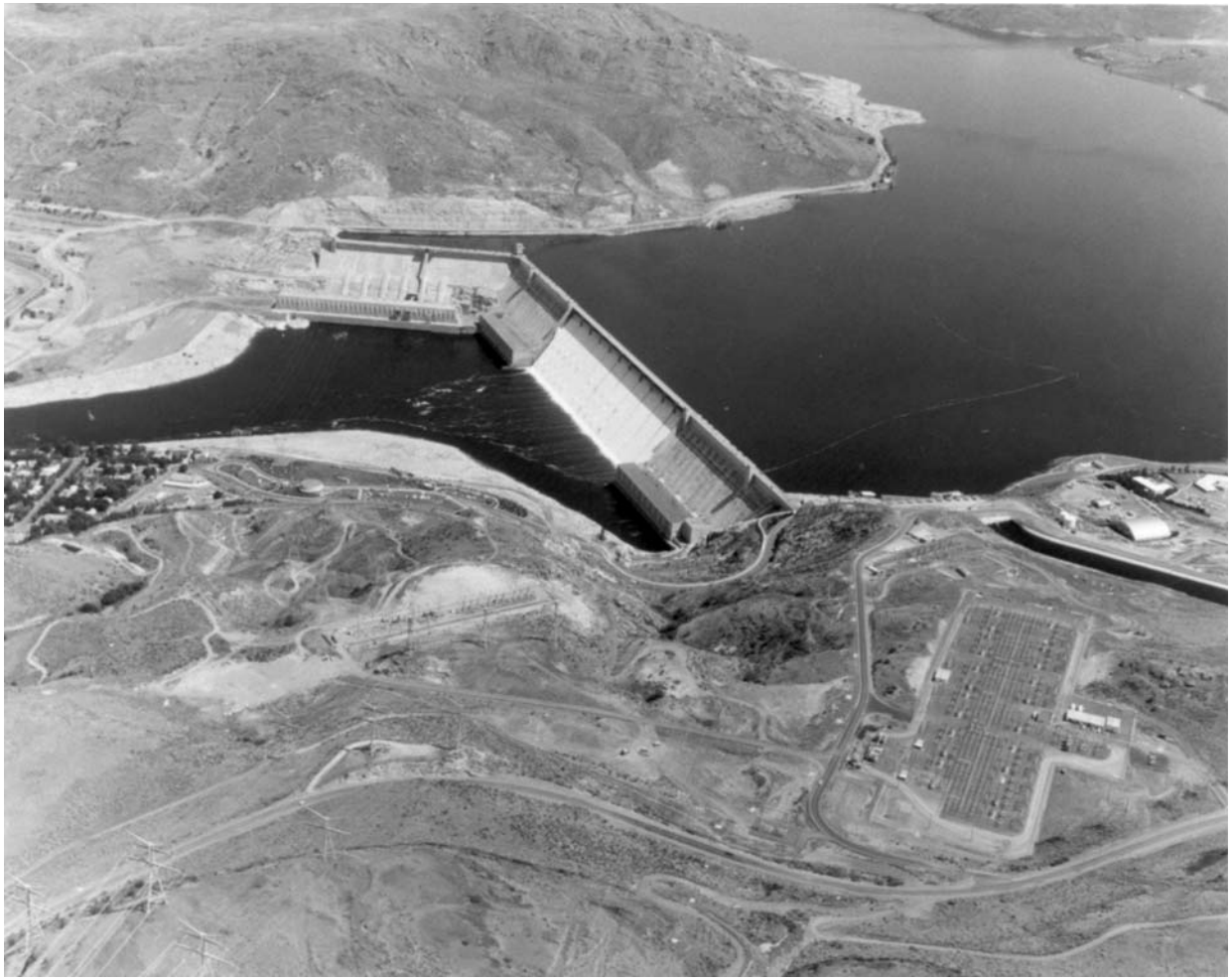
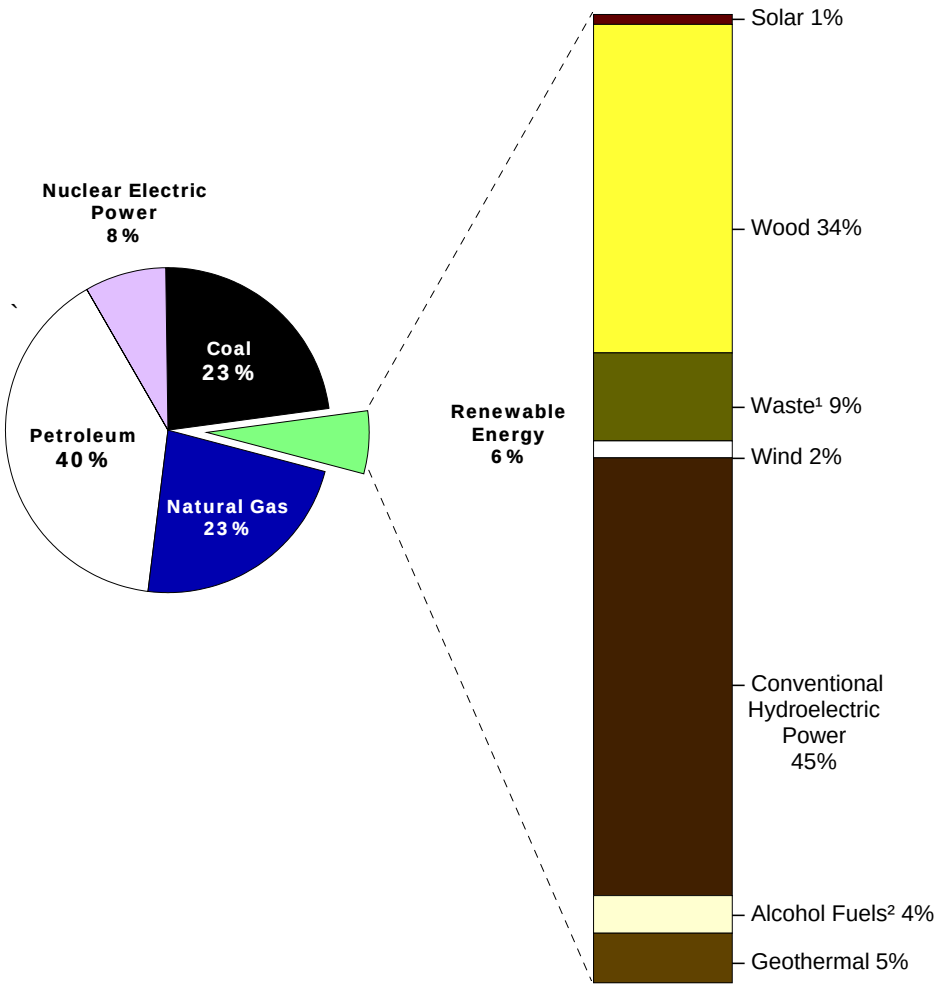
10 Renewable Energy



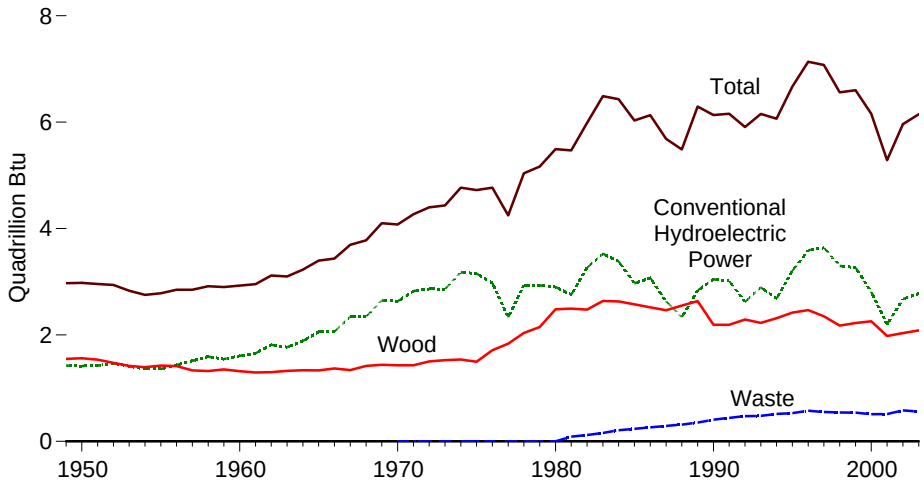
Grand Coulee Dam, Washington State. Source: U.S. Bureau of Reclamation.

Figure 10.1 Renewable Energy Consumption by Major Sources

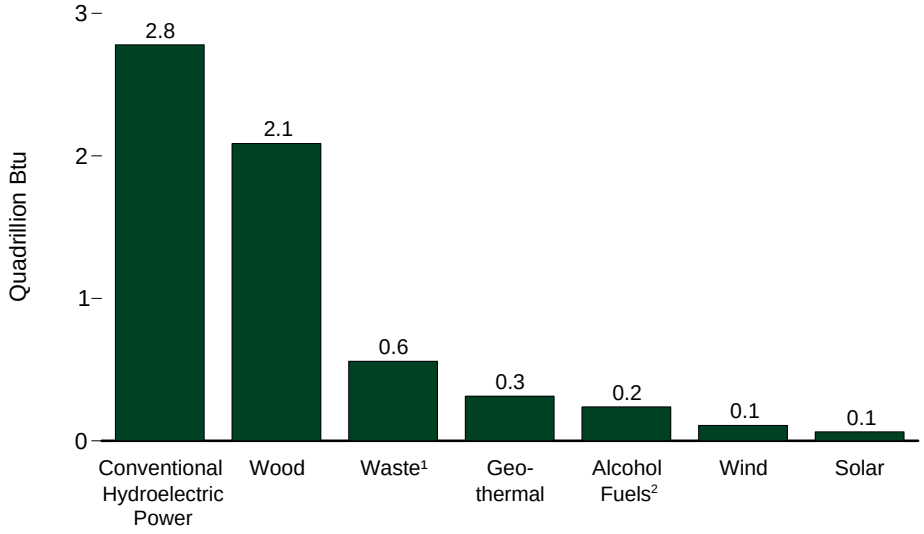
Renewable Energy as Share of Total Energy, 2003



Renewable Energy Total Consumption and Major Sources, 1949-2003



Renewable Energy Consumption by Source, 2003



[1] Municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass.
[2] Ethanol blended into motor gasoline.

Note: Because vertical scales differ, graphs should not be compared.
Sources: Tables 1.3 and 10.1.

Table 10.1 Renewable Energy Consumption by Source, Selected Years, 1949-2003

(Trillion Btu)

Year	Conventional Hydroelectric Power [1]	Wood [2]	Waste [3]	Alcohol Fuels [4]	Geothermal [5]	Solar [6]	Wind [7]	Total
1949	1,425	1,549	NA	NA	NA	NA	NA	2,974
1950	1,415	1,562	NA	NA	NA	NA	NA	2,978
1955	1,360	1,424	NA	NA	NA	NA	NA	2,784
1960	1,608	1,320	NA	NA	1	NA	NA	2,929
1965	2,059	1,335	NA	NA	4	NA	NA	3,398
1970	2,634	1,429	2	NA	11	NA	NA	4,076
1971	2,824	1,430	2	NA	12	NA	NA	4,268
1972	2,864	1,501	2	NA	31	NA	NA	4,398
1973	2,861	1,527	2	NA	43	NA	NA	4,433
1974	3,177	1,538	2	NA	53	NA	NA	4,769
1975	3,155	1,497	2	NA	70	NA	NA	4,723
1976	2,976	1,711	2	NA	78	NA	NA	4,768
1977	2,333	1,837	2	NA	77	NA	NA	4,249
1978	2,937	2,036	1	NA	64	NA	NA	5,039
1979	2,931	2,150	2	NA	84	NA	NA	5,166
1980	2,900	2,483	2	NA	110	NA	NA	5,494
1981	2,758	2,495	88	7	123	NA	NA	5,471
1982	3,266	2,477	119	19	105	NA	NA	5,985
1983	3,527	2,639	157	35	129	NA	(s)	6,488
1984	3,386	2,629	208	43	165	(s)	(s)	6,431
1985	2,970	2,576	236	52	198	(s)	(s)	6,033
1986	3,071	2,518	263	60	219	(s)	(s)	6,132
1987	2,635	2,465	289	69	229	(s)	(s)	5,687
1988	2,334	2,552	315	70	217	(s)	(s)	5,489
1989	2,837	2,637	354	71	317	55	22	6,294
1990	3,046	2,191	408	63	336	60	29	6,133
1991	3,016	2,190	440	73	346	63	31	6,158
1992	2,617	2,290	473	83	349	64	30	5,907
1993	2,892	R2,227	479	97	364	66	31	R6,156
1994	2,683	2,315	515	109	338	69	36	6,065
1995	3,205	2,420	531	117	294	70	33	6,669
1996	3,590	2,467	577	84	316	71	33	7,137
1997	3,640	2,350	551	106	325	70	34	7,075
1998	3,297	2,175	542	117	328	70	31	6,561
1999	3,268	2,224	540	122	331	69	46	6,599
2000	2,811	2,257	511	139	317	66	57	6,158
2001	2,201	R1,980	514	147	311	65	68	R5,286
2002	RP2,675	R2,036	R581	174	R328	P64	RP105	RP5,963
2003	P2,779	P2,086	P558	P239	P314	P63	P108	P6,150

[1] Hydroelectricity generated by pumped storage is not included in renewable energy.
[2] Wood, black liquor, and other wood waste.
[3] Municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass.
[4] Ethanol blended into motor gasoline.
[5] Geothermal electricity net generation, heat pump, and direct use energy.
[6] Solar thermal and photovoltaic electricity net generation, and solar thermal direct use energy.
[7] Wind electricity net generation.

R=Revised. P=Preliminary. NA=Not available. (s)=Less than 0.5 trillion Btu.

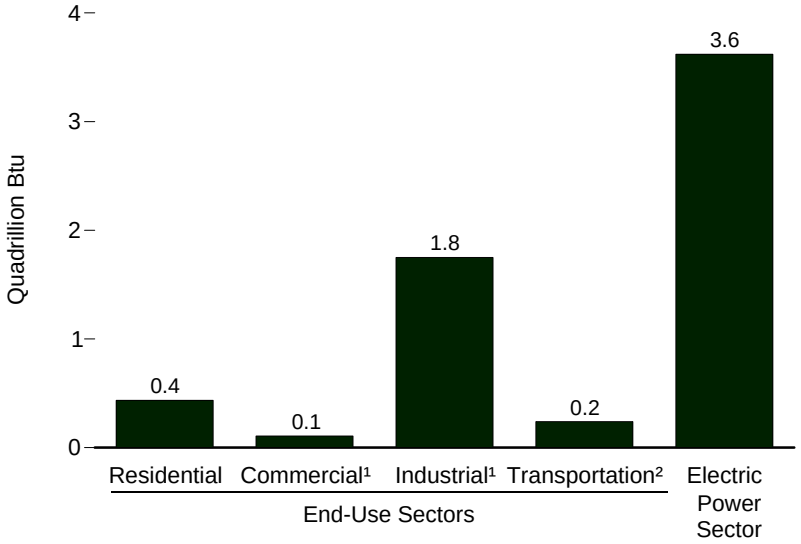
Notes: • See Table E1 for estimated renewable energy consumption for 1635-1945. • See Note 3, "Electricity Imports and Exports," at end of Section 8. • Totals may not equal sum of components due to independent rounding.

Web Pages: • For data not shown for 1951-1969, see http://www.eia.doe.gov/emeu/aer/renew.html. • For related information, see http://www.eia.doe.gov/fuelrenewable.html.

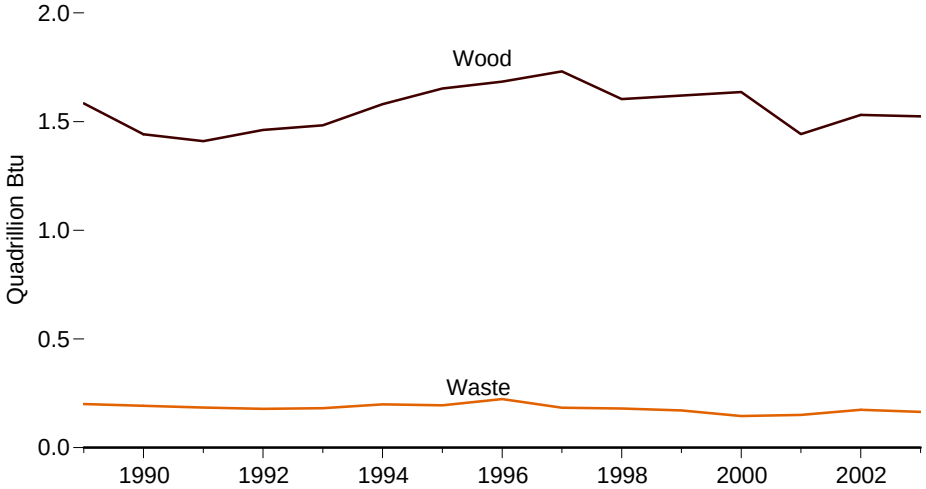
Sources: Tables 10.2a and 10.2b.

Figure 10.2a Renewable Energy Consumption: End-Use Sectors

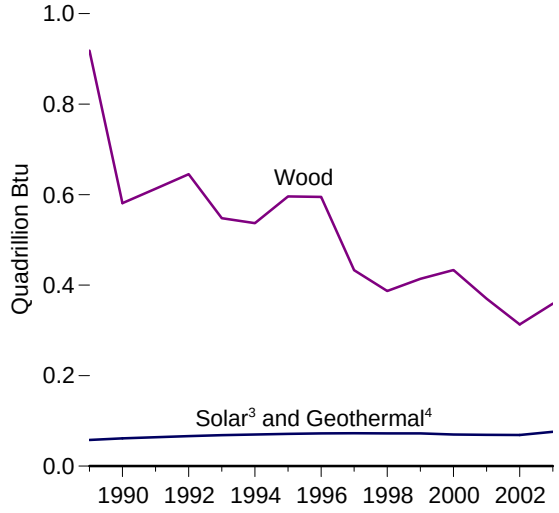
End-Use Sectors and Electric Power Sector, 2003



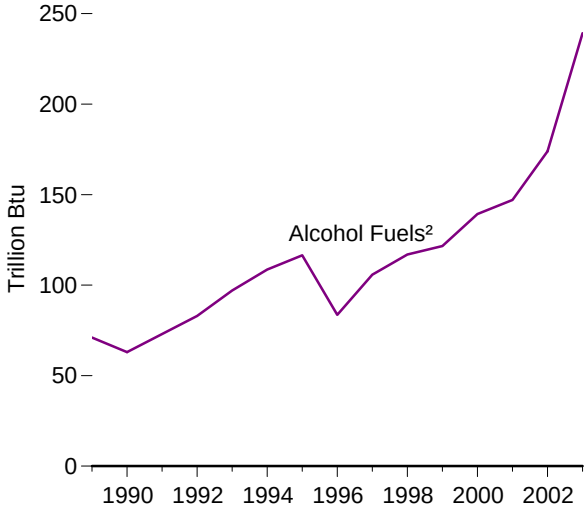
Industrial[1] Sector, Major Sources, 1989-2003



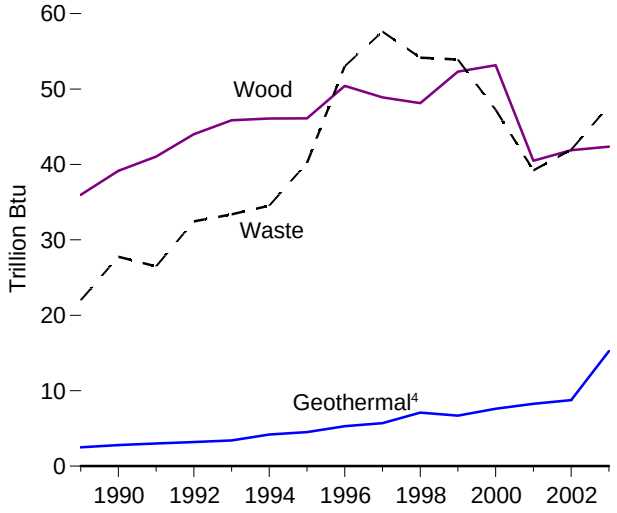
Residential Sector, 1989-2003



Transportation Sector, 1989-2003



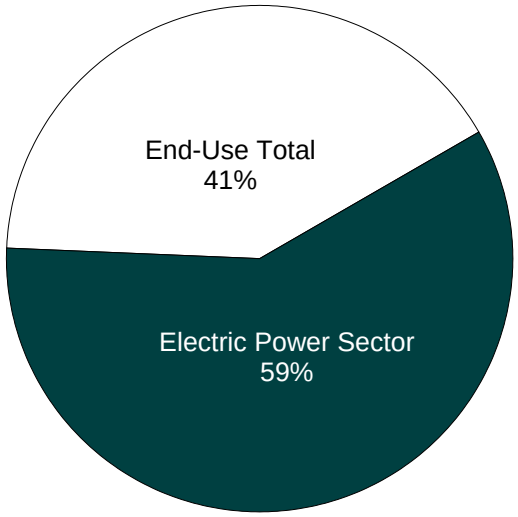
Commercial[1] Sector, Major Sources, 1989-2003



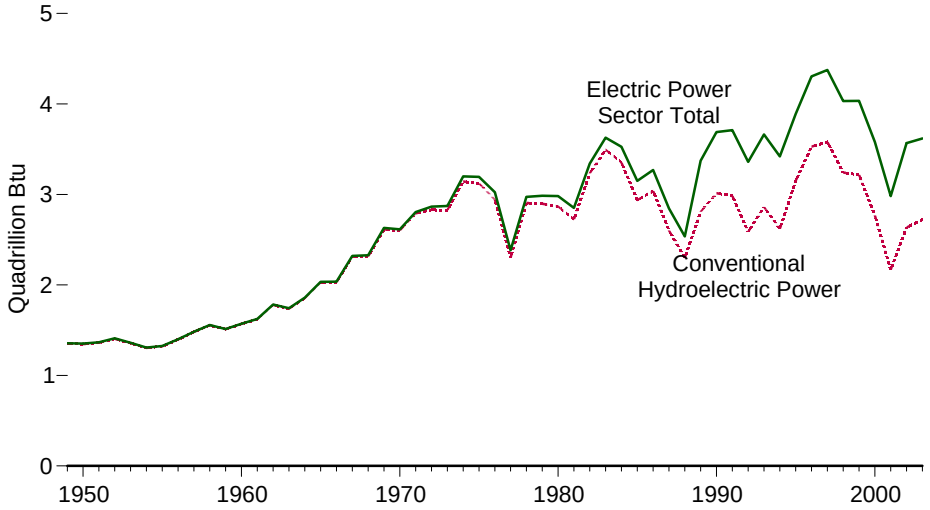
[1] Includes fuel used at combined-heat-and-power plants and a small number of electricity-only plants.
[2] Ethanol blended into motor gasoline.
[3] Solar thermal direct use energy and photovoltaic electricity generation. Includes small amounts of commercial sector use.
[4] Geothermal heat pump and direct use energy.
Notes: • See related Figure 10.2b on the electric power sector. • Because vertical scales differ, graphs should not be compared.
Sources: Tables 10.2a and 10.2b.

Figure 10.2b Renewable Energy Consumption: Electric Power Sector

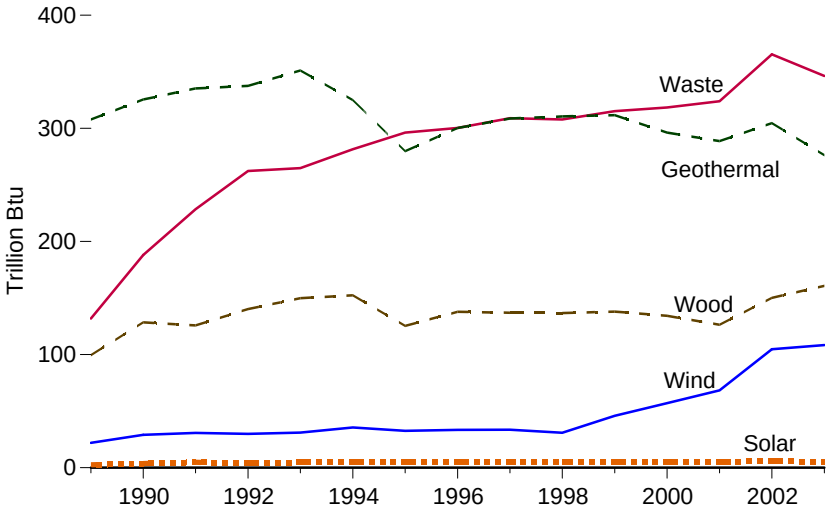
Electric Power Share of Total Renewable Energy Consumption, 2003



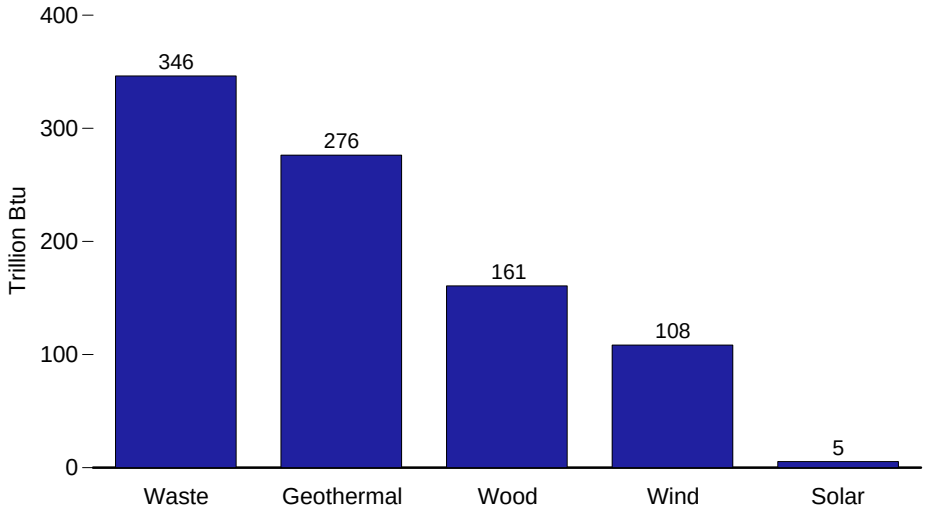
Electric Power Sector Total and Hydroelectric Power, 1949-2003



Non-Hydroelectric Power Sources, 1989-2003



Non-Hydroelectric Power Sources, 2003



Notes: • See related Figure 10.2a on the end-use sectors. • Because vertical scales differ, graphs should not be compared.

Sources: Tables 10.2a and 10.2b.

Table 10.2a Estimated Renewable Energy Consumption: End-Use Sectors, Selected Years, 1949-2003

(Trillion Btu)

	Residential				Commercial [1]					Industrial [2]					Transportation	
Year	Wood [3]	Geo-thermal [4]	Solar [5]	Total	Hydro-power [6]	Wood [3]	Waste [7]	Geo-thermal [4]	Total	Hydro-power [6]	Wood [3]	Waste [7]	Geo-thermal [4]	Total	Alcohol Fuels [8]	End-Use Total
1949	1,055	NA	NA	1,055	NA	20	NA	NA	20	76	468	NA	NA	544	NA	1,619
1950	1,006	NA	NA	1,006	NA	19	NA	NA	19	69	532	NA	NA	602	NA	1,626
1955	775	NA	NA	775	NA	15	NA	NA	15	38	631	NA	NA	669	NA	1,459
1960	627	NA	NA	627	NA	12	NA	NA	12	39	680	NA	NA	719	NA	1,357
1965	468	NA	NA	468	NA	9	NA	NA	9	33	855	NA	NA	888	NA	1,365
1970	401	NA	NA	401	NA	8	NA	NA	8	34	1,019	NA	NA	1,053	NA	1,461
1971	382	NA	NA	382	NA	7	NA	NA	7	34	1,040	NA	NA	1,074	NA	1,463
1972	380	NA	NA	380	NA	7	NA	NA	7	34	1,113	NA	NA	1,147	NA	1,534
1973	354	NA	NA	354	NA	7	NA	NA	7	35	1,165	NA	NA	1,200	NA	1,560
1974	371	NA	NA	371	NA	7	NA	NA	7	33	1,159	NA	NA	1,192	NA	1,570
1975	425	NA	NA	425	NA	8	NA	NA	8	32	1,063	NA	NA	1,096	NA	1,529
1976	482	NA	NA	482	NA	9	NA	NA	9	33	1,220	NA	NA	1,253	NA	1,744
1977	542	NA	NA	542	NA	10	NA	NA	10	33	1,281	NA	NA	1,314	NA	1,866
1978	622	NA	NA	622	NA	12	NA	NA	12	32	1,400	NA	NA	1,432	NA	2,066
1979	728	NA	NA	728	NA	14	NA	NA	14	34	1,405	NA	NA	1,439	NA	2,181
1980	859	NA	NA	859	NA	21	NA	NA	21	33	1,600	NA	NA	1,633	NA	2,513
1981	869	NA	NA	869	NA	21	NA	NA	21	33	1,602	87	NA	1,722	7	2,619
1982	937	NA	NA	937	NA	22	NA	NA	22	33	1,516	118	NA	1,667	19	2,645
1983	925	NA	NA	925	NA	22	NA	NA	22	33	1,690	155	NA	1,879	35	2,861
1984	923	NA	NA	923	NA	22	NA	NA	22	33	1,679	204	NA	1,916	43	2,904
1985	899	NA	NA	899	NA	24	NA	NA	24	33	1,645	230	NA	1,908	52	2,883
1986	876	NA	NA	876	NA	27	NA	NA	27	33	1,610	256	NA	1,899	60	2,862
1987	852	NA	NA	852	NA	29	NA	NA	29	33	1,576	282	NA	1,891	69	2,841
1988	885	NA	NA	885	NA	32	NA	NA	32	33	1,625	308	NA	1,965	70	2,952
1989	918	5	53	976	1	36	22	3	61	28	1,584	200	2	1,814	71	2,922
1990	581	6	56	642	1	39	28	3	71	31	1,442	192	2	1,667	63	2,444
1991	613	6	58	677	1	41	26	3	72	30	1,410	185	2	1,626	73	2,448
1992	645	6	60	711	1	44	32	3	81	31	1,461	179	2	1,672	83	2,548
1993	548	7	62	616	1	46	33	3	84	30	R1,483	181	2	R1,696	97	R2,493
1994	537	6	64	607	1	46	35	4	86	62	1,580	199	3	1,844	109	2,645
1995	596	7	65	667	1	46	40	5	92	55	1,652	195	3	1,905	117	2,781
1996	595	7	65	667	1	50	53	5	110	61	1,683	224	3	1,971	84	2,832
1997	433	8	65	506	1	49	58	6	113	58	1,731	184	3	1,976	106	2,701
1998	387	8	65	459	1	48	54	7	111	55	1,603	180	3	1,841	117	2,528
1999	414	9	64	486	1	52	54	7	114	49	1,620	171	4	1,843	122	2,565
2000	433	9	61	503	1	53	47	8	109	42	1,636	145	4	1,828	139	2,579
2001	R370	9	60	R439	1	R40	39	8	89	32	1,443	150	5	1,630	147	R2,305
2002	R313	10	R59	R382	RP (s)	R42	R42	9	RP93	RP39	R1,531	R174	5	RP1,748	174	RP2,397
2003	P359	P18	P58	P435	P1	P42	P48	P15	P106	P57	P1,524	P164	P5	P1,750	P239	P2,531

[1] Commercial sector, including commercial combined-heat-and-power (CHP) and commercial electricity-only plants.

[2] Industrial sector, including industrial combined-heat-and-power (CHP) and industrial electricity-only plants.

[3] Wood, black liquor, and other wood waste.

[4] Geothermal heat pump and direct use energy.

[5] Solar thermal direct use energy and photovoltaic electricity generation. Includes a small amount of commercial sector use.

[6] Conventional hydroelectric power.

[7] Municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass.

[8] Ethanol blended into motor gasoline.

R=Revised. P=Preliminary. NA=Not available. (s)=Less than 0.5 trillion Btu.

Notes:
- See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Secion 8.
- Totals may not equal sum of components due to independent rounding.

Web Pages:
- For data not shown for 1951-1969, see http://www.eia.doe.gov/emeu/aer/renew.html.
- For related information, see http://www.eia.doe.gov/fuelrenewable.html.

Sources: See end of section.

Table 10.2b Renewable Energy Consumption: Electric Power Sector and Total, Selected Years, 1949-2003

(Trillion Btu)

Year	Electric Power Sector [1]							Renewable Energy Consumption Total
	Conventional Hydroelectric Power	Wood [2]	Waste [3]	Geothermal [4]	Solar [5]	Wind [6]	Total	
1949	1,349	6	NA	NA	NA	NA	1,355	2,974
1950	1,346	5	NA	NA	NA	NA	1,351	2,978
1955	1,322	3	NA	NA	NA	NA	1,325	2,784
1960	1,569	2	NA	1	NA	NA	1,571	2,929
1965	2,026	3	NA	4	NA	NA	2,033	3,398
1970	2,600	1	2	11	NA	NA	2,615	4,076
1971	2,790	1	2	12	NA	NA	2,806	4,268
1972	2,829	1	2	31	NA	NA	2,864	4,398
1973	2,827	1	2	43	NA	NA	2,873	4,433
1974	3,143	1	2	53	NA	NA	3,199	4,769
1975	3,122	(s)	2	70	NA	NA	3,194	4,723
1976	2,943	1	2	78	NA	NA	3,024	4,768
1977	2,301	3	2	77	NA	NA	2,383	4,249
1978	2,905	2	1	64	NA	NA	2,973	5,039
1979	2,897	3	2	84	NA	NA	2,986	5,166
1980	2,867	3	2	110	NA	NA	2,982	5,494
1981	2,725	3	1	123	NA	NA	2,852	5,471
1982	3,233	2	1	105	NA	NA	3,341	5,985
1983	3,494	2	2	129	NA	(s)	3,627	6,488
1984	3,353	5	4	165	(s)	(s)	3,527	6,431
1985	2,937	8	7	198	(s)	(s)	3,150	6,033
1986	3,038	5	7	219	(s)	(s)	3,270	6,132
1987	2,602	8	7	229	(s)	(s)	2,846	5,687
1988	2,302	10	8	217	(s)	(s)	2,536	5,489
1989	[1]2,808	[1]100	[1]132	[1]308	[1]3	[1]22	[1]3,372	6,294
1990	3,014	129	188	326	4	29	3,689	6,133
1991	2,985	126	229	335	5	31	3,710	6,158
1992	2,586	140	262	338	4	30	3,360	5,907
1993	2,861	150	265	351	5	31	3,662	[R]6,156
1994	2,620	152	282	325	5	36	3,420	6,065
1995	3,149	125	296	280	5	33	3,889	6,669
1996	3,528	138	300	300	5	33	4,305	7,137
1997	3,581	137	309	309	5	34	4,375	7,075
1998	3,241	137	308	311	5	31	4,032	6,561
1999	3,218	138	315	312	5	46	4,034	6,599
2000	2,768	134	318	296	5	57	3,579	6,158
2001	2,169	126	324	289	6	68	2,982	[R]5,286
2002	[RP]2,636	[R]150	[R]365	[R]305	[P]6	[RP]105	[RP]3,567	[RP]5,963
2003	[P]2,722	[P]161	[P]346	[P]276	[P]5	[P]108	[P]3,619	[P]6,150

[1] Electricity-only and combined-heat-and-power (CHP) plants within the NAICS (North American Industry Classification System) 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Through 1988, data are for electric utilities only; beginning in 1989, data are for electric utilities and independent power producers.

[2] Wood, black liquor, and other wood waste.

[3] Municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass.

[4] Geothermal electricity net generation.

[5] Solar thermal and photovoltaic electricity net generation.

[6] Wind electricity net generation.

R=Revised. P=Preliminary. NA=Not available. (s)=Less than 0.5 trillion Btu.

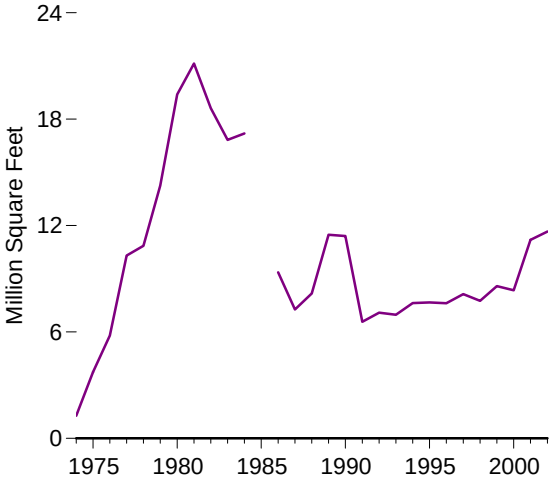
Notes: • See Note 3, "Electricity Imports and Exports," at end of Section 8. • Totals may not equal sum of components due to independent rounding.

Web Pages: • For data not shown for 1951-1969, see http://www.eia.doe.gov/emeu/aer/renew.html. • For related information, see http://www.eia.doe.gov/fuelrenewable.html.

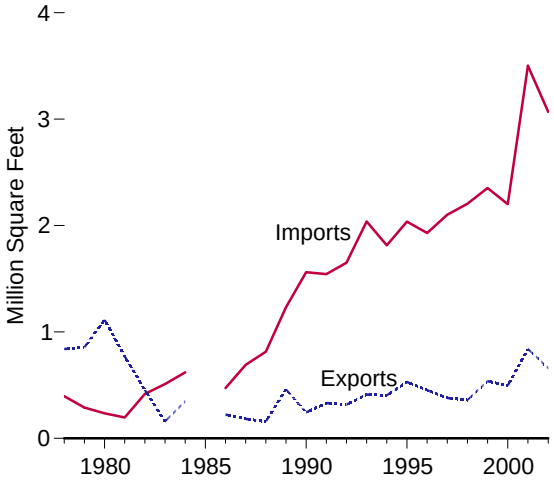
Sources: Tables 8.2b, 8.5b, 8.7b, and A6.

Figure 10.3 Solar Thermal Collector Shipments by Type, Price, and Trade

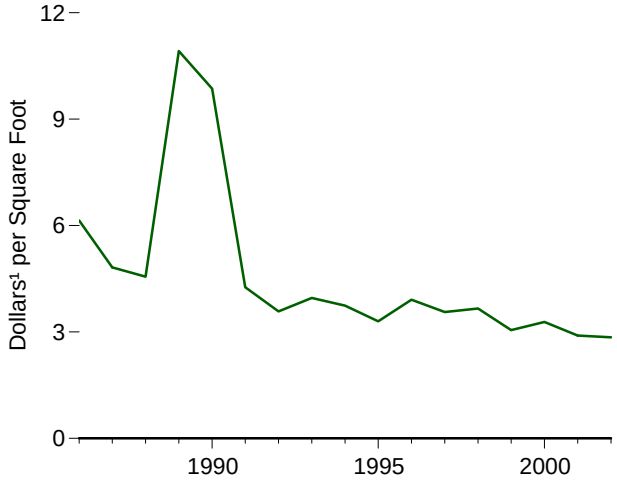
Total Shipments, 1974-1984 and 1986-2002



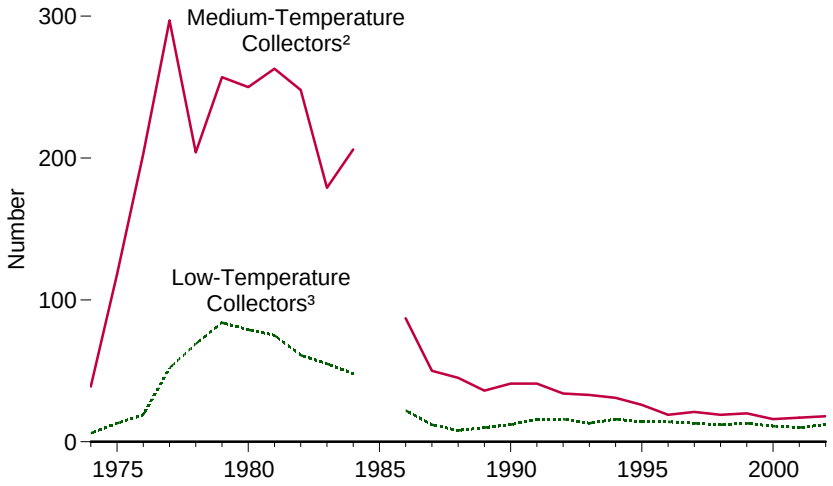
Trade, 1978-1984 and 1986-2002



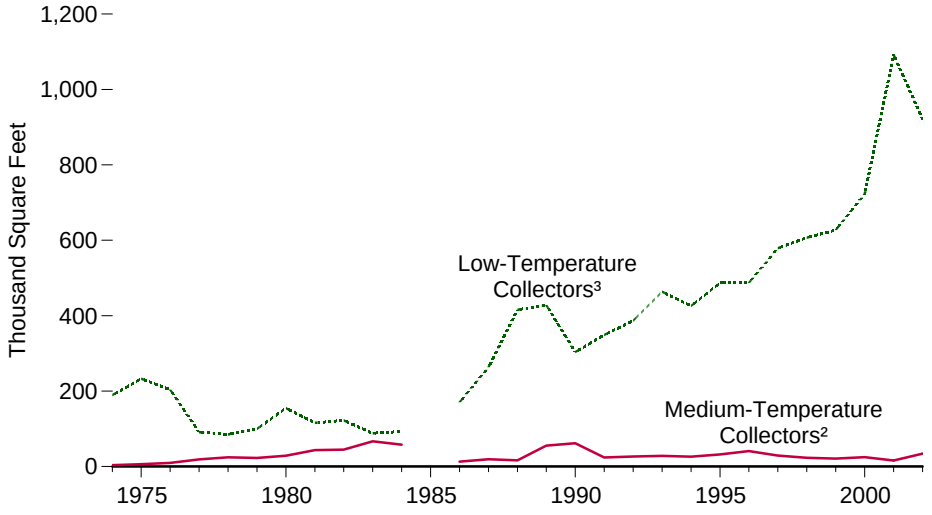
Price of Total Shipments, 1986-2002



Number of U.S. Manufacturers, 1974-1984 and 1986-2002



Average Annual Shipments per Manufacturer, 1974-1984 and 1986-2002



[1] Nominal dollars.

[2] Collectors that generally operate in the temperature range of 140 degrees Fahrenheit to 180 degrees Fahrenheit but can also operate at temperatures as low as 110 degrees Fahrenheit.

[3] Collectors that generally operate at temperatures below 110 degrees Fahrenheit.

Notes: • Data were not collected for 1985. • Special collectors–evacuated tube collectors or concentrating (focusing) collectors–are included in the medium-temperature category. • Because vertical scales differ, graphs should not be compared.

Source: Table 10.3.

Table 10.3 Solar Thermal Collector Shipments by Type, Price, and Trade, 1974-2002

(Thousand Square Feet, Except as Noted)

	Low-Temperature Collectors [1]				Medium-Temperature Collectors [2]				High-Temperature Collectors [3]		Total Shipments [4]		Trade	
Year	Number of U.S. Manu-facturers	Quantity Shipped	Shipments per Manu-facturer	Price [5] (dollars per square foot)	Number of U.S. Manu-facturers	Quantity Shipped	Shipments per Manu-facturer	Price [5] (dollars per square foot)	Quantity Shipped	Price [5] (dollars per square foot)	Quantity Shipped	Price [5] (dollars per square foot)	Imports	Exports
1974	6	1,137	189.5	NA	39	137	3.5	NA	NA	NA	1,274	NA	NA	NA
1975	13	3,026	232.8	NA	118	717	6.1	NA	NA	NA	3,743	NA	NA	NA
1976	19	3,876	204.0	NA	203	1,925	9.5	NA	NA	NA	5,801	NA	NA	NA
1977	52	4,743	91.2	NA	297	5,569	18.8	NA	NA	NA	10,312	NA	NA	NA
1978	69	5,872	85.1	NA	204	4,988	24.5	NA	NA	NA	10,860	NA	396	840
1979	84	8,394	100.0	NA	257	5,856	22.8	NA	NA	NA	14,251	NA	290	855
1980	79	12,233	154.8	NA	250	7,165	28.7	NA	NA	NA	19,398	NA	235	1,115
1981	75	8,677	115.7	NA	263	11,456	43.6	NA	NA	NA	21,133	NA	196	771
1982	61	7,476	122.6	NA	248	11,145	44.9	NA	NA	NA	18,621	NA	418	455
1983	55	4,853	88.2	NA	179	11,975	66.9	NA	NA	NA	16,828	NA	511	159
1984	48	4,479	93.3	NA	206	11,939	58.0	NA	773	NA	17,191	NA	621	348
1985	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1986	22	3,751	170.5	2.30	87	1,111	12.8	18.30	4,498	NA	9,360	6.14	473	224
1987	12	3,157	263.1	2.18	50	957	19.1	13.50	3,155	NA	7,269	4.82	691	182
1988	8	3,326	415.8	2.24	45	732	16.2	14.88	4,116	NA	8,174	4.56	814	158
1989	10	4,283	428.3	2.60	36	1,989	55.3	11.74	5,209	17.76	11,482	10.92	1,233	461
1990	12	3,645	303.8	2.90	41	2,527	61.6	7.68	5,237	15.74	11,409	9.86	1,562	245
1991	16	5,585	349.0	2.90	41	989	24.1	11.94	1	31.94	6,574	4.26	1,543	332
1992	16	6,187	386.7	2.50	34	897	26.4	10.96	2	75.66	7,086	3.58	1,650	316
1993	13	6,025	463.5	2.80	33	931	28.2	11.74	12	22.12	6,968	3.96	2,039	411
1994	16	6,823	426.0	2.54	31	803	26.0	13.54	2	177.00	7,627	3.74	1,815	405
1995	14	6,813	487.0	2.32	26	840	32.0	10.48	13	53.26	7,666	3.30	2,037	530
1996	14	6,821	487.0	2.67	19	785	41.0	14.48	10	18.75	7,616	3.91	1,930	454
1997	13	7,524	579.0	2.60	21	606	29.0	15.17	7	25.00	8,138	3.56	2,102	379
1998	12	7,292	607.0	2.83	19	443	23.0	15.17	21	53.21	7,756	3.66	2,206	360
1999	13	8,152	627.0	2.08	20	427	21.0	19.12	4	286.49	8,583	3.05	2,352	537
2000	11	7,948	723.0	2.09	16	400	25.0	23.98	5	223.26	8,354	3.28	2,201	496
2001	10	10,919	1,092.0	2.15	17	268	16.0	32.40	2	107.76	11,189	2.90	3,502	840
2002	12	11,046	921.0	1.97	18	615	34.0	18.63	2	22.50	11,663	2.85	3,068	659

[1] Low-temperature collectors are solar thermal collectors that generally operate at temperatures below 110° F.

[2] Medium-temperature collectors are solar thermal collectors that generally operate in the temperature range of 140° F to 180° F but can also operate at temperatures as low as 110° F. Special collectors are included in this category. Special collectors are evacuated tube collectors or concentrating (focusing) collectors. They operate in the temperature range from just above ambient temperature (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air conditioning and specialized industrial processes).

[3] High-temperature collectors are solar thermal collectors that generally operate at temperatures above 180° F.

[4] Total shipments as reported by respondents include all domestic and export shipments and may include imports that subsequently were shipped to domestic or to foreign customers.

[5] Prices, in nominal dollars, equal shipment value divided by quantity shipped. Value includes charges for advertising and warranties. Excluded are excise taxes and the cost of freight or transportation for the shipments.

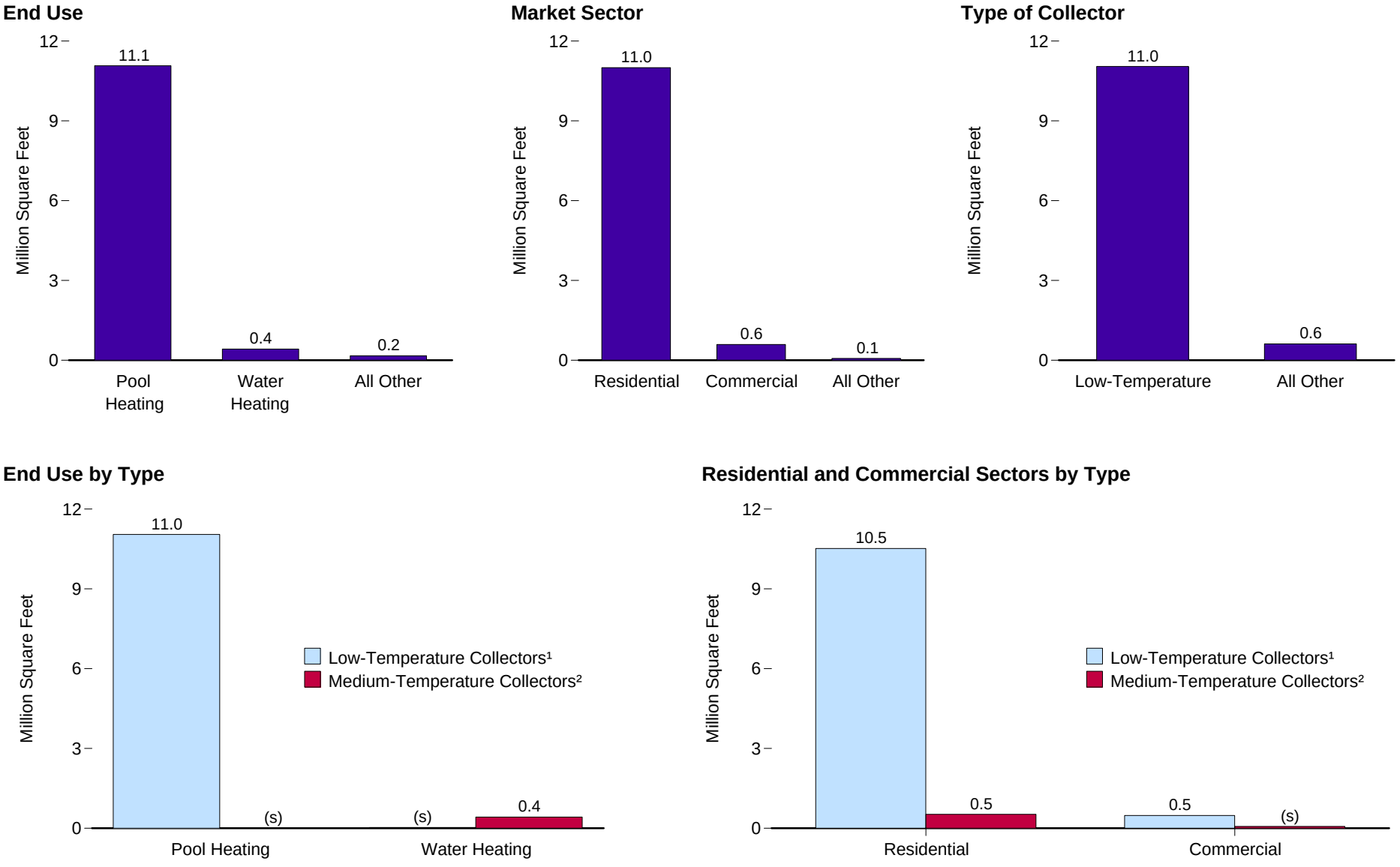
NA=Not available.

Notes: • Manufacturers producing more than one type of collector are accounted for in both groups. • No data are available for 1985. • High-temperature collector shipments were dominated by one manufacturer.

Web Page: For related information, see http://www.eia.doe.gov/fuelrenewable.html.

Sources: • 1974-1992—Energy Information Administration (EIA), *Solar Collector Manufacturing Activity,* annual reports. • 1993 forward—EIA, *Renewable Energy Annual,* annual reports.

Figure 10.4 Solar Thermal Collector Shipments by End Use, Market Sector, and Type, 2002



[1] Collectors that generally operate at temperatures below 110 degrees Fahrenheit.
[2] Collectors that generally operate in the temperature range of 140 degrees Fahrenheit to 180 degrees Fahrenheit but can also operate at temperatures as low as 110 degrees Fahrenheit.

(s)=Less than 0.05 million square feet.
Source: Table 10.4.

Table 10.4 Solar Thermal Collector Shipments by End Use, Market Sector, and Type, 2002

(Thousand Square Feet)

End Use	Low-Temperature Collectors [1]	Medium-Temperature Collectors [2]	High-Temperature Collectors [3]	Total
End-Use Total	**11,046**	**615**	**2**	[4]**11,663**
Pool Heating	11,045	28	0	11,073
Water Heating	1	422	0	423
Space Heating	0	146	0	146
Space Cooling	0	(s)	0	(s)
Combined Space and Water Heating	0	15	2	17
Process Heating	0	4	0	4
Electricity Generation	0	0	0	[4] 0
Other [5]	0	0	0	0
Market Sector Total	**11,046**	**615**	**2**	[4]**11,663**
Residential	10,519	481	0	11,000
Commercial	524	69	2	595
Industrial [6]	2	60	0	62
Electric Utility	0	4	0	[4] 4
Other [7]	0	1	0	1

[1] Low-temperature collectors are solar thermal collectors that generally operate at temperatures below 110° F.

[2] Medium-temperature collectors are solar thermal collectors that generally operate in the temperature range of 140° F to 180° F but can also operate at temperatures as low as 110° F. Special collectors are included in this category. Special collectors are evacuated tube collectors or concentrating (focusing) collectors. They operate in the temperature range from just above ambient temperature (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air conditioning and specialized industrial processes).

[3] High-temperature collectors are solar thermal collectors that generally operate at temperatures above 180° F. These are parabolic dish/trough collectors used primarily by independent power producers to generate electricity for the electric grid.

[4] Totals include other types of collectors not shown.

[5] "Other" includes shipments of solar thermal collectors for other uses, such as cooking foods, water pumping, water purification, desalinization, distilling, etc.

[6] Includes all independent power producers.

[7] "Other" includes shipments of solar thermal collectors to other sectors, such as government, including the military but excluding space applications.

(s)=Less than 0.5 thousand square feet.

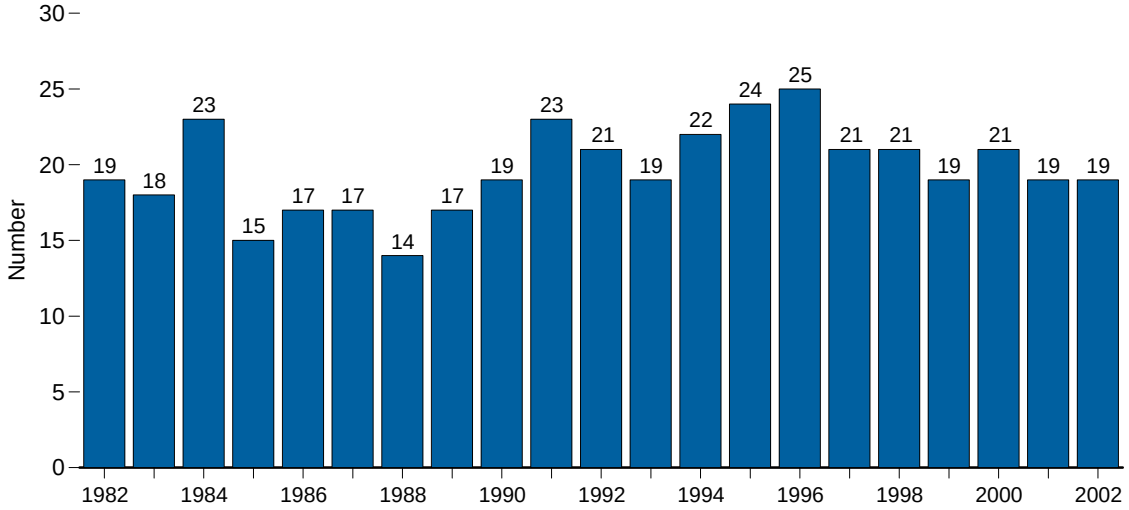
Notes: • Data represent shipments from U.S. manufacturers only. • Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see http://www.eia.doe.gov/fuelrenewable.html.

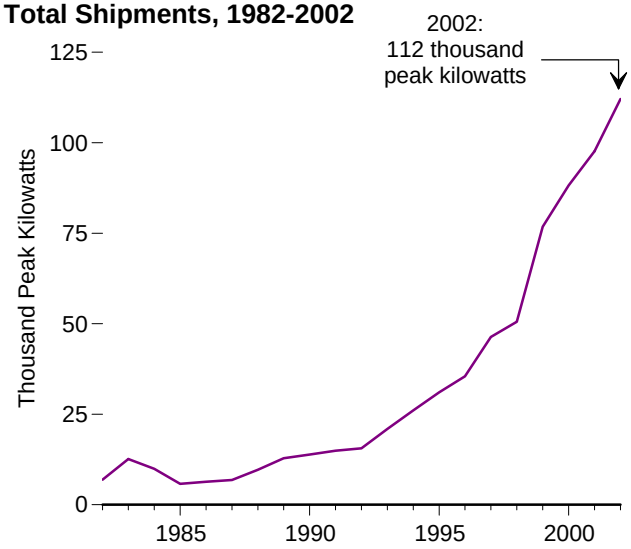
Source: Energy Information Administration, *Renewable Energy Annual 2002* (November 2003).

Figure 10.5 Photovoltaic Cell and Module Shipments, Trade, and Prices

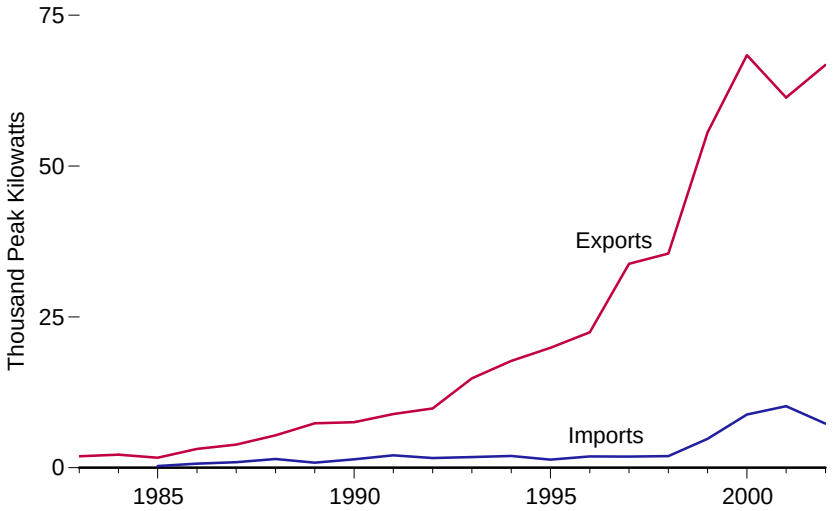
Number of U.S. Companies Reporting Shipments, 1982-2002



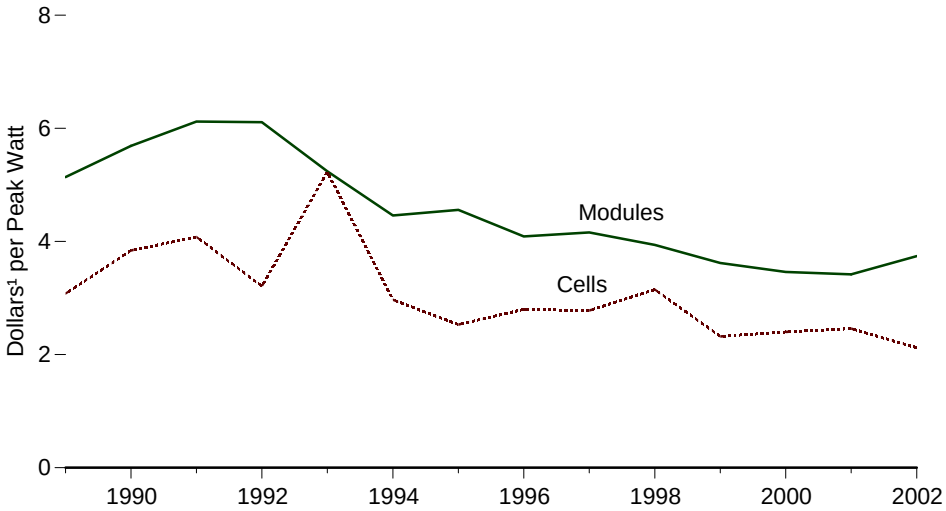
Total Shipments, 1982-2002



Trade, 1983-2002



Prices, 1989-2002



[1] Nominal dollars.
Note: Because vertical scales differ, graphs should not be compared.

Source: Table 10.5.

Table 10.5 Photovoltaic Cell and Module Shipments by Type, Trade, and Prices, 1982-2002

Year	Number of U.S. Companies Reporting Shipments	Shipments			Trade		Prices [1]	
		Crystalline Silicon	Thin-Film Silicon	Total [2]	Imports	Exports	Modules	Cells
		Peak Kilowatts					Dollars per Peak Watt	
1982	19	NA	NA	6,897	NA	NA	NA	NA
1983	18	NA	NA	12,620	NA	1,903	NA	NA
1984	23	NA	NA	9,912	NA	2,153	NA	NA
1985	15	5,461	303	5,769	285	1,670	NA	NA
1986	17	5,806	516	6,333	678	3,109	NA	NA
1987	17	5,613	1,230	6,850	921	3,821	NA	NA
1988	14	7,364	1,895	9,676	1,453	5,358	NA	NA
1989	17	10,747	1,628	12,825	826	7,363	5.14	3.08
1990	[3]19	12,492	1,321	[3]13,837	1,398	7,544	5.69	3.84
1991	23	14,205	723	14,939	2,059	8,905	6.12	4.08
1992	21	14,457	1,075	15,583	1,602	9,823	6.11	3.21
1993	19	20,146	782	20,951	1,767	14,814	5.24	5.23
1994	22	24,785	1,061	26,077	1,960	17,714	4.46	2.97
1995	24	29,740	1,266	31,059	1,337	19,871	4.56	2.53
1996	25	33,996	1,445	35,464	1,864	22,448	4.09	2.80
1997	21	44,314	1,886	46,354	1,853	33,793	4.16	2.78
1998	21	47,186	3,318	50,562	1,931	35,493	3.94	3.15
1999	19	73,461	3,269	76,787	4,784	55,562	3.62	2.32
2000	21	85,155	2,736	88,221	8,821	68,382	3.46	2.40
2001	19	84,651	12,541	97,666	10,204	61,356	3.42	2.46
2002	19	104,123	7,396	112,090	7,297	66,778	3.74	2.12

[1] Prices, in nominal dollars, equal shipment value divided by quantity shipped. Value includes charges for advertising and warranties. Excluded are excise taxes and the cost of freight or transportation for the shipments.

[2] Total shipments include all types of photovoltaic cells and modules (single-crystal silicon, cast silicon, ribbon silicon, thin-film silicon, and concentrator silicon) and internationally traded cells and modules. Shipments of cells and modules for space and satellite applications are not included.

[3] Data were imputed for one nonrespondent who exited the industry during 1990.

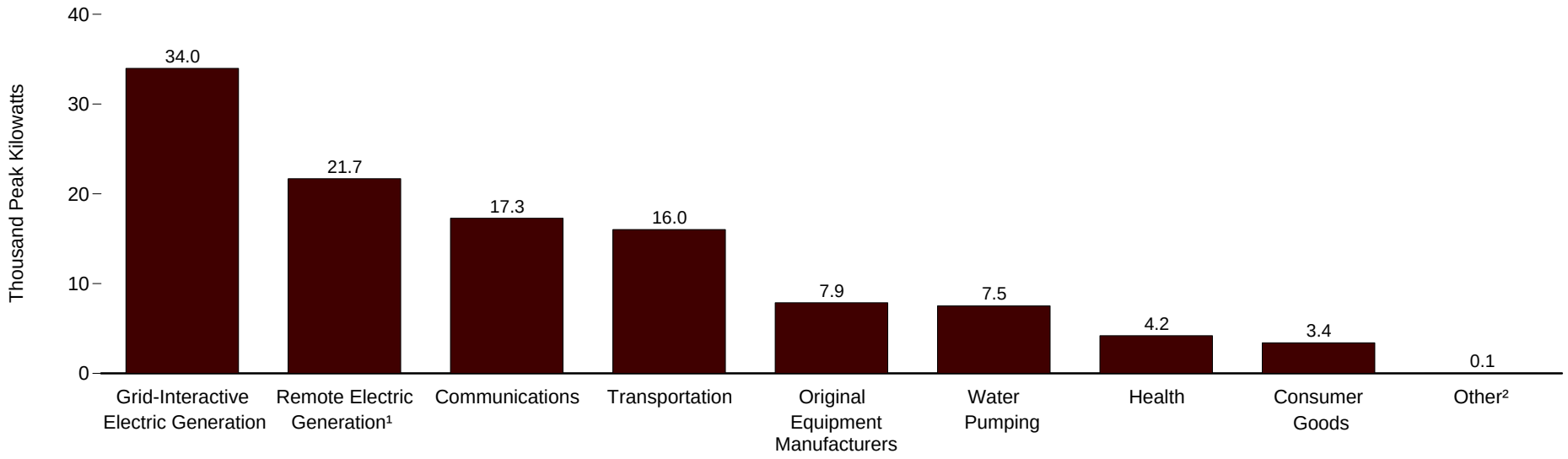
NA=Not available.

Web Page: For related information, see http://www.eia.doe.gov/fuelrenewable.html.

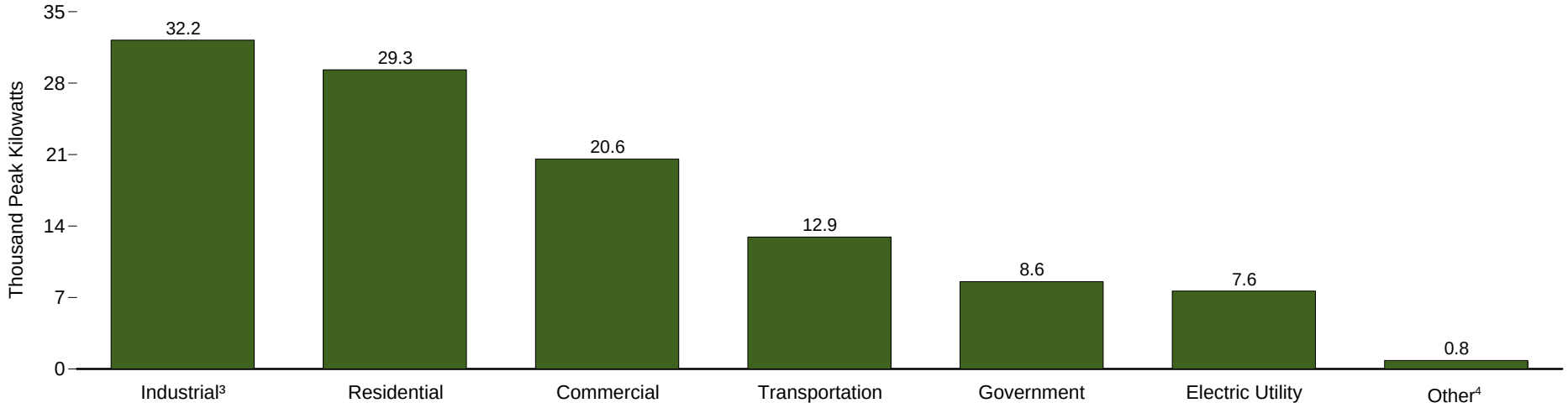
Sources: • 1982-1992—Energy Information Administration (EIA), *Solar Collector Manufacturing Activity,* annual reports. • 1993 forward—EIA, *Renewable Energy Annual,* annual reports.

Figure 10.6 Photovoltaic Cell and Module Shipments by End Use and Market Sector, 2002

By End Use



By Market Sector



[1] Units designed for installations that are not grid-interactive.
[2] Represents such applications as cooking food, desalinization, and distilling.
[3] Includes all independent power producers.
[4] Shipments to foreign governments and for specialty purposes.
Source: Table 10.6.

Table 10.6 Photovoltaic Cell and Module Shipments by End Use and Market Sector, 1989-2002

Year	End-Use									Market Sector							Total
			Electric Generation [1]														
	Communications	Consumer Goods	Grid-Interactive	Remote	Health	Original Equipment Manufacturers [2]	Transportation	Water Pumping	Other [3]	Residential	Commercial	Government	Industrial [4]	Transportation	Electric Utility	Other [5]	
	Amount Shipped (peak kilowatts)																
1989	2,590	2,788	1,251	2,620	5	1,595	1,196	711	69	1,439	3,850	1,077	3,993	1,130	785	551	12,825
1990	4,340	2,484	469	3,097	5	1,119	1,069	1,014	240	1,701	6,086	1,002	2,817	974	826	432	13,837
1991	3,538	3,312	856	3,594	61	1,315	1,523	729	13	3,624	3,345	815	3,947	1,555	1,275	377	14,939
1992	3,717	2,566	1,227	4,238	67	828	1,602	809	530	4,154	2,386	1,063	4,279	1,673	1,553	477	15,583
1993	3,846	946	1,096	5,761	674	2,023	4,238	2,294	74	5,237	4,115	1,325	5,352	2,564	1,503	856	20,951
1994	5,570	3,239	2,296	9,253	79	1,849	2,128	1,410	254	6,632	5,429	2,114	6,855	2,174	2,364	510	26,077
1995	5,154	1,025	4,585	8,233	776	3,188	4,203	2,727	1,170	6,272	8,100	2,000	7,198	2,383	3,759	1,347	31,059
1996	6,041	1,063	4,844	10,884	977	2,410	5,196	3,261	789	8,475	5,176	3,126	8,300	3,995	4,753	1,639	35,464
1997	7,383	347	8,273	8,630	1,303	5,245	6,705	3,783	4,684	10,993	8,111	3,909	11,748	3,574	5,651	2,367	46,354
1998	8,280	1,198	14,193	8,634	1,061	5,044	6,356	4,306	1,491	15,936	8,460	2,808	13,232	3,440	3,965	2,720	50,562
1999	12,147	2,292	24,782	10,829	1,466	12,400	8,486	4,063	322	19,817	17,283	3,107	24,972	4,341	5,876	1,392	76,787
2000	12,269	2,870	21,713	14,997	2,742	12,153	12,804	5,644	3,028	24,814	13,692	4,417	28,808	5,502	6,298	4,690	88,221
2001	14,743	4,059	27,226	21,447	3,203	6,268	12,636	7,444	641	33,262	15,710	5,728	28,063	8,486	5,846	571	97,666
2002	17,290	3,400	33,983	21,693	4,202	7,869	16,028	7,532	93	29,315	20,578	8,565	32,218	12,932	7,640	841	112,090
	Percent of Total																
1989	20.2	21.7	9.8	20.4	(s)	12.4	9.3	5.5	0.5	11.2	30.0	8.4	31.1	8.8	6.1	4.3	100.0
1990	31.4	18.0	3.4	22.4	(s)	8.1	7.7	7.3	1.7	12.3	44.0	7.2	20.4	7.0	6.0	3.1	100.0
1991	23.7	22.2	5.7	24.1	0.4	8.8	10.2	4.9	0.1	24.3	22.4	5.5	26.4	10.4	8.5	2.5	100.0
1992	23.9	16.5	7.9	27.2	0.4	5.3	10.3	5.2	3.4	26.7	15.3	6.8	27.5	10.7	10.0	3.1	100.0
1993	18.4	4.5	5.2	27.5	3.2	9.7	20.2	10.9	0.4	25.0	19.6	6.3	25.5	12.2	7.2	4.1	100.0
1994	21.4	12.4	8.8	35.5	0.3	7.1	8.2	5.4	1.0	25.4	20.8	8.1	26.3	8.3	9.1	2.0	100.0
1995	16.6	3.3	14.8	26.5	2.5	10.3	13.5	8.8	3.8	20.2	26.1	6.4	23.2	7.7	12.1	4.3	100.0
1996	17.0	3.0	13.7	30.7	2.8	6.8	14.7	9.2	2.2	23.9	14.6	8.8	23.4	11.3	13.4	4.6	100.0
1997	15.9	0.7	17.8	18.6	2.8	11.3	14.5	8.2	10.1	23.7	17.5	8.4	25.3	7.7	12.2	5.1	100.0
1998	16.4	2.4	28.1	17.1	2.1	10.0	12.6	8.5	2.9	31.5	16.7	5.6	26.2	6.8	7.8	5.4	100.0
1999	15.8	3.0	32.3	14.1	1.9	16.1	11.1	5.3	0.4	25.8	22.5	4.0	32.5	5.7	7.7	1.8	100.0
2000	13.9	3.3	24.6	17.0	3.1	13.8	14.5	6.4	3.4	28.1	15.5	5.0	32.7	6.2	7.1	5.3	100.0
2001	15.1	4.2	27.9	22.0	3.3	6.4	12.9	7.6	0.7	34.1	16.1	5.9	28.7	8.7	6.0	0.6	100.0
2002	15.4	3.0	30.3	19.4	3.7	7.0	14.3	6.7	0.1	26.2	18.4	7.6	28.7	11.5	6.8	0.8	100.0

[1] Grid-interactive means connection to the electrical distribution system; remote means electricity, for general use, that does not interact with the electrical distribution system, such as at an isolated residential site or mobile home. The other end uses in this table also include electricity generation but only for the specific use cited.

[2] "Original Equipment Manufacturers" are non-photovoltaic manufacturers that combine photovoltaic technology into existing or newly developed product lines.

[3] Represents such applications as cooking food, desalinization, and distilling.

[4] Includes all independent power producers.

[5] Shipments to foreign governments and for specialty purposes.

(s)=Less than 0.05 percent.

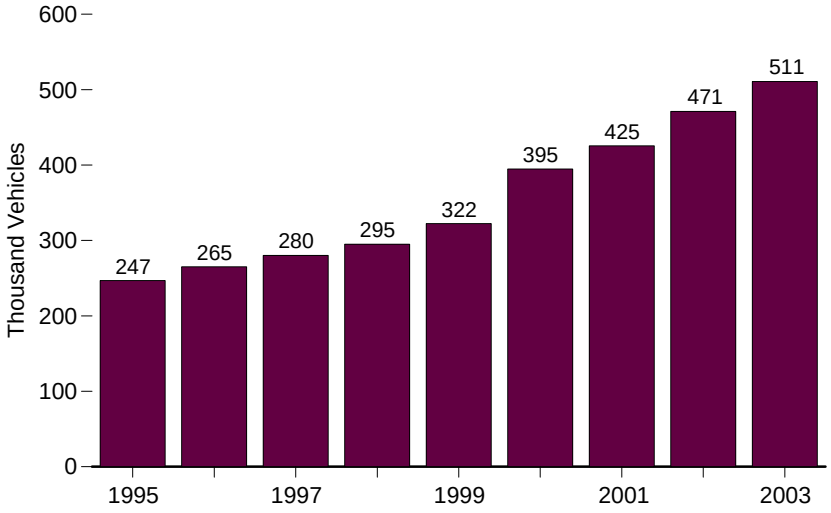
Note: Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see http://www.eia.doe.gov/fuelrenewable.html.

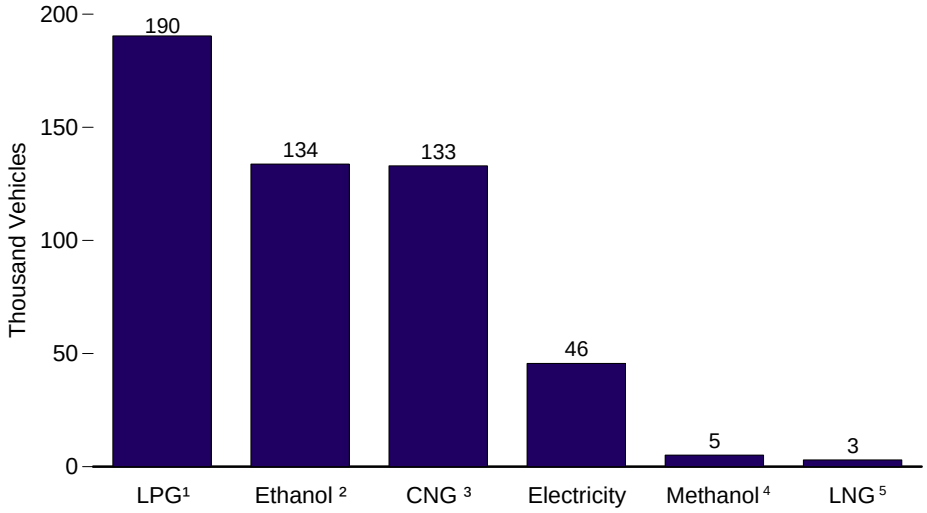
Sources: • 1989-1992—Energy Information Administration (EIA), *Solar Collector Manufacturing Activity,* annual reports. • 1993 forward—EIA, *Renewable Energy Annual,* annual reports.

Figure 10.7 Estimated Alternative-Fueled Vehicles and Consumption by Type

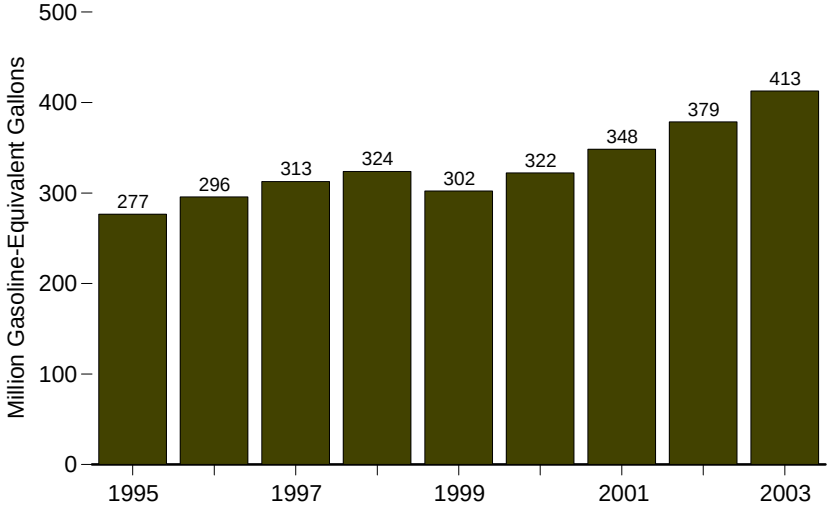
Vehicles in Use, 1995-2003



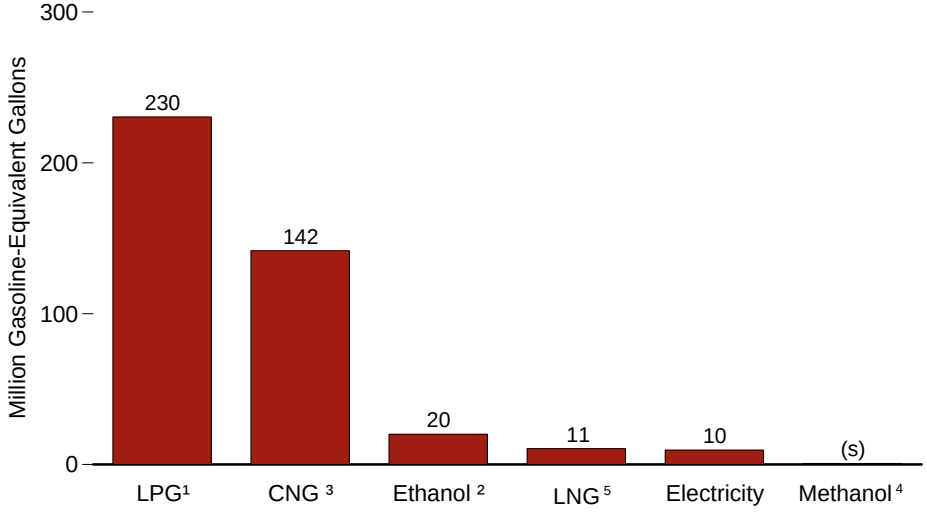
Vehicles in Use by Fuel Type, 2003



Fuel Consumption, 1995-2003



Fuel Consumption by Type, 2003



[1] Liquefied petroleum gases.
[2] Ethanol, 85 percent.
[3] Compressed natural gas.
[4] Methanol, 85 percent.
[5] Liquefied natural gas.
(s)=Less than 0.5 million gasoline-equivalent gallons.
Note: Because vertical scales differ, graphs should not be compared.
Source: Table 10.7.

Table 10.7 Estimated Alternative-Fueled Vehicles and Consumption of Replacement Fuels, 1992-2003

Year	Replacement Fuels [1]													
	Alternative Fuels [2]									Oxygenates [3]				
	Liquefied Petroleum Gases	Compressed Natural Gas	Liquefied Natural Gas	Methanol, 85 Percent [4]	Methanol, Neat [5]	Ethanol, 85 Percent [4]	Ethanol, 95 Percent [4]	Electricity [6]	Total	Methyl Tertiary Butyl Ether [7]	Ethanol in Gasohol [8]	Total	Biodiesel [9]	Total
	Number of Alternative-Fueled Vehicles [10] in Use													
1992	NA	23,191	90	4,850	404	172	38	1,607	NA	NA	NA	NA	NA	NA
1993	NA	32,714	299	10,263	414	441	27	1,690	NA	NA	NA	NA	NA	NA
1994	NA	41,227	484	15,484	415	605	33	2,224	NA	NA	NA	NA	NA	NA
1995	R172,806	50,218	603	18,319	386	1,527	136	2,860	R246,855	NA	NA	NA	NA	NA
1996	R175,585	60,144	663	20,265	172	4,536	361	3,280	R265,006	NA	NA	NA	NA	NA
1997	R175,679	68,571	813	21,040	172	9,130	347	4,453	R280,205	NA	NA	NA	NA	NA
1998	R177,183	78,782	1,172	19,648	200	12,788	14	5,243	R295,030	NA	NA	NA	NA	NA
1999	R178,610	91,267	1,681	18,964	198	24,604	14	6,964	R322,302	NA	NA	NA	NA	NA
2000	R181,994	R100,750	2,090	10,426	0	R87,570	4	R11,830	R394,664	NA	NA	NA	NA	NA
2001	R185,053	R111,851	2,576	7,827	0	R100,303	0	R17,847	R425,457	NA	NA	NA	NA	NA
2002	R187,680	R120,839	R2,708	5,873	0	R120,951	0	R33,047	R471,098	NA	NA	NA	NA	NA
2003P	190,438	132,988	3,030	4,917	0	133,776	0	45,656	510,805	NA	NA	NA	NA	NA
	Fuel Consumption (Thousand Gasoline-Equivalent Gallons)													
1992	NA	16,823	585	1,069	2,547	21	85	359	NA	1,175,000	701,000	1,876,000	NA	NA
1993	NA	21,603	1,901	1,593	3,166	48	80	288	NA	2,069,200	760,000	2,829,200	NA	NA
1994	NA	24,160	2,345	2,340	3,190	80	140	430	NA	2,018,800	845,900	2,864,700	NA	NA
1995	[11]232,701	35,162	2,759	2,023	2,150	190	995	663	276,643	2,691,200	910,700	3,601,900	NA	3,878,543
1996	[11]239,158	46,923	3,247	1,775	347	694	2,699	773	295,616	2,749,700	660,200	3,409,900	NA	3,705,516
1997	[11]238,356	65,192	3,714	1,554	347	1,280	1,136	1,010	312,589	3,104,200	830,700	3,934,900	NA	4,247,489
1998	[11,R]241,386	72,412	5,343	1,212	449	1,727	59	1,202	R323,790	2,903,400	889,500	3,792,900	NA	4,116,690
1999	R209,817	R79,620	R5,828	1,073	447	R3,916	R62	R1,524	R302,287	3,402,600	950,300	4,352,900	NA	4,655,187
2000	R212,576	R86,745	R7,259	585	R0	R12,071	13	R3,058	R322,307	3,296,100	1,085,800	4,381,900	6,816	4,711,023
2001	R215,876	R104,496	R8,921	R439	R0	R14,623	0	R4,066	R348,421	3,352,200	1,143,300	4,495,500	7,076	4,850,997
2002	R223,143	R120,670	R9,382	R337	0	R17,783	0	R7,274	R378,589	3,120,300	1,413,600	4,533,900	16,917	4,929,406
2003P	230,486	141,726	10,514	274	0	20,092	0	9,633	412,725	2,384,500	1,792,900	4,177,400	26,758	4,616,883

[1] See "Replacement Fuel" in Glossary.
[2] See "Alternative Fuel" in Glossary.
[3] See "Oxygenates" in Glossary.
[4] Remaining portion is motor gasoline. Consumption data include the motor gasoline portion of the fuel.
[5] One hundred percent methanol.
[6] Excludes gasoline-electric hybrids.
[7] In addition to methyl tertiary butyl ether (MTBE), includes a very small amount of other ethers, primarily tertiary amyl methyl ether (TAME) and ethyl tertiary butyl ether (ETBE).
[8] Data do not include the motor gasoline portion of the fuel.
[9] "Biodiesel" is any liquid biofuel suitable as a diesel fuel substitute or diesel fuel additive or extender. See "Biodiesel" in Glossary.
[10] See "Alternative-Fueled Vehicle" in Glossary.
[11] For 1995-1998, estimates of the number of vehicles operating on liquefied petroleum gases (LPG) were revised; however, no corresponding revisions were made to consumption of LPG by on-road vehicles. Revised consumption data will be available as other historical LPG vehicle-fuel-use data can be evaluated.

R=Revised. P=Preliminary. NA=Not available.

Note: Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see http://www.eia.doe.gov/fuelalternate.html.

Sources: • 1992-1994—Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished final report prepared for the Energy Information Administration (EIA) (McLean, VA, July 1996) and U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. • 1995 forward—EIA, "Alternatives to Traditional Transportation Fuels 2003 Estimated Data" (February 2004), Tables 1 and 10.

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Table 10.2a Sources: Wood, Residential: • 1949-1979—Energy Information Administration (EIA), *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2. • 1980-1983—EIA, *Estimates of U.S. Wood Energy Consumption 1980-1983*, Table ES1. • 1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 1. • 1985 and 1986—Values interpolated. • 1987—EIA, *Estimates of Biofuels Consumption in the United States During 1987*, Table 2. • 1988—Value interpolated. • 1989 forward— EIA, *Renewable Energy Trends 2003* (August 2004), Table B1. **Wood, Commercial**: • 1949-1979—EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2. • 1980-1983—EIA, *Estimates of U.S. Wood Energy Consumption 1980-1983*, Table ES1. • 1984—EIA, CNEAF estimate. • 1985–1988—Values interpolated. • 1989 forward—EIA, *Renewable Energy Trends 2003* (August 2004), Table B1. **Wood, Industrial**: • 1949-1979—EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2. • 1980-1983—EIA, *Estimates of U.S. Wood Energy Consumption 1980-1983*, Table ES1. • 1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 1. • 1985 and 1986—Values interpolated. • 1987—EIA, *Estimates of Biofuels Consumption in the United States During 1987*, Table 2. • 1988—Value interpolated. • 1989 forward—EIA, *Renewable Energy Trends 2003* (August 2004), Table B1. **Waste, Commercial**: Table 8.3b. **Waste, Industrial**: • 1981—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8, total waste consumption minus electric power sector waste consumption (see Table 10.2b). • 1982 and 1983—EIA, CNEAF, estimates for total waste consumption minus electric power sector waste consumption (see Table 10.2b). • 1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8, total waste consumption minus electric power sector waste consumption (see Table 10.2b). • 1985 and 1986—Values interpolated. • 1987—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8, total waste consumption minus electric power sector waste consumption (see Table 10.2b). • 1988—Value interpolated. • 1989 forward—EIA, *Renewable Energy Trends 2003* (August 2004), Table B1. **Alcohol Fuels**: • 1981— EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10. • 1982 and 1983—EIA, CNEAF estimates. • 1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10. • 1985 and 1986—Values interpolated. • 1987—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10. • 1988—Value interpolated. • 1989—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10. • 1990—EIA, *Estimates of U.S. Biomass Energy Consumption 1992*, Table D1. • 1991—Value interpolated. • 1992—EIA, *Estimates of U.S. Biomass Energy Consumption 1992*, Table D1. • 1993 forward—EIA, *Petroleum Supply Monthly* (*PSM*), Tables 2 and 28, and *Annual Energy Review* (*AER*) Table A1. Ten percent of the "Field Production" of "Oxygenated Finished Motor Gasoline" from *PSM* Table 2 is added to the "Refinery Input of Fuel Ethanol" from *PSM* Table 28. The sum is multiplied by the conversion factor of 3.539 million Btu per barrel as shown in the *AER* Table A1. **Hydropower**: Tables 8.1, 8.2c, and A6. **Geothermal**: • 1989 forward—EIA, *Renewable Energy Trends 2003* (August 2004), Table B1. **Solar**: • 1989 forward—EIA, *Renewable Energy Trends 2003* (August 2004), Table B1.