Notes and Sources

Text Notes

Legislation and Regulations

[*1*]State of California Air Resources Board, *Staff Report: Proposed Regulations for Low Emission Vehicles and Clean Fuels* (Sacramento, CA August 13, 1990).

[*2*]For more information on the Environmental Protection Agency's implementation of the fine particulate standard see http://www.epa.gov/airlinks/pm25_desig_guidance_final.pdf.

[*3*]For more information on the Environmental Protection Agency's implementation of the mercury emissions reduction see http://www.epa.gov/ttn/atw/combust/utiltox/utoxpg.html#REG.

[*4*]The Minerals Management Service (MMS) is the federal agency in the U.S. Department of the Interior that manages the nation's oil, natural gas, and other mineral resources on the outer continental shelf (OCS) in federal offshore waters. The agency also collects, accounts for, and disburses mineral revenues from Federal and American Indian leases, including royalty payments for oil and gas production from the OCS.

[*5*]A play is a set of known or postulated oil and (or) gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathway, trapping mechanism, and hydrocarbon type.

[*6*]The open season is a period when all parties are given equal consideration. Also, when a company becomes an open access transporter, it is generally expected to have an "open season" to accept bids for transportation. During that time, all shippers are treated equally in the queue for service, with space divided on a *pro rata* basis. When the open season is over, shippers are generally treated on a first come first served basis.

[*7*]The complete regulations are available in "Regulations of Connecticut State Agencies, Title 22a, Section 22a-174-1 to 22a-174-200," at web site www.dep.state.ct.us/air2/regs/mainregs.htm.

[*8*]Massachusetts Department of Environmental Protection, "Background Document and Technical Support for Public Hearings on Proposed Amendments to 310 CMR 7.00 et seq." (October 2003), web site www.state.ma.us/dep/bwp/daqc/daqcpubs.htm#regs.

[*9*]State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO), "Comparison of State Multi-Pollutant Strategies for Power Plants" (provided by Amy Royden, April 2003).

[*10*]State of Maine, "An Act to Provide Leadership in Addressing the Threat of Climate Change," Chapter 237, H.P. 622-L.D. 845, Session Laws of the State of Maine, 121st Legislature (Approved May 21, 2003), web site http://janus.state.me.us/legis/.

[*11*]"Regulations and Notices," web site www.state.ma.us/dep/bwp/daqc/daqcpubs.htm.

[*12*]Emission Control Plans," web site www.state.ma.us/dep/bwp/daqc/daqcpubs.htm.

[*13*]B.G. Rabe, "Greenhouse and Statehouse: The Evolving State Government Role in Climate Change" (Pew Center on Global Climate Change, November 2002), web site www.pewclimate.org.

[*14*]Web site www.state.ma.us/dep/bwp/daqc/daqcpubs.htm#regs.

[*15*]"Multiple Pollutant and Annual Budget Trading and Banking Program," Chapter Env-A2900, web site www.des.state.nh.us/ard/ardrules.htm.

[*16*]D. Andzelm, "The New Hampshire Clean Power Strategy: A Review," *Alberta Environment* (June 25, 2002), web site www3.gov.ab.ca/env/air/emissions_trading/.

[*17*]B.G. Rabe, "Greenhouse and Statehouse: The Evolving State Government Role in Climate Change" (Pew Center on Global Climate Change, November 2002), web site www.pewclimate.org.

[*18*]U.S. Environmental Protection Agency, Office of Regulatory Enforcement Division, EPA Region 2 Air Compliance Branch, "PSEG Fossil LLC Civil Judicial Settlement Fact Sheet" (January 2002), web site http://cfpub.epa.gov/compliance/resources/cases/civil/.

[*19*]See web site www.dec.state.ny.us/website/dar/adopted.html.

[*20*]U.S. Environmental Protection Agency, web site www.epa.gov/oar/oaq_caa.html.

[*21*]State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO), "Comparison of State Multi-Pollutant Strategies for Power Plants" (provided by Amy Royden, April 2003).

[*22*]North Carolina Department of Environment and Natural Resources, *Mercury Emissions and Mercury Controls for Coal-fired Electric Utility Boilers* (September 2003), web site http://daq.state.nc.us/news/leg/Mercury1_912003.pdf.

[*23*]North Carolina Department of Environment and Natural Resources, *CO_2 Emission Reduction Options for Coal-fired Electric Utility Boilers and Other Stationary Sources* (September 2003), web site http://daq.state.nc.us/news/leg/CO2_912003.pdf.

[*24*]North Carolina Department of Environment and Natural Resources and the North Carolina Utilities Commission, *Implementation of the "Clean Smokestacks Act"* (May 30, 2003), web site www.ncuc.commerce.state.nc.us/.

[*25*]State of Oregon, Oregon Administrative Rules, Chapter 345, Division 24, web site http://arcweb.sos.state.or.us/banners/rules.htm.

[*26*]S. Sadler, "Oregon Carbon Dioxide Emission Standards for New Energy Facilities," Oregon Office of Energy, Oregon Energy Facility Siting Council, Rule Division 24, OAR 345-024-0500 (1997), web sites www.energy.state.or.us and www.climatetrust.org.

[*27*]Assuming a plant heat rate of 10,000 Btu per kilowatthour and a CO_2 emission factor of 25.50 kg carbon per million Btu.

[*28*]See 40 CFR Parts 51 and 52, [FRL-7414-6; RIN 2060-AK28; Electronic Docket OAR-2002-0068; Legacy Docket A-2002-04], Prevention of Significant Deterioration (PSD) and Non-attainment New Source Review (NSR): Equipment Replacement Provision of the Routine Maintenance, Repair and Replacement Exclusion, at web site www.epa.gov/air/nsr-review/ERP_merged_8-27bh.pdf.

[*29*]See 40 CFR Parts 51 and 52, [FRL-7414-6; RIN 2060-AK28; Electronic Docket OAR-2002-0068; Legacy Docket A-2002-04], "Prevention of Significant Deterioration (PSD) and Non-attainment New Source Review (NSR): Equipment Replacement Provision of the Routine Maintenance, Repair and Replacement Exclusion," web site www.epa.gov/air/nsr-review/ERP_merged_8-27bh.pdf.

[*30*]See National Coal Council, *Increasing Electricity Availability From Coal-Fired Generation in the Near-Term* (May 2001), at web site www.nationalcoalcouncil.org/Documents/May2001report-revised.pdf.

[*31*]For a complete copy of the Energy Policy Act of 2003, see web site www.house.gov/rules/text_6cr.pdf.

[*32*]For a description, see U.S. Department of Energy, "Bush Administration Launches 'Climate Vision'" (Press Release No. PR-03-037, February 12, 2003).

Issues in Focus

[*33*]Detailed documentation of the NEMS Macroeconomic Activity Module is available at web site http://tonto.eia.doe.gov/FTPROOT/modeldoc/m065 (2003).pdf.

[*34*]C. Hulten, "Total Factor Productivity: A Short Biography," in C.R. Hulten, E.R. Dean, and M.J. Harper, Eds., *New Developments in Productivity Analysis* (Chicago, IL: The University of Chicago Press, 2001).

[*35*]The methodology used by the BLS is documented in U.S. Department of Labor, Bureau of Labor Statistics, *BLS Handbook of Methods*, Bulletin 2490 (Washington, DC, April 1997), web site www.bls.gov/opub/hom/home.htm; E.R. Dean and M.J. Harper, "The BLS Productivity Measurement Program," Discussion Paper presented at the Conference on Research in Income and Wealth: New Directions in Productivity Research (March 20-21, 1998), web site www.bls.gov/lpc/lprdh98.pdf; and C.R. Hulten, E.R. Dean, and M.J. Harper, Editors, *New Developments in Productivity Analysis* (Chicago, IL: The University of Chicago Press, 2001).

[*36*]L.H. Meyer, "What Happened to the New Economy?," Remarks before the New York Association for Business Economics and The Downtown Economists (New York, NY, June 6, 2001), web site www.federalreserve.gov/boarddocs/speeches/2001/20010606/.

[*37*]M.N. Baily, "The New Economy: Post Mortem or Second Wind?," *Journal of Economic Perspectives*, Vol. 16, No. 2 (Spring 2002).

[*38*]S.D. Oliner and D.F. Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?," *Journal of Economic Perspectives*, Vol. 14, No. 4 (Fall 2000); Council of Economic Advisors, *Economic Report of the President* (Washington, DC, January 2001); and D.W. Jorgenson, M.S. Ho, and K.J. Stiroh, "Projecting Productivity Growth: Lessons from the U.S. Growth Resurgence," *Economic Review*, Federal Reserve Bank of Atlanta (Third Quarter 2002).

[*39*]K.J. Stiroh, "Information Technology and the U.S. Productivity Revival: What do the Industry Data Say?," *American Economic Review*, Vol. 92, No. 5 (December 2002), pp. 1559-1576.

[*40*]J.B. DeLong, "Productivity Growth in the 2000s," unpublished manuscript, web site www.j-bradford-delong. net/ Econ_ Articles/ macro_ annual/ delong_ macro_annual_05.pdf; and J.B. DeLong and L.H. Summers, "The New Economy: Background, Questions, Speculations," in *Economic Policies for the Information Age* (Kansas City, KS, 2002: Federal Reserve Bank of Kansas City), web site www.j-bradford-delong.net/Econ_Articles/Summers_New_Economy_2001.html.

[*41*]R.J. Gordon, "Does the New Economy Measure Up to the Great Inventions of the Past?" *Journal of Economic Perspectives*, Vol. 14, No. 4 (Fall 2000); and R.J. Gordon, "Hi-Tech Innovation and Productivity Growth: Does Supply Create its Own Demand?" *NBER Working Paper No. W9437* (January 2003).

[*42*]U.S. Geological Survey, National Oil and Gas Resource Assessment Team, "1995 National Assessment of United States Oil and Gas Resources," *U.S. Geological Survey Circular 1118* (1995).

[*43*]U.S. Geological Survey, National Oil and Gas Resource Assessment Team, "1995 National Assessment of United States Oil and Gas Resources," *U.S. Geological Survey Circular 1118* (1995), p. 4.

[*44*]U.S. Geological Survey, National Oil and Gas Resource Assessment Team, "1995 National Assessment of United States Oil and Gas Resources," *U.S. Geological Survey Circular 1118* (1995), p. 5.

[*45*]The following basins (study areas) were reassessed by the USGS as part of a Federal interagency study of access restrictions in the Rocky Mountains: the Paradox/San Juan, the Uinta/Piceance, the Greater Green River, the Powder River, and the Montana Thrust Belt. The study, *Scientific Inventory of Onshore Federal Land's Oil and Gas Resources and Reserves and the Extent and Nature of Restrictions or Impediments to Their Development* (January 2003), was conducted under the authority of the Energy Policy and Conservation Act (EPCA).

[*46*]EIA, based on resource allocation parameters developed by Advanced Resources International from results of the study, *Scientific Inventory of Onshore Federal Land's Oil and Gas Resources and Reserves and the Extent and Nature of Restrictions or Impediments to Their Development*.

[*47*]The United States has been exporting LNG to Japan for more than 30 years, from a liquefaction plant in Kenai, Alaska, with a capacity of 68 billion cubic feet per year. The volume exported in 2002 was 63 billion cubic feet.

[*48*]EIA uses NEB projections as the major basis for estimating Canadian natural gas production. NEB's 1999 forecast was published in *Canadian Energy Supply and Demand to 2025*. Its 2003 projections were published in *Canada's Energy Future, Scenarios for Supply and Demand to 2025*. NPC's 1999 projections were published in *Natural Gas, Meeting the Challenges of the Nation's Growing Natural Gas Demand*. Its 2003 forecast was published in *Balancing Natural Gas Policy—Fueling the Demands of a Growing Economy*,Volume I, Summary of Findings and Recommendations.

[*49*]In situ bitumen production is accomplished through the injection of steam into the underground reservoir, which drives the bitumen to the production wells. Surface-mined bitumen uses the same mining techniques as are used for surfaced-mined coal.

[*50*]Examples of the first view (permanent loss) include Cambridge Economic Research Associates, *North American Natural Gas Watch*, "Pricing at Scarcity" (Spring 2003); and Charles River Associates, *The Potential for*

Natural Gas Demand Destruction, presentation to the Canadian Gas Association Annual Executive Conference (June 27, 2003), web site www.wdysevents.com/registrations/directpapers.asp?event=angm03web&paper=partridge. Examples of the opposite view include J.M. Dukert, “What Do Natural Gas Numbers Show? . . . Surprise!,” *Dialogue*, Newsletter of the United States Association for Energy Economics, Vol. 11, No. 2 (July 2003), pp. 30-32; and R.S. Linden, “Is It Real or Is It Hype?,” *Public Utilities Fortnightly* (August 2003), pp. 32-37.

[*51*]The most recently reported industrial-sector consumption data are for 1998. See Energy Information Administration, *Manufacturing Consumption of Energy 1998*, web site www.eia.doe.gov/emeu/mecs/mecs98/datatables/contents.html.

[*52*]Data provided by The Fertilizer Institute. Note that the nitrogenous fertilizer industry produces ammonia, which contains 82 percent nitrogen. Nitrogen is the nutrient that is used in fertilizer applications.

[*53*]The average fertilizer application for corn (the most fertilizer-intensive crop) was 137 pounds per acre during the 2002 crop year. That application rate implies that the embodied cost of energy in fertilizer was about $8.19 per acre during the 1990s. In 2003, the estimated embodied cost of energy increases to $12.85 per acre. In 2002, each acre produced an average of 130 bushels of corn.

[*54*]U.S. General Accounting Office, *Natural Gas: Domestic Nitrogen Fertilizer Production Depends on Natural Gas Price Availability and Prices* (September 2003), p. 6.

[*55*]The nitrogenous fertilizer industry reported that no petroleum was used as a feedstock in 1998. Calculated from Energy Information Administration, *Manufacturing Consumption of Energy 1998*, web site www.eia.doe.gov/emeu/mecs/mecs98/datatables/contents.html.

[*56*]The values reported are for Nitrogenous Fertilizer Manufacturer, NAICS Code 325311. The most recently reported data are for 1998. Values for additional years are NEMS projections. See Energy Information Administration, *Manufacturing Consumption of Energy 1998*, web site www.eia.doe.gov/emeu/mecs/mecs98/datatables/contents.html.

[*57*]Energy Information Administration, *Manufacturing Consumption of Energy 1994*, DOE/EIA-0512(94) (Washington, DC, December 1997), Table A59.

[*58*]U.S. Geological Survey, *Minerals Yearbook*, “Nitrogen,” various issues.

[*59*]U.S. Geological Survey, *Mineral Commodity Summaries*, “Nitrogen (Fixed) Ammonia” (January 2003), p. 118.

[*60*]Farmland Industries, “Farmland Files for Protection Under Chapter 11,” News Release (May 31, 2002).

[*61*]The NEMS model does not further disaggregate agricul tural chemicals (NAICS Code 32531) into its industrial segments; consequently, the agricultural chemicals industry is used as a proxy for the nitrogenous fertilizer industry (NAICS Code 325311). Over the 1997-2001 period, agricultural chemicals and nitrogenous fertilizer experienced similar growth rates (falling by 6 percent and 5 percent, respectively, per year). Nitrogenous fertilizer accounted for about 15 percent of the value of shipments in agricultural chemicals. Calculated from data in U.S. Census Bureau, *Annual Survey of Manufactures, Statistics for Industry Groups and Industries: 2001* (Washington, DC, January 2003).

[*62*]The calculations assume 33 percent efficiency (heat rate of 10,339) for an older gas-fired steam plant and 45 percent efficiency (heat rate of 7,582) for a new gas-fired combined-cycle plant.

[*63*]National Petroleum Council, *Balancing Natural Gas Policy—Fueling the Demands of a Growing Economy*,Volume I, Summary of Findings and Recommendations (Washington, DC, September 2003), web site www.npc.org/NG_Volume_1.pdf.

[*64*]The *AEO2004* and NPC accounting methods for the industrial and electric power sectors differ. For comparison, the *AEO2004* industrial and electric power sector projections have been adjusted to be consistent with the NPC accounting methodology.

[*65*]The Henry Hub spot price and the average wellhead price for natural gas are not equivalent measures. The difference between Henry Hub and wellhead gas prices fluctuates over time, and the Henry Hub price can exceed the average wellhead price by as little as a few cents per million Btu or as much as 70 cents per million Btu.

[*66*]Although the *AEO2004* and NPC gas resource base assumptions are different, a smaller NPC gas resource base does not necessarily imply a more expensive exploration and production cost profile. The NPC gas resource exploration and production cost profile is not available, so a direct comparison with the *AEO2004* resource base is not possible.

[*67*]The NPC modeling framework projects monthly gas consumption and supply, including gas injections and withdrawals from gas storage fields. Consequently, the NPC model in any particular year can project a net gas storage injection, which is accounted for as gas consumption, or a net gas storage withdrawal, which is accounted for as gas supply. The *AEO2004* modeling framework projects annual gas consumption and supply and assumes that gas storage injections and withdrawals exactly counterbalance over the course of a year.

[*68*]The NPC scenarios use a 2002 net gas import figure of 3.6 trillion cubic feet, compared with 3.5 trillion cubic feet in *AEO2004*.

[*69*]The Balanced Future scenario also recategorizes 28 trillion cubic feet of 58 trillion cubic feet of high cost, long-lead-time onshore gas resources in the Rocky Mountains as being fully accessible at the average cost and development delay.

[*70*]The *AEO2004* and NPC scenarios use somewhat different definitions for “unconventional gas.” *AEO2004* includes all natural gas contained in sandstone reservoirs with permeability less than 0.1 millidarcies; the NPC definition includes such reservoirs only if they are “continuous basin-centered” deposits. In this discussion, however, the NPC unconventional gas production numbers conform with the *AEO2004* definition.

[*71*]See H. Burness, W.D. Montgomery, and J. Quirk, “The Turnkey Era in Nuclear Power,” *Land Economics*, Vol. 56 (May 1980), pp. 188-202.

[*72*] Energy Information Administration, *An Analysis of Nuclear Power Plant Construction Costs*, DOE/EIA-0485 (Washington, DC, March 1986).

[*73*]See, for example, Energy Information Administration, *An Analysis of Nuclear Power Plant Construction Costs*,

DOE/EIA-0485 (Washington, DC, March 1986), Appendix B.

[*74*]U.S. Department of Energy, Office of Nuclear Energy, Science, and Technology, *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010* (Washington, DC, October 2001), Vol. 2. GE is also designing a newer BWR, the ESBWR, which is simpler and has more passive safety features than the ABWR. A cost estimate for the ESBWR has not yet been prepared.

[*75*]All the operating reactors in the United States use light water as a moderator. With the exception of the United Kingdom's gas-cooled reactors and CANDU units, the same is generally true in Europe and Asia. Both the ABWR and AP1000 are light-water reactors.

[*76*]The ACR-700 has never been built.

[*77*]In general, the information about the cost of foreign nuclear power plants is not as good as the U.S. data. The realized overnight costs for foreign units that entered commercial operation in the 1980s tended to range in the mid-$2,000s per kilowatt. There is also some evidence of growth in foreign nuclear power capital costs. See G. McKerron, "Why Do Nuclear Power Plant Construction Costs Continue To Increase?," *Energy Policy* (July 1992). It must be noted that this research is somewhat controversial. Additionally, recent experience suggests that costs of building nuclear power plants in Asia are falling.

[*78*]See, for example, *The Future of Nuclear Power* (Massachusetts Institute of Technology, August 2003).

[*79*]There are a number of pressurized light-water reactors (PWRs) either operating or under construction in South Korea that are improvements on existing PWRs and thus could be considered advanced—the System 80+ reactors manufactured by BNFL (Westinghouse). However, the vendor has chosen not to market those reactors in the United States but instead to focus on the AP1000. Therefore, they are not considered here. See U.S. Department of Energy, Office of Nuclear Energy, Science, and Technology, *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010* (Washington, DC, October 2001), Vol. 1, p. 21.

[*80*] There are a number of problems with "transferring" foreign costs and experience to the United States. The most obvious is the use of exchange rates, which may distort the underling cost differences. The firm that supplied the cost data to EIA used a Purchasing Power Parity Index, instead of official exchange rates, which corrects for some (but not all) problems with currency conversions. Additionally, some have argued that because of practices that are unique to Asia, the cost of building the same plant in the United States would be less than in Asia. For example, some have argued that payments to residents surrounding plants in Asia are included in the construction costs, and because such payments would not be made in the United States, the cost of building the same plant in the United States would be less than in Asia. Thus, $2,060 per kilowatt, which was used as the starting point in the calculations, is actually less than the realized costs of the two operating advanced plants. The exact amount of the cost reduction cannot be made public because of proprietary agreements with the firm supplying the cost information.

[*81*]Exclusive of contingencies, the estimated nuclear construction cost is about $1,650 per kilowatt. EIA uses a project contingency of 10 percent and a "technological optimism factor" of 5 percent.

[*82*]The AP1000 estimates were obtained from U.S. Department of Energy, Office of Nuclear Energy, Science, and Technology, *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010* (Washington, DC, October 2001), Vol. 2, Chapter 4, Table II. The direct overnight construction costs for the CANDU reactor were obtained from "New Fuel for the CANDU-And a New CANDU, Too!," *Nukem Market Report* (June 2002), web site www.aecl.ca/images/up-NUKEMJune2002.pdf. The first-of-a-kind costs were estimated by EIA. EIA also examined a case in which nuclear capital costs were reduced by 10 percent. Becuase the case did not result in the construction of any new nuclear units, the results are not presented.

[*83*]The vendor's estimate of the cost (inclusive of contingency) of the third-of-a-kind twin-unit AP1000 is about $1,066 per kilowatt.

[*84*]Energy Information Administration, *Derivatives and Risk Management in the Petroleum, Natural Gas, and Electricity Industries*, SR/SMG/2002-01 (Washington, DC, October 2002).

[*85*]The rate was later raised to 15 percent by the Crude Oil Windfall Profits Act of 1980, which extended the credit to December 31, 1985, when it was allowed to lapse for wind.

[*86*]Dollars are expressed in year 2002 values, except as otherwise noted.

[*87*]See IRS Form 8835, *Renewable Electricity Production Credit* for the year 2002, web site www.irs.gov/pub/irs-pdf/f8835.pdf.

[*88*]Interstate Renewable Energy Council, *Minnesota Renewable Energy Incentives* (September 22, 2003), database of State incentives for renewable energy, web site www.dsire.org. Note that 425 megawatts, the original mandated term in 1994, has subsequently been extended to 825 megawatts by 2006 and 1,125 by 2010.

[*89*]Tax Relief Extension Act of 1999, Public Law 106-170.

[*90*]EIA's *Annual Energy Review 2002*, Table 8.7a, indicates 1,487 megawatts of net installations in 2001 for plants over 10 megawatts. See web site www.eia.doe.gov/emeu/aer/elect.html. The American Wind Energy Association estimates 1,697 megawatts of installations of all sizes in 2001. See web site www.awea.org/faq/instcap.html.

[*91*]Job Creation and Worker Assistance Act of 2002, Public Law 107-147.

[*92*]Wind power facilities also receive a 5-year accelerated depreciation allowance.

[*93*]For further discussion of cost and performance improvements, see C. Namovicz, "Modeling Wind and Intermittent Generation in the National Energy Modeling System (NEMS)," in American Wind Energy Association, *WindPower 2003 Conference Proceedings* (2003).

[*94*]Cost includes "busbar" costs plus transmission interconnection charge, but does not include additional grid services that may be required to facilitate integration of wind power. Excellent wind resources refer to sites in wind power Class 6 or better, as defined by the Pacific Northwest Laboratory as a site with an annual average wind speed at 50 meter hub height of 8.0 meters per second (17.9 miles per hour) or higher. See D.L. Elliot et al.,

Wind Energy Resource Atlas of the United States (Pacific Northwest Laboratory, March 1987), p. 3.

[*95*]Note that the levelized cost of both natural gas and coal plants depends on expected utilization rates. For comparison purposes, an 85-percent utilization rate is assumed for coal and 87 percent for combined cycle. Effective utilization rates (capacity factors) for current technology wind plants range from 33 to 40 percent, depending on quality of resource. The 40-percent capacity factor corresponds to the lowest levelized wind cost.

[*96*]The uncertainty of the expiration/extension cycle cannot be easily emulated within the current structure of the National Energy Modeling System.

[*97*]All dollars are year 2002 unless otherwise indicated. A 7-percent discount rate is used to evaluate time-series monetary calculations in accordance with OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. See web site www.whitehouse.gov/omb/circulars/a094/a094.pdf.

[*98*]Cost for the construction of a simple wind plant on favorable land, excluding factors such as more difficult terrain, upgrading of existing transmission, or higher value land uses that would be increasingly encountered because better resources were already utilized.

[*99*]"President Announces Clear Skies & Global Climate Change Initiatives" (February 14, 2002), web site www.whitehouse.gov/news/releases/2002/02/20020214-5.html.

[*100*]U.S. Department of State, *U.S. Climate Action Report 2002* (Washington, DC, May 2002), Chapter 5, "Projected Greenhouse Gas Emissions," pp. 70-80, web site http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsUSClimateActionReport.html. Some adjustments have been made to the projections to reflect the most recent (2002) data published by EIA, as well as to estimate the intervening years of the projections, which were provided only for 5-year intervals in the State Department report. In addition, the projections were extrapolated to provide estimates through 2025.

Market Trends

[*101*]Energy-intensive industries include food, paper, bulk chemicals, petroleum refining, glass, cement, steel, and aluminum.

[*102*]The reference case represents EIA's current judgment regarding Organization of Petroleum Exporting Countries' (OPEC) expected behavior in the mid-term where production is adjusted to keep world oil prices in the $22 to $28 per barrel range. Since OPEC, particularly the Persian Gulf nations, is expected to be the dominant supplier of oil in the international market over the mid-term, the organization's production choices will significantly affect world oil prices. The low oil price scenario could result from a future market where all oil production becomes more competitive. The high price scenario could result from a more cohesive and market-assertive OPEC with lower production goals and other non-financial (geopolitical) considerations.

[*103*]The transportation sector has been left out of these calculations because levels of transportation sector electricity use have historically been far less than 1 percent of delivered electricity. In the transportation sector, the difference between total and delivered energy consumption is also less than 1 percent.

[*104*]The definition of the commercial sector for *AEO2004* is based on data from the 1999 Commercial Buildings Energy Consumption Survey (CBECS). See Energy Information Administration, 1999 CBECS Public Use Data Files (October 2002), web site www.eia.doe.gov/emeu/cbecs/. Nonsampling and sampling errors (found in any statistical sample survey) resulted in a higher commercial floorspace estimate than found with the 1995 CBECS. In addition, 1999 CBECS energy intensities varied from earlier estimates, providing a different composition of end-use consumption. These factors contribute to the pattern of commercial energy use projected for *AEO2004*. Further discussion is provided in Appendix G.

[*105*]The intensities shown were disaggregated using the divisia index. The divisia index is a weighted sum of growth rates and is separated into a sectoral shift or "output" effect and an energy efficiency or "substitution" effect. It has at least two properties that make it superior to other indexes. First, it is not sensitive to where in the time period or in which direction the index is computed. Second, when the effects are separated, the individual components have the same magnitude, regardless of which is calculated first. See Energy Information Administration, "Structural Shift and Aggregate Energy Efficiency in Manufacturing" (unpublished working paper in support of the National Energy Strategy, May 1990); and Boyd et al., "Separating the Changing Effects of U.S. Manufacturing Production from Energy Efficiency Improvements," *Energy Journal*, Vol. 8, No. 2 (1987).

[*106*]Estimated as consumption of alternative transportation fuels in crude oil Btu equivalence. Alternative fuels include ethanol, electricity, hydrogen, natural gas, and propane.

[*107*]*Federal Register*, Volume 68, No. 66, Monday, April 7, 2003, pp.16868-16900.

[*108*]Small light trucks (compact pickup trucks and compact vans) are used primarily as passenger vehicles, whereas medium light trucks (compact utility trucks and standard vans) and large light trucks (standard utility trucks and standard pickup trucks) are used more heavily for commercial purposes.

[*109*]U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond*, ORNL/CON-444 (Washington, DC, September 1997); J. DeCicco et al, *Technical Options for Improving the Fuel Economy of U.S. Cars and Light Trucks by 2010-2015* (Washington, DC: American Council for an Energy Efficient Economy, April 2001); M.A. Weiss et al, *On the Road in 2020: A Life-Cycle Analysis of New Automotive Technologies* (Cambridge, MA: Massachusetts Institute of Technology, October 2000); A. Vyas, C. Saricks, and F. Stodolsky, *Projected Effect of Future Energy Efficiency and Emissions Improving Technologies on Fuel Consumption of Heavy Trucks* (Argonne, IL: Argonne National Laboratory, 2001); and Energy and Environmental Analysis, Inc., *Documentation of Technologies included in the NEMS Fuel Economy Model for Passenger Cars and Light Trucks* (prepared for Energy Information Administration, September 30, 2002).

[*110*]Values for incremental investments and energy expenditure savings are discounted back to 2003 at a 7-percent real discount rate.

[*111*]Unless otherwise noted, the term "capacity" in the discussion of electricity generation indicates utility, nonutility, and combined heat and power capacity. The costs reflect the arithmetic average of the regional cost.

[*112*]*AEO2004* does not include off-grid photovoltaics (PV). Based on annual PV shipments from 1989 through 2001, EIA estimates that as much as 112 megawatts of remote electricity generation PV applications (i.e., off-grid power systems) were in service in 2001, plus an additional 305 megawatts in communications, transportation, and assorted other non-grid-connected, specialized applications. See *Annual Energy Review 2002*, Table 10.6 (annual PV shipments, 1989-2001). The approach used to develop the estimate, based on shipment data, provides an upper estimate of the size of the PV stock, including both grid-based and off-grid PV. It will overestimate the size of the stock, because shipments include a substantial number of units that are exported, and each year some of the PV units installed earlier will be retired from service or abandoned.

[*113*]Hydroelectric and landfill gas assumptions are unchanged from the reference case. Assumptions are obtained or derived from the Electric Power Research Institute and DOE, Office of Energy Efficiency and Renewable Energy, *Renewable Energy Technology Characterizations*, EPRI-TR-109496 (Washington, DC, December 1997), web site www.eren.doe.gov/power/techchar.html.

[*114*]Based on technology characterizations found in the National Renewable Energy Laboratory *2003 Power Technologies Databook*. See web site www.nrel.gov/analysis/power_databook/. Cost and performance projections in the *Databook* are sourced to U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy publications and documents.

[*115*]Associated-dissolved natural gas is produced in conjunction with crude oil. Nonassociated gas is produced without crude oil production.

[*116*]Unconventional gas includes tight (low permeability), sandstone gas, shale gas, and coalbed methane.

[*117*]Gas exports from the United States to Mexico continue to exceed imports from Mexico through the end of the projections.

[*118*]Variations in mining costs are not necessarily limited to changes in labor productivity and wage rates. Other factors that affect mining costs and, subsequently, the price of coal include such items as severance taxes, royalties, fuel costs, and the costs of parts and supplies.

[*119*]U.S. Environmental Protection Agency, web site www.epa.gov/airmarkets/arp/overview.html (October 25, 2002).

[*120*]**Buildings:** Energy Information Administration (EIA), *Technology Forecast Updates—Residential and Commercial Building Technologies—Advanced Adoption Case* (Arthur D. Little, Inc., October 2001). Industrial: EIA, *Industrial Model: Update on Energy Use and Industrial Characteristics* (Arthur D. Little, Inc., September 2001). **Transportation:** U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond,* ORNL/CON-444 (Washington, DC, September 1997); J. DeCicco and M. Ross, *An Updated Assessment of the Near-Term Potential for Improving Automotive Fuel Economy* (Washington, DC: American Council for an Energy-Efficient Economy, November 1993); and A. Vyas, C. Saricks, and F. Stodolsky, *Projected Effect of Future Energy Efficiency and Emissions Improving Technologies on Fuel Consumption of Heavy Trucks* (Argonne, IL: Argonne National Laboratory, 2001). **Fossil-fired generating technologies:** U.S. Department of Energy, Office of Fossil Energy. **Renewable generating technologies:** U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, and Electric Power Research Institute, *Renewable Energy Technology Characterizations*, EPRI-TR-109496 (Washington, DC, December 1997).

Table Notes and Sources

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Table 1. Total energy supply and disposition in the *AEO2004* reference case: summary, 2001-2025: Tables A1, A19, and A20. **Note:** Quantities are derived from historical volumes and assumed thermal conversion factors. Other production includes liquid hydrogen, methanol, supplemental natural gas, and some inputs to refineries. Net imports of petroleum include crude oil, petroleum products, unfinished oils, alcohols, ethers, and blending components. Other net imports include coal coke and electricity. Some refinery inputs appear as petroleum product consumption. Other consumption includes net electricity imports, liquid hydrogen, and methanol.

Table 2. Emissions from electricity generators in selected States, 2002: U.S. Environmental Protection Agency, web site www.epa.gov/airmarkets/emissions/prelimarp/index.html.

Table 3. Existing State air emissions legislation with potential impacts on the electricity generation sector: Sources cited in text.

Table 4. Labor productivity growth in the nonfarm business sector, 1948-1973 and 1973-1995: Source: M.N. Baily, "The New Economy: Post Mortem or Second Wind?," *Journal of Economic Perspectives*, Vol. 16, No. 2 (Spring 2002).

Table 5. Estimated changes in labor productivity growth between 1995-2000 and 1973-1995: M.N. Baily, "The New Economy: Post Mortem or Second Wind?," *Journal of Economic Perspectives*, Vol. 16, No. 2 (Spring 2002).

Table 6. Estimates of future steady-state growth in U.S. labor productivity: S.D. Oliner and D.E. Sichel, "Information Technology and Productivity: Where Are We Now and Where Are We Going?," *Federal Reserve Board Finance and Economics Discussion Series*, No. 2002-29 (May 2002), Table 5, web site www.federalreserve.gov/pubs/feds/2002/200229/200229abs.html.

Table 7. Principal deepwater fields in production or expected to start production by 2007: EIA computations based on MMS, *Gulf of Mexico Outer Continental Shelf Daily Oil and Gas Production Rate Projections From 2003-2007* (MMS 2003-028) and announcements in the trade press.

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Table 12. North American LNG regasification proposals as of December 1, 2003: Energy Information Administration, Office of Integrated Analysis and Forecasting.

Table 13. Projected Canadian tar sands oil supply and potential range of natural gas consumption in the *AEO2004* reference case, 2002-2025: Energy Information Administration, Office of Integrated Analysis and Forecasting.

Table 14. Overview of U.S. natural gas consumption and supply projections, 2002, 2010, and 2025: AEO2004 National Energy Modeling System run AEO2004.D101703E and NPC spreadsheets npcsm4a_GasProductionInBCF.xls, npcsm4a_Gas DemandBySectorInBCF.xls, npcsm4a_RegionalGas BalanceInBCF.xls, npcsm4ma_GasProductionInBCF.xls, npcsm4ma_GasDemandBySectorInBCF.xls, npcsm4ma_RegionalGasBalanceInBCF.xls, Supply_CurrentPath.xls, and Supply_BalancedFuture.xls. **Note:** The sum of the three components of NPC's lower 48 onshore gas production (associated, nonassociated, and unconventional) do not equal NPC's total lower 48 onshore gas production. Typically, the sum of these three components is 100 to 150 billion cubic feet less than total lower 48 onshore production.

Table 15. Growth rates for natural gas consumption in the industrial and electric power sectors, 2002-2025: AEO2004 National Energy Modeling System run AEO2004.D101703E and NPC spreadsheets npcsm4a_GasProductionInBCF.xls and npcsm4a_GasDemandBySectorInBCF.xls. **Note:** In *AEO2004*, incremental CHP natural gas consumption after 2001 is subtracted from the industrial sector and added to electric power sector gas consumption. In 2025, 979 billion cubic feet of gas is reallocated by this method.

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Table 19. Projected changes in U.S. greenhouse gas emissions, gross domestic product, and greenhouse gas intensity, 2002-2025: 2002 emissions: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, DOE/EIA-0573(2002) (Washington, DC, November 2003). **Carbon dioxide emissions and gross domestic product:** AEO2004 National Energy Modeling System, run AEO2004.D101703E. **Other gases and adjustments:** U.S. Department of State, *U.S. Climate Action Report 2002* (Washington, DC, May 2002), pp. 70-80 (2002 and 2012 values calculated by interpolation). **Note:** Greenhouse gas emissions totals exclude carbon sequestration, for consistency with Administration figures.

Table 20. New car and light truck horsepower ratings and market shares, 1990-2025: History: U.S. Environmental Protection Agency, Office of Transportation and Air Quality, *Light-Duty Automotive Technology And Fuel Economy Trends: 1975-2003*, EPA-420-S-03-004, April 2003. **Projections:** AEO2004 National Energy Modeling System, run AEO2004.D101703E.

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Table 25. Crude oil production from Gulf of Mexico offshore, 2002-2025: AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Table 26. Petroleum consumption and net imports in five cases, 2002 and 2025: 2002: Energy Information Administration, *Petroleum Supply Annual 2001, Vol. 1*, DOE/EIA-0340(2001)/1 (Washington, DC, June 2001). **2025:** Tables A11, B11, and C11.

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Figure 76. Nuclear power plant capacity factors, 1973-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 77. Grid-connected electricity generation from renewable energy sources, 1970-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Table A17. **Note:** Data for nonutility producers are not available before 1989.

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Figure 85. Natural gas consumption by end-use sector, 1990-2025: History: Electric utilities: Energy Information Administration (EIA), *Electric Power Annual 2001*, Vol. 1, DOE/EIA-0348(2001)/1 (Washington, DC, August 2001). **Nonutilities:** EIA, Form EIA-860B, "Annual Electric Generator Report-Nonutility." **Other:** EIA, *State Energy Data Report 1999*, DOE/EIA-0214(1999) (Washington, DC, May 2001). **Projections:** Table A13.

Figure 86. Natural gas prices by end-use sector, 1970-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Table A14.

Figure 87. Natural gas production by source, 1990-2025: History: Total production and Alaska: Energy Information Administration (EIA), *Natural Gas Annual 2000*, DOE/EIA-0131(2000) (Washington, DC, October 2001). **Offshore, associated-dissolved, and conventional:** EIA, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, DOE/EIA-0216. **Unconventional:** EIA, Office of Integrated Analysis and Forecasting. 2001 and projections: Table A15. **Note:** Unconventional gas recovery consists principally of production from reservoirs with low permeability (tight sands) but also includes methane from coal seams and gas from shales.

Figure 88. Lower 48 onshore natural gas production by supply region, 1990-2025: AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 89. Net U.S. imports of natural gas, 1970-2025: History: Energy Information Administration (EIA), *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Table A13.

Figure 90. Lower 48 natural gas wellhead prices in three cases, 1985-2025: Energy Information Administration, *Natural Gas Annual 2000*, DOE/EIA-0131(2000) (Washington, DC, October 2001). **2010 and 2025:** Tables A1 and B1.

Figure 91. Lower 48 natural gas production in three cases, 1970-2025: History: Energy Information Administration (EIA), *Natural Gas Annual 2000*, DOE/EIA-0131 (2000) (Washington, DC, October 2001). **2001 and Projections:** Table F10.

Figure 92. Lower 48 natural gas reserves in three cases, 1990-2025: 1990-1996: Energy Information Administration (EIA), Office of Integrated Analysis and Forecasting, computations based on well reports submitted to the American Petroleum Institute. **1997-2000:** EIA, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, DOE/EIA-0216(77-2000). **2001 and projections:** AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 93. Lower 48 crude oil wellhead prices in three cases, 1970-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Tables A15 and C15.

Figure 94. U.S. petroleum consumption in five cases, 1970-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Tables A11, B11, and C11.

Figure 95. Lower 48 crude oil reserves in three cases, 1990-2025: 1990-1996: Energy Information Administration (EIA), Office of Integrated Analysis and Forecasting, computations based on well reports submitted to the

American Petroleum Institute. **1997-2000:** EIA, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, DOE/EIA-0216(77-2000). **2001 and projections:** AEO2004 National Energy Modeling System, runs AEO2004.D101703E, LW2004.D101703B, and HW2004. D101703B.

Figure 96. Lower 48 crude oil production by source, 1970-2025: History: Total production: Energy Information Administration (EIA), *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Lower 48 offshore, 1970-1985:** U.S. Department of the Interior, *Federal Offshore Statistics: 1985*. **Lower 48 offshore, 1986-2001:** EIA, *Petroleum Supply Annual*, DOE/EIA-0340(86-00). **Lower 48 onshore:** EIA, Office of Integrated Analysis and Forecasting. **Projections:** Table A15.

Figure 97. Lower 48 crude oil production in three cases, 1990-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Table F11.

Figure 98. Alaskan crude oil production in three cases, 1990-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Table F11.

Figure 99. Petroleum supply, consumption, and imports, 1970-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Tables A11, B11, and C11. **Note:** Domestic supply includes domestic crude oil and natural gas plant liquids, other crude supply, other inputs, and refinery processing gain.

Figure 100. Domestic refining capacity in three cases, 1975-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Tables A11 and B11. **Note:** Beginning-of-year capacity data are used for previous year's end-of-year capacity.

Figure 101. Worldwide refining capacity by region, 2002 and 2025: History: *Oil and Gas Journal*, Energy Database (January 2001). **Projections:** AEO2004 National Energy Modeling System, run AEO2004.D101703E; and World Oil, Refining, Logistics, and Demand (WORLD) Model, run AEO04B.

Figure 102. Petroleum consumption by sector, 1970-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Table A11.

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Figure 104. U.S. ethanol consumption, 1993-2025: History: Energy Information Administration, *Petroleum Supply Annual 2001, Vol. 1*, DOE/EIA-0340(2001)/1 (Washington, DC, June 2002). **Projections:** Table A18.

Figure 105. Components of refined product costs, 2002 and 2025: Gasoline and diesel taxes: Federal Highway Administration, *Monthly Motor Fuel Reported by State* (Washington, DC, November 1998), web site www.fhwa.dot.gov/ohim/novmmfr.pdf. **Jet fuel taxes**: Energy Information Administration (EIA), Office of Oil and Gas. **2001:** Estimated from EIA, *Petroleum Marketing Monthly*, DOE/EIA-0380(2002/03) (Washington, DC, March 2002). **Projections:** Estimated from AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 106. Coal production by region, 1970-2025: History: Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003). **Projections:** Table A16.

Figure 107. Average minemouth price of coal by region, 1990-2025: History: Energy Information Administration (EIA), *Coal Industry Annual 2000*, DOE/EIA-0584(2000) (Washington, DC, January 2002), and EIA, *Annual Coal Report 2002*, DOE/EIA-0584(2002) (Washington, DC, November 2003). **Projections:** AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 108. Coal mining labor productivity by region, 1990-2025: History: Energy Information Administration (EIA), *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003), and EIA, *Annual Coal Report 2002*, DOE/EIA-0584(2002) (Washington, DC, November 2003). **Projections:** AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 109. U.S. coal mine employment by region, 1970-2025: History: 1970-1976: U.S. Department of the Interior, Bureau of Mines, *Minerals Yearbooks*; **1977-1978:** Energy Information Administration (EIA), *Energy Data Report, Coal-Bituminous and Lignite*, DOE/EIA-0118 and EIA, *Energy Data Report, Coal-Pennsylvania Anthracite*, DOE/EIA-0119; **1979-1992:** EIA, *Coal Production*, DOE/EIA-0118; **1993-2000:** EIA, *Coal Industry Annual*, DOE/EIA-0584; **2001-2002:** EIA, *Annual Coal Report 2002*, DOE/EIA-0584(2002) (Washington, DC, November 2003). **Projections:** AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 110. Average minemouth coal prices in three mining cost cases, 1990-2025: Tables A16 and F13.

Figure 111. Electricity and other coal consumption, 1970-2025: History: Energy Information Administration (EIA), *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003), and EIA, *Short-Term Energy Outlook October 2003*. **Projections:** Table A16.

Figure 112. Coal production by sulfur content, 2002, 2010, and 2025: AEO2004 National Energy Modeling System, run AEO2004.D101703E.

Figure 113. Coal consumption in the industrial and buildings sectors, 2002, 2010, and 2025: Table A16.

Figure 114. U.S. coal exports and imports, 2002, 2010 and 2025: History: Exports: U.S. Department of Commerce, Bureau of the Census, "Monthly Report EM 545;" **Imports:** U.S. Department of Commerce, Bureau of the Census, "Monthly Report IM 145." **Projections:** AEO2004 National Energy Modeling System, run AEO2004. D101703E.

Figure 115. Carbon dioxide emissions by sector and fuel, 1990-2025: History: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, DOE/EIA-0573(2002) (Washington, DC, October 2003). **Projections:** Table A19.

Figure 116. Carbon dioxide emissions from the electric power sector by fuel, 1990-2025: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, DOE/EIA-0573(2002) (Washington, DC, October 2003). **Projections:** Table A19.

Figure 117. Carbon dioxide emissions in three economic growth cases, 1990-2025: History: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, DOE/EIA-0573(2002) (Washington, DC, October 2003). **Projections:** Table B19.

Figure 118. Carbon dioxide emissions in three technology cases, 1990-2025: History: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, DOE/EIA-0573(2002) (Washington, DC, October 2003). **Projections:** Table F4.

Figure 119. Sulfur dioxide emissions from electricity generation, 1990-2025: History: 1990 and 1995: U.S. Environmental Protection Agency, *National Air Pollutant Emissions Trends, 1990-1998*, EPA- 454/R-00-002 (Washington, DC, March 2000). **2001:** U.S. Environmental Protection Agency, *Acid Rain Program Preliminary Summary Emissions Report, Fourth Quarter 2001*, web site www.epa.gov/airmarkets/emissions/prelimarp/index.html. **Projections:** Table A8.

Figure 120. Nitrogen oxide emissions from electricity generation, 1990-2025: History: 1990 and 1995: U.S. Environmental Protection Agency, *National Air Pollutant Emissions Trends, 1990-1998*, EPA- 454/R-00-002 (Washington, DC, March 2000). **2001:** U.S. Environmental Protection Agency, *Acid Rain Program Preliminary Summary Emissions Report, Fourth Quarter 200*1, web site www.epa.gov/airmarkets/emissions/prelimarp/index.html. **Projections:** Table A8.