

Plan B 4.0 - Supporting Data for Chapters 4 and 5 - World Energy Profile

[World Primary Energy Demand in 2006, with IEA Projection for 2008 and 2020](#)

[World Electricity Demand in 2006, with IEA Projection for 2008 and 2020](#)

[World Carbon Dioxide Emissions from Fossil Fuel Combustion in 2006, with IEA Projection for 2008 and 2020](#)

[World Electricity Consumption for Lighting by Sector and Potential Electricity Savings, 2005](#)

[Potential Worldwide Electricity Savings by Switching to More-Efficient Lighting and System Control](#)

[Energy Savings from Plan B Efficiency Improvements, 2020](#)

GRAPH: Plan B Energy Efficiency Measures

[Table 5-1. World Power and Energy from Renewables in 2008 and Plan B Goals for 2020](#)

[World Energy Consumption in 2008 and Plan B Goals for 2020](#)

[World Energy Consumption in 2008 and Plan B Goals for 2020 \(detailed\)](#)

[World Energy Growth Rates by Source, 2000-2008](#)

[World Installed Wind Electricity-Generating Capacity, 1980-2008](#)

GRAPH: World Installed Wind Electricity-Generating Capacity, 1980-2008

GRAPH: World Net Annual Installed Wind Electricity-Generating Capacity Additions, 1981-2008

[Cumulative Installed Wind Power Capacity in Leading Countries and the World, 1980-2008](#)

GRAPH: Cumulative Installed Wind Power Capacity in Leading Countries and the World, 1980-2008

[World Solar Photovoltaics Production, 1975-2008](#)

GRAPH: World Annual Solar Photovoltaics Production, 1975-2008

GRAPH: World Cumulative Solar Photovoltaics Production, 1975-2008

[Annual Solar Photovoltaics Production by Country, 1995-2008](#)

GRAPH: Annual Solar Photovoltaics Production in Selected Countries 1995-2008

[World Solar Photovoltaics Installations, 1998-2008](#)

GRAPH: World Annual Solar Photovoltaics Installations, 1998-2008

GRAPH: World Cumulative Solar Photovoltaics Installations, 1998-2008

[Annual Installed Solar Photovoltaics Capacity in Selected Countries and the World, 1998-2008](#)

[Cumulative Installed Solar Photovoltaics Capacity in Ten Leading Countries and the World, 2008](#)

[World Installed Concentrating Solar Thermal Power Capacity, 1980-2007](#)

GRAPH: World Installed Concentrating Solar Thermal Power Capacity, 1980-2007

[World's Top Ten Largest Proposed Concentrating Solar Thermal Projects as of June 2008](#)

[Solar Water and Space Heating Area in Select Countries and the World, Total and Per Person, 2007](#)

[Cumulative Installed Solar Water and Space Heating Capacity in Ten Leading Countries and the World, 2007](#)

[World Cumulative Installed Geothermal Electricity-Generating Capacity, 1950-2009](#)

GRAPH: World Cumulative Installed Geothermal Electricity-Generating Capacity, 1950-2009

[Cumulative Installed Geothermal Electricity-Generating Capacity by Country, 1990-2007](#)

[World Hydroelectric Consumption, 1965-2008](#)

GRAPH: World Hydroelectric Consumption, 1965-2008

[World Annual Fuel Ethanol Production, 1975-2009](#)

GRAPH: World Annual Fuel Ethanol Production, 1975-2009

[U.S. Annual Fuel Ethanol Production, 1978-2009](#)

GRAPH: U.S. Annual Fuel Ethanol Production, 1978-2009

[World Annual Biodiesel Production, 1991-2009](#)

GRAPH: World Annual Biodiesel Production, 1991-2009

[World Natural Gas Consumption, 1965-2008](#)

GRAPH: World Natural Gas Consumption, 1965-2008

[World Oil Production, 1950-2008](#)

GRAPH: World Oil Production, 1950-2008

[World's 20 Largest Oil Discoveries](#)

[Coal Consumption in Selected Countries and the World, 1980-2008](#)

GRAPH: World Coal Consumption, 1980-2005

GRAPH: Coal Consumption, Select Countries, 1980-2005

[World Cumulative Installed Nuclear Electricity-Generating Capacity, 1970-2008](#)

GRAPH: World Cumulative Installed Nuclear Electricity-Generating Capacity, 1970-2008

A full listing of data for the entire book is on-line at:

http://www.earthpolicy.org/index.php?/books/pb4/pb4_data

This is part of a supporting dataset for Lester R. Brown, **Plan B 4.0: Mobilizing to Save Civilization** (New York: W.W. Norton & Company, 2009). For more information and a free download of the book, see Earth Policy

World Primary Energy Demand in 2006, with IEA Projection for 2008 and 2020

Energy Source	Growth Rate, 2006-2015 Percent	Growth Rate, 2015-2020	World Primary Energy Demand 2006 Million Tons Oil Equivalent	World Primary Energy Demand 2008	World Primary Energy Demand 2020
Coal	3.1	1.7	3,053	3,246	4,374
Oil	1.3	0.9	4,029	4,134	4,744
<i>of which Transport</i>	1.7	1.4	2,105	2,177	2,620
Gas	2.1	1.5	2,407	2,509	3,130
Nuclear	1.3	0.6	728	747	842
Hydro	2.3	1.9	261	273	353
Biomass and Waste	1.7	1.3	396	422	582
Other Renewables	10.2	6.4	66	80	215
Total			10,940	11,412	14,240
Total Non-renewable			10,217	10,637	13,090
Total Renewable			723	775	1,150

Notes: Primary energy demand equals primary energy supply. Nuclear refers to the primary heat equivalent of the electricity produced by a nuclear plant with an average thermal efficiency of 33 percent. Biomass and waste includes commercially traded solid biomass and animal products, gas and liquids derived from biomass, industrial waste, and municipal waste. Other renewables include geothermal, solar, wind, tide, and wave energy for electricity and the direct use of geothermal and solar heat.

Source: Calculated by Earth Policy Institute from International Energy Agency (IEA), *World Energy Outlook 2008* (Paris: 2008), p. 506; IEA, *World Energy Outlook 2004* (Paris: 2004).

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World Electricity Demand in 2006, with IEA Projection for 2008 and 2020

Electricity Source	Growth Rate, 2006-2015	Growth Rate, 2015-2020	World Electricity Demand, 2006	World Electricity Demand, 2008	World Electricity Demand, 2020
	Percent		Terawatt-hours		
Coal	4.1	2.3	7,756	8,399	12,442
Oil	-0.5	-2.1	1,096	1,085	941
Gas	2.4	2.1	3,807	3,994	5,243
Nuclear	1.3	0.6	2,793	2,865	3,232
Hydro	2.3	1.9	3,035	3,178	4,101
Biomass and Waste	6.4	5.3	239	271	542
Wind	19.9	7.9	130	187	970
Geothermal	5.8	4.5	59	66	122
Solar	33.3	15.9	4	7	111
Tidal/Wave	8.0	8.4	1	1	3
Total Non-renewable			15,452	16,343	21,858
Total Renewable			3,468	3,710	5,849
Total			18,920	20,053	27,707

Notes: Electricity generation is equal to electricity demand and is defined as the electricity generated by power plants including own use and transmission and distribution losses. Hydropower includes both macro and micro hydropower generation. Biomass and waste includes solid biomass and animal products, gas and liquids derived from biomass, industrial waste, and municipal waste. Electricity generation from solar power includes both PV and solar thermal.

Source: Calculated by Earth Policy Institute from International Energy Agency, *World Energy Outlook 2008* (Paris: 2008), p. 507.

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World Carbon Dioxide Emissions from Fossil Fuel Combustion in 2006, with IEA Projection for 2008 and 2020

Emissions	Growth Rate, 2006-2015	Growth Rate, 2015-2020	CO ₂ Emissions, 2006	CO ₂ Emissions, 2008	CO ₂ Emissions, 2020
	Percent		Million Tons Carbon		
By Fuel:					
Coal	3.1	1.6	3,185	3,387	4,555
Oil	1.3	0.9	2,937	3,013	3,454
Gas	2.0	1.5	1,484	1,545	1,918
By Sector:					
Power Generation	2.9	1.6	3,119	3,303	4,365
Coal	3.2	1.7	2,273	2,423	3,300
Oil	-0.4	-1.9	241	239	211
Gas	2.8	2.0	605	639	853
Total Final Consumption	1.7	1.1	4,123	4,267	5,090
Coal	2.7	1.1	855	902	1,150
Oil	1.5	1.2	2,515	2,588	3,033
<i>of which transport</i>	1.7	1.3	1,708	1,767	2,126
<i>of which marine bunkers</i>	1.0	1.0	159	162	181
<i>of which international aviation</i>	2.2	1.8	108	113	145
Gas	1.4	1.2	754	775	907
Other Energy Sector			364	379	472
Total CO₂ Emissions	2.2	1.4	7,606	7,949	9,927

Notes: Power Generation refers to fuel use in electricity plants, heat plants, and combined heat and power, including both public plants and small plants that produce fuel for their own use. Total Final Consumption includes industry (e.g. construction, mining, manufacturing, and petrochemical feedstocks), transport, agriculture, residential, and non-energy use. Other Energy Sector includes transformation and transmission

Source: Calculated by Earth Policy Institute from International Energy Agency (IEA), *World Energy Outlook 2008* (Paris: 2008), p. 507.

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World Electricity Consumption for Lighting by Sector and Potential Electricity Savings, 2005

Lighting Sector	Worldwide Electricity Consumption for Lighting in 2005	Potential Electricity Savings	Potential Electricity Savings
	Terawatt-hours	Terawatt-hours	Percent
Total Residential Lighting	1,045	826	79
Total Commercial Lighting	1,460	971	66
OECD countries	915		
Non-OECD countries	545		
Total Industrial Lighting	632	307	49
Total Outdoor Stationary Lighting	281	113	40
Street lighting	147		
Car parks	113		
Traffic lights	19		
World Total, All Sectors	3,418	2,217	65

Notes: The World Total electricity consumption for lighting in 2005 of 3,418 TWh represents 19% of the world's total electricity consumption of 17,982 TWh. IEA's *Light's Labour's Lost* presents electricity use as final energy consumption (13,952 TWh in 2005), omitting transmission and distribution losses. Because we are interested in total primary energy consumption, including these losses, a conversion factor of 1.288 was applied to all values obtained from *Light's Labour's Lost* ($1.288 = 17,982/13,952$).

As outlined in *Plan B 4.0*, reducing lighting electricity consumption by 65% would decrease the share of electricity consumption for lighting from 19% to 7% of world total electricity consumption. The resulting electricity savings is enough to close 705 coal-fired power plants of 500 MW each (a 500-MW coal-fired power plant produces 3.15 TWh of electricity per year operating at 72% capacity).

Source: Compiled by Earth Policy Institute from International Energy Agency (IEA), *Light's Labour's Lost: Policies for Energy-efficient Lighting* (Paris: 2006); 2005 electricity consumption estimated from IEA, *World Energy Outlook 2006* (Paris: 2006).

This is part of a supporting dataset for Lester R. Brown, **Plan B 4.0: Mobilizing to Save Civilization** (New York: W.W. Norton & Company, 2009). For more information and a free download of the book, see Earth Policy Institute on-line at www.earthpolicy.org.

Potential Worldwide Electricity Savings by Switching to More-Efficient Lighting and Implementing System Control Technologies, 2005

Measure	Electricity Savings Terawatt-hours per Year
Residential - average efficacy equaling compact fluorescent (CFL) efficacy ¹	680
Residential - control systems ²	146
Commercial, non-OECD - switching to best fluorescent systems ³	235
Commercial, non-OECD - control systems ²	124
Commercial, OECD - switching to best fluorescent systems ⁴	409
Commercial, OECD - control systems ²	202
Industrial - switching to best fluorescent systems ⁵	91
Industrial - control systems ²	216
Traffic lights - converting to LEDs ⁶	15
External signage, U.S. - neon signs to LEDs ⁷	9
Street lighting - mercury vapor lamps to high pressure sodium ⁸	32
Car parks - dimming lights during off-peak hours ⁹	57
Total Electricity Savings	2,217

Notes: Unless otherwise noted, electricity savings is calculated by assuming the average efficacy of lighting in a particular sector is increased to the lighting efficacy of the best fluorescent systems in use today (92.3 lm/W).

¹ Worldwide, residential lighting has an average source-lumen efficacy of 21.5 lm/W. Source-lumen refers to the lumens emitted by the light source (i.e. a lamp) as opposed to a luminaire. A 13-watt CFL has an average system efficacy (lamp plus ballast efficacy) of approximately 60 lm/W. The residential energy savings is calculated assuming that the average efficacy of lighting in the residential sector is increased to the average efficacy of a 13-watt CFL (i.e., from 21.5 lm/W to 60 lm/W).

² A study by CADDET estimates that lighting energy consumption in the commercial sector can be reduced by 30-50% through the implementation of control systems (i.e., sensors that turn lights off in unoccupied spaces or reduce lighting during daylight hours). The potential electricity savings in the residential and industrial sectors from control systems are likely similar to the commercial sector, so a 40% reduction in energy consumption is assumed for implementation of control systems.

³ Average efficacy of commercial lighting in non-OECD countries is 52.6 lm/W

⁴ Average efficacy of commercial lighting in OECD countries including ballast losses is 51 lm/W

⁵ Worldwide, industrial sector lighting has an average source-lumen efficacy of 79 lm/W

⁶ Worldwide, traffic signals consume approximately 19.3 TWh/yr. Worldwide, if all incandescent-based signals were replaced by CFLs the energy saving would be around 15.5 TWh/yr

⁷ This value is for U.S. only; no good data exists for worldwide savings

⁸ Mercury vapor lamps provide 30% of outdoor lighting. Electricity savings are calculated by assuming that these mercury vapor lamps, with a luminaire efficacy of 13.5 lm/W, are replaced with tubular high-pressure sodium lamps with a luminaire efficacy of 50 lm/W

⁹ Assuming that 50% of illuminated hours are off-peak. All lights could be dimmed or 50% of lights could be switched off during non-peak hours

Source: Calculated by Earth Policy Institute from International Energy Agency (IEA), *Light's Labour's Lost: Policies for Energy-efficient Lighting* (Paris: 2006); a conversion factor of 1.288 used to convert electricity consumption into final consumption calculated from IEA, *World Energy Outlook 2006* (Paris: 2006); IEA Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADET), *Saving Energy with Efficient Lighting in Commercial Buildings, CADET Maxi Brochure 01* (Sittard, Netherlands: CADET), p. 5.

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Energy Savings from Plan B Efficiency Improvements, 2020

Sector	Energy Savings in 2020 Petajoules
Lighting	20,434
Appliances	20,434
Buildings	6,611
Industry	30,794
<i>Petrochemical</i>	11,805
<i>Steel</i>	5,374
<i>Cement</i>	3,615
<i>Other (motor systems, aluminum, paper)</i>	10,000
Transport	<u>78,655</u>
Total	<u>156,927</u>

Summary:

Projected increase in energy demand from 2006 to 2020	138,156
Total energy savings from efficiency improvements in 2020	<u>156,927</u>
Net change in energy demand from 2006 to 2020	<u>-18,771</u>

Source: Earth Policy Institute, 2009. Data sources include International Energy Agency (IEA), *World Energy Outlook 2008* (Paris: 2008), pp. 506-07; IEA, *Light's Labour's Lost: Policies for Energy-efficient Lighting* (Paris: 2006), pp. 25, 29; Florian Bressand, et al., *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity* (Washington, DC: McKinsey Global Institute, May 2007), p. 33, 106; Claude Mandil et al., *Tracking Industrial Energy Efficiency and CO₂ Emissions* (Paris: IEA, 2007), pp. 22-25, 39, 59-61, 140.

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Plan B Energy Efficiency Measures

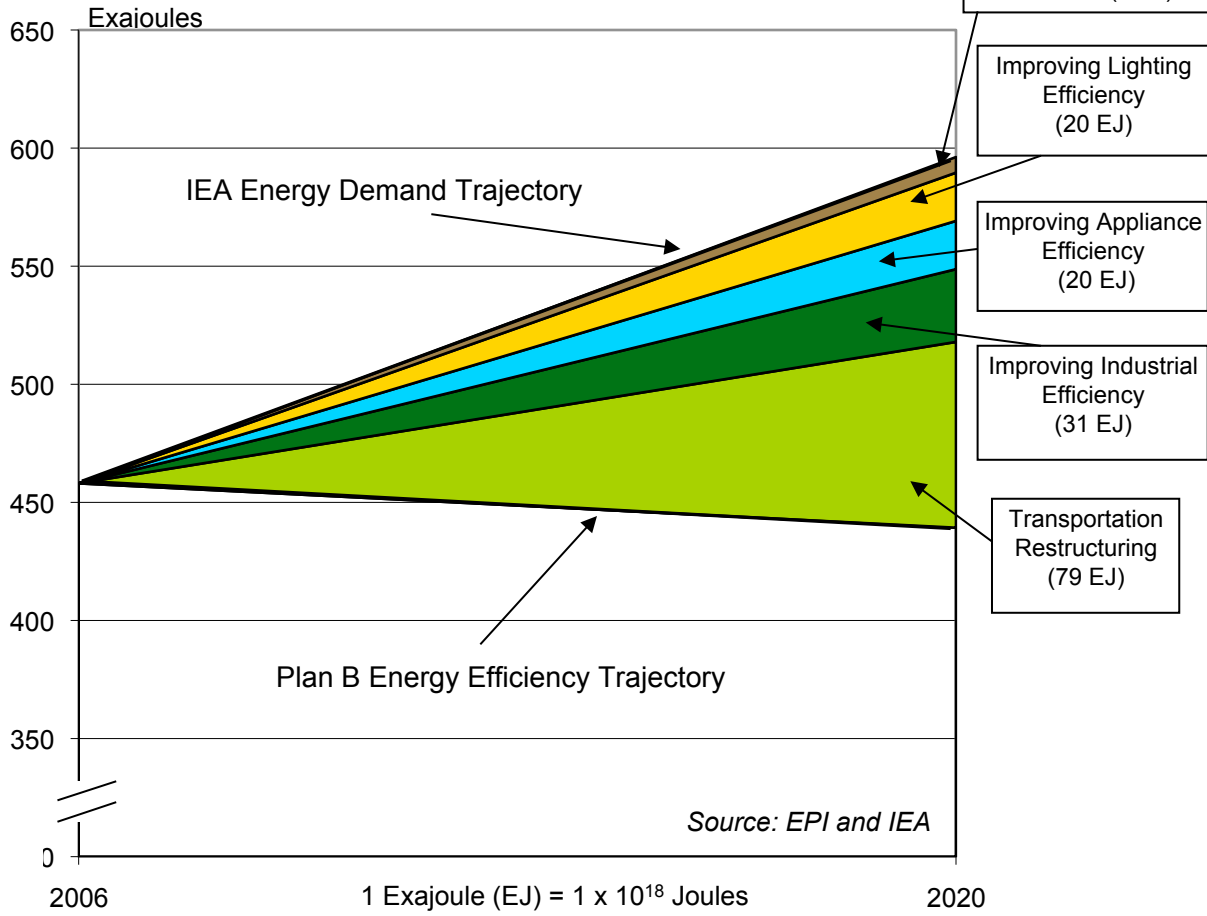


Table 5-1. World Power and Energy from Renewables in 2008 and Plan B Goals for 2020

Source			
Electricity Generating Capacity			
Wind	121	3,000	1,371
Solar Thermal Power Plants	0	200	3
Geothermal	10	200	298
Biomass	52	200	1,312
Hydropower	945	1,350	13,172
Total	1,143	6,450	16,261
Thermal Energy Capacity			
Solar Rooftop Water and Space Heaters	120	1,100	851
Geothermal	100	500	2,838
Biomass	250	350	6,307
Total	470	1,950	9,997

Source: Compiled by Earth Policy Institute, with wind electricity from Global Wind Energy Council, *Wind 2008 Report* (Brussels: 2009), p. 10; rooftop solar electric systems and solar electric power calculated by Earth Policy Institute using European Photovoltaic Industry Association (EPIA), *Global Outlook for Photovoltaics Until 2013* (Brussels: April 2009), pp. 3–4, and Ines Rutschmann, “A Couple of Megawatt Parks,” *PHOTON International* (September 2008), pp. 32–39; solar thermal power plants: Christoph Richter, Sven Teske, and Rebecca Short, *Concentrating Solar Power Global Outlook 2008*

from Renewable Energy Policy Network for the 21st Century, *Renewables Global Status Report: 2009* (Paris and Washington, DC: REN21 Secretariat and Worldwatch Institute, 2009), p. 23; rooftop solar and space heaters from Werner Weiss, Irene Bergmann, and Roman Stelzer, *Solar Heat Worldwide and Contribution to the Energy Supply 2007* (Gleisdorf, Austria: International Energy Agency, Solar Cooling Programme, May 2009), p. 21; geothermal heat from Jefferson Tester et al., *The Future of Geothermal Energy: Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st Century*

World Energy Consumption in 2008 and Plan B Goals for 2020

Source	2008	Goal
Electricity and Heat from Fossil Fuels and Nuclear	70,600	
Electricity from Renewable Sources	16,300	
Thermal Energy from Renewable Sources	10,000	
Transportation	93,000	

Source: Calculated by Earth Policy Institute from Table 5-1 using capacity factors from U.S. Dept. of Energy, National Renewable Energy Laboratory, *Power Technologies Energy Data Book*, (CO: August 2006), p. 201, with fossil fuels and nuclear data from International Energy Agency, *World Energy Outlook 2008*, (Paris: 2008), p. 507; and with transportation data from IEA, *World Energy Outlook 2008* (Paris: 2008) p. 507; E.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no.

Source

Electricity and Heat Generation from Fossil Fuels and Nuclear

Coal	30,237	
Oil	3,905	
Gas	14,379	
Nuclear	10,316	
Heat	11,774	
Total	<u>70,611</u>	<hr/>

Electricity Generation from Renewables

Wind	1,371	
Rooftop Solar Electric Systems	92	
Solar Electric Power Plants	12	
Solar Thermal Power Plants	3	
Geothermal	298	
Biomass	1,312	
Hydropower	13,172	
Total	<u>16,261</u>	<hr/>

Thermal Energy Capture from Renewable Sources

Solar Rooftop Water and Space Heaters	851	
Geothermal	2,838	
Biomass	6,307	
Total	<u>9,997</u>	<hr/>

Oil	91,155	
Fuel Ethanol	1,400	
Biodiesel	490	
Total	<u>93,045</u>	<hr/>

Total Energy Consumption	189,914	<hr/>
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Source: Calculated by Earth Policy Institute from Table 5-1 using capacity factors from U.S. Department of Energy, National Renewable Energy Laboratory, *Power Technologies Energy Book*, (Golden, CO: August 2006), p. 201, with fossil fuels and nuclear data from International Energy Agency (IEA) *World Energy Outlook 2008* (Paris: 2008) p. 507; and with transportation data

World Energy Growth Rates by Source, 2000-2008

Energy Source	Average Annual Growth Rate Percent	Compound Annual Growth Rate Percent
Wind Power	27.5	27.4
Solar Photovoltaics	33.0	33.9
Geothermal Power *	3.4	3.1
Geothermal Heat	18.9	16.1
Hydroelectric	2.2	2.3
Oil	1.3	1.3
Natural Gas	3.0	2.8
Nuclear Power	0.9	0.7
Coal	4.4	4.4
Biodiesel	41.2	43.8
Fuel Ethanol	15.7	18.5

* Note: Due to lack of 2008 data, growth rates for geothermal power are for 2000-2009.

Source: Compiled by Earth Policy Institute with wind power from Global Wind Energy Council, *Wind 2008 Report* (Brussels: 2009); solar photovoltaics from European Photovoltaic Industry, *Global Market Outlook for Photovoltaics Until 2013* (Brussels: April 2009), pp. 3-4; geothermal from Ruggero Bertani, "World Geothermal Generation in 2007," *GHC Bulletin*, September 2007; Slack, *Update on US Geothermal Power Production and Development* (Washington, DC: Geo Energy Association, 16 January 2008); Emerging Energy Research, *Global Geothermal Market*

Worldwatch Institute, various years); hydroelectric, oil, natural gas, nuclear, and coal from BP,

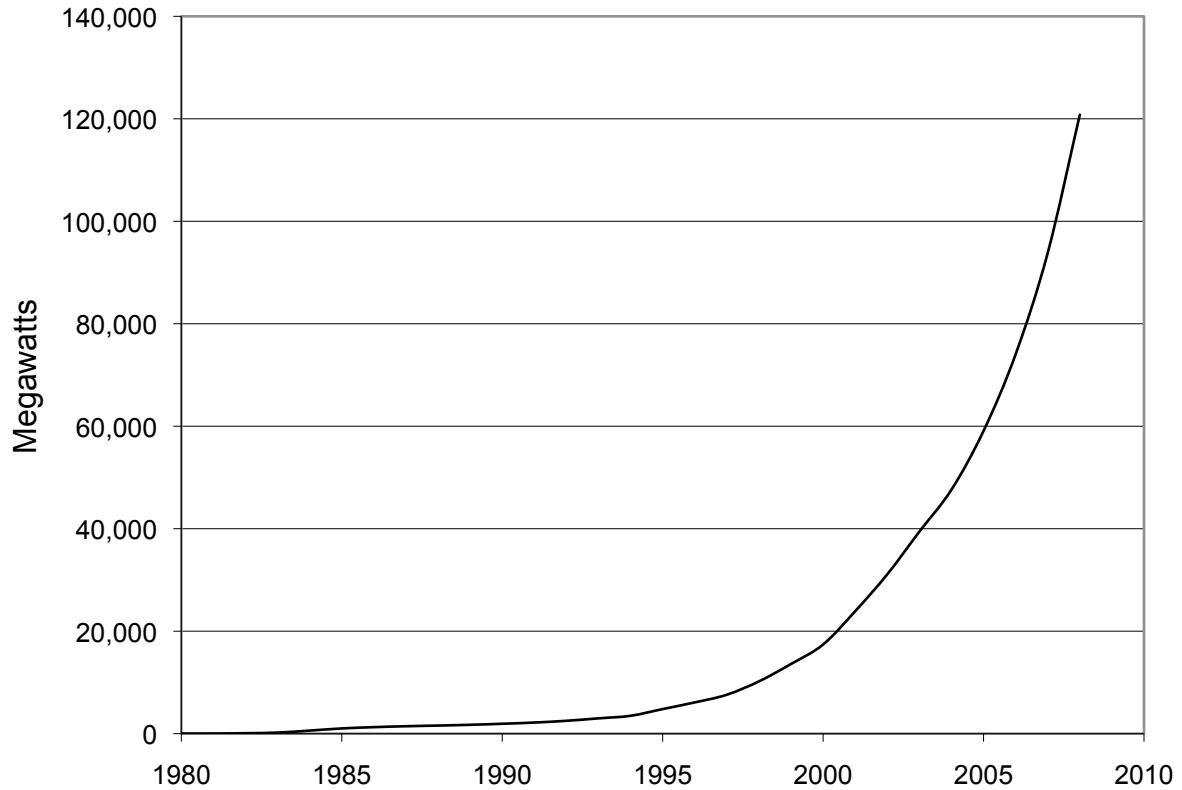
World Installed Wind Electricity-Generating Capacity, 1980-2008

1980	10	
1981	25	15
1982	90	65
1983	210	120
1984	600	390
1985	1,020	420
1986	1,270	250
1987	1,450	180
1988	1,580	130
1989	1,730	150
1990	1,930	200
1991	2,170	240
1992	2,510	340
1993	2,990	480
1994	3,490	500
1995	4,800	1,310
1996	6,100	1,300
1997	7,600	1,500
1998	10,200	2,600
1999	13,600	3,400
2000	17,400	3,800
2001	23,900	6,500
2002	31,100	7,200
2003	39,431	8,331
2004	47,620	8,189
2005	59,091	11,471
2006	74,052	14,961
2007	93,835	19,783
2008	120,798	26,963

* Note: Net annual addition equals new installations minus retirements.

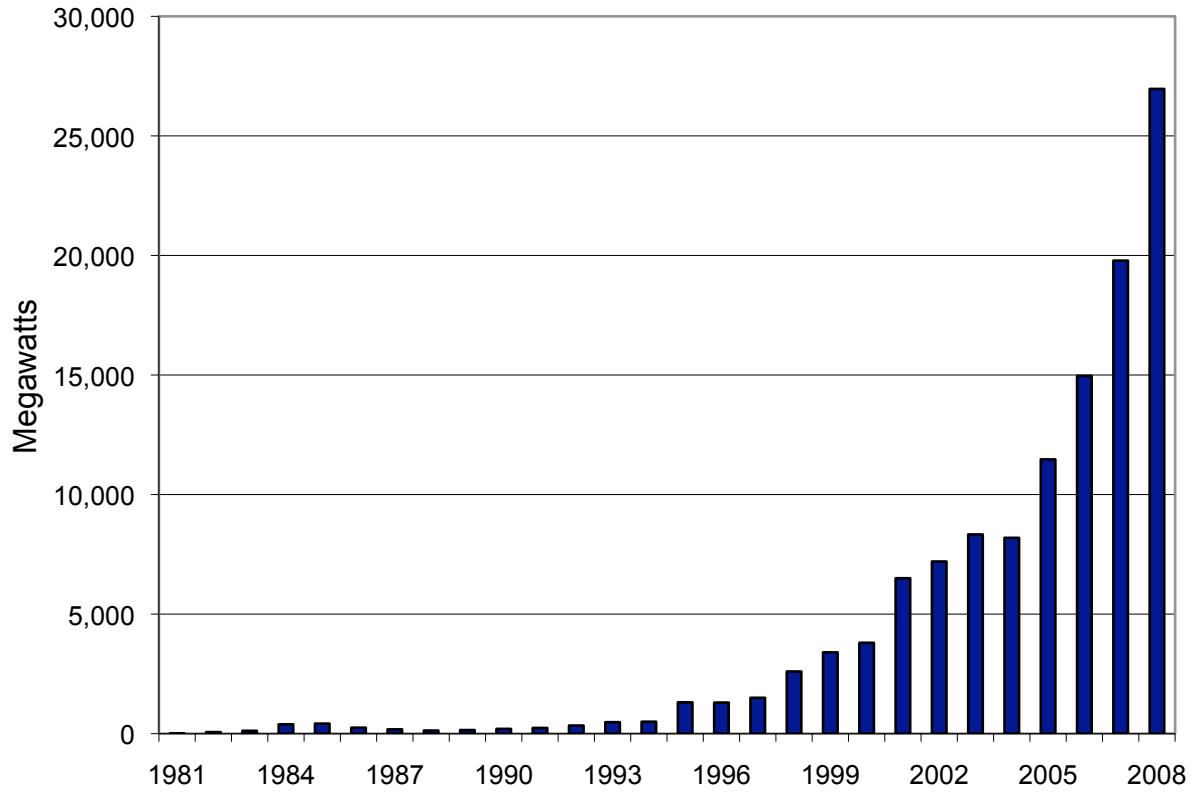
Source: Compiled by Earth Policy Institute with 1980-1994 data from Worldwind

World Cumulative Installed Wind Electricity-Generating Capacity, 1980-2008



Source: GWEC; Worldwatch

World Net Annual Installed Wind Electricity-Generating Capacity Additions, 1981-2008



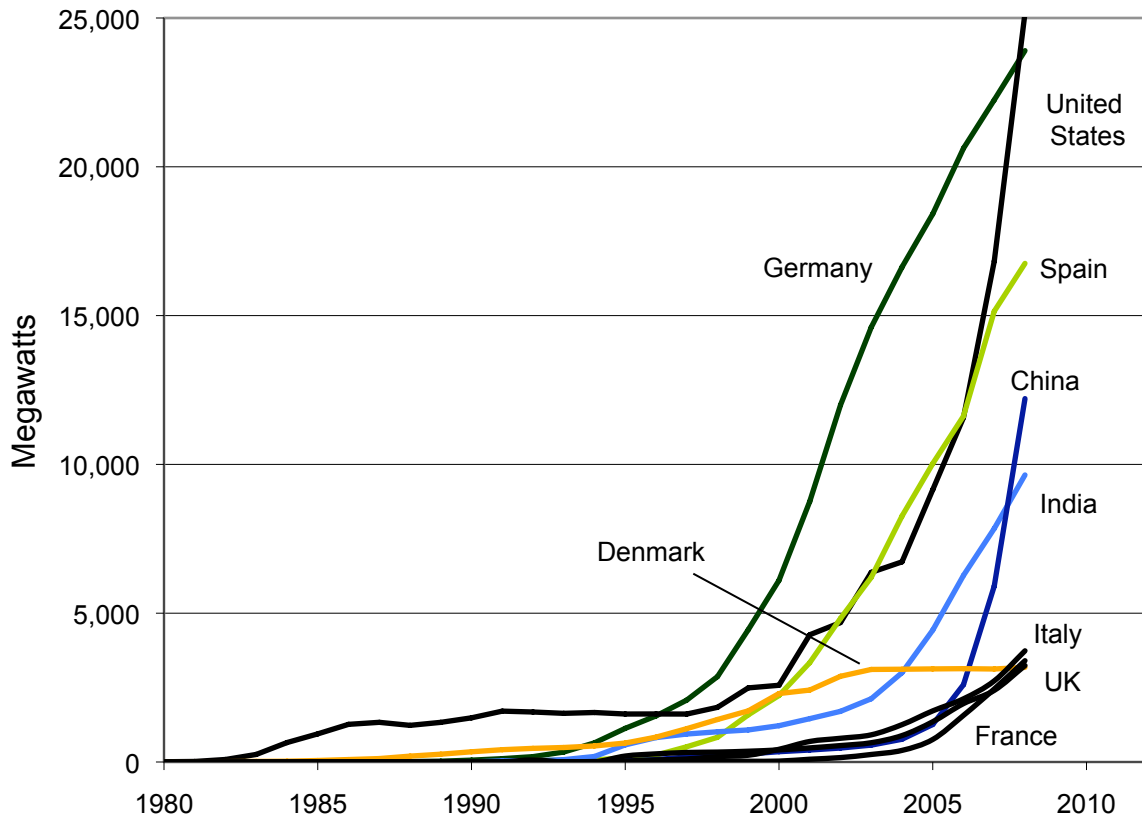
Source: GWEC; Worldwatch

Cumulative Installed Wind Electricity-Generating Capacity in Leading Countries and the World, '80-2008

1980	8	0	0	n.a.	0	0	0	0	5
1981	18	0	0	n.a.	0	0	0	0	7
1982	84	0	0	n.a.	0	0	0	0	12
1983	254	0	0	n.a.	0	0	0	0	20
1984	653	0	0	n.a.	0	0	0	0	27
1985	945	0	0	n.a.	0	0	0	0	50
1986	1,265	0	0	n.a.	0	0	0	0	82
1987	1,333	5	0	n.a.	0	0	0	0	115
1988	1,231	15	0	n.a.	0	0	0	0	197
1989	1,332	27	0	n.a.	0	0	0	0	262
1990	1,484	62	0	n.a.	0	0	0	0	343
1991	1,709	112	5	n.a.	39	0	0	4	413
1992	1,680	180	50	n.a.	39	2	0	69	458
1993	1,635	335	60	n.a.	79	4	2	n.a.	487
1994	1,663	643	70	n.a.	185	16	n.a.	n.a.	539
1995	1,612	1,130	140	38	576	32	3	200	637
1996	1,614	1,548	230	79	820	70	6	273	835
1997	1,611	2,080	512	170	940	103	10	319	1,120
1998	1,837	2,870	830	224	1,015	180	19	333	1,428
1999	2,490	4,445	1,584	268	1,077	227	25	362	1,718
2000	2,578	6,104	2,235	346	1,220	427	30	406	2,300
2001	4,275	8,754	3,337	402	1,456	690	93	474	2,417
2002	4,685	11,994	4,825	469	1,702	797	148	552	2,880
2003	6,372	14,609	6,203	567	2,125	913	253	648	3,110
2004	6,725	16,629	8,263	764	3,000	1,255	390	888	3,117
2005	9,149	18,415	10,027	1,260	4,430	1,718	757	1,353	3,128
2006	11,575	20,622	11,623	2,599	6,270	2,123	1,567	1,962	3,136
2007	16,824	22,247	15,145	5,910	7,845	2,726	2,454	2,406	3,125
2008	25,170	23,903	16,754	12,210	9,645	3,736	3,404	3,241	3,180

Source: Compiled by Earth Policy Institute with world data from Global Wind Energy Council (GWEC) *Wind 2008 Report* (Brussels: 2009), and Janet L. Sawin, "Wind Power Still Soaring," in *Worldwatch I Vital Signs 2007-2008* (New York: W. W. Norton & Company, 2007). Country data from *Worldwatch I Signposts 2001*, CD-ROM (Washington, DC: 2001); Chinese Renewable Energy Industries Association *Wind Power Report 2007* (Beijing: China Environmental Science Press, 2007); American Wind Energy Association, *Global Wind Energy Market Report*, various issues (Washington, DC: 2002-2005); GWEI this note; GWEC, *Global Wind 2006 Report* (Brussels: 2007); Francois Demarcq, "Perspectives in Fr

Cumulative Installed Wind Electricity-Generating Capacity in Selected Countries, 1980-2008



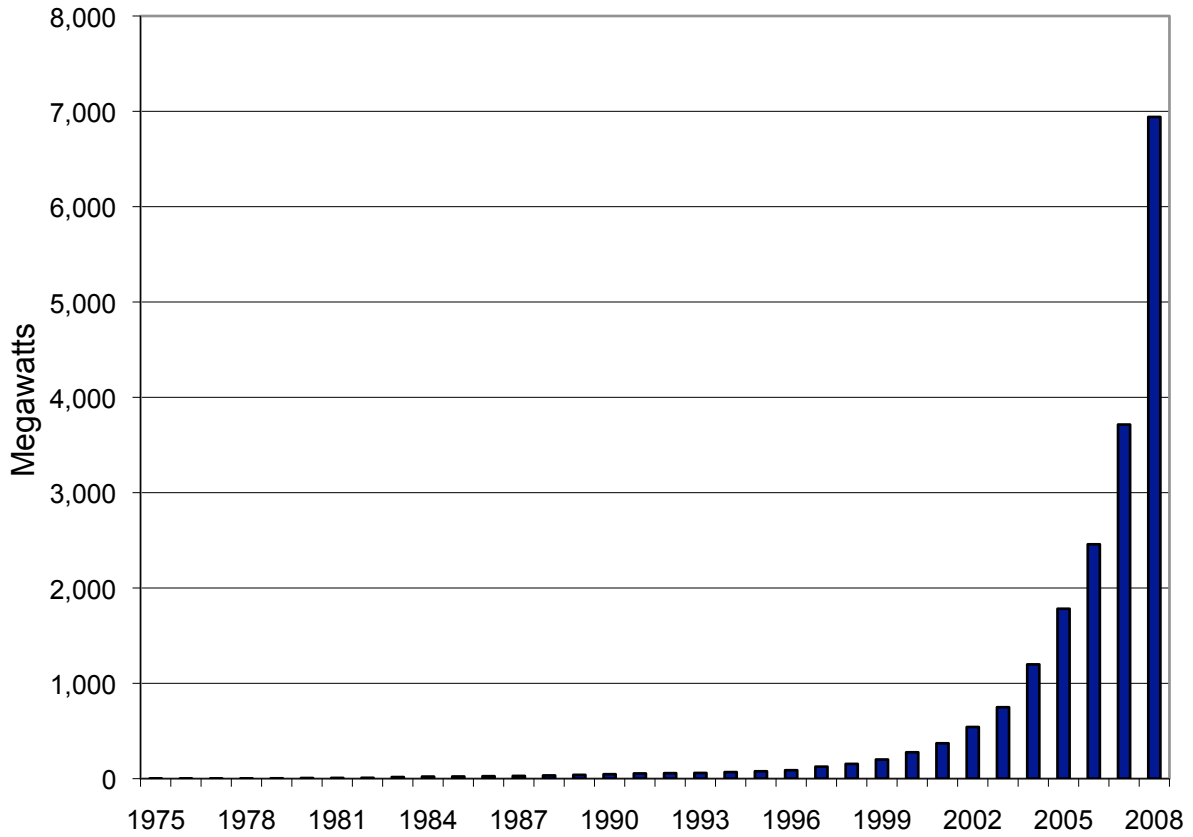
Source: Worldwatch; CREIA; AWEA; GWEC; Demarcq; BWEA; ANEV; EWEA

World Solar Photovoltaics Production, 1975-2008

1975	2	2
1976	2	4
1977	2	6
1978	3	9
1979	4	13
1980	7	20
1981	8	28
1982	9	37
1983	17	54
1984	22	76
1985	23	99
1986	26	125
1987	29	154
1988	34	188
1989	40	228
1990	47	275
1991	55	330
1992	58	388
1993	60	448
1994	69	517
1995	78	594
1996	89	683
1997	126	809
1998	155	964
1999	201	1,165
2000	277	1,442
2001	371	1,813
2002	542	2,355
2003	749	3,104
2004	1,199	4,303
2005	1,782	6,086
2006	2,459	8,544
2007	3,715	12,259
2008	6,941	19,200

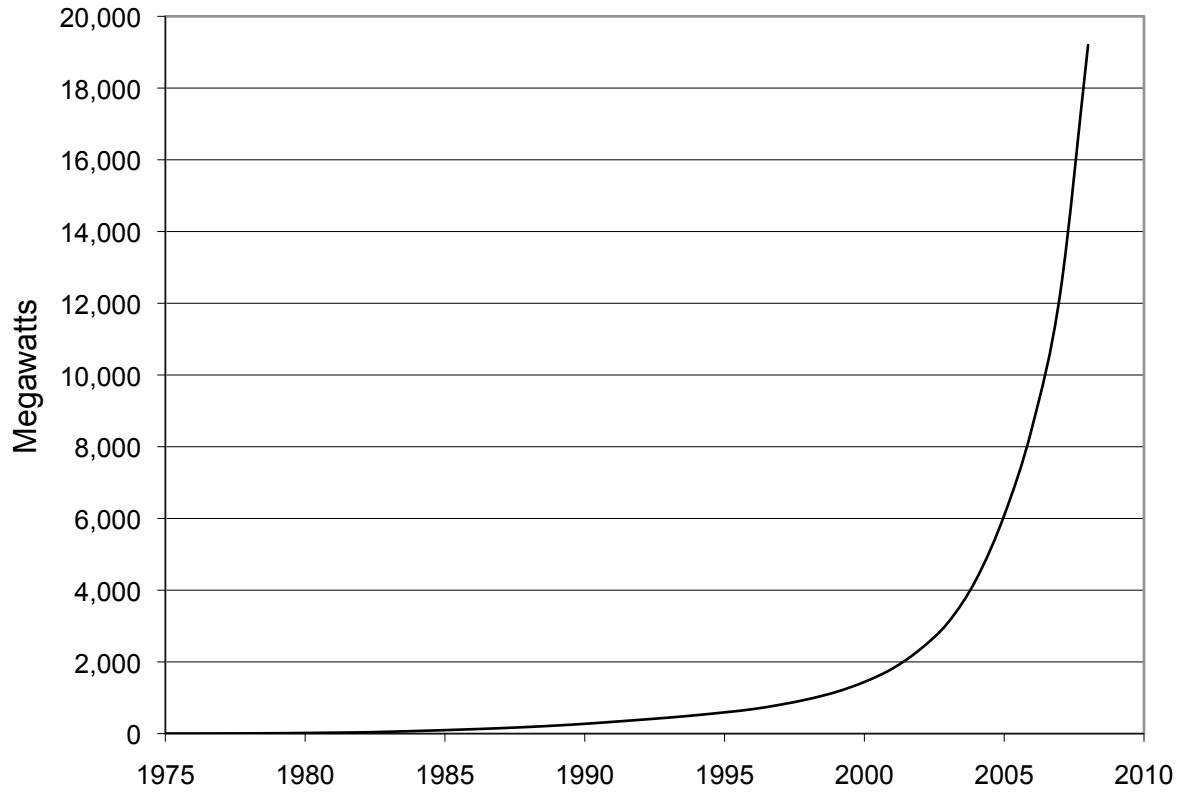
Source: Compiled by Earth Policy Institute with 1975-1979 data from Worldwatch Institute. *Sianposts 2004*. CD-ROM (Washington, DC: 2004); 1980-2000 from

World Annual Solar Photovoltaics Production, 1975-2008



Source: Worldwatch; Prometheus Institute and Greentech Media

World Cumulative Solar Photovoltaics Production, 1975-2008



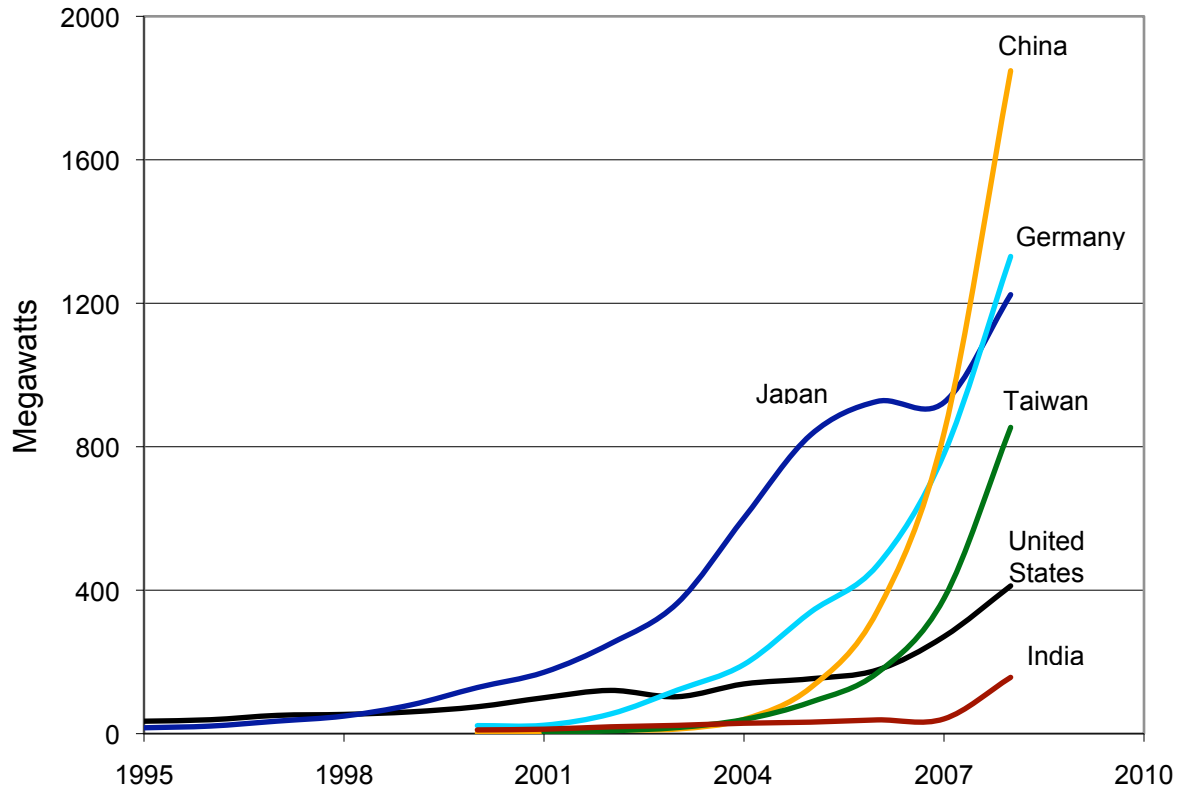
Source: Worldwatch; Prometheus Institute and Greentech Media

Annual Solar Photovoltaics Production by Country, 1995-2008

Year	Japan	Germany		China	Taiwan	India	Other
1995	35	16	n.a.	20	n.a.	n.a.	n.a.
1996	39	21	n.a.	19	n.a.	n.a.	n.a.
1997	51	35	n.a.	30	n.a.	n.a.	n.a.
1998	54	49	n.a.	34	n.a.	n.a.	n.a.
1999	61	80	n.a.	40	n.a.	n.a.	n.a.
2000	75	129	23	50	3	n.a.	10
2001	100	171	24	74	3	4	13
2002	121	251	55	123	10	8	19
2003	103	364	122	201	13	17	23
2004	139	602	193	312	40	39	29
2005	153	833	339	473	128	88	32
2006	178	926	469	673	342	170	38
2007	271	924	780	1,069	838	377	41
2008	412	1,224	1,331	1,907	1,848	854	157

Source: Compiled by Earth Policy Institute with 1995-1999 data from Worldwatch Institute, *Signpost*

Annual Solar Photovoltaics Production in Selected Countries, 1995-2008



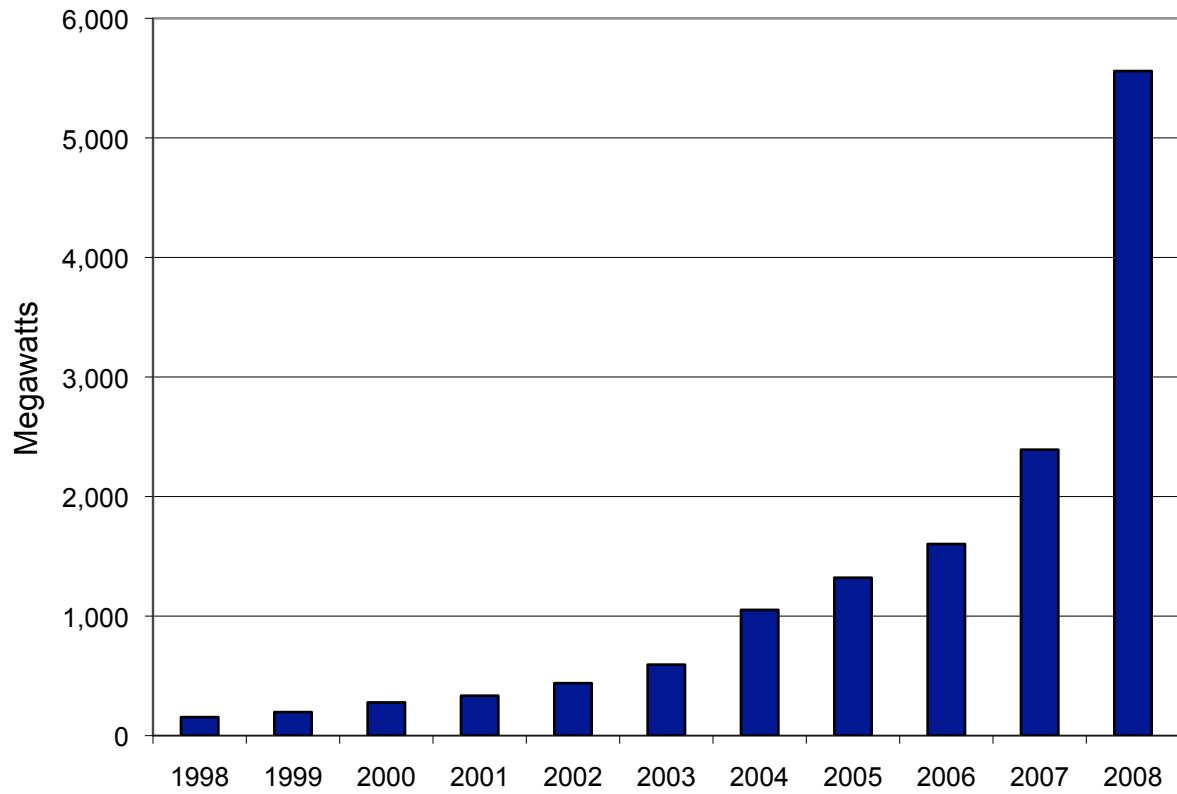
Source: Worldwatch; Prometheus Institute and Greentech Media

World Solar Photovoltaics Installations, 1998-2008

1998	155
1999	197
2000	278
2001	334
2002	439
2003	594
2004	1,052
2005	1,321
2006	1,603
2007	2,392
2008	5,559

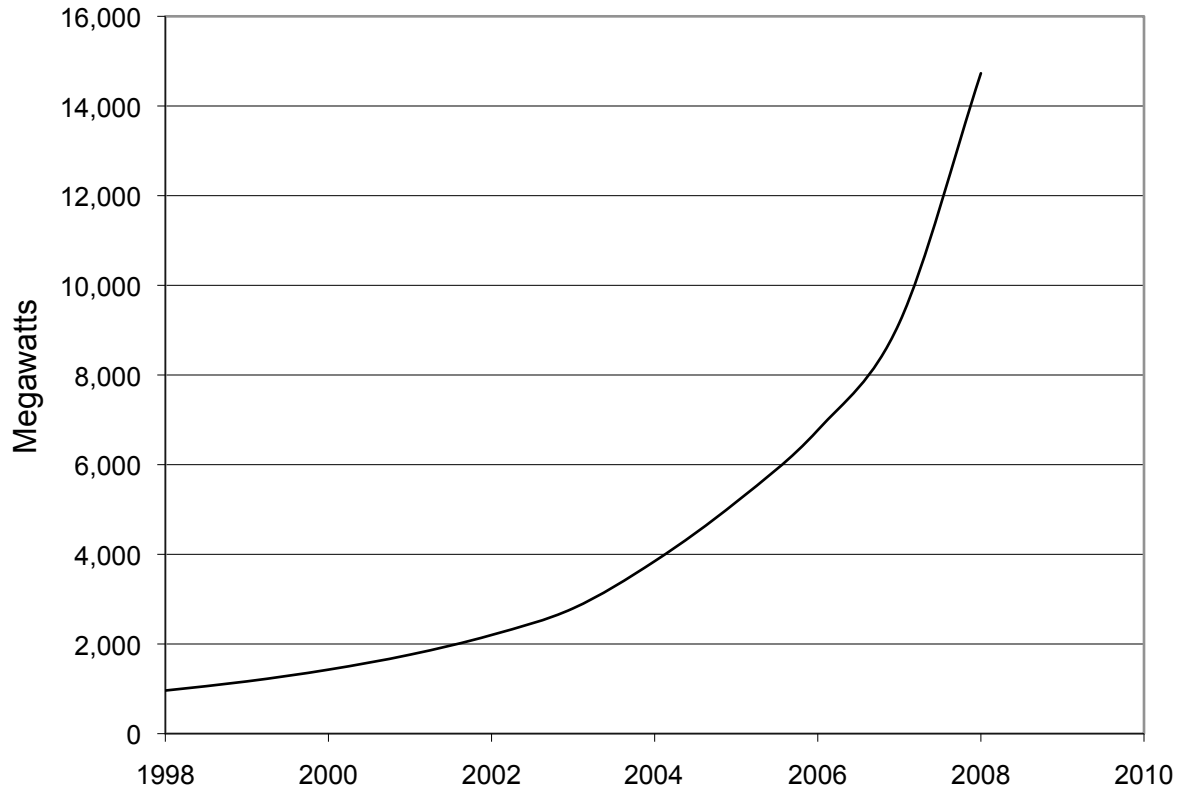
This is part of a supporting dataset for Lester R. Brown,

World Annual Solar Photovoltaics Installations, 1998-2008



Source: EPIA

World Cumulative Solar Photovoltaics Installations, 1998-2008



Source: EPIA

Annual Installed Solar Photovoltaics Capacity in Selected Countries and the World, '

1998	69	n.a.	0	10	8	68
1999	72	17	1	12	11	84
2000	112	22	n.a.	40	10	94
2001	135	29	2	78	16	75
2002	185	44	9	80	16	104
2003	223	63	10	150	50	98
2004	272	90	6	600	30	53
2005	290	114	26	850	30	12
2006	287	145	88	850	37	196
2007	210	207	560	1,100	108	207
2008	230	342	2,511	1,500	492	485

Cumulative Installed Solar Photovoltaics Capacity in Ten Leading Countries and the World,

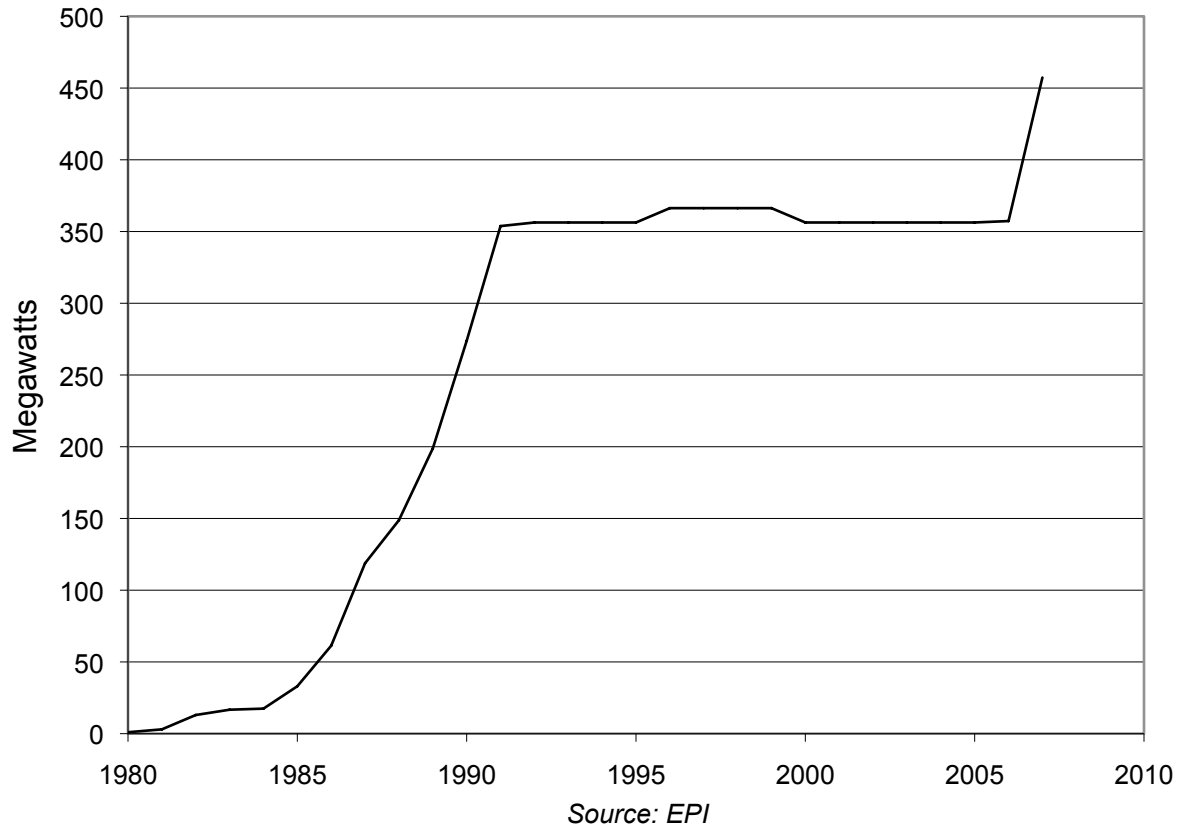
<u>Country</u>	<u>Megawatts</u>
Germany	5,308
Spain	3,223
Japan	2,149
United States	1,173
South Korea	352
Italy	350
China	145
India	90
France	87
Belgium	70
<u>World Total</u>	14,730

World Installed Concentrating Solar Thermal Power Capacity, 1980-2007

Year	Megawatts
1980	1
1981	3
1982	13
1983	17
1984	17
1985	33
1986	61
1987	119
1988	149
1989	199
1990	274
1991	354
1992	356
1993	356
1994	356
1995	356
1996	366
1997	366
1998	366
1999	366
2000	356
2001	356
2002	356
2003	356
2004	356
2005	356
2006	357
2007	457

Source: Compiled by Earth Policy Institute from Shirish Garud, *Making Solar Thermal Power (in India) a Reality* (New Delhi: The Energy and Resources Institute, 2006), p. 9; Rainer Aringhetti, *Concentrated Solar Thermal Power – Now!* (Brussels, Almeria, and Amsterdam: European Solar Industry Association, IEA SolarPACES, and Greenpeace International, September 2005), p. 10; Department of Energy (DOE), National Renewable Energy Laboratory (NREL), *U.S. Parabolic Power Plant Data*, electronic database, at www.nrel.gov/csp/troughnet/power_plant_data.html (May 2007); DOE, NREL, *Concentrating Solar Power: Energy from Mirrors* (Golden, CO: March

World Installed Concentrating Solar Thermal Power Capacity, 1980-2007



World's Top Ten Largest Proposed Concentrating Solar Thermal Projects as of June 2008

Location	Company	Project
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Country	Total Area	Population	Area
Cyprus	796	854	
Israel	4,937	6,932	
Austria	2,993	8,307	
Barbados	83	255	
Greece	3,573	11,112	
Jordan	848	5,941	
Turkey	10,150	73,004	
Germany	8,648	82,343	
China	114,140	1,329,090	
Australia	1,683	20,854	
Denmark	397	5,445	
Malta	29	406	
Switzerland	459	7,513	
Slovenia	117	2,010	
Taiwan	1,255	22,900	
Japan	6,952	127,396	
Luxembourg	19	475	
Sweden	252	9,159	
Spain	1,210	44,051	
New Zealand	113	4,193	
Portugal	282	10,641	
France	1,450	61,714	
Tunisia	218	10,069	
Netherlands	330	16,460	
Brazil	3,588	190,120	
Slovak Republic	98	5,394	
Italy	976	59,305	
Albania	50	3,132	
Belgium	146	10,531	
Czech Republic	113	10,268	
Macedonia	19	2,040	
Ireland	36	4,355	
United States	2,477	308,674	
Poland	235	38,132	
South Africa	248	49,173	
United Kingdom	305	60,899	
World	172,158	6,670,801	

Source: Werner Weigl, Irene Bergmann, and Roman Stelzer, *Sales Heat Worldwide: Markets and Cr*

<u>Country</u>	<u>Thermal Megawatts</u>
China	79,898
Turkey	7,105
Germany	6,054
Japan	4,866
Israel	3,456
Brazil	2,512
Greece	2,501
Austria	2,095
United States	1,734
India	1,505
World Total	120,511

World Cumulative Installed Geothermal Electricity-Generating Capacity,

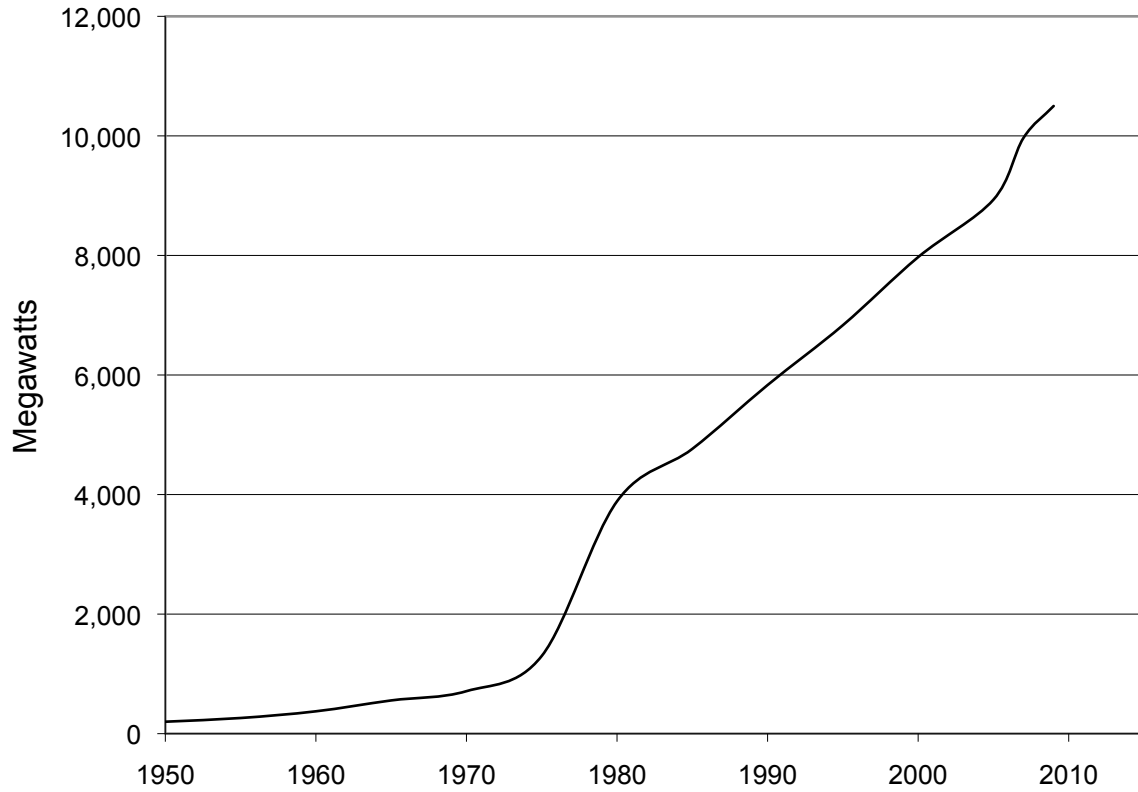
Year

1950	200
1955	262
1960	374
1965	556
1970	711
1975	1,300
1980	3,887
1985	4,764
1990	5,832
1995	6,833
2000	7,972
2005	8,933
2007	
2009	

* Note: Data for 2007 and 2009 are estimates.

Source: Compiled by Earth Policy Institute with 1950-1970 data from Worldwatch Institute, *Signposts 2004*, CD-ROM (Washington, DC: 2004); 1975-2005 data from Ruggero Bertani, "World Geothermal Generation in 2007," *GHC Bulletin*, Sept 2007, p. 8; 2007 figure calculated from Ruggero Bertani, "World Geothermal Capacity in 2007," *GHC Bulletin*, September 2007 with U.S. data from Mark Taylor, *U.S.*

World Cumulative Installed Geothermal Electricity-Generating Capacity, 1950-2009



Source: Worldwatch; Bertani; GEA; EER

Cumulative Installed Geothermal Electricity-Generating Capacity by Country,

Country	1990	1995	2000	2005	2007 *
Australia	0.0	0.2	0.2	0.2	0.2
Austria	0.0	0.0	0.0	1.1	1.1
China	19.2	28.8	29.2	27.8	27.8
Costa Rica	0.0	55.0	142.5	163.0	162.5
El Salvador	95.0	105.0	161.0	151.0	204.2
Ethiopia	0.0	0.0	7.3	7.3	7.3
France	4.2	4.2	4.2	14.7	14.7
Germany	0.0	0.0	0.0	0.2	8.4
Guatemala	0.0	33.4	33.4	33.0	53.0
Iceland	44.6	50.0	170.0	202.0	421.2
Indonesia	144.8	309.8	589.5	797.0	992.0
Italy	545.0	631.7	785.0	791.0	810.5
Japan	214.6	413.7	546.9	535.0	535.2
Kenya	45.0	45.0	45.0	129.0	128.8
Mexico	700.0	753.0	755.0	953.0	953.0
New Zealand	283.2	286.0	437.0	435.0	471.6
Nicaragua	35.0	70.0	70.0	77.0	87.4
Papua New Guinea	0.0	0.0	0.0	6.0	56.0
Philippines	891.0	1,227.0	1,909.0	1,930.0	1,969.7
Portugal	3.0	5.0	16.0	16.0	23.0
Russia	11.0	11.0	23.0	79.0	79.0
Thailand	0.3	0.3	0.3	0.3	0.3
Turkey	20.6	20.4	20.4	20.0	38.0
United States	2,774.6	2,816.7	2,228.0	2,564.0	2,923.5
World Total	5,831.1	6,866.1	7,972.9	8,932.6	9,968.4

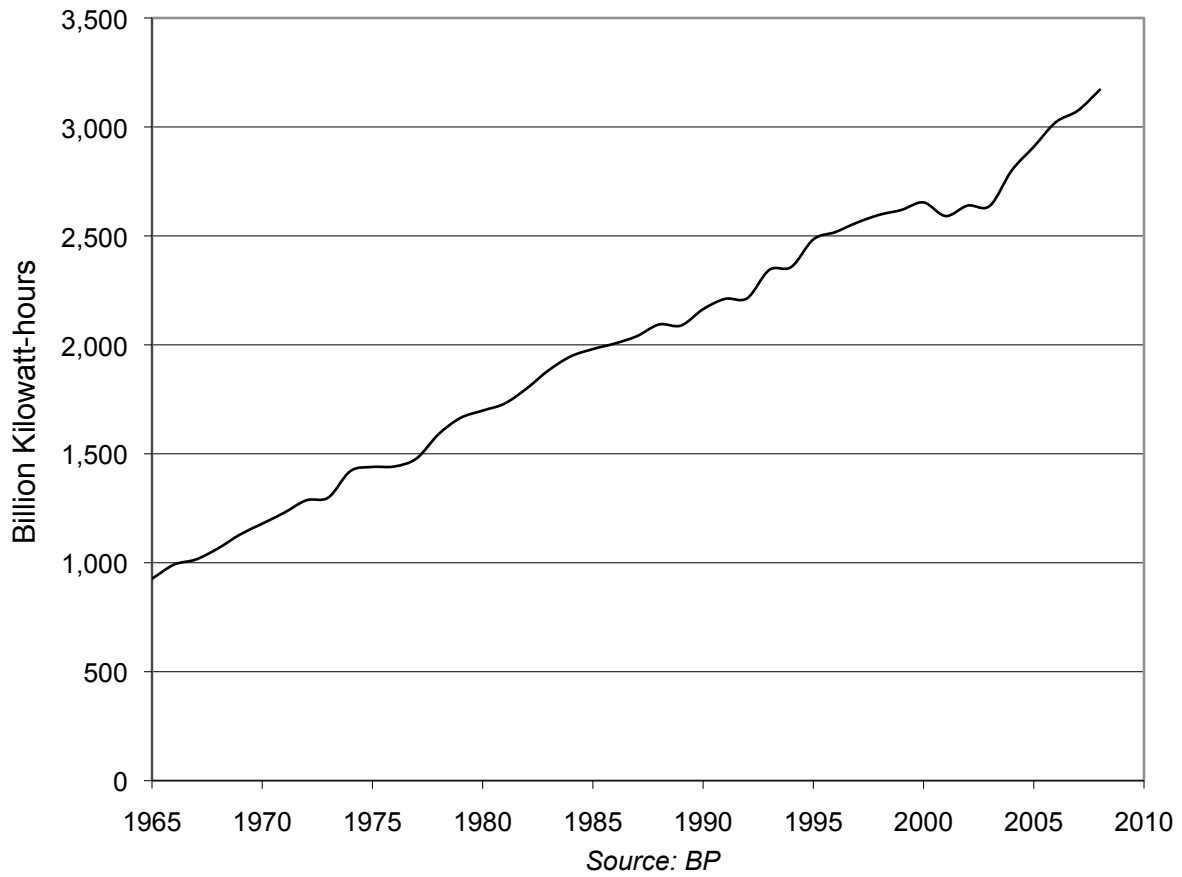
* Estimates.

Source: Compiled by Earth Policy Institute with 1990 and 1995 from Int Geothermal Association, "Installed Generating Capacity," at <http://iga.igg.cnr.it/geoworld/geoworld.php?sub=elgen>, updated 29 July 2000, 2005, and 2007 from Ruggero Bertani, "World Geothermal Gene

World Hydroelectric Consumption, 1965-2008

<u>Year</u>	<u>Consumption</u> Billion Kilowatt-hours
1965	926
1966	991
1967	1,015
1968	1,066
1969	1,130
1970	1,179
1971	1,230
1972	1,287
1973	1,299
1974	1,421
1975	1,440
1976	1,442
1977	1,479
1978	1,590
1979	1,665
1980	1,698
1981	1,731
1982	1,800
1983	1,884
1984	1,947
1985	1,981
1986	2,006
1987	2,040
1988	2,094
1989	2,089
1990	2,164
1991	2,211
1992	2,214
1993	2,344
1994	2,357
1995	2,484
1996	2,518
1997	2,562
1998	2,597
1999	2,619
2000	2,654
2001	2,591
2002	2,639
2003	2,637
2004	2,800
2005	2,909
2006	3,022

World Hydroelectric Consumption, 1965-2008

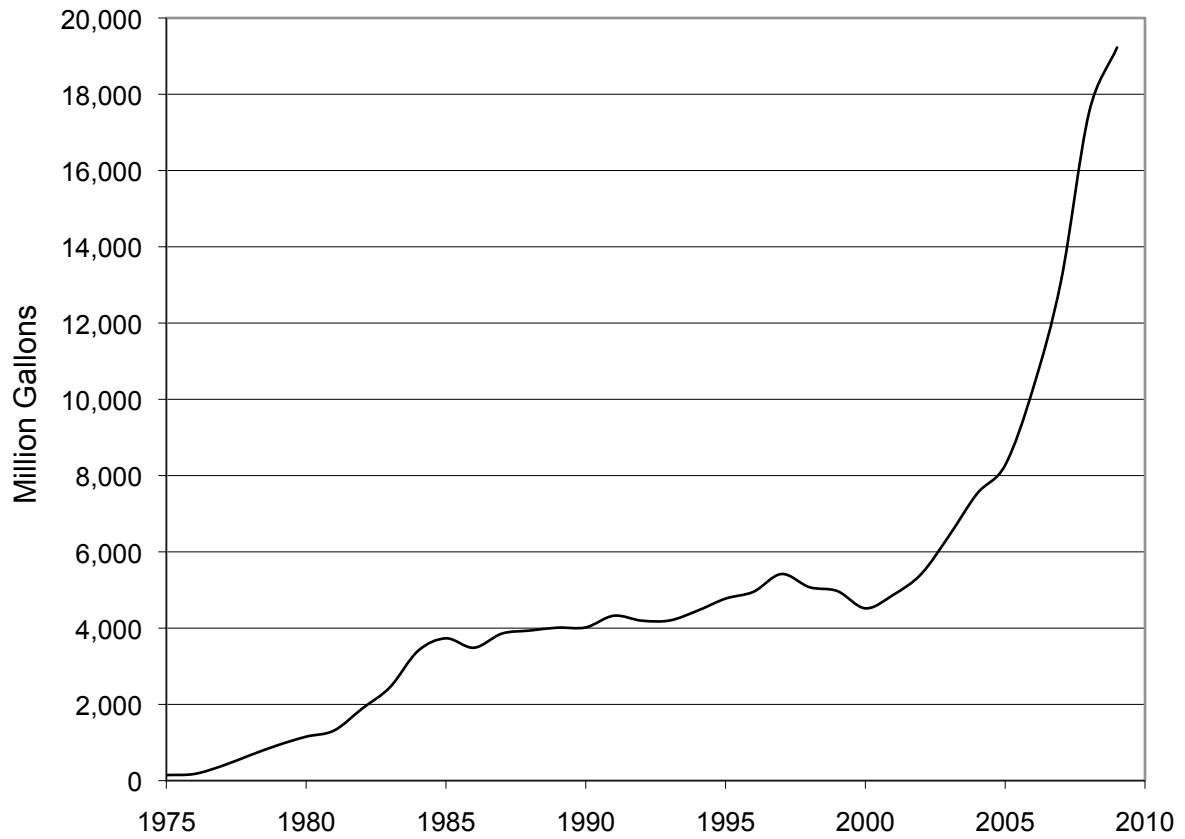


World Annual Fuel Ethanol Production, 1975-2009

Year	
1975	147
1976	175
1977	388
1978	668
1979	933
1980	1,154
1981	1,315
1982	1,889
1983	2,452
1984	3,403
1985	3,732
1986	3,485
1987	3,857
1988	3,937
1989	4,013
1990	4,019
1991	4,325
1992	4,196
1993	4,201
1994	4,458
1995	4,775
1996	4,954
1997	5,420
1998	5,073
1999	4,972
2000	4,519
2001	4,874
2002	5,420
2003	6,430
2004	7,531
2005	8,276
2006	10,293
2007	13,113
2008	17,524
2009 *	19,227

* Projection.

World Annual Fuel Ethanol Production, 1975-2009



Source: F.O. Licht

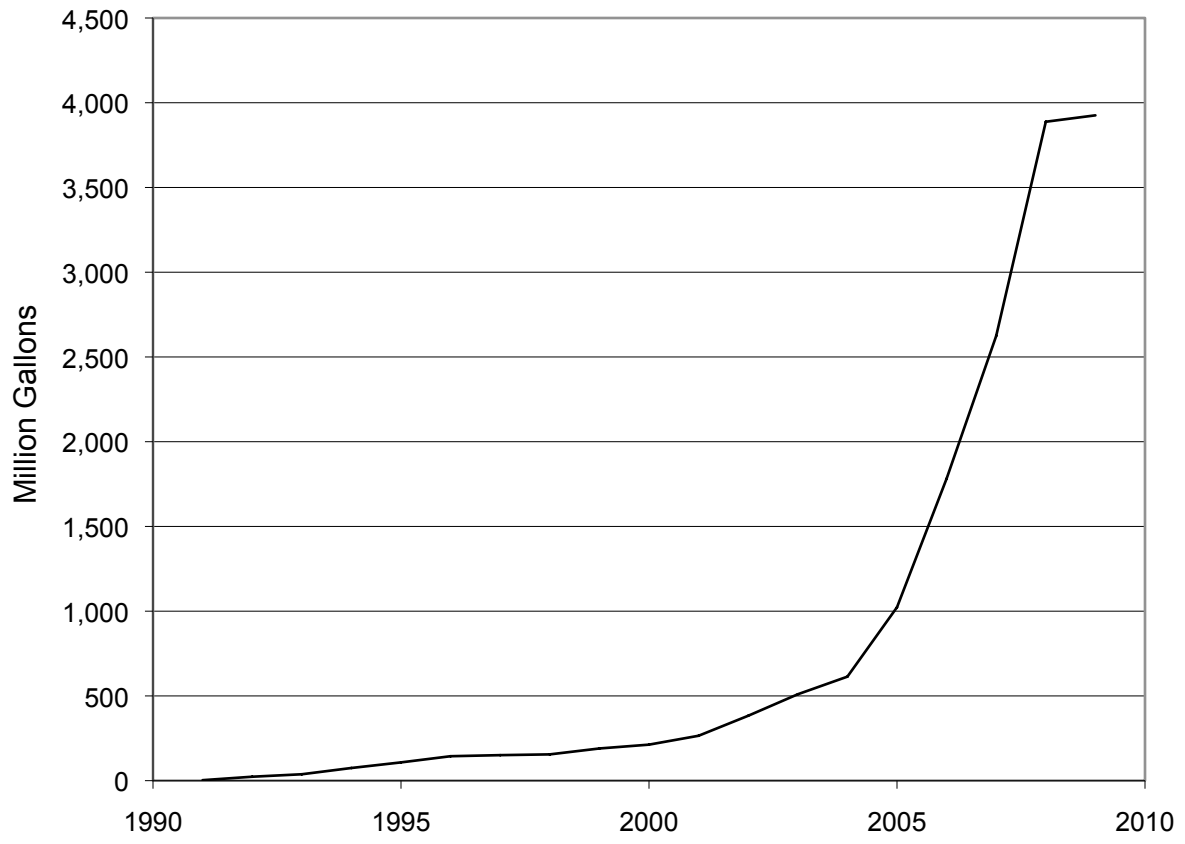
World Annual Biodiesel Production, 1991-2009

<u>Year</u>	<u>Annual Production</u>
1991	3
1992	23
1993	38
1994	75
1995	108
1996	144
1997	151
1998	155
1999	190
2000	213
2001	265
2002	383
2003	510
2004	614
2005	1,023
2006	1,782
2007	2,624
2008	3,888
2009 *	3,926

* Projection.

Source: Compiled by Earth Policy Institute with 1991-1999 data from E.O. Licht data, cited in S.

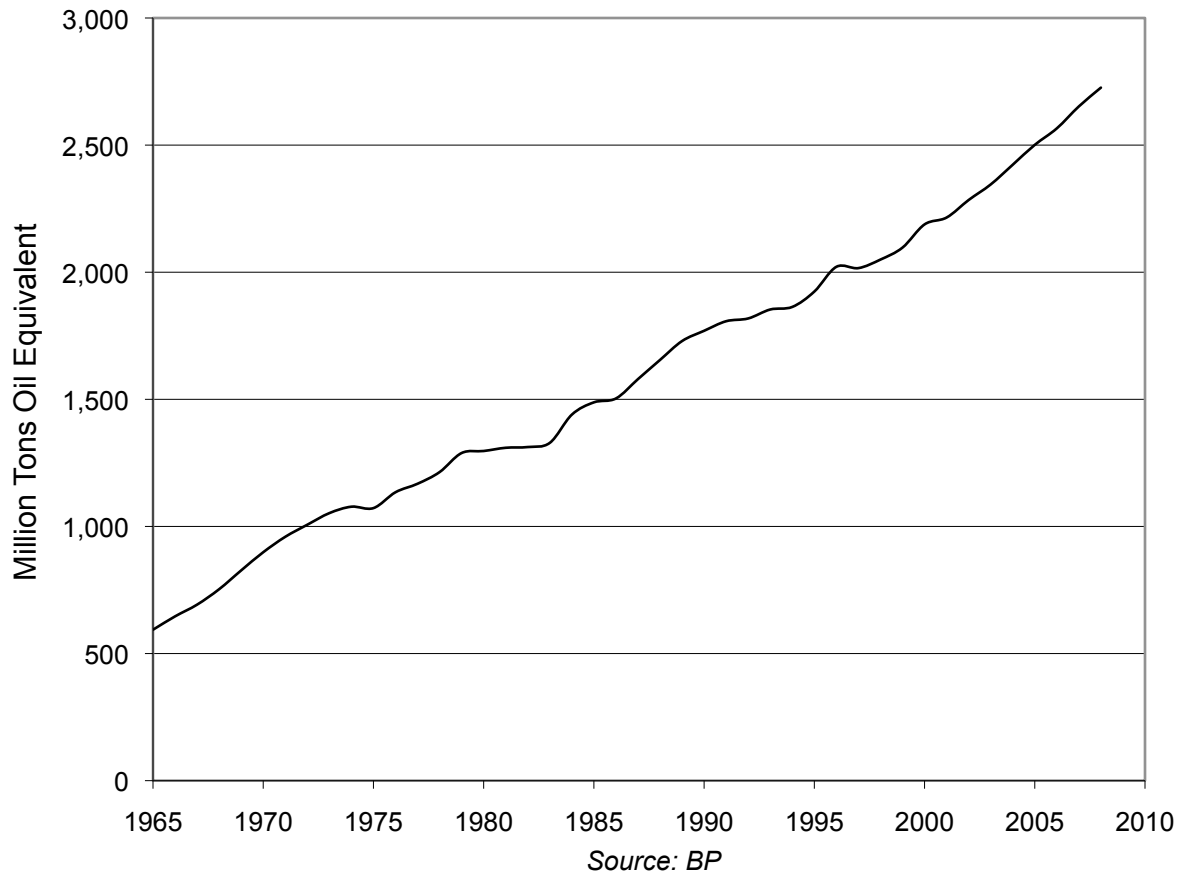
World Annual Biodiesel Production, 1991-2009



World Natural Gas Consumption, 1965-2008

<u>Year</u>	<u>Consumption</u>
	Million Tons Oil Equivalent
1965	594
1966	646
1967	692
1968	753
1969	827
1970	899
1971	959
1972	1,007
1973	1,052
1974	1,078
1975	1,072
1976	1,135
1977	1,168
1978	1,214
1979	1,289
1980	1,297
1981	1,309
1982	1,312
1983	1,329
1984	1,440
1985	1,488
1986	1,503
1987	1,580
1988	1,655
1989	1,729
1990	1,770
1991	1,807
1992	1,818
1993	1,853
1994	1,863
1995	1,924
1996	2,021
1997	2,016
1998	2,050
1999	2,097
2000	2,188
2001	2,215
2002	2,284
2003	2,345
2004	2,423
2005	2,501
2006	2,566
2007	2,652
2008	2,726

World Natural Gas Consumption, 1965-2008



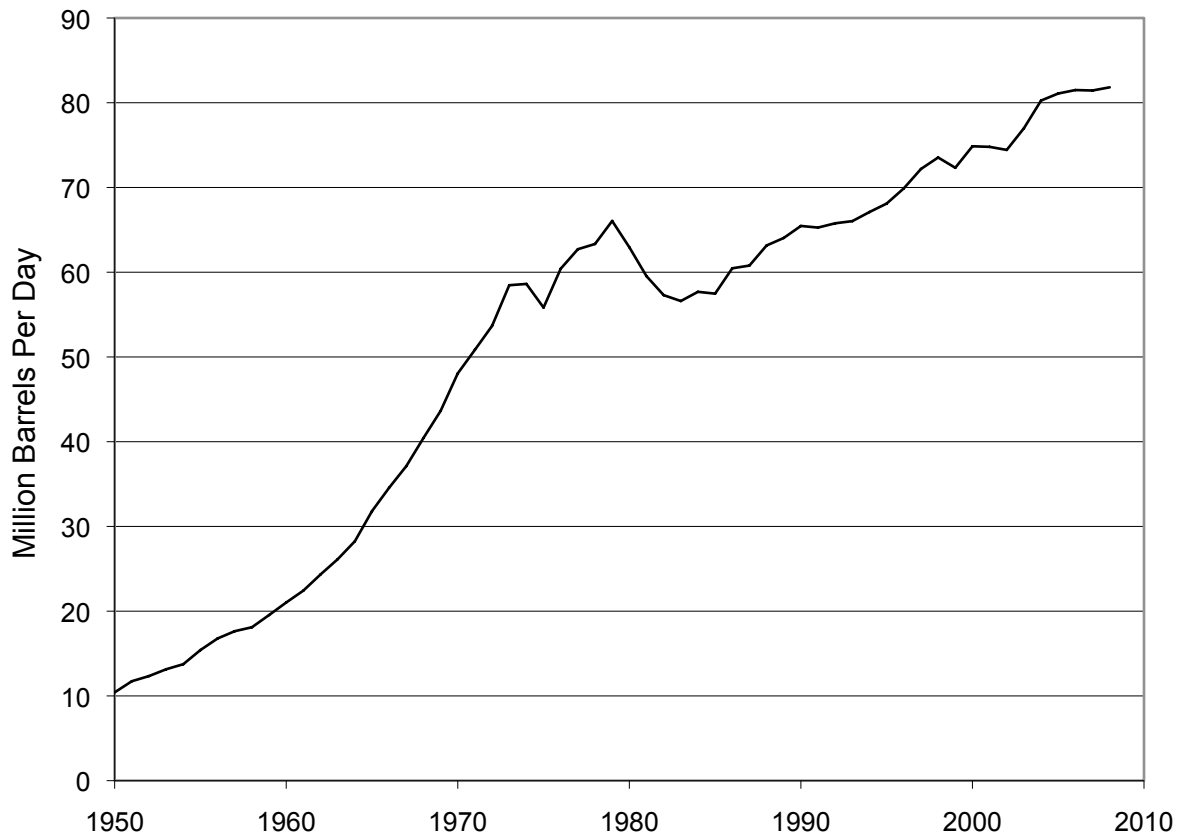
World Oil Production, 1950-2008

Year	Oil Production Million Barrels per Day
1950	10.42
1951	11.73
1952	12.34
1953	13.15
1954	13.74
1955	15.41
1956	16.78
1957	17.64
1958	18.10
1959	19.54
1960	21.03
1961	22.43
1962	24.33
1963	26.13
1964	28.25
1965	31.81
1966	34.57
1967	37.12
1968	40.44
1969	43.64
1970	48.06
1971	50.85
1972	53.67
1973	58.47
1974	58.62
1975	55.83
1976	60.41
1977	62.71
1978	63.33
1979	66.05
1980	62.95
1981	59.53
1982	57.30
1983	56.60
1984	57.69
1985	57.47
1986	60.46
1987	60.78
1988	63.15
1989	64.04
1990	65.46
1991	65.27
1992	65.77
1993	66.03

1998	73.54
1999	72.32
2000	74.86
2001	74.79
2002	74.43
2003	76.99
2004	80.26
2005	81.09
2006	81.50
2007	81.44
2008	81.82

Note: Oil production includes crude oil, shale oil, oil sands and natural gas liquids.

World Oil Production, 1950-2008



Source: BP; Worldwatch

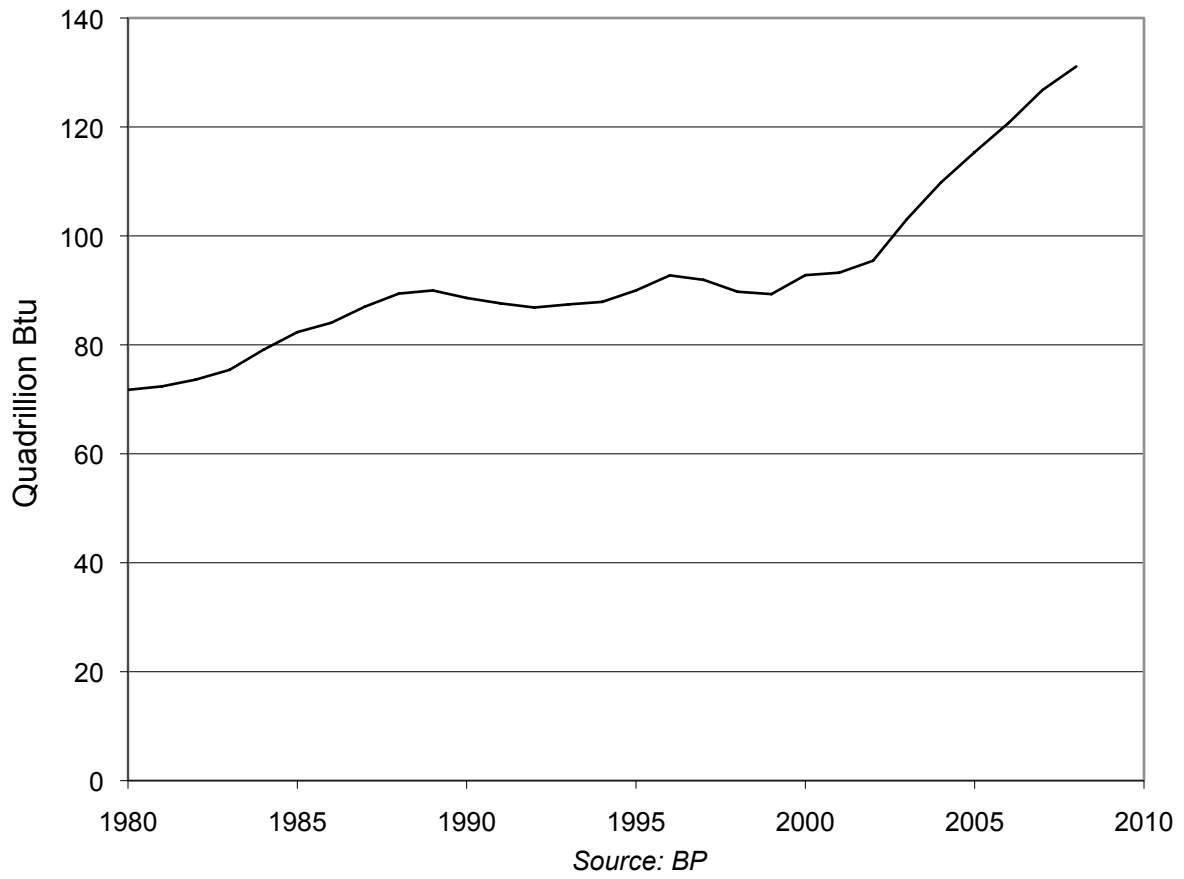
World's 20 Largest Oil Discoveries

Field	Country	Discovery	Size of Field Billion Barrels
Bolivar Coastal	Venezuela	1917	14 - 30
Kirkuk	Iraq	1927	15 - 25
Gashsaran	Iran	1928	12 - 14
Greater Burgan	Kuwait	1938	32 - 75
Abqaiq	Saudi Arabia	1941	13 - 19
Ghawar	Saudi Arabia	1948	66 - 150
Romashkino	Russia	1948	17
Safaniya	Saudi Arabia	1951	21 - 55
Rumaila North & South	Iraq	1953	19 - 30
Manifa	Saudi Arabia	1957	11 - 23
Khurais	Saudi Arabia	1957	13 - 19
Ahwaz	Iran	1958	13 - 15
Daqing	China	1959	13 - 18
Samotlor	Russia	1961	28
Berri	Saudi Arabia	1964	10 - 25
Zakum	United Arab Emirates	1964	17 - 21
Zuluf	Saudi Arabia	1965	11 - 20
Shaybah	Saudi Arabia	1968	7 - 22
Cantarell	Mexico	1976	11 - 20
East Baghdad	Iraq	1979	11 - 19

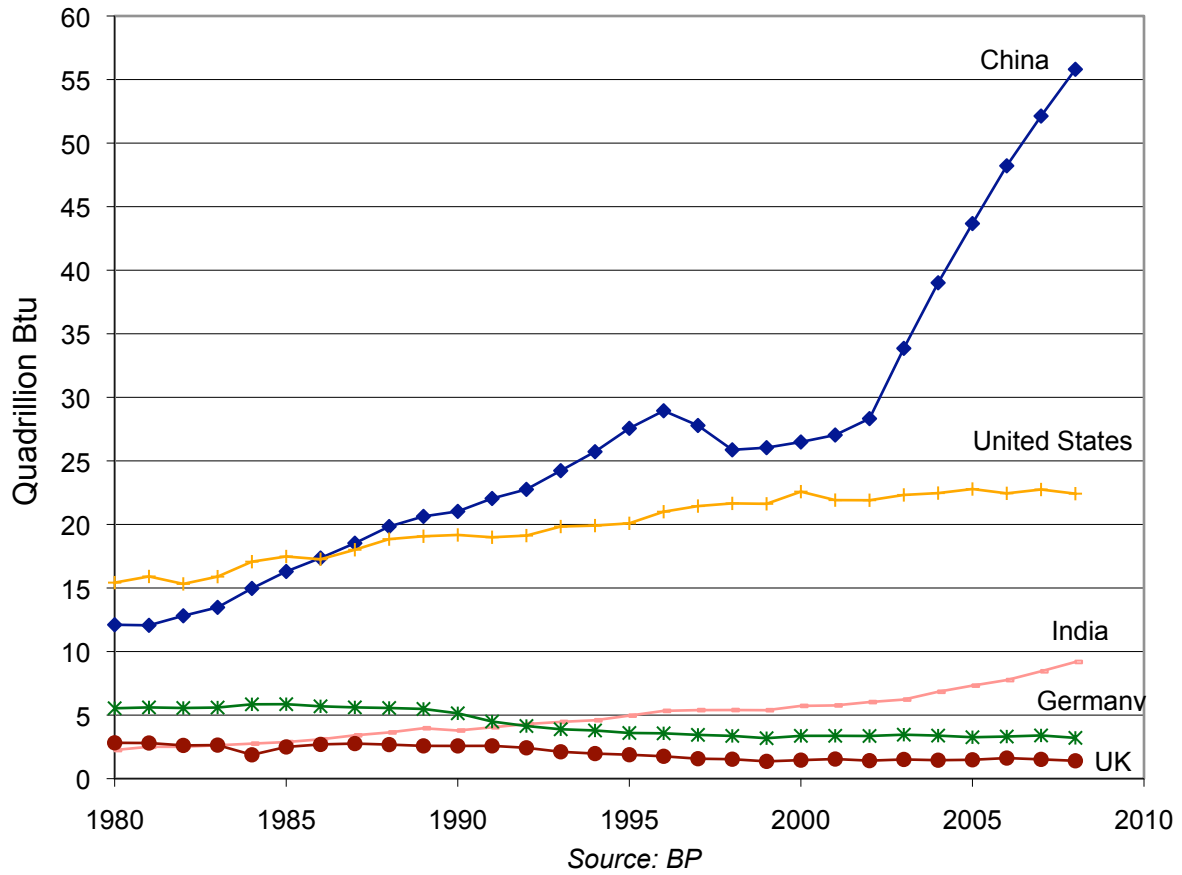
Press, 2007), p. 79.

1980	12.1	2.3	2.3	1.1	5.5	2.8	15.4
1981	12.1	2.5	2.5	1.0	5.6	2.8	15.9
1982	12.8	2.5	2.5	1.1	5.6	2.6	15.3
1983	13.5	2.6	2.5	1.0	5.6	2.6	15.9
1984	15.0	2.8	2.8	1.0	5.8	1.9	17.1
1985	16.3	2.9	2.9	0.9	5.9	2.5	17.5
1986	17.4	3.1	2.8	0.8	5.7	2.7	17.3
1987	18.5	3.4	2.8	0.7	5.6	2.8	18.0
1988	19.8	3.6	3.0	0.7	5.6	2.7	18.8
1989	20.6	4.0	3.0	0.8	5.5	2.6	19.1
1990	21.0	3.8	3.0	0.8	5.1	2.6	19.2
1991	22.0	4.0	3.1	0.8	4.5	2.6	19.0
1992	22.8	4.3	3.1	0.7	4.1	2.4	19.1
1993	24.2	4.5	3.1	0.6	3.9	2.1	19.8
1994	25.7	4.6	3.3	0.5	3.8	2.0	19.9
1995	27.6	5.0	3.4	0.6	3.6	1.9	20.1
1996	28.9	5.3	3.5	0.6	3.6	1.8	21.0
1997	27.8	5.4	3.6	0.5	3.4	1.6	21.4
1998	25.9	5.4	3.5	0.6	3.4	1.5	21.7
1999	26.0	5.4	3.6	0.6	3.2	1.4	21.6
2000	26.5	5.7	3.9	0.6	3.4	1.5	22.6
2001	27.0	5.8	4.1	0.5	3.4	1.5	21.9
2002	28.3	6.0	4.2	0.5	3.4	1.4	21.9
2003	33.9	6.2	4.5	0.5	3.5	1.5	22.3
2004	39.0	6.8	4.8	0.5	3.4	1.5	22.5
2005	43.7	7.3	4.8	0.5	3.3	1.5	22.8
2006	48.2	7.8	4.7	0.5	3.3	1.6	22.4
2007	52.1	8.4	5.0	0.5	3.4	1.5	22.7
2008	55.8	9.2	5.1	0.5	3.2	1.4	22.4
	165.4	142.4	69.4	-37.5	-37.6	-45.5	16.9

World Coal Consumption, 1980-2008



Coal Consumption in Selected Countries, 1980-2008

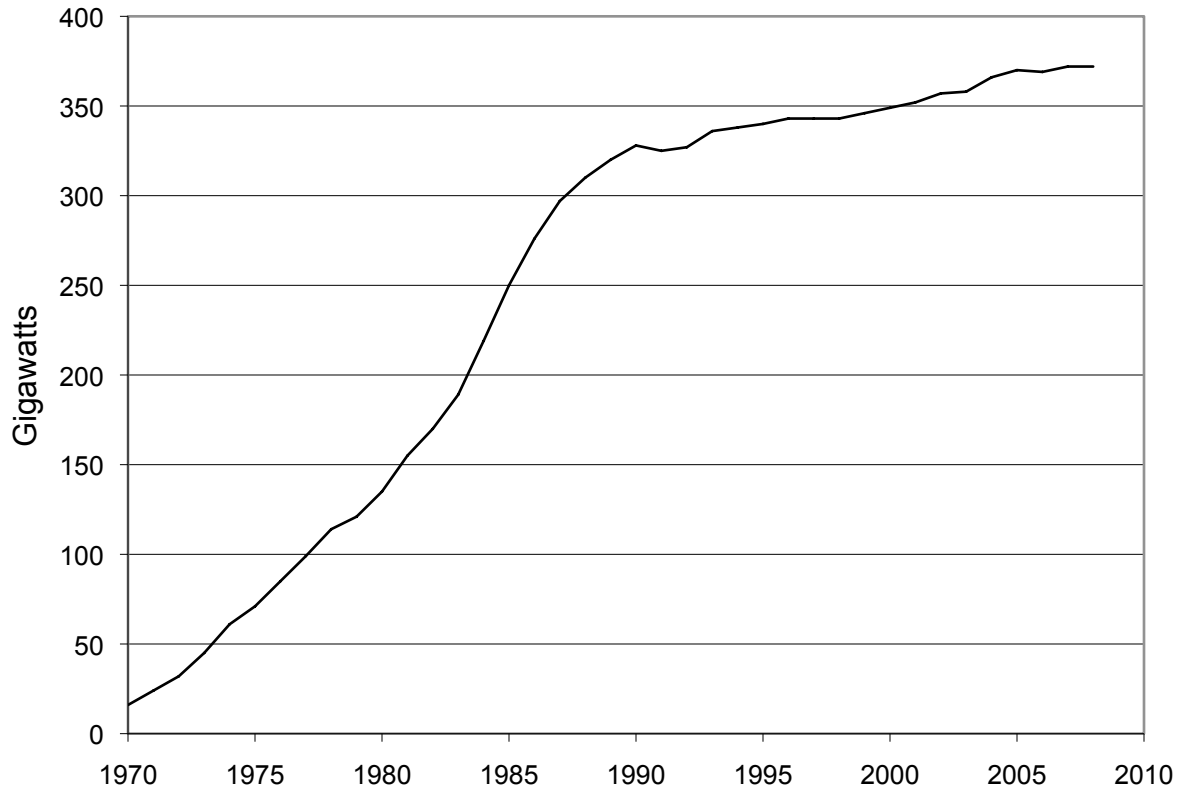


World Cumulative Installed Nuclear Electricity-Generating Capacity, 1970-2008

<u>Year</u>	<u>Installed Capacity</u> <u>Gigawatts</u>
1970	16
1971	24
1972	32
1973	45
1974	61
1975	71
1976	85
1977	99
1978	114
1979	121
1980	135
1981	155
1982	170
1983	189
1984	219
1985	250
1986	276
1987	297
1988	310
1989	320
1990	328
1991	325
1992	327
1993	336
1994	338
1995	340
1996	343
1997	343
1998	343
1999	346
2000	349
2001	352
2002	357
2003	358
2004	366
2005	370
2006	369
2007	372
2008	372

Source: Compiled by Earth Policy Institute with 1970-2004 data from Worldwatch Institute, *Worldwatch* 2005 (Washington, DC: 2005), p. 33; 2005 data from International Atomic Energy Agency, *Electricity and Nuclear Power Estimates for the Period up to 2030* (Vienna: July 2006), p. 17

World Cumulative Installed Nuclear Electricity-Generating Capacity, 1970-2008



Source: Worldwatch; IAEA; WNA