

## World on the Edge - Supporting Data for Chapter 9 - World Energy Profile

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

[http://www.earth-policy.org/books/wote/wote\\_data](http://www.earth-policy.org/books/wote/wote_data)

This is part of a supporting dataset for Lester R. Brown, **World On the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2010). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

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

Energy Source	Growth Rate, 2006-2015	Growth Rate, 2015-2020	World Primary Energy Demand 2006	World Primary Energy Demand 2008	World Primary Energy Demand 2020
	Percent		Million Tons Oil Equivalent		
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
<b>Total</b>			<b>10,940</b>	<b>11,412</b>	<b>14,240</b>
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
<b>Total</b>			<b>18,920</b>	<b>20,053</b>	<b>27,707</b>

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 and 2008, with IEA Projection for 2020

Emissions	Growth Rate,	Growth Rate,	CO <sub>2</sub> Emissions,	CO <sub>2</sub> Emissions,	CO <sub>2</sub> Emissions,
	2006-2015	2015-2020	2006	2008	2020
	Percent		Million Tons Carbon		
By Fuel:					
Coal	3.1	1.6	3,185	3,431	4,555
Oil	1.3	0.9	2,937	2,947	3,454
Gas	2.0	1.5	1,484	1,602	1,918
By Sector:					
Power Generation	2.9	1.6	3,119	3,250	4,365
Coal	3.2	1.7	2,273	2,365	3,300
Oil	-0.4	-1.9	241	236	211
Gas	2.8	2.0	605	650	853
Total Final Consumption	1.7	1.1	4,123	4,323	5,090
Coal	2.7	1.1	855	990	1,150
Oil	1.5	1.2	2,515	2,527	3,033
<i>of which transport</i>	1.7	1.3	1,708	1,746	2,126
<i>of which marine bunkers</i>	1.0	1.0	159	158	326
<i>of which international aviation</i>	2.2	1.8	108	124	145
Gas	1.4	1.2	754	807	907
Other Energy Sector			364	406	472
Total CO <sub>2</sub> Emissions	2.2	1.4	7,606	7,980	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 losses. Growth rates and 2020 projection are for the International Energy Agency Reference Scenario, which is "based on established trends and policies, without new initiatives by governments on energy security or climate change."

Source: Calculated by Earth Policy Institute with rates, 2006 data, and 2020 projection from International Energy Agency (IEA), *World Energy Outlook 2008* (Paris: 2008), p. 507; 2008 data from International Energy Agency (IEA), *World Energy Outlook 2010* (Paris: 2010), p. 620, with bunker data from Michael Chen, e-mail to Alexandra Giese, Earth Policy Institute, 30 November 2010.

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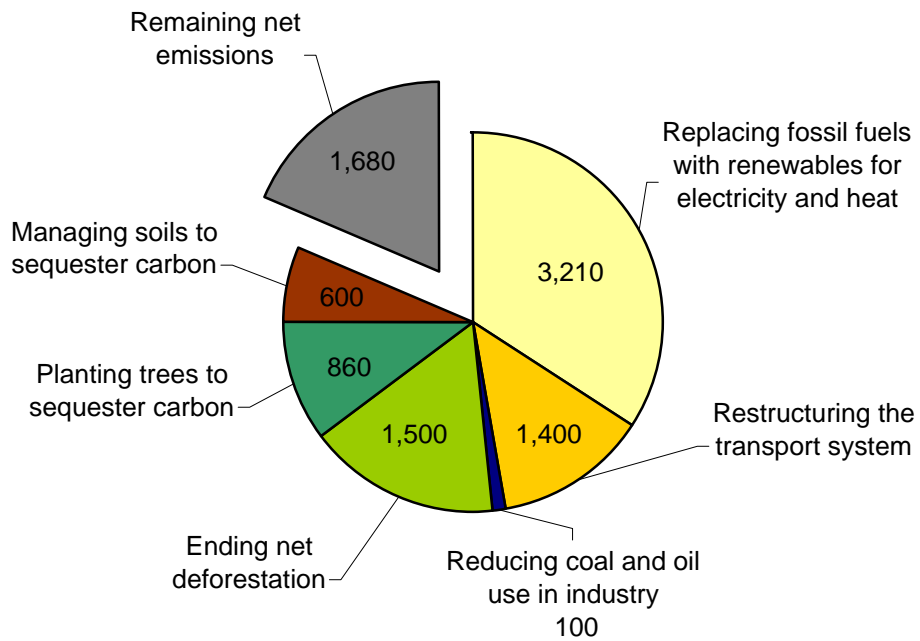
## Plan B Carbon Dioxide Emissions Reductions and Sequestration in 2020

Action	Amount
	Million Tons of Carbon
<b>Energy Restructuring</b>	
Replacing fossil fuels with renewables for electricity and heat	3,210
Restructuring the transport system	1,400
Reducing coal and oil use in industry	100
<b>Biological Carbon Sequestration</b>	
Ending net deforestation	1,500
Planting trees to sequester carbon	860
Managing soils to sequester carbon	600
<b>Total Carbon Dioxide Reductions in 2020</b>	<b>7,670</b>
Carbon Dioxide Emissions in 2006	9,350
<b>Percent Reduction from 2006 Baseline</b>	<b>82.0</b>

Source: Calculated by Earth Policy Institute using International Energy Agency (IEA), *World Energy Outlook 2008* (Paris: 2008), p. 507; IEA, *Tracking Industrial Energy Efficiency and CO2 Emissions* (Paris: 2007); Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, U.K.: Cambridge University Press, 2007), pp. 543, 559; and Rattan Lal, "Soil Carbon Sequestration Impacts on Global Climate Change and Food Security," *Science*, vol. 304 (11 June 2004), pp. 1,623–27.

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## Plan B Carbon Dioxide Emissions Reduction Goals for 2020 (Million Tons of Carbon)



Baseline Emissions (2006) = 9,350 Million Tons of Carbon

Source: EPI

## 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		
<b>World Total, All Sectors</b>	<b>3,418</b>	<b>2,217</b>	<b>65</b>

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).

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## 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 <sup>1</sup>	680
Residential - control systems <sup>2</sup>	146
Commercial, non-OECD - switching to best fluorescent systems <sup>3</sup>	235
Commercial, non-OECD - control systems <sup>2</sup>	124
Commercial, OECD - switching to best fluorescent systems <sup>4</sup>	409
Commercial, OECD - control systems <sup>2</sup>	202
Industrial - switching to best fluorescent systems <sup>5</sup>	91
Industrial - control systems <sup>2</sup>	216
Traffic lights - converting to LEDs <sup>6</sup>	15
External signage, U.S. - neon signs to LEDs <sup>7</sup>	9
Street lighting - mercury vapor lamps to high pressure sodium <sup>8</sup>	32
Car parks - dimming lights during off-peak hours <sup>9</sup>	57
<b>Total Electricity Savings</b>	<b>2,217</b>

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).

<sup>1</sup> 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).

<sup>2</sup> 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.

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

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

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

<sup>6</sup> 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.

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

<sup>8</sup> 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.

<sup>9</sup> 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>

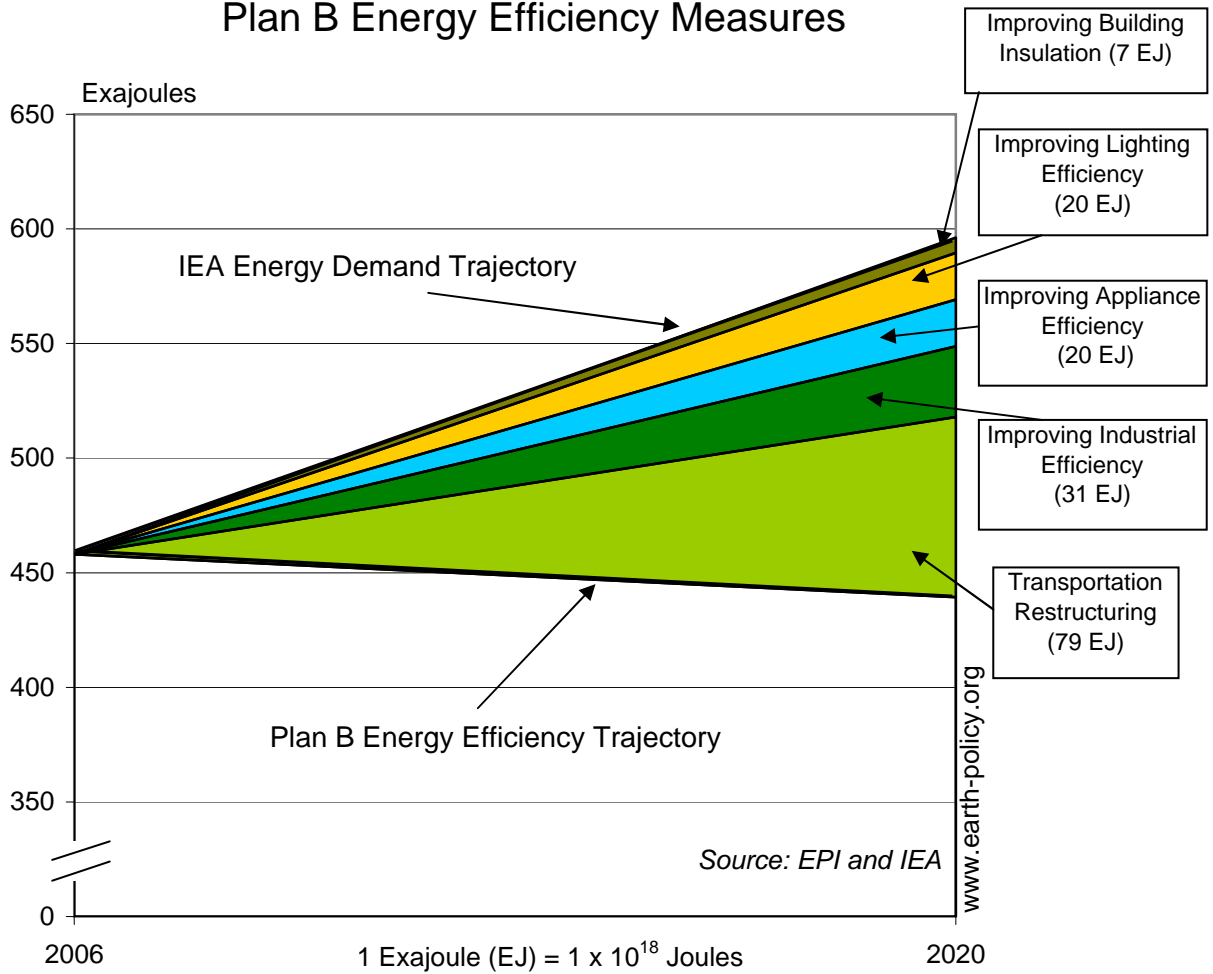
### Summary:

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 CO<sub>2</sub> Emissions* (Paris: IEA, 2007), pp. 22-25, 39, 59-61, 140.

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# Plan B Energy Efficiency Measures



## World Energy Consumption in 2008 and Plan B Goals for 2020

Source	2008	Goal for 2020 *
	Petajoules	
Electricity and Heat from Fossil Fuels and Nuclear	70,600	14,600
Electricity from Renewable Sources	16,300	87,000
Thermal Energy from Renewable Sources	10,700	30,800
Transportation	93,000	26,200

\* Note: Transportation energy consumption in 2020 is lower than in 2008 because, due to efficiency gains, an electrified transport system requires far less energy than a fossil-fuel-based one. 1 petajoule is equal to 1 billion megajoules.

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 Data 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 from IEA, *World Energy Outlook 2008*, (Paris: 2008), p. 507; F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 18 (26 May 2009), p. 365; F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 14, (26 March 2009), p. 288; energy conversion factors from Oak Ridge National Laboratory, "Bioenergy Conversion Factors," at [bioenergy.ornl.gov/papers/misc/energy\\_conv.html](http://bioenergy.ornl.gov/papers/misc/energy_conv.html), viewed 10 August 2009.

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## World Energy Consumption in 2008 and Plan B Goals for 2020

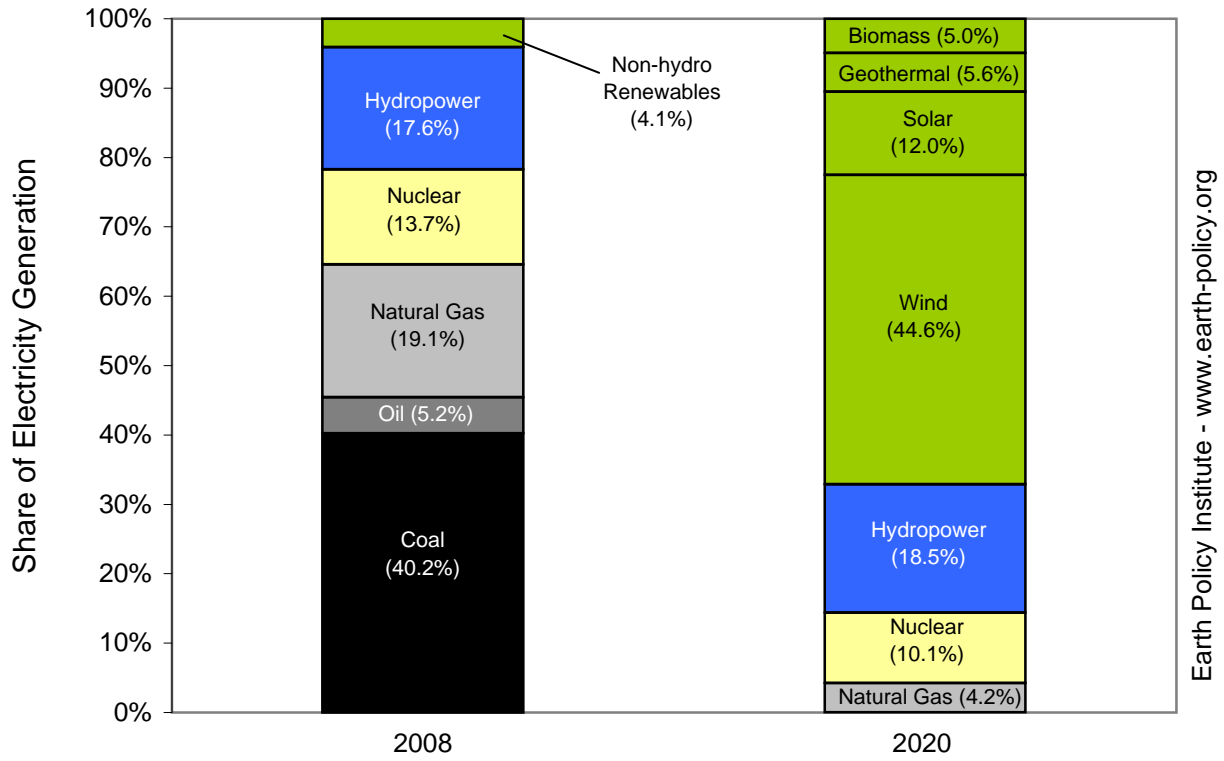
Source	2008 <sup>(1)</sup>	Goal for 2020
Petajoules		
<u>Electricity and Heat Generation from Fossil Fuels and Nuclear</u>		
Coal	30,237	0
Oil	3,905	0
Gas	14,379	4,314
Nuclear	10,316	10,316
Heat	11,774	0
Total	<u>70,611</u>	<u>14,629</u>
<u>Electricity Generation from Renewables</u>		
Wind	1,366	45,412
Solar Photovoltaics	111	10,643
Solar Thermal Power Plants	3	1,539
Geothermal	301	5,676
Biomass	1,312	5,046
Hydropower	13,228	18,818
Total	<u>16,321</u>	<u>87,134</u>
<u>Thermal Energy Capture from Renewable Sources</u>		
Solar Rooftop Water and Space Heaters	1,057	7,805
Geothermal	2,838	14,191
Biomass	6,812	8,830
Total	<u>10,707</u>	<u>30,826</u>
<u>Transportation Fuel Consumption <sup>(2)</sup></u>		
Oil	91,155	22,789
Fuel Ethanol	1,400	2,396
Biodiesel	490	1,045
Total	<u>93,045</u>	<u>26,230</u>
<b>Total Energy Consumption</b>	<b>190,684</b>	<b>158,819</b>

Notes: (1) Columns may not add to totals due to rounding; (2) Transportation energy consumption in 2020 is lower than in 2008 because, due to efficiency gains, an electrified transport system requires far less energy than a fossil-fuel-based one. 1 petajoule is equal to 1 billion megajoules.

Source: Calculated by Earth Policy Institute using capacity factors from U.S. Department of Energy, National Renewable Energy Laboratory, *Power Technologies Energy Data 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 from IEA, *World Energy Outlook 2008*, (Paris: 2008); F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 18 (26 May 2009), p. 365; F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 14, (26 March 2009), p. 288; energy conversion factors from Oak Ridge National Laboratory, "Bioenergy Conversion Factors," at [bioenergy.ornl.gov/papers/misc/energy\\_conv.html](http://bioenergy.ornl.gov/papers/misc/energy_conv.html), viewed 10 August 2009.

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## World Electricity Generation by Energy Source in 2008 and in the Plan B Economy of 2020



Source: EPI and IEA

## World Power and Energy from Renewables in 2008 and Plan B Goals for 2020

Source	Installed Capacity 2008	Installed Capacity 2020	Electricity and Heat Generation 2008	Electricity and Heat Generation 2020	Growth from 2008 to 2020	Share of Total Electricity and Heat Generation from Renewables in 2020
Electricity Generating Capacity	Electrical Gigawatts		Petajoules		x-fold	Percent
Wind	120	4,000	1,366	45,412	33	52
Solar Photovoltaics	16	1,500	111	10,643	96	12
Solar Thermal Power Plants	0	200	3	1,539	459	2
Geothermal	11	200	301	5,676	19	7
Biomass	52	200	1,312	5,046	4	6
Hydropower	<u>949</u>	<u>1,350</u>	<u>13,228</u>	<u>18,818</u>	<u>1</u>	<u>22</u>
Total	1,148	7,450	16,321	87,134	5	100
Thermal Energy Capacity	Thermal Gigawatts		Petajoules		x-fold	Percent
Solar Rooftop Water and Space Heaters	149	1,100	1,057	7,805	7	25
Geothermal	100	500	2,838	14,191	5	46
Biomass	<u>270</u>	<u>350</u>	<u>6,812</u>	<u>8,830</u>	<u>1</u>	<u>29</u>
Total	519	1,950	10,707	30,826	3	100

Source: Wind electricity from Global Wind Energy Council, *Global Wind 2009 Report* (Brussels: 2010), p. 12; solar photovoltaics from European Photovoltaic Industry Association (EPIA), *Global Market Outlook for Photovoltaics Until 2014* (Brussels: May 2010), p. 5; solar thermal power plants from Christoph Richter, Sven Teske, and Rebecca Short, *Concentrating Solar Power Global Outlook 2009* (Amsterdam, Tabernas, and Brussels: Greenpeace International, IEA SolarPACES, and European Solar Thermal Electricity Association, May 2009), p. 7; geothermal electricity, biomass electricity and heat, hydropower, including tidal and wave power, and rooftop solar water and space heaters from Renewable Energy Policy Network for the 21st Century, *Renewables 2010 Global Status Report* (Paris: REN21 Secretariat, 2010), pp. 54, 56; 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* (Cambridge, MA: Massachusetts Institute of Technology, 2006), p. 9; capacity factors used to convert installed capacity into actual electricity generation are from U.S. Department of Energy, National Renewable Energy Laboratory, *Power Technologies Energy Data Book* (Golden, CO: August 2006).

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).



## World Energy Growth Rates by Source, 2000-2009

Energy Source	Average Annual Growth Rate	Compound Annual Growth Rate
	Percent	Percent
Wind Power	27.9	31.8
Solar Photovoltaics	35.2	36.1
Geothermal Power *	3.0	3.0
Geothermal Heat	19.1	16.5
Hydroelectric	2.3	2.4
Oil	1.1	1.1
Natural Gas	2.4	2.2
Nuclear Power	0.7	0.5
Coal	3.9	3.8
Biodiesel	38.6	40.0
Fuel Ethanol	15.1	17.5

\* Note: Due to lack of complete data for 2009, growth rates for geothermal power are for 2000-2010.

Source: Compiled by Earth Policy Institute with wind power from Global Wind Energy Council, *Global Wind 2009 Report* (Brussels: 2010), p. 12; solar photovoltaics data from European Photovoltaic Industry Association (EPIA), *Global Market Outlook for Photovoltaics Until 2013* (Brussels: April 2009), pp. 3-4; 2007-2009 from EPIA, *Global Market Outlook for Photovoltaics Until 2014* (Brussels: May 2010), p. 5; geothermal power from International Geothermal Association, "Installed Generating Capacity," at [www.geothermal-energy.org/226,installed\\_generating\\_capacity.html](http://www.geothermal-energy.org/226,installed_generating_capacity.html), updated 2 July 2010; and from Alison Holm et al., *Geothermal Energy International Market Update* (Washington, DC: Geothermal Energy Association, May 2010), p. 4; geothermal heat from International Geothermal Association, "Direct Uses," at [www.geothermal-energy.org/246,direct\\_uses.html](http://www.geothermal-energy.org/246,direct_uses.html), updated 5 July 2010; Renewable Energy Policy Network for the 21st Century (REN21), *Renewables Global Status Report* (Paris: REN21 Secretariat, various years); hydroelectric, oil, natural gas, nuclear, and coal from BP, *Statistical Review of World Energy June 2010* (London: 2010); biodiesel from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 2 (23 September 2008), p. 29; and from F.O.Licht, *World Ethanol and Biofuels Report*, vol. 8, no. 13 (15 March 2010), p. 265; fuel ethanol from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 18 (26 May 2009), p. 3; and from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 8, no. 16 (28 April 2010), p. 328.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

## World Cumulative Installed Wind Power Capacity and Annual Addition, 1980-2009

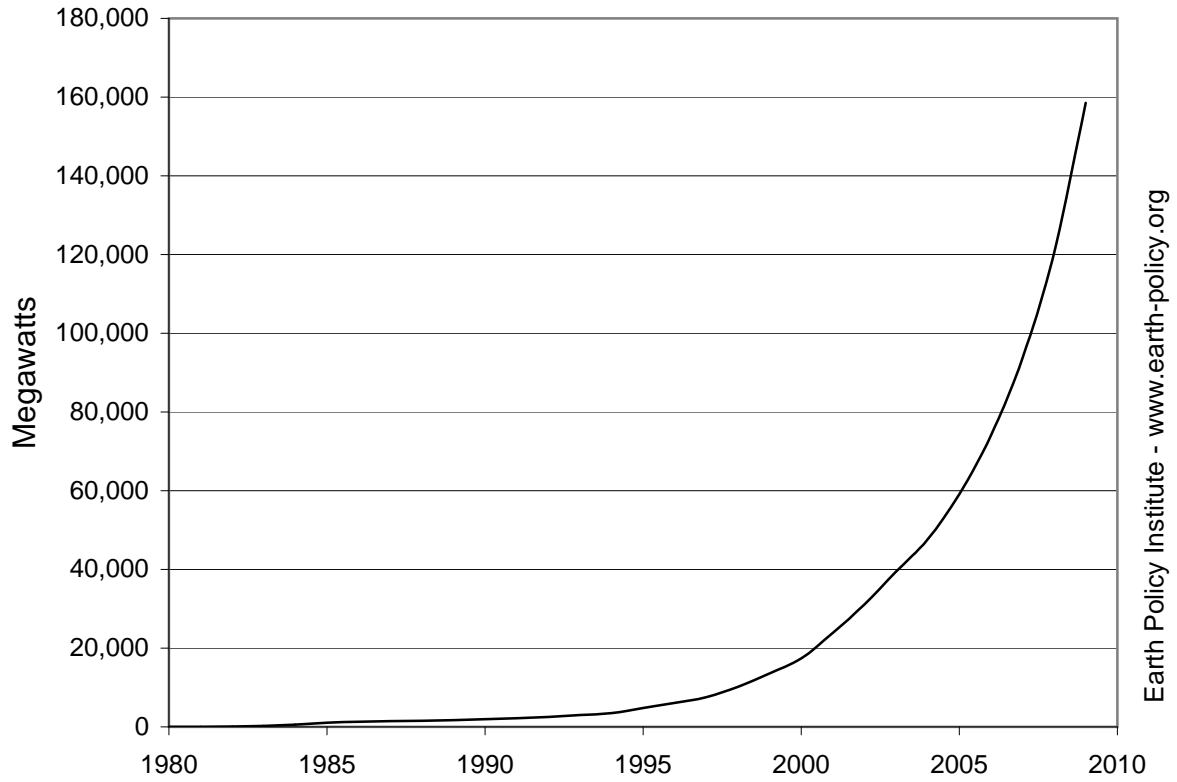
Year	Cumulative Installed Capacity	Net Annual Addition*
	Megawatts	
1980	10	
1981	25	15
1982	90	65
1983	210	120
1984	600	390
1985	1,020	420
1986	1,270	250
1987	1,450	180
1988	1,580	130
1989	1,730	150
1990	1,930	200
1991	2,170	240
1992	2,510	340
1993	2,990	480
1994	3,490	500
1995	4,780	1,290
1996	6,100	1,320
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	120,297	26,462
2009	158,505	38,208

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

Source: Compiled by Earth Policy Institute with 1980-1995 data from Janet L. Sawin, "Wind Power Still Soaring," in Worldwatch Institute, *Vital Signs 2007-2008* (New York: W. W. Norton & Company, 2007); 1996-2009 data from Global Wind Energy Council (GWEC), *Global Wind 2009 Report* (Brussels: 2010), p. 12.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

## World Cumulative Installed Wind Power Capacity, 1980-2009



Source: EPI from GWEC, Worldwatch

### Cumulative Installed Wind Power Capacity in Top Ten Countries and the World, 1980-2009

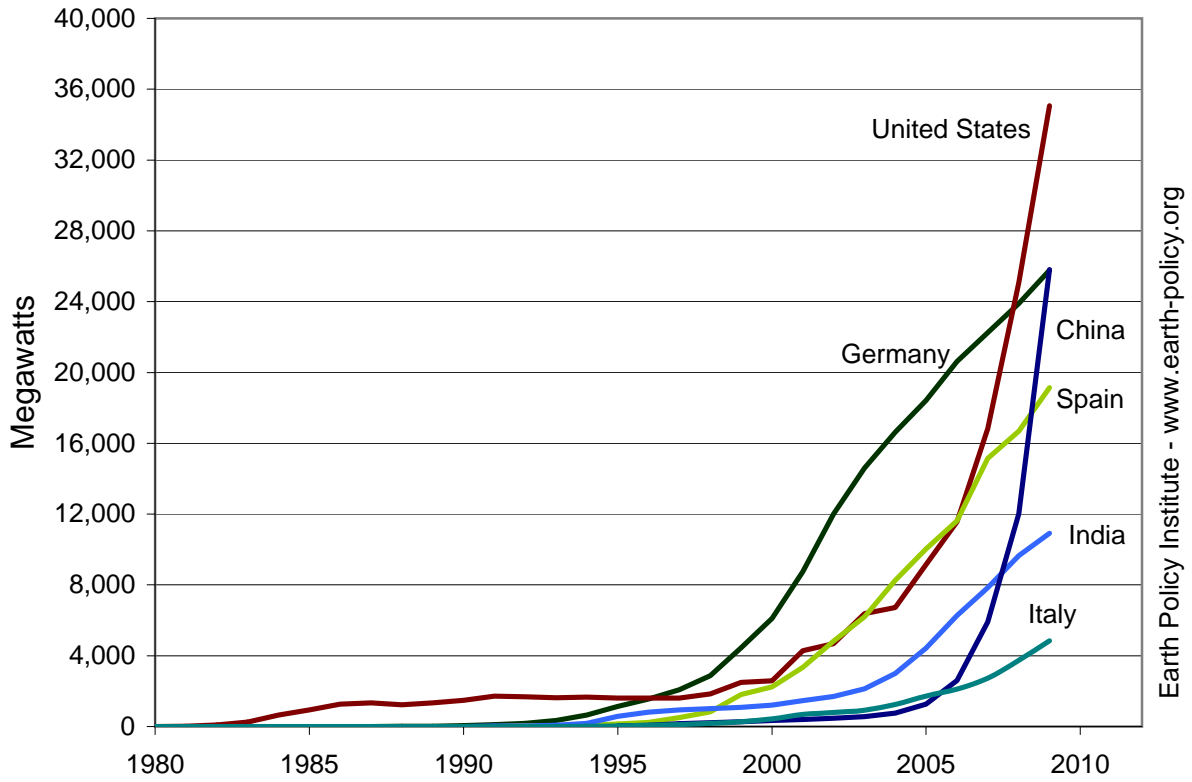
Year	U.S.	China	Germany	Spain	India	Italy	France	U.K.	Portugal	Denmark	World
----- Megawatts -----											
1980	8	n.a.	0	0	0	0	0	0	n.a.	5	10
1981	18	n.a.	0	0	0	0	0	0	n.a.	7	25
1982	84	n.a.	0	0	0	0	0	0	n.a.	12	90
1983	254	n.a.	0	0	0	0	0	0	n.a.	20	210
1984	653	n.a.	0	0	0	0	0	0	n.a.	27	600
1985	945	n.a.	0	0	0	0	0	0	n.a.	50	1,020
1986	1,265	n.a.	0	0	0	0	0	0	n.a.	82	1,270
1987	1,333	n.a.	5	0	0	0	0	0	n.a.	115	1,450
1988	1,231	n.a.	15	0	0	0	0	0	n.a.	197	1,580
1989	1,332	n.a.	27	0	0	0	0	0	n.a.	262	1,730
1990	1,484	n.a.	62	0	0	0	0	0	n.a.	343	1,930
1991	1,709	n.a.	112	5	39	1	0	4	n.a.	413	2,170
1992	1,680	n.a.	180	50	39	3	0	69	n.a.	458	2,510
1993	1,635	n.a.	335	60	79	6	2	n.a.	n.a.	487	2,990
1994	1,663	n.a.	643	70	185	18	n.a.	n.a.	n.a.	539	3,490
1995	1,612	38	1,130	140	576	32	3	200	n.a.	637	4,780
1996	1,614	79	1,548	230	820	70	6	273	n.a.	835	6,100
1997	1,611	170	2,080	512	940	103	10	319	n.a.	1,120	7,600
1998	1,837	224	2,875	834	1,015	180	19	333	60	1,443	10,200
1999	2,490	268	4,442	1,812	1,077	277	25	362	61	1,771	13,600
2000	2,578	346	6,113	2,235	1,220	427	66	406	100	2,417	17,400
2001	4,275	402	8,754	3,337	1,456	690	93	474	131	2,489	23,900
2002	4,685	469	11,994	4,825	1,702	797	148	552	195	2,889	31,100
2003	6,372	567	14,609	6,203	2,125	913	253	648	296	3,115	39,431
2004	6,725	764	16,629	8,263	3,000	1,255	390	888	522	3,123	47,620
2005	9,149	1,260	18,415	10,027	4,430	1,718	757	1,353	1,022	3,127	59,091
2006	11,575	2,599	20,622	11,623	6,270	2,123	1,567	1,962	1,716	3,135	74,052
2007	16,824	5,910	22,247	15,145	7,845	2,726	2,454	2,406	2,150	3,124	93,835
2008	25,068	12,020	23,903	16,689	9,655	3,736	3,404	2,974	2,862	3,163	120,297
2009	35,064	25,805	25,777	19,149	10,926	4,850	4,492	4,051	3,535	3,465	158,505

Note: n.a. = data not available.

Source: Compiled by Earth Policy Institute with world data from Janet L. Sawin, "Wind Power Still Soaring," in Worldwatch Institute, *Vital Signs 2007-2008* (New York: W. W. Norton & Company, 2007); Global Wind Energy Council (GWEC), *Global Wind 2009 Report* (Brussels: 2010). Country data from Worldwatch Institute, *Signposts 2001*, CD-ROM (Washington, DC: 2001); Chinese Renewable Energy Industries Association (CREIA), *China Wind Power Report 2007* (Beijing: China Environmental Science Press, 2007); American Wind Energy Association (AWEA), *Global Wind Energy Market Report*, (Washington, DC: 1999); GWEC, *Global Wind 2009 Report*, op. cit. this note; European Wind Energy Association (EWEA), *Wind Energy - The Facts* (Brussels: 1999 and 2004); François Demarcq, "Perspectives in France for the Coming Ten Years: WIND ENERGY," in *1999 European Wind Energy Conference* (Nice, France: 1999); British Wind Energy Association (BWEA), *Wind Energy in the UK* (London: 2008); Associazione Nazionale Energia del Vento (ANEV), "Installed Power Until 1999," email to Amy Heinzerling, Earth Policy Institute, 22 September 2009; EWEA, "Wind Energy Development in the EU 1998 to 2009," table downloaded from [www.ewea.org/index.php?id=180](http://www.ewea.org/index.php?id=180), 12 February 2010.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

## Cumulative Installed Wind Power Capacity in Leading Countries, 1980-2009



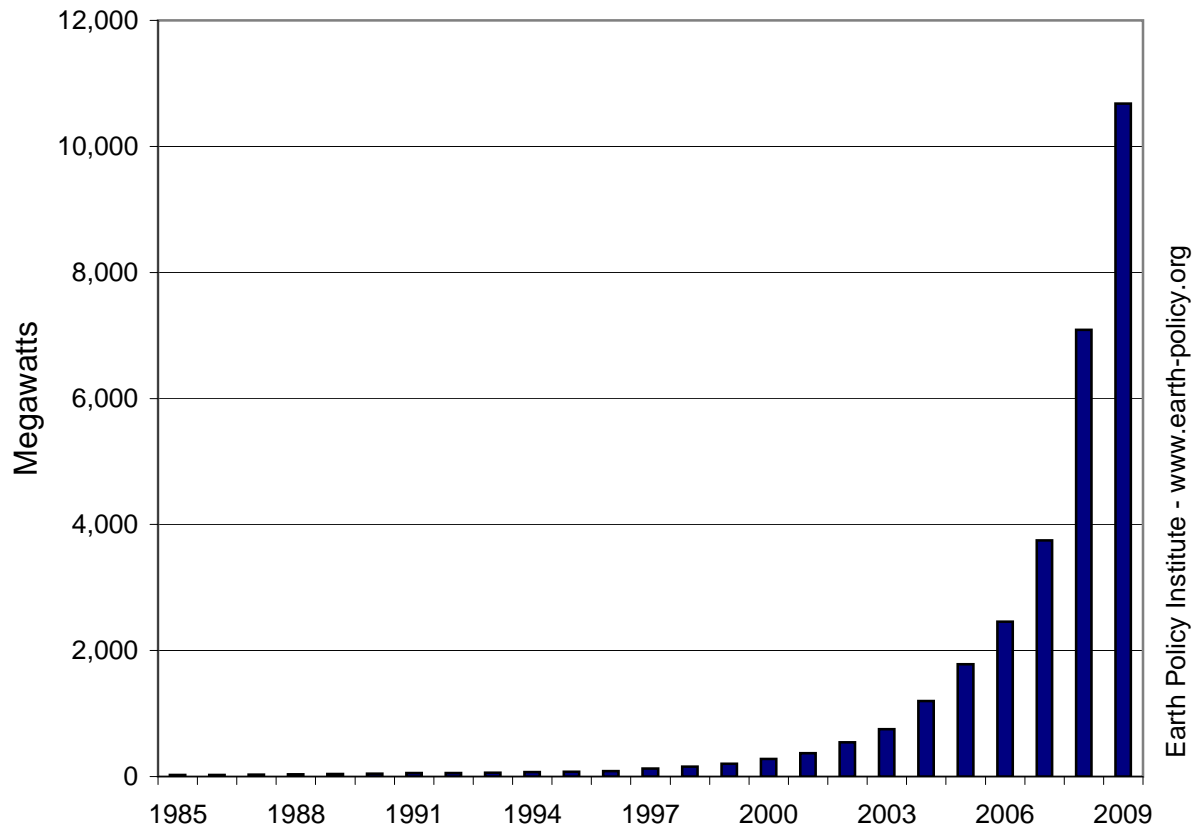
Source: EPI from Worldwatch, CREIA, AWEA, GWEC, ANEV, EWEA

## World Solar Photovoltaics Production, 1975-2009

Year	Annual Production	Cumulative Production
	Megawatts	
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	3,746	12,290
2008	7,089	19,380
2009	10,680	30,060

Source: Compiled by Earth Policy Institute with 1975-1979 data from Worldwatch Institute, *Signposts 2004*, CD-ROM (Washington, DC: 2004); 1980-2000 from Worldwatch Institute, *Vital Signs 2007-2008* (Washington DC: 2008), p. 39; 2001-2006 from Prometheus Institute and Greentech Media, "25th Annual Data Collection Results: PV Production Explodes in 2008," *PVNews*, vol. 28, no. 4 (April 2009), pp. 15-18; 2007-2009 from Shyam Mehta, GTM Research, e-mail to J. Matthew Roney, Earth Policy Institute, 21 June 2010.

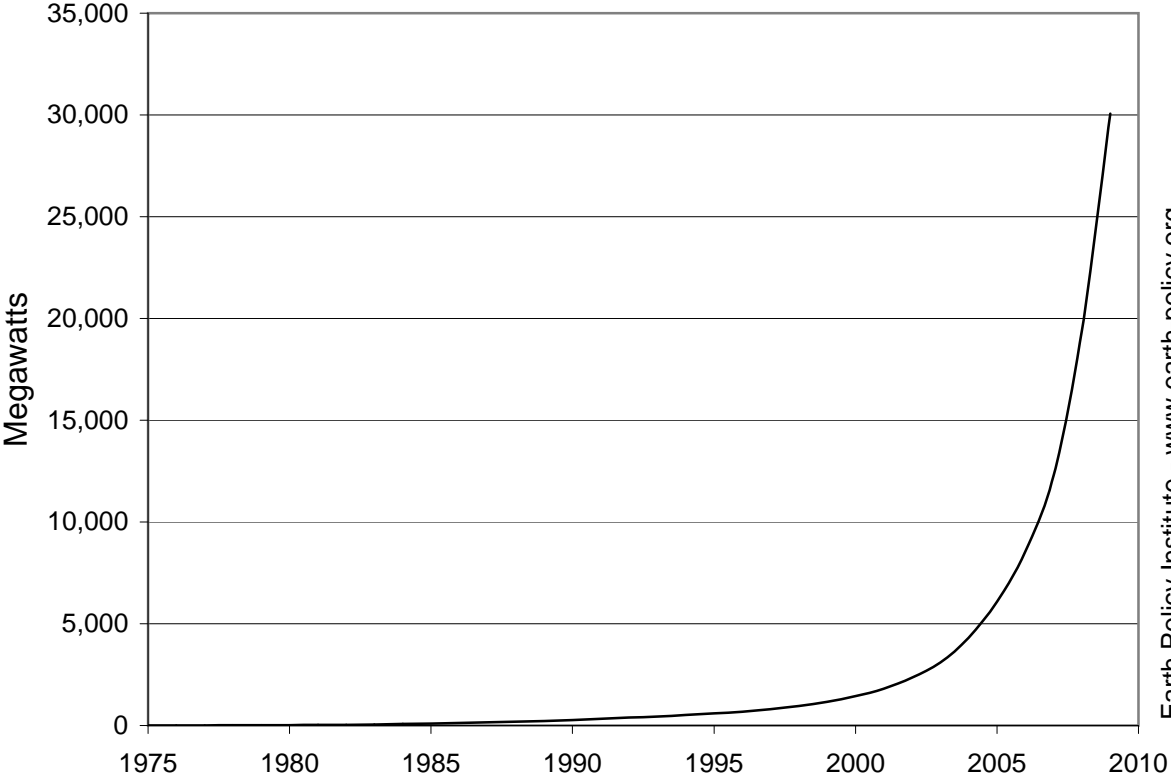
## World Annual Solar Photovoltaics Production, 1985-2009



Source: EPI from Worldwatch; Prometheus Institute; Greentech Media

Earth Policy Institute - [www.earth-policy.org](http://www.earth-policy.org)

# World Cumulative Solar Photovoltaics Production, 1975-2009



Earth Policy Institute - [www.earth-policy.org](http://www.earth-policy.org)

Source: EPI from Worldwatch; Prometheus Institute; Greentech Media



## Annual Solar Photovoltaics Production by Country, 1995-2009

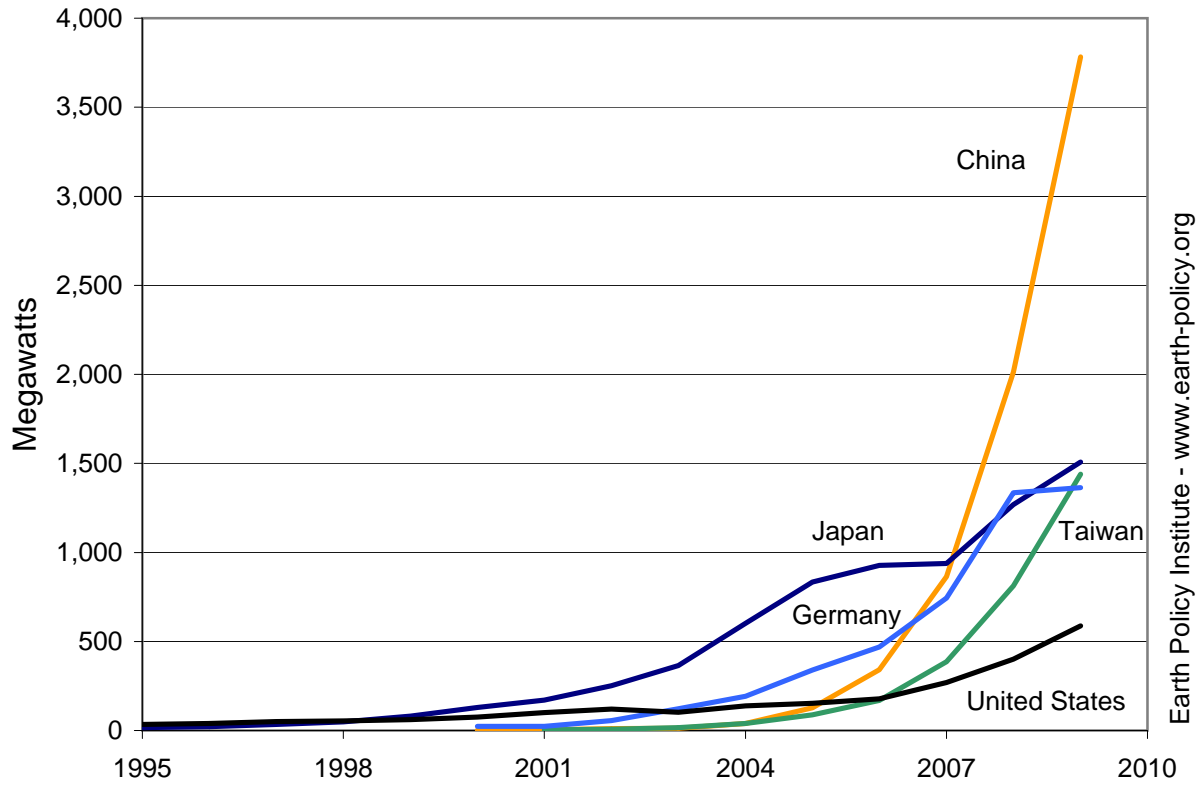
Year	China	Japan	Taiwan	Germany	United States	Others	Total
Megawatts							
1995	n.a.	16	n.a.	n.a.	35	n.a.	78
1996	n.a.	21	n.a.	n.a.	39	n.a.	89
1997	n.a.	35	n.a.	n.a.	51	n.a.	126
1998	n.a.	49	n.a.	n.a.	54	n.a.	155
1999	n.a.	80	n.a.	n.a.	61	n.a.	201
2000	3	129	n.a.	23	75	48	277
2001	3	171	4	24	100	70	371
2002	10	251	8	55	121	97	542
2003	13	364	17	122	103	131	749
2004	40	602	39	193	139	186	1,199
2005	128	833	88	339	153	241	1,782
2006	342	926	170	469	178	374	2,459
2007	864	938	387	744	269	545	3,746
2008	2,013	1,268	813	1,334	401	1,261	7,089
2009	3,782	1,508	1,439	1,364	587	2,000	10,680

Notes: n.a. = data not available. Rows may not add to totals due to rounding.

Source: Compiled by Earth Policy Institute with 1995-1999 data from Worldwatch Institute, *Signposts 2004*, CD-ROM (Washington, DC: 2005); 2000 data from Prometheus Institute, "23rd Annual Data Collection - Final," *PVNews*, vol. 26, no. 4 (April 2007), pp. 8-9; 2001-2006 from Prometheus Institute and Greentech Media, "25th Annual Data Collection Results: PV Production Explodes in 2008," *PVNews*, vol. 28, no. 4 (April 2009), pp. 15-18; 2007-2009 for Japan from Shyam Mehta, "26th Annual Data Collection Results: Another Bumper Year for Manufacturing Masks Turmoil," *PVNews*, vol. 29, no. 5 (May 2010), pp. 11-14; 2007-2009 for other countries and the world from Shyam Mehta, GTM Research, e-mail to J. Matthew Roney, Earth Policy Institute, 21 June 2010.

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## Annual Solar Photovoltaics Production in Selected Countries, 1995-2009



Source: EPI from Worldwatch; Prometheus Institute; Greentech Media

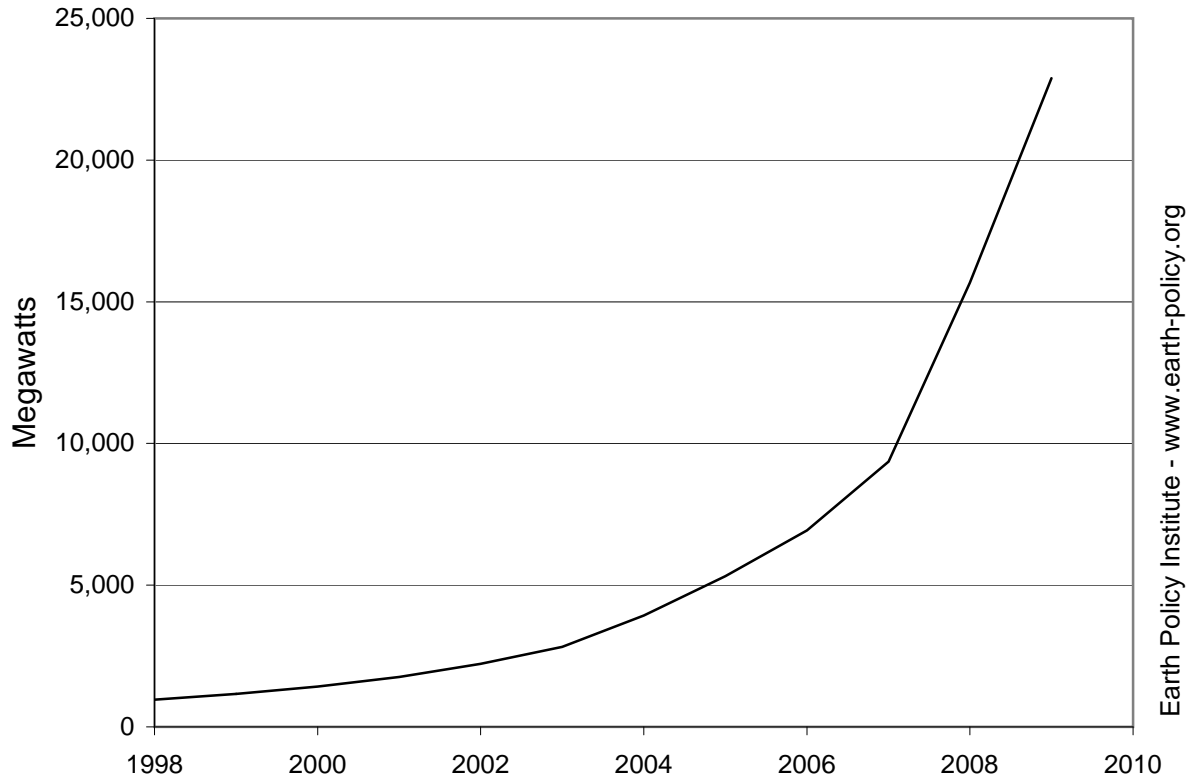
## World Cumulative Solar Photovoltaics Installations, 1998-2009

Year	Cumulative Installations Megawatts
1998	962
1999	1,166
2000	1,428
2001	1,762
2002	2,229
2003	2,823
2004	3,924
2005	5,323
2006	6,929
2007	9,360
2008	15,677
2009	22,893

Source: Compiled by Earth Policy Institute from European Photovoltaic Industry Association (EPIA), *Global Market Outlook for Photovoltaics Until 2013* (Brussels: April 2009), p. 3; EPIA, *Global Market Outlook for Photovoltaics Until 2014* (Brussels: May 2010), p. 5.

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# World Cumulative Solar Photovoltaics Installations, 1998-2009



Source: EPI from EPIA

Earth Policy Institute - [www.earth-policy.org](http://www.earth-policy.org)

### Annual Solar Photovoltaics Installations in Selected Countries and the World, 1998-2009

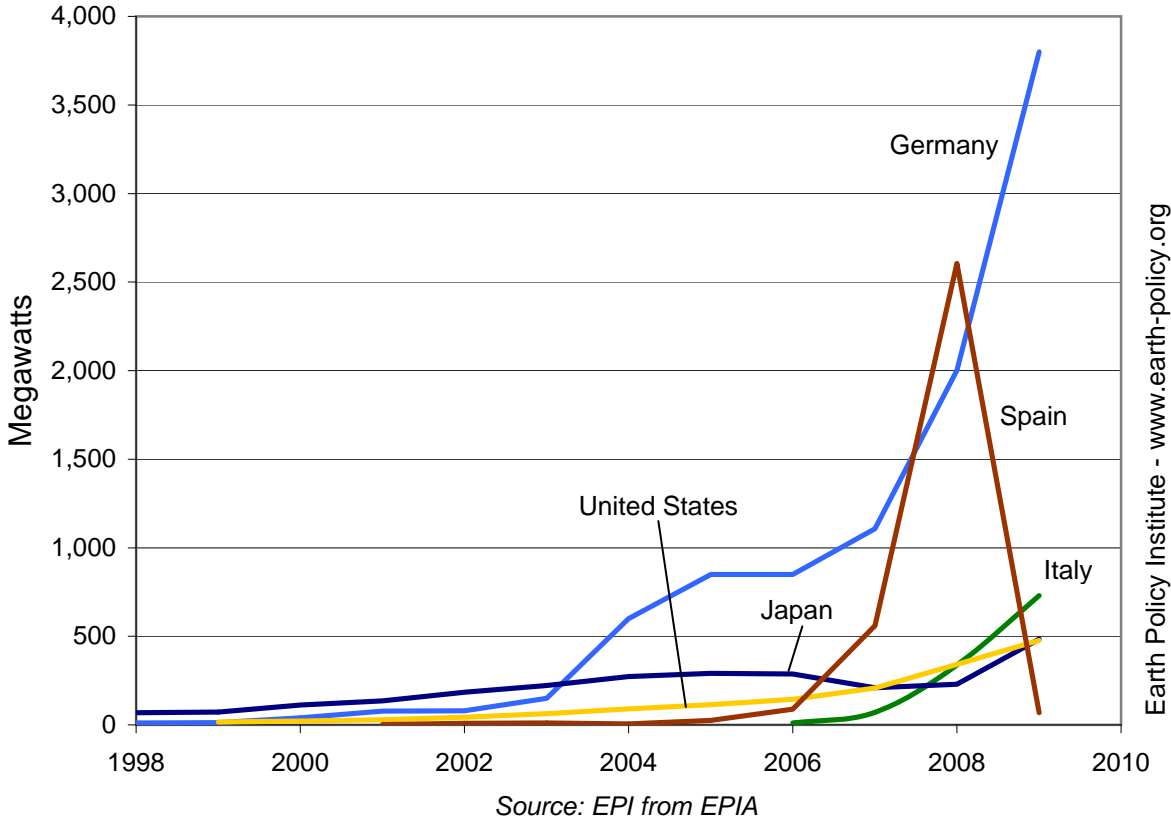
Year	Germany	Italy	Japan	U.S.	Spain	Others	World
	----- Megawatts -----						
1998	10	n.a.	69	n.a.	0	76	155
1999	12	n.a.	72	17	1	95	197
2000	40	n.a.	112	22	n.a.	94	278
2001	78	n.a.	135	29	2	90	334
2002	80	n.a.	185	44	9	121	439
2003	150	n.a.	223	63	10	148	594
2004	600	n.a.	272	90	6	84	1,052
2005	850	n.a.	290	114	26	41	1,321
2006	850	10	287	145	88	223	1,603
2007	1,107	70	210	207	560	276	2,430
2008	2,002	338	230	342	2,605	766	6,283
2009	3,800	730	484	477	69	1,656	7,216

Notes: n.a. = data not available. Values include both grid-connected and off-grid PV systems.

Source: Compiled by Earth Policy Institute with 1998-2006 from European Photovoltaic Industry Association (EPIA), *Global Market Outlook for Photovoltaics Until 2013* (Brussels: April 2009), p. 4; 2007-2009 from EPIA, *Global Market Outlook for Photovoltaics Until 2014* (Brussels: May 2010), pp. 5, 10, 15.

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# Annual Solar Photovoltaics Installations in Selected Countries, 1998-2009



## Cumulative Solar Photovoltaics Installations in Ten Leading Countries and the World, 2009

<u>Country</u>	<u>Cumulative Installed Capacity Megawatts</u>
Germany	9,779
Spain	3,386
Japan	2,633
United States	1,650
Italy	1,186
South Korea	520
Czech Republic	465
Belgium	363
China	305
France	272
India	120
<b><u>World Total</u></b>	<b><u>22,893</u></b>

Note: Values include both grid-connected and off-grid PV systems.

Source: Compiled by Earth Policy Institute from European Photovoltaic Industry Association (EPIA), *Global Market Outlook for Photovoltaics Until 2013* (Brussels: April 2009), p. 13; EPIA, *Global Market Outlook for Photovoltaics Until 2014* (Brussels: May 2010), pp. 5, 10-21.

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## World Installed Concentrating Solar Thermal Power Capacity, 1980-2009

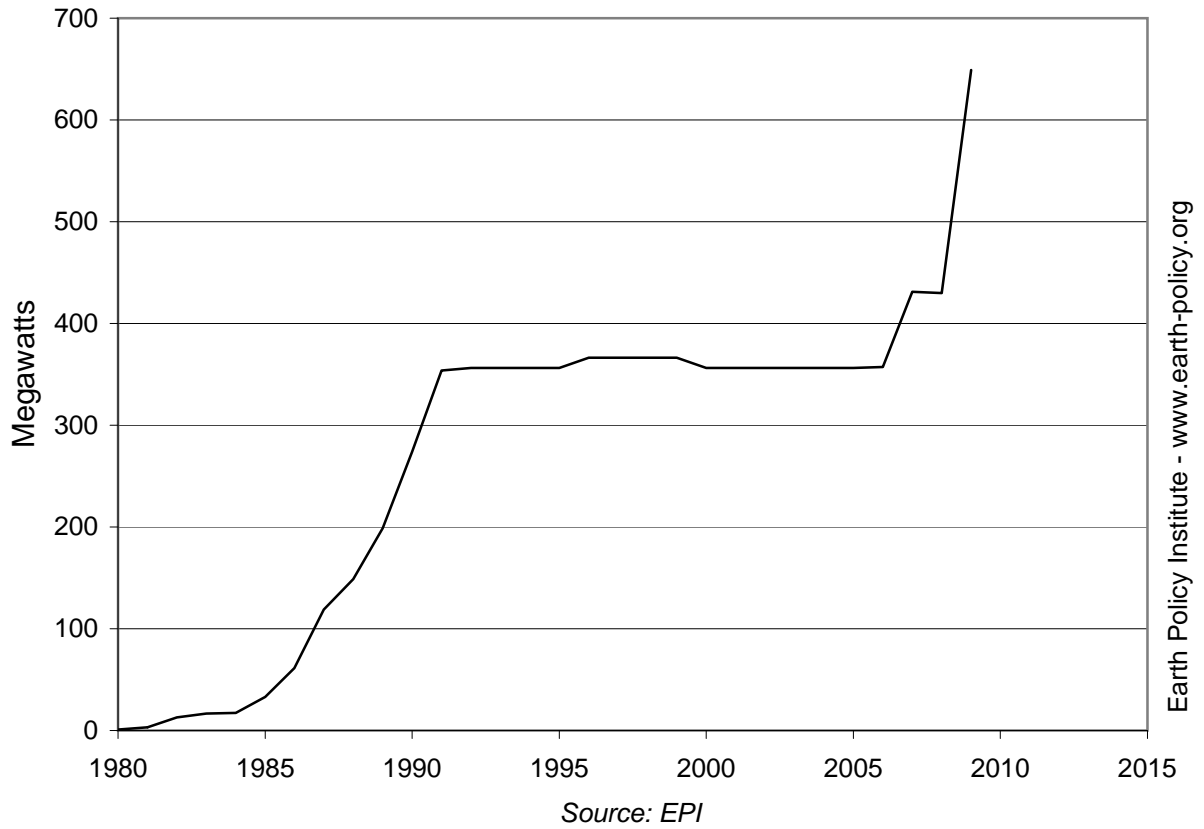
Year	Cumulative Installed Capacity Megawatts
1980	1
1981	3
1982	13
1983	17
1984	17
1985	33
1986	61
1987	119
1988	149
1989	199
1990	274
1991	354
1992	356
1993	356
1994	356
1995	356
1996	366
1997	366
1998	366
1999	366
2000	356
2001	356
2002	356
2003	356
2004	356
2005	356
2006	357
2007	431
2008	430
2009	649

Source: Compiled by Earth Policy Institute from Shirish Garud, *Making Solar Thermal Power Generation in India a Reality* (New Delhi: The Energy and Resources Institute, 2006), p. 9; Rainer Aringhoff et al., *Concentrated Solar Thermal Power – Now!* (Brussels, Almeria, and Amsterdam: European Solar Thermal Industry Association, IEA SolarPACES, and Greenpeace International, September 2005), p. 10; U.S. Department of Energy (DOE), National Renewable Energy Laboratory (NREL), *U.S. Parabolic Trough Power Plant Data*, electronic database, at [www.nrel.gov/csp/troughnet/power\\_plant\\_data.html](http://www.nrel.gov/csp/troughnet/power_plant_data.html), updated 8 May 2007; DOE, NREL, *Concentrating Solar Power: Energy from Mirrors* (Golden, CO: March 2001), p. 5; Reese Tisdale, "Solar CSP Developers...Friends or Foes," presentation at CSP Today 2008, San Francisco, CA, 29 January 2008; IHS Emerging Energy Research, "Global Concentrated Solar Power Markets and Strategies: 2010-2025," study announcement (Cambridge, MA: April 2010).

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# World Installed Concentrating Solar Thermal Power Capacity, 1980-2009



### Solar Water and Space Heating Area in Selected Countries and the World, Total and Per Person, 2008

Country	Total Area Thousand Square Meters	Population Thousands	Area Per Person Square Meters
Cyprus	804	862	0.93
Israel	3,773	7,051	0.54
Austria	3,340	8,337	0.40
Greece	3,870	11,137	0.35
Barbados	82	255	0.32
Jordan	893	6,136	0.15
Turkey	10,637	73,914	0.14
Germany	10,318	82,264	0.13
China	150,000	1,337,411	0.11
Australia	1,998	21,074	0.09
Malta	34	407	0.08
Denmark	413	5,458	0.08
Taiwan	1,696	23,000	0.07
Switzerland	540	7,541	0.07
Slovenia	123	2,015	0.06
Japan	5,874	127,293	0.05
Luxembourg	22	481	0.04
Spain	1,555	44,486	0.03
Portugal	353	10,677	0.03
New Zealand	128	4,230	0.03
Sweden	276	9,205	0.03
France	1,766	62,036	0.03
Tunisia	286	10,169	0.03
Italy	1,450	59,604	0.02
Belgium	228	10,590	0.02
Netherlands	343	16,528	0.02
Slovak Republic	107	5,400	0.02
Albania	58	3,143	0.02
Brazil	3,490	191,972	0.02
Ireland	76	4,437	0.02
Czech Republic	142	10,319	0.01
Macedonia	23	2,041	0.01
Poland	350	38,104	0.01
United States	2,725	311,666	0.01
United Kingdom	370	61,231	0.01
South Africa	276	49,668	0.01
<b>World</b>	<b>212,857</b>	<b>6,750,062</b>	<b>0.03</b>

Source: Compiled by Earth Policy Institute with China and world total from Li Junfeng and Ma Lingjuan, CREIA, cited in Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2010 Global Status Report* (Paris: REN21 Secretariat, 2010), p. 56; and with other countries from Werner Weiss and Franz Mauthner, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2008* (Gleisdorf, Austria: International Energy Agency, Solar Heating & Cooling Programme, May 2010), p. 25; population from U.N. Population Division, *World Population Prospects: The 2008 Revision Population Database*, at [esa.un.org/unpp](http://esa.un.org/unpp), updated 11 March 2009; Taiwan population from Population Reference Bureau, *2008 World Population Data Sheet* (Washington, DC: August 2008).

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## Cumulative Installed Solar Water and Space Heating Capacity in Ten Leading Countries and the World, 2008

Country	Cumulative Installed Capacity Thermal Megawatts
China	105,000
Turkey	7,446
Germany	7,223
Japan	4,112
Greece	2,709
Israel	2,641
Brazil	2,443
Austria	2,338
United States	1,907
India	1,772
<b>World Total</b>	<b>149,000</b>

Note: 2008 is the latest year for which complete data are available. The figure of 1.9 billion square feet of rooftop solar thermal collectors in China given in *World on the Edge* is an estimate for the end of 2009 from Li Junfeng of the Chinese Renewable Energy Industries Association (CREIA). This translates into 134,000 thermal megawatts for China in 2009.

Source: Compiled by Earth Policy Institute with China and world total from Li Junfeng and Ma Lingjuan, CREIA, cited in Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2010 Global Status Report* (Paris: REN21 Secretariat, 2010), p. 56; and with other countries from Werner Weiss and Franz Mauthner, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2008* (Gleisdorf, Austria: International Energy Agency, Solar Heating & Cooling Programme, May 2010), p. 25.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

## World Cumulative Installed Geothermal Electricity-Generating Capacity, 1950-2010

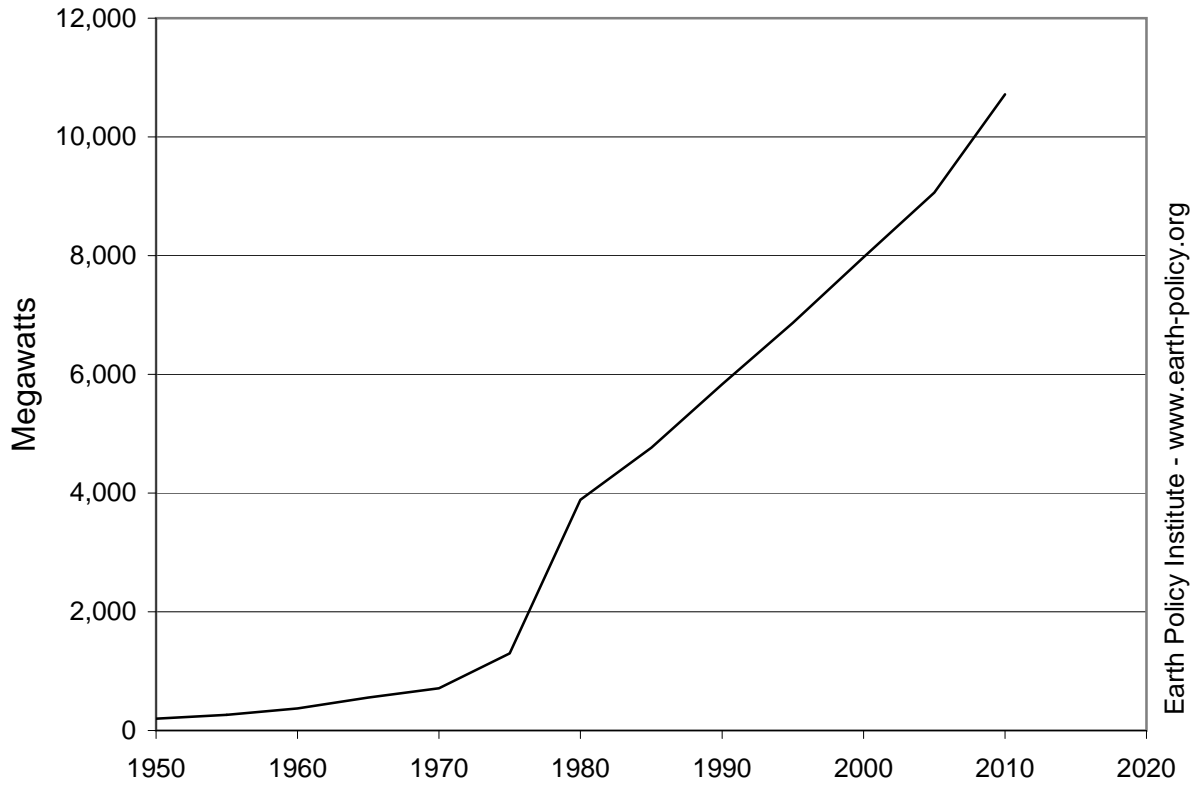
Year	Cumulative Installed Capacity Megawatts
1950	200
1955	262
1960	374
1965	556
1970	711
1975	1,300
1980	3,887
1985	4,764
1990	5,832
1995	6,867
2000	7,974
2005	9,064
2010 *	10,715

\* Note: Total installed capacity as of May 2010.

Source: Compiled by Earth Policy Institute with 1950-1970 data from Worldwatch Institute, *Signposts 2004*, CD-ROM (Washington, DC: 2004); 1975-1985 data from Ruggero Bertani, "World Geothermal Generation in 2007," *GHC Bulletin*, September 2007, p. 8; 1990-2005 from International Geothermal Association, "Installed Generating Capacity," at [www.geothermal-energy.org/226,installed\\_generating\\_capacity.html](http://www.geothermal-energy.org/226,installed_generating_capacity.html), updated 2 July 2010; 2010 estimate from Alison Holm et al., *Geothermal Energy International Market Update* (Washington, DC: Geothermal Energy Association, May 2010), p. 4.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

# World Cumulative Installed Geothermal Electricity-Generating Capacity, 1950-2010



Source: Worldwatch; Bertani; GEA

## Cumulative Installed Geothermal Electricity-Generating Capacity by Country, 1990-2010

Country	1990	1995	2000	2005	2010
	Megawatts				
Argentina	0.7	0.7	0.0	0.0	0.0
Australia	0.0	0.2	0.2	0.2	1.1
Austria	0.0	0.0	0.0	1.0	1.4
China	19.2	28.8	29.2	28.0	24.0
Costa Rica	0.0	55.0	142.5	163.0	166.0
El Salvador	95.0	105.0	161.0	151.0	204.0
Ethiopia	0.0	0.0	8.5	7.0	7.3
France	4.2	4.2	4.2	15.0	16.5
Germany	0.0	0.0	0.0	0.2	6.6
Guatemala	0.0	33.4	33.4	33.0	52.0
Iceland	44.6	50.0	170.0	322.0	575.0
Indonesia	144.8	309.8	589.5	797.0	1,179.0
Italy	545.0	631.7	785.0	790.0	843.0
Japan	214.6	413.7	546.9	535.0	535.2
Kenya	45.0	45.0	45.0	127.0	167.0
Mexico	700.0	753.0	755.0	953.0	958.0
New Zealand	283.2	286.0	437.0	435.0	628.0
Nicaragua	35.0	70.0	70.0	77.0	88.0
Papua New Guinea	0.0	0.0	0.0	39.0	56.0
Philippines	891.0	1,227.0	1,909.0	1,931.0	1,904.0
Portugal	3.0	5.0	16.0	16.0	29.0
Russia	11.0	11.0	23.0	79.0	82.0
Taiwan	n.a.	n.a.	n.a.	n.a.	3.3
Thailand	0.3	0.3	0.3	0.3	0.3
Turkey	20.6	20.4	20.4	20.4	82.0
United States	2,774.6	2,816.7	2,228.0	2,544.0	3,086.0
<b>World Total</b>	<b>5,831.7</b>	<b>6,866.8</b>	<b>7,974.1</b>	<b>9,064.1</b>	<b>10,715</b>

Notes: Data for 2010 are estimates as of May 2010; due to differences in data-gathering, 2010 country estimates from GEA do not sum exactly to World Total, which is IGA estimate; "n.a." indicates data not available.

Source: Compiled by Earth Policy Institute with 1990-2005 from International Geothermal Association (IGA), "Installed Generating Capacity," at [www.geothermal-energy.org/226,installed\\_generating\\_capacity.html](http://www.geothermal-energy.org/226,installed_generating_capacity.html), updated 2 July 2010; 2010 from Alison Holm et al., Geothermal Energy International Market Update (Washington, DC: Geothermal Energy Association (GEA), May 2010), pp. 8-10.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute online at [www.earth-policy.org](http://www.earth-policy.org).

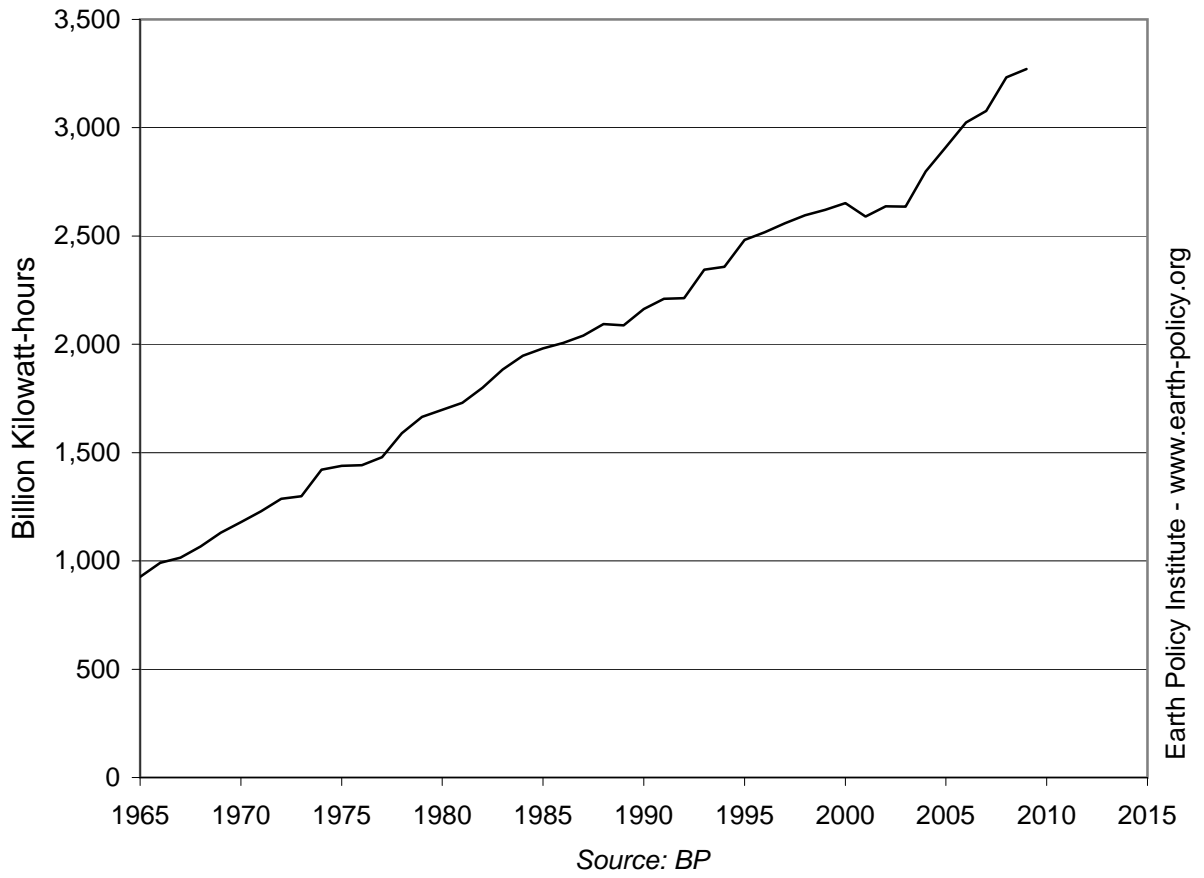
## World Hydroelectric Consumption, 1965-2009

<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	2,088
1990	2,162
1991	2,210
1992	2,213
1993	2,344
1994	2,357
1995	2,483
1996	2,518
1997	2,560
1998	2,596
1999	2,620
2000	2,652
2001	2,589
2002	2,638
2003	2,636
2004	2,798
2005	2,910
2006	3,024
2007	3,077
2008	3,232
<u>2009</u>	<u>3,272</u>

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

# World Hydroelectric Consumption, 1965-2009





## Hydroelectric Consumption in Ten Leading Countries and the World, 2009

Country	Consumption
	Billion Kilowatt-hours
China	616
Canada	399
Brazil	391
United States	275
Russia	176
Norway	127
India	106
Venezuela	86
Japan	74
Sweden	66
<b>World Total</b>	<b>3,272</b>

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

## World Fuel Ethanol Production, 1975-2010

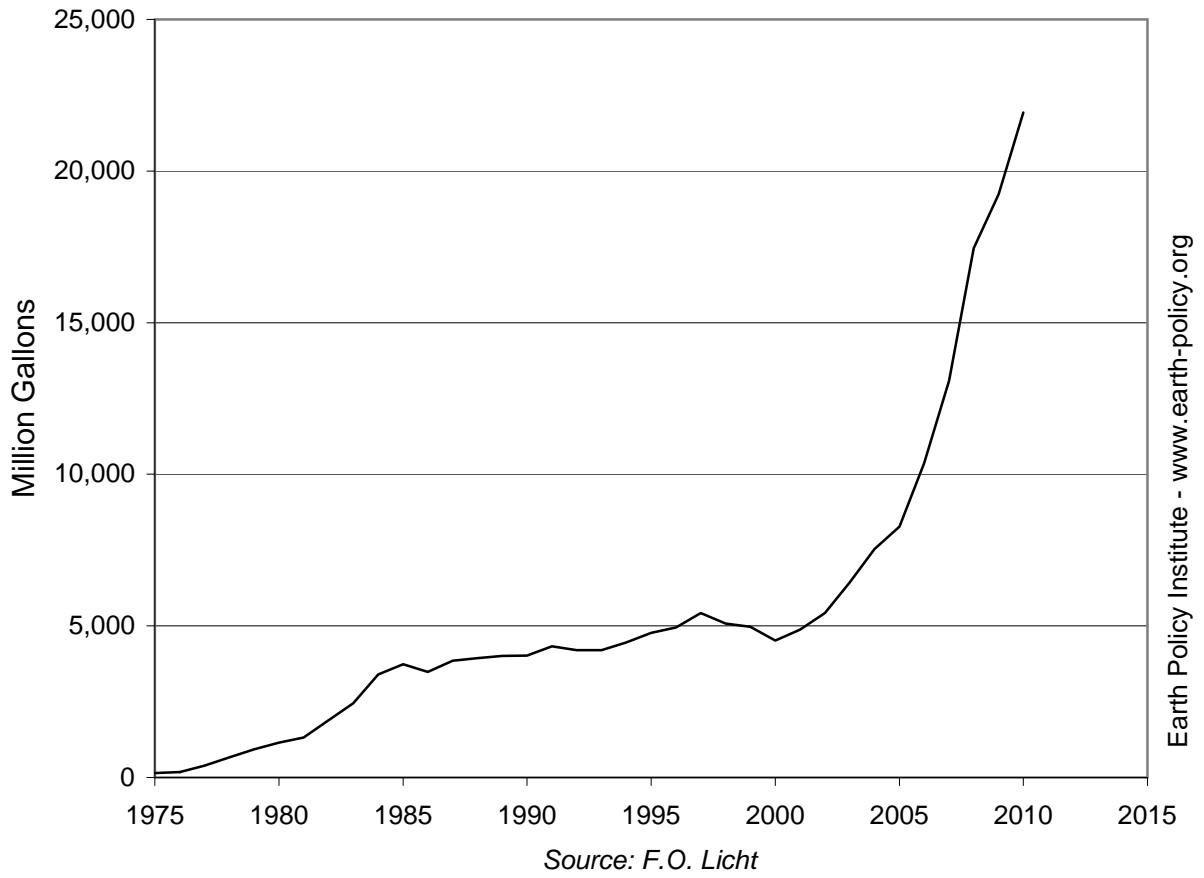
<u>Year</u>	<u>Production</u> Million Gallons
1975	147
1976	175
1977	388
1978	668
1979	933
1980	1,154
1981	1,315
1982	1,889
1983	2,452
1984	3,403
1985	3,732
1986	3,485
1987	3,857
1988	3,937
1989	4,013
1990	4,019
1991	4,325
1992	4,196
1993	4,201
1994	4,458
1995	4,775
1996	4,954
1997	5,420
1998	5,073
1999	4,972
2000	4,519
2001	4,874
2002	5,420
2003	6,430
2004	7,531
2005	8,276
2006	10,366
2007	13,090
2008	17,452
2009	19,239
2010 *	21,926

\* Projection.

Source: Compiled by Earth Policy Institute with data for 1975-1998 from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 6, no. 4 (23 October 2007), p. 63; 1999-2005 from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 18 (26 May 2009), p. 3; 2006-2010 from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 8, no. 16 (28 April 2010), p. 328.

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# World Fuel Ethanol Production, 1975-2010



## Fuel Ethanol Production in Ten Leading Countries and the World, 2010

Country	Production *
	Million Gallons
United States	11,993
Brazil	7,270
China	555
Canada	304
France	277
Germany	238
Spain	159
Thailand	139
Belgium	85
Colombia	85
<b>World Total</b>	<b>21,926</b>

\* Data are projections.

Source: F.O. Licht, *World Ethanol and Biofuels Report*, vol. 8, no. 16 (28 April 2010), p. 328.

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## World Biodiesel Production, 1991-2010

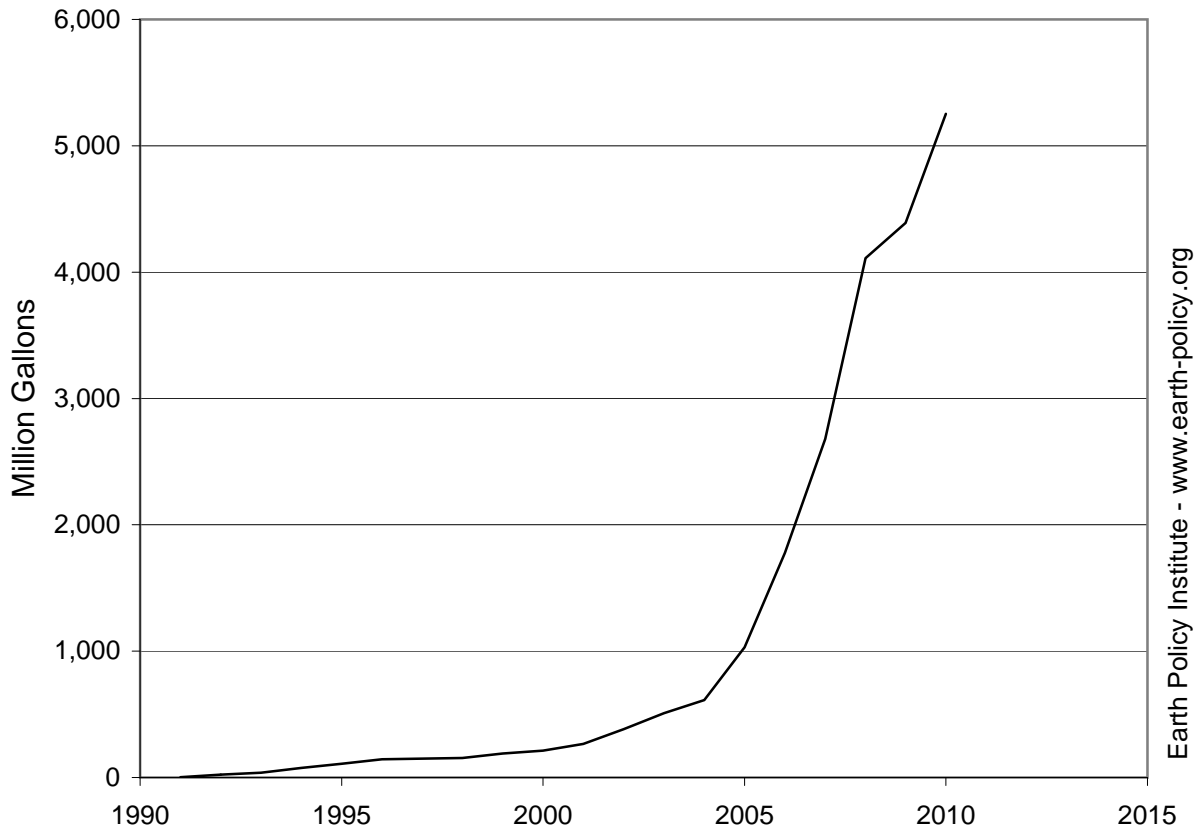
Year	Production Million Gallons
1991	3
1992	23
1993	38
1994	75
1995	108
1996	144
1997	151
1998	155
1999	190
2000	213
2001	265
2002	383
2003	510
2004	614
2005	1,032
2006	1,779
2007	2,679
2008	4,110
2009	4,390
2010 *	5,253

\* Projection.

Source: Compiled by Earth Policy Institute with 1991-1999 data from F.O. Licht data, cited in Suzanne Hunt and Peter Stair, "Biofuels Hit a Gusher," *Vital Signs 2006-2007* (Washington, DC: Worldwatch Institute, 2006), pp. 40-41; 2000-2004 data from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 2 (23 September 2008), p. 29; 2005-2010 data from F.O.Licht, *World Ethanol and Biofuels Report*, vol. 8, no. 13 (15 March 2010), p. 265.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

# World Biodiesel Production, 1991-2010



Source: F.O. Licht; Worldwatch

Earth Policy Institute - [www.earth-policy.org](http://www.earth-policy.org)

## **Biodiesel Production in Five Leading Countries and the World, 2010**

<u>Country</u>	<u>Production *</u> Million Gallons
United States	750
Argentina	690
Germany	660
France	630
Brazil	510
<b><u>World Total</u></b>	<b><u>5,253</u></b>

\* Data are projections.

Source: F.O. Licht, *World Ethanol and Biofuels Report*, vol. 8, no. 13 (15 March 2010), pp. 265, 267.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

## World Natural Gas Consumption, 1965-2009

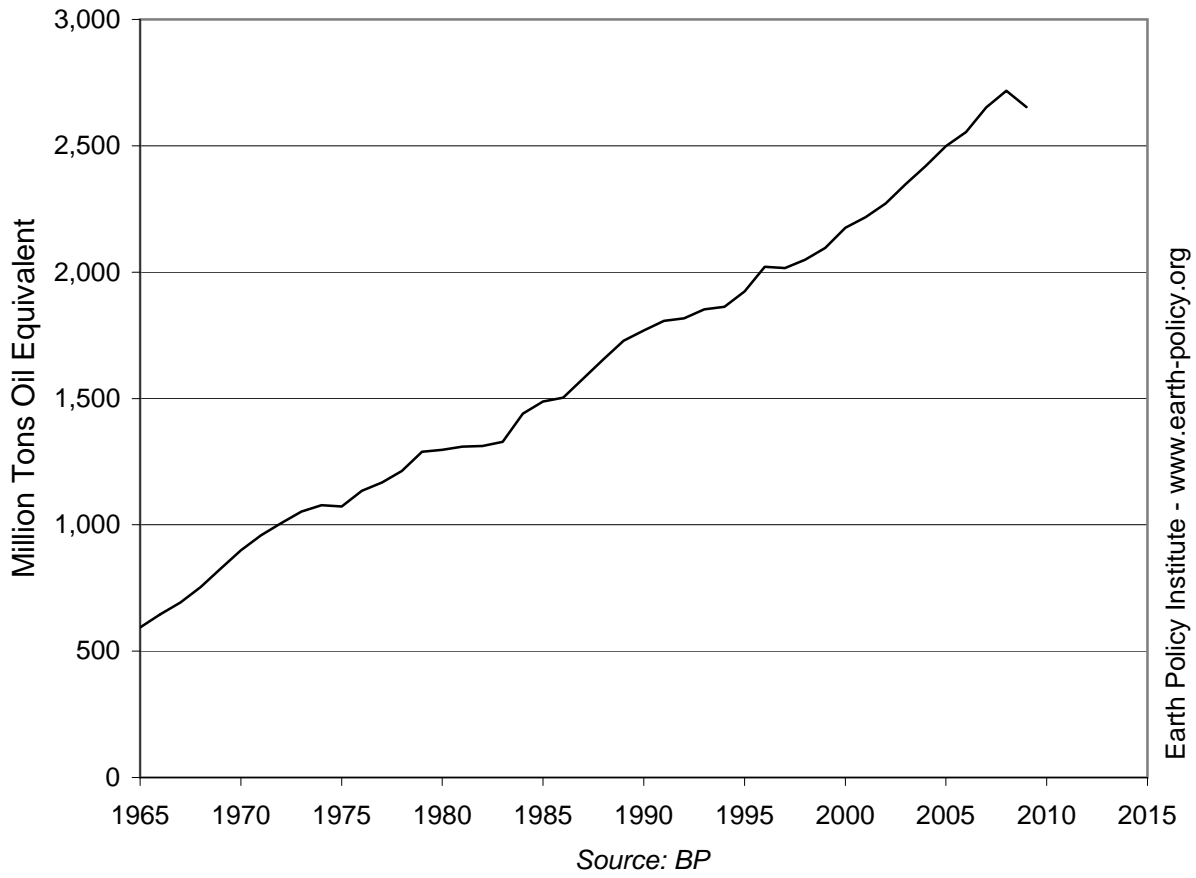
Year	Consumption
	Million Tons Oil Equivalent
1965	594
1966	646
1967	692
1968	753
1969	827
1970	899
1971	959
1972	1,007
1973	1,052
1974	1,078
1975	1,072
1976	1,135
1977	1,168
1978	1,214
1979	1,289
1980	1,297
1981	1,309
1982	1,312
1983	1,329
1984	1,440
1985	1,488
1986	1,503
1987	1,579
1988	1,655
1989	1,729
1990	1,769
1991	1,807
1992	1,817
1993	1,853
1994	1,863
1995	1,924
1996	2,021
1997	2,016
1998	2,049
1999	2,095
2000	2,175
2001	2,217
2002	2,272
2003	2,348
2004	2,420
2005	2,498
2006	2,554
2007	2,652
2008	2,717
2009	2,653

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).



# World Natural Gas Consumption, 1965-2009



## Natural Gas Consumption in Ten Leading Countries and the World, 2009

Country	Consumption
	Million Tons Oil Equivalent
United States	589
Russia	351
Iran	119
Canada	85
China	80
Japan	79
United Kingdom	78
Germany	70
Saudi Arabia	70
Italy	64
<b>World Total</b>	<b>2,653</b>

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

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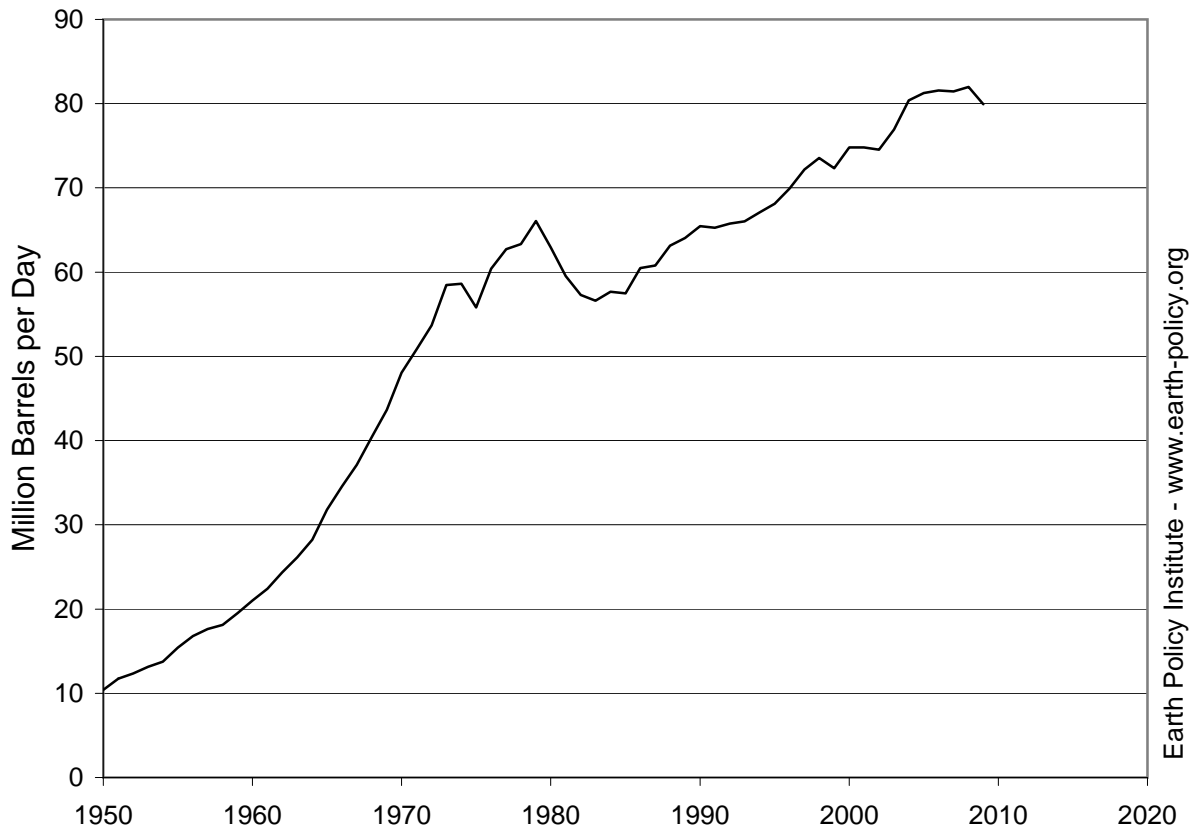
### World Oil Production, 1950-2009

Year	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
1994	67.10
1995	68.10
1996	69.90
1997	72.18
1998	73.54
1999	72.32
2000	74.82
2001	74.81
2002	74.53
2003	76.92
2004	80.37
2005	81.26
2006	81.56
2007	81.45
2008	81.99
2009	79.95

\* Includes crude oil, shale oil, oil sands and natural gas liquids.

Source: 1950-1964 compiled by Worldwatch Institute from U.S. Department of Defense and U.S. Department of Energy data; 1965-2009 data from BP, *Statistical Review of World Energy June 2010* (London: 2010).

# World Oil Production, 1950-2009



Source: BP; Worldwatch

Earth Policy Institute - [www.earth-policy.org](http://www.earth-policy.org)

## Top 20 Oil Producing Countries, 2009

Country	Production*
	Million Barrels per Day
Russia	10.03
Saudi Arabia	9.71
United States	7.20
Iran	4.22
China	3.79
Canada	3.21
Mexico	2.98
United Arab Emirates	2.60
Iraq	2.48
Kuwait	2.48
Venezuela	2.44
Norway	2.34
Nigeria	2.06
Brazil	2.03
Algeria	1.81
Angola	1.78
Kazakhstan	1.68
Libya	1.65
United Kingdom	1.45
Qatar	1.34
<b>World Total</b>	<b>79.95</b>

\* Includes crude oil, shale oil, oil sands and natural gas liquids.

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

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## Top 20 Oil Consuming Countries, 2009

Country	Consumption*
	Million Barrels per Day
United States	18.69
China	8.63
Japan	4.40
India	3.18
Russia	2.70
Saudi Arabia	2.61
Germany	2.42
Brazil	2.40
South Korea	2.33
Canada	2.20
Mexico	1.94
France	1.83
Iran	1.74
United Kingdom	1.61
Italy	1.58
Spain	1.49
Indonesia	1.34
Netherlands	1.05
Taiwan	1.01
Singapore	1.00
<b>World Total</b>	<b>84.08</b>

\* Includes ethanol and biodiesel.

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

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## Top 20 Oil Importing Countries, 2009

Country	Imports*
	Million Barrels per Day
United States	9.01
China	3.88
Japan	3.44
India	2.62
South Korea	2.32
Germany	1.97
Italy	1.54
France	1.44
Spain	1.06
Netherlands	0.97
United Kingdom	0.96
Taiwan	0.95
Singapore	0.86
Canada	0.81
Thailand	0.79
Belgium	0.64
South Africa	0.44
Belarus	0.43
Poland	0.40
Australia	0.40
<b>World Total</b>	<b>42.23</b>

\* Includes crude oil, shale oil, and oil sands. For the full list of included items, see U.S. Department of Energy (DOE), Energy Information Administration (EIA), "International Energy Glossary," at [www.eia.gov/emeu/iea/glossary.html#CrudeOil](http://www.eia.gov/emeu/iea/glossary.html#CrudeOil).

Source: U.S. Department of Energy, Energy Information Administration, *International Energy Statistics*, electronic database, at <http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm>, updated 31 October 2010.

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).



## 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

Source: Fredrik Robelius, *Giant Oil Fields - The Highway to Oil* (Uppsala, Sweden: Uppsala University Press, 2007), p. 79.

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### Coal Consumption in Top Ten Countries and the World, 1980-2009

Year	China	United States	India	Japan	South Africa	Russia	Germany	South Korea	Poland	Australia	World Total
	Quadrillion Btu										
1980	12.1	15.4	2.3	2.3	1.7	n.a.	5.5	0.5	4.0	0.7	71.4
1981	12.1	15.9	2.5	2.5	2.1	n.a.	5.6	0.6	3.6	1.1	72.4
1982	12.8	15.3	2.5	2.5	2.3	n.a.	5.6	0.6	3.7	1.1	73.5
1983	13.5	15.9	2.6	2.5	2.4	n.a.	5.6	0.7	3.7	1.1	75.3
1984	15.0	17.1	2.8	2.8	2.6	n.a.	5.8	0.8	3.9	1.1	78.9
1985	16.3	17.5	2.9	2.9	2.6	7.8	5.9	0.9	4.0	1.2	82.2
1986	17.4	17.3	3.1	2.8	2.7	8.0	5.7	0.9	4.1	1.2	83.7
1987	18.5	18.0	3.4	2.8	2.7	8.1	5.6	0.9	4.2	1.3	86.7
1988	19.8	18.8	3.6	3.0	2.9	8.0	5.6	1.0	4.1	1.4	89.3
1989	20.6	19.1	4.0	3.0	2.8	7.7	5.5	1.0	3.9	1.4	90.0
1990	21.0	19.2	3.8	3.0	2.8	7.2	5.1	1.0	3.2	1.4	88.7
1991	22.0	19.0	4.0	3.1	2.8	6.6	4.5	1.0	3.1	1.5	87.6
1992	22.8	19.1	4.3	3.1	2.7	6.1	4.1	0.9	2.9	1.5	86.8
1993	24.2	19.8	4.5	3.1	2.8	5.6	3.9	1.0	2.9	1.5	87.4
1994	25.7	19.9	4.6	3.3	2.9	5.0	3.8	1.1	2.9	1.5	87.9
1995	27.6	20.1	5.0	3.4	3.1	4.7	3.6	1.1	2.8	1.6	90.0
1996	28.9	21.0	5.3	3.5	3.2	4.6	3.6	1.3	2.9	1.7	92.7
1997	27.8	21.4	5.4	3.6	3.3	4.3	3.4	1.4	2.8	1.8	91.9
1998	25.9	21.7	5.4	3.5	3.3	4.0	3.4	1.4	2.5	1.8	89.7
1999	26.0	21.6	5.4	3.6	3.3	4.0	3.2	1.5	2.4	1.8	89.2
2000	26.5	22.6	5.7	3.9	3.3	4.2	3.4	1.7	2.3	1.9	92.8
2001	27.0	21.9	5.8	4.1	3.2	4.1	3.4	1.8	2.3	1.9	93.2
2002	28.3	21.9	6.0	4.2	3.3	4.1	3.4	1.9	2.3	2.0	95.4
2003	33.9	22.3	6.2	4.5	3.5	4.1	3.5	2.0	2.3	2.0	103.0
2004	39.0	22.5	6.8	4.8	3.8	4.0	3.4	2.1	2.3	2.1	109.7
2005	43.7	22.8	7.3	4.8	3.6	3.7	3.3	2.2	2.2	2.1	115.2
2006	48.2	22.4	7.8	4.7	3.7	3.8	3.3	2.2	2.3	2.2	120.6
2007	52.1	22.7	8.3	5.0	3.9	3.7	3.4	2.4	2.3	2.2	126.4
2008	55.8	22.4	9.2	5.1	4.1	4.0	3.2	2.6	2.2	2.0	130.4
2009	61.0	19.8	9.8	4.3	3.9	3.3	2.8	2.7	2.1	2.0	130.1

#### Percent

change,

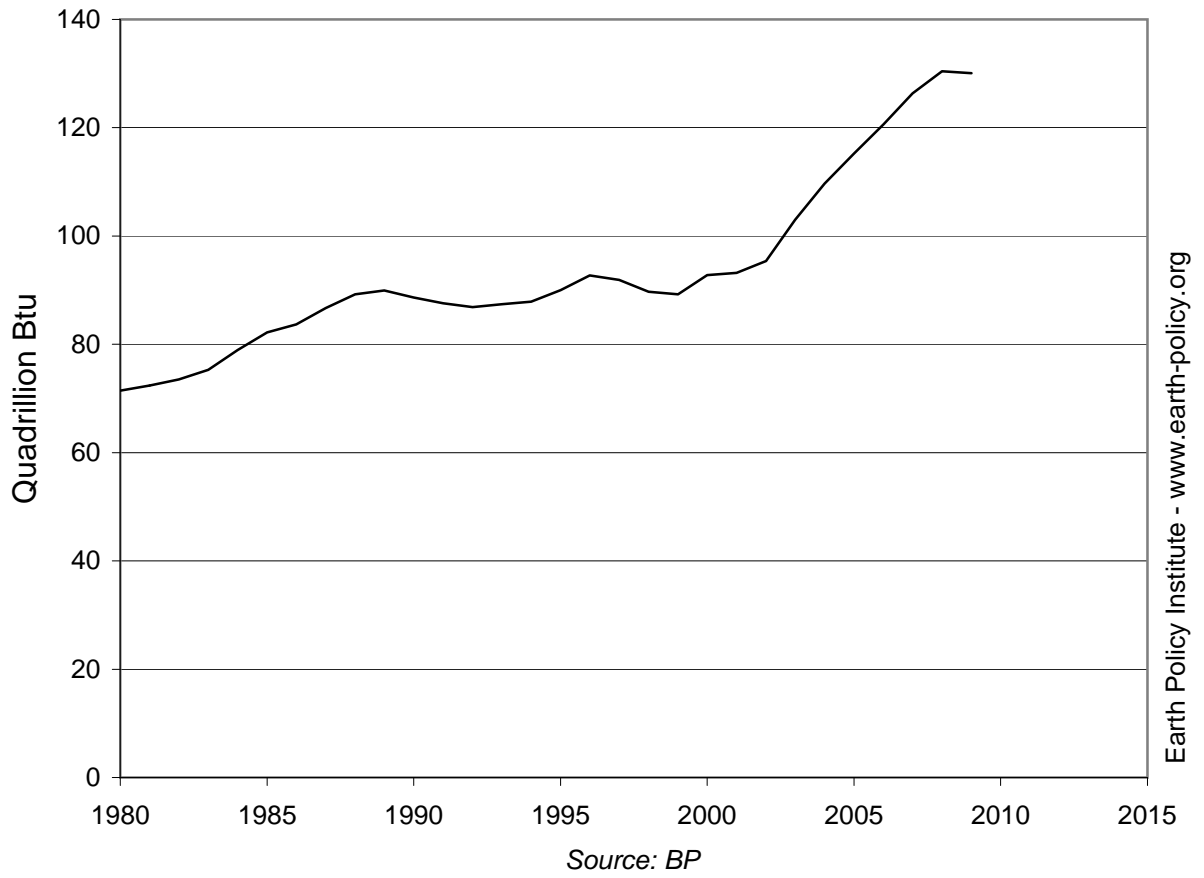
1990-2009:	190.1	3.1	157.5	43.2	39.4	-54.1	-45.2	181.3	-32.9	39.3	46.7
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Note: "n.a." indicates data not available.

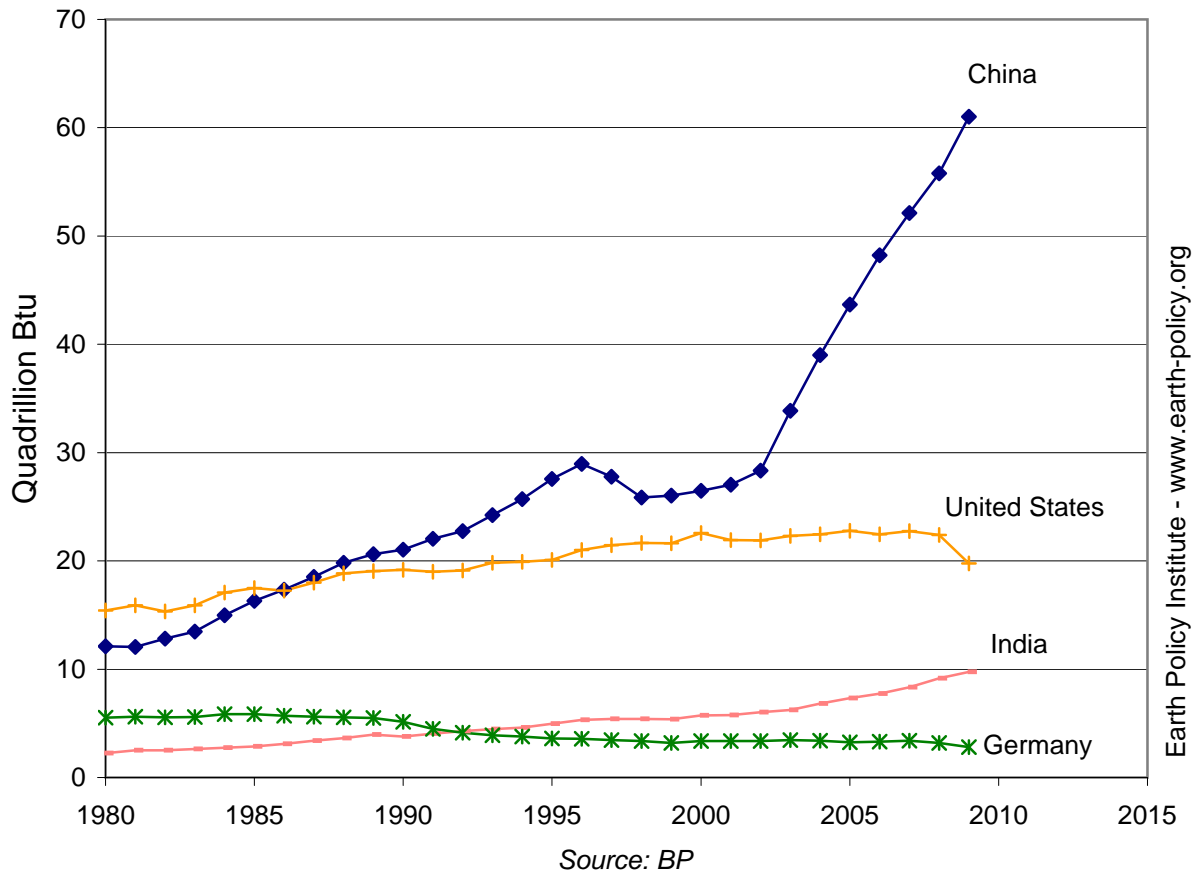
Source: Compiled by Earth Policy Institute from BP, *Statistical Review of World Energy June 2010* (London: 2010); million tons oil equivalent converted to Btu using conversion factor from International Energy Agency, "Unit Converter," at [www.iea.org/stats/unit.asp](http://www.iea.org/stats/unit.asp).

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

# World Coal Consumption, 1980-2009



# Coal Consumption in Selected Countries, 1980-2009



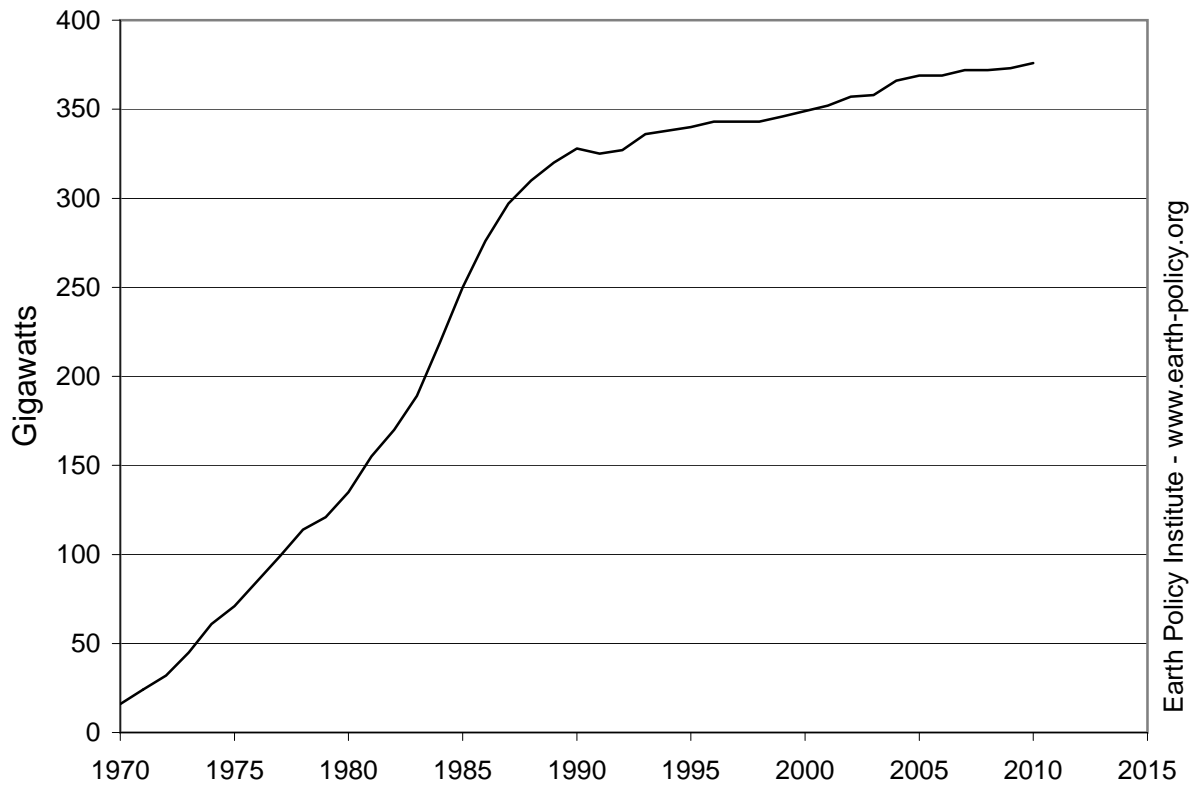
## World Cumulative Installed Nuclear Electricity-Generating Capacity, 1970-2010

Year	Installed Capacity Gigawatts
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	369
2006	369
2007	372
2008	372
2009	373
2010 *	376

\* Data for 2010 as of 1 December 2010.

Source: Compiled by Earth Policy Institute with 1970-2005 data from Worldwatch Institute, *Vital Signs 2007-2008* (Washington, DC: 2007), p. 35; 2006-2010 data from World Nuclear Association, "World Nuclear Power Reactors & Uranium Requirements," at [world-nuclear.org/info/reactors.html](http://world-nuclear.org/info/reactors.html), various years.

## World Cumulative Installed Nuclear Electricity-Generating Capacity, 1970-2010



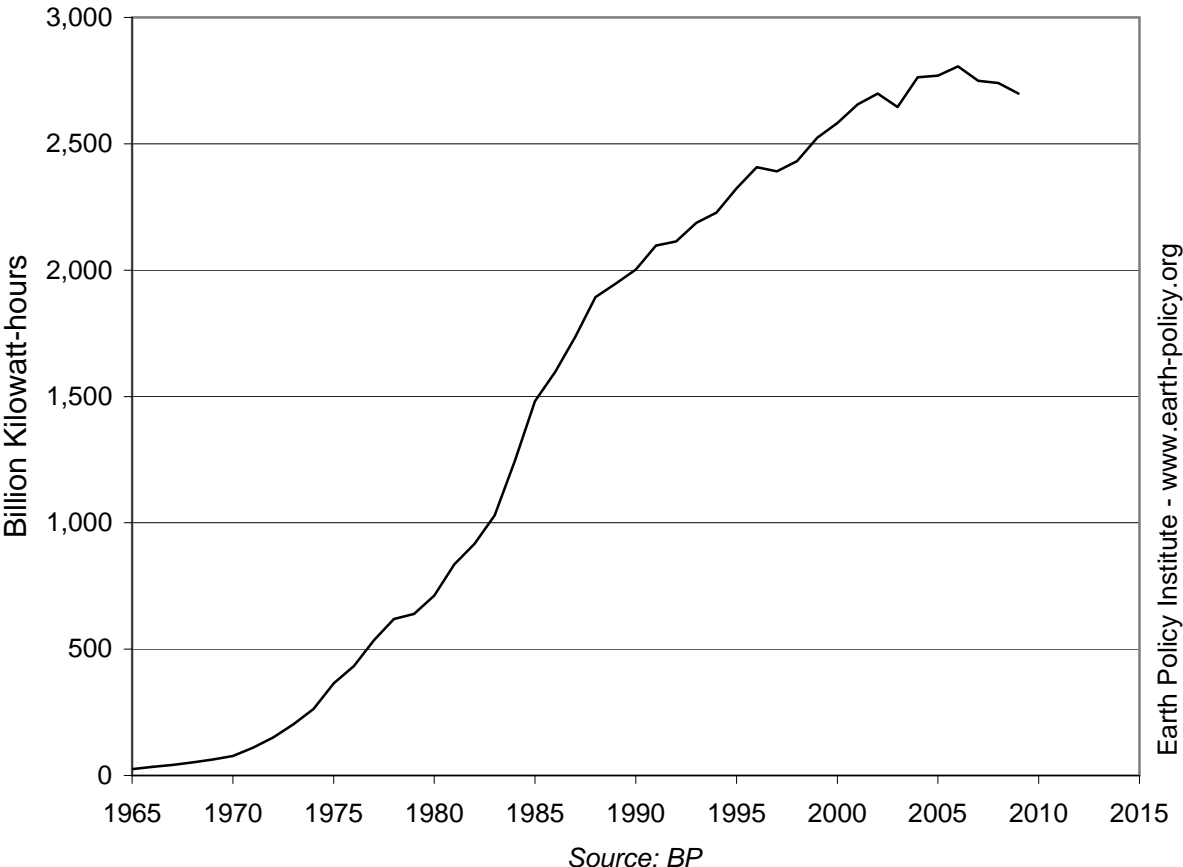
Source: *Worldwatch*; IAEA; WNA

## World Nuclear Energy Consumption, 1965-2009

Year	Consumption
	Billion Kilowatt-hours
1965	26
1966	34
1967	42
1968	52
1969	63
1970	77
1971	110
1972	151
1973	203
1974	263
1975	364
1976	433
1977	535
1978	619
1979	640
1980	711
1981	836
1982	917
1983	1,030
1984	1,245
1985	1,482
1986	1,597
1987	1,736
1988	1,893
1989	1,947
1990	2,002
1991	2,097
1992	2,114
1993	2,187
1994	2,228
1995	2,324
1996	2,408
1997	2,391
1998	2,431
1999	2,524
2000	2,582
2001	2,655
2002	2,699
2003	2,645
2004	2,763
2005	2,770
2006	2,806
2007	2,750
2008	2,741
2009	2,698

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

# World Nuclear Energy Consumption, 1965-2009





## Nuclear Energy Consumption in Ten Leading Countries and the World, 2009

Country	Consumption
	Billion Kilowatt-hours
United States	841
France	411
Japan	275
Russia	164
South Korea	148
Germany	135
Canada	90
Ukraine	82
China	70
United Kingdom	69
<b>World Total</b>	<b>2,698</b>

Source: BP, *Statistical Review of World Energy June 2010* (London: 2010).

This is part of a supporting dataset for Lester R. Brown, **World on the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2011). For more information and a free download of the book, see Earth Policy Institute online at [www.earth-policy.org](http://www.earth-policy.org).