U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

2011 Renewable Energy Data Book

Acknowledgments

This report was produced by Rachel Gelman, edited by Scott Gossett, and designed by Stacy Buchanan of the National Renewable Energy Laboratory (NREL). We greatly appreciate the input of Carla Frisch, Tien Nguyen, and Hoyt Battey of the U.S. Department of Energy, as well as Lynn Billman, Karlynn Cory, David Kline, and Robin Newmark of NREL.

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Key Findings

- The installed **global renewable electricity capacity nearly doubled between 2000 and 2011**, although renewable energy is a relatively small portion of total energy supply both globally and in the United States.

- **Renewable electricity represented nearly 13% of total installed capacity and more than 12% of total electric generation in the United States in 2011**. Installed renewable electricity capacity is more than 146 gigawatts (GW).

- In 2011 in the United States, wind and solar photovoltaics (PV) were two of the fastest growing electric generation technologies. **In 2011, cumulative installed wind capacity increased by nearly 17% and cumulative installed solar photovoltaic capacity grew more than 86% from the previous year**.

Key Findings, *continued*

- Worldwide, wind energy is one of the fastest growing renewable electricity technologies—**between 2000 and 2011, wind electricity generation worldwide increased by a factor of 13**. The United States experienced even more dramatic growth, as installed wind electricity capacity increased by a factor of 18 between 2000 and 2011.

- In the United States, renewable electricity has been capturing a growing percentage of new capacity additions during the past few years. **In 2011, renewable electricity accounted for more than 35% of all new electrical capacity installations in the United States**—a large change from 2004 when all renewable electricity captured only 2% of new capacity additions.

- Since 2006, the United States has been the world's leading ethanol producer. **Between 2000 and 2011, U.S. production of corn ethanol increased by a factor of 8**. The use of ethanol in gasoline blends in the United States has tripled since 2005.

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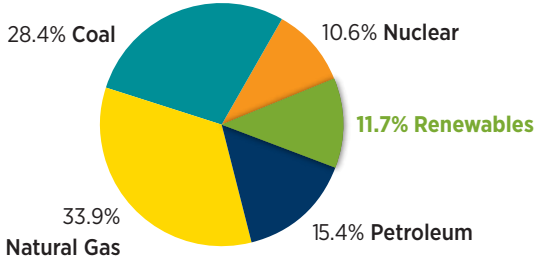
I. U.S. Energy Background Information

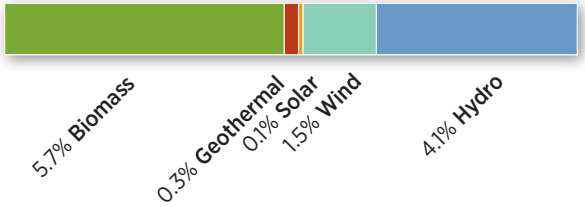
U.S. Energy Production and Consumption (2011)

I

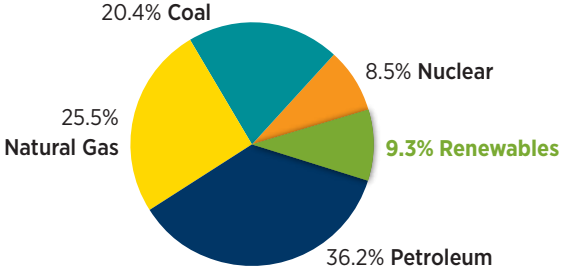
U.S. Energy Production (2011): 78.0 Quadrillion Btu



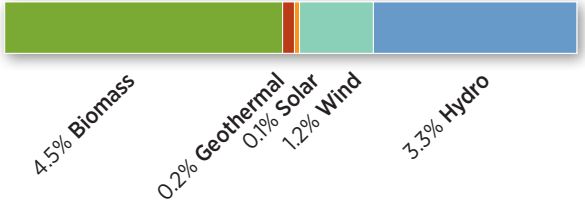
U.S. Renewable Energy Production: 9.2 Quadrillion Btu



U.S. Energy Consumption (2011): 97.5 Quadrillion Btu



U.S. Renewable Energy Consumption: 9.0 Quadrillion Btu



Source: EIA; full references are provided starting on p. 123.

Note: Energy consumption is higher than energy production due to oil imports.

All data reported as primary energy.

U.S. Energy Production by Energy Source (2000–2011)

I

	Coal	Natural Gas*	Petroleum	Nuclear	Renewables	Total Production (Quadrillion Btu)
2000	31.9%	31.2%	17.3%	11.0%	8.6%	71.3
2001	32.8%	31.7%	17.1%	11.2%	7.2%	71.7
2002	32.1%	31.0%	17.2%	11.5%	8.1%	70.7
2003	31.5%	31.4%	17.2%	11.4%	8.5%	70.0
2004	32.6%	30.7%	16.4%	11.7%	8.6%	70.2
2005	33.4%	30.1%	15.8%	11.8%	9.0%	69.4
2006	33.6%	30.2%	15.3%	11.6%	9.3%	70.8
2007	32.9%	31.1%	15.0%	11.8%	9.2%	71.4
2008	32.6%	31.6%	14.4%	11.5%	9.9%	73.1
2009	29.8%	32.6%	15.6%	11.5%	10.5%	72.6
2010	29.5%	32.9%	15.5%	11.3%	10.9%	74.8
2011	28.4%	33.9%	15.4%	10.6%	11.7%	78.0

Source: EIA

* Includes natural gas plant liquids.

Note: Annual totals may not equal 100% due to rounding.

U.S. Energy Consumption by Energy Source (2000–2011)

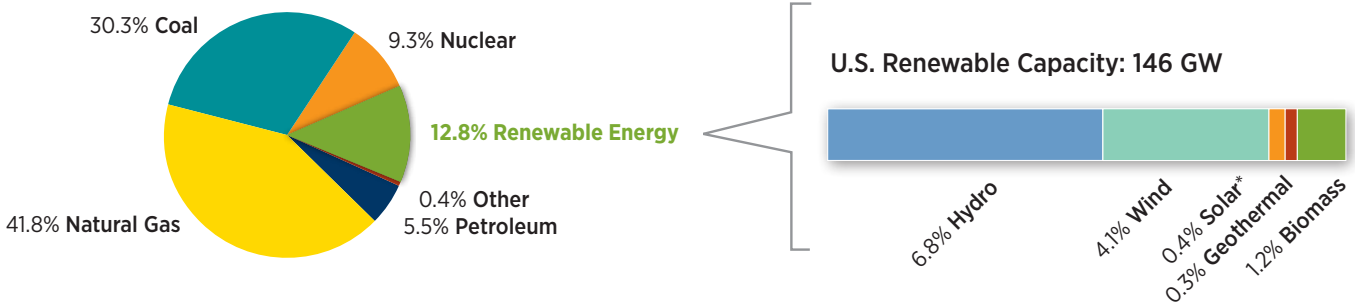
	Coal	Natural Gas	Petroleum	Nuclear	Renewables	Total Consumption (Quadrillion Btu)
2000	22.9%	24.1%	38.7%	8.0%	6.2%	98.7
2001	22.8%	23.7%	39.7%	8.4%	5.4%	96.1
2002	22.4%	24.1%	39.2%	8.3%	5.9%	97.6
2003	22.8%	23.3%	39.6%	8.1%	6.1%	97.9
2004	22.5%	22.9%	40.3%	8.2%	6.1%	100.0
2005	22.7%	22.5%	40.3%	8.1%	6.2%	100.2
2006	22.5%	22.3%	40.1%	8.3%	6.7%	99.6
2007	22.5%	23.4%	39.3%	8.3%	6.5%	101.3
2008	22.5%	24.0%	37.6%	8.5%	7.2%	99.3
2009	20.8%	24.8%	37.4%	8.8%	8.0%	94.5
2010	21.4%	24.8%	36.8%	8.6%	8.3%	97.7
2011	20.4%	25.5%	36.2%	8.5%	9.3%	97.5

Source: EIA

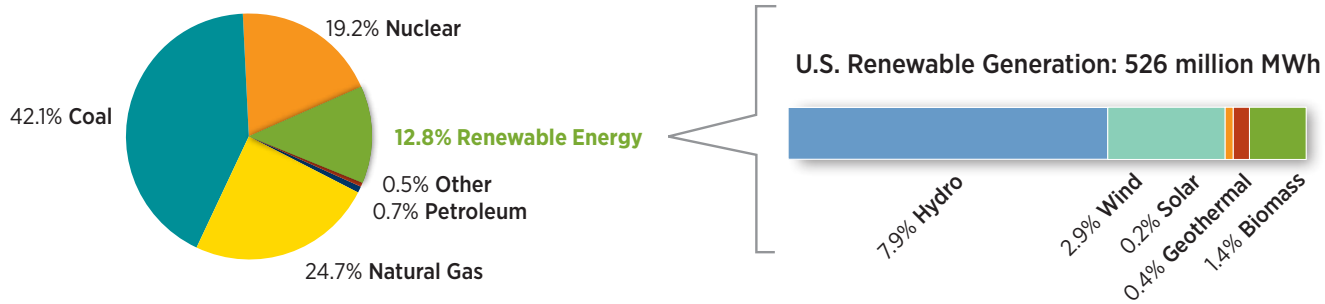
U.S. Electricity Nameplate Capacity and Generation (2011)

I

U.S. Electric Nameplate Capacity (2011): 1,146 GW



U.S. Electric Net Generation (2011): 4,117 million MWh



Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

Other includes: pumped storage, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies.

* On-grid capacity only.

U.S. Electric-Generating Capacity by Source (2000–2011)

I

	Coal	Petroleum	Natural Gas	Other Gases	Nuclear	Renewables	Other	Total Capacity (MW)
2000	39.6%	8.0%	28.6%	0.3%	12.3%	11.0%	0.1%	848,112
2001	37.6%	8.2%	31.6%	0.2%	11.7%	10.6%	0.1%	895,186
2002	35.2%	6.9%	36.7%	0.2%	10.9%	10.0%	0.1%	960,306
2003	33.2%	6.6%	39.9%	0.2%	10.4%	9.6%	0.1%	1,012,402
2004	32.5%	6.3%	41.0%	0.2%	10.2%	9.5%	0.1%	1,030,056
2005	32.1%	6.2%	41.7%	0.2%	10.1%	9.7%	0.1%	1,047,704
2006	31.8%	6.1%	41.9%	0.2%	10.0%	9.9%	0.1%	1,056,289
2007	31.5%	5.8%	42.1%	0.2%	9.9%	10.3%	0.1%	1,066,961
2008	30.5%	5.6%	41.4%	0.2%	9.6%	11.0%	0.1%	1,083,176
2009	30.7%	5.7%	41.7%	0.2%	9.7%	11.9%	0.1%	1,102,335
2010	30.6%	5.6%	41.7%	0.3%	9.5%	12.3%	0.1%	1,120,188
2011	30.3%	5.5%	41.8%	0.3%	9.3%	12.8%	0.1%	1,145,741

Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Electricity Generation by Source (2000–2011)

I

	Coal	Petroleum Liquids	Petroleum Coke	Natural Gas	Other Gases	Nuclear	Renewables	Other	Total Generation (million kWh)
2000	51.6%	2.7%	0.2%	15.8%	0.4%	19.8%	9.4%	0.1%	3,807,955
2001	50.8%	3.1%	0.3%	17.1%	0.2%	20.5%	7.7%	0.3%	3,745,745
2002	50.0%	2.0%	0.4%	17.9%	0.3%	20.2%	8.9%	0.4%	3,867,498
2003	50.7%	2.6%	0.4%	16.7%	0.4%	19.6%	9.1%	0.4%	3,892,115
2004	49.7%	2.5%	0.5%	17.8%	0.4%	19.8%	8.8%	0.4%	3,979,023
2005	49.5%	2.5%	0.6%	18.7%	0.3%	19.2%	8.8%	0.3%	4,062,458
2006	48.9%	1.1%	0.5%	20.1%	0.3%	19.3%	9.5%	0.3%	4,071,962
2007	48.4%	1.2%	0.4%	21.5%	0.3%	19.4%	8.5%	0.3%	4,164,748
2008	48.1%	0.8%	0.3%	21.4%	0.3%	19.5%	9.3%	0.3%	4,127,019
2009	44.4%	0.7%	0.3%	23.3%	0.3%	20.2%	10.6%	0.3%	3,956,989
2010	44.7%	0.6%	0.3%	23.9%	0.3%	19.5%	10.4%	0.3%	4,133,852
2011	42.1%	0.4%	0.3%	24.7%	0.3%	19.2%	12.8%	0.3%	4,117,287

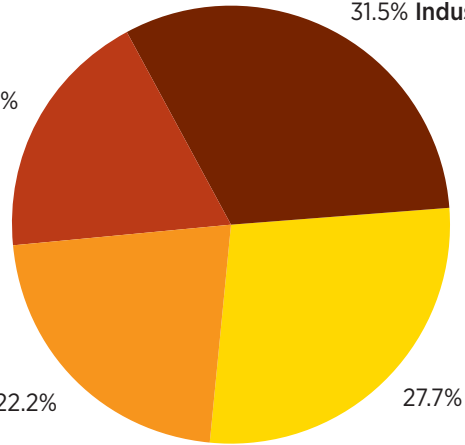
Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Energy Consumption by Sector (2011)

I

U.S. Energy Consumption in 2011 was 97.5 Quadrillion Btu

U.S. buildings represent 40.8% of energy use.

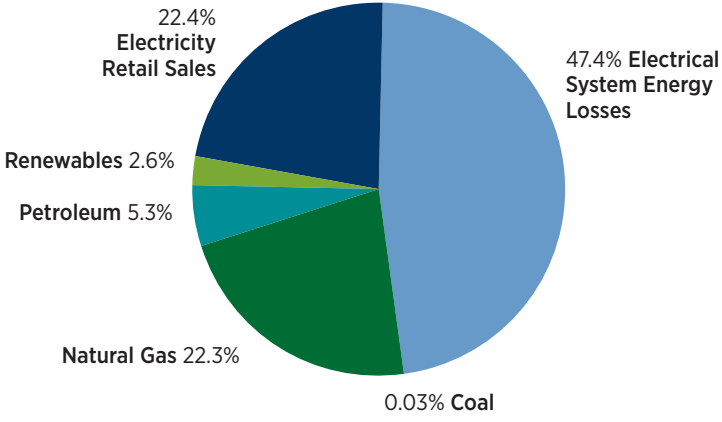


Source: EIA

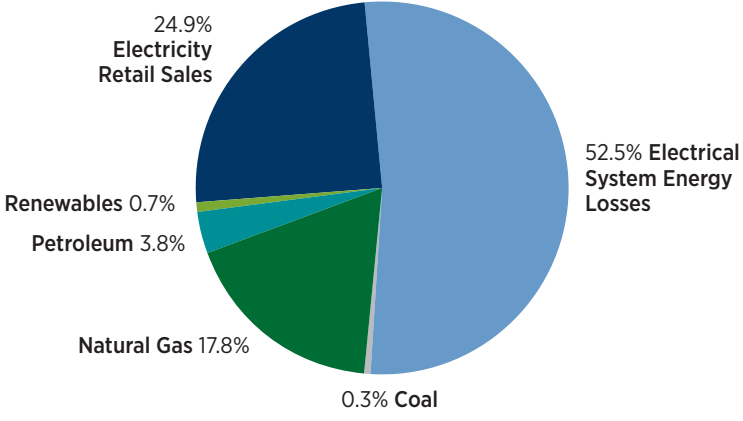
U.S. Energy Consumption – Residential and Commercial (2011)

I

Residential Energy Consumption
(21.7 Quadrillion Btu) – 2011



Commercial Energy Consumption
(18.1 Quadrillion Btu) – 2011

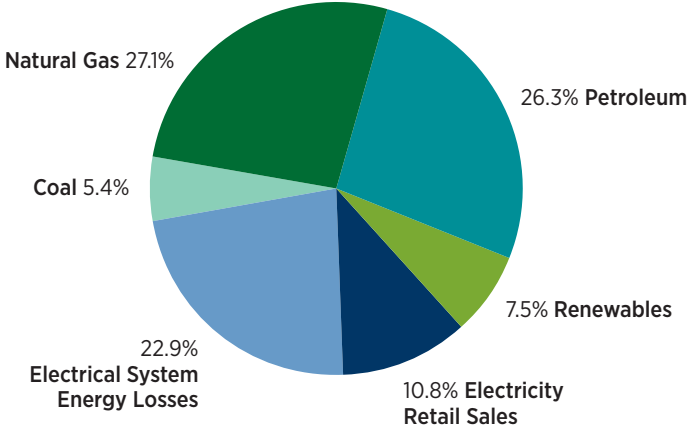


Source: EIA

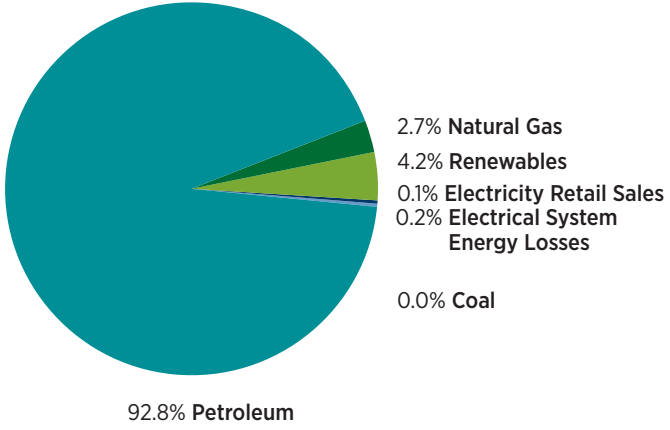
U.S. Energy Consumption – Industrial and Transportation (2011)

I

Industrial Energy Consumption
(30.7 Quadrillion Btu) – 2011



Transportation Energy Consumption
(27.1 Quadrillion Btu) – 2011



Source: EIA

II. Renewable Electricity in the United States

Renewable Electricity in the United States: Summary

- Since 2000, renewable electricity installations in the United States have more than tripled, and in 2011 represent **146 GW of installed U.S. capacity**.

- Installed renewable electricity capacity has grown at a compounded annual average of nearly **4.2% per year from 2000–2011**.

- U.S. renewable electricity in 2011 is 12.8% of total overall installed electricity capacity and 12.8 % of total annual generation in the United States.

- Wind and solar photovoltaics are the fastest growing renewable electricity sectors. **In 2011 in the United States, wind installed capacity increased by nearly 17% and solar photovoltaic installed capacity grew more than 86% from the previous year**.

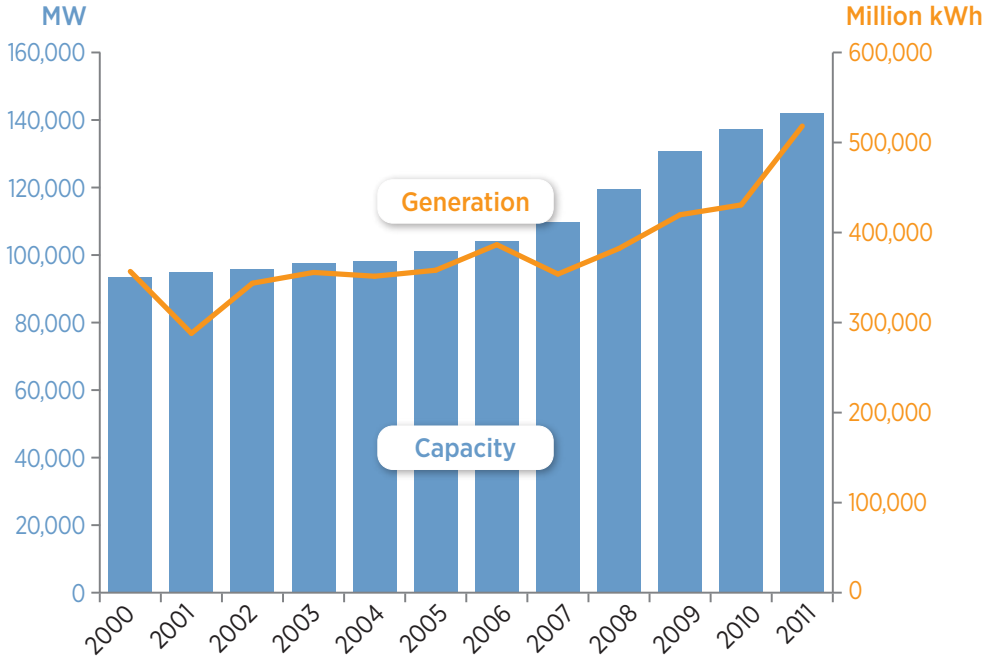
II

- In 2011 **in the United States, biomass** produced about **11% of total renewable electricity generation**, **wind produced 23%**, **solar** (photovoltaics and concentrating solar power) **produced 1%**, **hydropower produced 62%**, and **geothermal produced 3%.**

- **Wind energy** accounted for about **75% of newly installed U.S. renewable electricity capacity** in 2011.

- Electricity generation from biomass, geothermal, and hydropower have remained relatively stable since 2000.

U.S. Capacity and Generation: All Renewables

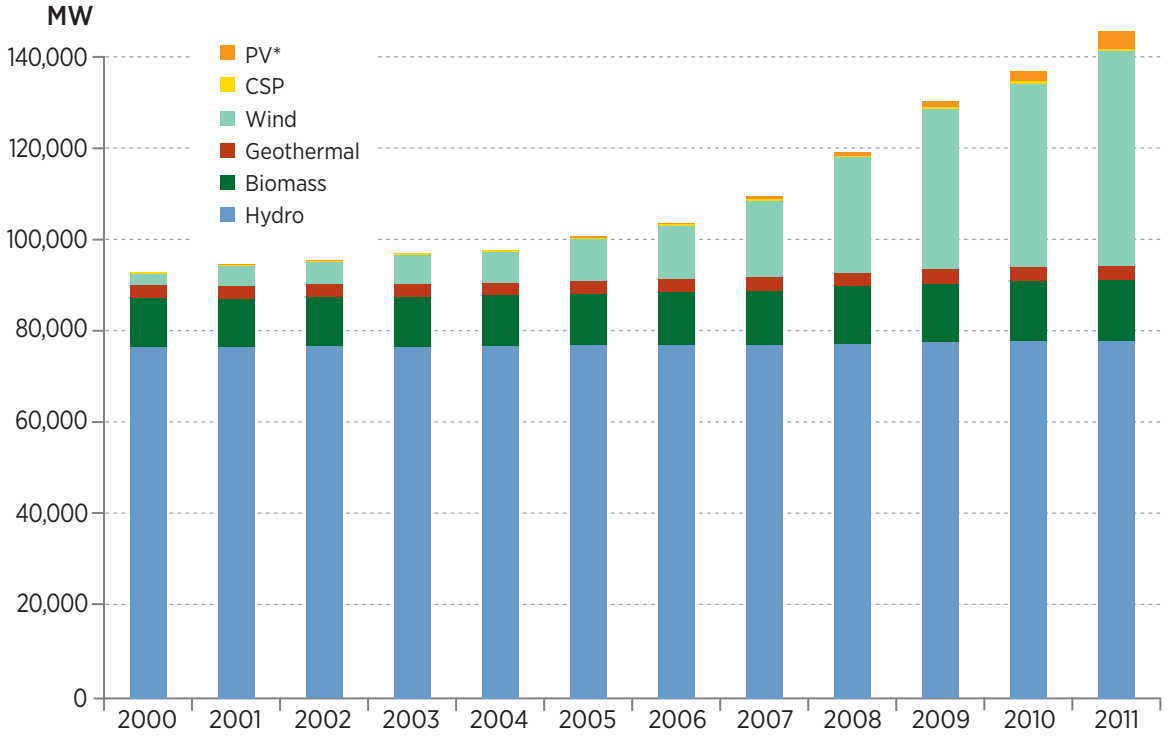


	Total Nameplate Capacity (MW)	Total Generation (Million kWh)
2000	93,370	356,789
2001	94,943	288,009
2002	95,804	343,740
2003	97,478	355,686
2004	98,195	351,465
2005	101,113	358,129
2006	104,072	386,474
2007	109,845	353,854
2008	119,639	382,276
2009	130,677	419,755
2010	137,286	430,668
2011	146,142	525,707

Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Renewable Electricity Generating Capacity by Source

II



Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

* Includes on-grid capacity only.

U.S. Renewable Electricity Nameplate Capacity Added (MW)

	Solar PV	CSP	Wind	Geothermal	Biomass	Hydro	Total Capacity Added	Capacity Added as a % of Total Renewable Energy
2001	11	0	1,697	0	(100)	(35)	**1,573**	2%
2002	23	0	411	0	291	136	**861**	1%
2003	45	0	1,667	0	(11)	(27)	**1,674**	2%
2004	58	0	372	0	177	110	**717**	1%
2005	79	0	2,396	30	189	224	**2,918**	3%
2006	105	1	2,454	3	331	65	**2,959**	3%
2007	169	64	5,237	106	185	13	**5,773**	5%
2008	311	(0)	8,425	104	747	208	**9,794**	8%
2009	438	11	9,922	46	351	270	**11,038**	8%
2010	896	78	5,108	15	218	294	**6,608**	5%
2011	1,858	9	6,816	86	222	33	**9,024**	6%

- annual decrease | annual increase +

Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Renewable Electricity Nameplate Capacity (MW) and Percent Cumulative Increase from Previous Year

II

	Hydro	Solar PV*	CSP	Wind	Geothermal	Biomass	Total Renewables
2001	**76,911** (0%)	**29** (62.4%)	**354** (0%)	**4,275** (65.8%)	**2,798** (0%)	**10,576** (-0.9%)	**94,943** (1.7%)
2002	**77,047** (0.2%)	**52** (76.9%)	**354** (0%)	**4,686** (9.6%)	**2,798** (0%)	**10,867** (2.8%)	**95,804** (0.9%)
2003	**77,020** (0%)	**97** (87.3%)	**354** (0%)	**6,353** (35.6%)	**2,798** (0%)	**10,856** (-0.1%)	**97,478** (1.7%)
2004	**77,130** (0.1%)	**155** (59.2%)	**354** (0%)	**6,725** (5.9%)	**2,798** (0%)	**11,033** (1.6%)	**98,195** (0.7%)
2005	**77,354** (0.3%)	**234** (51.0%)	**354** (0%)	**9,121** (35.6%)	**2,828** (1.1%)	**11,222** (1.7%)	**101,113** (3.0%)
2006	**77,419** (0.1%)	**339** (44.7%)	**355** (0.3%)	**11,575** (26.9%)	**2,831** (0.1%)	**11,553** (2.9%)	**104,072** (2.9%)
2007	**77,432** (0%)	**508** (49.8%)	**419** (18%)	**16,812** (45.2%)	**2,937** (3.7%)	**11,738** (1.6%)	**109,845** (5.5%)
2008	**77,640** (0.3%)	**819** (61.2%)	**419** (0%)	**25,237** (50.1%)	**3,040** (3.5%)	**12,485** (6.4%)	**119,639** (8.9%)
2009	**77,910** (0.3%)	**1,257** (53.5%)	**430** (2.6%)	**35,159** (39.3%)	**3,086** (1.5%)	**12,836** (2.8%)	**130,677** (9.2%)
2010	**78,204** (0.4%)	**2,153** (71.3%)	**507** (18.0%)	**40,267** (14.5%)	**3,101** (0.5%)	**13,053** (1.7%)	**137,286** (5.1%)
2011	**78,237** (0%)	**4,011** (86.3%)	**516** (1.7%)	**46,916** (16.5%)	**3,187** (2.8%)	**13,276** (1.7%)	**146,142** (6.5%)

- annual decrease | annual increase +

Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

* Includes on- and off-grid capacity.

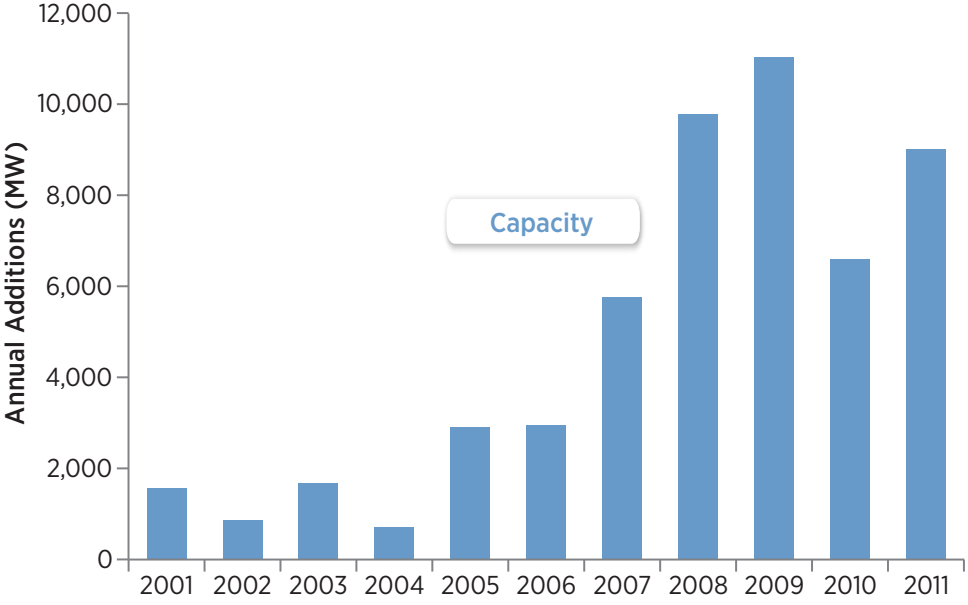
U.S. Renewable Electricity Capacity as a Percent of Total Electricity Generating Capacity

	Hydro	Solar PV	CSP	Wind	Geothermal	Biomass	All Renewables
2000	9.1%	0.0%	0.0%	0.3%	0.3%	1.3%	11.0%
2001	8.6%	0.0%	0.0%	0.5%	0.3%	1.2%	10.6%
2002	8.0%	0.0%	0.0%	0.5%	0.3%	1.1%	10.0%
2003	7.6%	0.0%	0.0%	0.6%	0.3%	1.1%	9.6%
2004	7.5%	0.0%	0.0%	0.7%	0.3%	1.1%	9.5%
2005	7.4%	0.0%	0.0%	0.9%	0.3%	1.1%	9.7%
2006	7.3%	0.0%	0.0%	1.1%	0.3%	1.1%	9.9%
2007	7.3%	0.0%	0.0%	1.6%	0.3%	1.1%	10.3%
2008	7.2%	0.1%	0.0%	2.3%	0.3%	1.2%	11.0%
2009	7.1%	0.1%	0.0%	3.2%	0.3%	1.2%	11.9%
2010	7.0%	0.2%	0.0%	3.6%	0.3%	1.2%	12.3%
2011	6.8%	0.4%	0.0%	4.1%	0.3%	1.2%	12.8%

Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Annual Installed Renewable Electric Capacity Growth

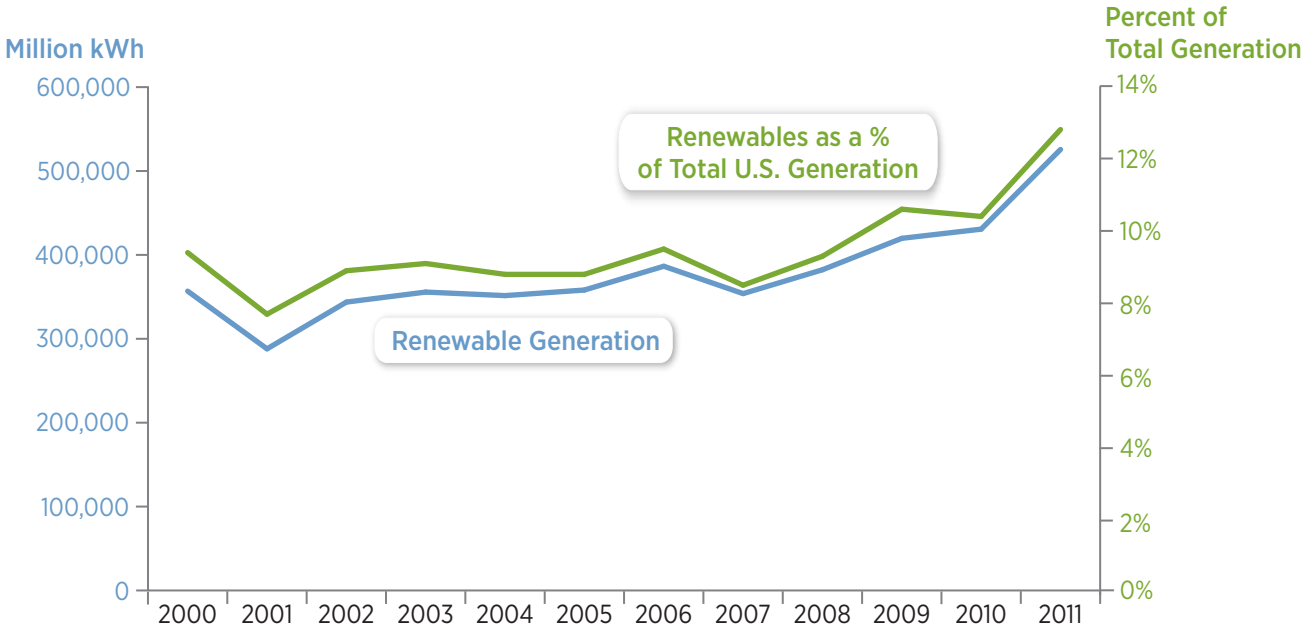
II



	Compounded Annual Growth Rate (2000–2011)
Wind	30.2%
Solar PV	63.4%
CSP	3.5%
Biomass	2.0%
Geothermal	1.2%
Hydro	0.2%
All Renewables	4.2%

Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

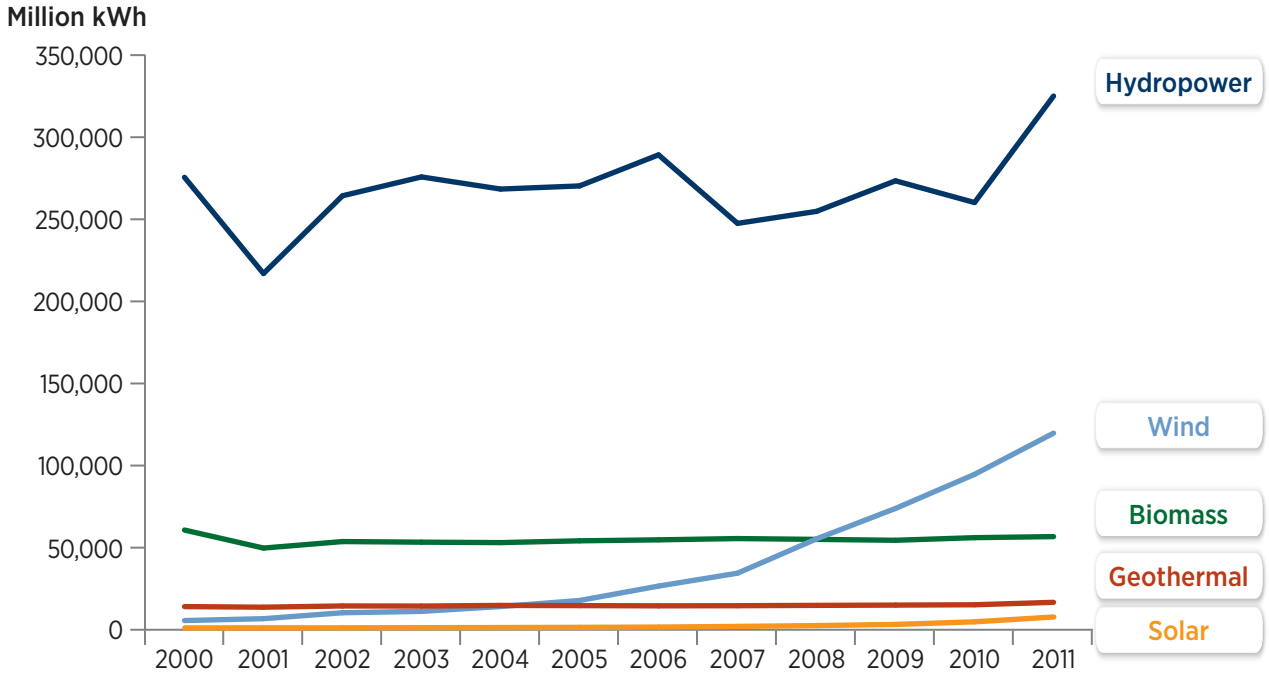
U.S. Renewable Electricity Generation



Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Renewable Electricity Generation by Technology

II



Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Renewable Electricity Generation as a Percent of Total U.S. Generation

II

	Hydro	Solar	Wind	Geothermal	Biomass	All Renewables
2000	7.2%	0.0%	0.1%	0.4%	1.6%	9.4%
2001	5.8%	0.0%	0.2%	0.4%	1.3%	7.7%
2002	6.8%	0.0%	0.3%	0.4%	1.4%	8.9%
2003	7.1%	0.0%	0.3%	0.4%	1.4%	9.1%
2004	6.7%	0.0%	0.4%	0.4%	1.3%	8.8%
2005	6.7%	0.0%	0.4%	0.4%	1.3%	8.8%
2006	7.1%	0.0%	0.7%	0.4%	1.3%	9.5%
2007	5.9%	0.0%	0.8%	0.4%	1.3%	8.5%
2008	6.2%	0.1%	1.3%	0.4%	1.3%	9.3%
2009	6.9%	0.1%	1.9%	0.4%	1.4%	10.6%
2010	6.3%	0.1%	2.3%	0.4%	1.4%	10.4%
2011	7.9%	0.2%	2.9%	0.4%	1.4%	12.8%

Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

U.S. Renewable Electricity Generation (Million kWh) and Percent Cumulative Increase from Previous Year

III

	Hydropower	Solar	Wind	Geothermal	Biomass	All Renewables
2000	**275,573** (-13.8%)	**804** (8.3%)	**5,593** (24.6%)	**14,093** (-5.0%)	**60,726** (1.9%)	**356,789** (-10.6%)
2001	**216,961** (-21.3%)	**822** (2.2%)	**6,737** (20.5%)	**13,741** (-2.5%)	**49,748** (-18.1%)	**288,009** (-19.3%)
2002	**264,329** (21.8%)	**857** (4.3%)	**10,354** (53.7%)	**14,491** (5.5%)	**53,709** (8.0%)	**343,740** (19.4%)
2003	**275,806** (4.3%)	**929** (8.4%)	**11,187** 8.0%	**14,424** (-0.5%)	**53,340** (-0.7%)	**355,686** (3.5%)
2004	**268,417** (-2.7%)	**1,020** (9.8%)	**14,144** (26.4%)	**14,811** (2.7%)	**53,073** (-0.5%)	**351,465** (-1.2%)
2005	**270,321** (0.7%)	**1,145** (12.2%)	**17,811** (25.9%)	**14,692** (-0.8%)	**54,160** (2.0%)	**358,129** (1.9%)
2006	**289,246** (7.0%)	**1,312** (14.6%)	**26,589** (49.3%)	**14,568** (-0.8%)	**54,759** (1.1%)	**386,474** (7.9%)
2007	**247,510** (-14.4%)	**1,718** (31.0%)	**34,450** (29.6%)	**14,637** (0.5%)	**55,539** (1.4%)	**353,854** (-8.4%)
2008	**254,831** (3.0%)	**2,208** (28.5%)	**55,363** (60.7%)	**14,840** (1.4%)	**55,034** (-0.9%)	**382,276** (8.0%)
2009	**273,455** (7.3%)	**2,922** (32.4%)	**73,886** (33.5%)	**15,009** (1.1%)	**54,493** (-1.0%)	**419,755** (9.8%)
2010	**260,203** (-4.8%)	4,505 (54.2%)	**94,652** (28.1%)	**15,219** (1.4%)	**56,089** (2.9%)	**430,668** (2.6%)
2011	**325,074** (24.9%)	7,454 (65.5%)	**119,747** (26.5%)	**16,700** (9.7%)	**56,732** (1.1%)	**525,707** (22.1%)

- annual decrease | annual increase +

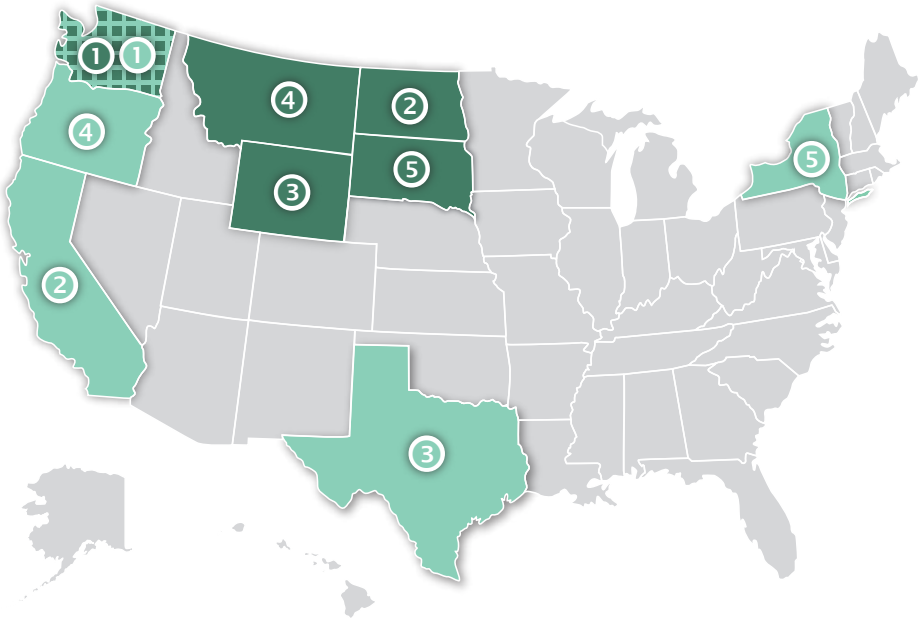
Sources: EIA, GEA, LBNL, SEIA/GTM, Larry Sherwood/IREC

State Renewable Energy Information: Summary

- In 2011, **Washington had the most installed renewable electric capacity** of any U.S. state (23,970 MW).
- In 2008, **Texas became the national leader** in wind power development, and in 2011 has more than 10 GW of wind capacity installed.
- California installed 921 MW of wind and 538 MW of solar capacity in 2011, the most of any state.
- A combination of **state incentives and renewable portfolio standards** for renewable electricity and renewable resource development has driven renewable growth in many states. Some wind development was driven by economics in select locations

Top States for Renewable Electricity Installed Capacity (2011)

II

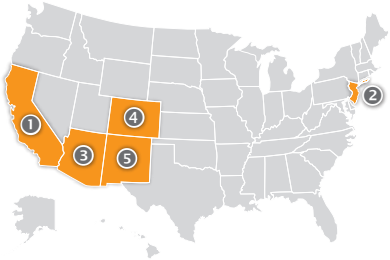


Total Renewables
1 Washington
2 California
3 Texas
4 Oregon
5 New York

Per Capita Renewables
1 Washington
2 North Dakota
3 Wyoming
4 Montana
5 South Dakota

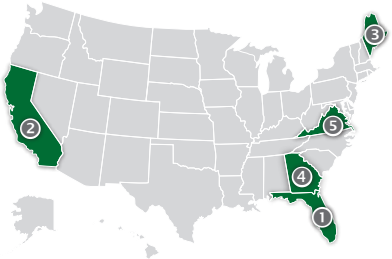
Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC, U.S. Census

Top States for Renewable Electricity Installed Capacity (2011)

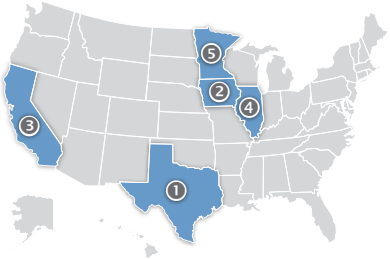


Solar PV	
1	California
2	New Jersey
3	Arizona
4	Colorado
5	New Mexico

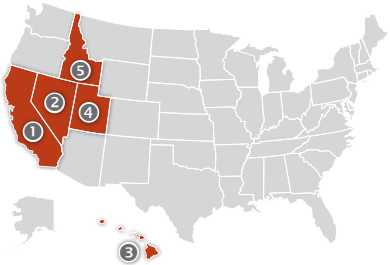
CSP	
1	California
2	Florida
3	Nevada
4	New Mexico
5	Arizona



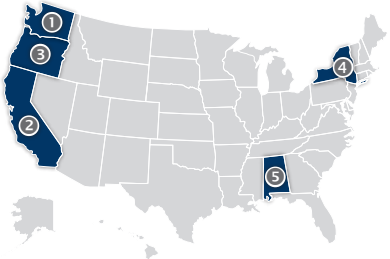
Biomass	
1	Florida
2	California
3	Maine
4	Georgia
5	Virginia



Wind	
1	Texas
2	Iowa
3	California
4	Illinois
5	Minnesota



Geothermal	
1	California
2	Nevada
3	Hawaii
4	Utah
5	Idaho



Hydropower	
1	Washington
2	California
3	Oregon
4	New York
5	Alabama

Sources: EIA, LBNL, GEA, Larry Sherwood/IREC, SEIA/GTM

Renewable Electricity Installed Capacity (MW) (2011)
NORTHEAST

II

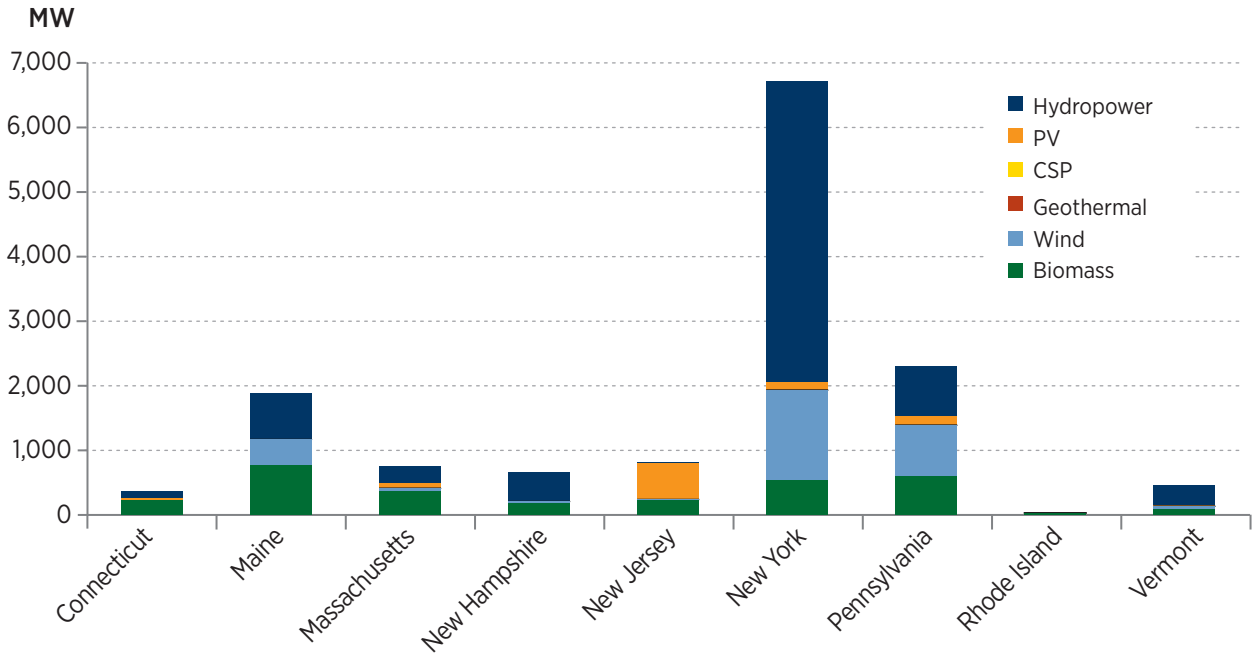
	Wind	PV*	CSP	Geothermal	Biomass	Hydropower	Total Renewables	Per capita RE watts/person
New York	1,403	123.8	0	0	529	4,657	**6,713**	**345**
Pennsylvania	789	133.1	0	0	600	778	**2,300**	**180**
Maine	397	1.1	0	0	771	726	**1,895**	**1,427**
New Jersey	8	565.9	0	0	231	13	**818**	**93**
Massachusetts	47	74.6	0	0	365	272	**759**	**115**
New Hampshire	26	3.1	0	0	182	446	**657**	**498**
Vermont	46	11.7	0	0	88	315	**461**	**736**
Connecticut	0	31.1	0	0	221	119	**371**	**103**
Rhode Island	2	1.2	0	0	26	3	**32**	**31**

Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC, U.S. Census

* Does not include off-grid installations

Renewable Electricity Installed Capacity (2011)
NORTHEAST

II



Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC

Renewable Electricity Installed Capacity (MW) (2011)
MIDWEST

II

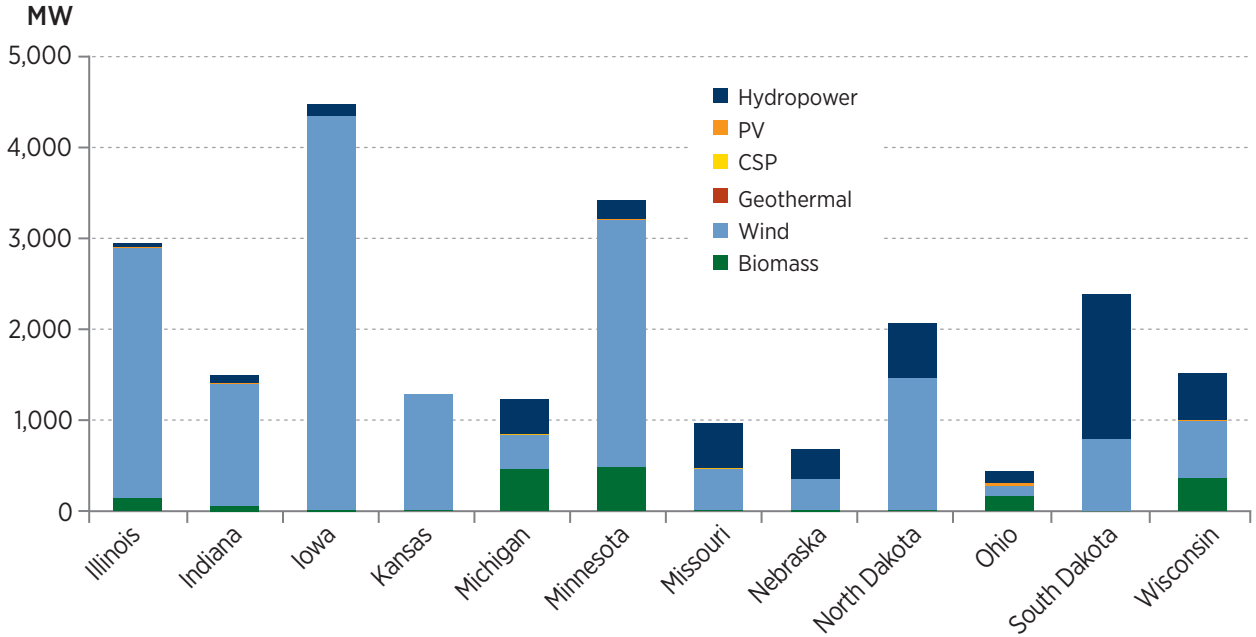
	Wind	PV*	CSP	Geothermal	Biomass	Hydropower	Total Renewables	Per Capita RE Watts/Person
Iowa	4,322	0.1	0	0	15	131	**4,468**	**1,459**
Minnesota	2,718	4.8	0	0	477	213	**3,413**	**639**
Illinois	2,742	16.2	0	0	142	40	**2,940**	**228**
South Dakota	784	0	0	0	0	1,598	**2,382**	**2,891**
North Dakota	1,445	0	0	0	10	614	**2,068**	**3,024**
Wisconsin	631	12.9	0	0	356	518	**1,518**	**266**
Indiana	1,340	3.5	0	0	56	92	**1,492**	**229**
Kansas	1,274	0.2	0	0	7	3	**1,284**	**447**
Michigan	377	8.8	0	0	460	383	**1,229**	**124**
Missouri	459	2.0	0	0	8	499	**968**	**161**
Nebraska	337	0.3	0	0	11	332	**681**	**370**
Ohio	112	31.6	0	0	163	128	**435**	**38**

Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC, U.S. Census

* Does not include off-grid installations

Renewable Electricity Installed Capacity (2011)
MIDWEST

II



Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC

Renewable Electricity Installed Capacity (MW) (2011)
SOUTH

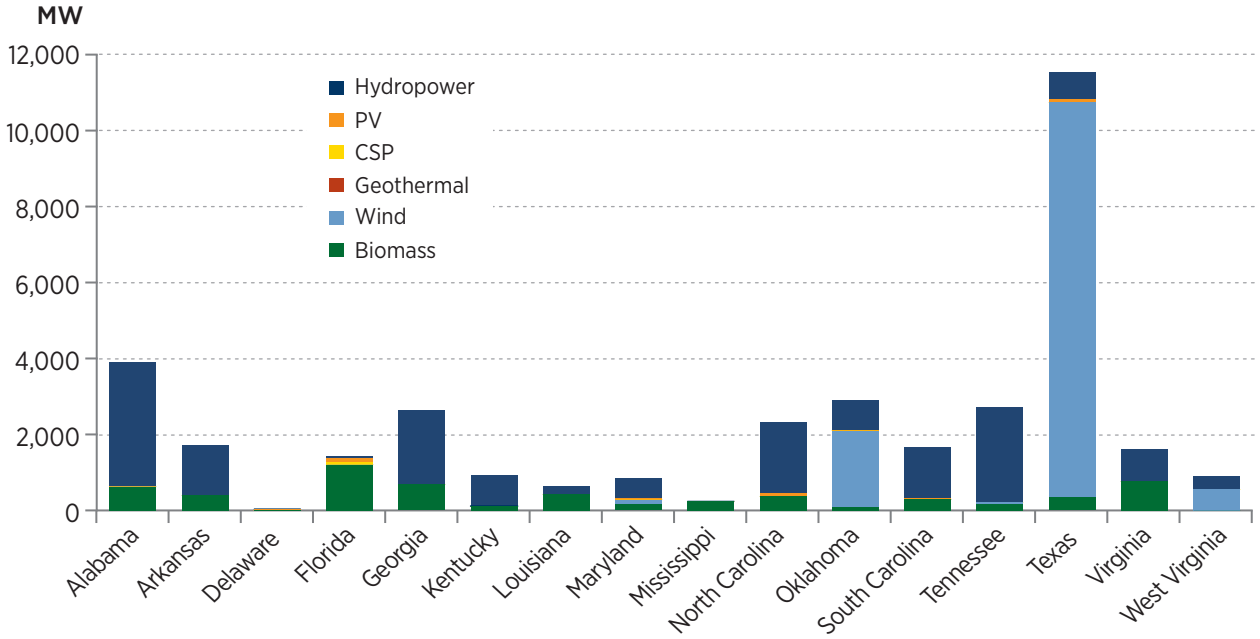
II

	Wind	PV*	CSP	Geothermal	Biomass	Hydropower	Total Renewables	Per Capita RE Watts/Person
Texas	10,394	85.6	0	0	345	698	**11,523**	**449**
Alabama	0	0.5	0	0	636	3,280	**3,916**	**815**
Oklahoma	2,007	0.2	0	0	85	805	**2,897**	**764**
Tennessee	29	22.0	0	0	202	2,499	**2,752**	**430**
Georgia	0	6.9	0	0	698	1,932	**2,637**	**269**
North Carolina	0	85.5	0	0	590	1,848	**2,523**	**261**
Arkansas	0	1.1	0	0	399	1,321	**1,721**	**586**
South Carolina	0	4.1	0	0	337	1,363	**1,704**	**364**
Virginia	0	4.5	0	0	681	832	**1,518**	**187**
Florida	0	95.0	75	0	1,254	56	**1,480**	**78**
Kentucky	0	3.3	0	0	110	804	**917**	**210**
West Virginia	564	0.6	0	0	2	325	**892**	**480**
Maryland	120	37.1	0	0	161	527	**845**	**145**
Louisiana	0	13.4	0	0	366	192	**572**	**125**
Mississippi	0	0.6	0	0	244	0	**245**	**82**
Delaware	2	26.5	0	0	8	0	**37**	**40**

Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC, U.S. Census

* Does not include off-grid installations

Renewable Electricity Installed Capacity (2011)
SOUTH



Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC

Renewable Electricity Installed Capacity (MW) (2011)
WEST

II

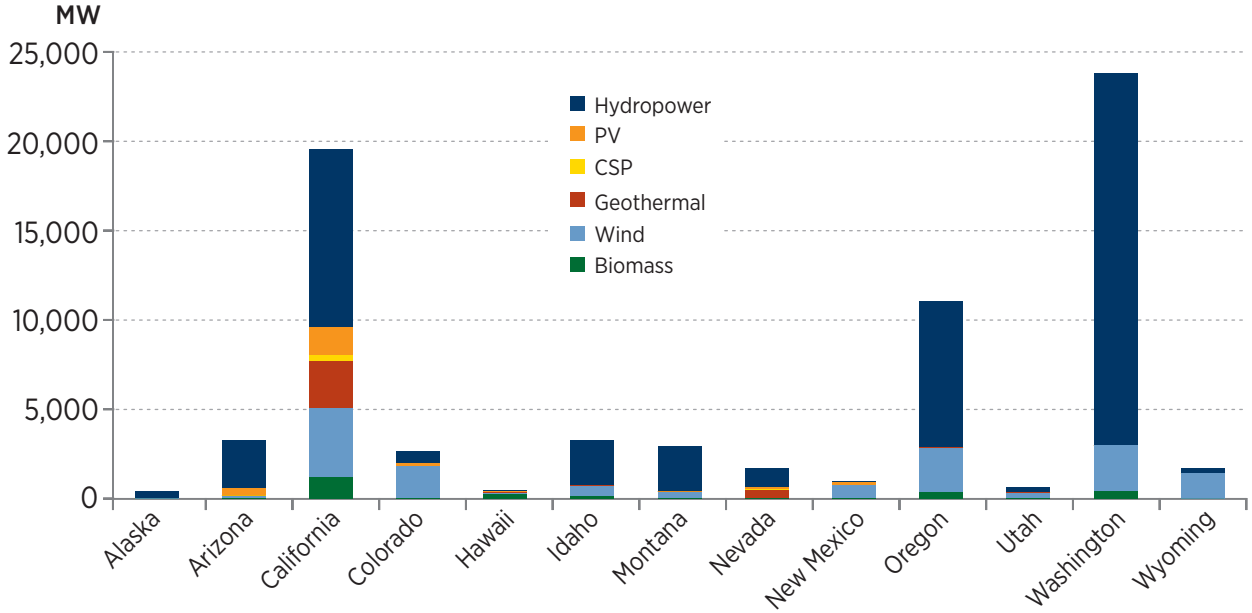
	Wind	PV*	CSP	Geothermal	Biomass	Hydropower	Total Renewables	Per Capita RE Watts/Person
Washington	2,573	12.3	0	0	431	20,954	**23,970**	**3,510**
California	3,917	1,563.6	365	2,615.4	1,199	10,046	**19,706**	**523**
Oregon	2,513	35.8	0	0.3	359	8,245	**11,153**	**2,881**
Idaho	618	0.4	0	15.8	137	2,540	**3,311**	**2,089**
Arizona	139	397.6	5	0	35	2,718	**3,295**	**508**
Montana	386	0.7	0	0	16	2,583	**2,985**	**2,990**
Colorado	1,805	196.7	2	0	18	645	**2,667**	**521**
Wyoming	1,412	0.2	0	0.3	0	303	**1,716**	**3,021**
Nevada	0	124.1	64	469.0	3	1,052	**1,713**	**629**
New Mexico	750	165.5	6	0	7	82	**1,010**	**485**
Utah	325	4.4	0	42.0	10	262	**643**	**228**
Hawaii	92	85.2	1	43.0	227	25	**472**	**344**
Alaska	11	0	0	0.7	0	420	**432**	**598**

Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC, U.S. Census

* Does not include off-grid installations

Renewable Electricity Installed Capacity (2011)
WEST

II



Sources: EIA, LBNL, GEA, SEIA/GTM, Larry Sherwood/IREC

III. Global Renewable Energy Development

Global Renewable Energy Development: Summary

III

- Cumulative global renewable electricity installed capacity has **grown by 72%** from 2000–2011 (from 748 GW to 1,285 GW).

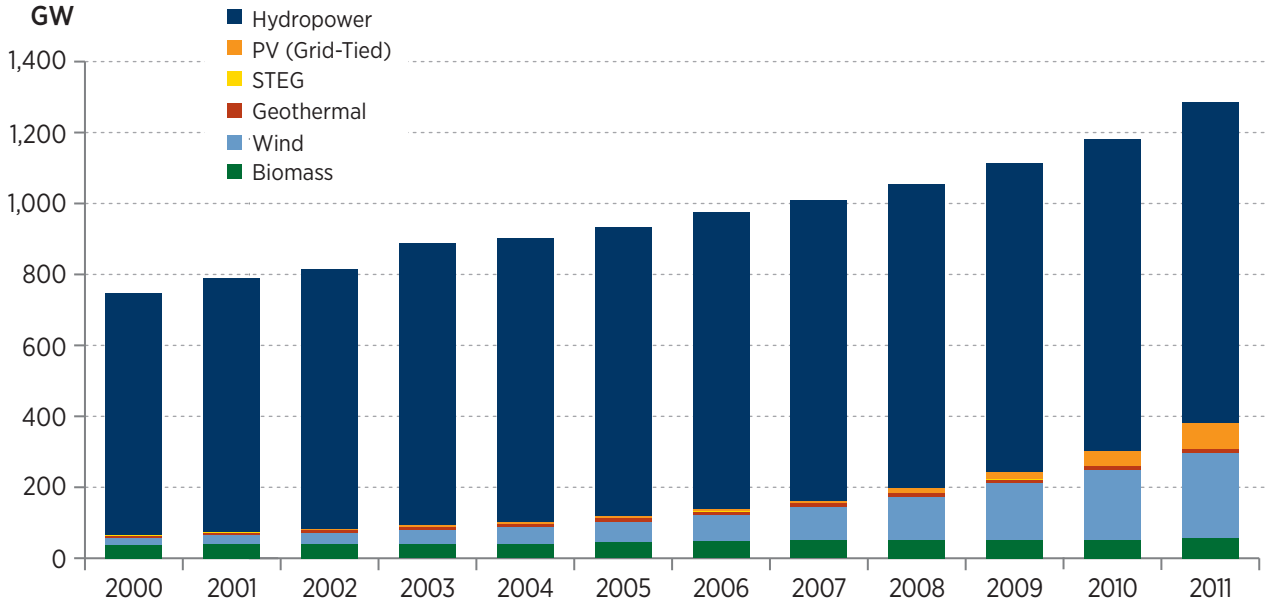
- Renewable energy accounts for **22%** of all global electricity generation (4,309 TWh).

- Wind and solar energy are the fastest growing renewable electricity technologies worldwide. Wind generation grew by a factor of 13 and solar photovoltaic generation **grew by a factor of more than 51** between 2000 and 2011.

- In 2011, Germany led the world in cumulative solar photovoltaic installed capacity. The United States leads the world in geothermal and biomass installed capacity. China leads in wind, and Spain leads in solar thermal electric generation (STEG).

Worldwide Renewable Electricity Capacity

III



Sources: EIA, Bloomberg New Energy Finance

World Renewable Cumulative Electricity Capacity Percent Increase from the Previous Year

	Hydro	Solar PV	STEG	Wind	Geothermal	Biomass	All Renewables
2000	0%	22%	0%	31%	0%	6%	1%
2001	5%	29%	0%	33%	0%	8%	6%
2002	2%	33%	0%	29%	2%	0%	3%
2003	9%	25%	0%	29%	9%	-3%	9%
2004	1%	33%	0%	20%	0%	0%	1%
2005	2%	38%	0%	23%	4%	13%	4%
2006	2%	32%	0%	25%	3%	7%	4%
2007	1%	5%	5%	27%	0%	6%	4%
2008	1%	71%	14%	29%	4%	4%	5%
2009	1%	62%	22%	31%	7%	4%	5%
2010	1%	90%	83%	24%	3%	15%	6%
2011	3%	79%	43%	22%	1%	11%	9%

- annual decrease | annual increase +

Sources: EIA, Bloomberg New Energy Finance

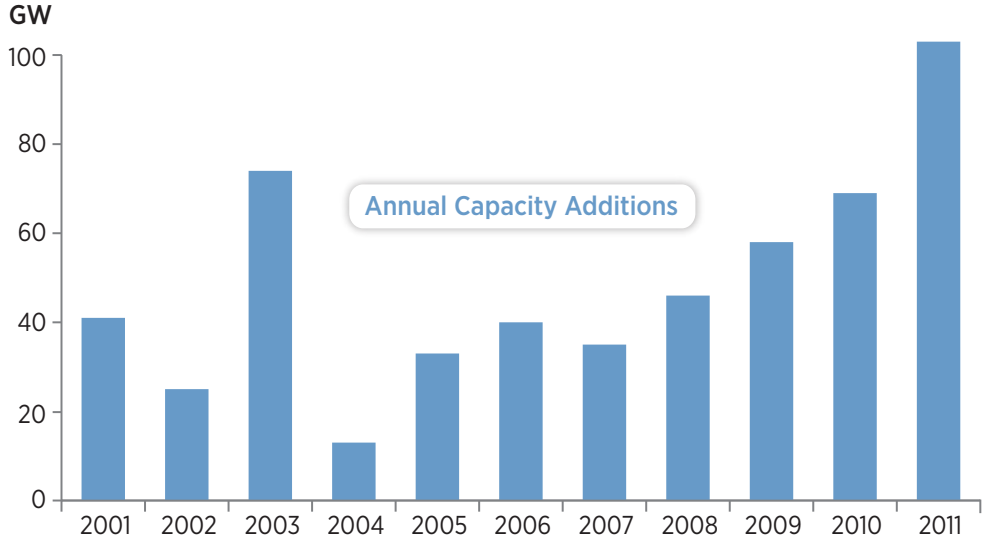
Renewable Electricity as a Percent of Total Installed Electricity Capacity Worldwide

III

	Hydro	Solar PV	STEG	Wind	Geothermal	Biomass	All Renewables	Renewable Capacity (GW)
2000	19.8%	0.0%	0.0%	0.5%	0.2%	1.1%	21.6%	748
2001	20.1%	0.1%	0.0%	0.7%	0.2%	1.1%	22.2%	789
2002	19.8%	0.1%	0.0%	0.8%	0.2%	1.1%	22.0%	814
2003	20.8%	0.1%	0.0%	1.0%	0.2%	1.0%	23.1%	888
2004	20.2%	0.1%	0.0%	1.2%	0.2%	1.0%	22.7%	901
2005	19.8%	0.1%	0.0%	1.4%	0.2%	1.1%	22.7%	934
2006	19.5%	0.2%	0.0%	1.7%	0.2%	1.1%	22.7%	974
2007	19.0%	0.2%	0.0%	2.1%	0.2%	1.1%	22.6%	1,009
2008	18.6%	0.3%	0.0%	2.6%	0.2%	1.1%	22.8%	1,055
2009	18.1%	0.4%	0.0%	3.3%	0.2%	1.1%	23.1%	1,113
2010	17.6%	0.8%	0.0%	3.9%	0.2%	1.0%	23.6%	1,182
2011	17.4%	1.4%	0.0%	4.6%	0.2%	1.1%	24.8%	1,285

Sources: EIA, Bloomberg New Energy Finance

Worldwide Annual Installed Renewable Electricity Growth

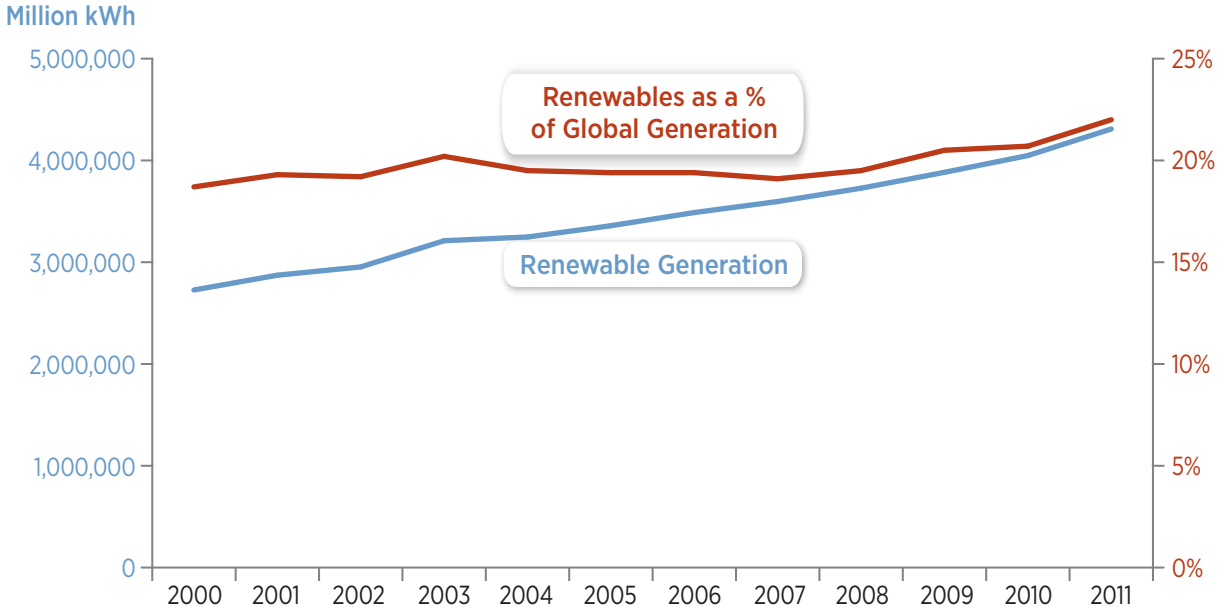


	Compounded Annual Growth Rate (2000–2011)
Wind	26.5%
PV (Grid-Tied)	43.0%
STEG	12.9%
Geothermal	3.1%
Biomass	4.1%
Hydro	2.6%
All Renewables	5.0%

Sources: EIA, Bloomberg New Energy Finance

Worldwide Renewable Electricity Generation

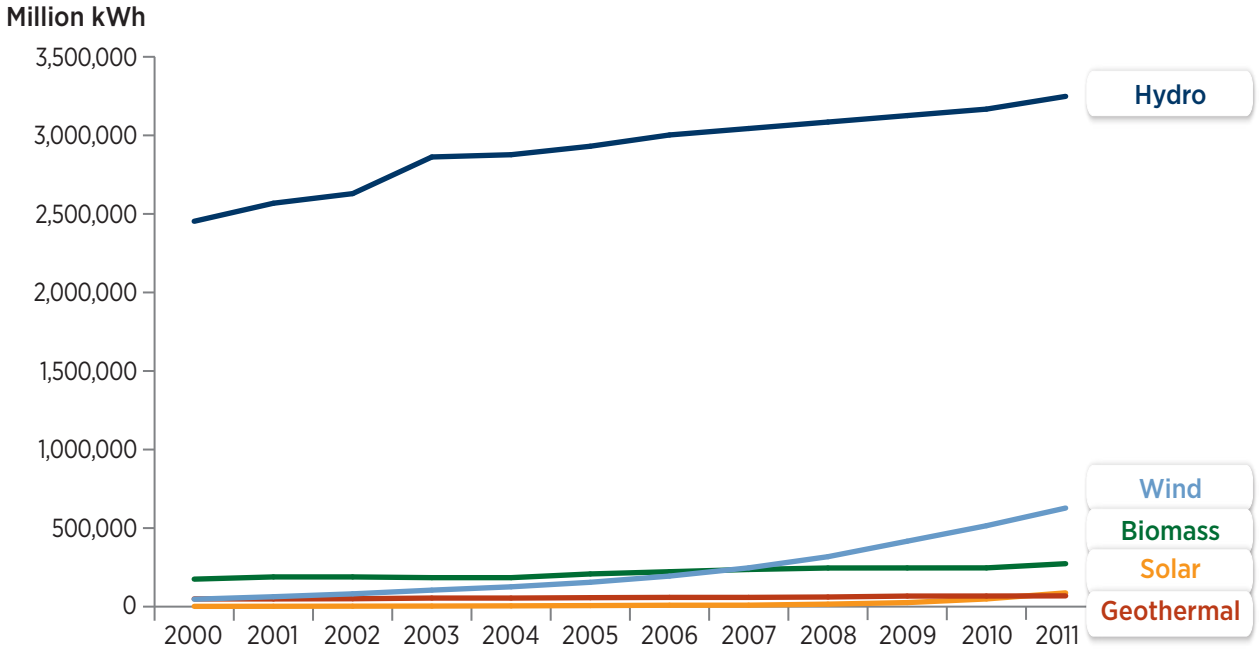
III



Generation derived using capacity factors of 14% for PV, 30% for wind, 70% for geothermal, 54% for biomass, 25% for CSP, and 41% for hydro.

Sources: EIA, Bloomberg New Energy Finance

Worldwide Renewable Electricity Generation by Technology (2000–2011)



Generation derived using capacity factors of 14% for PV, 30% of wind, 70% for geothermal, 54% for biomass, 25% for CSP, and 41% for hydro.

Sources: EIA, Bloomberg New Energy Finance

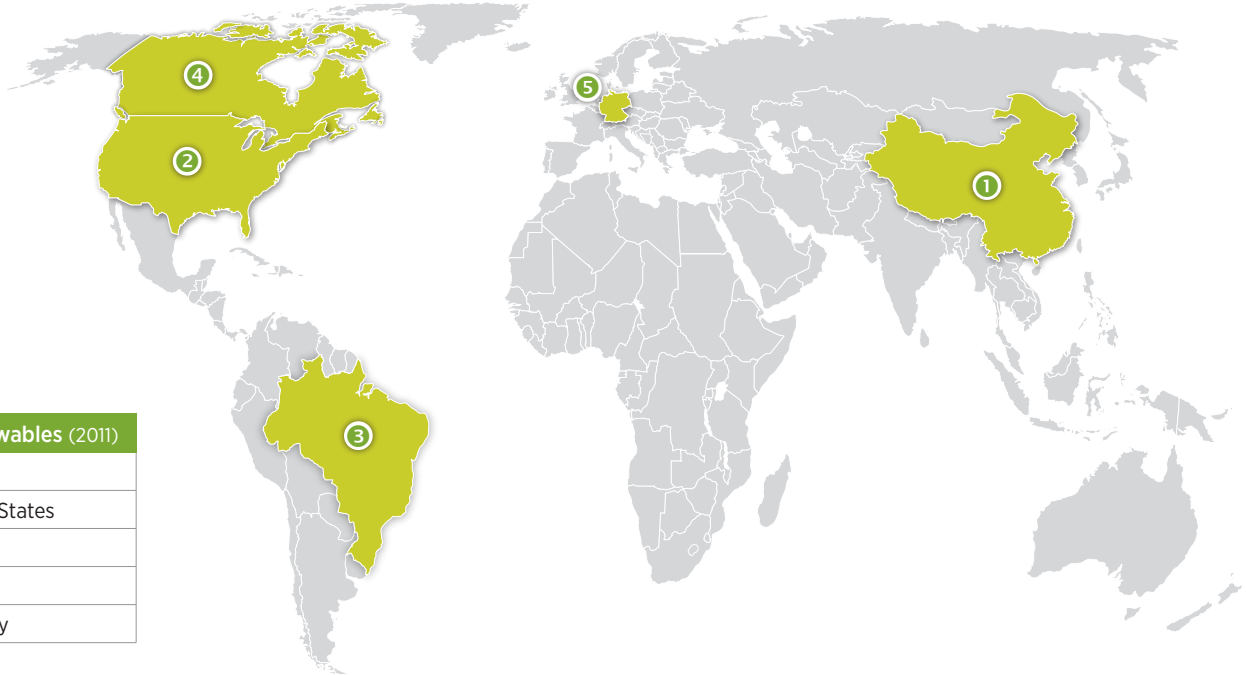
Worldwide Renewable Electricity Generation as a Percent of Total Generation

III

	Hydro	Solar PV	Biomass	Wind	Geothermal	All Renewables	Renewable Generation (million kWh)
2000	16.8%	0.0%	1.2%	0.3%	0.3%	18.7%	2,727,082
2001	17.3%	0.0%	1.3%	0.4%	0.3%	19.3%	2,872,463
2002	17.1%	0.0%	1.2%	0.5%	0.3%	19.2%	2,953,879
2003	18.0%	0.0%	1.2%	0.7%	0.3%	20.2%	3,211,282
2004	17.3%	0.0%	1.1%	0.8%	0.3%	19.5%	3,247,899
2005	16.9%	0.0%	1.2%	0.9%	0.3%	19.4%	3,358,626
2006	16.7%	0.1%	1.2%	1.1%	0.3%	19.4%	3,488,055
2007	17.4%	0.1%	1.3%	1.3%	0.3%	20.3%	3,596,408
2008	17.8%	0.1%	1.3%	1.7%	0.3%	21.1%	3,727,159
2009	17.8%	0.1%	1.3%	2.1%	0.3%	21.7%	3,883,180
2010	17.7%	0.3%	1.4%	2.5%	0.3%	22.3%	4,047,871
2011	16.6%	0.5%	1.4%	3.2%	0.4%	22.0%	4,309,125

Sources: EIA, Bloomberg New Energy Finance

Top Countries with Installed Renewable Electricity

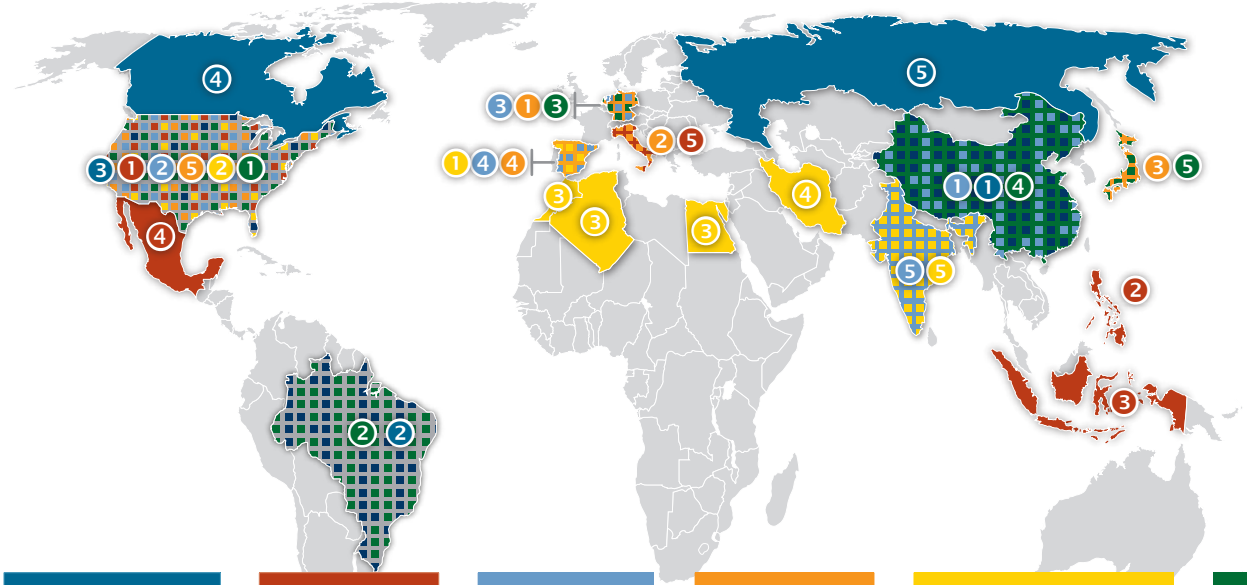


Total Renewables (2011)
1 China
2 United States
3 Brazil
4 Canada
5 Germany

Sources: EIA, Bloomberg New Energy Finance

Top Countries with Installed Renewable Electricity by Technology (2011)

III



Hydro	Geothermal	Wind	Solar PV	STEG	Biomass
1 China	1 United States	1 China	1 Germany	1 Spain	1 United States
2 Brazil	2 Philippines	2 United States	2 Italy	2 United States	2 Brazil
3 United States	3 Indonesia	3 Germany	3 Japan	3 Algeria/Egypt/Morocco	3 Germany
4 Canada	4 Mexico	4 Spain	4 Spain	4 Iran	4 China
5 Russian Federation	5 Italy	5 India	5 United States	5 India	5 Japan

Sources: EIA, Bloomberg New Energy Finance

IV. Wind

Wind: Summary

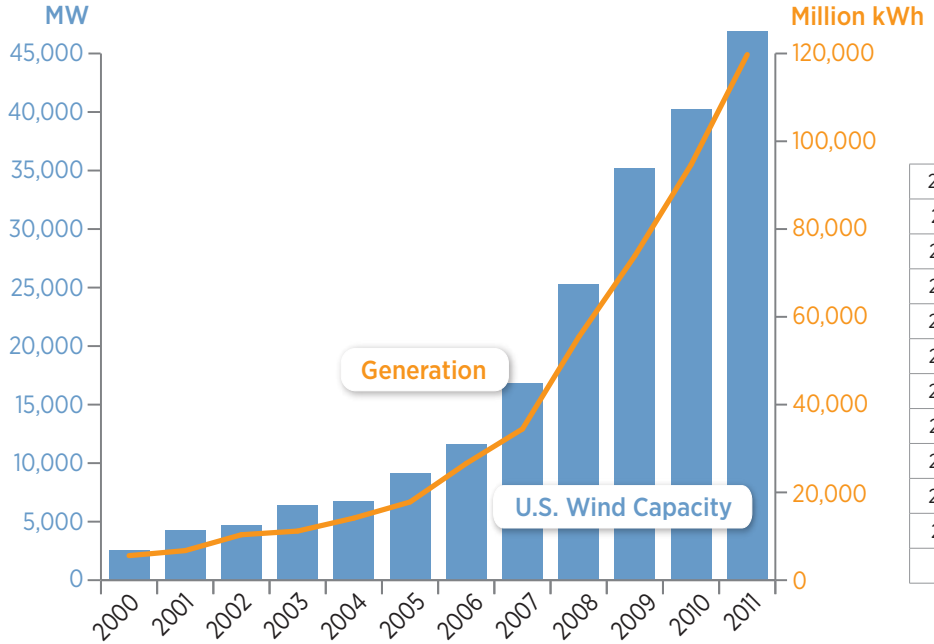
- In the United States, installed wind electricity capacity **increased more than 18 fold between 2000 and 2011**.

- In the United States, wind experienced strong growth **in 2011 and nearly 7 GW of new capacity was added**. California led the United States in wind installations in 2011, installing 921 MW of wind capacity.

- In 2010, **China surpassed the United States** as the world leader in cumulative installed wind capacity, with more than 63 GW installed as of the end of 2011.

U.S. Total Installed Wind Electricity Capacity and Generation

IV

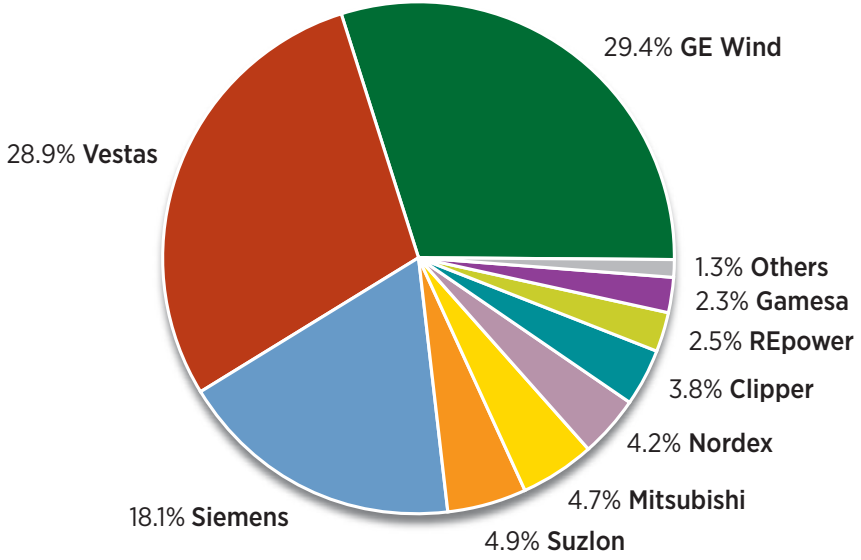


	U.S. Wind Electricity Generation (Million kWh)	U.S. Wind Electricity Capacity and Percent Increase from Previous Year	
		Total (MW)	% Increase
2000	5,593	2,578	2.6%
2001	6,737	4,275	65.8%
2002	10,354	4,686	9.6%
2003	11,187	6,353	35.6%
2004	14,144	6,725	5.9%
2005	17,811	9,121	35.6%
2006	26,589	11,575	26.9%
2007	34,450	16,812	45.2%
2008	55,363	25,237	50.1%
2009	73,886	35,159	39.3%
2010	94,652	40,267	14.5%
2011	119,747	46,916	16.5%

Sources: LBNL, EIA

U.S. Wind Turbine Market Share 2011

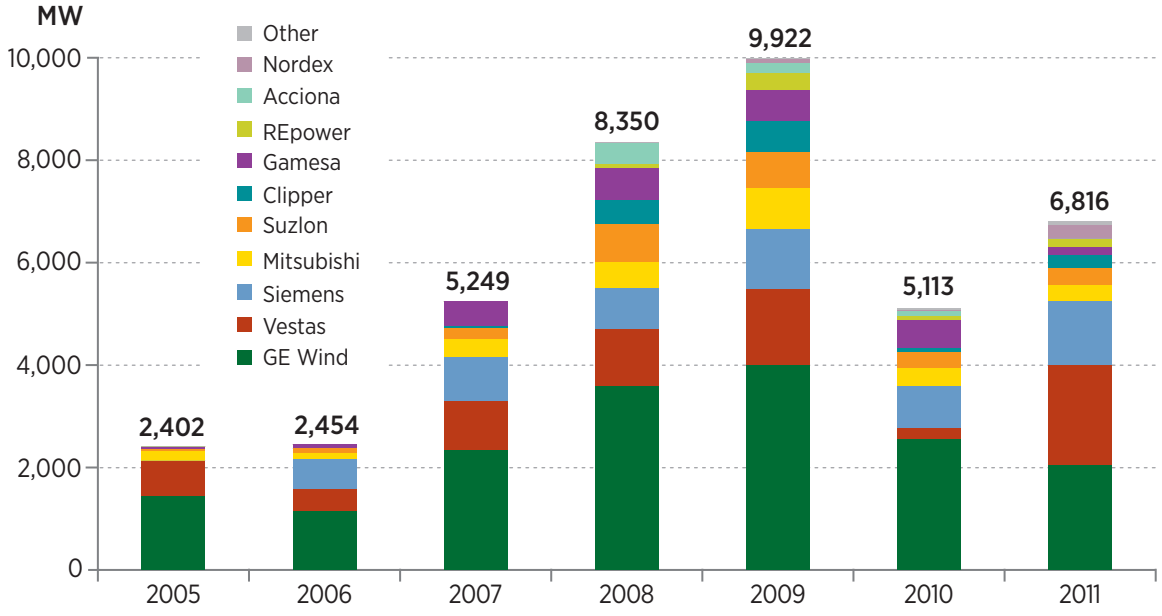
Total Turbine Installations: 6,816 MW



Source: LBNL

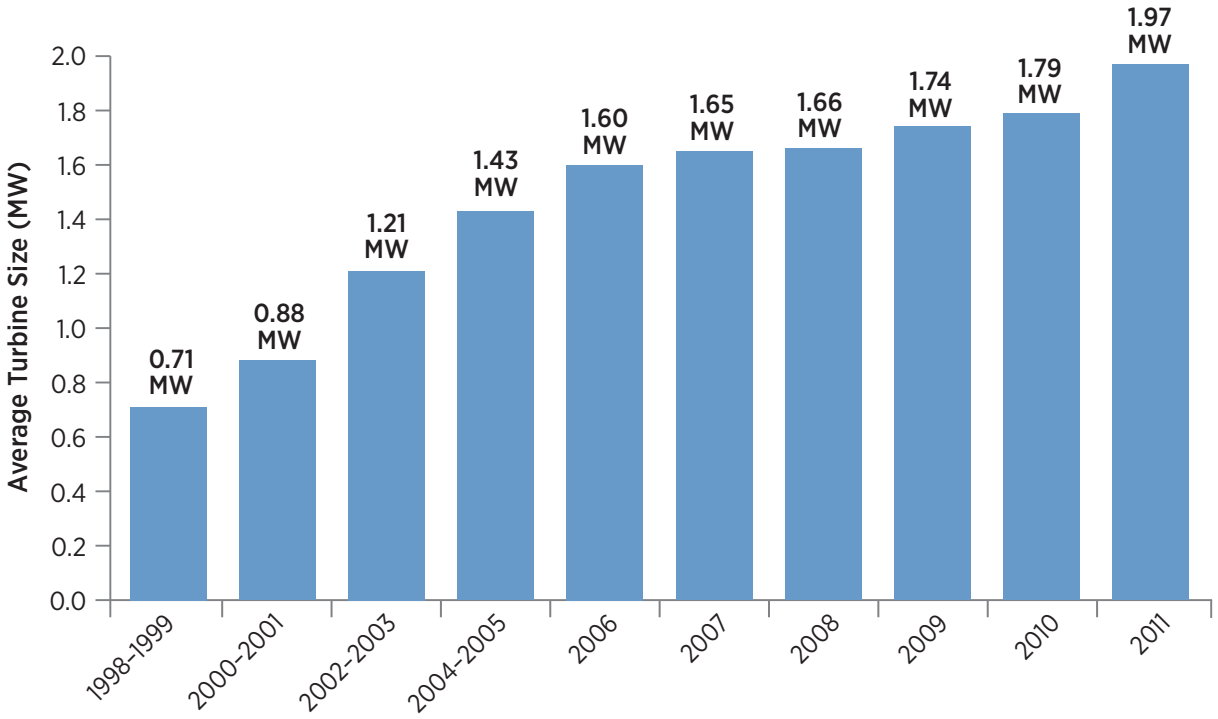
Annual U.S. Wind Turbine Installations, by Manufacturer (MW)

IV



Source: LBNL

U.S. Average Installed Turbine Size

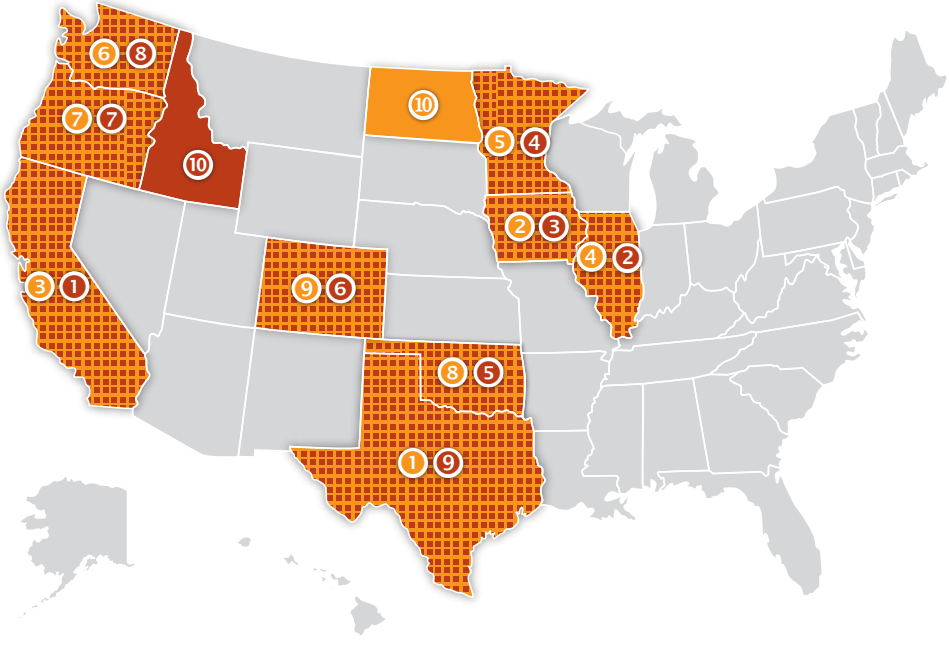


IV

Source: AWEA

States Leading Wind Power Development

IV

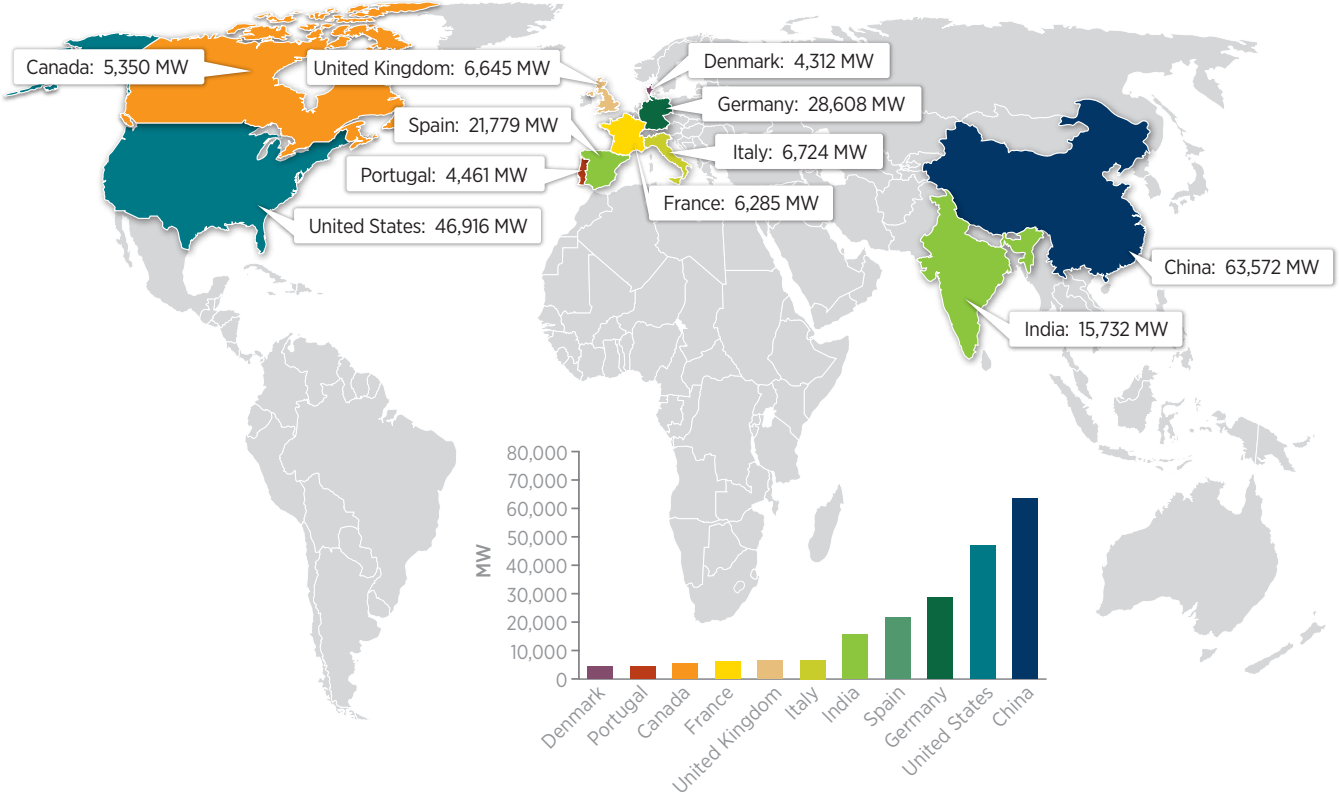


Cumulative Capacity (2011, MW)	
1 Texas	10,394
2 Iowa	4,322
3 California	3,917
4 Illinois	2,742
5 Minnesota	2,718
6 Washington	2,573
7 Oregon	2,513
8 Oklahoma	2,007
9 Colorado	1,805
10 North Dakota	1,445

Annual Capacity (2011, MW)	
1 California	921
2 Illinois	692
3 Iowa	647
4 Minnesota	542
5 Oklahoma	525
6 Colorado	506
7 Oregon	409
8 Washington	367
9 Texas	297
10 Idaho	265

Source: LBNL

Wind Electricity Capacity (2011) – Select Countries

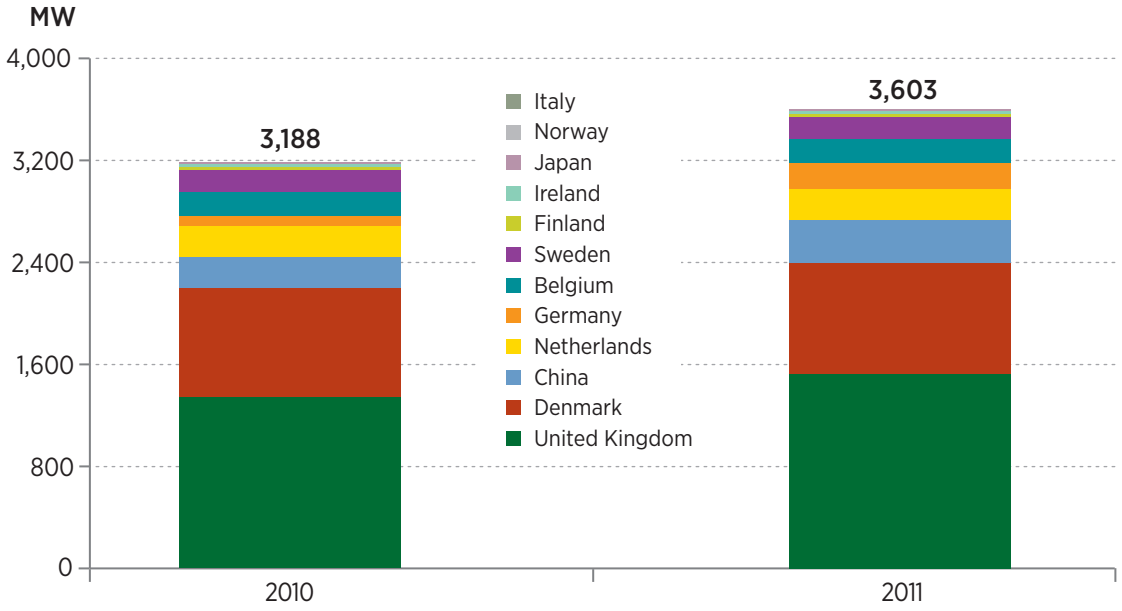


IV

Sources: LBNL, Bloomberg New Energy Finance

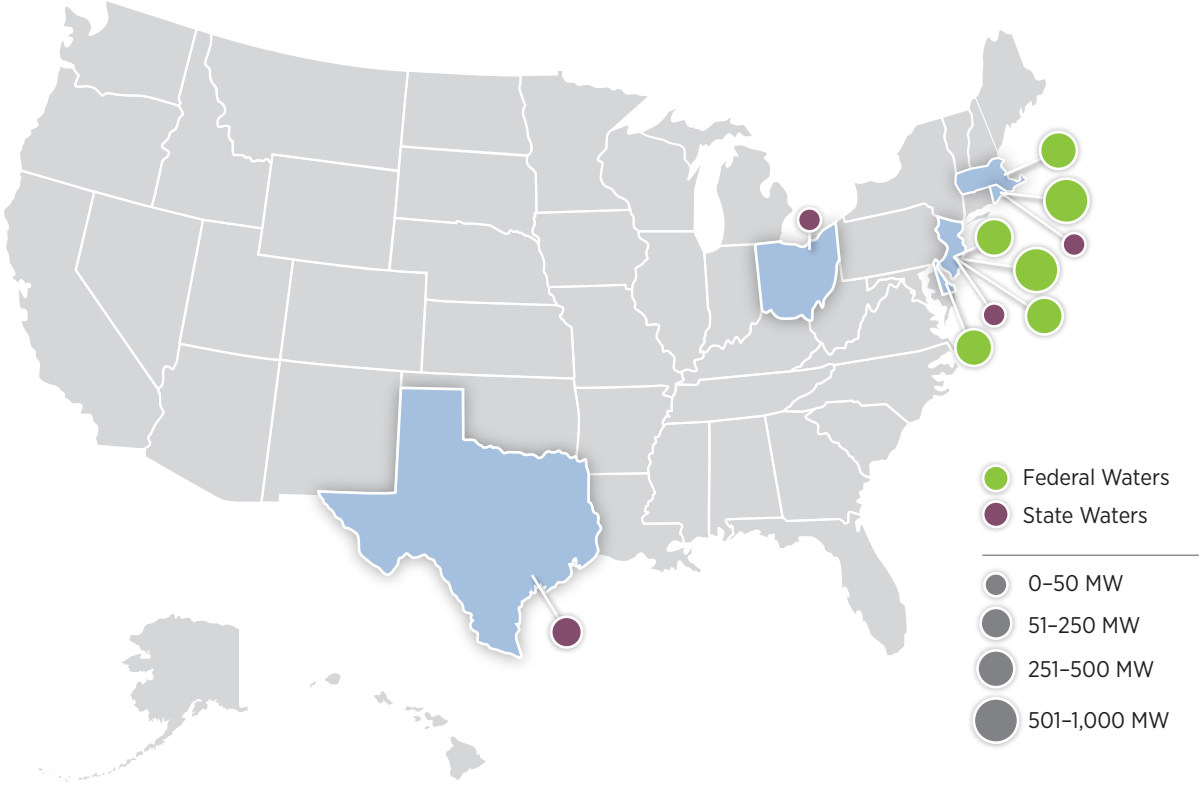
Cumulative Installed Offshore Wind Capacity By Country (MW)

IV



Source: Bloomberg New Energy Finance

U.S. Offshore Wind Electricity Proposed Projects



Source: LBNL, prepared by Navigant Consulting, 2012

V. Solar

Solar: Summary

- Solar electricity generation has **grown by a factor of more than 9 between 2000 and 2011**, but still represents a very small part of overall U.S. electricity generation (0.2%).

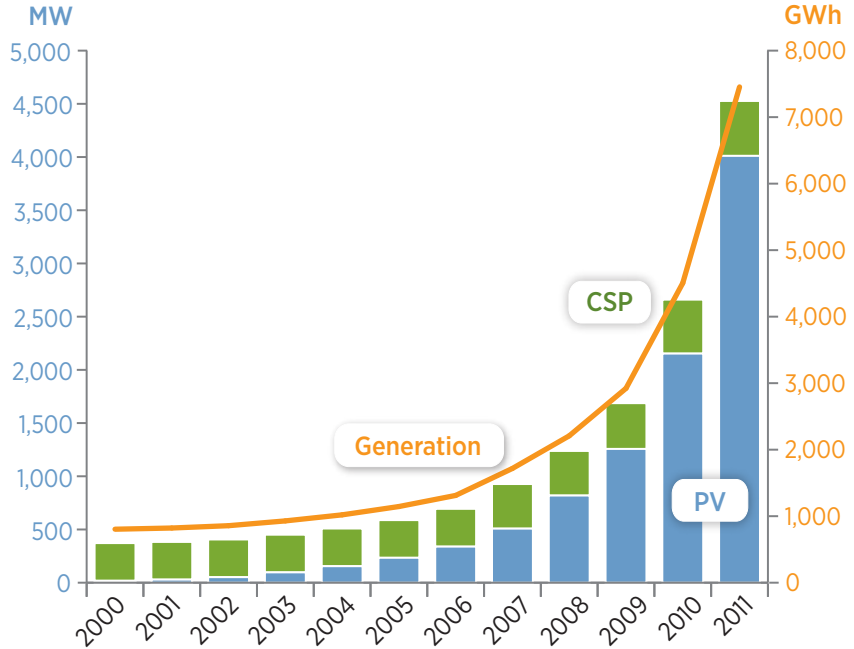
- Countries with extensive solar policies—such as Germany, Spain, Japan, and Italy—lead the world in solar photovoltaic (PV) deployment. Similarly, **U.S. states with extensive solar incentives lead the United States in both cumulative and annual installations in 2011** (California, New Jersey, Colorado, Arizona, and New Mexico).

- U.S. manufacturers currently have a small share of the world PV market. **Asian—particularly Chinese—manufacturers lead the market with nearly 77% of the global photovoltaic cell production**.

- A number of concentrating solar power (CSP) plants came online in 2011, including 11.7 MW in the United States.

U.S. Total Installed Solar Electricity Capacity and Generation

V



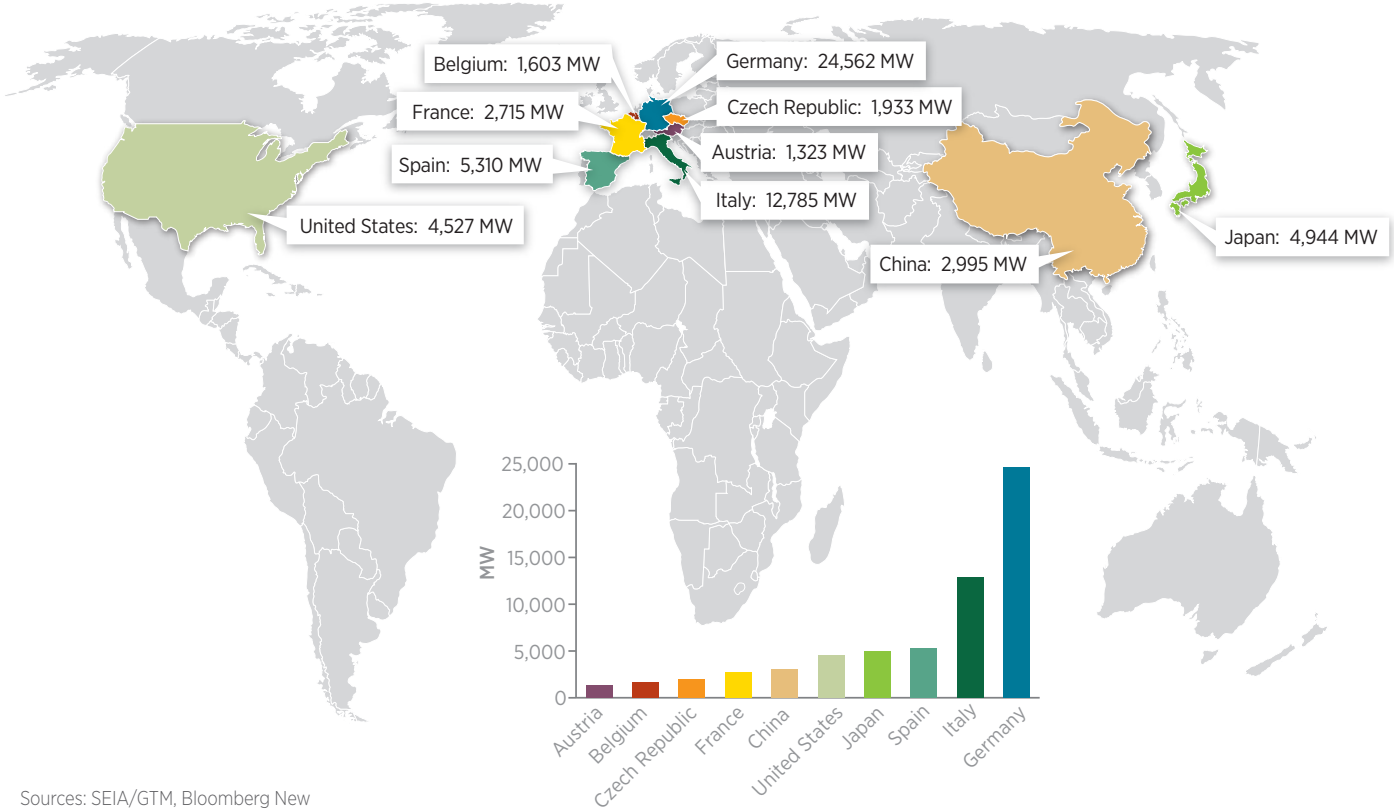
	U.S. Solar Energy Generation (Million kWh)	U.S. Solar Energy Capacity (MW) and % Increase from Previous Year			
		PV*	CSP	Total	Increase
2000	804	18	354	372	4.3%
2001	822	29	354	383	3.0%
2002	857	52	354	406	5.9%
2003	929	97	354	451	11.2%
2004	1,020	155	354	509	12.8%
2005	1,145	234	354	588	15.5%
2006	1,312	339	355	694	18.0%
2007	1,718	508	419	927	33.5%
2008	2,208	819	419	1,237	33.5%
2009	2,922	1,257	430	1,686	36.3%
2010	4,505	2,153	507	2,660	57.7%
2011	7,454	4,011	516	4,527	70.2%

Sources: SEIA/GTM, Larry Sherwood/IREC

Note: Generation numbers calculated from installed capacity using a 18% capacity factor for PV and 25% capacity factor for CSP.

* Includes on- and off-grid capacity.

Solar Electricity Installed Capacity (2011) – Select Countries



Sources: SEIA/GTM, Bloomberg New Energy Finance, Larry Sherwood/IREC

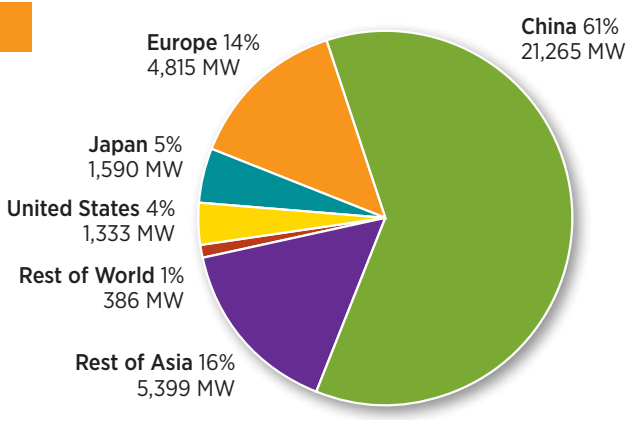
* Includes PV and CSP

V

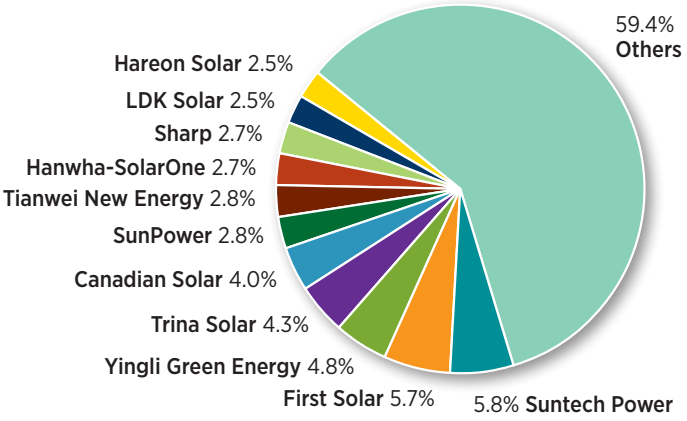
Global Solar Module Production 2011:

34,788 MW

By Country

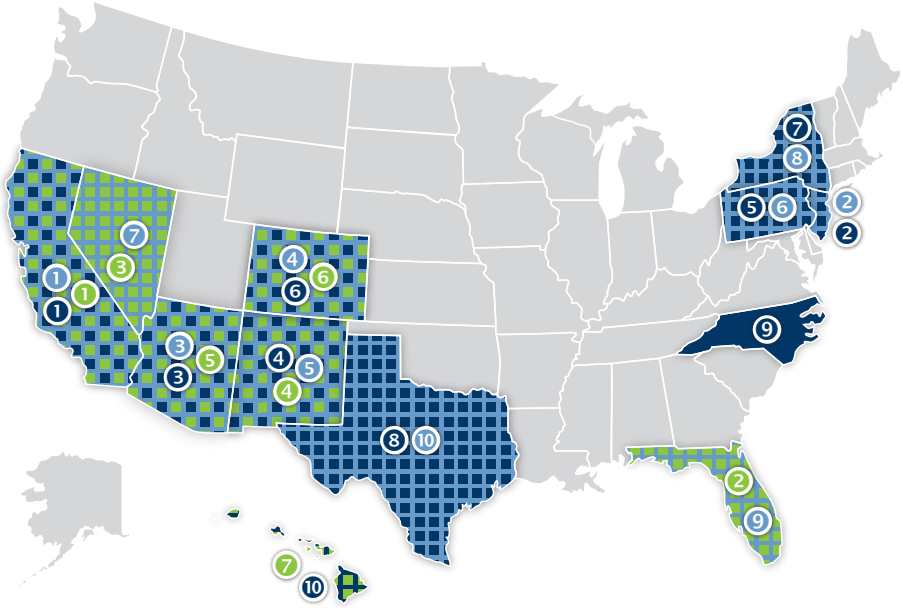


By Manufacturer



Source: GTM PV News, May 2012

States Leading Solar Electricity Development (2011)



PV Cumulative Capacity (2011, MW)	
1 California	1,563.6
2 New Jersey	565.9
3 Arizona	397.6
4 Colorado	196.7
5 New Mexico	165.5
6 Pennsylvania	133.1
7 Nevada	124.1
8 New York	123.8
9 Florida	95.0
10 Texas	85.6

PV Annual Capacity Additions (2011, MW)	
1 California	537.8
2 New Jersey	306.1
3 Arizona	287.8
4 New Mexico	122.1
5 Pennsylvania	78.2
6 Colorado	75.5
7 New York	68.3
8 Texas	51.1
9 North Carolina	45.5
10 Hawaii	40.5

CSP & CPV Cumulative Capacity (2011, MW)	
1 California	364.5
2 Florida	75
3 Nevada	64
4 New Mexico	6
5 Arizona	4.8
6 Colorado	2.4
7 Hawaii	0.8

Sources: SEIA/GTM, Larry Sherwood/IREC

Note: Grid-tied capacity only.

VI. Geothermal

Geothermal: Summary

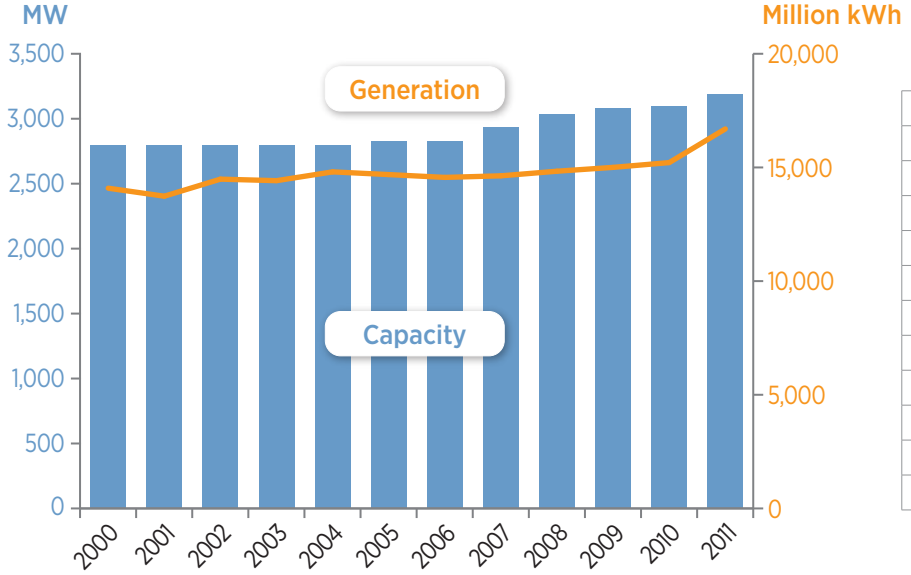
- U.S. geothermal electricity generation has remained relatively stable from 2000 to 2011, with the **past 11 years experiencing an average of 1.2% growth in annual capacity installed**.

- **The United States leads the world in installed geothermal electricity capacity and generation**, with most of that power installed in California.

- As a base-load source of energy, geothermal is distinct from other renewables such as wind and solar, because **it can provide consistent electricity**.

U.S. Geothermal Electricity Capacity and Generation

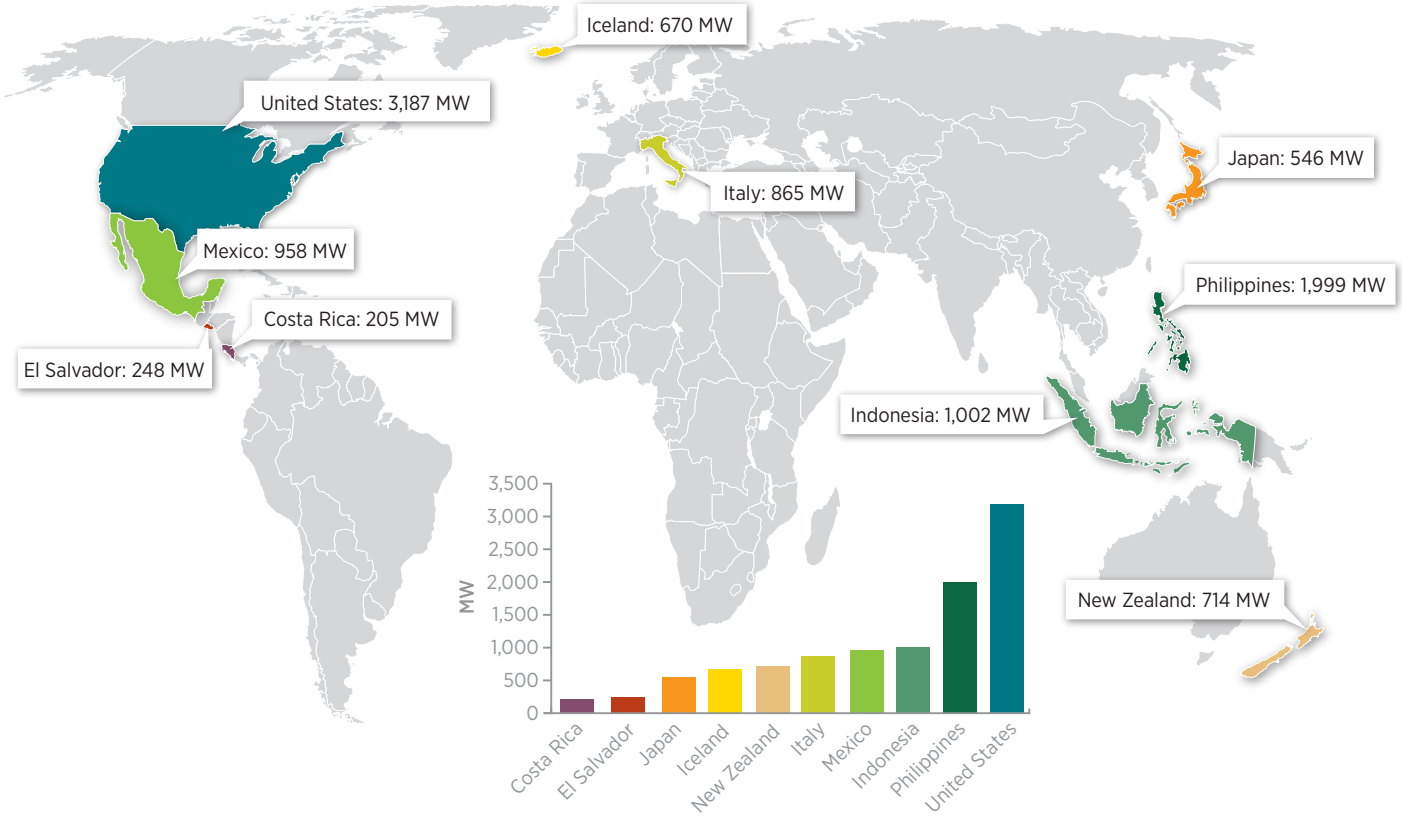
VI



	U.S. Geothermal Electricity Generation (Million kWh)	U.S. Geothermal Electricity Capacity and % Increase from Previous Year	
		Total (MW)	% Increase
2000	14,093	2,798	2.2%
2001	13,741	2,798	0.0%
2002	14,491	2,798	0.0%
2003	14,424	2,798	0.0%
2004	14,811	2,798	0.0%
2005	14,692	2,828	1.1%
2006	14,568	2,831	0.1%
2007	14,637	2,937	3.7%
2008	14,840	3,040	3.5%
2009	15,009	3,086	1.5%
2010	15,219	3,101	0.5%
2011	16,700	3,187	2.8%

Sources: GEA, EIA

Global Geothermal Electricity Capacity (2011) – Select Countries

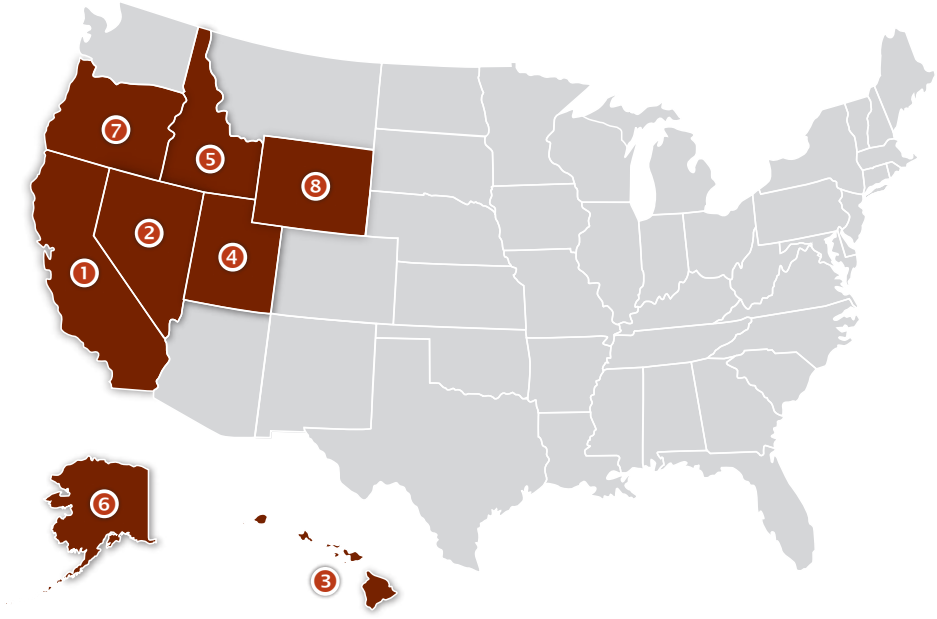


VI

Source: GEA, Bloomberg New Energy Finance

Cumulative State Geothermal Electricity Development (2011)

VI



Total Installed Capacity (2011, MW)	
1 California	2,615.4
2 Nevada	469.0
3 Hawaii	43.0
4 Utah	42.0
5 Idaho	15.8
6 Alaska	0.7
7 Oregon	0.3
8 Wyoming	0.3

Source: GEA

VI

VII. Biopower

Biopower: Summary

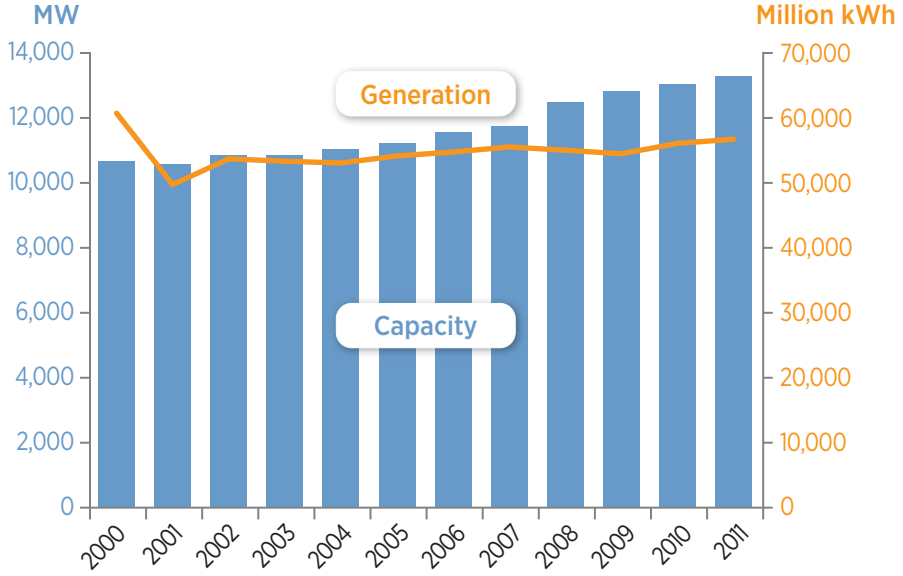
- Biopower electricity generation currently accounts for **11% of all renewable energy generated in the United States**.

- Biomass electricity primarily comes from wood and agricultural residues that are burned as a fuel for cogeneration in the industrial sector (such as in the pulp and paper industry).

- U.S. installed biopower capacity has grown recently, with a **Compound Annual Growth Rate (CAGR) of 2.0% from 2006–2011**.

U.S. Biopower Electricity Capacity and Generation

VII

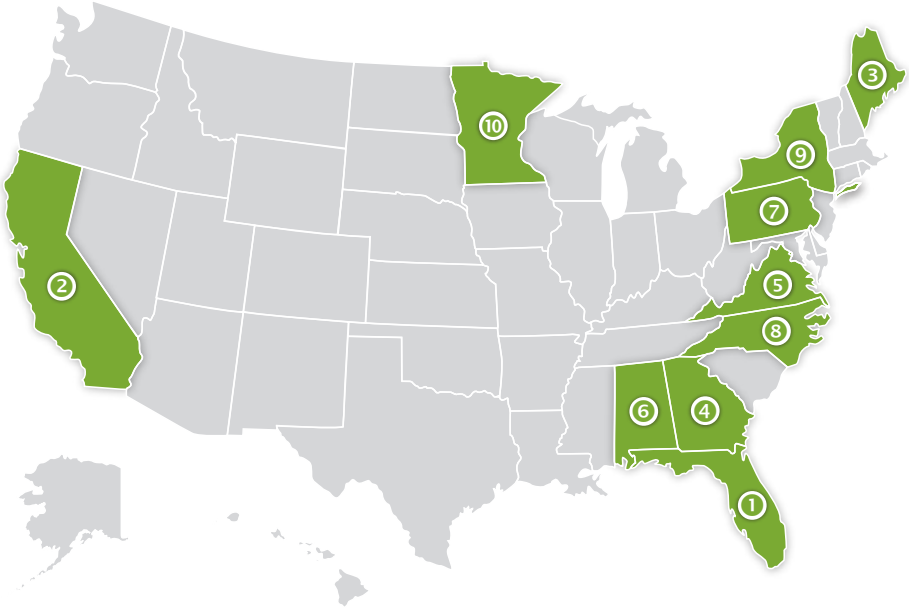


	U.S. Biopower Generation (Million kWh)	U.S. Biopower Capacity and % Increase from Previous Year	
		Total (MW)	% Change
2000	60,726	10,676	- 2.9%
2001	49,748	10,576	- 0.9%
2002	53,709	10,867	2.8%
2003	53,340	10,856	- 0.1%
2004	53,073	11,033	1.6%
2005	54,160	11,222	1.7%
2006	54,759	11,553	2.9%
2007	55,539	11,738	1.6%
2008	55,034	12,485	6.4%
2009	54,493	12,836	2.8%
2010	56,089	13,053	1.7%
2011	56,732	13,276	1.7%

Source: EIA

Note: The generation decrease between 2000 to 2001 reflects an EIA classification change. Beginning with 2001 data, non-biogenic municipal solid waste and tire-derived fuels were reclassified from waste biopower to non-renewable energy sources.

States Leading Biopower Electricity Development (2011)



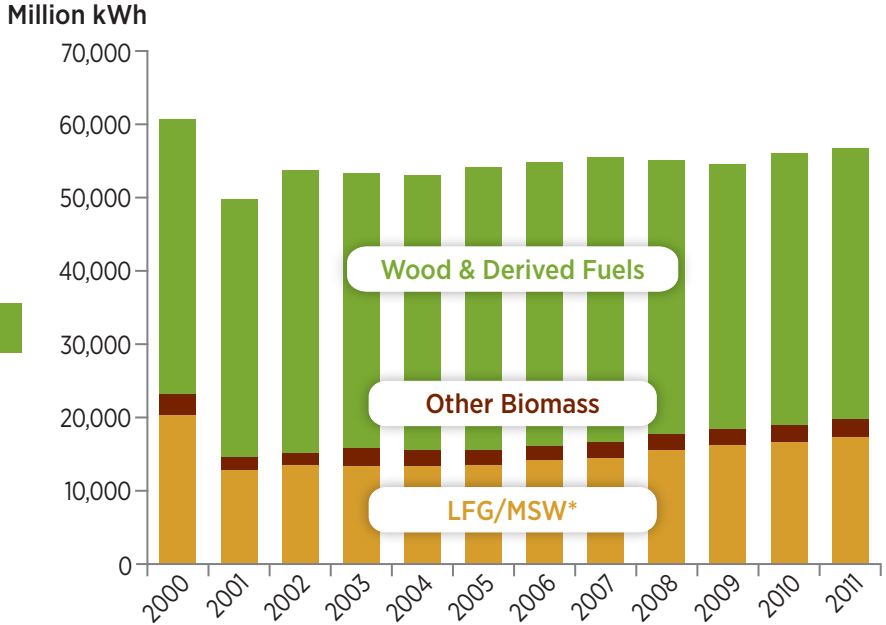
Total Installed Capacity (2011, MW)	
1 Florida	1,254
2 California	1,199
3 Maine	771
4 Georgia	698
5 Virginia	681
6 Alabama	636
7 Pennsylvania	600
8 North Carolina	590
9 New York	529
10 Minnesota	477

VII

Source: EIA

U.S. Biopower Electricity Generation Sources (2000–2011)

VII



	LFG/ MSW	Other Biomass	Wood and Derived Fuel	TOTAL
2000	20,305	2,826	37,595	60,726
2001	12,714**	1,834	35,200	49,748
2002	13,398	1,646	38,665	53,709
2003	13,383	2,428	37,529	53,340
2004	13,281	2,216	37,576	53,073
2005	13,470	2,009	38,681	54,160
2006	14,106	2,004	38,649	54,759
2007	14,462	2,063	39,014	55,539
2008	15,520	2,214	37,300	55,034
2009	16,140	2,303	36,050	54,493
2010	16,555	2,362	37,172	56,089
2011	17,316	2,470	36,946	56,732

Source: EIA

*Note: LFG stands for Landfill Gas and MSW stands for Municipal Solid Waste

**Note: The generation decrease between 2000 to 2001 reflects an EIA classification change. Beginning with 2001 data, non-biogenic municipal solid waste and tire-derived fuels were reclassified from waste biopower to non-renewable energy sources.

VII

VIII. Hydropower

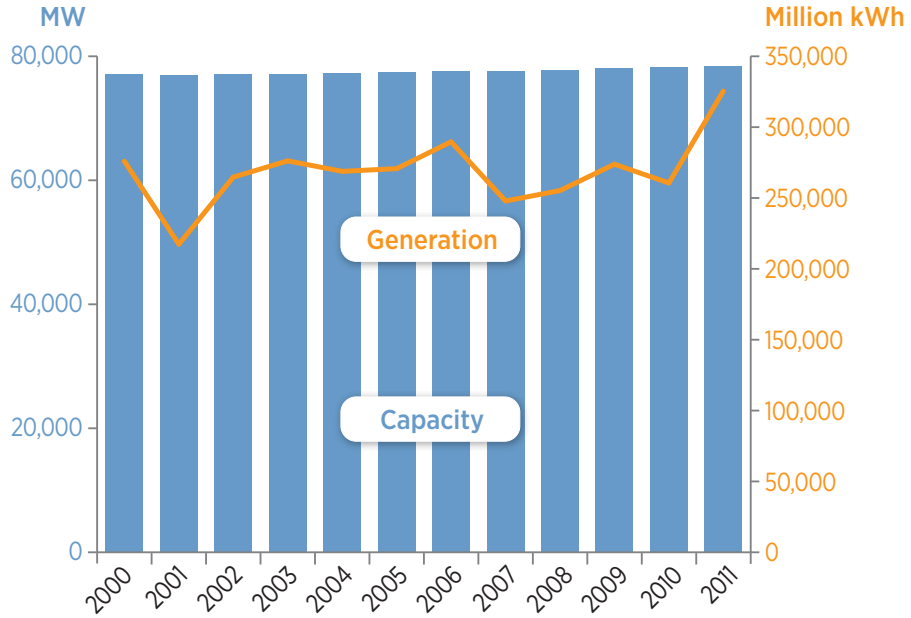
Hydropower: Summary

- Hydropower **capacity has remained essentially constant between 2000–2011**, with generation fluctuation depending on water supply.

- Hydropower remains the largest source of renewable electricity generation, primarily large-scale hydropower, which **accounts for 7.9% of U.S. electricity generation**.

U.S. Hydropower* Electricity Capacity and Generation

VIII

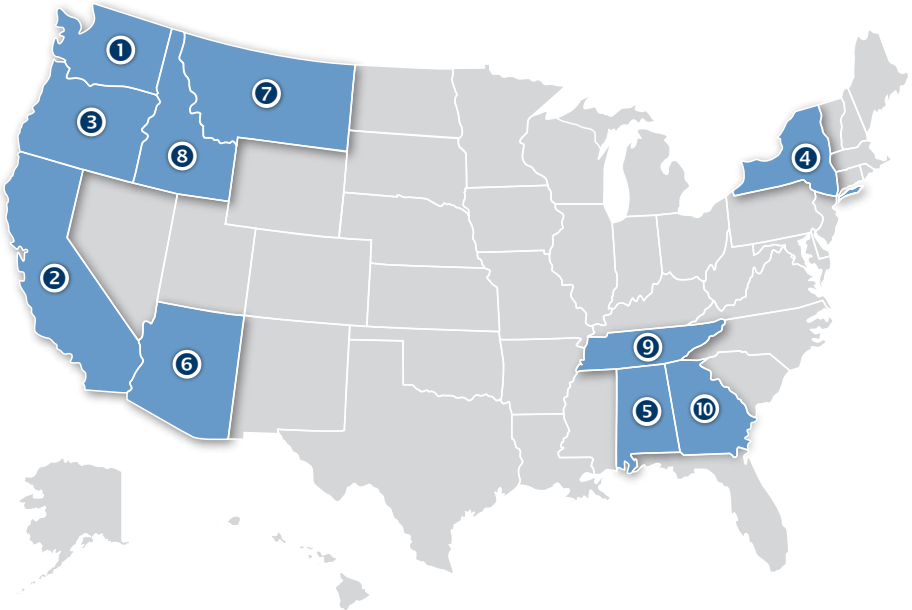


	U.S. Hydropower Generation (Million kWh)	U.S. Hydropower Capacity and % Increase from Previous Year	
		Total (MW)	% Increase
2000	275,573	76,946	0.0%
2001	216,961	76,911	0.0%
2002	264,329	77,047	0.2%
2003	275,806	77,020	0.0%
2004	268,417	77,130	0.1%
2005	270,321	77,354	0.3%
2006	289,246	77,419	0.1%
2007	247,510	77,432	0.0%
2008	254,831	77,640	0.3%
2009	273,445	77,910	0.3%
2010	260,203	78,204	0.4%
2011	325,074	78,237	0.0%

Source: EIA

*Note: Excludes pumped storage.

States Leading Hydropower Electricity Development (2011)



Capacity (2010, MW)	
1 Washington	20,954
2 California	10,046
3 Oregon	8,245
4 New York	4,657
5 Alabama	3,280
6 Arizona	2,718
7 Montana	2,583
8 Idaho	2,540
9 Tennessee	2,499
10 Georgia	1,932

VIII

Source: EIA

IX. Advanced Water Power

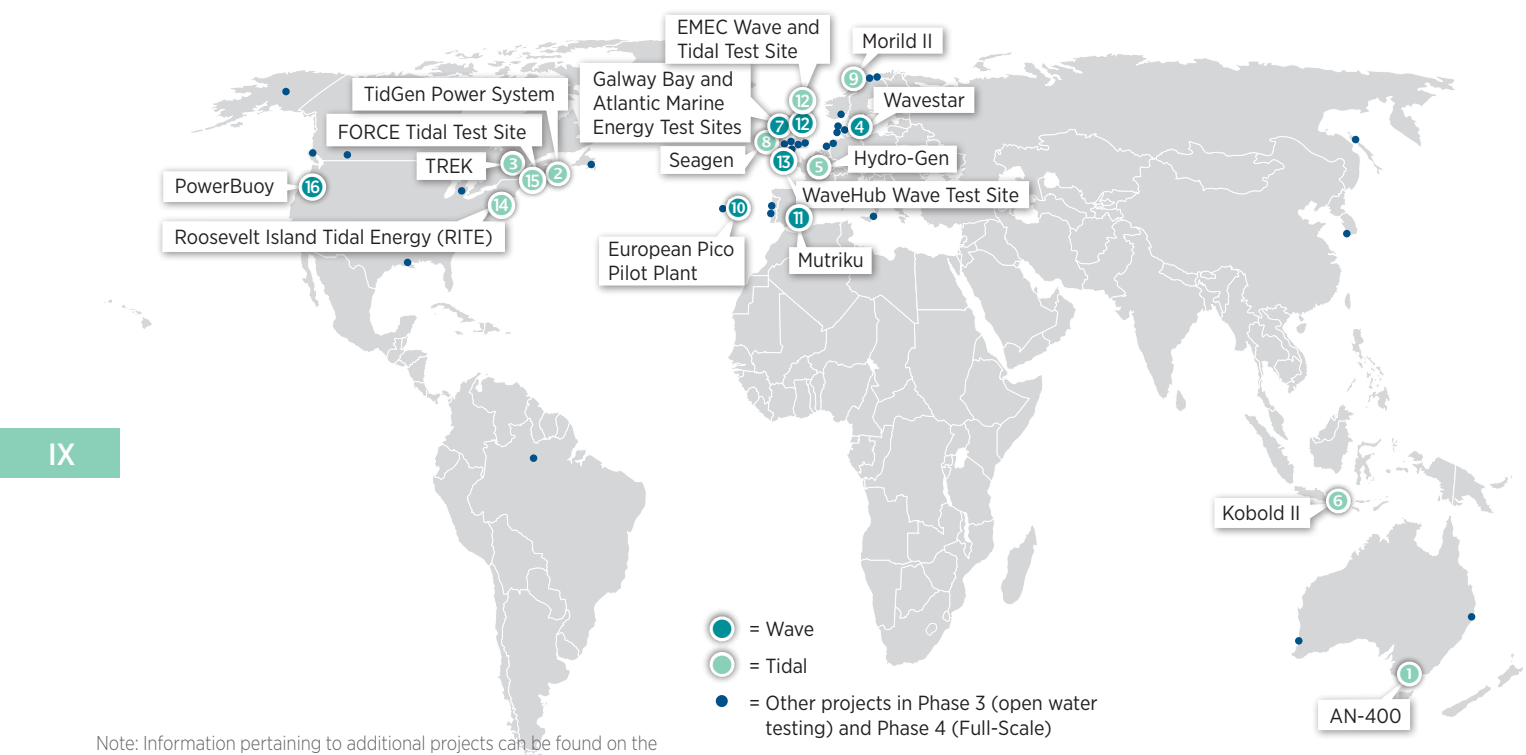
Advanced Water Power: Summary

- U.S. interest in advanced water power—such as **tidal, river, ocean current**, and **ocean wave** energy—has been steadily growing over the past few years, with many prototype projects in testing stages and permits being filed at the Federal Energy Regulatory Commission (FERC).

- No commercial wave or tidal plants came online in 2011, although two tidal power projects received licenses from FERC in early 2012: one being developed by Ocean Renewable Power Company in Cobscook Bay Maine, and one by Verdant Power in the East River of New York City.

- More information may be found at these websites:
  - Federal Energy Regulatory Commission (FERC): www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics.asp
  - The Water Power Program at the U.S. Department of Energy: www1.eere.energy.gov/water
  - The Ocean Energy Systems Implementing Agreement, established by the International Energy Agency: www.ocean-energy-systems.org

Worldwide Advanced Water Power: Sample of Commercial and Pilot Plants



Note: Information pertaining to additional projects can be found on the EERE's Marine and Hydrokinetic Technology Database, accessible online at: http://www1.eere.energy.gov/windandhydro/hydrokinetic/default.aspx

Sources: Ocean Energy Systems

Worldwide Advanced Water Power: Sample of Commercial and Pilot Plants

PROJECT NAME	Type	Country	Location	Size (MW)	Installed
1 AN-400	Tidal	Australia	San Remo, Victoria	0.40	2008
2 FORCE Tidal Test Site (Multiple Devices)	Tidal	Canada	Bay of Fundy, Parrsboro, NS	3+	2009
3 TREK	Tidal	Canada	Saint-Lawrence River	0.25	2010
4 Wavestar	Wave	Denmark	Hanstholm	0.60	2010
5 Hydro-Gen	Tidal	France	Paimpol-Brehat	2	2011
6 Kobold II	Tidal	Indonesia	Lombok Island	0.15	2012
7 Galway Bay and Atlantic Marine Energy Test Sites (Multiple Devices)	Wave	Ireland	Galway Bay and Belmullet Bay	1	2006
8 Seagen	Tidal	Ireland	Strangford Lough	1.20	2006
9 Morild II	Tidal	Norway	Lofoten	1.50	2010
10 European Pico Pilot Plant	Wave	Portugal	Cachorro, Pico Island	0.40	2005
11 Mutriku	Wave	Spain	Near Bilbao	0.3	2011
12 EMEC Wave and Tidal Test Site (Multiple Devices)	Wave/Tidal	United Kingdom	Scotland Stromness, Orkney	10+	2008
13 WaveHub Wave Test Site (Multiple Devices)	Wave	United Kingdom	Hayle, Cornwall	50+	2011
14 Roosevelt Island Tidal Energy (RITE)	Tidal	United States	New York City, NY	1	2012
15 TidGen Power System	Tidal	United States	Cobscook Bay, Maine	0.3	2012
16 PowerBuoy	Wave	United States	Reedsport, Oregon	0.10	2012

Note: Information pertaining to additional projects can be found on the EERE's Marine and Hydrokinetic Technology Database, accessible online at: http://www1.eere.energy.gov/windandhydro/hydrokinetic/default.aspx

Sources: Ocean Energy Systems

reliable
colorless
clean
green-friendly
ZERO EMISSION
HYDROGEN FUEL CELL HYBRID-ELECTRIC DRIVE
FC2
AC TRANSIT

X. Hydrogen

Hydrogen: Summary

- As of October 2012, there were approximately **58 hydrogen fueling stations** in the United States.
- There are more than 1,000 stationary fuel cell installations worldwide, 35 of which are greater than 1 MW in capacity.

X

Hydrogen Production

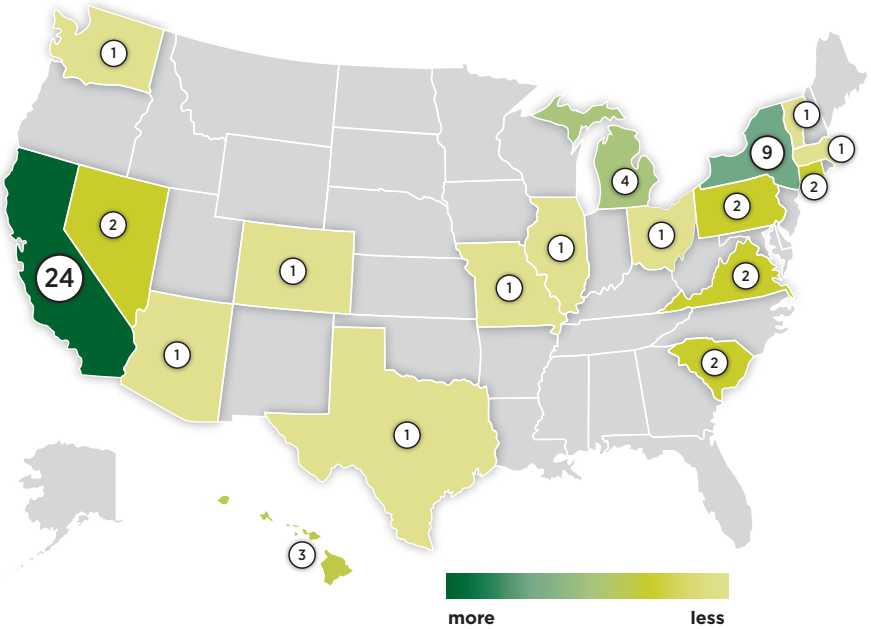
50 million tons of hydrogen are produced each year worldwide; **9 million** tons are consumed in the United States.

Approximately **60%** is used for making ammonia for fertilizer; **23%** is used to make gasoline cleaner by removing sulfur; **9%** is used to make methanol; and the remainder is for chemical processing, metal production, electronics, and for space exploration.

X

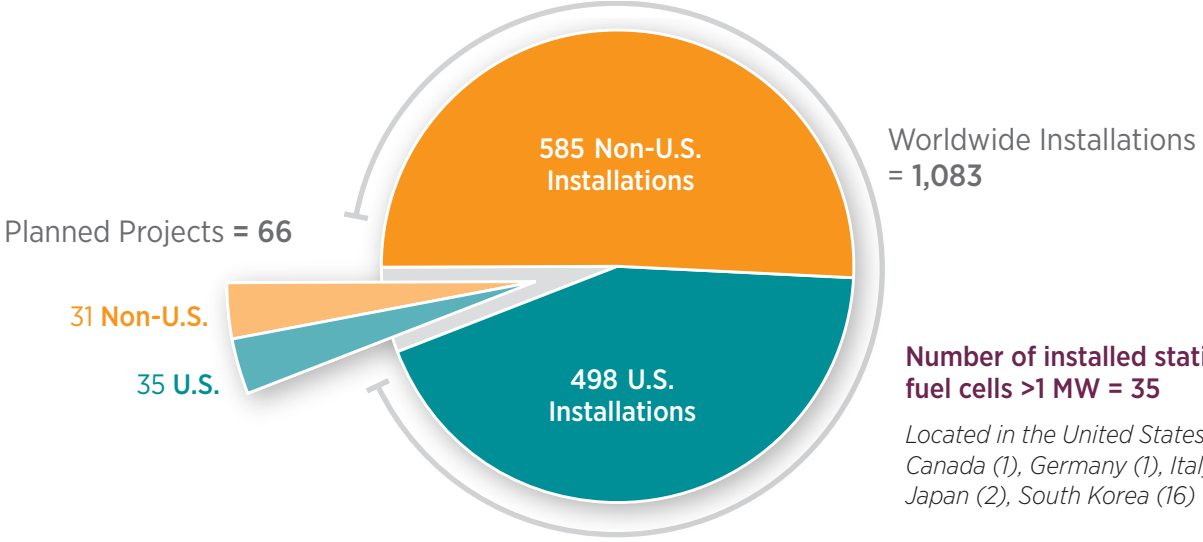
Number of Operational U.S. Hydrogen Fueling Stations

(October 2012 – **Total of 58**)



Sources: EERE, FuelCells.org

Stationary Fuel Cell Installations (2011)



Number of installed stationary fuel cells >1 MW = 35

Located in the United States (14), Canada (1), Germany (1), Italy (1), Japan (2), South Korea (16)

X

Source: FuelCells.org

XI. Renewable and Alternative Fuels

- Corn ethanol production in contrast to Brazil's ethanol, which is produced from sugar cane, continues to expand rapidly in the United States. **Between 2000 and 2011, production increased more than 8 times**.

- U.S. ethanol production **grew nearly 5% in 2011** over 2010 to reach almost **14,000 million gallons** per year.

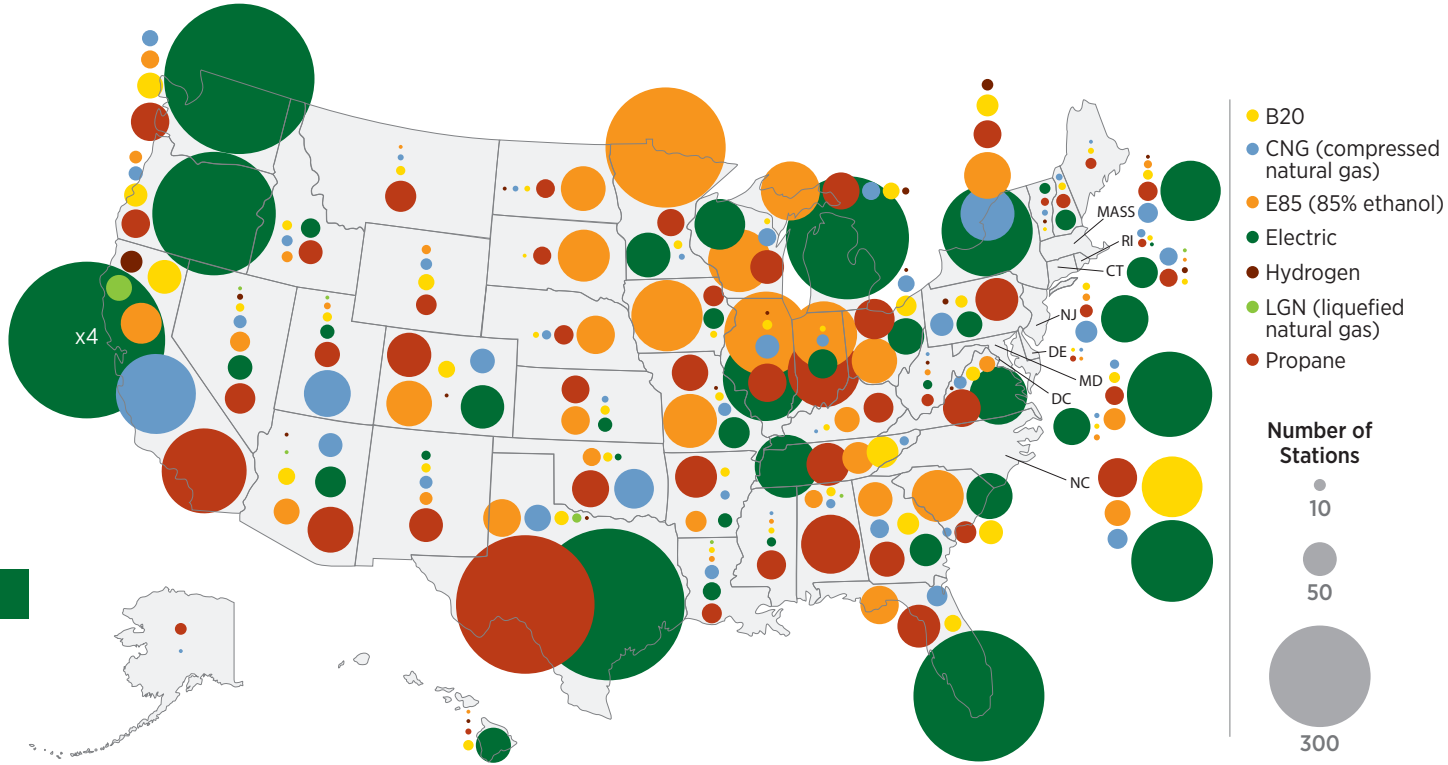
- In 2011, the United States* produced 62.2% of the world's ethanol, followed by Brazil at 24.9%, the European Union at 5.4%, China at 2.5%, and Canada at 2.1%.

- In 2011, the number of electric vehicle charging stations expanded by a factor of 9 to 6,033.

* Most U.S. ethanol is currently produced from corn (in contrast to Brazil's ethanol coming from sugar cane); but efforts are underway by the U.S. Department of Energy and others to commercialize cellulosic ethanol, which is produced from non-food crops.

Note: Ethanol is blended with gasoline and generally comprises up to 10% of the fuel with gasoline as the other 90% (E10). Additionally, flex-fuel vehicles can use a blend of 85% ethanol and 15% gasoline (E85).

Renewable and Alternative Fueling Stations by State

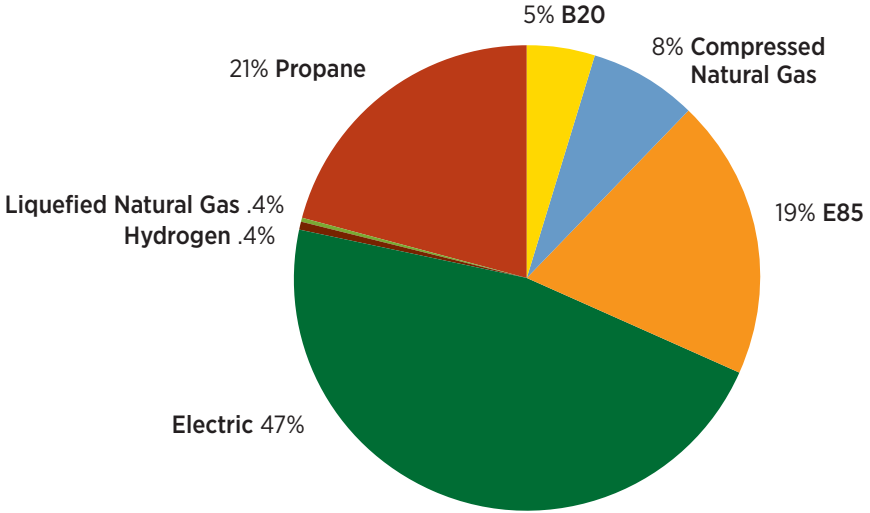


XI

Note: Data as of 1/31/2012

Sources: EERE, EIA

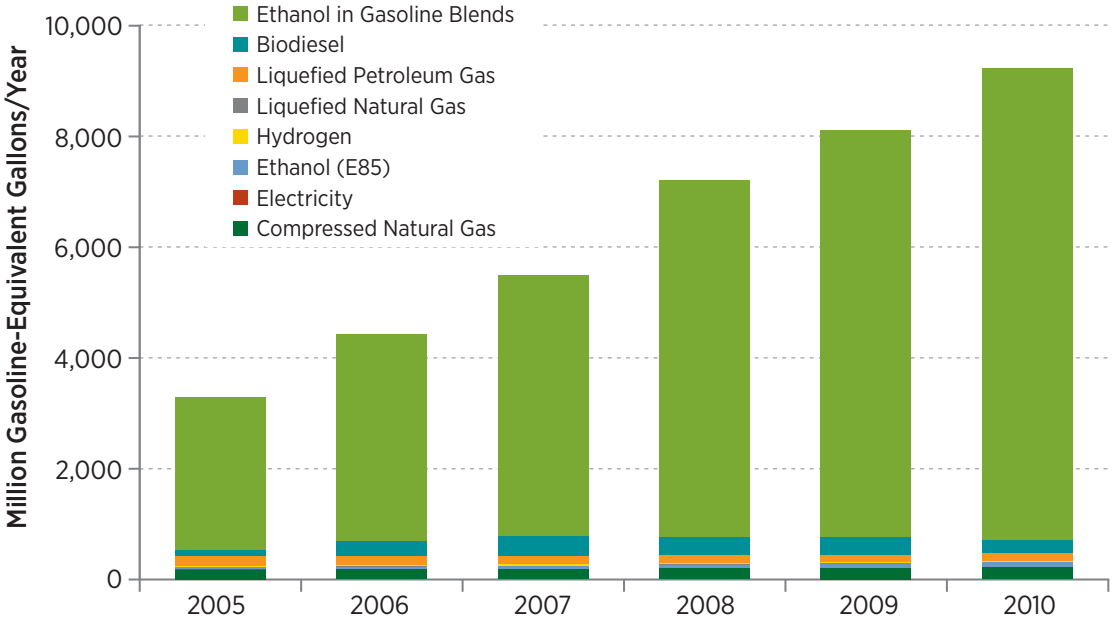
12,927 Alternative Fueling Stations in the United States



Note: Data as of 1/31/2012
Sources: EERE, EIA

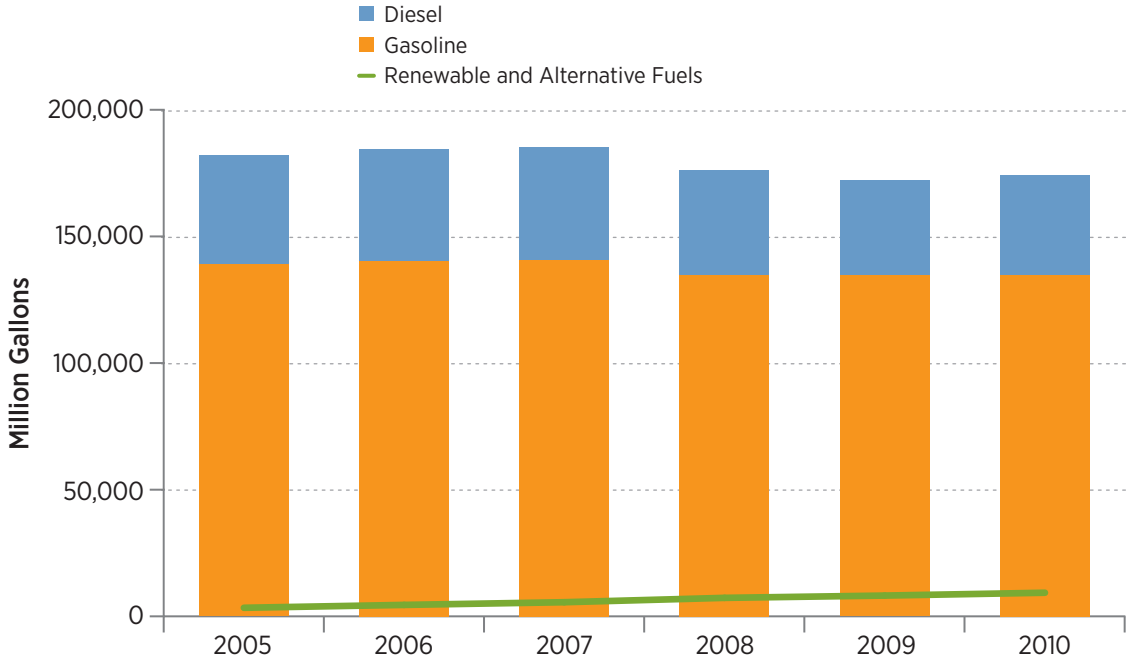
Consumption of Renewable and Alternative Fuel in the United States (2005–2010)

XI



Source: EIA

Consumption of Traditional Fuel in the United States (2005–2010)

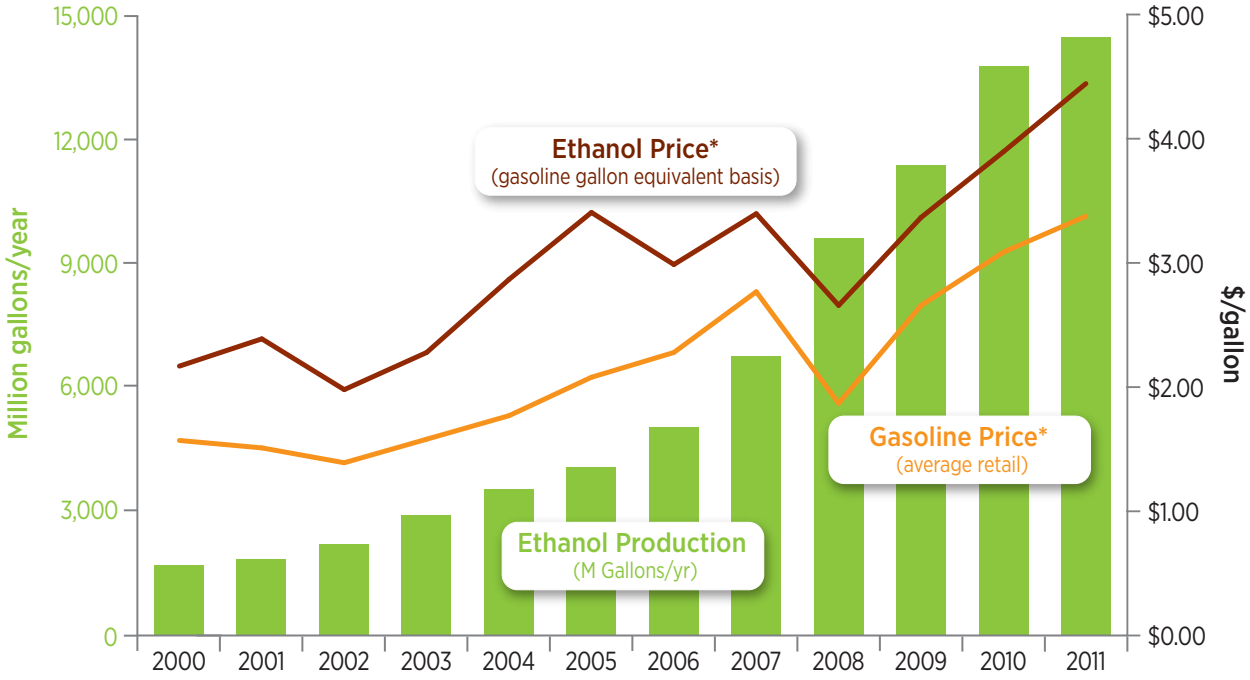


XI

Source: EIA

U.S. Corn Ethanol Production and Price Trends

In 2010, there were **1,424,878 ethanol (E85) fueled vehicles** on the road in the United States

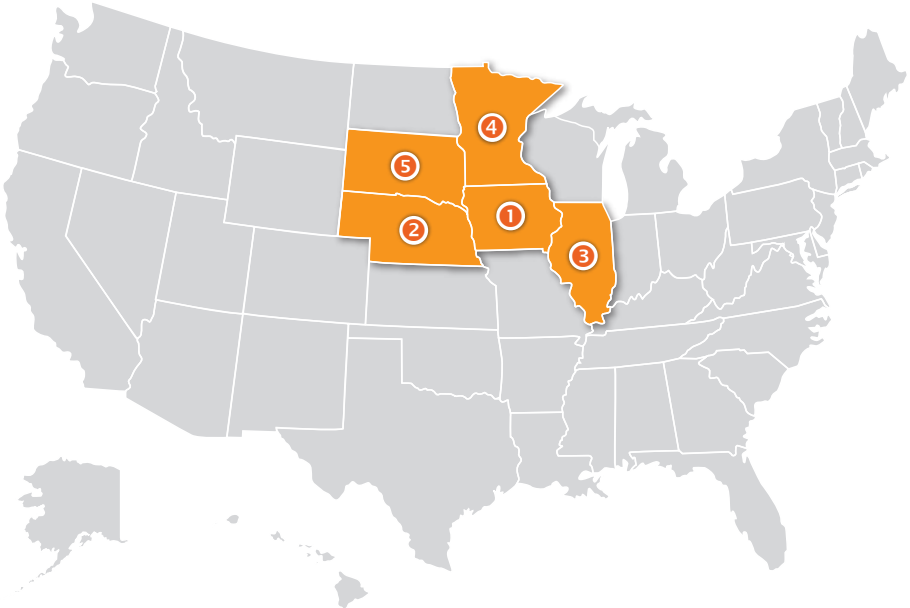


XI

Note: prices are inclusive of taxes.

Sources: RFA, EERE, EIA

U.S. Corn Ethanol Production Capacity



Top Five States for U.S. Ethanol (operating) Production Capacity in 2011 (millions of gallons/year)	
1 Iowa	3,625
2 Nebraska	1,973
3 Illinois	1,486
4 Minnesota	1,129
5 South Dakota	1,009

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Note: No sugarcane ethanol is currently produced in the United States.
Source: RFA

U.S. Corn Ethanol Production Capacity

Total U.S. Ethanol Operating Production Capacity (2011):

14,114 million gallons/year

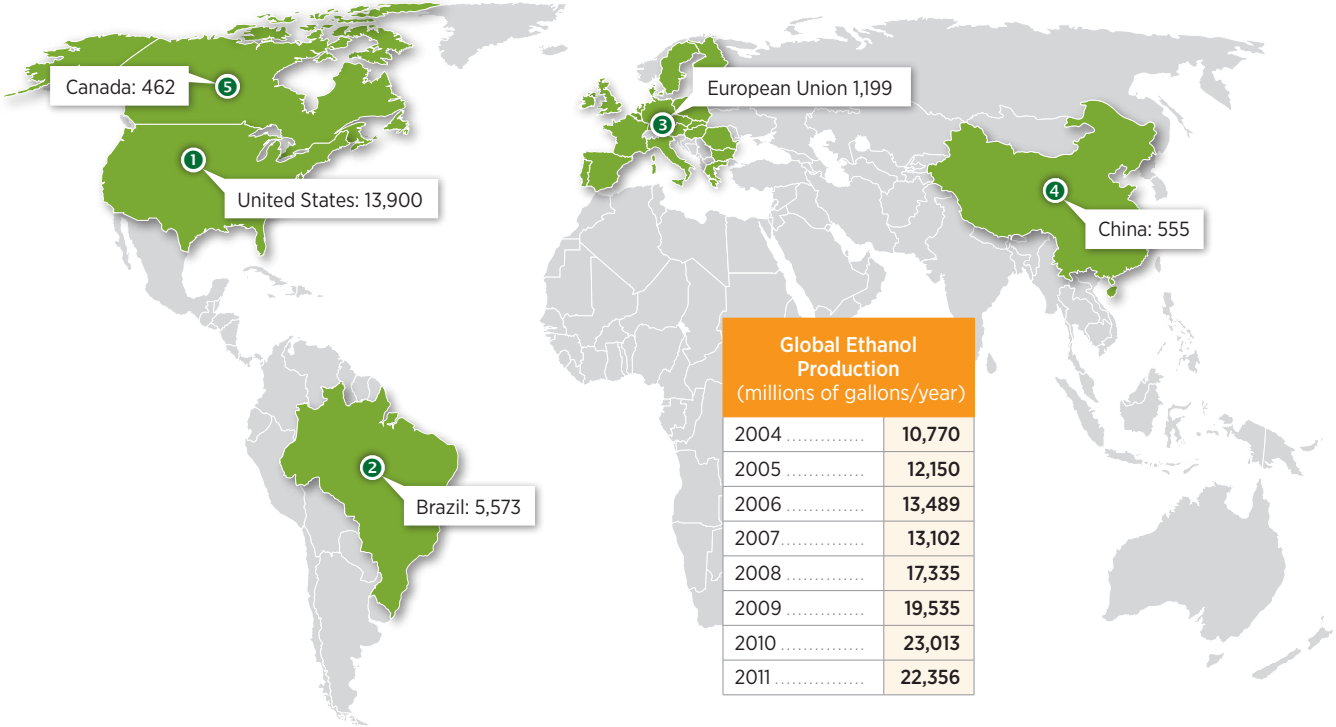
Top Five Ethanol Companies —Production Capacity 2011 (millions of gallons/year)	
1 Archer Daniels Midland Co.	1,750
2 Poet Biorefining	1,629
3 Valero Renewable Fuels	1,130
4 Green Plains Renewable Energy	730
5 Flint Hills Resources	435

XI

Source: RFA

Global Ethanol* Production

Top Five Countries (2011) **Ethanol Production** (millions of gallons/year)



Global Ethanol Production (millions of gallons/year)	
2004	**10,770**
2005	**12,150**
2006	**13,489**
2007	**13,102**
2008	**17,335**
2009	**19,535**
2010	**23,013**
2011	**22,356**

* Various feedstocks
Source: RFA

Renewable and Alternative Fuels – Biodiesel: Summary

- Biodiesel has expanded from a relatively small production base in 2000, to a total United States production of **1 billion gallons** in 2011. However, biodiesel is still a small percentage of the alternative fuel pool in the U.S., as 13 times more ethanol was produced in 2011.

- Biodiesel production in the United States in 2011 is **214 times** what it was in 2001.

- The United States leads the world in biodiesel production, followed by Germany, Argentina, Brazil, and France.

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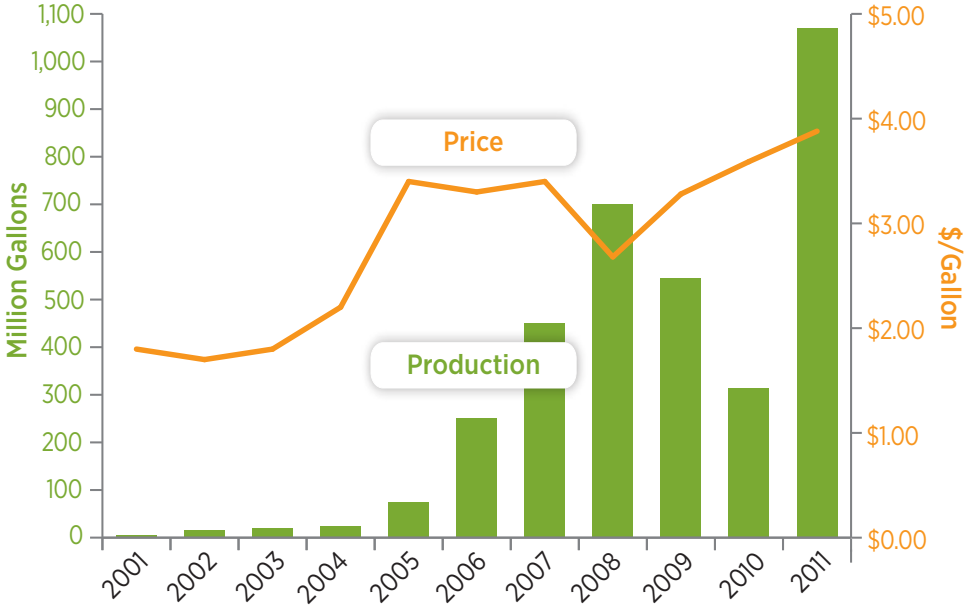
- Worldwide, biodiesel production globally grew more than 12% from 2010 to 2011.

U.S. Biodiesel Production and Price (2000–2011)



	Biodiesel Price (gasoline gallon equivalent basis) ($ per gallon)	Total U.S. Production (million gallons)
2001	1.80	5
2002	1.70	15
2003	1.80	20
2004	2.20	25
2005	3.40	75
2006	3.30	250
2007	3.40	450
2008	2.68	700
2009	3.28	545
2010	3.59	315
2011	3.88	1,070

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Sources: Biodiesel.org, EERE

U.S. Biodiesel Production Capacity

Total U.S. Biodiesel Production Capacity (2011): 1,404 million gallons/year

Top Five Biodiesel Companies — Production Capacity 2011 (millions of gallons/year)	
1 Renewable Energy Group, Inc	212
2 Renewable Biofuels, Inc	180
3 Imperium Renewables, Inc	100
4 Green Earth Fuels, LLC	90
5 Archer Daniels Midland Company	85

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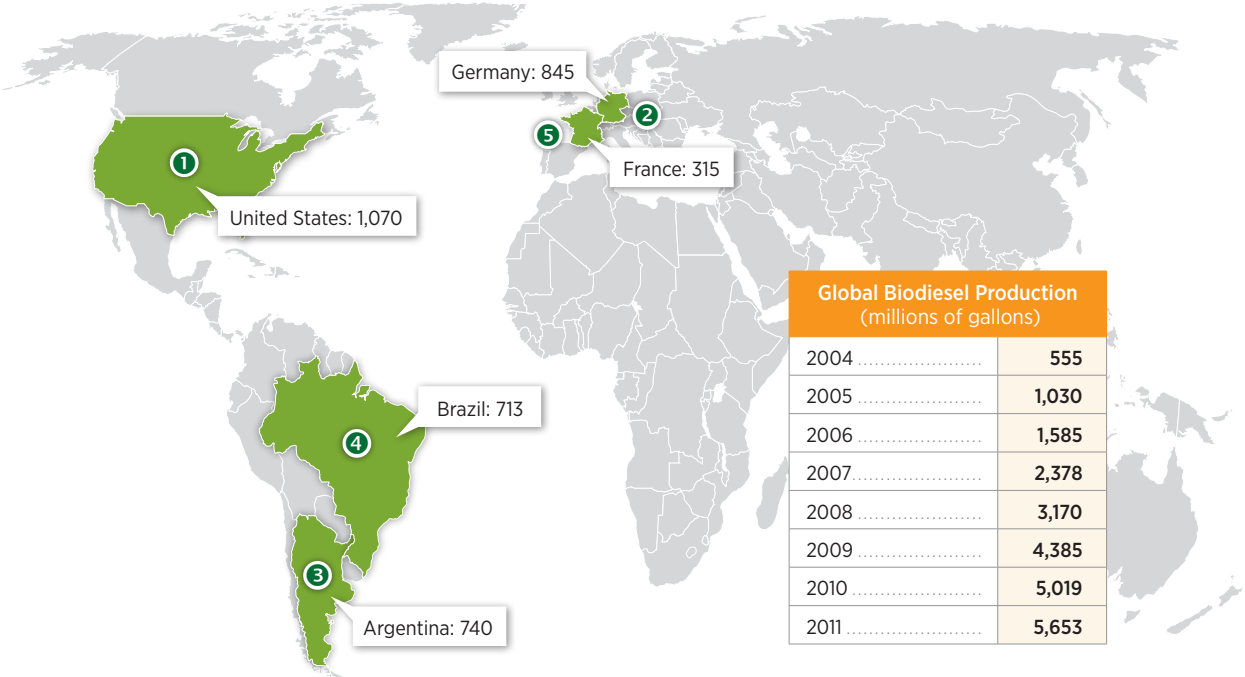
Sources: Biodiesel.org, REG, Renewable Biofuels Inc, Imperium Renewables, Green Earth Fuels LLC, ADM

Global Biodiesel Production

Top Five Countries (2011) **Biodiesel Production** (millions of gallons)



Global Biodiesel Production (millions of gallons)	
2004	555
2005	1,030
2006	1,585
2007	2,378
2008	3,170
2009	4,385
2010	5,019
2011	5,653

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Source: REN21

XII. Clean Energy Investments

Clean Energy Investments: Summary

- U.S. investment in renewable energy has grown dramatically in the past decade, and in **2011 annual investment reached more than $35 billion**.

- U.S. investment in wind energy projects **grew from $378 million in 2001 to more than $5 billion in 2011**.

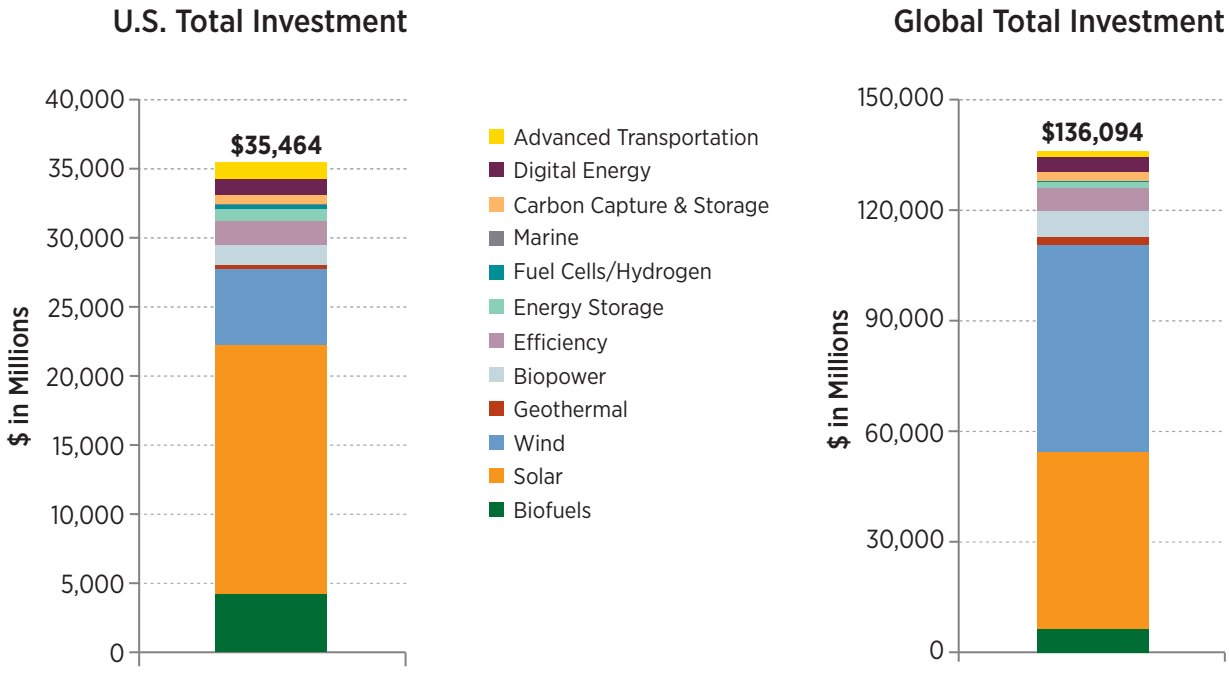
- In 2011, U.S. venture capital and private equity investment in renewable energy technology companies was nearly **$7 billion—up from $253 million in 2001**.

- U.S. venture capital and private equity investment in solar technology companies has **increased from $50 million in 2001 to more than $1.7 billion in 2011**.

XII

*All figures in 2011 real dollars.

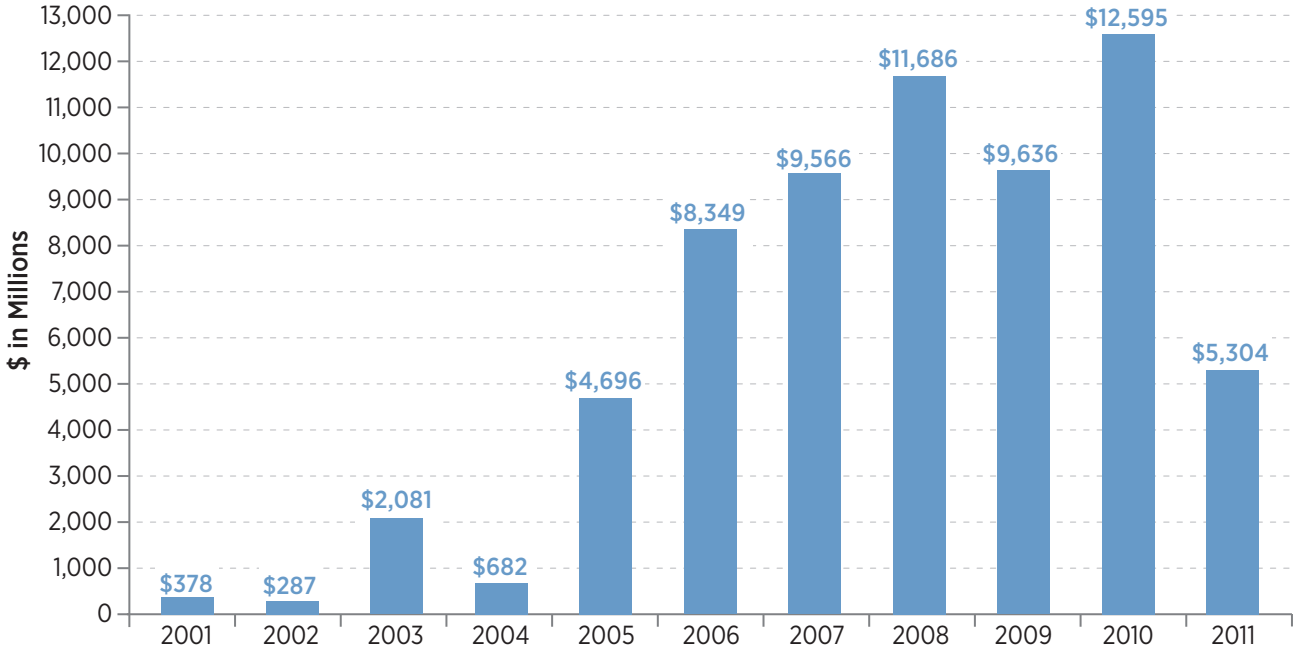
U.S. and Global Total Investment in Renewable Energy (2011)



XII

Source: Bloomberg New Energy Finance
Completed and disclosed deals only. Does not adjust for undisclosed transactions.
Includes VC/PE, public market activity, and asset financing.

U.S. Wind Energy Project Asset Financing Transactions (2001–2011)

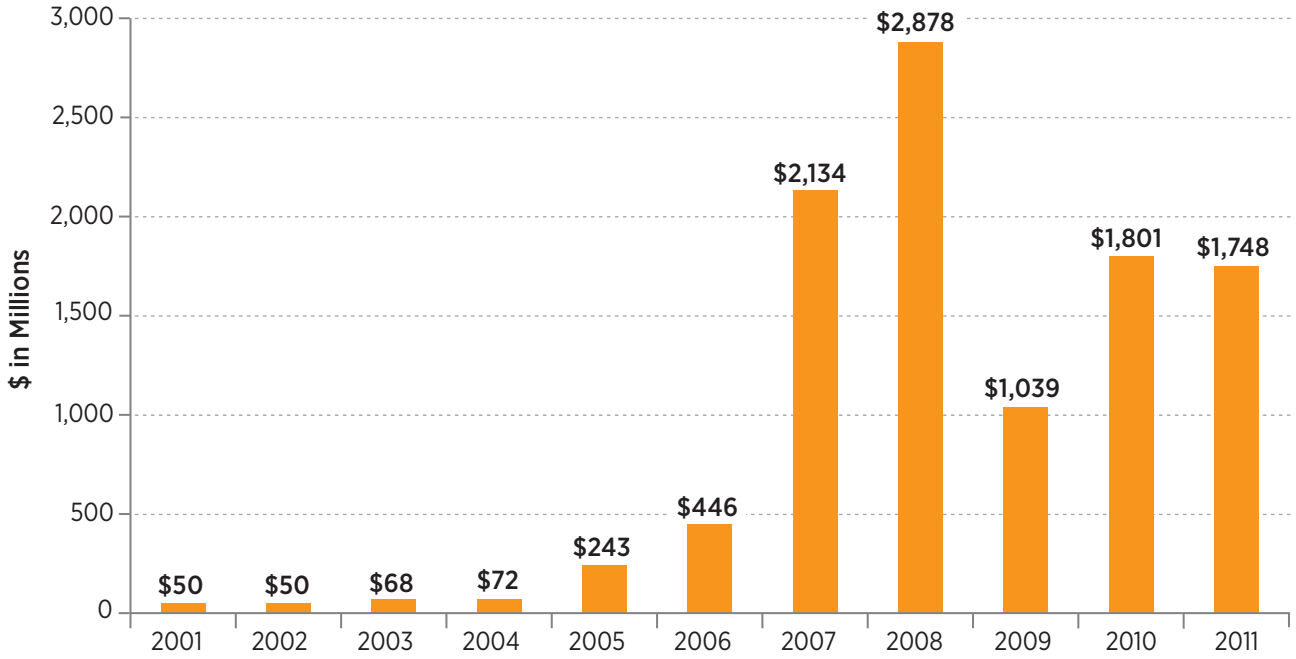


XII

*All figures in 2011 real dollars.

Figures represent disclosed deals derived from Bloomberg New Energy Finance's Desktop database.

U.S. Venture Capital and Private Equity Investment in Solar Energy Technology Companies (2001–2011)



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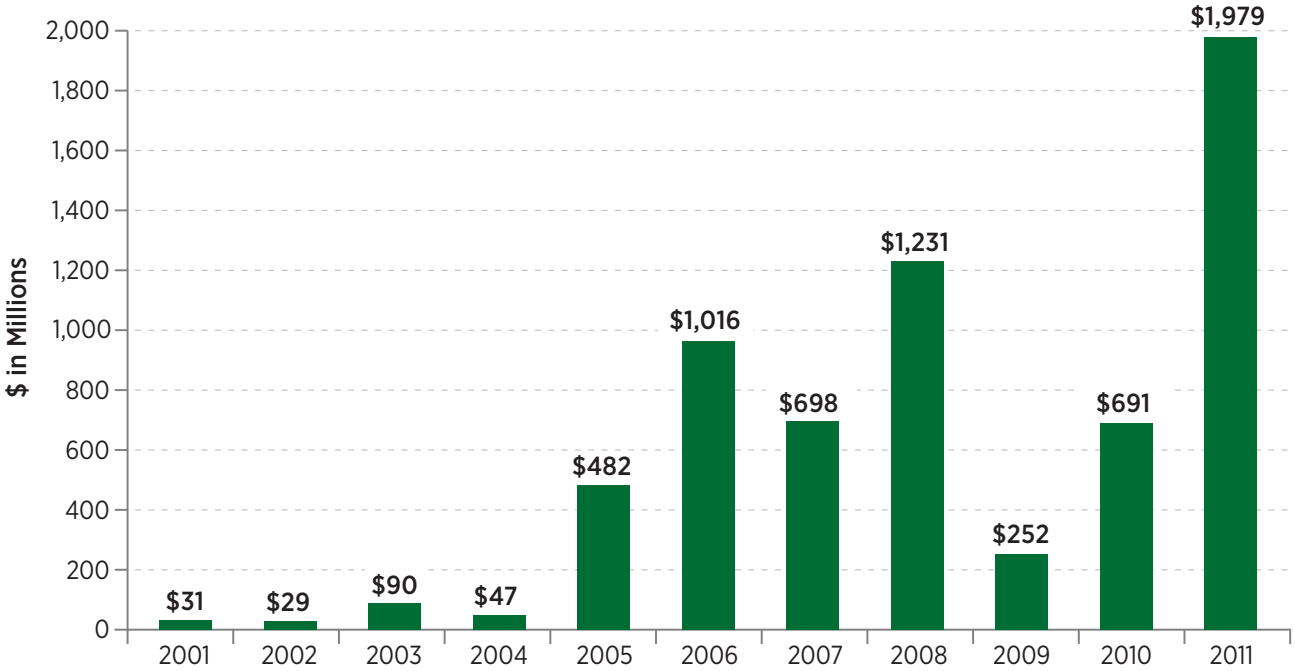
*All figures in 2011 real dollars.

Figures represent disclosed deals derived from Bloomberg New Energy Finance's Desktop database.

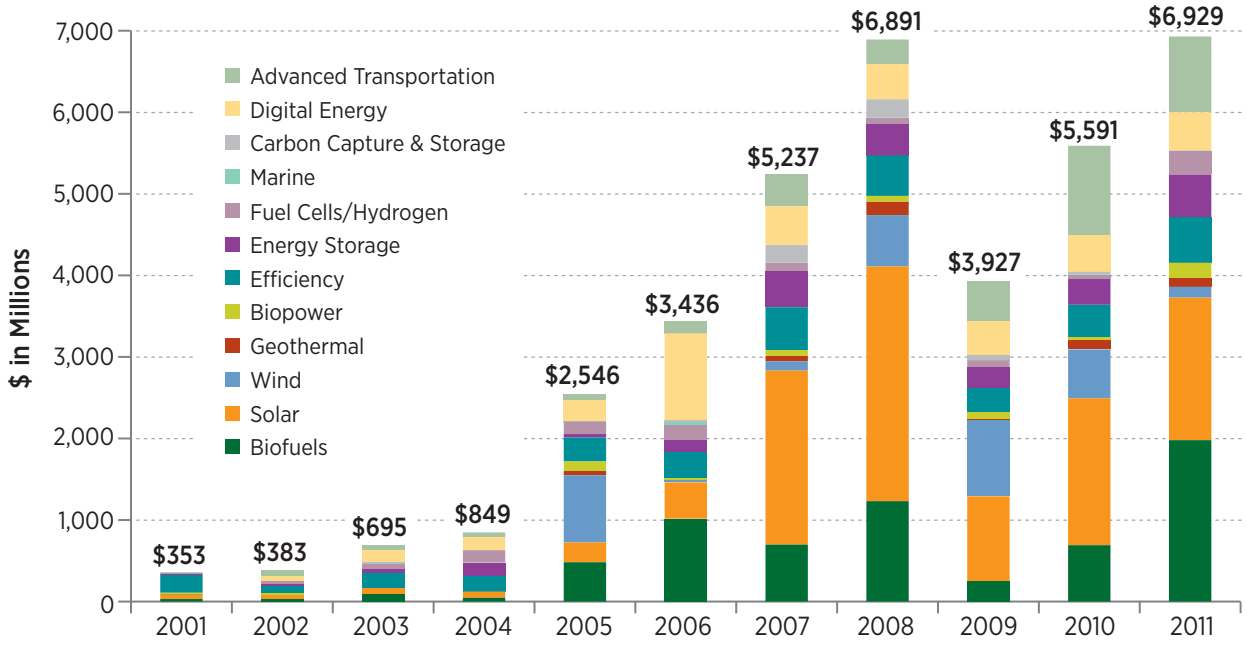
U.S. Venture Capital and Private Equity Investment in Biofuels Technology Companies (2001–2011)



*All figures in 2011 real dollars.

Figures represent disclosed deals derived from Bloomberg New Energy Finance's Desktop database.

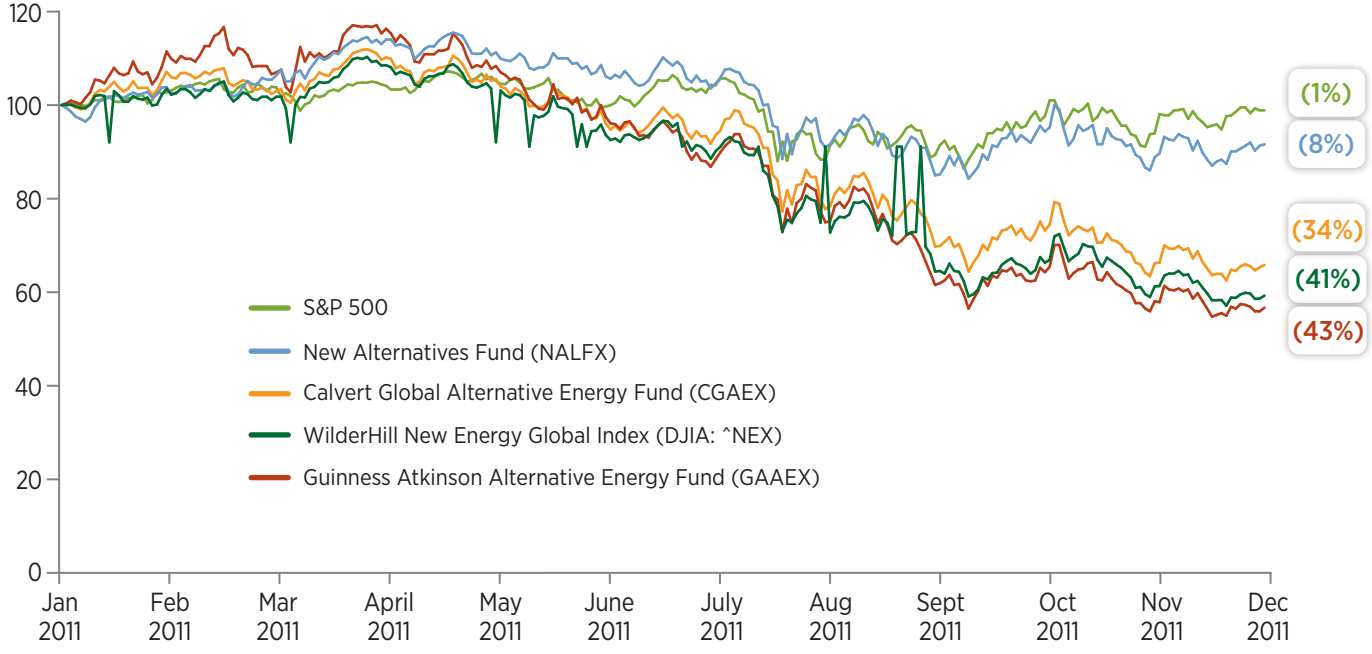
U.S. Venture Capital and Private Equity Investment in Renewable Energy Technology Companies (2001–2011)



*All figures in 2011 real dollars.

Figures represent disclosed deals derived from Bloomberg New Energy Finance's Desktop database.

Public Renewable Energy Index Performance (2011) (Indexed to 100)



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Public data

Index performance is calculated as a percentage of the fund or index price as of January 2, 2011. The four indices and funds shown above experienced declines in price while the S&P 500 remained relatively stable in 2011.

B20

A fuel containing a mixture of 20 percent biodiesel and 80 percent petrodiesel.

Baseload Capacity

The generating equipment normally operated to serve loads on an around-the-clock basis.

Biodiesel

Any liquid biofuel suitable as a diesel fuel substitute or diesel fuel additive or extender. Biodiesel fuels are typically made from oils such as soybeans, rapeseed, or sunflowers; or from animal tallow. Biodiesel can also be made from hydrocarbons derived from agricultural products such as rice hulls.

Biofuels

Liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation.

Biomass

Organic non-fossil material of biological origin.

British Thermal Unit (Btu)

The quantity of heat required to increase the temperature of 1 pound of liquid water by 1 degree Fahrenheit at the temperature at which water has its greatest density (approximately 39 degrees Fahrenheit).

Capacity Factor

The ratio of the electrical energy produced by a generating unit for a given period of time to the electrical energy that could have been produced at continuous full power operation during the same period.

Compound Annual Growth Rate

The year-over-year growth rate applied during a multiple-year period. The formula for calculating CAGR is (Current Value/ Base Value)^(1/# of years) - 1.

Concentrated Solar Power (CSP)

A solar energy conversion system characterized by the optical concentration of solar rays through an arrangement of mirrors to heat working fluid to a high temperature. Concentrated solar power (but not solar thermal power) may also refer to a system that focuses solar rays on a photovoltaic cell to increase conversion efficiency.

E85

A fuel containing a mixture of 85 percent ethanol and 15 percent gasoline.

Ethanol

A clear, colorless, flammable oxygenated hydrocarbon. Ethanol is typically produced chemically from ethylene, or biologically from fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. It is used in the United States as a gasoline octane enhancer and oxygenate (blended up to 10 percent concentration). Ethanol can also be used in high concentrations (E85) in vehicles designed for its use.

Federal Energy Regulatory Commission (FERC)

The federal agency with jurisdiction over interstate electricity sales, wholesale electric rates, hydroelectric licensing, some natural gas pricing, oil pipeline rates, and gas pipeline certification. FERC is an independent regulatory agency within the Department of Energy (DOE) and is the successor to the Federal Power Commission.

Flexible-Fuel Vehicles

Vehicles that can operate on (1) alternative fuels (such as E85); (2) 100 percent petroleum-based fuels; (3) any mixture of an alternative fuel (or fuels) and a petroleum-based fuel. Flexible-fuel vehicles have a single fuel system to handle alternative and petroleum-based fuels.

Fuel Cell

A device that produces electricity by converting the chemical energy of a fuel (e.g., hydrogen) directly into electrical energy. Fuel cells differ from conventional electrical cells in that the active materials such as fuel and oxygen are not contained within the cell but are supplied from outside. It does not contain an intermediate heat cycle, as do most other electrical generation techniques.

Generation

The total amount of electric energy produced by generating units and measured at the generating terminal in kilowatt-hours (kWh) or megawatt-hours (MWh).

Geothermal Energy

The heat that is extracted from hot water or steam that is mined from geothermal reservoirs in the earth's crust. Water or steam can be used as a working fluid for geothermal heat pumps, water heating, or electricity generation, and then is injected back into the earth.

Geothermal Heat Pump

A heat pump in which the refrigerant exchanges heat (in a heat exchanger) with a fluid circulating through an earth connection medium (ground or ground water). The fluid is contained in a variety of loop (pipe) configurations depending on the temperature of the ground and the ground area available. Loops may be installed horizontally or vertically in the ground or submersed in a body of water.

Gigawatt (GW)

One billion watts or one thousand megawatts or one million kW.

Gigawatt-hour (GWh)

One billion watt-hours.

Incremental Capacity

Capacity added on an annual basis.

Insolation

The amount of radiation from the sun received at the surface of the Earth in a particular geographic location or region.

Kilowatt (kW)

One thousand watts.

Kilowatt-hour (kWh)

A measure of electrical energy defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour. One kWh is equivalent to 3,412 Btu.

Landfill Gas

Gas that is generated by decomposition of organic material at landfill disposal sites. The average composition of landfill gas is approximately 50% methane and 50% carbon dioxide and water vapor by volume. The methane in landfill gas may be vented, flared, or combusted to generate electricity or useful thermal energy on-site, or injected into a pipeline for combustion off-site.

Megawatt (MW)

One million watts of electricity.

Megawatt-hour (MWh)

One thousand kilowatt-hours or 1 million watt-hours.

Municipal Solid Waste (MSW)

Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes.

Nameplate Capacity

The maximum rated output of a generator under specific conditions designated by the manufacturer. Nameplate capacity is usually indicated in units of kilovolt-amperes (kVA) and in kilowatts (kW) on a nameplate physically attached to the generator.

Ocean Energy

Energy conversion technologies that harness the energy in tides, waves, and thermal gradients in the oceans.

Photovoltaic (PV) Cell

PV cells convert incident light directly into electricity (direct current). An electronic device consisting of layers of semiconductor materials fabricated to form a junction (adjacent layers of materials with different electronic characteristics) and electrical contacts.

Pumped-Storage Hydroelectric Plant

A plant that usually generates electric energy during peak load periods by using water previously pumped into an elevated storage reservoir during off-peak periods when excess generating capacity is available to do so.

Renewable Energy Resources

Energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include: biomass, hydro, geothermal, solar, wind, and ocean energy.

Solar Thermal Collector

A device designed to receive solar radiation and convert it to thermal energy. Normally, a solar thermal collector includes a frame, glazing, and an absorber, together with appropriate insulation. The heat collected by the solar collector may be used immediately or stored for later use. Solar collectors are used for space heating; domestic hot water heating; and heating swimming pools, hot tubs, or spas.

Solar Thermal Electric Generation (STEG)

Conversion of solar energy to electricity using various technologies to heat a working fluid to power a turbine that drives a generator. Examples of these systems include central receiver systems, parabolic dish, and solar trough.

Thermoelectric Power Plant

A term used to identify a type of electric generating station, capacity, capability, or output in which the source of energy for the prime mover is heat.

Wind Energy

Kinetic energy present in wind motion that can be converted to mechanical energy for driving pumps, mills, and electric power generators.

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DOE/GO-102012-3598
October 2012

Prepared by the National Renewable Energy Laboratory (NREL)
NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

Printed with a renewable-source ink on paper containing at
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