hearing exhibits, September 29, 2016, 6.
[475] Some of these provinces, however, have substantially higher transportation costs. Shearer et al., *Boom and Bust 2016*, March 2016, 32; CNIA, post hearing brief to the USITC, October 17, 2016, 30–31; industry representative, telephone interview by USITC staff, February 15, 2017.
[476] CRU Group.

	Production (million mt)			Capacity (million mt)			Capacity utilization (%)			Number of smelters		
	2006	2011	2015	2006	2011	2015	2006	2011	2015	2006	2011	2015
Yunnan	0.5	0.9	1.4	0.6	1.0	1.6	78	90	84	3	3	3
Other	1.0	1.2	1.1	1.5	1.5	1.7	66	77	62	13	8	8
Total	9.4	19.6	30.8	14.0	23.2	38.1	90	85	81	89	95	96

Source: CRU Group.

Figure 6.2: China: Change in production capacity by province, 2011–15 (thousand mt)



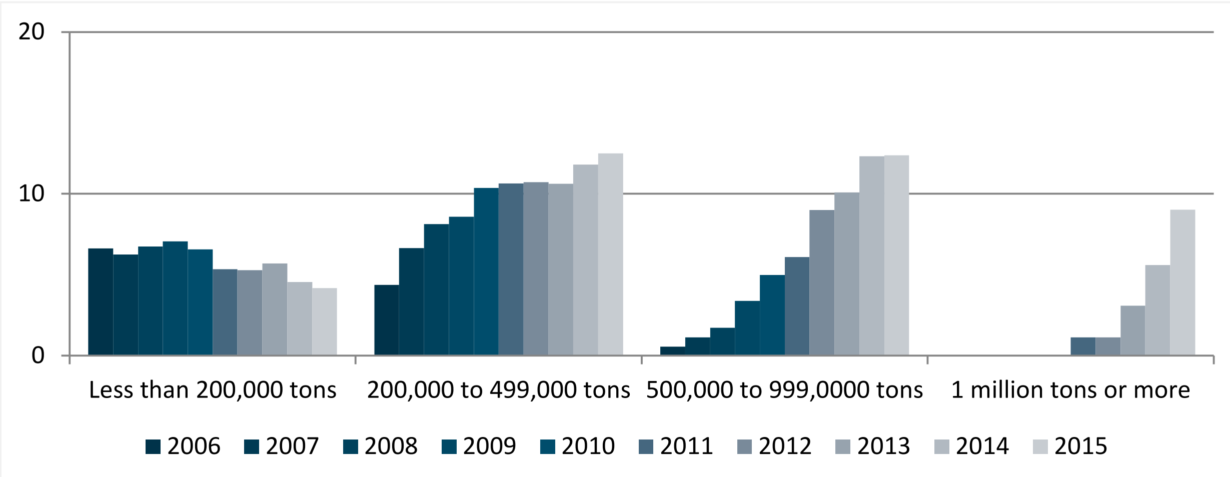
Source: CRU Group.

Chinese companies are substantially expanding smelter sizes, building large smelters at both existing sites and new locations. The number of smelters with a capacity of at least 500,000 mt per year increased from 1 in 2006 to 11 in 2011 and 25 in 2015, while the number of smelters with a capacity of 1 million mt or more per year increased from zero before 2011 to 6 in 2015 (figure 6.3).[477] The average capacity of newly announced smelters projects during 2012–15 exceeded 600,000 mt each year, though the average capacity of announced projects in the

[477] During 2011–15 the average smelter size increased by 58 percent, from 234,000 mt per year to 370,000 mt per year. Despite the significant number of large smelters, there are still many small smelters in China, as discussed below. CRU Group.

first three quarters of 2016 was lower, as most were brownfield projects.[478] These new, large smelters have more efficient technology, as will be discussed in the competitiveness section below.

Figure 6.3: China: Primary unwrought aluminum production capacity by smelter size, 2006–15, number of smelters



Source: CRU Group.
Note: Corresponds to appendix table L.22.

Many smaller smelters remain in China, though this number is declining overall. In 2015, there were 18 smelters with 100,000 mt or less in annual production capacity (down from 28 in 2011) and 43 smelters with 200,000 mt or less (down from 56 in 2011).[479] These small smelters are often high-cost producers, and the government has actively tried to close some of these small smelters as part of its efforts to reduce aluminum capacity.[480]

The trend toward building large smelters in lower-cost locations with newer technology and captive power plants has contributed to a wide variability in smelter costs in China. The average cash cost of production for smelters in China was around $2,300 per mt in 2011, while new smelter projects announced in 2012 had average cash costs of $1,500 per mt. In the third quarter of 2016 the average cash cost of production in China was $1,363 per mt, whereas new smelter projects announced from January to September 2016 had an average cash cost of only $1,206 per mt.[481] Smelter location and the use of captive power plants play a large role in cost variability. For example, according to a September 2014 presentation by Rusal, a smelter in

[478] Vazquez, hearing exhibits, September 29, 2016, 5.
[479] The capacity of individual smelters can vary over time. A few of the recorded small smelters in 2011 were the first phase of larger projects, while some of the "small" smelters in 2015 are smelters that shuttered some capacity during 2011–15. CRU Group.
[480] Industry representative, telephone interview by USITC staff, February 15, 2017; Williams, “The Market and China’s Role,” October 2015, 12.
[481] Vazquez, written testimony to the USITC, September 29, 2016, 3.

Xinjiang with a captive power plant would save $531 per mt in electricity costs as compared with a smelter in Henan using grid power, although about half of these savings would be offset by higher transportation costs.[482]

At certain times during 2011–15, a substantial share of Chinese aluminum smelters were unprofitable. According to the China Nonferrous Metals Industry Association (CNIA), the smelting industry in China was profitable during 2011–12 and 2015–16, but was unprofitable at certain times during 2013–14. Industry-wide net profit increased from $226 million in 2015 to $3.2 billion in 2016.[483] Primary aluminum profitability can quickly change, however, and can be higher or lower at any given point in time.[484] For example, in the third quarter of 2015, more than 90 percent of China's production capacity was unprofitable (based on their estimated cash costs of production).[485] By October 2016, however, 85 percent of Chinese primary aluminum producers were profitable.[486]

Employment and Wages

The labor intensity of Chinese primary aluminum production substantially declined during 2011–15 (table 6.3), but this was offset by increasing wages, resulting in relatively stable labor costs per metric ton of aluminum for smelters during 2011–15.[487] Although Chinese primary aluminum production is labor intensive in comparison to the rest of the world, labor costs per metric ton (before casting) were only 38 percent of costs in the rest of the world.[488] Labor costs and intensity vary by smelter, and private companies tend to have higher labor productivity and to pay lower wages than SOEs.[489]

---

[482] Mukhamedshin, "Energy Costs and Considerations," September 2014, 9.
[483] CNIA, written submission to the USITC, February 21, 2017, 24–25.
[484] A number of factors contribute to changing levels of profitability. Chinese smelter production costs can fluctuate as prices for coal, alumina, electricity, and other inputs change. At the same time, market prices for aluminum—which generally declined during 2011–15—can shift rapidly, as they did during the steep price decline in 2015. The Shanghai Futures Exchange (SHFE) price declined 24 percent in renminbi (RMB) terms (31 percent in U.S. dollar terms) from May to December 2015. Finally, analyses of industry profitability are based on countrywide data, and the closure or curtailment of unprofitable smelter capacity can significantly improve these data for the country as a whole. American Metal Market Website, http://www.amm.com/ (accessed August 2016–March 2017).
[485] Data from AZ China (consultancy), cited in USCC, "Sector Spotlight," November 4, 2015, 13.
[486] *Aluminum News*, "Costs of Domestic Primary Aluminum Rise," November 8, 2016.
[487] Chinese labor costs per mt of aluminum produced increased from $48 in 2011 to $52 in 2013, and then remained at an estimated $52 through 2015. CRU Group.
[488] In 2015, Chinese labor costs were $52 per mt, compared to $138 per mt in the rest of the world. China, meanwhile, employed 5.4 workers per thousand mt of aluminum produced, compared to 4.0 in the rest of the world. CRU Group.
[489] Wan Ling, "Chinese Labour Rates," April 7, 2016.

Table 6.3: China: Primary unwrought aluminum industry employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	152,696	157,527	162,002	163,796	165,973
Production (1,000 mt)	19,623	22,204	24,884	28,303	30,839
Productivity (workers/1,000 mt)	7.8	7.1	6.5	5.8	5.4
Average wages ($/hr)	3.39	3.84	4.38	4.95	5.29

Source: CRU Group.

Secondary Unwrought Aluminum

Number, Location, and Concentration

China's secondary aluminum industry, which is one of the largest in the world, is distinct from its primary aluminum industry. The secondary aluminum industry has little overlap in producers with the primary industry, as well as a lower share of production by SOEs, more foreign participation, and lower industry concentration (table 6.4). In addition, most secondary aluminum producers are not vertically integrated into downstream wrought production. The largest secondary producer in China is the Taiwan-based Sigma Group, which has almost 1 million mt of capacity. At least five other producers—including China-based firms and joint ventures between Japanese and Chinese companies—have at least 300,000 mt of annual capacity.[490] The scale of production at individual plants has substantially increased in recent years as new plants were built and small players left the industry. In 2011, there were an estimated 1,000 Chinese secondary aluminum producers, with only 6 companies producing more than 100,000 mt a year.[491] By the end of 2015, more than 20 firms had 100,000 mt in annual production capacity.[492] During the same time period, many smaller firms exited the industry, reportedly in response to tighter environmental regulations.[493]

Table 6.4: China: Examples of secondary producers with a capacity of at least 300,000 mt per year

Company	Headquarters location	China plant locations	China capacity (1,000 mt)
Baoding Longda Aluminum Industry Co., Ltd	Joint venture (China, Hong Kong, and Japan firms)	Guangdong, Hebei, Jilin, and Shandong	440
Chongqing Jiantao Aluminum Co., Ltd	China	Chongqing	300
Chongqing Shunbo Aluminum Alloy Co.	China	Chongqing, Guangdong	500

[490] Compiled by USITC staff from company websites, financial reports, and media reports.
[491] Some estimates more broadly put the number of firms in the "thousands." Poole, "Consolidation Likely," January 17, 2011; *Metal Bulletin*, "China Secondary Aluminum," May 28, 2012.
[492] Liu, "China Recycled Aluminum Industry," November 2015, 5.
[493] Wookey, "MB Recycled Al Conference: China's Secondary," November 17, 2015; Bijlhouwer, "China: Internal Changes," November 2014, 2.

Company	Headquarters location	China plant locations	China capacity (1,000 mt)
Delta Aluminium Industry Co., Ltd	Joint venture (Japan and Hong Kong)	Guangdong	300
Sigma Group	Taiwan	Chongqing, Fujian, Inner Mongolia, Jilin, Shandong, Shanghai, Sichuan	978
Ye Chiu Group	China	Jiangsu	300

Source: Compiled by USITC staff from company websites, financial reports, and media reports.
Note: Only includes secondary aluminum plants identified by USITC staff. Annual capacity based on the latest publicly available information.

Chinese secondary producers traditionally located in coastal regions of China for the ease of importing scrap. Increasingly, however, they have added production capacity inland in order to be near customers. One of the main drivers of growth in the secondary industry in China, similar to other countries, has been demand from the auto sector, leading companies to locate plants close to their customers in the auto industry. For example, Sigma's 100,000-mt-per-year facility in Shandong was brought online primarily to provide products to Hyundai.[494] Many producers now provide aluminum alloys in liquid form directly to their customers.[495] According to a 2012 estimate, wrought production using liquid secondary aluminum is about $125/mt less expensive than using secondary ingots, due to lower melt losses and other savings.[496]

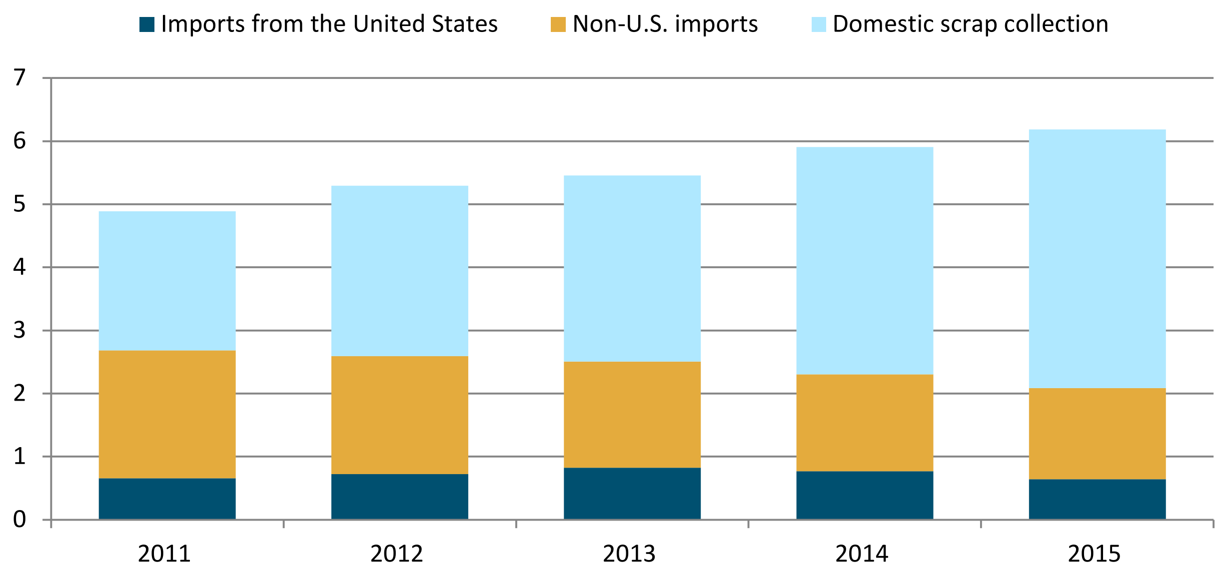
Transportation costs in general have been a challenge for the secondary aluminum industry, particularly in the past year. Chinese inland transportation costs increased starting in September 2016 due to a new rule that limited the maximum weight of trucks to prevent overloading.[497] Industry representatives and analysts estimated that these rules increased transportation costs by 20 to 25 percent.[498] Periods of high demand for coal, such as when it is being stockpiled for the winter months, can also raise inland transportation costs since coal uses the same transportation network.[499]

[494] Pawlek, "World Secondary Aluminum Industry Annual Review," August 2013, 11; Pawlek, "World Secondary Aluminum Industry Annual Review," August 2011, 12; O'Donovan, "MB'S Recycled Al Conf: Wang Kei Yip," November 12, 2010; Yee, "Weak Yen Dampens," November 22, 2016.
[495] Wookey, "MB Recycled Al Conference: China's Secondary," November 17, 2015; Liu, "China Recycled Aluminum Industry," 4, 10, 20; Pawlek, "World Secondary Aluminum," August 2011, 12; Pawlek, "World Secondary Aluminum," August 2012, 14; Pawlek, "World Secondary Aluminum," August 2013, 11.
[496] Pawlek, "World Secondary Aluminum," August 2012, 14.
[497] Yee, "Japan's ADC12," November 29, 2016; Yee, "Japanese Buyers Divided," November 15, 2016; Yang, "Aluminum Prices Surge," October 26, 2016. New regulations on overloading trucks took effect starting in September 2016 and created a backlog of aluminum in locations like Xinjiang. SMM, "What Changes Happen in China," January 23, 2017; Home, "China's Aluminum Output," October 25, 2016; industry representative, telephone interview by USITC staff, February 15, 2017.
[498] Yee, "Japan's ADC12," November 29, 2016.
[499] Yee, "Weak Yen Dampens," November 22, 2016; Yee, "Japanese Buyers Divided," November 15, 2016.

The supply chain for the secondary aluminum industry increasingly uses domestic scrap, but still relies on imports to meet a significant share of domestic demand. Its role in meeting domestic demand is declining, though. In 2015, just under 10 percent of Chinese secondary production involved scrap import, processing, and re-export in the form of secondary aluminum.[500] Domestic scrap collection in China increased 86 percent during 2011–15, totaling 4.1 million mt in 2015 (up from 2.2 million mt in 2011). Domestic scrap supplied 66 percent of the domestic market, up from 45 percent in 2011, though there is not always consistent domestic supply (figure 6.4).[501] Scrap imports from the world peaked in 2010[502] and subsequently declined for a variety of reasons. These included the increasing availability of low-priced domestic scrap; imported scrap's lack of price competitiveness;[503] tighter enforcement of environmental regulations (discussed below); low prices and wide availability of primary aluminum; slowing Chinese economic growth and therefore slower overall aluminum demand growth;[504] and improved sorting technology.[505]

[500] CNIA, post hearing brief to the USITC, October 17, 2016, exhibit 1, 20; IHS Markit, GTA database (accessed April 3, 2017).
[501] Minter, "CMRA Conference Report: Reversal of Fortune," January/February 2016; Minter, "Report: CMRA Conference—The Winds of Change," January/February 2013; IHS Markit, GTA database (accessed August 23, 2016); Gao Ning, "China—Leading Growth," November 21, 2016, 8.
[502] China is the largest global importer of aluminum scrap, and the United States is the largest supplier to China. China's scrap imports from the United States peaked in 2013. See chapter 4 for a discussion of the impact of China's scrap demand on the U.S. scrap market. IHS Markit, GTA database (accessed April 8, 2016).
[503] The supply chain for imported scrap from the United States was reportedly also disrupted by a labor dispute at U.S. West Coast ports, with scrap exports from the Los Angeles Customs District falling significantly in the first two months of 2015. Nuthall, "US West Coast," March 16, 2015; USITC DataWeb/USDOC (accessed December 18, 2016).
[504] Demand-related factors help to explain a lack of import growth, but cannot fully account for the decline in imports, given that secondary aluminum production in China is increasing.
[505] Minter, "CMRA Conference Report: Reversal of Fortune," January/February 2016; *Recycling Today*, "A Lack of Demand," July 28, 2015; MacAulay, "China's Aluminum Scrap Appetite," July 12, 2016; Keller, "Metals Market Meltdown," February 2016; Pickard, "Recycling Economics and Markets," April 1, 2014; Sepic, "As Prices Slump," September 2, 2015; Burnett-Nichols, "Looking beyond China," May/June 2015; Wookey, "MB Recycled Al Conference: China's Secondary," November 17, 2015; CNIA, post hearing brief to the USITC, October 17, 2016, exhibit 1, 14.

Figure 6.4: China: Aluminum scrap supply by source, 2011–15 (million mt)



Source: IHS Markit, GTA database (accessed April 3, 2017); Gao Ning, "China—Leading Growth," November 21, 2016, 8.
Note: China's imports, as listed in Harmonized Commodity Description and Coding System (HS) 7602, and domestic scrap collection. Corresponds to appendix table L.23.

Investment

The secondary industry is making substantial investments in upgrading technology, but according to some reports it needs further investments to improve efficiency and reduce energy consumption. Companies, for example, have invested in automated scrap-sorting equipment to replace manual sorting due to rising labor costs and new environmental regulations.[506] As noted above, companies are also increasingly providing liquid aluminum to customers.[507]

Chinese secondary producers have also invested in the United States and Europe to gain more control over their supply chains and access foreign technology. Chinese secondary producer Ye Chiu, for example, has a subsidiary in the United States to purchase scrap, and in 2016 acquired New Jersey-based Metalico, which had been a significant scrap supplier to Ye Chiu.[508] Chiho-

[506] Liu, "China Nonferrous Metals Recycling Industry," n.d. (accessed December 16, 2016), 5, 21; Wookey, "MB Recycled Al Conference: China's Secondary," November 17, 2015; Taylor, "2015 CMRA Convention: How Green," November 17, 2015; Liu, "China Recycled Aluminum Industry," November 2015, 6; Taylor, "2015 CMRA Convention: Seeking Efficiency," November 18, 2015; *Metal Bulletin Daily Alerts*, "China Secondary Aluminum," May 28, 2012.
[507] Liu, "China Nonferrous Metals Recycling Industry," n.d. (accessed December 16, 2016), 5; Liu, "China Recycled Aluminum Industry," 2015, 20.
[508] *Recycling Today*, "Metalico Sale," September 14, 2015; Taylor, "2016 CMRA: China Reaches Out," November 14, 2016; Metalico, "Schedule 14A," August 27, 2015, 3.

Tiande, which is based in Hong Kong, states that it is the largest scrap importer in China (including various other types of metal scrap) and has some secondary aluminum ingot production. In 2016, Chiho-Tiande acquired Scholz Holding GmbH, a European firm that processes scrap. The acquisition was reportedly intended to offer Chiho-Tiande more control over the scrap supply chain, improve its margins, and give it access to Scholz's technology.[509]

Employment and Wages

The labor intensity of Chinese secondary production varies widely, with some companies still relying on inefficient and manual sorting.[510] A review of company websites and financial reports indicated significant variation in the number of employees per metric ton of production capacity, though given the varying extent of vertical integration it is difficult to precisely compare employment levels. In 2016, Ye Chiu, which has production in both China and Malaysia, sold 261,000 mt of secondary aluminum, employing 841 production workers and 1,280 total employees. Sigma Group, with production in both China and Taiwan, reported a production capacity of 1 million mt in 2014 and 1,600 employees.[511]

Wage rates at secondary aluminum smelters also likely vary widely, depending on the location of production. Chinese secondary smelters are often located in major industrial and economic areas, and therefore are in regions with high manufacturing wages. Many Chinese producers, for example, are located in Guangdong, Chongqing, and high-wage provinces in the Yangtze River Delta.[512] Other firms, though, are in locations with lower wage rates. For example, Jiangxi is one of the fastest-growing secondary producing regions, and also has among the lowest wage rates of any Chinese province.[513]

Wrought Aluminum

Number, Location, and Concentration

China's wrought aluminum industry contains a mix of small and large firms and, unlike the primary industry, includes a number of U.S.- and European-owned subsidiaries. Some of the foreign-invested firms produce high-value-added products, as will be discussed in the

[509] Taylor, "2016 CMRA: China Reaches Out," November 14, 2016; Bloomberg News, "China Auto Boom," September 28, 2016; Chiho-Tiande, *2016 Interim Report*, 2016, 7; Chiho-Tiande, *Annual Report 2015*, 2015, 7, 156.
[510] Bijlhouwer, "China: Internal Changes," November 2014, 23–24; Liu, "China Recycled Aluminum Industry," November 2015, 11.
[511] Ye Chiu Group, *2015 Annual Report*, April 29, 2016, 11, 38; CMRA, "Sigma Group: Aluminum," October 23, 2014.
[512] Gao Ning, "China—Leading Growth," November 21, 2016, 12; NBS, Statistical Database (accessed January 4, 2017).
[513] Gao Ning, "China—Leading Growth," November 21, 2016, 12; NBS, Statistical Database (accessed January 4, 2017).

competitiveness section below. There are a number of SOEs involved in the production of wrought aluminum—one SOE, Chinalco, is one of the largest producers in China—but there are also a large number of private firms and foreign-invested enterprises.[514] Some wrought aluminum producers are vertically integrated upstream into primary aluminum, while certain other companies are vertically integrated into downstream products.

The industry overall is highly fragmented, with a large number of producers and no single firm capturing a large share of the market. There were about 850 producers of aluminum extrusions in 2015, with an average production capacity of 28,000 mt.[515] The largest aluminum extrusion producer, China Zhongwang, likely accounted for less than 5 percent of Chinese production in 2015.[516] Similarly, the 15 largest rolling mills in China in 2015 accounted for only 36 percent of China's flat-rolled products capacity.[517]

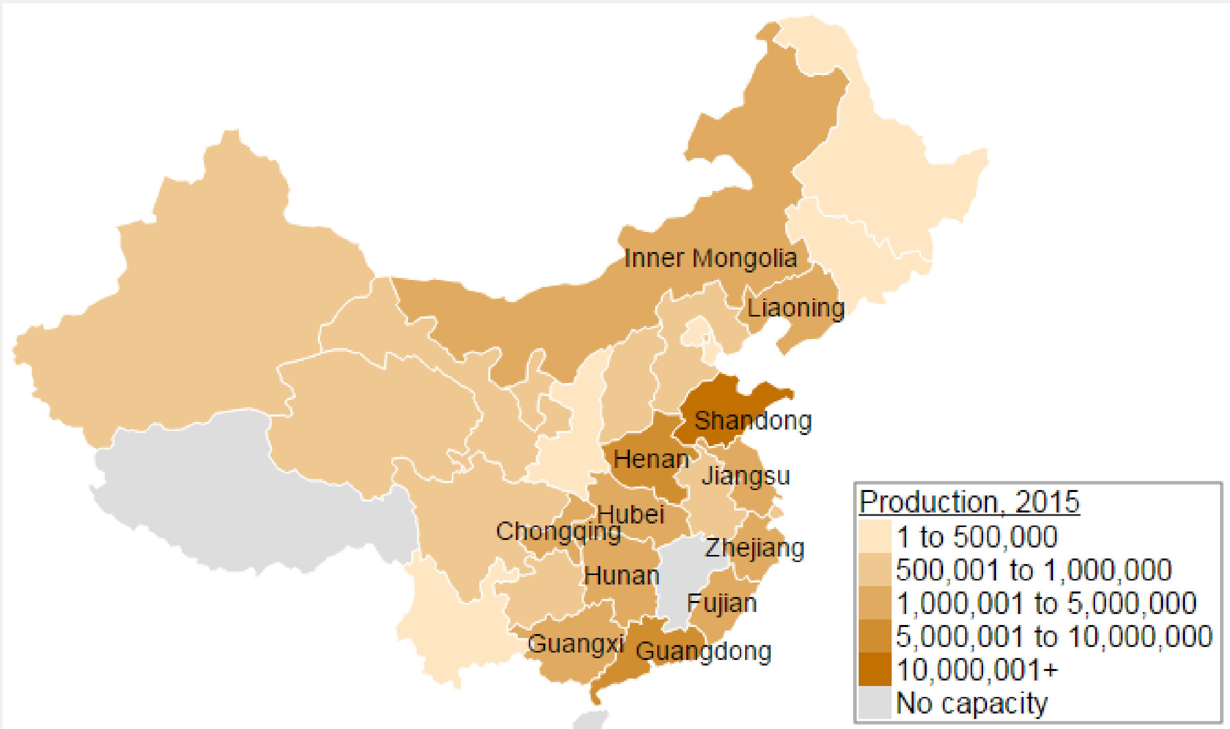
Chinese wrought aluminum producers built some large plants and made significant investments in new technology, thereby increasing productivity and economies of scale within the industry during 2011–15.[518] Firms are continuing to expand production, with China Zhongwang, for example, constructing a 1.8-million-mt rolling mill as of 2016.[519]At the same time, however, there are a large number of firms within the industry; many operate on a small scale and/or have low capacity utilization rates.

Wrought aluminum production is concentrated in East[520] and South Central China,[521] with production highest in Shandong followed by Henan and Guangdong provinces (figure 6.5).[522] Many wrought producers during 2011–15 expanded production close to primary aluminum producers to reduce input and production costs by using liquid aluminum. The share of wrought aluminum production that was located in Shandong increased from 16 to 19 percent during 2011–15; in Northwest China and Inner Mongolia,[523] it rose from 4 to 13 percent.[524] However, a number of other factors influenced location decisions—such as proximity to customers and

[514] For a list of Chinalco subsidiaries producing wrought aluminum products, see Chinalco website, http://www.chinalco.com.cn/zglyen/cpfw/ljgcp/A040404web_1.htm (accessed January 2, 2017).
[515] Leung, "China's 2016 Al Extrusion Exports," February 29, 2016.
[516] CRU Group.
[517] CRU Group.
[518] Vazquez, written testimony to the USITC, September 29, 2016, 3.
[519] China Zhongwang, "2016 Interim Results Corporate Presentation," August 25, 2016, 13.
[520] East China includes Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong provinces.
[521] South Central China includes Henan, Hubei, Hunan, Guangdong, Guangxi, and Hainan provinces.
[522] Based on data for production of aluminum products. As discussed below, these data differ from data on production of wrought aluminum from the CRU Group and other sources. NBS, Statistical Database (accessed January 4, 2017).
[523] Northwest China and Inner Mongolia includes the provinces of Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, and Inner Mongolia.
[524] NBS, Statistical Database (accessed January 4, 2017).

ease of export—and production expanded in some locations that were not close to primary aluminum production.[525] Henan, for example, maintained its market share in wrought production despite a drop in Henan's primary aluminum production. On the other hand, Guangdong's share of production significantly declined.[526]

Figure 6.5: China: Location of production of aluminum products,[a] 2015 (mt)



Source: NBS, Statistical Database (accessed January 4, 2017).
[a] This figure presents data on the production of aluminum products. As discussed below, these data appear to include a broader group of products than wrought aluminum as defined by CRU Group and other sources.

Wrought aluminum production primarily serves the domestic market, with exports accounting for about 10 percent of production.[527] The extent to which firms depend on exports varies widely. Some publicly traded firms, for example, report that domestic sales account for 98 percent or more of revenue. Other firms are more focused on export markets, with some reporting a substantially higher portion of revenue from foreign sales.[528]

---

[525] See, for example, Aleris, "Aluminum Extrusion Plant Overview," n.d., 12–13 (accessed February 26, 2017); Constellium, "Alcan Automotive Creates JV," October 5, 2009.
[526] NBS, Statistical Database (accessed January 4, 2017).
[527] Due to differences in data sources and coverage, it is difficult to calculate an exact percentage of wrought aluminum production that is exported. Exports under ordinary and processing trade accounted for 11 percent of CRU's reported production. CRU Group; IHS Markit, GTA database (accessed April 2016–February 2017).
[528] Based on data compiled by USITC staff from financial reports and other sources on revenue and the volume of sales by region.

China-based wrought aluminum producers primarily manufacture within China, but some producers have invested overseas, or have announced planned investments there. For example, in 2012, after the United States imposed antidumping and countervailing duties on imports of aluminum extrusions from China, China's Nanshan Aluminum opened an aluminum casting and extrusion plant in Lafayette, Indiana. In August 2016, U.S.-based rolled product producer Aleris announced it had agreed to be acquired by China Zhongwang. Both of these investments were also intended to improve market access (geographically or in particular market segments), while increasing access to technology or improving production processes.[529]

Employment and Wages

Chinese rolling mills increased productivity by 17 percent during 2011–15, though this was offset by a 45 percent increase in average hourly wages (table 6.5). Overall, labor is a relatively small share of rolled product manufacturing costs, ranging from 3 to 4 percent of costs for building sheet, 1xxx sheet, and foil stock.[530] However, labor costs rose 7 to 11 percent for these products during 2011–15, and the increase in wage rates had a larger impact on labor costs than productivity gains did.[531]

Table 6.5: China: Aluminum rolling mill employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	38,518	43,197	47,988	52,045	53,922
Productivity (workers/1,000 mt)	10.0	9.6	9.5	9.1	8.3
Average wages ($/hr)	4.04	4.27	4.81	5.29	5.86

Source: CRU Group.

Labor costs for publicly traded aluminum extrusion producers generally exceed 5 percent of production costs.[532] As with rolled products, however, increasing efficiency has been offset by rising wages, and the labor cost portion of non-material costs has substantially increased.[533]

---

[529] Von Alroth, "Why Nanshan Came to Indiana," May/June 201; Lynch, "China's Capitalist Road," March 19, 2014; Paulson Institute, *A Chinese Aluminum Company's Learning Curve*, October 2013, 11–12, 23–24; Aleris Corp., "Aleris to Be Acquired," August 29, 2016; Miller and Patterson, "Zhongwang's U.S. Business," August 29, 2016; Ng, "Zhongwang Says It'll Bring Jobs Stability," November 3, 2016; industry representative, telephone interview by USITC staff, October 4, 2016.

[530] CRU Group.

[531] CRU Group.

[532] Based on annual financial reports of publicly traded Chinese aluminum extrusion producers. In this chapter, references to publicly traded Chinese aluminum extrusion producers are to the following companies, or a subset thereof depending on information availability: China Zhongwang; Jiangsu Asia-Pacific Light Alloy Technology Co., Ltd.; Jilin Liyuan Precision Manufacturing Co., Ltd.; Fujian Minfa Aluminium Co., Ltd.; Suzhou Lopsking Aluminum Co., Ltd; Xingfa Aluminium; and Zhejiang Dongliang New Material Co. Ltd.

[533] Based on annual reports of publicly traded aluminum extrusion producers.

Production

Chinese aluminum production substantially increased across all three industry segments during 2011–15, driven primarily by domestic demand. In the primary aluminum industry, production exceeded demand during most years. But it dropped below consumption in 2016, as the decline in aluminum prices drove significant smelter closures or curtailments starting in the second half of 2015. Industry performance also varied significantly across smelters—while new and large smelters operated at high capacity utilization rates, older and smaller smelters operated at much lower ones. Production of all types of wrought products (extrusions, flat-rolled products, and wire and cable) increased during 2011–15, but the wrought industry operated at low capacity utilization rates and consistently produced in excess of domestic demand.[534]

Primary Unwrought Aluminum

Chinese primary aluminum production increased sharply during the first part of this century, rising from 3.1 million mt in 2001 to 30.8 million mt in 2015. At the same time, China's share of global production more than quadrupled, growing from 13 percent to 54 percent. During just the 2011–15 period, Chinese production rose from 19.6 to 30.8 million mt (57 percent) and China's share of global production rose from 43 percent to 54 percent (table 6.6). The increase in production has largely been driven by rising domestic demand for unwrought aluminum, which increased from 19.4 million mt in 2011 to 29.3 million mt in 2015 for reasons discussed below.[535] Official statistics indicate that this growth may be slowing: Chinese production increased only 1 percent in 2016, though monthly production grew almost every month from low levels early in the year.[536]

Table 6.6: China: Primary unwrought aluminum production, capacity, and capacity utilization, 2011–15

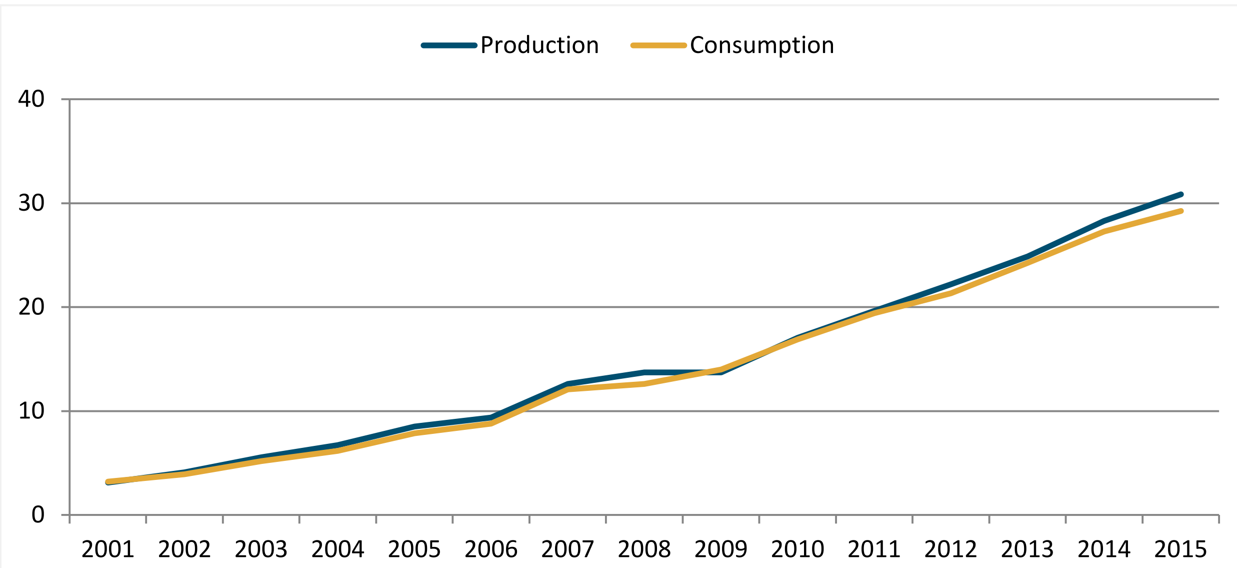
Attribute	2011	2012	2013	2014	2015
Production (1,000 mt)	19,623	22,204	24,884	28,303	30,839
Capacity (1,000 mt)	23,210	26,140	29,470	34,288	38,061
Capacity utilization (%)	85	85	84	83	81

Source: CRU Group.

[534] CRU Group.
[535] Some primary aluminum is incorporated into wrought products that are exported, so exports of wrought products are also contributing to the growth in Chinese primary aluminum production. CRU Group; European Chamber, "Overcapacity in China," 2016, 19.
[536] According to official statistics, China's production increased from 31.4 million mt in 2015 to 31.8 million mt in 2016. NBS, Statistical Database (accessed February 19, 2017 and June 14, 2017).

China's primary aluminum production exceeded consumption by 3.5 percent during 2011–15 (figure 6.6).[537] China has only limited exports of primary aluminum, so when there is excess production, most goes into inventory within China (unless it is exported as remelt semis). As China produced more than demanded during the entire 2011–15 period, CRU data indicate that inventories in China more than doubled, rising to 4.6 million mt by the period's end.[538] Inventories at the end of 2015 were equal to 15 percent of China's annual production, up from 11 percent in 2009.[539] Measured in terms of weeks, at the end of 2015 Chinese inventories represented just over 8 weeks of consumption (around the historical average for the aluminum industry of 8.5 weeks).[540] There was a substantial decline in inventories in 2016, primarily due to the curtailing of production capacity, though transportation bottlenecks also limited the inventory in official warehouses.[541]

Figure 6.6: China: Primary unwrought aluminum production and consumption, 2001–15 (million mt)



Source: CRU Group.
Note: Corresponds to appendix table L.24.

[537] Data on the extent to which production exceeds consumption can vary significantly by source, with some data even showing deficits while other data show surpluses. For example, CNIA data show production exceeding demand by only 0.5 percent during 2011–15, including demand exceeding supply in 2011. CRU Group.
[538] As with data on the extent to which production exceeds consumption, there are different estimates of the volume of global stocks accounted for by China. Harbor Aluminum has estimated that stocks within China totaled about 2 million mt at the end of 2015, but that there was an additional 1.3 million mt of remelt semis stored outside of China. CRU Group.
[539] CRU Group.
[540] Ibid.
[541] New regulations on overloading trucks, in effect starting in September 2016, created a backlog of aluminum in locations like Xinjiang. The increased production of liquid aluminum has also limited the amount of metal stored in warehouses. SMM, "What Changes Happen in China," January 23, 2017; Home, "China's Aluminum Output," October 25, 2016; industry representative, telephone interview by USITC staff, February 15, 2017.

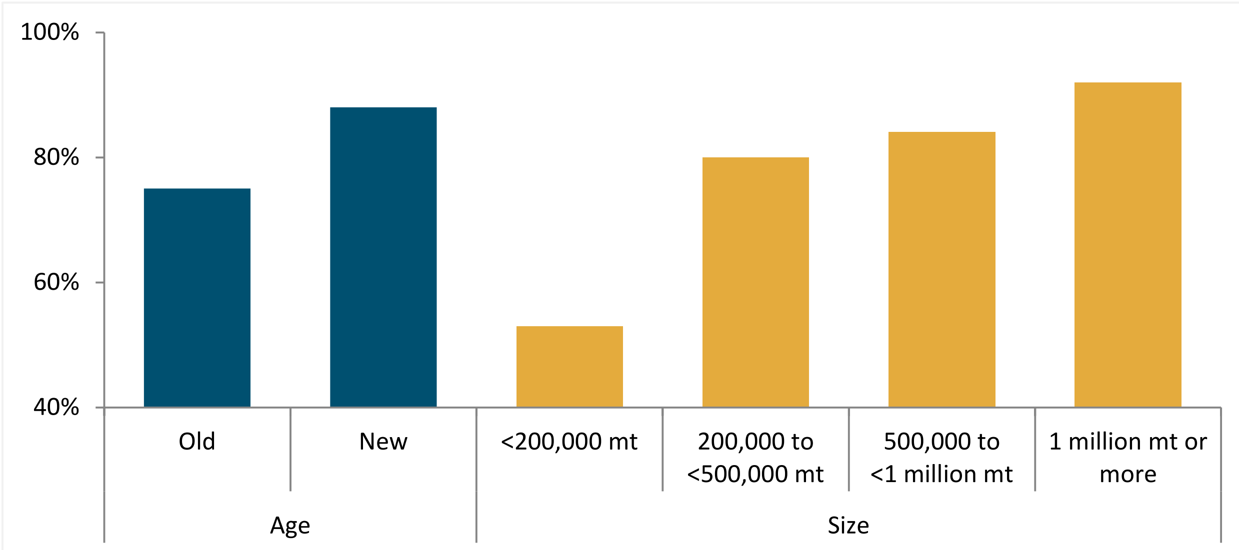
Chinese production capacity substantially increased during 2011–15, rising from 23.2 to 38.1 million mt (64 percent).[542] While some older, high-cost smelters were taken offline in 2015 and early 2016 due to low prices, new low-cost production capacity has continued to come online during 2016, and plans for additional smelters have continued to move forward.[543] Many of the smelters closed were in high-cost production locations, while many of the new smelters opened were in low-cost areas.[544] A substantial amount of curtailed capacity was restarted in 2016 due to higher prices.[545] Chinese production capacity is reportedly more flexible than in other regions of the world, and can be taken offline and ramped back up more quickly. Industry analysts point to several reasons for the responsiveness of Chinese production. One reason is that Chinese producers tend to have more flexibility in electricity purchases (unlike in the rest of the world, where some producers may have long-term contracts that can impose a penalty if they fail to purchase electricity). Another reason is that Chinese producers often pay lower costs to shut down and restart production.[546]

Chinese industry-wide primary aluminum capacity utilization in 2015 was 81 percent—higher than the rest of the world, but low by historic global industry standards. However, there was substantial variation in capacity utilization rates across the industry, generally correlating with both the age and the size of the smelter. For instance, “new” smelters, where more than half of the capacity was added during 2011–15, operated at an 88 percent capacity utilization rate, while older smelters operated at a 75 percent rate (figure 6.7).[547] Capacity utilization was similarly higher at large smelters (many of which are also newer smelters). Smelters with at least 1 million mt of capacity had utilization rates of 92 percent, whereas those with less than 200,000 mt of capacity had utilization rates of only 53 percent.[548]

---

[542] CRU Group.
[543] While some smelter projects were delayed, many continued to move forward. These smelters have low production costs that make them competitive in low-price environments. In addition, companies investing in smelters look at demand and prices over a long time horizon, and may not be as responsive to short-term price changes. Industry representative, telephone interview by USITC staff, December 16, 2016; industry representative, interview by USITC staff, Washington, DC, September 27, 2016; Aluminum Insider, “China’s East Hope Group,” March 14, 2016.
[544] Industry representative, interview by USITC staff, Washington, DC, September 27, 2016.
[545] Bloomberg News, “China Ramps Up,” April 6, 2016.
[546] Industry representative, telephone interview by USITC staff, February 15–16, 2017; industry representative, email message to USITC staff, February 23, 2017.
[547] CRU Group.
[548] Ibid.

Figure 6.7: China: Capacity utilization at smelters, by age and size, 2015 (percent)



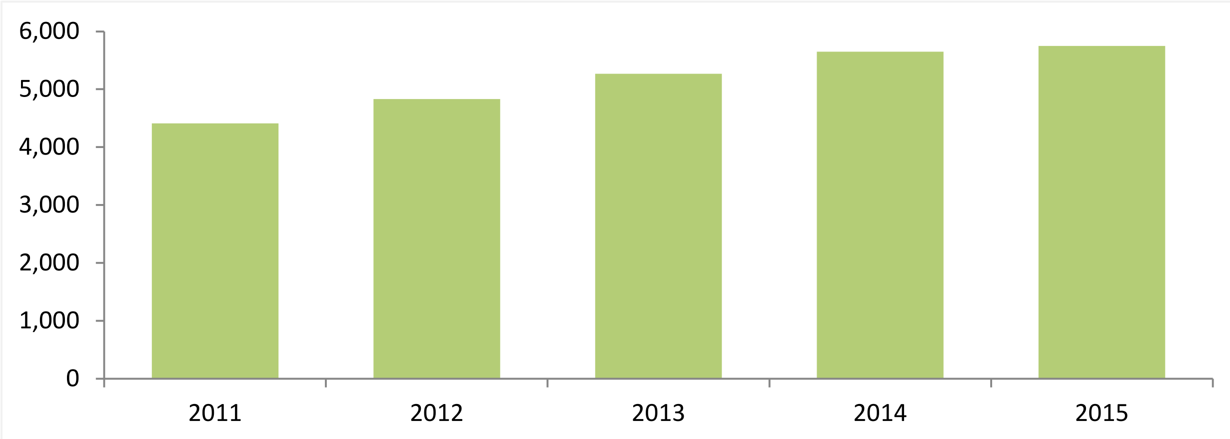
Source: CRU Group.
Note: "New" smelters are those where more than half of the capacity was added during 2011–15. Note: Corresponds to appendix table L.25.

Secondary Unwrought Aluminum

Secondary aluminum production also expanded substantially during 2011–15, rising by 30 percent (figure 6.8),[549] even though as a fraction of all unwrought aluminum production it decreased from 18 to 16 percent.[550] Nevertheless, China was one of the largest global producers of secondary aluminum in 2015.[551] Capacity utilization in the Chinese secondary industry, however, was relatively low, with some reports pointing to utilization rates of about 70 percent.[552]

[549] CNIA, posthearing brief to the USITC, October 17, 2016, exhibit 1, 20.
[550] Ibid., 20; CRU Group.
[551] WBMS, "Aluminium, Secondary Production," 2016, 13.
[552] In January 2016, CMRA indicated that the capacity utilization rate in the secondary nonferrous sector overall was about 70 percent. In 2012, capacity utilization in the secondary aluminum industry was reportedly 70 percent. In July 2016, capacity utilization rates for secondary aluminum firms were estimated by one industry representative to be about 80 percent for firms with both production for the domestic market and exports, and 60 percent for firms that only export. Liu, "China Nonferrous Metals Recycling Industry," January 2016, 21; Pawlek, "World Secondary Aluminum Industry Annual Review," August 2013, 11; Lin, "China ADC12 Export Prices," July 13, 2016.

Figure 6.8: China: Secondary unwrought aluminum production, 2011–15 (thousand mt)



Source: CNIA, post hearing brief to the USITC, October 17, 2016, exhibit 1, 20; CRU Group.
Note: Corresponds to appendix table L.26.

Wrought Aluminum

Chinese wrought aluminum production increased from 21.3 million mt to 31.4 million mt during 2011–15 (48 percent),[553] and China's share of global production increased from 45 to 53 percent (table 6.7).[554] The increase in production was largely driven by domestic demand, which increased from 20.1 to 29.5 million mt, though rising exports also contributed to the increase in production.[555] Aluminum extrusions accounted for 55 percent of Chinese aluminum wrought production and for the largest production increase in volume terms during 2011–15. Production of flat-rolled products and wire and cable also increased substantially, and they accounted for 29 percent and 16 percent of production in 2016, respectively. China's production mix differs from the rest of the world, where flat-rolled products account for the largest share of production. This divergence likely reflects—at least in part—the rapid growth in the construction sector in China and demand for aluminum extrusions in this sector.[556]

[553] The analysis of wrought production, capacity, and demand used in this analysis is based on data from CRU Group. Data from the CNIA and the National Bureau of Statistics of China (NBS) are also available (though 2015 CNIA and NBS data are the same). CNIA data and NBS data differ substantially from data collected by CRU Group, with a much higher estimate of wrought production and the volume of the difference increasing over time. CNIA and NBS, for example, estimate 2015 wrought aluminum production at 52 million mt. This appears to be due, at least in part, to a broader definition of the product coverage and possible double-counting, according to CRU Group. Williams, "Overcapacity in Chinese Rolled Product," January 14, 2016; NBS Statistical Database (accessed January 2017); CNIA written submission to the USITC, February 21, 2017, 4.
[554] CRU Group.
[555] Ibid.
[556] Ibid.

Table 6.7: China: Wrought aluminum production, capacity, and capacity utilization, 2011–15

Attribute	2011	2012	2013	2014	2015
Production (1,000 mt)					
Flat-rolled products	6,073	6,643	7,636	8,600	9,200
Extrusions	11,988	13,520	15,202	16,357	17,215
Wire and cable	3,215	4,064	4,379	4,779	4,989
Total	21,275	24,227	27,218	29,735	31,403
Capacity (1,000 mt)					
Flat-rolled products	7,901	9,516	11,162	13,035	14,753
Capacity utilization (%)					
Flat-rolled products	77	70	68	66	62

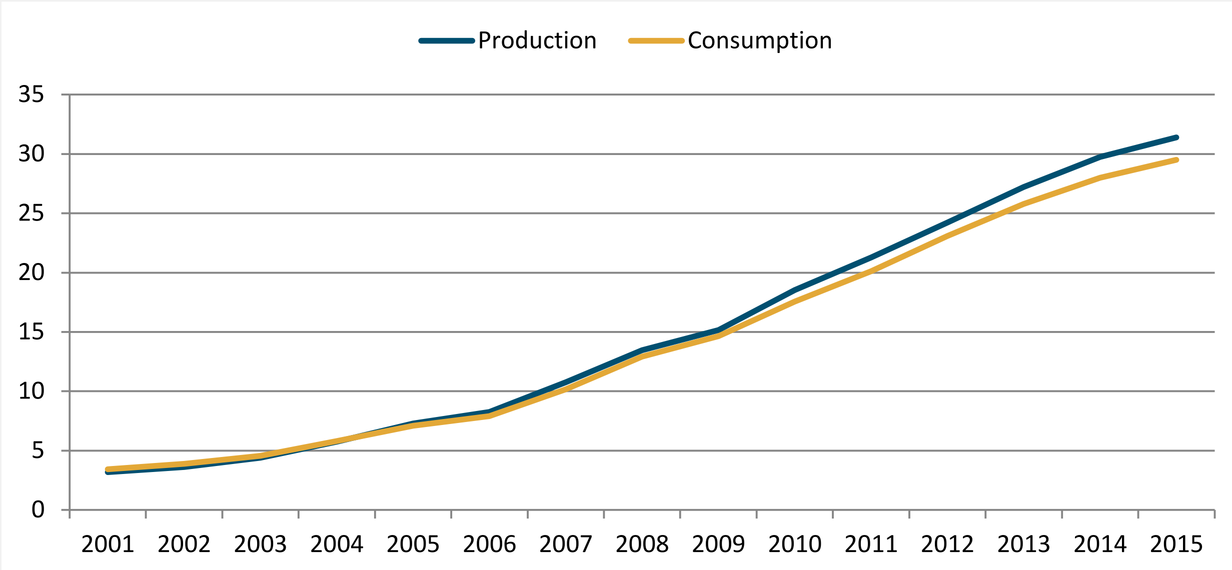
Source: CRU Group.

China's wrought aluminum production capacity also substantially increased during 2011–15. China's flat-rolled products capacity, for example, increased from 7.9 to 14.8 million mt (87 percent) during this period.[557] But capacity utilization in flat-rolled products declined from 77 percent in 2011 to 62 percent in 2015.[558] Capacity utilization for aluminum extrusions was also reportedly around 60 percent.[559] Capacity utilization may vary significantly depending on the product type. For example, capacity utilization for aluminum foil—a subset of flat-rolled products—was 84 percent in 2015.[560]

China's wrought production exceeded domestic consumption by a consistent 4 to 6 percent annually during 2006–15 (figure 6.9). While this excess production has been fairly consistent in percentage terms over time, it has grown substantially in absolute volume terms: production exceeded domestic consumption by 1.9 million mt in 2015, up from 300,000 mt in 2006. Flat-rolled products had the most excess production in 2015, with production exceeding consumption by 14 percent, followed by extrusions, for which production exceeded consumption by 5 percent. Production of wire and cable was roughly equal to consumption.[561] As noted above, Chinese wrought firms are more export oriented than primary aluminum producers, and much of their excess production is exported.

[557] CRU Group.
[558] Capacity utilization data for other wrought products were not readily available. CRU Group.
[559] Industry representative, telephone interview by USITC staff, February 27, 2016.
[560] Williams, "Overcapacity in Chinese Rolled Product," January 14, 2016.
[561] CRU Group.

Figure 6.9: China: Wrought aluminum production and consumption, 2001–15 (million mt)



Source: CRU Group.
Note: Corresponds to appendix table L.27.

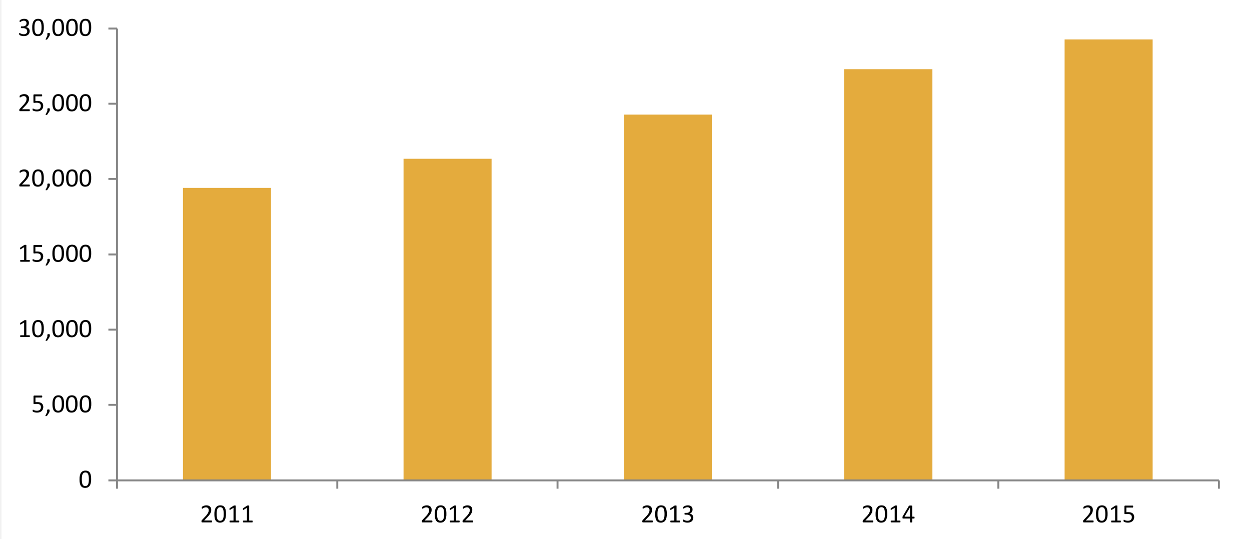
Consumption

Primary and Secondary Unwrought Aluminum

Chinese consumption of primary aluminum increased from 19.4 million mt in 2011 to 29.3 million mt in 2015 (51 percent), driven by domestic downstream demand (including domestic processing of primary aluminum into wrought products for export) (figure 6.10).[562] Secondary aluminum consumption likely increased from just under 4 million mt in 2011 to slightly over 5 million mt in 2015.[563] Combined consumption of primary and secondary aluminum increased from about 24 million mt in 2011 to almost 35 million mt in 2015.[564] Factors driving Chinese aluminum demand are discussed in the wrought aluminum section below.

[562] CRU Group.
[563] Apparent consumption based on production, import, and export data. Precise data are not included, since the exact value of secondary aluminum imports is not available. CNIA, post hearing brief to the USITC, October 17, 2016, exhibit 1, 20; IHS Markit, GTA database (accessed January 7, 2016).
[564] CRU Group.

Figure 6.10: China: Primary unwrought aluminum consumption, 2011–15 (thousand mt)



Source: CRU Group.
Note: Corresponds to appendix table L.28.

Wrought Aluminum

Chinese consumption of wrought aluminum significantly increased during 2001–15, driven by China's rapid economic growth and the use of aluminum as a substitute for other materials.[565] The construction industry has been the largest driver of the increase in aluminum demand; aluminum consumption in this industry expanded at an annual rate of 17 percent during 2001–15, reflecting a rapid expansion in construction in China (table 6.8).[566] Aluminum is used in a wide range of construction applications in China, such as transportation infrastructure (e.g., rail stations, airports) and commercial buildings (e.g., shopping malls, banks, hotels, hospitals, sports stadiums, and offices).

Table 6.8: China: Consumption of wrought aluminum by form and end use, 2011–15 (thousand mt)

Attribute	2011	2012	2013	2014	2015
By form					
Extrusions	11,501	13,006	14,607	15,623	16,464
Flat-rolled	5,412	6,033	6,821	7,610	8,069
Wire and cable	3,201	4,048	4,369	4,765	4,972
Total	20,114	23,087	25,797	27,998	29,505
By end use					
Construction	9,117	10,410	11,495	12,166	12,675
Electrical	3,486	4,362	4,849	5,328	5,577
Consumer durables	654	745	813	879	932

565 World Bank, "GDP Growth (Annual %)" (accessed January 7, 2017); CNIA, post hearing brief to the USITC, October 17, 2016, 5–6, 29–30.
566 CRU Group.

Attribute	2011	2012	2013	2014	2015
Foil stock	2,471	2,731	3,282	3,744	3,951
Machinery and equipment	2,021	2,311	2,527	2,763	2,973
Transport	1,510	1,563	1,735	1,856	2,013
Packaging	576	650	740	842	928
Other	278	316	357	419	456
Total	20,113	23,087	25,797	27,998	29,505

Source: CRU Group.

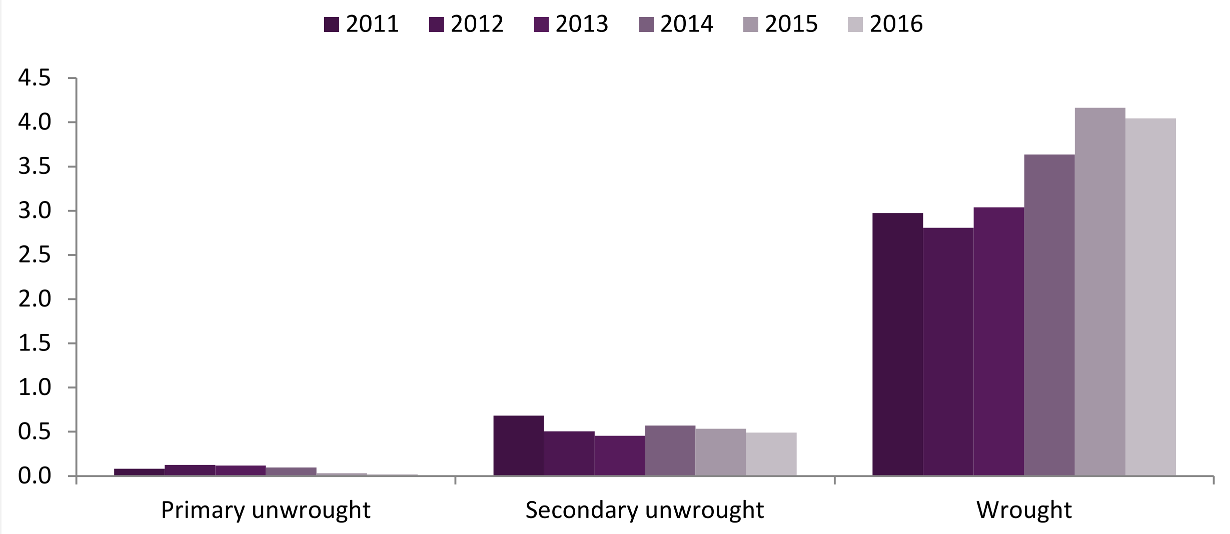
The rate of growth in China's demand for wrought aluminum slowed somewhat during 2011–15, reflecting slower growth in China's GDP, the end of the stimulus implemented by the Chinese government during the global recession, and the fact that China's service sector—which has lower aluminum intensity—is growing more rapidly than manufacturing and construction. The annual growth rate for wrought aluminum demand declined from 14.5 percent in 2011 to 5.4 percent in 2015, as annual GDP growth fell from 9.5 to 6.9 percent. Construction grew at the second-slowest rate of all sectors (after transportation), dropping from 12 percent annual growth to 4 percent annual growth. This reflects a decline in the annual percent growth in Chinese GDP from construction during 2011–15.[567]

Trade

China is the world's largest exporter[568] of wrought aluminum products, accounting for 33 percent of global exports in 2015. China's exports of wrought aluminum increased from 3.0 million mt in 2011 to 4.2 million mt in 2015 (40 percent) before declining to 4.0 million mt in 2016 (figure 6.11). China is not a significant exporter of primary aluminum, but exported slightly more than 500,000 mt of secondary aluminum, primarily to Asian markets (particularly Japan), in 2015.[569] About 600,000 mt of 2015 exports of wrought aluminum products were likely "remelt semis" (products for which the main use is likely remelting, see chapter 2 and appendix J).

[567] NBS, Statistical Database (accessed January 2017); CRU Group; World Bank, "GDP Growth (Annual %)" (accessed January 7, 2017); Lelyveld, "China's Smokestack," November 17, 2015; Aluminium Association of Canada, written testimony to the USITC, September 29, 2016, 8.
[568] The export data in this section of the report may vary slightly from data on China trade presented elsewhere in the report. In order to control for data issues and ensure comparability, other chapters in the report use mirror import data. However, this section uses Chinese export data for two reasons. First, Chinese data allows for the separation of primary and secondary aluminum exports. Second, Chinese export data allows for an examination of trends in wrought exports, either including or excluding remelt products. The data primarily cover the 2011–15 period specified in the request letter, but 2016 data will be added for context in certain instances, since these data are available for China. These 2016 data are not available for other countries, which rely on availability of mirror data for all trading partners, so this will also differ from trade data presented elsewhere in the report.
[569] IHS Markit, GTA database (accessed April 2016–January 2017).

Figure 6.11: China: Aluminum exports by type, 2011–16 (million mt)



Source: IHS Markit, GTA database (accessed February 23, 2017).
Notes: Secondary aluminum trade is based on exports under processing trade modes in HS 7601.20, as discussed below. Primary aluminum is based on all other trade in HS 7601. Wrought exports are based on Chinese exports in HS 7604–7608. Corresponds to appendix table L.29.

China is not a major importer of unwrought and wrought aluminum, with imports accounting for small share of the market, except for flat-rolled products. China's imports of unwrought aluminum—which traditionally have been highest when there is a large gap between prices in China and the rest of the world—have been declining over time. Imports of wrought products are also declining as domestic production of higher-value-added plates, sheets, and strip replaces imports.

Unwrought Aluminum

Exports

China is not a significant exporter of primary aluminum, which is subject to a 17 percent value-added tax (VAT) and, in most cases, a 15 percent export tariff. Annual exports of unwrought aluminum, not alloyed (HS 7601.10), averaged less than 100,000 mt during 2011–15 and were only about 30,000 mt in 2015 and 17,000 mt in 2016 (table 6.9).[570]

[570] "HS" is the Harmonized Commodity Description and Coding System used to encode tariffs worldwide. Primary aluminum exports generally correspond to exports in HS 7601.10, as most exports in HS 7601.20 are secondary aluminum, as discussed below. CNIA also reports exports of primary aluminum of 16,800 mt in 2016. IHS Markit, GTA database (accessed April 2016–January 2017); CNIA, written submission to the USITC, February 21, 2017, 5.

Table 6.9: China: Unwrought aluminum exports (HS 7601), by destination, 2011–16 (thousand mt)

	2011	2012	2013	2014	2015	2016
Tariff line						
Not alloyed, containing by weight 99.95% or more of aluminum (7601.10.10)	4	3	9	2	3	2
Not alloyed, other (7601.10.90)	78	122	107	95	28	15
Aluminum alloys (7601.20.00)	684	506	456	571	535	495
Total	766	631	572	667	566	512
Destination						
Japan	366	254	225	253	195	269
Hong Kong	139	144	129	188	206	120
South Korea	138	145	126	77	24	20
Vietnam	25	26	30	30	25	22
Taiwan	8	6	14	34	23	19
All other	91	57	48	85	93	61
Total	766	631	572	667	566	512

Source: IHS Markit, GTA database (accessed February 2017).
Note: Destination based on top five export destinations during 2011–15.

China is a more significant exporter of secondary aluminum, though secondary aluminum export volumes are declining as well. China's secondary aluminum exports are identifiable, according to industry and trade data, by examining the "processing trade" (defined below) classified in HS 7601.20, which comprised 99.6 percent of 2015 exports in this subheading. These exports match the figures for secondary exports reported by the China Nonferrous Metals Industry Association Recycling Metal Branch (CMRA) and other industry sources, and correlate with imports of aluminum scrap under processing trade regimes.[571]

China imports aluminum scrap under one of two processing trade modes, processes it, and exports the secondary aluminum. The two processing trade modes are as follows:

- **Processing and assembly:** Under the main processing type used in the secondary aluminum industry, the foreign firm retains ownership of the aluminum and the Chinese firm is paid a fee to transform the material into secondary aluminum. Using the processing and assembly mode offers considerable advantages to Chinese exports, as these products are not subject to tariffs or VAT, though Chinese firms also cannot deduct the VAT for any Chinese-produced inputs.[572]

[571] IHS Markit, GTA database (accessed December 15, 2016); Liu, "China Recycled Aluminium Industry," November 2015, 87; NBS, Statistical Database (accessed December 19, 2016); CNIA post hearing brief, exhibit 1, 20; Lin, "China ADC12 Export Prices," July 13, 2016.
[572] Kim and Lee, "China's Processing Trade," March/April 2013, 52; Manova and Yu, "How Firms Export," 2016, 122; Gourdon, Monjon, and Poncet, "Incomplete VAT Rebates," February 5, 2014, 5.

- **Processing with imported material:** Chinese firms take ownership of the materials and process them into a finished product that is then resold. This regime also offers certain benefits to Chinese exports, including duty-free entry for the raw materials and VAT rebates on domestic inputs.[573]

Chinese exports in 7601.20 that were conducted under the “processing and assembly” trade mode with customer-supplied materials totaled 366,000 mt in 2016, down from 593,000 mt in 2011 (table 6.10).[574] The main export destinations for these products were Japan and Hong Kong, though many of China’s recorded exports to Hong Kong likely had other final destinations.[575] Exports under the second regime—processing with imported materials—increased from 89,000 mt in 2011 to 125,000 mt in 2016, though this was down from 155,000 mt in 2014.[576] The United States was the leading source of scrap imports in 2015 under both modes.[577]

Table 6.10: China: Processing trade of aluminum scrap (HS 7602) and aluminum alloys (HS 7601.20), 2011–16 (thousand mt)

Tariff line and trade type	2011	2012	2013	2014	2015	2016
Imports of aluminum scrap						
Process and assembling	762	636	471	512	480	464
Process with imported materials	112	46	96	193	163	153
Total	874	682	567	705	643	616
Exports of aluminum alloys						
Process and assembling	593	466	386	414	393	366
Process with imported materials	89	39	69	155	140	125
Total	683	505	455	570	533	491
Destination of process and assembly exports						
Japan	292	228	173	114	104	167
Hong Kong	138	141	129	185	191	119
South Korea	57	22	15	18	14	5
Vietnam	25	25	29	26	19	18
All other	82	50	40	72	65	56
Total	593	466	386	414	393	366
Destination of process with imported materials exports						
Japan	69	23	51	126	88	101

[573] Kim and Lee, “China’s Processing Trade,” March/April 2013, 52; Manova and Yu, “How Firms Export,” 2016, 122.
[574] IHS Markit, GTA database (accessed February 2017).
[575] Examining mirror import data, as opposed to the Chinese trade data presented above, for all trade in HS 7601.20 shows that Japan absorbed 63 percent of China’s exports in 2015, followed by Thailand (6 percent), South Korea (5 percent), Malaysia (5 percent), and Vietnam (4 percent). Hong Kong was not among the major importers from China. IHS Markit, GTA database (accessed January–February 2017).
[576] IHS Markit, GTA database (accessed February 20, 2017).
[577] IHS Markit, GTA database (accessed April 4, 2017).

Tariff line and trade type	2011	2012	2013	2014	2015	2016
All other	20	16	18	29	52	25
Total	89	39	69	155	140	125

Source: IHS, Markit, GTA database (accessed February 2017).
Note: There may be small differences between the totals here and the totals presented above, where trade is not separately tracked by export program. The figures in this table include only processing trade and do not include other trade types in HS 7601.20 and 7602. Destinations are based on top export destinations during 2011–15.

Imports

China imports only a small amount of unwrought aluminum in comparison to domestic demand, with imports accounting for less than 1 percent of Chinese consumption.[578] Imports increased from 333,000 mt in 2011 to 640,000 mt in 2012, then declined to 224,000 mt in 2015 before rising slightly again to 255,000 mt in 2016 (table 6.11). Russia and Australia were the main import sources during this time period, but imports from leading sources fluctuated annually, and imports from both Russia and Australia substantially declined after 2012.[579] Unalloyed aluminum imports—which are subject to a 17 percent VAT and in some instances to a duty—tend to increase when the difference between the China price and the London Metal Exchange (LME) price increases (i.e., the China price is significantly higher) and imports are competitively priced.[580]

Table 6.11: China: Unwrought aluminum imports (HS 7601), by source, 2011–16 (thousand mt)

Source	2011	2012	2013	2014	2015	2016
Russia	106	180	121	73	11	13
Australia	80	105	92	80	38	38
Oman	24	65	32	30	18	27
India	10	44	34	22	9	24
United Arab Emirates	18	27	26	26	23	22
All other	95	219	177	123	124	131
Total	333	640	481	354	224	256

Source: IHS, Markit, GTA database (accessed February 2017).
Note: Order and list of countries based on total imports during 2011–15. Because of rounding, total may not equal the sum of line items; mt= metric tons.

578 CRU Group; IHS Markit, GTA database (accessed February 20, 2017).
579 IHS Markit, GTA database (accessed February 20, 2017).
580 Industry representative, interview by USITC staff, September 27, 2016; industry representative, telephone interview by USITC staff, February 15 and 16, 2017; IHS Markit, GTA database (accessed January 7, 2017); CNIA, "China Aluminum Industry," 2015, 10; LME price data from *Platts Monthly Reports* (accessed August 2016–March 2017); SHFE price data from American Metal Market Website, http://www.amm.com/ (accessed August 2016–March 2017).

Wrought Aluminum

Exports

Chinese exports of wrought aluminum increased substantially during 2011–15, rising from 3.0 to 4.2 million mt, before declining to 4.0 million mt in 2016 (table 6.12). Exports from bonded warehouses in China, however, appear to primarily be goods alleged to be remelt semis, and may not accurately reflect trends in exports of wrought products. Excluding these goods, Chinese exports increased from 2.6 million mt in 2011 to 3.6 million mt in 2015, and continued to increase slightly in 2016. The next section will focus on trends in trade other than exports from bonded warehouses and will be referred to as “ordinary and processing trade” for simplicity, though it also includes the small volume of trade listed under “other” in table 6.12. Bonded warehouse trade is described in chapter 2 and appendix J as part of the discussion of transshipments and remelt semis.

Table 6.12: China: Wrought aluminum exports (HS 7604–7608), 2011–16, by regime (thousand mt)

Regime	2011	2012	2013	2014	2015	2016
Ordinary trade	2,525	2,157	2,446	2,964	3,469	3,593
Inbound/outbound goods in bonded warehouses	277	291	287	374	466	277
Storage and transit goods in bonded warehouses	84	177	168	132	92	68
Process with imported materials	53	127	95	118	75	58
Process and assembling	12	26	17	18	32	19
All other	24	27	25	30	32	34
Total	2,974	2,805	3,039	3,637	4,166	4,050
Total, excluding bonded warehouses	2,614	2,337	2,583	3,131	3,608	3,704

Source: IHS, Markit, GTA database (accessed February 23, 2016).

The United States was the largest export destination for Chinese wrought products (accounting for 13 percent of Chinese exports in 2015), followed by South Korea (7 percent) and India (6 percent) (table 6.13).[581] Chinese wrought exports during 2011–15 were dominated by flat-rolled products, which accounted for more than 70 percent of exports annually during 2011–15 (table 6.14).[582] This likely reflects the composition of demand in the rest of the world (53 percent of non-China demand is for flat-rolled products)[583] as well as antidumping and countervailing duties in key export markets such as Australia, Canada, and the United States.[584]

581 IHS Markit, GTA database (accessed February 23, 2017).
582 Ibid.
583 CRU Group.
584 Bown, “Global Antidumping Database,” June 2016; Bown, “Global Countervailing Duties Database,” June 2016.

Table 6.13: China: Wrought aluminum exports (HS 7604–7608), by destination, 2011–16, ordinary and processing trade (thousand mt)

Destination	2011	2012	2013	2014	2015	2016
United States	213	209	298	405	481	546
Korea, South	182	83	98	200	241	159
India	105	106	140	183	213	209
Nigeria	157	162	190	184	170	133
Thailand	85	99	111	125	162	163
All other	1,871	1,679	1,746	2,034	2,340	2,495
Total	2,614	2,337	2,583	3,131	3,608	3,704

Source: IHS Markit, GTA database (accessed February 23, 2017).
Note: Top five export destinations in 2015.

Table 6.14: China: Wrought aluminum exports, by type, 2011–16, ordinary and processing trade (thousand mt)

Product type	2011	2012	2013	2014	2015	2016
Extrusions						
Bars, rods, and profiles (7604)	491	517	562	635	720	863
Tubes and pipes (7608)	82	82	88	91	102	104
Total	573	598	649	726	822	967
Flat-rolled products						
Plates, sheets, and strip (7606)	1,397	1,065	1,166	1,522	1,812	1,638
Foil (7607)	621	650	751	860	949	1,076
Total	2,018	1,715	1,917	2,383	2,761	2,715
Wire (7605)	23	24	17	22	25	22
Total	2,614	2,337	2,583	3,131	3,608	3,704

Source: IHS Markit, GTA database (accessed February 23, 2017).

The main driver of the growth in Chinese wrought exports, which are primarily lower-value-added products, is their price competitiveness. This is heavily influenced by the cost of aluminum inputs in comparison to costs in the rest of the world, and the cost of primary aluminum correlates most strongly with Chinese exports of plates, sheets, and strip (HS 7606), though it does also impact products such as extrusions. Chinese exports of plates, sheets, and strip declined in 2012 and 2013, at least in part, because there was only a small difference in the price of primary aluminum between China and the rest of the world. The cost competitiveness of Chinese inputs substantially increased during 2014, contributing to rising exports that year and into 2015.[585] Declining price competitiveness in raw materials did depress

[585] IHS Markit, GTA database (accessed February 23–April 6, 2017); *Platts Monthly Reports;* American Metal Market Website, http://www.amm.com/ (accessed August 2016–March 2017); Fog, “Market Outlook,” June 16, 2016, 14; Harbor Aluminum data in Arrowcrest Group, submission to the Australian Antidumping Commission, March 23, 2015, 15; Zou, “2017 Preview,” December 26, 2016; Zou, “China’s Unwrought Aluminum,” November 8, 2016.

exports of plates, sheets, and strip during 2016, but it was partially offset by strong foreign demand, the depreciation of the Chinese currency, and further declines in export prices.[586]

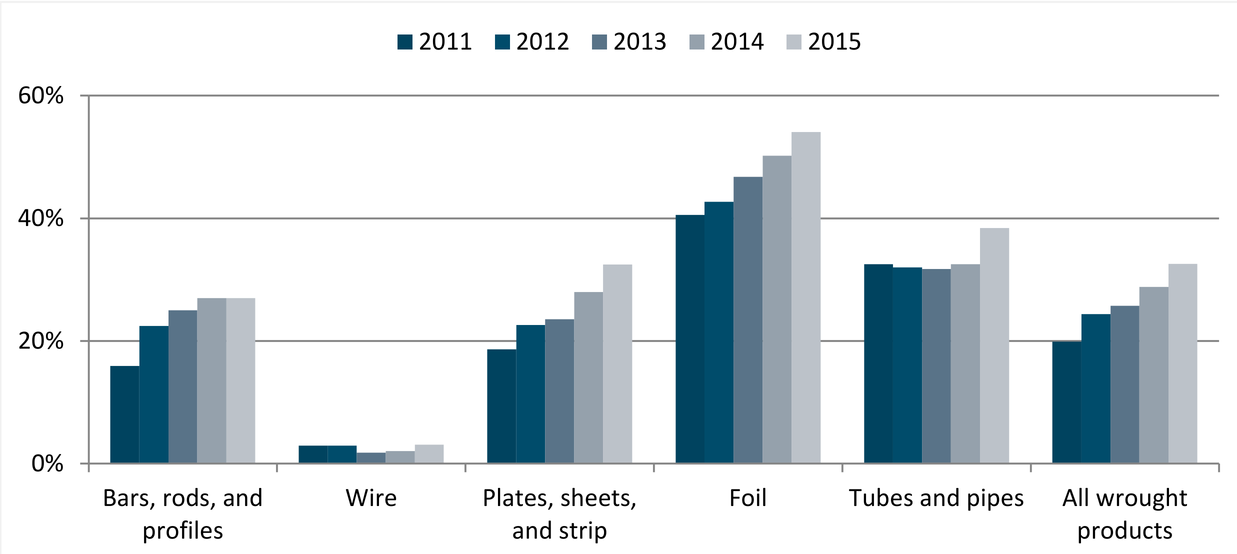
A number of other factors also contributed to significant Chinese exports and/or the growth in exports during 2011–15. Chinese exports have benefited from the movement of foreign producers into higher-value-added market segments and the desire of purchasers in those countries to ensure a large enough supply of lower-value-added or time-intensive products.[587] Chinese exports also benefit from favorable ocean freight costs, which are significantly lower than for producers in the rest of the world.[588] Chinese producers also have low conversion costs (costs for converting unwrought to wrought aluminum) for some products.[589]

China has rapidly increased its share of global wrought aluminum exports (based on ordinary and processing trade). Overall, this share rose from 20 to 33 percent during 2011–15 (figure 6.12). China's share of plate, sheet, and strip exports increased to 32 percent; of foil exports, to 54 percent; and of tube and pipe exports, to 38 percent.[590]

---

[586] Zou, "2017 Preview," December 26, 2016; Leung, "China's 2016 Extrusion Exports," February 29, 2016; IHS Markit, GTA database (accessed April 2017).
[587] Industry representative, interview by USITC staff, February 27, 2017; Beer Institute, written submission to the USITC, February 21, 2017, 14.
[588] Trade Data Services, Import Genius database (accessed November 2016); Datamyne database (accessed November 2016); USITC DataWeb/USDOC (accessed November 2016); Government of New Zealand, Statistics New Zealand database (accessed November 2016).
[589] Chinese firms do not have the lowest conversion costs for all products, however. For example, according to CRU data Chinese firms have relatively high conversion costs for building sheet. Watanabe, "Japan's Aluminium Foil," September 1, 2014; Watanabe, "China's Al Semis," August 22, 2014; Zou, "2017 Preview," December 26, 2016; industry representative, interview by USITC staff, February 17, 2017; CRU Group.
[590] IHS Markit, GTA database (accessed April 2016–February 2017).

Figure 6.12: China: Share (ordinary and processing trade) of global wrought aluminum exports, 2011–15



Source: IHS, Markit, GTA database (accessed April–August 2016).
Note: Corresponds to appendix table L.30.

Imports

Chinese imports of wrought aluminum dropped from 574,000 mt in 2011 to 469,000 mt in 2015, and fell further to 388,000 mt in 2016 (table 6.15). Chinese wrought imports are primarily high-value items, such as flat-rolled products for the auto and aerospace industries and foil for the electronics industry, that are not available in sufficient quantities from domestic producers.[591] The average unit price of Chinese imports of aluminum foil, for example, was more than $16,600/mt in 2015 (compared to $3,300/mt for exports), and the average unit price of plate, sheet, and strip imports was $4,000/mt (compared to $2,500/mt for exports). The major suppliers of these products are producers in South Korea, Japan, Taiwan, Germany, and the United States.[592]

Table 6.15: China: Wrought aluminum imports (HS 7604–7608), by source, 2011–16 (thousand mt)

Destination	2011	2012	2013	2014	2015	2016
South Korea	185	155	142	157	153	102
Japan	85	84	76	94	94	100
Taiwan	61	64	58	55	68	62
United States	37	39	34	31	33	34
Germany	51	47	41	29	30	25

591 CNIA, post hearing brief to the USITC, October 17, 2016, 8, 15, 22; IHS Markit, GTA database (accessed February 2017).
592 IHS Markit, GTA database (accessed April–August 2016).

Destination	2011	2012	2013	2014	2015	2016
All other	154	139	127	130	91	64
Total	574	527	478	496	469	388

Source: IHS Markit, GTA database (accessed February 23, 2017).
Note: Based on top five sources in 2015.

Flat-rolled product imports accounted for the largest share of Chinese imports and for about 5 percent of the Chinese market in 2015 (table 6.16). The market share of flat-rolled product imports is declining, however, likely due to the increased production of high-value-added products within China, as discussed below in the "Competitiveness Factors" section. Imports of extrusions and wire and cable accounted for less than 1 percent of the Chinese market.[593]

Table 6.16: China: Wrought aluminum imports, by product type, 2011–16 (thousand mt)

Product type	2011	2012	2013	2014	2015	2016
Extrusions						
Bars, rods, and profiles (7604)	70	77	62	68	69	63
Tubes and pipes (7608)	20	14	13	13	10	8
Total	90	91	75	81	79	71
Flat-rolled products						
Plates, sheets, and strip (7606)	418	374	339	347	325	246
Foil (7607)	57	55	56	60	56	60
Total	475	429	395	407	382	306
Wire (7605)	9	7	7	9	9	11
Total	574	527	478	496	469	388

Source: IHS, Markit, GTA database (accessed February 23, 2017).

Government Policies and Programs

The Chinese central and local governments have encouraged primary aluminum production through low tariffs on imports of raw materials, as well as a variety of programs that provide direct support to aluminum smelters, such as grants, tax incentives, loan policies, and lower electricity rates. At the same time, the government has tried to closely regulate primary aluminum production and limit exports, implementing policies to encourage greater energy efficiency, discourage pollution, and eliminate overcapacity in the industry. The primary aluminum sector also benefits from policies that support the downstream wrought aluminum industry.

The Chinese government has generally created a policy environment that is supportive of the secondary aluminum industry, promoting the development of the "circular" (recycling)

[593] CRU Group; HIS Market, GTA database (accessed April–August 2016).

economy and setting production targets in the 12th and 13th five-year plans.[594] Recent government initiatives have also aimed to increase China's domestic scrap collection.[595] At the same time, the government has implemented a number of environmental policies intended to better protect the environment and to phase out small, inefficient secondary producers.[596]

In the wrought aluminum sector, the government's policy environment encourages exports of many wrought aluminum products and supports the development of the industry. Many of the policies that help to reduce the production costs of primary aluminum also benefit wrought aluminum producers, as they contribute to lower input costs. Tariffs also discourage the import of competing wrought aluminum products.

The remainder of this section provides a more detailed overview of the main policy mechanisms that the government has used to encourage or discourage production and trade in unwrought and wrought aluminum. This section does not attempt to catalogue every policy in China, but rather to provide a broad overview of the policies and give specific examples to illustrate the types of policies implemented. Additional quantitative assessments of the impact of Chinese aluminum polices are provided in chapter 10.

Trade Policies[597]

Primary Unwrought Aluminum

China's trade policies support the production of primary aluminum for domestic consumption, but discourage exports. First, China maintains no import duties on bauxite and alumina, key inputs into aluminum production, though they are subject to China's 17 percent VAT.[598] Chinese unwrought aluminum imports are subject to rates of duty ranging from zero to 7 percent and to a 17 percent VAT.[599] As discussed above, these high import costs effectively limit

---

[594] The 13th five-year plan targets an annual growth rate of 8 percent and production of 9 million mt in 2020. Liu, "China Recycled Aluminum Industry," 12; Wan Ling, "Implications from China's 12th Nonferrous," April 24, 2012; Taylor, "Scaling Back Down," March 2016; Taylor, "2016 CMRA: Some Words," November 20, 2016.
[595] Taylor, "2016 CMRA: Some Words," November 20, 2016; Taylor, "2016 CMRA: Causes for Concern," November 20, 2016; Taylor, "Trial and Error," January 7, 2015.
[596] Taylor, "Scaling Back Down," January/February 2016; Wookey, "MB Recycled Al Conf: China's Secondary," November 17, 2015.
[597] All tariff and VAT rates presented in this section are for 2016, unless otherwise noted. This section will primarily focus on four types of trade policies: import tariffs, the VAT on imports, export tariffs, and the VAT on exports (including the VAT rebate). Imports of aluminum into China are subject to import tariffs and the 17 percent VAT. For certain aluminum exports, China applies an ad valorem export tariff. Chinese exports are also generally subject to the 17 percent VAT. However, a number of tariff lines are eligible for VAT rebates, thereby lowering the VAT on exports. China Customs, *2016 Customs Import and Export Tariff*, 2016.
[598] China Customs, *2016 Customs Import and Export Tariff*, 2016.
[599] China Customs, *2011 Customs Import and Export Tariff*, 2010; China Customs, *2016 Customs Import and Export Tariff*, 2016.

imports to periods of times when there is a significant difference between prices in China and the rest of the world.

The Chinese government generally discourages exports of unwrought aluminum, reportedly for environmental reasons (and to encourage exports of higher-value-added downstream products), imposing a 15 percent tariff and 17 percent VAT on exports of most unwrought aluminum.[600] These policies limit Chinese exports of primary aluminum, as demonstrated by the decline in exports following incremental decreases in (and the eventual removal of) VAT rebates and increases in the export tariff to its current level of 15 percent (discussed in the competitiveness section below). This is further confirmed by the Commission's model results (see chapter 10), which indicate that removing export barriers would result in a substantial increase in Chinese exports of primary aluminum.

Secondary Unwrought Aluminum

One of the primary mechanisms that the Chinese government has used to encourage the development of the secondary industry in China is taxes and tariffs. The Chinese government does not impose any duties on imports of aluminum scrap, but subjects scrap exports to a 15 percent export tariff, thereby improving the price competitiveness of scrap in the domestic market.[601] Further, while unwrought aluminum exports are generally subject to a 15 percent export tariff and a 17 percent VAT, secondary aluminum is typically exported under the processing trade regimes discussed above and thus is often exempt from many of these taxes.[602]

Wrought Aluminum

China has lowered barriers to the export of most wrought aluminum products, thereby reducing the cost of exports. Exports of aluminum foil, tubes and pipes, and plates, sheets, and strip are eligible for VAT rebates of 13 to 15 percent and are not subject to export tariffs.[603] China's export policies for bars, rods, and profiles (shapes) have been more mixed. The

---

[600] The Chinese government reportedly sought to limit exports of primary aluminum due to its energy-intensive nature, and the contribution of production and related power generation to environmental pollution (see the environmental policies section below). AFX News Limited, "China to Adjust Tariffs," November 17, 2006; China Mining and Metals Newswire, "China to Adjust," October 27, 2006; China Customs, *2011 Customs Import and Export Tariff*, 2010; China Customs, *2016 Customs Import and Export Tariff*, 2016; Metal Bulletin, "Alcoa Says China Likely to Deal," July 9, 2015; Platts, "China Unlikely to Cut 15% Export Tax," December 9, 2014.
[601] China Customs, *2016 Customs Import and Export Tariff*, 2016; USITC, hearing transcript, September 29, 2016, 66, 98–99 (Panneer).
[602] Liu, "China Nonferrous Metals Recycling Industry," January 2016, 11; Sun, "Beijing to Impose 15% Duty on Al Alloy Exports," August 18, 2008; Kim and Lee, "China's Processing Trade," March/April 2013, 52; Manova and Yu, "How Firms Export," 2016, 122; Gourdon, Monjon, and Poncet, "Incomplete VAT Rebates," February 5, 2014, 5.
[603] China Customs, *2016 Customs Import and Export Tariff*, 2016.

government imposed a 15 percent export tariff on bars and rods in order to limit exports, with the major stated impetus being environmental considerations.[604] However, China has subsequently removed export tariffs on bars and rods, and offers VAT rebates for exports of profiles of aluminum alloys. Wrought imports are subject to tariffs of 1 to 10 percent, and the 17 percent VAT.

Energy Policies

Chinese energy policies can have a substantial impact on reducing the production costs for aluminum smelters that purchase electricity. There are two aspects to China's electricity policies—central government policies that impact all companies, and local government policies specifically for aluminum producers. Energy policies oriented toward improving efficiency and environmental goals will be discussed in the environmental policies section below.

The central government has made a number of changes to electricity rates and market structure that have lowered costs for the aluminum industry. First, the government reduced electricity rates for all consumers. These rate reductions, while not targeted to the aluminum sector, have reduced costs for some aluminum smelters.[605] The government also introduced electricity market reforms to lower electricity prices and transmission and distribution costs. China plans to expand electricity transmission and distribution pricing reforms—currently being tested in a number of regions—nationwide in 2017. These reforms have the potential to further reduce electricity prices.[606]

Local governments, on the other hand, have directly intervened to support aluminum production through lower electricity rates. These are most often provided in times of low aluminum prices when companies are considering closing their production plants. This was particularly evident at the end of 2015, when Chinese aluminum producers planned to reduce production in response to low prices. In order to keep plants open and/or competitive with other producers receiving lower prices, provincial governments substantially lowered electricity prices for aluminum smelters.[607] The following are a few examples:

---

[604] Xinhua News Agency, "Higher Duty on Aluminum Export," July 20, 2007; Embassy of the People's Republic of China in Australia, "China Adjusts Tariff on Aluminum Products," July 20, 2007.
[605] BLS & Co and Tractus, "A Comparison of U.S. and China Electricity Costs," 2016; *Shanghai Daily*, "China Lowers," April 19, 2015; Moody's, "Moody's: China's On-grid Tariff," January 4, 2016.
[606] Xinhua, "China Decides to Expand," March 14,2016; Xinhua, "China to Expand Power Pricing," March 29, 2016; Fan Ruohong, "State Council Aims," December 15, 2015.
[607] *Metal Bulletin*, "China's Henan Issues," September 14, 2012; *Metal Bulletin*, "China Aluminium Smelters," June 1, 2012; Mok, "China Aluminum Smelters," November 3, 2015; Yam, "China Aluminium Smelters," November 6, 2015; Zhou, "China Aluminium Smelters' Power Costs," December 25, 2015.

- The per-kilowatt-hour (kWh) electricity price for Chalco's Liancheng plant was lowered from 5.6 cents per kWh to 3.8 cents in 2016.[608]
- Dongxing Aluminum received the same reduced rate as Chalco Liancheng in 2016.[609]
- A large number of other smelters were reported to be negotiating reductions of up to 2.2 cents per kWh in their electricity rates at the end of 2015.[610]

Environmental Policies

The Chinese government has implemented policies and increased enforcement of regulations to reduce pollution (box 6.1) across the aluminum value chain. Environmental policies implemented by the Chinese government, to the extent they are enforced, increase costs and/or reduce production. Recent environmental policies include:

- The government imposed higher electricity rates for inefficient primary aluminum smelters and required that, as of 2014, smelters meet a certain energy efficiency threshold.[611]
- In February 2017, the Ministry of Environmental Protection and the National Development and Reform Commission issued a new regulation requiring that alumina and aluminum producers in 28 northern cities cut output by 30 percent during the winter heating season (generally mid-November to mid-March).[612] According to initial estimates, the new rules would lead to a reduction in aluminum production of 1.3 million mt, and a reduction in alumina production of 2.71 million mt.[613]

---

[608] Yam, "China Aluminium Smelters," November 6, 2015.
[609] Zhou, "China Aluminium Smelters' Power Costs," December 25, 2015.
[610] Yam, "China Aluminium Smelters," November 6, 2015; Zhou, "China Aluminium Smelters' Power Costs," December 25, 2015.
[611] The law has different maximum energy efficiency levels for existing facilities, newly built facilities, and advanced facilities. According to one estimate, about 1.7 million mt of primary aluminum smelting capacity would fall into the category that would need to pay higher rates, although some would be able to reduce electricity use such that the total amount of capacity subject to the higher rates would ultimately be less than 1 million mt. Hao, Geng, and Hang, "GHG Emissions, " May 28, 2015, 268; Reuters, "Update 1—China to Impose," December 22, 2013; Yam, "China's Extra Power," January 8, 2014.
[612] Home, "China Lobs a Grenade," March 3, 2017; Bloomberg News, "China Said to Order," March 1, 2017.
[613] An analysis by Citigroup pointed to even higher production declines. In addition, the rules also require cuts in carbon anode production, and a resulting shortage of these anodes could curtail additional primary aluminum capacity. Furthermore, China amended its air pollution law to limit the sulfur content in petroleum coke, which is used in anodes in the aluminum industry. While this could effectively constrict anode supply for the aluminum industry, as of mid-December 2016 the new standards for the maximum sulfur content had not yet been set. Home, "China Lobs a Grenade," March 3, 2017; Bloomberg, "China Said to Order," March 1, 2017; Djukanovic, "Petroleum Coke Market Tightens," December 12, 2016.

- The government has subjected nonferrous scrap imports to increasing inspections and fees, as well as tighter enforcement of the maximum amount of contaminants that can be included in the scrap material.[614]
- In April 2015, the government approved new emission standards for secondary aluminum producers, with an implementation date of July 2015 for new facilities and January 2017 for existing facilities. CMRA estimated that the cost for firms to comply with these standards would be about $2 million and that not all companies would be able to meet the standards, though companies with a collective 3.5 million mt in annual capacity were already expected to meet them by the end of 2015.[615]

Box 6.1: China: Environmental Impact of Aluminum Production

Chinese production of primary aluminum, which reportedly accounts for about 5 percent of electricity consumption in China,[a] has significant impacts on China's environment. According to one life cycle analysis,[b] unwrought aluminum production accounted for 3.53 percent of Chinese carbon dioxide emissions,[c] 1.99 percent of particulate matter emissions, 3.47 percent of sulfur dioxide emissions, and 5.34 percent of nitrogen oxides emissions.[d] Further, other environmental pollution has been associated with primary aluminum production in China, such as the waste generated in the production process.[e]

[a] Zhang et al., "Environmental Footprint of Aluminum Production in China," October 1, 2016, 1242.
[b] This paragraph presents the environmental impacts as measured by recent studies, but does not present a full literature review of all relevant studies.
[c] Similarly, another study found that primary production accounted for 4 percent of Chinese greenhouse gas emissions in 2013, and that emissions per ton of aluminum production were "significantly higher" than the global average. Hao, Geng, and Hang, "GHG Emissions," May 28, 2015, 271.
[d] Zhang et al., "Environmental Footprint of Aluminum Production in China," October 1, 2016, 1249.
[e] Ibid., 1249–50.

These individual policies may raise costs for Chinese firms, but examining environmental regulations and compliance across the Chinese industry indicates that Chinese firms likely benefited from less stringent enforcement during 2011–15. U.S. industry representatives indicated at the Commission's hearing that the Chinese industry is polluting and that industries

[614] Wookey, "MB Recycled Aluminium Conference," November 17, 2015; Taylor, "Scaling Back Down," March 8, 2016; Taylor, "2015 CMRA Convention: Removing the Barriers," November 17, 2015; Taylor, "2015 CMRA Convention: How Green?" November 17, 2015; Recycling International, "China's Import Demands," April 16, 2013; Flower, "What Operation Green Fence Has Meant," February 10, 2016.
[615] Liu, "China Recycled Aluminium Industry," November 17, 2015, 9–10; Liu, "China Nonferrous Metals Recycling Industry," January 21–23, 2016, 13; Wookey, "MB Recycled Al Conference: China's Secondary," November 17, 2015.

in other countries comply with higher levels of environmental protection.[616] Available information does indicate that Chinese firms have underinvested in pollution control technology and processes. For example, in 2016 the government increased environmental inspections, including of aluminum firms. These inspections identified environmental issues throughout the aluminum supply chain, including in the production of carbon anodes, alumina, electricity (at captive power plants), primary aluminum, secondary aluminum, and wrought aluminum. The government issued substantial penalties on firms not in compliance with environmental laws, including fines and orders to close capacity, and required many firms to upgrade equipment (often including switching from coal to natural gas).[617] Environmental groups have also reported that coal-fired captive power plants in China often start construction without being permitted, and that government inspections have found they do not meet applicable emissions standards.[618]

The extent of the costs that firms have avoided by not investing in pollution control equipment is significant. One large firm that had been cited in reports by media and nongovernmental organizations as not meeting environmental standards stated that it had invested $185 million in environmental protection equipment in the first 10 months of 2016.[619]

Financing

Government involvement in lending has also aided Chinese aluminum producers. In 2012, for example, Yunnan province announced a policy that allowed SOEs to use inventory as collateral for the loans. The loans would go to the SOEs, but the government would pay the interest on the loans.[620] Government entities also provide loans directly to companies. For example, Chalco received loans from local bureaus of the Ministry of Finance, with outstanding loans totaling

---

[616] Hearing transcript, September 29, 2014, 34, 151 (Reyes), 71 (Chevalier), 152–153 (Scott). Chinese industry representatives, on the other hand, stated that energy efficiency is improving and that Chinese smelters have invested in more efficient and less polluting supercritical and ultra-supercritical technology. According to the CNIA, almost 25 percent of primary aluminum capacity uses supercritical units of 660 MW or above. CNIA, post hearing brief, exhibit 1, 2, 5–6, 20. (Supercritical and ultra-supercritical plants operate at high pressures, making them more efficient and lowering greenhouse gas emissions. As of 2014, new coal plants in China are required to be ultra-supercritical plants 600 MW in size or greater.) Shearer et al., *Boom and Bust 2016*, March 2016, 33; IEA, *Technology Roadmap: High-Efficiency, Low-Emissions*, 2012, 14–15.
[617] SMM, "What's Impact on Chinese Aluminum Producers?" December 12, 2016; Aluminum Insider, "Chinese Smelters," November 9, 2016; Home, "China's Giant Aluminum Machine," February 21, 2017; Platts, "China's ADC Aluminum Export," December 6, 2016; Home, "Aluminum Sector Seeks," March 23, 2017; SMM, "Domestic Aluminum Processing Enterprises," February 17, 2017; SMM, "Prebaked Anode Poised," February 21, 2017; McBeth, "Aluminum Buyers," November 3, 2016.
[618] Shearer et al., *Boom and Bust 2016*, March 2016, 31–33.
[619] Shearer et al., *Boom and Bust 2016*, March 2016, 32; China Hongqiao, "Clarification Announcement," November 23, 2016, 13–16; Aluminum Insider, "Chinese Smelters," November 9, 2016.
[620] *Kazakhstan Mining Weekly*, "Yunnan Offers Subsidized Loans," October 15, 2012.

$3.7 million at the end of 2015.[621] Interest rates on government loans received by aluminum companies may be lower than the market rates.[622] Firms may be able to access funding from sources such as the China Development Bank for international investments.[623]

SOEs also benefit from their affiliation with the government in terms of low interest rates and access to credit. Chinese banks are typically more willing to lend to SOEs than to private firms and provide them with loans at lower rates than those they give to private Chinese firms (lending rates specific to the aluminum sector will be discussed below).[624] Chalco's credit rating from international rating agencies directly benefits from its affiliation with the government and from the expectation that the government will give it assistance, if needed, to repay its debts.[625]

Among analysts covering the aluminum industry, there similarly does not seem to be a consensus on the role financing[626] plays in the competitiveness of the Chinese aluminum industry.[627] According to one industry analyst, financing in China for the aluminum industry is easily available.[628] Another industry representative indicated that firms in China do not receive particularly low interest rates in comparison to aluminum firms in other regions, and that this is not a significant factor in lower capital expenditures in China.[629] A different analyst indicated that low-interest loans and debt forgiveness are key factors in the continued viability of China's

[621] Chalco, "Form 20-F," April 15, 2016, F-125.
[622] China Hongqiao, *2010 Annual Report*, 2011, 54.
[623] *Jamaica Observer*, "JISCO Pledges," September 22, 2016; *New York Times*, "Rio Discusses Selling," February 2, 2009.
[624] Elliot and Yan, "The Chinese Financial System," July 2013, 3–4; Hong, "China's Small Businesses," April 1, 2015; Fan and Hope, "The Role of State-Owned Enterprises," 12. Elliot and Yan indicate five general reasons why banks may be more willing to lend to SOEs: (1) "strong business positions" (such as large market share), (2) "implicit government guarantees," (3) perceptions among loan officers that lending to SOEs is less risky in terms of job security, (4) relationships between bank officers and SOE officials, and (5) "direct government or party influence."
[625] Fitch, "Fitch Affirms Chinese Aluminium," October 17, 2016; S&P, "S&P Cuts Chalco," February 2, 2012.
[626] Chinese unwrought and wrought aluminum producers have used bank loans, loans from government entities, bonds, and other financing methods to fund operating expenditures and capital investments. A substantial portion of the financing comes from entities within China, but firms have also sought financing from international sources, and some loans are denominated in foreign currency. In some instances, funding for expenses comes directly from government entities, as discussed above. Chalco, "Form 20-F," April 15, 2016, 69, 85–87; China Hongqiao, *2015 Annual Report*, 2016, 95–105; China Zhongwang, *2015 Annual Report*, 12, 28, 29, 30, 33, 113–15.
[627] U.S. industry representatives stated that access to low-cost financing provides Chinese firms with a competitive advantage. USITC, hearing transcript, September 29, 2016, 35 (Reyes), 139, 179 (Scott), 256–257, 274 (Price). In contrast, Chinese industry representatives stated that financing is market based, that Chinese aluminum firms pay relatively high interest rates, and that there have been limits on their access to capital, since they have not accessed all available types of funding. CNIA, post hearing brief to the USITC, October 17, 2016, 38; Wen Xianjun, "Aluminum Industry in China and International Trade," October 27, 2016; Wu, "Aluminum Industry in China and International Trade," October 2016.
[628] Industry representative, interview by USITC staff, Washington, DC, September 27, 2016.
[629] Industry representative, telephone interview by USITC staff, December 16, 2016.

primary metals industry.[630] A review of available information for the largest Chinese primary and wrought aluminum producers indicates that the annual loan portfolios for these firms during 2011–15 tended to have interest rates at or below the People's Bank of China (PBOC) one-year benchmark lending rate.[631]

Tax Benefits

Chinese aluminum producers also receive various tax benefits that can lower tax-related costs and increase profits. China's general corporate tax rate is 25 percent, but certain Chinese aluminum companies qualify for a lower 15 percent tax rate—often because they are new and high-tech enterprises, or are "encouraged" enterprises located in Western China.[632] Aluminum companies also may qualify for various local tax rebates for their domestic operations.[633] For example, Jimsar county in Xinjiang Province has policies to reimburse—in the first five years of production—a share of the corporate income tax and the VAT retained by the local government back to downstream aluminum companies. The share of the tax reimbursed increases with plant size, and also is higher for companies that produce aluminum foil.[634]

In the secondary industry, effective July 1, 2015, Chinese secondary aluminum producers are eligible for a 30 percent VAT rebate if more than 70 percent of their production uses certain types of recycled aluminum sources (e.g., end-of life vehicles, wire, cable, cans) and they meet other standards (e.g., environmental protection requirements).[635] CMRA estimates that this VAT rebate will increase secondary producers' profit margins by about 2 percent.[636]

Grants

Government grants provide significant benefits for Chinese aluminum producers across the value chain, and can fund expenses ranging from research and development to investments in plants and equipment. The amount of this direct support varies significantly by company and

---

[630] Burton and Hughes, "U.S. Challenge to China," February 12, 2015.
[631] Based on the Chalco, China Hongqiao, and China Zhongwang annual reports, 2011–15. PBOC interest rates from Investing.com website, http://www.investing.com/economic-calendar/pboc-interest-rate-decision-1083 (accessed December 30, 2016).
[632] Foreign companies with plants in China may also qualify for this lower tax rate if they meet the applicable conditions. Chalco, "Form 20-F," April 15, 2016, 56, F-149; China Zhongwang, *2015 Annual Report*, 2016, 21; XinRen Aluminum, *2014 Annual Report*, 2015, 68; Gränges, *2015 Annual Report*, 2016, 42, 58, 73–74.
[633] Jimsar County, Xinjian Province website, http://www.xjzsw.gov.cn/html/zszc/dzzc/2016-04-06/26615.html (accessed February 27, 2017).
[634] Jimsar County, Xinjian Province Website, http://www.xjzsw.gov.cn/html/zszc/dzzc/2016-04-06/26615.html (accessed February 27, 2017).
[635] Liu, "China Recycled Aluminium Industry," November 17, 2015, 8; Liu, "China Nonferrous Metals Recycling Industry," January 2016, 12.
[636] Liu, "China Recycled Aluminium Industry," November 17, 2015, 8.

year. Public information for 15 primary and wrought producers indicates that, for these companies, income from government grants increased from about $50 million in 2011 to almost $500 million in 2015.[637] Chalco, an SOE and the second-largest primary aluminum producer, reported the highest value, with income from government grants of more than $270 million.[638] On the other hand, China Hongqiao Group, a private company and the largest primary aluminum producer, reported cash flows from the receipt of government grants of $8 million in 2015, and no cash flows from government grants in 2014.[639]

Government grants are provided for a broad range of purposes, such as research and development, opening new production lines, investing in environmental technologies, and keeping production plants open. Chalco, for example, reports that in addition to electricity price support, it receives “research subsidies” and “grants on environment protection projects.”[640] Yunnan Aluminum received support from late 2015, according to a Yunnan government official, to maintain employment.[641] Shandong Nanshan Aluminium received grants for a variety of purposes, such as research, environmental protection and conservation, and modernization and improvement of production lines.[642] Xingfa Aluminium reports receiving government grants to fund operating expenses, as well as government grants for purchasing fixed assets.[643]

Low-priced Inputs Provided by State-Owned Enterprise

Chinese SOEs have reportedly provided inputs to unwrought and wrought aluminum producers at low prices, reducing production costs. According to a Citi Research report, for example, China Hongqiao purchases alumina under long-term contracts from with a local government SOE.[644] A review of available data indicates that China Hongqiao likely purchased alumina at rates below

[637] These data are only for these 15 companies, and therefore the amount of grants received by all firms in the industry in 2015 was likely higher. In addition, for these companies, this total is likely only a portion of the benefits that firms receive from government policies, as it only applies to income recorded as government grants on financial statements. Companies may use different accounting methods and approaches to reporting government grants; therefore, there may be some differences in what is included. Further, the data on government grants presented here do not include deferred income. Government grants and support listed in financial reports may also include some of the benefits discussed in other sections, such as reduced loan rates, and therefore may be broader than the coverage of this section. Compiled from company financial reports of publicly traded companies.
[638] Chalco, “Form 20-F,” April 15, 2016, 10.
[639] China Hongqiao, *2015 Annual Report*, 51.
[640] Chalco, “Form 20-F,” April 15, 2016, 71.
[641] Spegele, “China Continues to Prop Up,” May 9, 2016.
[642] Shandong Nanshan Aluminum, *2016 Semi-Annual Report*, 2016, 83–86.
[643] Xingfa Aluminum, *2015 Annual Report*, 2016, 102, 133–34.
[644] Citi Research, "China Hongqiao," February 12, 2016, 13.

what would be expected, given market prices.[645] Similarly, both the U.S. Department of Commerce and the Australian Anti-Dumping Commission have found that SOEs were providing primary aluminum to wrought producers for less than adequate remuneration.[646]

Recent Efforts to Curb Overcapacity[647]

The Chinese central government has sought to reduce capacity in China,[648] but industry representatives indicate that the impacts of these changes have been limited due to slow implementation at the local level and modest goals for some of the policies.[649] In addition, the Chinese government's goal is not an overall reduction in Chinese production or demand for aluminum. In the October 2016 revision to the country's five-year plan, the Ministry of Industry and Information Technology (MIIT) projected primary aluminum demand in China to rise to 40 million mt in 2020 (up from 32.1 million mt in 2016), though the MIIT reiterated that it would not approve new aluminum capacity.[650]

One of the ways that the Chinese government has sought to reduce smelter capacity is by identifying specific smelters for closure. This policy has been effective in encouraging smelters to close, but the volume of production capacity targeted accounts for a relatively small share of China's total production capacity. [651] Overall, MIIT identified almost 2 million mt of capacity for closure during 2011–15.[652] CM Group reports 1.8 million mt of related capacity closures during

[645] For example, China Hongqiao purchased alumina from the firm, which is reportedly a high-cost producer, on a long-term contract at 19 percent below market prices in 2012, according to Citi Research. The price was also significantly lower than typical contract prices in China, the SOE's spot sales prices (though these are not readily available for the entire year), and import unit values (including the VAT). Citi Research, "China Hongqiao," February 12, 2016, 13; Mok, "Chinese Alumina Contracts May Change," January 16, 2012; Comtex News Network, "Chalco to Raise Alumina Price in 2013," December 17, 2012; Li, "Chinese Smelters Opt for Spot Alumina Imports," February 6, 2012. Spot prices based on data reported in China Metals Weekly; IHS Markit, GTA database (accessed March 29, 2017); and American Metal Market website, http://www.amm.com/ (accessed August 2016–March 2017).
[646] Marsh, "Issues and Decision Memorandum," March 28, 2011, 32–36; Australian Anti-Dumping Commission, "Review of Anti-Dumping Measures," July 13, 2015, 53.
[647] There are different definitions of overcapacity, as noted earlier in this report. This section does not specifically rely on a particular definition of overcapacity; rather, it covers Chinese policies on what the government perceives to be overcapacity.
[648] The United States and China have engaged in discussions on overcapacity in the aluminum sector. In addition, the United States has recently filed a request at the WTO for dispute settlement with China in regard to alleged government support of its aluminum industry. This request was in part related to overcapacity in China, with the USTR stating that "artificially cheap loans from banks and low-priced inputs for Chinese aluminum are contributing to excess capacity." USTR, "Obama Administration Files WTO Complaint," January 12, 2017; McDonald, "China Vows to Cut Aluminum Output," September 23, 2016; USDOC, "U.S. Fact Sheet: 26th U.S.-China Joint Commission," November 23, 2015.
[649] Industry representative, telephone interview by USITC staff, February 15–16, 2017.
[650] Teo, "China's Base Metals Demand," October 19, 2016; CNIA, written submission to the USITC, February 21, 2017, 4.
[651] Industry representative, telephone interview by USITC staff, February 15–16, 2017.
[652] Clark, written submission to the USITC, February 22, 2017, 40.

2011–15, with closures relatively evenly split between SOEs (52 percent) and private firms (48 percent).[653]

Recent policy changes have also been targeted toward overcapacity. In June 2016, China's State Council released its "Guiding Opinion on Building Sound Market Environment, Promoting Non-Ferrous Metals Industry to Adjust Structure and to Transform and Improving Efficiency," which included a goal of keeping the aluminum capacity utilization rate above 90 percent. It listed a number of specific tasks and assigned relevant ministries to address the imbalance between supply and demand; increase market applications; and enhance industry innovation.[654] In August 2016, the MIIT announced that it would use the enforcement of energy, environmental, and safety standards to reduce overcapacity in a number of industries, including aluminum. It also announced changes in lending policies that would allow some firms to access credit to restructure, but would bar lending to smelters identified for closure.[655]

Other

A number of other policies affect Chinese aluminum producers, including:

- Land-use fees: The Chinese government has reportedly granted land-use rights to aluminum companies at discounted rates. For example, Jimsar county in Xinjiang province provides land use rights to downstream aluminum companies at discounted rates. The amount of land that it will provide for at lower rates varies with the production capacity of the company.[656]
- Aluminum stockpiling: In their June 2016 statement, one of the tasks outlined by the State Council was to improve and increase non-ferrous metal reserves.[657] During 2008–09, the Chinese government also supported the stockpiling of aluminum.[658]

---

[653] Clark, written submission to the USITC, February 22, 2017, 41.
[654] Government of China, Office of the State Council, "Suggestions of the General Office of the State Council," June 5, 2016.
[655] Stanway, "China to Use," August 12, 2016.
[656] Jimsar County, Xinjian Province website, http://www.xjzsw.gov.cn/html/zszc/dzzc/2016-04-06/26615.html (accessed February 27, 2017).
[657] Government of China, Office of the State Council, "Suggestions of the General Office," June 5, 2016.
[658] CNIA, written submission to the USITC, February 21, 2017, 23.

- Truck overloading: In September 2016, China implemented a new rule that limited the maximum weight of trucks to prevent overloading. Although this raised aluminum transportation costs for aluminum and production-related inputs.[659] It might also have long-term benefits for the aluminum industry in driving demand for lighter trucks.

Issues Raised in Ongoing WTO and U.S. Antidumping and Countervailing Duty Investigations

On January 12, 2017, the United States submitted a request to the WTO for consultations regarding alleged subsidies to producers of primary aluminum.[204] The request specifically noted the following measures, though it indicated that the consultations are not necessarily limited to these measures:

- "China provides loans and other financing to primary aluminum producers through banks that are government agencies or entities, public bodies, or private bodies. . . . Loans provide a benefit to each recipient because they are provided to that recipient at interest rates below those which the recipient otherwise would have paid on a comparable commercial loan which the recipient could actually have obtained on the market."[660]
- "China, through producers and resellers of coal, provides coal to Hongqiao. This provision of coal provides a benefit to Hongqiao because it is provided to the recipient for less than adequate remuneration."[661]
- "China, through Binzhou Gaoxin, provides alumina to Hongqiao. This provision of alumina provides a benefit to Hongqiao because it is provided to the recipient for less than adequate remuneration."[662]
- "China, through Binzhou Gaoxin, provides electricity to Hongqiao. This provision of electricity provides a benefit to Hongqiao because it is provided to the recipient for less than adequate remuneration."[663]

On March 9, 2017, the Aluminum Association Trade Enforcement Working Group and the members of that group submitted petitions for the imposition of antidumping and

[659] It might also have long-term benefits for the aluminum industry in driving demand for lighter trucks. Yee, "Japan's ADC12," November 29, 2016; Yee, "Japanese Buyers Divided," November 15, 2016; Yang, "Aluminum Prices Surge," October 26, 2016; McBeth, "Aluminum Buyers," November 3, 2016; Chu Daye, "Domestic Producers Predict Higher Consumption," October 31, 2016.
[660] WTO, "China–Subsidies to Producers of Primary Aluminum," January 17, 2017, 1–2.
[661] Ibid., 2.
[662] Ibid., 2.
[663] Ibid., 2.

countervailing duties on certain aluminum foil from China.[664] Subsidy allegations are detailed in table 6.17. On April 21, 2017, the Commission "determined that there is a reasonable indication that a U.S. industry is materially injured by reason of imports of aluminum foil from China that are allegedly subsidized and sold in the United States at less than fair value," and voted to continue the investigations on aluminum foil from China.[665]

Table 6.17: Subsidy Allegations: Certain Aluminum Foil from the People's Republic of China

Policies
Preferential Lending
Policy loans to the aluminum foil industry
Preferential loans for state-owned enterprises (SOEs)
Export loans from Chinese state-owned banks
Export credits from Export-Import Bank of China (including export seller's credit and export buyer's credit)
Equity Infusions and Exemption for SOEs from Distributing Dividends
Equity infusions into Nanshan Aluminum
Exemptions for SOEs from distributing dividends
Income Tax and Direct Tax Programs
Income tax reduction for high - or new technology enterprises
Income tax deductions for research and development expenses under the enterprise income tax law
Income tax concessionsfor enterprises engaged in comprehensive resource utilization
Income tax deductions/credits for purchase of special equipment
Income tax credits for foreign-invested enterprises and certain domestically owned companies purchasing Chinese-made equipment
Indirect Tax Programs
Import tariff and VAT exemptions on imported equipment for encouraged industries
VAT rebates on domestically produced equipment
Stamp tax exemption on share transfers under non-tradeable share reform
Deed tax exemption for SOEs undergoing mergers or restructuring
Government Provision of Goods and Services for Less Than Adequate Remuneration
Provision of land for less than adequate remuneration
Provision of primary aluminum for less than adequate remuneration
Provision of steam coal for less than adequate remuneration
Provision of electricity for less than adequate remuneration
Grant Programs
Central government and sub-central government support for the development of famous brands and China world top brands
The state key technology renovation project fund
Foreign trade development fund
Grants for energy conservation and emission reduction
Grants for the retirement of capacity
Grants for the relocation of productive facilities

[664] The Aluminum Association Trade Enforcement Working Group, cover letter to petitions for the imposition of antidumping and countervailing duties, March 9, 2017.
[665] USITC, "USITC Votes to Continue Investigations on Aluminum Foil from China," April 21, 2017.

Policies
Grants to Nanshan Aluminum

Source: The Aluminum Association Trade Enforcement Working Group, “Antidumping and Countervailing Duty Petition Volume III: Subsidy Allegation,” March 9, 2017, i–vi.
Note: FIE = foreign-invested enterprise.

Competitive Factors

China’s competitiveness in the aluminum industry is influenced by a number of factors, including input costs, capital costs, transportation costs, exchange rates, taxes and duties on exports, and the extent of value-added production. These factors are briefly discussed in table 6.18, and then several factors are discussed in more depth in the following sections.

Table 6.18: China: Select competitive factors

Competitive factor	Segment (most significant impact)	Impact on competitiveness
Alumina costs	Primary	Chinese average annual alumina delivered costs declined 19 percent during 2011–15, but remained more expensive than in the rest of the world.[a]
Anode costs	Primary	Chinese anode costs declined 27 percent during 2011–15, but were 1 percent higher than in the rest of the world in 2015, as global prices fell more quickly.[b]
Electricity costs	Primary	Declining electricity costs have substantially increased the competitiveness of Chinese primary aluminum producers.
Capital costs	All	Low capital costs (costs to build, expand, or upgrade/modernize a plant) substantially increase the cost competitiveness of Chinese producers.
Domestic scrap collection	Secondary	China’s growing domestic scrap collection is increasing the amount of scrap available to domestic producers and lowering costs. However, reliability of scrap supply can be a challenge.
Economies of scale	All	The construction of large plants with significant economies of scale lowered costs for some firms. However, there are still many small producers.
Environmental compliance costs	All	The Chinese government had implemented a number of environmental regulations since 2011, but producers likely benefited from a lack of compliance with existing regulations.
Exchange rates	All	The renminbi (RMB) strengthened against the U.S. dollar during 2007–14, then leveled off and started declining in mid-2015.[e] Similarly, measured in real terms against a basket of currencies, the RMB strengthened until 2015, then leveled off and began to decline in early 2016.[f]
Financing	All	Chinese firms appear to benefit from somewhat lower-interest loans, but there are differing views on the extent to which loan rates give Chinese producers a competitive advantage.
Labor costs	All	Chinese productivity is increasing, but these benefits have largely been offset by rising wages. In the secondary sector, in particular, rising labor costs have had a significant impact on competitiveness.
Raw material costs	Wrought	Declining relative raw material costs significantly increased the competitiveness of Chinese wrought aluminum producers during 2014–15. Firms have also benefited from lower costs due to the increased use of liquid aluminum.
Taxes and tariffs on exports	Primary and secondary	The Chinese export tariff and VAT likely significantly limit Chinese primary aluminum exports, and limit exports of secondary aluminum to those firms using imported scrap.

Competitive factor	Segment (most significant impact)	Impact on competitiveness
Transportation costs	Secondary and wrought	In the secondary industry, rising inland transportation costs have negatively impacted industry competitiveness. Chinese producers have advantages in being able to provide more timely shipments to nearby markets, but disadvantages in more distant markets due to freight costs.[g] Many wrought producers benefit from lower transportation costs for raw materials due to their proximity to primary and secondary aluminum producers. Distribution costs, on the other hand, increased for a number of aluminum extrusion producers during 2011–15.[h] Trends in costs to deliver 1xxx sheet and building sheet were mixed, but for both products the average delivery cost rose during 2011–15 as compared to the world average.[i] However, Chinese exporters benefit from lower ocean freight costs than competitors.[j]
Value-added production	Wrought	High-value-added products made up a relatively low share of Chinese firms' production during 2011–15. Chinese firms are moving up the value chain but have only limited production of certain high-value-added products.
Vertical integration	Primary and wrought	Upstream vertical integration for primary aluminum producers contributed to lower costs, as did their downstream integration with wrought aluminum producers.

Source: Compiled by USITC staff

[a] CRU Group.
[b] Chinese anode costs increased in late 2016 and into early 2017 due to higher raw material prices; new and tighter enforcement of environmental regulations; rising demand combined with limited additional supply; and increased shipping costs due to rules on overloading trucks. CRU Group; Djukanovic, "Petroleum Coke Market Tightens," December 12, 2016; McBeth, "Aluminum Buyers," November 3, 2016; McBeth, "Calcined Petcoke Market," January 12, 2017; McBeth, "Calcined Petcoke Market: Prices Steady," December 8, 2016.
[e] Federal Reserve, Historical Exchange Rates for the Chinese Yuan Renminbi, https://www.federalreserve.gov/releases/h10/hist/dat00_ch.htm (accessed February 15, 2017).
[f] BIS, "Effective Exchange Rate Indices" (accessed February 15, 2017).
[g] Yee, "Japan's Chinese ADC12," October 25, 2016; Yee, "Japan's ADC12 Import," May 31, 2016.
[h] Based on annual reports of publicly traded aluminum extrusion producers.
[i] CRU Group.
[j] Trade Data Services, Import Genius database (accessed November 2016); Datamyne database (accessed November 2016); USITC DataWeb/USDOC (accessed November 2016); Statistics New Zealand (accessed November 2016).

Primary Unwrought Aluminum

Cost Overview

China's average business costs for production were substantially above those for the rest of the world throughout 2011–15.[666] However, the cost of primary aluminum production in China declined substantially during this time period.[667] China's cost competitiveness further improved

[666] The data presented here generally show the average business costs for the industry and provide a useful overview of the industry overall, but it is important to note that there is wide variation across the Chinese industry and for specific types of products, as described in the industry structure and production sections. For example, in the primary aluminum industry, China has some low-cost smelters and some of the highest-cost smelters in the world, and smelter costs vary widely by region and source of inputs. In addition, many of the new smelters coming online in China are lower cost than existing smelters.
[667] CRU Group.

in 2016 due to declining electricity prices, the closure or idling of high-cost smelters, and investment in new low-cost smelters; these smelters benefit from economies of scale, new technology, and captive electric plants, some of which also have dedicated coal mines. As a result, by the third quarter of 2016 the gap between the average cash cost of production (before casting) in China and the rest of the world narrowed to $17/mt—a 1 percent difference.[668] This trend reversed in the last quarter of 2016, however, as rising input costs led to increasing production costs for some smelters.[669]

For the Chinese industry as a whole, the largest components of production costs were alumina, electricity, and anodes (table 6.19). Alumina surpassed electricity as the largest cost component during 2011–15, reflecting the more rapid decline in electricity prices in China.[670] The extent to which these factors contribute to production costs varies by smelter, depending on their location, source of electricity, and other variables.

Table 6.19: China: Primary unwrought aluminum average business costs, 2011–15, (dollars per mt of aluminum produced)

Cost component	2011	2012	2013	2014	2015
Alumina	872	845	817	790	709
Electricity	931	929	862	724	614
Labor	48	49	52	52	52
Anode	256	220	215	200	186
Other[a]	168	157	155	149	137
Total liquid metal costs	2,275	2,200	2,101	1,914	1,697
Casthouse	56	53	51	49	45
Net realizations[b]	-130	-396	-441	-260	-207
Average business costs	2,200	1,858	1,711	1,703	1,534
Global average business costs	2,041	1,766	1,639	1,541	1,435

Source: CRU Group.

Note: Because of rounding, totals may not equal the sum of line items.

[a] "Other costs" covers bath material, pot relining, smelter fuel, maintenance and other supplies, sustaining capital, and working capital on supplies.

[b] CRU Group uses "net realizations" cost adjustments to reflect variances in product quality that impact production costs, but does not include overhead costs in overall corporate costs.

Declining Electric Power Costs Enhance Smelter Competitiveness

Chinese primary aluminum production is increasingly price competitive, and in part this is due to declining electricity costs. The average primary aluminum electricity price in China declined from 6.6 cents per kWh in 2011 to 3 cents per kWh in 2016, and for new plants the average

[668] Data for the rest of the world do not include the United States. Vazquez, hearing exhibits, 3.

[669] Burton, "Metals—Shanghai Aluminum," October 26, 2016.

[670] CRU Group.

electricity price was only 1.5 cents per kWh in 2016.[671] In addition to declining electricity costs, the energy efficiency of Chinese aluminum smelters substantially increased during 2011–15.

Four primary factors are contributing to the electricity cost decline:

- First, power prices for Chinese aluminum companies that buy electricity from the grid are declining, as discussed above, and local governments have reduced costs for some producers.
- Second, aluminum companies have entered into power purchase agreements to buy electricity directly from power producers and thereby lower electricity costs.[672]
- Third, aluminum companies have increasingly invested in power plants, often with dedicated coal supplies or in regions with access to low-cost coal.[673] These captive plants can significantly reduce energy costs for companies, though the gap between the grid and self-generated electricity price may be narrowing due to provincial governments lowering grid prices for some aluminum producers.[674]
- Fourth, declining coal prices contributed to lower electricity prices, though coal prices started to rise again in 2016. This coal price decline is part of the reason that grid electricity prices have been falling China-wide, but it also benefits firms with captive plants that purchase coal.[675]

Companies have also invested in improving efficiency to reduce production costs, and new plants that come online are more efficient than older plants, contributing to overall efficiency gains.[676] Many Chinese firms have invested in technology using larger cells in their production lines, with more than half of smelters now operating at more than 400 kilo amperes (kA) and some exceeding 600 kA. These larger sizes improve efficiency and cut electricity costs for Chinese aluminum producers, and make China's smelters more efficient on average than in the

[671] Vazquez, hearing exhibits, September 29, 2016, 8.
[672] BLS & Co and Tractus, "A Comparison of U.S. and China Electricity Costs," 2016, http://blsstrategies.com/docs/news/News_181.pdf; Barclays, "Aluminum Corporation of China," May 7, 2015, 1, 3; Zhou, "China Aluminium Smelters' Power Costs," December 25, 2015; CNIA, written submission to the USITC, February 21, 2017, 19.
[673] A benchmark new coal power plant in China in the second half of 2016 had among the lowest levelized costs of energy (LCOE) in the world, including all energy sources. The LCOE from a new coal power plant in China was roughly equal to the LCOE of new combined cycle gas plant in the United States. Bloomberg New Energy Finance database, https://www.bnef.com (accessed December 31, 2016); IAI Statistics database (accessed December 19, 2016); South China Morning Post, "China Hongqiao Builds," June 14, 2015; Vazquez, hearing exhibits, September 29, 2016, 6; industry representative, interview by USITC staff, February 15–16, 2017.
[674] China Hongqiao Group Limited, 2015 Annual Results Announcement, 14 March 2016, 16; Zhou, "China Aluminium Smelters' Power Costs," December 25, 2015.
[675] Vazquez, hearing exhibits, September 29, 2016, 7; Zhou, "China Aluminium Smelters' Power Costs," December 25, 2015; Burton, "Metals—Shanghai Aluminum," October 26, 2016.
[676] *South China Morning Post*, "China Hongqiao Builds," June 14, 2015; Djukanovic, "Global Aluminum Smelters' Production," April 20, 2016; Hao, Geng, and Hang, "GHG Emissions," 2016, 268.

rest of the world.[677] Overall, Chinese smelters' energy use per metric ton of aluminum produced declined 3 percent during 2011–15.[678] However, there are some smelters using older and less efficient technology, and some smelters reportedly do not reach optimal efficiency due to insufficient upkeep.[679]

Alumina Delivered Costs Substantially Declined

Chinese average annual alumina delivered costs fell 19 percent during 2011–15, but remained significantly more expensive than in the rest of the world (excluding the United States).[680] As with aluminum smelters, Chinese firms' alumina costs vary widely, depending on factors such as whether production is in-house and the in-house production costs, where the smelter is located, and whether alumina is purchased on the spot market or via long-term contracts.[681] While alumina prices in China dropped sharply in 2015 along with the decline in aluminum prices, several factors also drove declines in production costs and delivered costs during 2011–15:

- The price of Chinese coal—the main fuel source in China for alumina production—declined more than 50 percent from June 2011 to May 2016.[682]
- The energy required per metric ton of alumina production in China declined by 33 percent during 2011–15. As a result, China's energy intensity fell from 22 percent more than the global average in 2011 to only 5 percent more than the average in 2015.[683]

---

[677] Wen, "Aluminum Industry in China and International Trade," 6–7; Adkins, "Out with the Old Thinking," July/August 2016; Fickling, "It's Not China's Fault," October 10, 2016; Chalieco, "Electrolytic Aluminum Technology," February 8, 2014; Wookey, "China Is Most Efficient," October 31, 2016.
[678] Based on kWh (AC) per mt of aluminum production. Data are broken out for the following regions: Africa, Asia (excluding China), GCC countries, China, North America, South America, Europe, and Oceania. IAI, IAI Statistics database (accessed February 2017).
[679] Adkins, "Out with the Old Thinking," July/August 2016; Fickling, "It's Not China's Fault," October 10, 2016; Wookey, "China Is Most Efficient," October 31, 2016.
[680] CRU Group.
[681] Alan Clark, "Considerations in Bauxite," February 2015, 17; Deutsch Markets Research, *Bauxite and Alumina*, June 15, 2016, 10; Alumina Limited, *2016 Half-Year Results*, 2016, 29; Citi Research, "China Hongqiao," February 12, 2016, 13; industry representative, interview by USITC staff, Washington, DC, September 27, 2016; CMAAX, "Weekly: Domestic Alumina Prices Continue to Rise," November 14, 2016; CMAAX, "Weekly: Domestic Alumina Prices," December 5, 2016.
[682] Yam, "China Alumina Prices," June 11, 2015; Norrgren, "Strong U.S. Dollar," June 24, 2016.
[683] IAI, IAI Statistics database (accessed September 2016).

- As with aluminum smelters, many of the new alumina refineries that Chinese firms are bringing online are large, highly efficient, low-cost plants.[684] Capital expenditures for new alumina refineries are also significantly lower than in the rest of the world.[685]
- These new refineries are often part of vertically integrated production that includes captive power plants and downstream aluminum smelters, thereby lowering the delivered cost of the alumina to the smelter.[686]
- Prices of imported alumina declined 30 percent during 2011–16, similar to the rate of decline in import prices for other major aluminum-producing countries.[687]

Somewhat offsetting these drivers of long-term cost declines have been fluctuations in the cost of imported bauxite and supply chain disruptions. Chinese import prices for bauxite rose from $46/mt in 2011 to $57/mt in 2014 before declining to $48/mt in 2016.[688]

Chinese alumina production costs and prices started to rise again in the second half of 2016. Chinese firms significantly curtailed production—particularly at high-cost refineries—in late 2015 and early 2016, when a significant share of production was cash-negative due to low prices.[689] Combined with increasing demand, tighter enforcement of environmental rules, and higher raw material and transportation costs, this led to an increase in prices in the second half of 2016.[690] A significant percentage of curtailed capacity has been restarted, however, and firms continue to bring new capacity online.[691]

---

[684] There are also some existing higher-cost refineries that are expanding production. Zheng and Wang, *Alumina and Aluminum Monthly,* December 2014, 10–11; CMAAX, "Weekly: Domestic Alumina Prices," December 5, 2016; Alumina Limited, *2016 Half-Year Results*, 2016, 29; Deutsch Markets Research, *Bauxite and Alumina*, June 15, 2016.
[685] Wood, "Keeping the Bauxite and Alumina Industry," February 25, 2014, 7.
[686] Deutsch Markets Research, *Bauxite and Alumina*, June 15, 2016, 16.
[687] IHS Markit, GTA database (accessed March 29, 2017).
[688] China imported about 48 percent of the bauxite it uses in alumina production in 2015. Disruptions in the supply chain for imports (such as Indonesia's ban on exports) can cause increases in the alumina price, though Chinese firms have typically stockpiled alumina in advance of anticipated disruptions. Chinese firms are increasingly investing overseas in order to ensure a stable supply of raw materials, and in some cases have started to invest in overseas alumina production. China Nonferrous Metals News, "UC Rusal Sells Equity," November 23, 2016; Aladdiny News, "Shandong Weiqiao Operations Boom in 2016," December 7, 2016; industry representative, interview by USITC staff, October 27, 2016; Alumina Limited, *2015 Full Year Results*, February 2, 2016, 18–20; Alumina Limited, *2016 Half-Year Results*, 2016, 25, 30; IHS Markit, GTA database (accessed August 10, 2016); USGS, *Bauxite and Alumina*, 2016.
[689] Alumina Limited, *2015 Full Year Results*, February 2, 2016, 18–20; Alcoa, *4th Quarter Earnings*, January 24, 2017, 20.
[690] CMAAX, "Weekly: Domestic Alumina Prices," December 5, 2016; Aladdiny News, "China's BX Consumption," November 30, 2016; CMAAX, "Weekly: Smelters Limit AA Price Growth," November 28, 2016; Antaike News, "China AA Market Remains Strong," November 7, 2016.
[691] CMAAX, "Weekly: Domestic Alumina Prices," December 5, 2016; Fubao News, "Growth of Domestic," November 28, 2016; Aladdiny News, "China's BX Consumption," November 30, 2016; Aladdiny News, "Strong Chinese Demand," November 10, 2016.

Low Cost of Investments in New, Large-scale, Technologically Advanced Smelters Reduce Production Costs

Chinese alumina refineries and aluminum smelter capital costs are among the lowest in the world. The capital costs of Chinese refineries and smelters is—on average—less than half of the costs of plants in the rest of the world, excluding plants built by Chinese firms outside of China.[692] A number of factors contribute to these low capital costs, including low labor costs for project construction; short time frames for permitting (particularly for brownfield projects) and construction; the fact that they replicate the design of other plants; and the use of higher-amperage cells (which require smaller footprints and have lower capital costs).[693] The government policies discussed above, such as grants and low land-use fees, may also contribute to lower capital expenditures for companies, both to construct new plants and to expand/upgrade existing ones.

Taxes and Duties Limit Exports of Unwrought Aluminum

The Chinese export tariff and VAT likely significantly limit Chinese primary aluminum exports. China was the second-largest global exporter of unwrought, unalloyed aluminum (HS 7601.10) in 2004, but exports declined following the removal of a VAT rebate and imposition of a 5 percent export tariff. Exports dropped even further following the increase in the export tariff to 15 percent in late 2006 (figure 6.13).[694] After 2006 China increased exports of aluminum

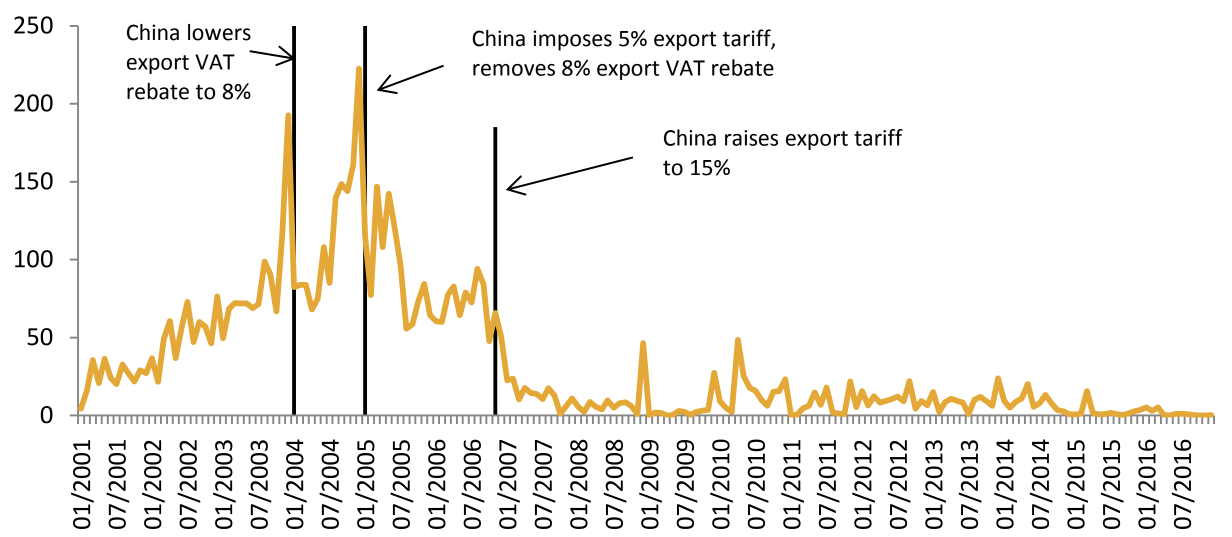
[692] For example, according to a 2014 presentation, the average cost for alumina refinery construction in China was $600–$800/mt, and the average cost in the rest of the world was $1,600-$2,000 or more/mt. CNIA states that the investment cost of a new primary aluminum smelter in China is about $1,100/mt. Other data point to a somewhat higher capital expenditure costs for smelters in China. Baise Mining Group, for example, announced plans in October 2016 to build a smelter with 300,000 mt of annual capacity and a 700 MW power plant at a cost of slightly less than $2,400/mt. According to one industry representative, the cost of a more expensive Chinese smelter is in the area of $3,000/mt. These compare to costs, according to CNIA, of about $6,000/mt in the Middle East. According to an industry representative, capital costs are about $6,000/mt in Russia and about $7,000/mt in Norway. Plants built by Chinese firms in Vietnam, on the other hand, reportedly have low capital costs. JCP Investment Partners indicates that the average cost in the rest of the world is twice the China cost. Wood, “Keeping the Bauxite and Alumina Industry,” February 25, 2014, 7; CNIA, post hearing brief to the USITC, October 17, 2016, 36; JCP Investment Partners, "The Aluminium Market Outlook," August 2012, 2; Lee, “China’s Baise,” October 10, 2016; industry representative, telephone interview by USITC staff, December 16, 2016.

[693] Industry representative, telephone interview by USITC staff, December 16, 2016; Wood, "Keeping the Bauxite and Alumina Industry Profitable," February 25, 2014, 7; CNIA, post hearing brief, October 17, 2016, 36; JCP Investment Partners, "The Aluminium Market Outlook," August 2012, 2; industry representative, interview by USITC staff, February 16, 2017; Wen, “Aluminum Industry in China,” October 2016, 6–7.

[694] Exports in 7601.10.10 (aluminum, not alloyed, containing by weight 99.95% or more of aluminum) were not subject to export duties during 2011–15, but this higher-purity aluminum accounts for only a small share of Chinese exports. China Customs, *2011 Customs Import and Export Tariff*, 2010; China Customs, *2016 Customs Import and Export Tariff*, 2016; IHS Markit, GTA database (accessed March 30, 2017); Chan, "Taxman Seeks Aluminium Output Cut," July 20, 2007.

alloys (ordinary trade, excluding processing trade), but these exports also declined following the imposition of a 15 percent export tariff on aluminum alloys in 2008.[695]

Figure 6.13: China: Exports of unwrought, unalloyed aluminum (HS 7601.10), 2001–16, and export tariffs (thousand mt)



Source: IHS, Markit, GTA database (accessed March 30, 2017); Chan, "Taxman Seeks Aluminum Output Cut," July 20, 2007.
Note: In 2006, China split 7601.10.00 (unwrought, unalloyed aluminum) into two tariff lines, 7601.10.10 (Containing by weight 99.95% or more of aluminum) and 7601.10.90 (Other). Exports in 7601.10.00 are not subject to an export tariff, but account for a small share of trade.
Note: Corresponds to appendix table L.31.

Secondary Unwrought Aluminum

Cost Overview

Aluminum scrap is the largest cost component of secondary aluminum production costs in China. Ye Chiu noted that aluminum scrap accounts for up to about 80 percent of the costs of secondary aluminum production, with processing the other major cost component for secondary aluminum production.[696] The supply chain for other inputs is also important in the competitiveness of Chinese secondary aluminum. For example, the price of silicon, which accounts for a significant share of aluminum alloys such as ADC12, also impacts the price of secondary aluminum.[697]

---

[695] IHS Markit, GTA database (accessed March 30, 2017); Watanabe and Mok, "Asia to Feel Impact," August 25, 2008.
[696] Ye Chiu Group, *2015 Annual Report*, n.d., 2016, 17.
[697] Yee, “Weak Yen Dampens,” November 22, 2016; Yee, “Japan’s ADC12,” November 29, 2016.

Growing Domestic Scrap Supply Lowers Costs, Though Imports Remain Important

China's secondary aluminum industry uses both domestic and imported scrap in its aluminum production, with domestic scrap accounting for an increasing share of the market. The growth of the domestic supply chain for aluminum scrap benefits Chinese producers due to its reportedly lower price.[698] While China is a major importer, its 15 export tariff and 17 percent VAT on aluminum scrap exports ensure that domestic scrap remains within the country.[699] China is able to benefit more from scrap imports than many other countries because it is able to import aluminum scrap at among the lowest prices in the world.[700] The price of imported scrap declined from $1,722/mt in 2011 to $1,148/mt in 2016.[701]

Rising Labor Costs Weaken Competitiveness

The competitiveness of Chinese secondary aluminum production reportedly has been negatively impacted by rising labor rates.[702] For example, in the region with the most production capacity (as of November 2015), the Yangtze River Delta,[703] wages in Jiangsu (one of the major producing provinces in the region) increased 61 percent during 2011–15.[704] And in China's second-largest producing region, the Pearl River Delta,[705] Guangdong manufacturing wages increased more than 60 percent during 2011–15.[706] Companies are substantially increasing their investment in automation,[707] which will likely decrease the labor intensity of production in China. However, there still exists wide variation in the labor intensity of

---

[698] Gao, "China–Leading Growth," November 21, 2016, 9.
[699] USITC, hearing transcript, September 29, 2016, 99,100 (Paneer and Price); China Customs, *2016 Customs Import and Export Tariff*, 2016.
[700] China's 2015 import average unit value (AUV) for aluminum scrap was 7 percent below the average AUV for the rest of the world. IHS Markit, GTA database (accessed March 30, 2017). Among the factors contributing to low prices for Chinese imports are low shipping costs. According to a witness at the Commission hearing, "It is cheaper to export scrap to China from the U.S. West Coast than it is to ship to the Midwest, where most of the U.S. aluminum remelt facilities are based." Vazquez, written statement to USITC, September 28, 2016. Chinese firms have also invested in the United States and Europe in order to have more direct control over their supply chains, as discussed in chapter 6.
[701] IHS Markit, GTA database (accessed December 18, 2016); Wookey, "MB Recycled Al Conference: China's Secondary," November 17, 2015; Wookey, "MB Recycled Al Conference: North America's Scrap," November 17, 2015.
[702] *Metal Bulletin*, "China Secondary Aluminium," May 28, 2012; *Recycling Today*, "CMRA 2014: Several Challenges," November 10, 2014.
[703] Liu, "China Recycled Aluminium Industry," November 2015, 2.
[704] NBS, Statistical Database (accessed January 2017).
[705] Liu, "China Recycled Aluminium Industry," November 2015, 2.
[706] NBS, Statistical Database (accessed January 2017).
[707] *Metal Bulletin*, "China Secondary Aluminium," May 28, 2012; Liu, "China Recycled Aluminium Industry," November 2015, 6; Liu, "China Nonferrous Metals Recycling Industry," January 2016, 4.

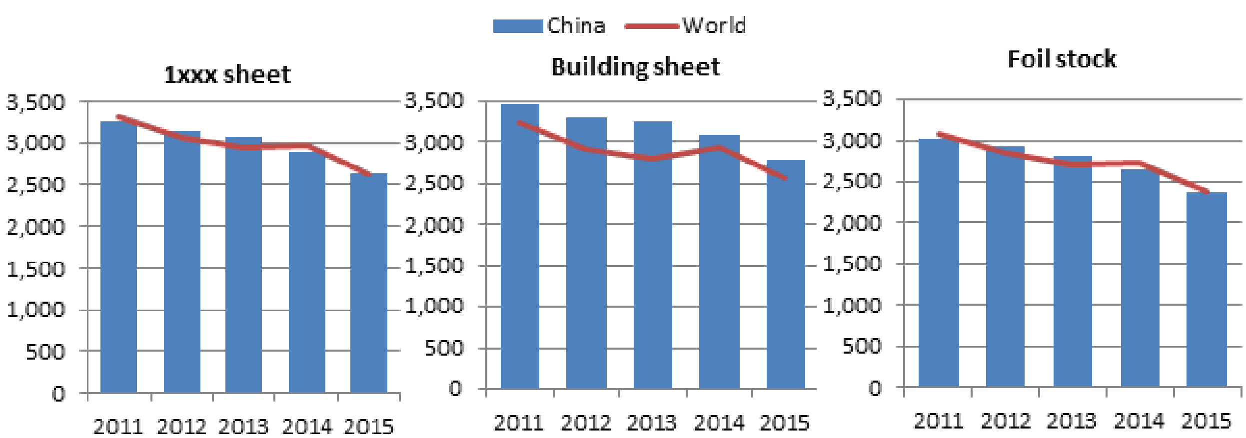
production, with some companies, for example, still relying on inefficient and manual sorting.[708]

Wrought Aluminum

Cost Overview

Chinese wrought aluminum production costs generally declined during 2011–15, driven by declines in raw material prices and other production costs. Business costs for building sheet, 1xxx sheet, and foil stock, for example, declined by 19 to 22 percent during 2011–15, largely moving in line with global business costs (though Chinese building sheet tends to be more expensive) and the cost of raw material inputs (figure 6.14).[709] Aluminum extrusion costs also declined, according to available data, though the extent to which costs declined varied by company and product.[710]

Figure 6.14: China: Chinese and global average business costs for certain aluminum flat-rolled products, 2011–15 (dollars per mt)



Source: CRU Group.
Note: Corresponds to appendix table L.32.

The decline in raw material costs contributed significantly to lower production costs. Raw materials—particularly unwrought aluminum—typically account for the largest share of Chinese production costs for wrought products. Raw materials, for example, account for 87 percent of business costs for foil stock, 78 percent of the cost for 1xxx sheet, and 69 percent of building sheet costs.[711] Similarly, raw materials typically accounted for more than 80 percent

[708] Bijlhouwer, “China: Internal Changes,” November 2014, 23–24; Liu, “China Recycled Aluminium Industry,” November 2015, 11.
[709] CRU Group.
[710] Compiled from financial reports of publicly traded Chinese aluminum extrusion producers.
[711] CRU Group.

of production costs for aluminum extrusion producers in 2015.[712] The cost of raw material inputs for foil stock, 1xxx sheet, and building sheet fell each year during 2011–15, and over the full time period they declined 24 to 27 percent, depending on the product.[713] Raw material costs similarly declined for aluminum extrusion producers. For example, Xingfa's ingot costs per metric ton of wrought sales declined 26 percent during 2011–15, and China Zhongwang's raw material costs per metric ton declined 21 percent during the same period.[714]

In the Chinese aluminum extrusion industry, non-material costs also appear to be decreasing. China Zhongwang's non-raw material costs per metric ton, for example, declined 5 percent during 2011–15, though rising labor costs have put upward pressure on non-material costs.[715] Non-material costs for producers of certain flat-rolled products, on the other hand, increased during 2011–15, rising 3 percent for 1xxx sheet, 2 percent for foil stock, and 8 percent for building sheet—though costs did decline from 2014 to 2015. Energy (5 to 10 percent of business costs in 2015) and labor costs rose for all three products during 2011–15, with energy costs increasing 10 to 19 percent and labor costs increasing 7 to 11 percent.[716]

Declining Relative Raw Material Costs Enhanced Competitiveness during 2014–15

China's wrought aluminum cost competitiveness significantly improved during 2014–15 due to declining raw material prices, after relatively high raw material prices made exports less competitive during 2012–13. In 2013, raw material prices for foil stock, 1xxx sheet, and building sheet, for example, were 7 to 13 percent above the global average, depending on the product and the year. During 2014–15, on the other hand, raw material costs for these three products were close to the global average, significantly increasing the competitiveness of Chinese firms.[717] However, for exports in particular, Chinese firms enjoyed significantly lower unwrought aluminum prices during 2014–15. Taking into account the VAT system and rebates on exports, the effective aluminum input prices that Chinese wrought producers paid in 2014–15 were substantially lower than the prices paid by producers in other countries.[718]

---

[712] Compiled from annual financial reports of publicly traded Chinese aluminum extrusion producers.
[713] CRU Group.
[714] Compiled from China Zhongwang and Xinfa Aluminum's 2011 to 2015 Annual Reports.
[715] China Zhongwang, 2011 and 2015 Annual Reports; annual reports of publicly traded aluminum extrusion producers.
[716] CRU Group.
[717] Ibid.
[718] IHS Markit, GTA database (accessed February 23–April 6, 2017); *Platts Monthly Reports* (accessed August 2016–March 2017); American Metal Market Website, http://www.amm.com/ (accessed August 2016–March 2017); Fog, "Market Outlook," June 16, 2016, 14; data for Harbor Aluminum found in Arrowcrest Group's submission to the Australian Antidumping Commission, March 23, 2015, 15.

In addition, the Chinese industry has undergone some structural shifts that are lowering material costs, including the related trends of locating plants in close proximity to aluminum smelters and using more liquid aluminum in production, which lowers production costs. Liquid aluminum accounted for 37 percent of primary aluminum production in 2015, up from 21 percent in 2011 and 6 percent in 2007.[719] China's East Hope Group estimated in 2014 that wrought aluminum producers locating close to its plant in Xinjiang would save it casting costs of about $130/mt and metal delivery costs of $80/mt.[720] These savings may be passed directly through to related parties, but separate wrought aluminum producers may not realize all of the savings, as primary aluminum producers may capture some of these benefits.[721]

Wrought producers also derive costs savings from the use of liquid aluminum. Firms that use liquid aluminum have melt loss savings and reduce electricity use for re-melting, according to industry representatives.[722] The East Hope Group expected that the production companies that located close to it would reduce costs by about $80 to $160/mt.[723] Similarly, as noted above, wrought production using liquid secondary aluminum is about $125/mt less expensive, according to a 2012 estimate.[724]

Moving Up the Product Value Chain Is Starting to Increase Competitiveness in Value-added Products

A large portion of Chinese wrought aluminum production has typically been extrusions for the construction sector, and some firms in the Chinese industry have previously focused on production volume rather than on improving quality. However, many firms are seeking to take advantage of expected significant growth in high-end markets, and to move away from relying on more price-sensitive commodity products. In addition, some foreign firms have invested in production specifically to supply higher-end applications.[725] Among China-based firms, the extent to which producers are seeking to move into higher-end applications varies by company, as indicated by significant differences in the share of revenue invested in research and

[719] CRU Group.
[720] Antaike, "East Hope Group," December 2014, 21–22.
[721] Industry representative, interview by USITC staff, February 15, 2017.
[722] Industry representatives, interviews by USITC staff, October 26, 2016, and December 16, 2016.
[723] Antaike, "East Hope Group," December 2014, 21–22.
[724] Pawlek, "World Secondary Aluminum Industry Annual Review," August 2012, 14.
[725] Burns, "China: A Growing Presence," September 20, 2016; Aleris, "Aleris Attains Qualification to Supply Bombardier," September 29, 2014; Vimetco website, http://www.vimetco.com/about/strategy (accessed February 21, 2017); Burton, "China Aluminum Makers," October 17, 2016; Shandong Nanshan Aluminum, *2015 Annual Report*, 2016, 9–10; CNIA, written submission to the USITC, February 21, 2017, 13–14; Wu, "Expanding Application and Consumption Fields of Aluminum," October 27, 2016.

development by aluminum extrusion producers.[726] Further, the extent to which Chinese firms can produce for higher-end applications varies by sector.

China's production of aluminum for the aerospace sector is increasing, with a greater number of both foreign-invested and Chinese-headquartered firms becoming qualified to supply flat-rolled products to major Western aircraft producers. One of the first Chinese suppliers to a Western firm was Southwest Aluminum, which started supplying aluminum plate to Airbus in 2011.[727] U.S.-based Aleris's China plant qualified to supply Bombardier in 2014, and Aleris announced in 2016 that it would start supplying 2000 and 7000 plate for Airbus wings.[728] Nanshan Aluminum received a contract from Boeing to supply plate in 2016.[729] A number of other firms supply products to the aerospace sector, including extrusions and rolled products.[730] Additional production capacity for the aerospace industry is likely to come online. China Zhongwang, for example, is opening a new plant and has engaged in test production of 7055 aluminum alloy for the aerospace sector.[731]

Chinese producers are increasingly supplying extrusions to the automotive sector, and a number of foreign-invested firms also produce for this sector in China.[732] China likely produced 800,000 to 900,000 mt of aluminum extrusions for the automotive sector in 2015.[733] This will probably continue to increase, as demand for aluminum extrusions in the transportation sector is forecast to grow 73 percent to 2.9 million mt per year by 2020.[734]

China, on the other hand, is not a major producer of aluminum sheet for the auto industry, and the two main producers are subsidiaries of U.S.- and Japan-based companies.[735] Chinese production of automotive sheet totaled only 40,000 mt in 2016, some of which was

[726] Based on data compiled by USTC staff from company annual reports.
[727] Perrett, "Nanshan Aluminum," November 8, 2016.
[728] Perrett, "Aleris's Chinese Mill," October 31, 2016; Aleris, "Aleris Attains Qualification," September 29, 2014.
[729] Perrett, "Nanshan Aluminum," November 8, 2016.
[730] See, for example, China Aluminium Network, "Northeast Light Alloy Co., Ltd Praised," September 4, 2012; China Zhongwang, "Industry Certification," June 19, 2014; Arconic website, http://www.arconic.com/global/en/contact/locations.asp?country=China (accessed February 21, 2017).
[731] China Zhongwang, "Tianjin Zhongwang Succeeds," August 24, 2016.
[732] Shandong Nanshan Aluminum, *2015 Annual Report*, 2016, 9–10; Burton, "China Aluminum Makers," October 17, 2016; Vimetco NV, *Annual Report 2015*, 16; Arconic, http://www.arconic.com/global/en/contact/locations.asp?country=China (accessed April 2017); Constellium, "Alcan Automotive," October 5, 2009.
[733] The market in China for extrusions for automotive applications was estimated at slightly over 900,000 mt in 2015, while imports of extrusions for all applications totaled less than 100,000 mt. China Zhongwang, "2016 Interim Results Corporate Presentation," August 25, 2016, 22; IHS Markit, GTA database (accessed February 20, 2017).
[734] China Zhongwang, "2016 Interim Results Corporate Presentation," August 25, 2016, 22.
[735] Industry representative, interview by USITC staff, February 27, 2017; CNIA, written submission to the USITC, February 21, 2017, 13–14.

exported.[736] Demand for flat-rolled products in the auto sector in China was estimated at only 53,000 mt (5 percent of global demand) in 2015.[737]

China still imports some high-value-added products where domestic production is insufficient to meet domestic demand, as discussed above. China is likely becoming more self-sufficient in some of these product areas, as evidenced by the decline in imports of plate, sheet, and strip. On the other hand, China continues to rely on imports of certain high-value-added products. For example, despite being a major exporter of aluminum foil, China was the third-largest importer in value terms in 2015, and the quantity of imports increased slightly during 2011–16. China is importing very high value foil products, with the unit value of imports from Japan exceeding $14,000/mt and from South Korea exceeding $22,000/mt in 2015.[738]

[736] CNIA, written submission to the USITC, February 21, 2017, 13.
[737] This is forecast to increase to 1.0 million mt in 2025. China Zhongwang, “2015 Annual Results Announcement,” March 24, 2016, 25.
[738] In comparison, the 2015 unit value of Chinese foil exports was $3,340 per mt in 2015. IHS Markit, GTA database (accessed February 21, 2017). Japanese manufacturer Showa Denko, for example produces high purity, capacity grade aluminum foil in Japan. Some of this foil is shipped to China, were it is processed into finished products for the Chinese market. Showa Denko, “Showa Denko Completes”, October 16, 2013; Showa Denko, “Showa Denko Decides to Expand,” May 10, 2017.

Bibliography

Adkins, Paul. “Out with the Old Thinking.” *Aluminum International Today*, July/August 2016:10–11. https://issuu.com/quartzmetals/docs/aluminium_international_today_july.

Aladdiny News. “China’s BX Consumption Hits a New High in October,” November 30, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/china%E2%80%99s-bx-consumption-hits-a-new-high-in-october.

———. “Shandong Weiqiao Operations Boom in 2016,” December 7, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/shandong-weiqiao-operations-boom-in-2016.

———. “Strong Chinese Demand for Malaysian BX,” November 10, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/strong-chinese-demand-for-malaysian-bx.

Alcoa Corporation. “Alcoa Corporation Reports Fourth Quarter 2016 Results.” News release, January 24, 2017. http://investors.alcoa.com/news-releases/2017/01-24-2017-210955079.

Aleris Corporation. “Aleris to be Acquired by Zhongwang USA LLC,” August 29, 2016. http://investor.aleris.com/2016-08-29-Aleris-To-Be-Acquired-By-Zhongwang-USA-LLC.

———. “Aluminum Extrusion Plant Overview,” n.d. https://www.aleris.com/wp-content/uploads/2014/08/Aluminum-Extrusion-Plant-Overview_engl_DC_2012_11_20_final_web.pdf (accessed February 26, 2017).

———. “Aleris Attains Qualification to Supply Bombardier from Zhenjiang, China.” News release, September 29, 2014. http://investor.aleris.com/2014-09-29-Aleris-Attains-Qualification-to-Supply-Bombardier-from-Zhenjiang-China.

Alumina Limited. “2015 Full Year Results,” February 2, 2016. http://www.aluminalimited.com/uploads/2015-Full-Year-Presentation.pdf.

———. “2016 Half-Year Results,” August 24, 2016. http://www.aluminalimited.com/uploads/2016-Half-Year-Presentation_1.pdf.

———. *ASX Full Year Report*, December 31, 2016. http://www.aluminalimited.com/results/.

———. *ASX Half Year Report*, June 30, 2016. http://www.aluminalimited.com/results/.

Aluminium Association of Canada. Written submission to the U.S. International Trade commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry,* September 29, 2016.

The Aluminum Association Trade Enforcement Working Group. Cover letter to petitions for the imposition of antidumping and countervailing duties, Certain Aluminum Foil from the People's Republic of China, March 9, 2017.

———. "Antidumping and Countervailing Duty Petition Volume III: Subsidy Allegation." Certain Aluminum Foil from the People's Republic of China, March 9, 2017.

Aluminum Corporation of China Ltd. "Form 6-K." Report of foreign issuer for Securities and Exchange Commission, February 28, 2014. https://www.sec.gov/cgi-bin/browse-edgar?action=getcompany&CIK=0001161611&owner=include&count=100&hidefilings=0.

———. "Form 20-F." Annual report for the Securities and Exchange Commission for the fiscal year ending in December 31, 2015, April 15, 2016. https://www.acnnewswire.com/press-release/english/29477/annual-report-on-form-.

———. "Form 20-F." Annual report pursuant to section 13 or 15 of the Securities Exchange Act of 1934 for the fiscal year ended December 31, 2015. https://www.acnnewswire.com/press-release/english/29477/annual-report-on-form-.

———. "Form 20-F." Annual report pursuant to Section 13 or 15 of the Securities Exchange Act of 1934 for the fiscal year ended December 31, 2016, 2017.

Aluminium Insider. "Chinese Smelters Again under the Gun as Beijing Launches Second Round of Environmental Inspections," November 9, 2016. http://aluminiuminsider.com/chinesesmeltersagainunderthegunasbeijinglaunchessecondroundofenvironmentalinspections/.

Aluminum News. "Costs of Domestic Primary Aluminum Rise," November 8, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/costs-of-domestic-primary-al-rise.

Antaike. "China AA Market Remains Strong," November 7, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/china-aa-market-remains-strong.

Arrowcrest Group. Written submission to the Australian Anti-Dumping Commission in connection with inv. no. 2011/54, *Certain Aluminium Road Wheels Exported to Australia from the People's Republic of China: Initiation of an Accelerated Review Customs Act 1901-Part XVB,* March 23, 2015.

http://www.adcommission.gov.au/cases/Documents/026-Submission-AustralianIndustry-ArrowcrestGroupptyltd.pdf.

Australian Anti-Dumping Commission. *Review of Anti-Dumping Measures: Certain Aluminium Extrusions Exported from the People's Republic of China.* Report no. 248, July 13, 2015.

Bank for International Settlements (BIS). "Effective Exchange Rate Indices," August 16, 2016. http://www.bis.org/statistics/eer.htm.

Barclays Bank PLC. "Aluminum Corporation of China Ltd," May 7, 2015.

Beer Institute. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-447, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, February 21, 2017.

Bijlhouwer, Frans. "China: Internal Changes and External Effects." Presentation, 22nd International Recycled Aluminium Conference, November 17–19, 2014. http://www.metalbulletin.com/events/presentations/7407/22nd-international-recycled-aluminium-conference/a0ID000000X0k7ZMAR/005-frans-bijlhouwerpdf.html.

Bloomberg. Bloomberg New Energy Finance Database. https://www.bnef.com (accessed December 31, 2016).

Bloomberg News. "China Said to Order Steel, Aluminum Curbs to Fight Pollution," March 1, 2017. https://www.bloomberg.com/news/articles/2017-03-01/china-said-to-order-steel-and-aluminum-curbs-to-fight-pollution.

———. "China Auto Boom Is Warning to World Miners Facing Scrap Age," September 28, 2016. https://www.bloomberg.com/news/articles/2016-09-29/china-s-auto-boom-is-warning-to-world-miners-facing-age-of-scrap.

———. "China Growth Estimates Up as Leaders Mull 2017 Economic Plan," December 15, 2016. https://www.bloomberg.com/news/articles/2016-12-16/china-growth-estimates-rise-as-leaders-mull-2017-economic-plan.

———. "China Ramps Up Aluminum Output as 20% Rally Allows Restarts," April 6, 2016. http://www.bloomberg.com/news/articles/2016-04-06/china-ramps-up-aluminum-production-as-20-rally-allows-restarts.

BLS & Co and Tractus. "A Comparison of U.S. and China Electricity Costs," 2016. http://blsstrategies.com/docs/news/News_181.pdf.

Bown, Chad P. “Global Antidumping Database.” The World Bank, June 2016. http://econ.worldbank.org/ttbd/gad/.

———. “Global Countervailing Duties Database,” The World Bank, June 2016. http://econ.worldbank.org/ttbd/gcvd/.

Burnett-Nichols, Helen. “Looking beyond China.” *Scrap Magazine*, May/June 2015. http://www.isri.org/news-publications/scrap-magazine/scrap-articles/looking-beyond-china#.V7y5Pv72Z9A.

Burns, Stuart. “China: A Growing Presence in Automotive and Aerospace Aluminum.” MetalMiner, September 20, 2016. https://agmetalminer.com/2016/09/20/china-a-growing-presence-in-automotive-and-aerospace-aluminum/.

Burton, Melanie, and Krista Hughes. “U.S. Challenge to China Subsidies Stretches to Aluminium Products.” Reuters, February 12, 2015. http://www.reuters.com/article/usa-trade-china-aluminium-idUSL5N0VM1H320150212.

Burton, Melanie. “China Aluminum Makers to Target Auto, Aerospace in Global Push.” Reuters, October 17, 2016. http://www.reuters.com/article/us-china-aluminium-expansion-idUSKBN12H0EG.

———. “Metals—Shanghai Aluminum Hits 2-year High on Coal Price Surge.” Reuters, October 26, 2016. http://www.cnbc.com/2016/10/26/reuters-america-metals-shanghai-aluminum-hits-2-year-high-on-coal-price-surge.html.

Callick, Rowan. “Chinese Producers Losing Money.” *The Australian*, October 27, 2015. https://www.lexisnexis.com (fee required).

Chan, Carol. “Taxman Seeks Aluminium Output Cut.” *South China Morning Post*, July 20, 2007. http://www.lexis.com (fee required).

Chiho-Tiande. *2016 Interim Report*, June 30, 2016. http://chiho-tiande.com/financial-information/.

———. *Annual Report 2015*, December 31, 2015. http://chiho-tiande.com/financial-information/.

China Aluminum International Engineering Corporation Limited (Chalieco). “Electrolytic Aluminum Technology of Chalieco Realized Major Breakthrough.” News release, February 8, 2014. http://www.chalieco.com.cn/en/index.php/news/company_content/199.html.

China Aluminium Network. "Northeast Light Alloy Co., Ltd Praised by China Aerospace Science and Technology Corporation." News release, September 4, 2012. http://www.alu.com.cn/enNews/NewsInfo_16639.html.

China Association of Automobile Manufacturers (CAAM). "New Energy Vehicles Kept a High-Speed Growth," November 3, 2016. http://www.caam.org.cn/AutomotivesStatistics/20161103/0905200308.html.

———. "The Sales and Production of New Energy Vehicles Kept Growing," January 13, 2014. http://www.caam.org.cn/AutomotivesStatistics/20140113/1605112305.html.

China Hongqiao Group Limited (China Hongqiao). "Annual Results for the Year Ended 31 December 2015," March 11, 2016. http://www.todayir.com/webcasting/hongqiao_15ar.

——— "2015 Annual Results Announcement," 14 March 2016. http://www.hongqiaochina.com/UpLoad/en/20160314051909_China%20Hongqiao%20FY2015%20annual%20results%20presentation_English.pdf.

———. "China Hongqiao Announces Annual Results," March 3, 2015. http://hongqiaochina.com/en/touzi_thgg.aspx

———. "Clarification Announcement," November 23, 2016. http://hongqiaochina.com/en/touzi_thgg.aspx.

———. *Annual Report 2010*, December 31, 2010. http://hongqiaochina.com/en/touzi_report.aspx.

———. *Annual Report 2015*, December 31, 2015. http://hongqiaochina.com/en/touzi_report.aspx.

China Nonferrous Metals Industry Association (CNIA). "China Aluminum Industry: A Nice Future or a Bumpy Road Ahead?" Slide presentation, 2015. http://www.metalchina.com/2015/metals/down/1.pdf.

———. Posthearing brief to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, October 17, 2016.

———. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, February 21, 2017.

China Nonferrous Metals Industry Association Recycling Metal Branch (CMRA). "Sigma Group: Aluminum," October 23, 2014. http://www.cmra.cn/en/sigma-group.html.

China Nonferrous Metals News. "Development Directions for China's Aluminium Extrusion Industry in the 12th Five-year Plan Era," June 3, 2013. The Bauxite Index. http://www.zhongwang.com/en/index.php?ctl=news&act=detials&cid=78&infoid=79&did=403.

———. "UC Rusal Sells Equity in Alpart to Jiuquan Iron and Steel," November 23, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/uc-rusal-sells-equity-in-alpart-to-jiuquan-iron-and-steel.

China Zhongwang Holdings (China Zhongwang) Ltd. "2016 Interim Results Corporate Presentation," August 25, 2016. http://en.zhongwang.com/upload/file/2017/03/15/51a2a4df868c4177ac55f94285c9e2bc.pdf.

———. "Announcement of Annual Results for the Year Ended 31 December 2015." News release, March 24, 2016. http://en.zhongwang.com/investor/gong-gao-ji-tong-han.jsp?nowPage=4&year=2016.

———. "Announcement of Interim Results for the Six Months Ended 30 June 2016." News release, March 24, 2016. http://en.zhongwang.com/investor/gong-gao-ji-tong-han.jsp?nowPage=2&year=2016.

———. *2015 Annual Report*, 2016. http://www.zhongwang.com/en/index.php?ctl=invest&act=list2&cid=106&infoid=117.

———. "Industry Certification Supports China Zhongwang's Development in Aerospace Aluminum Business." News release, June 19, 2014. http://www.zhongwang.com/en/index.php?ctl=news&act=detials&cid=78&infoid=79&did=861.

———. "Tianjin Zhongwang Succeeds in Rolling 7055 Aerospace Aluminium Plate." News release, August 24, 2016. http://www.zhongwang.com/en/index.php?ctl=news&act=detials&cid=78&infoid=79&did=1090.

Chu Daye. "Domestic Producers Predict Higher Consumption Will Offset Overcapacity." *Global Times* (China), October 31, 2016. http://www.globaltimes.cn/content/1014992.shtml.

Citi Research. "China Hongqiao," February 12, 2016.

Clark, Al. CM Group. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, February 22, 2017.

———. Hearing exhibits submitted to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

———. "Considerations in Bauxite Value-in-Use (ViU) Pricing—The CBIX Index." CM Group. 21st Bauxite and Alumina Conference, Miami, February 24–26, 2015. http://www.metalbulletin.com/events/download.ashx/document/speaker/7453/a0ID000000X0k8LMAR/Presentation.

CMAAX. "Weekly: Domestic Alumina Prices Continue to Rise," December 5, 2016. https://thebauxiteindex.com/cbix/news/domestic-alumina-prices-continue-to-rise-3.

———. "Weekly: Domestic Alumina Prices Continue to Rise on Larger Transactions," November 14, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/weekly-domestic-alumina-prices-continue-to-rise-on-larger-transactions.

———. "Weekly: Smelters Limit AA Price Growth with Increased Procurements," November 28, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/weekly-smelters-limit-aa-price-growth-with-increased-procurements.

CMRA. *See* China Nonferrous Metals Industry Association Recycling Metal Branch.

CNIA. *See* China Nonferrous Metals Industry Association.

Comtex News Network Inc. "Chalco to Raise Alumina Price in 2013," December 17, 2012. http://www.lexis.com (fee required).

Constellium. "Alcan Automotive Creates JV to Capture Strong Growth of Greener Products in China." News release, October 5, 2009. http://constellium.us/media/newsandpressreleases/pressreleasesonly/alcanautomotivecreatesjvtocapturestronggrowthofgreenerproductsinchina.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Datamyne, Inc. Datamyne database. http://www.datamyne.com/ (accessed various dates).

Deutsch Markets Research. *Bauxite and Alumina*, June 15, 2016. http://pg.jrj.com.cn/acc/Res/CN_RES/INDUS/2016/6/15/4d94aa4d-da2a-4cba-a75d-871e063d25d3.pdf.

Djukanovic, Goran. "Global Aluminium Smelters' Production Costs on Decline." Aluminum Insider, April 20, 2016. http://aluminiuminsider.com/global-aluminium-smelters-production-costs-on-decline/.

———. "Petroleum Coke Market Tightens." Aluminium Insider, December 12, 2016. http://aluminiuminsider.com/petroleum-coke-market-tightens/.

Elliott, Douglas J., and Kai Yan. *The Chinese Financial System: An Introduction and Overview.* John L. Thornton China Center at Brookings, July 2013. https://www.brookings.edu/research/the-chinese-financial-system-an-introduction-and-overview/.

Embassy of the People's Republic of China in Australia. "China Adjusts Tariff on Aluminum Products to Cut Energy Consumption, Pollution." News release (Xinhua), July 20, 2007. http://au.china-embassy.org/eng/zt/GlobeClimateChange/t342616.htm.

European Union Chamber of Commerce in China (European Chamber). *Overcapacity in China: An Impediment to the Party's Reform Agenda*, February 22, 2016. http://www.europeanchamber.com.cn/en/publications-overcapacity-in-china .

Fan, Gang, and Nicholas C. Hope. "The Role of State-Owned Enterprises in the Chinese Economy." *U.S. China Economic Relations in the Next Ten Years*, China-United States Exchange Foundation, 2013. http://www.chinausfocus.com/2022/wp-content/uploads/Part+02-Chapter+16.pdf.

Fan, Ruohong. "State Council Aims to Cut Power Prices for Big Manufacturers." Caixin, December 15, 2015. http://english.caixin.com/2015-12-15/100888436.html.

Federal Reserve. Historic Exchange Rates for the Chinese Yuan Renminbi. https://www.federalreserve.gov/releases/h10/hist/dat00_ch.htm (accessed September 12, 2016).

Fickling, David. "It's Not China's Fault That U.S. Aluminum Is Suffering." Bloomberg, October 10, 2016. https://www.bloomberg.com/gadfly/articles/2016-10-10/china-isn-t-the-reason-u-s-aluminum-is-suffering].

Fitch. "Fitch Affirms Chinese Aluminium Producer Chalco at 'BBB+'; Outlook Stable," October 17, 2016. https://www.fitchratings.com/site/pr/1013212.

Flower, Will. "What Operation Green Fence Has Meant for Recycling." waste360, February 10, 2016. http://www.waste360.com/business/what-operation-green-fence-has-meant-recycling.

Fog, Kathrine. "Market Outlook Investor Presentation." PowerPoint. Norsk Hydro ASA, June 16, 2016.

Fubao News. "Growth of Domestic AA Output Slows," November 28, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/growth-of-domestic-aa-output-slows.

———. "Qinghai Jiayun Al Resumes Production," December 2, 2016. The Bauxite Index. https://thebauxiteindex.com/cbix/news/qinghai-jiayun-al-resumes-production.

Fujian Minfa Aluminium Co Ltd. *Annual Report*. Six annual reports, 2011–17. http://quicktake.morningstar.com/stocknet/secdocuments.aspx?symbol=002578&country=chn.

Gao Ning. "China–Leading Growth in the Asian and World Market." Presentation at MetalBulletin 24th International Recycled Aluminium Conference, November 21, 2016. http://www.metalbulletin.com/events/international-recycled-aluminium-conference/presentations.html.

Government of China. China Customs. *2011 Customs Import and Export Tariff of the People's Republic of China*. Economic Daily Press, 2010.

———. *2016 Customs Import and Export Tariff of the People's Republic of China*. Economic Daily Press, 2016.

Government of China. General Administration of Customs. Import data.

Government of China. Office of the State Council. "Suggestions of the General Office of the State Council," June 5, 2016. http://www.gov.cn/zhengce/content/2016-06/16/content_5082726.htm.

Gourdon, Julien, Stephanie Monjon, and Sandra Poncet. "Incomplete VAT Rebates to Exporters: How Do they Affect China's Export Performance?" CEPII Working Paper, February 5, 2014. http://www.cepii.fr/PDF_PUB/wp/2014/wp2014-05.pdf.

Gränges. "2015 Annual Report," March 11, 2016. http://www.granges.com/investors/reports-and-presentations/.

Han Hao, Yong Geng, and Wen Hang. "GHG Emissions from Primary Aluminum Production in China: Regional Disparity and Policy Implications." *Applied Energy* 166 (March 15, 2016): 264–72. http://www.sciencedirect.com/science/article/pii/S030626191500687X (fee required).

Home, Andy. "Aluminum Sector Seeks Way to Tackle China-induced Instability." Reuters, March 23, 2017. http://www.reuters.com/article/us-china-aluminium-home-idUSKBN16U380.

———. "China Lobs a Grenade into the Aluminum Supply Chain." Reuters, March 3, 2017. http://www.cnbc.com/2017/03/03/reuters-america-column-china-lobs-a-grenade-into-the-aluminum-supply-chain-andy-home.html.

———. "China's Giant Aluminum Machine Cranks Up Again." Reuters, February 21, 2017. http://www.cnbc.com/2017/02/21/reuters-america-column-chinas-giant-aluminum-machine-cranks-up-again-andy-home.html.

———. "China's Aluminum Output Booms as Shanghai Disconnect Looms." Reuters, October 25, 2016. http://www.reuters.com/article/us-china-aluminium-ahome-idUSKCN12P1WU.

Hong, Shen. "China's Small Businesses Lose Out on Cheaper Loans." *Wall Street Journal*, April 1, 2015. http://www.wsj.com/articles/chinas-small-businesses-lose-out-on-cheaper-loans-1427860298.

IHS Markit. Global Trade Atlas (GTA) database. https://www.gtis.com (accessed April 2016–February 2017).

Interfax News Agency. "China to Adjust Import and Export Tax on Energy and Metal Products Next Month." China Mining and Metals Newswire, October 27, 2006.

International Aluminium Institute (IAI). IAI Statistics database. http://www.world-aluminium.org/statistics/ (accessed various dates).

International Energy Agency (IEA). *Technology Roadmap: High-Efficiency, Low-Emissions Coal-Fired Power Generation*, 2012. http://www.iea.org.

J.P. Morgan Asset Management. "China: The Path to Interest Rate Liberalization," July 2015. https://am.jpmorgan.com/blob-gim/1383216432861/83456/WP-GL-China-The-path-to-interest-rate-liberalization.pdf.

Jamaica Observer. "JISCO Pledges to Ensure Sustainability of ALPART," September 22, 2016. http://www.jamaicaobserver.com/news/JISCO-pledges-to-ensure-sustainability-of-ALPART.

JCP Investment Partners. "The Aluminium Market Outlook," August 2012.

Jiangsu Asia-Pacific Light Alloy Technology Co., Ltd. "2015 Annual Report," April 2016.

Kazakhstan Mining Weekly. "Yunnan Offers Subsidized Loans to Metals Firms," October 15, 2012. https://www.lexisnexis.com (fee required).

Keller, Maura. "Metals Market Meltdown." *American Recycler News*, February 2016. http://americanrecycler.com/8568759/index.php/news/metal-recycling/1519-metals-market-meltdown.

Kim, Bawoo, and Youngho Lee. "China's Processing Trade: Trends and Implications." *KIET Industrial Economic Review* 18, no. 2 (March/April 2013): 50–61. https://library.kiet.re.kr.

Leavenworth, Stuart. "Chinese Environmentalists Accuse 1,000 Companies of Polluting." McClatchy, December 9, 2014. http://www.mcclatchydc.com/news/nationworld/world/article24777235.html.

Lee, Winnie. "China's Baise Plans to Build 300,000 Mt/Year Al Smelter in Guangxi." *Platts Metals Daily*, October 10, 2016. https://www.lexisnexis.com (fee required).

Lelyveld, Michael. "China's Smokestack Industries Seek Support Analysis." *Eurasia Review*, November 17, 2015. http://www.lexis.com (fee required).

Leung, Joshua. "China's 2016 Aluminum Extrusion Exports Rise 7%: CNMIA." *Platts Metals Daily*, February 29, 2016.

Li Xiaowei. "Chinese Smelters Opt for Spot Alumina Imports." *Metal Bulletin Weekly*, February 6, 2012. http://www.lexis.com (fee required).

Lin, Linda. "China ADC12 Export Prices Widen amid Softer Yuan, Oversupply." *Metal Bulletin*, July 13, 2016. https://www.metalbulletin.com/Article/3569868/China-ADC12-export-prices-widen-amid-softer-yuan-oversupply.html.

Liu Wei. "China Nonferrous Metals Recycling Industry." China Nonferrous Metals Industry Association Recycling Metal Branch. PowerPoint prepared for Metal Recycling Association of India (MRAI) 3rd International Indian Metals Recycling Conference, New

Delhi, January 21–23, 2016 (accessed December 16, 2016). http://www.mrai.org.in/site/assets/files/6925/presentation_liu_wei.pdf.

———. "China Recycled Aluminium Industry–Government Demand and Patterns." China Nonferrous Metals Industry Association Recycling Metal Branch. PowerPoint prepared for the 22nd International Recycled Aluminium Conference, Berlin, November 2015.

Lynch, David J. "China's Capitalist Road Reaches Indiana as Spending Soars." Bloomberg, March 19, 2014. https://www.bloomberg.com/news/articles/2014-03-19/china-s-capitalist-road-reaches-indiana-as-spending-soars.

MacAulay, Brad. "China's Aluminum Scrap Appetite Lifts US Exports." *American Metal Market Magazine*, July 12, 2016. https://www.lexisnexis.com (fee required).

Manova, Kalina, and Zhihong Yu. "How Firms Export: Processing vs. Ordinary Trade with Financial Frictions." *Journal of International Economics* 100 (February 22, 2016): 120–37. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2177073.

Marsh, Christian. "Issues and Decision Memorandum for the Final Determination in the Countervailing Duty Investigation of Aluminum Extrusions from the People's Republic of China (PRC)." U.S. Department of Commerce. International Trade Administration, C-570-968, March 28, 2011.

McBeth, Karen. "Aluminum Buyers Face Tighter Chinese Calcined Petcoke Supply, Sudden Price Increases." *Platts Metals Daily*, November 3, 2016. http://www.lexis.com (fee required).

———. "Calcined Petcoke Market: Perceived Uptrend Sparks Inquiries." *Platts Coal Trader International*, January 12, 2017. http://www.lexis.com (fee required).

———. "Calcined Petcoke Market: Prices Steady in Nov despite Higher Chinese Offers." *Platts Coal Trader International*, December 8, 2016. http://www.lexis.com (fee required).

McDonald, Joe. "China Vows to Cut Aluminum Output, but Producers Plan Growth." Associated Press, September 13, 2016. http://bigstory.ap.org/article/d546b215c5bf4d7dafc62b7dd724a9db/china-vows-cut-aluminum-output-producers-plan-growth.

Metal Bulletin Daily Alerts. "China's Henan Issues Action Plan to Hasten Development of Aluminium Industry," September 14, 2012. https://www.lexisnexis.com (fee required).

Metal Bulletin. "Alcoa Says China Likely to Deal with Fake Semis Exports," July 9, 2015. https://www.metalbulletin.com/Article/3469680/Alcoa-says-China-likely-to-deal-with-fake-semis-exports.html (fee required).

———. “China Aluminium Smelters Offered Extra Subsidies to Keep Producing,” June 1, 2012. https://www.lexisnexis.com (fee required).

———. “China Secondary Aluminium Production May Feel Global Economic Pinch in 2012,” May 28, 2012. https://www.metalbulletin.com/Article/3033800/Non-Ferrous/China-secondary-aluminium-production-may-feel-global-economic-pinch-in-2012.html.

Metalico, Inc. “Schedule 14A.” Proxy statement for the Securities and Exchange Commission, August 27, 2015. https://www.sec.gov/Archives/edgar/data/1048685/000162612915000197/metalico-defa14a_072715.htm.

Metals Service Center Institute (MSCI). Prehearing brief to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 12, 2016.

Miller, John W. “Novelis CEO Sees Electric Cars Energizing Aluminum Makers.” *Wall Street Journal*, March 5, 2015. http://www.wsj.com/articles/novelis-ceo-says-electric-cars-will-boost-demand-for-aluminum-1425589768.

Miller, John W., and Scott Patterson. “Zhongwang’s U.S. Business to Buy Aluminum Company Aleris.” *Wall Street Journal*, August 29, 2016. https://www.wsj.com/articles/china-zhongwang-to-buy-aluminum-company-aleris-1472475642.

Minter, Adam. “CMRA Conference Report: Reversal of Fortune.” *Scrap Magazine*, January/February 2016. http://www.isri.org/news-publications/scrap-magazine/scrap-articles/cmra-conference-report-reversal-of-fortune#.V7zWJfkrJ-A.

———. “Report: CMRA Conference—The Winds of Change.” *Scrap Magazine*, January/February 2013. http://www.isri.org/news-publications/scrap-magazine/scrap-articles/report-cmra-conference-the-winds-of-change#.V7zWMPkrJ-A.

Mok, Yuencheng. “Chinese Alumina Contracts May Change.” *Platts Metals Week*, January 16, 2012. https://www.lexisnexis.com (fee required).

———. “China Aluminum Smelters Seek Government Subsidies on Power While Mulling Capacity Cuts.” *Platts Metals Daily*, November 3, 2015. https://www.lexisnexis.com (fee required).

Moody’s. “Moody’s: China’s On-grid Tariff Cut Is Credit Negative for Coal-fired Power Generators,” January 4, 2016. https://www.moodys.com/research/Moodys-Chinas-on-grid-tariff-cut-is-credit-negative-for--PR_341859.

Mukhamedshin, Oleg. “Energy Costs and Considerations in Primary Smelting and the China Factor.” September 2014. http://www.metalbulletin.com/events/download.ashx/document/speaker/7043/a0ID000000X0juBMAR/Presentation.

National Bureau of Statistics of China (NBS). Statistical Database. http://www.stats.gov.cn/english/ (accessed various dates).

New York Times. “Rio Discusses Selling Assets to China,” February 2, 2009. http://www.nytimes.com/2009/02/02/business/worldbusiness/02iht-mine.3.19869273.html.

Government of New Zealand. Statistics New Zealand database. http://www.stats.govt.nz/infoshare (accessed various dates).

Ng, Eric. “Zhongwang Says It’ll Bring Jobs Stability to Aleris, Hits Back at US Opposition to US$2.3 Bln Takeover.” *South China Morning Post*, November 3, 2016. http://www.scmp.com/business/companies/article/2042649/zhongwang-says-itll-bring-jobs-stability-aleris-hits-back-us.

Norrgren, Helena. “Strong U.S. Dollar, Weak Fuel Prices and Bauxite Barter Lead to Lower Operating Costs at Alumina Refineries.” CRU Insight, June 24, 2016. http://www.crugroup.com. (fee required).

Nuthall, Keith. “US West Coast Labour Dispute Deal Struck.” *Metal Bulletin*, March 16, 2015. https://www.lexisnexis.com (fee required).

O’Donovan, Barbara. “MB’S Recycled Al Conf: Wang Kei Yip Will Double Al Alloy Output.” *Metal Bulletin*, November 12, 2010. https://www.lexisnexis.com (fee required).

Paulson Institute. “A Chinese Aluminum Company’s Learning Curve in the US Market.” Paulson Papers on Investment, October 2013. http://www.paulsoninstitute.org/wp-content/uploads/2017/01/Paulson-Paper-on-Investment_Nanshan_English_R.pdf.

Pawlek, Rudolf P. “World Secondary Aluminum Industry Annual Review.” *Light Metal Age*, August 2011, 6–16.

———. “World Secondary Aluminum Industry Annual Review.” *Light Metal Age*, August 2012, 8–18.

———. “World Secondary Aluminum Industry Annual Review.” *Light Metal Age*, August 2013.

Perrett, Bradley. “Aleris’s Chinese Mill Joins Move into Higher Grades for Airbus.” *Aviation Week*, October 31, 2016. http://aviationweek.com/zhuhai-2016/aleris-s-chinese-mill-joins-move-higher-grades-airbus.

———. “Nanshan Aluminum Supplying Boeing with Plate.” *Aviation Daily*, November 8, 2016. http://aviationweek.com/zhuhai-2016/nanshan-aluminum-supplying-boeing-plate.

Pickard, Joe. “Recycling Economics and Markets: Scrap Recycling Industry Trends and Outlook.” Presentation for Carolina Recycling Association 2014 Annual Conference, April 1, 2014, Asheville, North Carolina. http://www.cra-recycle.org/wp-content/uploads/2014/05/CRA-G1-Joe-Pickard.pdf.

Platts. “China’s ADC Aluminum Export Prices Rise after Japan Buy Tender; Domestic Prices Soften,” December 6, 2016. http://www.platts.com/latest-news/metals/tokyo/chinas-adc-aluminum-export-prices-rise-after-27724540.

———. “China Unlikely to Cut 15% Export Tax on Primary Aluminum: Sources,” December 9, 2014. http://www.platts.com/latest-news/metals/sydney/china-unlikely-to-cut-15-export-tax-on-primary-27916222.

———. “China’s Aluminum Demand to Surge 34% in 2016–20 on Growth in Transport Sector: CNIA,” December 23, 2015.

Poole, Anthony. “Consolidation Likely in China Secondary Aluminum: Sigma Executive.” Platts, January 17, 2011. http://www.platts.com/latest-news/metals/sandiego/consolidation-likely-in-china-secondary-aluminum-6753631.

Recycling International. “China’s Import Demands ’Not Unreasonable,’” April 16, 2013. http://www.recyclinginternational.com/recycling-news/7012/research-and-legislation/china/china-039-s-import-demands-039-not-unreasonable-039.

Recycling Today. “A Lack of Demand and Too Much Supply,” July 28, 2015. http://www.recyclingtoday.com/article/rt0815-nonferrous-scrap-market-pricing/.

———. “CMRA 2014: Several Challenges in China,” November 10, 2014. http://www.recyclingtoday.com/article/cmra-2014-guangzhou-nonferrous/.

———. “Metalico Sale Is Final; CEO Aguero Sells Shares, U.S. Scrap Recycling Firm Sold to Company Linked to Ye Chiu Group Chairman.” http://www.recyclingtoday.com/article/metalico-ye-chiu-scrap-recycling-sale/.

Reuters. “S&P Cuts Chalco to ’BBB’: Otlk Negative.” Standard & Poor’s news release, February 2, 2012. http://www.reuters.com/article/idAFWLA230820120202.

———. “Update 1—China to Impose Tiered Power Pricing for Aluminium Smelters,” December 22, 2013. http://www.reuters.com/article/china-aluminium-idUSL3N0K206J20131223.

Sepic, Matt. “As Prices Slump, Metal Recyclers Steel Themselves.” Minnesota Public Radio, September 2, 2015. https://www.mprnews.org/story/2015/09/02/scarp-metal.

Shandong Nanshan Aluminum. *2016 Semi-Annual Report*, 2016.

———.*2015 Annual Report,* April 5, 2016. http://quicktake.morningstar.com/stocknet/secdocuments.aspx?symbol=600219&country=chn.

Shanghai Daily. “China Lowers Electricity Price for Grid, Enterprise Users,” April 19, 2015. http://www.shanghaidaily.com/business/economy/China-lowers-electricity-price-for-grid-enterprise-users/shdaily.shtml.

Shanghai Metals Market (SMM). “Domestic Aluminum Processing Enterprises to Face New Inspections, SMM Reports.” News release, February 12, 2017. https://news.metal.com/newscontent/100723903/domestic-aluminum-processing-enterprises-to-face-new-inspections,-smm-reports.

———. “Prebaked Anode Poised to Keep Advancing in China, SMM Predicts.” News release, February 21, 2017. https://news.metal.com/newscontent/100724347/prebaked-anode-poised-to-keep-advancing-in-china-smm-predicts.

———. “What’s Impact on Chinese Aluminum Producers from New Environmental Drive? SMM Reports.” News release, December 12, 2016. https://news.metal.com/newscontent/100714606/What%E2%80%99s-Impact-on-Chinese-Aluminum-Producers-from-New-Environmental-Drive%3F-SMM-Reports.

———. “What Changes Happen in China Aluminum Market in 2016 after Price Surges? SMM Exclusive.” News release, January 23, 2017.

https://news.metal.com/newscontent/100720886/what-changes-happen-in-china-aluminum-market-in-2016-after-price-surges-smm-exclusive.

Shearer, Christine, Nicole Ghio, Lauri Myllyvirta, Aiqun Yu, and Ted Nace. *Boom and Bust 2016: Tracking the Global Coal Plant Pipeline*. CoalSwarm, Sierra Club, and Greenpeace, March 2016. http://sierraclub.org/sites/www.sierraclub.org/files/uploads-wysiwig/final%20boom%20and%20bust%202017%20(3-27-16).pdf.

Shenwan Hongyuan Securities. "Focus on Cost Reduction, Looking to Be Profitable This Year." News release, May 7, 2015. www.hysec.com.

Showa Denko K.K. "Showa Denko Completes High Purity Aluminum Foil Plant in China." News release, October 16, 2013. http://www.sdk.co.jp/english /news/.13382/13769.html

———. *"Showa Denko Decides to Expand High Purity Aluminum Foil Plant in China." News release, May 10, 2017.* http://www.sdk.co.jp/english/news/2017/16657.html

South China Morning Post. "China Hongqiao Builds More Power Plants and Secures Materials Abroad," June 14, 2015. http://www.scmp.com/business/china-business/article/1822085/china-hongqiao-builds-more-power-plants-and-secures.

Spegele, Brian. "China Continues to Prop Up Its Ailing Factories, Adding to Global Glut." *Wall Street Journal*, May 9, 2016. http://www.wsj.com/articles/chinese-exports-surge-amid-overcapacity-at-home-1462746980.

Stanway, David. "China to Use Tougher Environmental Standards to Tackle Capacity Glut." Reuters, August 12, 2016. http://www.reuters.com/article/us-china-overcapacity-idUSKCN10O065.

Sun, Lacey Lei. "Beijing to Impose 15% Duty on Al Alloy Exports." *Metal Bulletin*, August 18, 2008. https://www.lexisnexis.com (fee required).

Taylor, Brian. "2015 CMRA Convention: How Green Is My Industry?" *Recycling Today*, November 17, 2015. http://www.recyclingtoday.com/article/cmra-2015-recycling-green-industry/.

———. "2015 CMRA Convention: Removing the Barriers." *Recycling Today*, November 17, 2015. http://www.recyclingtoday.com/article/cmra-2015-trade-barriers-recycling/.

———. "2015 CMRA Convention: Seeking Efficiency and Eco-friendliness." *Recycling Today*, November 18, 2015. http://www.recyclingtoday.com/article/cmra-2015-recycling-technology-nonferrous/.

———. “2016 CMRA: Causes for Concern.” *Recycling Today*, November 20, 2016. http://www.recyclingtoday.com/article/cmra-china-economy-automobile-recycling/.

———. “2016 CMRA: China Reaches Out.” *Recycling Today*, November 14, 2016. http://www.recyclingtoday.com/article/china-cmra-metal-recycling-investment/.

———. “2016 CMRA: Some Words of Support.” *Recycling Today*, November 20, 2016. http://www.recyclingtoday.com/article/china-metal-recycling-government-support-cmra/.

———. “Scaling Back Down.” *Recycling Today*, March 8, 2016. http://www.recyclingtoday.com/article/scaling-back-down/.

———. “Trial and Error.” *Recycling Today*, January 7, 2015. http://www.recyclingtoday.com/article/rt0115-cmra-convention-industry-challenges/.

Teo, Vivian. “China’s Base Metals Demand Expected to Slow over Next 5 Years." *Metal Bulletin*, October 19, 2016. http://www.lexis.com.

Trade Data Services, Inc. Import Genius database. https://www.importgenius.com/ (accessed various dates).

United Nations (UN). Department of Economic and Social Affairs. Population Division. World Population Prospects: The 2015 Revision. Custom data acquired via website, 2015. https://esa.un.org/unpd/wpp/DataQuery/.

U.S. Department of Commerce (USDOC). "U.S. Fact Sheet: 26th U.S.-China Joint Commission on Commerce and Trade," November 23, 2015. https://www.commerce.gov/news/fact-sheets/2015/11/us-fact-sheet-26th-us-china-joint-commission-commerce-and-trade.

U.S.-China Economic and Security Review Commission (USCC). “Sector Spotlight: U.S. Aluminum Sector under Pressure from China.” Monthly analysis of U.S.-China Trade Data, November 4, 2015. http://origin.www.uscc.gov/sites/default/files/Research/November%20Trade%20Bulletin%202015_0.pdf.

U.S. Geological Survey (USGS). “Bauxite and Alumina.” Mineral Commodities Summary, 2012. https://minerals.usgs.gov/minerals/pubs/commodity/bauxite/mcs-2012-bauxi.pdf.

———. “Bauxite and Alumina.” Mineral Commodities Summary, 2013. https://minerals.usgs.gov/minerals/pubs/commodity/bauxite/mcs-2013-bauxi.pdf.

———. "Bauxite and Alumina." Mineral Commodities Summary, 2014. https://minerals.usgs.gov/minerals/pubs/commodity/bauxite/mcs-2014-bauxi.pdf.

———. "Bauxite and Alumina." Mineral Commodities Summary, 2015. https://minerals.usgs.gov/minerals/pubs/commodity/bauxite/mcs-2015-bauxi.pdf.

———. "Bauxite and Alumina." Mineral Commodities Summary, 2016. https://minerals.usgs.gov/minerals/pubs/commodity/bauxite/mcs-2016-bauxi.pdf.

U.S. International Trade Commission (USITC). Hearing transcript in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry,* September 29, 2016.

———. "USITC Votes to Continue Investigations on Aluminum Foil from China." News release, April 21, 2017. https://www.usitc.gov/press_room/news_release/2017/er0421ll755.htm.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Department of Commerce (USDOC). https://dataweb.usitc.gov/ (accessed various dates).

U.S. Trade Representative (USTR). "Obama Administration Files WTO Complaint on China's Subsidies to Aluminum Producers." News release, January 12, 2017. https://ustr.gov/about-us/policy-offices/press-office/press-releases/2017/january/Obama-Administration-Files-WTO-Complaint-China-Aluminum.

Vazquez, Jorge. Hearing exhibits in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, September 29, 2016.

———. Written testimony in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, September 29, 2016.

Government of Vietnam. General Department of Vietnam Customs. HS Chapter 76 Import Data, Excel Spreadsheet, December 2016.

Vimetco NV. *Annual Report 2015*, 2016. http://www.vimetco.com/ir/reports.

Von Alroth, Joanné. "Why Nanshan Came to Indiana." *Forward*, May/June 2012, https://www.msci.org/forward-archives/artmid/4643/articleid/752/209.

Watanabe, Mayumi, and Yuencheng Mok. "Asia to Feel Impact of China Tax in Two Months: Sources." *Platts Metals Week*, August 25, 2008. http://www.lexis.com (fee required).

Watanabe, Mayumi. “Japan’s Aluminum Foil Imports from China Reach Record High.” *Platts Metals Daily*, September 1, 2014.

———. “China’s Aluminum Semis Exports to Ease Global Tightness: Macquarie.” *Platts Metals Daily*, August 22, 2014.

Wen, Xianjun. “Aluminum Industry in China and International Trade.” Presentation at China Aluminum Week Conference, Nanning, China, October 2016.

Williams, Paul. “Overcapacity in Chinese Rolled Product Sector Increases Focus on Exports.” CRU, January 14, 2016. http://www.crugroup.com/about-cru/cruinsight/Overcapacity_in_Chinese_rolled_product_sector_increases_focus_on_exports.

———. “The Market and China’s Role.” CRU Group. Presentation at the Aluminum Association Annual Meeting, Nashville, TN, October 20–21, 2015. http://www.aluminum.org/sites/default/files/10-20%20Gen%20Ses%202%20Paul%20Williams%20pp.pdf.

Wood, Andrew. “Keeping the Bauxite and Alumina Industry Profitable—Challenges and Opportunities.” Alumina Ltd. Presentation at the *Metal Bulletin* 20th Bauxite and Alumina Conference, Miami, FL, February 25, 2014.

Wookey, Jethro. “China Is Most Efficient Aluminium Producer Nation.” *Metal Bulletin*, October 31, 2016. https://www.fastmarkets.com/base-metals-news/aluminium/lme-week-2016-china-is-most-efficient-aluminium-producer-nation-123097/.

———. “MB Recycled Al Conf: China’s Secondary Al Industry Moves Inland.” *Metal Bulletin Daily Alerts*, November 17, 2015. https://www.lexisnexis.com.

———. “MB Recycled Al Conf: North America’s Scrap Overhang Will Persist.” *Metal Bulletin Daily Alerts*, November 17, 2015. https://www.lexisnexis.com (fee required).

World Bank. “GDP Growth (Annual %).” http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG (accessed January 7, 2017).

World Bureau of Metal Statistics (WBMS). “Aluminium, Secondary Production.” *World Metal Statistics, 2016 Yearbook.* Ware, Herts, United Kingdom: WBMS, 2016.

World Trade Organization (WTO). “China—Subsidies to Producers of Primary Aluminum: Request for Consultations by the United States.” WT/DSS19/1, G/SCM/D113/1, G/L/1173, Document no. 17-0301, January 17, 2017.

https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S006.aspx?Query=(%20@Symbol=%20(wt/ds519/1%20))&Language=ENGLISH&Context=FomerScriptedSearch&languageUIChanged=true#.

Xingfa. *2015 Annual Report*, March 31, 2015.

Xinhua. "China Decides to Expand Electricity Pricing Reform," March 14, 2016. http://english.gov.cn/state_council/ministries/2016/03/14/content_281475307399030.htm.

———. "Higher Duty on Aluminum Export to Cut Pollution," July 20, 2007. http://www.china.org.cn/english/environment/217779.htm.

———. "China to Expand Power Pricing Reform Nationwide," March 29, 2016. http://www.chinadailyasia.com/nation/201603/.

XinRen Aluminum. *2014 Annual Report*, 2015.

Yam, Polly. "China Alumina Prices Drop on Growing Supply as Production Costs Fall." Reuters, June 11, 2015. http://www.reuters.com/article/china-aluminium-alumina-idUSL3N0YX1XD20150611.

———. "China Aluminium Smelters Seek Power Fee Cuts as Metal Price Hits Lows." Reuters, November 6, 2015. http://www.reuters.com/article/china-aluminium-power-idUSL3N13138W20151106.

———. "China's Extra Power Fees for Aluminium Smelters Not Likely to Boost Prices." Reuters, January 8, 2014. http://www.reuters.com/article/china-aluminium-power-idUSL3N0KI16720140108.

Yam, Polly, and David Stanway. "Aluminum Stockpiling Fund Gives Glimpse of China Metals Reforms." Reuters, January 21, 2016. http://www.reuters.com/article/us-china-metals-stockpiling-idUSKCN0UZ1QZ.

Yang, Stephanie. "Aluminum Prices Surge Thanks to Logjam in China." *MoneyBeat* (blog), *Wall Street Journal*, October 26, 2016. http://blogs.wsj.com/moneybeat/2016/10/26/aluminum-prices-surge-thanks-to-logjam-in-china/.

Ye Chiu Group. *2015 Annual Report*, April 29, 2016. http://www.yechiu.com/en/investor.php/financial/1.

Yee, Alvin. "Japan's ADC12 Import Trade Picks up on Yen Rebound." *Platts Metals Daily*, November 29, 2016. https://www.lexisnexis.com.

———. "Japan's ADC12 Import Trades from China Thin on Weak Yen." *Platts Metals Daily*, May 31, 2016. https://www.lexisnexis.com.

Yee, Alvin. "Japan's Chinese ADC12 Alloy Import Trades Stall." *Platts Metals Daily*, October 25, 2016. https://www.lexisnexis.com.

———. "Japanese Buyers Divided as Chinese ADC12 Import Offers Jump." *Platts Metals Daily*, November 15, 2016. https://www.lexisnexis.com.

———. "Weak Yen Dampens Japan's Chinese ADC12 Import Trade." *Platts Metals Daily*, November 22, 2016. https://www.lexisnexis.com.

Zhang, Yanlu, Mingxing Sun, Jinglan Hong, Xiaofei Han, Jing He, Wenxiao Shi, and Xiangzhi Li. "Environmental Footprint of Aluminum Production in China." *Journal of Cleaner Production* 133 (October 1, 2016): 1242–51.

Zheng Jiaju and Wang Zhongkui, eds. *Alumina and Aluminum Monthly.* Antaike (China) no. 216 (December 2014), 21–22. http://www.antaike.com/uploadfiles/20150107/2015010715412711777.pdf.

Zhou, Rebecca. "China Aluminium Smelters' Power Costs on Downtrend." CRU Group, December 25, 2015.

Zou, Susan. "China's Unwrought Aluminium, Aluminium Products Exports Up 6% y-o-y in October." *Metal Bulletin Daily Alerts*, November 8, 2016.

———. "Will China's Aluminium Imports, Exports See a Repeat of the Surges of 2016?" *Metal Bulletin Daily Alerts*, December 26, 2016.

Chapter 7
Gulf Cooperation Council Countries

Overview

The aluminum industry is an important cornerstone of the Gulf Cooperation Council (GCC)[739] economies. Primary aluminum production in the region has grown rapidly over the past decade, to the point where the GCC countries accounted for 9 percent of global primary aluminum production in 2015.[740] According to the Gulf Aluminium Council, this industry is growing in the GCC countries by 8.6 percent annually, almost twice the global aluminum growth rate of 4.4 percent,[741] as a result of investments in new smelters and capacity increases in existing smelters. In addition, during the past few years the GCC economies have begun to increase their production of value-added wrought aluminum products.

Aluminum production in the region has benefited from policies of the GCC countries, which aim to diversify their economies by developing their non-petroleum sectors to reduce their long-term exposure to volatility in the global petroleum market. These policies include low-interest loans, lack of corporate taxes, low rents, and outright land grants. GCC countries have also supported the industry by investing in high-quality port infrastructure to facilitate the export of goods, as well as construction projects in their domestic markets that boost regional consumption of both unwrought and wrought aluminum.

The GCC has two key competitive advantages in producing primary aluminum. First, since the production of aluminum is energy-intensive, GCC primary aluminum producers benefit from low electricity costs as a result of extensive domestic low-cost natural gas reserves and government support programs. Second, GCC aluminum producers have also lowered their production costs through investments in upstream and downstream production and technological improvements.

To gain greater control over their raw material prices, the GCC countries have integrated their aluminum supply chain by investing in upstream production—purchasing bauxite mines abroad and creating alumina refineries domestically. The GCC producers also benefit significantly from investments and technological improvements made through joint ventures with leading multinational aluminum companies (such as U.S.-based Alcoa), which are often minority owners

---

[739] The GCC countries are Bahrain, Oman, Qatar, Saudi Arabia, Kuwait, and the United Arab Emirates.
[740] *Technical Review Middle East*, “GCC Aluminium Production Records Seven Percent Growth,” January 28, 2016.
[741] Hy Industry Corporation, “Aluminum Middle East Market Studies,” April 20, 2016.

with less than 51 percent ownership in the joint venture. Most smelters in the GCC region were built over the last decade and use the most cost-efficient technology. New alumina refineries in the region are expected to be operational in the next five years and are also expected to benefit from a lower cost of production due to technological improvements over older refineries. Moreover, due to the increased availability of domestic primary aluminum production, the GCC countries are now investing heavily in downstream wrought aluminum production.

As a result of both government support policies and production process improvements, the GCC producers presently have the lowest global average production costs for primary aluminum. This has enabled the GCC countries to have a direct impact on the global aluminum market. GCC primary aluminum exports have increased 15 percent from 2011 to 2015, displacing exports from other sources—mostly the European Union (EU) and Russia.

Industry Structure

The GCC unwrought aluminum industry includes producers that concentrate on primary aluminum production, as well as others that are more integrated with the upstream supply chain through acquisitions of alumina refineries or bauxite mines. Other than Kuwait, each GCC country has a single large primary aluminum producer and numerous wrought aluminum producers, the majority of which produce flat-rolled aluminum products. (Kuwait has no primary aluminum production.) The GCC countries lack secondary aluminum production, with the exception of Bahrain, which produces a minimal amount of aluminum powder flakes.[742]

Primary Unwrought Aluminum

Except for Bahrain and the United Arab Emirates (UAE), both of which started primary aluminum production back in 1960s and 1970s, most GCC countries began producing primary aluminum in the mid-2000s. Many of the primary aluminum producers in the GCC countries are joint ventures between state-owned enterprises (SOEs) and international aluminum-producing conglomerates, such as Rio Tinto,[743] Norsk Hydro,[744] and Alcoa[745] (table 7.1). GCC primary aluminum producers concentrate on manufacturing billets intended for extruding wrought aluminum forms suitable for the construction, automotive, and transportation markets, and ingots for flat-rolled products suitable for packaging industries.

---

[742] Gulf Aluminium Council, "Facts and Figures: Key Indicators," 2013.
[743] Rio Tinto is a British-Australian based multinational corporation focused on the metal and mining industry. It is the largest global bauxite producer and the second-largest global alumina producer.
[744] Norsk Hydro is a Norway-based aluminum and energy company with operations in more than 50 countries. For a discussion on Norway's aluminum industry, see chapter 9.
[745] Alcoa is a U.S.-based multinational company and the third-largest global producer of aluminum. For a discussion on the United States' aluminum industry, see chapter 4.

Table 7.1: GCC countries: Primary unwrought aluminum products, 2016

Company	Location	Year Established	Ownership structure	Ownership entities (share)	Capacity (1,000 mt)
Aluminium Bahrain (Alba)	Bahrain	1968	Mixed public-private joint venture	Bahrain Mumtalakat Holding Company (SOE): 70%; SABIC Investment Company (mixed private firm and SOE): 21%; public ownership: 10%	960
Sohar Aluminium	Oman	2004	Mixed public-private joint venture	Oman Oil[a] (SOE): 40%; Abu Dhabi National Energy Company[b] (SOE): 40%; Rio Tinto (British-Australian publicly traded company): 20%	393
Qatalum	Qatar	2010	Mixed public-private joint venture	Qatar Petroleum (SOE): 50%; Norsk Hydro (private Norway-based company): 50%	620
Ma'aden Aluminium Company	Saudi Arabia	2013	Mixed public-private joint venture	Alcoa (U.S.-based private company): 75%; Saudi Arabia Mining Company: (SOE): 25%[c]	760
Emirates Global Aluminium (EGA)	United Arab Emirates	1979	Joint public partnership	Mubadala Development Corporation of Abu Dhabi[d] (SOE): 50%; Investment Corporation of Dubai (SOE): 50%	2,421

Source: Company websites (accessed June–August 2016).
Note: mt = metric tons. Because of rounding, total shares for each country may not add up to 100 percent.
[a] Oman Oil Company is wholly owned by the Government of Oman. Oman Oil website, http://www.oman-oil.com/index.php (accessed June 20, 2016).
[b] Abu Dhabi National Energy Company (also known as Taqa) is 75.1 percent indirectly owned by the government of Abu Dhabi. Taqa website, https://www.taqaglobal.com/ (accessed June 17, 2016).
[c] Ma'aden website, http://www.maaden.com.sa/en/about/history (accessed June 20, 2016).
[d] USGS, "United Arab Emirates," 2013 Minerals Yearbook; EGA, written submission to the USITC, January 23, 2017, 2.

Some large GCC producers, such as Alba and Emirates Global Aluminum (EGA),[746] focus on the smelting stage of the production value chain.[747] Other producers, such as Saudi producer Ma'aden, are more integrated into the upstream supply chain and have recently expanded in this area by acquiring bauxite mines and investing in alumina refineries. Ma'aden's operations in Saudi Arabia consist of a bauxite mine,[748] an alumina refinery, a primary aluminum

[746] EGA's core operating assets consist of Dubai Aluminium (Dubal) and Emirates Aluminium (Emal). Dubal operates a smelter with 1 million tons of primary aluminum capacity in Jebel Ali, Dubai. Emal operates a smelter capable of producing 1.3 million tons of primary aluminum per year in Al Tawleelah, UAE, which commenced production in 2009. EGA's collective production from these two smelters makes the company the fifth-largest global producer of primary aluminum. Emirates Global Aluminium website, http://www.ega.ae/en/who-we-are/corporate-profile/ (accessed June 20, 2016).
[747] Nappi, "The Global Aluminium Industry: 40 Years from 1972," February 2013, 22.
[748] Al Ba'itha bauxite mine is an affiliate of Ma'aden's bauxite, an aluminum ore crushing and handling facility, located in Saudi Arabia. The production capacity of Al Bai'itha bauxite mine is 4 million mt annually. The bauxite is

processing facility, and a rolling plant mill. The GCC primary aluminum industry is concentrated around ports along the Persian Gulf, which reduces shipping time to global markets (figure 7.1).

In 2015 the UAE was the fourth-largest primary aluminum producer worldwide and the largest primary aluminum producer in the GCC region, accounting for close to half of the GCC region's primary aluminum capacity.[749] Unlike most other GCC countries (except Bahrain), the UAE benefited from having an established aluminum industry, due to its earlier investments in new smelters.[750] EGA, the UAE's sole primary aluminum producer, states that its primary aluminum products fall into three categories: (1) high-purity and foundry remelt products for electronic, aerospace, and automotive applications; (2) rolled products for packaging, lithographic sheets, and automotive uses; and (3) billets for extrusion and forging, useful for the construction, industrial, transportation, and automotive industries.[751] EGA has expanded its capacity in recent years through investments, and has one of the world's largest single-site primary aluminum production facilities.[752] In 2014, EGA expanded its smelter capacity at its Al Taweelah facility to 520,000 metric tons (mt) a year.[753] According to EGA, it invested $15 billion in improving aluminum production from 2004–15, and will invest another $5 billion to further increase capacity in order to meet growing global aluminum demand.[754] Both of EGA's primary aluminum smelters, in Abu Dhabi and Dubai, are reportedly operating at full capacity.[755]

transported to Ma'aden's facility in Ras Al Khair via railway. Ma'aden website, http://www.maaden.com.sa/en/about/history (accessed June 20, 2016).

[749] Burns, "Middle Eastern Aluminum Leads World, outside China," April 20, 2015.

[750] Reed Exhibitions, "Middle East Aluminium Industry under Global Spotlight," April 14, 2015.

[751] EGA, written submission to the USITC, January 23, 2017, 3.

[752] Ibid.

[753] As of 2014, EGA's product mix of unwrought aluminum consists of 1.1 million mt per year of billet, 780,000 mt of foundry, 380,000 mt of slab, and 240,000 mt of unalloyed aluminum. Al Attar, "The Middle East as an Emerging Hub," January 2014; USGS, "United Arab Emirates," *2013 Minerals Yearbook*, 5.7.

[754] Reed Exhibitions, "Middle East Aluminium Industry under Global Spotlight," April 14, 2015.

[755] EGA, written submission to the USITC, January 23, 2017.

Figure 7.1: GCC countries: Locations of primary unwrought aluminum smelters, 2016

Source: Compiled by USITC staff from Al Attar, "The Middle East as an Emerging Hub," 2014.

The second-largest primary aluminum producer in the GCC region in 2015 was Bahrain. Aluminum Bahrain (Alba) is the country's only primary aluminum producer, and had production capacity of over 960,000 mt that year.[756] In April 2014, Alba modernized a potline at one of its smelters, increasing its primary aluminum capacity by 4,000 mt per year. In addition, the company has secured a 10-year natural-gas supply line through an agreement with state-owned Bahrain Petroleum Company, which will allow Alba to expand its capacity to an anticipated 1.3 million mt annually by 2017–18.[757] Bahrain has less natural gas than other GCC countries and has been subject to increases in natural gas prices in recent years; Alba's new supply agreement reportedly will insulate it from natural gas shortages and price hikes, allowing uninterrupted primary aluminum production.[758]

The third-largest primary aluminum producer in the GCC region in 2015 was Saudi Arabia, with an annual production capacity of 760,000 mt. Saudi Arabia had no primary aluminum production until 2013,[759] with the creation of Ma'aden Aluminum.[760] Between 2012 and 2014, Ma'aden's smelter added 520,000 mt of primary aluminum capacity. The Ma'aden facility benefits from a bauxite mine in central Saudi Arabia, which is connected by rail to an alumina refinery and the aluminum smelter. Ma'aden also manufactures aluminum sheet at its rolling mill, located near its smelter.[761]

The fourth- and fifth-largest primary aluminum producers in the GCC region in 2015 were Qatar and Oman, respectively.[762] Oman's only primary aluminum producer, Sohar, added 20,000 mt of capacity during 2011–15, while Qatar-based Qatalum increased capacity by 23,000 mt to 620,000 mt.[763]

The GCC primary aluminum industry employed close to 14,000 workers in 2015, a 34 percent increase since 2011 (table 7.2). Employment grew the most in Saudi Arabia with the launching of its Ma'aden smelter in 2013. Bahrain and the UAE have also increased the number of employees engaged in the primary aluminum industry since 2013.

---

[756] According to Alba's website, Alba's primary aluminum production mix consists of extrusion billets (consisting of 40 percent of their product mix), liquid metal (30 percent), foundry alloy ingots (14 percent), rolling slabs (13 percent), and standard ingots (3 percent). Alba website, http://www.albasmelter.com/Range/Aluminiumproducts/pages/Propertzi.aspx (accessed June 20, 2016).
[757] *News of Bahrain*, "Bapco, Alba Sign Gas Supply Deal," November 29, 2015.
[758] Alba, *Annual Report 2015*, 2015, 16.
[759] Gulf Aluminium Council, "Facts and Figures, GCC Primary Production" (accessed June 23, 2016).
[760] Ma'aden Aluminium (MA) is a joint venture between the Saudi Arabian Mining Company (Ma'aden) and Alcoa. Ma'aden website, http://www.maaden.com.sa/en/business/aluminium (accessed June 14, 2016).
[761] Ma'aden website, http://www.maaden.com.sa/en/business/aluminium (accessed June 14, 2016).
[762] Gulf Aluminium Council, "Facts and Figures, GCC Primary Production" (accessed June 23, 2016).
[763] Sohar Aluminium was formed in 2004 to commence primary production in Oman via construction of a greenfield smelter. Sohar Aluminium, http://www.sohar-aluminium.com/en/content/company-profile (accessed June 14, 2016).

GCC primary producers were more productive per worker than counterparts in Europe, China, and Russia, while on par with workers in Canada, Norway, and the United States. Average GCC wage rates per hour for primary aluminum production in 2015 were close to average wages rates in Canada and Norway, and 23 percent lower than in the United States.

Table 7.2: GCC countries: Primary unwrought aluminum industry employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	10,392	10,803	11,314	13,580	13,937
Production (1,000 mt)	3,482	3,662	3,888	4,864	5,110
Productivity (workers/ 1,000 mt)	3	3	2.9	2.8	2.7
Average wages ($/hr)	25.03–34.76	26.87–37.57	28.18–38.14	30.03–37.93	31.23–39.45

Source: USITC staff estimates based on CRU Group.
Note: Employment, production, and productivity based on CRU's data for Bahrain, Oman, Qatar, Saudi Arabia, and UAE. Average wages reflect a range of these countries' wages.

Wrought Aluminum

Although the GCC aluminum sector has historically focused on primary aluminum production, it is now increasingly engaged in producing wrought aluminum by manufacturing higher-value-added goods, such as aluminum plates, sheets, foil, bars, and rods, as well as rolled and extruded products. GCC wrought aluminum producers are not primarily owned by or affiliated with GCC primary aluminum producers, yet they benefit from close proximity to and long-term supplier relationships with the primary aluminum producers in their respective countries. Bahrain and the UAE have the most developed wrought aluminum sector, while new entrants have been joining the industry over the past decade in the other GCC countries (table 7.3). The GCC region plans additional investments in value-added aluminum products in order to strengthen the downstream aluminum industry in the near future.[764] The GCC wrought aluminum industry employs 1,660 workers in aluminum rolling mills in Saudi Arabia, Bahrain, and Oman, a total which has more than doubled since 2011.

[764] Saadi, "UAE Steps On to the Global Aluminium Stage," December 17, 2013.

Table 7.3: GCC countries: Major wrought aluminum producers and their principal products

Company	Location	Wrought products mix	Total capacity (1,000 mt)	Year production began
Al Hamad Industrial Co. LLC	UAE	Profiles	13	1998
Alumill Tech Gulf LLC a	Saudi Arabia	Coils, sheets	24	(b)
Aluminium Products Company (ALUPCO)	Saudi Arabia	Profiles	85	1975
Arabian Extrusion Factory	UAE	Solid and hollow profiles	18	2002
Bahrain Welding Wire Products	Bahrain	Rod, wire	50	2005
Bahrain Aluminium Extrusion Company (BALEXCO)	Bahrain	Tubes, bars, rods	23	1977
Elite Extrusion LLC a	UAE	Profiles	24	(b)
Emirates Extrusion Factory LLC	UAE	Tubes, bars, angles	14	1993
Gulf Aluminium Rolling Mill Company (Garmco)	Bahrain	Coils, sheets	160	1981
Gulf Extrusion Company	UAE	Profiles	60	1978
Ma'aden	Saudi Arabia	Sheets	380	2014
Midal Cables Limited	Bahrain, Saudi Arabia	Rods, wires, cables, tubes	450	1997
National Aluminium Extrusion LLCa	UAE	Solid and hollow sections	24	(b)
Oman Aluminium Rolling Company LLC	Oman	Coils, foils	140	2011
Oman Cables Industry	Oman	Wire	120	1984
Qatar Aluminium Extrusion Co. (Qalex)	Qatar	Profiles	8	2015
White Aluminium Extrusion	UAE	Angles, tubes, bars	28	2007

Source: Company websites (accessed June–August 2016).
[a] Alumill Tech Gulf LLC, Elite Extrusion LLC, and National Aluminium Extrusion LLC are separate companies under a UAE-based parent company, Elite Group of Companies.
[b] Not available.

Saudi Arabia has the largest capacity for wrought aluminum production in the GCC region. The country accounted for approximately one-half of the GCC region’s capacity for flat-rolled aluminum products and 40 percent of the production capacity for aluminum extrusions (such as bars, rods, and profiles) in 2013.[765] Saudi Arabia’s leading role in wrought aluminum production among the GCC countries is due to initiatives at its Ma’aden plant, which commenced semifinished and finished aluminum production at its rolling mill in 2014. [766] Another Saudi

[765] Gulf Aluminium Council, “Facts and Figures: Key Indicators for the Aluminium Industry in the Gulf,” 2013.
[766] Ma’aden, “Rolling Mill at Ma’aden-Alcoa Joint Venture,” June 24, 2014.

company, the Aluminium Products Company (Alupco), has annual production capacity up to 100,000 mt of profile products at its Dammam and Jeddah plants.[767]

Bahrain ranks second in wrought aluminum production capacity among the GCC countries, although its wrought aluminum industry is more developed and has been in existence longer than Saudi Arabia's. In 2013, Bahrain accounted for over 80 percent of GCC production capacity in aluminum wire and cable and over 20 percent of its production capacity in aluminum plate, sheet, and foil.[768] Bahrain's downstream aluminum production was created to complement Alba's primary aluminum production in the late 1970s. Bahrain's major producer in this subsector, the Gulf Aluminium Rolling Mill Company (Garmco),[769] is one of the largest wrought aluminum producers in the GCC region, specializing in flat-rolled aluminum products such as aluminum sheets, coils, and foil.[770] As of 2016, Garmco's production capacity for these goods was 160,000 mt.[771] Garmco's capacity is anticipated to increase as a result of a remelt project that will recycle aluminum, ultimately increasing Garmco's capacity to 120,000 mt of aluminum slabs. Construction for Garmco's remelt project began in March 2016, with completion anticipated by November 2017.[772] Another Bahraini producer, the Bahrain Aluminium Extrusion Company (Balexco), manufactures aluminum profiles and has a capacity of 21,000 mt.[773]

The UAE had the third-largest capacity for wrought aluminum products in 2013, with a focus on aluminum bars, rods, and profiles. According to EGA, the UAE's wrought aluminum sector has an annual capacity of roughly 375,000 mt in 2017, and EGA anticipates that this capacity will expand 575,000 mt over the next 23 years as a result of increased production from Taweelah Aluminum Extrusion Company (a UAE aluminum producer for automotive applications) and Ducab Cable Manufacturing Company (a UAE aluminum wire rod producer).[774]

Among GCC countries, Oman has the fourth-largest capacity for wrought aluminum production, and the third-largest capacity to produce plate, sheet, and foil, with an annual production capacity of 160,000 mt in 2013.[775] The dominant Omani wrought aluminum producer is the Oman Aluminum Rolling Company (OARC), which started producing flat-rolled aluminum

---

[767] Alupco website, http://www.alupco.com (accessed June 14, 2016).
[768] Gulf Aluminium Council, "Facts and Figures: Key Indicators for the Aluminium Industry in the Gulf," 2013.
[769] The Gulf Aluminium Rolling Mill Company (Garmco) is a joint venture company based in Bahrain, with a 38 percent Bahraini ownership.
[770] Government of Bahrain, Ministry of Industry, Commerce and Tourism, "Aluminium Industry Sector," n.d. (accessed April 25, 2017).
[771] Garmco's products are primarily marketed for export to other GCC countries, Europe, and the United States. Garmco website, http://www.garmco.com/ (accessed June 20, 2016).
[772] Gulf Aluminium Council, "$55 Million Re-Melt Expansion at GARMCO," March 2016.
[773] Approximately 20 percent of Balexco's products are used domestically, and the rest are exported to other global markets.
[774] EGA, written submission to the USITC, January 23, 2017.
[775] Gulf Aluminium Council, "Facts and Figures: Key Indicators for the Aluminium Industry in the Gulf," 2013.

products in 2011, including aluminum sheets[776] and coils.[777] OARC's annual capacity to produce aluminum sheets increased to 140,000 mt in 2015. OARC's wrought aluminum production benefits from its proximity to Sohar's aluminum smelter, and it has a long-term contract with Sohar to supply its primary aluminum.[778]

Production

Primary Unwrought Aluminum

The GCC became the world's fastest-growing primary aluminum producer in 2015, accounting for 10 percent of global primary aluminum production.[779] The GCC countries increased their primary aluminum production by 47 percent during 2011–15, from 3.5 million mt to 5.1 million mt as a result of new smelters coming online, capacity increases at existing smelters, and technological improvements, most notably in the UAE and Saudi Arabia (table 7.4).[780] During the period, GCC primary aluminum producers tended to operate at or near full production capacity.[781] Industry analysts project that primary aluminum production in the GCC region will increase to 6.9 million mt by 2020 as a result of new smelters in Saudi Arabia and planned expansions in Bahrain, Oman, and the UAE. Most GCC countries concentrate their production on high-purity primary aluminum that can be used for higher-end markets, like the electronics, construction, and aerospace industries.[782]

Table 7.4: GCC countries: Primary unwrought aluminum production, capacity, and capacity utilization, 2011–15

Attribute/producer	2011	2012	2013	2014	2015
Production **(1,000 mt)**					
GCC countries	3,482	3,662	3,888	4,864	5,110
Bahrain	880	890	913	932	961
UAE	1,763	1,808	1,824	2,285	2,380
Oman	373	360	354	365	377
Qatar	465	604	609	617	622
Saudi Arabia			187	665	770

[776] OARC's aluminum sheets are heavily exported to global markets, mainly in North America and the Middle East. OARC website, http://www.oman-arc.com/about-us/corporate-overview/ (accessed June 20, 2016).
[777] OARC also produces aluminum coils in a variety of alloy grades and added an aluminum coil coating unit to its plant in 2014. OARC produces aluminum coils ranging from 75 microns up to 1,933 mm wide, in a variety of alloy grades. OARC website, http://www.oman-arc.com/about-us/corporate-overview/ (accessed June 20, 2016).
[778] Sohar website, http://www.sohar-aluminium.com/ (accessed June 20, 2016).
[779] CRU Group.
[780] USGS, 2014 Minerals Yearbook, "The Middle East," 49.3.
[781] CRU Group.
[782] EGA website, "Primary Aluminium," http://www.ega.ae/ (accessed January 23, 2017); Alba website, http://www.albasmelter.com/Range/Aluminiumproducts/pages/Liquid.aspx (accessed January 23, 2017); EGA, written submission to the USITC, January 23, 2017, 3, 8.

Attribute/producer	2011	2012	2013	2014	2015
Capacity **(1,000 mt)**					
GCC	3,628	3,816	4,533	5,050	5,154
Bahrain	883	895	922	922	960
UAE	1,775	1,819	1,942	2,387	2,421
Oman	373	378	385	391	393
Qatar	597	604	607	610	620
Saudi Arabia	(a)	120	678	740	760
Capacity utilization[b] **(%)**					
GCC countries	96	96	86	96	99
Bahrain	100	99	99	101	100
UAE	99	99	94	96	98
Oman	100	95	92	93	96
Qatar	78	100	100	101	100
Saudi Arabia	(a)	0	28	90	101

Source: CRU Group.
Note: Kuwait had no primary production during the period.
[a] Not available.
[b] Capacity utilization may exceed 100 percent based on available data.

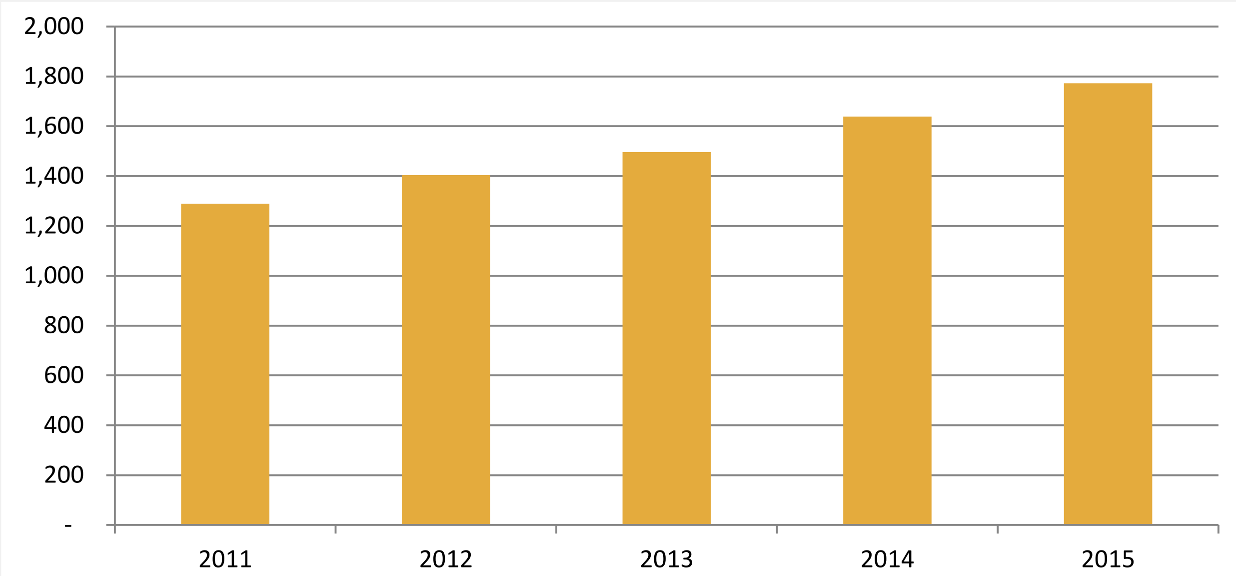
From 2011 to 2015, the share of primary aluminum production output changed somewhat among GCC countries. In particular, the entry of Saudi Arabia as a primary aluminum producer in 2013 contributed significantly to the large increase in primary aluminum production in the GCC region during 2014–15. The UAE also showed strong growth, while Bahrain, Oman, and Qatar made more modest gains in primary production during this period.

Wrought Aluminum

As the GCC countries rapidly expanded their primary aluminum supply, many also began engaging in value-added wrought aluminum production focused on the higher-end automotive, electronic, construction, and aerospace markets.[783] According to industry observers, 40 percent of total GCC primary aluminum production was used by the region's downstream wrought aluminum sector in 2015.[784] GCC countries' production of wrought aluminum rose by an estimated 37 percent during 2011–15 (figure 7.2). The Middle East's wrought aluminum production (including that of the GCC economies and six other Middle East countries) is largely concentrated in aluminum extrusions, such as rods and conductors (46 percent of all GCC wrought aluminum production in 2015), followed by flat-rolled products (35 percent) and aluminum wire and cables (18 percent).[785]

[783] Daylami, "Downstream Opportunities," March/April 2013.
[784] *Technical Review Middle East*, "GCC Aluminium Production Records Seven Per Cent Growth," January 28, 2016.
[785] The Middle East's wrought aluminum production is overstated because it includes statistics for Iran, Iraq, Israel, Lebanon, Syria, and Turkey. Specific GCC wrought aluminum statistics were unavailable. CRU Group.

Figure 7.2: GCC countries: Wrought aluminum production, 2011–2015 (thousand mt)



Source: USITC estimate based on CRU Group.
Note: Corresponds to appendix table L.33.

The GCC countries' wrought aluminum capacity has increased in recent years, as the GCC countries added more finishing capacity for wrought aluminum products. Overall, the GCC region has the most capacity for flat-rolled aluminum products, such as plate, sheet, and foil (table 7.5). Industry sources estimate that future capacity for extrusions in the GCC region will increase to 600,000 mt from its current capacity of 450,000 mt.[786]

Table 7.5: GCC countries: Wrought aluminum production capacity, by country, 2013

Wrought aluminum product	UAE	Bahrain	Saudi Arabia	Oman	Qatar	Total
Bars, rods, and profiles	192	30	170	18	15	425
Plate, sheet, and foil	85	165	380	160	(a)	790
Wires and cable	20	225	(a)	30	(a)	275
Total	297	420	550	208	15	1,490

Source: Gulf Aluminum Council, "Facts and Figures: Key Indicators," 2013.
Note: Aluminum cable is not considered a wrought aluminum product for the purposes of this report, but has been included due to the lack of breakouts between aluminum wires classified under HS heading 7605 and cable classified under HS heading 7614 in the trade data provided by the Gulf Aluminum Council. HS refers to the Harmonized Commodity Description and Coding System, which classifies traded goods for tariff purposes.
[a] Not available.

[786] *Metalworld*, "Reshaping the GCC Aluminium Downstream Industry," April 2015. GCC capacity for castings is also estimated to increase three times to 300,000 mt in the future.

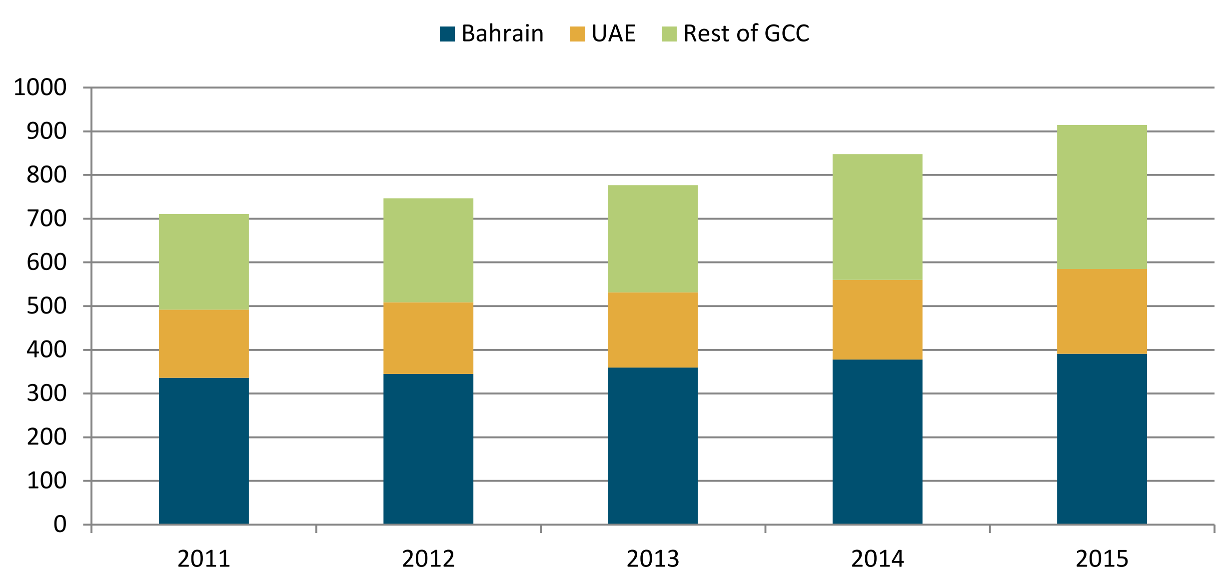
Consumption

GCC countries collectively account for nearly 10 percent of global aluminum production, with a significant share of this output being consumed regionally.[787] The GCC region's consumption of wrought aluminum and primary unwrought aluminum increased proportionately to each other from 2011 to 2015.

Unwrought Aluminum

Primary aluminum consumption in the GCC countries rose by nearly 30 percent during 2011–15 (figure 7.3). Bahrain and the UAE accounted for roughly two-thirds of GCC consumption in 2015, which is not surprising, since those countries represented the majority of the GCC's wrought industry during the period. However, the share of GCC consumption accounted for by the other member countries also showed strong growth, which likely continued into 2016 with the rising wrought aluminum output of Saudi Arabia's Ma'aden facility.

Figure 7.3: GCC countries: Primary unwrought aluminum consumption, 2011–15 (thousand mt)



Source: CRU Group.
Note: Individual consumption statistics were available only for the UAE and Bahrain. Statistics for the remainder of the region were aggregated. Corresponds to appendix table L.34.

[787] Market Realist, "Analyzing the Aluminum Industry's Key Dynamics," December 9, 2015.

Wrought Aluminum

The GCC aluminum industry has benefited from strong regional demand since the 1970s. This was especially true as recently as the mid-2000s, when the GCC governments rapidly increased their fiscal spending for domestic construction and infrastructure projects. In 2007, the construction and architectural applications industries comprised an estimated 90 percent of the end-use market for wrought aluminum in the region.[788] However, this share dropped to 51 percent in 2015 as construction in the GCC countries slowed down somewhat (table 7.6).[789] EGA has stated that demand from GCC countries for wrought aluminum products is expected to grow in the future, particularly in the transportation and construction sectors, as these industries are resorting to lightweight aluminum for fuel and energy efficiencies.[790]

Aluminum is highly sought after in the GCC construction sector due to its strength, malleability, and high heat conductivity.[791] Domestic demand for aluminum in the construction sector has been strongest in the UAE, Saudi Arabia, and Qatar. EGA stated that the UAE's wrought aluminum market has been growing at roughly 10 percent per year—twice the global rate—largely as a result of continuing construction projects in the Middle East.[792] Demand from the GCC electric industry has also increased, and accounted for 28 percent of GCC domestic consumption of wrought aluminum in 2015, which is high compared to the world average. Other GCC demand factors for wrought aluminum include increased consumption in the transportation and foil stock segments.[793]

[788] Hanieh, *Class and Capitalism in the Gulf Arab States*, 2011, 117.
[789] CRU Group.
[790] EGA, written submission to the USITC, January 23, 2017, 8–9.
[791] NAPCO, "Africa's Booming Construction Sector," February 12, 2015.
[792] EGA, written submission to the USITC, January 23, 2017.
[793] CRU Group.

Table 7.6: GCC countries: Consumption of wrought aluminum by form and end use, 2011–15 (thousand mt)

Attribute	2011	2012	2013	2014	2015
By form					
Extrusions	275	298	330	368	402
Flat-rolled	249	258	279	283	290
Wire and cable	170	184	206	249	248
Total	690	740	815	900	940
By end use					
Construction	352	373	407	442	476
Electrical	187	200	224	268	267
Foil stock	52	59	69	73	77
Transport	28	30	33	35	36
Machinery and equipment	30	30	32	33	34
Consumer durables	23	24	25	26	26
Packaging	14	14	15	15	15
Other	9	9	10	10	10
Total	695	739	815	900	940

Source: CRU Group.

Trade

Unwrought Aluminum

Exports

GCC countries primary unwrought aluminum production increasingly exceeded domestic consumption during period 2011–15, which translated into rising exports. Total GCC countries' exports of unwrought aluminum grew by 45 percent during the period (table 7.7). The UAE supplied over half of all GCC countries' unwrought aluminum exports in 2015. The UAE's exports increased 31 percent during 2011–15, while Qatar's exports increased by 54 percent;[794]

[794] On June 5, 2017, Bahrain, Egypt, Saudi Arabia, and the United Arab Emirates severed political, economic, and logistical ties with Qatar. Qatalum, the only primary aluminum producer in that country, historically shipped its primary aluminum to the UAE's port of Jebel Ali, at which point the aluminum was loaded onto larger oceangoing vessels for shipment to other destinations. After the UAE severed ties with Qatar, Qatalum began shipping primary aluminum through Kuwait and Oman, and directly from Qatar's own port of Doha, as a short-term solution. Dagenborg and Solsvik, "Qatar's Aluminum Exports Blocked, Norsk Hydro Seeking Other Routes," June 6, 2017; Qatalum, "Qatalum Working to Solve Logistical Challenges Arising from Middle-East Tensions, June 13, 2017; Reuters, "Hydro CEO Says Qatar Aluminium Exports Go as Planned Despite Tensions," June 13, 2017; Walker and Konst, "Hydro's Qatalum Smelter Resumes Exports but Shipment Delays Expected," June 14, 2017.

meanwhile, Oman and Bahrain's exports declined by 19 percent and 7 percent respectively.795 Saudi Arabia substantially increased its unwrought aluminum exports with the addition of its Ma'aden smelter.

The country's unwrought aluminum exports more than tripled during 2013–15 to 615,000 mt; 2013 was the first operational year of the Ma'aden smelter.Nearly all of the GCC countries' annual aluminum exports are shipped to large non-GCC markets such as the EU, the United States, and Japan (table 7.8).[796] GCC exports of unwrought aluminum to the United States increased 71 percent during 2011–15 (figure 7.4). The growth was mostly attributable to rising exports from Saudi Arabia, Bahrain, and the UAE. EGA stated in January 2017 that over 98 percent of the UAE's exports to the United States are value-added products.[797]

Table 7.7: GCC countries: Exports of unwrought aluminum (HS 7601), by country, 2011–15 (thousand mt)

Exporter	2011	2012	2013	2014	2015
United Arab Emirates	1,625	1,720	1,767	2,060	2,128
Saudi Arabia	6	13	146	395	615
Qatar	368	575	584	596	566
Bahrain	383	431	398	399	355
Oman	333	319	227	271	272
Total	2,715	3,059	3,172	3,722	3,936

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner country imports. Because of rounding, totals may not equal sum of line items. Kuwait did not export unwrought aluminum during 2011–15.

---

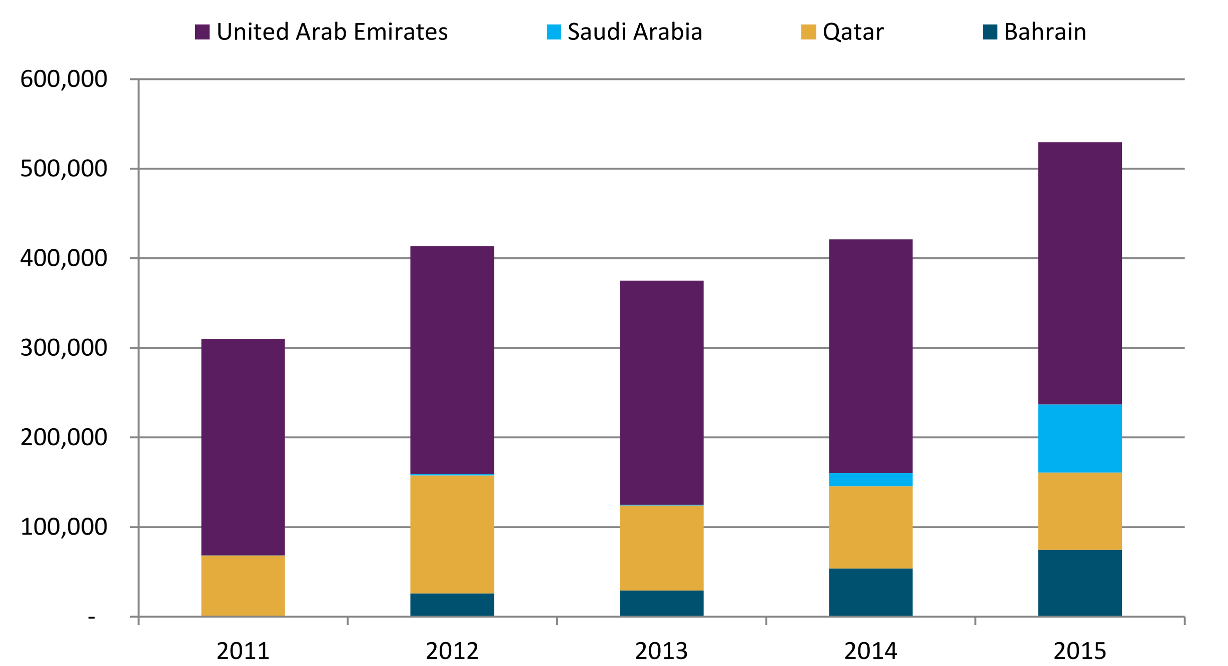
[795] Oman's exports in 2010–11 are not reflective of actual Omani aluminum production, since Oman produced 367,000 mt and 373,000 mt of aluminum in 2010 and 2011 respectively. Many of Oman's exports may be re-exports or exports under bilateral investment treaties in which Oman's exports receive preferential duty treatment. For example, Oman has a bilateral treaty with South Korea, which was its largest export market in 2010 and 2011, accounting for 46 percent and 75 percent of Oman's exports in 2010 and 2011, respectively.
[796] Gulf Aluminium Council, "Gulf Cooperation Council and European Union," (accessed April 25, 2017).
[797] EGA, written submission to the USITC, January 23, 2017, 8.

Table 7.8: GCC countries: Unwrought aluminum exports (HS 7601), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
United States	310	414	375	421	530
Japan	231	292	342	485	439
South Korea	274	291	309	447	419
Turkey	184	213	239	274	317
Taiwan	182	185	203	288	289
Malaysia	121	154	130	180	263
Thailand	199	221	213	221	237
Germany	77	117	136	160	201
India	104	168	213	205	182
Italy	142	134	140	138	160
All other	839	826	800	871	845
Total external	2,663	3,014	3,099	3,690	3,882
Intra-GCC trade	52	45	72	31	54
Total	2,715	3,059	3,172	3,722	3,936

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner country imports. Because of rounding, totals may not equal sum of line items.

Figure 7.4: GCC countries: Exports of primary unwrought aluminum products to the United States (HS headings 7601), 2011–15 (thousand mt)



Source: Official statistics compiled from USITC (accessed January 26, 2017).
Note: Corresponds to appendix table L.35.

Imports

GCC imports of unwrought aluminum have historically been minimal (100,000 mt or less annually), given the abundance of primary aluminum production in the region. During the 2011–15 period, reported[798] GCC imports of unwrought aluminum fluctuated slightly based on the extent to which regional production supplied regional demand. For instance, during 2010–11, imports fell slightly due to sufficient production from regional smelters and then rose during 2012–13 amid insufficient regional supply. Saudi Arabia accounted for most reported GCC imports in 2015, while the UAE accounted for most in 2014, although imports were negligible during both of these years. Intraregional trade between GCC countries appears to be important. During 2011–15, roughly half of reported GCC unwrought aluminum imports were sourced from other GCC countries.[799] China was the largest non-GCC country supplier of unwrought aluminum imports during this period.[800]

Wrought Aluminum

Exports

The GCC's unwrought aluminum industry has much larger production and export levels than its wrought aluminum industry. However, the GCC region is investing heavily in its wrought aluminum industry with both new producers and capacity expansions by existing wrought producers. Collectively, the GCC countries were a net exporter of wrought aluminum products in 2015, yet were net importers from 2011–14. Overall, GCC global exports of wrought aluminum fluctuated during 2011–15 (table 7.9). Bahrain was the top GCC exporter, accounting for 60 percent of the region's wrought aluminum exports in 2015, followed by the UAE.

About half of GCC exports were destined to other GCC countries during 2011–15. The largest non-GCC export destinations for wrought aluminum were the United States and Morocco, accounting for 11 percent and 8 percent respectively, during 2011–15. GCC exports of wrought aluminum to the United States increased slightly, yet accounted for less than 2 percent of total U.S. wrought imports from 2011–15. Bahrain accounted for almost all of GCC exports of

---

[798] Import data for unwrought aluminum are not available for all GCC countries in each year during 2011–15. In this paragraph, the export statistics presented are only for those countries for which data was reported.

[799] In June 2017, Saudi Arabia, Egypt, the United Arab Emirates, and Bahrain on Monday cut political and economic ties with Qatar. Qatalum, Qatar's only primary aluminum producer, historically shipped its primary aluminum to UAE's Jebel Ali port, at which point these exports are loaded onto larger vessels and exported to other destinations. After certain Middle East countries severed ties with Qatar, Qatalum began shipping primary aluminum through Kuwait and Oman, and directly from Qatar's port, as a short-term solution. Dagenborg and Solsvik, "Qatar's Aluminum Exports Blocked, Norsk Hydro Seeking Other Routes." June 6, 2017; Reuters, "Hydro CEO Says Qatar Aluminium Exports Go as Planned Despite Tensions," June 13, 2017; Walker and Konst, "Hydro's Qatalum Smelter Resumes Exports but Shipment Delays Expected," June 14, 2017.

[800] IHS Markit, GTA database, HS subheading 7601.

wrought aluminum to the U.S. market during this period. Most of these exports were aluminum plate, sheet, and strip.

Forty-four percent of GCC wrought exports during 2011–15 consisted of aluminum bars, rods, and profiles (table 7.10). Bahraini wrought aluminum exports were evenly divided among aluminum bars, rods, and profiles; aluminum wire; and aluminum plate, sheet, and strip. Over one-half of the UAE's wrought aluminum exports consisted of aluminum bars, rods, and profiles during 2011–15, while close to one-quarter consisted of aluminum plate, sheet, and strip.

Table 7.9: GCC countries: Wrought aluminum exports (HS 7604–08), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
United States	19	45	43	49	42
Morocco	25	24	25	33	29
Egypt	15	11	15	15	25
Jordan	9	9	13	14	22
India	19	18	17	44	18
All other	198	181	200	178	104
Total extra-GCC exports	287	288	313	333	240
Intra-GCC exports	297	372	462	174	386
Total	584	660	775	507	626

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on "mirror data." Because of rounding, totals may not equal sum of line items.

Table 7.10: GCC countries: Wrought aluminum exports, by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions	270	310	379	169	264
Bars, rods, and profiles (HS 7604)	267	307	378	168	261
Tubes and pipes (HS 7608)	3	3	2	2	2
Flat-rolled products	173	177	205	187	182
Plates, sheets, and strip (HS 7606)	139	144	174	156	160
Foil (HS 7607)	35	33	31	31	21
Wire (HS 7605)	140	174	191	150	181
Total	584	660	775	507	626

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on "mirror data." Because of rounding, totals may not equal sum of line items.
[a] Less than 500 mt.

GCC exports of wrought aluminum to the United States increased 12 percent, yet accounted for less than 4 percent of total U.S. wrought imports from 2011–15. Bahrain supplied almost all of GCC exports of wrought aluminum to the U.S. market during this period. Most of these exports were aluminum plate, sheet, and strip.

Imports

Overall, GCC imports of wrought aluminum products increased 40 percent from 2011 to 2013 before declining significantly during 2014–15 (table 7.11).[801] Intraregional trade accounted for a large share of GCC wrought product imports—roughly 30–60 percent annually. The top non-GCC import source for wrought aluminum products in 2015 was China. Saudi Arabia was the largest GCC importer of wrought aluminum products during 2011–15, accounting for more than one-half of total GCC imports during this time, although 60 percent of Saudi's imports were supplied by other GCC countries.

Flat-rolled aluminum products made up 90 percent of all GCC wrought aluminum imports during 2011–15 (table 7.12). More than three-quarters of the flat-rolled imports consisted of aluminum plate, sheet, and strip (table 7.14). The demand for wrought aluminum imports was mostly driven by the region's booming construction sector.

Table 7.11: GCC countries: Wrought aluminum imports (HS 7604-7608), by source, 2011–15 (thousand mt)

Source	2011	2012	2013	2014	2015
China	154	172	205	131	91
Germany	42	52	70	28	63
South Korea	24	9	17	15	16
Malaysia	23	22	14	3	13
France	18	28	27	6	8
All other	164	217	215	150	41
Total external	426	500	548	333	232
Intra-GCC trade	297	372	462	174	386
Total	723	873	1,010	507	619

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, totals may not equal sum of line items.

[801] Data for imports from Saudi Arabia in 2014 and the UAE in 2015 were unavailable through Global Trade Atlas. Therefore, USITC staff cannot ascertain the total quantity of GCC imports from 2014–15. However, both Saudi Arabia and the UAE showed an increase in imports generally during 2011–15 for the years for which Global Trade Atlas (GTA) data were available.

Table 7.12: GCC countries: Wrought aluminum imports, by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions	23	33	30	20	12
Bars, rods, and profiles (HS 7604)	18	28	26	19	7
Tubes and pipes (HS 7608)	4	5	4	1	5
Flat-rolled products	379	446	504	295	206
Plates, sheets, and strip (HS 7606)	310	361	407	235	154
Foil (HS 7607)	69	85	97	60	52
Wire (HS 7605)	25	22	15	19	14
Total	426	500	548	333	232

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal sum of line items.

Government Policies and Programs

A key component of the GCC countries' industrialization strategy is the implementation of both general and specific government policies and programs for investment in energy-intensive industries, which made aluminum one of the region's largest and fastest-growing non-petroleum economic sectors.[802] Some of these policies and programs are focused on energy and electricity, labor, and corporate taxes for aluminum companies. Historically, GCC governments have implemented energy policies allowing the region to have one of the lowest global energy prices, yet the highest levels of energy consumption per capita.[803]

By 2015, however, the GCC countries began implementing reforms aimed at decreasing governments' role in supporting low energy prices—a fundamental shift in GCC policies.[804] This shift was a result of the declining petroleum prices, which negatively affected the GCC economies and prompted GCC governments to seek additional sources of revenue. However, despite the GCC governments' reductions in energy price supports, the region still has among the world's lowest energy prices because of its abundant supply of natural gas.[805]

Moreover, most energy-price reforms have targeted residential consumers (particularly expatriates) rather than commercial businesses.[806] The UAE appears to be the only country in the GCC region that no longer has government-supported electricity programs for its aluminum sector. In 2011, the UAE government imposed a 15–20 percent increase in electricity prices on commercial businesses, expatriates, and government agencies.[807] Other GCC countries are also

[802] Fattouh, Sen, and Moerenhout, "Striking the Right Balance? GCC Energy Pricing," May 2016.
[803] IMF, "Economic Prospects and Policy Challenges for the GCC Countries," October 5, 2013.
[804] Fattouh, Sen, and Moerenhout, "Striking the Right Balance? GCC Energy Pricing," May 2016.
[805] Ibid.
[806] Boersma and Griffiths, "Reforming Energy Subsidies," January 2016.
[807] Ibid.

seeking to reduce government support of electricity costs in their region due to their strained fiscal budgets.

GCC governments are also aiming to develop jobs in the aluminum sector to employ their rapidly growing youth population.[808] In particular, GCC governments adopted policies aimed at employing more citizens in private sector jobs, which are currently dominated by expatriates.[809] These government policies range from longer-term approaches, such as increased spending on education and vocational training for citizens,[810] to shorter-term voluntary measures aimed at ensuring that a certain percentage of nationals are in the workforce (a policy known as "nationalization") and limiting certain jobs to citizens (table 7.13).[811]

Table 7.13: GCC countries: Selected government policies and programs

Country	Policy name	Description
Corporate policies		
United Arab Emirates	Federal Industry Law	Industrial projects must have 51 percent ownership by a UAE national, and projects must be managed by a UAE national or have a board of directors with a majority of UAE nationals.
Oman	Foreign Capital Investment Law	All foreign investments require approval by the Ministry of Commerce and Industry. Foreign investors may own up to 49 percent of companies in non-free trade zones, and 70 to 100 percent in free trade zones.
Bahrain	Commercial Companies Law	Under this law, an individual establishment is a non-incorporated entity owned by one individual who must be a citizen of Bahrain or another GCC country.
Investment policies		
Bahrain	Invest Aluminium Bahrain Program	This program was set up by Bahrain’s Ministry of Finance and the Ministry of Industry and Commerce to develop Bahrain’s downstream aluminum industry, create more job opportunities for Bahrainis, enhance export earnings, and achieve greater value added.
Production policies		
Oman	2004 Electricity Law	Under this law, electricity generation is open to competition, while transmission and distribution are the domains of a state-owned monopoly, the Electricity Holding Company (EHC).
Labor policies		
Bahrain	Bahrainization Law	According to Bahrain’s Labour Market Regulatory Authority, the Bahrainization Law states that one Bahraini must be hired for every four foreign workers employed in a company. There is a Bahrainization target rate of at least 25 percent in the aluminum industry.
Oman	Omanization Laws	Oman’s government set a quota in 1998 for Oman nationals to make up 35 percent of the workforce in private industry.

[808] IMF, “Economic Prospects and Policy Challenges for the GCC Countries,” October 5, 2013.
[809] EY, “Solving Unemployment for GCC Nationals,” November 4, 2013.
[810] Ibid.
[811] Ibid.

Country	Policy name	Description
Qatar	National Development Strategy	This policy has a program known as "Qatarization" to support the hiring and career development of Qataris in the workforce. There is a general target of 50 percent Qatarization across the economy.

Source: WTO, Trade Policy Reviews of Bahrain, Oman, Saudi Arabia, Qatar, and the UAE, 2013–16.

To attract well-educated and skilled nationals to the aluminum industry, GCC aluminum companies have to compete with public-sector employment positions, which are often guaranteed for nationals and are more lucrative. [812] The impact of these nationalization policies creates a demand for higher wages for nationals, thereby increasing labor costs in the GCC region. Nevertheless, there has been more national representation in the GCC aluminum sector. Bahrain's only primary aluminum producer, Alba, employs 5,000 workers in its plant, of which 87 percent are Bahraini citizens. Overall, Bahraini citizens make up 65 percent of aluminum sector employees in Bahrain.[813] EGA notes in its written submission to the Commission that it supports Emiratization and that approximately 20 percent of its 7,000 employees based in the UAE are Emiratis.[814]

Further, GCC primary aluminum producers are at least partially owned by SOEs and may profit from certain financial benefits, such as receiving preferential loans and not having to pay corporate taxes.[815] Both UAE and Bahrain governments have implemented policies supporting their non-imposition of corporate taxes, while Saudi Arabia, Qatar, Kuwait, and Oman have low corporate tax rates of between 10 to 20 percent.[816] Some GCC governments also provide aluminum producers with low rents or land grants letting the producers use industrial areas for aluminum facilities.[817] According to industry experts, GCC primary aluminum producers are also able to benefit from financial backing from their respective national governments, thereby minimizing their financial risk.[818] The upstream aluminum industry, consisting mostly of primarily aluminum production, was initially financed by state capital, with some significant investment from foreign capital.[819] In addition, thanks to these corporate and investment policies, GCC aluminum companies have been able to attract significant state capital

---

[812] Hertog, "A Comparative Assessment of Labor Market Nationalization Policies in the GCC," 2012.
[813] Government of Bahrain, Ministry of Industry, Commerce and Tourism, "Aluminium Industry Sector," 2013, http://www.moic.gov.bh/En/Industry/Industrial%20Sectors/Aluminium/Pages/Aluminium.aspx.
[814] EGA clarified in its submission that its government does not dictate employment policies with respect to Emiratization. EGA, written submission to the USITC, January 23, 2017.
[815] Marmore MENA Intelligence, "Status of Tax Regime in the GCC," April 1, 2015; Hertog, "Private Sector and Reform in the GCC," 2, 20.
[816] Marmore MENA Intelligence, "Status of Tax Regime in the GCC," April 1, 2015; EGA, written submission to the USITC, January 23, 2017.
[817] Oxford Business Group, "The Report: Bahrain 2012," 120, 124, 199.
[818] Perez, "GCC Aluminum 2016," 2016, http://gbreports.com/wp-content/uploads/2016/02/GCC-Aluminium-2016-Web-Version.pdf.
[819] Hanieh, *Capitalism and Class in the Gulf Arab States*, 2011.

investments from other GCC countries, to create and boost production in new smelters.[820] For example, Alba's creation was financed largely by state capital from both Bahrain and Saudi Arabia.[821]

Competitive Factors

The GCC region's competitiveness as a top global aluminum producer benefited from lower electricity costs, owing to ready access to natural gas and government-facilitated low electricity costs; gaining more control of its raw material inputs, including bauxite and alumina; and heightened investment in new state-of-the-art smelters that use innovative technology for more efficient production. Other competitive factors include the GCC's modern transportation infrastructure, with access to ports along the Persian Gulf; ready access to financing and capital; low or zero corporate taxes; and access to skilled labor (table 7.14).

Table 7.14: GCC countries: Select competitive factors for primary unwrought aluminum

Competitive factor	Impact on competitiveness
Low electricity costs owing to the GCC's abundant natural gas supply and government support programs	The GCC's primary aluminum industry benefits from government-facilitated programs that reduce the cost of electricity in most GCC countries. Abundant natural gas supplies also lower electricity costs in the GCC region.
Upstream investments in alumina and bauxite	GCC countries have made their aluminum industries more competitive by gaining control over raw materials through investments in global bauxite mines and in both domestic and international alumina refineries.
Efficiencies from new and technologically advanced smelters	Large new state-of-the art smelters in the GCC use the latest smelting technology to increase production efficiency, output, and capacity and capture economies of scale.
Smelters with access to ports that have modern infrastructure	The GCC's aluminum sector profits from the superior quality of the GCC's port infrastructure, aided by its access to ports along the Persian Gulf, which enhances the sector's ability to move aluminum products in and out of the country efficiently and at low cost.[a]
Access to skilled labor	The GCC aluminum industry enjoys access to a skilled and well-educated labor force composed of both GCC nationals and expatriate workers.[b]
Ready access to financing and capital	Potential investors in the GCC aluminum industry can find ready access to financing and capital. According to industry experts, GCC primary aluminum producers benefit from the financial backing of their respective national governments, which are also major shareholders in or owners of the primary

[820] Ibid.

[821] In 2016, Alba secured a $1.5 billion dollar loan from two state-owned entities, Gulf International Bank and National Bank of Bahrain, and a market-based lender, J.P. Morgan, to expand its potline and add a power plant to its smelter. However, some GCC producers also rely heavily on financing solely from commercial lending institutions, or a hybrid of state-owned banks and commercial banks. EGA stated in its written submission that it does not rely heavily on state capital or preferential loans from the UAE government, and instead funded its operations from its "own cash flow or through loans provided on commercial terms from market-based lending institutions." Aluminium Insider, "Alba Increases Line 6," September 10, 2016; GBR, *GCC Aluminium 2016*, 2016, 11; EGA, written submission to USITC, January 23, 2017, 10–11.

Competitive factor	Impact on competitiveness
	aluminum companies. The government role minimizes financial risk to these companies and their shareholders.[c]
Low or no corporate taxes	The GCC region has government policies featuring a low corporate tax regime to attract foreign investment.[d] The World Bank's Global Competitiveness Index report 2015–2016 ranked all the GCC countries (with the exception of Oman) in the top seven countries globally for low overall corporate tax rates.[e]

Source: Compiled by USITC staff.

[a] World Bank, Quality of Port Infrastructure database (accessed April 25, 2017); Rof, "GCC Differs in Will to Improve," August 4, 2015.

[b] GBR, *GCC Aluminium 2016*, 2016, 17; A.T. Kearney, "How GCC Smelters Can Continue to Grow Profitably," June 2013; interview with industry representative, February 21, 2017, Washington D.C.

[c] Aluminium Insider, "Alba Increases Line 6," September 10, 2016; GBR, *GCC Aluminum 2016*, 2016, 11; EGA, written submission to USITC, January 23, 2017, 10–11.

[d] Marmore MENA Intelligence, "Status of Tax Regime in the GCC," April 1, 2015.

[e] World Bank, Global Competitiveness Index 2015–16 (accessed August 19, 2016); Marmore MENA Intelligence, "Status of Tax Regime in the GCC," April 1, 2015; EGA, written submission to the USITC, January 23, 2017, 11.

Cost Overview

GCC producers had the lowest global average production costs for primary aluminum production during 2011–15. GCC average business costs dropped 23 percent between 2011 and 2015 (from $1,644 per mt in 2011 to $1,261 per mt in 2015), mostly as a result of alumina costs falling by 24 percent and anode costs falling by 30 percent during the same period (table 7.15). By contrast, average power costs in the GCC remained constant during 2011–15 at $23 per megawatt. Average GCC labor costs rose 8 percent from 2011 to 2015, coming to $170 per mt of aluminum in 2015. Nonetheless, the GCC's average smelter labor costs are substantially lower than those of the United States ($246 per mt in 2015), though they are much higher than for China ($52 per mt) and Russia ($59 per mt).[822]

Saudi Arabia had the lowest global average business cost for primary aluminum production in 2015 as a result of its operational efficiencies and the low costs of natural gas and hence electricity in its newly built Ma'aden smelter. The average business cost for Saudi Arabia fell 18 percent, from $1,267 per mt in 2013, the Ma'aden smelter's first year of production, to $1,033 per mt in 2015 (table 7.16). The average business cost for Saudi Arabia's aluminum sector is 28 percent lower than the global average business cost of $1,434 per mt in 2015. [823]

During 2012–14, Qatar had the lowest global average business cost, which likely was attributable to its low electricity and natural gas costs. In 2015, on the other hand, the UAE moved up the global cost curve relative to other countries: while its average production costs decreased at a rate of 18 percent during 2011–15, the global average fell faster at close to 30 percent. This decline in the UAE's cost competitiveness may have been the result of

[822] CRU Group.

[823] Ibid.

increased electricity costs (since the UAE does not provide government support for electricity as other GCC countries do) as well as higher labor costs.[824]

Table 7.15: GCC countries: Primary unwrought aluminum average business costs, 2011–15 (dollar per mt of aluminum produced)

Cost component	2011	2012	2013	2014	2015
Alumina	717	612	592	584	543
Electricity	388	345	397	396	396
Labor	157	163	165	169	170
Anode	246	222	201	187	173
Other[a]	151	149	162	162	158
Total liquid metal costs	1,659	1,541	1,517	1,497	1,404
Casthouse	112	120	118	108	113
Net realizations[b]	127	-163	-237	-347	-292
Average business costs	1,644	1,499	1,398	1,258	1,261
Global average business costs	2,042	1,765	1,639	1,540	1,434
LME cash price	2,395	2,018	1,845	1,867	1,661

Source: CRU Group.
Notes: Because of rounding, totals may not equal sum of line items. For 2013–15, costs are based on the weighted average costs of Bahrain, Oman, Qatar, Saudi Arabia, and United Arab Emirates; for 2011–12, Saudi Arabia is not included in the average costs because its business costs were not available.
a Other costs cover bath material, pot relining, smelter fuel, maintenance and other supplies, sustaining capital, working capital or supplies.
b CRU uses the net realization cost adjustments to account for variances in product quality impacting production costs, but do not include overheard costs in overall corporate cost.

Table 7.16: GCC countries: Primary unwrought aluminum average business costs, by country, 2011–15 (dollars per mt of primary aluminum)

Producer	2011	2012	2013	2014	2015
Bahrain	1,620	1,528	1,442	1,301	1,283
Oman	1,589	1,443	1,401	1,367	1,317
Qatar	1,634	1,406	1,253	1,009	1,089
Saudi Arabia	(a)	(a)	1,267	1,099	1,033
United Arab Emirates	1,670	1,526	1,437	1,335	1,363
Global average business costs	2,042	1,765	1,639	1,540	1,434

Source: CRU Group.
[a] Not available.

Low Electricity Costs Are a Key Competitive Advantage for Primary Production

The leading factor in the GCC's competitiveness in the primary aluminum industry is its abundant natural gas supplies, which are used to generate low-cost electricity for the

[824] Ibid.

electrolytic process in smelters.[825] The low GCC energy and electricity prices accelerated a shift in global primary aluminum production from higher-cost regions to the GCC region beginning in the early 2000s.[826] Natural gas was almost exclusively used as the energy source to power primary aluminum smelters in the GCC region during 2012–15, unlike other global producers that rely on hydropower or coal-fired electrical energy sources.[827] Natural gas is abundant in the region, with the GCC countries holding approximately one-fifth of all global natural gas reserves.[828] The GCC region benefits from natural gas prices more than 40 percent lower than those in the United States.

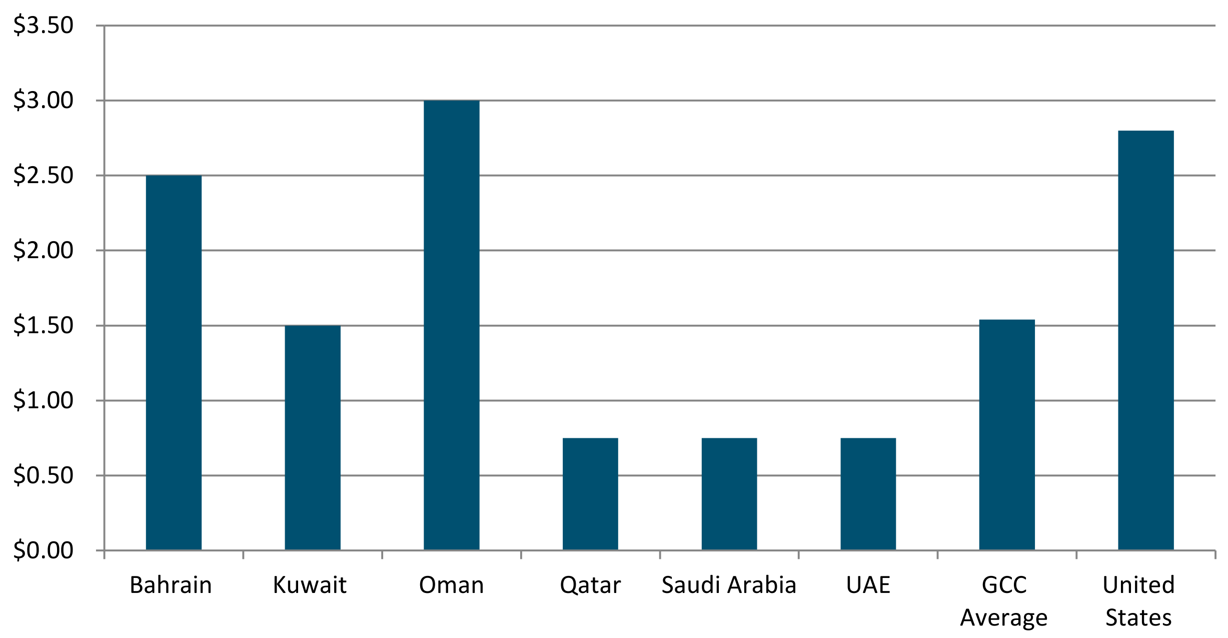
According to the IMF, the GCC countries with the lowest natural gas prices are Qatar, Saudi Arabia, and the UAE, all priced at $0.75 per one million British thermal units (MMbtu) (figure 7.5).[829] However, EGA stated in its written submission to the Commission that its purchase price for natural gas is substantially higher than $0.75 per MMbtu.[830] EGA indicated that it entered into long-term contracts for the purchase of natural gas at the time of construction of its two smelters.[831] It maintains that these contracts reflected market trends for natural gas prices at the time the contract was drawn up, and that prices are adjusted for inflation during the contract period.[832] Although UAE ranked seventh largest globally for its natural gas reserves, the country continues to be a net natural gas importer to meet its increasing domestic energy consumption, especially for the aluminum sector.[833]

Qatar is the largest global exporter of natural gas in the GCC region, supplying 12 percent of global exports in 2013.[834] Although the GCC countries are not among Qatar's largest export markets for natural gas, Qatar does export natural gas via pipeline to the UAE and Oman for use in generating electricity for aluminum production.[835]

---

[825] Although the GCC region uses 14,889 kilowatt hours (kWh) to produce a metric ton of primary aluminum, which is slightly above the global average (though well below China's), the higher electricity usage is more than offset by lower electricity prices. According to World Aluminium's website, the global average is 14,829 kWh to produce a metric ton of primary aluminum, and China's is 13,596 kWh. World Aluminium, "Primary Aluminium Smelting Energy Intensity," September 30, 2015.
[826] Nappi, "The Global Aluminium Industry: 40 Years from 1972," February 2013.
[827] World Aluminium, "Primary Aluminium Smelting Power Consumption," September 30, 2015.
[828] IRENA, *Renewable Energy Market Analysis: The GCC Region*, 2016, 22.
[829] IMF, "Energy Price Reforms in the GCC," November 2015, 5.
[830] EGA, written submission to the USITC, February 15, 2017, 3–4.
[831] Ibid.
[832] Ibid.
[833] USGS, *2013 Minerals Yearbook*, "United Arab Emirates," August 2015, 61.1–61.2
[834] IRENA, *Renewable Energy Market Analysis: The GCC Region*, 2016, 13.
[835] EIA, "Qatar," October 20, 2015.

Figure 7.5: GCC countries: Natural-gas prices for GCC countries and the United States, January–August 2015 (dollars per million British thermal units (MMbtu))



Source: IMF, “Energy Price Reforms in the GCC,” November 2015, 5.
Note: Corresponds to appendix table L.36.

Electricity prices in GCC countries have historically been among the world’s lowest, due to government support, and have been set by the government since the GCC countries nationalized oil production in the 1970s.[836] According to the International Energy Agency, one-third of all the electricity generated in the region uses subsidized petroleum.[837] While five of the six GCC governments have modestly reduced electricity support for businesses, electricity prices are still much lower than in other global markets.[838] The GCC region’s electricity costs on average are about half those in the United States (figure 7.6).

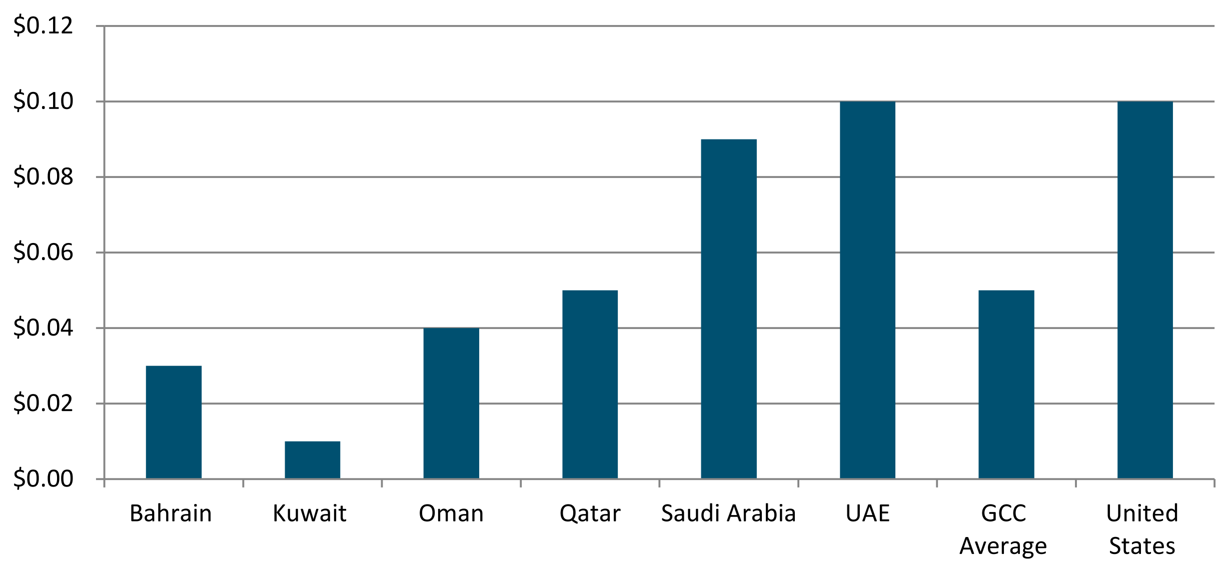
Power costs vary considerably within the region. Kuwait has the lowest electricity costs per kWh among GCC countries, followed by Bahrain and Oman. Some primary aluminum smelters—for example, the Bahraini producer Alba—generate their own electricity.[839] Among all GCC countries, the UAE has the highest electricity cost, which is roughly equal to the electricity cost for the United States. However, EGA owns and operates two natural gas-fired

---

[836] Krane and Hung, “Energy Subsidy Reform in the Persian Gulf,” April 28, 2016, 1.
[837] Nicola, “Fossil Fuel Subsidies Fall in Gain for Renewables,” January 30, 2015; Boersma and Griffiths, *Reforming Energy Subsidies*, January 2016.
[838] Krane and Hung, “Energy Subsidy Reform in the Persian Gulf,” April 28, 2016, 1–2.
[839] WTO, *Trade Policy Review: Bahrain,* March 18, 2014. Alba generates 13 percent of Bahrain’s energy requirements, and sells its excess energy to Bahrain’s Electricity and Water Authority, a government entity, under a contingency supply agreement.

power plants that meet the electricity needs for its smelters, and does not purchase electricity or receive government support from the UAE government.[840]

Figure 7.6: GCC countries: Electricity prices for GCC countries and the United States, January–August 2015 (dollars per kilowatt hour)



Source: IMF, "Energy Price Reforms in the GCC," November 2015, 5.
Note: Corresponds to appendix table L.37.

Upstream Investments Assure Raw Material Supply for Smelters

In the GCC region, alumina is the largest cost component for primary aluminum production, comprising over 40 percent of GCC producers' average business costs during 2011–15 (table 7.17).[841] During the same period, the GCC countries increased their competitiveness in aluminum production by gaining control over raw materials through upstream investments in global bauxite mines and alumina refineries. Average GCC alumina costs have dropped from $717/mt in 2011 to $543/mt in 2015 (a 25 percent decrease).

The GCC aluminum industry historically purchased bauxite from global suppliers, most notably Australia. However, in recent years GCC producers have invested in African and Latin American countries to become more vertically integrated with their upstream supply chains. For example, Mubadala Development Corporation (EGA's state-owned parent company) and Dubal signed a

[840] EGA, written submission to the USITC, January 23, 2017, 11. Also, EGA's power tariff costs are offset by the use of their proprietary technology that uses less energy for the same amount of primary aluminum production. Industry representative, interview by USITC staff, February 21, 2017, Washington, DC.
[841] CRU Group.

deal in 2013 through the Guinea Alumina Corporation (GAC) (a joint venture firm owned by the two companies) to invest $5 billion in Guinea for access to a bauxite mine.[842] Under the purchase agreement, GAC is building a bauxite mine to be operational by 2017. EGA stated in January 2017 that the mine is expected to have annual production capacity of 12 million mt of high-grade bauxite.[843] Further, Saudi Arabia has been investing in production of its domestic bauxite resources, raising its bauxite production to 2 million mt in 2015—a 10-fold increase from 2011 levels.[844]

The GCC countries have also invested in global alumina refineries in order to control their supply of alumina. EGA stated in its written submission to the Commission that the alumina market has become more consolidated in recent years, causing prices of alumina to increase.[845] To protect against volatility in alumina prices, EGA invested through GAC in an alumina refinery, which is anticipated to be operational by 2022.[846] Construction of the alumina refinery is expected to begin in 2018, with an initial capacity of 2 million mt of alumina per year.[847] EGA also holds a 45 percent ownership interest in Cameroon Alumina through a joint venture, which will develop an alumina refinery with 3 million mts of capacity. In addition, through its subsidiary Dubal EGA has a 19 percent ownership in a Brazil-based joint venture, Companhia de Alumina do Pará, which is in the process of building an alumina refinery. Lastly, EGA is building a $2.8 billion alumina refinery in Abu Dhabi with capacity to produce 2 million mts of alumina annually.[848] Plant construction is planned for two phases, with the first phase anticipated in 2017.[849]

Efficiencies from Investment in New and Technologically Advanced Smelters

The GCC aluminum industry has also benefited from investments in new smelters and capacity increases over the past decade. These new smelters are typically three times larger than smelters in other regions[850] and provide a competitive advantage to GCC producers due to their improved economies of scale and lower operational costs per metric ton.[851] Partially as a result of the large smelters, the GCC region has a low average business cost for primary production,

---

[842] Guinea is estimated to mine more than 25 million mt of bauxite annually, making it the world's largest supplier. Saadi, "UAE Steps On to the Global Aluminium Stage," December 17, 2013.
[843] EGA, written submission to the USITC, January 23, 2017, 5.
[844] Before 2011, Saudi Arabia had no domestic bauxite production. WBMS, "WMS Yearbook 2016."
[845] EGA, written submission to the USITC, January 23, 2017, 14.
[846] Industry representatives, interview by USITC staff, February 21, 2017, Washington, DC.
[847] Saadi, "UAE Steps On to the Global Aluminium Stage," December 17, 2013.
[848] EGA, written submission to the USITC, January 23, 2017, 5.
[849] EGA, "Al Taweela Alumina," 2.
[850] A.T. Kearney, "How GCC Smelters Can Continue Growing Profitably," 2013.
[851] Ibid.

averaging $1,217/mt, with Saudi Arabia being the lowest cost globally at $1,033/mt in 2015.[852] According to industry sources, GCC's investments in the aluminum industry are forecast to reach $55 billion in 2020 as a result of new projects and capacity increases in smelters, which is in addition to the $30 billion in investments expended by 2011.[853]

New smelters within the GCC region also have enhanced their competiveness by using innovative technologies, which improve product output and capacity.[854] For example, EGA's smelter in Dubai is using a proprietary technology that averages 3,290 kg in output per day, which doubled the output from its older technology.[855] EGA states it developed its own in-house "DX technology," increasing smelter productivity and resulting in one of the lowest rates of energy consumption per kilogram of aluminum produced compared to a majority of [global] aluminum smelters.[856] Further, Ma'aden is using a high-amperage cell technology that reduces its operating costs and improves its production efficiency.[857] Lastly, Sohar is the first smelter in the world to implement Rio Tinto Alcan's AP36 smelting technology, which improves manpower productivity and power efficiency.[858]

The new technology also provides GCC countries with what is said to be one of the most environmentally clean smelter systems in the world.[859] In the last five years alone, the GCC aluminum industry increased wastewater recycling by 150 percent and solid waste recycling by 48 percent, as well as reducing greenhouse gas emissions by 15 percent. All the smelters in the GCC region have achieved the ISO standard 14001 for their environmental management systems.[860]

---

[852] CRU Group.
[853] *Arab News,* "Aluminium Sector Investments in Gulf," August 12, 2014.
[854] A.T. Kearney, "How GCC Smelters Can Continue Growing Profitably," 2013.
[855] Ibid.
[856] EGA, written submission to the USITC, January 23, 2017, 13–14.
[857] A.T. Kearney, "How GCC Smelters Can Continue Growing Profitably," 2013.
[858] Arabian Business.com., "Gulf Aluminium Industry: Bright Future," February 18, 2012.
[859] *Metalworld*, "Reshaping the GCC Aluminium Downstream Industry," April 2015.
[860] *Metalworld*, "Reshaping the GCC Aluminium Downstream Industry," April 2015. According to the International Organization for Standardization (ISO), ISO 14001 is an internationally agreed standard that sets out the requirements for an environmental management system. This standard improves a company's "environmental performance through more efficient use of resources and reduction of waste." ISO website, "ISO 14001: 2015," https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/introduction_to_iso_14001.pdf (accessed May 11, 2017).

Bibliography

Al Attar, Walid. "The Middle East as an Emerging Hub." PowerPoint presentation for Platt's Aluminum Symposium 2014, Ft. Lauderdale, FL, January 12–14, 2014. http://www.platts.com/IM.Platts.Content/ProductsServices/ConferenceandEvents/2014/gc403/presentations/Walid_Al_Attar.pdf.

Aluminium Bahrain (Alba). *Annual Report 2015: Embracing Changes and Turning Them into Opportunities*, 2015. http://www.albasmelter.com/IR/Publications/Documents/Annual%20Reports/AnnualReport2015.pdf.

Aluminium Insider. "Alba Increases Line 6 Loan Amount to US $1.5 Billion," September 10, 2016. http://aluminiuminsider.com/alba-increases-line-6-loan-amount-to-us1-5-billion/.

Aluminum Association. "Aluminum: The Element of Sustainability," n.d. http://www.aluminum.org/sites/default/files/SustainabilityBrochure_0.pdf (accessed June 20, 2016).

Arab News. "Aluminum Sector Investments in Gulf to Reach $55bn by 2020," August 12, 2014. http://www.arabnews.com/news/economy/614916.

Arabian Business.com. "Gulf Aluminum Industry: Bright Future," February 18, 2012. http://www.arabianbusiness.com/gulf-aluminium-industry-bright-future-445723.html?page=1#.V1WBff72aic.

A.T. Kearney. "How GCC Smelters Can Continue Growing Profitably," 2013. https://www.atkearney.com/documents/10192/1386420/How+GCC+Smelters+Can+Continue+Growing+Profitably.pdf/b8ccbe8b-d563-488c-950e-887f2fccb285.

Boersma, Tim, and Steve Griffiths. *Reforming Energy Subsidies: Initial Lessons in the United Arab Emirates*. Brookings Institution, January 2016. https://www.brookings.edu/wp-content/uploads/2016/07/brookings_masdar_reforming_energy_subsidies_uae.pdf.

Burns, Stuart. "Middle Eastern Aluminum Leads World, Outside China, in Growth." Metal Miner, April 20, 2015. https://agmetalminer.com/2015/04/20/middle-eastern-aluminum-leads-the-world-outside-china-in-growth/.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Dagenborg, Joachim and Terje Solsvik. “Qatar's Aluminum Exports Blocked, Norsk Hydro Seeking Other Routes.” Reuters, June 6, 2017. https://www.reuters.com/article/us-gulf-qatar-norsk-hydro-aluminium-idUSKBN18X0HF.

Daylami, Mahmood. “Downstream Opportunities.” *Aluminium International Today*, March/April 2013.

De, Maitrayee. “Can Aluminium Become a Channel for Middle East Economic Diversity?” *Al Circle* (blog), June 1, 2015. http://blog.alcircle.com/2015/06/01/can-aluminium-become-channel-middle-easts-economic-diversity/.

EIA. *See* U.S. Energy Information Administration.

Emirates Global Aluminium (EGA). “Al Taweelah Alumina: The UAE's First Alumina Refinery,” n.d. http://www.ega.ae/media/1575/al-taweelah-alumina-leafletweb.pdf. (accessed May 17, 2017).

———. Written submission to the USITC in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, February 15, 2017.

———. Written submission to the USITC in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, January 23, 2017.

Ernst & Young (EY). “Solving Unemployment for GCC Nationals: A Sectoral Approach,” November 4, 2013. http://performance.ey.com/wp-content/uploads/downloads/2013/11/EY-Performance-Solving-unemployment.pdf.

Fattouh, Bassam, Anupama Sen, and Tom Moerenhout. “Striking the Right Balance? GCC Energy Pricing Reforms in a Low Price Environment.” University of Oxford. Oxford Institute for Energy Studies. Oxford Energy Comment, May 2016. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2016/04/Striking-the-Right-Balance-GCC-Energy-Pricing-Reforms-in-a-Low-Price-Environment.pdf.

Global Business Reports (GBR). *GCC Aluminium 2016*, 2016. http://gbreports.com/wp-content/uploads/2016/02/GCC-Aluminium-2016-Web-Version.pdf

Government of Bahrain. Ministry of Industry, Commerce and Tourism. “Aluminium Industry Sector,” n.d. http://www.moic.gov.bh/En/Industry/Industrial%20Sectors/Aluminium/Pages/Aluminium.aspx (accessed June 20, 2016).

Gulf Aluminium Council. “$55 Million Re-melt Expansion at GARMCO.” *Aluminium in the Gulf* (newsletter), March 2016. http://www.gac.ae/GAC_Newsletter_Mar2016.pdf.

———. “Facts and Figures: GCC Primary Production for 2012/2015.” http://www.gac.ae/Gulf-Aluminium-Council-Facts-Figures.aspx (accessed June 23, 2016)

———. “Facts and Figures: Key Indicators for the Aluminium Industry in the Gulf,” 2013.

———. “Gulf Cooperation Council and European Union,” n.d. http://www.gac.ae/Uploads/GAC-Br3_26_20144904641035.pdf (accessed April 25, 2017).

Hanieh, Adam. *Class and Capitalism in the Gulf Arab States*. United Kingdom: Palgrave Macmillan, 2011.

Hertog, Steffen. *The Private Sector and Reform in the Gulf Cooperation Council*. London School of Economics and Political Science. Kuwait Programme on Development, Governance and Globalisation in the Gulf States, Research Paper No. 30, July 2013. http://www.lse.ac.uk/middleEastCentre/kuwait/documents/the-private-sector-and-reform-in-the-gcc.pdf.

Hy Industry Corporation. “Aluminum Middle East Market Studies.” News release, April 20, 2016. http://www.hyindustry.com/bencandy.php?fid=47&id=86.

International Monetary Fund (IMF). “Economic Prospects and Policy Challenges for the GCC Countries.” Annual Meeting of Ministers of Finance and Central Bank Governors, Riyadh, Saudi Arabia, October 5, 2013. https://www.imf.org/external/np/pp/eng/2013/100513b.pdf.

———. “Energy Price Reforms in the GCC—What Lessons Can be Learned from International Experiences.” Conference paper for Annual Meeting of Ministers of Finance and Central Bank Governors, Doha, Qatar, November 10, 2015. https://www.imf.org/external/np/pp/eng/2015/111015b.pdf.

International Renewable Energy Agency (IRENA). *Renewable Energy Market Analysis: The GCC Region*. Abu Dhabi: IRENA, 2016. http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=691.

IHS Markit. Global Trade Atlas (GTA) database. https://www.ihs.com/products/maritime-global-trade-atlas.html (accessed various dates).

Krane, Jim, and Shih Yu (Elsie) Hung. "Energy Subsidy Reform in the Persian Gulf: The End of the Big Oil Giveaway." Rice University's Baker Institute for Public Policy, Center for Energy Studies. Issue brief, April 28, 2016. https://scholarship.rice.edu/bitstream/handle/1911/91262/BI-Brief-042816-CES_GulfSubsidy.pdf?sequence=1&isAllowed=y.

Ma'aden. "Rolling Mill at Ma'aden-Alcoa Joint Venture Manufactures First Production-grade Coil." News release, June 24, 2014. http://www.maaden.com.sa/en/news_details/144.

Market Realist. "Analyzing the Aluminum Industry's Key Dynamics," December 9, 2015. http://marketrealist.com/2014/12/dynamics-major-regions-produce-aluminum/.

Marmore MENA Intelligence. "Status of Tax Regime in the GCC," April 1, 2015. https://www.e-marmore.com/Blog/Regulatory/April/Status-of-Tax-Regime-in-GCC.

Metalworld (newsletter). "Reshaping the GCC Aluminium Downstream Industry," April 2015, 36–44. http://metalworld.co.in/newsletter/2015/Apr15/Outlook0415.pdf.

Nappi, Carmine. "The Global Aluminium Industry: 40 Years from 1972." World Aluminium, February 2013. http://www.world-aluminium.org/media/filer_public/2013/02/25/an_outlook_of_the_global_aluminium_industry_1972_-_present_day.pdf.

National Aluminium Products Company SAOG (NAPCO). "Africa's Booming Construction Sector Signals High Demand for Aluminum." News release, February 12, 2015. http://napcooman.com/news/item/Africas-booming-construction-sector-signals-high-demand-for-aluminum.

News of Bahrain. "Bapco, Alba Sign Gas Supply Deal," November 29, 2015. http://www.newsofbahrain.com/viewNews.php?ppId=9828&TYPE=Posts&pid=23&MNU=4&SUB.

Nicola, Stefan. "Fossil Fuel Subsidies Fall in Gain for Renewables." Bloomberg Business, January 30, 2015. http://www.bloomberg.com/news/articles/2015-01-30/fossil-fuel-subsidies-fall-in-gain-for-renewables.

Oxford Business Group, "The Report: Bahrain 2012." https://www.oxfordbusinessgroup.com/companies/bahrain/alba.

Perez, Josie. "GCC Aluminum 2016." *Global Business Reports.* 2016. http://gbreports.com/wp-content/uploads/2016/02/GCC-Aluminium-2016-Web-Version.pdf.

Qatalum. "Qatalum Working to Solve Logistical Challenges," June 13, 2017.

Qatar Aluminum (Qatalum) Ltd. "Qatalum Working to Solve Logistical Challenges Arising from Middle-East Tensions." June 6, 2016. https://www.qatalum.com/Media/News/Pages/Qatalum-working-to-solve-logistical-challenges-arising-from-Middle-East-tensions.aspx.

Reed Exhibitions. "Middle East Aluminium Industry under Global Spotlight as ALUMINUM MIDDLE EAST 2015 Opens in Dubai." Press release, April 14, 2015. http://www.reedexpo.com/de/Pressemitteilungen/2015/Middle-East-aluminium-industry-under-global-spotlight-as-ALUMINIUM-MIDDLE-EAST-2015-opens-in-Dubai-/.

Reuters. "Hydro CEO Says Qatar Aluminium Exports Go as Planned Despite Tensions," June 13, 2017. https://www.reuters.com/article/gulf-qatar-norsk-hydro-idUSO9N1IC00R.

Rof, Jordi. "GCC Differs in Will to Improve Infrastructure Developments." *Khaleej Times* (Dubai), August 4, 2015. http://www.khaleejtimes.com/business/infrastructure/gcc-differs-in-will-to-improve-infrastructure-developments.

Saadi, Dania. "UAE Steps On to the Global Aluminium Stage." *The National* (UAE), December 17, 2013. http://www.thenational.ae/business/industry-insights/economics/uae-steps-on-to-the-global-aluminium-stage.

Sandoval, Dan. "Finding a Path." *Recycling Today*, January 18, 2013. http://www.recyclingtoday.com/article/rtge0113-aluminum-commodity-focus/.

Technical Review Middle East. "Construction Boom Encourages Expansion of Aluminium Companies in the UAE," November 13, 2014. http://www.technicalreview.me/manufacturing/metals/construction-boom-encourages-eef-and-wae-to-expand-in-the-uae.

———. "GCC Aluminium Production Records Seven per Cent Growth in 2015," January 28, 2016. http://www.technicalreviewmiddleeast.com/manufacturing/metals/gcc-aluminium-production-records-seven-per-cent-growth-in-2015.

Thomson Reuters Zawya. "Aluminium Scrap Generated in the Middle East Estimated to Reach 500,000 MT by 2015, Says Frost & Sullivan," June 5, 2014. https://www.zawya.com/story/Aluminium_Scrap_generated_in_the_Middle_East_estimated_to_reach_500000_MT_by_2015_says_Frost__Sullivan-ZAWYA20140605072600/.

U.S. Energy Information Administration (EIA). "Qatar: International Energy Data and Analysis." Last updated October 20, 2015. https://www.eia.gov/beta/international/analysis_includes/countries_long/Qatar/qatar.pdf.

U.S. Geological Survey (USGS). "The Mineral Industries of the Middle East" (advance release), by Mowafa Taib, Waseem A. Abdulameer, Sinan Hastorun, Glenn J. Wallace, Philip M. Mobbs, David R. Wilburn, and Thomas R. Yager. *2013 Minerals Yearbook,* May 2016. http://minerals.usgs.gov/minerals/pubs/country/2013/myb3-sum-2013-middle-east.pdf.

———. "United Arab Emirates" (advance release), by Waseem A. Abdulameer. *2013 Minerals Yearbook*, August 2015. http://minerals.usgs.gov/minerals/pubs/country/2013/myb3-2013-ae.pdf.

Walker, Ian and Benedict Konst. **"**Hydro's Qatalum Smelter Resumes Exports but Shipment Delays Expected." *Metal Bulletin*, June 14, 2017. https://www.metalbulletin.com/Article/3725157/base-metals/Hydros-Qatalum-smelter-resumes-exports-but-shipment-delays-expected.html.

World Aluminium. "Primary Aluminium Smelting Power Consumption," September 30, 2015. http://www.world-aluminium.org/statistics/primary-aluminium-smelting-power-consumption/#data.

———. "Primary Aluminium Smelting Energy Intensity," September 30, 2015. http://www.world-aluminium.org/statistics/primary-aluminium-smelting-energy-intensity/#map.

World Bank. Global Competitiveness Index 2015–16. http://reports.weforum.org/global-competitiveness-report-2015-2016/competitiveness-rankings/ (accessed August 19, 2016).

———. Quality of Port Infrastructure database. http://data.worldbank.org/indicator/IQ.WEF.PORT.XQ?order=wbapi_data_value_2015+wbapi_data_value+wbapi_data_value-last&sort=desc (accessed June 20, 2016).

World Bureau of Metal Statistics (WBMS). "Aluminum, Qatar." *World Metal Statistics*. Ware, Herts, United Kingdom: WBMS, November 2014.

World Trade Organization (WTO). *Trade Policy Review: Kingdom of Bahrain*. Report by the Secretariat WT/TPR/S/294, March 18, 2014. https://www.wto.org/english/tratop_e/tpr_e/s294_e.pdf.

———. *Trade Policy Review: Oman*. Report by the Secretariat WT/TPR/S/295, March 18, 2013. https://www.wto.org/english/tratop_e/tpr_e/s295_e.pdf.

———. *Trade Policy Review: The Kingdom of Saudi Arabia*. Report by the Secretariat WT/TPR/S/333, February 29, 2016. https://www.wto.org/english/tratop_e/tpr_e/s333_e.pdf.

———. *Trade Policy Review: Qatar*. Report by the Secretariat WT/TPR/S/296, March 18, 2014. https://www.wto.org/english/tratop_e/tpr_e/s296_e.pdf.

———. *Trade Policy Review: United Arab Emirates*. Report by the Secretariat WT/TPR/S/338, April 27, 2016. https://www.wto.org/english/tratop_e/tpr_e/s338_e.pdf.

Chapter 8
Russia

Overview

Russia is one of the world's largest producers of primary unwrought aluminum and is the world's largest exporter of unwrought aluminum. Its primary aluminum industry is consolidated under one firm, United Company Rusal (Rusal), which is the world's second-largest primary aluminum producer. Although Russia's production of primary aluminum fell during 2011–15 with the closing of inefficient, obsolete smelter capacity at a time of declining aluminum prices, the country will likely continue to be a globally cost-competitive producer and exporter of primary aluminum.

Russia's position as one of the world's lower-cost producers of primary aluminum is largely attributable to the country's abundant, relatively inexpensive hydroelectric power. In addition, Rusal has been transitioning to new, more efficient technologies and smelters that have contributed to lower production costs, which have fallen below the London Metal Exchange (LME) price of aluminum in recent years. These advantages help to offset Russia's transportation costs, which are estimated to be the world's highest. Russia's primary aluminum is transported long distances, largely by rail, from its Siberian smelters to various ports, from which it reaches customers in the Commonwealth of Independent States (CIS),[861] Europe, and Asia.

In contrast to its role as a leading primary aluminum producer, Russia is a less prominent player in the global production and trade of secondary and wrought aluminum. The Russian wrought aluminum sector is considerably less developed than that in other leading world industries, in part because of its relatively small domestic market as well as numerous taxation, regulatory, and financing challenges that reportedly deter investment. Russia's secondary aluminum industry has also remained relatively small, reflecting the limited collection and recycling of waste and scrap because of unprofitability and the public perception of it as an undesirable activity.

Several government proposals focus on encouraging growth in the wrought aluminum products market. Rusal, the Aluminum Association of Russia, and the government of Krasnoyarsk

---

[861] The Commonwealth of Independent States (CIS) includes nine full members (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan) and two associate states (Turkmenistan and Ukraine).

(Siberia) are pursuing the development of a special economic-zone project known as "Aluminum Valley," which would emphasize the manufacture of downstream aluminum products. In addition, the Russian Federation's Ministry of Industry and Trade has been tasked with drafting a decree focusing on the development of ferrous and nonferrous metallurgy for the period up to 2030, and with contributing to another draft decree concerning measures to stimulate demand for aluminum products.[862]

Industry Structure

The Russian primary aluminum industry is consolidated under one firm, Rusal, which is the world's second-largest primary aluminum producer. Rusal is vertically integrated into bauxite mining and alumina refining through its global operations. In contrast, as noted above, the Russian secondary and wrought aluminum sectors are relatively small and remain focused more on domestic and regional markets.

Primary Unwrought Aluminum

Number, Location, and Concentration of Firms

The Rusal conglomerate[863] accounted for 6 percent of global primary aluminum output in 2015. The Russian aluminum industry was consolidated under Rusal in 2007, when it merged with the Russian firm Siberian-Urals Aluminum Company (SUAL)[864] and with the alumina operations of the Swiss firm Glencore. This consolidation was reportedly supported by the Russian government and is in line with Russia's industrial policy goal of consolidation, despite the fact that Rusal is a private sector undertaking.[865]

The firm is vertically integrated upstream into bauxite mining and alumina refining within Russia, but also has a global reach. As of 2015, Rusal owned all or part of a total of 8 bauxite mines and 11 alumina refineries that supply its 14 aluminum smelters and 4 foil mills,[866] all of

[862] Latest News for Traders, "Medvedev Instructed the Ministry of Industry and Trade," April 8, 2016.
[863] Rusal's shareholders include En+, with a controlling interest of 48.13 percent; Onexim, 17.02 percent; Siberian-Urals Aluminum Partners Limited (SUAL Partners), 15.80 percent; Amokenga Holdings (controlled by Glencore International AG), 8.75 percent; the public, 10.05 percent; and management, 0.25 percent. En+ is controlled by Oleg Deripaska, who indirectly holds 91.6 percent of the firm and is president/CEO of Rusal. UC Rusal, *Driven by Green Power*, May 5, 2016, 130, 167.
[864] SUAL was engaged in bauxite extraction, alumina refining, primary aluminum production, and the manufacture of aluminum semi-finished and finished products.
[865] Bidlack, *Russia and Eurasia 2015–2016*, August 2015, 121; *Financial Times*, "Russia Creates a New National Champion," August 31, 2006.
[866] Of these operations, five smelters, four alumina refineries, and one bauxite mine are currently mothballed. UC Rusal, *Driven by Green Power*, May 5, 2016, 9.

which employ over 60,000 people in 19 different countries.[867] Rusal reportedly has the internal company resources to supply all of its alumina needs and nearly 80 percent of its bauxite needs.[868]

In Russia, the firm operated three alumina refineries, two bauxite mines, and eight aluminum smelters as of 2015 (table 8.1). Rusal's aluminum operations are concentrated in Siberia near hydroelectric power facilities, and operate at capacity utilization rates in excess of 90 percent (figure 8.1).[869] Since 2013, Rusal has closed four unprofitable smelters, most in western Russia, primarily due to high energy prices and the expiration of long-term electricity supply agreements.[870] Two additional smelters, Kandalaksha and Novokuznetsk, were considered for closure, but these plans were shelved as primary aluminum prices rose to over $1,500 per metric ton (mt) in 2016, which exceeded the production costs of these two smelters.[871]

Table 8.1: Russia: Primary unwrought aluminum smelters, 2016

Name	Nameplate capacity (mt)	Production in 2015 (mt)	Year commissioned	Status
Bogoslovsk Aluminium Smelter	190,000	0	1940s	Shut down in 2013
Boguchansky Aluminium Smelter	588,000	0	2010	Start-up in mid-2016
Bratsk Aluminium Smelter	1,006,000	1,005,000	1966	Operating
Irkutsk Aluminium Smelter	410,000	410,000	1962	Operating
Kandalaksha Aluminium Smelter	76,000	66,000	1951	Operating
Khakas Aluminium Smelter	297,000	289,000	2006	Operating
Krasnoyarsk Aluminium Smelter	1,013,000	1,013,000	1964	Operating
Nadvoitsy Aluminium Smelter	24,000	12,000	1954	Operating
Novokuznetsk Aluminium Smelter	215,000	209,000	1943	Operating
Sayanogorsk Aluminium Smelter	542,000	525,000	1984	Operating
Urals Aluminium Smelter	75,000	0	1944	No production in 2015
Taishet Aluminium Smelter	750,000[a]	0	2007	Construction started in 2007
Volgograd Aluminium Smelter	100,000	0	1959	No production in 2015
Volkhov Aluminium Smelter	24,000	0	1932	Shut down in 2013

Source: UC Rusal, *Driven by Green Power*, May 5, 2016.
[a] Planned.

[867] UC Rusal, "Working in RUSAL," http://www.rusal.ru/en/career/work_in_company/ (accessed May 12, 2017).
[868] UC Rusal, *Driven by Green Power*, May 5, 2016, 8.
[869] USITC, hearing transcript, September 29, 2016, 307 (testimony of Scott States, Rusal America Corp.).
[870] Mishanina, "RUSAL to Halt Aluminum Production at Four of Its Factories," August 30, 2012.
[871] TASS, "Rusal Decides Not to Close Plants," June 20, 2016; UC Rusal, "UC Rusal Will Double Aluminum Supplies," September 28, 2016.

Figure 8.1: Russia: Locations of primary unwrought aluminum, alumina, and bauxite operations, 2015

Source: Rusal, *Driven by Green Power*, May 5, 2016, 10–11.

Employment and Wages

In conjunction with the smelter closures, Russian employment in the primary aluminum industry fell by 24 percent, from 20,668 workers in 2011 to 15,693 workers in 2015 (table 8.2). The employment decline, combined with technology advancements, helped to improve labor productivity: the number of employees required to produce 1,000 mt of primary aluminum fell from 5.2 to 4.4 during 2011–15. Hourly wage rates at Russian smelters declined in U.S. dollar terms, from a peak of $11.77 in 2013 to $6.84 in 2015, due in large part to the nearly 50 percent depreciation of the ruble against the dollar.

Table 8.2: Russia: Primary unwrought aluminum industry employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	20,668	20,551	17,632	15,614	15,693
Production (1,000 mt)	3,990	4,024	3,724	3,488	3,529
Productivity (workers/1,000 mt)	5.2	5.1	4.7	4.5	4.4
Average wages ($/hr)	10.77	11.19	11.77	9.99	6.84

Source: CRU Group.

Investment

Rusal reportedly intends to be the sole supplier of Russia's primary aluminum needs in the future.[872] To help meet anticipated increased demand for aluminum, Rusal is currently building two new primary aluminum smelters—Boguchansky, located in the Angara area of Siberia, and Taishet in the Irkutsk region—at a cost of $4 billion.[873] The Boguchanskoye Energy and Metals Complex (BEMO) smelter, with a planned capacity of 588,000 mt when completed in 2018, will receive 100 percent of its electric power from the newly built Boguchanskaya hydroelectric power plant.[874] The smelter started production in mid-2016, with a nameplate capacity of 147,000 mt in its first stage. Capacity at BEMO may be capped at 300,000 mt if the Taishet smelter is completed.[875]

Construction of the Taishet smelter, which began in 2007 with a planned capacity of 750,000 mt, was halted in November 2013 in response to falling aluminum prices. This smelter's planned output has since been scaled back to 430,000 mt,[876] with construction about 60 percent complete. A total of $800 million is being sought to finish the project as Rusal attempts to build a coalition of foreign and domestic banks. Rusal is reportedly looking for additional investors to fund this project, including RusHydro,[877] a hydroelectricity company majority owned by the Russian Federation through the Federal Assets Administration Agency.[878] Completion of the Taishet project will depend on market conditions, especially those within Russia.[879]

Secondary Unwrought Aluminum

Russia's secondary unwrought aluminum industry is relatively small, representing 14 **percent** of its primary aluminum output. About 150 secondary plants produce aluminum alloys in Russia, most of which are located in the European part of Russia.[880] Leading secondary producers include IC Vtormet (with capacity of 107,000 mt), Mordovvtorsyrye LLC (over 60,000 mt), and Permtsvetmet (30,000 mt).

[872] Aluminium Insider, "RUSAL Plans to Be Russia's Sole Supplier," July 15, 2016.
[873] Butterworth, "Russia's Raw Materials Business on the Rise," January 2008.
[874] UC Rusal, *Driven by Green Power*, May 5, 2016, 22.
[875] Aluminium Insider, "Aluminum Prices Stable," September 18, 2016.
[876] Ibid.
[877] TASS, "RUSAL Decides Not To Close Plants," June 20, 2016.
[878] UC Rusal, *Driven by Green Power*, May 5, 2016, 25. The Russian Federation, represented by the Federal Assets Administration Agency, holds nearly two-thirds of RusHydro's equity capital. RusHydro, "Share Capital," http://www.eng.rushydro.ru/investors/stock-market/capital/ (accessed February 7, 2017).
[879] UC Rusal, written testimony to the USITC, September 12, 2016, 8–9.
[880] UC Rusal, written submission to the USITC, February 17, 2017, 9.

Rusalit is a group of companies that together form a major secondary aluminum producer, with an annual capacity of 80,000 mt. One of the group companies, Vzas, is reportedly the only plant in Russia producing aluminum alloy type 3104 (for production of aluminum tape and cans) from secondary materials (aluminum cans).[881]

Rusal is the only producer with an integrated recycler:[882] it produces secondary aluminum alloys through its Rusal Resal division at two plants (Alexeevka and Novosemeykino), both located southeast of Moscow in the Samara region of Russia. In 2012, Rusal produced 25,500 mt of secondary aluminum products.[883] Rusal recycles its own waste and sends slag to Resal, which uses the slag and additional scrap to produce secondary aluminum alloys.[884]

Wrought Aluminum

Over 1,200 firms manufacture wrought aluminum products in Russia. They are concentrated in the Moscow region, the Sverdlovsk region, and Krasnoyarsk Territory, which account for approximately 39 percent of Russian production.[885]

Three producers, Alcoa Inc. (ZAO Alcoa SMZ), Kamensk-Uralsky Metallurgical Plant, and Krasnoyarsk Metallurgical Plant Ltd., are leading Russian manufacturers of wrought aluminum products.[886] ZAO Alcoa SMZ (Samara Metallurgical Plant) produces flat-rolled, extruded, and forged products for markets that include aerospace, shipbuilding, oil and gas, and packaging, among others. The company has the largest extrusion and forging presses in Russia. This plant is reportedly Russia's largest producer of wrought aluminum, accounting for nearly 40 percent of the mill products market.[887] The Kamensk-Uralsky Metallurgical Plant makes aluminum plate, extruded profiles, rods and bars, and pipe and tube for a variety of markets, including aerospace, shipbuilding, and oil and gas. The Krasnoyarsk Metallurgical Plant Ltd.is a manufacturer of not only aluminum alloy billets, but also wire, rod, bars, profiles, and forged products. It is a downstream unit of En+, Rusal's largest shareholder, and its primary aluminum is largely supplied by Rusal.[888]

---

[881] Rusalit, "Russia Aluminum Casting" (accessed February 15, 2017).
[882] UC Rusal, written submission to the USITC, February 17, 2017, 8.
[883] *Scrap Register*, "Russia's Rusal to Produce 5000 Mt/Year," June 24, 2013.
[884] UC Rusal, written submission to the USITC, February 17, 2017, 8.
[885] Ibid., 4.
[886] Frost & Sullivan, "Russia's Aluminium Product Manufacturers," December 4, 2012.
[887] ZAO Alcoa SMZ website, http://alcoa.p1.inter.alcoa.com/russia/en/info_page/SMZ_about.asp (accessed February 15, 2017).
[888] En+, "Non-ferrous Metals," http://eng.enplus.ru/business/nonferrous_metal/ (accessed February 22, 2017).

Rusal also operates two foil operations (Rusal Sayana and Ural Foil) in Russia. In addition, the Stupino Metallurgical Company manufactures semi-finished aluminum alloy products.[889] A number of smaller, specialized companies reportedly manufacture higher value-added aluminum products such as profiles, siding, or roofing.[890]

Flat-rolled products are considered to represent the largest share of Russia's wrought aluminum industry segment. Estimated employment at Russian aluminum rolling mills was 5,051 workers in 2015, an increase of 7 percent from 2011 (table 8.3). Worker productivity appears to have remained rather stable over the period at about 16 workers per 1,000 mt.

Table 8.3: Russia: Aluminum rolling mill employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	4,716	4,726	4,953	4,976	5,051
Productivity (workers/1,000 mt)	16	16	17	16	16
Average wages ($/hr)	11.13	11.88	12.64	12.00	12.20

Source: CRU Group.

Production

Primary Unwrought Aluminum

As noted earlier, Russia's primary aluminum output declined from 2011 to 2015 with the closing of inefficient, obsolete smelter capacity during a period of declining aluminum prices. Russia is currently the world's second-largest single-country producer of primary aluminum after China, producing 3.5 million mt in 2015 (table 8.4).[891] Rusal produces extrusion billets (alloy series 6xxx and 1xxx), rolling slabs (most alloy series), wire rod, primary foundry alloys (ingots and T-bars), and high-purity aluminum (ingots and T-bars). In addition, Rusal produces primary aluminum remelt ingots and primary aluminum T-bar ingots.[892]

Declining aluminum prices and ruble depreciation helped Rusal to cut costs, in part because its energy supply contracts are tied to the LME price (figure 8.2).[893] The average cost for Rusal to produce a metric ton of primary aluminum tracked more closely with the LME price toward the end of the period, with a 2015 year-end cost of $1,455 per mt—well below the LME price of $1,661 per mt. By midyear 2016, this gap had widened slightly, despite a decline in the LME

[889] Stupino Metallurgical Company website, http://www.smk.ru/html/eng/html/about.html (accessed January 19, 2017). Alcoa sold its Rostov plant, Belaya Kalitva, to Stupino Titanium Company in 2015. *Metal Bulletin*, "Alcoa Sells Russian Mill," April 8, 2015.
[890] Frost & Sullivan, "Russia's Aluminium Product Manufacturers," December 4, 2012.
[891] Rusal's production of primary aluminum reached 3.7 million mt in 2016. UC Rusal, *Creating Value,* 2016, 1.
[892] UC Rusal, *Aluminum Crafted by Hydro Energy*, 2016.
[893] Aluminium Insider, "Global Aluminium Smelters' Production Costs," April 20, 2016.

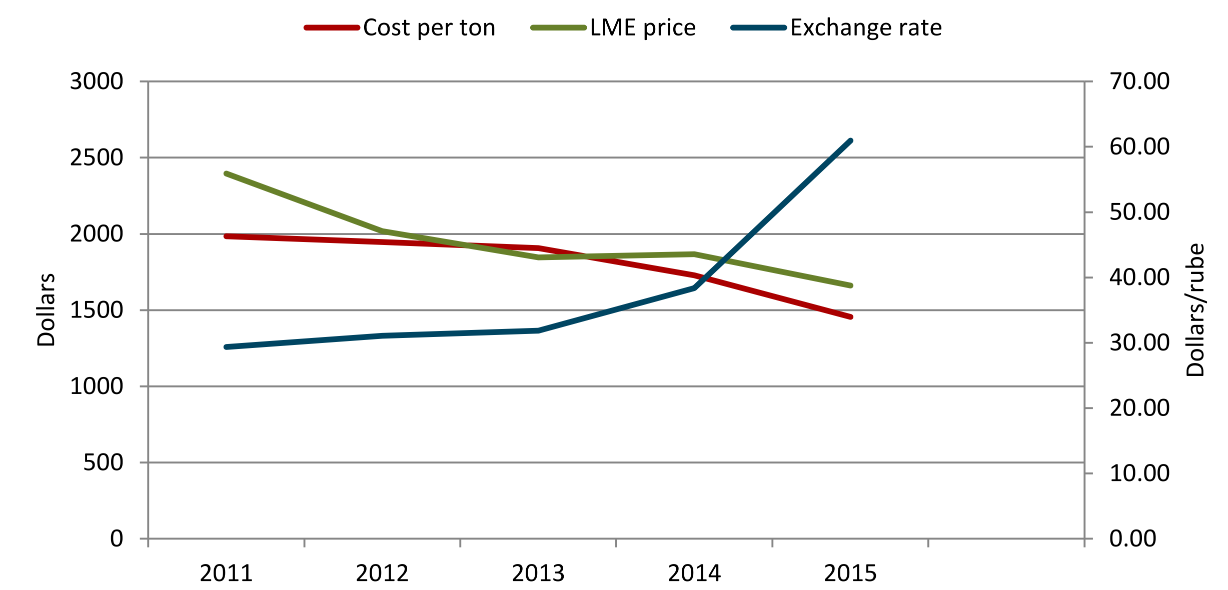
price. Rusal's cost fell to $1,330 per mt, compared to the LME price of $1,543 per mt,[894] due to production efficiencies and input cost reductions.[895]

Table 8.4: Russia: Primary unwrought aluminum production, capacity, and capacity utilization, 2011–15

Attribute	2011	2012	2013	2014	2015
Production (1,000 mt)	3,990	4,024	3,724	3,488	3,529
Capacity (1,000 mt)	4,326	4,315	4,093	3,940	3,758
Capacity utilization (%)	92	93	91	89	94

Source: CRU Group.

Figure 8.2: Russia: Rusal and LME primary unwrought aluminum prices and ruble exchange rate, 2011–15



Source: CRU Group, UC Rusal annual reports, 2011–15.
Note: Corresponds to appendix table L.38.

Secondary Unwrought Aluminum

Russia produced between 480,000 and 519,000 mt of secondary aluminum annually during 2011–15, which was about 11 percent of the comparable U.S. total of 4.6 million mt in 2015. Russia's total secondary aluminum capacity is estimated at 600,000 mt. Russia's secondary aluminum production closely followed its scrap collection totals, which ran at 547,000–580,000 mt over the period (table 8.5). Collection and recycling of waste and scrap, including aluminum products, are not common in Russia, in part because of unprofitability and the

[894] UC Rusal, *Quality Matters*: *Interim Report 2016*, August 25, 2016, 13.
[895] UC Rusal, "UC Rusal Announces 2016 Third Quarter and Nine Months Results," November 11, 2016.

stigma associated with recycling, which is seen as an undesirable activity.[896] More than 80 percent of Russian domestic waste goes to landfills.[897] Of the scrap that is collected for recycling, principal sources include cans, household scrap, and industrial scrap.[898] With an export duty on aluminum scrap exports in place since 2000, most scrap collected in Russia is reportedly used to manufacture remelt scrap ingot.[899]

Table 8.5: Russia: Secondary aluminum scrap collection and alloy production, 2011–15 (thousand mt)

Secondary aluminum	2011	2012	2013	2014	2015
Scrap collection	547	560	559	580	558
Secondary alloy production	480	491	496	519	502

Source: UC Rusal, written testimony to the USITC, September 12, 2016, 14.

Wrought Aluminum

Russian production of wrought aluminum products is estimated to represent less than 1 percent of the global total. Estimated production remained relatively flat over 2011–15, with the most notable shift occurring in flat-rolled products, where output rose by 9 percent (table 8.6). Despite this gain, throughout the period this sector continued to operate below estimated capacity. One industry analyst indicated that it is “cheaper, easier and more reliable” for Russia to import wrought aluminum products than to produce them locally because of the numerous taxation, regulatory, and financing challenges that have made investment in this sector problematic.[900] Russian-made wrought products are principally used in packaging and consumer goods, cables, and machine engineering markets, which together accounted for 54 percent of Russian shipments.[901]

[896] Arkhangelskaya, “Recycling in Russia,” August 30, 2016; Halme, “Putin’s Russia, Where Recycling Is for Crooks,” February 4, 2016.
[897] Halme, “Putin’s Russia, Where Recycling Is for Crooks,” February 4, 2016.
[898] UC Rusal, written submission to the USITC, February 17, 2017, 9.
[899] UC Rusal, “Aluminum Market in Russia and the C.I.S.,” January 2016.
[900] Ibid.
[901] UC Rusal, written submission to the USITC, February 17, 2017, 3.

Table 8.6: Russia: Wrought aluminum production, capacity, and capacity utilization, 2011–15

Attribute	2011	2012	2013	2014	2015
Production (1,000 mt)					
Flat-rolled products	367	378	388	388	401
Extrusions	197	213	234	219	204
Wire and cable	184	199	206	191	174
Total	749	790	828	798	779
Capacity 1,000 mt)					
Flat-rolled products	1,028	1,035	1,038	1,038	1,038
Capacity utilization (%)					
Flat-rolled products	36	37	37	37	39

Source: CRU Group.

Consumption

Unwrought Aluminum

Despite Russia's position as the world's second-largest primary aluminum producer, the Russian market for aluminum is significantly smaller and less developed than that of other leading world markets. Consequently, the majority of Russian production of primary and secondary aluminum is exported, and the volume of imports is small. Russian consumption of primary aluminum in 2015 totaled 696,000 mt—about 11 percent of the U.S. market size (6.6 million mt) for the same year (table 8.7).[902] Per capita primary aluminum consumption in Russia reached 5.4 kilograms (kg) in 2014, compared to the world average of about 7.5 kg and the U.S. average of roughly 16 kg.[903] Russia has targeted the world average aluminum consumption rate as its goal for 2021.[904]

Table 8.7: Russia: Unwrought aluminum consumption by type, 2011–15 (thousand mt)

Type	2011	2012	2013	2014	2015
Primary	807	827	799	762	696
Secondary	172	222	222	229	207

Source: UC Rusal, "Aluminum Market in Russia and the C.I.S.," January, 2016; UC Rusal, written testimony to the USITC, September 12, 2016, 15; UC Rusal, written submission to the USITC, February 17, 2017, 14.

The largest end-use industry for primary aluminum in the CIS in 2015 was rolling mills (47 percent or 375,000 mt), which principally convert primary aluminum into foil and

[902] UC Rusal, written testimony to the USITC, September 12, 2016, 15; CRU Group.
[903] UC Rusal, "Aluminum Market in Russia and the C.I.S.," January 2016.
[904] UC Rusal, written submission to the USITC, February 17, 2017, 9.

packaging. The second-largest industry was cable and wire, with a 23 percent (180,000 mt) share in 2015.[905]

The largest end-use industry for secondary unwrought aluminum was the extrusion industry, followed by the steel industry.[906] The most promising markets for secondary aluminum are the construction and automotive industries. To improve prospects in these and other markets, the quality of secondary aluminum alloys produced by small Russian producers would need greater consistency to meet the technical requirements of end-use markets, especially consumer goods.[907]

Wrought Aluminum

With respect to semifinished and finished aluminum products, Rusal reported that in 2015 nearly 30 percent of the estimated 1.6 million mt market in Russia was supplied by imports. The two leading end users for semifinished and finished aluminum products were packaging and foil producers (27 percent) and automotive firms (16 percent).[908] Rusal anticipates that Russia's increased aluminum consumption will be driven by growth in the automotive industry, with Russian-based producers of aluminum gaining market share.[909]

Another perspective on the wrought aluminum market shows that consumption is concentrated in the electrical, construction, and packaging sectors, which accounted for 63 percent of total consumption of wrought aluminum products in 2015 (table 8.8). Following increased market growth during 2011–13, consumption of many wrought aluminum products fell in 2014 and further declined in all but one end-use market in 2015, reflecting the slowdown in the Russian economy. In terms of product forms, flat-rolled products accounted for nearly one-half of wrought aluminum consumption in 2015, and all but one product category posted a decline in 2015.

---

[905] UC Rusal, "Aluminum Market in Russia and the C.I.S.," January, 2016.
[906] Ibid.
[907] UC Rusal, written submission to the USITC, February 17, 2017, 13.
[908] UC Rusal, "Aluminum Market in Russia and the C.I.S.," January, 2016.
[909] *Aluminum International Today*, "Aluminium's Role in Russian Automotive," May 14, 2014.

Table 8.8: Russia: Consumption of wrought aluminum by product form and end use, 2011–15 (thousand mt)

Attribute	2011	2012	2013	2014	2015
By product form					
Flat-rolled	338	356	350	329	314
Wire and cable	190	204	208	191	174
Extrusions	149	180	194	178	159
Total	677	741	752	698	648
By end-use					
Electrical	208	224	227	209	191
Construction	113	133	139	125	113
Packaging	115	122	115	109	105
Foil stock	71	76	78	82	80
Transport	71	79	81	74	62
Machinery and equipment	50	55	54	51	42
Other	21	21	26	21	29
Consumer durables	27	30	31	29	27
Total	676	740	751	700	649

Source: CRU Group.

Several challenges have been reported to hinder increased aluminum consumption in Russia. One of the most significant has been the decline of many consuming industries with the collapse of the Soviet Union, when production capacity fell by 30 percent for aviation and space, 74 percent for shipbuilding, and 40 percent for automotive. Another significant hurdle is the technological and structural differences between Russia and Western end-use industries that result in lower aluminum content in Russian finished goods.[910] For example, outdated Russian standards and codes often restrict the use of aluminum in the construction, transportation, electric-power transmission, and defense sectors (box 8.1).[911]

Other issues also affect the level of aluminum consumption in Russia. Inconsistent metal chemistry reportedly hinders the ability of the smaller secondary aluminum producers to make larger inroads into Russian markets, contributing to the export of about one-half of Russia’s secondary output.[912] Moreover, aluminum is often perceived as incapable of withstanding the Russian climate. As a result, packaging and foil, rather than the electrical and construction sectors, are traditionally the largest markets for aluminum in the CIS.[913] More recently, low global crude-petroleum prices have had a significant dampening effect on the Russian economy because of its reliance on the petroleum sector. As a result, Russian aluminum consumption

[910] UC Rusal, written submission to the USITC, February 17, 2017, 9.
[911] Aluminium Insider, "Symposium Synopsis—2016 Platts Aluminum Symposium," January 29, 2016.
[912] UC Rusal, “Aluminum Market in Russia and the C.I.S.,” January 2016.
[913] Ibid.

declined in 2015, and it is anticipated that this pattern will continue until petroleum prices recover.[914]

Box 8.1: Russian Regulations That Limit Aluminum Use

Several regulations currently limit the use of aluminum in leading Russian end-use markets. In the construction sector, for example, Russia's standards do not allow bridge structures to be made from aluminum and its alloys. In another case, the absence of a Russian standard for suspended ventilated aluminum façade systems means that firms must spend their resources developing and testing products that meet their own specifications, rather than an industry standard. Moreover, Russia's code for electrical installations mandates the use of certain dimensions of copper wire, instead of aluminum, for residential and office buildings.[a]

[a] Rusal, written submission to the USITC, February 17, 2017, 12.

Rusal's priority is to develop the Russian aluminum market in areas where it has an advantage.[915] Rusal has set a target for future Russian consumption at 2 million mt by 2020. The company's focus is on expanding aluminum uses, substituting aluminum for other materials, developing local capacity, changing restrictive legislation and industry standards, promoting exports, and reducing imports.[916] In the longer run, Rusal seeks to sell 75 percent of its aluminum output to Russian markets,[917] and anticipates that its sales in both Russia and other CIS countries will exceed 1 million mt by 2019.[918]

Rusal is reportedly working with the Russian government to increase domestic aluminum consumption to meet these sales targets. To increase consumption, Rusal has indicated that it plans to target the automotive, aerospace, defense, and construction sectors. In addition, Rusal is changing its marketing and sales focus to encourage the export of value-added wrought aluminum products, for example, in an effort to promote local manufacturing.[919]

Rusal is also working with various partners to stimulate domestic aluminum demand and to create new aluminum applications that leverage the infrastructure and skilled labor available from the closure of smelters.[920] The company is pursuing more than 80 projects aimed at increasing aluminum demand in collaboration with the Ministry of Industry and Trade, Aluminum Association of Russia, and other interested parties. The number of projects will reportedly exceed 100 in 2017.[921] In addition, the newly created Aluminum Association of

---

[914] Ibid.
[915] USITC, hearing transcript, September 29, 2016, 310 (testimony of Scott States, Rusal America Corp.).
[916] UC Rusal, "Aluminum Market in Russia and the C.I.S.," January 2016.
[917] Latest World News, "Aluminum Valley' in Krasnoyarsk," October 7, 2016.
[918] Prime, "Russia's RUSAL Wants to Raise Domestic Aluminum Sales," September 13, 2016.
[919] Aluminium Insider, "Symposium Synopsis—2016 Platts Aluminum Symposium," January 29, 2016.
[920] UC Rusal, *Driven by Green Power*, May 5, 2016, 35.
[921] Prime, "Russia's RUSAL Wants to Raise Domestic Aluminum Sales," September 13, 2016.

Russia[922] is developing a number of initiatives to promote domestic aluminum consumption and boost local demand, including the increased use of aluminum for cables, facades, windows, bridges, railway cars, and other products.[923]

Trade

Russia is a large net exporter of aluminum and its products, especially unwrought aluminum. Production is concentrated in primary aluminum, much of which is exported because domestic demand by major consuming industries, such as aerospace and automotive, significantly lags behind demand in other parts of the world.

Unwrought

Russia was the world's leading exporter of unwrought aluminum in 2015, shipping nearly 3.3 million mt to global markets and accounting for 14 percent of these global exports. Japan, Turkey, and the Netherlands were the leading export destinations in 2015 (table 8.9). A spike in unwrought aluminum exports in 2014 is attributable to a quadrupling of exports that year to the Netherlands, where three LME warehouses are located.[924] According to official trade and production statistics, exports of unwrought aluminum accounted for nearly 92 percent of Russia's aluminum exports in 2015, and represented nearly 92 percent of its primary aluminum production.[925] Nearly two-thirds of primary aluminum exports are believed to be unalloyed.[926] Of the total unwrought aluminum export volume, secondary unwrought aluminum alloys are believed to account for about 7 percent, at 240,000 mt. The leading market for secondary alloy exports is Japan, which accounted for 75 percent of such exports.[927] Russia's imports of unwrought aluminum represented approximately 1 percent of its export total (less than 50,000 mt).

[922] The Aluminum Association of Russia was created at the end of 2015. Tara I Upakovka, "Aluminum Producers Consolidated Against Import," 2015. The association's objective is to help develop aluminum-consuming industries through activities such as improving the regulatory framework to encourage new technologies and products, and researching improvements to the legal system to expand the use of aluminum. UC Rusal, written submission to the USITC, February 17, 2017, 10–11.
[923] UC Rusal, written testimony to the USITC, September 12, 2016, 13.
[924] See chapter 2, "Global Overview," for more information on the LME and metal warehouses.
[925] IHS Markit, GTA database (accessed September 22, 2016).
[926] Ibid.
[927] UC Rusal, written submission to the USITC, February 17, 2017, 8.

Table 8.9: Russia: Unwrought aluminum exports (HS 7601), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
Japan	472	588	437	606	495
Turkey	430	420	380	479	428
Netherlands	159	114	140	625	427
United States	224	290	187	321	287
South Korea	298	379	244	247	189
Brazil	3	8	7	167	172
Greece	92	68	81	120	137
Germany	124	94	97	147	123
Poland	73	64	40	45	110
Mexico	43	57	52	39	110
All other	997	836	923	974	787
Total	2,916	2,919	2,588	3,771	3,265

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner country imports.

Wrought

Russia is also a net exporter of wrought aluminum products, although at a much smaller scale than its unwrought aluminum exports. Aluminum wire and plates, sheets, and strip were the leading wrought export categories in 2015, accounting for 74 percent of all of Russia's wrought aluminum exports (table 8.10). Leading export markets for Russia's wrought aluminum in 2015 were Germany, Belarus, the United States, and Poland, accounting for 54 percent (nearly 155,000 mt) of the total (table 8.11).

Table 8.10: Russia: Wrought aluminum exports, by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions					
Bars, rods, and profiles (HS 7604)	53	56	45	47	46
Tubes and pipes (HS 7608)	5	5	4	3	3
Total	58	60	50	50	50
Flat-rolled products					
Plates, sheets, and strip (HS 7606)	106	85	92	96	102
Foil (HS 7607)	29	32	38	37	26
Total	135	117	130	132	129
Wire (HS 7605)	82	95	96	109	110
Total	275	272	276	291	289

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports are based on partner country imports. Because of rounding, total may not equal the sum of the line items.

Table 8.11: Russia: Wrought aluminum exports (HS 7604–7608), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
Germany	80	66	75	76	66
Belarus	26	28	30	30	30
United States	14	21	30	31	30
Poland	19	19	27	19	29
Finland	4	5	9	13	19
All other	133	134	105	122	115
Total	275	272	276	291	289

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner country imports. Because of rounding, total may not equal the sum of the line items.

Russia's imports of wrought aluminum products are concentrated in plate, sheet, and strip; foil; and bars, rods, and profiles, which together accounted for 92 percent of the total (table 8.12). Leading foreign suppliers of wrought aluminum products were China, Belarus, and Germany, accounting for 58 percent (nearly 52,000 mt) of total Russian imports in 2015 (table 8.13).

Table 8.12: Russia: Wrought aluminum imports, by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions					
Bars, rods, and profiles (HS 7604)	16	16	37	35	26
Tubes and pipes (HS 7608)	3	3	4	4	3
Total	19	19	41	39	29
Flat-rolled products					
Plates, sheets, and strip (HS 7606)	42	41	42	36	30
Foil (HS 7607)	25	30	30	31	26
Total	67	70	72	67	56
Wire (HS 7605)	6	5	3	5	4
Imports total	92	95	116	111	90

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal the sum of the line items.

Table 8.13: Russia: Wrought aluminum imports (HS 7604–7608), by source, 2011–15 (thousand mt)

Source	2011	2012	2013	2014	2015
China	35	32	38	33	27
Belarus	0	0	18	21	14
Germany	16	17	14	15	11
Serbia	4	8	9	6	5
Greece	1	2	3	4	5
All other	35	35	34	32	28
Total	92	95	116	111	90

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal the sum of the line items.

Government Policies and Programs

As a 100 percent privately owned company, Rusal has indicated that it does not receive any government assistance, whether it is low-cost energy, tax rebates for exports of its products, or other special assistance programs.[928] However, several Russian programs were identified that may support or influence aluminum industry production and trade as well as market demand. In some cases, further details about these programs and their current status are not readily available.

State Aluminum Reserve

Russia's Ministry of Industry and Trade proposed the establishment of a state reserve facility of nonferrous metals, including up to 1 million mt of aluminum to support future consumption growth in the domestic market.[929] Rusal had suggested the state reserve project, claiming that such a reserve would support domestic aluminum demand. The fund would buy aluminum at the market price and sell it back to Rusal at the same price seven years later.[930] However, the Russian government did not support the reserve, and the proposal was not implemented.[931]

Investment Fund of the Russian Federation

The infrastructure for the power plant associated with Rusal's BEMO smelter was financed by the Investment Fund of the Russian Federation, which was approved by the Russian government to provide 26.4 billion rubles for the project.[932] Russian state-owned organizations indicate that $2.6 billion was spent completing BEMO, which includes the Boguchansky hydroelectric power plant and the Boguchansky aluminum smelter. The complex is one of the largest combined public and private investment ventures attempted in Russia since 1990,[933] and may have the effect of lowering the smelter's production costs.

Scrap Export Duty

Russia's aluminum waste and scrap exports are subject to a 20 percent duty, which is expected to drop to 10 percent in fall 2017 under Russia's commitments to the World Trade Organization

---

[928] UC Rusal, written testimony to the USITC, September 12, 2016, 3.
[929] Hannigan, "UC Rusal: Global Aluminium Industry Overview," May 20, 2014, 8; UC Rusal, written submission to the USITC, February 17, 2017, 25.
[930] TASS, "Deputy PM Supports Setting Up Russian Aluminum State Reserve," August 9, 2013; UC Rusal, "Rusal Sees Aluminum Deficit Driving Delivery Premium," February 21, 2014.
[931] UC Rusal, written submission to the USITC, February 17, 2017, 25.
[932] UC Rusal, *Driven by Green Power*, May 5, 2016, 26.
[933] Poindexter, "Russian US$2.6 Billion Investment," December 23, 2014.

(WTO).[934] Such scrap exports were subject to a duty in excess of 50 percent when initially introduced in 2000.[935] The scrap export duty was applied in part to discourage illegal production of nonferrous scrap by making these products unprofitable or substantially less profitable,[936] but may also have the effect of reducing production costs for Russia's small secondary aluminum industry.

As part of its WTO accession, Russia committed to eliminating export duties on scrap metals, including aluminum, within five years of joining the WTO.[937] However, in 2015 Russia threatened to impose a scrap export ban by adding scrap to a list of commodities that are considered “essential for the domestic market,” which may be subject to temporary export restrictions or prohibitions in exceptional cases. According to the USTR, Russia did expand the list of products for which exports could be restricted or banned, including ferrous steel and nonferrous scrap.[938]

Unwrought Aluminum Export Duties

Although the Russian Federation reported an export duty of 1.25 percent ad valorem on unwrought aluminum alloys[939] under Government Resolution No. 705 of July 25, 2014,[940] Rusal indicates that that these duties have been eliminated.[941] The duties were applied to exports to non-Eurasian Economic Union (EAEU) countries.[942] However, as a condition of its entry into the WTO, Russia committed to freezing or reducing its existing export duties, which are generally applied to raw-material exports.[943]

---

[934] UC Rusal, written submission to the USITC, February 17, 2017, 6.
[935] UC Rusal, “Aluminum Market in Russia and the C.I.S.,” January 2016.
[936] WTO, *Report of the Working Party*, November 17, 2011.
[937] USTR, “Russia,” 2013. The Russian Federation joined the WTO on August 22, 2012.
[938] Ibid., 2016.
[939] HTS classifications 7601.20.9100 and 7601.20.9900.
[940] WTO, “Trade Policy Review: Russian Federation,“ August 24, 2016, 67.
[941] UC RUSAL, written submission to the USITC, February 17, 2017, 22.
[942] WTO, “Trade Policy Review: Russian Federation,” August 24, 2016, 67.
[943] Blackthorne International Transport, “‘Export Whatever You Want!,’” July 25, 2016.

Special Economic Zones

“Aluminum Valley” is a proposed special economic zone (SEZ)[944] in the Krasnoyarsk region of Siberia that would unite the Krasnoyarsk aluminum smelter and other local companies to manufacture downstream aluminum products. The project is being developed by Rusal, the Aluminum Association of Russia, and the government of the Krasnoyarsk territory.[945] Rusal indicated that the project will encourage innovative aluminum production and processing technologies, the use of new and nanostructured materials, and the development of aluminum alloys.[946]

A goal of the SEZ is to attract foreign direct investment and technology.[947] About 10 potential investors currently plan to establish production in the region, with about $300 million of new investment expected.[948] However, Aluminum Valley does not yet have SEZ status, and has neither a management company nor the rights to land and infrastructure for any investors.[949]

Firms located in the SEZ will reportedly have access to the local engineering and transportation infrastructure and will likely benefit from reduced costs because of their closeness to the regional primary aluminum supply.[950] They will also benefit from lower or no taxes; no duties or VATs on imported equipment, components, or materials; and no duties on exported finished goods.[951]

Government Strategy to Develop Ferrous and Nonferrous Metallurgy

The Ministry of Industry and Trade of the Russian Federation has approved a development strategy for nonferrous metallurgy for 2014–20 and to 2030. The strategy, which provides a

---

[944] Special economic zones were established in 2006 to provide favorable customs and tax conditions guaranteed by the government of the Russian Federation. Benefits include (1) tax (income, property, transport, and land) preferences; (2) access to infrastructure for business development; (3) special customs regime (e.g., no customs duty or value-added tax on foreign goods); (4) reduced administrative barriers; (5) access to qualified personnel resources; and (6) a simplified migration regime for highly qualified foreign staff. Ministry of Economic Development of the Russian Federation, Integrated Foreign Economic Information Portal (accessed January 21, 2017).
[945] Latest News Resource, “Deripaska Predicted Krasnoyarsk Krai Investment,” n.d. (accessed January 21, 2017); Latest News Resource, “In Krasnoyarsk Region Will Appear Aluminum Valley,” n.d. (accessed May 2, 2017).
[946] Latest World News, “Aluminum Valley in Krasnoyarsk,” October 7, 2016.
[947] Latest News Resource, “Deripaska Predicted Krasnoyarsk Krai Investment,” n.d. (accessed May 2, 2017) Latest News Resource, “In Krasnoyarsk Region Will Appear Aluminum Valley,” n.d. (accessed January 21, 2017).
[948] UC Rusal, written submission to the USITC, February 17, 2017, 21.
[949] Ibid.
[950] Latest News Resource, “Deripaska Predicted Krasnoyarsk Krai Investment,” n.d. (accessed May 2, 2017); Latest News Resource, “In Krasnoyarsk Region Will Appear Aluminum Valley,” n.d. (accessed January 21, 2017).
[951] UC Rusal, “Industrial Park 'Aluminum Valley' Project,” September 7, 2016.

multiyear framework for the nonferrous industry, outlines a list of possible actions and measures that could be taken to further develop the aluminum industry. If approved by the Russian government, these measures could receive funding allowing them to be implemented.[952] These measures reportedly include policies to promote the use of aluminum in railway cars and in electric power transmission.[953]

Competitive Factors

For the primary aluminum industry, access to lower-priced electricity is a key advantage, as Rusal acknowledges in its 2015 annual report. Rusal indicates that its "competitive position in the global aluminum industry is highly dependent on continued access to inexpensive and uninterrupted electricity supply, in particular, long-term contracts for such electricity."[954] Rusal notes that as a subsidiary of the En+ Group, "En+ is able to influence the outcome of important decisions relating to the Group's business, which includes transactions with certain related parties."[955] Most significantly, Rusal has short- and long-term electricity and supply contracts with companies controlled by En+, as well as contracts for transport logistics services. These contracts are considered connected transactions that are on "normal commercials terms or better."[956]

While electricity access is primary, the firm also considers its in-house research and development (R&D) to be a competitive asset. Furthermore, its vertical integration into the upstream aluminum supply chain likely contributes to an improved competitive position, guaranteeing high-quality raw material supplies. Finally, transportation costs and exchange rates also affect Russia's primary aluminum industry competitiveness (table 8.14). Given the relatively small size of Russia's secondary and wrought aluminum sectors, this section will focus on the primary unwrought aluminum industry.

[952] UC Rusal, written submission to the USITC, February 17, 2017, 25.
[953] Latest News for Traders, "Medvedev Instructed the Ministry of Industry and Trade," April 8, 2016.
[954] UC Rusal, *Driven by Green Power*, May 5, 2016, 66.
[955] Ibid.
[956] Ibid., 95, 114.

Table 8.14: Russia: Select competitive factors for primary unwrought aluminum

Competitive factor	Description
Favorable electricity costs	Russian smelters are largely powered by inexpensive, renewable hydroelectric power.
Access to raw material supplies	Rusal, the sole Russian producer, is vertically integrated into upstream raw material supplies to guarantee availability of high-quality, low-cost bauxite.
High transportation costs	Because the majority of Russian primary aluminum production is located in Siberia, raw-material inputs and primary aluminum exports must travel long distances to reach intended markets.
Technological innovation	Rusal leverages its R&D capabilities to develop advanced technologies to improve efficiency and reduce environmental impact.

Source: Compiled by USITC staff.

Cost Overview

Russia is one of the world's lower-cost producers of primary aluminum, with its principal advantage being access to lower-cost energy, particularly hydroelectric power. The moderate price of electricity helps to offset Russia's transportation costs, which are estimated to be the world's highest among major aluminum producers. With respect to raw materials, Russia's alumina costs were estimated at $604 per mt in 2015, about 7 percent below the world average of $647per mt. These costs declined by 22 percent from the 2011 level of $770 per mt (table 8.15). Russia's dollar-denominated business costs per metric ton of primary aluminum fell below the LME price and below the world average business cost for each year of the period. Russia's dollar-denominated business costs per mt declined by an estimated 38 percent during 2011–15, to $1,220 per mt, in large part because of the substantial depreciation of the ruble and its effect on dollar-denominated production costs. During 2011–15, the ruble fell to record lows against the U.S. dollar, dropping by nearly 50 percent to 60.94 rubles to the dollar.

Table 8.15: Russia: Primary unwrought aluminum average business costs, 2011–15 (dollar per mt of aluminum produced)

Cost component	2011	2012	2013	2014	2015
Alumina	770	713	711	674	604
Electricity	544	515	522	464	408
Labor	108	110	109	87	59
Anode	271	217	180	147	139
Other[a]	222	213	215	195	169
Total liquid metal costs	1,915	1,768	1,737	1,568	1,378
Casthouse	78	76	75	72	62
Net realizations[b]	-31	-274	-324	-290	-219
Average business costs	1,961	1,570	1,488	1,349	1,220
Global average business costs	1,909	1,702	1,589	1,392	1,350
LME cash price ($/mt)[c]	2,395	2,018	1,845	1,867	1,661

Source: CRU Group.
Note: Because of rounding, totals may not equal the sum of the line items.

[a] "Other costs" covers bath material, pot relining, smelter fuel, maintenance and other supplies, sustaining capital, and working capital on supplies.
[b] CRU Group uses the "net realization" cost adjustments to account for variances in products quality impacting production costs, but does not include overhead costs in overall corporate costs.
[c] Global aluminum prices are based on the three-month London Metal Exchange (LME) cash costs as reported by CRU Group.

Low Electric Power Costs Are a Key Competitive Advantage

Access to relatively inexpensive, environmentally friendly, and renewable hydroelectric power is central to the competitive strategy of Rusal and the Russian aluminum industry.[957] Rusal's smelters are largely powered by lower-cost hydroelectricity derived from the many rivers located in south central Russia, which supply 90 percent of Rusal's energy needs.[958] As a result, electricity currently represents about 25 percent of the cost per metric ton of Rusal's Russian smelters.[959] In addition, Rusal has indicated that the carbon intensity of aluminum production is a key competitive condition, as customers increasingly seek to purchase aluminum that is manufactured with a low carbon footprint.[960] To better meet that customer preference, Rusal has set a target to source nearly 100 percent of its purchased energy from non-carbon sources by 2020.[961]

Rusal has been referred to as "a master at finding cheap sources of power."[962] According to En+, Rusal's controlling shareholder, the synergetic nature of aluminum and electricity has led En+ to acquire aluminum and energy companies that can provide low-cost electricity to Rusal's smelters.[963] En+ controls several energy assets that supply electricity to Rusal facilities, including the Ondskaya hydropower plant, which provides 100 percent of the power needs of the Nadvoitsy smelter.[964] En+ Group also owns Russia's largest independent electricity generator, EuroSibEnergo (ESE). ESE generates about 40 percent of Siberia's electricity,[965] and Rusal's smelters in this region have long-term electricity supply contracts with ESE.[966] Rusal's

[957] UC Rusal, *Driven by Green Power*, May 5, 2016, 131; UC Rusal, written testimony to the USITC, September 12, 2016, 13.
[958] UC Rusal, *Driven by Green Power*, May 5, 2016, 8.
[959] UC Rusal, written submission to the USITC, February 17, 2017, 17. Rusal stated in its 2015 annual report that its energy costs represented 27 percent of the total cost of its sales of primary aluminum. UC Rusal, *Driven by Green Power*, May 5, 2016, 51.
[960] USITC, hearing transcript, September 29, 2016 (testimony of Scott States, Rusal). Rusal is a member of the Aluminum Stewardship Initiative, which represents a broad spectrum of aluminum associations, producers and purchasers, and other organizations focused on greater sustainability and transparency in the aluminum industry. See the Aluminum Stewardship Initiative, https://aluminium-stewardship.org/about-asi/.
[961] USITC, hearing transcript, September 29, 2016, 311 (testimony of Scott States, Rusal America Corp.).
[962] Boyarsky, "Aluminum Industry Faces Uncertain Future," August 22, 2012.
[963] En+ Group, "Our History," http://eng.enplus.ru/about/history/?print=Y (accessed February 8, 2017).
[964] UC Rusal, written testimony to the USITC, September 12, 2016, 14.
[965] En+ Group, "Energy," http://eng.enplus.ru/business/energetics/ (accessed February 8, 2017).
[966] En+ Group, "Non-Ferrous Metals," http://eng.enplus.ru/business/energetics/ (accessed February 8, 2017).

Bratsk, Irkutsk, and Krasnoyarsk smelters consume about half of the electricity generated by ESE. This hydroelectric power is supplied to Rusal under long-term contracts, with the electricity price tied to the LME price of aluminum. This pricing relationship reportedly provides "a sustainable and well-balanced development pattern for the two companies."[967]

In 2015, the total value of Rusal's long- and short-term electricity and capacity supply contracts, and of its miscellaneous electricity and capacity transmission contracts with the associates of En+, was $413.1 million. Of this total, long-term contracts for electricity supply accounted for 46 percent ($191.4 million) of total electricity purchases. Short-term contracts accounted for 26 percent ($107.8 million); some of these were contracted with Irkutskaya Energosbytovaya, another company controlled by Rusal's shareholder En+. The remainder represented contracts with Irkutsk Electronetwork, which is also controlled by En+.[968]

Upstream Investments Assure Raw Material Supplies

Although Russia benefits from abundant hydroelectric power, it lacks sufficient high-quality, low-cost domestic bauxite resources for refining into alumina. The quality of Russian bauxite is reportedly inferior to that of many other leading bauxite sources. Hence, securing sufficient high-quality bauxite at competitive prices is considered critical to Rusal.[969] To produce aluminum both efficiently and cost effectively, Rusal has invested in numerous bauxite mines and alumina refineries around the world, both to be certain of having enough bauxite and to benefit from selling bauxite when market conditions are favorable. As a result, nearly 80 percent of its bauxite needs and all of its alumina needs are supplied from internal resources.[970]

Research and Development Leads to Technological Innovation

According to Rusal, one of its major competitive advantages is its in-house R&D activities, engineering capabilities, and design resources, which the company leverages to develop "cutting-edge technologies, state-of-the-art equipment and technically advanced facilities." [971]

[967] En+ Group, "Our History," http://eng.enplus.ru/about/history/?print=Y (accessed February 8, 2017).
[968] UC Rusal, *Driven by Green Power*, May 5, 2016, 95–97.
[969] Ibid., 25.
[970] Ibid., 8; UC Rusal, written testimony to the USITC, September 12, 2016, 5.
[971] UC Rusal, "Innovation," Http://Rusal.Ru/En/Development/Innovations/ (accessed February 7, 2017).

Rusal emphasizes that it is investing in state-of-the-art technology to improve the efficiency and lower the environmental impact of its smelting operations.[972]

In its smelters, Rusal largely employs Söderberg and proprietary Rusal prebaked anode technology (RA-300, RA-400, and RA-500).[973] These are newer technologies; developed to replace those previously relied on by Russian smelters that did not meet international standards. Six of Rusal's eight operating smelters were built before the mid-1960s using older, less efficient, and less environmentally friendly technologies. Rusal has retrofitted and converted older smelting capacity with newer production technologies, such as RA-300; according to Rusal, RA-300 reduces emissions, lowers operating costs, and reduces capital expenditures.[974] Rusal also designed a new generation of Söderberg potlines, referred to as Clean Söderberg, which uses colloidal anode rather than anode paste (colloidal anode contains less pitch than anode paste).[975] Clean Söderberg, which reportedly delivers greater production efficiency and reduced environmental impact, is currently being introduced at Rusal's largest smelters.[976]

Clean Söderberg was put into operation at Krasnoyarsk in 2009, and was then added to the Bratsk, Novokuznetsk, Irkutsk, and Volgograd smelters.[977] RA-300 is installed at the Khakas, Sayanogorsk, and Boguchansky smelters.[978] RA-400 is also installed at the Khakas plant and will be used at the Taishet aluminum plant. A RA-550 potline was added to the Sayanogorsk aluminum smelter in October 2016, with seven additional potlines planned by Rusal for Sayanogorsk. Rusal reportedly intends to use this new, more efficient technology in future smelters as well.[979]

Rusal is also testing inert anode technology, which eliminates the use of carbon and therefore lessens greenhouse gas emissions.[980] Inert anode technology is expected to significantly improve the environmental performance of aluminum smelters by substantially reducing

---

[972] USITC, hearing transcript, September 29, 2016, 311 (testimony of Scott States, Rusal America Corp.).
[973] Each progression of Rusal's proprietary technology refers to the greater amperage employed in potlines. Most modern potlines at leading aluminum smelters operate at amperages of about 300 to 600 kiloamperes. Kvande and Drabløs, "The Aluminum Smelting Process", May 2014; Pingin et al., "RUSAL High-Amperage Technologies", September 2–4, 2010, 287.
[974] UC Rusal, written submission to the USITC, February 17, 2017, 15.
[975] UC Rusal, "Clean Soederberg," http://www.rusal.ru/en/development/ecology/soderberg/ (accessed May 12, 2017).
[976] UC Rusal, written testimony to the USITC, September 12, 2016, 17.
[977] UC Rusal, "Clean Soederberg," http://rusal.ru/en/development/ecology/soderberg/ (accessed May 12, 2017).
[978] UC Rusal, "Khas Aluminium Smelter," http://www.rusal.ru/en/about/39/ (accessed May 2, 2017); UC Rusal, "Sayanogorsk Aluminium Smelter," http://www.rusal.ru/en/about/4/ (accessed May 2, 2017); UC Rusal, written submission to the USITC, February 17, 2017, 16.
[979] Aluminium Insider, "Rusal Debuts Cleaner, More Efficient Electrolysis Cell," October 27, 2016.
[980] Basic Element Company, "RUSAL Presents Its Unique Technology," December 28, 2009; UC Rusal, *Driven by Green Power*, May 5, 2016, 29.

carbon dioxide emissions and by generating oxygen instead. Other expected advantages of this method are lower operating and construction costs for greenfield smelters, for which costs are anticipated to be around 30 percent below those of smelters with traditional production technology.[981] Rusal's inert anode project is being cofinanced by the Skolkovo Foundation to the tune of 750 million rubles. Of this amount, 130 million rubles has been approved.[982]

Distance from Suppliers and Markets Raises Transportation Costs

Russia's aluminum shipments and exports, as well as raw material imports, are transported long distances to and from Rusal's main production facilities in Siberia. These facilities are located 4,500 to 5,500 kilometers (roughly 2,800 to 3,400 miles) from any ports or border crossings.[983] Transportation costs are reported to have a significant impact on the delivered costs of Russian primary aluminum.[984] Estimated metal delivery costs of Russian product totaled $83 per mt in 2015, the highest for all of the global producers examined. Such costs represented nearly 7 percent of the business cost of producing a metric ton of primary aluminum in Russia.

[981] Basic Element Company, "RUSAL Presents Its Unique Technology," December 28, 2009.
[982] Moggridge, "UC Rusal: Pushing Ahead with Inert Anode Development," February 7, 2013.
[983] UC Rusal, written submission to the USITC, February 17, 2017, 18.
[984] UC Rusal, "Energetics," http://www.rusal.ru/en/aluminium/energetics (accessed February 8, 2017).

Bibliography

Aluminium Insider. “Aluminium Prices Stable for First Time in Five Years: Rusal,” September 18, 2016. http://aluminiuminsider.com/aluminium-prices-stable-for-first-time-in-five-years-rusal/.

———. “Global Aluminium Smelters’ Production Costs On Decline,” April 20, 2016. http://aluminiuminsider.com/global-aluminium-smelters-production-costs-on-decline/.

———. “Rusal Debuts Cleaner, More Efficient Electrolysis Cell,” October 27, 2016. http://aluminiuminsider.com/rusal-debuts-cleaner-more-efficient-electrolysis-cell/.

———. “Rusal Plans to Be Russia’s Sole Supplier of Aluminium by 2025,” July 15, 2016. http://aluminiuminsider.com/rusal-plans-to-be-russias-sole-supplier-of-aluminium-by-2025/.

———. “Symposium Synopsis—2016 Platts Aluminum Symposium,” January 29, 2016. http://aluminiuminsider.com/symposium-synopsis-2016-platts-aluminum-symposium/.

Aluminium International Today. “Aluminium's Role in Russian Automotives,” May 14, 2014. http://www.basel.ru/en/in_focus/gazgroup_14_05_2014/.

Arkhangelskaya, Svetlana. “Recycling in Russia—Time to Get Dirty.” Russia Beyond the Headlines, TV-Novosti, August 30, 2016. http://rbth.com/science_and_tech/2016/08/30/recycling-in-russia-time-to-get-dirty_625569.

Basic Element Company. “RUSAL Presents Its Unique Technology to RUSNANO Head.” Press release, December 28, 2009. http://www.basel.ru/en/sectornews/rusalnews_17_12_2009/.

Bidlack, Richard. *Russia and Eurasia*, *2015–2016*. 46th ed. The World Today Series. Lanham, MD: Rowman & Littlefield International, August 2015.

Blackthorne International Transport. “’Export Whatever You Want!’ – Russia Plans to Reduce Export Duties,” July 25, 2016. https://blackthornetransport.co.uk/export-whatever-want-russia-plans-reduce-export-duties/.

Boyarsky, Alexei. “Aluminum Industry Faces Uncertain Future.” Russia Beyond the Headlines, TV-Novosti, August 22, 2012. http://rbth.com/articles/2012/08/22/the_foil_master_17593.html.

Butterworth-Hayes, Philip. “Russia’s Raw Materials Business on the Rise.” *Aerospace America*, January 2008. http://www.aerospaceamerica.org/Documents/Archives/2008/January%202008/INTERNATIONAL%20BEAT_Jan2008.pdf.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Financial Times. “Russia Creates a New National Champion,” August 31, 2006. http://www.ft.com/cms/s/0/95947d7a-388c-11db-ae2c-0000779e2340.html#axzz4LTki2V1D.

Frost & Sullivan. “Russia’s Aluminium Product Manufacturers Have Nothing to Fear from Accession to the WTO, Assures Frost & Sullivan.” Press release, December 4, 2012. http://www.frost.com/prod/servlet/press-release.pag?docid=270403315.

Government of Russia. Ministry of Economic Development of the Russian Federation. Integrated Foreign Economic Information Portal. “Special Economic Zones in Russia—Which and Where.” http://www.ved.gov.ru/eng/investing/sez/ (accessed January 21, 2017).

Halme, Minna. “Putin’s Russia, Where Recycling Is for Crooks.” *Newsweek*, February 4, 2016. http://www.newsweek.com/putins-russia-where-recycling-crooks-422796.

IHS Markit. Global Trade Atlas (GTA) database. https://www.ihs.com/products/maritime-global-trade-atlas.html (accessed various dates).

Kvande, Halvor, and Per Arne Drabløs. “The Aluminum Smelting Process and Innovative Alternative Technologies.” Supplement, *Journal of Occupational and Environmental Medicine* 56, no. 5S (May 2014): S23–S32. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4131935/.

Latest News Resource. “Deripaska Predicted Krasnoyarsk Krai Investment of 17 Billion Rubles,” n.d. https://latestnewsresource.com/en/news/breaking-news-deripaska-sprognoziroval-krasnojarskomu-kraju-investitsij-na-17-milliardov-rublej- (accessed January 21, 2017).

———. “In Krasnoyarsk Region Will Appear Aluminum Valley,” n.d. https://latestnewsresource.com/en/news/breaking-news-v-krasnojarskom-krae-pojavitsja-aljuminievaja-dolina (accessed May 2, 2017).

Latest News for Traders. "Medvedev Instructed the Ministry of Industry and Trade to Prepare for December 20, Strategy of Metallurgy Development through 2030," April 8, 2016. http://en.news-4-traders.ru/medvedev-instructed-the-ministry-of-industry-and-trade-to-prepare-for-december-20-strategy-of-metallurgy-development-through-2030.html.

Latest World News. "'Aluminum Valley' in Krasnoyarsk—A Real Project or Imitation?" October 7, 2016. http://en.news-original.ru/aluminum-valley-in-krasnoyarsk-a-real-project-or-imitation.html.

Metal Bulletin. "Alcoa Sells Russian Mill to Subsidiary of Stupino Titanium Co.," April 8, 2015. https://www.metalbulletin.com/Article/3442965/Alcoa-sells-Russian-mill-to-subsidiary-of-Stupino-Titanium-Co.html.

Mishanina, Anastasia. "Rusal to Halt Aluminum Production at Four of Its Factories." Russia Beyond the Headlines, TV-Novosti, August 30, 2012. http://rbth.com/articles/2012/08/30/rusal_to_halt_aluminum_production_at_four_of_its_factories_17809.html.

Moggridge, Matthew. "UC Rusal: Pushing Ahead with Inert Anode Development." *Aluminium International Today*, February 7, 2013. http://www.aluminiumtoday.com/news/view/uc-rusal-pushing-ahead-with-inert-anode-development.

Pingin, V.V., A.V. Zavadyak, G.V. Arkhipov, M.A. Pak, V.V. Platonov, A.V. Proshkin, A.P. Skachko, and I.I. Puzanov. "RUSAL High-Amperage Technologies—8 Years of Dynamic Evolution." In "Aluminium Reduction Technology," part VI of the proceedings of the Second International Congress—Non-Ferrous Metals, Krasnoyarsk, Russia, September 2–4, 2010. www.congnghe-sx.com/upload/files/part6%281%29.pdf.

Poindexter, Gregory B. "Russian US$2.6 Billion Investment Helps Put 3,000-MW Boguchany Hydroelectric Power Plant Online." HydroWorld.com, December 23, 2014. http://www.hydroworld.com/articles/2014/12/russian-us-2-6-billion-investment-helps-put-3-000-mw-boguchany-hydroelectric-power-plant-online.html.

PRIME. "Russia's RUSAL Wants to Raise Domestic Aluminum Sales 7–8% in 2017," September 13, 2016. http://www.1prime.biz/news/0/%7B556C7901-A2C3-4365-A74F-2F8B27EC2593%7D.uif.

Rusal. *See* UC Rusal.

Rusalit. "Russian Aluminium Casting." Company booklet, n.d. (accessed February 15, 2017).

Scrap Register. “Russia’s Rusal to Produce 5000 mt/Year of Secondary Aluminum for Omen JV,” June 24, 2013. http://www.scrapregister.com/news/988/russias-rusal-to-produce-5000-mtyear-of-secondary-aluminum-for-omen-jv.

Tara I Upakovka. “Aluminum Producers Consolidated against Import,” 2015. http://www.magpack.ru/en/win/2015/6/6-2015-3.html.

TASS. “Deputy PM Supports Setting Up Russian Aluminum State Reserve,” August 9, 2013. http://secure.butb.by/engl/index.php?page=49&date=2013-08-19&id=34901.

———. “Rusal Decides Not to Close Plants with Capacity of 200,000 Tonnes of Aluminum per Year,” June 20, 2016. http://tass.com/economy/883545.

UC Rusal. *Aluminum Crafted by Hydro Energy.* Product catalogue 2016. http://www.rusal.ru/en/clients/products/first_alum/.

———. “Aluminum Market in Russia and the C.I.S.” Slide presentation, January 2016. http://www.rusal.ru/en/press-center/presentations/.

———. *Creating Value: 2016 Annual Report*, 2016. http://www.rusal.ru/en/investors/reports/.

———. *Driven by Green Power: 2015 Annual Report*, May 5, 2016. http://www.rusal.ru/en/investors/reports/.

———. “Industrial Park 'Aluminum Valley' Project.” Slide presentation, September 7, 2016. http://www.rusal.ru/en/press-center/presentations/.

———. *Quality Matters: Interim Report 2016*, August 25, 2016. http://www.rusal.ru/en/investors/reports/.

———. “Rusal Sees Aluminum Deficit Driving Delivery Premium.” Bloomberg, February 21, 2014. https://www.bloomberg.com/news/articles/2014-02-21/rusal-sees-aluminum-deficit-driving-delivery-premium-to-50-1-.

———. “UC RUSAL Announces 2016 Third Quarter and Nine Months Results.” Press release, November 11, 2016. http://www.rusal.ru/en/press-center/press-releases/16111/.

———. “UC Rusal Will Double Aluminium Supplies to Russia in Next Five Years.” Press release, September 28, 2016. http://www.rusal.ru/en/press-center/articles/1587/.

———. Written submission to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 12, 2016.

———. Written testimony submitted to the U.S. International Trade Commission in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 12, 2016.

UC Rusal Australia. "UC RUSAL: Global Aluminium Industry Overview." PowerPoint presentation by John Hannagan, UC Rusal Australia, May 20, 2014. http://www.rusal.ru/upload/iblock/bbb/Analystpresentation%20CRU.pdf.

U.S. International Trade Commission (USITC). Hearing transcript in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

U.S. Trade Representative (USTR). "Russia." *The 2013 National Trade Estimate Report on Foreign Trade Barriers*. Washington, DC: USTR, March 2013. https://ustr.gov/about-us/policy-offices/press-office/reports-and-publications/2013/NTE-FTB.

———. "Russia." *The 2016 National Trade Estimate Report on Foreign Trade Barriers*, n.d. https://ustr.gov/sites/default/files/2016-NTE-Report-FINAL.pdf.

World Trade Organization (WTO). *Report of the Working Party on the Accession of the Russian Federation to the World Trade Organization*, November 17, 2011. https://docsonline.wto.org/dol2fe/Pages/SS/DirectDoc.aspx?filename=t%3A%2Fwt%2Fmin11%2F2.doc&.

———. "Trade Policy Review: Russian Federation," August 24, 2016. https://www.wto.org/english/tratop_e/tpr_e/tp445_e.htm.

Chapter 9
Europe

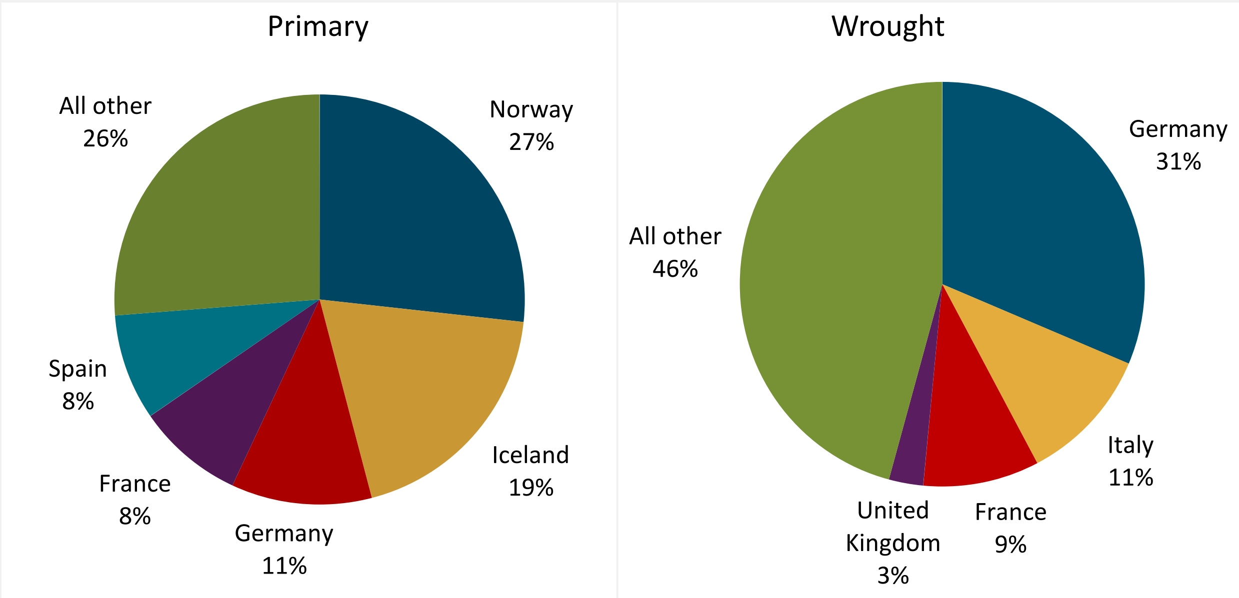
Overview

The European aluminum industry includes the 28 member states of the European Union (EU or EU-28),[985] as well as Iceland, Norway, Switzerland, and others.[986] (It does not, however, include Russia.)[987] These European countries together form the world's second-largest producer region of primary aluminum after Asia.[988] Collectively, European countries are the second-largest producers of secondary aluminum after the United States and of wrought aluminum after China.[989] Europe has substantial production within three segments of the aluminum value chain: primary unwrought, secondary unwrought, and wrought aluminum. European production and exports are heavily concentrated in two countries—Norway for primary unwrought aluminum and Germany for secondary unwrought and wrought aluminum (figure 9.1). As most trade in Europe is intraregional, this chapter largely focuses on these two countries.

---

[985] The EU member states are Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.
[986] Albania, Armenia, Belarus, Bosnia, Georgia, Macedonia, Moldova, Montenegro, Serbia, and Ukraine.
[987] Information and statistics in this chapter are based on CRU Group's Western Europe and Eastern Europe countries, excluding Russia. The European Aluminum Association data for Europe includes Turkey but does not include Georgia or Armenia, unless otherwise noted. See chapter 8 for more information about the Russian aluminum industry.
[988] CRU Group. See chapters 5 and 7 for more information about the Chinese and GCC countries aluminum industries, respectively.
[989] WBMS, "Aluminum, Secondary Production," *World Metal Statistics, 2016 Yearbook*, 2017, 13. See chapter 4 for more information about the U.S. aluminum industry.

Figure 9.1: Europe: Share of primary and wrought aluminum production by countries, 2011–15



Source: CRU Group.
Note: Because of rounding, total may not equal 100 percent. Corresponds to appendix table L.39.

Norway's abundance of cheap hydroelectric power (hydropower) largely accounts for its competitive advantage in the production of primary aluminum. Germany, on the other hand, has areas with geographically concentrated industries that attract secondary and wrought aluminum facilities. German secondary producers benefit from ready access to large quantities of domestically generated scrap. In addition, German wrought producers benefit from close commercial relationships with their customers, particularly for research and development (R&D) collaborations.[990] Moreover, investments in advanced technology have enhanced Germany's competitiveness in manufacturing flat-rolled products suitable for the European aerospace and automotive industries.[991]

[990] Grave et al., *Electricity Costs of Energy Intensive Industries*, July 2015, 53; industry representative, telephone interview by USITC staff, February 28, 2017; ECORYS, *Competitiveness of the EU Non-ferrous Metals Industries*, 2011, 13.
[991] See "Competitive Factors" below.

Industry Structure

The European industry operates in almost all stages of the aluminum supply chain, from alumina refining through wrought production and scrap recovery, but not bauxite mining.[992] As of 2016, the European industry comprised over 600 facilities in the three segments of primary unwrought, secondary unwrought and wrought aluminum; these facilities are located in 30 countries.[993] The unwrought aluminum segment consists of 28 primary smelters[994] and a large network of secondary facilities. The wrought aluminum segment is capable of producing nearly every type of wrought product.[995]

Many vertically or horizontally integrated multinational aluminum firms operate in Europe, along with numerous smaller European-based producers in the secondary and wrought segments. The leading European producing firms include Norsk Hydro ASA (Hydro), based in Norway (with smelters located in Norway and Germany); Alcoa Corp. (Alcoa), based in New York (with operations in Iceland, Norway, and Spain); Rio Tinto Group (Rio Tinto), based in the United Kingdom (UK) (Iceland and France); and Trimet Aluminum SE (Trimet), which is based in Germany and produces there.[996]

Although 15 European countries operated primary smelters during 2011–15, Norway and Iceland accounted for nearly one-half of the region's production, followed by Germany, France,

---

[992] European Aluminum, *Common Goals, Shared Action,* April 2015, 16; European Aluminum, *Blueprint 2016–2019*, September 2016, 3.

[993] European Aluminum, *Common Goals, Shared Action,* April 2015, 16; European Aluminum, *Blueprint 2016–2019,* September 2016, 3; European Aluminum, Data: Industry by Plant (accessed January 5, 2017).

[994] Norway has 7 smelters, Germany has 5, Iceland and Spain both have 3, France has 2, and eight other European countries each have 1 smelter apiece. With respect to Iceland, Alcoa Corp. and Century Aluminum Co. (both U.S.-based multinational firms), and the Rio Tinto Group (a UK-based multinational firm) each own 1 of the 3 operating smelters. All 3 of these smelters were operational before 2011–15. Iceland's smelting capacity may increase in the near future. Press reports indicate that a fourth smelter is being built in Skagabyggth (northwest Iceland) as an Icelandic-Chinese joint venture, largely with Chinese funding by the China Nonferrous Metal Industry's Foreign Engineering and Construction Corporation (NFC). In addition, Century Aluminum has stated that it expects to resume construction of a new smelter in Helguvik (frozen since 2008) if a favorable deal on electricity can be reached. The smelter in Turkey is excluded from the European total of 28. European Aluminum, Data: Industry by Plant (accessed January 5, 2017); Arnarsdóttir, "Chinese to Fund New Smelter in Northwest Iceland," July 3, 2015; CenturyAluminium.com, "Helguvik, Iceland," http://centuryaluminum.com/plants-products/helguvik-iceland/ (accessed June 2, 2017).

[995] See, e.g., CRU Group; European Aluminum, http://www.european-aluminium.eu/; see also the section "Germany: Secondary Unwrought and Wrought Aluminum," below in this chapter.

[996] European Aluminum, Data: Industry by Plant (accessed January 5, 2017); Hydro, "Hydro Worldwide," http://www.hydro.com/en/about-hydro/hydro-worldwide/; Alcoa, "Locations," http://www.alcoa.com/global/en/who-we-are/locations/default.asp; Trimet, "About Trimet," http://www.trimet.eu/en/ueber_trimet; Rio Tinto, "Aluminum Projects and Operations," http://www.riotinto.com/aluminium-83.aspx#map/operations (all accessed February 28, 2017).

and Spain, which together often from accounted for another one-quarter.[997] The smelters in Norway (hydropower) and Iceland (hydropower and geothermal power) benefit from low-cost electricity, while others located throughout the rest of Europe must rely on higher-cost electricity, coal-fired or nuclear sources.[998] High energy costs, coupled with falling aluminum prices and lower consumption demand, forced the closure of three European smelters—at Vlissingen in the Netherlands (December 2011), Lynemouth in the UK (March 2012), and Portovesme in Sardinia, Italy (2014).[999] Over this five-year period, European smelting capacity shrank by 10 percent,[1000]and smelter employment declined by nearly one-quarter (24 percent). But productivity improved as the number of workers per thousand metric tons (mt) of output declined by 17 percent (table 9.1).

Table 9.1: Europe: Primary unwrought aluminum industry employment, production, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	19,384	16,054	15,066	14,683	14,743
Production (1,000 mt)	4,694	4,240	4,228	4,212	4,352
Productivity (workers/1,000 mt)	4.1	3.8	3.6	3.5	3.4
Average wages ($/hr) [a]	34.96	33.63	35.35	36.00	31.25

Source: CRU Group.
[a] Average wages based on CRU Group's Western Europe average. Western Europe accounted for 92 percent of European primary production during 2011–15.

The vast majority of measurable European secondary production occurs in the EU countries and Norway. Germany and Italy account for over one-half of the European secondary output, while Norway and Spain combined accounted for close to one-quarter of output.[1001] Secondary production is attractive in Europe because it is significantly less energy intensive than primary smelting and there are large and increasing quantities of domestically generated scrap available within the region. About 71 percent of secondary capacity in Europe is held by remelters that provide secondary unwrought aluminum to wrought product mills.[1002] Reportedly, the EU has produced more secondary than primary unwrought aluminum since 2005.[1003]

[997] Excludes Turkey from the count of producing countries. European Aluminum, Data: Industry by Plant (accessed January 5, 2017); CRU Group.
[998] Moya and Boulamanti, *Production Costs from Energy-Intensive Industries*, 2016, 36; Buchan, *Costs, Competitiveness and Climate Policy*, April 2014, 5.
[999] European Aluminum, "Data: Focus on EU Smelters," March 24, 2016; Jones-Merlin, "The Closure of the Lynemouth Aluminum Smelter," April 2012; Zalco, "History of Zalco," http://zalco.nl/en/history (accessed January 10, 2017); Djukanovic, "No Threat of Closure," December 1, 2016; Platts, "Alcoa to Permanently Shutter Portovesme," August 25, 2014; industry representative, telephone interview by USITC staff, October 11, 2016.
[1000] CRU Group.
[1001] Based on 2011–15. WBMS, "Aluminum, Secondary Production," *World Metal Statistics, 2016 Yearbook*, 2017, 13.
[1002] European Aluminum, *Recycling Aluminum*, September 2015, 15.
[1003] CPES, *Final Report Aluminum*, October 1, 2013, 83, 101.

Europe maintains a large, diverse, and competitive wrought products segment. The European industry is heavily oriented toward flat-rolled products (FRPs) to supply its transportation and packaging markets.[1004] Most of the world's largest multinational wrought producers, including Atlanta-based Novelis Inc., Amsterdam-based Constellium, Oslo-based Sapa Group and Hydro, and Cleveland-based Aleris International Inc. (Aleris), have production facilities in at least one European country. Many of these firms are vertically integrated upstream into unwrought production. While wrought production is spread across Europe, Germany accounted for the largest share of the region's output, followed by Italy and France. Specifically, roughly one-fifth of Europe's more than 60 rolling mills and more than 40 percent of Europe's rolling capacity are located in Germany.[1005]

Norway: Primary Unwrought Aluminum

Norway's aluminum industry is highly concentrated in primary unwrought aluminum production, with 7 smelters, or one-quarter of Europe's 28 smelters in 2016 (table 9.2). The primary aluminum industry in Norway is highly consolidated and export oriented because domestic demand is limited. Two multinational companies operate Norwegian smelters, Hydro[1006] with 5 smelters, accounting for more than three-quarters of Norwegian primary production in 2015, and Alcoa with 2 smelters.[1007] During 2011–15, smelter employment fell by 18 percent (table 9.3).[1008] Despite a rise in labor productivity (the number of workers per thousand mt of output fell by 25 percent), workers' average hourly wages fell by 11 percent in dollar terms, in part due to depreciation of the Norwegian krone against the U.S. dollar.

[1004] CRU Group.

[1005] Excluding rolling mills in Turkey. European Aluminum, Data: Industry by Plant (accessed January 5, 2017).

[1006] While Hydro is a publicly traded multinational, the Norwegian government is a part owner of the firm with a 30–40 percent ownership share, depending on the year. Industry representative, telephone interview by USITC staff, November 14, 2016; Norwegian Ministry of Trade, *The State Ownership Report 2015*, October 2016, 56.

[1007] Multinational producer Rio Tinto exited the Norwegian primary segment with the 2014 sale of its former smelter, Søral (now Husnes), to Hydro.

[1008] Many Norwegian smelters include anode production facilities and casthouses. See, e.g., Hydro, "Hydro Worldwide: Norway," http://www.hydro.com/en/About-Hydro/Hydro-worldwide/Norway/ (accessed July 25, 2016).

Table 9.2: Norway: Primary unwrought aluminum smelters, 2017

Smelter	Owner	Year established	Operational status	Capacity (thousand mt)
Sunndal	Hydro	1954	Operating	400+
Årdal	Hydro	1986	Operating	204
Karmøy[a]	Hydro	1967	Operating	190
Alcoa Mosjoen	Alcoa	1962	Operating	188
Alcoa Lista	Alcoa	1971	Operating	96
Husnes[b]	Hydro	1965	Operating	90
Høyanger	Hydro	1918	Operating	64

Source: Alcoa, "Alcoa Lista," http://www.alcoa.com/locations/norway_lista/en/home.asp (accessed July 25, 2016); Hydro, "Hydro Worldwide: Norway," http://www.hydro.com/en/About-Hydro/Hydro-worldwide/Norway/(accessed July 25, 2016); Hydro, *Annual Report*, 2015, 4, 90; Hydro, "Hydro Husnes," http://www.hydro.com/no/hydro-i-norge/var-virksomhet/her-finner-du-oss/husnes/hydro-husnes/ (accessed July 25, 2016, and January 6, 2017); Norsk Hydro, "Her finner du oss"[You'll Find Us Here], http://www.hydro.com/no/Hydro-i-Norge/Var-virksomhet/Her-finner-du-oss/ (accessed July 25, 2016); Alcoa, "Norway," http://www.alcoa.com/norway/no/default.asp (accessed January 6, 2017).

[a] Hydro is building an new smelting facility at Karmøy that is expected to add 200,000 mt of capacity annually. The new facility will use Hydro's HAL4e technology and HAL4e Ultra technology.

[b] Formerly known as Søral, acquired by Hydro in 2014 from Rio Tinto.

Table 9.3: Norway: Primary unwrought aluminum industry employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	3,142	3,010	2,607	2,555	2,584
Production (1,000 mt)	1,126	1,138	1,160	1,173	1,213
Productivity (workers/1,000 mt)	2.8	2.6	2.2	2.2	2.1
Average wages ($/hr)	40.70	39.61	41.44	42.33	36.11

Source: CRU Group.

There were no smelter closures or new smelters constructed in Norway during 2011–15, though Hydro is expanding the capacity of its Karmøy facility by 200,000 mt per year; completion is anticipated by the end of 2017.[1009] Nevertheless, most Norwegian smelters are fairly small, and even the relatively large Sunndal plant is roughly one-half the size of the largest new smelters in China.[1010] Most smelters have been in operation for at least half a century in Norway, although the smelting technology has been updated at older plants.[1011] Smelters are located on the coastline, which gives ready access to European export markets. The majority of

[1009] Hydro is building three new potlines. Hydro, "Hydro to Build the Karmøy Technology Pilot," February 16, 2017.

[1010] NASDAQ, "Norsk Hydro: Capacity Increase," December 3, 2002; Hydro, Primary Production, October 3, 2016.

[1011] The vast majority of Norwegian smelters currently use prebake anode technology, which is more efficient than the once common Söderberg technology. By contrast, Alcoa Lista uses new Söderberg carbon anode technology instead of prebake. Alcoa, "Alcoa Lista," http://www.alcoa.com/locations/norway_lista/en/home.asp (accessed July 25, 2016); Hydro, "Hydro Worldwide: Norway," http://www.hydro.com/en/About-Hydro/Hydro-worldwide/Norway/ (accessed July 25, 2016); Hydro, *Annual Report, 2015*, 4, 90; Hydro, "Hydro Husnes," http://www.hydro.com/no/Hydro-i-Norge/Var-virksomhet/Her-finner-du-oss/Husnes-Sor-Norge-Aluminum-AS/ (accessed July 25, 2016, and January 6, 2017); Hydro, "You'll Find Us Here," http://www.hydro.com/no/Hydro-i-Norge/Var-virksomhet/Her-finner-du-oss/ (accessed July 25, 2016); Alcoa, "Norway," http://www.alcoa.com/norway/no/default.asp (accessed January 6, 2017).

Norwegian unwrought aluminum is exported because of the very limited demand from the country's small domestic downstream industry.

Although no alumina refineries operate in Norway, both Hydro and Alcoa are self-sufficient in alumina because they own bauxite mines and alumina refineries abroad. Both firms have upstream operations in Brazil, while Alcoa has additional operations in Australia and Spain.[1012]

Germany: Secondary Unwrought and Wrought Aluminum

Germany is among Europe's largest producers of secondary unwrought and is the largest producer of wrought aluminum. Its manufacturing is characterized by highly integrated supply chains, regional industry concentration, and close connections to other German manufacturers.[1013] Most aluminum-producing facilities are concentrated in two broad regions of the country.[1014] The first region consists of the western, northwestern, and central parts of the country, where secondary aluminum facilities and rolling and extrusion mills are located.[1015] The western part is also home to three of the four German primary smelters. The second region is in the southwest,[1016] where the heart of the German automotive industry is found; it has secondary aluminum facilities and extrusion mills as well as a rolling mill.

Secondary Unwrought Aluminum

Germany is one of Europe's largest secondary unwrought aluminum producers, with over 30 facilities.[1017] Among these is the world's largest aluminum recycling plant, Novelis Deutschland's Nachterstedt facility, with an annual production capacity of 400,000 mt of sheet ingot.[1018] Many large firms are involved in German secondary production, including German-based Trimet and multinationals Hydro and Novelis.[1019] These firms often locate their

[1012] Alcoa, "What We Do: Alumina"; Alcoa, "What We Do: Bauxite"; Hydro, "Brazil" (all accessed July 25, 2016).
[1013] Manufacturing accounted for 30.5 percent of Germany's GDP in 2014. GDA, "Business Activity in Aluminum Sector Mixed," September 1, 2016; Rutten, *The Energiewend*e, 2014, 16.
[1014] European Aluminum, Data: Industry by Plant (accessed January 6, 2017).
[1015] This region stretches from the state of North Rhine-Westphalia (in western Germany), across the south of Lower Saxony and Bremen (in northwestern Germany), to Saxony-Anhalt (in central Germany).
[1016] Aluminum production is especially concentrated in the state of Baden-Württemberg.
[1017] European Aluminum, *Recycling Aluminum*, September 2015, 2.
[1018] Novelis, "Geographic Locations," Europe, http://novelis.com/about-us/locations/ (accessed February 7 2017); WMW, "World's Largest Aluminum Recycling Plant," October 10, 2014.
[1019] See, e.g., European Aluminium, *Recycling Aluminum*, September 2015, 2; Trimet, "Locations," http://www.trimet.eu/en/ueber_trimet/standorte/soemmerda (accessed February 21, 2017); Hydro, "Germany," http://www.hydro.com/en/about-hydro/hydro-worldwide/germany/ (accessed February 8, 2017).

secondary facilities near to or within either primary or wrought production facilities, aimed at ensuring the availability and lowering the cost of new scrap.[1020]

Many of the large multinational companies operating in Germany have expanded their secondary facilities since 2011, encouraged by access to reliable sources of scrap in the German market, government policies that encourage recycling, and consumers interested in increasing the use of recycled materials.[1021] This development includes the new recycling center opened in 2011 at Aluminum Norf GmbH (AluNorf), jointly owned by Novelis and Hydro, and the enormous recycling center opened by Novelis in Nachterstedt, Germany, in 2014. Novelis has a stated goal that 80 percent of its wrought products will be manufactured from recycled aluminum by 2020.[1022] More recently, in 2016, Hydro invested in new secondary operations at its facility in Nuess, with a capacity to melt down 50,000 mt of used beverage cans (UBCs) annually.[1023]

Wrought Aluminum

German wrought production is concentrated in FRPs and is dominated by multinational firms.[1024] Constellium and Aleris both have rolling mills,[1025] while Hydro and Novelis both operate several rolling mills as well as their AluNorf joint venture.[1026] AluNorf, reportedly the world's largest rolling mill, has both hot- and cold-rolled production lines. The firm estimated

---

[1020] See, e.g., European Aluminum, "Data: Industry by Plant," http://www.european-aluminium.eu/data/industry-overview/european-overview-aluminium-plants-location/ (accessed January 6, 2017).

[1021] See the "Government Policies and Programs" and the "Competitive Factors" sections below. Also, some automakers, including BMW and Mercedes, are reportedly supportive of increasing recycled content in automobiles. See, e.g., Ludwig, "JLR Gets Real about Recycled Aluminum Loops," July 22, 2016; Daimler, "Aluminum Bodyshell in the New Mercedes-Benz SL," November 22, 2011; Reed Exhibitions, "Recycling Pavilion at Aluminum 2016," June 29, 2016.

[1022] Mayr, "Novelis Opens New Automotive Aluminum Sheet Line," November 15, 2015; WMW, "Aluminum Recycling Expansion," March 2, 2011. Secondary aluminum is usually requires less energy to produce and is less expensive than primary aluminum.

[1023] Hydro also has a remelting plant at Rackwitz and recycling at Dormagen. See, e.g., *Recycling Today*, "Hydro Starts Up Its New Plant in Germany," May 8, 2016; Hydro, "Hydro Enters into New Long-Term Power Contract," June 2, 2016; Hydro, "Hydro Worldwide: Germany," http://www.hydro.com/en/about-hydro/hydro-worldwide/germany/ (accessed December 4, 2016).

[1024] Aluminum extrusions and wire are produced by firms based in Germany, and to a lesser extent, neighboring countries. Industry consultant, telephone interview by USITC staff, March 7, 2017.

[1025] Aleris, "Rolled Products Germany GmbH," https://www.aleris.com/locations/aeris-rolled-products-germany-gmbh/ (accessed February 16, 2017); Constellium, "Industrial Platform," http://www.constellium.com/Aluminum-company/manufacturing-recycling-plants (accessed February 16, 2017).

[1026] Hydro, "Germany," http://www.hydro.com/en/about-hydro/hydro-worldwide/germany/ (accessed December 4, 2016); Novelis, "Geographic Locations, Europe," http://novelis.com/about-us/locations/ (accessed February 7 2017); AluNorf, "About Us," https://www.alunorf.de/alunorf/alunorf.nsf/id/about-us-en (accessed February 7 2017).

that its production of over 1.5 million mt of FRPs was three-quarters of total German rolled aluminum output in 2014.[1027]

The German FRP sub-segment is diverse in output. Increasingly, however, it is focused on producing for the transportation sector, as more and more aluminum is being used in the production of motor vehicles. Novelis opened a new automotive sheet production line with state-of-the-art equipment at its Nachterstedt plant in 2015.[1028] The Nachterstedt plant also produces other rolled products, including building products and sheet for aluminum cans.[1029] Hydro added a new rolling line at the Grevenbroich facility to increase its capacity for auto-body sheet by 150,000 mt in 2015.[1030] In addition, some manufacturers use state-of-the-art technology to create differentiated products that meet higher technical specifications for the aerospace industries. The Aleris mill in Koblenz produces plate for aerospace applications and is part of the Airbus Group's supply chain.[1031] As a result of the new capacity, total employment from rolling mill production grew over 5 percent to 6,346 workers during 2011–15 (table 9.4). Productivity improved slightly over this period, but wages fluctuated in dollar terms.

Table 9.4: Germany: Aluminum rolling mill employment, productivity, and wages, 2011–15

Attribute	2011	2012	2013	2014	2015
Employment (number, full-time equivalent)	6,032	6,098	6,222	6,259	6,346
Productivity (workers/1,000 mt)	3.5	3.5	3.4	3.3	3.4
Average wages ($/hr)	42.08	39.71	42.01	43.43	38.66

Source: CRU Group.

[1027] AluNorf, "Economic Relevance (as at 2014)," https://www.alunorf.de/alunorf/alunorf.nsf/id/economic-relevance-en (accessed February 7, 2017).
[1028] This brings Novelis' capacity for just the automotive industry to 350,000 mt in Europe as a whole annually. Mayr, "Novelis Opens New Automotive Aluminum Sheet Line," November 19, 2015.
[1029] Novelis, "Geographic Locations, Europe," http://novelis.com/about-us/locations/ (accessed February 7 2017).
[1030] *Aluminum Insider*, "Norsk Hydro Opens €45 Million Recycling Plant," May 7, 2016.
[1031] In addition, German-based Otto Fuchs produces extruded and other aluminum products for aerospace applications as part of the Airbus supply chain. Aleris, "Rolled Products Germany GmbH," https://www.aleris.com/locations/aeris-rolled-products-germany-gmbh/ (accessed February 16, 2017); Airbus Group, "Airbus Procurement Organisation and Major Suppliers," June 5, 2015, 4; Schüco, "The Otto Fuchs Group," https://www.schueco.com/web2/sy/company/about_schueco/otto_fuchs_group (accessed February 16, 2017); Otto Fuchs, "Aerospace Industry," http://www.otto-fuchs.com/en/business-areas/aerospace-industry.html (accessed February 16, 2017).

Production

Primary Unwrought Aluminum

Between 2011 and 2015, Europe's share of global primary aluminum production continued its long-term decline, falling from 10 percent to about 8 percent while production expanded in China and the Gulf Corporation Council (GCC) countries.[1032] High energy costs in a number of European countries, coupled with falling aluminum prices and lower consumption demand in the wake of the 2009 global financial crisis, led to the closure of three smelters and drove down Europe's primary production by 7 percent during 2011–15 (table 9.5). These reductions were somewhat offset by increasing production in European countries that have access to less-expensive energy (Norway and Iceland) or offer exemptions to certain electricity fees (Germany).[1033]

European primary production became more concentrated in Norway, Iceland, Germany, and France as the remaining producers' output declined by one-third, or by more than 650,000 mt, between 2011 and 2015. Already established as the largest primary producer in Europe, Norway's production rose 8 percent during 2011–15. In part, this was in response to the anticipated increase in global demand for primary aluminum as a substitute for other products, including steel in automobiles and copper in cables.[1034] As a result, Norway's share of European production rose by almost 4 percentage points, and its capacity utilization increased from 86 percent in 2011 to 92 percent in 2015.

Table 9.5: Europe: Primary unwrought aluminum production, capacity, and capacity utilization, 2011–15

Attribute/producer	2011	2012	2013	2014	2015
Production (1,000 mt)					
Norway	1,126	1,138	1,160	1,173	1,213
Iceland	805	816	838	848	855
Germany	432	408	492	531	542
France	334	349	351	379	417
Spain	412	352	349	353	349
All other	1,585	1,177	1,038	928	976
Total	4,694	4,240	4,228	4,212	4,352
Capacity (1,000 mt)					
Norway	1,305	1,318	1,318	1,318	1,318
Iceland	812	823	847	849	864
Germany	630	630	630	630	632
France	453	404	404	412	415
Spain	408	411	411	411	411

[1032] CRU Group.
[1033] See the "Government Policies and Programs" section below.
[1034] Hydro, *Annual Report 2015*, 6; Alcoa, *Annual Report 2015*, 6; Hydro, *Annual Report 2013*, 7.

Attribute/producer	2011	2012	2013	2014	2015
All other	2,103	2,033	1,957	1,699	1,518
Total	5,711	5,619	5,566	5,318	5,157
Capacity utilization[a] (%)					
Norway	86	86	88	89	92
Iceland	99	99	99	100	99
Germany	69	65	78	84	86
France	74	86	87	92	100
Spain	101	86	85	86	85
All other	75	58	53	55	64
Total	82	75	76	79	84

Source: CRU Group.
[a] Capacity utilization may exceed 100 percent based on available data and due to rounding.
Note: Because of rounding, total may not equal the sum of the line items.

Secondary Unwrought Aluminum

Based on available data, Europe accounted for an average of 26 percent of annual global production of secondary unwrought aluminum during 2011–15.[1035] Over this same period, European secondary production rose by 3 percent.[1036] Germany's output was relatively stable at about 620,000 mt during 2011–15, ranking it as the second-largest producer in Europe behind Italy, and the fifth largest worldwide.[1037]

Wrought Aluminum

As a region, Europe is the second-largest producer of wrought aluminum products after China.[1038] Between 2011 and 2015, Europe's share of global wrought production dropped from 17 percent to 14 percent, while China expanded its output.[1039] Annual European production was stable throughout the period—within 2 percent of the period average of 7.9 million mt—although it trended higher during 2014–15 (table 9.6). During 2011–15, 60 percent of European wrought production consisted of FRPs. Aluminum extrusions accounted for about 35 percent of

[1035] WBMS, "Aluminum: Secondary Production," 2017, 13. Because Europe has a large number of producers with recycling facilities attached to smelters or wrought plants, it is likely that actual secondary production is higher than the data presented here suggest. See, e.g., European Aluminum, Data: Location by Plant (accessed January 5, 2017); Hydro, "Hydro Worldwide," http://www.hydro.com/en/About-Hydro/Hydro-worldwide/ (accessed November 5, 2017).
[1036] WBMS, "Aluminum, Secondary Production," 2017, 13.
[1037] Historically, Germany was Europe's largest secondary producer and the world's fourth largest, but it has not yet returned to the annual average levels of 784,000 mt achieved in the pre-recession period of 2006–08. However, a large portion of Germany's secondary production is likely not captured in these data. This is because many German wrought facilities have in-house secondary production through closed-loop systems and because a number of German producers expanded capacity during the period. WBMS, "Aluminum, Secondary Production," 2017, 13.
[1038] CRU Group.
[1039] Ibid.

wrought production during this period, but generally trended downward—almost 4 percent lower in 2015 than in 2011. This decrease was due in part to lower demand from the construction industry, a major consumer of extruded aluminum products.[1040]

Table 9.6: Europe and Germany: Wrought aluminum production, capacity, and capacity utilization, 2011–15 (thousand mt)

Attribute	2011	2012	2013	2014	2015
Production (1,000 mt)					
Europe					
Flat-rolled products	4,537	4,536	4,657	4,761	4,761
Extrusions	2,887	2,733	2,714	2,806	2,782
Wire and cable	509	509	497	512	515
Total	7,932	7,778	7,868	8,079	8,058
Germany					
Flat-rolled products	1,835	1,854	1,933	1,952	1,899
Extrusions	603	552	556	591	587
Wire and cable	21	23	23	23	21
Total	2,459	2,430	2,512	2,567	2,507
Capacity, flat-rolled products (1,000 mt)					
Europe	5,855	5,900	5,974	6,097	6,167
Germany	2,158	2,188	2,188	2,188	2,208
Capacity utilization, flat-rolled products (%)					
Europe	77	77	78	78	77
Germany	85	85	88	89	86

Source: CRU Group.
Note: Because of rounding, total may not equal the sum of the line items.

Germany is the largest producer of wrought aluminum in Europe, accounting for 31 percent of European and 4 percent of global production in 2015.[1041] During 2011–15, German production trended higher, although not consistently: during the last three years, 2013–15, production averaged about 2.5 million mt annually, up from the 2.4 million mt average during 2011–12. Germany is a major producer of FRPs, which accounted for over three-quarters of its wrought aluminum production during 2011–15. The vast majority of the remaining semi-finished production was of extrusions, which accounted for about 23 percent of Germany's wrought aluminum production during the period.

[1040] CRU Group; Trading Economics, “Euro Area Construction Output” (accessed February 16, 2017); European Aluminum, written submission to the USITC, October 7, 2016, 12.
[1041] CRU Group.

Consumption

Unwrought Aluminum

Although European consumption of primary unwrought aluminum increased during 2011–15, its share of global consumption fell from 17 percent to about 14 percent during this period, largely due to rapidly growing consumption in China (table 9.7).[1042] According to available secondary consumption data, roughly 34 percent of the aluminum ingot consumed in European wrought production originated from recycled scrap in 2015, up from 29 percent in 2011.[1043]

European consumption of unwrought aluminum of both primary and secondary origin grew 13 percent between 2011 and 2015.[1044] The driving force behind this is the increased consumption of aluminum in the region's transportation and packaging industries.[1045] Use of aluminum by these industries is being encouraged in many countries by EU policies, including those which mandated increased recycling of vehicles parts and packaging materials and encourage vehicle light weighting to reduce carbon dioxide emissions.[1046] The German wrought aluminum industry, which is the largest in Europe, is also the region's largest consumer of unwrought aluminum.

Table 9.7: Europe: Primary unwrought aluminum consumption by country, 2011–15 (thousand mt)

Country	2011	2012	2013	2014	2015
Germany	2,077	2,063	2,073	2,188	2,215
Italy	891	776	784	837	881
France	569	538	572	611	637
Spain	590	556	532	553	548
Belgium	350	345	317	298	289
Greece	216	219	256	259	269
Austria	293	264	244	237	253
Switzerland	214	195	200	216	238
Norway	222	207	211	226	233
All other	2,038	1,993	2,037	2,092	2,150
Total	7,460	7,156	7,226	7,517	7,713

Source: CRU Group.
Note: Because of rounding, total may not equal the sum of the line items.

[1042] Ibid.
[1043] World Aluminum data include both new and old scrap (e.g., scrap used by remelters and refiners) that has been sold on the market. USITC staff calculations based on World Aluminum data for 2011 and 2015 (2015 is the most recent year available). World Aluminum, "Global Aluminum Flow" (accessed May 8, 2017).
[1044] USITC staff calculations based on World Aluminum data for 2011 and 2015 (2015 is the most recent year available). World Aluminum, "Global Aluminum Flow" (accessed May 8, 2017).
[1045] See, e.g., OICA, Production Statistics 2011–15; GDA, "Business Activity in the Spring of 2015," May 21, 2015, 1.
[1046] See the "Government Policies and Programs" section below. See also, e.g., McKinsey, *Lightweight, Heavy Impact*, February 2012; European Aluminum, *Aluminum in Cars*, n.d. (accessed May 11, 2017).

Wrought Aluminum

As a region, Europe is the world's second-largest consumer of wrought aluminum after China. Much of this consumption is driven by the region's growing transportation manufacturing sector. FRPs, which are major inputs to the transportation sector, represented 57 percent of European wrought aluminum consumption in 2015 (table 9.8).[1047] The three largest end-use sectors—transportation, construction, and packaging—accounted for about 60 percent of wrought aluminum consumption in Europe during 2011–15. The majority of European consumption is supplied by production within the region.[1048] Overall, Germany accounted for 31 percent of European wrought consumption during 2011–15, and its trends were largely similar to the overall European trends.

Table 9.8: Europe: Consumption of wrought aluminum by form and end-use, 2011–15 (thousand mt)

Attribute	2011	2012	2013	2014	2015
By form					
Flat-rolled	4,446	4,332	4,442	4,576	4,669
Extrusions	3,080	2,899	2,841	2,969	2,949
Wire and cable	641	617	593	625	625
Total	8,166	7,848	7,876	8,170	8,243
By end-use					
Transport	1,676	1,711	1,757	1,913	2,016
Construction	1,979	1,824	1,799	1,871	1,873
Packaging	1,104	1,119	1,151	1,178	1,199
Machinery and equipment	966	909	933	963	955
Electrical	994	917	888	921	924
Foil stock	754	723	690	690	675
Consumer durables	393	335	339	356	358
Other	300	310	321	279	242
Total	8,166	7,848	7,876	8,170	8,243

Source: CRU Group.
Note: Because of rounding, total may not equal the sum of the line items.

Trade

Most European aluminum trade is intraregional,[1049] facilitated by geographic proximity and well-developed transportation links. Such trade is further encouraged by the regional economic integration achieved through the EU and by the European Economic Area (EEA) Agreement. The

[1047] CRU Group.
[1048] During 2011–15, European consumption of FRPs was about 4 percent below production, but Europe's consumption exceeded production of extrusions by 6 percent and of wire and cable by 18 percent. CRU Group.
[1049] Europe (excluding Russia) is the world's largest importer and exporter when including intra-EU trade. Excluding intra-EU trade, Europe is the world's largest importer and the third-largest exporter of unwrought aluminum. IHS Markit, GTA database (accessed September 22, 2016).

EEA Agreement gives 31 European countries[1050] duty-free access to each other's markets, including the region's largest aluminum-producing and -consuming countries.[1051] Most unwrought and wrought aluminum sourced from outside the EEA Agreement face tariffs, which are mostly low (below 10 percent).[1052] In addition to tariffs, as of 2017 the EU has three active antidumping orders on certain aluminum foil products: China is covered by two of these orders, and Russia by one.[1053]

Unwrought Aluminum

Exports

During 2011–15, European countries accounted for approximately one-third of global unwrought aluminum exports, the majority of which were intraregional (table 9.9).[1054] The three largest producers—Norway, Iceland, and Germany—are also the largest European exporters. The leading European exporter is the Netherlands, although it is not among the larger producers of unwrought aluminum. The Netherlands also hosts large aluminum warehouses for the London Metal Exchange (LME) and is a major regional transshipment point with several seaports.[1055] Export data for the UK, and to a lesser extent for Germany, also likely include some regional transshipments.[1056]

[1050] The 28 EU members, plus Norway, Iceland, and Liechtenstein.
[1051] EFTA, "European Economic Area—EEA Agreement," http://www.efta.int/ (accessed January 25, 2017).
[1052] European countries not in the EU maintain their own tariff schedules with different duty rates. For example, Switzerland maintains specific duties on aluminum products, most of which are 22–29 Swiss francs (approximately $22-29 as of May 2017) per 100 kg gross, while Norway does not maintain any duties on aluminum products. Norwegian Customs Tariff, http://tolltariffen.toll.no/templates_TAD/Tolltariffen/StartPage.aspx?id=312480&epslanguage=en (accessed January 11, 2017); WTO, Tariff Download Facility: Switzerland HS2016, http://tariffdata.wto.org/default.aspx (accessed April 10, 2017); Swiss Exchange, https://www.six-swiss-exchange.com/services/currency_cross_rates_matrix_en.html (accessed May 16, 2017).
[1053] EC, Commission Implementing Regulation (EU) 2015/2384, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R2384&from=EN; EC, Commission Implementing Regulation (EU) No 217/2013, http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:069:0011:0020:EN:PDF; EC, Commission Implementing Regulation (EU) 2015/2385, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R2385&from=EN.
[1054] Although Europe exported more aluminum by the end of 2015 than it did in 2011, its share of exports declined because of growing exports in other regions of the world.
[1055] For more information on LME's warehouses and global aluminum stocks, see the "stocks" section in chapter 2.
[1056] The UK has over 15 secondary facilities, but since the closure of the Lynemouth smelter, it has had only limited primary production (47,000 mt during 2012–15). IHS Markit, GTA database (accessed September 22, 2016); CRU Group; European Aluminum, Data: Industry by Plant (accessed March 6, 2017).

Table 9.9: Europe: Leading exporters of unwrought aluminum (HS 7601), 2011–15 (thousand mt)

Exporter	2011	2012	2013	2014	2015
Netherlands	2,140	1,744	1,725	1,999	1,873
Norway	1,432	1,362	1,298	1,320	1,252
Iceland	771	718	279	739	319
Germany	450	349	358	343	487
United Kingdom	509	401	318	332	330
All other	2,598	2,484	2,592	2,676	2,728
Total	7,901	7,058	6,570	7,408	6,989

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Export figures are based on figures for partner country imports. The fluctuations in Iceland's exports in 2013 and 2015 are likely the result of data reporting errors in the trading partners' import data (a.k.a. "mirror data") being used in this report: Icelandic export data do not show similar fluctuations. As a result, exporters were ranked on total exports for 2011–15 rather than for 2015 alone. Because of rounding, total may not equal the sum of the line items.

Norway is the largest exporter of unwrought aluminum in Europe (other than the Netherlands, which primarily is a transshipper) and is the fifth-largest exporter globally.[1057] Nearly all of Norway's exports are primary aluminum. The vast majority of its exports go to other European countries—almost 99 percent on average during 2011–15.[1058] Norway's exports generally trended lower—by 13 percent during 2011–15 (table 9.10)—largely because of increased competition from Russia and from the United Arab Emirates (UAE), both among the world's lower-cost producing countries.

Table 9.10: Norway: Unwrought aluminum exports (HS 7601), top destinations and the United States, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
Netherlands	950	910	880	834	743
Spain	54	73	93	102	116
Sweden	161	114	96	112	105
Poland	0	33	51	71	74
Denmark	60	52	30	43	58
United States	2	7	18	9	14
All other	205	173	130	149	142
Total	1,432	1,362	1,298	1,320	1,252

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Export figures are based on figures for partner country imports. The United States was the 10th-largest destination for Norway's unwrought aluminum exports in 2015. Because of rounding, total may not equal the sum of the line items.

[1057] Most exports attributed to the Netherlands were produced in other countries, including Norway. As noted in the previous section, the Netherlands is not a major producer of primary aluminum—it has one primary plant and several recycling plants—but has a major European port and serves as an important export and import point into Europe.
[1058] Norway's largest non-European export destination during this period was the United States. However, while Norway's exports to the United States fluctuated significantly on an annual basis, they never exceeded 1.5 percent of its total exports.

Imports

Europe accounted for one-half of global unwrought aluminum imports during 2011–15. The largest European importers of unwrought aluminum are countries with sizable wrought industries (Germany, Italy, and France) or that serve as entry points for the European market (the Netherlands and Belgium) (table 9.11). Imports from outside Europe are necessary to meet European consumption demand because, on average, primary unwrought aluminum consumption exceeded its production by 45 percent during 2011–15. The largest non-regional supplier is Russia, followed by the UAE.[1059]

Table 9.11: Europe: Leading importers of unwrought aluminum (HS 7601), 2011–15 (thousand mt)

Importer	2011	2012	2013	2014	2015
Germany	2,536	2,443	2,414	2,591	2,526
Netherlands	2,145	1,959	2,062	2,514	2,199
Italy	1,047	845	993	1,116	1,132
France	540	412	473	562	539
Belgium	626	549	532	466	516
All other	3,949	3,613	3,558	3,846	3,812
Total	10,842	9,821	10,033	11,096	10,724

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal the sum of the line items.

Germany is the largest importer of unwrought aluminum in Europe and is the third-largest importer in the world after the United States and Japan. Germany imports substantially more unwrought aluminum than it exports—often more than six times as much annually during 2011–15.[1060] This reflects demand for unwrought aluminum from the large German wrought aluminum sector. While German imports fluctuated annually, they were generally close to the 2.5 million mt period average for 2011–15 (table 9.12). Germany sourced the vast majority from other European countries.[1061] Imports from the UK fell noticeably due to the closure of the Lynemouth smelter, while imports from the UAE rose almost 27 percent annually on average during 2011–15.

[1059] Based on EU imports. In 2015, the EU imported 1.2 million mt of unwrought aluminum from Russia, 600,000 mt from the UAE. IHS Markit, GTA database (accessed September 22, 2016).
[1060] IHS Markit, GTA database (accessed September 22, 2016).
[1061] The Netherlands has supplied over 40 percent of German unwrought imports since 2012. While some of this product is of Dutch origin—the Netherlands has one primary plant and several recycling plants—most of it was produced in other countries, including Norway. The supplier mix of Dutch imports was rather erratic during 2011–15, but Norway was consistently the largest supplier and never supplied less than one-third of imports. Other large suppliers included Russia and Iceland. IHS Markit, GTA database (accessed July 19, 2017); European Aluminum, Data: Industry by Plant (accessed February 15, 2017).

Table 9.12: Germany: Unwrought aluminum imports (HS 7601), by source, 2011–15 (thousand mt)

Source	2011	2012	2013	2014	2015
Netherlands	972	1,022	1,001	1,127	1,068
United Kingdom	338	284	217	242	228
United Arab Emirates	77	114	130	154	199
France	144	143	127	137	176
Austria	121	136	140	154	168
All other	885	743	798	777	687
Total	2,536	2,443	2,414	2,591	2,526

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal the sum of the line items.

Wrought Aluminum

Exports

European countries are major exporters of wrought aluminum products, accounting for almost one-half of global wrought exports during 2011–15 (table 9.13). For most of this period, European exports of wrought products grew, driven primarily by increasing exports of plate, sheet, and strip. The largest wrought producer, Germany, accounted for about one-quarter (26 percent) of wrought exports by European countries; France, Italy, Spain, and Austria combined accounted for another 27 percent. As with unwrought aluminum, most wrought exports are intraregional.

Table 9.13: Europe: Leading exporters of wrought aluminum (HS 7604–7608), 2011–15 (thousand mt)

Exporter	2011	2012	2013	2014	2015
Germany	1,838	1,815	1,804	1,862	2,059
France	665	638	599	600	582
Italy	607	552	611	628	635
Spain	376	383	403	434	449
Austria	388	367	350	364	366
All other	3,086	2,977	3,101	3,168	3,238
Total	6,960	6,732	6,869	7,056	7,331

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner country imports. Because of rounding, total may not equal the sum of the line items.

German exports of wrought aluminum products are also mostly intraregional, with about 80 percent sent to other European countries during 2011–15. German exports, despite initially declining from 2011 through 2013, rose 12 percent over this five-year period (table 9.14). Plate, sheet, and strip accounted for the largest share of German exports, increasing their share from 62 percent in 2011 to 69 percent in 2015. About three-quarters (77 percent) of German plate, sheet, and strip exports were to other European countries during 2011–15. German exports of these products rose by almost 6 percent annually during that period and were increasingly concentrated in the three largest markets—the United Kingdom, Belgium, and France (table 9.15). The UK and France are two of the four largest vehicle producers in Europe, and generate increasing demand for FRPs.[1062] Belgium depends on imports for its FRPs because of its limited domestic rolling capacity.[1063]

Table 9.14: Germany: Wrought aluminum exports, by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions	351	363	288	296	289
Bars, rods, and profiles (HS 7604)	261	316	252	256	252
Tubes and pipes (HS 7608)	90	47	36	40	37
Flat-rolled products	1,454	1,428	1,485	1,527	1,741
Plates, sheets, and strip (HS 7606)	1,133	1,132	1,172	1,206	1,412
Foil (HS 7607)	321	296	313	321	329
Wire (HS 7605)	33	24	32	39	29
Total	1,838	1,815	1,804	1,862	2,059

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner country imports. Because of rounding, total may not equal the sum of the line items.

Table 9.15: Germany: Aluminum plate, sheet, and strip exports (HS 7606), by destination, 2011–15 (thousand mt)

Destination	2011	2012	2013	2014	2015
United Kingdom	212	200	198	268	372
Belgium	84	83	99	138	155
France	121	118	103	98	102
Poland	81	89	88	89	85
Italy	79	76	72	60	70
All other	556	566	612	552	627
Total	1,133	1,132	1,172	1,206	1,412

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Exports based on partner country imports. Because of rounding, total may not equal the sum of the line items.

Imports

Europe accounted for about one-half of world imports of wrought aluminum; most were sourced from other European countries.[1064] The largest wrought importers are countries with

[1062] See, e.g., OICA, Production Statistics: 2011–15; Kayakiran, "Auto Industry Drives Comeback," January 28, 2015; European Aluminum, Data: Industry by Plant (accessed February 15, 2017).
[1063] European Aluminum, Data: Industry by Plant (accessed February 15, 2017).
[1064] IHS Markit, GTA database (accessed September 22, 2016).

large populations and manufacturing sectors, particularly for automobiles.[1065] Germany, France, and the UK are three of the four largest automakers in Europe (table 9.16).

Table 9.16: Europe: Leading importers of wrought aluminum (HS 7604–7608), 2011–15 (thousand mt)

Importer	2011	2012	2013	2014	2015
Germany	1,613	1,499	1,449	1,559	1,702
United Kingdom	711	695	720	802	863
France	764	769	777	782	808
Netherlands	525	466	456	494	544
Italy	569	493	510	498	515
All other	3,131	2,874	2,985	3,192	3,369
Total	7,313	6,796	6,896	7,326	7,799

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal the sum of the line items.

Germany is the world's largest importer of wrought products, despite being an overall net exporter;[1066] it accounted for about 11 percent of global imports during 2011–15. Throughout this period, over three-quarters of imports were either of plate, sheet, and strip, or of bars, rods, and profiles (table 9.17). Between 2011 and 2015, the share of imports held by plate, sheet, and strip grew from 43 percent to 52 percent, driven by rising demand in the automotive industry.[1067] Between 2011 and 2015, almost 90 percent of German imports of wrought products were from other European countries.

Table 9.17: Germany: Wrought aluminum imports, by product form, 2011–15 (thousand mt)

Product form	2011	2012	2013	2014	2015
Extrusions	628	562	513	532	526
Bars, rods, and profiles (HS 7604)	561	503	456	477	471
Tubes and pipes (HS 7608)	67	59	57	55	56
Flat-rolled products	876	834	833	915	1,064
Plates, sheets, and strip (HS 7606)	697	653	642	723	877
Foil (HS 7607)	180	181	192	191	187
Wire (HS 7605)	109	103	102	112	111
Total	1,613	1,499	1,449	1,559	1,702

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: Because of rounding, total may not equal the sum of the line items.

[1065] Excluding the Netherlands, which, as discussed earlier, has a large LME warehouse and is a transshipment point for wrought aluminum. OICA, Production Statistics: 2011–15; UNDESA, World Population Prospects: Total Population, 2015.
[1066] Germany's manufacturers are major consumers of aluminum; however, since Germany can serve as a point of entry for the EU, some of these products maybe destined for other EU markets. IHS Markit, GTA database (accessed September 22, 2017).
[1067] Bars, rods, and profiles accounted for 28 percent of German wrought imports in 2015.

Government Policies and Programs

Germany is impacted not only by its own national policies but also by EU laws and regulations;[1068] to a lesser extent this also holds true for Norway, although it is not an EU member (box 9.1). EU policies cover many areas that directly or indirectly affect the EU aluminum market. Those include policies on environmental protection, climate change, energy production, commodity markets, trade, and competition, in addition to general business and labor regulations.[1069] The most notable of these policies are those creating a low-carbon economy, improving air quality, and reducing pollution and waste (table 9.18).[1070]

Box 9.1: How EU legislation Affects Norway and Iceland

Norway and Iceland are not member states of the EU. Aluminum producers in those two countries, however, are subject to certain EU laws and have access to the EU market under the 1994 European Economic Area (EEA) Agreement. This agreement covers all EU member states and three European Free Trade Association (EFTA) member states: Iceland, Liechtenstein, and Norway.[a]

Under the EEA Agreement, Norway and Iceland follow EU legislation in many areas, including the “four freedoms,” which are the freedom of movement for goods, people,[b] services, and capital.[c] Under the freedom of movement for goods, Norway and Iceland enjoy duty-free access to EU member countries for their aluminum, boosting their price competitiveness in the EU market.[d] Per the EEA Agreement, Norway and Iceland also follow what the European Commission (EC) terms “flanking policies,” which include environmental, transport, and competition policies.[e] This subjects Norwegian and Icelandic aluminum producers to the EU’s rigorous environmental policies and many of their associated costs, although Norwegian environmental policies can reportedly sometimes be as stringent.[f]

[a] The EFTA also includes Switzerland. EFTA, “EEA Agreement,” (accessed January 25, 2017).
[b] In addition, Norway and Iceland are members of the Schengen Area, which allows free movement of people between countries. The Schengen Visa Info, “Schengen Area Countries List,” 2017.
[c] EFTA, “EEA Agreement,” (accessed January 25, 2017); EC, “Countries and Regions: Norway” (accessed January 25, 2017); EC, “Countries and Regions: Iceland," (accessed May 16, 2017).
[d] EFTA, “EEA Agreement,” (accessed January 25, 2017); Norway EU Ministry, “The European Economic Area Agreement,” October 8, 2016.

[1068] One policy area of note is Germany's energy policies, commonly known as *Energiewende* (energy transition). The Energiewende is intended to move the country away from electricity generated from high-carbon sources (e.g., coal) and nuclear energy to low-carbon renewable energy. The centerpiece of the Energiewende is the Renewable Energy Source Act (known by its German acronym, EEG) of 2000, as amended, that established policies intended to improve energy efficiency and encourage the development of renewable energy. But they have also significantly raised electricity costs in Germany for most consumers. Reportedly, the rule of thumb is that the more energy a Germany company consumes, the lower its electricity prices are—in part because of exemptions that are given to energy-intensive industries, including primary aluminum. See, e.g., Frondel et al., “Economic Impacts,” 2010, 4049; EuroActive.de, “Germany to Cut Rebates for Industry,” March 28, 2014; Agora Energiewend, *Understanding the Energiewende*, 2015; Morris, “28 Billion Annually for the Energiewende?” September 2, 2015.
[1069] EU competition policies not only govern mergers and antitrust regulations but also govern aid given to businesses by member states. An extensive list of EU laws and regulations in eight policy areas governing aluminum production, sales, and trade has been compiled by the Center for European Policy Studies (CEPS). CPES, *Assessment of the Cumulative Cost Impact,* October 1, 2013, 37–38, 108–239.
[1070] EC, "Environment: Environment Action Programme to 2020," June 8, 2016.

[e] EFTA, "EEA Agreement" (accessed January 25, 2017); EC, "Countries and Regions: Norway" (accessed January 25, 2017). EC, "Countries and Regions: Iceland," (accessed May 16, 2017).
[f] For example, Norway has made a series of increasingly ambitious pledges to reduce its greenhouse gas emissions starting with the Kyoto pledge and has established its own emissions trading system plan, which was fully harmonized with the EU's Emissions Trading System in phase 3. EDF and IETA, "Norway, The World's Carbon Markets," May 2013, 1–2.

Table 9.18: European Union: Select environmental, recycling, and waste policies affecting the aluminum industry

Policy/regulations	Description
Environmental policies	The majority of these policies increase regulatory costs for most aluminum producers.
EU Emissions Trading System (ETS)	The ETS is a "cap and trade" system to reduce greenhouse gas emissions. Since entering into force in 2005, emissions reduction standards have been raised in three phases: 2005–07, 2008–12, and 2013–20. Primary smelters were indirectly impacted as electric-power generators were covered by the ETS. During Phase 3 (2013–20), the ETS began directly covering aluminum industry emissions of carbon dioxide and perfluorocarbons. Under state-aid guidelines, the EU allows offsets of increased electricity costs related to the ETS to downstream aluminum producers, although in May 2012, offsets were capped at about 50 percent of costs. Reportedly, most EU countries have not funded such offsets.
Regulation for Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and associated legislation	REACH's stated goal is to protect humans and the environment from harmful chemicals, while preserving the competitiveness of EU chemical industries. Compliance with REACH increases administrative expenses for aluminum producers. Under REACH, producers must register covered chemicals and provide information about their use in the supply chain, which requires systems to track and share this information. Registration requirements are applicable to a number of substances if imported directly by the primary aluminum industry, including aluminum oxide, as well as hydrated and aluminum fluoride.
State aid	The main state aid measures that apply to the aluminum industry include aid aimed at environmental protection measures that go beyond what EU rules require and aid to offset increased electricity costs resulting from the ETS. State aid is regulated by the European Commission, and some programs have been struck down: relatively few programs are currently funded.
Industrial Emissions Directive (IED)	Producers of alumina and aluminum are required to obtain an IED permit that sets "Emission Limit Values based on Best Available Techniques." The IED requires environmental inspections every one to three years.
Recycling and waste policies	These policies generally increase the availability of aluminum and other types of scrap.
Waste Framework Directive (WFD)	The WFD establishes waste management requirements and responsibilities, and promotes waste prevention, potentially increasing secondary metal supply. It sets principles that most EU waste regulations follow for reducing, reusing, and recycling. The "polluter pays" principle assigns responsibility for the cost of waste management to waste producers.
End-of-Life-Vehicles (ELV) Directive	The ELV directive promotes the recycling of inputs, including the use of aluminum in motor vehicles. As of January 1, 2015, the reuse and recovery rate was set at a minimum of 95 percent (by weight) of vehicles, and the reuse and recycling rate at a minimum of 85 percent.
Packaging and Packaging Waste Directive	This directive promotes the reduction of packaging waste and the increase of recycling, potentially expanding supplies of secondary metals. Aluminum is one of the main metallic packaging materials, especially for beverage containers.
Landfill Directive	The Landfill Directive provides landfill classifications and landfill operations guidance. It seeks to reduce landfill waste, potentially increasing secondary metal supply.
WFD End-of-Waste	WFD end-of-waste criteria define the conditions under which aluminum scrap ceases

Policy/regulations	Description
Criteria	to be considered waste. By not being categorized as waste, aluminum scrap is able to be exported to third countries.

Source: Roberts, "Indirect Co2 Emissions," July 11, 2012; Alcoa, "The Indirect Effects of EU's ETS" (accessed January 9, 2017); CPES, *Assessment of the Cumulative Cost Impact*, October 1, 2013; EC, *Guidelines on State Aid for Environmental Protection and Energy 2014–2020* (accessed February 6, 2017); EC, *Guidelines on Certain State Aid Measures in the Context of the Greenhouse Gas Emission Allowance Trading Scheme Post-2012* (accessed February 6, 2017); EC, *Guidelines on Certain State Aid Measures*, June 5, 2012; EC, "State Aid: Greece," July 13, 2011; EC, "State Aid: Commission Decides on Two German Support Schemes," July 17, 2013; EC, *Directive 2010/75/EU of the European Parliament and of the Council on Industrial Emissions*, November 24, 2010; EC, *Environment: Waste: Waste Framework Directive: End-of-Waste Criteria*, June 6, 2016; EC, *Council Regulation (EU) No 333/2011 of 31 March 2011 Establishing Criteria Determining When Certain Types of Scrap Metal Cease to be Waste*, April 8, 2011; ECORYS, *Competitiveness of the EU Non-ferrous Metals Industries*, 2011, 90; EC, *Directive 2008/98/EC of the European Parliament and of the Council on Waste and Repealing Certain Directives*, November 19, 2008; EC, *Directive 94/62/EC on Packaging and Packaging Waste*, December 20, 1994; Eurostat, Packaging Waste Statistics, May 2016; EC, *Directive 1999/31/EC on the Landfill of Waste*, April 26, 1999; industry consultant, Interview by USITC staff, September 28, 2016, and March 7, 2017.

Competitive Factors

Norway: Primary Unwrought Aluminum

Norway's principal competitive advantage in primary aluminum production is its hydroelectric power, which provides inexpensive electricity to smelters. The Norwegian primary industry has other competitive advantages as well. These include its technical innovations, particularly those seeking to develop more energy-efficient smelting methods, and its secure supply of alumina from external sources (table 9.19). Despite being among the more cost-competitive producers worldwide, Norwegian smelters' average cost of production (COP) was typically higher than that of two of their key competitors—Russia and the UAE.[1071]

Table 9.19: Norway: Select competitive factors for primary aluminum

Competitive factor	Impact on competitiveness
Business environment	Competitiveness is enhanced by a relatively good business environment, as measured by the World Bank's Ease of Doing Business Index (where Norway ranked in the top 5 percent for 2015–16).
Exchange rate	During the period, smelters benefited from currency devaluations, which lowered the costs of some key inputs in dollar terms, including alumina. See below for further detail.
Energy costs	Norway's competitiveness is enhanced by its ability to utilize hydroelectric power, which provides less expensive energy. See below for further detail.
Proximity to the European market	Norway is advantaged by being close to the large European market, which has substantial demand for primary aluminum. This proximity also enhances its reliability as a supplier to European customers. Norway also has good transportation links with the rest of Europe. Competitiveness is enhanced by Norway's membership in the EEA Agreement, which provides freedom of movement of goods and duty-free entry to

[1071] This is because Norway's costs for one or both key inputs—electricity and alumina—was higher in most years during 2011–15. Russia's COP was close, but slightly lower than Norway's COP in most years. The GCC countries were among the countries with the lowest costs of production in the world (see chapter 7, "Gulf States," and chapter 8, "Russia"). CRU Group.

Competitive factor	Impact on competitiveness
	the large EU market.
Research and development (R&D)	Norway has a strong reputation for aluminum-related R&D. See below for further detail.
Smelter scale	Norway's smelters are relatively small, especially compared to new facilities, including those in China and the GCC countries, and therefore are not as able to take advantage of economies of scale.
Technology	Norwegian smelters primarily use the industry standard prebake technology. However, technology upgrades are being made: the Karmøy smelter is expanding and will use Hydro's newly developed HAL4e technology and HAL4e Ultra technology, which are expected to have lower-than-average energy consumption.
Upstream alumina supply	Smelters in Norway are self-sufficient in alumina through Hydro's and Alcoa's ownership of bauxite mines and alumina refineries in third countries.

Source: European Aluminum, written submission to the USITC, October 7, 2016; industry consultant, interview by USITC staff, September 28, 2016; industry representative, telephone interview by USITC staff, November 14, 2016. Alcoa, "What We Do: Alumina" (accessed February 13, 2017); Alcoa, "What We Do: Bauxite" (accessed February 13, 2017); Hydro, "Brazil" (accessed January 5, 2017). OECD, Dataset: World Indicators of Skills for Employment: Labour Productivity (accessed February 3, 2017); BLS, ILC of Hourly Compensation Costs, table 1.1, August 9, 2013; IMF, IMF Exchange Rates: Euros and USD, January 01, 2011–December 31, 2015; WEF, "Competitiveness Rankings, Germany," September 29, 2015; World Bank, Development Indicators (accessed January 17, 2017). Norsk, "Hydro Worldwide: Norway" (accessed July 25, 2016); Norsk, *Annual Report 2015*, 2016; Hydro, *Annual Report 2010*, 2011; Alcoa, "Norway" (accessed January 6, 2017).

Cost Overview

During 2011–15, Norway's average COP fell by about 35 percent to $1,274 per mt because all of its major input costs declined in dollar terms throughout the period (table 9.20). Alumina is Norway's largest input cost, accounting for on average 36 percent of liquid metal production costs during 2011–15. In that period, average Norwegian alumina costs declined about 19 percent, principally because producing alumina in Brazil became less expensive due to declining fuel costs and the depreciation of the Brazilian real against the U.S. dollar.[1072] Reflecting its access to inexpensive energy, power was Norway's second-largest input cost, accounting for on average 26 percent of liquid metal production costs.[1073] In addition, power and other domestic costs, including labor, were incurred in Norwegian kroner, which also depreciated against the U.S. dollar in 2014 and 2015.[1074]

[1072] Both Hydro and Alcoa produce alumina in Brazil, and on average, Norway imported 72 percent of its alumina (HS 2818.20) from Brazil during 2011–15. IHS Markit, GTA database (accessed February 3, 2017); Norrgren, "Strong US Dollar, Weak Fuel Prices and Bauxite Barter Lead," June 24, 2016; Forte, "Brazil Real Currency Falls," March 7, 2015; Aglionby, "Petrobras: Timeline of a Scandal," February 4, 2015; Sambo, Orr, and Godoy, "Brazilian Real Drops," September 22, 2015; Alcoa, "What We Do: Alumina" (accessed February 13, 2017); Hydro, "Brazil" (accessed January 5, 2017).

[1073] CRU Group; Roberts, "Aluminum Smelter Power Tariffs," May 19, 2015.

[1074] Falling oil prices were the initial cause of the Norwegian krone's devaluation, although in 2015 other factors reportedly contributed, including the Greek debt crisis, changes in global stock markets including in China, and cuts in interest rates by the Norwegian Central Bank. IMF, representative rates for the period January 01, 2011–December 31, 2015 (accessed November 10, 2016); Berglund, "Norway's 'Krone' Caught in a Storm," July 21, 2015; Berglund, "Krone Falls and Rises," August 25, 2015; Pandey, "Norwegian Krone Tumbles," September 24, 2015.

Table 9.20: Norway: Primary unwrought aluminum average business costs, 2011–15 (dollars per mt of primary aluminum)

Cost component	2011	2012	2013	2014	2015
Alumina	762	666	641	639	614
Electricity	529	521	523	496	390
Labor	184	171	154	151	126
Anode	373	346	293	269	247
Other[a]	307	286	241	245	210
Total liquid metal costs	2,154	1,990	1,851	1,800	1,587
Casthouse	160	147	134	132	118
Net realizations[b]	-340	-378	-399	-589	-433
Average business costs	1,974	1,758	1,588	1,345	1,274
Global average business costs	2,041	1,766	1,639	1,541	1,435
LME cash price	2,395	2,018	1,845	1,867	1,661

Source: CRU Group.
Note: Because of rounding, total may not equal the sum of the line items.
[a] Other costs cover bath material, pot relining, smelter fuel, maintenance and other supplies, sustaining capital, and working capital on supplies.
[b] CRU Group uses the net realization cost adjustments to account for variances in products quality impacting production costs.

Low Electric Power Costs—A Key Competitive Advantage

Norway's global competitiveness in primary aluminum is largely based on the availability of low-cost electricity.[1075] Norway's natural-resource endowment——mountainous terrain with abundant water flows from rain, lakes, and snowmelt——creates ideal conditions for generating hydroelectric power, which provides about 96 percent of the country's electricity needs.[1076] In fact, the construction of Norway's hydroelectric infrastructure was the driving force behind the establishment of the country's primary aluminum industry in the early 1900s.[1077]

In addition to cheap hydropower, Norwegian smelters have long-term power contracts that provide greater pricing stability for producers and, during 2011–15, prices that were lower than

[1075] Norwegian industrial electricity prices are low for a member of the Organization for Economic Co-operation and Development (OECD) and for a European country in particular—they were about 60 percent below the European average during 2011–15. Only Iceland, with its hydropower and geothermic power, has similarly cheap energy in Europe. In the EU, power can account for as much as 40 percent of the total cost of production of primary unwrought aluminum. IAE, Energy Prices and Taxes, Fourth Quarter 2016, 351; Moya and Boulamanti, *Production Costs from Energy-Intensive Industries*, 2016, 36**;** Buchan, *Costs, Competitiveness and Climate Policy*, April 2014, 5.
[1076] Based on 2011–14, most recent years available. World Bank, Indicators: Infrastructure: Electricity Production from Hydroelectric Sources, October 14, 2016; Joint Norwegian-German Declaration, "Norway's Indirect Storage" (accessed November 15, 2016); Hydro, "From Power to Water" (accessed November 15, 2016); Gonzalez, Kilinc, and Weidemann, *Renewable Energy Development,* 2011, 17.
[1077] Moen, *Innovation and Production in the Norwegian Aluminum Industry*, 2007, 8.

the domestic industrial average.[1078] Hydro purchases electricity from the national grid through a mix of medium- to long-term contracts.[1079] As of 2016, Hydro had assured contract power supplies for its Norwegian smelters through 2030.[1080] Alcoa obtains most of its power through long-term contracts and currently has a 20-year contract (valid until 2020) with Vattenfall, a major Swedish-owned power company.[1081] The EU's Emissions Trading System (ETS) (table 9.18) had a relatively minor impact on Norwegian smelters because hydropower does not generate carbon dioxide emissions (see box 9.2).[1082] Therefore, indirect electricity prices for Norwegian smelters did not increase with the introduction of the ETS as they did in countries with higher carbon-content electricity sources.[1083]

Box 9.2: EU Environmental Polices Raise Production Costs, Albeit Unevenly

The cost of complying with EU environmental policies, especially the ETS, puts many European facilities that are subject to these regulations at a competitive disadvantage.[a] In 2011, a research and consulting company, ECORYS, found that environmental compliance costs are higher in the EU than in other countries, particularly Russia, China, the GCC countries, and other developing countries.[b] The impact of these policies affects producers at different points in the value chain differently, with primary producers being the most negatively affected.[c] A Centre for European Policy Studies (CPES) report estimated that between 2002 and 2012, the cost associated with all EU regulations averaged 8 percent of the cost of production (COP) for primary aluminum producers, although the actual cost burden was closely tied to electricity arrangements.[d] European Aluminum estimated that EU environmental regulations added an average of 11 percent to the cost of primary production.[e]

Secondary and downstream rollers and extruders also incurred additional costs related to the EU's environmental regulations, although CPES was unable to calculate the cumulative impact that the EU environmental regulations had on these producers.[f] Reportedly, larger plants are more likely to be impacted by the ETS.[g]

[a] EU regulations cover EU member states and some EFTA countries. Environmental policies, as discussed here, are all policies that directly or indirectly protect the environment, including policies on climate change (e.g., the ETS), air and water quality, and the treatment of chemicals (e.g., REACH).
[b] ECORYS, *Competitiveness*, 2011, 12.
[c] Additionally, countries may interpret and enforce these policies differently. ECORYS, *Competitiveness*, 2011, 14.
[d] Eight percent is based on CPES intermediate estimate. However, a company's energy arrangement was a major determinate of its regulatory cost burden. For example, EU smelters with self-generated power or who had electricity prices set in older

[1078] IAE, Energy Prices and Taxes Fourth Quarter 2016, 351; CRU Group.
[1079] While Hydro also owns an extensive network of hydroelectric plants, the electricity it generates is sold onto the Norwegian power grid. Industry representative, telephone interview by USITC staff, November 14, 2016; Hydro, "Energy," 2016, 159, 162–62; CPES, *Final Report Aluminum,* October 1, 2013.
[1080] Hydro, "Energy," 2016, 159, 162–62.
[1081] The Alcoa contract rates are linked both to the U.S. dollar-Norwegian krone exchange rate and to the price of aluminum. Alcoa, *Annual Report* 2015, February 19, 2016, 7, 16; VattenFall, "About VattenFall," https://corporate.vattenfall.com/about-vattenfall/ (accessed January 6, 2017).
[1082] Like a growing number of European firms, Hydro is committed to reducing its carbon footprint, with a goal of becoming carbon neutral by 2020. Norsk Hydro, *Annual Report*, 2015, 5. See also, e.g., CPES, *Final Report Aluminum*, October 1, 2013; Frondel, Schmidt, and Vance, "Emissions Trading," 2012; Alcoa, "Norway," http://www.alcoa.com/norway/no/default.asp (accessed with Google Translate January 6, 2017).
[1083] Frondel, Schmidt, and Vance, "Emissions Trading," 2012; IEA, *Energy Technology Perspectives 2016*, 125.

long-term contracts had a much lower regulatory burden, between 1 to 2 percent of COP while the other smelters averaged 12 percent of COP. CPES, Assessment of the Cumulative Cost Impact, October 1, 2013, 3, 4, 8-9, 60–61.
[e] European Aluminum, written submission to the USITC, October 7, 2016.
[f] CPES, *Assessment of the Cumulative Cost Impact*, October 1, 2013, 70–75.
[g] Industry consultant, telephone interview by USITC staff, October 11, 2016.

Research and Development Leads to Technological Improvements

The Norwegian aluminum industry, led by Hydro, has a strong reputation for aluminum-related R&D, which provides a competitive strength in the global market.[1084] Norway has a number of institutes that conduct aluminum-related R&D, including the Norwegian University of Science and Technology; SINTEF, a large independent Norwegian research organization;[1085] the Research Council of Norway; Enova; and Prosessindustriens Miljøfond.[1086] Recently, Enova contributed 1.6 billion krone to Hydro for major primary-smelting research projects.[1087]

In its pursuit of technological advances to lower the electricity intensity of its primary facilities, Hydro is building a full-scale pilot project at its Karmøy smelter that uses new types of HAL-series potline technology. In 2015, Norway's potroom power consumption was just under 13.8 megawatt-hours (MWh) per mt, close to the average level of the top 10 global unwrought aluminum exporters.[1088] However, the two new HAL-series technology systems are estimated to consume roughly 15 percent less energy per mt than the global average. The expectation is that this will result in the lowest carbon footprint of any smelter in the world.[1089] Such technology would make the new Karmøy plant more efficient than many of the new, large-scale smelters in China and the GCC countries.[1090]

[1084] Industry consultant, interview by USITC staff, September, 28, 2016; Hydro, *Annual Report*, 2015, 90.
[1085] Moen, Innovation and Production, 2007, 18, 23; Hydro, *Annual Report*, 2015, 90; SINTEF, "This is SINTEF," https://www.sintef.no/en/about-us/this-is-sintef/?id=229075 (accessed November 15, 2016).
[1086] Hydro, *Annual Report*, 2015, 90.
[1087] Hydro, *Annual Report*, 2015, 90.
[1088] USITC staff calculation as a simple average of potroom power consumption for the top 10 largest primary aluminum exporters in 2015, excluding the Netherlands. CRU Group; IHS Markit, GTA database (accessed September 22, 2016).
[1089] The Karmøy plant will contain HAL4e technology, which is projected to use 12.3 kWh/kg, and HAL4e Ultra technology, which is projected to use 11.5–11.8 kWh/kg. *Light Metal Age*, "Hydro to Build Karmøy Primary Aluminum Pilot Plant," February 23, 2016; Hydro, *Annual Report*, 2015, 90.
[1090] Wookey, "China Is Most Efficient Aluminum Producer Nation," October 31, 2016.

Germany: Secondary Unwrought and Wrought Aluminum

Germany's secondary and wrought aluminum segments benefit from regional concentration, which improves the reliability of access to certain inputs, facilitates R&D collaboration, and minimizes transportation time and costs.[1091] The major competitive advantage for Germany's secondary segment is its reliable access to scrap.[1092] Advantages for the wrought segment are its investments in advanced technology, technical expertise, and R&D capabilities, along with the ability to produce a wide range of products, especially value-added FRPs for the automotive and aerospace sectors.

Table 9.21: Germany: Select competitive factors for secondary unwrought and wrought aluminum

Competitive factor	Segment	Impact on competitiveness
Business environment	Secondary and wrought	Competitiveness is enhanced by a relatively good business environment, as measured by the World Bank's Ease of Doing Business Index (where Germany ranked in the top 10 percent for 2015–16).
Energy costs	Secondary and wrought	Energy costs for producers can vary substantially by product and by the type of production technology used. German electricity prices are high, even for a developed country, because of Germany's Energiewende policies. Energy is a relatively large cost for secondary producers (estimated at about 22 percent of COP) but low for many rolled products, indicating the use of very energy-efficient rolling technology.
Environmental polices compliance costs	Secondary and wrought	EU and German environmental policies generally raise the costs of production in the aluminum industry, although the impact varies by industry segment and plant.
Exchange rate	Secondary and wrought	Devaluation of the euro against the U.S. dollar, starting in late 2014, was a short-term benefit for dollar-denominated aluminum exports.
Industry concentration	Secondary and wrought	Competitiveness is enhanced by being a part of the country's industrial regions. See below for further detail.
Infrastructure	Secondary and wrought	A good transportation infrastructure, including extensive road, rails, and port networks, lowers aluminum producers' delivery costs and enhances reliability of supply.
Labor costs	Secondary and wrought	Germany has high labor costs by global standards, but the impact of labor costs varies by product. Labor costs are mitigated by the high productivity of the German workforce and, to a lesser extent, by the use of capital-inventive technology. Overall, the impact varies by product, likely raising costs for more labor-intensive products.
Product diversity	Wrought	The German industry has the ability to produce a wide range of wrought products, allowing it to compete in numerous sub-segments, particularly the flat-rolled market. These vary from highly advanced

[1091] Grave et al., *Electricity Costs of Energy Intensive Industries*, July 2015, 53; industry representative, telephone interview by USITC staff, February 28, 2017; ECORYS, *Competitiveness*, 2011, 13.
[1092] See, e.g., European Aluminum, written submission to the USITC, October 7, 2016, 1; WMW, "World's Largest Aluminum Recycling Plant," October 10, 2014; Befesa, "Befesa Aluminum Germany Inaugurates Aluminum-recycling Plant," March 12, 2014; IHS Markit, GTA database (accessed September 22, 2016).

Competitive factor	Segment	Impact on competitiveness
		aerospace and automotive FRPs to less differentiated FRPs, such as foil.
Scrap availability	Secondary	Large quantities of domestic scrap are generated by high recycling rates, aided by government policies which encourage recycling. See below for further detail.
Technology	Secondary and wrought	Competitiveness is enhanced by the use of advanced technology, which facilitates production of technically advanced products, and mitigates high electricity consumption and labor costs. Reportedly, both Germany and Europe have very good scrap-sorting technology because of investments by the large remelting firms, which is important for ensuring good quality supply. See below for further detail.

Source: CPES, *Assessment of the Cumulative Cost Impact*, October 1, 2013; ECORYS, *Competitiveness*, 2011 ; European Aluminum, written submission to the USITC, October 7, 2016; industry consultants, interviews or telephone interviews by USITC staff, February 16, 2017, March 7, 2017; GDA, "Business Activity in Aluminum Sector Mixed," September 1, 2016; OECD, Dataset: World Indicators of Skills for Employment; Labour Productivity (accessed February 3, 2017); BLS, ILC of Hourly Compensation Costs, table 1.1, August 9, 2013; IMF, IMF Exchange Rates: Euros and USD, January 1, 2011–December 31, 2015 ; WEF, Competitiveness Rankings, Germany, September 29, 2015; World Bank, Development Indicators (accessed January 17, 2017); IAE, Energy Prices and Taxes Fourth Quarter 2016, 351; industry expert, phone interview with Commission staff, March 7, 2017; CRU Group; Eurostat, electricity price statistics, table 6, November2016; Grave et al., *Electricity Costs of Energy Intensive Industries*, July 2015, 56, 40–41, 53; Agora Energiewend, *Understanding the Energiewende*, 2015, 3132.

Cost Overview

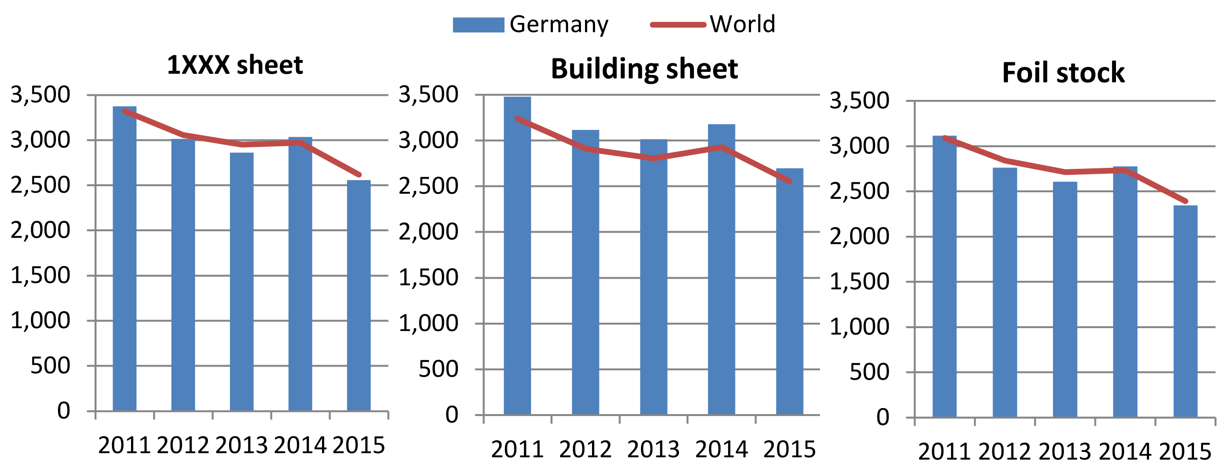
Primary aluminum and scrap are the biggest material inputs and are the major cost drivers for both secondary and wrought producers. Other significant costs are generally for electricity and labor, which are high in Germany. The cost competiveness of German secondary and wrought exports improved in U.S.-dollar terms with the depreciation of the euro starting in late 2014.[1093]

Germany's costs for FRPs have generally followed the trend of global production costs because the price of the largest material input, unwrought aluminum is set on the LME (figure 9.2). For German flat-rolled producers, raw-material costs account for 73 percent of the average business costs of producing foil stock, 83 percent of 1xxx (unalloyed aluminum) sheet, and 86 percent of building sheet in 2015.[1094] Reflecting the decline of LME aluminum prices, which fell by roughly one-third during 2011–15, total raw material prices in Germany fell for all three FRPs by about one-quarter over this period.[1095] In addition, as a result of this depreciation of

[1093] This euro depreciation was caused by a number of factors, including a divergence in U.S. and EU monetary policies, the economic crisis in Greece, and slower than expected growth in the euro area than in the United States. IMF, IMF Exchange Rates: Euros and USD, January 01, 2011–December 31, 2015; Elliott, "Euro Sinks to 12-Year Low," March 11, 2015; Koester, "Three Currency Predictions," December 21, 2015.
[1094] CRU Group.
[1095] LME prices per CRU Group.

the euro against the dollar, Germany's average business costs in dollar terms for the three FRPs fell between 15 and 16 percent during 2014–15.[1096] While costs for these three FRPs generally followed global trends, Germany tended to be slightly more cost competitive on average in producing foil sheet and 1xxx sheet, but less cost competitive in producing building sheet, where labor and energy costs accounted for about 16 percent of COP during 2013–15.[1097]

Figure 9.2: Germany and world: Certain aluminum flat-rolled products, average business costs for 2011–15 (dollars per mt)



Source: CRU Group.
Note: Corresponds to appendix table L.40.

Regional Concentration Enhances Competitiveness for the Aluminum Industry

Regional concentration enhances the competitiveness of the German aluminum industry via proximity to both large customers and input sources. General benefits include ready access to skilled labor, which is key to the industry's high productivity,[1098] and reduced transportation time and costs, which increase supply reliability.[1099] Proximity to large end-use markets exerts significant influence on wrought-production cost competitiveness;[1100] countries that are the most competitive wrought aluminum producers (China, Germany, and the United States) have sizable end-use markets. Germany's transportation markets are the largest consumers of

[1096] Between 2011 and mid-2014, the euro-dollar exchange rates were relatively consistent at about €/$1.33, but then the euro fell 20 percent to €/$1.11 in 2015. IMF, IMF Exchange Rates: Euros and USD, January 01, 2011–December 31, 2015.
[1097] CRU Group.
[1098] Parilla, Trujillo, and Berube, *Skills and Innovation Strategies*, 2015, 7, 15-18; industry consultant, telephone interview by USITC staff, March 7, 2017.
[1099] ECORYS, *Competitiveness*, 2011, 13; Grave et al., *Electricity Costs of Energy Intensive Industries*, July 2015, 53; European Aluminum, written submission to the USITC, October 7, 2016.
[1100] Industry representative, telephone interview by USITC staff, December 16, 2016.

wrought aluminum products, and the proximity of customers who demand high-value-added products contributed to the development of a competitive wrought segment. In Germany, proximity to customers enables wrought aluminum firms to build close, collaborative relationships that foster the development of new aluminum alloys and products.[1101] Proximity to large end-use markets also exerts significant influence on secondary production cost competitiveness, as German secondary producers not only benefit from high levels of domestic recovery of old scrap, but also seek close ties with their customers, facilitating the capture of high-quality scrap in closed-loop systems.[1102] Both the reliable access to scrap and fostering of research and innovation are further discussed below.

Abundant Scrap Generation Facilitates a Large Secondary Industry

High levels of aluminum scrap generation and highly efficient recycling in Germany—and in Europe as a whole—result in an abundance of aluminum scrap being available for secondary unwrought production. On a per capita basis, Europe recycled more aluminum scrap than any other region of the world in 2013—approximately 11 kg in Europe, compared to about 9 kg in North America and just over 6 kg in China.[1103] Germany's recycling rate exceeds even the European average. For example, by 2012 Germany was recycling about 89 percent of all aluminum packaging (compared with 60 percent in Europe as of 2016) and 96 percent of UBCs (compared with 70 percent in Europe).[1104] A number of EU laws and regulations promote recycling, reuse, and recovery of used materials (table 9.18). Due to these policies and to the recycling infrastructure, European Aluminum estimates that the region's recycled aluminum supply is growing by 3 to 4 percent annually.[1105] Moreover, secondary producers seek to locate

[1101] Industry representative, telephone interview by USITC staff, February 28, 2017; ECORYS, *Competitiveness*, 2011, 13; Novelis, "Automotive Aluminum" (accessed February 22, 2017); Aleris, "Research and Development" (accessed February 22, 2017); Grave et al., *Electricity Costs of Energy Intensive Industries*, July 2015, 53. USITC, hearing transcript, September 29, 2016, 54 (testimony of Matt Aboud, president, Hydro Aluminum Metals USA); Parilla, Trujillo, and Berube, *Skills and Innovation Strategies*, 2015, 9–12; industry representative, telephone interview by USITC staff, February 8, 2017; industry representative, telephone interview by USITC staff, March 7, 2017.

[1102] Liu, "Aluminum in Automotive," April 21, 2015; European Aluminum, written submission to the USITC, October 7, 2016, 1; ECORYS, *Competitiveness*, 2011, 17; industry consultant, telephone interview by USITC staff, February 16, 2017.

[1103] European recovery rates for 2016 were 90 percent of all aluminum consumed in the construction and automotive industries, 60 percent of packaging, and 70 percent of UBCs. European Aluminum, *Recycling*, September 2015, 10.

[1104] GDA, "Recycling of Aluminum Packaging," December 11, 2014; Recycling International, "Germany Up to 89%," January 20, 2014; European Aluminum, "Euro 2016 Fans Encouraged to Recycle," July 1, 2016; BottleBill.org, Germany, June 22, 2016.

[1105] European Aluminum, *Recycling Aluminum*, September 2015, 18.

facilities close to their scrap suppliers, which are downstream or smelting facilities.[1106] This makes Germany an attractive place to locate secondary facilities and was reportedly a factor in Novelis choosing to build the world's largest recycling facility at its Nachterstedt location.[1107]

Investment in Technologies and Research and Development Gives Germany a Competitive Advantage in High-value Flat-rolled Products

Germany's flat-rolled production capabilities include technically sophisticated FRPs, such automotive and aerospace sheet, for which advanced technology, technical expertise, and innovation are key to competitiveness. Automotive use has become the major driver of growth for the FRP sub-segment, but automotive sheet requires specialty equipment, such as continuous annealing solution heat (CASH) lines, which are not needed for other types of FRPs.[1108] Although only a few firms reportedly have this equipment, many of them are operating in Germany to be close to automotive production, including Constellium, Novelis, and Hydro.[1109] The number of CASH lines in Germany has increased, as both Novelis and Hydro reported investments to expand their auto-body sheet capacity in 2015.[1110] More specifically, as Europe's third-largest aluminum producer, Hydro had announced plans in 2015 to invest $147 million to increase its aluminum automotive sheet production after a record volume of shipments.[1111] Moreover, the firm collaborated with a leading regional automobile producer, Mercedes-Benz, to develop the welding techniques that reduced assembly costs.[1112]

Furthermore, Germany is one of the few countries possessing the technical expertise and the technology to meet the exacting specifications of the aerospace industry for wrought aluminum

[1106] Producers of secondary unwrought aluminum for the wrought industry are known as remelters in Europe. A key part of their competitiveness is having access to a clean supply of high-quality scrap, which encourages them to locate plants near their suppliers. Industry expert, phone interview by USITC staff, February 16, 2017; industry expert, phone interview by USITC staff, October 11, 2016; European Aluminum, Data: Industry by Plant (accessed January 5, 2017).

[1107] Novelis, "Novelis Opens World's Largest Aluminum Recycling Facility," October 1, 2014; industry consultant, telephone interview by USITC staff (accessed February 16, 2017); Reuters, "Novelis Opens Aluminum Recycling Plant," October 1, 2014.

[1108] Minter, "How Aleris Recycled Itself," February 28, 2014; Truett, "Aluminum Gains Automotive Momentum," April 21, 2014; industry representative, telephone interview by USITC staff, February 28, 2017.

[1109] Minter, "How Aleris Recycled Itself," February 28, 2014; Truett, "Aluminum Gains Automotive Momentum," April 21, 2014; Constellium, "Singen Aluminum Plant, Germany" (accessed February 22, 2017); Hydro, "Germany" (accessed October 5, 2016); Novelis, "Geographic Locations, Europe" (accessed January 9, 2017).

[1110] Mayr, "Novelis Opens New Automotive Aluminum Sheet Line," November 19, 2015; *Aluminum Insider*, "Norsk Hydro Opens €45 million Recycling Plant," May 7, 2016.

[1111] Kayakiran, "Auto Industry Drives Comeback," January 28, 2015.

[1112] Kayakiran, "Auto Industry Drives Comeback," January 28, 2015.

products.[1113] Aerospace production in Germany, as elsewhere in Europe, is concentrated among a small number of specialized firms tied into the Airbus Group supply chain.[1114] In Europe, Aleris produces FRPs for aerospace only at its Koblenz plant,[1115] using advanced plate-producing technology and serving as the model for a newly built Aleris plant in China.[1116]

Given that R&D for wrought aluminum is market driven; wrought producers normally develop new products in collaboration with customers.[1117] Aluminum producers locate R&D centers near Germany's industrial regions, which facilitates collaboration with customers. For example, Hydro's largest R&D center, which specializes in rolled products, is located in Bonn.[1118] Aleris's Koblenz R&D center specializes in aerospace, while its Aachen R&D center supports the internal R&D of its broader customer base in the area.[1119]

[1113] Germany's principal competitors are from the United States and other European countries. Airbus Group, "Airbus Procurement Organisation and Major Suppliers," June 5, 2015; Bloomberg, "China Buying Boeing Supplier," September 5, 2016.
[1114] Producers can also supply other aerospace manufactures. Aleris, "Rolled Products Germany GmbH" (accessed February 22, 2017); Airbus Group, "Airbus Procurement Organisation and Major Suppliers," June 5, 2015; Otto Fuchs, "Aerospace Industry" (accessed February 22, 2017).
[1115] Otto Fuchs also produces for aerospace, although the company specializes in extrusions and other non-wrought products. Otto Fuchs, "Company" (accessed February 22, 2017); Aleris, "Aerospace" (accessed March 2, 2017); Aleris, "Rolled Products" (accessed February 22, 2017).
[1116] Aleris, "Aerospace" (accessed March 2, 2017); Aleris, "Rolled Products" (accessed February 22, 2017).
[1117] Industry representative, telephone interview by USITC staff, February 28, 2017; ECORYS, *Competitiveness*, 2011, 13; Novelis, "Automotive Aluminum" (accessed February 22, 2017); Aleris, "Research and Development" (accessed February 22, 2017); Grave et al., *Electricity Costs of Energy Intensive Industries*, July 2015, 53.
[1118] Hydro's R&D center is a legacy of its acquisition of VMA in 2002. Industry representative, telephone interview by USITC staff, February 28, 2017.
[1119] Hydro, "R&D Bonn," June 26, 2014; Aleris, "Research and Development" (accessed February 22, 2017); Minter, "How Aleris Recycled Itself," February 28, 2014.

Bibliography

Aglionby, John. “Petrobras: Timeline of a Scandal.” *Financial Times,* February 4, 2015. https://www.ft.com/content/850711b6-ac78-11e4-9d32-00144feab7de.

Agora Energiewend. *Understanding the Energiewende*. Berlin, Germany: IET, October 2015. https://www.google.com/search?q=Agora+Energiewend%2C+Understanding+the+Energiewende%2C&rlz=1C1CHBD_enUS722US722&oq=Agora+Energiewend%2C+Understanding+the+Energiewende%2C&aqs=chrome..69i57.343j0j7&sourceid=chrome&ie=UTF-8#.

Airbus Group. *Flying Ahead: Annual Report 2015*. Leiden, the Netherlands: Airbus Group, June 16, 2016. http://www.airbusgroup.com/int/en/investors-shareholders/Annual-reports-and-registration-documents.html.

———. “Airbus Procurement Organisation and Major Suppliers,” June 5, 2015. http://www.airbus.com/fileadmin/media_gallery/files/supply_world/Airbus-Procurement-Organisation-Major-Suppliers-June2015.pdf.

Alcoa Norway ANS. *Annual Report 2015: Alcoa Norway ANS*. Olso, Norway: Alcoa Norway ANS, May 10, 2016. http://www.alcoa.com/norway/no/pdf/annual-report.pdf.

Alcoa Corp. “The Indirect Effects of EU’s Emissions Trading Scheme (ETS).” News release, n.d. http://www.logos-eu.com/ets-en/ETS-Alcoa.html (accessed January 9, 2017).

———. “Norway” (in Norwegian). http://www.alcoa.com/norway/no/default.asp (accessed January 6, 2017).

———. *Unlocking Value: Annual Report 2015*. Pittsburgh, PA: Alcoa, February 19, 2016. http://www.viewmaterial.com/aa/AA_15AR.PDF.

———. “What We Do: Alumina.” https://www.alcoa.com/global/en/what-we-do/alumina/default.asp (accessed February 13, 2017).

———. “What We Do: Bauxite.” http://www.alcoa.com/global/en/what-we-do/bauxite/default.asp (accessed February 13, 2017).

Aleris International Inc. (Aleris). “Industries: Aerospace.” https://www.aleris.com/industries/aerospace/ (accessed March 2, 2017).

———. “Research and Development.” https://www.aleris.com/company/research-development/ (accessed February 22, 2017).

———. “Rolled Products.” https://www.aleris.com/company/rolled-products/ (accessed February 22, 2017).

———. “Rolled Products Germany GmbH.” https://www.aleris.com/locations/aeris-rolled-products-germany-gmbh/ (accessed February 22, 2017).

Aluminium Insider. “Norsk Hydro Opens €45 Million Recycling Plant in Western Germany,” May 7, 2016. http://aluminiuminsider.com/norsk-hydro-opens-e45-million-recycling-plant-in-western-germany/.

———. “Norsk Hydro to Invest US$1.18MM to Establish Aluminum Innovation Center,” March 24, 2016. http://aluminiuminsider.com/norsk-hydro-to-invest-us1-18mm-to-establish-aluminium-innovation-center/.

Arnarsdóttir, Eygló Svala. Chinese to Fund New Smelter in Northwest Iceland.” *Iceland Review Online,* July 3, 2015. http://icelandreview.com/news/2015/07/03/chinese-fund-new-smelter-northwest-iceland.

Befesa Aluminum Germany GmbH (Befesa). “Befesa Aluminum Germany Inaugurates Aluminum-recycling Plant.” News release, March 12, 2014. http://www.befesa.com/web/en/prensa/historico_de_noticias/2014/bef_20141204.html.

Bell, Terence. “Commodities: The World’s Biggest Aluminum Producers 2012.” *The Balance*, updated November 20, 2016. https://www.thebalance.com/the-10-biggest-aluminum-producers-2012-2339722.

———. “The Biggest Aluminum Producers 2014.” *The Balance*, updated November 20, 2016. https://www.thebalance.com/the-10-biggest-aluminum-producers-2014-2339724.

Berglund, Nina. “Norway’s ‘Krone’ Caught in a Storm.” News in English, July 21, 2015. http://www.newsinenglish.no/2015/07/21/norways-krone-rides-the-waves/.

———. “Krone Falls and Rises with Wild Market.” News in English, August 25, 2015. http://www.newsinenglish.no/2015/08/25/krone-falls-and-rises-with-market/.

Bloomberg News. “China Buying Boeing Supplier Signals Aluminum’s Future,” September 5, 2016. https://www.bloomberg.com/news/articles/2016-09-05/china-chasing-cars-and-planes-heralds-next-upheaval-for-aluminum.

Buchan, David. *Costs, Competitiveness and Climate Policy: Distortions across Europe*. Oxford, UK: University of Oxford, Oxford Institute for Energy Studies, April 2014.

https://www.oxfordenergy.org/wpcms/wp-content/uploads/2014/04/Costs-Competitiveness-and-Climate-Policy.pdf.

Central Intelligence Agency (CIA). "Country Comparison: Roadways." *World Factbook* https://www.cia.gov/library/publications/the-world-factbook/rankorder/2085rank.html (accessed January 17, 2017).

Centre for European Policy Studies (CPES). *Assessment of the Cumulative Cost Impact for the Steel and Aluminum Industry: Final Report Aluminium*. Brussels, Belgium: CPES, October 1, 2013. https://www.ceps.eu/system/files/final-report-aluminium_en.pdf

Constellium. "Singen Aluminum Plant, Germany." http://www.constellium.com/aluminium-company/manufacturing-recycling-plants/singen-germany (accessed February 22, 2017).

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Daimler AG. "Aluminum Bodyshell in the New Mercedes-Benz SL: Under the Bottom Line; 140 Kilos Lighter." News release, November 22, 2011. http://media.daimler.com/marsMediaSite/en/instance/ko/Aluminium-bodyshell-in-the-new-Mercedes-Benz-SL-Under-the-bo.xhtml?oid=9817820.

Djukanovic, Goran. "No Threat of Closure for South East Europe's Smelters in Near Future." *Aluminium Insider*, December 1, 2016. http://aluminiuminsider.com/no-threat-closure-south-east-europes-smelters-near-future/.

ECORYS Research and Consulting (ECORYS). *Competitiveness of the EU Non-ferrous Metals Industries*. Rotterdam, the Netherlands: ECORYS, April 5, 2011. https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/system/files/ged/82%20fn97624_nfm_final_report_5_april_en.pdf.

Elliott, Larry. "Euro Sinks to 12-year Low in Value against the Dollar." *Guardian,* March 11, 2015. https://www.theguardian.com/business/2015/mar/11/euro-12-year-low-gainst-the-dollar.

Environmental Defense Fund (EDF) and International Emissions Trading Association (IETA). "Norway, The World's Carbon Markets: Markets; A Case Study Guide to Emissions Trading," May 2013. https://www.edf.org/sites/default/files/EDF_IETA_Norway_Case_Study_May_2013.pdf.

EuroActive.de. "Germany to Cut Rebates for Industry." March 28, 2014. http://www.euractiv.com/section/trade-society/news/germany-to-cut-energy-rebates-for-industry-renewable-subsidies/.

European Aluminium. *Activity Report 2015*. Brussels, Belgium: European Aluminium, March 2016. http://www.european-aluminium.eu/media/1691/2015_european_aluminium_activity_report_v2.pdf.

———. *Aluminium in Cars: Unlocking the Light-Weighting Potential*. Brussels, Belgium: European Aluminium, n.d. http://www.european-aluminium.eu/media/1326/aluminium-in-cars-unlocking-the-lightweighting-potential.pdf (accessed May 11, 2017).

———. *Blueprint 2016–2019: Drivers of Change*. Brussels, Belgium: European Aluminium, September 1, 2016. http://www.european-aluminium.eu/media/1711/20160901-blueprint-2016-2019_drivers-of-change.pdf.

———. *Common Goals, Shared Action: The European Aluminium Industry's Sustainability Roadmap toward 2025.* Brussels, Belgium: European Aluminium, April 2015. http://www.aluminiumcentrum.nl/aluminiumcentrum.nl/files/Doc/Aluminium%20het%20groene%20metaal/European-aluminium-industry_Sustainability-Roadmap-towards-2025.pdf.

———. Data: Overview of the European Aluminium Industry by Plant. http://www.european-aluminium.eu/data/industry-overview/european-overview-aluminium-plants-location/ (accessed multiple dates).

———. Data: Focus on EU smelters; Production Since 2002, updated March 24, 2016. http://www.european-aluminium.eu/data/industry-overview/focus-on-eu-smelters/ (accessed multiple dates).

———. "Euro 2016 Fans Encouraged to Recycle." News release, July 1, 2016. http://www.european-aluminium.eu/resource-hub/euro-2016-fans-encouraged-to-recycle/.

———. Posthearing submission to the USITC in connection with inv. no 332-557, *Aluminum Competitive Conditions Affecting U.S. Industry*, October 7, 2016.

———. *Recycling Aluminum—A Pathway to a Sustainable Economy*. Brussels, Belgium: European Aluminium, September 2015. http://www.european-aluminium.eu/media/1712/ea_recycling-brochure-2016.pdf.

European Commission (EC). “Communication from the Commission—Guidelines on Certain State Aid Measures in the Context of the Greenhouse Gas Emission Allowance Trading Scheme Post-2012.” *Official Journal of the European Union.* 2012/C158/04, June 5, 2012. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52012XC0605(01)&from=EN.

———. Council Regulation (EU) No 333/2011 of 31 March 2011 Establishing Criteria Determining When Certain Types of Scrap Metal Cease to be Waste under Directive 2008/98/EC of the European Parliament and of the Council. Brussels, Belgium: EC, April 2011. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011R0333.

———. “Countries and Regions: Norway,” http://ec.europa.eu/trade/policy/countries-and-regions/countries/norway/ (accessed January 25, 2017).

———. “Countries and Regions: Iceland,” http://ec.europa.eu/trade/policy/countries-and-regions/countries/iceland/ (accessed May 16, 2017).

———. Directive 94/62/EC on Packaging and Packaging Waste, December 20, 1994. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01994L0062-20150526&from=EN.

———. Directive 1999/31/EC on the Landfill of Waste, April 26, 1999. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri= CELEX:31999L0031&from=en.

———. Directive 2008/98/EC of the European Parliament and of the Council on Waste and Repealing Certain Directives, November 19, 2008. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32008L0098&from=EN.

———. Directive 2008/98/EC on Waste (Waste Framework Directive), June 9, 2016. http://ec.europa.eu/environment/waste/framework/.

———. Directive 2010/75/EU of the European Parliament and of the Council on Industrial Emissions, November 24, 2010. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0075&from=EN.

———. “Environment: Environment Action Programme to 2020,” June 8, 2016. http://ec.europa.eu/environment/action-programme/.

———. *Environment: Waste; Waste Framework Directive (End-of-Waste Criteria)*. Directive 2008/98/EC. Brussels, Belgium: EC, June 6, 2016. http://ec.europa.eu/environment/waste/framework/end_of_waste.htm.

———. "The EU Emissions Trading System (EU ETS): Phases 1 and 2 (2005–2012)." http://ec.europa.eu/clima/policies/ets/pre2013/index_en.htm (accessed October 6, 2016).

———. "The EU Emissions Trading System (EU ETS): Revision for Phase 4 (2021–2030)." http://ec.europa.eu/clima/policies/ets/revision/index_en.htm (accessed October 6, 2016).

———. "Guidelines on Certain State Aid Measures in the Context of the Greenhouse Gas Emission Allowance Trading Scheme Post-2012," June 5, 2012. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52012XC0605(01)&from=EN.

———. "Guidelines on State Aid for Environmental Protection and Energy 2014–2020," June 28, 2014. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52014XC0628%2801%29.

———. "Trade: Agreements," February 3, 2017. http://ec.europa.eu/trade/policy/countries-and-regions/agreements/#_other-countries.

———. "State Aid: Commission Decides on Two German Support Schemes for Energy-intensive Industries." News release, July 17, 2013. http://europa.eu/rapid/press-release_IP-13-704_en.htm.

———. "State Aid: Greece Needs to Recover Around €17 Million from Aluminium of Greece." News release, July 13, 2011. http://europa.eu/rapid/press-release_IP-11-864_en.htm.

Environmental Defense Fund (EDF) and International Emissions Trading Association (IETA). "Norway: The World's Carbon Markets; A Case Study Guide to Emissions Trading," May 2013. https://www.edf.org/sites/default/files/EDF_IETA_Norway_Case_Study_May_2013.pdf.

European Free Trade Association (EFTA). "EEA Agreement," http://www.efta.int/eea/eea-agreement (accessed January 25, 2017).

Eurostat. "Electricity Price Statistics," November 18, 2016. http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics.

———. "End-of-Life Vehicles— Reuse, Recycling and Recovery, Totals," October 25, 2016. http://ec.europa.eu/eurostat/web/waste/key-waste-streams/elvs.

———. "Packaging Waste Statistics," May 2016. http://ec.europa.eu/eurostat/statistics-explained/index.php/Packaging_waste_statistics.

Forte, Jay. "Brazil Real Currency Falls to Lowest in Over 10 Years to U.S. Dollar." *The Rio Times*, March 7, 2015. http://riotimesonline.com/brazil-news/rio-business/brazil-real-currency-falls-to-lowest-in-10-years-to-dollar/.

Frondel, Manuel, Christoph M. Schmidt, and Colin Vance. "Emissions Trading: Impact on Electricity Prices and Energy-Intensive Industries." *Intereconomics*, 2012. http://archive.intereconomics.eu/downloads/getfile.php?id=810.

Frondel, Manuel, Nolan Ritter, Christoph M. Schmidt, and Colin Vance. "Economic Impacts from the Promotion of Renewable Energy Technologies." *Energy Policy,* August 2010: 4048–49. http://dx.doi.org/10.1016/j.enpol.2010.03.029.

Fuchs, Richard. "German Cabinet Puts Brakes on Clean Energy Transition." Deutsche Welle (DW), September 6, 2016. http://www.dw.com/en/german-cabinet-puts-brakes-on-clean-energy-transition/a-19318942.

Gesamtverband der Aluminiumindustrie e.V. (GDA) [Federation of the aluminum producing and processing industry]. "Aluminium Industry Shows Good Development in Volumes." News release, October 8, 2014.

———. "Aluminium im Verkehrswesen: Mit Leichtigkeit Bewegen" [Aluminum in Transport: Move with Ease]. News release, n.d. http://www.aluinfo.de/mobilitaet.html (accessed January 4, 2017).

———. "Business Activity Good Overall." News release, July 29, 2015.

———. "Business Activity in Aluminium Sector Mixed," September 1, 2016.

———. "Business Activity in the Spring of 2015." News release, May 21, 2015.

———. (German Aluminum Industry Association). "Recycling of Aluminum Packaging," December 11, 2014.

Gonzalez, David, Aygün Kilinc, and Nicole Weidemann. *Renewable Energy Development in Norway*. Center for Applied International Finance and Development (CAIFD). Nuremberg, Germany: CAIFD, 2011. https://www.thnuernberg.de/fileadmin/Fachbereiche/bw/studienschwerpunkte/international_business/Master/CAIFD/SeminarPapers/HydropowerNorway_SeminarPaper.pdf.

Government of Germany. Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Federal Ministry for the Environment). "Developments in Germany Following the Nuclear Disaster in Japan," July 18, 2016. http://www.bmub.bund.de/en/topics/nuclear-safety-radiological-protection/nuclear-safety/tschernobyl-und-die-folgen/response-to-fukushima/overview/.

Government of Norway. Norway Mission to the EU (Norway EU Mission). "Areas of Cooperation: The European Economic Area Agreement," October 8, 2016. https://www.norway.no/en/missions/eu/areas-of-cooperation/the-eea-agreement/.

———. Norwegian Ministry of Trade, Industries, and Fisheries (Norwegian Ministry of Trade). *The State Ownership Report 2015.* Oslo, Norway: Ministry of Trade, October 2016. https://www.regjeringen.no/contentassets/5e1a7917c5cb46cb8bf478f7daaa3ff5/the-state-ownership-report-2015.pdf.

———. Toll Customs. "Tolltariffen" (Norwegian Customs Tariff). http://tolltariffen.toll.no/templates_TAD/Tolltariffen/StartPage.aspx?id=312480&epslanguage=en (accessed January 11, 2017).

Grave, Katharina, Mandana Hazrat, Sil Boeve, Felix von Blücher, and Charles Bourgault ((ECOFYS); Barbara Breitschopf, Nele Friedrichsen, Marlene Arens, Ali Aydemir, Martin Pudlik, Vicki Duscha, and Jose Ordonez (Fraunhofer-ISI:); and Christian Lutz, Anett Grossmann, and Markus Flaute (GWS). *Electricity Costs of Energy Intensive Industries, an International Comparison*. Berlin, Germany: ECOFYS Germany GmbH, July 2015. http://www.ecofys.com/files/files/ecofys-fraunhoferisi-2015-electricity-costs-of-energy-intensive-industries.pdf (accessed October 28, 2016).

Hydro. *See* Norsk Hydro SA.

Huetter, John. "New BMW 5 Series Loses 137 lbs.; Has Aluminum, HS Steel, Magnesium—But No Carbon Fiber." *Repairer Driven News*, October 14, 2016. http://www.repairerdrivennews.com/2016/10/14/new-bmw-5-series-loses-137-lbs-has-aluminum-hs-steel-magnesium-but-no-carbon-fiber/.

IHS Global Insight. *Assessment of the Effectiveness of Scrapping Schemes for Vehicles*. London, UK: IHS Markit, Final Report, March 2010. http://www.bec.mise.gov.it/site/bec/home/contributi/approfondimenti/documento3581.html.

IHS Markit. Global Trade Atlas (GTA) database. https://www.ihs.com/products/maritime-global-trade-atlas.html (accessed various dates).

Joint Norwegian-German Declaration. "Norway's Indirect Storage," http://jointdeclaration.org/motivation/norsk-norges-indirekte-lagring/ (accessed November 15, 2016).

Jones-Merlin, David. "The Closure of the Lynemouth Aluminium Smelter: An Analysis." Civitas, April 2012. http://www.civitas.org.uk/content/files/aluminium2012.pdf.

Jones, Tim. "BMW Cutting Vehicle Weight with Increased Use of Aluminum." Bimmerfest, August 10, 2010. http://www.bimmerfest.com/news/476134/bmw-cutting-vehicle-weight-with-increased-use-of-aluminum/.

Kayakiran, Firat. "Auto Industry Drives Comeback in Aluminum Prices." *Automotive News*, January 28, 2015. http://www.autonews.com/article/20150128/OEM10/150129811/auto-industry-drives-comeback-in-aluminum-prices.

Kennedy, Simon, and Jim Jetter. "Statoil to Buy Norsk Hydro's Oil, Gas Division." *MarketWatch*, December 18, 20016. http://www.marketwatch.com/story/statoil-to-buy-norsk-hydro-energy-division-for-about-30-billion.

Koester, Wolfgang. "Three Currency Predictions for 2016." *CFO*, December 21, 2015. http://ww2.cfo.com/risk-management/2015/12/three-currency-predictions-2016/.

Light Metal Age. "Hydro to Build Karmøy Primary Aluminum Pilot Plant," February 23, 2016. https://www.lightmetalage.com/news/industry-news/smelting/hydro-to-build-karmoy-pilot-plant/.

Liu, James. "Aluminium in Automotive: This Is Just the Beginning." *Novelis Blog*, April 21, 2015. http://novelis.com/aluminium-in-automotive-this-is-just-the-beginning/.

Ludwig, Christopher. "JLR Gets Real About Recycled Aluminium Loops." *Automotive Logistics,* July 22, 2016. http://automotivelogistics.media/intelligence/jlr-gets-real-recycled-aluminium-loops.

Maverick, J.B. "Who Are BMW's Main Suppliers?" *Investopedia*, March 29, 2016. http://www.investopedia.com/ask/answers/060115/who-are-bmws-main-suppliers.asp.

Mayr, Erwin. “Novelis Opens New Automotive Aluminium Sheet Line in Nachterstedt.” *Novelis Blog*, November 19, 2015. http://novelis.com/novelis-opens-new-automotive-aluminium-sheet-line-in-nachterstedt/.

McKinsey & Company. *Lightweight, Heavy Impact.* Report, February 2012. https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/automotive%20and%20assembly/pdfs/lightweight_heavy_impact.ashx.

Menton, Jessica. “Why Is The Euro Falling? Here Are Four Factors Driving the Currency’s Slide.” *International Business Times*, March 12, 2015. http://www.ibtimes.com/why-euro-falling-here-are-four-factors-driving-currencys-slide-1844334.

Metal Bulletin. “Price Book: Scrap and Secondary; Non-Ferrous Scrap; Aluminum Scrap.” https://www.metalbulletin.com/My-price-book.html (accessed February 10, 2017).

Minter, Steve. “How Aleris Recycled Itself.” *IndustryWeek*, February 28, 2014. http://www.industryweek.com/companies-amp-executives/how-aleris-recycled-itself?page=2.

Morris, Craig. “28 Billion Annually for the Energiewende?” EnergyTransition newsletter, September 2, 2015. https://energytransition.org/2015/09/28-billion-annually-for-the-energiewende/.

Moya, Jose, and Aikaterini Boulamanti. *Production Costs from Energy-Intensive Industries in the EU and Third Countries*. JRC Science for Policy Report EUR27729EN. Brussels, Belgium: European Commission, 2016. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC100101/ldna27729enn.pdf.

National Association of Securities Dealers Automated Quotations (NASDAQ) Inc. “Norsk Hydro: Capacity Increase—Official Opening of New Sunndal.” News release, December 3, 2002. https://globenewswire.com/news-release/2002/12/03/292443/34429/en/Norsk-Hydro-Capacity-Increase-Official-Opening-of-New-Sunndal.html.

Nicolson, Chris. “Norsk Hydro to Buy Vale Assets for $4.9 Billion.” *New York Times,* May 10, 2011. https://dealbook.nytimes.com/2010/05/03/norsk-hydro-to-buy-vale-assets-for-4-9-billion/?_r=0.

Norrgren, Helena. “Strong US Dollar, Weak Fuel Prices and Bauxite Barter Lead to Lower Operating Costs at Alumina Refineries.” *CRU Insight*, June 24, 2016. http://www.crugroup.com/about-cru/cruinsight/Strong_US_dollar_weak_fuel_prices_and_bauxite_barter_lead_to_lower_operating_costs_at_alumina_refineries (accessed October 17, 2016).

Norsk Hydro SA (Hydro). *Annual Report 2010.* Oslo, Norway: Hydro, 2011. http://www.hydro.com/en/investor-relations/reporting/annual-reporting-2010/.

———. *Annual Report 2013.* Oslo, Norway: Hydro, 2014. http://www.hydro.com/globalassets/1-english/investor-relations/annual-report/2013/downloads/annual-report-2013.pdf.

———. *Annual Report 2015*. Oslo, Norway: Hydro, 2016. http://www.hydro.com/globalassets/1-english/investor-relations/annual-report/2015/downloads/01_annual_report_2015.pdf.

———. “Brazil.” http://www.hydro.com/en/about-hydro/hydro-worldwide/brazil/ (accessed January 5, 2017).

———. “Energy: Capital Markets Day 2016,” 2016. http://www.hydro.com/globalassets/1-english/investor-relations/capital-markets-day/2016/hydro-cmd-2016---energy.pdf.

———. “From Power to Water.” http://www.hydro.com/en/Products/Hydropower/From-water-to-power (accessed November 15, 2016).

———. “Germany,” http://www.hydro.com/en/about-hydro/hydro-worldwide/germany/ (accessed October 5, 2016).

———. “Hydro Acquires Vale’s Remaining Shares in Paragominas.” News release, December 16, 2016. http://www.hydro.com/en/press-room/Archive/2016/hydro-acquires-vales-remaining-shares-in-paragominas/.

———. “Hydro Enters into New Long-Term Power Contract for Neuss Aluminium Plant in Germany.” News release, June 2, 2016. http://www.hydro.com/en/press-room/Archive/2016/hydro-enters-into-new-long-term-power-contract-for-neuss-aluminium-plant-in-germany/.

———. “Hydro to Build the Karmøy Technology Pilot.” News release, February 16, 2017. http://www.hydro.com/en/press-room/Archive/2016/hydro-to-build-the-karmoy-technology-pilot/.

———. “Hydro Worldwide: Norway,” http://www.hydro.com/en/About-Hydro/Hydro-worldwide/Norway/ (accessed July 25, 2016).

———. "Investor Presentation May 2015: Q1 2015," May 2015. http://www.hydro.com/globalassets/1-english/investor-relations/quarterly-reporting/old-investor-presentations/investor-presentation---april-2015.pdf.

———. "Norway." http://www.hydro.com/en/about-hydro/hydro-worldwide/norway/ (accessed January 5, 2017).

———. "Primary Production," October 3, 2016. http://www.hydro.com/en/about-aluminium/Aluminium-life-cycle/Primary-production/.

———. "Resource Management," October 11, 2016. http://www.hydro.com/en/our-future/Environment/Resource-management/.

———. "R&D Bonn," June 26, 2014. http://www.hydro.com/en/press-room/Archive/2014/RD-Bonn-Driving-force-in-aluminium-for-progress-in-Europe/.

Novelis Inc. "Automotive Aluminum." http://novelis.com/markets-we-serve/automotive/ (accessed February 22, 2017).

———. "Automotive and Transportation." http://novelis.com/automotive-and-transportation/ (accessed February 22, 2017).

———. "Geographic Locations, Europe." http://novelis.com/about-us/locations/ (accessed January 9, 2017).

———. "Novelis Opens World's Largest Aluminum Recycling Facility." News release, October 1, 2014. http://novelis.com/zh-hans/media-center/news-releases/novelis-opens-worlds-largest-aluminum-recycling-facility/.

Nübold, Wolfgang. "Aluminum Smelter in Voerde Once Again Producing at Full Capacity." Trimet news release, August 23, 2016. http://www.trimet.eu/en/presse/pressemitteilungen/2016/2016-06-27-aluminum-smelter-in-voerde-once-again-producing-at-full-capacity.

Organisation for Economic Co-operation and Development (OECD). Dataset: World Indicators of Skills for Employment: Labour Productivity. http://www.oecd.org/employment/skills-for-employment-indicators.htm (accessed February 3, 2017).

Organisation Internationale des Constructeurs d'Automobiles (OICA) (International Organization of Motor Vehicle Manufacturers). Production Statistics: 2011–15. http://www.oica.net/category/production-statistics/2012-statistics/ (accessed February 14, 2017).

Otto Fuchs KG. "Aerospace Industry." http://www.otto-fuchs.com/en/business-areas/aerospace-industry.html (accessed February 22, 2017).

———. "Company." http://www.otto-fuchs.com/en/company/otto-fuchs-group.html (accessed February 22, 2017).

Pandey, Avaneesh. "Norwegian Krone Tumbles to 13-Year Low after Central Bank Slashes Interest Rate." *International Business Times*, September 24, 2015. http://www.ibtimes.com/norwegian-krone-tumbles-13-year-low-after-central-bank-slashes-interest-rate-2111914.

Parilla, Joseph, Jesus Leal Trujillo, and Alan Berube. *Skills and Innovation Strategies to Strengthen U.S. Manufacturing: Lessons from Germany*. Washington, DC: The Brookings Institution, 2015. https://www.brookings.edu/wp-content/uploads/2016/06/LessonsFromGermany.pdf.

Platts. "Alcoa to Permanently Shutter Portovesme Smelter in Sardinia," August 25, 2014. http://www.platts.com/latest-news/metals/pittsburgh/alcoa-to-permanently-shutter-portovesme-smelter-21120450.

Recycling Today. "Hydro Starts Up its New Plant in Germany," May 8, 2016. http://www.recyclingtoday.com/article/hydro-aluminum-recycling-ubcs-germany/.

International Aluminium Institute. "Industry Structure," n.d. http://recycling.world-aluminium.org/review/industry-structure.html (accessed February 10, 2017).

Reed Exhibitions. "Recycling Pavilion at Aluminum 2016: Aluminum Scrap Is an Important Contribution to Aluminum Supplies." News release, June 29, 2016. http://www.reedexpo.com/Press-Releases/2016/Recycling-Pavilion-at-ALUMINIUM-2016-Aluminium-scrap-is-an-important-contribution-to-aluminium-supplies/.

Reuters. "Novelis Opens Aluminum Recycling Plant in Germany," October 1, 2014. http://www.reuters.com/article/germany-aluminium-novelis-idUSL6N0RW0TE20141001.

Roberts, Sion. "Aluminum Smelter Power Tariffs: Winners and Losers." *CRU Insight*, May 19, 2015. http://www.crugroup.com/about-cru/cruinsight/Aluminium_Smelter_Power_Tariffs_Winners_and_Losers.

———. "Indirect CO2 Emissions and the Aluminium Industry." *CRU Insight*, July 11, 2012. http://www.crugroup.com/about-cru/cruinsight/IndirectCO2EmissionsandtheAluminiumIndustry.

Roelf, Wendell. "European Cars to Use More Aluminum to Meet CO2 Targets," Reuters, May 17, 2016. http://www.reuters.com/article/us-europe-aluminium-autos-idUSKCN0WJ1JS.

Ruparel, Raoul. "Will the Euro Get Weaker?" *Forbes*, April 29, 2015. http://www.forbes.com/sites/raoulruparel/2015/04/29/will-the-euro-get-weaker/#33572b4f4be8.

Rutten, Daan. *The Energiewende and Germany's Industrial Policy*. Hague, The Netherlands: Clingendael International Energy Programme, 2014. www.clingendaelenergy.com/inc/upload/files/Ciep_paper_2014-07_web_1.pdf.

Sambo, Paula, Emma Orr, and Denyse Godoy. "Brazilian Real Drops to Record Low Against U.S. Dollar." Bloomberg, September 22, 2015. https://www.bloomberg.com/news/articles/2015-09-22/brazil-s-currency-tumbles-to-record-on-pessimism-over-budget.

Sapa Group. "Sapa to Sell Raufoss Extrusion and Swedish Assets to SKA Invest." News release, September 11, 2013. http://www.sapagroup.com/en/newswall/2013/sapa-to-sell-raufoss-extrusion-and-swedish-assets-to-ska-invest/.

Schengen Visa Info. "The Schengen Area Countries List," http://www.schengenvisainfo.com/schengen-visa-countries-list/ (accessed January 25, 2017).

Torné, Ricard. "Norway: Norwegian Krone Tumbles on Falling Oil Prices." Focus Economics, December 17, 2014. http://www.focus-economics.com/countries/norway/news/exchange-rate/norwegian-krone-tumbles-on-falling-oil-prices.

Trading Economics. "Euro Area Construction Output: 1992–2017; 10 years." http://www.tradingeconomics.com/euro-area/construction-output (accessed February 16, 2017).

———. "Germany Construction Output: 1992–2017; 10 years." http://www.tradingeconomics.com/germany/construction-output (accessed January 23, 2017).

Truett, Richard. "Aluminum Gains Automotive Momentum." *Automotive News*, April 21, 2014. http://www.autonews.com/article/20140421/OEM10/304219995/aluminum-gains-automotive-momentum-with-f-150.

United Nations Department of Economic and Social Affairs (UNDESA). "World Population Prospects: The 2015 Revision; Total Population." https://esa.un.org/unpd/wpp/Download/Standard/Population/ (accessed March 7, 2017).

U.S. International Trade Commission (USITC). Hearing transcript in connection with inv. no. 332-557, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, September 29, 2016.

Waste Management World (WMW). "Aluminium Recycling Expansion at Massive Alunorf Aluminium Plant in Germany," March 2, 2011. https://waste-management-world.com/a/aluminium-recycling-expansion-at-massive-alunorf-aluminium-plant-in-germany.

———. "World's Largest Aluminium Recycling Plant Opened in Germany," October 10, 2014. https://waste-management-world.com/a/worlds-largest-aluminium-recycling-plant-opened-in-germany.

Wookey, Jethro. "China Is Most Efficient Aluminum Producer Nation." *Metal Bulletin*, October 31, 2016. https://www.fastmarkets.com/base-metals-news/aluminium/lme-week-2016-china-is-most-efficient-aluminium-producer-nation-123097/.

World Aluminium. "Global Aluminium Flow: 2011–14." http://www.world-aluminium.org/statistics/massflow/ (accessed multiple dates).

World Bank. "Development Indicators: Container Port Traffic, Rail Lines, Logistics Performance Index, Internet Users, and Ease of Doing Business." http://data.worldbank.org/indicator?tab=all (accessed January 17, 2017).

———. "Economy Rankings, Benchmarked to June 2016." http://www.doingbusiness.org/rankings (accessed January 25, 2016).

———. "Indicators: Infrastructure: Electricity Production from Hydroelectric Sources," October 14, 2016. http://data.worldbank.org/indicator.

World Economic Forum (WEF). *The Global Competitiveness Report 2015–2016, Competitiveness Dataset (XLS); Pillar7 Labor Market Efficiency*. Cologny, Switzerland: WEF, September 29, 2015. http://reports.weforum.org/global-competitiveness-report-2015-2016/.

———. “Competitiveness Rankings.” In *The Global Competitiveness Report 2015–2016, Competitiveness Dataset (XLS); Pillar7 Labor Market Efficiency*. Cologny, Switzerland: WEF, September 29, 2015. http://reports.weforum.org/global-competitiveness-report-2015-2016/competitiveness-rankings/.

Chapter 10 Quantitative Assessment of the Impact of Certain Foreign Government Policies

Summary

This chapter contains a quantitative assessment of the impact of foreign governments' policies on aluminum markets, both in the United States and worldwide. Chapters 5–9 identify a large number of foreign government policies that affected aluminum production, consumption, and trade in all or part of 2011–15. However, this chapter's quantitative assessment was conducted on the subset of those policies for which the Commission obtained enough information to precisely quantify their effects.[1120] The policies assessed quantitatively in this chapter are limited to three broad sets: Chinese trade policies, Chinese domestic policies, and Gulf Cooperation Council (GCC) countries' energy policies.[1121]

The assessment showed that each of these sets of policies had different effects on world aluminum markets. The quantified Chinese trade policies discouraged production and export in all three Chinese aluminum segments (primary unwrought, secondary unwrought and wrought products). But the effect was most pronounced in the primary unwrought aluminum segment, where the trade policies reduced production and exports by 8 percent and 91 percent, respectively. In contrast, Chinese domestic policies encouraged Chinese production and export. These policies had the largest impact on the wrought aluminum segment, and are estimated to have increased production and exports in that segment by 13 percent and 80 percent, respectively. In the GCC countries, the policies lowered the energy costs faced by producers, leading to higher production of energy-intensive primary aluminum. The model estimates that these policies increased GCC countries production and exports of primary aluminum by 22 percent and 30 percent, respectively.

The quantified policies had opposite but smaller effects on the United States. Chinese trade policies caused increases in U.S. aluminum production, ranging from 0.1 percent for secondary

[1120] Because non-quantified policies are not modeled, this quantitative assessment is only a partial estimate of the economic effects of all of the policies. And since some non-quantified policies increase world production while others decrease it, is unclear if the net effect of the non-quantified policies is positive or negative.
[1121] The six member countries of the GCC are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE).

unwrought to 2.2 percent for primary unwrought, while Chinese domestic policies caused somewhat larger decreases in U.S. production, ranging from 0.4 percent for secondary unwrought to 4.6 percent for wrought. Energy policies in the GCC countries had a minor effect in lowering U.S. domestic production, ranging from 0.0 for secondary to 0.9 percent for primary unwrought.[1122]

Methodological Approach

This analysis used the computable general equilibrium model of the world economy created by the Global Trade Analysis Project (GTAP). The GTAP model is a global trade model that takes into account the linkages between all industries in each country and the pattern of trade flows across borders. As a result of these features, the model is able to quantify the direct and indirect effects that policies in one country or segment have on other countries and segments. For example, it can quantify the impact that Chinese export taxes on primary unwrought aluminum have on U.S. production of wrought aluminum. GTAP is widely used to quantify the impact of policies on international trade, and the Commission has used different versions of the GTAP model in Commission reports examining the Trans-Pacific Partnership,[1123] Indian government policies,[1124] and the U.S.-Korea Free Trade Agreement.[1125] To analyze the effects of foreign government policies on the aluminum sector, the standard GTAP model was revised to include more detailed information about the aluminum industry.[1126] See appendix K for a more technical description of the construction of this aluminum-focused GTAP model, hereafter referred to as the "model". The appendix also discusses limitations of the model, such as data availability and the difficulty of modeling large policy changes in computable general equilibrium models.

Analyzing the effect of foreign government policies requires two steps: (1) translating the foreign government policies into a tax or subsidy rate (an ad valorem equivalent), and then (2) comparing the way the model predicts aluminum markets would look ***with*** the policies to the way it predicts they would look ***without*** the policies. The following two sections describe how these steps are accomplished.

[1122] See appendix K for additional model results, including the aggregate effect of all the policies combined and their impacts on additional countries.
[1123] USITC, *Trans-Pacific Partnership Agreement*, May 2016.
[1124] USITC, *Trade, Investment, and Industrial Policies in India*, December 2014.
[1125] USITC, *U.S.-Korea Free Trade Agreement*, September 2007.
[1126] Neither the base GTAP model nor the aluminum version explicitly includes inventories.

Policies

The set of all foreign government policies that might influence industry competition is extremely large. In order to find the most significant policies, the Commission conducted interviews with market participants, held a public hearing to receive testimony and written submissions from interested parties, and conducted research to identify the policies and programs likely to have the strongest effect on the prevailing competitive conditions of the aluminum industry.

Detailed descriptions of these policies are presented in the policies sections of chapters 5–9 of this report, but a summary is provided in table 10.1. This table lists the foreign government policies that were identified in chapters 5–9 as relevant to the aluminum industry during all or part of 2011–15 and notes whether each is included in the model. As mentioned above, the Commission's quantitative analysis estimates the effects of some, but not all, of these policies. For many policies, the Commission was able to obtain enough information to discuss it qualitatively, but not enough to measure the policy's effects precisely enough to include it in the quantitative assessment. Since such policies are not included, this quantitative assessment is only a partial estimate of the economic effects of all of the policies.

The effects of the non-quantified policies vary substantially by region, with some decreasing costs and others increasing costs. In general, decreasing production costs, lowering the price of inputs, or providing cheap or low-cost financing shift the supply curve out, increasing the quantity produced. Increasing production costs by imposing environmental regulations or hiring restrictions have the opposite effect, decreasing world production.

The non-quantified Canadian and Russian policies likely decrease primary aluminum production costs in those countries (see chapters 5 and 8). For example, in Russia, the infrastructure for the power plant associated with Rusal's BEMO smelter was financed by the Investment Fund of the Russian Federation, which was approved by the Russian government to provide 26.4 billion rubles.[1127] Canada's measures include national tax and tariff policies that supported the purchase and use of large-scale machinery (including aluminum machinery) and Quebec provincial initiatives to promote increased production as well as encourage innovation by the aluminum industry.

[1127] UC Rusal, *Driven by Green Power*, May 5, 2016, 26.

By contrast, the non-quantified European policies, on net, increase their production costs in these countries (see chapter 9) and thus decrease world production.[1128] The cost of complying with EU environmental policies, especially the ETS, puts competitive European facilities that are subject to these regulations at a competitive disadvantage.

The non-quantified Chinese and GCC countries policies include some that increase their production costs and others that decrease their costs (see chapters 6 and 7).[1129] The Chinese central and local governments have encouraged secondary aluminum production by imposing export taxes on aluminum scrap, and have encouraged wrought production by offering discounted land use fees for downstream wrought producers. At the same time, the government has tried to implement policies to encourage greater energy efficiency and discourage pollution. In the GCC countries, primary aluminum producers are at least partially owned by state-owned enterprises and therefore might receive certain financial benefits, such as low-cost loans. Moreover, similar to the situation in China, some GCC countries governments also offer aluminum producers low rents or land grants for establishing aluminum production facilities, which likely will decrease the production cost, particularly for GCC countries' primary industry. However, GCC countries governments are also aiming to develop jobs in the aluminum sector to employ their rapidly growing youth population. In particular, GCC countries governments have adopted policies aimed at employing more citizens in private sector jobs, which are currently dominated by expatriates. These policies will like increase the industry's labor cost, and its production cost, accordingly. [1130] In sum, since different non-quantified policies move world markets in different directions and the impact of non-quantified policies in some of the world's largest producers is unclear, it is also unclear if the net effect on non-quantified policies on world production is positive or negative.

The policies whose impacts are quantified by the model can be grouped into three categories: Chinese trade policies, Chinese domestic policies, and GCC countries energy policies.[1131] Table 10.2 lists the policy groups as well as their 2015 ad valorem equivalent (AVE) tax or subsidy rates.[1132]

[1128] Some individual EU policies (recycling and waste policies) actually increase the availability of secondary aluminum metal supply (scrap supply) and thus individually reduce the cost of secondary and wrought aluminum production.
[1129] Chinese environmental policy is likely to be the non-quantified policy with the largest impact on world markets.
[1130] EY, "Solving Unemployment for GCC Nationals," November 4, 2013.
[1131] See the relevant country/region chapters 5–9 for detailed discussions of these policies and programs.
[1132] See appendix K for an explanation of how these AVEs were calculated.

Table 10.1: Foreign government policies and programs identified in chapters 5–9, their qualitative effects, and whether included in the model

Policy	Qualitative effect of the policy	Does the model estimate the effect of this policy?
Canada		
Low-cost electricity	Lowers production costs, especially for primary unwrought	No
Low-cost financing	Lowers production costs	No
Accelerated depreciation schedules for machinery and equipment	Lowers production costs	No
Government procurement	Increases demand for aluminum	No
China		
Export taxes on primary, secondary, and wrought	Discourages exports, lowers input costs for wrought	Yes, under Chinese trade policies
Export taxes on aluminum scrap	Discourages exports of scrap, lowers production costs for secondary	No
Value added tax on exports and partial rebate	Discourages exports, especially for primary wrought	Yes, under Chinese trade policies
Reduced electricity prices	Lowers production costs, especially for primary unwrought	Yes, under Chinese domestic policies
Higher electricity prices for inefficient smelters	Increases production costs for inefficient primary smelters	Yes, under Chinese domestic policies
Minimum energy-efficiency thresholds	Increases production costs for inefficient primary smelters	No
Environmental policies	Increases production costs	No
Overcapacity policies	Lowers production capacity	No
Low-cost financing	Lowers production costs	Yes, under China domestic policies
Tax benefits for facilities that are new or in Western China	Lowers production costs	No
VAT rebates for secondary and wrought	Lowers production costs	Yes, under Chinese domestic policies
Grants	Lowers production costs	Yes, under Chinese domestic policies
Discounted land use fees	Lowers production costs	No
Government stockpiling	Increases demand for aluminum	No
Wrought policies named in antidumping cases	Lowers production costs	Yes, under Chinese domestic policies
Western Europe		
“Energy transition” in Germany (*Energiewende*)	Increases production costs, especially for primary unwrought	No
Environmental policies	Increases production costs	No
Gulf Cooperation Council (GCC) countries		
Low-cost electricity	Lowers production costs	Yes, under GCC countries energy policies
Low-cost natural gas	Lowers production costs	Yes, under GCC countries energy policies
Corporate ownership policies	Increases production costs	No
Low-cost financing	Lowers production costs	No
Tax benefits	Lowers production costs	No
Low rents, land grants, and investment programs	Lowers production costs	No
Investment promotion	Lowers production costs	No
Labor policies and hiring	Increases production costs	No

Policy	Qualitative effect of the policy	Does the model estimate the effect of this policy?
preferences		
Russia		
Export taxes on unwrought aluminum	Discourage exports of unwrought and reduces production costs for wrought	Yes, see appendix K
Export taxes on aluminum scrap	Discourages exports of aluminum scrap and reduces production costs for secondary	No
State aluminum reserve	Increases demand for aluminum	No, did not exist in 2011–15
Aluminum Valley special economic zones	Increases aluminum production and consumption	No, did not exist in 2011–15
Development plans	Increases demand for aluminum	No, did not exist in 2011–15
Direct government investment	Lowers production costs	No

Source: Compiled from the “Government Policies and Programs” sections of chapters 5–9.

Table 10.2: Foreign government policies and programs addressed by model and their ad valorem equivalent tax or subsidy rates

Policy	Rate (percent)
Chinese trade policies	
Tax on export of primary unwrought aluminum	29.5
Tax on export of secondary unwrought aluminum	4.2
Tax on export of wrought aluminum	2.8
Chinese domestic policies	
Financial support for production of primary unwrought aluminum	3.8
Financial support for production of secondary unwrought aluminum	2.1
Financial support for production of wrought aluminum	9.6
Support for financing for primary unwrought aluminum	5.0
Gulf Cooperation Council energy policies	
Financial support for purchases of natural gas by all aluminum sectors	23.6
Financial support for purchases of electricity by all aluminum sectors	25.2

Source: USITC staff calculations; see appendix K for the methodology.

Each tax or subsidy rate presented in table 10.2 is the net AVE of multiple policies from table 10.1. The Chinese trade policies are the combined effect of China’s export taxes, its value-added tax (VAT) on exports, and export VAT rebate. These add up to a net tax on the export of aluminum products. So, for example, if a Chinese firm wanted to export $100 of primary unwrought aluminum, it would need to pay (on average) $17 for the VAT and $12.50 in export taxes; it would receive $0 in VAT rebates, for a total payment of $29.50. The export VAT and taxes tend to be higher for primary unwrought aluminum than for other aluminum segments, and the export VAT rebate tends to be lower; the resulting AVE rate is thus highest for primary unwrought.

The Chinese domestic policies included in the model are production supports for all aluminum sectors, subsidized financing through low-interest loans, and low cost electricity for primary unwrought producers. The AVE of these policies is largest for wrought production.

Finally, the GCC countries energy policies lower the price of electricity and natural gas. This is most relevant to primary unwrought producers, as energy accounts for a large share of their production costs.

Simulations of Policy Changes

The model estimates the effect of these policies by comparing what aluminum markets look like under different policy scenarios. The baseline “no-policy” scenario is what the 2011 world economy would hypothetically have looked like if none of the quantified aluminum policies had existed.[1133] That is, all the rates in Table 10.2 are set equal to zero in the baseline.

This baseline is compared to three other scenarios, each of which imposes one of the policy groups. Each scenario modifies the baseline by changing the AVE rates for one of the policy groups to its values in Table 10.2 while leaving the rates for the other groups at zero. The results of the simulations should be interpreted as the effect of ***imposing*** the policies, rather than the effect of ***removing*** the policies. So the value of “-0.1” for the change in the price of primary unwrought aluminum in Table 10.3 means that Chinese trade policies lower the price of primary unwrought aluminum in China by 0.1 percent.

Results

The different policies had different effects on world aluminum markets, in terms of both the countries and industries impacted. The Chinese trade policies discouraged production and export of all three Chinese aluminum segments, but the effect was most pronounced in primary unwrought. The Chinese domestic policies had the opposite effect, encouraging Chinese production and export, especially of wrought aluminum. In the GCC countries, energy policies encouraged the production of energy-intensive primary unwrought. Each of these policies had the opposite effect on the United States. See appendix K for additional model results, including the aggregate effect of all the policies combined and their impacts on additional countries.

[1133] Note that the baseline is not the actual world economy in 2011, as these aluminum policies did exist in 2011. The baseline is what 2011 would have looked like if the policies did not exist. See appendix K for more details.

Chinese Trade Policies

The selected Chinese trade policies acted as export taxes that discouraged the export of each of the aluminum segments, with the percentage drop in exports reflecting the size of the AVE for that segment (table 10.3). These effects are consistent with the expectation that imposing export taxes on a commodity should reduce production and exports of that commodity.

Table 10.3: Effect of selected Chinese trade policies on Chinese aluminum prices, production, and trade

						Commodity
	Primary unwrought		**Secondary unwrought**			**Wrought**
Change in	Percent	Million $	Percent	Million $	Percent	Million $
Price	-0.1	NA	0.0	NA	0.0	NA
Production	-8.0	-4,052	-0.8	-75	-1.9	-1,306
Imports	-21.3	-751	-1.0	-5	-1.1	-102
Exports	-91.3	-4,778	-27.4	-70	-17.4	-1,333

Source: USITC staff calculations.
Note: The selected Chinese trade policies are limited to export taxes, the VAT on exports, and the VAT rebate on exports. The effect of these policies is the difference between the no-policy scenario (baseline) and the scenario where the selected Chinese trade policies were implemented. Price changes are all relative, so the price change in terms of millions of dollars are “NA” or not applicable.

Primary unwrought aluminum had the largest AVE rate, and thus these policies had the largest impact on that commodity. Chinese trade policies reduced primary unwrought production in China by 8 percent ($4.1 billion), imports from the world by 21 percent ($751 million), and exports to the world by 91 percent ($4.8 billion). The large drop in primary unwrought production meant that relatively little primary unwrought was diverted from exports to the domestic market. As a result, the market price of primary unwrought fell by only 0.1 percent in China.

Chinese trade policies also negatively affected wrought and secondary unwrought production, although to a much lesser extent than primary unwrought. The policies reduced Chinese wrought production by 1.9 percent ($1.3 billion) and exports by 17 percent ($1.3 billion). Secondary unwrought production fell by 0.8 percent, and its exports fell by 27 percent.

The model results show that Chinese trade policies had a small, but positive, effect on U.S. aluminum production and exports (table 10.4): by reducing Chinese exports, they reduced the competition faced by U.S. producers. However, the impact of these policies on the United States was weaker than their impact on China. This is not surprising, since the policies directly affected all Chinese exports, but only indirectly affected the United States through their impact on world aluminum markets. Moreover, only a very small fraction of U.S. primary aluminum imports originate from China.[1134]

Table 10.4: Effect of selected Chinese trade policies on U.S. aluminum prices, production, and trade

Commodity	Primary unwrought		Secondary unwrought		Wrought	
Change in	Percent	Million $	Percent	Million $	Percent	Million $
Price	0.0	NA	0.0	NA	0.0	NA
Production	2.2	112	0.1	6	0.9	207
Imports	-0.1	-5	-0.1	-1	-0.9	-57
Exports	16.3	102	0.3	2	2.8	138

Source: USITC staff calculations.
Note: The selected Chinese trade policies are limited to export taxes, the VAT on exports, and the VAT rebate on exports. The effect of these policies is the difference between the no-policy scenario (baseline) and the scenario where the selected Chinese trade policies were implemented. Price changes are all relative, so the price change in terms of millions of dollars are “NA” or not applicable.

Chinese Domestic Policies

The selected Chinese domestic policies acted as production supports, encouraging the production and export of aluminum products (table 10.5). As with Chinese trade policies, the effects of the Chinese domestic policies on different aluminum sectors reflects the size of the AVEs for those sectors (table 10.2). The strongest impact of these policies was on wrought aluminum, with production and exports increasing by 13.4 percent ($9.4 billion) and 80.4 percent ($6.2 billion), respectively.

Table 10.5: Effect of selected Chinese domestic policies on Chinese aluminum prices, production, and trade

Commodity	Primary unwrought		Secondary unwrought		Wrought	
Change in	Percent	Million $	Percent	Million $	Percent	Million $
Price	-3.9	NA	-2.2	NA	-9.3	NA
Production	3.7	1,899	2	188	13.4	9,395
Imports	-7.3	-259	-6.6	-33	-25.9	-2,364
Exports	20.3	1,060	15.1	39	80.4	6,179

Source: USITC staff calculations.
Note: The selected Chinese domestic policies are limited to energy policies, financing, VAT rebates, grants, and fees. The effect of these policies is the difference between the no-policy scenario (baseline) and the scenario where the selected Chinese domestic policies were implemented. Price changes are all relative, so the price change in terms of millions of dollars are “NA” or not applicable.

The model estimates that Chinese domestic policies negatively affected the U.S. aluminum industry by lowering its production and exports (table 10.6). By boosting Chinese production, the policies increased the competition faced by U.S. producers, which in turn lowered U.S. production and exports of each aluminum commodity. Wrought aluminum was by far the most

[1134] See the "Trade" section of chapter 4.

heavily impacted segment, with U.S. production declining by 4.6 percent ($1.1 billion) and U.S. exports falling by 15.8 percent ($771 million).

Table 10.6: Effect of selected Chinese domestic policies on U.S. aluminum prices, production, and trade

						Commodity
	Primary unwrought		**Secondary unwrought**			**Wrought**
Change in	Percent	Million $	Percent	Million $	Percent	Million $
Price	-0.1	NA	-0.1	NA	-0.1	NA
Production	-0.9	-47	-0.4	-23	-4.6	-1,088
Imports	-0.4	-16	-0.4	-4	3.9	256
Exports	-4.9	-31	-1	-6	-15.8	-771

Source: USITC staff calculations.
Note: The selected Chinese domestic policies are limited to energy policies, financing, VAT rebates, grants, and fees. The effect of these policies is the difference between the no-policy scenario (baseline) and the scenario where the selected Chinese domestic policies were implemented. Price changes are all relative, so the price change in terms of millions of dollars are "NA" or not applicable.

Gulf Cooperation Council Energy Policies

The identified GCC countries energy policies served to lower the cost of electricity and natural gas for producers. This benefit is especially important for primary unwrought producers, as energy accounts for a large share of production costs. As a result, primary unwrought was by far the most impacted commodity (table 10.7). The energy policies in the GCC countries are estimated to have raised production and exports in this sector by 22 percent ($1.3 billion) and 30 percent ($1.2 billion), respectively.

Table 10.7: Effect of selected Gulf Cooperation Council (GCC) country energy policies on GCC country aluminum prices, production, and trade

						Commodity
	Primary unwrought		**Secondary unwrought**			**Wrought**
Change in	Percent	Million $	Percent	Million $	Percent	Million $
Price	-4.4	NA	-0.5	NA	-0.5	NA
Production	22.4	1,294	3.9	1	2.8	117
Imports	-1.9	-17	-0.2	0	-0.2	-4
Exports	30.4	1,239	4.0	1	3.1	109

Source: USITC staff calculations.
Note: The GCC countries energy policies are limited to those that lowered the cost of electricity and natural gas. The effect of these policies is the difference between the no-policy scenario (baseline) and the scenario where the GCC countries energy policies were implemented. Price changes are all relative, so the price change in terms of millions of dollars are "NA" or not applicable.

GCC countries energy policies negatively impacted the U.S. aluminum industry, depressing its production and exports (table 10.8). By increasing GCC countries production, the policies increased the competition faced by U.S. producers, which decreased U.S. production and exports of each aluminum commodity. As the GCC countries production increase was almost entirely in primary unwrought, the negative U.S. effects were concentrated there as well. As a result of these GCC countries energy policies, U.S. production fell by 0.9 percent ($46 million) and exports by 0.8 percent ($5 million). It is evident, however, that the impact of the GCC countries policies on the United States was small relative to that of the Chinese policies. Although the GCC countries energy policies have higher AVE rates than the Chinese policies do, GCC countries production was much smaller than Chinese production.[1135] As a result, the GCC countries policies had a much smaller impact on U.S. markets than the Chinese policies did.

Table 10.8: Effect of selected Gulf Cooperation Council (GCC) countries energy policies on U.S. aluminum prices, production, and trade

	Primary unwrought		**Secondary unwrought**		***Commodity*** **Wrought**	
Change in	Percent	Million $	Percent	Million $	Percent	Million $
Price	0.0	NA	0.0	NA	0.0	NA
Production	-0.9	-46	0.0	0	-0.1	-13
Imports	0.9	41	0.0	0	0.0	1
Exports	-0.8	-5	0.0	0	-0.2	-11

Source: USITC staff calculations.
Note: The GCC countries energy policies are limited to those that lowered the cost of electricity and natural gas. The effect of these policies is the difference between the no-policy scenario (baseline) and the scenario where the GCC countries energy policies were implemented. Price changes are all relative, so the price change in terms of millions of dollars are "NA" or not applicable.

Comparison of Model and Survey

For this report, the Commission conducted a survey of U.S. aluminum producers.[1136] As part of the survey, U.S. aluminum producers were asked for their opinions on the effect of foreign government policies and programs on their production. Most U.S. secondary unwrought and wrought producers stated that they could not estimate the effects of the policies. But for those that could, their responses were similar to the model results. Note that in the survey, firms were asked about the effect of ***removing*** foreign policies, while the model looks at the effect of ***imposing*** the policies.

For U.S. secondary unwrought producers, the model found that the identified China trade policies reduced their production by 0.1 percent, the China domestic policies reduced their production by 0.4 percent, and the GCC countries energy policies reduced it by 0.0 percent. In the survey, "increase in production" was their most common response for the effect of removing foreign government policies.[1137] More detailed survey responses are not publishable due to confidentiality requirements and the small number of producers.

[1135] See the "Production" sections of chapters 6 and 7.
[1136] See appendix F for the survey questionnaire, appendix G for the survey methodology, and appendix H for the survey results.
[1137] See appendix table H.6, survey question 3.11, in appendix H.

For U.S. wrought producers, the model found that the identified China trade policies increased production by 0.9 percent, the identified China domestic policies reduced production by 4.6 percent, and the GCC countries energy policies reduced it by 0.1 percent. In the survey, their most common response was that removing foreign policies would increase production between 1 percent and 10 percent.[1138]

Survey responses from primary unwrought producers are not publishable due to confidentiality requirements and the small number of producers.

[1138] See appendix table H.20, survey question 4.22, in appendix H.

Bibliography

Ernst & Young (EY). "Solving Unemployment for GCC Nationals: A Sectoral Approach," November 4, 2013. http://performance.ey.com/wp-content/uploads/downloads/2013/11/EY-Performance-Solving-unemployment.pdf.

Fattouh, Bassam, Anupama Sen, and Tom Moerenhout. "Striking the Right Balance? GCC Energy Pricing Reforms in a Low Price Environment." University of Oxford. Oxford Institute for Energy Studies. Oxford Energy Comment, May 2016. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2016/04/Striking-the-Right-Balance-GCC-Energy-Pricing-Reforms-in-a-Low-Price-Environment.pdf.

UC Rusal. *Driven by Green Power: 2015 Annual Report*, May 5, 2016. http://www.rusal.ru/en/investors/reports/.

U.S. International Trade Commission (USITC). *U.S.-Korea Free Trade Agreement: Potential Economy-wide and Selected Sectoral Effects*. USITC Publication No. 3949. Washington, DC: USITC, September 2007. https://www.usitc.gov/publications/pub3949.pdf.

———. *Trade, Investment, and Industrial Policies in India: Effects on the U. S. Economy*. USITC Publication No. 4501. Washington, DC: USITC, December 2014. https://www.usitc.gov/publications/332/pub4501.pdf.

———. *Trans-Pacific Partnership Agreement: Likely Impact on the U.S. Economy and on Specific Industry Sectors*. USITC Publication No. 4607. Washington, DC: USITC, May 2016. https://www.usitc.gov/publications/332/pub4607.pdf.

Appendix A
Request Letter

COMMITTEE ON WAYS AND MEANS

U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515

February 24, 2016

The Honorable Meredith Broadbent
Chairman
U.S. International Trade Commission
500 E Street, SW
Washington, DC 20436

Dear Chairman Broadbent:

The Committee on Ways and Means is interested in obtaining current information on relevant factors affecting the global competitiveness of the U.S. aluminum industry. The U.S. aluminum industry remains a globally successful producer of aluminum products. A healthy and growing aluminum industry is not only important to our economy, but is also vital for our national defense.

In order to better assess the current market conditions confronting the U.S. industry, we request that the U.S. International Trade Commission conduct an investigation under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), and provide a report setting forth the results of the investigation. The investigation should cover unwrought (e.g., primary and secondary) and wrought (e.g., semi-finished) aluminum products

To the extent that information is available, the report should contain:

- an overview of the aluminum industry in the United States and other major global producing and exporting countries, including production, production capacity, capacity utilization, employment, wages, inventories, supply chains, domestic demand, and exports;
- information on recent trade trends and developments in the global market for aluminum, including U.S. and other major foreign producer imports and exports, and trade flows through third countries for further processing and subsequent exports;
- a comparison of the competitive strengths and weaknesses of aluminum production and exports in the United States and other major producing and exporting countries, including such factors as producer revenue and production costs, industry structure, input prices and availability, energy costs and sources, production technology, product innovation, exchange rates, and pricing, as well as government policies and programs that directly or indirectly affect aluminum production and exporting in these countries;
- in countries where unwrought aluminum capacity has significantly increased, identify factors driving those capacity and related production changes; and
- a qualitative and, to the extent possible, quantitative assessment of the impact of government policies and programs in major foreign aluminum producing and exporting countries on their aluminum production, exports, consumption, and domestic prices, as well as on the U.S. aluminum industry and on aluminum markets worldwide.

The report should focus primarily on the 2011-2015 time period, but examine longer term trends since 2001. To develop detailed information on the domestic aluminum market and industry, it is anticipated that the Commission will need to collect primary data from market participants through questionnaires. The Committee requests that the Commission transmit its report to Congress no later than 16 months following the receipt of this request. It is the Committee's intent to make the Commission's report available to the public in its entirety. Therefore, the report should not include any confidential business information.

Thank you for your attention to this request.

Sincerely,

Kevin Brady

Cc: Rep. Sandy Levin, Ranking Member

Appendix B
Federal Register Notices

4. Assume risks and waive claims against the Federal Government and its related entities (15 U.S.C. 3719(i)(1)(B)); and,

5. Not use Federal facilities, or consult with Federal employees *during the competition* unless the facilities and employees are made available to all individuals and entities participating in the competition on an equitable basis.

The following individuals or entities are not eligible regardless of whether they meet the criteria set forth above:

1. Any individual who employs an evaluator on the Judging Panel or otherwise has a material business relationship or affiliation with any Judge.

2. Any individual who is a member of any Judge's immediate family or household.

3. The Seeker, participating organizations, and any advertising agency, contractor or other individual or organization involved with the design, production, promotion, execution, or distribution of the prize competition; all employees, representatives and agents thereof; and all members of the immediate family or household of any such individual, employee, representative, or agent.

4. Any individual or entity that uses Federal funds to develop the proposed solution now or any time in the past, unless such use is consistent with the grant award, or other applicable Federal funds awarding document. NOTE: Submissions that propose to improve or adapt existing federally funded technologies for the solution sought in this prize competition are eligible.

Consultation: Geotechnical engineers, biologists, facility managers, and technical specialists from across Reclamation and U.S. Army Corps of Engineers were consulted in identifying and selecting the topic of this prize competition. Direct and indirect input from various stakeholders and partners associated with the asset management program efforts by these agencies were also considered.

Public Disclosure: InnoCentive, Inc. is administering this challenge under a challenge support services contract with Reclamation. Participation is conditioned on providing the data required on InnoCentive's online registration form. Personal data will be processed in accordance with InnoCentive's Privacy Policy which can be located at *http://www.innocentive.com/privacy.php.* Before including your address, phone number, email address, or other personal identifying information in your proposal, you should be aware that the Seeker is under no obligation to withhold such information from public disclosure, and it may be made publicly available at any time. Neither InnoCentive nor the Seeker is responsible for human error, theft, destruction, or damage to proposed solutions, or other factors beyond its reasonable control. Solver assumes any and all risks and waives any and all claims against the Seeker and its related entities, except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from participation in this competition, whether the injury, death, damage, or loss arises through negligence or otherwise.

Dated: August 22, 2016.

David Raff,

Science Advisor.

[FR Doc. 2016–20497 Filed 8–26–16; 8:45 am]

BILLING CODE 4332–90–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–557]

Aluminum: Competitive Conditions Affecting the U.S. Industry Submission of Questionnaire for OMB Review

AGENCY: United States International Trade Commission.

ACTION: Notice of submission of request for approval of a questionnaire to the Office of Management and Budget. This notice is being given pursuant to the Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35).

*Purpose of Information Collection:*The information requested by the questionnaire is for use by the Commission in connection with investigation No. 332–557, *Aluminum: Competitive Conditions Affecting the U.S. Industry.* The investigation was instituted under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)) at the request of the House Committee on Ways and Means (the Committee). The Commission expects to deliver its report to the Committee by June 26, 2017.

Summary of Proposal:

(1) *Number of forms submitted:* 1.

(2) *Title of form:* Unwrought and Wrought Aluminum Questionnaire.

(3) *Type of request:* New.

(4) *Frequency of use:* Industry questionnaire, single data gathering, scheduled for 2016.

(5) *Description of respondents:* U.S. producers of unwrought and wrought aluminum.

(6) *Estimated number of questionnaires to be mailed:* 280.

(7) *Estimated total number of hours to complete the questionnaire per respondent:* 12 hours.

(8) Information obtained from the questionnaire that qualifies as confidential business information will be so treated by the Commission and not disclosed in a manner that would reveal the individual operations of a firm.

Additional Information or Comment: Copies of the questionnaire and supporting documents may be obtained from project leader Karl Tsuji (*karl.tsuji@usitc.gov* or 202–205–3434) or deputy project leader Mihir Torsekar (*mihir.torsekar@usitc.gov* or 202–205–3350). Comments about the proposal should be directed to the Office of Management and Budget, Office of Information and Regulatory Affairs, Room 10102 (Docket Library), Washington, DC 20503, ATTENTION: Docket Librarian. All comments should be specific, indicating which part of the questionnaire is objectionable, describing the concern in detail, and including specific suggested revisions or language changes. Copies of any comments should be provided to Kirit Amin, Chief Information Officer, U.S. International Trade Commission, 500 E Street SW., Washington, DC 20436, who is the Commission's designated Senior Official under the Paperwork Reduction Act.

General information concerning the Commission may also be obtained by accessing its Internet address (*https://www.usitc.gov*). Hearing-impaired individuals are advised that information on this matter can be obtained by contacting the TDD terminal on 202–205–1810. Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Secretary at 202–205–2000.

By order of the Commission.

Issued: August 23, 2016.

Lisa R. Barton,

Secretary to the Commission.

[FR Doc. 2016–20567 Filed 8–26–16; 8:45 am]

BILLING CODE 7020–02–P

DEPARTMENT OF JUSTICE

[Docket No. OIP–0002]

Notice of Chief Freedom of Information Act Officer Council Meeting

AGENCY: Department of Justice.

ACTION: Notice of Chief FOIA Officer Council meeting.

SUMMARY: In accordance with the Freedom of Information Act (5 U.S.C. 552(k), DOJ announces the second

elaborates upon the Commission's rules with respect to electronic filing.

Additional written submissions to the Commission, including requests pursuant to section 201.12 of the Commission's rules, shall not be accepted unless good cause is shown for accepting such submissions, or unless the submission is pursuant to a specific request by a Commissioner or Commission staff.

In accordance with sections 201.16(c) and 207.3 of the Commission's rules, each document filed by a party to the investigations must be served on all other parties to the investigations (as identified by either the public or BPI service list), and a certificate of service must be timely filed. The Secretary will not accept a document for filing without a certificate of service.

Authority: These investigations are being conducted under authority of title VII of the Tariff Act of 1930; this notice is published pursuant to section 207.21 of the Commission's rules.

By order of the Commission.

Issued: June 21, 2016.

William R. Bishop,

Supervisory Hearings and Information Officer.

[FR Doc. 2016–15053 Filed 6–24–16; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–557]

Aluminum: Competitive Conditions Affecting the U.S. Industry: Proposed Information Collection; Comment Request; Aluminum: Competitive Conditions Affecting the U.S. Industry Questionnaire

AGENCY: United States International Trade Commission.

ACTION: Notice.

SUMMARY: In accordance with the provisions of the Paperwork Reduction Act of 1995, the U.S. International Trade Commission (Commission) hereby gives notice that it plans to submit a request for approval of a questionnaire to the Office of Management and Budget for review and requests public comment on its draft collection.

DATES: To ensure consideration, written comments must be submitted on or before August 24, 2016.

ADDRESSES: Direct all written comments to Karl Tsuji, Project Leader, or Mihir Torsekar, Deputy Project Leader, U.S. International Trade Commission, 500 E Street SW., Washington, DC 20436 (or via email at *karl.tsuji@usitc.gov* or *mihir.torsekar@usitc.gov*).

Additional Information: Copies of the questionnaire and supporting investigation documents may be obtained from project leader Karl Tsuji (*karl.tsuji@usitc.gov* or 202–205–3434) or deputy project leader Mihir Torsekar (*mihir.torsekar@usitc.gov* or 202–205–3350). Hearing-impaired individuals may obtain information on this matter by contacting the Commission's TDD terminal at 202–205–1810. General information concerning the Commission may also be obtained by accessing its Web site (*http://www.usitc.gov*). Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202–205–2000.

SUPPLEMENTARY INFORMATION:

Purpose of Information Collection: The information requested by the questionnaire is for use by the Commission in connection with Investigation No. 332–557, *Aluminum: Competitive Conditions Affecting the U.S. Industry,* instituted under the authority of section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)). This investigation was requested by the House Committee on Ways and Means (the Committee), 81 FR 21591, April 12, 2016. The Committee anticipated that the Commission would need to include a survey to help develop detailed information on the domestic aluminum market and industry. The Commission expects to deliver the results of its investigation to the Committee by June 27, 2017.

Summary of Proposal

(1) Number of forms submitted: 1.
(2) Title of form: Aluminum: Competitive Conditions Affecting the U.S. Industry Questionnaire.
(3) Type of request: New.
(4) Frequency of use: Industry questionnaire, single data gathering, scheduled for 2016.
(5) Description of respondents: U.S. producers of unwrought and wrought aluminum.
(6) Estimated number of respondents: 260.
(7) Estimated total number of hours to complete the questionnaire per respondent: 12 hours.
(8) Information obtained from the questionnaire that qualifies as confidential business information will be so treated by the Commission and not disclosed in a manner that would reveal the individual operations of a firm.

I. Abstract

The House Committee on Ways and Means (the Committee) has directed the Commission to produce a report that examines relevant factors affecting global competitiveness of the U.S. aluminum industry. The Committee has requested that the report (1) provide an overview of the aluminum industry in the United States and other major global producing and exporting countries; (2) describe recent trends and developments in the global market for aluminum; (3) compare competitive strengths and weaknesses of aluminum production and exports in the United States and other major producing and exporting countries; (4) identify factors driving capacity and related production changes in countries where unwrought aluminum capacity has significantly increased; and (5) assess the impact of government policies and programs in major foreign aluminum producing and exporting countries. The Committee has anticipated the need for questionnaires in order to develop detailed information on the domestic aluminum market and industry.

II. Method of Collection

Respondents will be mailed a letter directing them to download and fill out a form-fillable PDF questionnaire. Respondents will also receive a follow-up email. Once complete, respondents may submit it by uploading it to a secure Webserver, emailing it to the study team, faxing it, or mailing a hard copy to the Commission.

III. Request for Comments

Comments are invited on (1) whether the proposed collection of information is necessary; (2) the accuracy of the agency's estimate of the burden (including hours and cost) of the proposed collection of information; (3) ways to enhance the quality, utility, and clarity of the information to be collected; and (4) ways to minimize the burden of the collection of information on respondents, including through the use of automated collection techniques or other forms of information technology.

The draft questionnaire and other supplementary documents may be downloaded from the USITC Web site at *https://www.usitc.gov/aluminum.*

Comments submitted in response to this notice will be summarized and/or included in the request for OMB approval of this information collection; they will also become a matter of public record.

By order of the Commission.

Dated: June 17, 2016.

Lisa R. Barton,

Secretary to the Commission.

[FR Doc. 2016–14835 Filed 6–24–16; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 337–TA–962]

Certain Resealable Packages With Slider Devices; Notice of Request for Statements on the Public Interest

AGENCY: U.S. International Trade Commission.

ACTION: Notice.

SUMMARY: Notice is hereby given that the presiding administrative law judge (''ALJ'') has issued a Final Initial Determination on Violation of Section 337 and Recommended Determination on Remedy and Bonding in the above-captioned investigation. The Commission is soliciting comments on public interest issues raised by the recommended relief should the Commission find a violation of section 337, as amended, 19 U.S.C. 1337. The ALJ recommended a limited exclusion order directed against certain resealable packages with slider devices imported by respondents Inteplast Group, Ltd. of Livingston, New Jersey and Minigrip, LLC of Alpharetta, Georgia, and a cease and desist order directed against respondents. This notice is soliciting public interest comments from the public only. Parties are to file public interest submissions pursuant to 19 CFR 210.50(a)(4).

FOR FURTHER INFORMATION CONTACT: Clint A. Gerdine, Office of the General Counsel, U.S. International Trade Commission, 500 E Street SW., Washington, DC 20436, telephone (202) 708–2310. Copies of non-confidential documents filed in connection with this investigation are or will be available for inspection during official business hours (8:45 a.m. to 5:15 p.m.) in the Office of the Secretary, U.S. International Trade Commission, 500 E Street SW., Washington, DC 20436, telephone (202) 205–2000. General information concerning the Commission may also be obtained by accessing its Internet server at *http://www.usitc.gov.* The public record for this investigation may be viewed on the Commission's electronic docket (EDIS) at *http://edis.usitc.gov.* Hearing-impaired persons are advised that information on this matter can be obtained by contacting the Commission's TDD terminal on (202) 205–1810.

SUPPLEMENTARY INFORMATION: Section 337 of the Tariff Act of 1930 provides that if the Commission finds a violation it shall exclude the articles concerned from the United States:

> unless, after considering the effect of such exclusion upon the public health and welfare, competition conditions in the United States economy, the production of like or directly competitive articles in the United States consumers, it finds that such articles should not be excluded from entry.

19 U.S.C. 1337(d)(1). A similar provision applies to cease and desist orders. 19 U.S.C. 1337(f)(1).

The Commission is interested in further development of the record on the public interest in its investigations. Accordingly, members of the public are invited to file submissions of no more than five (5) pages, inclusive of attachments, concerning the public interest in light of the administrative law judge's Recommended Determination on Remedy and Bonding issued in this investigation on June 20, 2016. Comments should address whether issuance of an exclusion order and/or cease and desist orders in this investigation could affect the public health and welfare in the United States, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, or United States consumers.

In particular, the Commission is interested in comments that:

(i) Explain how the articles potentially subject to the recommended orders are used in the United States;

(ii) identify any public health, safety, or welfare concerns in the United States relating to the recommended orders;

(iii) indicate the extent to which like or directly competitive articles are produced in the United States or are otherwise available in the United States, with respect to the articles potentially subject to the recommended orders;

(iv) indicate whether Complainant, Complainant's licensees, and/or third party suppliers have the capacity to replace the volume of articles potentially subject to the recommended orders within a commercially reasonable time; and

(v) explain how the recommended orders would impact consumers in the United States.

Written submissions must be filed no later than by close of business on July 27, 2016.

Persons filing written submissions must file the original document electronically on or before the deadlines stated above and submit 8 true paper copies to the Office of the Secretary by noon the next day pursuant to Commission rule 210.4(f), 19 CFR 210.4(f). Submissions should refer to the investigation number (''Inv. No. 337–TA–962'') in a prominent place on the cover page and/or the first page. (*See* Handbook for Electronic Filing Procedures, *http://www.usitc.gov/secretary/fed_reg_notices/rules/handbook_on_electronic_filing.pdf*). Persons with questions regarding filing should contact the Secretary (202–205–2000).

Any person desiring to submit a document (or portion thereof) to the Commission in confidence must request confidential treatment unless the information has already been granted such treatment during the proceedings. All such requests should be directed to the Secretary of the Commission and must include a full statement of the reasons why the Commission should grant such treatment. *See* 19 CFR 201.6. Documents for which confidential treatment by the Commission is sought will be treated accordingly. A redacted non-confidential version of the document must also be filed simultaneously with any confidential filing. All non-confidential written submissions will be available for public inspection at the Office of the Secretary and on EDIS.

This action is taken under authority of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. 1337, and Part 210 of the Commission's Rules of Practice and Procedure (19 CFR part 210).

By order of the Commission.

Issued: June 21, 2016.

William R. Bishop,

Supervisory Hearings and Information Officer.

[FR Doc. 2016–15093 Filed 6–24–16; 8:45 am]

BILLING CODE 7020–02–P

DEPARTMENT OF JUSTICE

Bureau of Alcohol, Tobacco, Firearms and Explosives

[OMB Number 1140–0096]

Agency Information Collection Activities; Proposed eCollection eComments Requested; Environmental Information (ATF F 5000.29)

AGENCY: Bureau of Alcohol, Tobacco, Firearms and Explosives, Department of Justice.

ACTION: 60-day notice.

SUMMARY: The Department of Justice (DOJ), Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), will submit the following information collection request to the Office of

Federal Register / Vol. 81, No. 70 / Tuesday, April 12, 2016 / Notices **21591**

1673b(b)). Notice of the scheduling of the final phase of the Commission's investigation and of a public hearing to be held in connection therewith was given by posting copies of the notice in the Office of the Secretary, U.S. International Trade Commission, Washington, DC, and by publishing the notice in the **Federal Register** of October 21, 2015 (80 FR 63833). The hearing was held in Washington, DC, on February 11, 2016, and all persons who requested the opportunity were permitted to appear in person or by counsel.

The Commission made this determination pursuant to section 735(b) of the Tariff Act of 1930 (19 U.S.C. 1673d(b)). It completed and filed its determination in this investigation on April 6, 2016. The views of the Commission are contained in USITC Publication 4600 (April 2016), entitled *Silicomanganese from Australia: Investigation No. 731–TA–1269 (Final).*

By order of the Commission.

Issued: April 6, 2016.

Lisa R. Barton,

Secretary to the Commission.

[FR Doc. 2016–08268 Filed 4–11–16; 8:45 am]

BILLING CODE 7020–02–P

INTERNATIONAL TRADE COMMISSION

[Investigation No. 332–557]

Aluminum: Competitive Conditions Affecting the U.S. Industry Institution of Investigation and Scheduling of Hearing

AGENCY: United States International Trade Commission.

ACTION: Notice of investigation and scheduling of a public hearing.

SUMMARY: Following receipt of a request dated February 24, 2016 from the U.S. House of Representatives, Committee on Ways and Means (Committee) under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)), the U.S. International Trade Commission (Commission) instituted investigation No. 332–557: *Aluminum: Competitive Conditions Affecting the U.S. Industry.*

DATES:

September 5, 2016: Deadline for filing requests to appear at the public hearing.

September 12, 2016: Deadline for filing pre-hearing briefs and statements.

September 29, 2016: Public hearing.

October 7, 2016: Deadline for filing post-hearing briefs and submissions.

February 21, 2017: Deadline for filing all other written statements.

June 26, 2017: Transmittal of Commission report to the Committee.

ADDRESSES: All Commission offices, including the Commission's hearing rooms, are located in the United States International Trade Commission Building, 500 E Street SW., Washington, DC. All written submissions should be addressed to the Secretary, United States International Trade Commission, 500 E Street SW., Washington, DC 20436. The public record for this investigation may be viewed on the Commission's electronic docket (EDIS) at *https://edis.usitc.gov/edis3-internal/app.*

FOR FURTHER INFORMATION CONTACT: Project Leader Karl Tsuji (202–205–3434 or *karl.tsuji@usitc.gov*) for information specific to this investigation. For information on the legal aspects of these investigations, contact William Gearhart of the Commission's Office of the General Counsel (202–205–3091 or *william.gearhart@usitc.gov*). The media should contact Margaret O'Laughlin, Office of External Relations (202–205–1819 or *margaret.olaughlin@usitc.gov*). Hearing-impaired individuals may obtain information on this matter by contacting the Commission's TDD terminal at 202–205–1810. General information concerning the Commission may also be obtained by accessing its Internet server (*http://www.usitc.gov*). Persons with mobility impairments who will need special assistance in gaining access to the Commission should contact the Office of the Secretary at 202–205–2000.

Background: As requested by the Committee, the investigation will cover unwrought (*e.g.,* primary and secondary) and wrought (*e.g.,* semi-finished) aluminum products. The Commission's report will provide, to the extent that information is available:

- An overview of the aluminum industry in the United States and other major global producing and exporting countries, including production, production capacity, capacity utilization, employment, wages, inventories, supply chains, domestic demand, and exports;
- Information on recent trade trends and developments in the global market for aluminum, including U.S. and other major foreign producer imports and exports, and trade flows through third countries for further processing and subsequent exports;
- A comparison of the competitive strengths and weaknesses of aluminum production and exports in the United States and other major producing and exporting countries, including such factors as producer revenue and production costs, industry structure, input prices and availability, energy costs and sources, production technology, product innovation, exchange rates, and pricing, as well as government policies and programs that directly or indirectly affect aluminum production and exporting in these countries;
- In countries where unwrought aluminum capacity has significantly increased, identify factors driving those capacity and related production changes; and
- A qualitative and, to the extent possible, quantitative assessment of the impact of government policies and programs in major foreign aluminum producing and exporting countries on their aluminum production, exports, consumption, and domestic prices, as well as on the U.S. aluminum industry and on aluminum markets worldwide.

As requested, the report will focus primarily on the 2011–2015 time period, but examine longer term trends since 2001 when appropriate.

The Committee asked that the Commission transmit its report not later than 16 months after receipt of the request, and the Commission will transmit its report by June 26, 2017. The Committee also stated that it intends to make the Commission's report available to the public in its entirety and asked that the report not include any confidential business information.

Public Hearing: A public hearing in connection with this investigation will be held at the U.S. International Trade Commission Building, 500 E Street SW., Washington, DC, beginning at 9:30 a.m. on September 29, 2016. Requests to appear at the public hearing should be filed with the Secretary, no later than 5:15 p.m., September 5, 2016 in accordance with the requirements in the "Submissions" section below. All pre-hearing briefs and statements should be filed not later than 5:15 p.m., September 12, 2016; and all post-hearing briefs and statements should be filed not later than 5:15 p.m., October 7, 2016. In the event that, as of the close of business on September 5, 2016, no witnesses are scheduled to appear at the hearing, the hearing will be canceled. Any person interested in attending the hearing as an observer or nonparticipant should contact the Office of the Secretary at 202–205–2000 after September 5, 2016, for information concerning whether the hearing will be held.

Written Submissions: In lieu of or in addition to participating in the hearing, interested parties are invited to file written submissions concerning this investigation. All written submissions should be addressed to the Secretary, and should be received not later than

5:15 p.m., February 21, 2017. All written submissions must conform to the provisions of section 201.8 of the Commission's Rules of Practice and Procedure (19 CFR 201.8). Section 201.8 and the Commission's Handbook on Filing Procedures require that interested parties file documents electronically on or before the filing deadline and submit eight (8) true paper copies by 12:00 p.m. eastern time on the next business day. In the event that confidential treatment of a document is requested, interested parties must file, at the same time as the eight paper copies, at least four (4) additional true paper copies in which the confidential information must be deleted (see the following paragraphs for further information regarding confidential business information). Persons with questions regarding electronic filing should contact the Office of the Secretary, Docket Services Division (202–205–1802).

Confidential Business Information. Any submissions that contain confidential business information must also conform to the requirements of section 201.6 of the Commission's Rules of Practice and Procedure (19 CFR 201.6). Section 201.6 of the rules requires that the cover of the document and the individual pages be clearly marked as to whether they are the ''confidential'' or ''non-confidential'' version, and that the confidential business information is clearly identified by means of brackets. All written submissions, except for confidential business information, will be made available for inspection by interested parties.

As requested by the Committee, the Commission will not include any confidential business information in the report that it sends to the Committee or makes available to the public. However, all information, including confidential business information, submitted in this investigation may be disclosed to and used: (i) By the Commission, its employees and Offices, and contract personnel (a) for developing or maintaining the records of this or a related proceeding, or (b) in internal investigations, audits, reviews, and evaluations relating to the programs, personnel, and operations of the Commission including under 5 U.S.C. Appendix 3; or (ii) by U.S. government employees and contract personnel for cybersecurity purposes. The Commission will not otherwise disclose any confidential business information in a manner that would reveal the operations of the firm supplying the information.

Summaries of Written Submissions: The Commission intends to publish summaries of the positions of interested persons. Persons wishing to have a summary of their position included in the report should include a summary with their written submission. The summary may not exceed 500 words, should be in MS Word format or a format that can be easily converted to MS Word, and should not include any confidential business information. The summary will be published as provided if it meets these requirements and is germane to the subject matter of the investigation. The Commission will identify the name of the organization furnishing the summary and will include a link to the Commission's Electronic Document Information System (EDIS) where the full written submission can be found.

By order of the Commission.

Issued: April 6, 2016.

Lisa Barton,

Secretary to the Commission.

[FR Doc. 2016–08269 Filed 4–11–16; 8:45 am]

BILLING CODE 7020–02–P

LEGAL SERVICES CORPORATION

Sunshine Act Meeting

SUMMARY: Notice is hereby given, pursuant to the provisions of the Government in the Sunshine Act, that the Operations and Regulations Committee (Committee) of the Board of Directors for the Legal Services Corporation (LSC) will hold a Rulemaking Workshop (Workshop) to solicit public input on revisions to LSC's Cost Standards and Procedures and the Property Acquisition and Management Manual (PAMM).

DATE AND TIME: Wednesday, April 20, 2016, 1:30–4:30 p.m. EDT.

LOCATION: F. William McCalpin Conference Center, Legal Services Corporation Headquarters, 3333 K Street NW., 3rd Floor, Washington DC 20007.

PUBLIC OBSERVATION AND PARTICIPATION: LSC encourages observation of and participation in the Workshop by interested individuals and organizations. The Workshop will be entirely open to public observation and will include opportunities for individuals who are not members of the panel to participate in person or via telephone. Persons interested in speaking during the public comment period are encouraged to pre-register by submitting a request in writing prior to close of business on Monday, April 18, 2016, to Stefanie K. Davis, Assistant General Counsel, at *sdavis@lsc.gov.* Those who pre-register will be scheduled to speak first. LSC will transcribe the meeting and make the transcript available to members of the public who are unable to attend. Individuals who wish to listen and/or participate in the proceedings remotely may do so by following the telephone call-in directions provided below.

CALL-IN DIRECTIONS FOR PUBLIC OBSERVATION AND PARTICIPATION:

- Call toll-free number: 1–872–240–3212;
- When prompted, enter the following numeric pass code: 925–917–349.
- When connected to the call, please immediately ''MUTE'' your telephone.

Members of the public are asked to keep their telephones muted to eliminate background noises. To avoid disrupting the meeting, please refrain from placing the call on hold if doing so will trigger recorded music or other sound. The Workshop moderator will solicit public comment as provided in the following Workshop Agenda.

STATUS OF MEETING: Open.

MATTERS TO BE CONSIDERED:

1. Introductory remarks.
   - Charles N.W. Keckler, Chair, Operations and Regulations Committee
2. Panelist introductions (including a description of the program's funding composition and brief overview of the areas in which each panelist sees the most differences between the requirements imposed by LSC and other funders).
   - Steve Pelletier, Northwest Justice Project
   - George Elliott, Legal Aid of Northwest Texas
   - Steve Ogilvie, Inland Counties Legal Services
   - AnnaMarie Johnson, Nevada Legal Services
   - Shamim Huq, Legal Aid Society of Northeastern New York
   - Patrick McClintock, Iowa Legal Aid Foundation
   - Jon Asher, Colorado Legal Services
   - Michael Maher, Legal Action of Wisconsin
   - Robin Murphy, National Legal Aid and Defender Association
3. Discussion of other funders' prior approval requirements for purchases of personal and real property.
4. Discussion of disposition of personal and real property acquired with non-LSC funds.
5. Discussion of approval requirements imposed by other funders for procurement of services.
6. Discussion of other funders' requirements governing intellectual property created using various funding sources.

Appendix C
Calendar of Hearing Witnesses

CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject:	Aluminum: Competitive Conditions Affecting the U.S. Industry
Inv. No.:	332-557
Date and Time:	September 29, 2016 - 9:30 a.m.

Sessions were held in connection with this investigation in the Main Hearing Room (room 101), 500 E Street, S.W., Washington, DC.

CONGRESSIONAL APPEARANCES:

The Honorable Joe Manchin III, United States Senator, West Virginia

DELEGATION WITNESS:

Delegation of the European Union to the United States
Washington, DC

Damien Levie, Trade Counsellor

PANEL 1: Domestic Producers

ORGANIZATION AND WITNESS:

Scepter, Inc.
Waverly, TN

Garney B. Scott III, President

Alcoa Inc.
Washington, DC

Tim Reyes, President, Alcoa Cast Products

PANEL 1: Domestic Producers (continued)

ORGANIZATION AND WITNESS:
Goetz Fitzpatrick LLP
New York, NY
on behalf of

Brazeway, Inc.

Stephanie Hickman Boyse, President and Chief Executive Officer

Michael Adams, Senior Vice President, Market and Product Development

Donald R. Dinan) – OF COUNSEL

Wiley Rein LLP
Washington, DC
on behalf of

Century Aluminum

Michael A. Bless, President; Chief Executive Officer and Director

Jesse E. Gary, Executive Vice President; General Counsel and Secretary

Alan H. Price)
) – OF COUNSEL
Robert E. DeFrancesco)

Hydro Aluminum Metals USA
Baltimore, MD

Matt Aboud, President

Novelis Corporation
Atlanta, GA

Ganesh Panneer, Vice President and General Manager, Automotive, North America

PANEL 1: Domestic Producers (continued)

ORGANIZATION AND WITNESS:
Jupiter Aluminum Corp.
Hammond, IN

Paul-Henri Chevalier, President

Constellium Rolled Products Ravenswood, LLC
Ravenswood, WV

Lloyd A. Stemple, Chief Executive Officer

PANEL 2: Domestic Industry, Consultancy, and Labor Associations

ORGANIZATION AND WITNESS:

CM Group
Australia

Al Clark, Managing Director

Wiley Rein LLP Washington, DC
on behalf of

The Aluminum Extrusions Fair Trade Committee ("AEFTC")

Susan Johnson, President, Futura Industries Corporation; U.S. Aluminum Extruder; and Member of the AEFTC

W. Brook Hamilton, President, The William L. Bonnell Company; U.S. Aluminum Extruder; and Member of the AEFTC

Jason Weber, Director Business Development – Emerging Markets, Sapa Extrusions, Inc.; U.S. Aluminum Extruder; and Member of the AEFTC

Jeff Henderson, President, AEFTC and Aluminum Extruders Council ("AEC")

Alan H. Price)
) – OF COUNSEL
Robert E. DeFrancesco)

PANEL 2: Domestic Industry, Consultancy, and Labor Associations (continued)

ORGANIZATION AND WITNESS:

Winston & Strawn LLP
Washington, DC
on behalf of

The Metals Service Center Institute ("MSCI")

Holman Head, President and Chief Operating Officer,
O'Neal Industries; and Vice Chairman of MSCI

John Fehrenbach)
) – OF COUNSEL
Peter N. Hiebert)

The United Steel, Paper and Forestry, Rubber
Manufacturing, Energy, Allied Industrial
& Service Workers International Union ("USW")
Washington, DC

Holly Hart, Legislative Director and Assistant
to the President, USW

Andrew Meserve, President, USW Local 9423

Robert Smith, President, USW Local 420-A

HARBOR Aluminum Intelligence Unit LLC
Austin, TX

Jorge Vasquez, Founder and Managing Director

The Aluminum Association
Arlington, VA

Heidi Brock, President and Chief Executive Officer

PANEL 3: Foreign Producers, Consultancy, and Industry Associations

ORGANIZATION AND WITNESS:

European Aluminium
Brussels, Belgium

Dr. Gerd Götz, Director General

Akin Gump Strauss Hauer & Feld LLP
Washington, DC
on behalf of

UC Rusal

Scott States, President, Rusal America Corp.

Anton Bazulev, Advisor, International and Special Projects, UC Rusal

Spencer S. Griffith)
) – OF COUNSEL
Ken Markowitz)

Aluminum Association of Canada
Montreal, Quebec, Canada

Jean Simard, President and Chief Executive Officer

Perkins Coie LLP
Washington, DC
on behalf of

China Nonferrous Metals Industry Association ("CNIA")

Xianjun Wen, Vice Chairman

Xinda Mo, Division Chief

Yanjie Tang, Interpreter

Michael P. House)
) – OF COUNSEL
Shuaiqi Yuan)

-END-

Appendix D
Summary of the Views of Interested Parties

Summary of Views of Interested Parties

Interested parties had the opportunity to file written submissions to the Commission in the course of this investigation and to provide summaries of the positions expressed in the submissions for inclusion in this report. This appendix contains these written summaries, provided that they meet certain requirements set out in the notice of investigation (appendix B). The Commission has not edited these summaries. This appendix also contains the names of other interested parties who filed written submissions during investigation but did not provide written summaries. A copy of each written submission is available in the Commission's Electronic Docket Information System (EDIS).[1139] The Commission also held a public hearing in connection with this investigation on September 29, 2016 (appendix C). The full text of the transcript of the Commission's hearing is also available on EDIS.

Written Submissions

Senator Sherrod Brown

No written summary. Please see EDIS for full submission.

Senator Joe Manchin III

No written summary. Please see EDIS for full submission.

Senator Shelley Moore Capito

No written summary. Please see EDIS for full submission.

Senator David Perdue

While there has been a tentative recovery in the price of aluminum, excessive production by foreign aluminum producers was a key factor in the collapse of aluminum prices. For nearly a decade, aluminum producers in the United States have faced an uneven playing field, forced to compete against foreign aluminum producers who benefit from state assistance, including generous government subsidies.

On numerous occasions in the past, this Commission has investigated countervailing duty evasion and dumping practices by foreign aluminum suppliers, including Chinese exporters. In two previous cases regarding aluminum extrusion imports the commission found egregious

[1139] Available online at http://edis.usitc.gov.

antidumping violations and subsidy rates as high as 374 percent ad valorem. Rather than comply with U.S. law, the offending companies have instead misclassified aluminum products and transshipped aluminum through other nations in order to continue evading legitimate U.S. customs duties. Collectively, these practices have weakened the American primary aluminum industry, which has seen smelting operations decline by nearly 75 percent since this practice began.

If left unchecked, this unfair competition will threaten downstream aluminum markets. Aluminum remains one of the most efficient of recyclable metals, and rolled aluminum is an increasingly crucial component in automotive and other high tech manufacturing industries. Without proper enforcement of U.S. trade laws, American companies will be undercut and American workers will lose their jobs.

We encourage the Commission to carefully examine the competitive conditions for U.S. producers in the rolled and other downstream aluminum markets, including aluminum recycling.

Senator Charles E. Schumer

No written summary. Please see EDIS for full submission.

Senator Ron Wyden

No written summary. Please see EDIS for full submission.

Representative Andy Barr

Thank you for the opportunity to submit written testimony for the record regarding competitive conditions affecting the US aluminum industry.

The United States has a strong national and strategic interest in preserving a fair and open market for aluminum products. Producers of advanced aluminum products and industry leaders in the recycling of aluminum are making significant contributions to the U.S. economy by employing large numbers of Americans, paying taxes and being good stewards of scarce resources. If the U.S. wants to maintain a domestic aluminum industry capable of competing in these high-end applications so important to our future, it must ensure that the US market for rolled aluminum and other downstream aluminum products is not distorted by unfair trade policies.

I am especially encouraged by the United States' emergence as a global leader in aluminum recycling. My congressional district is home to a facility owned and operated by Novelis that is responsible for recycling approximately 20 percent of all aluminum cans in the US. The recycled aluminum cans are melted down to produce aluminum ingots used to manufacture new beverage cans and other products. Novel is able to save more than 90 percent of the energy required to produce primary metal by recycling aluminum into sheet ingot. This process is both environmentally and economically sustainable and I commend Novelis for their leadership in this area.

The Novelis employees in Kentucky's Sixth Congressional District know they are doing their part to remain competitive, but the threat of distortions in the market for aluminum scrap and overcapacity in the US market is unrelenting. When foreign competitors cheat and choose to continually disregard trade laws, they threaten the existence of the American aluminum industry and good-paying, high-skilled jobs that allow American workers to support their families.

We encourage the Commission to carefully examine the competitive conditions for US producers in the rolled and other downstream aluminum markets, including aluminum recycling. Chairman Williamson and Members of the Commission, thank you for considering my views on this matter and my constituents appreciate your thorough investigation of the facts of this case.

Representatives Suzan DelBene, Bill Johnson, Dave Loebsack, Larry Bucshon, and Tim Murphy

As members of the Congressional Aluminum Caucus, we appreciate the attention that the Commission is giving to investigating factors affecting the global competitiveness of the U.S. aluminum industry. Our Congressional districts are directly impacted by the successes and challenges of U.S. aluminum producers in a global market and look forward to a comprehensive and detailed report that will be provided next year to the House Ways and Means Committee.

The aluminum industry is a critical economic and strategic element to the U.S. economy and to the communities where it employs thousands of workers. The aluminum industry represents $186 billion of economic activity and employs over 160,000 workers. The contribution of aluminum products to our quality of life, our national security, and the economic well-being of numerous American communities cannot be overstated.

Aluminum products are used in everything from fuel efficient vehicles to sustainable packaging to green buildings, not to mention thousands of consumer products from cans to step ladders. The great news is that demand for aluminum products is growing in the United States and around the globe. At the September 29th hearing, the USITC will hear from many of the companies that are making aluminum products.

As promising as the demand outlook is for aluminum, the industry faces a number of challenges that are inhibiting an even brighter future for U.S. producers. Under normal circumstances, U.S. aluminum producers and workers would be well-positioned to benefit from increasing demand. However, as representatives of the U.S. industry will testify, the global supply of aluminum is far outpacing demand growth.

That fact is threatening the viability of the U.S. aluminum industry and its workers. Specifically, a large surge in capacity and production by Chinese producers over the past decade, and particularly over the past five years, has depressed global prices and has adversely affected both primary and secondary aluminum producers in the United States. We trust the Commission will examine factors driving increased Chinese production and the implications of global oversupply in its research and report.

Representative David B. McKinley

The United States has a strong national interest in preserving a fair and open market for aluminum products, which is why your investigation is so important in the face of unfair competition from foreign nations and producers.

The aluminum industry is a critical part of the U.S. economy. Producers of advanced aluminum products and industry leaders in the recycling of aluminum, such as Novelis Corporation in my congressional district, employ large numbers of Americans in good-paying jobs and pay significant taxes to both state and federal government—contributing to the economic health of both states and the nation. The aluminum industry has a particularly strong presence in West Virginia. According to the latest statistics from the Aluminum Association, the industry employs over 8,000 individuals at 7 facilities across West Virginia. In addition to Novelis Corporation, aluminum producers in West Virginia include Skana Aluminum Co., Aleris International Inc., AL Solutions Inc., Tecnocap LLC, and Constellium.

The United States also benefits from the fact that aluminum is the most recyclable of all materials. Unlike many materials, aluminum is highly economical to recycle, in large part because recycling aluminum requires 90 percent less energy to produce than the primary production of the metal. Aluminum’s special properties have allowed the industry to develop new and exciting products that benefit consumers both at home and abroad. Rolled aluminum products, for example, are increasingly being used by the automotive sector, beverage and container producers, industrial users and other customers.

In order to maintain a domestic aluminum industry capable of supplying the raw material for the products of the future, our government must ensure that the market for rolled aluminum—and other downstream products—is not distorted by unfair trade. Employees and managers at companies such as Novelis, which my staff and I have personally toured, use every tool at their disposal to remain competitive, but the threat of distortions and overcapacity in the aluminum market remains. When our foreign competitors do not play by the rules and choose to continually disregard trade laws, they threaten the very existence of the American aluminum industry and good-paying, high-skilled jobs that allow West Virginians to support their families.

I encourage the Commission to carefully examine the competitive conditions for U.S. producers in the rolled and other downstream aluminum markets, including aluminum recycling.

Representative Tim Ryan

No written summary. Please see EDIS for full submission.

Alcoa Inc.

No written summary. Please see EDIS for full submission

Aluminum Association

The Aluminum Association represents the entire aluminum value chain–from primary producers to recyclers to fabricators and their suppliers. Its members have manufacturing operations in 35 states, account for 70 percent of the aluminum and aluminum products shipped in North America, and create $186 billion in economic activity. Aluminum products touch American lives daily in packaging, transportation, construction, aerospace, and countless consumer products. Having a competitive, economically healthy domestic aluminum industry is vital for America and the many communities dependent on its jobs.

In recent years, the global competitiveness of the U.S. aluminum industry has been impacted by a number of trends and developments, including the emergence of China as the dominant global producer. China is an important U.S. trading partner, but the Chinese aluminum industry has expanded beyond its domestic needs. Its huge supply on the world market has adversely impacted U.S. producers of primary and downstream products. As the data in the USITC competitive analysis will undoubtedly show, Chinese aluminum production has grown from 10 percent of the world total in the early 2000s to over 55 percent today. Chinese oversupply has put downward pressure on world prices which in turn has resulted in the shuttering of U.S. aluminum smelters. Moreover, as the USITC analysis will also likely inform, Chinese aluminum production is based largely on coal-based electricity, encouraged by government policies making it inexpensive, but also highly carbon-emitting. Chinese expansion into value-added downstream products and circumvention of U.S. duties through misclassification and/or transshipment through third countries are other major competitiveness concerns.

Research by the CM Group, an Australian-based analytics firm known for its expertise of the global aluminum industry, reinforces the fact that Chinese aluminum capacity continues to expand despite slower growth in domestic demand. Other analysts have testified and provided similar information to the Commission. Numerous national and provincial policies aid Chinese companies, a significant share of which are state-owned enterprises (SOEs). The data also show that Chinese policies to date attempting to control capacity increases have been limited and ineffective.

U.S. and global demand for aluminum is rising. The metal has a significant role in many new and innovative applications reducing energy use in transportation. Global demand is estimated to grow at roughly a 3.8 percent annual rate, driven in large part by the use of aluminum in transportation in the United States. The domestic industry is at a juncture where it will either be able to take advantage of this growth opportunity, or will be suppressed by unfair trade practices affecting its ability to do so.

The U.S. aluminum industry embraces competition that is fair and transparent. In the case of China, we believe that the Chinese government should pursue policies that align with its own stated sustainable development goals by eliminating subsidies, lending and other incentives that artificially support its aluminum industry and by allowing inefficient and antiquated facilities to close. Absent the impact of undue Chinese supply, profitability and employment in the U.S. aluminum industry would increase.

Aluminium Association of Canada

Canada’s primary aluminium industry is a 100 years in the making. It stretches all the way from British Columbia on the Pacific Coast with Rio Tinto’s recently modernized Kitimat operation, to Quebec in the Eastern Atlantic region where 90% of Canada’s total yearly output of 3.2 million tons is produced, with 9 smelting operations including Alouette’s on the North shore, Alcoa’s 3 plants, and Rio Tinto's self-powered Saguenay plants.

Canada’s primary industry has since its original development been an integral part of the North American aluminium industrial value chain with a large part of its annual output exported to the USA, year after year.

Ever since the beginning of smelting operations in Canada by Alcoa in Shawinigan in the early 1900s, our two countries have worked in a seamless way to sustain the North American value chain.

From smelters powered entirely from hydroelectricity, and billions of dollars invested in plant modernization, today’s 10,000 Canadian workers provide a low carbon, responsibly produced aluminum to the 150,000 American workers employed in the value added downstream processing industry.

On top of our clean energy, massive investments in ongoing plant modernization and operational efficiency have lowered our greenhouse gas (GHG) emissions to the lowest in the world. Compared to the reference year 1990, by 2009, the Canadian aluminium industry had nearly doubled its output while reducing its total emissions by 26 percent, and in 2014 by 37 percent (in CO2-equivalent tons) while its emissions intensity were reduced by 66%.

A carbon footprint is the sum of GHG emissions accumulated during a product's lifecycle. If we include only the stages taking place in Quebec (foundry, electrolysis, and anode production), Quebec's aluminum smelters account for three times fewer GHG emissions than the global average per ton of aluminum produced, and seven to eight times fewer than China's mostly coal-based production.

Another way to look at this is the following: Should we transfer Canada's overall capacity of three million tons annually to China with its heavy carbon footprint it would add a net additional contribution to global emissions of 51 million tons of GHG emissions—more than a third of Canada's total reduction target for 2020.

Our social impact is also of great importance by North-American standards, providing the well-paid jobs in Canada's manufacturing sector, which contribute to the overall economic vitality of communities in which we operate.

Aluminum Extruders Fair Trade Committee

The U.S. aluminum extrusions industry is composed of more than 100 producers, most of them relatively small. The smaller producers in particular are especially vulnerable to competition from unfairly traded imports. The imposition of antidumping and countervailing duties on imports of aluminum extrusions from China has been especially beneficial to these smaller producers.

China is not the only source of imports of extrusions, though. As Chinese production of primary aluminum exploded, its exports of extrusions also grew, increasing by 50 percent from 2011 to 2015. As imports from China flood markets around the world, the extruders in those countries look for other markets as well. The United States is one of the largest and most open markets for aluminum extrusions, so that it is often the export market of first and last resort. In fact, imports of aluminum extrusions increased by nearly 47 percent from 2011 to 2015, even as prices fell. This puts enormous pressure on the smaller U.S. producers in particular. In addition, the AEFTC has provided the U.S. Department of Commerce with information showing that

Chinese producers are attempting to avoid the imposition of antidumping and countervailing duties by transshipping their products through third countries and by making minor alterations to their products.

The expansion of Chinese primary aluminum capacity has caused a sharp decrease in primary aluminum prices, as reflected in the London Metal Exchange base prices. As prices have fallen, the U.S. primary aluminum industry has shut down an increasing amount of capacity. This has forced the domestic aluminum extrusions industry to rely increasingly on imported aluminum billets. The price for billets in the United States is based on the LME base price, with premiums for regional delivery and for billets. Because it costs more to deliver imported billets than domestically produced ones, lower billet prices have been at least partially offset by higher premiums. In addition, reliance on imports increases the difficulty of supply chain management for U.S. extruders, and exposes them to greater chances for disruption of supply.

A significant portion of China's downstream semi-finished consumption is made up of aluminum extrusion production because most aluminum consumption in China is centered around the construction industry. Demand for extrusions in the Chinese construction industry is projected to decline, however. This could make even more Chinese production available for export, leading to even greater excess supply and even lower prices around the world.

Beer Institute

No written summary. Please see EDIS for full submission.

Brazeway Inc.

Brazeway manufactures extruded aluminum tubing for use in the automobile and residential and commercial building air conditioning markets. Brazeway also manufactures aluminum extruded products, including extruded aluminum tube and fin evaporator coils (FECs) for appliances and commercial refrigeration.

By 2006, due to low-priced Chinese imports, Brazeway had lost over 85 percent of one of its largest customer’s business. In addition, another of Brazeway’s largest customers threatened the company with a similar loss of business. That loss of market share would have crippled Brazeway’s FEC business and threatened its existence. To stay in business, Brazeway was forced to reduce its biggest customers’ prices to the “Chinese price.”

The Chinese import surge resulted in unrealistic low prices–even below COP. Brazeway was forced to close its factory in Adrian, Michigan, resulting in permanent layoffs and cancelled and reduced benefits to remaining workers. To offset the lower prices caused by Chinese imports

Brazeway cut costs by canceling or postponing capital investment and product R&D. Chinese price suppression resulted in reduced profitability and significant losses across the industry. Brazeway's very existence was threatened.

To remain in business and compete with the low prices caused by Chinese imports, Brazeway moved a portion of its FEC production to Mexico. Brazeway continues to manufacture FECs at its plant in Hopkinsville, Kentucky. FEC production in both the United States and Mexico relies on extruded aluminum tube manufactured by Brazeway at its Hopkinsville plant and its factory in Shelbyville, Indiana.

In 2011, the Department of Commerce found that Chinese extruded aluminum products, including FECs, were being dumped and were receiving illegal export subsidies. As a result, Commerce imposed significant antidumping and countervailing duties.

Prices stabilized at this new, reduced level because the threat of further reductions were alleviated by the antidumping and countervailing duties orders. Brazeway's major lost customers returned. Customers who had threatened to leave for Chinese imports stayed. Employment and wages increased. Although Brazeway continued concessions in pricing and other terms to its customers in response to competition within the healthy U.S. market, renewed profitability allowed Brazeway to invest in new plant and equipment, expand production, and increase R&D in the United States.

Brazeway's sales of FEC's continue to increase. Increased sales, prices, and profits have allowed Brazeway to invest in emerging technologies, such as the shift from copper to aluminum in the commercial and residential HVAC market.

If the antidumping and countervailing duties were removed, the situation that existed prior to their imposition would almost certainly return with the same adverse results to wages, prices, employment, and profitability. Brazeway's major customers are resistant to enter into new long term supply contracts, signaling that they are willing to again leave for dumped Chinese imports.

In summary, the FEC business in the United States is stable. Profits are sustainable and investments into new products and technologies are increasing. Still, the single-largest threat to the U.S. FEC industry remains renewed predatory market behavior by Chinese producers and importers.

Century Aluminum Co. and Noranda Alumina LLC

As the Commission's investigation thus far has confirmed, the massive overcapacity and oversupply in China's aluminum industry is devastating the global aluminum industry. American manufacturers throughout the value chain, including Century Aluminum (“Century”), Noranda Alumina LLC (“Noranda”) and various parts of the downstream aluminum industry, testified at the Commission’s hearing as to the harmful effects of China's overcapacity crisis. Aluminum producers in Canada, Europe, and even Russia confirmed the global consequences of Chinese overcapacity. Indeed, the world's aluminum producers are effectively in agreement that they are being decimated by the unfair practices of Chinese aluminum producers.

China's overcapacity crisis, which has been acknowledged by producers worldwide, will not disappear on its own. Despite repeated promises to the contrary, Chinese producers have continually increased their capacity and production. And, without action, they will continue to do so in the future. In fact, the Vice Chairman of the China Nonferrous Industry Association (“CNIA”) admitted this explicitly to the Commission, stating: “China will certainly build more factories.”

The explosion of China’s primary aluminum production in the years since the country joined the World Trade Organization (WTO) is a stark reminder that the rules of the modem global trading system were not, in the words of former Assistant U.S. Trade Representative Douglas Newkirk, "written with a socialist market economy in mind.” In 2003, when China’s State Council released an early set of guidelines purportedly to restrict burgeoning overcapacity in aluminum and other industrial sectors, the country’s aluminum production capacity was less than six million tons per year. Today, despite several subsequent iterations of similar so-called overcapacity initiatives, Chinese production capacity is set to exceed 40 million tons-per-year by the end of2016-more than half of total global capacity. This massive build-up and its effect on world prices threaten to put the U.S. aluminum industry out of business for good. American smelters from New York, to Indiana, to Washington have already closed their doors, depriving local workers and communities of sorely needed jobs and tax revenue. This situation cannot be permitted to persist and worsen. The continued viability of the aluminum industry outside of China, and especially in the United States, is dependent upon a prompt and effective solution to China's overcapacity and overproduction.

China Nonferrous Metals Industry Association

China’s primary aluminum production is to meet the significant expansion of domestic demand in China. Due to the 15 percent tariff imposed on exports of primary aluminum, China for more than a decade has had only a very minimal amount of primary aluminum sold to foreign markets. Accordingly, the primary aluminum produced in China could not possibly depress aluminum price worldwide, including the United States. Further, any increase in U.S. imports of wrought aluminum products from China was not caused by a surge of Chinese exports; in fact, the increase of wrought aluminum imports was insignificant given substantially increased demand in the U.S. market. Furthermore, the U.S. has imposed countervailing and antidumping duties on China's exported extruded aluminum products since 2011, and thus the prices of such products in the United States market by definition reflect fair prices. Therefore, China's aluminum production and exports do not threaten the competitiveness of the U.S. aluminum industry.

Measures taken by the Government of China have proactively eliminated domestic imbalanced production, and the expansion of aluminum applications has led to increases in domestic demand within China. In accordance with recently promulgated government guidance, new production capacity will be strictly controlled and backward production capacity will be eliminated. Any projects involving the expansion of aluminum production capacity, in any form, must satisfy the "equal replacement" or the "reduction replacement" requirements.

China's aluminum industry has cost effective energy resources to support its production. In recent years, China's electricity generation companies have utilized advanced technology and equipment to generate power. As a result, the electricity generating process now satisfies the high-level environmental protection requirements and has achieved a low level of CO2 emissions. Further, the aluminum industry has shifted its production to the domestic regions with abundant energy resources. Moreover, the more extensively equipped captive power and directly negotiated prices with power generation companies help the aluminum producers obtain electricity at lower, more cost-efficient prices.

China's aluminum industry is operating pursuant to market principles, and the Government of China does not provide any form of subsidies to the aluminum industry. The Government of China strictly prohibits any local government agencies at the provincial and municipal levels from offering any preferential policies regarding land, energy resources, taxation or electricity to attract business and investment in the aluminum industry. Banks and financial institutions do not provide any forms of special treatment regarding the interest rates, terms of loans or preferential loans to the aluminum industry. Rather, banks in China consider and evaluate companies' overall operation status, potential risks, and the ability to make payments on the loan to approve any loan. Loan criteria for the aluminum industry are based on commercial loan market benchmarks in China and are grounded in market reality.

CM Group

No written summary. Please see EDIS for full submission.

Constellium Rolled Products Ravenswood LLC

Constellium is a global sector leader that develops innovative, value added aluminum products for a broad scope of markets and applications, including aerospace, automotive and packaging. We have a large industrial presence and have made significant investments in the U.S. with plants in Ravenswood, WV, Muscle Shoals, AL, Van Buren, MI, Bowling Green, KY and White, GA, and with a brand new R&D hub in Plymouth, MI.

Today, our business and the U.S. aluminum industry are threatened by China's long-term practice of market-distorting policies and overproduction. Predatory pricing, favorable export policies for aluminum semi-fabricated products, non-reciprocity in market access, less stringent regulations with respect to labor and environment protection have allowed Chinese companies to operate in the U.S. market with an unfair advantage, resulting in an uneven playing field for U.S. companies.

Non-reciprocity in the access to low cost raw material puts our industry at great disadvantage. Primary aluminum traded on the Shanghai Futures Exchange (SHFE) has regularly a price advantage over the price paid by U.S. players based on the London Metal Exchange–but non-Chinese players cannot buy this raw material at the same price on the SHFE, as there is a 15 percent export duty on primary metal and on aluminum scrap.

This cost advantage is even greater for the Chinese aluminum conversion industry, as Chinese rollers and extruders, in addition to benefiting from lower production costs and lower raw material costs, are also profiting from a 13% VAT rebate on their exports.

This situation threatens our downstream business which relies on both high value added products and larger volume products (such as commodities), because of the large installed capacity and equipment of our plants–rolling mills in particular are significant investments which require substantial volumes to cover for their fixed cost. Our industry is directly threatened today by the Chinese competition on these larger volume products, which are benefiting from China's unfair pricing and are not yet protected by an import duty tax. This then affects our value added products business.

As China's interest and skills in aluminum value added products are rising, our industry is at even greater risk. In the coming years, China is expected to acquire the technical knowledge to produce also higher end products, and will be competing against our industry on the full range of rolled products. Measures need to be taken to ensure this is done in a fair and transparent environment.

Constellium believes that time has come to increase trade import tariffs on all aluminum flat rolled products imported into the U.S. from China to a 30% trade import duty. The existing 30% import duty imposed on Chinese extrusion products in the U.S. and Canada has proved to be the right move and has allowed the extrusion industry in both countries to recover. A similar import duty on rolled products would protect our industry against China's overproduction and unfair pricing, and allow us to continue to grow and invest in the U.S. market.

Delegation of the European Union to the United States

No written summary. Please see EDIS for hearing testimony.

Emirates Global Aluminium and DUBAL America Inc.

Emirates Global Aluminium ("EGA") and DUBAL America Inc. ("DAI"), a member of the EGA group of companies, appreciates this opportunity to provide the U.S. International Trade Commission with information relevant to its investigation, pursuant to 19 U.S.C. § 1332(g), of Aluminum: Competitive Conditions Affecting the U.S. Industry.

EGA has long been one of the world's largest and pre-eminent suppliers of high-quality primary aluminum products, and plays an integral, reliable, and responsible role in supplying a number of U.S. strategic sectors-including the aerospace, automobile, construction, and electronics sectors-with high-quality inputs. EGA appreciates the opportunity to participate in this investigation, and looks forward to working with the Commission's investigative team to provide information helpful to its ongoing work. With this initial submission, EGA provides a number of comments and facts that, we hope, will help frame the Commission's understanding of the UAE industry and its role in the U.S. market.

Specifically, Section II of this pre-hearing submission provides an overview of EGA, including a summary of the aluminum products it manufactures in the UAE and markets globally. Section III addresses the historic trends and projections that continue to drive the growth of the global aluminum industry. Section IV describes EGA's history of constructive engagement with its U.S. customers, and also explains the manner in which EGA's investments in aluminum production in the UAE benefit U.S. exporters of capital-intensive goods.

European Aluminium

No written summary. Please see EDIS for full submission.

HARBOR Aluminum Intelligence Unit LLC

No written summary. Please see EDIS for full submission.

Hulamin Operations Proprietary Ltd.

No written summary. Please see EDIS for full submission.

Hydro Aluminum Metals USA

No written summary. Please see EDIS for full submission.

Jupiter Aluminum Corp.

No written summary. Please see EDIS for full submission.

Metals Service Center Institute

The following comments are submitted on behalf of the Metals Service Center Institute ("MSCI"), a U.S. trade association representing over 300 U.S. and Canadian member companies which operate in over 1,200 business locations across North America and employ more than an estimated 50,000 workers. Member service centers supply the aluminum requirements of more than an estimated 300,000 downstream manufacturers and fabricators, many of whom operate in an increasingly competitive global economy. Collectively, service centers represent an important outlet for domestic aluminum mills, purchasing more than an estimated 2.1 billion pounds of aluminum mill products in 2014. Service centers cut, form, slit, blank, polish, and further process aluminum purchased from mills and then sell these processed aluminum products directly to manufacturers, machine shops, and others in the aluminum supply chain.

Given the position of service centers within the aluminum distribution chain, MSCI believes its interests mirror the "national interest." Service centers, which process and distribute aluminum as the "middlemen" in that chain, are an important barometer of the health of the entire industry. Service centers purchase both domestically and foreign produced aluminum for processing. A healthy service center sector, with increasing shipments, is generally indicative of a healthy aluminum industry. If service center shipments are down over an extended period of time, that is generally an indication, like the proverbial canary in the coal mine, that there are problems in the aluminum production and aluminum consuming industries as well.

Service centers need a strong and viable U.S. production base and will suffer economic harm if the domestic mills collapse. Likewise, service centers will suffer harm if needed imports are cut off or their customers find themselves priced out of their own markets due to high material costs. Like the country as a whole, the service center industry requires thoughtful trade policy initiatives that avoid the binary or sterile choices of the past. The U.S. economy, as well as the service center industry, needs a competitive domestic aluminum sector and a competitive domestic manufacturing base in the broadest sense.

North American Die Casting Association

No written summary. Please see EDIS for full submission.

Novelis Corp.

On September 29, 2016, the U.S. International Trade Commission (“Commission”) held a hearing to discuss competitive conditions affecting the U.S. aluminum industry. This hearing was part of a fact-finding investigation that has been undertaken by the Commission pursuant to Section 332 of the Tariff Act of 1930, as amended, in response to a request from the Committee on Ways and Means of the U.S. House of Representatives. At the hearing, the Commission heard testimony from numerous witnesses, including Ganesh Panneer, Vice President and General Manager-Automotive, North America of Novelis Inc. (“Novelis”).

Novelis is grateful for the opportunity that it was given to testify and to answer questions at the Commission’s hearing. Novelis appreciates the Commission’s efforts to investigate and understand the difficulties facing U.S. aluminum producers, and Novelis intends to cooperate with the Commission as it continues this fact-finding investigation.

At this point, Novelis already has provided the Commission with the information contained in its Pre-Hearing Brief of September 12 and the testimony of Mr. Panneer. Furthermore, interested parties will have an additional opportunity to comment on this proceeding by filing a written submission no later than February 21, 2017. Accordingly, this post-hearing submission will focus on two topics. First, Novelis will discuss the challenges faced by domestic producers of downstream aluminum products, including products made from aluminum scrap recycling. Second, Novelis will address questions from Commission staff. Novelis believes that this information will be helpful to the Commission as it considers the issues in this investigation.

Rio Tinto

No written summary. Please see EDIS for full submission.

Scepter Inc.

No written summary. Please see EDIS for full submission.

UC Rusal

No written summary. Please see EDIS for full submission.

UNO International Trade Strategy

No written summary. Please see EDIS for full submission.

United States Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union

The United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union ("the USW") represents workers in all segments of the aluminum industry in the United States and Canada, including the production of primary aluminum, of foil, sheets, and plate, and of aluminum extrusions. The USW has seen thousands of its members lose their jobs over the past few years as the primary aluminum industry in the United States has contracted rapidly. This contraction is directly due to the headlong expansion of Chinese primary aluminum production and a subsequent collapse in global prices for aluminum.

Aluminum is an internationally traded commodity, with prices worldwide pegged to the price on the London Metal Exchange (with a regional premium in the United States). As Chinese exports of both unwrought aluminum and aluminum products such as foil, sheet, and extrusions have flooded the rest of the world, prices have plummeted. Although it includes many of the most efficient producers in the world, the U.S. primary aluminum industry has not been able to withstand this collapse in prices. As a consequence, U.S. production of primary aluminum has fallen from 2.07 million tons in 2012 to an estimated 890,000 tons in 2016. By the end of 2016, only five aluminum smelters will remain in operation in the United States, compared to 14 as recently as 2011. Even the remaining smelters are operating at less than 50 percent of capacity.

These closures have directly cost an estimated 6,615 workers their jobs. This represents lost wages of some $500 million. The impact on the communities where these smelters are located has been devastating. Many more workers have been indirectly injured. Primary production is not the only segment of the industry that is suffering. Imports of aluminum foil, sheet and plate, especially from China, have also been increasing rapidly. The USW is deeply concerned that if these trends continue, the domestic sheet, plate and foil producers will be forced out of business as well.

One aluminum product of particular concern is high-purity aluminum, which is used in key defense applications. Only one U.S. smelter, that of Century Aluminum in Hawesville, Kentucky, is capable of producing high-purity aluminum. If Century is forced to close this smelter, the United States will lose not just its capacity for high-purity aluminum production, but also the expertise needed to make that vital product. In such a case, the United States would be forced to rely on sources in China, Russia, or the Middle East for the high-purity aluminum it needs. For all these reasons, the USW urges the Commission to find in this investigation that the economic security and prosperity of the United States requires a healthy primary steel industry; that the domestic industry is in danger; and that failure to act will have serious adverse consequences.

Appendix E
Harmonized System Classifications for Unwrought and Wrought Aluminum Products

Harmonized System Classifications for Unwrought and Wrought Aluminum Products

Unwrought aluminum is classified under Harmonized System (HS) heading 7601 (table E.1).The HS does not further distinguish between primary versus secondary origins in the production process. Wrought aluminum products are classified under HS headings 7604–7608.

Table E.1: Harmonized System (HS) classifications: Unwrought and wrought aluminum products, by 4-digit headings and 6-digit subheadings

HS heading and subheading	Description
7601	Unwrought aluminum:
760110	Unwrought, of aluminum not alloyed
760120	Unwrought, of aluminum alloys
7604	Aluminum bars, rods and profiles:
760410	Bars, rods and profiles, of aluminum not alloyed
760421	Hollow profiles, of aluminum alloys
760429	Bars, rods and profiles, other than hollow profiles, of aluminum alloys
7605	Aluminum wire:
760511	Wire, maximum cross-sectional dimension over 7 mm, of aluminum not alloyed
760519	Wire, maximum cross-sectional dimension 7 mm or less, of aluminum not alloyed
760521	Wire, maximum cross-sectional dimension over 7 mm, of aluminum alloys
760529	Wire, maximum cross-sectional dimension 7 mm or less, of aluminum alloys
7606	Aluminum plates, sheets, and strip, thickness exceeding 0.2 mm:
760611	Plates, sheets and strip, rectangular (including square), of aluminum not alloyed
760612	Plates, sheets and strip, rectangular (including square), of aluminum alloys
760691	Plates, sheets and strip, other than rectangular (including square), of aluminum not alloyed
760692	Plates, sheets and strip, other than rectangular (including square), of aluminum alloys
7607	Aluminum foil, of a thickness (excluding any backing) not exceeding 0.2 mm:
760711	Aluminum foil, not backed, not further worked than rolled
760719	Aluminum foil, not backed, further worked
760720	Aluminum foil, backed
7608	Aluminum tubes and pipes:
760810	Tubes and pipes, of aluminum not alloyed
760820	Tubes and pipes, aluminum alloys

Source: USITC, "Chapter 76, Aluminum and Articles Thereof," *Harmonized Tariff Schedule (2017 Basic Edition)*, February 2017, 76-3–76-9. https://hts.usitc.gov/current (accessed April 7, 2017).

Appendix F
Survey Questionnaire

UNITED STATES
INTERNATIONAL TRADE COMMISSION

UNWROUGHT AND WROUGHT ALUMINUM QUESTIONNAIRE

Written Completion Version

United States International Trade Commission
Attention: Aluminum Survey Project Team
Office of Industries, Room 511-G
500 E Street, SW, Washington, DC 20436
Fax: 202-205-2217

The U.S. International Trade Commission (USITC or Commission) is conducting a fact-finding investigation on the factors affecting the global competitiveness of the U.S. aluminum industry, focusing on unwrought and wrought aluminum products and related markets. The House Committee on Ways and Means requested this investigation, and has directed the USITC to collect data from market participants. By completing this questionnaire, you will be helping the Committee assess the market conditions confronting the U.S. industry.

Please read the questionnaire carefully. In all cases, section 1, questions 2.1, 3.1, and 4.1, and sections 5 and 6 must be completed. Sections 2, 3, and 4 must be completed depending on your responses to questions 2.1, 3.1, and 4.1.

You can learn more about this investigation (no. 332-557) by going to the following webpage:

https://www.usitc.gov/research_and_analysis/what_we_are_working_on.htm

Your organization is required by law to respond to this questionnaire.

Please read all instructions and return the completed questionnaire to the USITC no later than November 4, 2016.

We are requesting this information under the authority of section 332(g) of the Tariff Act of 1930 (19 U.S.C. § 1332(g)). Completing the questionnaire is mandatory, and failure to reply as directed can result in a subpoena or other order to compel the submission of records or information in your possession (19 U.S.C. § 1333(a)). For more information on this questionnaire, contact project team members Karl Tsuji or Mihir Torsekar at *aluminumsurvey@usitc.gov*. You may also call the team at 202-205-3225 or 202-205-3342.

Confidentiality

The Commission has designated as "confidential business information" the information you provide in response to this questionnaire, to the extent that such information would reveal the operations of your organization and is not otherwise available to the public. The Commission will not disclose such confidential business information except as provided for in section 5 of this questionnaire. Information received in response to this questionnaire will be aggregated with information from other questionnaire responses and will not be published in a manner that would reveal the operations of your organization.

OMB no. 3117-0229; Expiration date: 9/30/2019
No response is required if a currently valid OMB control number is not displayed

Instructions

1. **Retrieving the written completion version of the questionnaire.** If you need another copy of the questionnaire, please contact the project team (see cover for contact information). This version of the questionnaire is appropriate if you are completing the questionnaire using written responses.

An electronic completion version of the questionnaire is also available. It has been designed to simplify the entry process and minimize the need for our staff to contact your firm for clarifications. If your firm would prefer to use the electronic completion version, please go to the webpage below using a web browser and download it to your computer.

https://www.usitc.gov/research_and_analysis/surveys/aluminum_competitive_conditions_affecting_us.htm

2. **Entering information.** Provide responses for each question that applies to your organization. Write a response or check a box as indicated in each question.

3. **Entering numeric data.** Enter data for production, shipments, employment, etc., in full figures, not in thousands, millions, or similar format. See the table below for examples.

How to report numeric figures	
If a production value is $1,200,500, enter in full figures as:	1200500
If the number of employees is 1,550, enter in full figures as:	1550
Note: After you enter a numeric figure, commas between digits will appear automatically.	

4. **Units of quantity.** All quantities should be reported in metric tons (1 metric ton = 1.10231 short ton).

5. **Submitting the questionnaire.** Mail or fax the completed questionnaire to us (see address and fax number below). Sending the questionnaire by U.S. mail is not recommended because this type of mail undergoes additional processing to screen for hazardous material that will likely substantially delay the delivery. Overnight mail service is recommended.

United States International Trade Commission
Attention: Aluminum Survey Project Team
Office of Industries, Room 511-G
500 E Street, SW, Washington, DC 20436
Fax: 202-205-2217

6. **Follow up.** The Commission will be compiling the information from the questionnaire responses to analyze the global competitiveness of the U.S. aluminum industry. During the analysis phase, we may contact you for follow up discussions about interpreting the data and other issues affecting the industry.

General information

1. **Coordinating your organization's response.** If separate persons or departments within your organization will share responsibility for completing this questionnaire, coordinate your responses so that the information your organization gives us is consistent. This will minimize our need to contact you for clarifications.

2. **Relationship to corporate structure.** Provide a single response for your organization's activities. This may require your organization to combine information from two or more business units.

If it is not possible to combine responses, or it is unreasonably burdensome, your organization may provide separate responses for business units, but ensure that the information is complete and that there is no double-counting. If you have joint venture organizations operating in the United States, ensure there is no double-counting with other business units of the joint venture partners.

3. **U.S. affiliates of foreign companies.** Respond as if the affiliate were an independent organization operating in the United States. For example, show production for the affiliate and its subsidiaries only, and not for the foreign corporation.

4. **"You" and "Your."** Parts of the questionnaire refer to "you" and "your." These words refer to the organization that is responding to the questionnaire.

5. **"United States."** This refers to the customs territory of the United States, which includes the 50 states, the District of Columbia, and Puerto Rico.

6. **Year**. All references to "years" mean "calendar years." If you normally use fiscal years, convert to a calendar year basis for the responses in this questionnaire.

7. **Questionnaire structure.** This questionnaire is composed of six sections, as shown below.

Table of Contents

Definitions

1. **Aluminum and aluminum alloy series:** A system of classifying aluminum and aluminum alloys based on chemical composition. Classifications are designated using a 4-number nomenclature. For example, the 2XXX series includes copper as the main alloying metal. For more information, go to the following webpage:

http://www.aluminum.org/resources/industry-standards/aluminum-alloys-101

2. **Aluminum, unalloyed:** Metal containing by weight at least 99 percent of aluminum, meeting the chemical composition of series 1XXX.

A. **High-purity aluminum:** Metal with at least 99.8 percent aluminum.

3. **Aluminum, alloyed:** All other metals in which aluminum predominates by weight, meeting the composition of all series except 1XXX.

4. **Unwrought aluminum**: Aluminum products in the form of ingots, blocks, billets, slabs and similar manufactured forms. This term does not encompass rolled, forged, drawn, or extruded products, tubular products, or cast or sintered forms which have been machined or processed, other than by simple trimming, scalping, or descaling. These products include the following types:

A. **Primary unwrought aluminum**: Aluminum produced directly from bauxite or alumina, typically at a primary smelter. Aluminum alloys produced subsequently are also included.

B. **Secondary unwrought aluminum:** Aluminum and aluminum alloys that are typically produced at secondary smelters, cast houses, or remelters. Usually produced from scrap, but may also be produced using a combination of aluminum scrap and primary aluminum.

5. **Wrought aluminum:** Rolled, drawn, extruded, or otherwise mechanically formed products of aluminum or aluminum alloys. For the purposes of this questionnaire, forged products are not included. Also, near net shape cast products (e.g., automobile engine block) are not included. Wrought aluminum product groups include:

A. **Plate products:** Flat-surfaced products (other than the unwrought products of U.S. Harmonized Tariff Schedule (HTS) heading 7601) of a uniform thickness greater than one-quarter inch (6.3 mm), coiled or not, of solid rectangular (other than square) cross-section with or without rounded corners (including "modified rectangles" of which two opposite sides are convex arcs, the other two sides being straight, of equal length and parallel). Products may be of a rectangular (including square) shape with a thickness not exceeding one-tenth of the width, or shapes other than rectangular or square, of any size, provided that they do not assume the character of other products. Encompasses plates with patterns (for example, grooves, ribs, checkers, tears, buttons, lozenges), including when such products have been perforated, corrugated, polished, or coated.

B. **Sheet, strip, and foil products:** Flat-surfaced products (other than the unwrought products of HTS heading 7601) of a uniform thickness equal to or less than one-quarter inch (6.3 mm), coiled or not, of solid rectangular (other than square) cross-section with or without rounded corners (including "modified rectangles" of which two opposite sides are convex arcs, the other two sides being straight, of equal length and parallel). Products may be of a rectangular (including square) shape with a thickness not exceeding one-tenth of the width, or shapes other than rectangular or square, of any size, provided that they do not assume the character of other products. Encompasses sheet, strip, and foil with patterns (for example, grooves, ribs, checkers, tears, buttons, lozenges), including when such products which have been perforated, corrugated, polished, or coated.

Definitions-Contined

C. **Wire products:** Rolled, extruded, or drawn products, in coils, which have a uniform solid cross-section along their whole length in the shape of circles, ovals, rectangles (including squares), equilateral triangles or regular convex polygons (including "flattened circles" and "modified rectangles," of which two opposite sides are convex arcs, the other two sides being straight, of equal length and parallel). Products with a rectangular (including square), triangular or polygonal cross-section may have corners rounded along their whole length. The thickness of rectangular products (including "modified rectangular") have a cross-section that exceeds one-tenth of the width.

D. **Bars and rods:** Rolled, extruded, or drawn products, not in coils, which have a uniform solid cross-section along their whole length in the shape of circles, ovals, rectangles (including squares), equilateral triangles, or regular convex polygons (including "flattened circles" and "modified rectangles," of which two opposite sides are convex arcs, the other two sides being straight, of equal length and parallel). Products with a rectangular (including square), triangular or polygonal cross-section may have corners rounded along their whole length. The thickness of rectangular products (including "modified rectangular") have a cross-section that exceeds one-tenth of the width.

E. **Profiles:** Rolled, extruded, drawn, forged, or formed products, coiled or not, of a uniform cross-section along their whole length, which do not conform to any of the definitions of bars, rods, wire, plates, sheets, strip, foil, tubes, or pipes.

F. **Tube and pipe products:** Hollow products, coiled or not, which have a uniform cross-section with only one enclosed void along their whole length in the shape of circles, ovals, rectangles (including squares), equilateral triangles, or regular convex polygons, and which have a uniform wall thickness. Products with a rectangular (including square), equilateral triangular, or regular convex polygonal cross-section, which may have corners rounded along their whole length, are also to be considered as tubes and pipes, provided the inner and outer cross-sections are concentric and have the same form and orientation. Tubes and pipes of the foregoing cross-sections may be polished, coated, bent, threaded, drilled, waisted, expanded, or cone-shaped, or fitted with flanges, collars, or rings.

6. **Capital expenditures:** Expenditures for (1) plant construction, (2) improvements to existing plant and equipment, and (3) purchases of new or existing plant, property, machinery, and equipment. Include direct expenditures by your firm, and expenditures by other firms (e.g., construction companies) done for your firm. Capital expenditures for R&D-related property, plant, and equipment are included in this category. Expenses for routine maintenance and repair are not included. Investments in financial instruments are also not included.

7. **Employee and FTE:** The term "employee" refers only to your firm's employees at facilities located in the United States. The term includes production and related workers, warehouse/distribution workers, sales staff, managers, supervisors, technicians, and office workers related to the activity of manufacturing the products covered in this section. All employee figures should be reported on a full-time equivalent (FTE) basis. The term "FTE" reflects the total number of regular straight-time hours worked by employees, divided by the number of compensable hours applicable to each calendar year. Hours related to annual leave, sick leave, and compensatory time off and other approved leave categories are considered to be "hours worked." But overtime or holiday hours are not considered "hours worked."

Other definitions appear in the sections that follow.

Section 1: Basic Information

1.1 Enter the 5-digit identification number that was in the notification letter we sent to your organization. This will allow the project team to track your response. If you do not know this number, leave the entry area blank and proceed to the next question.

Identification number [ ]

1.2 List your organization's primary address and a contact person. If you are reporting information for a subsidiary instead of a single response for your whole organization, adjust the organization name below to indicate that (for example, Unwrought Aluminum Corp. - Virginia operations).

Organization name

Address

City | State | Zip code | Website address (www.name.domain)

Contact person's name | Contact person's job title | Contact person's location

Contact person's telephone number (xxx-xxx-xxxx) | Contact person's email address (xxx@xxx.xxx)

1.3 Is the organization named above a subsidiary of an organization operating in the United States?

- ☐ Yes Parent company name: [ ]
- ☐ No

If this questionnaire has been sent to one or more subsidiaries and/or the related parent company, there should be one coordinated response. If it is not possible to coordinate responses, or it is unreasonably burdensome, your organization may provide separate responses for subsidiaries, but ensure that the information is complete for your entire organization and that there is no double-counting.

1.4 Is the organization named above a parent company operating in the United States?

- ☐ Yes
- ☐ No

If your organization is a parent company, this submission should reflect all the activities of the subsidiaries that have U.S. operations. Alternatively, each subsidiary with U.S. operations may provide a separate questionnaire response. In that case, note the instructions in 1.3 above.

Section 2: Primary unwrought aluminum

2.1 Did your organization produce any primary unwrought aluminum products (including products made of aluminum alloys) in facilities **located in the United States** at any time during 2011-2015? Read the product definitions on page 4 carefully before answering this question.

☐ Yes

☐ No

Note: If you produce these products and then use them to produce a downstream product ("captive consumption"), check "Yes" above. For example, if you produce primary unwrought aluminum billets and make extruded products with these billets, you are considered to be an unwrought producer for the purposes of this questionnaire.

If you answered "Yes" to question 2.1, please go to the next question.

If you answered "No" to question 2.1, please go to section 3.

To see how to report numeric data, go to item 3 on page 2.

2.2 Provide the value of any capital expenditures your firm made in primary unwrought (unalloyed and alloyed) aluminum production activities during 2011-2015 in the United States. Do not include capital expenditures, if any, made in your firm's foreign entities. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only capital expenditures that can be attributed directly to your U.S. operations.

For a definition of capital expenditures, go to item 6 on page 5.

#	Item	2011	2012	2013	2014	2015
		Capital expenditures (in full figure dollars)				
1	Capital expenditures related to primary unwrought aluminum operations					

2.3 Comparing 2015 with 2011, did the costs listed below increase or decrease for your U.S. primary unwrought aluminum operations? Provide only one response for each cost item.

#	Cost item	Don't know	Little or no change (less than 1 percent increase or decrease)	Increased, 2015 compared with 2011 (indicate percentage)	Decreased, 2015 compared with 2011 (indicate percentage)
1	Alumina	☐	☐		
2	Carbon for anodes	☐	☐		
3	Other raw material costs (for example, alloying agents)	☐	☐		
4	Labor	☐	☐		
5	Electricity	☐	☐		
6	Other energy costs	☐	☐		
7	Shipping/transport	☐	☐		
8	Other: Specify	☐	☐		

2.4 Did your firm's exports of primary unwrought aluminum products **increase** during 2011-2015? If so, list below the country or countries to which the quantity of such exports increased the most (up to three countries). If the question does not apply, leave response areas blank.

Item	Country (make selection if applicable)	Quantity increase amount (indicate percentage)
First country		
Second country		
Third country		

2.5 Did your firm's exports of primary unwrought aluminum products **decrease** during 2011-2015? If so, list below the country or countries to which the quantity of such exports decreased the most (up to three countries). If the question does not apply, leave response areas blank.

Item	Country (make selection if applicable)	Quantity decrease amount (indicate percentage)
First country		
Second country		
Third country		

2.6 How would the removal of foreign government policies and programs (for example, VAT rebates, export taxes, preferential loans, below-market energy costs) have impacted your firm's 2015 production of primary unwrought aluminum products (in terms of quantity) in the United States? Write in one of the following: Cannot estimate; No effect; the percentage increase in production; or the percentage decrease in production.

Effect estimate | |

Section 3: Secondary unwrought aluminum

3.1 Did your organization produce any secondary unwrought aluminum products (including products made of aluminum alloys) in facilities **located in the United States** at any time during 2011-2015? Read the product definitions on page 4 carefully before answering this question.

☐ Yes

☐ No

Note: Secondary products can be produced at a variety of operations, including secondary smelters and cast houses. If you operate any one of these, you are considered to be a secondary unwrought producer for the purposes of this questionnaire and you should check "Yes" above.

Also, if you produce these products and use them to produce a downstream product ("captive consumption"), you should check "Yes" above. For example, if you produce secondary unwrought aluminum billets and make extruded products with these billets, you are considered to be a secondary unwrought producer for the purposes of this questionnaire.

If you answered "Yes" to question 3.1, please go to the next question.

If you answered "No" to question 3.1, please go to section 4.

To see how to report numeric data, go to item 3 on page 2.

All quantities should be reported in metric tons (1 metric ton = 1.10231 short ton).

3.2 Provide the following information as related to your secondary unwrought aluminum operations in the United States. Careful estimates are acceptable. Do not include data for other operations, such as downstream products (you may need to allocate between unwrought aluminum and downstream operations). If your firm is an affiliate of a foreign firm, include only data that can be directly attributed to your U.S. facilities.

Production versus shipments: Production is your firm's output, including additions to the firm's inventory. Shipments includes commercial shipments (including internal transfers) to downstream plants, including shipments from your firm's inventory.

For definitions of employee and FTE, go to item 7 on page 5. For a definition of capital expenditures, go to item 6 on page 5.

#	Item	2011	2012	2013	2014	2015
1	Production (full figure metric tons)					
2	Production capacity (full figure metric tons)					
3	Number of employees (full figures on an FTE basis) for secondary unwrought aluminum operations					
4	Capital expenditures (full figure dollars) related to secondary unwrought aluminum operations					

Tolling is a business arrangement between two firms for the conversion or processing of one product into another product. A tolling contract typically does not require the converter or processor to purchase the input material or to sell the output product.

3.3 List the quantity and value of your firm's total shipments (including internal transfers valued at market prices) of secondary unwrought aluminum products to domestic and foreign markets. Include only products **produced by your firm in facilities located in the United States**. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only production that can be directly attributed to your U.S. facilities.

Do not include shipments of products produced by other firms under a tolling or similar agreement. However, if your firm itself produced products under a tolling or similar agreement, include these shipments.

If your firm produced and shipped any of the products listed below under a tolling or similar agreement, check this box. ☐

#	Item	2011	2012	2013	2014	2015
Shipments of **secondary unwrought aluminum products** produced at your U.S. operations. Include internal transfers (i.e., products used by your downstream operations) valued at market prices.						
Unalloyed:						
1	Quantity (full figure metric tons)					
2	Value (full figure dollars)*					
Alloyed:						
3	Quantity (full figure metric tons)					
4	Value (full figure dollars)*					
* Provide the full sales value, including all raw material costs.						

3.4 Comparing 2015 with 2011, did the costs listed below increase or decrease for your U.S. secondary unwrought aluminum operations? Provide only one response for each cost item.

#	Cost item	Don't know	Little or no change (less than 1 percent increase or decrease)	Increased, 2015 compared with 2011 (indicate percentage)	Decreased, 2015 compared with 2011 (indicate percentage)
1	Aluminum/aluminum alloy scrap	☐	☐		
2	Primary aluminum	☐	☐		
3	Other raw material costs (for example, alloying agents)	☐	☐		
4	Labor	☐	☐		
5	Energy	☐	☐		
6	Shipping/transport	☐	☐		
7	Other: specify	☐	☐		

3.5 List your purchases of the indicated raw materials that you used as **feedstock** for 2011 and 2015, by type and source (domestic or foreign). Use full figures for the the value and quantity of such purchases.

		2011		2015	
#	**Aluminum and aluminum alloy raw material purchased and used for feedstock**	**Quantity (full figure metric tons)**	**Value (full figure dollars)**	**Quantity (full figure metric tons)**	**Value (full figure dollars)**
Domestic source:					
1	High-purity primary unwrought				
2	Primary unwrought other than high purity				
3	Secondary unwrought				
4	Scrap				
5	Wrought aluminum used as feedstock (for example, semi-fabricated products intended for re-melting)				
Foreign source:					
6	High-purity primary unwrought				
7	Primary unwrought other than high purity				
8	Secondary unwrought				
9	Scrap				
10	Wrought aluminum used as feedstock (for example, semi-fabricated products intended for re-melting)				
Source unknown:					
11	High-purity primary unwrought				
12	Primary unwrought other than high purity				
13	Secondary unwrought				
14	Scrap				
15	Wrought aluminum used as feedstock (for example, semi-fabricated products intended for re-melting)				

3.6 Did your firm's exports of secondary unwrought aluminum products **increase** during 2011-2015? If so, list below the country or countries to which the quantity of such exports increased the most (up to three countries). If the question does not apply, leave response areas blank.

Item	Country (make selection if applicable)	Quantity increase amount (indicate percentage)
First country		
Second country		
Third country		

3.7 Did your firm's exports of secondary unwrought aluminum products **decrease** during 2011-2015? If so, list below the country or countries to which the quantity of such exports decreased the most (up to three countries). If the question does not apply, leave response areas blank.

Item	Country (make selection if applicable)	Quantity decrease amount (indicate percentage)
First country		
Second country		
Third country		

3.8 During 2011-2015, did your firm import any secondary unwrought aluminum products that you did not use as feedstock (i.e., the products were commercially sold)? If so, indicate the most important country or countries in terms of quantity below (up to three countries). If not, leave the response areas blank.

First country	
Second country	
Third country	

3.9 Does your firm have any operations (including joint ventures) in foreign countries that produce secondary unwrought aluminum products? If so, list the most important country or countries in terms of production quantity below (up to three countries). If you do not have foreign operations, leave the response areas blank.

First country	
Second country	
Third country	

3.10 During 2011-2015, has your firm considered investing in foreign secondary unwrought aluminum operations, in either existing or new facilities (including joint ventures)? If so, list the leading target country or countries below (up to three countries). If you did not consider such investments, then leave the response areas blank.

First country	
Second country	
Third country	

3.11 How would the removal of foreign government policies and programs (for example, VAT rebates, export taxes, preferential loans, below-market energy costs) have impacted your firm's 2015 production of secondary unwrought aluminum products (in terms of quantity) in the United States? Write in one of the following: Cannot estimate; No effect; the percentage increase in production; or the percentage decrease in production.

Effect estimate	

Section 4: Wrought aluminum

4.1 Indicate whether your organization produced any of the following wrought aluminum products (including products made of aluminum alloys) in facilities **located in the United States** at any time during 2011-2015. Read the product definitions on page 4 carefully before answering this question. Check all that apply.

- ☐ 1. Plate products
- ☐ 2. Sheet, strip, or foil products
- ☐ 3. Wire products
- ☐ 4. Profiles, bars, or rod products
- ☐ 5. Tube or pipe products
- ☐ 6. None of the above

For product definitions, go to item 5 on page 4.

Note: If you produce any wrought aluminum products, and use them to produce downstream products ("captive consumption"), check the appropriate box above. For example, if you produce aluminum sheet and make beverage cans with this sheet, you are considered to be a wrought producer for the purposes of this questionnaire, and you should check the "Sheet, strip, or foil products" box. You would report data for the sheet in this section.

If you checked any of the first five boxes in question 4.1, please go to the next question.

If you answered "None of the above" to question 4.1, please go to section 5.

To see how to report numeric data, go to item 3 on page 2.

All quantities should be reported in metric tons (1 metric ton = 1.10231 short ton)

4.2 List the production capacity (in metric tons) of your firm's wrought (unalloyed and alloyed) aluminum products **in facilities located in the United States**. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only capacity and production that can be directly attributed to your U.S. facilities.

Do not include capacity of other firms that may be producing products for your firm under a tolling or similar agreement. However, if your firm itself has capacity under a tolling or similar agreement, include this capacity.

#	Product group	2011	2012	2013	2014	2015
		Metric tons (full figures)				
Production capacity at U.S. facilities for **wrought aluminum products (including unalloyed and alloyed products)**						
1	Plate products					
2	Sheet, strip, foil products					
3	Wire products					
4	Profile/bar/rod products					
5	Tube or pipe products					

Production versus shipments: Production is your firm's output, including additions to the firm's inventory. Shipments includes commercial shipments (including internal transfers) to downstream plants, including shipments from your firm's inventory.

Tolling is a business arrangement between two firms for the conversion or processing of one product into another product. A tolling contract typically does not require the converter or processor to purchase the input material or to sell the output product.

4.3 List the production (in metric tons) of your firm's wrought (unalloyed and alloyed) aluminum products **in facilities located in the United States**. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only capacity and production that can be directly attributed to your U.S. facilities.

Do not include production of other firms that may be producing products for your firm under a tolling or similar agreement. However, if your firm itself produced under a tolling or similar agreement, include this production.

#	Product group	2011	2012	2013	2014	2015
		Metric tons (full figures)				
Production at U.S. facilities for **wrought aluminum products (including unalloyed and alloyed products)**						
Plate products:						
1	Unalloyed, series 1XXX					
2	Non-heat treatable (alloy series 3XXX, 5XXX)					
3	Heat treatable (alloy series 2XXX, 7XXX)					
4	Heat treatable (alloy series 6XXX)					
5	All other plate products of series not specified above					
Sheet, strip, foil products:						
6	Unalloyed, series 1XXX					
7	Non-heat treatable (alloy series 3XXX, 5XXX)					
8	Heat treatable (alloy series 2XXX, 7XXX)					
9	Heat treatable (alloy series 6XXX)					
10	All other sheet, strip, and foil products of series not specified above					
Wire products:						
11	Unalloyed and alloyed					
Profile/bar/rod products:						
12	Unalloyed and alloyed					
Tube or pipe products:						
13	Unalloyed and alloyed					

4.4 List the **quantity** of your firm's total shipments (including internal transfers) of wrought (unalloyed and alloyed) aluminum products to domestic and foreign markets, broken down by the product groups shown below. Include only products **produced by your firm in facilities located in the United States**. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only production that can be directly attributed to your U.S. facilities.

Do not include shipments of products produced by other firms under a tolling or similar agreement. However, if your firm itself produced products under a tolling or similar agreement, include these shipments.

#	Product group	2011	2012	2013	2014	2015
		Metric tons (full figures)				
Quantity of shipments from U.S. facilities of **wrought (unalloyed and alloyed) aluminum products.** Include internal transfers (i.e., products used by your downstream operations).						
Plate products:						
1	Unalloyed, series 1XXX					
2	Non-heat treatable (alloy series 3XXX, 5XXX)					
3	Heat treatable (alloy series 2XXX, 7XXX)					
4	Heat treatable (alloy series 6XXX)					
5	All other plate products of series not specified above					
Sheet, strip, or foil products:						
6	Unalloyed, series 1XXX					
7	Non-heat treatable (alloy series 3XXX, 5XXX)					
8	Heat treatable (alloy series 2XXX, 7XXX)					
9	Heat treatable (alloy series 6XXX)					
10	All other sheet, strip, and foil products of series not specified above					
Wire products:						
11	Unalloyed					
12	Alloyed					
Profile/bar/rod products:						
13	Unalloyed					
14	Alloyed					
Tube or pipe products:						
15	Unalloyed					
16	Alloyed					

4.5 List the **value** of your firm's total shipments (including internal transfers valued at market prices) of wrought (unalloyed and alloyed) aluminum products to domestic and foreign markets, broken down by the product groups shown below. Include only products **produced by your firm in facilities located in the United States**. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only production that can be directly attributed to your U.S. facilities.

Do not include shipments of products produced by other firms under a tolling or similar agreement. However, if your firm itself produced products under a tolling or similar agreement, include these shipments.

If your firm produced and shipped any of the products listed below under a tolling or similar agreement, check this box. ☐

#	Product group	2011	2012	2013	2014	2015
		Value (full figure dollars)				
Value of shipments from U.S. facilities of **wrought (unalloyed and alloyed) aluminum products.** Provide the full value, including all raw material costs. Include internal transfers (i.e., products used by your downstream operations) valued at market prices.						
Plate products:						
1	Unalloyed, series 1XXX					
2	Non-heat treatable (alloy series 3XXX, 5XXX)					
3	Heat treatable (alloy series 2XXX, 7XXX)					
4	Heat treatable (alloy series 6XXX)					
5	All other plate products of series not specified above					
Sheet, strip, or foil products:						
6	Unalloyed, series 1XXX					
7	Non-heat treatable (alloy series 3XXX, 5XXX)					
8	Heat treatable (alloy series 2XXX, 7XXX)					
9	Heat treatable (alloy series 6XXX)					
10	All other sheet, strip, and foil products of series not specified above					
Wire products:						
11	Unalloyed					
12	Alloyed					
Profile/bar/rod products:						
13	Unalloyed					
14	Alloyed					
Tube or pipe products:						
15	Unalloyed					
16	Alloyed					

4.6 List the **quantity and value** of your firm's **exports** of wrought (unalloyed and alloyed) aluminum products, broken down by the product groups shown below. Include only products **produced by your firm in facilities located in the United States**. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only production that can be directly attributed to your U.S. facilities.

Do not include exports of products produced by other firms under a tolling or similar agreement. However, if your firm itself produced products under a tolling or similar agreement, include these exports.

#	Product group	2011	2012	2013	2014	2015
Exports of **wrought (unalloyed and alloyed) aluminum products** produced at your U.S. facilities. Provide the full value, including all raw material costs.						
Plates, sheets, strip, or foil products:						
1	Quantity (full figure metric tons)					
2	Value (full figure dollars)					
Wire products:						
3	Quantity (full figure metric tons)					
4	Value (full figure dollars)					
Profile/bar/rod products:						
5	Quantity (full figure metric tons)					
6	Value (full figure dollars)*					
Tube or pipe products:						
7	Quantity (full figure metric tons)					
8	Value (full figure dollars)					

4.7 For the export shipments listed in question 4.6, which foreign market(s) accounted for the **largest increases** in terms of quantity. List the most important country or countries below. If the question does not apply, leave response areas blank.

Item	Country (make selection if applicable)	Quantity increase amount (indicate percentage)
First country		
Second country		
Third country		

4.8 For the export shipments listed in question 4.6, which foreign market(s) accounted for the **largest decreases** in terms of quantity. List the most important country or countries below. If the question does not apply, leave response areas blank.

Item	Country (make selection if applicable)	Quantity decrease amount (indicate percentage)
First country		
Second country		
Third country		

4.9 Indicate which of the following describes the changes in your firm's U.S. production capacity for wrought (unalloyed and alloyed) products during 2011-2015. Check all that apply.

- ☐ Expanded production capacity at existing establishments
- ☐ Reduced production capacity at existing establishments
- ☐ Acquired production establishments
- ☐ Sold or otherwise disposed of production establishments
- ☐ No change

4.10 List the number of your firm's employees on a full-time equivalent (FTE) basis that correspond to your U.S. facilities that produce wrought (unalloyed and alloyed) aluminum products. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only employees who can be directly attributed to your firm's U.S. activities.

For definitions of employee and FTE, go to item 7 on page 5.

#	Product group	2011	2012	2013	2014	2015
Employment at U.S. facilities for **wrought aluminum products (including unalloyed and alloyed products)**						
		Number of employees (full figures on an FTE basis)				
1	Plate, sheets, strip, or foil products					
2	Wire products					
3	Profile/bar/rod products					
4	Tube or pipe products					
5	Employees that cannot be attributed to only one product group (use this category if absolutely necessary)					

4.11 List the value of any capital expenditures your firm made in wrought (unalloyed and alloyed) aluminum production activities during 2011-2015 in the United States for the product groups shown below. Do not include capital expenditures, if any, made in your firm's foreign entities. Careful estimates are acceptable. If your firm is an affiliate of a foreign firm, include only capital expenditures that can be attributed directly to your U.S. operations.

For a definition of capital expenditures, go to item 6 on page 5.

#	Product group	2011	2012	2013	2014	2015
Capital expenditures at U.S. facilities producing **wrought aluminum products (including unalloyed and alloyed products)**						
		Capital Expenditures (full figure dollars)				
Plate products:						
1	Non-heat treated					
2	Heat treated					
Sheets, strip, or foil products:						
3	Non-heat treated					
4	Heat treated					
Wire products:						
5	All wire products					
Profile/bar/rod products:						
6	All profile/bar/rod products					
Tube or pipe products:						
7	All tube or pipe products					
Unattributed capital expenditures:						
8	Capital expenditures that cannot be attributed to only one product group (use this category only if more specific breakouts are not available)					

4.12 List your customer types, by percentage of your firm's 2011 and 2015 shipments reported in question 4.4.

#	Customer type	2011	2015
		Percent of shipments by quantity	
1	Wrought producers in the United States not owned by your firm		
2	Downstream producers (i.e., firms that consume your wrought products to make other products, such as parts for an airplane wing) in the United States owned by your firm		
3	Downstream producers in the United States not owned by your firm		
4	Distributors or service centers in the United States		
5	Other or unknown		
6	Total (should sum to 100)		

4.13 List the ultimate end use markets, by percentage of your firm's 2011 and 2015 shipments reported in question 4.4. If your shipments go to a distributor or service center and you do not know the ultimate end use, classify these shipments in item 11.

To view an end use guide with examples, please go to:
https://www.usitc.gov/documents/aluminum/end_use_guide_2016.pdf

#	Ultimate end use market	2011	2015
		Percent of shipments by quantity	
1	Containers and packaging, not including beverage cans		
2	Beverage cans		
3	Building and construction		
4	Transportation, automotive		
5	Transportation, commercial aerospace		
6	Transportation, defense aerospace		
7	Transportation, all other or undifferentiated		
8	Electrical		
9	Consumer durables		
10	Machinery and equipment		
11	Other or unknown		
12	Total (should sum to 100)		

4.14 Comparing 2015 with 2011, did the costs listed below increase or decrease for your U.S. wrought aluminum operations? Provide only one response for each cost item.

#	Cost item	Don't know	Little or no change (less than 1 percent increase or decrease)	Increased, 2015 compared with 2011 (indicate percentage)	Decreased, 2015 compared with 2011 (indicate percentage)
1	Labor	☐	☐		
2	Energy	☐	☐		
3	Shipping/transport	☐	☐		
4	Other: Specify	☐	☐		

4.15 List your purchases of the indicated unwrought products (domestic and imported) and wrought products (imports only) that you used internally or commercially sold in the United States for 2011 and 2015, by product group. Include products you imported from related firms in foreign countries.

		2011		2015	
#	**Aluminum and aluminum alloy product purchases**	**Quantity (full figure metric tons)**	**Value (full figure dollars)**	**Quantity (full figure metric tons)**	**Value (full figure dollars)**
Unwrought products (aluminum products in the form of ingots, blocks, billets, slabs, and similar manufactured forms) used as is (not for melting):					
1	Unalloyed, domestic sources				
2	Alloyed, domestic sources				
3	Unalloyed, imported				
4	Alloyed, imported				
Plate products:					
5	Non-heat treated, imported				
6	Heat treated, imported				
Sheet, strip, and foil products:					
7	Non-heat treated, imported				
8	Heat treated, imported				
Wire products:					
9	Unalloyed and alloyed				
Profile/bar/rod products					
10	Unalloyed and alloyed				
Tube or pipe products:					
11	Unalloyed and alloyed				

4.16 For the imports listed in question 4.15, list the foreign supplier that accounted for the **largest increases** in terms of quantity. List the most important country or countries below. If the question does not apply, leave response areas blank.

Item	**Country (make selection if applicable)**	**Quantity increase amount (indicate percentage)**
First country		
Second country		
Third country		

4.17 For the imports listed in question 4.15, list the foreign supplier that accounted for the **largest decreases** in terms of quantity. List the most important country or countries below. If the question does not apply, leave response areas blank.

Item	**Country (make selection if applicable)**	**Quantity decrease amount (indicate percentage)**
First country		
Second country		
Third country		

4.18 List the country or countries of origin of the wrought products that compete with your wrought products most successfully in the United States market (up to three countries). If there are no major competitors, leave the response areas blank.

Country	U.S. market competitor
First country	
Second country	
Third country	

4.19 List the country or countries of origin of the wrought products that compete with your wrought products most successfully in foreign markets (up to three countries). If there are no major competitors, leave the response areas blank.

Country	Foreign market competitor
Select the country of origin of the competitor, not the market in which you compete	
First country	
Second country	
Third country	

4.20 Does your firm have operations (including joint ventures) in foreign countries that produce wrought aluminum products? If so, list the most important country or countries in terms of the quantity of production below (up to three countries). If you do not have such operations, leave the response areas blank.

First country

Second country

Third country

4.21 During 2011-2015, has your firm considered investing in foreign wrought aluminum operations, in either existing or new facilities (including joint ventures)? If so, list the leading target country or countries below (up to three countries). If you did not consider such investments, leave the response areas blank.

First country

Second country

Third country

4.22 How would the removal of foreign government policies and programs (for example, VAT rebates, export taxes, preferential loans, below-market energy costs) have impacted your firm's 2015 production of wrought aluminum products (in terms of quantity) in the United States? Write in one of the following: Cannot estimate; No effect; the percentage increase in production; or the percentage decrease in production.

Effect estimate

Section 5. Certification

I, the undersigned, acknowledge that all information, including confidential business information, submitted in response to this request for information and throughout this investigation may be disclosed to and used:

(i) by the Commission, its employees and Offices, and contract personnel (a) for developing or maintaining the records of this investigation, or (b) in internal investigations, audits, reviews, and evaluations relating to the programs, personnel, and operations of the Commission including under 5 U.S.C. Appendix 3; or

(ii) by U.S. government employees and contract personnel, solely for cybersecurity purposes. I understand that all contract personnel will sign appropriate nondisclosure agreements.

You are strongly encouraged to use the Commission's secure drop-box system to electronically submit your questionnaire to the Commission to protect your sensitive information from unauthorized disclosure. This system uses Federal Information Processing Standards (FIPS) 140-2 cryptographic algorithms to encrypt data in transit. Submitting your nonpublic documents by a means that does not use these encryption algorithms (such as by email) may subject your firm's nonpublic information to unauthorized disclosure during transmission. If you choose a non-encrypted method of electronic transmission, the Commission warns you that the risk of such possible unauthorized disclosure is assumed by you and not by the Commission.

The information your organization provides in response to this questionnaire will be treated by the Commission as confidential and will not be disclosed to the public unless required by law. The information will be aggregated with information from other questionnaire responses and will not be published in a way that would reveal the operations of your organization. The House Committee on Ways and Means has asked that the Commission not include any confidential business information in the report it transmits to it.

Certifier's name and title	Date of certification (mm/dd/yy)

Certifier's signature (not necessary if submitting electronically)

If you are submitting an electronic version of this certificate to the Commission, check the box below in place of a written signature to indicate that the authorized official listed has certified the information provided.

☐ Certified

Section 6. Submitting the Questionnaire

6.1 Before submitting your organization's completed questionnaire, report the actual number of hours required and the cost to your organization of completing this questionnaire, including all preparatory activities.

Hours [ ] Cost ($) [ ]

6.2 If your organization would like to further explain any of the responses in your submitted questionnaire, provide comments to us by email at aluminumsurvey@usitc.gov.

6.3 If your organization would like to give us a written submission for the public record, go to the webpage below to view the *Federal Register* notice about this investigation and go to page 2 of this notice for instructions. All written submissions are due by February 21, 2017.

https://www.usitc.gov/secretary/fed_reg_notices/332/332_557_notice04062016sgl.pdf

6.4 Please check the following:

Make sure contact information is provided in question 1.2.

Make sure all numbers are full figures and not in thousands or millions. For example, if a production value is $5,000, enter as 5,000.

Make sure unit data are all in metric tons.

Make sure the percentages in both columns of table 4.12 sum to 100.

Make sure the percentages in both columns of table 4.13 sum to 100.

6.5 Mail or fax the completed questionnaire to us (see address and fax number below). Sending the questionnaire by U.S. mail is not recommended because this type of mail undergoes additional processing to screen for hazardous material that will likely substantially delay the delivery. Overnight mail service is recommended.

United States International Trade Commission
Attention: Aluminum Survey Project Team
Office of Industries, Room 511-G
500 E Street, SW, Washington, DC 20436
Fax: 202-205-2217

Thank you for providing your response. The Commission will be compiling the information from the questionnaire responses to analyze the global competitiveness of the U.S. aluminum industry. During the analysis phase, we may contact you for follow up discussions about interpreting the data and other issues affecting the industry.

Appendix G
Description of the Commission's Survey Methodology

Description of the Commission's Survey Methodology

Survey Methods

In his letter to the U.S. International Trade Commission (Commission),[1140] the Chairman of the U.S. House of Representatives Committee on Ways and Means (Committee) requested that the Commission examine factors affecting the global competitiveness of the U.S. aluminum industry. The Commission's investigation was to use, among other information sources, primary data collected from a survey of U.S. companies in order to develop detailed information on the domestic aluminum industry. To comply with this request, the Commission developed a questionnaire to collect information on the operations of U.S. firms. The Commission held a focus group and conducted field and cognitive testing of its questionnaire with companies in June and July 2016. The Commission submitted its questionnaire to the U.S. Office of Management and Budget for approval in August 2016. After receiving approval in September 2016, the Commission sent the questionnaire to 245 U.S. companies.

Surveying for this investigation consisted of three major steps. First, the Commission used research to identify firms and generated a list of U.S. companies in the aluminum industry. Second, it decided to conduct a census of firms, rather than selecting a sample, and sent questionnaires to all firms identified. Finally, the Commission combined responses from the individual questionnaires to produce statistically representative estimates of U.S. companies' operations.

Population

The first step in the survey process was to generate an exhaustive list of firms producing aluminum in the United States. The Commission used three primary sources of data to compile this list: (1) the Orbis database, to identify firms by North American Industry Classification System (NAICS) codes that are associated with aluminum production (table G.1); (2) transaction-level business information obtained from U.S. Customs and Border Protection; and (3) industry association mailing lists, combined with industry analyst research. Commission staff then evaluated the list to remove duplicates and firms that produce solely products that are outside the scope of the investigation. The final list included 245 firms that were determined to produce aluminum products subject to this investigation.

[1140] See appendix A for the Committee's request letter.

Table G.1: North American Industry Classification System (NAICS) codes used to compile the list of firms in the aluminum industry

2012 NAICS code	2012 NAICS title
331313	Alumina Refining and Primary Aluminum Production
331314	Secondary Smelting and Alloying of Aluminum
331315	Aluminum Sheet, Plate, and Foil Manufacturing
331318	Other Aluminum Rolling, Drawing, and Extruding

Source: Compiled by USITC staff.

Response Rates

Based on the Commission's authority under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1333(a)), all organizations that received a questionnaire were legally required to complete it. The companies received an initial mailing informing them of the study and the questionnaire, followed by a letter containing instructions for completing it within 30 days. They then received two follow-up mailings reminding them to complete the questionnaire.

The survey had an overall response rate of 65 percent of all firms contacted. This response rate reflects all of the adjustments that were made to the survey sample and population. Such adjustments were needed in order to account for companies that were unreachable, no longer in business, or otherwise exempt from the survey. Of the 245 questionnaires mailed, 4 were returned as undeliverable by the U.S. Postal Service. In addition, 63 firms were granted exemptions from the survey. Thirty-three (more than half) of these firms either were too small and lacked the resources to fill out the survey, or were out of business, or had been acquired by another firm. The other 30 firms completed the questionnaire indicating they did not produce products within the scope of the investigation. Additional questionnaires had been received by organizations who had acquired firms on the original mailing list. After all adjustments, there were 186 firms in the population, with 120 responding.

Commission staff estimates the survey results included a large share of the industry. Table G.2 shows the response rate by industry segment and estimated share of production.

Table G.2: Response rate and estimated share of production by aluminum industry segment (percent)

Industry segment	Response rate	Estimated share of production
Primary	100	100
Secondary	78	86
Wrought	64	79

Source: Compiled by USITC staff.

Weighting Adjustments and Analysis of Responses

Once the Commission received the completed questionnaires, they were reviewed by Commission staff to ensure that respondents had properly reported all data. In cases where data were missing or appeared inconsistent, staff contacted respondents to obtain corrected data.

After the data were collected and reviewed, Commission staff combined the responses from individual organizations. One of the concerns faced when conducting a census, versus taking a sample, is what to do if the response rate is not high enough. When conducting a census, a response rate of 100 percent is desired for perfect results. Because the Commission's response rate was below 90 percent, an adjustment was needed in order for the data to be representative of the entire industry.

Nonresponse Analysis

Given the information gathered in the questionnaire for responders and information obtained during step 1 of the survey process for nonresponders, the Commission was able to perform tests to determine if specific types of firms were more likely to respond than others. Such tests check into whether or not specific characteristics of members in the population are correlated with responding to the survey. Complete information on these characteristics is required for all responders and nonresponders. In this case, the information available was about firm employment and the types of products a firm produced.

Historically, in Commission investigations involving a survey, a firm's size has been a strong predictor of the likelihood that it will to respond to the survey. Generally, the more employees a firm has, the more likely it is that the firm will respond to a survey. However, in this case, employment correlated poorly with response, with a pairwise correlation coefficient of -0.07. Commission staff also used a logistic regression model to test correlation of response with the log of employment and with the types of products firms produce. All of the estimated coefficients were found to be not statistically different from zero. Considering the lack of correlation between failure to respond and information about firm traits, Commission staff did not perform a nonresponse weighting adjustment.[1141]

Poststratification

Because Commission staff had credible data on the products that members of the survey population produced, a poststratification weighting adjustment was considered a viable

[1141] For details on nonresponse adjustments, see USITC, *Trade, Investment, and Industrial Policies in India: Effects on the U.S. Economy*, 2014, appendix F.

method of weighting responses to estimates of the population. Poststratification weighting uses official population figures as the basis for calculating weight adjustments across different groups in the population ("poststrata"). The population was poststratified by the products the firms produce, resulting in 13 different strata. The poststratification weighting adjustment was calculated as the inverse of the proportion of responders in each stratum to the total firms in each stratum. Overall, the results of the weighting adjustment ranged from 1.0 to 2.1, with an average weight of 1.2. Table G.3 below shows average weight by segment.

Table G.3: Average weight by aluminum industry segment

Industry segment	Average weight
Primary	1.0
Secondary, merchant	1.2
Secondary, captive	1.0
Wrought	1.6

Source: Compiled by USITC staff.

Appendix H
Survey Results

Survey Responses

The following tables present the compiled and weighted (see appendix G) responses received from recipients of the survey form (see appendix F) issued by the U.S. International Trade Commission (Commission or USITC) on September 30, 2016. The survey was sent to firms involved in the U.S. aluminum industry in connection with the Commission's investigation.

Wherever possible, this chapter provides the survey responses to the degree of disaggregation specified in the original survey question. However, certain responses are combined or suppressed when necessary, per the table footnotes, due to confidentiality concerns arising from either the limited number or concentration of respondents.[1142] Commission staff calculations of additional data (e.g., capacity utilization, labor participation, average unit values, etc.) from the survey responses are indicated by table footnotes.

Primary Unwrought Aluminum

The Commission survey team found it necessary to suppress the responses of the primary unwrought aluminum producers to questions 2.1 through 2.6 due to confidentiality concerns arising from both the limited number and concentration of respondents.

Secondary Unwrought Aluminum

Survey responses for secondary unwrought aluminum producers are disaggregated among "large captive producers" (with 400,000 metric tons (mt) or more of production in 2015), "small captive producers" (with less than 400,000 mt of production in 2015), and "merchant producers." Captive producers are those that responded "Yes" to a question asking if they produced both secondary unwrought aluminum (question 3.1) and wrought aluminum products (question 4.1). Merchant producers are those that responded "Yes" to a question asking if they produced only secondary unwrought aluminum (question 3.1). Responses to questions 3.6 through 3.10 were suppressed due to confidentiality concerns arising from the limited number of respondents.

[1142] The Commission's criteria for suppressing survey results to avoid revealing the operations of any single respondent to a question are (1) there must be a minimum of three respondents; (2) no two respondents' responses combined may make up 90 percent or more of the aggregate total for any item in any year; and 3) no single respondent's response may make up 75 percent or more of the aggregate total for any item in any year.

Table H.1: Survey question 3.2: Secondary unwrought aluminum operations, 2011–15

Item	2011	2012	2013	2014	2015
Production (1,000 mt)					
Captive producers					
Large captive producers	3,883	4,033	4,095	4,171	4,222
Small captive producers	460	503	567	658	745
Total	4,343	4,535	4,662	4,828	4,967
Merchant producers	3,230	3,397	3,407	3,466	3,620
Total	7,573	7,933	8,069	8,295	8,587
Capacity (1,000 mt)					
Captive producers	5,198	5,206	5,270	5,529	5,549
Merchant producers	4,261	4,388	4,403	4,504	4,445
Total	9,459	9,595	9,673	10,033	9,993
Capacity utilization (%)[a]					
Captive producers	83.5	87.1	88.5	87.3	89.5
Merchant producers	75.8	77.4	77.4	77.0	81.4
Average	80.1	82.7	83.4	82.7	85.9
Employment (number, full-time equivalent)					
Captive producers	2,391	2,394	2,437	2,556	2,655
Merchant producers	4,437	4,611	4,463	4,680	4,869
Total	6,828	7,005	6,900	7,236	7,524
Labor participation (workers / 1,000 mt)[a]					
Captive producers	0.6	0.5	0.5	0.5	0.5
Merchant producers	1.4	1.4	1.3	1.4	1.3
Total	0.9	0.9	0.9	0.9	0.9
Investment (1,000 $)					
Captive producers	69,997	124,183	137,502	183,835	47,773
Merchant producers	186,766	195,754	155,507	173,146	180,138
Total	256,763	319,937	293,009	356,981	227,912

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
Note: mt = metric tons.
[a] USITC staff calculations.

Table H.2: Survey question 3.3: Secondary unwrought aluminum, shipments, 2011–15[a]

Item	2011	2012	2013	2014	2015
Quantity (1,000 mt)					
Captive producers	3,986	4,145	4,238	4,348	4,474
Merchant producers	3,104	3,193	3,211	3,257	3,427
Total	7,090	7,338	7,449	7,605	7,901
Value (million $)					
Captive producers	8,498	7,695	7,440	8,429	7,318
Merchant producers	4,315	4,207	4,258	4,633	4,510
Total	12,813	11,901	11,698	13,063	11,828
Unit values ($/mt)[b]					
Captive producers	2,132	1,856	1,755	1,939	1,636
Merchant producers	1,390	1,317	1,326	1,422	1,316
Average	1,807	1,622	1,570	1,718	1,497

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
Note: mt = metric tons.
[a] U.S. shipments of captive and merchant producers could not also be reported by alloy type (i.e., unalloyed versus alloyed aluminum) due to confidentiality concerns.
[b] USITC staff calculations.

Table H.3: Survey question 3.4: Secondary unwrought aluminum, input cost changes, 2011–15 (percent)

Input cost change	Aluminum scrap	Primary aluminum	Other raw materials	Labor	Energy	Shipping transport	Other
Increased 2015 compared to 2011	19.9	15.2	28.2	84.1	23.0	55.4	22.5
Decreased 2015 compared to 2011	71.0	57.3	42.0	9.2	64.1	21.5	4.9
Don't know or little or no change[a]	9.1	27.6	29.8	6.7	12.9	23.1	72.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
[a] The responses for "Don't know" and "Little or no change" were aggregated due to confidentiality concerns.

Table H.4: Survey, question 3.5: Secondary unwrought aluminum, raw materials purchases by sources, 2011–15

Source and raw material	Quantity (1,000 mt) 2011	2015	Value (million $) 2011	2015	Unit value ($/mt)[a] 2011	2015
Reported sources[b]						
Domestic	3,478	4,446	6,758	6,246	1,943	1,405
Foreign	642	797	1,729	1,590	2,691	1,996
Unknown	941	1,095	1,894	1,596	2,013	1,458
Total	5,061	6,337	10,381	9,432	2,051	1,488
All sources						
High-purity primary unwrought	587	649	1,374	1,196	2,342	1,841
Primary unwrought other than high purity	898	1,124	2,340	2,233	2,608	1,988
Secondary unwrought	359	226	937	450	2,608	1,992
Scrap	3,121	4,189	5,668	5,471	1,816	1,306
Wrought aluminum used as feed stock	96	150	62	82	640	550
Total	5,061	6,337	10,381	9,432	2,051	1,488

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
[a] USITC staff calculations.
[b] Reported sources could not be further disaggregated into raw materials due to confidentiality concerns.

Table H.5: Survey question 3.5: Secondary unwrought aluminum, raw materials purchases by sources, 2011–15

Item Source	Quantity (1,000 mt) 2011	2015	Value (million $) 2011	2015	Unit value ($/mt)[a] 2011	2015
Reported source						
Domestic						
Captive producers	1,506	1,661	3,441	3,080	2,284	1,854
Merchant producers	1,972	2,785	3,317	3,165	1,683	1,137
Subtotal	3,478	4,446	6,758	6,245	1,943	1,405
Foreign[b]	642	797	1,729	1,590	2,691	1,996
Unknown[b]	941	1,095	1,894	1,596	2,013	1,458
Total	5,061	6,337	10,381	9,431	2,051	1,488
All sources						
Captive producers	2,875	3,268	6,945	6,139	2,416	1,878
Merchant producers	2,186	3,069	3,436	3,293	1,572	1,073
Total	5,061	6,337	10,381	9,431	2,051	1,488

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
[a] USITC staff calculations.
[b] Foreign and unknown sources could not be further disaggregated by captive versus merchant producers due to confidentiality concerns.

Table H.6: Survey question 3.11: Secondary unwrought aluminum, estimates of impact of removal of foreign government policies and programs on U.S. firms' 2015 production levels

Impact	%
Cannot estimate	64.0
Increase in production	17.7
No effect	10.5
Decrease in production	7.8
Total	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

Wrought Aluminum

Wrought aluminum producers were those that either responded “Yes” to a single question asking if they produced wrought aluminum (question 4.1) or responded “Yes” to two questions—one asking if they produced secondary unwrought aluminum (question 3.1) and the other asking if they produced wrought aluminum (question 4.1). Responses to questions 4.7 and 4.8, and to questions 4.16 through 4.21, were suppressed due to confidentiality concerns arising from the limited number of respondents.

Table H.7: Survey questions 4.2 and 4.3: Wrought aluminum, capacity, production, and capacity utilization, 2011–15

Item	2011	2012	2013	2014	2015
Capacity (1,000 mt)					
Plate products	237	244	255	263	270
Sheet, strip, foil products	4,523	4,477	4,429	4,386	4,465
Wire products	699	741	745	720	718
Profile, bar, rod products	2,233	2,328	2,436	2,508	2,566
Tube or pipe products	888	959	994	1,049	1,049
Total	8,580	8,750	8,858	8,927	9,068
Production (1,000 mt)					
Plate products	215	236	250	258	268
Sheet, strip, foil products	3,925	3,990	4,016	4,103	4,125
Wire products	389	454	451	422	445
Profile, bar, rod products	1,473	1,597	1,682	1,764	1,835
Tube or pipe products	299	325	356	402	434
Total	6,302	6,603	6,754	6,948	7,107
Capacity utilization (%)[a]					
Plate products	91.0	96.8	98.3	98.1	99.1
Sheet, strip, foil products	86.8	89.1	90.7	93.5	92.4
Wire products	55.7	61.3	60.5	58.6	62.1
Profile, bar, rod products	66.0	68.6	69.1	70.3	71.5
Tube or pipe products	33.7	33.9	35.8	38.3	41.4
Average	73.5	75.5	76.3	77.8	78.4

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
Note: mt = metric tons.
[a] USITC staff calculations.

Table H.8: Survey question 4.3: Wrought aluminum, production by product groups, 2011–15 (thousand mt)

Product group	2011	2012	2013	2014	2015
Plate, sheet, strip, foil products					
Unalloyed, series 1XXX	144	147	140	145	124
Non-heat treatable (alloy series 3XXX, 5XXX)	3,220	3,268	3,322	3,313	3,261
Heat treatable (alloy series 2XXX, 7XXX)	188	218	236	236	265
Heat treatable (alloy series 6XXX)	139	149	157	229	369
All other plate and sheet products of series not specified above	450	444	411	438	373
Subtotal	4,141	4,227	4,266	4,361	4,392
Wire products	389	454	451	422	445
Profile, bar, and rod products	1,473	1,597	1,682	1,764	1,835
Tube or pipe products	299	325	356	402	434
Total	6,302	6,603	6,754	6,948	7,107

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

Table H.9: Survey question 4.4: Wrought aluminum, shipment quantities by product groups, 2011–15 (thousand mt)

Product group	2011	2012	2013	2014	2015
Plate, sheet, strip, foil products					
Unalloyed, series 1XXX	155	150	138	145	135
Non-heat treatable (alloy series 3XXX, 5XXX)	3,447	3,490	3,737	3,599	3,529
Heat treatable (alloy series 2XXX, 7XXX)	187	218	235	235	263
Heat treatable (alloy series 6XXX)	136	147	155	227	367
All other plate and sheet products of series not specified above	444	427	390	406	332
Subtotal	4,370	4,433	4,654	4,612	4,626
Wire products					
Unalloyed	223	254	252	252	237
Alloyed	65	85	104	114	115
Subtotal	288	339	355	367	353
Profile, bar, rod products					
Unalloyed	74	68	60	71	47
Alloyed	1,340	1,449	1,540	1,649	1,735
Subtotal	1,414	1,517	1,601	1,720	1,781
Tube or pipe products					
Unalloyed	23	23	21	24	21
Alloyed	258	230	246	276	309
Subtotal	280	253	267	301	331
Total	6,352	6,541	6,877	6,998	7,091

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

Table H.10: Survey question 4.5: Wrought aluminum, shipment values by product groups, 2011–15 (million dollars)

Product group	2011	2012	2013	2014	2015
Plate, sheet, strip, foil products					
Unalloyed, series 1XXX	621	549	505	531	457
Non-heat treatable (alloy series 3XXX, 5XXX)	8,930	10,238	9,632	9,876	9,240
Heat treatable (alloy series 2XXX, 7XXX)	1,368	1,679	1,750	1,720	1,819
Heat treatable (alloy series 6XXX)	540	564	586	843	1,312
All other plate and sheet products of series not specified above	983	918	865	804	725
Subtotal	12,442	13,948	13,337	13,776	13,553
Wire products					
Unalloyed	1,233	1,400	1,352	1,369	1,193
Alloyed	473	602	688	720	724
Subtotal	1,706	2,002	2,040	2,089	1,917
Profile, bar, rod products					
Unalloyed	159	143	122	146	88
Alloyed	5,793	6,033	6,297	6,806	7,057
Subtotal	5,952	6,176	6,419	6,952	7,145
Tube or pipe products					
Unalloyed	107	101	92	102	89
Alloyed	991	1,100	1,195	1,361	1,461
Subtotal	1,098	1,201	1,287	1,463	1,551
Total	21,198	23,327	23,084	24,280	24,166

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

Table H.11: Survey questions 4.4 and 4.5: Wrought aluminum, shipment unit values by product groups, 2011–15 (dollars per mt)[a]

Product group	2011	2012	2013	2014	2015
Plate, sheet, strip, foil products					
Unalloyed, series 1XXX	3,997	3,657	3,666	3,667	3,371
Non-heat treatable (alloy series 3XXX, 5XXX)	2,591	2,933	2,577	2,744	2,618
Heat treatable (alloy series 2XXX, 7XXX)	7,320	7,691	7,452	7,334	6,930
Heat treatable (alloy series 6XXX)	3,957	3,827	3,783	3,718	3,571
All other plate and sheet products of series not specified above	2,215	2,151	2,218	1,980	2,183
Subtotal average	2,847	3,147	2,865	2,987	2,930
Wire products					
Unalloyed	5,528	5,511	5,374	5,425	5,025
Alloyed	7,261	7,119	6,645	6,306	6,291
Subtotal average	5,920	5,913	5,745	5,699	5,439
Profile, bar, rod products					
Unalloyed	2,146	2,113	2,034	2,055	1,879

Product group	2011	2012	2013	2014	2015
Alloyed	4,324	4,163	4,088	4,128	4,068
Subtotal average	4,210	4,072	4,010	4,043	4,011
Tube or pipe products					
Unalloyed	4,742	4,430	4,462	4,226	4,173
Alloyed	3,845	4,776	4,858	4,923	4,723
Subtotal average	3,918	4,745	4,827	4,867	4,687
Total average	3,337	3,566	3,357	3,469	3,408

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
[a] USITC staff calculations.

Table H.12: Survey question 4.6: Wrought aluminum, export quantities, values, and unit values, 2011–15

Product group	2011	2012	2013	2014	2015
Quantity (1,000 mt)					
Plate, sheet, strip, foil products	504	517	540	503	431
Wire products	73	84	89	86	82
Profile, bar, rod products	19	23	23	28	26
Tube or pipe products	79	77	82	86	39
Total	675	700	736	703	578
Value (million $)					
Plate, sheet, strip, foil products	1,725	1,897	1,987	1,860	1,688
Wire products	397	445	467	468	436
Profile, bar, rod products	103	116	118	143	134
Tube or pipe products	303	278	334	330	182
Total	2,528	2,737	2,906	2,800	2,440
Unit value ($/mt)[a]					
Plate, sheet, strip, foil products	3,420	3,668	3,677	3,698	3,913
Wire products	5,450	5,327	5,226	5,438	5,288
Profile, bar, rod products	5,481	5,145	5,060	5,033	5,216
Tube or pipe products	3,813	3,635	4,047	3,856	4,729
Average	3,742	3,910	3,951	3,984	4,221

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
Note: mt = metric tons.
[a] USITC staff calculations.

Table H.13: Survey question 4.9: Wrought aluminum, U.S. production capacity changes, 2011–15 (percent)

Production capacity change	**Yes**	**No**
Expanded production capacity at existing establishments	43.0	57.0
Reduced production capacity at existing establishments	7.5	92.5
Acquired production establishments	11.2	88.8
Sold or otherwise disposed of production establishments	4.2	95.8
No change	4.2	95.8

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
Note: Responders were able to check more than one response to this question.

Table H.14: Survey question 4.10: Wrought aluminum, employees, 2011–15 (number, full-time equivalent basis)

Product group	**2011**	**2012**	**2013**	**2014**	**2015**
Plate, sheets, strip, foil products	13,832	14,150	14,190	14,675	15,071
Profile, bar, rod products	14,262	15,104	15,620	16,293	16,806
Tube or pipe products	3,460	3,395	3,284	3,401	3,555
Wire products	3,846	4,293	4,419	4,388	4,524
Employees that cannot be attributed to only one product group	6,182	6,030	5,977	6,461	6,907
Total	41,583	42,972	43,489	45,219	46,862

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

Table H.15: Survey question 4.11: Wrought aluminum, capital expenditures at U.S. facilities, 2011–15 (thousand dollars)

Product group	**2011**	**2012**	**2013**	**2014**	**2015**
Plate, sheet, strip, foil products[a]					
Plate products	30,863	39,133	47,459	42,631	117,121
Sheet, strip, foil products	245,617	410,997	414,927	386,523	532,644
Subtotal	276,480	450,131	462,386	429,154	649,765
Plate, sheet, strip, foil products					
Non-heat treated	210,035	179,804	187,069	276,162	294,753
Heat treated	66,446	270,326	275,317	152,992	355,012
Subtotal	276,480	450,131	462,386	429,154	649,765
Wire products	40,014	104,689	53,331	110,212	71,862
Profile, bar, rod products	132,732	114,424	157,975	148,706	153,257
Tube or pipe products	20,081	24,559	33,645	70,778	36,129
Capital expenditures that cannot be attributed to only one product group	132,946	160,421	105,602	74,118	84,259
Total	602,254	854,223	812,939	832,968	995,271

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
[a] Plate products were merged with sheets, strip, and foil products due to confidentiality concerns.

Table H.16: Survey question 4.12: Wrought aluminum, shipments by customer type, 2011 and 2015

Customer type	2011 1,000 mt[a]	2011 %	2015 1,000 mt[a]	2015 %
Wrought producers in the United States, not owned by your firm	105	1.7	108	1.5
Downstream producers in the United States, owned by your firm	700	11.0	808	11.4
Downstream producers in the United States, not owned by your firm	4,176	65.8	4,753	67.0
Distributors or service centers in the United States	1,144	18.0	1,190	16.8
Other or unknown	226	3.6	232	3.3
Total	6,352	100.0	7,091	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
[a] USITC staff calculations, based on responses to question 4.4.

Table H.17: Survey question 4.13: Wrought aluminum, shipments by end-use consuming sector, 2011 and 2015

Customer type	2011 1,000 mt[a]	2011 %	2015 1,000 mt[a]	2015 %
Transportation				
Automotive	310	4.9	1,021	14.4
Commercial aerospace	305	4.8	338	4.8
Defense aerospace	26	0.4	22	0.3
All other or undifferentiated	639	10.1	861	12.2
Subtotal	1,280	20.2	2,242	31.6
Containers and packaging				
Beverage cans	1,515	23.9	1,302	18.4
Other containers and packaging	417	6.6	449	6.3
Subtotal	1,932	30.4	1,751	24.7
Building and construction	1,095	17.2	1,183	16.7
Electrical	419	6.6	435	6.1
Consumer durables	247	3.9	307	4.3
Machinery and equipment	148	2.3	209	3.0
Other or unknown	1,231	19.4	960	13.6
Total	6,352	100.0	7,087	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
Note: mt = metric tons.
[a] USITC staff calculations, based on responses to question 4.4.

Table H.18: Survey question 4.14: Wrought aluminum, changes in input costs, 2011 and 2015 (percent)

Input cost change	Labor	Energy	Shipping transport	Other
Increased 2015 compared to 2011	86.8	49.0	60.7	30.6
Decreased 2015 compared to 2011	2.7	24.6	13.5	9.8
Don't know or little or no change[a]	10.5	26.4	25.8	59.7
Total	100.0	100.0	100.0	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
[a] The responses for "Don't know" and "Little or no change" were aggregated due to confidentiality concerns.

Table H.19: Survey question 4.15: Wrought aluminum, producers' purchases of unwrought and wrought aluminum products used internally or commercially sold, 2011–15

	Quantity (1,000 mt)		Value (million $)		Unit value ($/mt)[a]	
Product	2011	2015	2011	2015	2011	2015
Unwrought products used as is						
Unalloyed, domestic sources	579	541	1,466	1,027	2,531	1,900
Alloyed, domestic sources	670	987	1,455	2,208	2,173	2,237
Unalloyed, imported	171	194	426	390	2,487	2,004
Alloyed, imported	875	1,155	2,338	2,427	2,672	2,102
Total	2,295	2,876	5,686	6,052	2,477	2,104
Plate, sheet, strip, and foil products						
Non-heat treated, imported	205	8	454	22	2,213	2,777
Heat treated, imported	4	28	14	78	3,896	2,753
Subtotal	209	36	467	100	2,241	2,758
Wire products, imported	15	64	44	154	2,965	2,399
Profile, bar, rod products, imported	170	251	479	685	2,820	2,731
Tube or pipe products, imported	57	72	155	166	2,718	2,300
Total	450	423	1,146	1,105	2,544	2,609

Source: USITC survey of U.S. aluminum producers, September 30, 2016.
Note: mt = metric tons.
[a] USITC staff calculations.

Table H.20: Survey question 4.22: Wrought aluminum, estimates of the impact of removal of foreign government policies and programs on U.S. firms' 2015 production levels

Impact	%
Cannot estimate	40.3
Decrease in production of more than 10 percent	13.7
Decrease in production of 1–10 percent	4.0
No effect	8.9
Increase in production of 1–10 percent	20.1
Increase in production of more than 10 percent	12.9
Total	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

Appendix I
Aluminum Technical Background

Aluminum Technical Background

Included in this appendix are more technical details about the raw materials, electrolytic smelting process, unwrought aluminum products, aluminum alloy compositions, wrought processes, and pricing, as background information for the text in chapter 1, “Aluminum Overview.”

Primary Unwrought Aluminum

The primary unwrought aluminum smelting process originates with the mining of bauxite, the principal type of aluminum ore (figure I.1a).[1143] The United States, having limited bauxite resources, is entirely dependent on imports to meet its domestic consumption needs.[1144] Alumina, an aluminum oxide (figure I.1b), is refined from bauxite ore by the multistep Bayer process that filters out the clay minerals and iron oxides (as an alkaline slurry of “red mud”) and chemically converts the aluminum-bearing minerals into pure aluminum oxide.[1145] Roughly 4–5 metric tons (mt) of bauxite are refined into the 2 mt of alumina required for electrolytic smelting into 1 mt of aluminum metal.[1146] The alumina-refining process accounts for roughly one-third of the cost to produce primary unwrought aluminum.[1147]

Figure I.1: Bauxite ore and refined alumina, the raw materials for primary aluminum smelting

I.1a: Bauxite (close-up of the nodular texture)

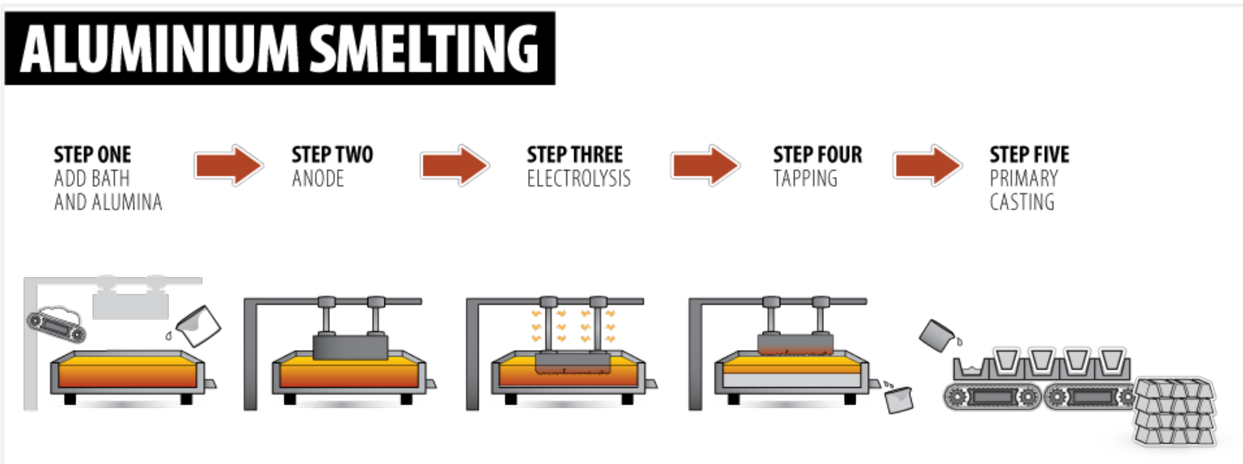
I.1b: Alumina

Sources: Figure I.1a. Bauxite (photo from Queensland Resources Council, 2011, for Oresome Resources). Figure I.1b. Alumina powder (Al2O3) (photo from Reade International Corp.).

[1143] Bauxite is a brittle, massive rock, with a nodular texture, containing hydrous aluminum oxides (böhmite and disaspore) and aluminum hydroxide (gibbsite) minerals mixed with clay minerals and iron oxides. Typically, bauxite occurs in near-surface deposits located in tropical and subtropical regions of the world. Aluminum Association, “Bauxite,” 2016; IAI, “Mining Process,” 2016.
[1144] Australia is the world’s leading bauxite producer, followed by China, Brazil, India, Malaysia, Guinea, and Jamaica. Together these countries recorded nearly nine-tenths (89 percent) of bauxite mine output worldwide in 2015. Bray, “Bauxite and Alumina,” January 2016, 32–33.
[1145] Aluminum Association, “Alumina Refining,” 2016; IAI, “Refining Process,” 2016; UC Rusal, “How Aluminum Is Produced,” 2017.
[1146] Bray, “Bauxite and Alumina,” January 2016, 33.
[1147] IAI, “Mining Process,” 2016.

Primary aluminum producers use the Hall-Héroult electrolytic process[1148] to smelt alumina into molten aluminum (figure I.2), which then can be cast into various primary unwrought products. The smelting process starts by dissolving alumina in a bath of molten cryolite (sodium aluminum hexafluoride) in pots ("electrolytic cells") connected in a potline ("series"). Each cell is lined with baked carbon (consisting of petroleum coke with pitch as a binder) to form a negative electrode (cathode), while carbon blocks lowered into the cell bath serve as the positive electrode (anode).[1149] An electric current passing from the anode, through the cryolite solution, to the cathode disassociates the alumina into molten aluminum and oxygen. The molten aluminum formed at the cathode then sinks to the bottom of the pot. Oxygen forming at the anodes reacts with the carbon, releasing carbon dioxide as a byproduct. The anodes gradually burn away and periodically must be replaced.

Figure I.2: The Hall-Héroult primary aluminum smelting process



Source: Aluminum smelting (flowchart illustration from Australian Aluminium Council).

Molten aluminum is then removed from the pots through the process of tapping, and transported to a casthouse. At the casthouse, the molten aluminum is typically alloyed with other nonferrous metals,[1150] then poured into molds to solidify into unwrought forms (figure

[1148] See figure I.2.
[1149] Carbon-block anodes are formed by two different technologies: prebake and Söderberg cells. In the prebake technology, the petroleum coke and pitch mixture ("green paste") is shaped, either in a press or with a vibrocompactor. It is then baked in a furnace to form a solid carbon block. Next, a steel rod with multiple prongs is inserted into the carbon block, which serves as a conduit for the electric current to reach the carbon block during the electrolytic smelting process. Prebake pots contain multiple carbon blocks that require periodic replacement as they are consumed. By contrast, Söderberg cells consist of a single large anode housed in a large steel container. Unlike in the prebake technology, the green paste is baked as it moves from the top to the bottom of the Söderberg cell. Söderberg anodes are considered a less efficient technology than prebake cells, with higher emission rates and lower energy-efficiency levels. Some producers have improved the Söderberg technology to reduce emissions and increase production efficiency. Aluminum-production.com, "The Aluminum Smelting Process: Prebake and Soderberg," 2009; UC Rusal, "Clean Soederberg," 2017.
[1150] IAI, "Reduction," 2016.

I.3). Any product resulting from the casting process is considered primary unwrought aluminum so long as it does not receive any further heat treatment or cold working.[1151] Alternately, molten aluminum removed from the pots can be poured into refractory-lined steel crucibles for transport, typically by road, to customers. Transport crucibles have holding capacity ranging from less than 1 mt to several mt of molten aluminum.[1152]

Figure I.3: Forms of unwrought aluminum products


I.3a: Ingots


I.3b: Billets


I.3c: Slabs


I.3d: Wire rod

Sources: Figure I.3a. Aluminum ingots (photo from Maha Uthai Eneray Co. Ltd., “Active Sellers: Available Aluminum Ingots 99.7% & 99.9% Sell Offer”). Figure I.3b. Aluminum billets (photo from Star Exports). Figure I.3c. Aluminum slabs (photo from Hili Allied Overseas, “Primary Aluminum (LME Registered), Aluminum Slab”). Figure I.3d. Aluminum wire rod (photo from Donmetindustry).

[1151] A cast product that receives heat treatment or cold working is classified as a wrought aluminum product because there is value added to the product.

[1152] The crucible is filled by pouring molten aluminum into the fill port of the crucible cover. Tapping ports at the bottom or a pour spout near the top facilitate removal of the molten aluminum from the crucible. To secure it during transport, the crucible’s base is fitted with lug plates that match and lock onto the lugs protruding from the bed or frame of the trailer. For more information about molten aluminum transport crucibles, see e.g.: Bartz Maschinenbau GmbH, “Transport Crucibles,” n.d. http://en.maschinenbau-bartz.de/transportbehaelter.html?&L=1; Mansell and Associates LLC, “Molten Metal Transfer Crucibles,” n.d. http://mansellandassociates.net/HotMetalPotTransferCrucibles.html; Techni-Term, “Crucibles for Road Transport of Liquid Aluminum,” n.d. http://www,technuterm,cin/@en-us/1-5-article_en-us_9.htma (all accessed June 14, 2017.

Alloyed and Unalloyed Aluminum

Depending on the final end-use requirements, aluminum is often alloyed with other nonferrous metals to elicit certain characteristics, such as improved strength, corrosion resistance, electrical and thermal conductivity, malleability, and other physical properties (table I.1). The alloying metals are mixed into the molten aluminum during both the primary and secondary unwrought production processes; the molten aluminum is then cast into various unwrought products. The main alloying metals in 2xxx, 7xxx, and 8xxx series alloys are respectively copper, zinc, and elements such as lithium and titanium, and these metals are used to produce certain aerospace components that require higher strength and low density. However, for products that require different qualities such as formability and corrosion resistance, producers may use a 1xxx series alloy, which is considered commercially pure aluminum, or a 3xxx series alloy, where the main alloying metal is manganese. Products that use 1xxx series alloys include food packaging trays and radiator tubing, while products that use 3xxx series alloys include beverage cans and certain home appliances.

Aluminum alloys are further distinguished by how they can be strengthened and hardened—either by heat-treating and precipitation-hardening (aging) or by cold-working. Heat-treatable alloys (series 2xxx, 6xxx, and 7xxx) are heated and then rapidly cooled to improve hardening.[1153] By contrast, non-heat-treatable alloys (series 1xxx, 3xxx, 4xxx, and 5xxx) are cold-worked by various mechanical processes, such as rolling or forging, to induce strain hardening of the metal.[1154]

Table I.1: Wrought aluminum alloys, properties, and major end uses

Series	Alloying metal	Properties	Major end uses
1xxx	Pure aluminum (Al)	Commercially pure (containing 99 percent or more Al by weight) Non-heat-treatable Low strength, excellent formability, high thermal and electrical conductivity, high corrosion resistance, highly reflective	Aircraft frames, fuel filters, electric-power grid lines, radiator tubing, lighting reflectors, decorative components, food packaging trays
2xxx	Copper (Cu)	Heat-treatable High strength, low corrosion resistance, good elevated temperature strength	Aircraft skin, aircraft fittings and wheels, ballistic armor, forged machine components
3xxx	Manganese (Mn)	Non-heat-treatable Medium strength, good formability,	Storage tanks, beverage cans, home appliances, heat exchangers, pressure

[1153] Heating and quenching aluminum alloys homogenously distributes and freezes in place the alloying metal(s) throughout the aluminum. Precipitation hardening can be performed either at room temperature (natural aging) or in a low-temperature furnace (artificial aging). Aluminum Association, "Aluminum Alloys 101," 2017; ASM International, "Aluminum and Aluminum Alloys," 2017.
[1154] Aluminum Association, "Aluminum Alloys 101," 2017; Aluminum Association, *Rolling Aluminum*, December 2007, 2–6; ASM International, "Aluminum and Aluminum Alloys," 2017.

Series	Alloying metal	Properties	Major end uses
		good corrosion resistance	vessels, siding, gutters
4xxx	Silicon (Si)	Non-heat-treatable High castability, high machinability, high fluidity, low ductility, lower melting temperature	Welding wire, brazing alloys, and filler metal especially for structural and automotive applications
5xxx	Magnesium (Mg)	Non-heat-treatable Medium to high strength, good formability, excellent marine corrosion resistance	Interior automotive, appliance trim, pressure vessels, armor plate, marine and cryogenic components
6xxx	Magnesium (Mg) and silicon (Si)	Heat-treatable Medium-high strength, good corrosion resistance, easily extruded	Exterior automotive, automotive profiles, railcars, tubing, marine vessel frames, screw stock, doors and windows
7xxx	Zinc (Zn)	Heat-treatable Very high strength, poor corrosion resistance, prone to stress corrosion	Aircraft, truck trailers, railcars, armor plate, ski poles, tennis rackets
8xxx	Other elements, including lithium (Li), nickel (Ni), tin (Sn), and titanium (Ti)	Heat-treatable (Al-Li alloys) Very high strength, low density	Aircraft and aerospace structures, foil, heat exchangers (air conditioning)

Source: Aluminum Association, “Aluminum Alloys 101,” 2017; ASM International, “Subject Guide: Aluminum and Aluminum Alloys,” 2017; Havrilla, “Joining Aluminum with Laser,” July 12, 2013.

[a] There are three-digit series for various cast aluminum alloys, but aluminum foundry and die-casting products are not included in this investigation.

Wrought Aluminum

The wrought aluminum products shown in figure I.4 are formed by various mechanical working processes describe below.

Figure I.4: Forms of wrought aluminum products

I.4a: Coiled cold-rolled sheet

I.4b: Extruded tubing

I.4c: Cold-drawn bar

I.4d: Forged pistons[a]

Sources: Figure I.4a. Coiled cold-rolled aluminum sheet (photo from Globe Metal and Power FZE, "Mill Finish Aluminium Coils/Sheet Supplier in Dubai"). Figure I.4b. Extruded aluminum tubing (photo from Kaiser Aluminum Corp., "Tube and Pipe"). Figure I.4c. Cold-drawn aluminum bars (photo from Alibaba, "30mm 40mm 70mm Small Diameter Cold Drawn 7075 t6 Aluminum Bar"). Figure I.4d. Forged aluminum pistons (photo from Aluminum Precision Products).

[a] Although forgings are wrought products, they are not included in this investigation, since they are often classified as downstream finished products for purposes of international trade.

Rolling

To produce plate, sheet, and foil, the unwrought aluminum is first heated in a pusher furnace to homogenize the various alloying metals, then hot-rolled. In the hot-rolling process, an aluminum ingot or slab is passed back and forth under intense pressure between paired cylindrical steel rolls, which forces the aluminum to become thinner and longer. The aluminum is passed between the rolls until it approaches the desired thickness (gauge).[1155] Depending on the intended end use, hot-rolled flat-rolled products (FRPs) also can be cold-rolled as an additional step. Before cold-rolling, the hot-rolled aluminum is first cooled to room temperature, then passed between rolls to the desired gauge, and finally either wound into coils or cut to length.[1156] Capital costs, including construction and equipment, for a new (greenfield) rolling mill are estimated at $1.3 billion.[1157]

Extruding

In the extrusion process, a preheated solid aluminum billet (usually cylindrical in cross-section) is forced under pressure through a smaller steel die opening (aperture).[1158]The elongated aluminum that emerges from the extrusion press takes the shape of the die aperture.[1159] Extruding temperature is an important determinant of certain characteristics such as hardness and finish.[1160]

Drawing

Aluminum rods (having circular cross sections), bars (having either circular or multiple flat-sided cross sections), wire (less than ⅜ inch in diameter), tubes, and pipes (whether produced by extrusion or rolling) can be further reduced in diameter, surface-finished, or both by drawing them through a series of steel dies, or even drawing them directly from molten aluminum.[1161]

[1155] Novelis, “Hot Rolling” (accessed July 28, 2016).
[1156] Novelis, “Cold Rolling” (accessed July 28, 2016).
[1157] *Aluminium Insider*, “Braidy Industries Announces Plans,” May 4, 2017.
[1158] Aluminum Association, “Extrusions,” 2016.
[1159] This process is often compared to the Play-Doh Fun Factory. Taber Extrusions, “The Process of Aluminum Extrusions,” May 18, 2011.
[1160] Bonnell Aluminum, “Aluminum Extrusion Process,” 2016.
[1161] Aluminum Association, “Rod and Bar,” 2016.

Forging

During the forging process, heated unwrought aluminum is pressed, pounded, or squeezed to shape under intense pressure. Forged products are sought for end uses requiring high-strength but lighter-weight metal, particularly in the aerospace industry.[1162] Aluminum forgings are not included in this investigation, as they are often classified as finished products for purposes of international trade.

Pricing

Aluminum prices are largely set via global and regional exchanges, along with regional premiums that include transaction and transportation costs. For example, a wrought producer may charge a price that includes the prevailing exchange cost for the relevant volume of aluminum (which covers its input costs) along with a conversion fee.[1163] The following section discusses transaction costs and regional premiums.

Transaction Costs and Regional Premiums

Each region of the world has a price premium based on the London Metal Exchange (LME) cash settlement price, which reflects costs associated with transferring aluminum from storage warehouses to downstream consumers. The main premium for the United States is the *Metals Week* (MW) U.S. Aluminum Transaction price. This is an all-inclusive price for primary aluminum that is determined through a survey of producers, traders, and downstream consumers (including rolling mills and extruders) and is a premium to the LME cash settlement price.[1164] This price reflects both out-loading and delivery costs to downstream factories, in addition to supply and demand throughout North America. The transaction price has been extended to regions beyond North America in recent years.[1165]

The MW U.S. Aluminum Transaction Premium is determined by physical spot deals, bids, and offers reported through a daily survey sent out to spot buyers and sellers.[1166] It uses a representative sample of end users (including sheet mills, remelt billet makers, extruders, rod mills, etc.), producers, and traders. This price reflects delivery to a typical consumer throughout the broader U.S. Midwest region by either rail or truck.[1167] In the U.S. aluminum industry, it is often is referred to as the “U.S. Midwest premium.”

[1162] Aluminum Association, “Forgings,” 2016.
[1163] Industry representative, interview by USITC staff, October 3, 2016.
[1164] LME, “LME Aluminium Contract Specifications, Physical Specifications,” 2017.
[1165] S&P Global Platts, "The Price of US Aluminum: Metals Price Assessments," 2016.
[1166] Spot deals refer to immediate transfer of aluminum (either physical or cash) from buyer to seller.
[1167] S&P Global Platts, "Methodology and Specifications Guide: Nonferrous," August 2016.

Bibliography

Alibaba. "Product Details: 30mm 40mm 70mm Small Diameter Cold Drawn 7075 t6 Aluminum Bar." Photograph of cold-drawn bar. https://www.alibaba.com/product-detail/30mm-40mm-70mm-Small-Diameter-Cold_60412703360.html (accessed January 27, 2017).

Aluminum-production.com. "The Aluminum Smelting Process: Prebake and Soderberg," 2009. http://www.aluminum-production.com/prebake_soderberg.html.

Aluminum Association. "Aluminum Alloys 101." Arlington, VA: Aluminum Association, 2017. http://www.aluminum.org/resources/industry-standards/aluminum-alloys-101 (accessed January 12, 2017).

———. "Processing: Forgings." http://www.aluminum.org/industries/processing/forgings (accessed July 26, 2016).

———. "Processing: Rod and Bar." http://www.aluminum.org/industries/processing/rod-bar (accessed July 11, 2016).

———. "Production: Alumina Refining." http://www.aluminum.org/industries/production/alumina-refining (accessed July 11, 2016).

———. "Production: Bauxite." http://www.aluminum.org/industries/production/bauxite (accessed July 11, 2016).

———. "Production: Extrusions." http://www.aluminum.org/industries/processing/extrusions (accessed July 11, 2016).

———. *Rolling Aluminum: From the Mine through the Mill*. Sheet and Plate Division Technology Committee manual, December 2007. http://www.aluminum.org/sites/default/files/Rolling_Aluminum_From_The_Mine_Through_The_Mill.pdf.

Aluminium Insider. "Braidy Industries Announces Plans for U.S.'s First New Aluminum Rolling Mill in 30 Years," May 4, 2017. http://aluminiuminsider.com/braidy-industries-announces-plans-u-s-s-first-new-aluminium-rolling-mill-three-decades/ (accessed May 10, 2017).

Aluminum Precision Products. "Forged Pistons." Photograph of forged pistons. http://www.aluminumprecision.com/products/forged-pistons/ (accessed January 27, 2017).

American Society for Metals (ASM) International. "Subject Guide: Aluminum and Aluminum Alloys." Materials Park, OH: ASM International, 2017. http://www.asminternational.org/web/guest/aluminum/subject-guide.

Australian Aluminum Council (AAC). "Aluminum Smelting." Flowchart of aluminum smelting process. http://aluminium.org.au/flowchart/aluminium-smelting.html (accessed January 27, 2017).

Bonnell Aluminum. "Aluminum Extrusion Process." https://www.bonlalum.com/education/aluminum_extrusion_process.shtml (accessed July 26, 2016).

Bray, E. Lee. "Bauxite and Alumina." *Mineral Commodity Summaries 2016*. Reston, VA: U.S. Geological Survey, January 2016. https://minerals.usgs.gov/minerals/pubs/commodity/bauxite/mcs-2016-bauxi.pdf.

Donmetindustry. "Aluminum Wire Rod." Photograph of aluminum wire rod. http://donmetindustry.com/en/node/25 (accessed January 27, 2017).

Globe Metal and Power FZE. "Mill Finish Aluminium Products: Mill Finish Aluminum Coils/Sheet Supplier and Manufacturer in UAE/Oman/Saudi/Qatar." Photograph of coiled cold-rolled aluminum sheet. http://www.globemetalsuae.com/aluminium-finish-dealer-UAE.html (accessed January 27, 2017).

Havrilla, David. "Joining Aluminum with Laser." *Practical Welding Today*. Elgin, IL: Fabricators and Manufacturers Association (FMA) International, July 12, 2013. http://www.thefabricator.com/article/laserwelding/joining-aluminum-with-laser.

Hili Allied Overseas. "Our Products: Non Ferrous; Primary Aluminum (LME Registered), Aluminum Slab." Photograph of aluminum slabs. http://www.hiliallied.com/web/our-products/non-ferrous (accessed January 27, 2017).

International Aluminium Institute (IAI). "Mining Process." http://bauxite.world-aluminium.org/mining/process.html (accessed January 24, 2016).

———. "Reduction." http://primary.world-aluminium.org/processes/reduction.html (accessed January 27, 2017).

———. "Refining Process." http://bauxite.world-aluminium.org/refining/process.html (accessed January 24, 2016).

Kaiser Aluminum Corp. “Products: Tube and Pipe.” Photograph of extruded aluminum tubing. https://www.kaiseraluminum.com/customers/products/extrusions/tube (accessed January 27, 2017).

London Metals Exchange (LME). “LME Aluminium Contract Specifications, Physical Specifications.” London, United Kingdom: LME, 2017. http://www.lme.com/en-gb/metals/non-ferrous/aluminium/contract-specifications/physical.

Maha Uthai Eneray Co. Ltd. “Active Sellers: Available Aluminum Ingots 99.7% & 99.9%: Sell Offer.” Photograph of aluminum ingots. http://www.recycleinme.com/rim-zimatrading/selloffer-46674.aspx (accessed January 27, 2017).

Novelis Inc. “Aluminum Rolling Process: Cold Rolling.” http://novelis.com/about-us/manufacturing-capabilities-rolling/#1444751568387-c2c61795-159c (accessed July 28, 2016).

———. “Aluminum Rolling Process: Hot Rolling.” http://novelis.com/about-us/manufacturing-capabilities-rolling/#1444751568386-dd8f59a6-2648 (accessed July 28, 2016).

Queensland Resources Council. “Bauxite.” Photograph, 2011, for Oresome Resources. http://www.oresomeresources.com/media_centre_view/resource/image_bauxite/category//section//parent/ (accessed February 22, 2017).

Reade International Corp. “Products: Alumina Powder (AI203).” Photograph of alumina. http://www.reade.com/products/alumina-powder-al2o3 (accessed January 17, 2017).

S&P Global Platts. “Methodology and Specifications Guide: Nonferrous.” New York, NY: S&P Global, August 2016. http://www.platts.com/elqNow/elqNotAuthRedir.htm?ref=/IM.Platts.Content/MethodologyReferences/MethodologySpecs/nonferrous.pdf.

———. “The Price of US Aluminum: Metals Price Assessments.” New York, NY: S&P Global, 2016. http://www.platts.com/price-assessments/metals/aluminum-transaction.

Star Exports. “Aluminum Billets.” Photograph from company website. http://www.startradex.com/Aluminium+Billets/3/ (accessed January 27, 2017).

Taber Extrusions. “The Process of Aluminum Extrusion,” May 18, 2011. http://taberextrusions.com/the-process-of-aluminum-extrusion/.

UC Rusal. "Aluminum Production: How Aluminum Is Produced." http://www.aluminiumleader.com/production/how_aluminium_is_produced (accessed February 17, 2017).

———. "Sustainable Development: Environment; Clean Soederberg." http://www.rusal.ru/en/development/ecology/soderberg/ (accessed January 27, 2017).

Appendix J
Aluminum Trade Flows through Third Countries

Overview

As part of its request letter, the U.S. House of Representatives Committee on Ways and Means asked the Commission to provide information on developments in "trade flows through third countries for further processing and subsequent export."[1168] To identify such flows, the Commission interviewed industry experts as well as reviewed trade data, industry and economic literature, testimony at the Commission's public hearing, and written submissions to the Commission. This appendix discusses the countries and aluminum products likely involved in third-country trade flows, the size and patterns of such flows, and U.S. industry concerns.

Countries and Products

The Commission identified several types of trade flows through third countries, including those through countries that are major regional shipping hubs and that have London Metal Exchange (LME) warehouses[1169] (e.g., the Netherlands). However, most of the identified flows were unlikely to have involved further processing[1170] (i.e., conversion from one form of aluminum to another). The only major flows identified by the Commission that potentially involved aluminum intended for further processing were from China through Mexico, Malaysia, and Vietnam. However, to date, most of this aluminum has stayed in inventories (non LME-traded) and has not been further processed, as described later in this appendix. These trade flows from China were identified largely through articles in industry press and input from industry representatives, and were cross-checked by examining the trade data.

Much of the concern expressed by U.S. industry (see the Industry Concerns section of this appendix) about third-country trade flows has focused on aluminum extrusions (such as bars, rods, and profiles). Extrusions are a subset of wrought aluminum products and are classified under heading 7604 of the Harmonized System (HS).[1171] In particular, the U.S. industry's concern has centered on products termed "remelt semis." Remelt semis are unwrought aluminum products that are minimally manufactured to appear as wrought products (e.g.,

[1168] See appendix A for the Committee's request letter.

[1169] LME-traded products are high-grade unalloyed or alloyed unwrought aluminum sent to authorized local warehouse sites for storage before contract delivery. They are classified in heading 7601 of the global Harmonized Commodity Description and Coding System (HS), which covers traded goods for tariff purposes. Aluminum enters LME warehouses as ingots and other primary forms and leaves in those same forms, without further processing. For more information on the LME warehouse system, see box 1.2 in chapter 1.

[1170] Unwrought aluminum has traditionally been exported in large volumes to countries for conversion into wrought products. In many cases, the wrought products are then exported. This traditional type of aluminum trade flow was considered to be outside the scope of "trade flows through third countries."

[1171] USITC, hearing transcript, September 29, 2017, 28–29 (testimony of Garney B. Scott III, Scepter Industries and Aluminum Association); industry representatives, interviews by USITC staff, Nanning, China, October 27, 2016; Clemence, "Illicit Trade in China's Semis Is a Full-Blown Problem," December 16, 2015.

extrusions).[1172] However, remelt semis do not have the alloy content required for many end uses, and purchasers must melt them down to start over with the manufacture of new unwrought products. Spikes in Chinese exports of bars, rods, and profiles to countries with relatively modest domestic demand for extrusions (in particular, Mexico, Malaysia, and Vietnam) have drawn particular attention. Given the focus on extrusion exports from China, the remainder of this appendix will principally examine trade in the goods covered by HS 7604.[1173]

Likely Size of Third-country Trade

As outlined below, trade data appear to confirm that most of the third-country trade from China in 2011–15 was in the form of goods classified as extrusions (HS 7604) and originated from bonded warehouses in China. Chinese exports of extrusions (HS 7604) from bonded warehouses to Mexico, Malaysia, and Vietnam totaled nearly 1.4 million mt during 2011–15 (table J.1). This total roughly corresponds to various industry analysts' estimates of stockpiled Chinese aluminum products in those countries.[1174] In 2015, global primary aluminum production (and consumption) was roughly 57 million mt and global stocks were about 14 million mt. Inventories of 1.4 million mt of Chinese aluminum would therefore equate to roughly 2–3 percent of global production and about10 percent of global stocks.

[1172] USITC, hearing transcript, September 29, 2017, 28–29 (testimony of Garney B. Scott III, Scepter Industries and Aluminum Association).
[1173] There are allegations of circumvention and misclassification related to other aluminum products, such as sheets, strip and plates (HS 7606) as well as coil and pallets (HS 7606 and HS 7616, respectively). For example, the Aluminum Association alleges that coil entering the United States under HS 7606 is commonly misclassified as wrought, when it is actually is primary unwrought metal (HS 7601) and should be classified as such. Metal Miner, "Reclassification an Answer for Fake Chinese Aluminum Semis?" August 17, 2016; Williams, "Overcapacity in Chinese Rolled Product Sector," January 14, 2016.
At the time this report was being written, U.S. industry representatives asserted that misclassified coil and pallets had been sent directly to the United States rather than through third countries. As noted above, aluminum coil is classified under HS 7606 (plates, sheets, and strip exceeding 0.2 mm) and aluminum pallets are classified under HS 7616 (other articles of aluminum). USITC, HTS, "Chapter 76: Aluminum and Articles Thereof," 2017; USCBP, CROSS, "The Tariff Classification of Metal Pallets from Mexico," May 19, 1994.
[1174] USITC, hearing transcript, September 29, 2017, 219–20 (testimony of Jorge Vazquez, Harbor Aluminum); Patterson, Miller, and Yap, "Chinese Billionaire Linked to Giant Aluminum Stockpile," September 9, 2016; industry representative, interview by USITC staff, October 27, 2016; industry representative, telephone interview by USITC staff, November 14, 2016.

Table J.1: Third-country trade: Volume of trade flows of aluminum bars, rods, and profiles (HS 7604) compared to volume of global production of unwrought aluminum and extrusions, 2010–15 (thousand mt)

Attribute	2011	2012	2013	2014	2015	Total
Exports from China to Mexico, Malaysia, and Vietnam	338	331	43	211	467	1,389
Global primary production	46,042	47,945	50,616	54,206	57,167	215,978
Global extrusions production	20,818	22,566	24,455	26,022	26,931	120,792
Global stocks of primary aluminum	12,671	13,297	13,599	13,589	14,200	(a)

Source: CRU Group; IHS Markit, GTA database (accessed November 16, 2016).
[a] Annual inventory levels include aluminum accumulated from previous years and not yet sold into consumption. As a result, a cumulative total that adds each of the annual totals is not meaningful and is not presented here.

Exports and Trade Flows of Aluminum Bars, Rods, and Profiles from China

Chinese exports of potential remelt semis appear to have been shipped from bonded warehouses in China. Chinese exports from bonded warehouses of all wrought products (including extrusions—HS 7604) rose from 361,000 mt in 2011 to 558,000 mt in 2015 before declining to 345,000 mt in 2016 (table J.2); however, it is unlikely that all of these exports were remelt semis. Over the six years from 2011 to 2016, the main destinations for wrought product exports from China shifted from Mexico to Malaysia and Vietnam, and then almost entirely to Vietnam.

Table J.2: Third-country trade: Chinese exports of all wrought products (HS 7604–7608) from bonded warehouses (thousand mt)

Export mode or country destination	2011	2012	2013	2014	2015	2016
Exports by mode						
Inbound/outbound goods in bonded warehouses	277	291	287	374	466	277
Storage and transit goods in bonded warehouses	84	177	168	132	92	68
Total, bonded warehouses	361	468	456	507	558	345
Exports by destination						
Vietnam	2	129	263	251	519	337
Malaysia	(a)	(a)	64	213	30	1
Mexico	341	330	43	1	1	(a)
All other	18	9	85	42	8	7
Total	361	468	456	507	558	345

Source: IHS Markit, GTA database (accessed February 23, 2017).
[a] Less than 500 mt.

Of China's total exports labeled as wrought products that were shipped from bonded warehouses during 2011–15, roughly 60 percent were classified as extrusions (HS 7604). Chinese exports of goods labeled as bars, rods, and profiles in HS 7604 from bonded warehouses to the United States, Malaysia, Mexico, and Vietnam reached a total of about 1.4 million mt during 2011–15 (table J.3). Again, this total is roughly consistent with various industry analysts' estimates of stockpiled Chinese aluminum products in Mexico, Malaysia, and Vietnam.

Table J.3: Third-country trade: China's exports of aluminum bars, rods, and profiles (HS 7604) from bonded warehouses, 2011–15 (mt)

Country	2011	2012	2013	2014	2015	Five-year total
United States	902	3,558	3,441	4,734	340	12,975
Mexico	338,108	329,917	42,645	780	984	712,434
Malaysia	19	39	5	175,837	24,406	200,306
Vietnam	8	718	796	34,060	441,158	476,740
Total	339,037	334,232	46,887	215,411	466,889	1,402,456

Source: IHS Markit, GTA database (accessed November 16, 2016).

There is an industry consensus that one company in particular, China Zhongwang, has been affiliated with flows of product classified under HS 7604 from China to third countries.[1175] Zhongwang's chairman has denied allegations of transshipment[1176] and noted that China Zhongwang does not have a manufacturing base outside of China (which would presumably prevent the company from remelting and further processing its own aluminum abroad).[1177] Nevertheless, in 2015 the largest exporter of these products from bonded warehouses in China to Vietnam was a trading company that primarily traded products from Liaoning Zhongwang Group Co.,[1178] a subsidiary of China Zhongwang.[1179] The trading company accounted for 53 percent of China's 2015 exports to Vietnam from bonded warehouses of goods classified under HS 7604.21.00 (hollow profiles of aluminum alloys) and 7604.29.90 (aluminum alloys other than hollow profiles, bars, and rods)[1180] and 97 percent of China's 2015 exports of products in these subheadings from bonded warehouses to Malaysia.[1181]

[1175] Patterson, Miller, and Yap, "Chinese Billionaire Linked to Giant Aluminum Stockpile," September 9, 2016; industry representative, interview by USITC staff, October 27, 2016; industry representative, telephone interview by USITC staff, November 14, 2016.
[1176] Patterson, Miller, and Yap, "Chinese Billionaire Linked to Giant Aluminum Stockpile," September 9, 2016.
[1177] Jun, "Nonferrous Industry Body Refutes Claim," September 12, 2016.
[1178] ETCN, China customs data, January 6, 2017; AEC, "Yingkou Qianxiang Trade Co. Ltd.," March 12, 2015.
[1179] Ritchie, Martin and Rogers, Jason, "China Zhongwang Bids to Improve Valuation With Shanghai Listing," *Bloomberg,* March 22, 2016.
[1180] These are the two main Chinese tariff lines within HS 7604 for exports from bonded warehouses. ETCN, China customs data (accessed January 6, 2017).
[1181] ETCN, China customs data, January 6, 2017.

As Mexico and Vietnam received the large majority of these trade flows, each of these countries is discussed in detail below.

Trade Flows to and from Mexico

Mexico was the initial destination for Chinese exports of products that potentially included remelt semis during 2011–15. Mexican imports of goods classified as extrusions under HS 7604 jumped from 87,269 mt in 2010 to 391,277 mt in 2011 and 450,918 mt in 2012, before easing back down to 87,845 mt in 2015 (table J.4). The vast majority of the imports in 2011 and 2012 were from China. The 2011–12 import totals were extremely high for Mexico, with the 2012 total more than double the country's apparent consumption in 2010. During 2010–15, Mexico's export levels ranged from only 14,274 mt to 29,243 mt, suggesting that the vast majority of the imported material stayed in Mexico during that period. However, in 2016, Mexico began exporting large quantities of aluminum extrusions under HS 7604 to Vietnam (table J.5).

Table J.4: Third-country trade: Mexican aluminum extrusions (HS 7604): production and trade, 2010–15 (mt)

Item	2010	2011	2012	2013	2014	2015
Production	123,495	133,491	161,427	171,550	209,964	205,505
Total imports	87,269	391,277	450,918	169,627	110,647	87,845
From China	17,550	321,100	353,401	64,805	7,592	9,433
Total exports	9,426	14,274	17,610	21,159	29,243	28,323
To the United States	8,987	13,447	16,379	19,570	27,033	25,427

Source: CRU Group; IHS Markit, GTA database (accessed November 16, 2016).
Note: Mexico has a number of aluminum imports recorded in unlabeled units. These imports are not included in these data.

Table J.5: Third-country trade: Mexican exports to Vietnam of aluminum bars, rods, and profiles (HS 7604), 2016

Commodity	Description	Value ($)	Quantity (mt)
7604	Aluminum bars, rods, and profiles	815,042,369	497,087
760421	Aluminum alloy hollow profiles	151,608,245	91,885
760429	Aluminum alloy bars, rods, and non-hollow profiles	663,434,074	405,202

Source: IHS Markit, GTA database (accessed November 16, 2016).

Mexico has a much smaller aluminum extrusions industry than the United States. In 2015, Mexico produced 205,505 mt of extrusions, up from 133,491 mt in 2011. If the goods imported from China were remelted to be used as inputs to the Mexican extrusion industry, they would far outstrip the needs of the industry.

Ostensibly, the Mexican company Aluminicaste stockpiled aluminum products in Mexico before ultimately shipping the products to Vietnam.[1182] Aluminicaste has produced billet, slab, and forging billet in Mexico since 2012; however, the company does not list any extrusion facilities on its website.[1183] Trade data appear to show these products being shipped from Mexico to Vietnam (after several years in Mexico), possibly without any processing having taken place in Mexico. Aluminicaste, for example, shipped close to 500,000 mt under HS 7604 from Mexico to Vietnam in 2016.[1184]

Trade Flows to and from Vietnam

Vietnam appears to be the main export destination for products that potentially include remelt semis, both in terms of direct exports from China and exports of products that were warehoused in Mexico. Vietnamese imports under HS 7604 grew sharply during 2011–15, from less than 20,000 mt annually during 2011–13 to 53,388 mt in 2014 and 494,306 mt in 2015. China supplied roughly 80 percent of the imports in 2015. Vietnam’s exports rose—also markedly, but still to very modest levels—during 2011–15, growing from 9,000 mt to 25,000 mt. Evidently, the vast majority of the imported product was either consumed in Vietnam or placed in inventories there.

Vietnam has a competitive small to medium-sized extrusions industry supported by foreign investment. In 2015, Vietnam's production capacity for aluminum extrusions was between 103,800 and 330,500 mt per year.[1185] Vietnamese production of aluminum extrusions increased from 2014 to 2015 by 24 percent, from 59,548 mt to 73,960 mt (table J.6).[1186]

[1182] Patterson, Miller, and Yap, “Chinese Billionaire Linked to Giant Aluminum Stockpile in Mexican Desert,” September 9, 2016.
[1183] Aluminicaste website, http://www.aluminicaste.com/en.html (accessed December 9, 2016).
[1184] Trade Data Services, Import Genius database (accessed April 25, 2017). Mexican trade data listed 528,000 mt of exports of 7604 as returned goods (retorno de mercancias) to Vietnam during a period covering March–September 2016, which is another indication that further processing did not occur in Mexico. Trade data also indicated that these exports entered Mexico under the IMMEX decree (Decree for the Promotion of the Manufacturing, Maquila and Export Service Industry), which allows temporary importation of inputs for processing or servicing, “free of general import tax, value added tax and, where appropriate, countervailing duties.”
[1185] Clemence, “New Numbers Show China’s Continuing Trade,” April 6, 2016; *Metal Bulletin*, "Aluminum Grows in Southeast Asia,” September 2016, 36.
[1186] Clemence, “New Numbers Show China’s Continuing Trade,” April 6, 2016.

Table J.6: Third-country trade: Vietnamese aluminum extrusions (HS 7604): production and trade, 2010–15 (mt)

Item	2011	2012	2013	2014	2015
Production	(a)	(a)	(a)	59,548	73,960
Total imports	12,219	13,951	13,805	53,388	494,306
From China	5,352	6,103	6,529	40,053	463,089
Total exports	8,950	12,519	17,171	15,507	25,463
To United States	244	792	1,846	3,706	9,029

Source: Clemence, “New Numbers Show China’s Continuing Trade,” April 6, 2016; IHS Markit, GTA database (accessed November 16, 2016).
Note: "Mirror data" are used for imports and exports. For Vietnamese imports, mirror data would be the supplying countries' exports to Vietnam. For Vietnamese exports, mirror data would be the importing countries' imports from Vietnam. Mirror data are used due to the lack of complete Vietnamese trade data.
[a] Data not available.

As of 2016, the largest extruder in Vietnam was the Australian-owned Global Vietnam Aluminum Co. Ltd. (GVA). In 2016, GVA reported an annual production capacity of 100,000 mt of extrusions; in addition, it also has the ability to produce 200,000 mt of billets per year. GVA does not serve Vietnam’s domestic extrusions market and operates under an export-only manufacturing license.[1187] Other large extrusion companies include Yng Hua Vietnam Co., Ltd, and Tung Kuang Industrial Joint Stock Co,[1188] while Sapa Ben Thanh Group is a small-scale extruder that specializes in high-end construction applications.[1189]

In 2015, according to transaction-level data, GVA imported 486,000 mt of product classified under HS 7604.21 and 7604.29 into Vietnam from China; this total roughly corresponds to exports under the same HS 6-digit classifications from Chinese bonded warehouses to Vietnam (table J.3). GVA’s imports from China in 2015 entered at an average unit value (AUV) of $1.78 per kilogram (kg), substantially lower than the Chinese export value for these same products.[1190] Then, from May 2015 through October 2016, GVA shipped a small volume of 6000 series alloyed aluminum extrusions to the United States.[1191]

[1187] Clemence, “New Numbers Show China’s Continuing Trade,” April 6, 2016; *Metal Bulletin*, "Aluminum Grows in Southeast Asia,” September 2016, 36.
[1188] *Metal Bulletin*, "Aluminum Grows in Southeast Asia,” September 2016, 36.
[1189] Clemence, “New Numbers Show China’s Continuing Trade,” April 6, 2016; *Metal Bulletin*, "Aluminum Grows in Southeast Asia,” September 2016, 36.
[1190] Goods typically enter Vietnam under one of two types of import filings: raw materials imported for processing or goods imported for storage in bonded warehouses. The listed exporter is “Global Tower Worldwide,” a Singapore-based company (though the products originated in China). Datamyne, Datamyne database (accessed December 19, 2016).
[1191] This figure may include products other than aluminum extrusions. Trade Data Services, Import Genius database, data sorted for Vietnam as country of origin, Global Vietnam as shipper, and removed aluminum billet 6063 (accessed November 16, 2016).

GVA also purportedly remelted semis into primary billets (classified under 7601) and exported them to Brazil in 2015–16.[1192] This was a new trade flow: from 2011 to 2014, Brazil did not receive any imports under HS 7601 from Vietnam.[1193] In 2015, 25 mt of 6063 series alloyed billet arrived in Brazil from Vietnam, while another 2,045 mt arrived in 2016. The AUV of these 2015 imports was $1.88 per kg, and the AUV for 2016 imports was $1.66 per kg.[1194] That is, the upstream billet from Vietnam had a higher AUV than for the downstream extrusion from China. Typically, it would be the reverse, lending support to the possibility that the alleged Chinese extrusions were in reality remelt semis used as an input to making the aluminum billet. In addition, in 2016, GVA shipped a small amount of 6063 series alloyed billet from Vietnam to the United States and from Vietnam to India.[1195] Given the small amount of exports of extrusions and billet shipped by GVA, it appears that, for now, the vast majority of the trade flows of aluminum extrusions from China to Vietnam remain in Vietnamese stockpiles.

Industry representatives in Vietnam have confirmed that the annual throughput volume for aluminum bars at Long Binh, the site of Saigon Newport Corp's bonded warehouse, has increased rapidly in a short time, growing from approximately 68,000 mt in 2015 to 316,000 mt by October 2016.[1196] Reportedly, nearly all of the imports of aluminum bars that arrived at Long Binh in 2016 were from China (about 70 percent, an established supplier country) and Mexico (roughly 30 percent, a new supplier).[1197] Industry representatives have noted that Vietnam has lower storage rates for bonded warehouses than other countries, which might make Vietnam an attractive warehouse destination.[1198]

Industry Concerns

Reports of large spikes of aluminum exports from China to third countries have led to considerable discussion among U.S. and global industry representatives about the products' classification, the incentives of the Chinese exporters, and the current status of the shipments. The U.S. aluminum industry has stated that trade flows through third countries for further processing and subsequent export may be associated with exports originating from China that could be circumventing Chinese export rules or certain U.S. antidumping (AD) or countervailing

[1192] Clemence, "New Numbers Show China's Continuing Trade," April 6, 2016.
[1193] IHS Markit, GTA database (accessed November 16, 2016).
[1194] Datamyne, Datamyne database (accessed November 8, 2016).
[1195] Trade Data Services, Import Genius database (accessed November 16, 2016).
[1196] Industry representative, interview by USITC staff, Ho Chi Minh City, Vietnam, October 19, 2016.
[1197] Ibid.
[1198] Ibid.

duty (CVD) orders.[1199] In particular, U.S. industry representatives have asserted that certain Chinese exporters may be purposefully misclassifying exports of unwrought aluminum (HS 7601) as extrusions (HS 7604), a form of wrought aluminum, to avoid Chinese export restraints.

As noted by industry representatives, there would seem to be financial incentives for Chinese exporters to misclassify primary aluminum (HS 7601) exports as extrusions (HS 7604).[1200] First, the Chinese government imposes a 15 percent tariff on exports of most forms of primary aluminum (HS 7601) but does not impose tariffs on many exports of extrusions (HS 7604). Second, exports of certain wrought products are eligible to receive up to a 13 percent rebate from the Chinese government on any value-added tax (VAT) paid; this rebate is not available for exports of primary aluminum, which are subject to the full 17 percent VAT.[1201] This means that exports under HS 7601 have a tax burden as high as 32 percent, while exports under HS 7604 have a tax burden as low as 4 percent.[1202] Another representative stated that the export tariff and VAT rebates incentivize the production of legitimate wrought products (for customs purposes) intended for eventual remelting.[1203]

None of the U.S. industry sources can confirm that the Chinese exports under HS 7604 are remelt semis. However, one source stated that based on available photos of the stocks of Chinese material in Vietnam, the products appear to be useful only for remelting. Moreover, a

---

[1199] With respect to circumvention of U.S. AD or CVD orders, the Aluminum Extruders Council filed a petition in October 2015 with the U.S. Commerce Department (USDOC) for a joint Scope Clarification and Anti-Circumvention Inquiry against China Zhongwang Holdings Ltd. The petition asserted that the company (1) welded fake extrusions together and imported them as products that resemble “aluminum pallets” and (2) imported 5xxx alloys to circumvent the U.S. AD order on aluminum extrusions. In November 2016, USDOC preliminarily determined that China Zhongwang had used heat-treated 5050 alloy aluminum extrusions to avoid duties. These products could be exported to the United States directly or via a third country.

[1200] USITC, hearing transcript, September 29, 2017, 35–36 (testimony of Tim Reyes, Alcoa Cast Products); industry representatives, interview by USITC staff, July 21, 2016.

[1201] Home, “Alcoa Shines a Light on China’s 'Fake Semis' Trade,” July 13, 2015; industry representative, presentation to USITC staff, September 27, 2016, slide 29. These products and rebates are as follows: aluminum alloy profiles, 13 percent (HS 7604.21); aluminum alloy plates, sheets, and strips, 13 percent (HS 7606); aluminum foil, 15 percent (HS 7607).

[1202] The incentives for exporting remelt semis reportedly changed over time for certain HS categories as Chinese policies changed. For example, in 2008, Chinese authorities noticed that exports of primary metal were apparently misclassified under HS 7604.29 (aluminum alloy bars, rods and nonhollow profiles), and China responded by removing the VAT rebate and adding a 5–15 percent export tariff on HS 7604.2910 (the tariff varies depending on the cross-sectional perimeter of the product). A 15 percent export tax was also applied to exports of goods under HS 7604.1010 (bars, rods and profiles, not alloyed), and the VAT rebate was removed. However, in 2015, China subsequently announced it would remove the 5–15 percent export tariff on HS 7604.29, as well as the 15 percent export tariff on HS 7604.1010. Industry representative, presentation with USITC staff, September 27, 2016, slide 29; Cang and Ritchie, “China’s Aluminum Set to Worsen Glut,” April 23, 2015.

[1203] Industry representative, telephone interview by USITC staff, November 14, 2016.

consultant to the aluminum industry testified at the Commission's hearing that his firm's intelligence suggests the products are "P1020 semis," i.e., semis destined for remelt.

Meanwhile, however, the Chinese Nonferrous Metals Industry Association (CNIA) states that the transshipment and remelt scenarios are not likely. In particular, CNIA asserts that if a Chinese company shipped product to Mexico it would be unable to gain a certificate of origin from Mexico.[1204] Without such a certificate of Mexican origin, the products likely would still be considered of Chinese origin and therefore subject to U.S. AD and CVD orders.

Despite their concerns, industry representatives largely concur that most of the product (likely remelt semis) has remained in stockpiles and has not yet entered consumption chains. However, some representatives have asserted that the stockpiled Chinese aluminum has put downward pressure on global aluminum prices or that they are wary of the possible impact of the stockpiles once the aluminum is released into consumption chains.[1205]

[1204] Jun, "Nonferrous Industry Body Refutes Claim," September 12, 2016.

[1205] See, e.g., public statements of Klaus Kleinfeld, CEO of Alcoa, about the impact of remelt semis on global aluminum prices. Deux, "Aluminum Is a Poor Man's Steel," August 4, 2016; Aluminium Insider, "Evidence Points to Much Larger Fake Semi Trade," October 21, 2016; industry representative, interview by USITC staff, October 27, 2016; industry representative, telephone interview by USITC staff, November 14, 2016.

Bibliography

Aluminium Insider. "Evidence Points to Much Larger Fake Semi Trade Relocating to Vietnam," October 21, 2016. http://aluminiuminsider.com/exclusive-evidence-points-to-much-larger-fake-semi-trade-relocating-to-vietnam.

Aluminum Extruders Council (AEC). "AEC Files Scope Clarification and Circumvention Case against China Zhongwang Holdings Ltd." News release, October 23, 2015. http://www.aec.org/?page=2015_ZhongwangCase.

Aluminum Extruders Council (AEC). "Yingkou Qianxiang Trade Co. Ltd., Experian/Sinotrust Business Credit Report," March 12, 2015. http://www.aec.org/.

Cang, Alfred, and Martin Ritchie. "China's Aluminum Set to Worsen Glut as Export Taxes Removed." Bloomberg News, April 23, 2015. http://www.bloomberg.com/news/articles/2015-04-23/china-aluminum-supply-set-to-worsen-glut-as-export-taxes-removed.

Clemence, Christopher. "Illicit Trade in China's Semis Is a Full-Blown Problem." Aluminium Insider, December 16, 2015. http://aluminiuminsider.com/illicit-trade-in-chinas-semis-is-a-full-blown-problem.

———. "New Numbers Show China's Continuing Trade in Fake Semis." Aluminium Insider, April 6, 2016. http://aluminiuminsider.com/exclusive-new-numbers-show-chinas-continuing-trade-in-fake-semis.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Datamyne Inc. Datamyne database. http://www.datamyne.com/ (accessed various dates).

Deux, Joe. "Aluminum Is a Poor Man's Steel When It Comes to Fighting China." Bloomberg News, August 4, 2016. http://www.bloomberg.com/news/articles/2016-08-04/aluminum-is-a-poor-man-s-steel-when-it-comes-to-fighting-china.

ETCN. China Customs data. Excel dataset, January 6, 2017.

Government of Mexico. Secretaría de Economía (SE). "IMMEX, Manufacturing, Maquila and Export Services Industry." Mexico City, Mexico: Ministry of the Economy, 2010. http://www.2006-2012.economia.gob.mx/industry/foreign-trade-instruments/immex.

Home, Andy. “Alcoa Shines a Light on China’s ‘Fake Semis’ Trade.” Reuters, July 13, 2015. http://www.reuters.com/article/us-china-aluminium-ahome-idUSKCN0PO03C20150714.

IHS Markit. Global Trade Atlas (GTA) database. https://www.ihs.com/products/maritime-global-trade-atlas.html (accessed various dates).

Jun, Xie. “Nonferrous Industry Body Refutes Claim That Chinese Company Is Evading US Tariffs.” *Global Times.* U.S. Edition, September 12, 2016. http://www.globaltimes.cn/content/1006123.shtml.

Metal Bulletin. "Aluminum Grows in Southeast Asia,” September 2016, 36. http://www.metalbulletin.com/events/download.ashx/document/speaker/6588/a0ID000000X0jhIMAR/Presentation.

MetalMiner. “Reclassification an Answer for Fake Chinese Aluminum Semis?” August 17, 2016. http://agmetalminer.com/2016/08/17/reclassification-an-answer-for-fake-chinese-aluminum-semis.

Patterson, Scott, Biman Mukherji, and Vu Trong Khanh. ”Giant Aluminum Stockpile Was Shipped From Mexico to Vietnam.” *Wall Street Journal*, December 1, 2016. https://www.wsj.com/articles/giant-aluminum-stockpile-was-shipped-from-mexico-to-vietnam-1480588228.

Patterson, Scott, John W. Miller, and Chuin-Wei Yap. “Chinese Billionaire Linked to Giant Aluminum Stockpile in Mexican Desert.” *Wall Street Journal*, September 9, 2016. http://www.wsj.com/articles/chinese-billionaire-linked-to-giant-aluminum-stockpile-in-mexican-desert-1473356054.

Ritchie, Martin and Rogers, Jason, “China Zhongwang Bids to Improve Valuation With Shanghai Listing," *Bloomberg News,* March 22, 2016. https://www.bloomberg.com/news/articles/2016-03-23/zhongwang-seeks-shanghai-listing-via-asset-swap-with-realtor.

Trade Data Services. Import Genius database. https://app.importgenius.com (accessed various dates).

U.S. Customs and Border Protection (USCBP). Customs Rulings Online Search System (CROSS). “The Tariff Classification of Metal Pallets from Mexico.” Ruling Letter NY 897469. New York, NY: USCBP, May 19, 1994. https://rulings.cbp.gov/index.asp?ru=897469&qu=aluminum+pallets&vw=detail.

U.S. International Trade Commission (USITC). *Harmonized Tariff Schedule of the United States* (HTSUS), *2017 Basic Edition*. Washington, DC: USITC, February 2017. https://hts.usitc.gov/current.

U.S. International Trade Commission (USITC). Hearing transcript in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, September 29, 2016.

Williams, Paul. “Overcapacity in Chinese Rolled Products Sector Increases Focus on Exports,” CRU Group, January 14, 2016.

Appendix K
Technical Appendix to the Quantitative Assessment of the Impact of Certain Foreign Government Policies

Introduction

This appendix provides additional details on the **aluminum model** described in chapter 10. Developed by the U.S. International Trade Commission (Commission or USITC), this model improves upon the standard Global Trade Analysis Project (GTAP) model in two ways: it adds three new aluminum-related sectors, and it adds aluminum policies. This appendix describes how these improvements were made and discusses several other features of the model. It covers the following topics: (1) adding the three aluminum sectors, (2) adding government policies, (3) notable model limitations, (4) lost wages of U.S. workers, (5) reporting the aggregate effect of all policies combined, (6) a comparison of model and survey results, (7) a list of regions and commodities in the model, (8) concordance tables, and (9) model software.

Adding the Three Aluminum Sectors

Version 9.0 of the GTAP database contains information on the world economy in 2011 for 140 regions and 57 traded commodities. This database has separate regions for each of the major aluminum-producing and -consuming countries. However, the GTAP sector Nonferrous Metals (NFM) combines all types of aluminum, as well as all other nonferrous metals, into a single commodity.[1206] This means that for an analysis of world aluminum trade, the GTAP database is sufficiently disaggregated in terms of regions, but not sectors.[1207]

The Commission improved the standard GTAP model's ability to model aluminum by disaggregating NFM into four new sectors:[1208] primary unwrought aluminum, secondary unwrought aluminum, wrought aluminum, and other nonferrous metals (called "remainder NFM").[1209] This extension required the creation of four matrices describing the use, cost, cross-use, and trade of aluminum.

The rest of this section is organized into seven subsections. Two subsections cover data generation for domestic production and domestic price, both of which are relevant to multiple matrices. Four related subsections follow—one for each of the four matrices. A final subsection discusses remainder NFM.

[1206] See Carrico, Jones, and Tsigas, "Disaggregate U.S. Labor Statistics for the USAGE 2.0 and GTAP CGE Models," October 2012, 19.
[1207] In the GTAP framework, each industry produces one commodity (good or service). The terms "sector," "commodity," and "industry" all refer to the same economic division within the model.
[1208] This is accomplished by using the GTAP utility SplitCom. SplitCom is able to split a commodity/industry/sector in the GTAP database into two or more new commodities/industries/sectors.
[1209] Note that remainder NFM contains several aluminum-related commodities: bauxite, alumina, and non-wrought aluminum commodities such as aluminum powders.

Domestic Price Data

Domestic prices for different aluminum commodities were assumed to be equal to the export price of that commodity in IHS Markit's Global Trade Atlas (GTA) database[1210] for 2011. See the section on the trade matrix for additional information.

Domestic Production Data

Aluminum production by country in 2011 comes from different sources, depending on the country and aluminum commodity. Note that production data are not available for some countries and therefore must be estimated. This subsection will discuss existing data first, and then estimation.

Primary Unwrought and Wrought Production Data

For almost all countries, primary unwrought and wrought aluminum production data for 2011 were compiled by the CRU Group under contract by the Commission. These data, however, used different regional aggregations for primary aluminum and wrought aluminum. The Commission therefore mapped the CRU Group's primary aluminum regions to the Commission aluminum model's regions using the concordance in table K.12, and mapped the CRU Group's wrought aluminum regions to the Commission aluminum model's regions using the concordance in table K.13. Note, however, that these are not perfect concordances. For example, consider the "Rest of Western Europe" and "Rest of Eastern Europe ex. Russia" regions in the CRU Group database. These regions include some countries that are in the European Union (EU), and others that are outside it. The decision was made to map all these countries to the EU.

For Taiwan and Norway, wrought production data were not taken from the CRU Group database. For Taiwan, 2011 wrought production figures were taken from World Bureau of Metal Statistics (WBMS) data.[1211] Norwegian wrought production was calculated by summing the wrought production capacity listed on the websites of the country's four mills and

---

[1210] The GTA database from IHS Markit is available at https://www.ihs.com/products/maritime-global-trade-atlas.html.
[1211] WBMS, "Aluminum, Global Production, Consumption, and Trade, 2006–15," 2016.

multiplying by the average capacity utilization of Western Europe in 2011.[1212] Western European average capacity utilization was taken from the data specifically compiled by the CRU Group for the Commission.

Secondary Production Data

Like the data for primary and wrought aluminum, the data for secondary unwrought aluminum production by country in 2011 come from different sources, depending on the country. For most countries, secondary production data for 2011 are those of the World Bureau of Metal Statistics (WBMS).[1213] For Oceania, it was assumed that Australia was 100 percent of Oceanian production of each aluminum commodity.

Secondary production data for China, Russia, and the Gulf Cooperation Council (GCC) countries come from different sources. Russian secondary production figures were taken from the World Trade Organization.[1214] Chinese secondary production data come from the China Non-ferrous Metals Industry Association.[1215]

GCC secondary production was more complex to calculate. Secondary aluminum consists of scrap and aluminum powders. *Gulf Industrial Bulletin* indicates that the region's powder production is 6,000 metric tons annually.[1216] Biswas (2016) indicates that the GCC countries only aluminum scrap recycling smelter is Saudi Arabia's Ma'aden smelter.[1217] However, this smelter does not appear to be producing: firms typically put out a press release when a smelter begins production, and the Commission could not find one for Ma'aden. Additionally, interviews with industry sources indicated that they were not aware that the smelter had started production. This leaves the Bahrain powder production as the only secondary production in the GCC countries.

[1212] Norsk Hydro ASA (Hydro), "Hydro Aluminium Rolled Products AS, Holmestrand," 2016,http://www.hydro.com/en/about-hydro/hydro-worldwide/norway/holmestrand/hydro-aluminium-rolled-products-as; Hydro, "Hydro Aluminium Rolled Products AS, Karmøy," 2016, http://www.hydro.com/en/about-hydro/hydro-worldwide/norway/karmoy/hydro-aluminium-rolled-products-as-karmoy; Sapa Group, " Sapa to Sell Raufoss Extrusion and Swedish Assets to SKA Invest," September 11, 2013, http://www.hydro.com/en/press-room/Archive/2013/Sapa-to-sell-Raufoss-extrusion-and-Swedish-assets-to-SKA-Invest/; Sapa Group, "Sapa Profiler Magnor," n.d. http://www.sapagroup.com/no/sapa-profiler-as/jj/pressverk-pa-magnor (accessed February 7, 2017).

[1213] WBMS, "Aluminum, Global Production, Consumption, and Trade, 2006–15," 2016.

[1214] WTO, *Trade Policy Review: Russian Federation*, August 24, 2016, 67.

[1215] CNIA, post-hearing brief to the USITC, October 17, 2016, exhibit 1, 20.

[1216] GOIC, "Development of Aluminum Industry in the GCC States," April 2006.

[1217] Biswas, "GCC Primary Producers Can Trigger the Growth," December 3, 2016.

Estimating Missing Production Data

Production data was not available for all aluminum industry sectors in all regions. However, a computable general equilibrium model such as the GTAP model requires production to be specified for all regions and sectors. To solve this problem, production data for missing countries and sectors were estimated using available data.

Known data were used to estimate values for missing data. In particular, the value of NFM production was available from the GTAP database for all regions in the pre-simulation values of the GTAP coefficient VOM.[1218] The value of known world production of primary, secondary, and wrought aluminum was calculated by multiplying the quantity of production in each country for which there were CRU Group data by the domestic price of that good in that country.[1219] The next step was to calculate the ratio of known primary, secondary, or wrought production in the world, to the world value of production of NFM.

These three ratios could then be used to calculate production in regions with missing data. For regions for which data on the production of a commodity (say, primary aluminum) were missing, it was assumed that production of primary aluminum was equal to the region's production of NFM times the world ratio of primary aluminum to NFM. This procedure was modified for missing data in South Korea and Taiwan, where the Japan ratio was used instead of the world ratio. See table K.1 for a summary of estimation regions used for each region-commodity pair with missing data.

Table K.1: Regions used to create production data for region-commodity pairs with missing production

	Region used to create production data		
Region missing production data	**Primary unwrought**	**Secondary unwrought**	**Wrought**
South Korea	Japan	Japan	Japan
Taiwan	Japan	Data not missing	Data not missing
Other Asia	World total	World total	World total
India	Data not missing	World total	World total
Latin America	World total	World total	World total
Middle East and North Africa	World total	World total	World total
Sub-Saharan Africa	World total	World total	World total
Rest of the world	World total	World total	World total

Source: Compiled by USITC staff.

[1218] For more information on the variables used in the GTAP model, see https://www.gtap.agecon.purdue.edu/models/setsVariables.asp.
[1219] Recall that the domestic price is equal to the trade-weighted average export price.

Cost Matrix

The cost matrix is a three-dimensional matrix that gives the expenditure on each commodity by each aluminum industry in each region. Several steps were taken to construct this matrix.

The process began with the U.S. Census Bureau's *Annual Survey of Manufacturers* (ASM).[1220] This survey has data on the inputs used to produce each aluminum commodity in the United States in 2011. However, the survey's output and input commodities use a different basis, compared both to each other and to the aluminum model. Therefore, the survey's output sectors were matched with the aluminum model's sectors, as shown in table K.14, and aggregated so that its data could be on the same sector basis as the aluminum model. Next, it was necessary to deal with the fact that the ASM does not list each of its output sectors' expenditures on every specific input, but only expenditures on broad input categories roughly corresponding to capital (K), labor (L), energy (E), materials (M), and services (S). Each commodity used by GTAP was matched to one of these input categories, as shown in table K.15.

Next the cost matrix was calculated. For each triplet of aluminum-producing sector, region, and input commodity, that element of the matrix is equal to the product of three terms divided by a fourth term. The three terms are (1) the production of that aluminum commodity in that region; (2) expenditures by NFM in that region that was spent on that GTAP commodity (taken from the baseline GTAP database); (3) the expenditure by that aluminum output sector on that ASM input category (capital, labor, energy, materials, or services); their product is divided by (4) the total expenditure by all aluminum output sectors on that ASM input category (capital, labor, energy, materials, or services).

Trade Matrix

The trade matrix is a three-dimensional matrix that gives trade flows by commodity, source region, and destination region. This matrix is constructed using information from several sources.

The GTA database provides information on bilateral imports and exports for each region in 2011.[1221] This dataset lists the prices, quantities, and values for trade between each pair of source and destination countries. The GTA sectors (on a Harmonized System 6-digit basis) and aluminum model sectors were matched using table K.16. Trade-weighted averages were used

[1220] Data are available from http://www2.census.gov/econ2011/AM/sector31/AM1131GS101.zip.
[1221] IHS Markit, GTA database.

to calculate import and export prices for the three aluminum commodities.[1222] The GTA database erroneously reports non-zero Canada-to-Canada bilateral trade, so this was set equal to zero.

However, note that table K.16 combines both primary and secondary unwrought aluminum into a single sector. As a result, the next step was to apportion trade data for unwrought aluminum between primary unwrought and secondary unwrought. However, exact data on this split were available only for country pairs in which China was the source country. For China, exact data on secondary exports was available from the GTA database under "exports by regime." It was calculated by combining “Process and assembling” and “Process with imported materials.”[1223] For all other country pairs, unwrought trade was apportioned between primary and secondary by assuming that the ratio of values of primary to secondary in exports was the same as their ratio in the value of production for the source country.

Use Matrix

The use matrix is a three-dimensional matrix that gives the use of each commodity, in each region, by each aggregate user (intermediates, households, government, and investment). Total use of each aluminum commodity in each region was assumed to be proportional to the production of the commodity in that region. The GTAP database gives the percentage of NFM used by each of the four aggregate users. Total use was then apportioned between each of the four users by assuming that for each aluminum commodity and region, the percentage of that commodity used by each user was the same as the percentage of NFM used by that user.

Cross-use Matrix

Cross-use is the use of aluminum commodities in the production of aluminum commodities. The cross-use matrix is a three-dimensional weight matrix that gives the use by each aluminum commodity (producer), of each aluminum commodity (input), in each region.

In general, the value of a cell in this matrix is equal to the value of production of the producing commodity in that region, times the value of production of the used commodity in that region. However, for certain pairs of commodities, the matrices’ cells are set equal to zero. It is assumed that primary unwrought aluminum uses no primary unwrought, secondary unwrought or wrought aluminum (only remainder NFM, which is where alumina is). Secondary unwrought uses primary unwrought, secondary unwrought, and remainder NFM, but not wrought.

[1222] For tariff purposes, tradable goods are classified using the global Harmonized System (HS), more fully known as the Harmonized Commodity Description and Coding System. HS codes may have from 2 to 6 digits; longer codes denote a more specific category.
[1223] See chapter 6 for more details on China's secondary exports and its relationship to processing trade.

Wrought uses primary unwrought, secondary unwrought, and wrought, but not remainder NFM. Remainder NFM uses wrought and remainder NFM but not primary or secondary unwrought.

Remainder Nonferrous Metals

The default GTAP sector of NFM contains not only the three aluminum commodities of interest, but other commodities as well. When the three aluminum commodities are removed, the remaining aluminum and non-aluminum commodities of NFM are put into the new sector "remainder NFM."

The values of variables for remainder NFM are equal to the difference between those variables in the original GTAP database and the sum of those variables for the aluminum commodities. So, for each region, production of remainder NFM is equal to the difference between the production of each aluminum commodity, and pre-simulation value of VOM NFM from the original GTAP database. Exports of remainder NFM for each source and destination region are the equal to the exports as calculated in the trade matrix section, minus pre-simulation VXMD NFM from the original GTAP database.[1224] However, this would set bilateral trade to less than zero for some regions and commodities. Instead, bilateral trade is set equal to zero in those cases.

Use of remainder NFM in each region is equal to the difference between the sum of the use of each of the aluminum commodities in that region and ROWB from the original GTAP database.[1225] For each producing industry in each region, its expenditure (the cost matrix) on remainder NFM is equal to the difference between its expenditure on NFM in the original GTAP matrix (COLB) and its expenditure on each of the three new aluminum commodities.[1226] The cross-use matrix for remainder NFM is not a remainder, but is calculated in exactly the same way as it is for the other aluminum industries.

Adding Government Policies

Aluminum policies are represented in the model as various taxes and subsidies on the production or trade of aluminum commodities. This section describes the procedure for both calculating the ad valorem equivalent rates of the selected policies, and the procedure for adding those policies to the baseline.

[1224] For more information on the variables used in the GTAP model, see https://www.gtap.agecon.purdue.edu/models/setsVariables.asp.

[1225] ROWB is the name used by SplitCom.

[1226] COLB is the name used by SplitCom.

Calculating Ad Valorem Equivalent Rates

In the real world, aluminum policies contain many rules and features. However, the aluminum model is a system of equations, and thus the policy must be expressed numerically and incorporated in one of the model's equations. The approach used expresses the policy as an ad valorem equivalent (AVE), or percentage, tax or subsidy on the price of a good at a particular point in production or consumption within the model. For example, a tax on exports is expressed as a percentage increase in the export price of a good, while an input subsidy is represented by a percentage reduction in the price a producer pays for an input in the production process.

The following section describes how these AVE rates are calculated for each set of policies: the Chinese trade policies, the Chinese domestic policies, the GCC countries energy policies, and the Russian policies.[1227] Table K.2 summarize the AVE rates resulting from these procedures. AVE rates for both 2011 and 2015 are presented because the model uses both. In order to create the baseline—i.e., the 2011 world economy with no policies—the 2011 rates must be removed from the actual 2011 world economy. But then to estimate the impact of the 2015 policy rates, the 2015 rates are imposed.

Table K.2: Aluminum policy variables in the aluminum model and their average unit values (AVE)

	AVE rate (%)	
Policy	2011	2015
Chinese trade policies		
Tax on export of primary unwrought	30.9	29.5
Tax on export secondary unwrought	2.4	4.2
Tax on export of wrought	4.0	2.8
Chinese domestic policies		
Financial support for production of primary unwrought	0.2	3.8
Financial support for production of secondary unwrought	0.0	2.1
Financial support for production of wrought	8.5	9.6
Support for purchases of capital by primary unwrought	5.0	5.0
GCC countries' energy policies		
Financial support for purchases of natural gas by all aluminum	23.6	23.6
Financial support for purchases of electricity by all aluminum	25.2	25.2
Russian policies		
Tax on export of primary and secondary unwrought	0.3	0.3

Source: USITC staff calculations.

[1227] As discussed below, the Russian policies were omitted from the discussion in chapter 10 because of the small size of their effects.

Chinese Trade Policies

The three Chinese trade policies included in the model are export tariffs, the value-added tax (VAT), and the VAT rebate. The export tax used in the model is the net effect of these three policies. This tax rate was calculated as follows.

First, the rate for each tariff line was calculated. The Commission looked at each tariff line and calculated that line's export tax rate, which is equal to the export tariff rate (0 to 15 percent), plus the VAT rate on exports (17 percent), minus the VAT rebate rate (0 to 15 percent). Next, the export tax rate for a line was multiplied by the value of Chinese exports in that tariff line. This gave total export taxes "paid" for that tariff line. Note that this means for tariff lines with full rebate, the VAT is trade neutral (an export tax of zero) while for lines with no rebate, the VAT functions as a 17 percent export tax.[1228]

Next, the rate was calculated for each aluminum commodity (primary unwrought, secondary unwrought, and wrought). Export tariff lines were matched to commodities using table K.14. To get the total taxes paid for each commodity, the export taxes paid for all of the export tariff lines matched to that commodity were added up. The trade-weighted export tax for a commodity is equal to total export taxes paid for that commodity divided by the total value of all of its exports. This is the rate presented in table K.2.

Two adjustments were made to the calculations for particular tariff lines. In the case of secondary aluminum, its VAT and export tariff rates were set to zero for certain trade modes to account for customs and VAT benefits associated with "processing trade" (see the China chapter for details). In the case of wrought aluminum, remelt semis were excluded when calculating the average VAT rate for all of wrought, resulting in a lower estimated VAT rate on exports. This adjustment was made to ensure that there was not a penalty applied to these exports when, in fact, they may be receiving a benefit by being exported as wrought rather than primary and thereby avoiding the higher export duties on primary aluminum. See chapter 2 and appendix J for a detailed discussion of remelt semis.

Chinese Domestic Policies: Primary Unwrought

The model's production subsidy for primary unwrought is equal to the sum of the AVE rates for the electricity and direct support policies. The cost input subsidy for capital used in primary unwrought is equal to the AVE rate of the financing support.

[1228] Feldstein and Krugman theoretically showed that a destination-based VAT system with a complete export tax rebate has neutral effects on exports and imports, while Chandra and Long found empirical evidence for China that higher VAT rebates increase exports. Feldstein and Krugman, "VAT Rebates and Export Performance in China," 2013; Chandra and Long, "International Trade Effects of Value-added Tax," 1990.

The value of reduced electricity rates for primary aluminum producers was calculated in several steps. The calculation began with the publicly reported rate reductions agreed to or under negotiation in 2015,[1229] net of the higher rates that some inefficient smelters pay.[1230] The tax or subsidy rates for electricity at each smelter were applied to data on the electricity rates and production costs for each smelter in order to calculate the AVE tax or subsidy rate at each smelter, expressed as a percent of the smelter's total production costs.[1231] The subsidy rate for the entire industry was calculated by weighting each smelter's subsidy rate by its capacity. For policies that only existed during part of the year, the rate was used that applied during the time it existed.

The AVE rate for direct support for primary aluminum producers was calculated based on the actual amount of such support received. For firms where this information was available, direct support rate on a revenue basis was calculated by taking the amount of direct support and dividing by firm revenue.[1232] Direct support rate on a cost basis was calculated by dividing direct support by firm costs. The average of these two direct support rates was used as the AVE production subsidy rate from direct support for the entire industry.

There are limited data on government support for purchase of capital in China. The Commission assumed that the average government support for capital purchases in Chinese primary production is a result of the difference between benchmark loan rates and those paid by Chinese primary aluminum producers for which data were available. Their interest rates were lower than the People's Bank of China benchmark rate during 2011–15. The two interest rates were applied to the capital costs of an aluminum smelter, and the differences in the initial capital costs plus interest over the life of the aluminum smelter at the two different rates were calculated. The result showed a 5 percent lower cost of capital due to the lower interest rates.[1233]

[1229] Data on electricity rates are compiled from reports by the media and consulting firms. See, for example, Yam, "China Aluminum Smelters," November 6, 2015; Zhou, "China Aluminum Smelters' Power," December 25, 2015.
[1230] According to one estimate, about 1.7 million tons of primary aluminum smelting capacity would fall into the category that would need to pay higher rates, although some smelters would be able to reduce electricity use such that the total amount of capacity subject to the higher rates would ultimately be less than 1 million tons. Yam, "China's Extra Power," January 8, 2014.
[1231] Note that this means that although the policy is really government assistance to lower an input cost, we express it as an equivalent production subsidy.
[1232] Compiled from financial reports of various publicly traded Chinese primary aluminum companies and company-level production cost information.
[1233] People's Bank of China interest rates are from the Investing.com website, http://www.investing.com/economic-calendar/pboc-interest-rate-decision-1083 (accessed December 30, 2016). Financing cost data are compiled from financial reports of various publicly traded Chinese primary aluminum companies and company-level production cost information.

Chinese Domestic Policies: Secondary Unwrought

The rate of the production subsidy for secondary unwrought is equal to the AVE of the secondary VAT refund policy. Note that despite the similar name, this VAT policy is distinct from the export VAT issue. This policy's AVE was calculated using estimates from the China Nonferrous Metals Industry Association Recycling Metal Branch of the value of this policy for secondary aluminum producers.[1234] This policy was only in effect for part of 2015, and the AVE rate used is the one that applied during the time it was in effect.

Chinese Domestic Policies: Wrought

Wrought subsidy rates for the model were based on the countervailing duty subsidy rates calculated as part of antidumping orcountervailing duty investigations in Australia, Canada, and the United States.[1235] Rates for 2011 were equal to the average of rates calculated in the initial investigations, and rates for 2015 were equal to the average rates calculated in reviews in Australia and the United States, as Canada did not update its rates. All of these rates were specifically for aluminum extrusions, but, in the absence of rate calculations for rolled products, they were applied across the entire wrought aluminum industry.

GCC Countries Energy Policies

As discussed in chapter 7, some GCC countries governments maintain programs to lower electricity or natural gas prices paid by their industry. AVE rates for these policies were calculated as follows. Average electricity prices for each country in 2015 were taken from an International Monetary Fund (IMF) study.[1236] The subsidy rate was calculated on a dollar-per-kilowatt-hour ($ per kilowatt-hour) basis by assuming that the United Arab Emirates (UAE) provided no electricity support and assuming that all differences in electricity prices between a country and the UAE prices are due to the government support. From this it was possible to calculate the subsidy in each country. Then, the average electricity subsidy of the GCC countries was calculated, by weighting each country by its primary aluminum production. This yielded the GCC countries average subsidy rate on a $ per kWh basis. This was then turned into an AVE rate by dividing it by the price of electricity in the UAE. The same procedure was used for natural gas, but instead of UAE, Oman was used as the reference country assumed to provide no government support. The same AVEs were used for both 2011 and 2015.

[1234] Wei, "China Recycled Aluminium Industry," November 17, 2015, 8.

[1235] 81 Fed. Reg. 92778 (December 20, 2016); 76 Fed. Reg. 30653 (May, 26, 2011); CBSA, "Statement of Reasons," March 3, 2009; Australian Government, Anti-Dumping Commission, "Review of Anti-dumping Measures," July 13, 2015, 54–55; Australian Government, Anti-Dumping Commission, "Certain Aluminum Extrusions," April 15, 2010, 13.

[1236] IMF, "Energy Price Reforms in the GCC," November 2015, 5.

Russian Policies

Russia has a 1.25 percent export tariff on unwrought aluminum alloys (HTS tariff lines 7601.20.9100 and 7601.20.9990).[1237] These alloys are 26.45 percent of Russian exports of unwrought aluminum, which means that this policy's trade-weighted AVE export tax rate is 0.33 percent.[1238] Due to the low rates imposed by these policies, they were omitted from discussion in chapter 10. But their rates were used in the creation of the baseline, and their effects are included in the aggregate effects presented later in this appendix.

Creating the Baseline

Although aluminum policies existed in the actual year 2011, the model's baseline is a hypothetical year 2011 with no aluminum policies. As a result, the baseline had to be constructed by taking the actual year 2011 and removing the effect of the policies that existed in that year.[1239]

This is accomplished in two simulations, one using the GTAP utility AlterTax, the other with a normal closure. The Commission's starting point was the aluminum database, split to include the three new aluminum sectors, but using the tax and subsidy rate data from the original GTAP database. AlterTax was used to modify the baseline GTAP database in order to set the relevant tax rates equal to their 2011 rates, as shown in table K.2. The resulting updated database was used as the baseline for a new simulation. In this new simulation, the policies rates were all set to zero. This produced a hypothetical view of what 2011 would have looked like if none of the selected aluminum policies existed. It is this final database that was used as the baseline in the experiments discussed in chapter 10, which imposed the Chinese domestic policies, the Chinese trade policies, or the GCC countries energy policies that existed in 2015.

Model Limitations

This modeling approach has certain limitations that should be kept in mind. Some limitations have clear effects. For example, there is little information on the use of aluminum in the production of aluminum; the model does not have a separate alumina or scrap sector; and large changes have large potentials for error. These limitations weaken the model's ability to make predictions related to the aluminum supply chain or to changes with large magnitudes.

[1237] Government of Russia. "Table 3.20 Selected Export Duties in the Russian Federation." Resolution no. 705 of July 25, 2014. Cited in WTO, *Trade Policy Review: Russian Federation*, August 24, 2016, 67.
[1238] IHS Markit, GTA database.
[1239] The experiments then impose the policies that existed in 2015.

But the effect of other limitations is unclear. As discussed in chapter 10, the model can only quantify the effects of policies for which AVEs have been calculated. Additionally, information was not available on many parameter values for the aluminum sector, such as the elasticity of substitution between foreign and domestic aluminum, so default GTAP values were used.

Returning to the limitations for which effects are clear, note that the first limitation stems from the fact that there is little information on the use of aluminum by aluminum producers. The lack of data on this topic meant that the construction of the cross-cost matrix had to rely on general assumptions about the production process, rather than specific data on the use of each aluminum input, by each aluminum producer, in each region. This increases the potential for error in the model’s predictions for how a change in one aluminum sector will affect downstream or upstream aluminum sectors.

A similar issue arises regarding aluminum scrap and alumina. The aluminum model does not have separate sectors for these two important aluminum-related commodities. Alumina is lumped in with the "remainder NFM" category, but it is unclear where aluminum scrap would be located in the GTAP framework. Again, this increases the potential for error in predictions related to the supply chain, although more for unwrought than for wrought aluminum.

Finally, the predictions of the GTAP model (and thus the aluminum model) are less accurate for very large changes than they are for small ones. This is because the model typically assumes that elasticities are constant. However, the “true” elasticity may change as prices (or quantities) change; so as model variables get very different from the baseline, the elasticities used by the model can become increasingly inaccurate. This is of particular concern for this analysis, as some of the results of the model are very large changes. For example, the model predicts that China's trade policies have reduced Chinese primary unwrought exports by 89.4 percent (table K.7). Such results have a large potential for error.

Lost Wages of U.S. Workers

The quantitative assessment of government programs in this chapter considers how aluminum production, demand, and trade shift throughout the world economy in response to these programs. However, changes in production also bring about shifts in demand for labor. When foreign government programs lead to falling U.S. production, labor demand also falls, and U.S. workers are displaced from the aluminum industry to other industries. The simulation model itself does not consider the displacement costs of U.S. workers moving from the aluminum industry to another; this section endeavors to do so.

Total lost wages in table K.3 are calculated by multiplying (1) the simulated decline in employment by (2) the size of the work force and (3) the lost wages per displaced employee.

However, lost wages per displaced employee are very difficult to measure (see below), and any imprecision here leads to proportional imprecision in the total lost wages as well. Additionally, this analysis is restricted to policies that imply a decline in U.S. employment, and the only lost wages considered are those associated with the aluminum industry; we do not consider displacement costs more broadly in the economy.

Table K.3: Lost wages of U.S. workers due to the effect of selected policies (million $)

Policy	Primary unwrought	Secondary unwrought	Wrought
Chinese trade policies	NA	NA	NA
Chinese domestic policies	1.5	0.4	41.0
GCC countries' energy policies	1.5	0.0	0.5
Aggregate effect of all policies combined	NA	0.3	30.2

Source: USITC staff calculations.
Note: For policies that increased U.S. employment, lost wages are not applicable.

The first and second pieces of information for this calculation were straightforward to acquire. The percentage decline in aluminum industry employment was taken from the decline in the labor demand from the policy simulations. Employment by sector of the aluminum industry was drawn from the U.S. Census Bureau's *Annual Survey of Manufactures* for 2011.[1240] Employment in primary unwrought aluminum was 7,151 that year; in secondary unwrought aluminum, 4,942; and in wrought aluminum, 36,895.

Estimates of the duration of unemployment and lost wages for aluminum workers were drawn from two iterations of the U.S. Census Bureau's *Current Population Survey*. As part of the survey, a "Displaced Worker, Employee Tenure, and Mobility Supplement" is conducted every other January. The Commission relied on the January 2012 and 2014 surveys, each of which spanned the previous three years (2009–11 and 2011–13, respectively), to estimate the average displacement experience in the primary metals and fabricated metal products industry.

It is difficult to estimate the lost wages per displaced aluminum employee, as there are very few relevant observations in the survey. The aluminum industry itself is too narrow to be captured by the survey. Each survey covers more than 50,000 respondents, but the primary metals and fabricated metal products industry is nonetheless a relatively small part of the overall economy. Only 5 workers in the 2012 survey and 6 workers in the 2014 survey were identified as having lost their jobs in 2011. Combining the experiences of these 11 workers, we arrive at an average duration of unemployment of 32 weeks and $23,656 of lost wages per employee. However, the small number of observations means that this estimate is likely imprecise.

[1240] See table K.15 for a concordance between this survey and the aluminum model's aluminum sectors.

Aggregate Effect of All Aluminum Policies

Chapter 10 presented the effect of particular sets of policies: the selected Chinese domestic or trade policies, and the GCC countries energy policies. This section gives the aggregate effect of all policies together. It compares the baseline, a hypothetical 2011 with no aluminum policies, to a hypothetical 2011 with all aluminum policies for all countries at their 2015 rates. This also includes the Russian policies, which (as noted earlier) were omitted from discussion in chapter 10 due to their low rate. Results are similar to just adding up the impact of the simulations presented in chapter 10. However, since the aggregate combines the effects of very different policy instruments in different countries, the impacts can be more easily understood by looking at their effects individually (as presented in chapter 10) than in aggregate (as presented here).

In aggregate, the policies reduced world aluminum prices (table K.4). Prices fell by the largest amounts in China and the GCC countries, where the identified policies were located.

Table K.4: Aggregate effect of all policies on prices of aluminum commodities by region (percent change)

Region	Primary unwrought	Secondary unwrought	Wrought
United States	-0.1	-0.1	-0.1
China	-4.0	-2.2	-9.3
GCC countries	-4.3	-0.5	-0.4
European Union	0.0	0.0	0.0
Canada	0.0	0.0	0.0
Russia	0.0	0.0	0.0
Rest of the world	0.0	0.0	0.0
World	-0.5	-0.1	-0.6

Source: USITC staff calculations.

In aggregate, the quantified policies increased world aluminum production (table K.5). The largest impacts on production were in China and the GCC countries (where the policies were located) and also in the "rest of the world" (which combines all other countries).

Table K.5: Aggregate effect of all policies on production of aluminum commodities by region

	Primary unwrought		Secondary unwrought		Wrought	
Region	%	million $	%	million $	%	million $
United States	0.8	43	-0.2	-14	-3.4	-803
China	-6.0	-3,055	1.0	98	10.3	7,220
GCC countries	42.1	2,434	3.2	1	-7.0	-288
European Union	0.0	0	0.3	20	-3.6	1,365
Canada	1.5	96	-0.5	-3	-5.9	-155
Russia	-0.7	-63	-2.6	-42	-4.3	-127
Rest of the world	6.4	1,583	-0.7	-66	-8.0	-3,997
World	0.9	1,037	0.0	-6	0.3	484

Source: USITC staff calculations.

In aggregate, the quantified policies had the largest impact on Chinese and GCC countries trade (tables K.6 and K.7). The aggregate impact of the policies was to reduce Chinese aluminum imports. Chinese exports increased for wrought but decreased for unwrought. In the GCC countries, unwrought imports fell and exports increased. The reverse happened for wrought, where imports increased and exports fell.

Table K.6: Aggregate effect of all policies on imports of aluminum commodities by destination region

	Primary unwrought		Secondary unwrought		Wrought	
Destination	%	million $	%	million $	%	million $
United States	0.5	18	-0.6	-6	2.4	157
China	-30.6	-1,084	-7.8	-39	-27.3	-2,495
GCC countries	-6.5	-56	-0.6	0	0.6	15
European Union	-0.2	-29	-0.4	-25	0.0	10
Canada	-9.9	-63	-0.5	-1	0.2	2
Russia	-4.3	-5	-0.4	0	6.1	19
Rest of the world	-5.5	-793	-1.5	-63	3.4	752

Source: USITC staff calculations.

Table K.7: Aggregate effect of all policies on exports of aluminum commodities by source region

	Primary unwrought		Secondary unwrought		Wrought	
Source	Percent	Million $	Percent	Million $	Percent	Million $
United States	13.6	85	-0.6	-3	-12.3	-599
China	-89.4	-4,679	-15.8	-41	51.9	3,988
GCC countries	57.8	2,356	3.3	1.0	-7.7	-273
European Union	0.3	11	0.4	17	-4.6	-1,264
Canada	1.0	46	-0.5	-3	-6.5	-147
Russia	-1.2	-50	-3.3	-41	-6.9	-111
Rest of the world	7.4	881	-1.3	-61	-15.1	-3,061

Source: USITC staff calculations.

Large impacts (on a dollar value basis) were also seen in the "rest of the world." This is because the rest of the world region contains many of the main export markets for Chinese aluminum (for example, Japan, South Korea, and Vietnam). By decreasing Chinese exports of primary aluminum, the policies increased domestic aluminum production in these regions (as a whole). The same effect occurs in reverse when the policies increased Chinese exports of wrought, reducing aluminum production in the "rest of the world."

Comparing Model and Survey Results

For this report, the Commission conducted a survey of U.S. aluminum producers.[1241] As part of the survey, U.S. aluminum producers were asked for their opinions on the effect of foreign government policies and programs on their production. Most secondary unwrought and wrought producers could not estimate the effects of the policies. But for those that could, their responses were similar to the model results. Note that in the survey, firms were asked about the effect of ***removing*** foreign policies, while the model looks at the effect of ***imposing*** the policies.

For secondary unwrought producers, the model found that the identified policies reduce production by 0.2 percent (see the preceding section on aggregate effects of the policies). In the survey, "increase in production" was their most common quantifiable response for the effect of removing the policies (table K.8).[1242] More detailed survey responses are not publishable due to confidentiality requirements and the small number of producers.

Table K.8: Survey question 3.11: Secondary unwrought aluminum, estimates of impact of removal of foreign government policies and programs on U.S. firms' 2015 production levels

Impact	%
Cannot estimate	64.0
Increase in production	17.7
No effect	10.5
Decrease in production	7.8
Total	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

For wrought producers, the model found that the identified policies reduce production by 3.4 percent. In the survey, their most common quantifiable response was that removing foreign policies would increase production between 1 percent and 10 percent (table K.9).[1243]

[1241] See appendix F for the survey questionnaire, appendix G for the survey methodology, and appendix H for the survey results.
[1242] See also, appendix table H.6, survey question 3.11, in appendix H.
[1243] See also appendix table H.20, survey question 4.22, in appendix H.

Table K.9: Survey question 4.22: Wrought aluminum, estimates of the impact of removal of foreign government policies and programs on U.S. firms' 2015 production levels

Impact	%
Cannot estimate	40.3
Decrease in production of more than 10 percent	13.7
Decrease in production of 1–10 percent	4.0
No effect	8.9
Increase in production of 1–10 percent	20.1
Increase in production of more than 10 percent	12.9
Total	100.0

Source: USITC survey of U.S. aluminum producers, September 30, 2016.

Survey responses from primary unwrought producers are not publishable due to confidentiality requirements and the small number of producers.

List of Regions and Commodities

The aluminum model has 30 traded commodities (table K.8) and 17 regions (table K.9).

Table K.10: List of commodities in the aluminum model

Aluminum model commodity	Description
Agffh	Crops, livestock, forest fish
Coa	Coal
Oil	Oil
Gas	Gas
Omn	Minerals nec
b_t	Beverages and tobacco products
Food	Processed food and food nec
TextWapp	Textiles and clothing
Otn	Transport equipment nec
Mvh	Motor vehicles and parts
Fmp	Metal products
Omf	Manufactures nec
LightMnfc	Light manufacturing
Ele	Electronic equipment
PrimaryUN	Primary unwrought aluminum
SecondaryUN	Secondary unwrought aluminum
Wrought	Wrought aluminum
RemainderNFM	Remainder of original GTAP commodity NFM
i_s	Ferrous metals
Nmm	Mineral products nec
Ome	Machinery and equipment nec
HeavyMnfc	Heavy manufacturing
Ely	Electricity
Gdt	Gas manufacture, distribution
Util_Cons	Utilities and construction
Wtp	Sea transport

Aluminum model commodity	Description
Trd	Trade
Otp	Transport nec
TransComm	Transport and communication
OthServices	Other services

Source: Compiled by USITC staff.
Note: Nec = not elsewhere classified.

Table K.11: List of regions in the aluminum model

Aluminum model region	Description
Oceania	Oceania
China	China
Jpn	Japan
Kor	South Korea
Twn	Taiwan
OthAsia	Other Asia
Ind	India
Usa	United States of America
Can	Canada
LatinAmer	Latin America
EU_28	European Union (28 member countries)
GCC	Gulf Cooperation Council
MENA	Other Middle East and North Africa
SSA	Sub-Saharan Africa
Rus	Russian Federation
Nor	Norway
Rest of world	Rest of the world

Source: Compiled by USITC staff.

Concordance Tables

Tables K.12 through K.16 list the concordance tables used to map sectors, commodities, or regions between different datasets.

Table K.12: Concordance between CRU Group primary regions and aluminum model regions

CRU Group primary region	Aluminum model region
USA	usa
Canada	can
Mexico	LatinAmer
Germany	EU_28
France	EU_28
Italy	EU_28
UK	EU_28
Netherlands	EU_28
Iceland	Rest of world
Norway	Nor
Greece	EU_28
Switzerland	Rest of world
Sweden	EU_28
Spain	EU_28
Bosnia	RestofWorld
Montenegro	RestofWorld
Slovenia	EU_28
Russia	rus
Ukraine	RestofWorld
Slovakia	EU_28
Hungary	EU_28
Poland	EU_28
Romania	EU_28
China	china
Japan	jpn
India	ind
Indonesia	OthAsia
Malaysia	OthAsia
N.Korea	OthAsia
Iran	MENA
Bahrain	gcc
UAE	gcc
Turkey	MENA
Oman	gcc
Qatar	gcc
Saudi Arabia	gcc
Tajikistan	RestofWorld
Kazakhstan	RestofWorld
Azerbaijan	RestofWorld
South Africa	SSA
Cameroon	SSA
Nigeria	SSA
Mozambique	SSA
Egypt	MENA

CRU Group primary region	Aluminum model region
Ghana	SSA
Australia	Oceania
New Zealand	Oceania
Argentina	LatinAmer
Brazil	LatinAmer
Venezuela	LatinAmer

Source: Compiled by USITC staff.

Table K.13: Concordance between CRU Group wrought regions and aluminum model regions

CRU Group wrought region	Aluminum model region
USA	usa
Canada	can
Mexico	LatinAmer
Germany	EU_28
Italy	EU_28
France	EU_28
UK	EU_28
Rest of Western Europe	EU_28
Russia	rus
Eastern Europe ex. Russia	EU_28
China	china
Japan	jpn
India	ind
Middle East	MENA
Australasia	Oceania
Africa	SSA
Central & South America	LatinAmer

Source: Compiled by USITC staff.

Table K.14: Concordance between NAICS sectors and aluminum model commodities

Aluminum model commodity	NAICS sector
Primary unwrought	331312
Secondary unwrought	331314
Wrought	331316, 33131N
Remainder NFM	331311, 3314

Source: Compiled by USITC staff.
Note: NAICS is the North American Industry Classification System. NAICS 331315 and 331319 are wrought aluminum sectors but are not listed in the U.S. Census Bureau's *Annual Survey of Manufacturers*.

Table K.15: Concordance between *Annual Survey of Manufacturers* (ASM) input categories and aluminum model commodities

Aluminum model commodity	ASM input category
agffh	M
Coa	E
Oil	E
Gas	E
Omn	M
b_t	M
Food	M
TextWapp	M

Aluminum model commodity	ASM input category
Otn	M
Mvh	M
Fmp	M
Omf	M
LightMnfc	M
Ele	M
i_s	M
Nmm	M
Ome	M
HeavyMnfc	M
Ely	E
Gdt	E
Util_Cons	M
Wtp	S
Trd	S
Otp	S
TransComm	S
OthServices	S
Land	K
Labor	L
Capital	K
NatRes	K

Source: Compiled by USITC staff.
Note: Categories are K = Capital, L = Labor, E = Energy, M = Materials, and S = Services.

Table K.16: Concordance between Global Trade Atlas (GTA) database commodities and aluminum model commodities

GTA commodity	Aluminum model commodity	GTA database commodity description [sic]
262011	Remainder NFM	Hard zinc spelter
262019	Remainder NFM	Zinc dross and skimmings (not from from the mfr. of iron or steel)
262021	Remainder NFM	Leaded gasoline sludges and leaded anti-knock compound sludges, containing mainly lead
262029	Remainder NFM	Ash and residues (other than from the manufacture of iron or steel), containing mainly lead, nesoi
262030	Remainder NFM	Ash and residues (not from the mfr. of iron or steel), containing mainly copper
262040	Remainder NFM	Ash and residues (not from the mfr. of iron or steel), containing mainly aluminum
262060	Remainder NFM	Ash/residues contain arsenic, mercury, thallium or their mixtures, kind used only for extraction of arsenic or manufacture of its compounds
262091	Remainder NFM	Ash and residues (other than from the manufacture of iron or steel), containing antimony, beryllium, cadmium, chromium or their mixtures
281820	Remainder NFM	Aluminum oxide, other than artificial corundum
710610	Remainder NFM	Silver powder
710691	Remainder NFM	Silver bullion and dore
710692	Remainder NFM	Silver (incl. silver plate w gold/platinum),semi manufacture, rectangular/near rectangular shape,99.5% or > pure, marked only by wgt/identity
710700	Remainder NFM	Base metals clad with silver, not further worked than semi manufactured
710811	Remainder NFM	Gold powder

GTA commodity	Aluminum model commodity	GTA database commodity description [sic]
710812	Remainder NFM	Gold, nonmonetary, bullion and dore
710813	Remainder NFM	Gold leaf
710820	Remainder NFM	Gold, monetary, in unwrought, semi manufactured or powder form
710900	Remainder NFM	Base metals or silver clad with gold, but not further worked than semi manufactured
711011	Remainder NFM	Platinum, unwrought or in powder form
711019	Remainder NFM	Platinum, in semi manufactured forms
711021	Remainder NFM	Palladium, unwrought or in powder form
711029	Remainder NFM	Palladium, in semi manufactured forms
711031	Remainder NFM	Rhodium, unwrought or in powder form
711039	Remainder NFM	Rhodium, in semi manufactured forms
711041	Remainder NFM	Iridium, osmium and ruthenium, unwrought or in powder form
711049	Remainder NFM	Iridium, osmium and ruthenium, in semi manufactured forms
711100	Remainder NFM	Base metals, silver or gold clad with platinum, not further worked than semi manufactured
711230	Remainder NFM	Ash containing precious metals or precious metal compounds
711291	Remainder NFM	Gold waste and scrap, including metal clad with gold but excluding sweepings containing other precious metals
711292	Remainder NFM	Platinum waste and scrap, including metal clad with platinum but excluding sweepings containing other precious metals
711299	Remainder NFM	Precious metal (other than of gold or platinum) waste and scrap, including metal clad with precious metals, nesoi
711510	Remainder NFM	Platinum catalysts in the form of wire cloth or grill
740110	Remainder NFM	Copper mattes
740120	Remainder NFM	Cement copper (precipitated copper)
740200	Remainder NFM	Unrefined copper; copper anodes for electrolytic refining
740311	Remainder NFM	Refined copper cathodes and sections of cathodes
740312	Remainder NFM	Refined copper, wire bars
740313	Remainder NFM	Refined copper, billets
740319	Remainder NFM	Refined copper, unwrought articles nesoi
740321	Remainder NFM	Copper-zinc base alloys (brass), unwrought nesoi
740322	Remainder NFM	Copper-tin base alloys (bronze), unwrought nesoi
740323	Remainder NFM	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver), unwrought nesoi
740329	Remainder NFM	Copper alloys (o/than copper-zinc, copper-tin, copper-nickel(cupro-nickel) or copper-nickel-zinc base alloys, unwrought nesoi
740400	Remainder NFM	Copper spent anodes; copper waste & scrap containing less than 94% by weight of copper
740500	Remainder NFM	Copper master alloys, containing 5% or more but n/more than 15% by weight of phosphorus
740610	Remainder NFM	Copper, powders of non-lamellar structure
740620	Remainder NFM	Copper, powders of lamellar structure; copper flakes
740710	Remainder NFM	Refined copper, hollow profiles
740721	Remainder NFM	Copper-zinc base alloys (brass), hollow profiles
740722	Remainder NFM	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver), hollow profiles
740729	Remainder NFM	Copper alloys (o/than brass, cupro-nickel or nickel silver), hollow profiles
740811	Remainder NFM	Refined copper, wire, w/maximum cross-sectional dimension over 9.5 mm
740819	Remainder NFM	Refined copper, wire, w/maximum cross-sectional dimension of 6 mm or less
740821	Remainder NFM	Copper-zinc base alloys (brass), wire

GTA commodity	Aluminum model commodity	GTA database commodity description [sic]
740822	Remainder NFM	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver), wire, coated or plated with metal
740829	Remainder NFM	Copper alloys (o/than brass, cupro-nickel or nickel-silver), wire, coated or plated with metal
740911	Remainder NFM	Refined copper, plates, sheets and strip, in coils, with a thickness of 5 mm or more
740919	Remainder NFM	Refined copper, plates, sheets and strip, not in coils, with a thickness of 5 mm or more
740921	Remainder NFM	Copper-zinc base alloys (brass), plates, sheets and strip, in coils
740929	Remainder NFM	Copper-zinc base alloys (brass), plates, sheets and strip, not in coils
740931	Remainder NFM	Copper-tin base alloys (bronze), plates, sheets and strip, in coils. with a thickness of 5 mm or more
740939	Remainder NFM	Copper-tin base alloys (bronze), plates, sheets and strip, with a thickness of 5 mm or more
740940	Remainder NFM	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver), plates, sheets and strip, w/thickness o/0.15mm
740990	Remainder NFM	Copper alloys (o/than brass/bronze/cupro-nickel/nickel silver), plates, sheets & strip, with thickness of 5 mm or more
741011	Remainder NFM	Refined copper, foil, w/thickness of 0.15 mm or less, not backed
741012	Remainder NFM	Copper alloys, foil, w/thickness of 0.15 mm or less, not backed
741021	Remainder NFM	Refined copper, clad laminates, w/thickness of 0.15 mm or less, backed
741022	Remainder NFM	Copper alloys, foil, w/thickness of 0.15 mm or less, backed
741110	Remainder NFM	Refined copper, tubes and pipes, seamless
741121	Remainder NFM	Copper-zinc base alloys (brass), tubes and pipes, seamless
741122	Remainder NFM	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel-silver), tubes and pipes
741129	Remainder NFM	Copper alloys (o/than brass/cupro-nickel/nickel-silver), pipes and tubes, seamless
741210	Remainder NFM	Refined copper, fittings for tubes and pipes
741220	Remainder NFM	Copper alloys, fittings for tubes and pipes
750110	Remainder NFM	Nickel mattes
750120	Remainder NFM	Nickel oxide sinters and other intermediate products of nickel metallurgy
750210	Remainder NFM	Nickel (o/than alloy), unwrought
750220	Remainder NFM	Nickel alloys, unwrought
750300	Remainder NFM	Nickel, waste and scrap
750400	Remainder NFM	Nickel, powders and flakes
750511	Remainder NFM	Nickel (o/than alloy), bars and rods, cold formed
750512	Remainder NFM	Nickel alloy, bars and rods, cold formed
750521	Remainder NFM	Nickel (o/than alloy), wire, cold formed
750522	Remainder NFM	Nickel alloy, wire, cold formed
750610	Remainder NFM	Nickel (o/than alloy), plates, sheets and strip, cold formed
750620	Remainder NFM	Nickel alloy, plates, sheets and strip, cold formed
750711	Remainder NFM	Nickel (o/than alloy), tubes and pipes
750712	Remainder NFM	Nickel alloy, tubes and pipes
750720	Remainder NFM	Nickel, fittings for tubes and pipes
760110	Unwrought	Aluminum (o/than alloy), unwrought, in coils, w/uniform x-section throughout length & w/least cross-sectional dimension n/o 9.5 mm
760120	Unwrought	Aluminum alloys, unwrought, in coils, w/uniform x-section throughout length & w/least cross-sectional dimension n/o 9.5 mm
760200	Remainder NFM	Aluminum, waste and scrap
760310	Remainder NFM	Aluminum, powders of non-lamellar structure

GTA commodity	Aluminum model commodity	GTA database commodity description [sic]
760320	Remainder NFM	Aluminum, powders of lamellar structure; aluminum flakes
760410	Wrought	Aluminum (o/than alloy), profiles
760421	Wrought	Aluminum alloy, hollow profiles
760429	Wrought	Aluminum alloy, profiles (o/than hollow profiles)
760511	Wrought	Aluminum (o/than alloy), wire, with a maximum cross-sectional dimension over 7 mm
760519	Wrought	Aluminum (o/than alloy), wire, with a maximum cross-sectional dimension of 7 mm or less
760521	Wrought	Aluminum alloy, wire, with a maximum cross-sectional dimension over 7 mm
760529	Wrought	Aluminum alloy, wire, with a maximum cross-sectional dimension of 7 mm or less
760611	Wrought	Aluminum (o/than alloy), plates/sheets/strip, w/thick. o/0.2mm, rectangular (incl. sq), not clad
760612	Wrought	Aluminum alloy, plates/sheets/strip, w/thick. o/0.2mm, rectangular (incl. sq), not clad
760691	Wrought	Aluminum (o/than alloy), plates/sheets/strip, w/thick. o/0.2mm, o/than rectangular (incl. sq), not clad
760692	Wrought	Aluminum alloy, plates/sheets/strip, w/thick. o/0.2mm, o/than rectangular (incl. sq), not clad
760711	Wrought	Aluminum, foil, w/thickness n/o 0.01 mm, rolled but not further worked, not backed
760719	Wrought	Aluminum, etched capacitor foil, w/thickness n/o 0.2 mm, not rolled or rolled and further worked, not backed
760720	Wrought	Aluminum, foil, w/thickness n/o 0.2 mm, backed, covered or decorated with a character, design, fancy effect or pattern
760810	Wrought	Aluminum (o/than alloy), tubes and pipes
760820	Wrought	Aluminum alloy, tubes and pipes
760900	Wrought	Aluminum, fittings for tubes and pipes
780110	Remainder NFM	Refined lead, unwrought
780191	Remainder NFM	Lead (o/than refined lead), containing by weight antimony as the principal other element, unwrought
780199	Remainder NFM	Lead (o/than refined lead), bullion
780200	Remainder NFM	Lead, waste and scrap
780300	Remainder NFM	Lead, bars, rods, profiles and wire
780411	Remainder NFM	Lead, sheets, strip and foil, w/thickness n/o 0.2 mm, excluding any backing
780419	Remainder NFM	Lead, plates & sheets, strip and foil w/thickness o/0.2mm, nesoi
780420	Remainder NFM	Lead, powders and flakes
780500	Remainder NFM	Lead, tubes or pipes and fittings for tubes or pipes
790111	Remainder NFM	Zinc (o/than alloy), unwrought, containing o/99.99% by weight of zinc
790112	Remainder NFM	Zinc (o/than alloy), unwrought, casting-grade zinc, containing at least 97.5% but less than 99.99% by weight of zinc
790120	Remainder NFM	Zinc alloy, unwrought
790200	Remainder NFM	Zinc, waste and scrap
790310	Remainder NFM	Zinc, dust
790390	Remainder NFM	Zinc, powders
790400	Remainder NFM	Zinc, bars, rods, profiles and wire
790500	Remainder NFM	Zinc, plates, sheets, strip and foil
790600	Remainder NFM	Zinc, tubes or pipes and fittings for tubes or pipes
800110	Remainder NFM	Tin (o/than alloy), unwrought
800120	Remainder NFM	Tin alloy, unwrought

GTA commodity	Aluminum model commodity	GTA database commodity description [sic]
800200	Remainder NFM	Tin, waste and scrap
800300	Remainder NFM	Tin, bars, rods, profiles and wire
800400	Remainder NFM	Tin, plates, sheets and strip, of a thickness exceeding 0.20 mm
800500	Remainder NFM	Tin. foil, w/thickness (excluding any backing) n/o 0.2 mm
800600	Remainder NFM	Tin, tubes or pipes and fittings for tubes or pipes
810110	Remainder NFM	Tungsten, powders
810194	Remainder NFM	Tungsten, unwrought (including bars and rods obtained simply by sintering)
810195	Remainder NFM	Tungsten bars and rods (o/than those obtained simply by sintering), profiles, plates, sheets, strip and foil
810196	Remainder NFM	Tungsten wire
810197	Remainder NFM	Tungsten waste and scrap
810199	Remainder NFM	Tungsten, articles nesoi
810210	Remainder NFM	Molybdenum, powders
810294	Remainder NFM	Molybdenum, unwrought (including bars and rods obtained simply by sintering)
810295	Remainder NFM	Molybdenum bars and rods (o/than those obtained simply by sintering)
810296	Remainder NFM	Molybdenum wire
810297	Remainder NFM	Molybdenum waste and scrap
810299	Remainder NFM	Molybdenum, articles nesoi
810320	Remainder NFM	Tantalum, unwrought (including bars and rods obtained simply by sintering); tantalum powders
810330	Remainder NFM	Tantalum waste and scrap
810390	Remainder NFM	Tantalum, articles nesoi
810411	Remainder NFM	Magnesium, unwrought, containing at least 99.8 percent by weight of magnesium
810419	Remainder NFM	Magnesium, unwrought, nesoi
810420	Remainder NFM	Magnesium, waste and scrap
810430	Remainder NFM	Magnesium, raspings, turnings and granules graded according to size; magnesium powders
810490	Remainder NFM	Magnesium, articles nesoi
810520	Remainder NFM	Cobalt alloys, unwrought
810530	Remainder NFM	Cobalt waste and scrap
810590	Remainder NFM	Cobalt, articles thereof nesoi
810600	Remainder NFM	Bismuth (including waste & scrap) and articles thereof, nesoi
810720	Remainder NFM	Cadmium, unwrought; cadmium powders
810730	Remainder NFM	Cadmium waste and scrap
810790	Remainder NFM	Cadmium, articles thereof nesoi
810820	Remainder NFM	Titanium, unwrought; titanium powders
810830	Remainder NFM	Titanium waste and scrap
810890	Remainder NFM	Titanium, articles nesoi
810920	Remainder NFM	Zirconium, unwrought; zirconium powders
810930	Remainder NFM	Zirconium waste and scrap
810990	Remainder NFM	Zirconium, articles, nesoi
811010	Remainder NFM	Antimony, unwrought; antimony powders
811020	Remainder NFM	Antimony waste and scrap
811090	Remainder NFM	Articles of antimony, nesoi
811100	Remainder NFM	Manganese, waste and scrap
811212	Remainder NFM	Beryllium, unwrought; beryllium powders
811213	Remainder NFM	Beryllium waste and scrap
811219	Remainder NFM	Beryllium, articles nesoi
811221	Remainder NFM	Chromium, unwrought; chromium powders

GTA commodity	Aluminum model commodity	GTA database commodity description [sic]
811222	Remainder NFM	Chromium waste and scrap
811229	Remainder NFM	Articles of chromium, nesoi
811230	Remainder NFM	Germanium, waste and scrap
811240	Remainder NFM	Vanadium, waste and scrap
811251	Remainder NFM	Thallium, unwrought; thallium powders
811252	Remainder NFM	Thallium waste and scrap
811259	Remainder NFM	Articles of thallium, nesoi
811292	Remainder NFM	Waste and scrap of gallium, hafnium, indium, niobium or rhenium
811299	Remainder NFM	Articles of gallium, hafnium, indium, niobium or rhenium, nesoi
811300	Remainder NFM	Cermets (including waste & scrap) and articles thereof

Source: Compiled by USITC staff.
Note: “Unwrought” is not a commodity in the aluminum model. In the model, unwrought is split between primary and secondary unwrought aluminum, as detailed in the section of this appendix on the trade matrix. Nesoi = not elsewhere specified or included. o/than = other than. w/ = with. For additional information on commodity descriptions and abbreviations, refer to the GTA database.

Model Software

The Commission's analysis is based on the comparative static version of the GTAP computable general equilibrium model, version 6.2, solved using RunGTAP version 3.61 and GEMPACK version 11.4.003.

Bibliography

Biswas, Beethika. "GCC Primary Producers Can Trigger the Growth of an Equally Strong Aluminium Recycling Industry." *AlCircle Blog*, December 3, 2016. http://blog.alcircle.com/2016/12/03/gcc-primary-producers-can-trigger-growth-equally-strong-aluminium-recycling-industry/ (accessed May 1, 2017).

Carrico, Caitlyn, Lin Jones, and Marinos Tsigas. "Disaggregate U.S. Labor Statistics for the USAGE 2.0 and GTAP CGE Models." Office of Economics Working Paper no. 2012-10D. Washington, DC: U.S. International Trade Commission, October 2012. http://www.usitc.gov/publications/332/EC201210D.pdf.

Chandra, Piyush, and Cheryl Long. "VAT Rebates and Export Performance in China: Firm-level Evidence." *Journal of Public Economics* 102 (June 2013): 13–22. http://dx.doi.org/10.1016/j.jpubeco.2013.03.005.

China Nonferrous Metals Industry Association (CNIA). Posthearing brief to the U.S. International Trade Commission in connection with inv. no. 332-557, Aluminum: Competitive Conditions Affecting the U.S. Industry, October 17, 2016.

CRU Group. Aluminum statistical datasets, September 23, 2016–March 2, 2017. https://www.crugroup.com/analysis/aluminium/.

Feldstein, Martin S., and Paul R. Krugman. "International Trade Effects of Value-added Tax." In A. Razin and J. Slemrod (Eds.), *Taxation in the Global Economy,* 263–82. Chicago, IL: University of Chicago Press, 1990.

Government of Australia. Anti-Dumping Commission. "Review of Anti-dumping Measures: Certain Aluminum Extrusions Exported from the People's Republic of China." Report no. 248, July 13, 2015. http://www.adcommission.gov.au/cases/EPR%20193%20%20250/EPR%20248%20-%20archived/067%20-%20Report%20-%20%20REP%20248%20Findings%20%20(1).pdf.

Government of Australia. Anti-Dumping Commission. "Certain Aluminum Extrusions Exported to Australia from the People's Republic of China." Report to the Minister no. 148, April 15, 2010.

Government of Canada. Canada Border Services Agency (CBSA). "Statement of Reasons." 4214-22 AD/1379 and 4218-26 CV/124, March 3, 2009. http://www.cbsa-asfc.gc.ca/sima-lmsi/i-e/ad1379/ad1379-i08-fd-eng.html.

Gulf Organization for Industrial Consulting (GOIC). "Development of Aluminum Industry in the GCC States." *Gulf Industrial Bulletin*, April 2006. http://www.mafhoum.com/press9/279E15.pdf (accessed May 1, 2017).

IHS Markit. Global Trade Atlas (GTA) database. https://www.ihs.com/products/maritime-global-trade-atlas.html (accessed various dates).

International Monetary Fund (IMF). "Energy Price Reforms in the GCC—What Can Be Learned from International Experiences." Annual Meeting of Ministers of Finance and Central Bank Governors. Washington, DC: IMF, November 2015. https://www.imf.org/external/np/pp/eng/2015/111015b.pdf.

Wei, Liu. "China Recycled Aluminum Industry—Government Demand and Patterns." China Nonferrous Metals Industry Association Recycling Metal Branch (CMRA), November 2015.

World Bureau of Metal Statistics (WBMS). *World Metal Statistics Yearbook 2016*. Ware, Herts, United Kingdom: WBMS, 2017.

World Trade Organization (WTO). *Trade Policy Review: Russian Federation*. Document WT/TPR/G/345. Geneva, Switzerland: WTO, August 24, 2016. https://www.wto.org/english/tratop_e/tpr_e/s345_e.pdf.

Yam, Polly. "China's Extra Power Fees for Aluminium Smelters Not Likely to Boost Prices." Reuters, January 8, 2014. http://www.reuters.com/article/china-aluminium-power-idUSL3N0KI16720140108.

Zhou, Rebecca. "China Aluminium Smelters' Power Costs on Downtrend." CRU Group, December 25, 2015.

Appendix L
Data Tables for Figures

Table L.1: Production and consumption of primary aluminum in China compared to the rest of the world (excluding China), 2001, 2011, and 2015 (thousand mt)

		2001		2011		2015
Primary	**Production**	**Consumption**	**Production**	**Consumption**	**Production**	**Consumption**
China	3,124	3,212	19,623	19,417	30,839	29,267
ROW (excl. China)	21,043	20,386	26,420	25,572	26,329	27,290

Source: Compiled by USITC staff from CRU Group.
Note This data corresponds to fig. ES.1.

Table L.2: Production and consumption of wrought aluminum in China compared to the rest of the world (excluding China), 2001, 2011, and 2015 (thousand mt)

Wrought		2001		2011		2015
China	3,195	3,440	21,275	20,113	31,403	29,505
ROW (ex. China)	21,472	21,404	25,623	27,051	27,673	30,017

Source: Compiled by USITC staff from CRU Group.
Note This data corresponds to fig. ES.2.

Table L.3: Total world stocks of primary unwrought aluminum and global aluminum prices, 2011–15

U.S. Production and Capacity

	2011	2012	2013	2014	2015	2016
Production	1,986	2,070	1,948	1,718	1,587	840
Capacity	3,028	2,740	2,748	2,577	2,452	1,500

Source: CRU Group.
Note Reported Stocks reflect only official statistics, while unreported stocks reflect CRU Group's calculation of the additional residual once consumption is subtracted from production. This data corresponds to fig. ES.3.

Table L.4: U.S. production and capacity, 2011–16 (thousand mt)

	2011	2012	2013	2014	2015
Reported stocks	7,445	8,138	8,189	7,381	6,305
Unreported stocks	5,226	5,159	5,410	6,209	7,895
LME Cash	2,395	2,018	1,845	1,867	1,661

Source: CRU Group, 2011–2015.
Note U.S. Geological Survey, (2016). This data corresponds to fig. ES.4.

Table L.5: World: Consumption of aluminum wrought products by major end-use sectors, 2015

End-use sector	1,000 mt	Percent
Construction	20,515	34
Electrical	10,185	17
Transport	7,318	12
Packaging	6,200	10
Foil stock	6,172	10
Machinery and equipment	5,475	9
Consumer durables	2,404	4
Other	1,252	2
Total	59,522	100

Source: CRU Group.
Note This data corresponds to fig. 1.2.

Table L.6: Global primary and secondary aluminum prices, 2011–16, in dollars per mt

Year	Month	LME (cash)	SHFE	UBCs	Old Sheet
2011	January	2439.125	2513.365	1951.089	1719.604
	March				1826.153
	April	2662.292		2204.62	
	August		2775.513		
	December	2021.475		1668.897	1506.042
2012	February	2203.548			
	March			1812.198	1642.442
	June			1605.25	
	August	1837.716	2333.452		1453.815
	September		2452.832		
2013	January			1809.993	
	February	2053.138			1642.442
	September			1551.501	
	December				1477.095
2014	February	1693.588			
	March		2095.758		1616.714
	August	2029.888			
	September		2343.411		
	November			2022.739	
2015	January		2081.198		
	May		2161.433		
	June			1273.168	
	November	1465.381	1606.357		
	December				1096.005
2016	November	1734.864	2127.922		
	December	1730.25	1941.596	1521.188	1240.099

Source: Metal Bulletin, S&P Global Platts Metals Week Price Notification Monthly Reports, January 2011 through December 2015 (accessed various dates).
Note: This data corresponds to fig. 2.4.

Table L.7: World: Primary aluminum stocks and prices, 2011–15

	2011	2012	2013	2014	2015
LME (cash)	2,395	2,018	1,845	1,867	1,661
Average business cost of production ($/mt of aluminum produced)	2,042	1,765	1,639	1,540	1,434
Electricity cost	697	701	670	600	527
Alumina cost	785	735	722	707	647
Anodes cost	274	237	219	200	185
Other costs	286	92	28	33	75

Source: CRU Group.
Note: Reported stocks reflect only official statistics, while unreported stocks reflect CRU Group's calculation of the additional residual once consumption is subtracted from production.
Note: This data corresponds to fig. 2.5.

Table L.8: World: Price and input costs for production of primary unwrought aluminum, 2011–15

	2011	2012	2013	2014	2015
Reported stocks	7,445	8,138	8,189	7,381	6,305
Unreported stocks	5,226	5,159	5,410	6,209	7,895
LME Cash	2,395	2,018	1,845	1,867	1,661

Source: CRU Group.
Note: Global aluminum prices are based on the LME cash price as reported by CRU Group; electricity cost is based on potroom power costs. Other/adjustments include the costs associated with labor, pot relining, casthouse, and site activities. It also includes net realizations adjustments (or credits) to reflect variances in product mix and quality. This data corresponds to fig. 2.6.

Table L.9: Share of average business costs for select products accounted for by raw materials, 2015, select rolled products (share of average business costs) percent

	1xxx sheet	Building sheet	Foil stock
Raw materials (unwrought aluminum)	77	75	86
Energy	7	6	5
Labor	5	7	4
Other	11	12	6

Source: CRU Group.
Note: This data corresponds to fig. 3.1.

Table L.10: Average business costs of production for selected primary aluminum producing countries, 2011–15 (dollars per mt of aluminum)

	2011	2012	2013	2014	2015
Canada	1,839	1,615	1,495	1,222	1,202
China	2,200	1,858	1,711	1,703	1,534
Norway	1,974	1,758	1,588	1,345	1,274
Russia	1,961	1,570	1,488	1,349	1,220
U.S.	2,074	1,867	1,797	1,559	1,550
World	2,042	1,765	1,639	1,540	1,434

Source: CRU Group.
Note: This data corresponds to fig. 3.2.

Table L.11: Exchange rates can impact competitiveness, index 2010 equals 100

	Canada	China	European Union	Russia	UAE	USA
2011	102.03	99.69	96.51	103.44	98.03	96.87
	101.96	99.25	97.55	105.29	97.33	96.17
	103.14	98.63	100.08	106.84	96.32	95.23
	104.26	97.85	101.70	105.97	94.93	93.68
	103.45	98.06	100.59	106.97	95.07	93.54
	101.73	98.24	100.80	106.77	94.89	93.60
	103.93	98.08	99.22	107.47	94.67	93.02
	101.26	98.79	99.63	103.28	94.65	93.50
	100.30	101.66	99.19	99.43	97.38	96.21
	99.03	103.08	99.75	98.34	98.45	97.31
	98.86	103.78	99.23	100.70	99.26	97.91
	98.93	105.21	97.73	100.38	100.77	98.75

	Canada	China	European Union	Russia	UAE	USA
	99.82	105.59	94.41	102.23	100.53	98.35
	100.69	104.29	94.94	105.32	98.73	96.58
	101.14	105.04	96.01	107.35	99.58	97.10
	101.52	105.36	96.00	107.09	100.04	97.42
2012	100.52	106.43	94.78	104.93	101.98	99.17
	99.11	106.92	94.30	100.92	103.52	100.59
	100.38	106.61	91.91	104.37	103.60	100.08
	101.94	106.08	91.90	104.84	103.07	99.22
	102.46	105.27	94.26	104.42	101.41	97.68
	101.52	105.74	94.79	105.18	100.59	97.32
	100.71	107.07	94.10	105.36	101.46	97.99
	100.57	106.68	95.61	106.69	100.87	97.34
	100.14	107.36	95.64	109.28	100.74	97.36
	99.14	108.23	96.44	109.75	101.04	98.14
	97.99	109.98	96.02	109.51	102.35	99.09
	98.29	110.91	96.03	107.96	102.16	98.70
2013	98.37	112.55	96.25	108.99	102.65	99.18
	97.43	112.85	98.02	105.48	103.56	99.88
	96.73	113.79	97.36	105.81	104.58	100.44
	96.43	113.62	98.57	103.89	105.01	100.26
	96.79	113.35	98.65	104.82	105.06	100.15
	96.07	112.13	99.23	105.48	103.37	99.09
	95.30	113.45	99.04	104.92	104.22	99.93
	93.52	114.25	100.66	104.18	103.88	100.09
	91.36	115.63	99.37	102.88	104.44	101.01
	90.69	114.89	99.66	98.54	104.35	101.19
	90.32	112.73	101.46	96.43	103.85	101.12
	91.26	111.21	100.94	98.24	103.53	100.75
2014	92.27	110.60	99.85	101.51	103.15	100.43
	92.82	111.00	99.02	104.05	103.56	100.62
	93.57	111.49	97.88	103.81	103.55	100.36
	92.17	113.42	97.34	101.04	104.41	101.30
	91.99	115.88	96.08	98.24	105.80	102.80
	90.86	117.71	95.44	93.07	106.85	104.14
	90.48	120.48	95.51	85.00	108.29	105.90
	89.31	121.49	96.26	72.23	109.90	108.38
	86.26	123.03	91.45	68.30	111.55	110.63
	83.86	123.53	89.85	70.60	112.44	112.22
	84.11	126.01	87.91	78.15	114.38	114.24
	85.37	125.84	86.87	88.98	114.05	113.44
2015	86.64	124.77	88.68	91.42	113.35	112.47
	85.54	125.89	89.71	84.99	113.76	113.33
	82.74	127.41	88.28	82.73	114.64	115.19
	81.40	126.32	90.71	72.77	116.02	117.24
	80.71	126.19	92.16	71.95	116.74	118.04
	81.71	125.56	91.70	76.17	115.84	117.07
	81.06	127.30	88.89	76.39	117.87	118.93
	78.40	125.91	90.60	71.29	118.14	120.11
	76.35	124.86	90.70	66.30	119.43	122.58

	Canada	China	European Union	Russia	UAE	USA
	78.23	123.89	91.54	65.48	118.61	121.49
	81.35	122.95	91.52	71.54	117.35	119.22
	83.40	121.31	91.89	74.54	115.78	117.20
2016	83.27	121.09	92.45	75.87	116.53	118.37
	83.69	119.49	91.98	77.05	116.84	118.79
	82.95	117.94	91.08	79.38	117.62	119.43
	82.72	117.07	91.50	77.89	116.69	118.32
	82.07	116.95	91.82	78.35	116.84	119.22
	81.58	117.22	91.57	82.06	118.24	120.36
	80.86	117.61	91.12	81.78	120.31	123.42
	81.77	118.55	90.53	86.87	122.19	125.51

Source: Bank for International Settlements, via Federal Reserve Bank of St. Louis (accessed February 15, 2017).
Note: UAE = United Arab Emirates. The Emirati dhirma is pegged to the U.S. dollar. This data corresponds to Box 3.1 figure.

Table L.12: China: Selected provincial grid or captive power electricity costs for primary aluminum production at smelters, 2014 (dollars per mt)

Province	Electricity cost ($/mt)
Sichuan (grid)	979
Henan (grid)	901
Henan (captive)	841
Shandong (captive)	694
Xinjiang (captive)	482

Source: Mukhamedshin, “Energy Costs and Considerations,” September 2014, 10.
Note: The plant in Xinjiang is a Xinfa aluminum smelter, the one in Shandong a China Hongqiao smelter, the captive plant in Henan an Aluminum Corp. of China (Chalco) smelter, the grid-connected plant in Henan a Zhongfu smelter, and the plant in Sichuan a Sichuan Qiya smelter. This data corresponds to fig. 3.3.

Table L.13: Number of smelters with at least 500,000 metric tons in annual capacity, 2015

	Smelter capacity 500 thousand to <1 million tons	Smelter capacity 1 million tons or more
China	19	6
GCC countries	3	2
Russia	1	2
Canada	1	0
ROW	5	1

Source: CRU Group.
Note: ROW = rest of the world. India is the only country in the rest of the world with more than one smelter that has at least 500,000 mt of capacity per year. This data corresponds to fig. 3.4.

Table L.14: Primary aluminum delivery costs, 2015 (dollars per mt)

Country	$ per mt
Canada	61
China	29
GCC countries	33
Norway	11
Russia	83
U.S.	26

Source: CRU Group.
Note: Based on delivered costs to customers per metric ton of aluminum. This metric is influenced by the proximity of supplying countries to their main markets and can reflect regional premiums. It does not reflect a per-mile transportation cost. This data corresponds to fig. 3.5.

Table L.15: Labor costs for select flat-rolled products, 2015 (dollars per mt)

Country	1xxx sheet	Building sheet	Foil stock
China	71	89	45
Germany	123	284	126
United States	211	147	123

Source: CRU Group.
This data corresponds to fig 3.6.

Table L.16: United States: Primary unwrought aluminum industry production, by casthouse products, 2011–15 (percent)

Source data	2011	2012	2013	2014	2015
Primary remelt ingot	47	43	43	37	36
Primary extrusions billet	21	22	24	27	26
Primary slab	18	18	18	20	22
Primary foundry alloy (PFA)	4	6	5	6	7
Primary wire rod	5	5	5	4	5
Primary liquid metal shipments	5	6	5	6	4
Continuously cast strip	0	0	0	0	0
	100	100	100	100	100.00

Source: CRU Group.
Note: This data corresponds to fig. 4.3.

Table L.17: United States: Unwrought aluminum consumption, 2011 and 2015

Type	2011	2015
Primary aluminum production	1,986	1,587
Scrap recovery	3,425	4,603
Net unwrought aluminum imports	2,454	3,033
	7,865	9,223

Source: Estimated by USITC staff from data collected from USITC survey results; from Bray, “Aluminum (Advanced Release),” 2012–15; and from official trade statistics of the USDOC presented on USITC's DataWeb (accessed April 6, 2017),
Note: This data corresponds to fig. 4.4.

Table L.18: United States: Wrought aluminum imports from China, by product form, 2011–16 (thousand mt)

Commodity	Unit	Description	2011	2012	2013	2014	2015	2016
7606	T	Plates, sheets, and strip (HS 7606)	129,837	95,281	175,321	266,564	371,093	350,263
7607	T	Foil (HS 7607)	71,516	74,655	96,464	122,285	150,282	170,803
		Other (HS 7604, 7605, 7608)	7,485	12,910	10,838	11,878	8,791	10,168
7604	T	Bars, rods, and profiles (HS 7604)	4,354	6,005	9,392	9,964	5,521	6,244
7605	T	Wire (HS 7605)	2,175	5,891	581	878	2,449	2,909
7608	T	Tubes and pipes (HS 7608)	956	1,014	865	1,036	821	1015

Source: IHS Markit, GTA database (accessed April 7, 2017).
Note: This data corresponds to fig. 4.5.

Table L.19: United States: Certain aluminum flat-rolled products, average business costs, 2011–15 (dollars per mt)

US COP					
Product and costs	**2011**	**2012**	**2013**	**2014**	**2015**
Sheet 1xxx					
United States	3,194	2,851	2,705	2,963	2,594
World	3,321	3,057	2,951	2,973	2,616
Building Sheet					
United States	3,013	2,654	2,561	2,757	2,394
World	3,237	2,909	2,803	2,927	2,553
Foil Stock					
United States	3,041	2,703	2,649	2,862	2,491
World	3,090	2,840	2,714	2,735	2,393

Source: CRU Group
Note: This data corresponds to fig. 4.6.

Table L.20: Canada: Unwrought aluminum exports to global and U.S. markets, 2011–15 (thousand mt)

Year	Exports to the World	Exports to the United States	Non-U.S. Exports
2011	2,479	1,838	641
2012	2,400	1,835	565
2013	2,630	2,061	569
2014	2,481	1,994	487
2015	2,469	2,210	259

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: This data corresponds to fig. 5.2.

Table L.21: Canada: Wrought aluminum imports and exports, 2011–15 (thousand mt)

Year	Canadian Wrought Imports	Canadian Wrought Exports
2011	506	515
2012	563	489
2013	574	431
2014	593	446
2015	623	462

Source: IHS Markit, GTA database (accessed September 22, 2016).
Note: This data corresponds to fig. 5.3.

Table L.22: China: Primary unwrought aluminum production capacity by smelter size, 2006–15, number of smelters

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Less than 200,000 tons	6,633	6,243	6,742	7,066	6,577	5,338	5,287	5,690	4,552	4,173
200,000 to 499,000 tons	4,378	6,644	8,134	8,581	10,368	10,642	10,717	10,617	11,797	12,494
500,000 to 999,0000 tons	560	1,138	1,735	3,384	4,995	6,091	8,996	10,082	12,330	12,376
1 million tons or more	0	0	0	0	0	1,140	1,140	3,080	5,609	9,018

Source: CRU Group.
Note: This data corresponds to fig. 6.3.

Table L.23: China: Aluminum scrap supply by source, 2011–15 (million mt)

	2011	2012	2013	2014	2015
Imports from the United States	655	723	822	769	641
Non-U.S. imports	2,031	1,870	1,682	1,537	1,446
Domestic scrap collection	2,200	2,700	2,950	3,600	4,100
	4,886	5,293	5,454	5,906	6,187

Source: IHS Markit, GTA database (accessed April 3, 2017); Gao Ning, "China—Leading Growth," November 21, 2016, 8.
Note: China's imports, as listed in Harmonized Commodity Description and Coding System (HS) 7602, and domestic scrap collection. This data corresponds to fig. 6.4.

Table L.24: China: Primary unwrought aluminum production and consumption, 2001–15 (million mt)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Production	3,124	4,097	5,539	6,736	8,508	9,362	12,600	13,712	13,715	17,046	19,623	22,204	24,884	28,303	30,839
Consumption	3,212	3,932	5,173	6,156	7,858	8,790	12,096	12,622	14,001	16,902	19,417	21,345	24,274	27,292	29,267

Source: CRU Group.
Note: This data corresponds to fig. 6.6.

Table L.25: Capacity utilization Chinese aluminum smelters, by age and size, 2015, percent

	Utilization rate
Old	75
New	88
<200,000 tons	53
200,000 to 499,000 tons	80
500,000 to 999,000 tons	84
1 million tons or more	92

Source: CRU Group.
Note: "New" smelters are those where more than half of the capacity was added during 2011–15. This data corresponds to fig. 6.7.

Table L.26: China: Secondary unwrought aluminum production, 2011–15 (thousand mt)

	2011	2012	2013	2014	2015
Secondary production	4,410	4,830	5,270	5,650	5,750

Source: CNIA, post hearing brief to the USITC, October 17, 2016, exhibit 1, 20; CRU Group.
Note: This data corresponds to fig. 6.8.

Table L.27: China: Wrought aluminum production and consumption, 2001–15 (million mt)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Production	3	4	4	6	7	8	11	13	15	19	21	24	27	30	31
Consumption	3	4	5	6	7	8	10	13	15	18	20	23	26	28	30

Source: CRU Group.
Note: This data corresponds to fig. 6.9.

Table L.28: China: Primary unwrought aluminum consumption, 2011–15 (thousand mt)

	2011	2012	2013	2014	2015
Unwrought aluminum consumption	19,417	21,345	24,274	27,292	29,267

Source: CRU Group.
Note: This data corresponds to fig. 6.10.

Table L.29: China: Aluminum exports by type, 2011–16 (million mt)

	2011	2012	2013	2014	2015	2016
Wrought	2,973,590	2,805,362	3,038,649	3,637,302	4,165,779	4,043,972
Secondary unwrought	682,726	504,564	455,178	569,550	532,967	491,398
Primary unwrought	83,396	126,650	117,102	97,421	32,672	20,188

Source: IHS Markit, GTA database (accessed February 23, 2017).
Note: Secondary aluminum trade is based on exports under processing trade modes in HS 7601.20, as discussed below. Primary aluminum is based on all other trade in HS 7601. Wrought exports are based on Chinese exports in HS 7604–7608. This data corresponds to fig. 6.11.

Table L.30: China: Share (ordinary and processing trade) of global wrought aluminum exports, 2011–15

	2011	2012	2013	2014	2015
Bars, rods, and profiles	16	22	25	27	27
Wire	3	3	2	2	3
Plates, sheets, and strip	19	23	24	28	32
Foil	41	43	47	50	54
Tubes and pipes	33	32	32	33	38
All wrought products	20	24	26	29	33

Source: IHS, Markit, GTA database (accessed April–August 2016).
Note: This data corresponds to fig. 6.12.

Table L.31: China: Exports of unwrought, unalloyed aluminum (HS 7601.10), 2001–16, and export tariffs (thousand mt)

Month	Change in tariffs	Exports (tons)
01/2001		4,373
02/2001		16,278
03/2001		35,472
04/2001		20,698
05/2001		36,356
06/2001		23,978
07/2001		20,152
08/2001		32,644
09/2001		27,143
10/2001		21,743
11/2001		28,963
12/2001		27,101
01/2002		36,768
02/2002		21,677
03/2002		49,073
04/2002		60,534
05/2002		36,794
06/2002		56,646
07/2002		72,825

Month	Change in tariffs	Exports (tons)
08/2002		47,004
09/2002		60,064
10/2002		56,876
11/2002		46,269
12/2002		76,470
01/2003		49,410
02/2003		68,638
03/2003		72,001
04/2003		71,888
05/2003		71,795
06/2003		68,812
07/2003		71,546
08/2003		98,743
09/2003		90,390
10/2003		66,780
11/2003		115,663
12/2003		192,695
01/2004	China lowers export VAT rebate to 8%	82,303
02/2004		83,818
03/2004		83,739
04/2004		67,903
05/2004		75,040
06/2004		108,018
07/2004		84,984
08/2004		139,684
09/2004		148,391
10/2004		143,934
11/2004		160,819
12/2004		222,592
01/2005	China imposes 5% export tariff, removes 8% export VAT rebate	114,930
02/2005		77,123
03/2005		146,859
04/2005		107,961
05/2005		142,280
06/2005		121,022
07/2005		95,910
08/2005		55,690
09/2005		58,514
10/2005		73,120
11/2005		84,485

Month	Change in tariffs	Exports (tons)
12/2005		64,384
01/2006		60,371
02/2006		59,899
03/2006		77,579
04/2006		82,785
05/2006		64,264
06/2006		78,792
07/2006		72,477
08/2006		94,082
09/2006		84,230
10/2006		47,739
11/2006	China raises export tariff to 15%	65,816
12/2006		50,747
01/2007		22,548
02/2007		23,596
03/2007		10,362
04/2007		17,581
05/2007		14,378
06/2007		13,805
07/2007		10,405
08/2007		17,376
09/2007		12,712
10/2007		1,043
11/2007		6,103
12/2007		10,884
01/2008		5,521
02/2008		2,372
03/2008		8,619
04/2008		5,569
05/2008		4,022
06/2008		9,630
07/2008		4,848
08/2008		7,882
09/2008		8,435
10/2008		6,011
11/2008		854
12/2008		46,364
01/2009		82
02/2009		1,911
03/2009		1,683

Month	Change in tariffs	Exports (tons)
04/2009		118
05/2009		258
06/2009		2,872
07/2009		2,222
08/2009		530
09/2009		2,255
10/2009		3,175
11/2009		3,503
12/2009		27,295
01/2010		9,129
02/2010		4,739
03/2010		2,212
04/2010		48,546
05/2010		25,265
06/2010		17,703
07/2010		15,925
08/2010		9,820
09/2010		6,133
10/2010		15,145
11/2010		15,718
12/2010		23,207
01/2011		235
02/2011		479
03/2011		4,446
04/2011		6,201
05/2011		14,863
06/2011		6,789
07/2011		17,862
08/2011		1,907
09/2011		1,164
10/2011		826
11/2011		21,767
12/2011		5,332
01/2012		15,646
02/2012		6,430
03/2012		12,288
04/2012		8,201
05/2012		9,280
06/2012		10,524
07/2012		12,128

Month	Change in tariffs	Exports (tons)
08/2012		8,977
09/2012		21,915
10/2012		4,379
11/2012		9,190
12/2012		6,613
01/2013		15,088
02/2013		2,226
03/2013		8,422
04/2013		10,633
05/2013		9,442
06/2013		8,163
07/2013		817
08/2013		10,179
09/2013		11,960
10/2013		9,296
11/2013		6,082
12/2013		23,741
01/2014		9,557
02/2014		5,038
03/2014		8,917
04/2014		10,985
05/2014		20,235
06/2014		5,648
07/2014		7,893
08/2014		13,177
09/2014		7,902
10/2014		3,435
11/2014		2,750
12/2014		924
01/2015		582
02/2015		1,098
03/2015		15,620
04/2015		1,613
05/2015		618
06/2015		881
07/2015		1,613
08/2015		742
09/2015		221
10/2015		1,177
11/2015		2,648

Month	Change in tariffs	Exports (tons)
12/2015		3,518
01/2016		5,165
02/2016		2,985
03/2016		5,196
04/2016		151
05/2016		29
06/2016		1,068
07/2016		1,108
08/2016		785
09/2016		174
10/2016		28
11/2016		24
12/2016		250

Source: IHS, Markit, GTA database (accessed March 30, 2017); Chan, "Taxman Seeks Aluminum Output Cut," July 20, 2007.
Note: In 2006, China split 7601.10.00 (unwrought, unalloyed aluminum) into two tariff lines, 7601.10.10 (Containing by weight 99.95% or more of aluminum) and 7601.10.90 (Other). Exports in 7601.10.00 are not subject to an export tariff, but account for a small share of trade. This data corresponds to fig. 6.13.

Table L.32: China: Chinese and global average business costs for certain aluminum flat-rolled products, 2011–15 (dollars per mt)

	2011	2012	2013	2014	2015
1xxx sheet					
China	3,266	3,144	3,076	2,894	2,625
World	3320.614	3057.481	2950.822	2972.774	2616.245
Foil stock					
China	3032.82	2937.072	2807.694	2642.129	2365.506
World	3090.387	2840.079	2713.628	2735.329	2392.634
Building sheet					
China	3463.286	3299.12	3237.929	3091.61	2794.826
World	3237.243	2908.732	2802.848	2926.681	2552.659

Source: CRU Group.
Note: This data corresponds to fig. 6.14.

Table L.33: GCC countries: Wrought aluminum production, 2011-15 (thousand mt)

	2011	2012	2013	2014	2015
Production	1,289	1,403	1,497	1,639	1,772

Source: USITC estimate based on CRU Group.
Note: This data corresponds with fig. 7.2.

Table L.34: GCC countries: Primary unwrought aluminum consumption by country, 2011–15 (thousand mt)

	2011	2012	2013	2014	2015
Bahrain	336	345	360	378	391
United Arab Emirates	156	164	172	183	194
All other	219	238	245	288	330

Source: CRU Group.
Note: Individual consumption statistics were available only for the UAE and Bahrain. Statistics for the remainder of the region were aggregated. This data corresponds to fig. 7.3.

Table L.35: GCC countries: Exports of primary unwrought aluminum products to the United States (HS headings 7601), 2011–15 (thousand mt)

	2011	2012	2013	2014	2015
Bahrain	40	25,916	29,268	53,873	74,423
Qatar	68,240	131,832	94,985	91,731	86,325
Saudi Arabia	45	1,498	469	14,403	76,130
United Arab Emirates	241,726	254,476	250,432	260,921	292,764
GCC Total	310,050	413,723	375,154	420,928	529,642

Source: Official statistics compiled from USITC (accessed January 26, 2017).
Note: This data corresponds to fig. 7.4.

Table L.36: GCC countries: Natural-gas prices for GCC countries and the United States, January–August 2015 (dollars per million British thermal units (MMbtu))

Country	MMbtu
Bahrain	2.5
Kuwait	1.5
Oman	3
Qatar	0.75
Saudi Arabia	0.75
United Arab Emirates	0.75
GCC Average	1.54
United States	2.8

Source: IMF, "Energy Price Reforms in the GCC," November 2015, 5.
Note: This data corresponds to fig. 7.5.

Table L.37: GCC countries: Electricity prices for GCC countries and the United States, January–August 2015 (dollars per kilowatt hour)

Country	$ per kWh
Bahrain	0.03
Kuwait	0.01
Oman	0.04
Qatar	0.05
Saudi Arabia	0.09
United Arab Emirates	0.1
GCC Average	0.05
United States	0.1

Source: IMF, "Energy Price Reforms in the GCC," November 2015, 5.
Note: This data corresponds to fig. 7.6.

Table L.38: Russia: Rusal and LME primary unwrought aluminum prices and ruble exchange rate, 2011–15

Year	Exchange rate	Cost per ton	LME price
2011	29.38	1984	2395
2012	31.09	1946	2018
2013	31.84	1907	1845
2014	38.38	1729	1867
2015	60.94	1455	1661

Source: CRU Group; UC Rusal annual reports, 2011–15.
Note: This data corresponds to fig. 8.2.

Table L.39: Europe: Share of primary and wrought aluminum production by countries, 2011–15

Primary Aluminum		Wrought Aluminum	
Country	Percentage	Country	Percentage
Norway	27%	Germany	31%
Iceland	19%	Italy	11%
Germany	11%	France	9%
France	8%	United Kingdom	3%
Spain	8%	Rest of Europe	46%
Rest of Europe	26%		

Source: CRU Group.
Note: Because of rounding, total may not equal 100 percent. This data corresponds to fig. 9.1.

Table L.40: Germany and world: Average business costs for certain aluminum flat-rolled products, 2011–15 (dollars per mt)

Product/ Country or Region	2011	2012	2013	2014	2015
Sheet 1xxx					
Germany	3,376	3,015	2,863	3,034	2,556
World Avg.	3,321	3,057	2,951	2,973	2,616
Building Sheet					
Germany	3,476	3,114	3,012	3,178	2,696
World	3,237	2,909	2,803	2,927	2,553
Foil Stock					
Germany	3,114	2,763	2,609	2,778	2,345
World	3,090	2,840	2,714	2,735	2,393

Source: CRU Group.
Note: This data corresponds to fig. 9.2.