U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

2017 Renewable Energy Data Book

Including Data and Trends for Energy Storage and Electric Vehicles

Acknowledgments

This data book was produced by Sam Koebrich, Emily Chen, Thomas Bowen, Sydney Forrester, and Tian Tian; edited by Mike Meshek; and designed by Stacy Buchanan of the National Renewable Energy Laboratory (NREL). We greatly appreciate the input, review, and support of Gian Porro, Jaquelin Cochran, Philipp Beiter, Jeff Logan, and Rich Tusing (NREL); David Gohlke and Yan (Joann) Zhou (Argonne National Laboratory); Steve Capanna, Ookie Ma, Paul Spitsen, Ian Hamos, Dave Rench-McCauley, Patrick Gilman, Josh Mengers, David Hume, Allison Johnson, Hoyt Battey, Fred Joseck, Rachael Nealer, Heather Croteau, Katherine McMahon, and Zia Haq (U.S. Department of Energy).

Notes

Capacity data are reported in watts (typically megawatts and gigawatts) of alternating current (AC) unless indicated otherwise.

The primary data represented and synthesized in the 2017 Renewable Energy Data Book come from the publicly available data sources identified on page 136.

Solar photovoltaic generation data include all grid-connected utility-scale and distributed photovoltaics. Total U.S. power generation numbers in this data book may differ from those reported by the U.S. Energy Information Administration (EIA) in the Electric Power Monthly and Monthly Energy Review. Reported U.S. wind capacity and generation data do not include smaller, customer-sited wind turbines (i.e., distributed wind).

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Key Findings

- **Overall U.S. energy consumption increased slightly** to 97.7 quadrillion British thermal units (Btu) in 2017—a **0.2% increase** from 2016. Compared to 2016, energy consumption increased in 2017 for renewables (+7.4%) and petroleum (+0.6%). Consumption decreased for natural gas (-1.4%), nuclear (-0.1%), and coal (-2.6%).
- U.S. **electric power sector energy consumption** continued its decline, dropping to 37.2 quadrillion Btu in 2017, a **1.3% decline** from 2016.
- In 2017, U.S. **renewable electricity**[1] **grew to 19.7% of total installed capacity and 17.7% of total electricity generation**. Installed renewable electricity capacity exceeded 232 gigawatts (GW) in 2017, generating 715 terawatt-hours (TWh).
- **U.S. hydropower produced over 41.9% of total renewable electricity generation**, **wind produced more than 35%**, **solar (photovoltaic [PV] and concentrating solar power [CSP])**[2] **produced more than 11%**, **biomass produced nearly 9%**, **and geothermal produced more than 2%**.
- In 2017, **renewable electricity accounted for 60% of U.S. electricity capacity additions,** compared to 67% in 2016. **Coal-fired generation comprised nearly 54% (6.9 GW) of retirements** in 2017.[3]

Source: U.S. Energy Information Administration (EIA); full references are provided beginning on page 123.

[1] Renewable electricity includes solar, wind, geothermal, hydropower, and biopower unless indicated otherwise.

[2] Reported solar data combine utility-scale PV, distributed PV, and CSP unless indicated otherwise.

[3] Retired Resources are those listed in EIA Form 860 as retired. Other decreases in capacity such as nameplate capacity reductions, or converting a resource to a different fuel type are not included in retirements. In total, U.S. operable coal capacity declined by 11.2 GW in 2017.

Key Findings (continued)

- In 2017, **U.S. wind *capacity* increased by more than 8.3% (6.8 GW)**, accounting for **more than 43% of renewable electricity capacity installed**. U.S. **wind *generation* increased by 12%** compared to 2016, and it reached a total of 254 TWh by the end of 2017.
- **U.S. solar electricity *capacity* increased by 26% (8.9 GW_{AC}[1])**, accounting for **more than 56% of newly installed U.S. renewable electricity capacity** in 2017.[2] **Solar *generation* reached a total of 81 TWh** in 2017.
- **U.S. hydropower capacity remained relatively stable** from 2000 to 2017. **U.S. biomass and geothermal electricity capacities saw slight decreases (-66 MW and -72 MW respectively)** in 2017.
- **Installed *global* renewable electricity capacity** continued to increase, and it **represented 32.2% of total electricity capacity worldwide** in 2017.
- In 2017, solar PV continued to be one of the fastest-growing technologies worldwide with a **32.7% *global* capacity increase**.
- **Globally, new investments in clean energy in 2017 increased by 3%** from 2016 to $333 billion.

Sources: EIA and SEIA/GTM

[1] Solar generator capacity estimates are derived from EIA-860 compliance reporting for generators greater than 1 MW in capacity. Smaller solar generator capacity is based on data from the Solar Energy Industries Association/Greentech Media (SEIA/GTM) *Solar Market Insight 2017 Year-in-Review* report.

[2] Capacity data are reported in watts of alternating current (AC) unless indicated otherwise. While EIA-860 reports utility-scale solar capacity in MW_{AC}, SEIA/GTM reports small-scale grid-connected PV capacity in MW_{DC}. The solar industry typically reports capacity in MW_{DC}. Based on consultation with developers, SEIA/GTM use an 87% MW_{DC}-to-MW_{AC} derate factor for small-scale generators. The data book uses the 87% derate factor when small-scale capacity figures are added to a cumulative MW_{AC} total.

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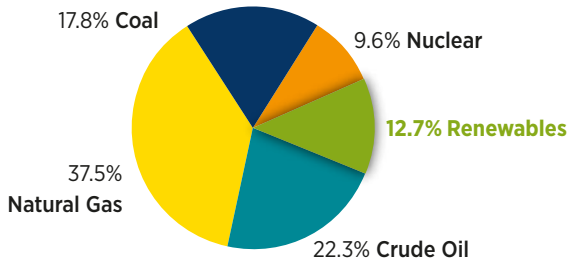
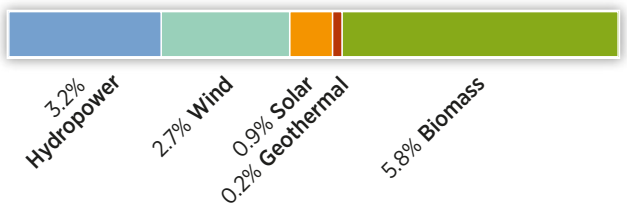
U.S. Energy Production and Consumption (2017)

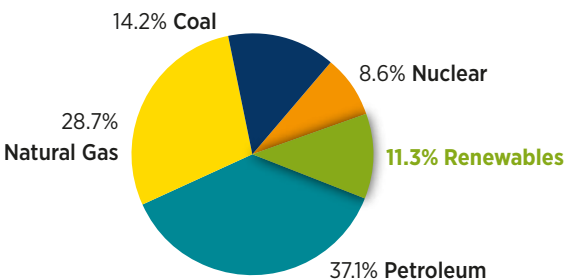
U.S. Energy Production (2017): 87.6 Quadrillion Btu



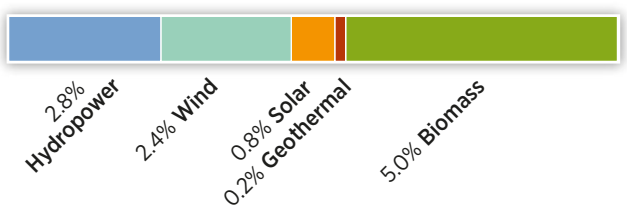
U.S. Renewable Energy Production: 11.1 Quadrillion Btu



U.S. Energy Consumption (2017): 97.7 Quadrillion Btu



U.S. Renewable Energy Consumption: 11.0 Quadrillion Btu



Source: EIA

The difference in the amount of energy consumed and produced is made up by net imports and changes in stockpiles of energy. All data are reported as primary energy. Reported values may vary from those included in previous editions of the *Renewable Energy Data Book* (data book) due to retroactive changes by EIA.

U.S. Energy Production by Energy Source

	Coal	Natural Gas[1]	Crude Oil	Nuclear	Renewables	Total Production (Quadrillion Btu)
2007	32.9%	31.1%	15.0%	11.8%	9.1%	71.4
2008	32.6%	31.6%	14.5%	11.5%	9.8%	73.2
2009	29.8%	32.6%	15.6%	11.5%	10.5%	72.6
2010	29.4%	32.8%	15.5%	11.3%	11.0%	74.8
2011	28.5%	33.8%	15.3%	10.6%	11.8%	78.0
2012	26.1%	35.1%	17.4%	10.2%	11.2%	79.3
2013	24.4%	34.7%	19.3%	10.1%	11.5%	81.9
2014	23.1%	35.1%	21.1%	9.5%	11.1%	87.7
2015	20.3%	37.0%	22.3%	9.5%	10.9%	88.2
2016	17.4%	38.4%	22.0%	10.0%	12.2%	84.4
2017	17.8%	37.5%	22.3%	9.6%	12.7%	87.6

Source: EIA

Annual totals may not equal 100% due to rounding.

Reported values may vary from those included in previous editions of the data book due to retroactive changes by EIA.

[1] Includes natural gas liquids.

U.S. Energy Consumption by Energy Source

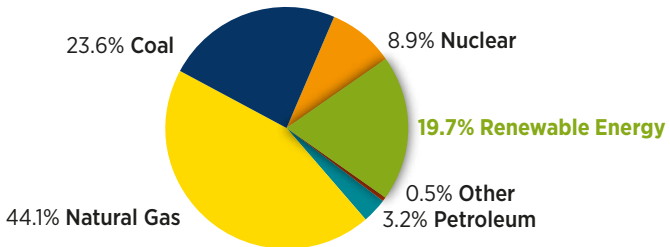
	Coal	Natural Gas	Petroleum	Nuclear	Renewables	Total Consumption (Quadrillion Btu)
2007	22.5%	23.4%	39.1%	8.4%	6.5%	101.0
2008	22.6%	24.1%	37.3%	8.5%	7.3%	98.9
2009	20.9%	24.9%	37.1%	8.9%	8.1%	94.1
2010	21.4%	25.2%	36.4%	8.6%	8.4%	97.6
2011	20.3%	25.7%	35.9%	8.5%	9.4%	97.0
2012	18.4%	27.6%	36.0%	8.5%	9.3%	94.5
2013	18.5%	27.5%	35.6%	8.5%	9.7%	97.3
2014	18.3%	27.8%	35.4%	8.5%	9.9%	98.5
2015	15.9%	28.9%	36.5%	8.5%	9.9%	97.5
2016	14.6%	29.2%	36.9%	8.6%	10.5%	97.6
2017	14.2%	28.7%	37.1%	8.6%	11.3%	97.7

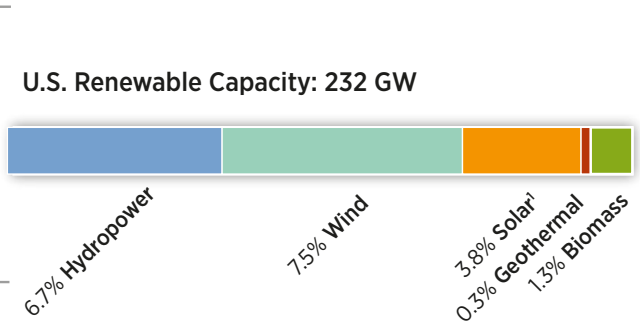
Source: EIA

Reported values may vary from those included in previous editions of the data book due to retroactive changes by EIA.

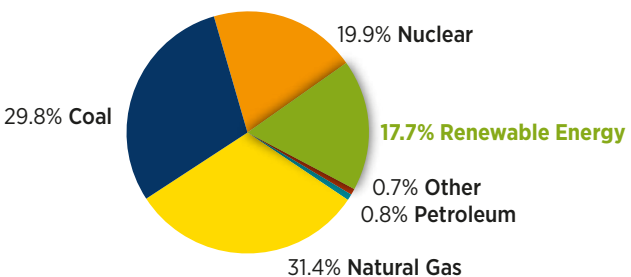
U.S. Electricity Nameplate Capacity and Generation (2017)

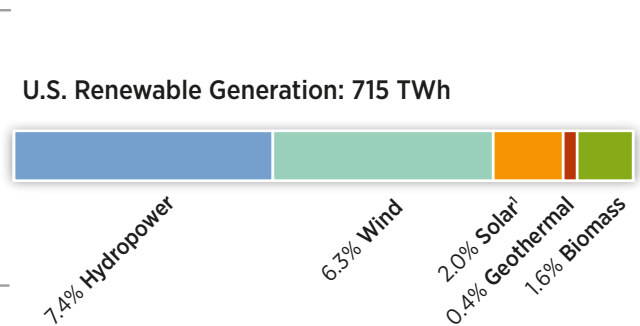
U.S. Electric Nameplate Capacity (2017): 1,184 GW





U.S. Electric Net Generation (2017): 4,049 TWh





Sources: EIA, Lawrence Berkeley National Laboratory (LBNL), and SEIA/GTM Research (GTM)

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

Totals and percentages may not correspond due to rounding.

[1]Grid-connected only; Previous editions of the data book used a fixed capacity factor (18%) to calculate PV generation; this year's data book introduces (1) estimations from the Distributed Generation module of the EIA's National Energy Modelling System (DG NEMS) for small-scale PV and (2) utility-scale PV generation from EIA's Electric Power Monthly.

U.S. Electricity Generating Capacity by Source

	Coal	Petroleum	Natural Gas	Other Gases	Nuclear	Renewables[1]	Other	Total Capacity (MW)
2007	31.5%	5.8%	42.1%	0.2%	9.9%	10.3%	0.1%	1,067,160
2008	30.5%	5.6%	41.4%	0.2%	9.6%	11.1%	0.1%	1,083,237
2009	30.7%	5.7%	41.8%	0.1%	9.7%	11.9%	0.1%	1,102,544
2010	30.6%	5.6%	41.6%	0.1%	9.5%	12.3%	0.3%	1,120,271
2011	30.3%	5.1%	42.1%	0.1%	9.4%	12.8%	0.1%	1,135,384
2012	29.2%	4.7%	42.3%	0.1%	9.4%	14.2%	0.2%	1,151,303
2013	28.7%	4.3%	42.6%	0.1%	9.1%	14.8%	0.2%	1,147,532
2014	28.1%	4.0%	42.7%	0.2%	9.0%	15.7%	0.3%	1,159,023
2015	26.4%	3.7%	43.6%	0.2%	9.0%	17.0%	0.2%	1,156,672
2016	24.8%	3.4%	43.8%	0.2%	9.0%	18.6%	0.2%	1,169,675
2017	23.6%	3.2%	44.1%	0.2%	8.9%	19.7%	0.3%	1,183,804

Sources: EIA, LBNL, and SEIA/GTM

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

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1] Grid-connected PV only. This does not include off-grid installations, but does include distributed photovoltaics capable of exporting power to distribution or transmission systems.

U.S. Electricity Generation by Source

	Coal	Petroleum Liquids	Petroleum Coke	Natural Gas	Other Gases	Nuclear	Renewables[1]	Other	Total Generation (GWh)
2007	48.4%	1.2%	0.4%	21.5%	0.3%	19.4%	8.5%	0.3%	4,163,642
2008	48.1%	0.8%	0.3%	21.4%	0.3%	19.5%	9.2%	0.3%	4,125,675
2009	44.4%	0.7%	0.3%	23.3%	0.3%	20.2%	10.6%	0.3%	3,955,540
2010	44.7%	0.6%	0.3%	23.9%	0.3%	19.5%	10.4%	0.3%	4,131,520
2011	42.2%	0.4%	0.3%	24.7%	0.3%	19.2%	12.5%	0.3%	4,107,981
2012	37.3%	0.3%	0.2%	30.2%	0.3%	19.0%	12.3%	0.3%	4,054,880
2013	38.8%	0.3%	0.3%	27.6%	0.3%	19.3%	13.0%	0.3%	4,079,349
2014	38.5%	0.4%	0.3%	27.4%	0.3%	19.4%	13.4%	0.3%	4,111,724
2015	33.0%	0.4%	0.3%	32.5%	0.3%	19.4%	13.7%	0.3%	4,098,815
2016	30.2%	0.3%	0.6%	33.6%	0.3%	19.6%	15.4%	0.3%	4,104,518
2017	29.8%	0.3%	0.5%	31.4%	0.3%	19.9%	17.7%	0.3%	4,049,365

Sources: EIA and SEIA/GTM

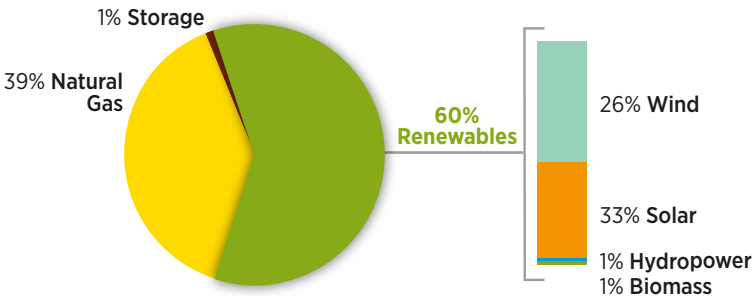
Other includes pumped storage, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies.

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

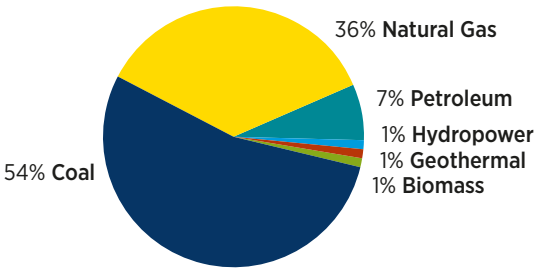
[1] Grid-connected PV only.

U.S. Electricity Generating Capacity Additions and Retirements (2017)

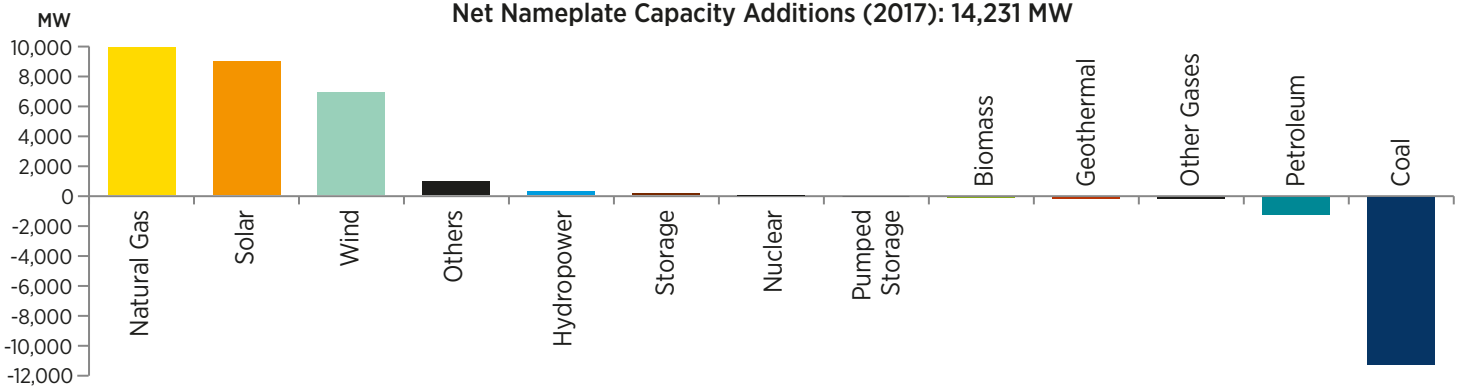
Capacity Additions (2017): 27,133 MW



Capacity Retirements (2017): 12,891 MW



Net Nameplate Capacity Additions (2017): 14,231 MW



Source: EIA

Other includes batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies. Capacity additions and retirements below 1% of total are not displayed.

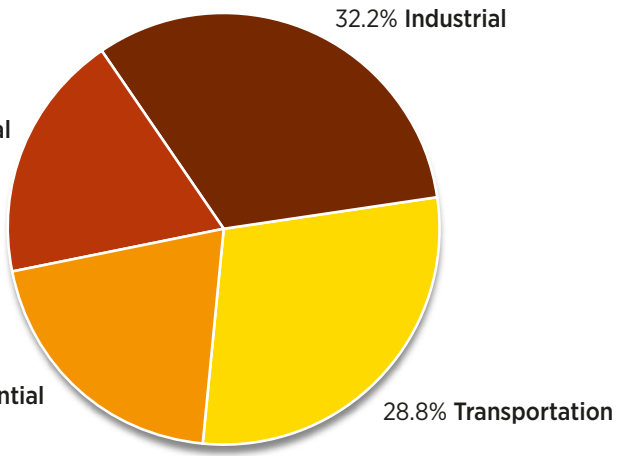
Totals may not equal 100% due to rounding.

Retired Resources are those listed in EIA Form 860 as retired which include generators that were canceled before project completion. Other decreases in capacity such as nameplate capacity reduction, or converting a resource to a different fuel type are not included in retirements.

U.S. Energy Consumption by Sector (2017)

U.S. Energy Consumption (2017): 97.7 Quadrillion Btu

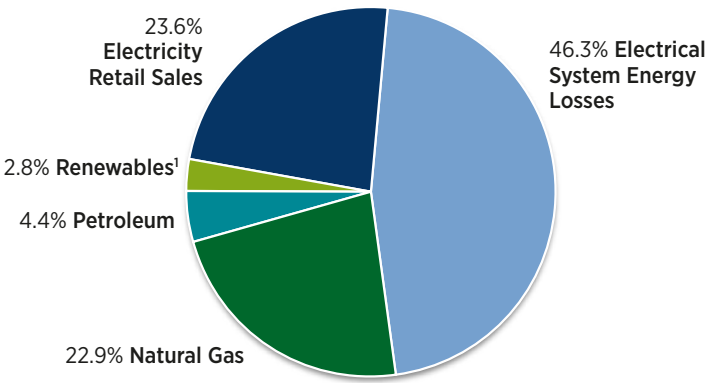
U.S. buildings represent 38.9% of total energy use (residential and commercial sectors combined).



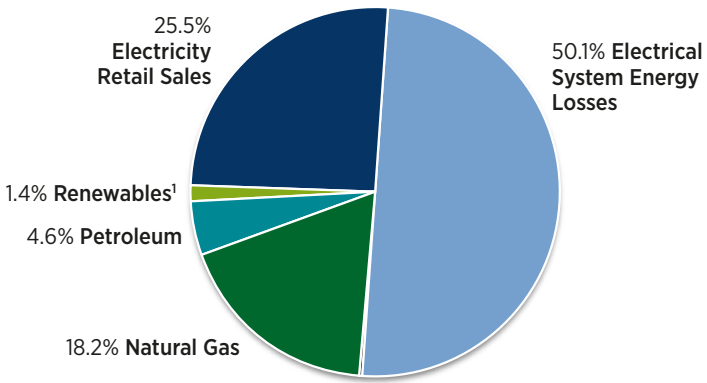
Source: EIA
Totals may not equal 100% due to rounding.

U.S. Energy Consumption – Residential and Commercial (2017)

2017 Residential Energy Consumption
20.0 Quadrillion Btu



2017 Commercial Energy Consumption
18.0 Quadrillion Btu



Source: EIA

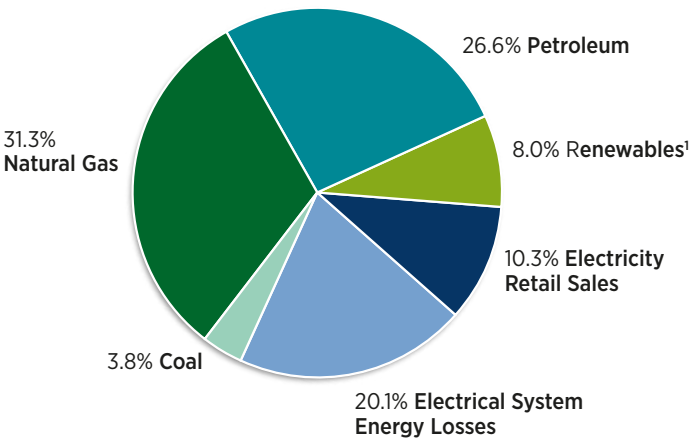
[1] The direct renewables contribution consists primarily of wood and wood-derived fuels, municipal solid waste, solar thermal direct-use energy and PV electricity net generation, and geothermal heat pump and direct-use energy.

U.S. Energy Consumption – Industry and Transportation (2017)

I

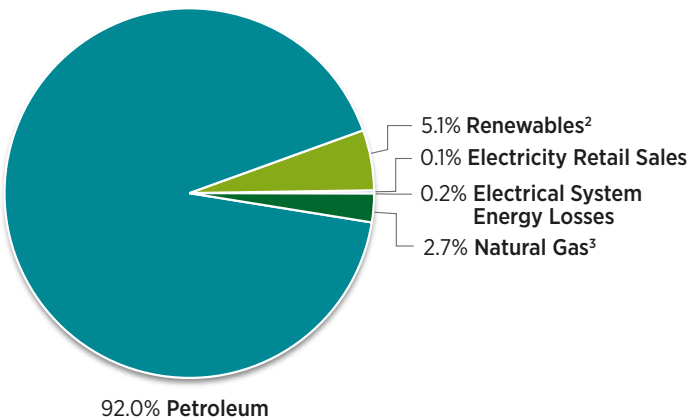
2017 Industrial Energy Consumption

31.5 Quadrillion Btu



2017 Transportation Energy Consumption

27.9 Quadrillion Btu



Source: EIA

[1] For industrial consumption, the direct renewables contribution consists primarily of wood and wood-derived fuels, municipal solid waste, and conventional hydropower.

[2] For transportation consumption, the direct renewables contribution consists primarily of fuel ethanol and biodiesel.

[3] For transportation consumption, more than 96% of natural gas is used in the operation of pipelines, primarily in compressors.

II. Renewable Electricity in the United States

Renewable Electricity in the United States: Summary

- Renewable electricity in 2017 was **19.7% of total installed electricity capacity and 17.7% of total annual generation in the United States**.
- Since 2007, cumulative installed renewable electricity capacity has grown 112%, from 110 GW to **more than 233 GW** in 2017. This growth is equivalent to an average of 12.3 GW installed capacity per year and a **7.8% per year** compound annual growth rate (CAGR).
- **U.S. renewable electricity capacity expanded by 7.3% (15.8 GW)** in 2017, down from a 10.5% (20.6 GW) increase in 2016.
- Overall, **renewable generation increased 13.4% in 2017, up from a growth rate of 12.5% in 2016**. Solar electricity generation increased by 40.4% (to 81 TWh) and wind electricity generation increased by 12.0% (to 254 TWh). Generation from hydropower increased by 12.0% (to 300 TWh).
- **U.S. annual electricity generation from solar and wind has increased by a factor of 10 since 2007**.

- **Wind capacity** grew 6.8 GW in 2017, **16% less than the 8.2 GW of growth in 2016.** Wind now represents **7.5% of U.S. cumulative installed electricity capacity.** In 2017, wind accounted for more than **43% of newly installed U.S. renewable electricity capacity** and **26% of newly installed electricity capacity from all generation sources.**

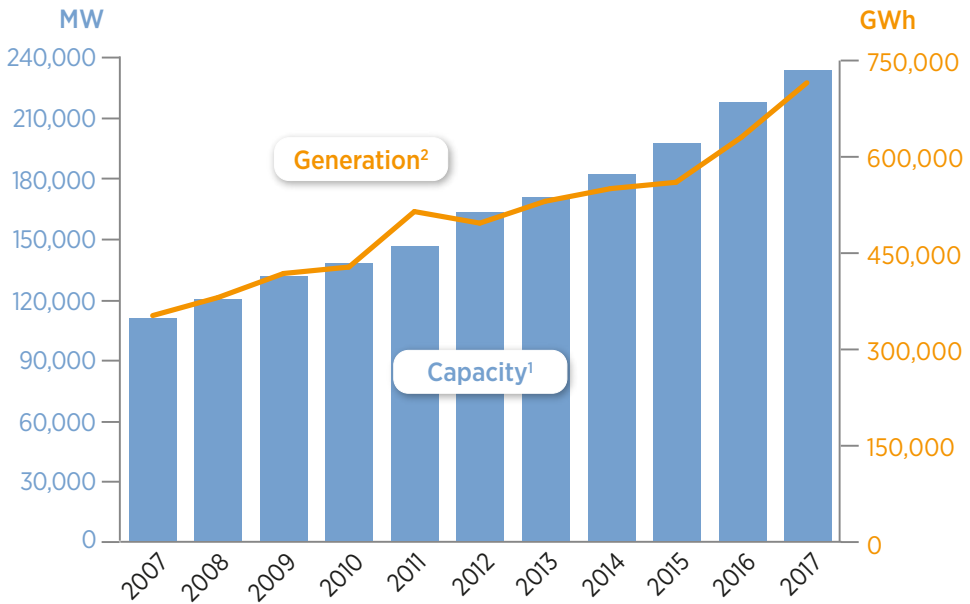
- **Solar PV**[1] **capacity** expanded by 8.9 GW_{AC} while CSP installed capacity remained constant during 2017. Solar electricity, including solar PV and CSP, represents **3.7% of U.S. cumulative installed electricity capacity.** In 2017, solar PV accounted for more than **54% of newly installed U.S. renewable electricity capacity** and **33% of newly installed electricity capacity from all generation sources**.

- **Combined wind and solar generation (335 TWh) exceeded production from hydropower (300 TWh)**.

- In 2017, **U.S. hydropower produced 41.9% of total renewable electricity generation, wind produced 35.5%, solar (PV and CSP) produced 11.3%, biomass produced 9.0%, and geothermal produced 2.2%**.

[1] Solar generator capacity estimates are derived from EIA-860 compliance reporting for generators greater than 1 MW in capacity. Smaller solar generator capacity is based on data from the Solar Energy Industries Association/Greentech Media (SEIA/GTM) Solar Market Insight 2017 Year-in-Review report.

U.S. Capacity and Generation: All Renewables



	Cumulative RE Nameplate Capacity[1] (MW)	Annual RE Generation[2] (GWh)
2000	**93,668**	**356,478**
2001	**95,239**	**287,730**
2002	**96,102**	**343,438**
2003	**97,765**	**355,291**
2004	**98,469**	**351,020**
2005	**101,374**	**357,650**
2006	**104,358**	**385,772**
2007	**110,044**	**352,748**
2008	**119,701**	**380,932**
2009	**130,890**	**418,306**
2010	**137,369**	**428,336**
2011	**145,803**	**514,756**
2012	**163,021**	**496,737**
2013	**170,152**	**530,777**
2014	**181,818**	**550,525**
2015	**196,899**	**560,363**
2016	**217,479**	**630,602**
2017	**233,323**	**715,355**

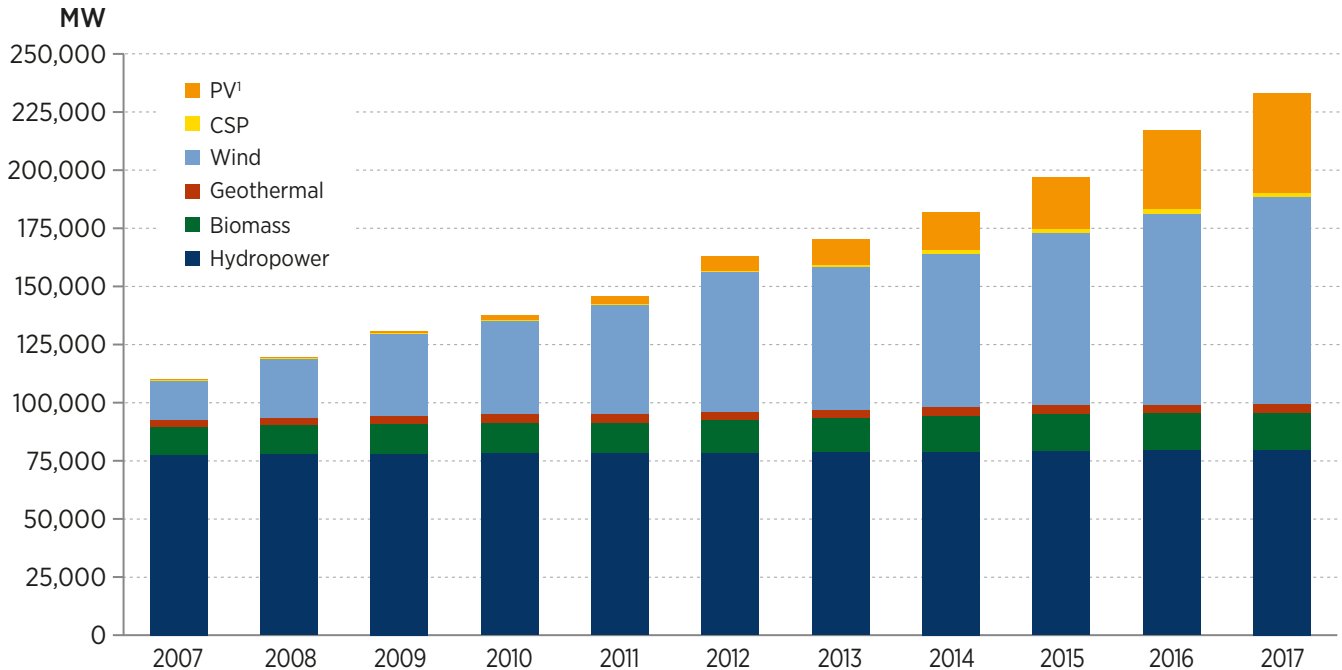
Sources: EIA, LBNL, and SEIA/GTM

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1] A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}. This factor has been adapted from SEIA/GTM.

[2] Small-scale PV generation has been estimated using EIA DG NEMS.

U.S. Renewable Electricity Nameplate Capacity by Source



Sources: EIA, LBNL, and SEIA/GTM

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1] Grid-connected only; a de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

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

	Solar PV	CSP	Wind	Geothermal	Biomass	Hydropower	Total Capacity Added[1]	Capacity Added as a Percentage of Total Renewable Energy
2007	123	64	5,237	64	185	13	**5,686**	**5%**
2008	229	0	8,425	47	747	208	**9,657**	**8%**
2009	464	72	9,918	115	351	270	**11,189**	**9%**
2010	779	0	5,112	77	218	294	**6,479**	**5%**
2011	1,641	(2)	6,649	2	154	(10)	**8,434**	**6%**
2012	3,018	0	13,089	224	840	47	**17,218**	**11%**
2013	4,323	795	1,102	37	658	216	**7,131**	**4%**
2014	5,375	409	4,772	(4)	778	336	**11,666**	**6%**
2015	6,052	81	8,113	55	617	164	**15,081**	**8%**
2016	12,123	0	8,151	(7)	(106)	419	**20,580**	**9%**
2017	8,934	0	6,830	(72)	(66)	218	**15,844**	**7%**

- annual decrease | annual increase +

Sources: EIA, LBNL, and SEIA/GTM

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[1] A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC} in the calculation of total capacity added.

Cumulative U.S. Renewable Electricity Nameplate Capacity (MW) and Annual Percentage Change

	Hydropower	Solar PV	CSP	Wind	Geothermal	Biomass	Total Renewables[1]
2007	77,432 (0.0%)	384 (47.2%)	419 (18.0%)	16,812 (45.2%)	3,259 (2.0%)	11,738 (1.6%)	110,044 (5.4%)
2008	77,640 (0.3%)	614 (59.7%)	419 (0.0%)	25,237 (50.1%)	3,306 (1.4%)	12,485 (6.4%)	119,701 (8.8%)
2009	77,910 (0.3%)	1,077 (75.5%)	491 (17.2%)	35,155 (39.3%)	3,421 (3.5%)	12,836 (2.8%)	130,890 (9.3%)
2010	78,204 (0.4%)	1,856 (72.3%)	491 (0.0%)	40,267 (14.5%)	3,498 (2.3%)	13,053 (1.7%)	137,369 (5.0%)
2011	78,194 (0.0%)	3,497 (88.4%)	490 (-0.3%)	46,916 (16.5%)	3,500 (0.1%)	13,207 (1.2%)	145,803 (6.1%)
2012	78,241 (0.1%)	6,514 (86.3%)	490 (0.0%)	60,005 (27.9%)	3,724 (6.4%)	14,047 (6.4%)	163,021 (11.8%)
2013	78,457 (0.3%)	10,837 (66.4%)	1,285 (162.4%)	61,107 (1.8%)	3,761 (1.0%)	14,705 (4.7%)	170,152 (4.4%)
2014	78,793 (0.4%)	16,213 (49.6%)	1,693 (31.8%)	65,879 (7.8%)	3,757 (-0.1%)	15,483 (5.3%)	181,818 (6.9%)
2015	78,957 (0.2%)	22,264 (37.3%)	1,775 (4.8%)	73,992 (12.3%)	3,812 (1.5%)	16,100 (4.0%)	196,899 (8.3%)
2016	79,376 (0.5%)	34,387 (54.5%)	1,775 (0.0%)	82,143 (11.0%)	3,805 (-0.2%)	15,993 (-0.7%)	217,479 (10.5%)
2017	79,595 (0.3%)	43,321 (26.0%)	1,775 (0.0%)	88,973 (8.3%)	3,732 (-1.9%)	15,928 (-0.4%)	233,323 (7.3%)

Sources: EIA, LBNL, and SEIA/GTM

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1] A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC} in the calculation of total renewables.

U.S. Renewable Electricity Capacity as a Percentage of Total Electricity Capacity

	Hydropower	Solar PV	CSP	Wind	Geothermal	Biomass	Total Renewables[1]
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%	**11.1%**
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	6.9%	0.3%	0.0%	4.1%	0.3%	1.2%	**12.8%**
2012	6.8%	0.6%	0.0%	5.2%	0.3%	1.2%	**14.2%**
2013	6.8%	0.9%	0.1%	5.3%	0.3%	1.3%	**14.8%**
2014	6.8%	1.4%	0.1%	5.7%	0.3%	1.3%	**15.7%**
2015	6.8%	1.9%	0.2%	6.4%	0.3%	1.4%	**17.0%**
2016	6.8%	2.9%	0.2%	7.0%	0.3%	1.4%	**18.6%**
2017	6.7%	3.7%	0.1%	7.5%	0.3%	1.3%	**19.7%**

Sources: EIA, LBNL, and SEIA/GTM

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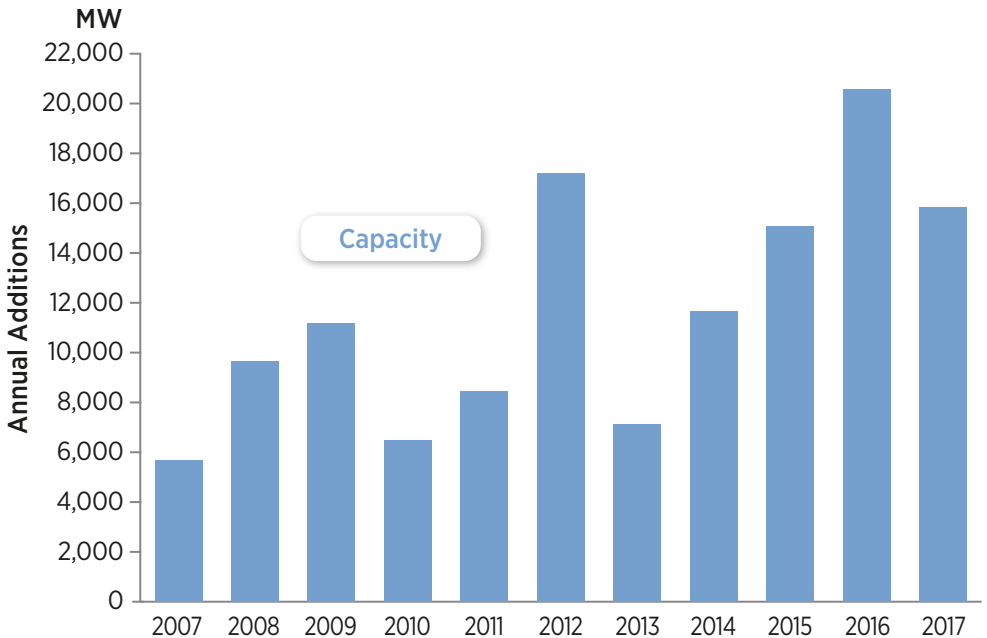
[1] A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC} in the calculation of total capacity added.

U.S. Annual Installed Renewable Electricity Capacity Growth



	Compound Annual Growth Rate (2007–2017)
Wind	**18.1%**
Solar PV[1]	**60.4%**
CSP	**15.5%**
Biomass	**3.1%**
Geothermal	**1.4%**
Hydropower	**0.3%**
All Renewables	**7.8%**

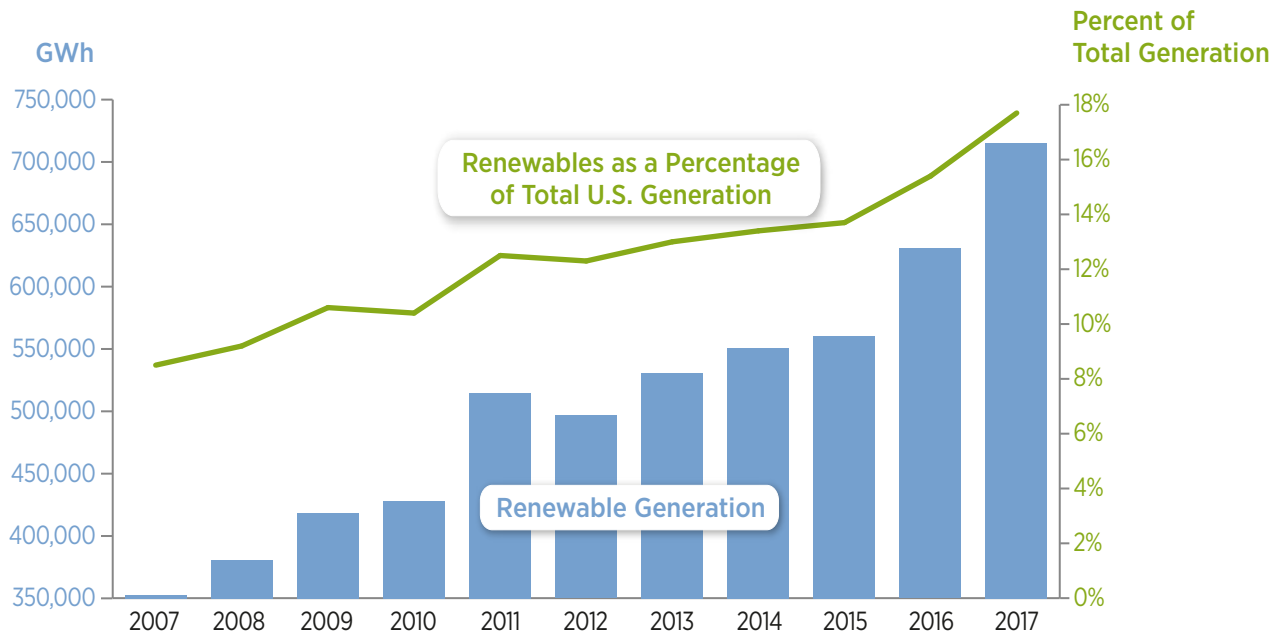
Sources: EIA, LBNL, and SEIA/GTM

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1] A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC} in the calculation of total capacity added.

U.S. Renewable Electricity Generation

II

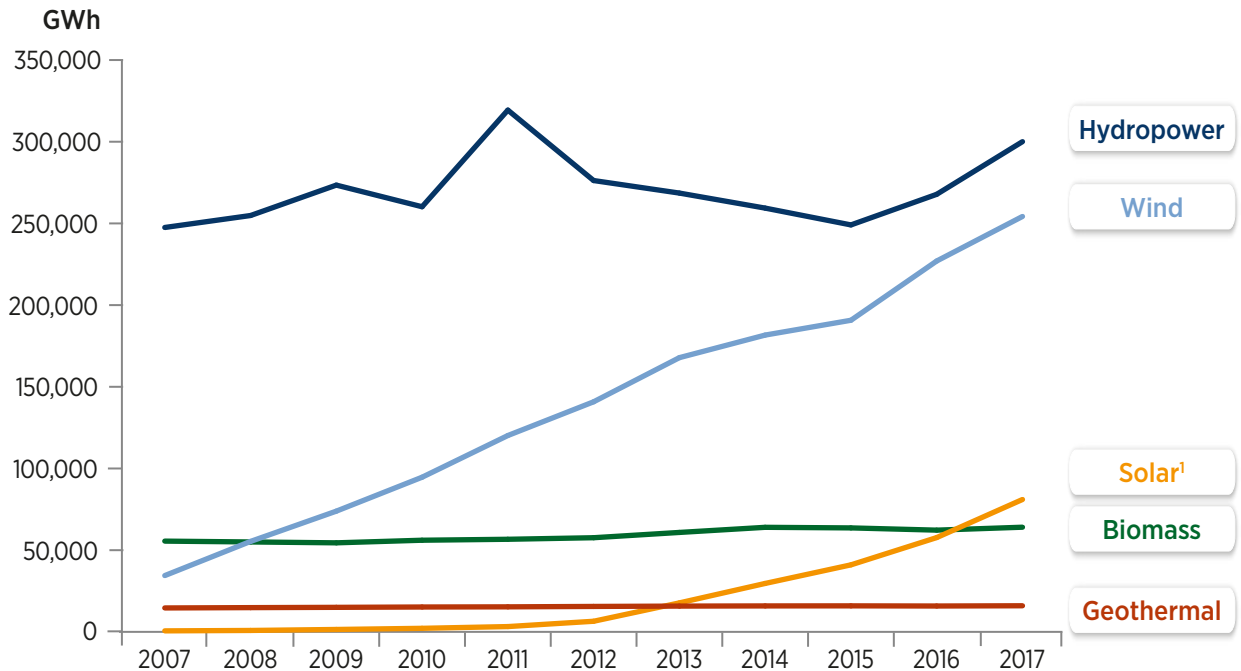


Sources: EIA, LBNL, and SEIA/GTM

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

Small-scale PV generation has been estimated using EIA DG NEMS.

U.S. Renewable Electricity Generation by Technology



Sources: EIA, LBNL, and SEIA/GTM

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1] Small-scale PV generation has been estimated using EIA DG NEMS.

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

	Hydropower	Solar[1]	Wind	Geothermal	Biomass	Total Renewables
2007	5.9%	0.0%	0.8%	0.4%	1.3%	8.5%
2008	6.2%	0.0%	1.3%	0.4%	1.3%	9.2%
2009	6.9%	0.0%	1.9%	0.4%	1.4%	10.6%
2010	6.3%	0.1%	2.3%	0.4%	1.4%	10.4%
2011	7.8%	0.1%	2.9%	0.4%	1.4%	12.5%
2012	6.8%	0.2%	3.5%	0.4%	1.4%	12.3%
2013	6.6%	0.4%	4.1%	0.4%	1.5%	13.0%
2014	6.3%	0.7%	4.4%	0.4%	1.6%	13.4%
2015	6.1%	1.0%	4.7%	0.4%	1.6%	13.7%
2016	6.5%	1.4%	5.5%	0.4%	1.5%	15.4%
2017	7.4%	2.0%	6.3%	0.4%	1.6%	17.7%

Sources: EIA, LBNL, and SEIA/GTM

Total will not equal 100% as renewables represent only a fraction of total U.S. electricity generation.

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1]Small-scale PV generation has been estimated using EIA DG NEMS.

U.S. Renewable Electricity Generation (GWh) and Annual Percent Change

II

	Hydropower	Solar[1]	Wind	Geothermal	Biomass	All Renewables
2007	247,510 (-14.4%)	612 (20.5%)	34,450 (29.6%)	14,637 (0.5%)	55,539 (1.2%)	352,748 (-8.6%)
2008	254,831 (3.0%)	864 (41.2%)	55,363 (60.7%)	14,840 (1.4%)	55,034 (-0.9%)	380,932 (8.0%)
2009	273,445 (7.3%)	1,473 (70.5%)	73,886 (33.5%)	15,009 (1.1%)	54,493 (-1.0%)	418,306 (9.8%)
2010	260,203 (-4.8%)	2,173 (47.5%)	94,652 (28.1%)	15,219 (1.4%)	56,089 (2.9%)	428,336 (2.4%)
2011	319,355 (22.7%)	3,237 (49.0%)	120,177 (27.0%)	15,316 (0.6%)	56,671 (1.0%)	514,756 (20.2%)
2012	276,240 (-13.5%)	6,491 (100.5%)	140,822 (17.2%)	15,562 (1.6%)	57,622 (1.7%)	496,737 (-3.5%)
2013	268,565 (-2.8%)	17,739 (173.3%)	167,840 (19.2%)	15,775 (1.4%)	60,858 (5.6%)	530,777 (6.9%)
2014	259,367 (-3.4%)	29,636 (67.1%)	181,655 (8.2%)	15,877 (0.6%)	63,990 (5.1%)	550,525 (3.7%)
2015	249,080 (-4.0%)	41,014 (38.4%)	190,719 (5.0%)	15,918 (0.3%)	63,632 (-0.6%)	560,363 (1.8%)
2016	267,812 (7.5%)	57,711 (40.7%)	226,993 (19.0%)	15,826 (-0.6%)	62,260 (-2.2%)	630,602 (12.5%)
2017	300,045 (12.0%)	81,023 (40.4%)	254,254 (12.0%)	15,976 (0.9%)	64,057 (2.9%)	715,355 (13.4%)

- annual decrease | annual increase +

Sources: EIA, LBNL, and SEIA/GTM

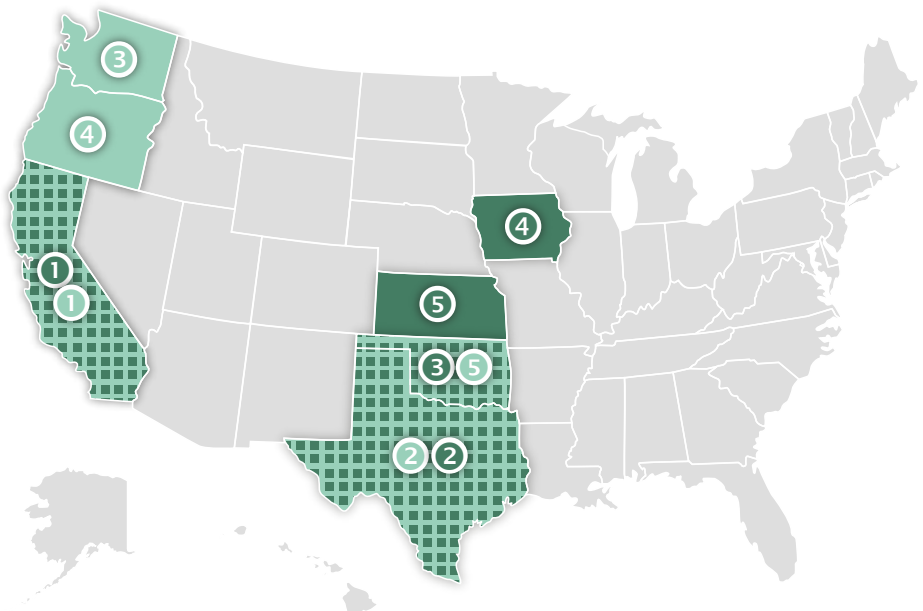
Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1]Small-scale PV generation has been estimated using EIA DG NEMS.

State Renewable Energy Information: Summary

- In 2017, **California continued to have the most installed renewable electricity capacity** of any state (more than 37 GW), followed by Texas (more than 25 GW) and Washington (nearly 25 GW).
- **Mississippi had the highest annual growth rate** (53%) **in installed renewable electricity capacity additions in 2017, followed by New Mexico** (36%), **Rhode Island** (32%), **the District of Columbia** (32%), **and Missouri** (25%). Additions in solar capacity were the main driver of renewable electricity capacity growth in Mississippi, Rhode Island, and the District of Columbia, whereas additions in wind capacity accounted for most of the growth in New Mexico and Missouri.
- **In per-capita terms, North Dakota** continued to have the **most installed renewable electricity capacity**, followed by **Washington** and **Montana**. North Dakota continued to have the highest wind installed electricity capacity per capita. Nevada continued to lead all states in PV installed electricity capacity per capita.
- **California continued to install the most solar PV capacity** of all states in 2017 (more than 2.7 GW_{DC} [2.3 GW_{AC}]).
- **Texas**, the state with the greatest amount of installed wind capacity in 2017, **experienced 11.4% growth of installed wind capacity (2.3 GW) and saw an increase of solar PV capacity of more than 110% (648 MW_{AC})**.

Top States for Cumulative Renewable Electricity Installed Capacity (2017)



Total Renewables
1 California
2 Texas
3 Washington
4 Oregon
5 Oklahoma

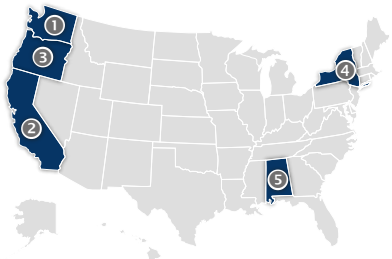
Non-Hydro Renewables
1 California
2 Texas
3 Oklahoma
4 Iowa
5 Kansas

Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

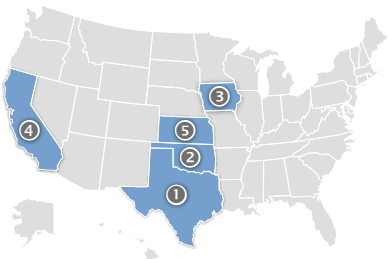
Includes grid-connected solar, wind, geothermal, hydropower and biopower

A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

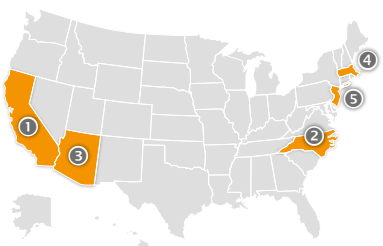
Top States for Cumulative Renewable Electricity Installed Capacity (2017)



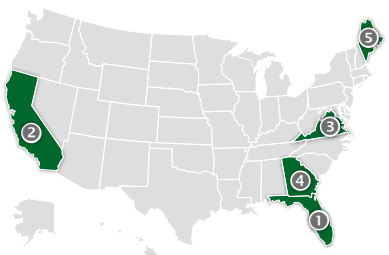
Hydropower	
1	Washington
2	California
3	Oregon
4	New York
5	Alabama



Wind	
1	Texas
2	Oklahoma
3	Iowa
4	California
5	Kansas

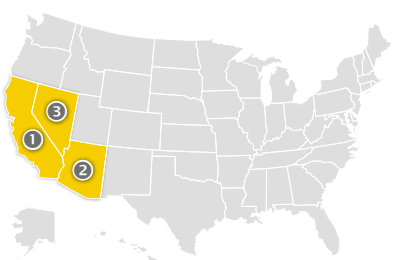


Solar PV[1]	
1	California
2	North Carolina
3	Arizona
4	Massachusetts
5	New Jersey



Biomass	
1	Florida
2	California
3	Virginia
4	Georgia
5	Maine

Geothermal	
1	California
2	Nevada
3	Utah
4	Hawaii
5	Oregon



CSP	
1	California
2	Arizona
3	Nevada

Sources: EIA, LBNL, and SEIA/GTM

[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

Cumulative Renewable Electricity Installed Capacity (MW) (2017)
NORTHEAST

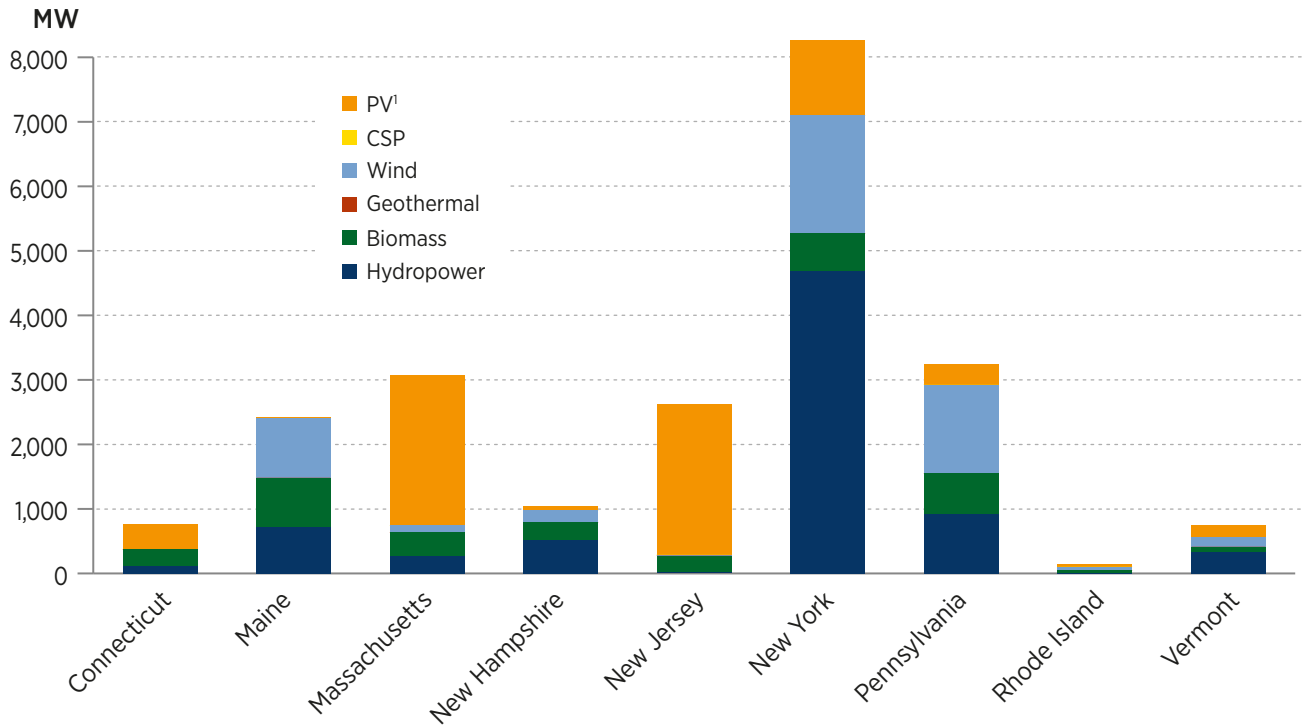
	Wind	PV	CSP	Geothermal	Biomass	Hydropower	Total Renewables[1]	Non-Hydro Renewables
Connecticut	5	385	0	0	254	119	**763**	**644**
Maine	923	6	0	0	769	715	**2,413**	**1,698**
Massachusetts	111	2,330	0	0	361	270	**3,072**	**2,802**
New Hampshire	185	61	0	0	277	516	**1,039**	**523**
New Jersey	9	2,330	0	0	262	15	**2,616**	**2,601**
New York	1,829	1,167	0	0	586	4684	**8,266**	**3,582**
Pennsylvania	1,369	351	0	0	634	920	**3,274**	**2,355**
Rhode Island	54	42	0	0	44	3	**143**	**140**
Vermont	149	179	0	0	84	328	**741**	**412**

Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

[1] A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC} in the calculation of total renewable capacity.

Cumulative Renewable Electricity Installed Capacity (2017)
NORTHEAST



Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

Cumulative Renewable Electricity Installed Capacity (MW) (2017)
MIDWEST

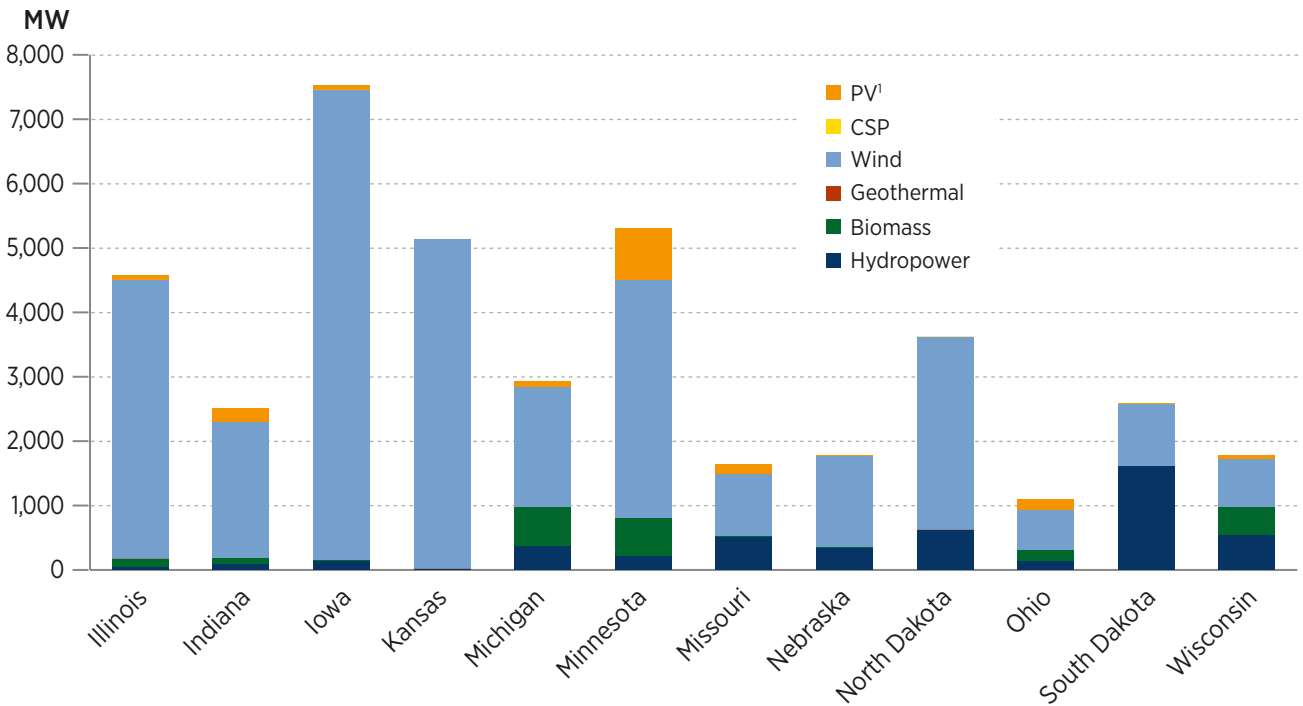
	Wind	PV	CSP	Geothermal	Biomass	Hydropower	Total Renewables[1]	Non-Hydro Renewables
Illinois	4,332	74	0	0	133	40	**4,579**	**4,539**
Indiana	2,117	227	0	0	80	92	**2,516**	**2,424**
Iowa	7,308	60	0	0	21	129	**7,519**	**7,389**
Kansas	5,110	4	0	0	9	7	**5,130**	**5,123**
Michigan	1,860	105	0	0	613	362	**2,940**	**2,579**
Minnesota	3,699	814	0	0	584	215	**5,312**	**5,097**
Missouri	959	165	0	0	17	506	**1,647**	**1,141**
Nebraska	1,415	16	0	0	16	332	**1,779**	**1,446**
North Dakota	2,996	0	0	0	10	614	**3,620**	**3,006**
Ohio	617	165	0	0	180	129	**1,091**	**963**
South Dakota	977	1	0	0	0	1,602	**2,580**	**978**
Wisconsin	746	54	0	0	437	537	**1,774**	**1,236**

Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

Cumulative Renewable Electricity Installed Capacity (2017)
MIDWEST



Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

Cumulative Renewable Electricity Installed Capacity (MW) (2017)
SOUTH

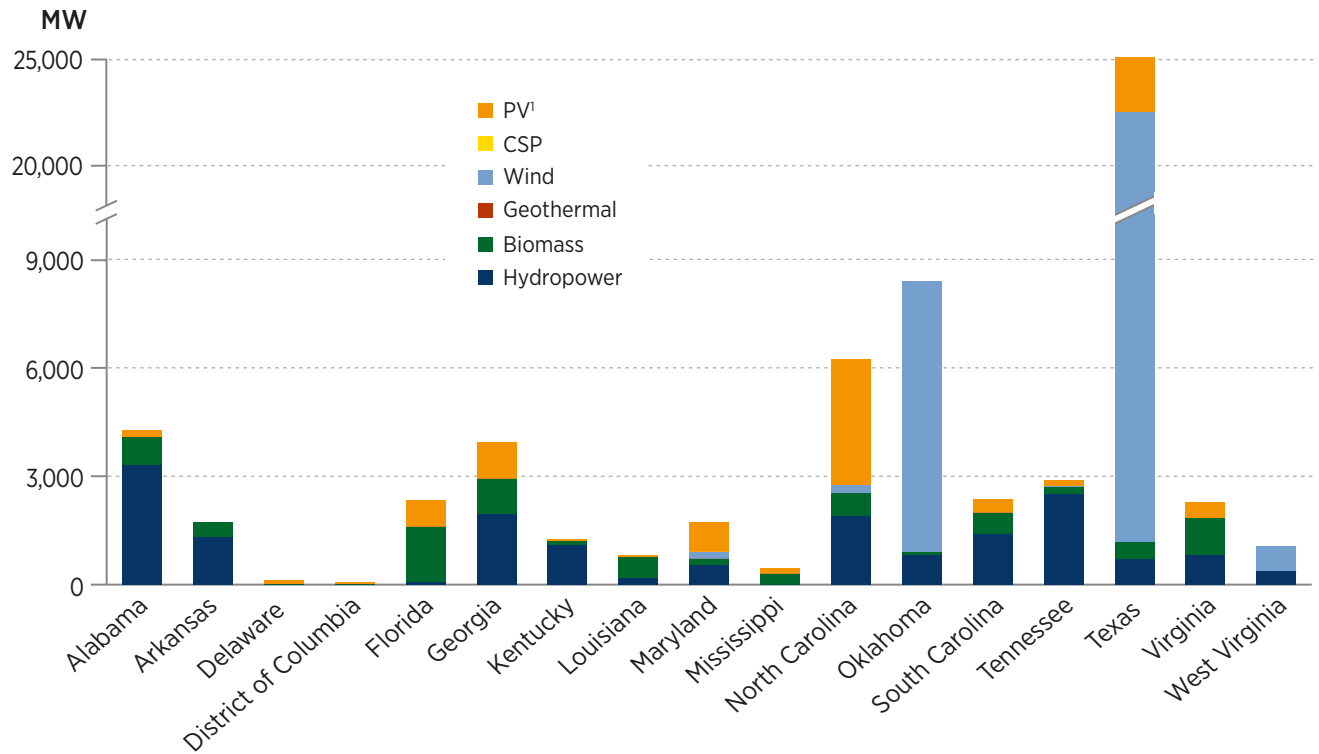
	Wind	PV	CSP	Geothermal	Biomass	Hydropower	Total Renewables[1]	Non-Hydro Renewables
Alabama	0	198	0	0	763	3,319	**4,280**	**961**
Arkansas	0	24	0	0	391	1,321	**1,736**	**415**
Delaware	2	102	0	0	12	0	**116**	**116**
District of Columbia	0	42	0	0	14	0	**56**	**56**
Florida	0	737	0	0	1,542	56	**2,334**	**2,279**
Georgia	0	1,019	0	0	962	1,963	**3,944**	**1,980**
Kentucky	0	39	0	0	113	1,093	**1,245**	**152**
Louisiana	0	72	0	0	557	192	**821**	**629**
Maryland	191	829	0	0	162	551	**1,733**	**1,182**
Mississippi	0	163	0	0	296	0	**459**	**459**
North Carolina	208	3,495	0	0	645	1,890	**6,238**	**4,348**
Oklahoma	7,495	23	0	0	88	809	**8,415**	**7,606**
South Carolina	0	367	0	0	589	1,397	**2,353**	**956**
Tennessee	29	160	0	0	200	2,499	**2,888**	**389**
Texas	22,599	1,536	0	0	460	709	**25,304**	**24,595**
Virginia	0	444	0	0	1,018	822	**2,285**	**1,463**
West Virginia	686	0	0	0	0	371	**1,057**	**686**

Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

Cumulative Renewable Electricity Installed Capacity (2017)
SOUTH



Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

Cumulative Renewable Electricity Installed Capacity (MW) (2017)
WEST

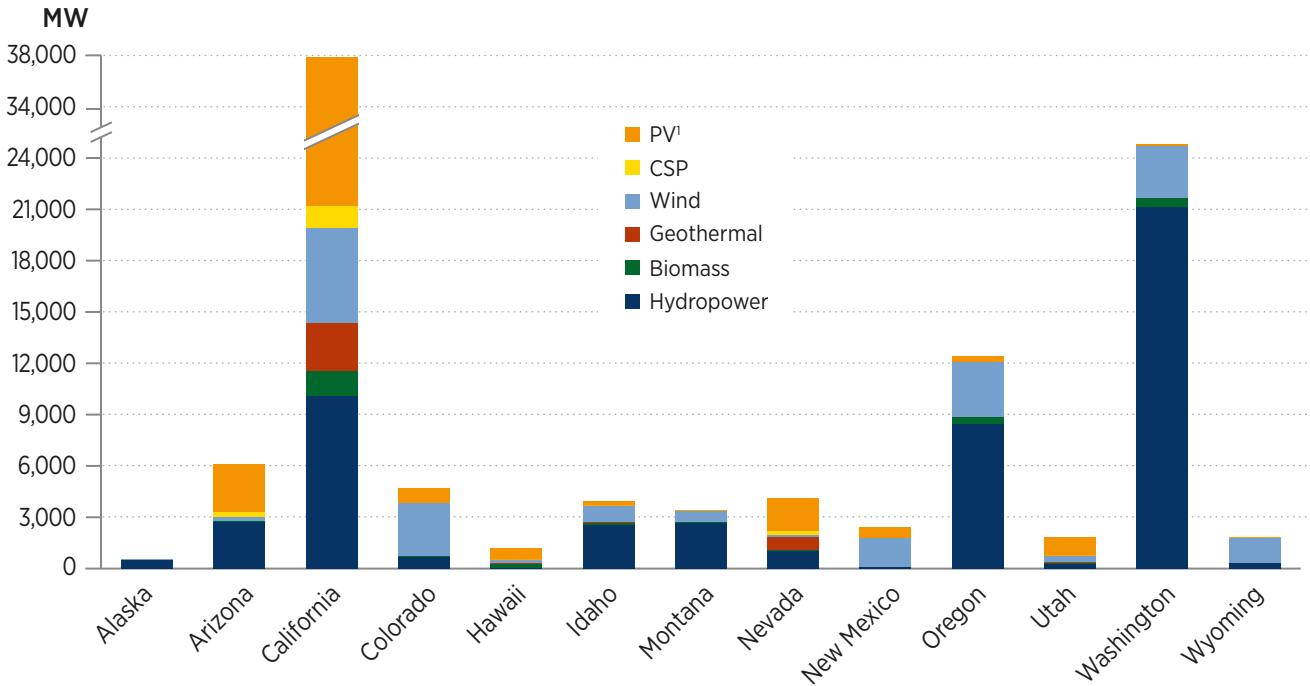
	Wind	PV	CSP	Geothermal	Biomass	Hydropower	Total Renewables[1]	Non-Hydro Renewables
Alaska	62	0	0	0	12	475	**549**	**74**
Arizona	268	2,817	280	0	36	2,718	**6,119**	**3,401**
California	5,555	16,548	1,294	2,798	1,465	10,062	**37,721**	**27,659**
Colorado	3,106	869	0	0	34	672	**4,681**	**4,009**
Hawaii	206	689	0	51	230	27	**1,202**	**1,175**
Idaho	973	252	0	18	130	2,541	**3,914**	**1,373**
Montana	695	24	0	0	3	2,671	**3,393**	**722**
Nevada	152	1,931	201	741	15	1,052	**4,092**	**3,039**
New Mexico	1,682	629	0	4	5	82	**2,402**	**2,320**
Oregon	3,213	343	0	37	359	8,451	**12,402**	**3,951**
Utah	391	1,084	0	84	14	262	**1,835**	**1,572**
Washington	3,075	97	0	0	474	21,139	**24,784**	**3,646**
Wyoming	1,489	1	0	0	0	303	**1,794**	**1,490**

Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

Cumulative Renewable Electricity Installed Capacity (2017)
WEST



Sources: EIA, LBNL, SEIA/GTM, and U.S. Census Bureau

Regions do not correspond to U.S. census designations.

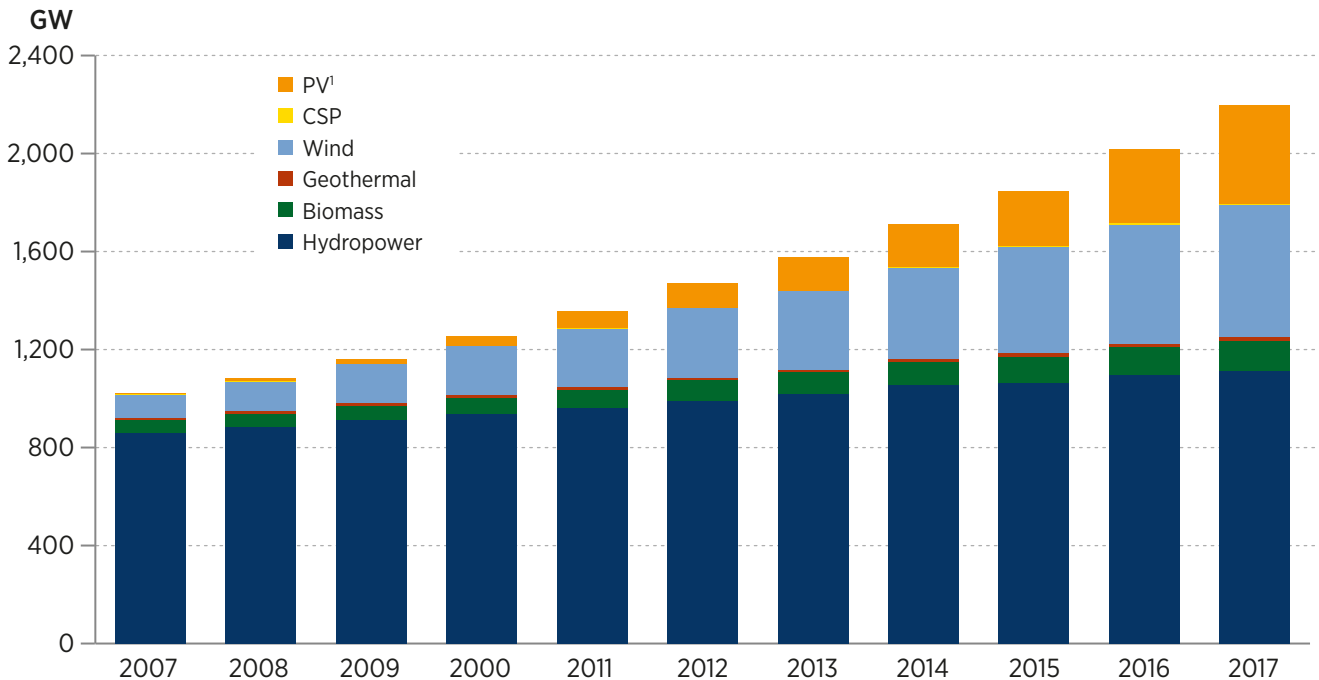
[1] Grid-connected only; A de-rate factor of 87% has been applied to convert small-scale PV installed nameplate capacity from MW_{DC} to MW_{AC}.

III. Global Renewable Energy Development

Global Renewable Energy Development: Summary

- Cumulative **global installed capacity of renewable electricity grew by 8.9%** in 2017 (from 2,016 GW to 2,196 GW), which continued the steady growth of recent years (7.9% CAGR from 2007 to 2017).
- Globally, **hydropower comprised 50.7% of cumulative installed renewable electricity capacity, followed by wind (24.5%), solar PV and CSP (18.3%), biomass (5.6%), and geothermal (0.6%)** in 2017.
- Renewable sources accounted for nearly **27% (6,584 TWh) of all electricity generation worldwide** in 2017.
- **Global solar PV cumulative installed capacity increased by 32.7%** in 2017. **Wind installed capacity grew by 10.7% globally**.
- In 2017, **China continued to lead the world in cumulative renewable electricity installed capacity**. China also led in cumulative wind, hydropower, and grid-connected solar PV capacity. Spain led in installed CSP capacity. The United States continued to lead geothermal and biomass installed capacity and was second in cumulative renewable electricity installed capacity.

Global Renewable Electricity Capacity



Source: Renewable Energy Policy Network for the 21st Century (REN21)

Reported values may vary from those included in previous editions of the data book due to retroactive changes.

[1] Grid-connected only

Global Renewable Cumulative Electricity Capacity Annual Percent Change

	Hydropower	PV[1]	CSP	Wind	Geothermal	Biomass	All Renewables
2007	3%	5%	5%	27%	0%	6%	5%
2008	3%	71%	14%	29%	4%	4%	6%
2009	3%	62%	22%	31%	7%	15%	7%
2010	3%	90%	83%	25%	3%	13%	8%
2011	3%	78%	43%	20%	1%	9%	8%
2012	3%	41%	57%	19%	5%	12%	8%
2013	3%	38%	36%	13%	3%	6%	7%
2014	4%	28%	29%	16%	6%	6%	9%
2015	1%	28%	9%	17%	3%	14%	8%
2016	3%	33%	0%	12%	2%	6%	9%
2017	2%	33%	2%	11%	4%	9%	9%
CAGR (2007–2017)	3%	49%	27%	19%	4%	9%	8%

- annual decrease | annual increase +

Source: REN21

Reported values may vary from those included in previous editions of the data book due to retroactive changes by REN21.

[1] Grid-connected only

Renewable Electricity as a Percentage of Total Installed Global Electricity Capacity

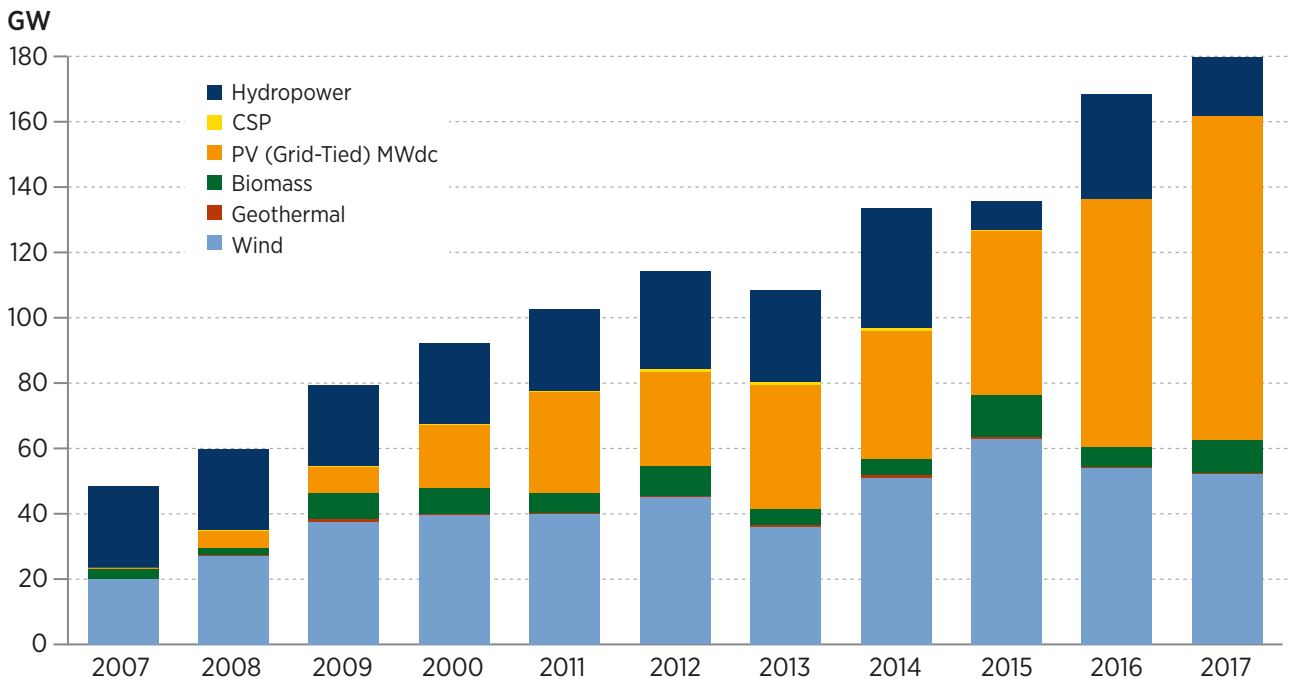
	Hydropower	PV[1]	CSP	Wind	Geothermal	Biomass	All Renewables	Renewable Capacity (GW)
2007	19.2%	0.2%	0.0%	2.1%	0.2%	1.1%	22.8%	1,022
2008	19.1%	0.3%	0.0%	2.6%	0.2%	1.1%	23.3%	1,082
2009	18.8%	0.4%	0.0%	3.3%	0.2%	1.2%	24.0%	1,161
2010	18.4%	0.8%	0.0%	3.9%	0.2%	1.3%	24.7%	1,253
2011	18.1%	1.3%	0.0%	4.5%	0.2%	1.4%	25.5%	1,356
2012	17.9%	1.8%	0.0%	5.1%	0.2%	1.5%	26.6%	1,470
2013	17.7%	2.4%	0.1%	5.6%	0.2%	1.5%	27.5%	1,579
2014	17.5%	2.9%	0.1%	6.1%	0.2%	1.5%	28.4%	1,712
2015	17.0%	3.6%	0.1%	6.9%	0.2%	1.7%	29.5%	1,848
2016	16.8%	4.6%	0.1%	7.4%	0.2%	1.7%	30.8%	2,016
2017	16.3%	5.9%	0.1%	7.9%	0.2%	1.8%	32.2%	2,196

Source: REN21

Reported values may vary from those included in previous editions of the data book due to retroactive changes by REN21.

[1] Grid-connected only

Global Annual Installed Renewable Electricity Capacity Growth

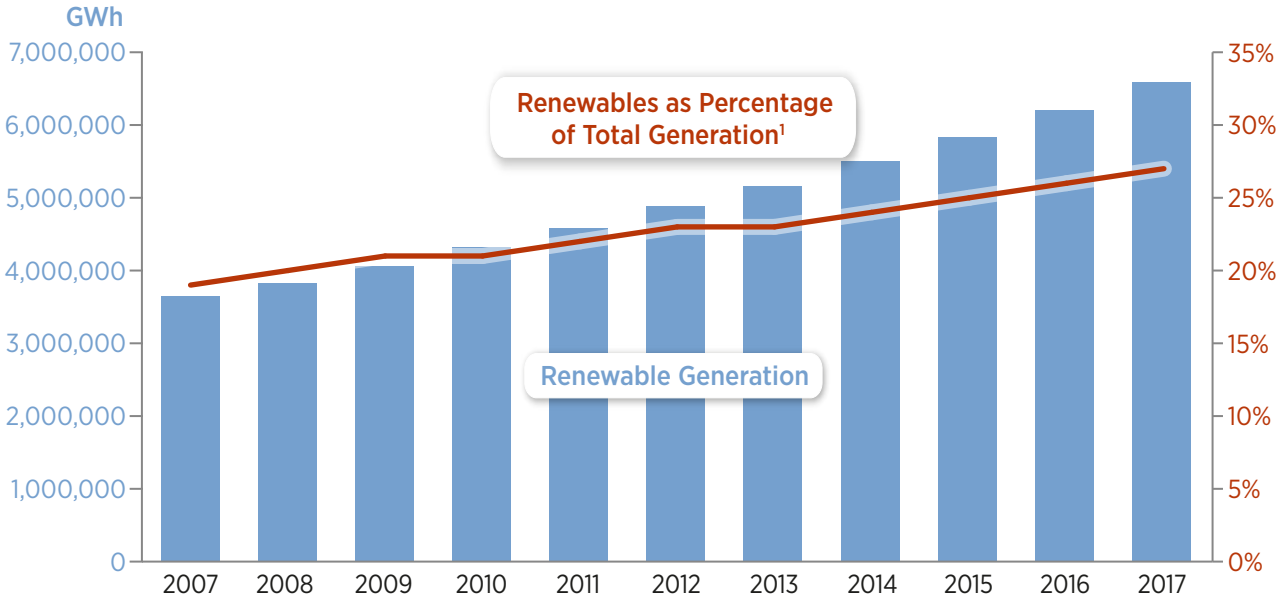


Source: REN21

Reported values may vary from those included in previous editions of the data book due to retroactive changes by REN21.

[1] Grid-connected only

Global Renewable Electricity Generation



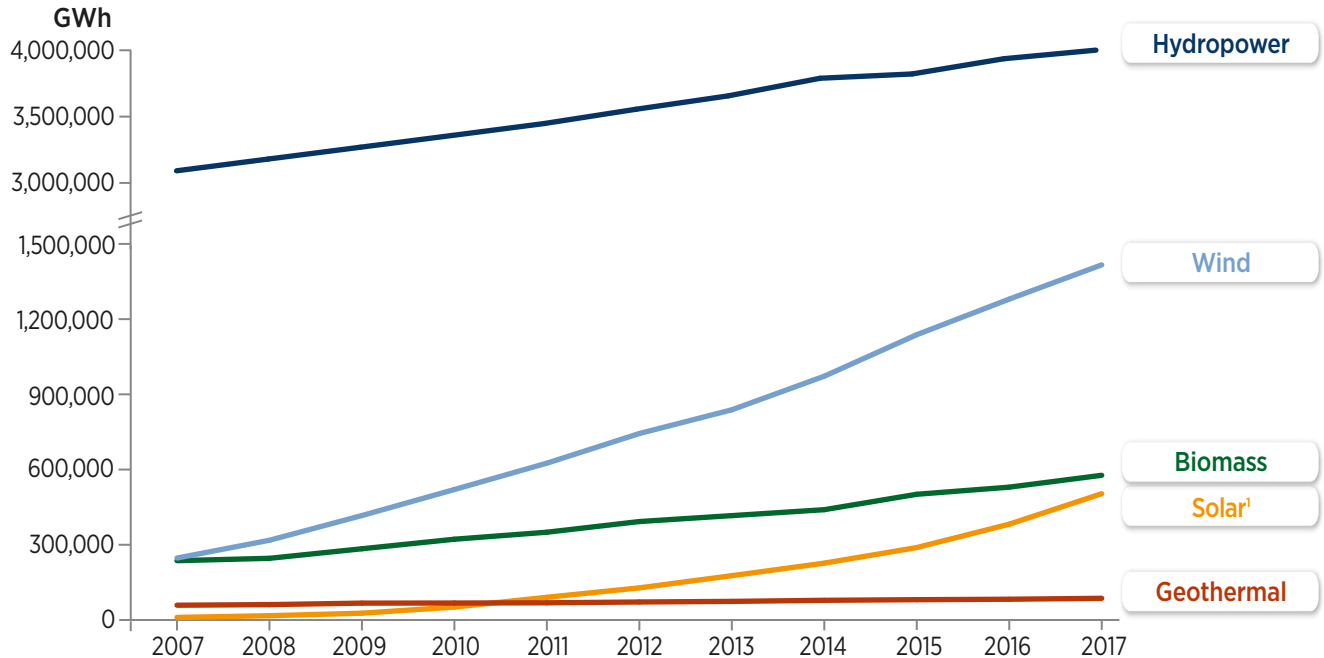
Sources: REN21, EIA

Generation derived using the following capacity factors: 41% for hydropower, 14% for PV, 25% for CSP, 54% for biomass, 30% for wind, and 70% for geothermal.

Reported values may vary from those included in previous editions of the data book due to retroactive changes by REN21.

[1] Total generation is estimated for 2016–2017 usind a CAGR. All other years are based on EIA data.

Global Renewable Electricity Generation by Technology



Source: REN21

Reported values may vary from those included in previous editions of the data book due to retroactive changes by REN21.

Generation derived using the following capacity factors: 41% for hydropower, 14% for PV, 25% for CSP, 54% for biomass, 30% for wind, and 70% for geothermal.

Note the vertical scale has a discontinuity.

[1] Includes CSP and grid-connected PV; capacity is reported in MW_{AC}.

Global Renewable Electricity Generation as a Percentage of Total Generation

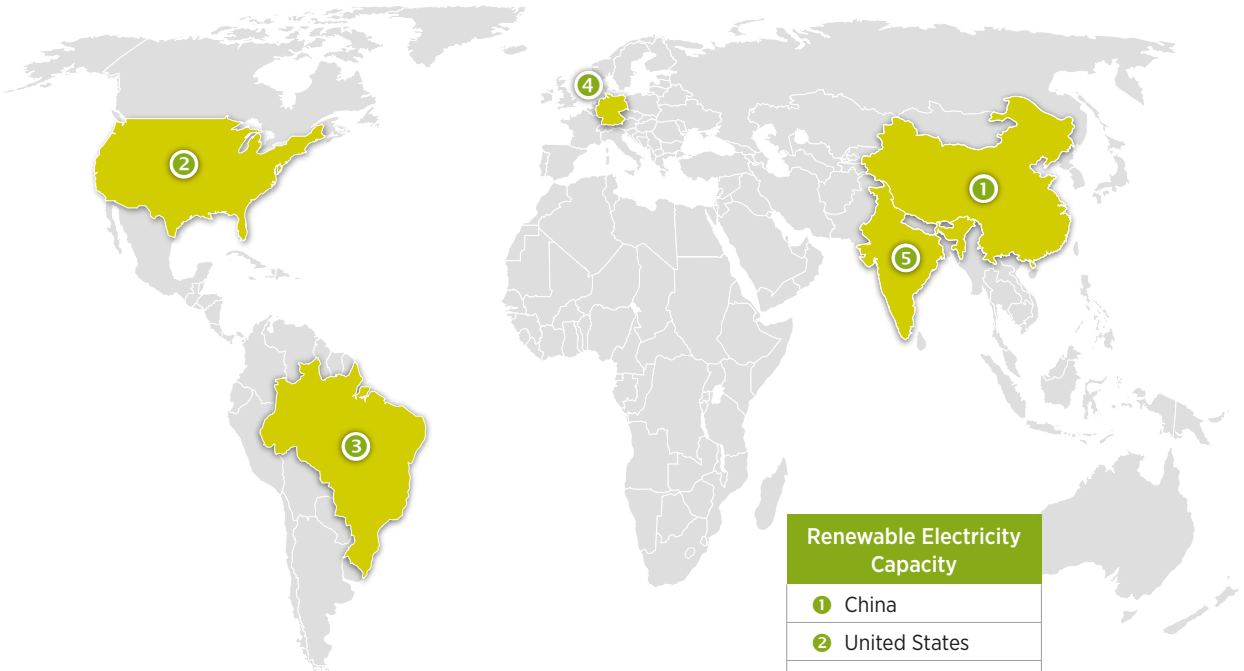
	Hydropower	Solar[1]	Biomass	Wind	Geothermal	All Renewables	Renewable Generation (GWh)
2007	16.4%	0.1%	1.3%	1.3%	0.3%	19.3%	3,644,173
2008	16.6%	0.1%	1.3%	1.7%	0.3%	19.9%	3,822,689
2009	17.1%	0.1%	1.5%	2.2%	0.4%	21.3%	4,064,206
2010	16.4%	0.3%	1.6%	2.5%	0.3%	21.1%	4,319,733
2011	16.3%	0.4%	1.7%	3.0%	0.3%	21.7%	4,582,578
2012	16.5%	0.6%	1.8%	3.4%	0.3%	22.7%	4,891,891
2013	16.5%	0.8%	1.9%	3.8%	0.3%	23.2%	5,161,742
2014	16.7%	1.0%	1.9%	4.3%	0.3%	24.3%	5,506,624
2015	16.6%	1.3%	2.2%	4.9%	0.4%	25.3%	5,830,656
2016	16.6%	1.6%	2.2%	5.4%	0.3%	26.1%	6,210,928
2017	16.4%	2.1%	2.4%	5.8%	0.4%	26.9%	6,584,848

Source: REN21

Reported values may vary from those included in previous editions of the data book due to retroactive changes by REN21.

[1] Includes CSP and grid-connected PV; generation derived using the following capacity factors: 41% for hydropower, 14% for PV, 25% for CSP, 54% for biomass, 30% for wind, and 70% for geothermal.

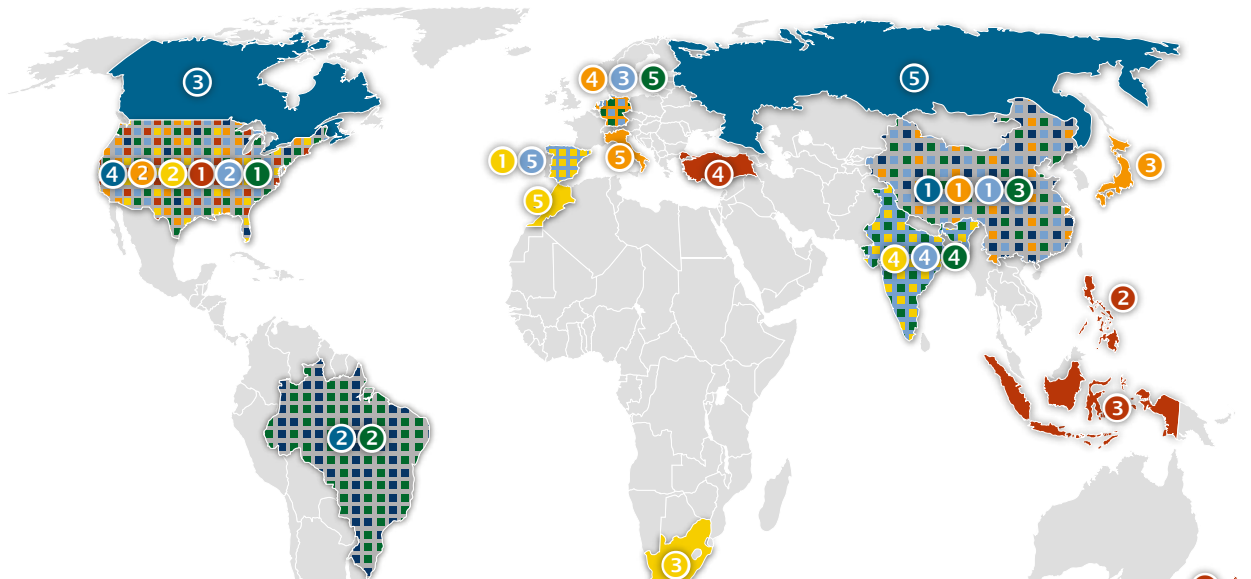
Top Countries for Renewable Electricity Installed Capacity (2017)



Renewable Electricity Capacity
1 China
2 United States
3 Brazil
4 Germany
5 India

Source: REN21

Top Countries with Installed Renewable Electricity Capacity by Technology (2017)



Hydropower	PV[1]	CSP	Geothermal	Wind	Biomass
1 China	1 China	1 Spain	1 United States	1 China	1 United States
2 Brazil	2 United States	2 United States	2 Philippines	2 United States	2 Brazil
3 Canada	3 Japan	3 South Africa	3 Indonesia	3 Germany	3 China
4 United States	4 Germany	4 India	4 Turkey	4 India	4 India
5 Russia	5 Italy	5 Morocco	5 New Zealand	5 Spain	5 Germany

Source: REN21

[1]Grid-connected only

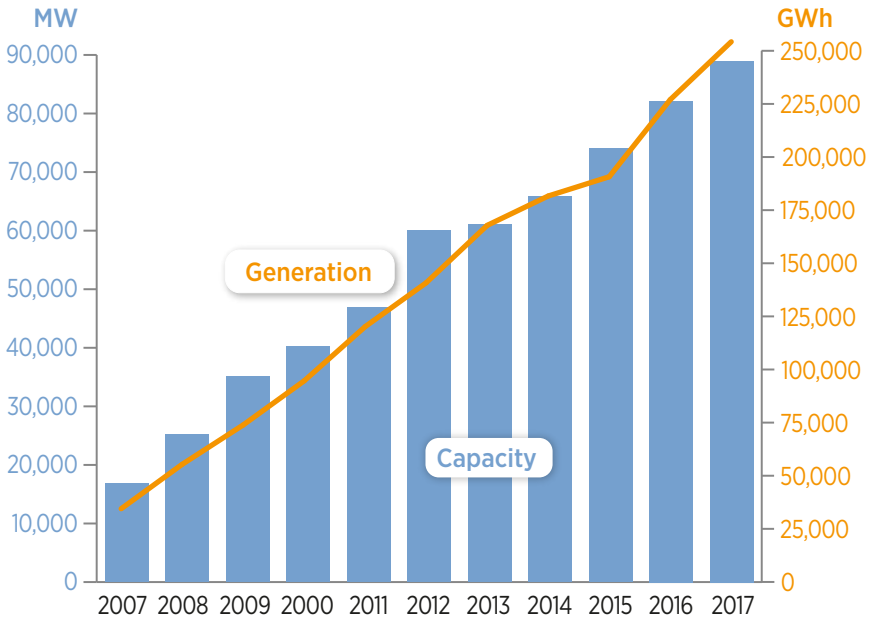
IV. Wind

Wind: Summary

- In the United States, wind installed capacity grew 8.3% in 2017, compared to 11% in 2016. **More than 7.0 GW of additional wind capacity was installed** in 2017, leading to a **total cumulative capacity of nearly 89 GW**.
- States with some of the highest cumulative wind installed capacity also experienced the most growth in capacity in 2017, including Texas (2.3 GW), Oklahoma (0.9 GW), and Kansas (0.7 GW). New Mexico (0.6 GW) also saw a large increase in installed wind capacity in 2017.
- **Global cumulative installed wind capacity reached 539 GW** in 2017.
- In 2017, **China continued to lead the world in cumulative installed wind capacity**, with capacity additions of over 19.7 GW.
- Although the 30-MW Block Island Wind Farm in Rhode Island remains the only operational offshore wind project in the United States, **as of 2017 an additional 25.5 GW of offshore wind capacity is in various planning stages**. These projects are largely on the East Coast (92%). The top five states for planned offshore wind capacity were Massachusetts (10.3 GW), New Jersey (4.2 GW), North Carolina (3.7 GW), Virginia (1.3 GW), and Hawaii (1.2 GW).[1]
- Globally, offshore wind installations grew 30% from 14.5 GW to 18.8 GW from 2016.

[1] These capacities are a combination of specific developer announcements and technical potential estimations for developer-controlled lease areas. For a specific breakdown of developer announcements and technical potential estimates, see EERE, 2017 Offshore Wind Technologies Market Report.

U.S. Total Installed Wind Electricity Capacity and Generation



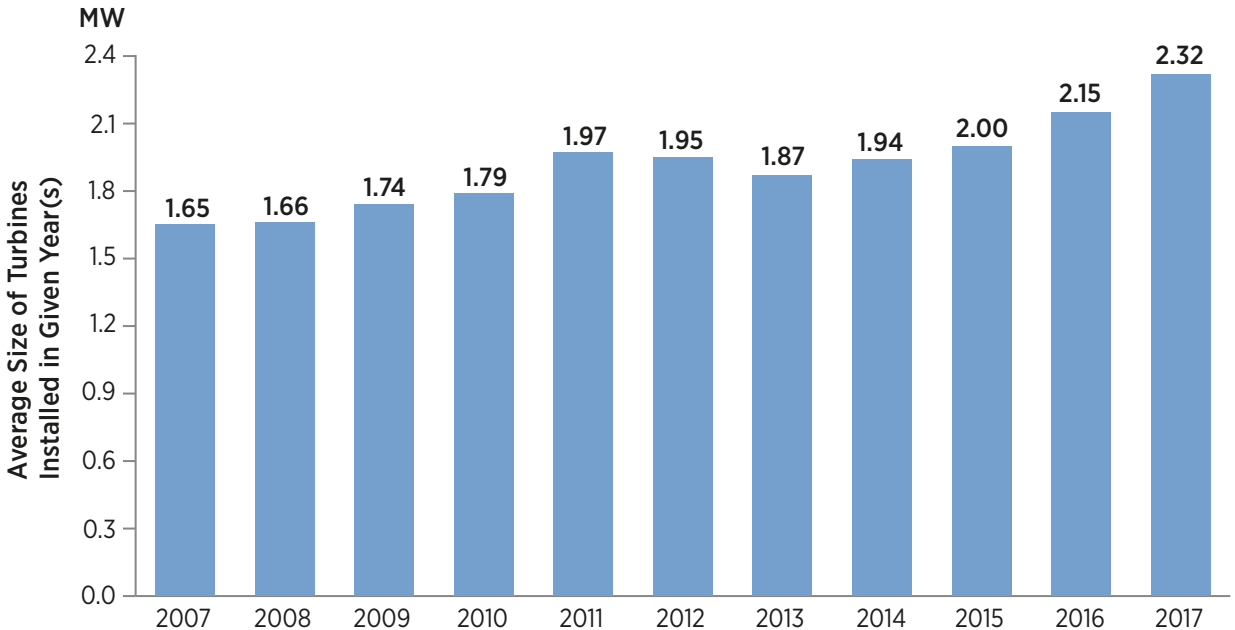
	U.S. Wind Electricity Generation (GWh)	U.S. Wind Electricity Capacity and Percent Increase from Previous Year	
		Total (MW)	% Increase
2000	5,593	2,578	2.6%
2001	6,737	4,275	65.8%
2002	10,354	4,686	9.6%
2003	11,187	6,353	35.6%
2004	14,144	6,725	5.9%
2005	17,811	9,121	35.6%
2006	26,589	11,575	26.9%
2007	34,450	16,812	45.2%
2008	55,363	25,237	50.1%
2009	73,886	35,155	39.3%
2010	94,652	40,267	14.5%
2011	120,177	46,916	16.5%
2012	140,822	60,005	27.9%
2013	167,840	61,107	1.8%
2014	181,655	65,879	7.8%
2015	190,719	73,992	12.3%
2016	226,993	82,143	11.0%
2017	254,254	88,973	8.3%

Sources: LBNL (capacity data) and EIA (generation data)

LBNL data include installed capacity that is online and installed as of the end of the year. A wind project, or the capacity portion of a wind project, is reported as online when it is delivering electricity to the power grid or ultimate point of delivery. The timing of installation is usually consistent with "commercial operation date" but may differ, and specific criteria are at the discretion of the wind project owner.

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

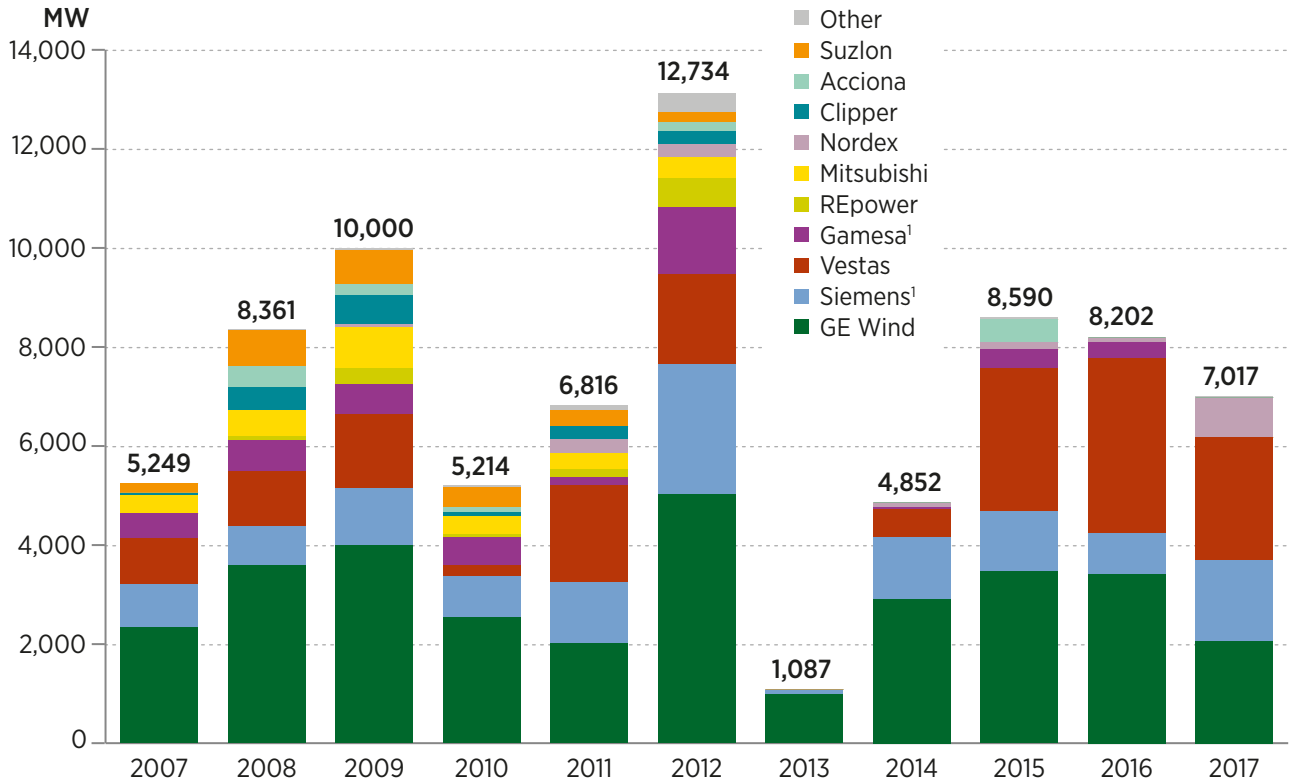
U.S. Average Installed Turbine Size



IV

Source: American Wind Energy Association

U.S. Annual Wind Turbine Installations by Manufacturer

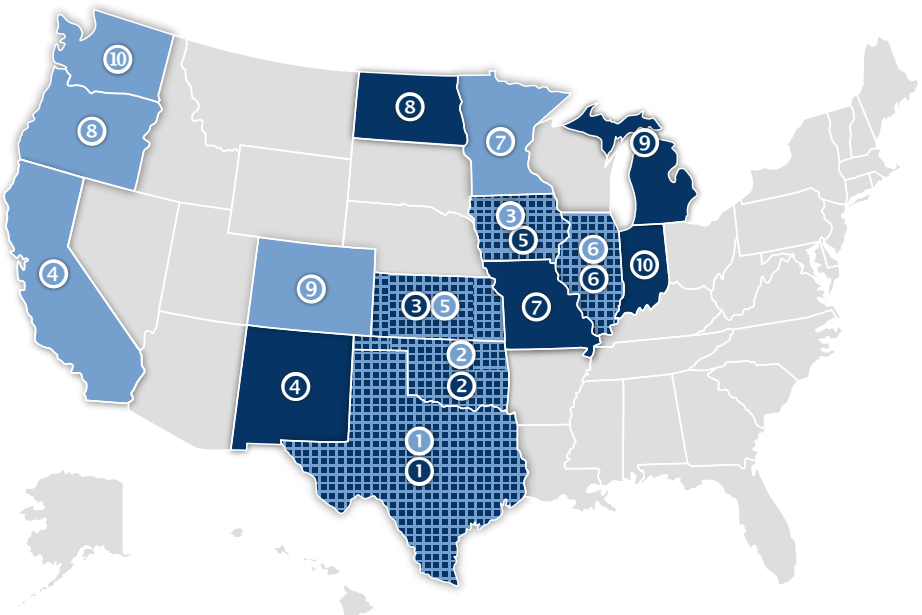


Source: LBNL

Reported values may vary from those included in previous editions of the data book due to retroactive changes by LBNL.

[1] Siemens and Gamesa merged in 2017. The data for 2017 reflects the wind turbine installations for the newly merged company.

States Leading Wind Electricity Development (2017)

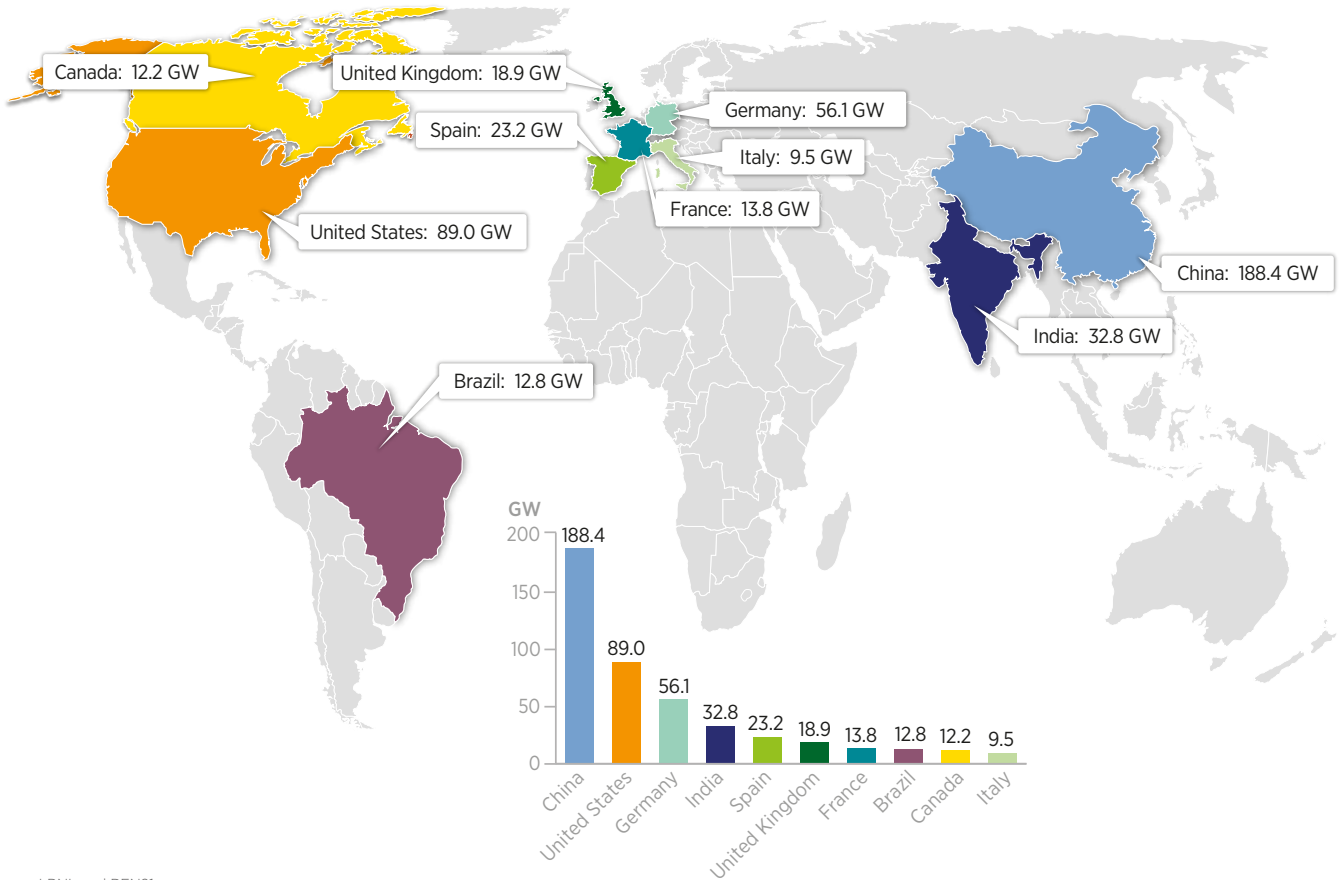


Cumulative Capacity (MW)	
1 Texas	22,599
2 Oklahoma	7,495
3 Iowa	7,308
4 California	5,555
5 Kansas	5,110
6 Illinois	4,332
7 Minnesota	3,699
8 Oregon	3,213
9 Colorado	3,106
10 Washington	3,075

Annual Capacity Additions (MW)	
1 Texas	2,305
2 Oklahoma	851
3 Kansas	659
4 New Mexico	570
5 Iowa	397
6 Illinois	306
7 Missouri	300
8 North Dakota	249
9 Michigan	249
10 Indiana	220

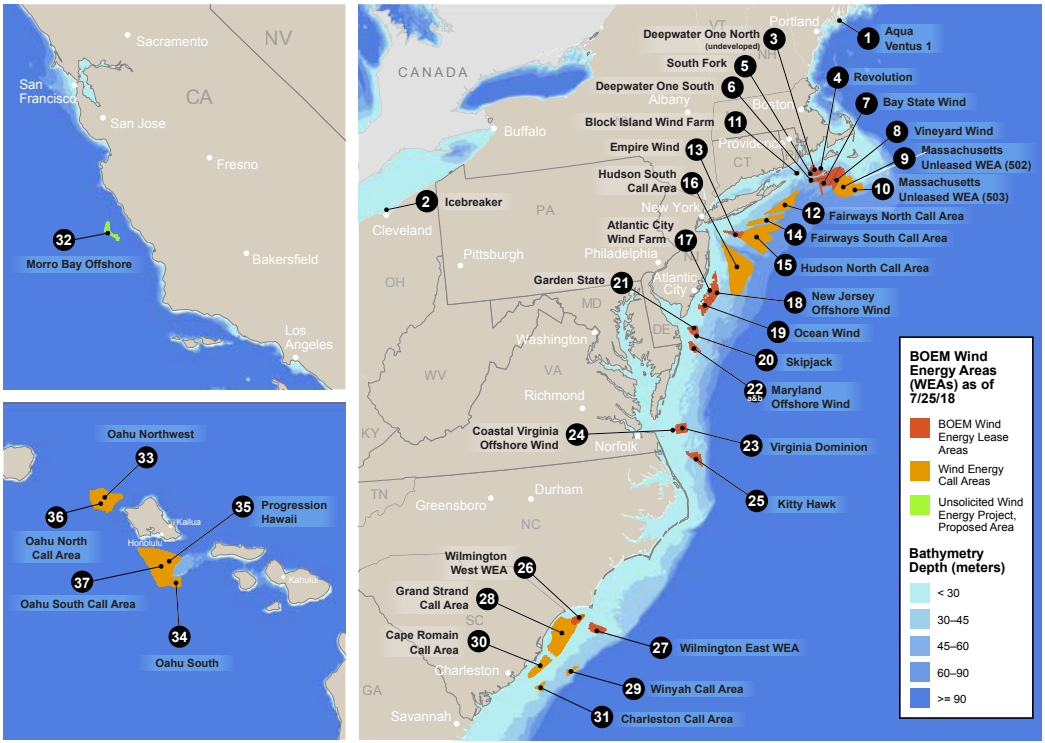
Source: LBNL

Cumulative Wind Electricity Capacity (2017) – Top 10 Countries



Sources: LBNL and REN21
Includes offshore wind

Proposed U.S. Offshore Wind Electricity Projects (2016)

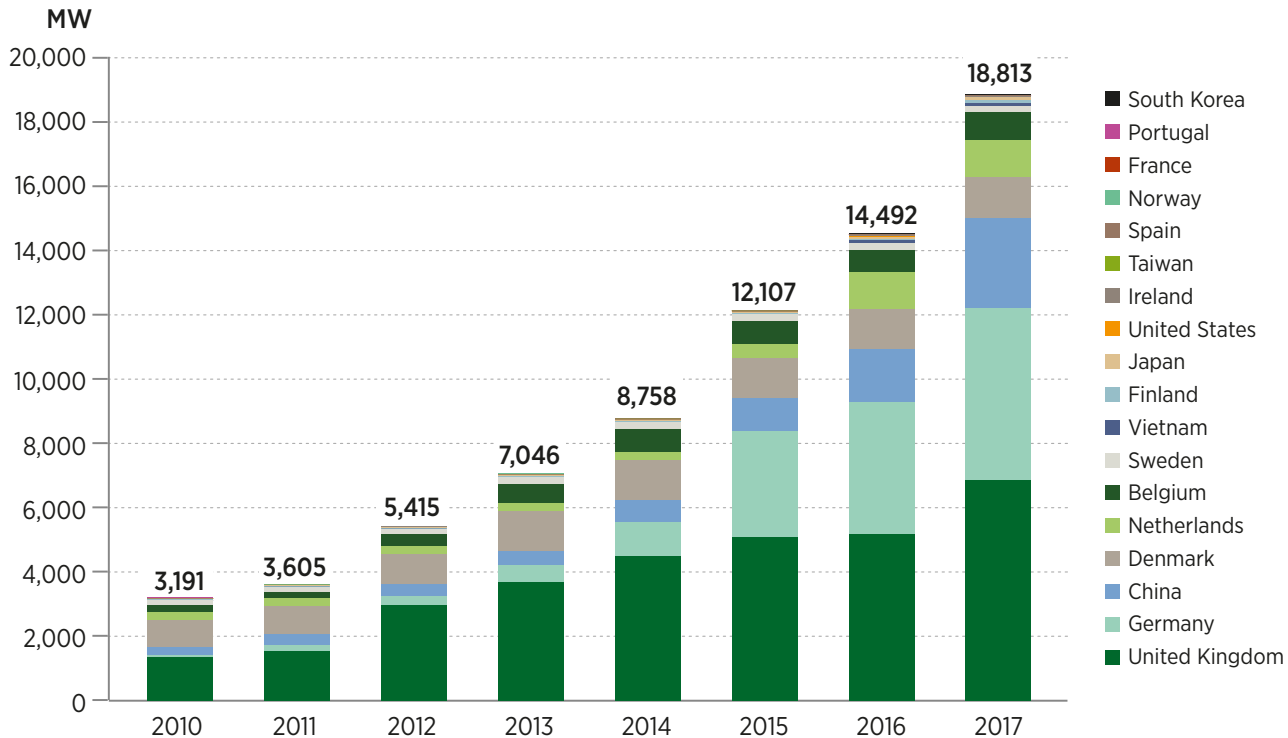


	Project Owner (Project Name)	State	Current Status	Project Pipeline (MW)
33	AW Oahu Northwest	HI	Planning	400
34	AW Oahu South	HI	Planning	400
35	Progression Hawaii	HI	Planning	400
32	Morro Bay	CA	Planning	765
27	WEA Wilmington East	NC	Planning	1,623
26	WEA Wilmington West	NC	Planning	627
9	Massachusetts WEA 502	MA	Planning	3012
10	Masachusetts WEA 503	MA	Planning	1707
3	Undeveloped Portion of Deepwater ONE North	MA	Site Control	495
6	Deepwater ONE South	MA	Site Control	816
7	Bay State	MA	Site Control	2,277
8	Undeveloped Portion of Vineyard Wind	MA	Site Control	1225
13	Empire Wind	NY	Site Control	963
19	Ørsted Ocean Wind	NJ	Site Control	1,947
18	US Wind	NJ	Site Control	2226
21	Deepwater Garden State	DE	Site Control	1050
22	US Wind	MD	Site Control	718
23	Dominion	VA	Site Control	1371
24	Coastal Virginia Offshore Wind	VA	Site Control	12
25	Avangrid Kitty Hawk	NC	Site Control	1,485
1	Marne Aqua Ventus I	ME	P/PI	12
8	Vineyard Wind	MA	P/PI	800
4	Revolution Wind	RI & CT	P/PI	600
2	Icebreaker	OH	P/PI	21
5	South Fork	NY	P/CA	90
20	Skipjack	MD	P/CA	120
23	US Wind	MD	P/CA	248
17	Fishermen's Energy	NJ	P/PI	24
11	Block Island Wind Farm	RI	Operating	30

Source: DOE Office of Energy Efficiency and Renewable Energy (EERE)

Planning: begins when developer or regulatory agency initiates formal site control process; Site Control: begins when developer obtains development rights to a site; P/PI: Permitting/Procurement Initiated; begins when developer files major permit applications or when the relevant regulatory authority initiates an auction (or other process) to procure energy for the project; P/CA: Permitting/Contract Awarded; begins when the project's permit applications have been approved or when a developer has been selected from the procurement process; Operating: begins when the project has been connected to the power grid and all units are fully commissioned.

Cumulative Offshore Wind Electricity Capacity by Country



IV

Source: Global Wind Energy Council (GWEC)

Reported values may vary from those included in previous editions of the data book due to retroactive changes by GWEC.

V. Solar

Solar: Summary

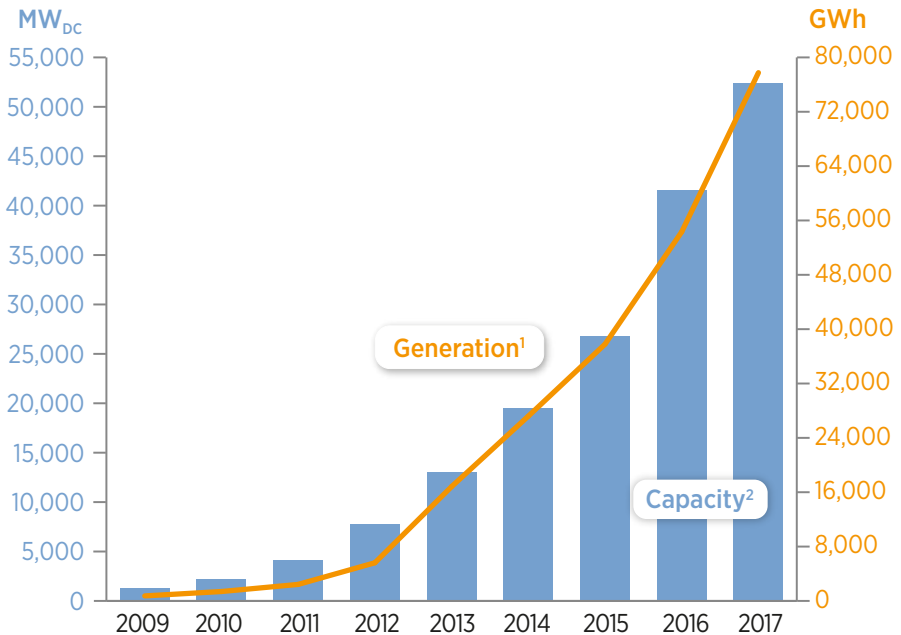
- **U.S. solar installed capacity increased by 24.7%** in 2017. PV capacity grew by 26% and CSP capacity was even with 2016.
- Consistently high growth rates over the last decade have resulted in a total of **52,356 MW_{DC} (43,321 MW_{AC}) of PV capacity[1] in the United States** as of the end of 2017.
- With no new capacity additions in 2017, **installed CSP capacity remained at 1,775 MW_{AC}.**
- **U.S. solar generation**, from PV and CSP combined, totaled more than **81 TWh**, which represents approximately **2% of total U.S. generation** in 2017.
- Both utility-scale and residential markets have driven PV solar capacity growth in the United States over the last three years. **Distributed PV generation in 2017 totaled 28 TWh, which represents 36% of total solar PV generation**.
- **In 2017, community solar programs' installed capacity increased by 112% (387 MW_{DC}) to a cumulative total of 734 MW_{DC}.[2]**
- **Distributed PV installed capacity grew by 27%** in 2017, **outpacing a 25% increase in utility-scale PV installed capacity.**

Sources: EIA and SEIA/GTM

[1] While EIA-860 reports utility-scale solar capacity in MW_{AC}, SEIA/GTM reports small-scale grid-connected PV capacity in MW_{DC}. The solar industry typically reports capacity in MW_{DC}. Based on consultation with developers, SEIA/GTM use an 87% MW_{DC} to MW_{AC} derate factor for installations below 10 MW. The data book uses the 87% derate factor when small-scale capacity figures are added to a cumulative MW_{AC} total. In the solar section of the data book, capacity figures are reported in MW_{DC} to conform with the solar industry standard. To do this, EIA-860 capacity is converted to MW_{DC} assuming an 80% MW_{DC}-to-MW_{AC} derate factor, which is the conservative estimate of converter efficiency used by the EIA. For more information, see "New EIA Data Show Total Grid-Connected Photovoltaic Solar Capacity," October 24, 2012, https://www.eia.gov/todayinenergy/detail.php?id=8510

[2] Community solar is a solar power installation that provides proportional output and financial payoff to individual members of a community.

U.S. PV Electricity Installed Capacity and Generation



	U.S. PV Generation[1] (GWh)	U.S. PV Capacity[2] (MW$_{DC}$) and % Increase from Previous Year	
		PV	Increase
2009	738	1,253	–
2010	1,384	2,175	72%
2011	2,431	4,127	88%
2012	5,615	7,762	86%
2013	16,824	12,999	66%
2014	27,195	19,515	50%
2015	37,787	26,796	37%
2016	54,327	41,572	54%
2017	77,754	52,356	26%

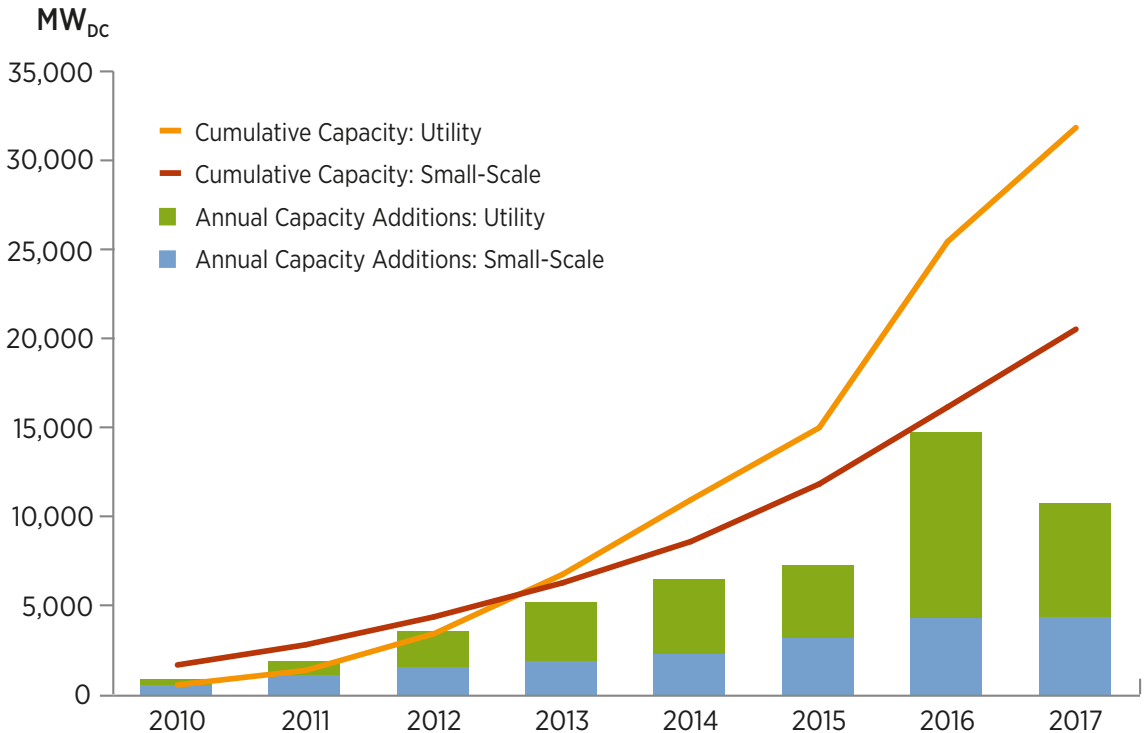
V

Sources: EIA and SEIA/GTM

[1] Grid-connected only; capacity is reported in MW$_{DC}$. A de-rate 80% has been used to convert utility-scale solar from MW$_{AC}$ to MW$_{DC}$.

[2] Solar generator capacity estimates are derived from EIA-860 compliance reporting for generators greater than 1 MW in capacity. Smaller solar generator capacity is based on data from the SEIA/GTM *Solar Market Insight 2017 Year-in-Review* report.

U.S. PV Cumulative Capacity by Segment

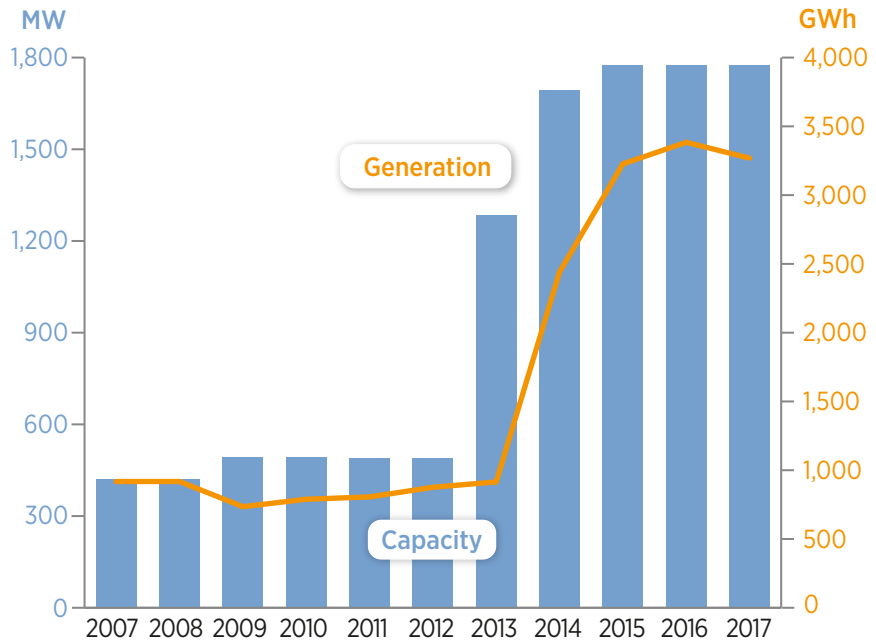


V

Sources: EIA and SEIA/GTM

Grid-connected only; capacity is reported in MW_{DC}. A de-rate 80% has been used to convert utility-scale solar from MW_{AC} to MW_{DC}.

U.S. CSP Electricity Installed Capacity and Generation

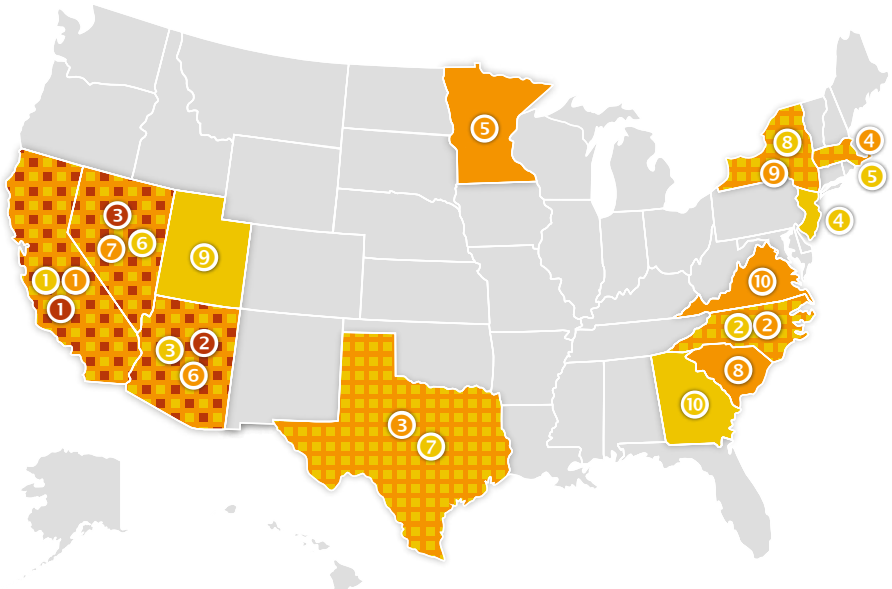


	U.S. CSP Generation (GWh)	U.S. CSP Capacity (MW) and % Increase from Previous Year	
		CSP	Increase
2000	775	354	—
2001	775	354	0%
2002	775	354	0%
2003	775	354	0%
2004	775	354	0%
2005	775	354	0%
2006	777	355	0%
2007	918	419	18%
2008	918	419	0%
2009	735	491	3%
2010	789	491	0%
2011	806	490	0%
2012	876	490	0%
2013	915	1,285	162%
2014	2,441	1,693	32%
2015	3,227	1,775	5%
2016	3,384	1,775	0%
2017	3,269	1,775	0%

V

Source: EIA
CSP capacity is reported in MW_{AC}.

States Leading Solar Electricity Development (2017)



PV Cumulative Capacity[1] (MW)	
1 California	19,972
2 North Carolina	4,355
3 Arizona	3,417
4 New Jersey	2,746
5 Massachusetts	2,744
6 Nevada	2,389
7 Texas	1,890
8 New York	1,358
9 Utah	1,332
10 Georgia	1,270

PV Annual Capacity[1] Additions (MW)	
1 California	2,736
2 North Carolina	1,164
3 Texas	910
4 Massachusetts	659
5 Minnesota	576
6 Arizona	442
7 Nevada	386
8 South Carolina	373
9 New York	361
10 Virginia	348

CSP Cumulative Capacity[2] (MW)	
1 California	1,294
2 Arizona	280
3 Nevada	201

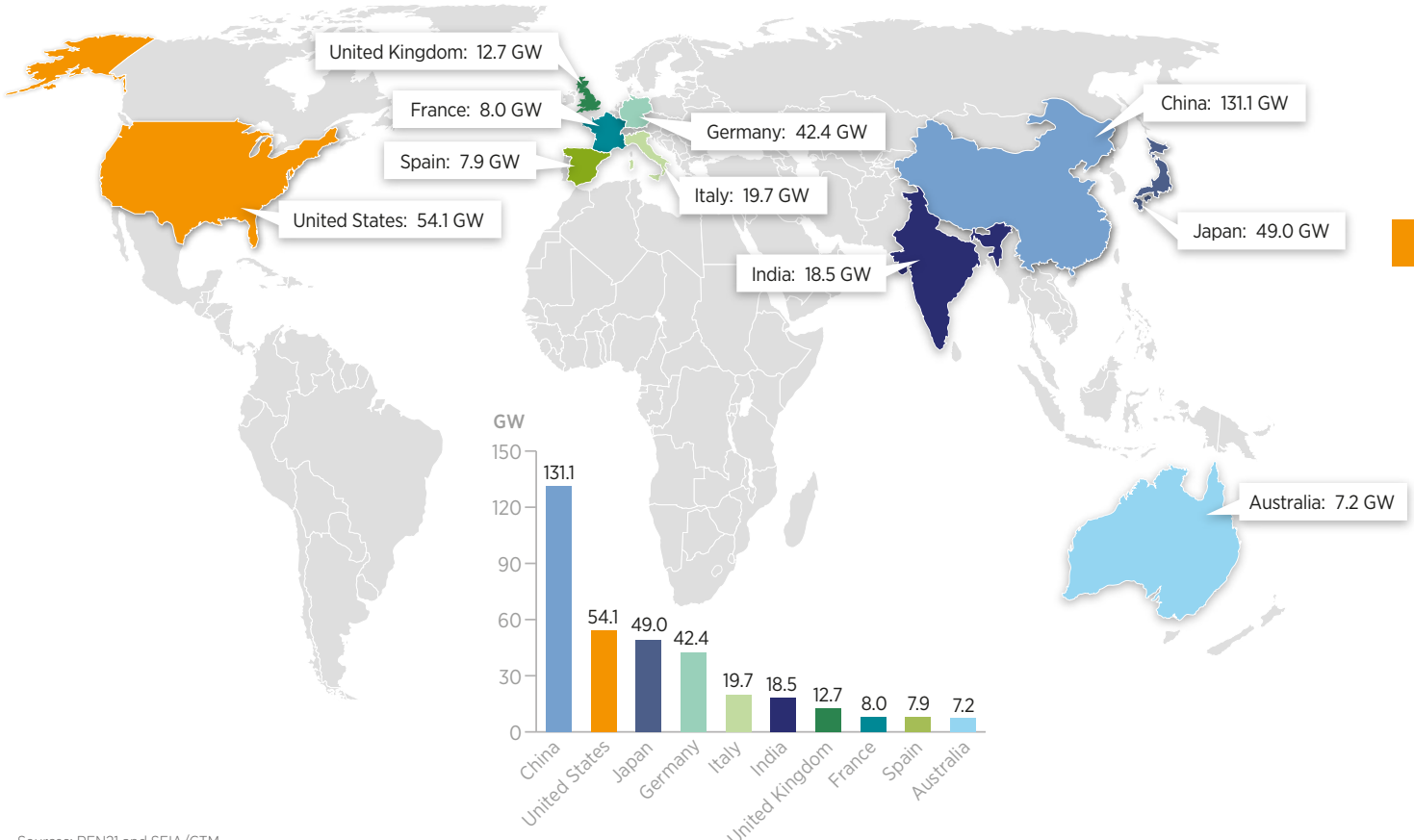
V

Source: SEIA/GTM

[1] Grid-connected only; capacity is reported in MW_{DC}. A de-rate 80% has been used to convert utility-scale solar from MW_{AC} to MW_{DC}.

[2] CSP capacity is reported in MW_{AC}.

Cumulative Solar Electricity Capacity (2017) – Select Countries



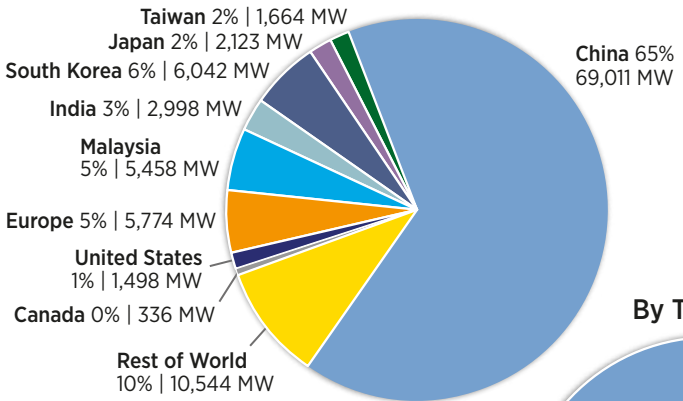
Sources: REN21 and SEIA/GTM

Includes CSP and grid-connected PV; PV is reported in MW_{DC}, and CSP is reported in MW_{AC}

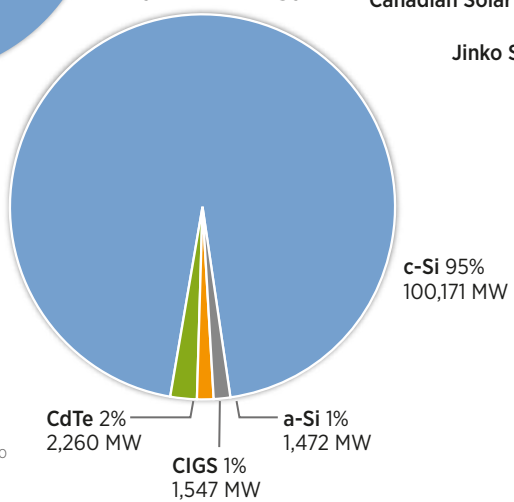
Global Photovoltaic Manufacturing (2017)

Global Solar Module Production (2017): 105,817 MW

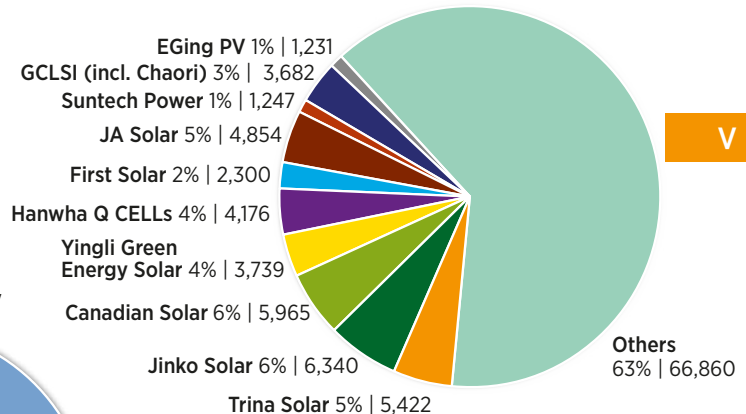
By Country



By Technology



By Manufacturer



Sources: GTM Research and PV Pulse

Module production is reported in MW_{DC}.

Tracked PV cell technologies include Mono-Crystalline Silicon (Mono c-Si), Cadmium Telluride (CdTe), Copper Indium Gallium Selenide (CIGS), Amorphous Silicon (a-Si), and Crystalline Silicon (c-Si).

VI. Geothermal

Geothermal: Summary

- **U.S. geothermal installed capacity has remained relatively stable since 2000**. Despite a decrease (-1.9%) of installed capacity in 2017 due to a plant retirement in California, **geothermal generation increased slightly.**

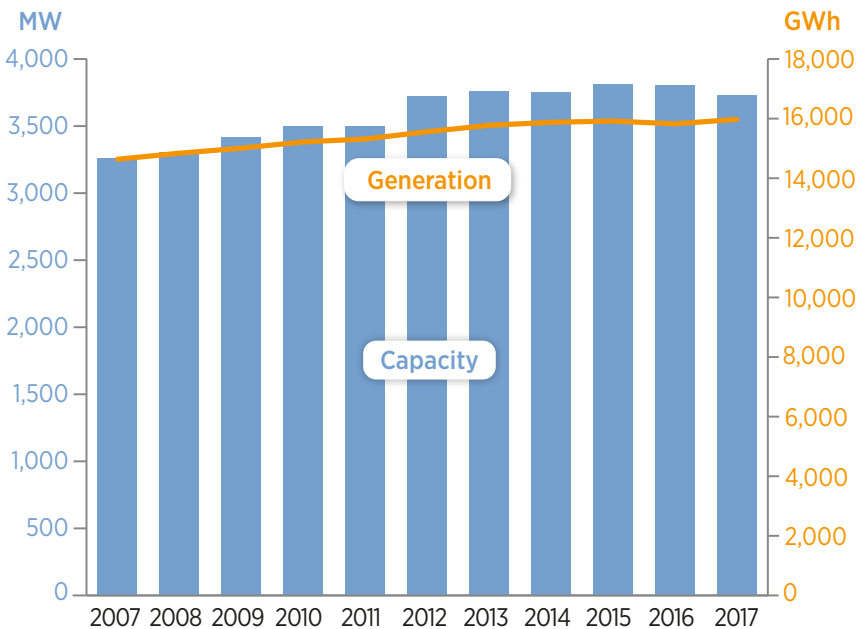
- **The United States continued to lead the world in** 2017 in installed geothermal electricity **capacity** (over 3.7 GW) **and generation** (more than 15.9 TWh), with most of the capacity installed in California and Nevada.

- The U.S. Department of Energy (DOE) Frontier Observatory for Research in Geothermal Energy **(FORGE) is the first dedicated field site of its kind for testing targeted EGS research and development**. FORGE Phase 2 activities will focus on fully instrumenting, characterizing, and permitting candidate sites for a single full-scale operation.

- Currently, the DOE has selected five potential candidate sites for its FORGE Phase 2 initiative in Oregon, Idaho, Nevada, Utah and California.

Source: EERE

U.S. Geothermal Electricity Capacity and Generation

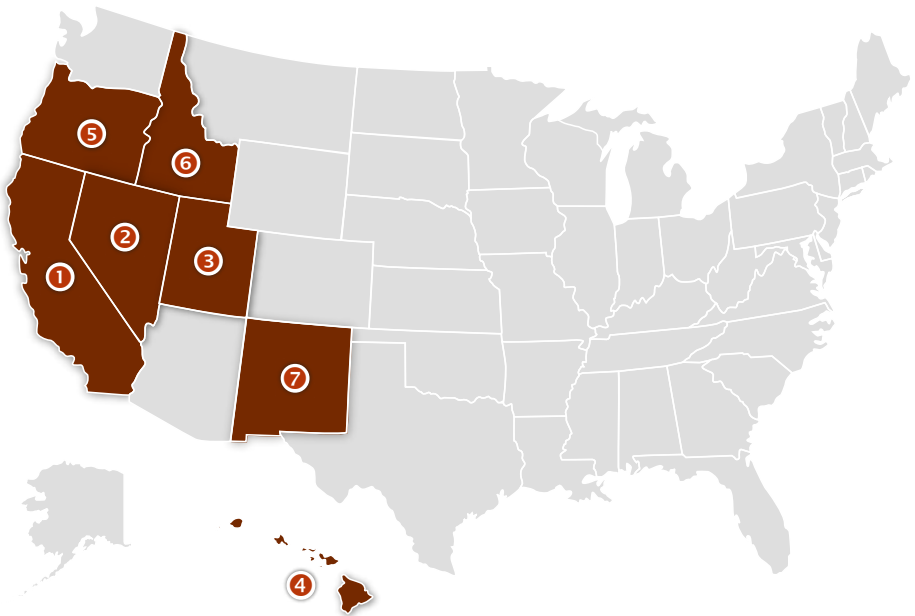


	U.S. Geothermal Electricity Generation (GWh)	U.S. Geothermal Electricity Capacity and % Increase from Previous Year	
		Total (MW)	% Increase
2000	14,093	3,100	—
2001	13,741	3,100	0.0%
2002	14,491	3,108	0.2%
2003	14,424	3,108	0.0%
2004	14,811	3,108	0.0%
2005	14,692	3,143	1.1%
2006	14,568	3,195	1.7%
2007	14,637	3,259	2.0%
2008	14,840	3,306	1.4%
2009	15,009	3,421	3.5%
2010	15,219	3,498	2.3%
2011	15,316	3,500	0.1%
2012	15,562	3,724	6.4%
2013	15,775	3,761	1.0%
2014	15,877	3,757	-0.1%
2015	15,918	3,812	1.5%
2016	15,826	3,805	-0.2%
2017	15,976	3,732	-1.9%

VI

Source: EIA

Cumulative State Geothermal Electricity Development (2017)



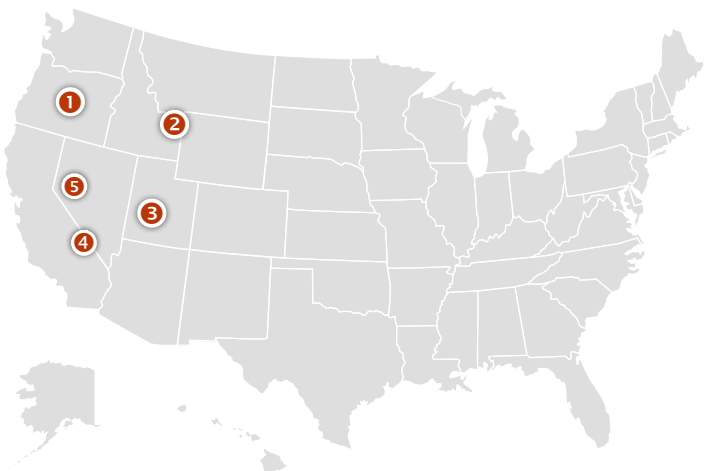
Total Installed Capacity (MW)	
1 California	2788
2 Nevada	751
3 Utah	84
4 Hawaii	51
5 Oregon	37
6 Idaho	18
7 New Mexico	4

VI

Source: EIA

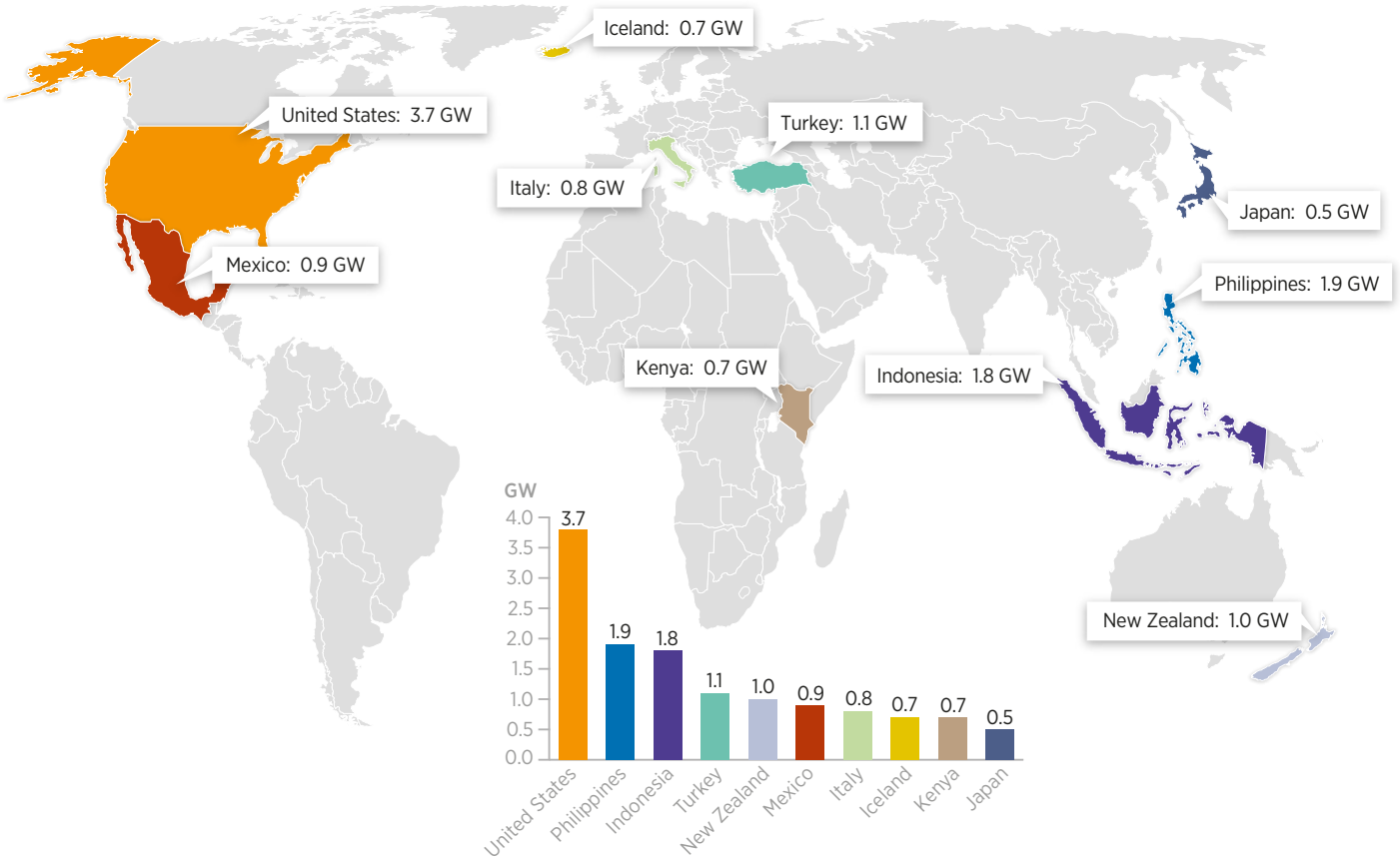
Potential Candidate U.S. FORGE Phase 2 Projects

Project location	Collaborators
1 Newberry Volcano, OR	PNNL, AltaRock, OSU
2 Snake River Plain, ID	INL, NREL, CAES, UofU, University of Oklahoma, Baker Hughes, Geo-Hydro, LLNL, IDDWR, IDGS, USGS, US Geothermal, Campbell Scientific, Geothermal Resource Group
3 Milford, UT	UofU, UTGS, USGS, Geothermal Resources Group, INL, Temple
4 Coso, CA	Sandia, LBNL, USGS, UNR, GeothermEx, U.S. Navy, Coso Operating Company, Itasca
5 Fallon, NV	Sandia, LBNL, USGS, UNR, GeothermEx, U.S. Navy, Ormat, Itasca



Source: EERE

Cumulative Geothermal Electricity Capacity (2017) – Top 10 Countries



Sources: EIA and REN21

Geothermal capacity values may vary from those included in previous editions of the data book due to a change in source from the Geothermal Energy Association to the REN21.

VII. Biopower

Biopower: Summary

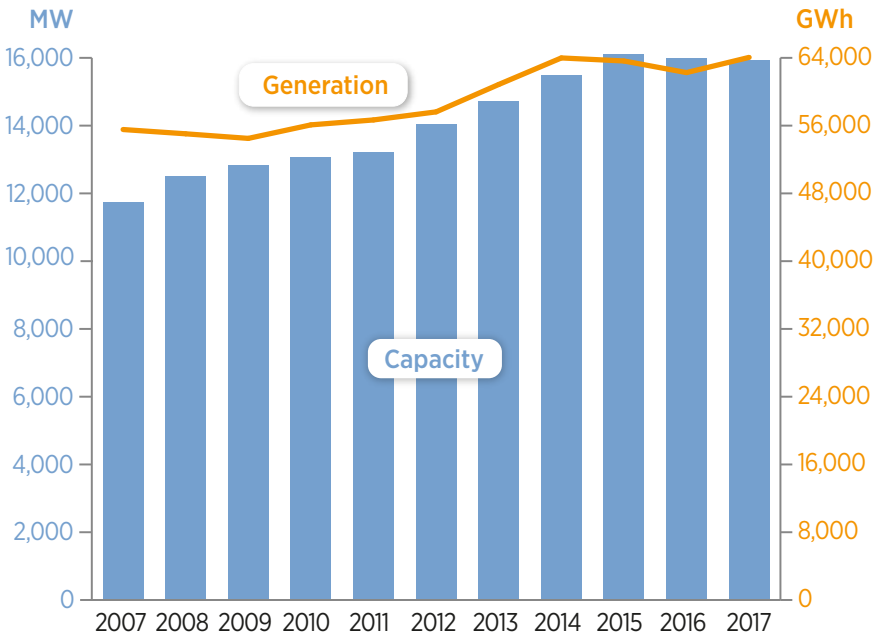
- U.S. biopower installed electricity **capacity decreased by 0.4% in 2017 to approximately 15.9 GW**.

- In 2017, biopower electricity generation increased by 2.9%, and it accounted for more than **9% of all renewable energy generated in the United States** and 1.6% of total U.S. electricity generation from all sources.

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

- The top five states for biopower capacity in 2017 were Florida (1.54 GW), California (1.42 GW), Virginia (1.02 GW) Georgia (0.96 GW), and Maine (0.77 GW).

U.S. Biopower Electricity Capacity and Generation



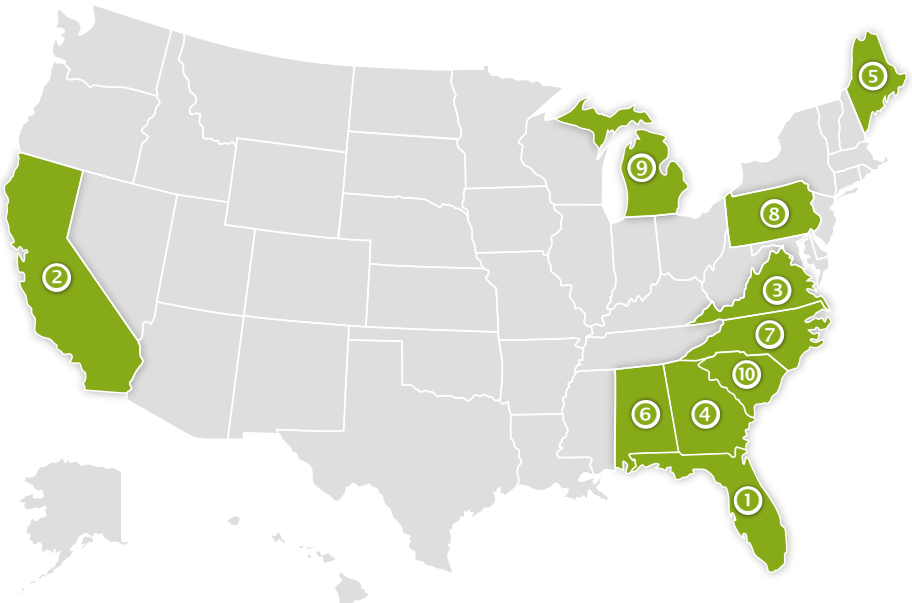
	U.S. Biopower Generation (GWh)	U.S. Biopower Capacity and % Change from Previous Year	
		Total (MW)	% Change
2000	60,726	10,676	- 2.9%
2001	49,748	10,576	- 0.9%
2002	53,709	10,867	2.8%
2003	53,340	10,856	- 0.1%
2004	53,073	11,033	1.6%
2005	54,276	11,222	1.7%
2006	54,861	11,553	2.9%
2007	55,539	11,738	1.6%
2008	55,034	12,485	6.4%
2009	54,493	12,836	2.8%
2010	56,089	13,053	1.7%
2011	56,671	13,207	1.2%
2012	57,622	14,047	6.4%
2013	60,858	14,705	4.7%
2014	63,990	15,483	5.3%
2015	63,632	16,100	4.0%
2016	62,260	15,993	-0.7%
2017	64,057	15,928	-0.4%

VII

Source: EIA

Reported values may vary from those included in previous editions of the data book due to retroactive changes by EIA.

States Leading Biopower Electricity Installed Capacity (2017)



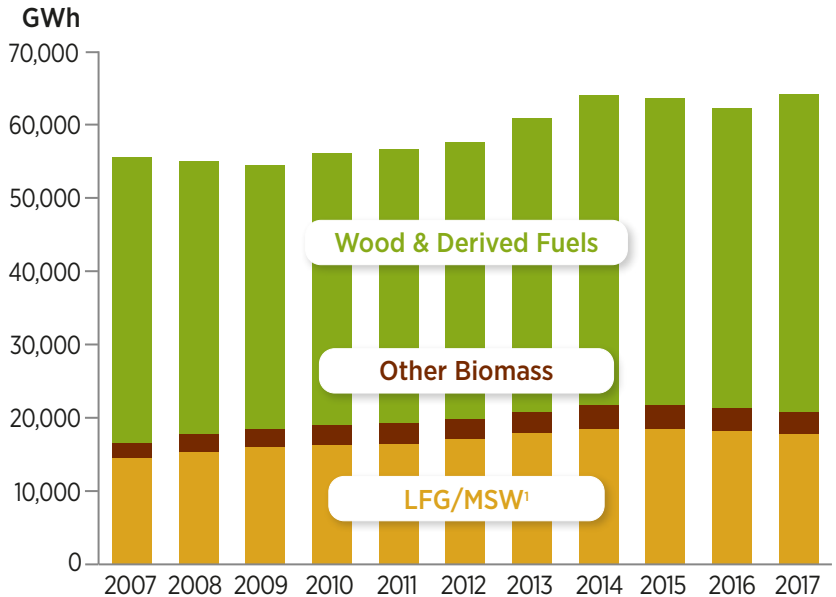
Total Installed Capacity (MW)[1]	
1 Florida	1,542
2 California	1,424
3 Virginia	1,018
4 Georgia	962
5 Maine	769
6 Alabama	763
7 North Carolina	645
8 Pennsylvania	634
9 Michigan	613
10 South Carolina	588

VII

Source: EIA

[1]Estimated based on proposed capacity additions

U.S. Biopower Electricity Generation Sources



	LFG/ MSW[1] (GWh)	Other Biomass[2]	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	13,472	1,948	38,856	54,276
2006	14,155	1,944	38,762	54,861
2007	14,462	2,063	39,014	55,539
2008	15,253	2,481	37,300	55,034
2009	15,982	2,461	36,050	54,493
2010	16,304	2,613	37,172	56,089
2011	16,398	2,824	37,449	56,671
2012	17,123	2,700	37,799	57,622
2013	17,844	2,986	40,028	60,858
2014	18,448	3,202	42,340	63,990
2015	18,502	3,201	41,929	63,632
2016	18,182	3,131	40,947	62,260
2017	17,840	2,933	43,284	64,057

VII

Source: EIA

Reported values may vary from those included in previous editions of the data book due to retroactive changes by EIA.

[1] LFG = landfill gas; MSW = municipal solid waste.

[2] Includes biogenic municipal solid waste, landfill gas, sludge waste, agricultural byproducts, and other biomass.

VIII. Hydropower

Hydropower: Summary

- While installed U.S. hydropower capacity remained relatively flat during 2017 at 79.6 GW, **generation increased by 12.9%** in 2017.
- Hydropower, primarily from large-scale plants, remains the **largest source of renewable electricity generation** in 2017, **accounting for 7.4% of U.S. total electricity generation and 41.9% of U.S. renewable electricity generation**.
- **From 2007 to 2017, $8.9 billion of rehabilitations and upgrades (R&U)** were started at 158 existing hydropower plants, with **nearly $600 million of R&U investments occurring in 2017** alone. Of the R&U investments from 2007 to 2017, 61% were directed toward hydroelectric-pumped storage, which is greater than pumped storage's share of installed federal hydroelectric capacity (51%).
- **Projects to power non-powered dams**[1] **account for 62% of newly proposed hydropower projects and 92% of proposed capacity additions.**
- While the **total capacity of 21.6 GW remained unchanged, pumped-hydro storage use declined to 6.5 TWh** in 2017, 2.9% less than in 2016.

Source: EIA, EERE Hydropower Market Report 2018

[1] A non-powered dam does not produce electricity; rather, it provides various services ranging from water supply to inland navigation.

Hydropower: Summary (continued)

- Hydropower installed capacity continued to be **concentrated in the West**, led by Washington (21.1 GW), California (10.1 GW), and Oregon (8.5 GW).[1]

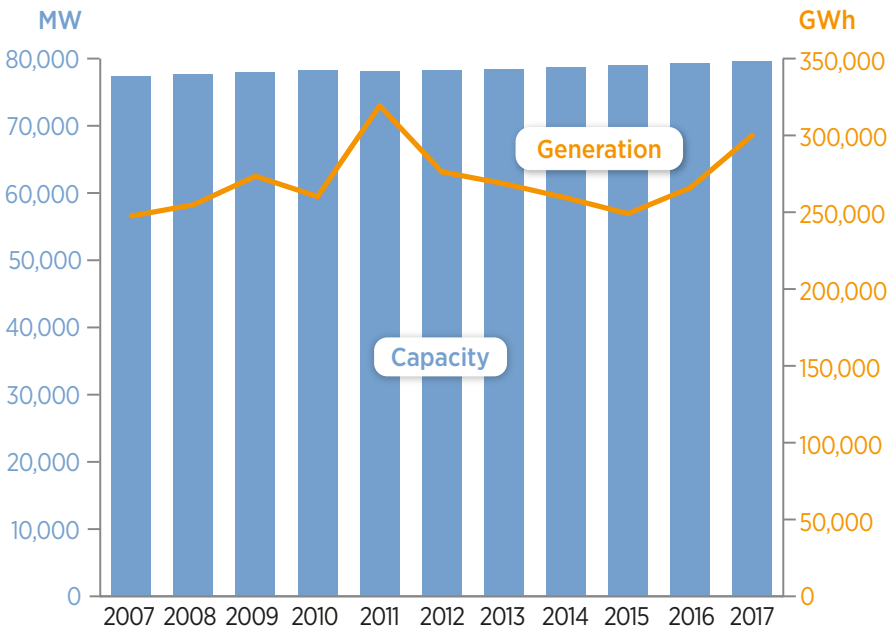
- *Globally*, with an installed capacity of 1.1 TW, **hydropower provides 60.8% of generation from renewables**.

VIII

Source: REN 21

[1] Excludes pumped storage

U.S. Hydropower Electricity Capacity and Generation

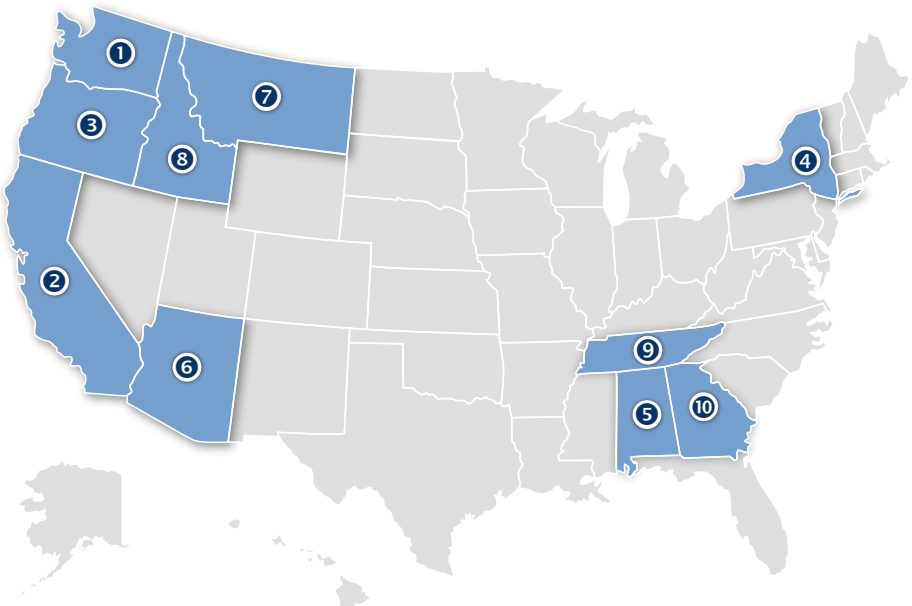


	U.S. Hydropower Generation (GWh)	U.S. Hydropower Capacity and % Increase from Previous Year	
		Total (MW)	% Increase
2000	**275,573**	**76,946**	**0.0%**
2001	**216,961**	**76,911**	**0.0%**
2002	**264,329**	**77,047**	**0.2%**
2003	**275,806**	**77,020**	**0.0%**
2004	**268,417**	**77,130**	**0.1%**
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	**319,355**	**78,194**	**0.0%**
2012	**276,240**	**78,241**	**0.1%**
2013	**268,565**	**78,457**	**0.3%**
2014	**259,367**	**78,793**	**0.4%**
2015	**249,080**	**78,957**	**0.2%**
2016	**265,829**	**79,376**	**0.5%**
2017	**300,045**	**79,595**	**0.3%**

VIII

Source: EIA
Excludes pumped-hydro storage
Reported values may vary from those included in previous editions of the data book due to retroactive changes by EIA.

States Leading Hydropower Electricity Installed Capacity (2017)



Total Installed Capacity (MW)	
1 Washington	21,139
2 California	10,061
3 Oregon	8,451
4 New York	4,684
5 Alabama	3,319
6 Arizona	2,718
7 Montana	2,671
8 Idaho	2,541
9 Tennessee	2,499
10 Georgia	1,963

VIII

Source: EIA
Excludes pumped-hydro storage.

IX. Marine and Hydrokinetic Power

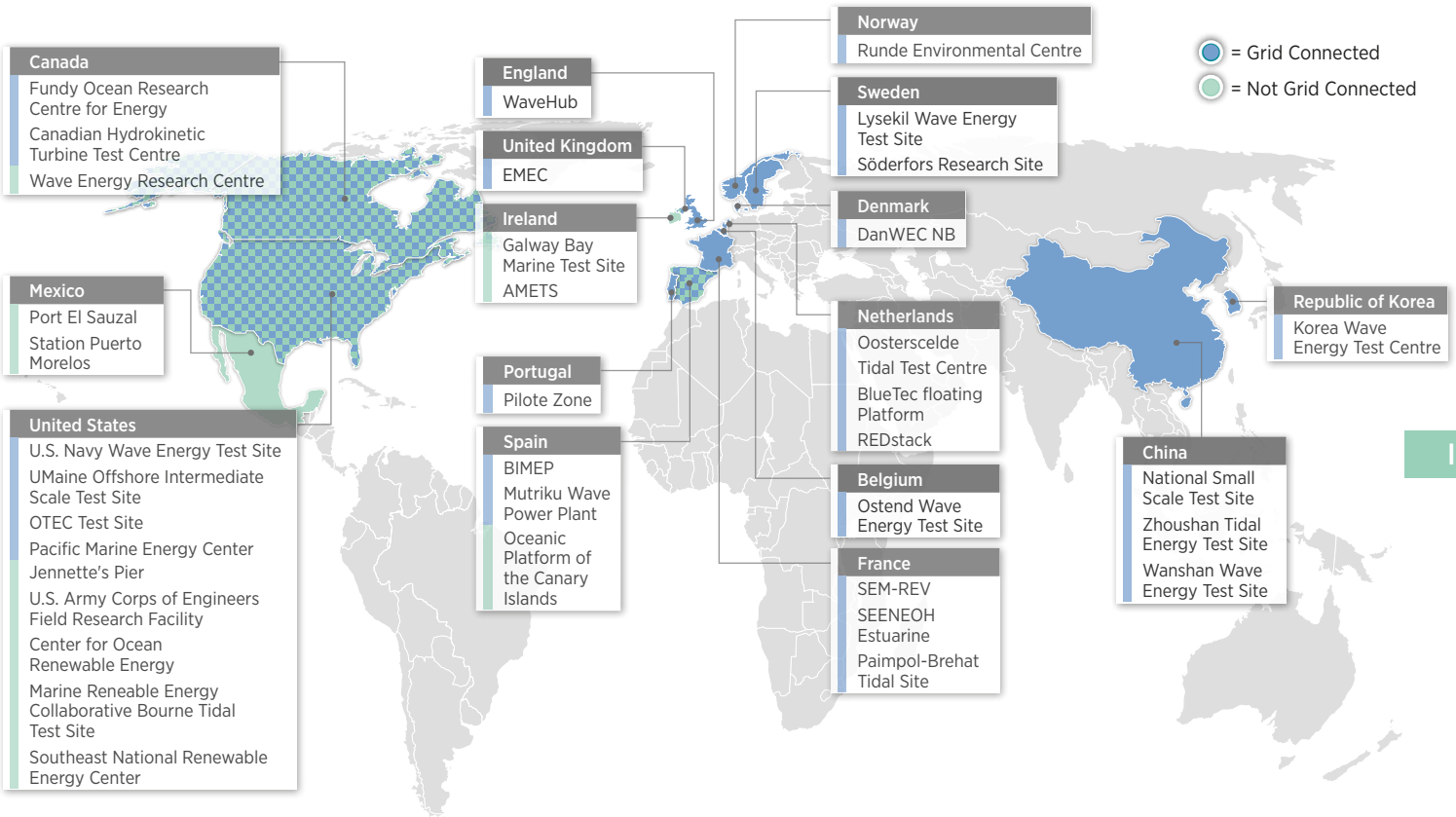
Marine and Hydrokinetic Power: Summary

- Most marine and hydrokinetic power (MHK) projects worldwide continue to be in a **pilot deployment and test-site status**. Technology development activity is concentrated in North America, Europe, Oceana, and Asia. Specifically, pilot deployments are concentrated in the United Kingdom (36%) and the United States (16%).
- As of 2017, there were only two licensed hydrokinetic projects in the United States: operated by Verdant Power in New York (1.05 MW) and Ocean Renewable Power Company in Maine (0.3 MW).
- In 2017, negotiations were concluded for construction of the PacWave Test Site on the coast of Oregon. This wave energy test facility, which is expected to become operational in 2021, will include 20 wave energy converters and is expected to supply up to 20 MW of electricity to the grid.
- The MeyGen Tidal Array in Scotland delivered over 2 GWh of electricity to the grid following its commissioning in July 2017.

Source: Ocean Energy Systems

- In 2017, DOE announced an additional $12 million across four new projects to support the development of MHK energy technologies:
  - Aquaharmonics is the first place winner and CalWave Power Technologies is the second place winner of the Wave Energy Prize. Each will build open-ocean prototypes of wave energy converters in Oregon and California respectively.
  - Portland State University in Oregon will develop a magnetically geared generator to improve the cost, reliability and efficiency of MHK devices.
  - Revision Consulting will integrate wave measurement data to predict ocean waves, which will help MHK devices more efficiently convert energy from waves.

Global Marine and Hydrokinetic Power – Examples of Open Sea Test Sites



Source: Ocean Energy Systems

Information about these and additional projects can be found in the EERE Marine and Hydrokinetic Technology Database at http://en.openei.org/wiki/Marine_and_Hydrokinetic_Technology_Database.

X. Energy Storage

Energy Storage: Summary – United States

- 1,395 MW of utility-scale electrochemical, electromechanical, and thermal storage systems[1] was installed in the United States as of 2017. Pumped-hydro storage was the largest contributor to U.S. storage installed capacity with 21,640 MW.
- U.S. utility-scale electrochemical, electromechanical, and thermal storage cumulative installed capacity expanded by 14.9% in 2017, down from a 25.9% increase in 2016.
- In 2017, **all new utility-scale storage installations in the United States were electrochemical** (106.6 MW). There were no new electrochemical, thermal storage, or pumped-hydro projects.
- Since 2007, **62% of new storage capacity in the United States has been electrochemical** (729 MW), **4.5% has been electromechanical** (52 MW), and **33% has been thermal** (392 MW).
- There have been two molten salt thermal storage projects in the United States since 2007, both of which use concentrated solar power (CSP) to store energy in molten salt.

X

Source: EIA and DOE-OE Global Energy Storage Database

Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned. Pumped-hydro storage is also referred to in Section VIII.

[1] Electrochemical storage devices include lead-acid batteries, lithium-ion batteries, metal-air batteries, nickel-based batteries, sodium-based batteries, and flow batteries. Electromechanical storage devices include flywheels, compressed air technologies, and gravitational storage. Thermal storage in this data book includes only those technologies that store thermal energy and converts this energy to electricity. Typically, thermal storage is used with CSP, but these projects are only included in this section if they use a conduit, such as molten salt, to continue providing power without the presence of solar radiation.

Energy Storage: Summary – United States (continued)

- Electrochemical battery projects have grown from 8 MW in 2007 to 228 MW in 2017, which corresponds with a CAGR of 39.8%.
- The **average duration** of electrochemical batteries installed in the United States in 2017 was **3.1 hours** with an average capacity of 7 MW.
- Renewable-paired storage[1] accounted for **47.2%** (658.5 MW) of installed utility-scale electrochemical, electromechanical, and thermal storage installed capacity in the United States on 2017 storage.
- Cumulative renewable-paired storage installed capacity has grown from 0.25 MW in 2007 to 658.5 MW in 2017.
- Renewable-paired storage capacity in the United States expanded by 1.7% in 2017, down from a 6.9% increase in 2016.
- Third-party ownership accounted for nearly 75% of U.S. utility-scale renewable-paired cumulative installed capacity in 2017 (491 MW), followed by utility ownership with 13% (85.6 MW) and customer ownership with 12% (81.6 MW).

X

Source: DOE-OE Global Energy Storage Database

Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

[1] Renewable-paired storage systems are those flagged within the DOE-OE Global Energy Storage Database as being connected to on-site renewable generation.

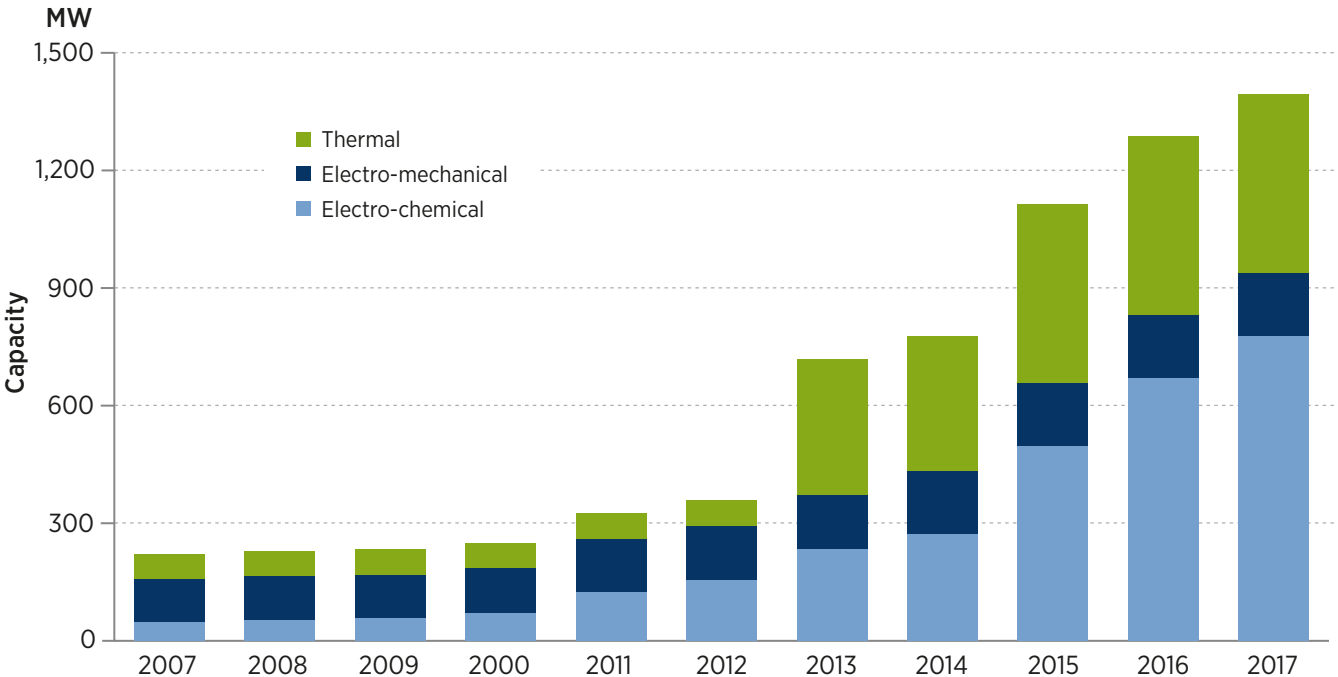
Energy Storage: Summary – United States (continued)

- States leading in utility-scale electrochemical, electromechanical, and thermal storage cumulative installed capacity in 2017 also led in renewable-paired storage. The top three leading states for storage capacity were **Arizona** (311 MW, including 291 MW of renewable-paired storage capacity), **California** (232 MW, including 51.5 MW of renewable-paired capacity), and **Nevada** (174 MW, including 110 MW of renewable-paired capacity).
- States leading in per-capita energy storage capacity in 2017 were **Alaska** (81.5 watts per capita), **Nevada** (58.1 watts per capita), and **Arizona** (44.3 watts per capita). States leading in per-capita renewable-paired storage installed capacity were **Arizona** (41.5 watts per capita), **Nevada** (36.7 watts per capita), and **West Virginia** (17.3 watts per capita).
- States leading in electrochemical storage capacity in 2017 were **California** (nearly 230 MW), **Illinois** (more than 143 MW), and **West Virginia** (nearly 67 MW).
- Cumulatively, of the 658.5 MW of renewable-paired storage capacity in the United States, **third-party ownership**[1] **accounted for nearly 75% renewable-paired capacity** (491 MW), followed by **utility ownership with 13%** (85.6 MW) and **customer ownership with 12%** (81.6 MW).

X

Sources: DOE-OE Global Energy Storage Database and U.S. Census Bureau
Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

U.S. Energy Storage Cumulative Capacity



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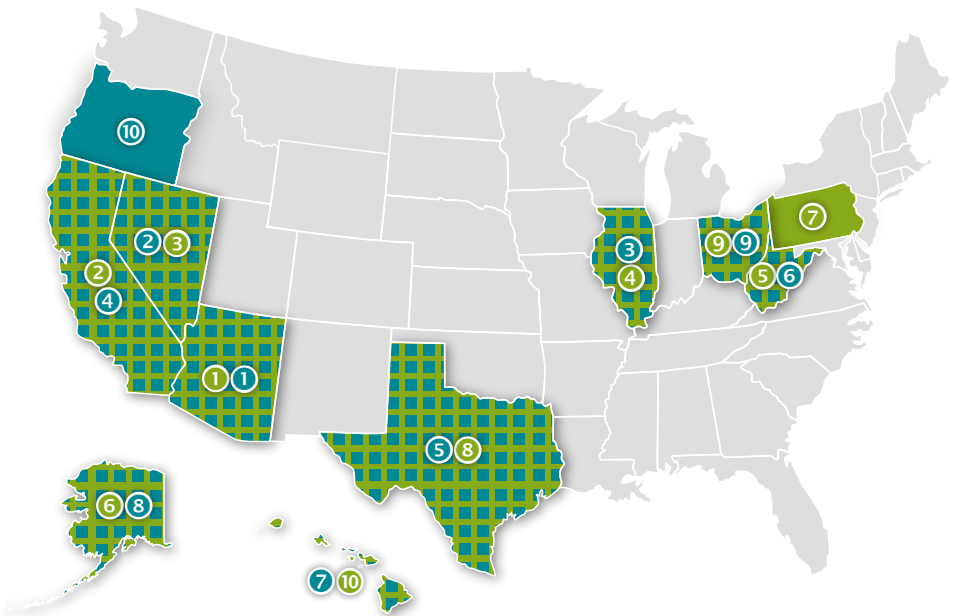
Source: DOE-OE Global Energy Storage Database
Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

States Leading Energy Storage Development (2017)

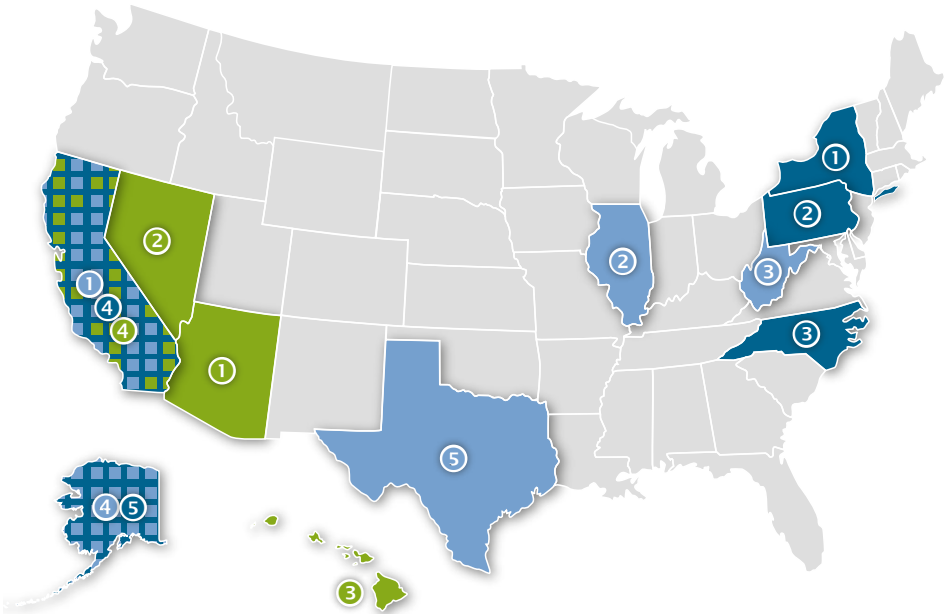


Cumulative Storage Capacity (MW)	
1 Arizona	311
2 California	232
3 Nevada	174
4 Illinois	143
5 West Virginia	67
6 Alaska	60
7 Pennsylvania	55
8 Texas	54
9 Ohio	47
10 Hawaii	40

Cumulative Renewable-Paired Storage Capacity (MW)	
1 Arizona	291
2 Nevada	110
3 Illinois	83
4 California	52
5 Texas	39
6 West Virginia	32
7 Hawaii	13
8 Alaska	7
9 Ohio	7
10 Oregon	5

Source: DOE-OE Global Energy Storage Database
Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

States Leading Energy Storage Development by Technology (2017)



Electro-Chemical: Cumulative Storage Capacity (MW)	
1 California	230
2 Illinois	143
3 West Virginia	67
4 Alaska	58
5 Texas	52

Electro-Mechanical: Cumulative Storage Capacity (MW)	
1 New York	20
2 Pennsylvania	20
3 North Carolina	4
4 California	2
5 Alaska	2

Thermal: Cumulative Storage Capacity (MW)	
1 Arizona	280
2 Nevada	174
3 Hawaii	2
4 California	0.005

Source: DOE-OE Global Energy Storage Database
Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

Energy Storage: Summary – Global

- Pumped-hydro storage was the largest contributor to global energy storage installed capacity as of 2017, with 153 GW. 3.2 GW of new capacity was installed globally.
- In 2017, **58% of new storage capacity installed was thermal** (582 MW), **41% was electrochemical** (410 MW), and **0.5% was electromechanical** (5 MW).
- Since 2007, **53% of global storage capacity installed has been thermal** (2330 MW), **43% has been electrochemical** (1,892 MW), and **3% has been electromechanical** (142 MW).
- **Since 2007, electrochemical systems have accounted for 87.6% of all storage projects in the world,** or 516 out of 589 total projects.
- The global average duration of electrochemical batteries installed in 2017 was **3.2 hours** with an average capacity of 10.4 MW.
- The United States led the world in utility-scale electrochemical, electromechanical, and thermal storage cumulative installed capacity in 2017 with 1,395 MW, followed by Germany (nearly 1,014 MW) and Spain (more than 991 MW).

Source: DOE-OE Global Energy Storage Database, EERE Hydropower Market Report 2018, REN 21
Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

- Countries leading in electrochemical storage cumulative installed capacity in 2017 were the United States (more than 776 MW), Germany (nearly 335 MW), and Japan (nearly 237 MW).

- Countries leading in per capita utility-scale storage cumulative installed capacity were Chile (22.6 watts), Spain (20.2 watts), and Israel (14.6 watts).

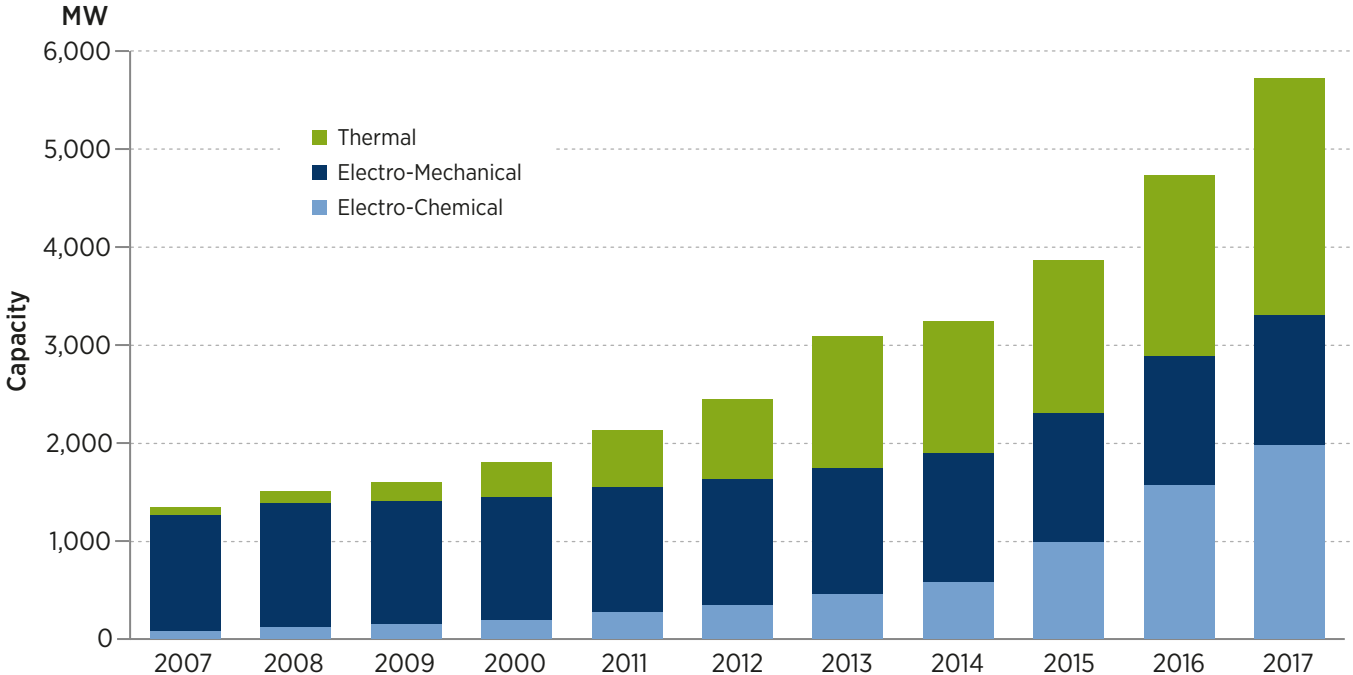
- Renewable-paired storage accounted for **22.4%** of the world's total storage capacity. In total, 5,728 MW of storage is installed including 1,284 MW of renewable-paired storage.

- Since 2007, renewable-paired storage capacity has grown from 16.0 MW to 1,284 MW. This is equivalent to an average of more than 302 MW of new capacity per year.

- The three countries leading in renewable-paired storage installed capacity in 2017 are the **United States** (nearly 659 MW), **South Africa** (205 MW), and **Australia** (more than 160 MW).

Sources: DOE-OE Global Energy Storage Database and CIA World Factbook
Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

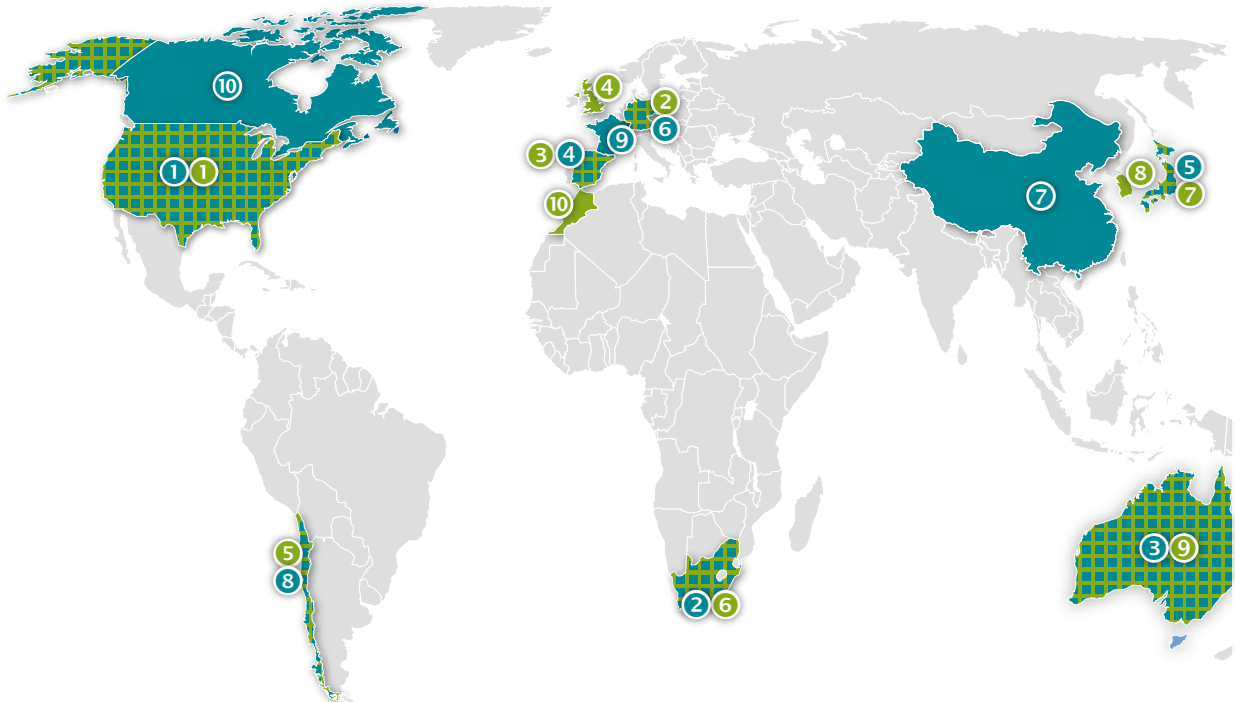
Global Energy Storage Capacity (2017)



X

Source: DOE-OE Global Energy Storage Database
Pumped-hydro storage is excluded from capacity metrics unless specifically mentioned.

Top Countries for Energy Storage Installed Capacity (2017)

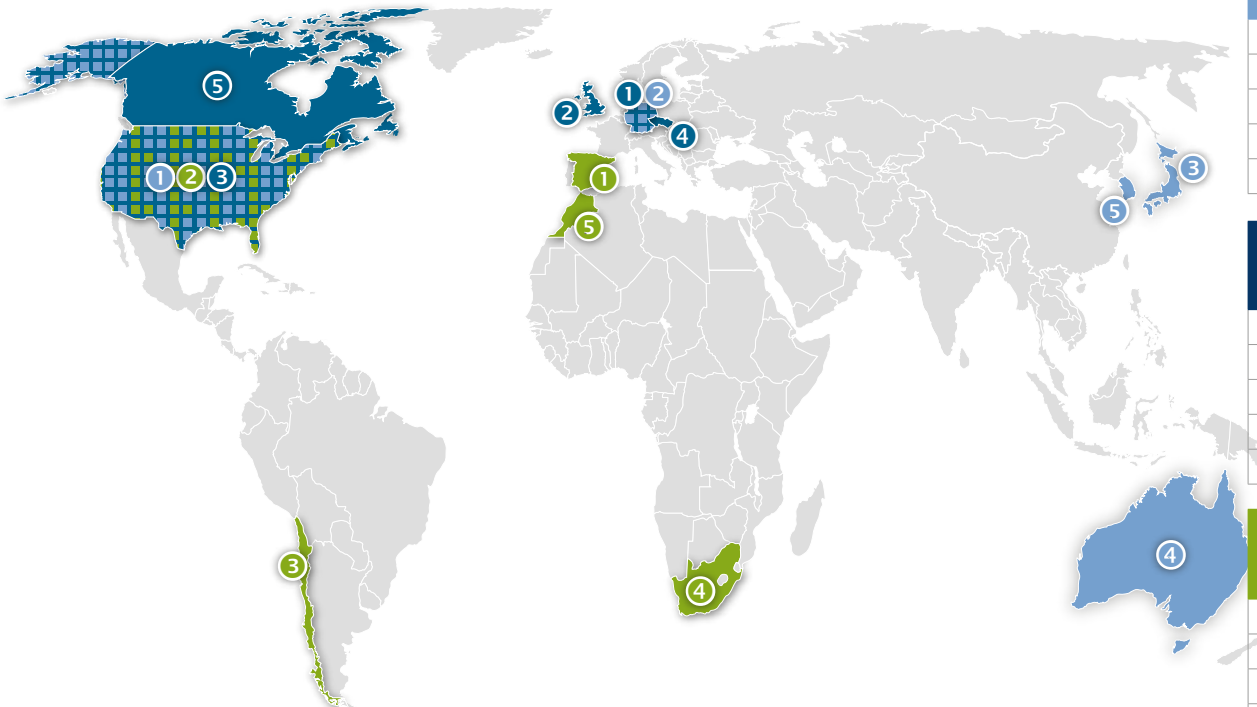


Cumulative Storage Capacity (MW)	
1 United States	1395
2 Germany	1014
3 Spain	991
4 United Kingdom	444
5 Chile	403
6 South Africa	305
7 Japan	237
8 South Korea	167
9 Australia	161
10 Morocco	161

Cumulative Renewable-Paired Storage Capacity (MW)	
1 United States	659
2 South Africa	205
3 Australia	160
4 Spain	112
5 Japan	52
6 Germany	21
7 China	14
8 Chile	11
9 France	10
10 Canada	8

Source: DOE-OE Global Energy Storage Database

Top Countries for Energy Storage Installed Capacity by Technology (2017)



Electro-Chemical: Cumulative Storage Capacity (MW)	
1 United States	776
2 Germany	335
3 Japan	237
4 Australia	162
5 South Korea	161

Electro-Mechanical: Cumulative Storage Capacity (MW)	
1 Germany	677
2 United Kingdom	400
3 United States	163
4 Czech Republic	70
5 Canada	14

Thermal: Cumulative Storage Capacity (MW)	
1 Spain	961
2 United States	456
3 Chile	371
4 South Africa	305
5 Morocco	161

Source: DOE-OE Global Energy Storage Database

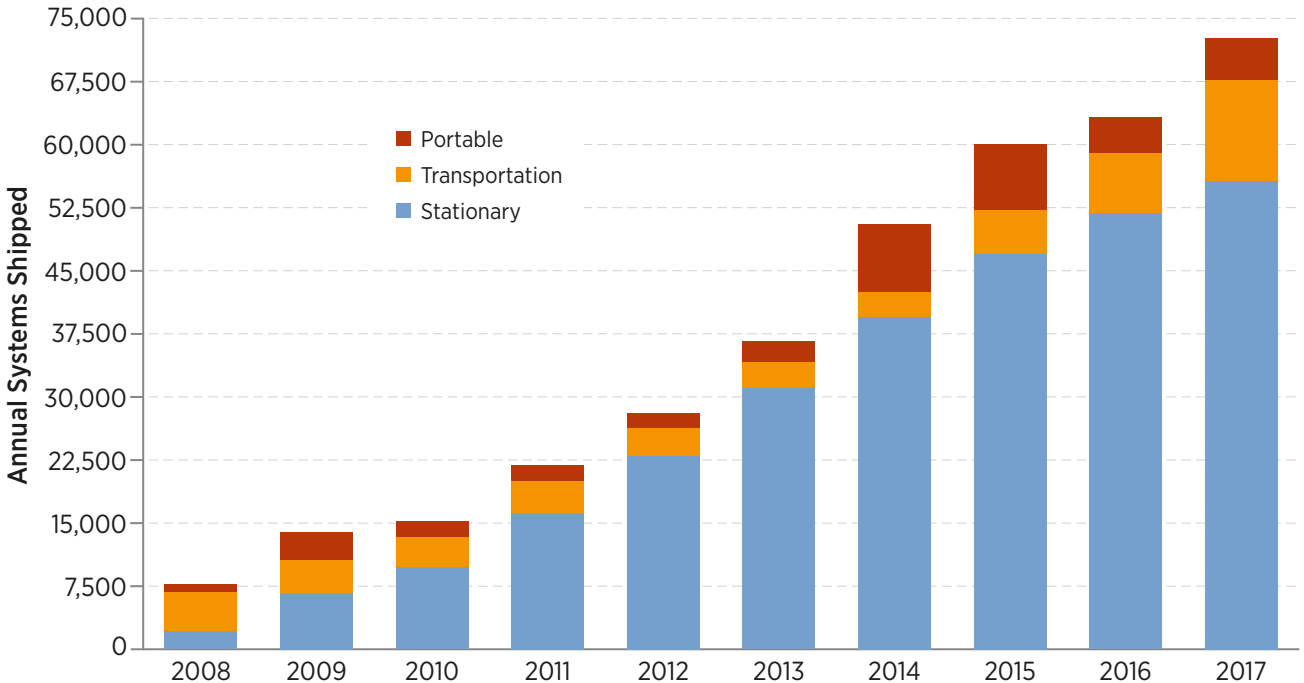
XI. Hydrogen and Fuel Cells

Hydrogen and Fuel Cells: Summary

- In 2017, **global fuel cell shipments by rated power totaled nearly 650 MW, a ~30% increase** from 2016 (~520 MW). Most of the growth in 2017 was due to transportation fuel cell shipments.
- By the end of 2017, approximately 20,000 hydrogen fuel cell forklifts were in operation, mostly in North America. Plug Power continued to dominate the supply, with over 95% of the market share.
- Fuel cell electric buses (FCEBs) applications continue to grow with deployment projects focused in Europe and China. The second Joint Initiative for hydrogen Vehicles across Europe (JIVE2) is seeking to deploy 152 FCEBs at €625,000 (~$745,000) per bus. China also plans to develop and deploy over 2,000 hydrogen fuel cell buses in the coming years. In the United States, over 30 FCEBs are currently in operation: 25 in California, 7 in Ohio, 2 in Delaware, and 1 in Michigan. Nearly 40 buses are currently in planning in states such as Ohio, Connecticut, Hawaii, Illinois and New York.
- Global stationary fuel cell shipments for both backup and prime power (less than 1 kW to multi-MW) totaled approximately 220 MW in 2017, a 6% increase over 2016.
- Of the approximately 60 hydrogen stations available in the United States by the end of 2017, 30 were available as commercial retail fueling stations in California. Plans are underway for 200 in the state by 2025 along with several in the Northeast.
- In the United States, over 3,500 commercial fuel cell passenger vehicles have been sold or leased through 2017.

Sources: EERE, E4tech, NREL, CaFCP, HTAC, and POSCO Energy

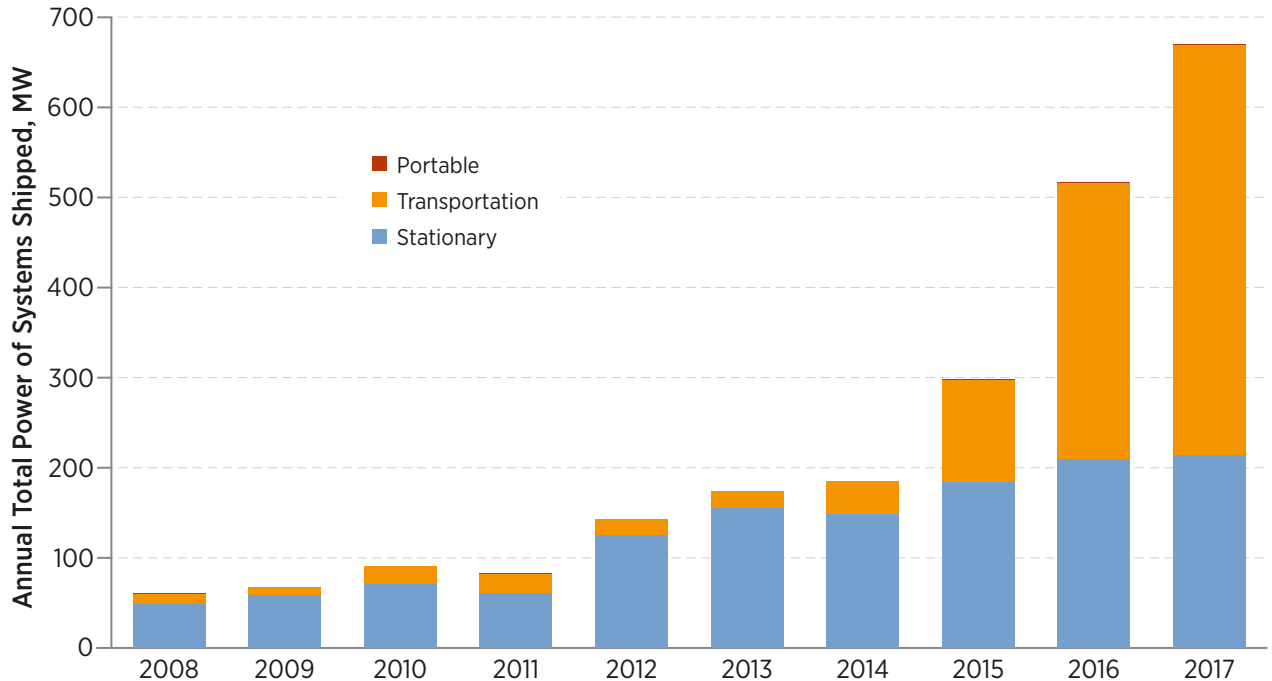
Annual Total Number of Fuel Cell Systems Shipped by Application, World Markets



XI

Sources: EERE, Navigant Research (2008–2013), and E4tech (2014–2017)
Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

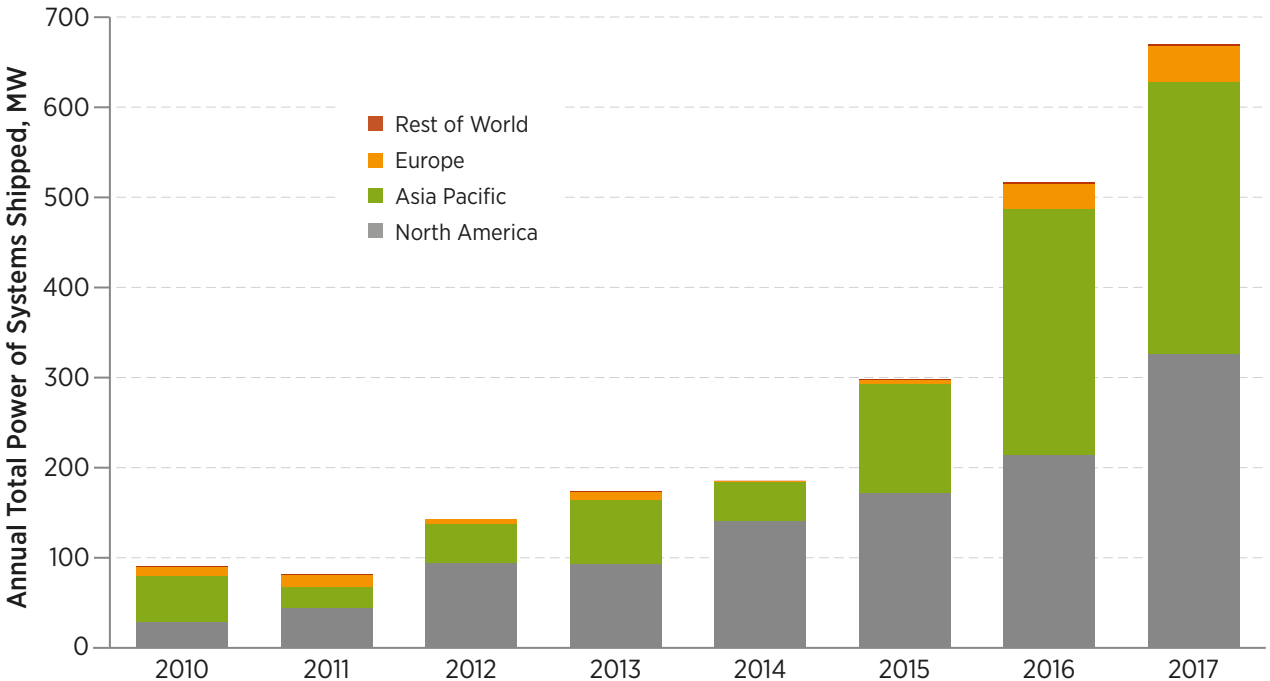
Annual Rated Power of Fuel Cell Systems Shipped by Application, World Markets



XI

Sources: EERE, Navigant Research (2008–2013), and E4tech (2014–2017)
Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

Annual Rated Power of Fuel Cell Systems Shipped by Region, World Markets



XI

Sources: EERE, Navigant Research (2008–2013), and E4tech (2014–2017)
Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

XII. Plug-In Electric Vehicles

Plug-In Electric Vehicles: Summary

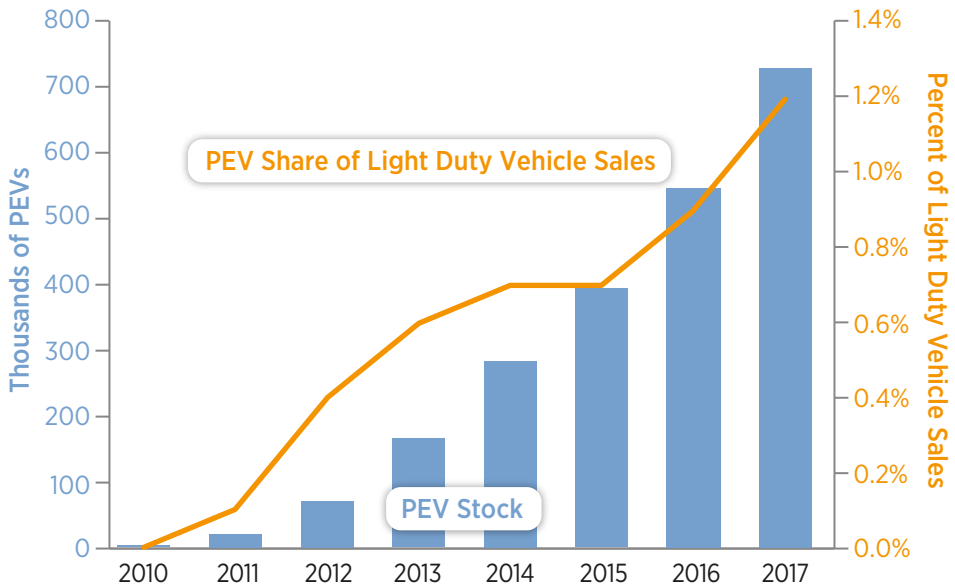
- Approximately 195,600 plug-in electric vehicles (PEV) were sold in the United States in 2017. Plug-in hybrid electric vehicles (PHEV) and battery electric vehicles (BEV) each accounted for roughly half of the annual sales for all plug-in vehicles.

- Over 50 different PEV models were actively selling in the market in 2017, covering various vehicle sizes from two-seaters to standard SUVs; the top 10 selling models accounted for nearly 80% of the market. Large cars and small station wagons each accounted for about 25% of sales in 2017 due to the success of Tesla Model S and Chevy Bolt, respectively.

- Tesla's Model S was the top selling model with about 26,500 units sold, followed by Tesla's Model X with 21,700 units sold. Chevy Volt and Prius PHEVs each sold over 20,000 units.

Source: Argonne National Laboratory

U.S. PEV Stock and Share of Light Duty Vehicle Sales

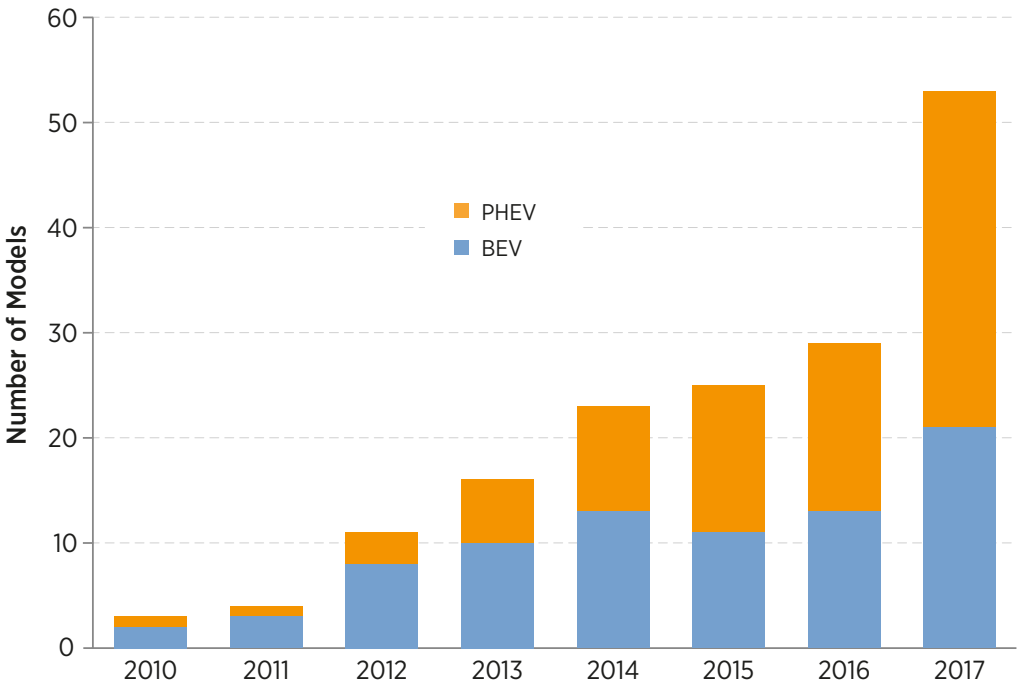


	Estimated PEV Stock (thousands)	PEV Share of Light Duty Vehicle Sales
2010	0	0.0%
2011	18	0.1%
2012	71	0.4%
2013	167	0.6%
2014	284	0.7%
2015	395	0.7%
2016	549	0.9%
2017	735	1.2%

Source: Argonne National Laboratory

Note: PEV stock is equal to the cumulative sum of annual plug-in vehicle sales indexed to the NHTSA Vehicle Survivability and Travel Mileage Schedules.

Number of Available PEV Models in the United States

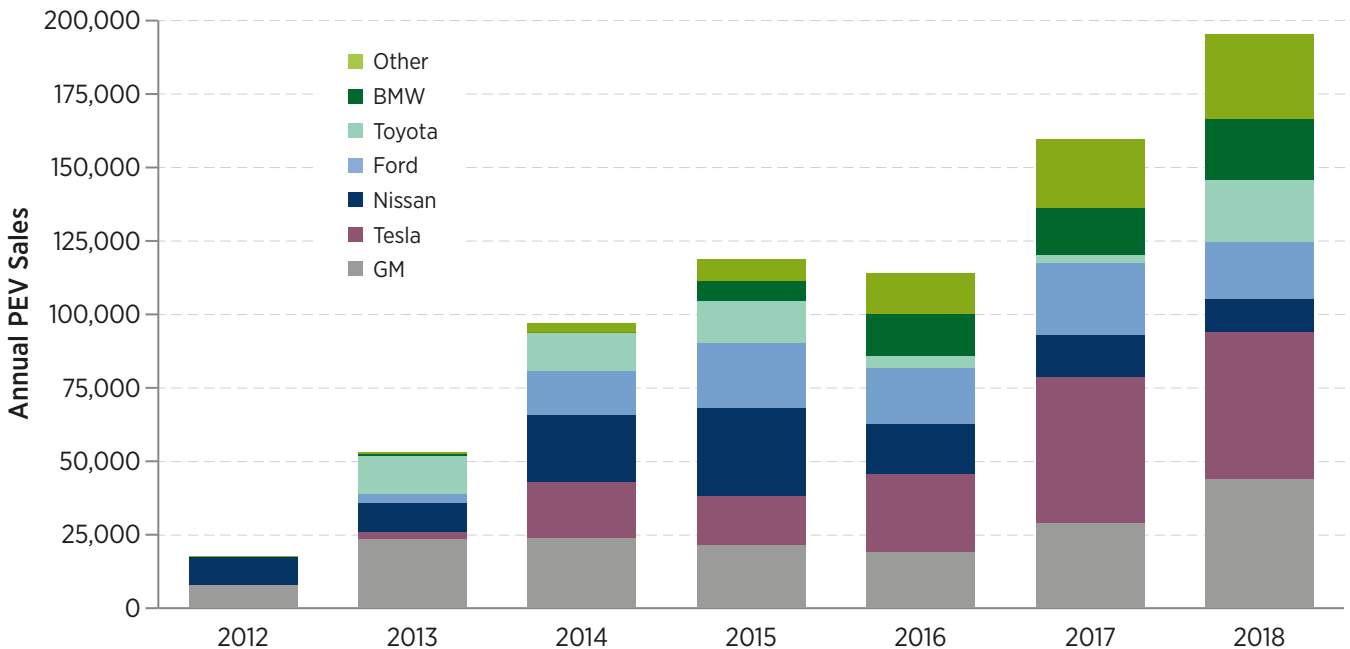


	Available Models	
	BEV	PHEV
2010	2	1
2011	3	1
2012	8	3
2013	10	6
2014	13	10
2015	11	14
2016	13	16
2017	21	32

XII

Source: Oak Ridge National Laboratory

U.S. Annual PEV Sales by Manufacturer



XII

Source: Argonne National Laboratory

The 'Other' category includes Porsche, MINI, Mitsubishi, Volvo, Jaguar, Honda, Kia, Smart, Hyundai, Fiat, Chrysler, VW, Audi, and Mercedes Benz.

XIII. Renewable and Alternative Fuels

Renewable and Alternative Fuels: Summary

- **U.S. ethanol production increased by more than 3.6% to 15.8 billion gallons** in 2017, while ethanol prices decreased and gasoline prices increased.

- In 2017, **the United States produced 58.4% of the world's ethanol**,[1] followed by Brazil (26.1%), the European Union (5.2%), China (3.2%), and Canada (1.7%).

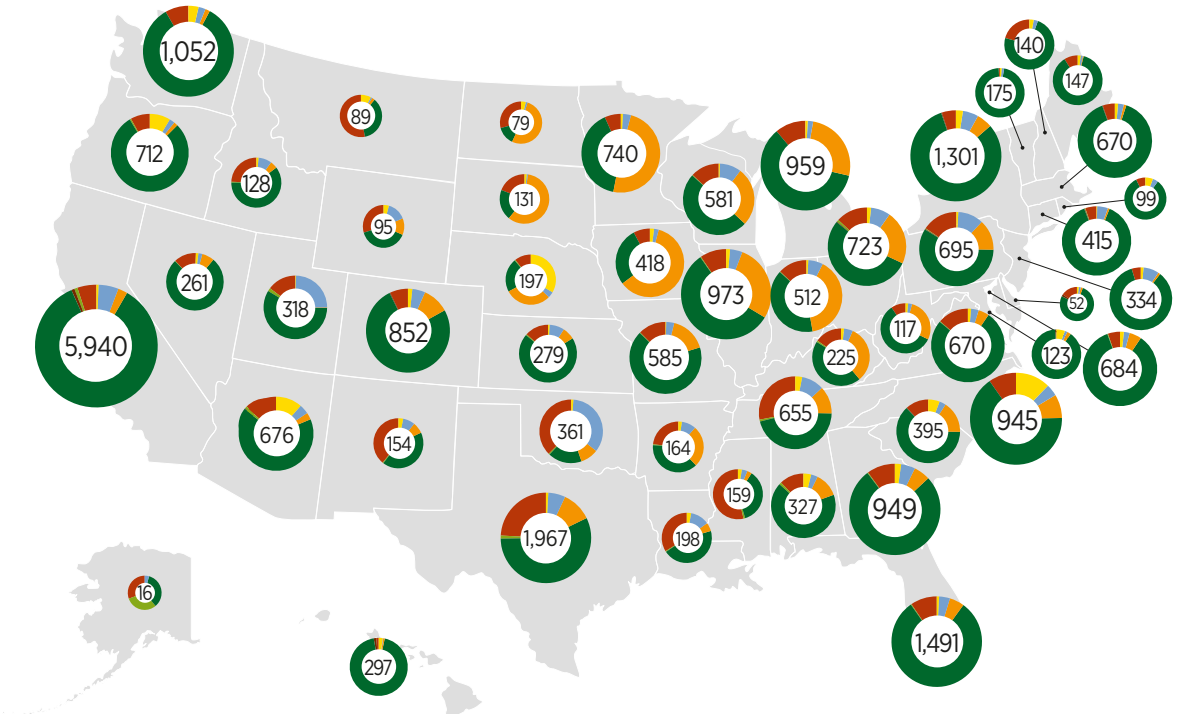
- In 2017, **the number of public and private alternative fueling stations in the United States increased by nearly 11%, to a total of more than 30,000** stations with more than 45,000 charging outlets. Electric vehicle charging stations comprise more than 69% (~21,000 stations) of the total count of alternative fueling stations.

XIII

Source: EERE Alternative Fuels Data Center

[1] The renewable fuel standard (RFS) in the United States sets targets that limit the amount of renewable fuel (including corn ethanol) and increase levels of cellulosic and advanced biofuels (including cellulosic ethanol). Achieving substantial growth in the ethanol market size is challenging given that gasoline in the United States is generally sold as a 10% ethanol (E10) and that ethanol production volumes above that level would need to enter the E15 or E85 markets.

Renewable and Alternative Fueling Stations by State (2017)



Breakdown of Stations by State

- B20 (20% biodiesel)
- CNG (compressed natural gas)
- E85 (85% ethanol)
- Electric[1]
- Hydrogen
- LNG (liquefied natural gas)
- Propane

Total Renewable and Alternative Fueling Stations by State

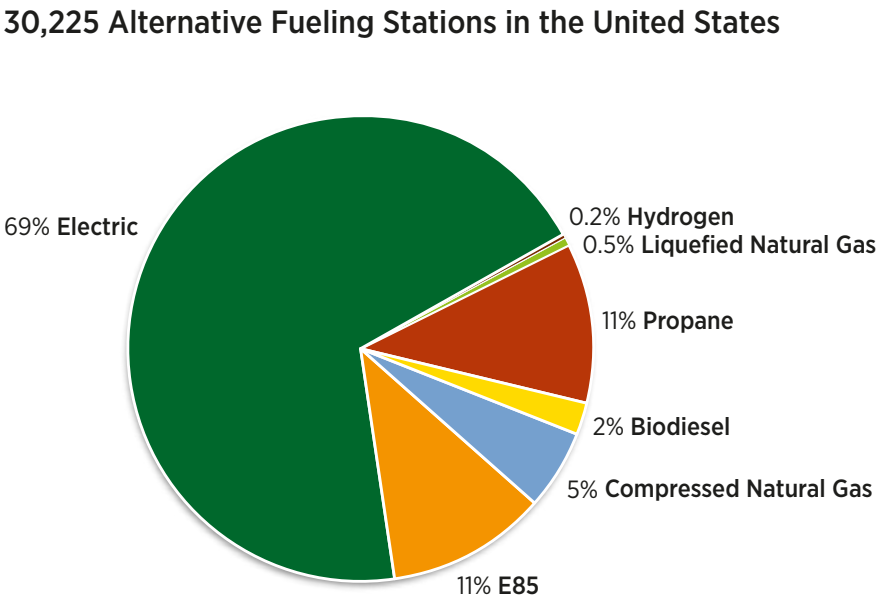
XIII

Source: EERE Alternative Fuels Data Center

For the full list of fueling station counts, see "Alternative Fueling Station Counts by State" at http://www.afdc.energy.gov/afdc/fuels/stations_counts.html.

[1]Public and private electric vehicle charging stations; there were more than 45,000 charging outlets in 2017.

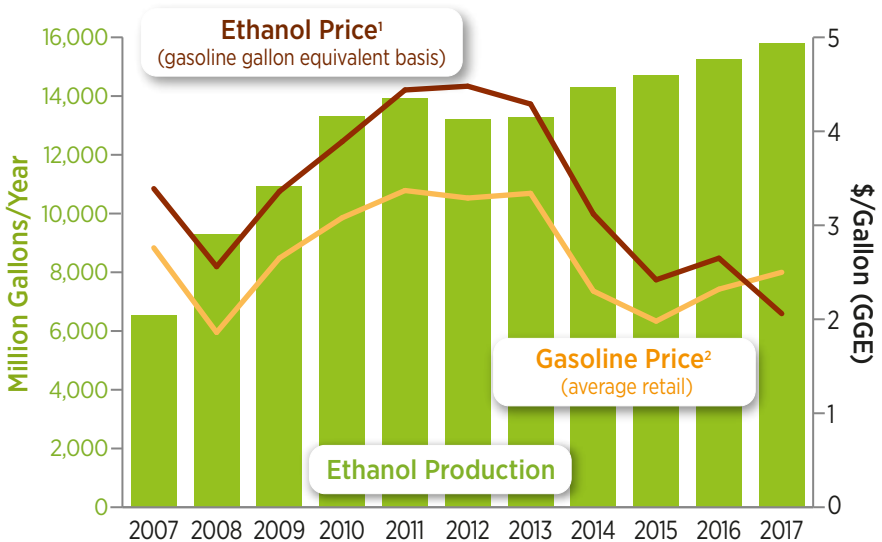
Renewable and Alternative Fueling Stations by Type (2017)



XIII

Source: EERE Alternative Fuels Data Center

U.S. Corn Ethanol Production and Prices



	Gasoline Price (average retail, $/gallon)	Ethanol Price (gasoline gallon equivalent basis, $/gallon)	Ethanol Production (million gallons/ year)
2000	$1.56	$2.16	1,622
2001	$1.50	$2.38	1,765
2002	$1.38	$1.97	2,140
2003	$1.54	$2.27	2,810
2004	$1.76	$2.86	3,404
2005	$2.07	$3.40	3,904
2006	$2.27	$2.98	4,884
2007	$2.76	$3.39	6,521
2008	$1.86	$2.56	9,309
2009	$2.65	$3.36	10,938
2010	$3.08	$3.89	13,298
2011	$3.37	$4.44	13,929
2012	$3.29	$4.48	13,218
2013	$3.34	$4.29	13,293
2014	$2.30	$3.12	14,300
2015	$1.98	$2.42	14,700
2016	$2.32	$2.65	15,250
2017	$2.50	$2.06	15,800

XIII

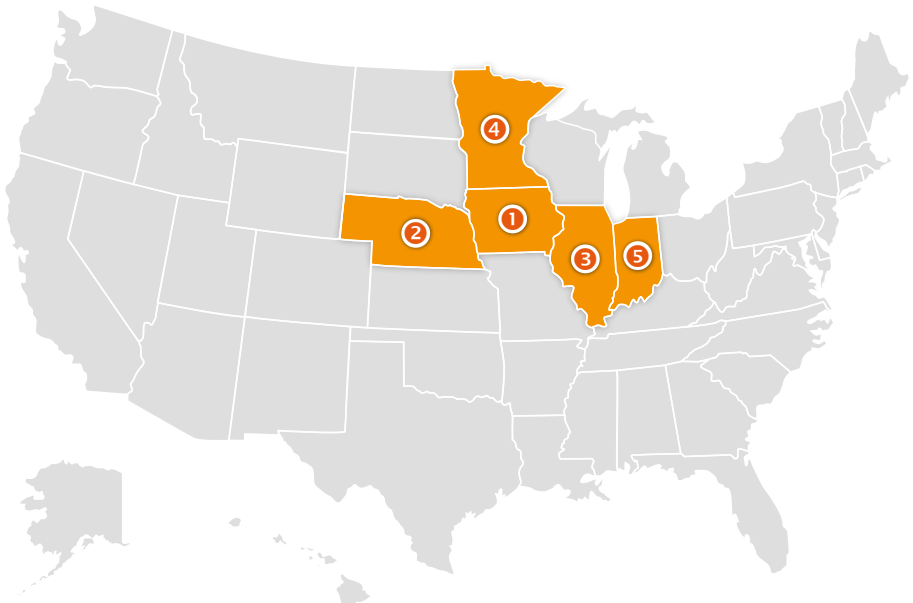
Sources: Renewable Fuels Association (RFA) and EERE

Reported values may vary from those included in previous editions of the data book due to retroactive changes in data sources.

[1] Ethanol price is based on the average retail price for E85 fuel blend, inclusive of taxes.

[2] Gasoline price is based on the average retail price for E10, inclusive of taxes.

U.S. Corn Ethanol Production Capacity (2017)



Top Five States for U.S. Ethanol (operating) Production Capacity in 2017 (millions of gallons/year)	
1 Iowa	4,177
2 Nebraska	2,229
3 Illinois	1,779
4 Minnesota	1,217
5 Indiana	1,173

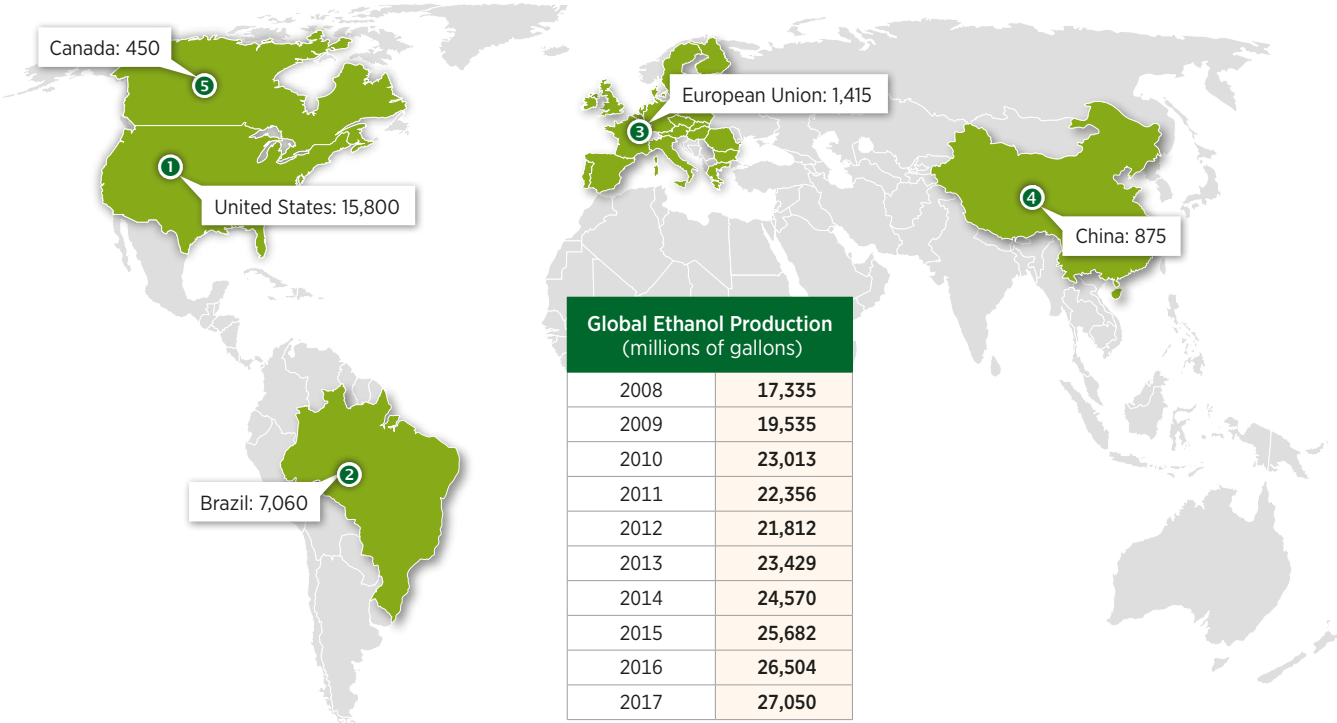
XIII

Source: RFA

No sugarcane ethanol is currently produced in the United States.

Global Ethanol[1] Production

Top Five Regions (2017) **Ethanol Production** (millions of gallons)



Global Ethanol Production (millions of gallons)	
2008	**17,335**
2009	**19,535**
2010	**23,013**
2011	**22,356**
2012	**21,812**
2013	**23,429**
2014	**24,570**
2015	**25,682**
2016	**26,504**
2017	**27,050**

Source: RFA

[1] Various feedstocks

Biodiesel: Summary

- **U.S. biodiesel production decreased to 2.65 billion gallons** (2.8 billion gasoline gallons equivalent) in 2017, down from 2.9 billion gallons in 2016.[1]

- Excluding this year's decrease, biodiesel production in the United States has increased steadily over the last decade. Production volume increased approximately by a factor of six from 2007 to 2017.

- In 2017, **the United States led the world in biodiesel production**, followed by Brazil, Germany, and Argentina.

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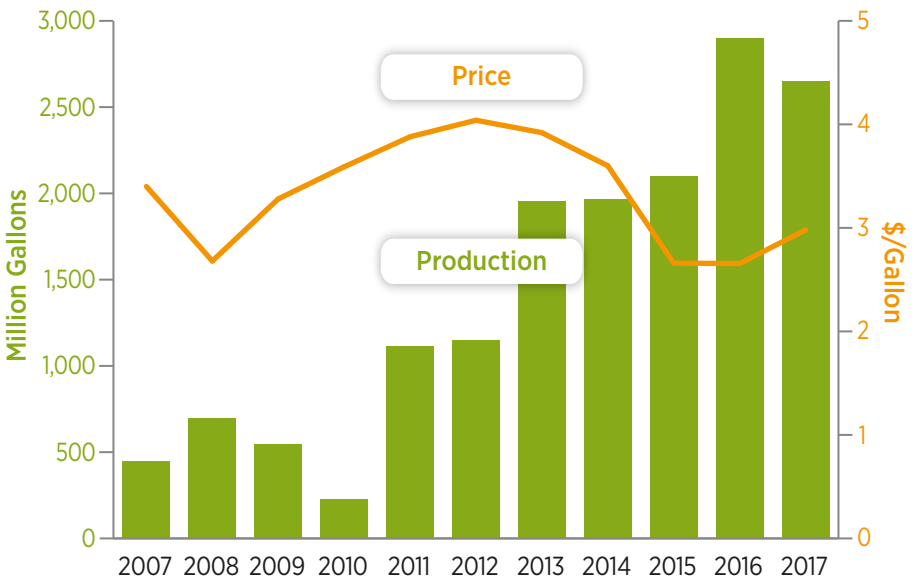
[1] Reported values may vary from those included in previous versions of the *Renewable Energy Data Book* due to retroactive changes in source data. The conversion rate is based on an unweighted average of B100 and B20 conversion rates.

U.S. Biodiesel Production and Price



	Biodiesel Price[1] (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	230
2011	3.88	1,116
2012	4.04	1,147
2013	3.92	1,958
2014	3.60	1,969
2015	2.66	2,099
2016	2.66	2,898
2017	2.98	2,653

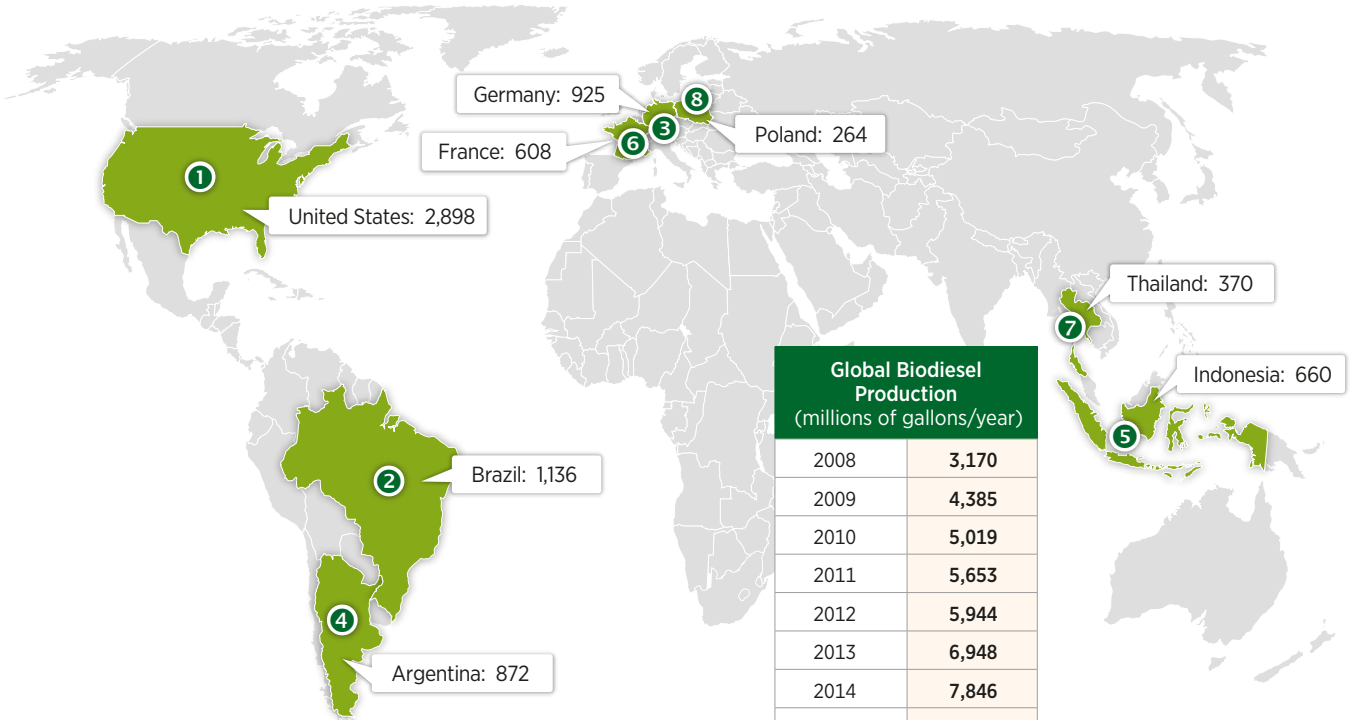
XIII

Sources: EERE; Production data are from http://biodiesel.org/.

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1]Biodiesel price is an unweighted average of prices for B20 and B99–B100.

Global Biodiesel Production (2017) – Top 10 Countries



Global Biodiesel Production (millions of gallons/year)	
2008	**3,170**
2009	**4,385**
2010	**5,019**
2011	**5,653**
2012	**5,944**
2013	**6,948**
2014	**7,846**
2015	**7,952**
2016	**8,136**
2017	**8,110**

Source: REN21

XIV. Clean Energy Investments

Clean Energy Investment: Summary

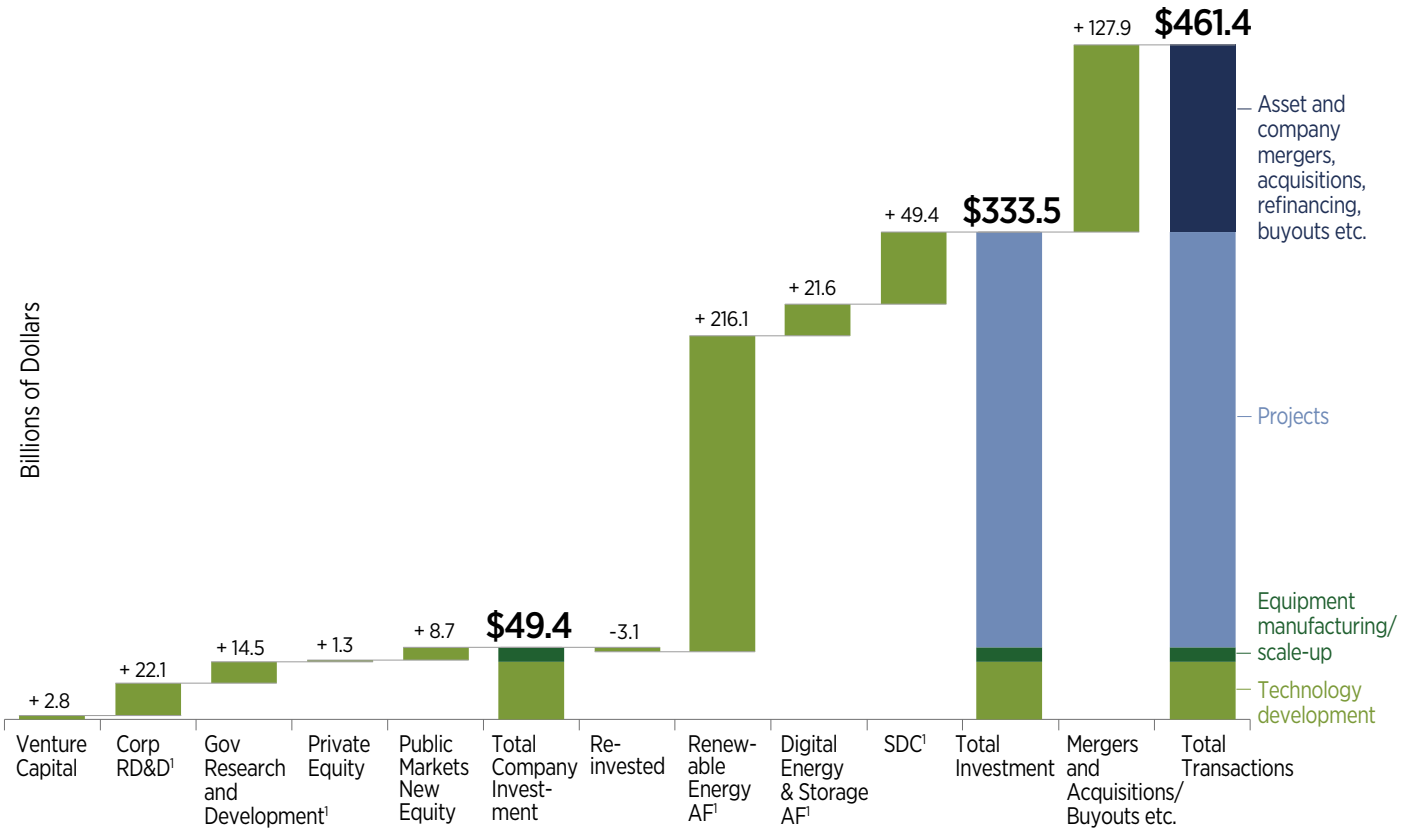
- **Global investment in clean energy in 2017 increased by 3% from 2016 to $333 billion (up from $325 billion in 2016)**.
- **New investment in clean energy in the United States declined 6.3% to $41.3 billion in 2017** (down from $44.1 billion in 2016). The **U.S. share of global investment decreased to 12.4%** in 2017 from 13.6% in 2016.
- **Worldwide, wind and solar continued to experience the highest levels of new investment of all renewable technologies** in 2017 (95% of all asset classes), although investment declined by 12% for wind and increased by 18% for solar.
- **Globally, new venture capital and private equity** investment in clean energy saw a sharp decrease (-45%) to $4.1 billion in 2017, down from $7.5 billion in 2016.
- While government research and development (R&D) expenditures remained flat ($14.5 billion in 2017, compared to $14.4 billion in 2016), **corporate R&D expenditures grew by 65%** to $22 billion in 2017.

XIV

Source: Bloomberg New Energy Finance (BNEF)

Reported values may vary from those included in previous versions of the *Renewable Energy Data Book* due to retroactive changes in source data.

Clean Energy Investment Types and Flows (2017) – Global



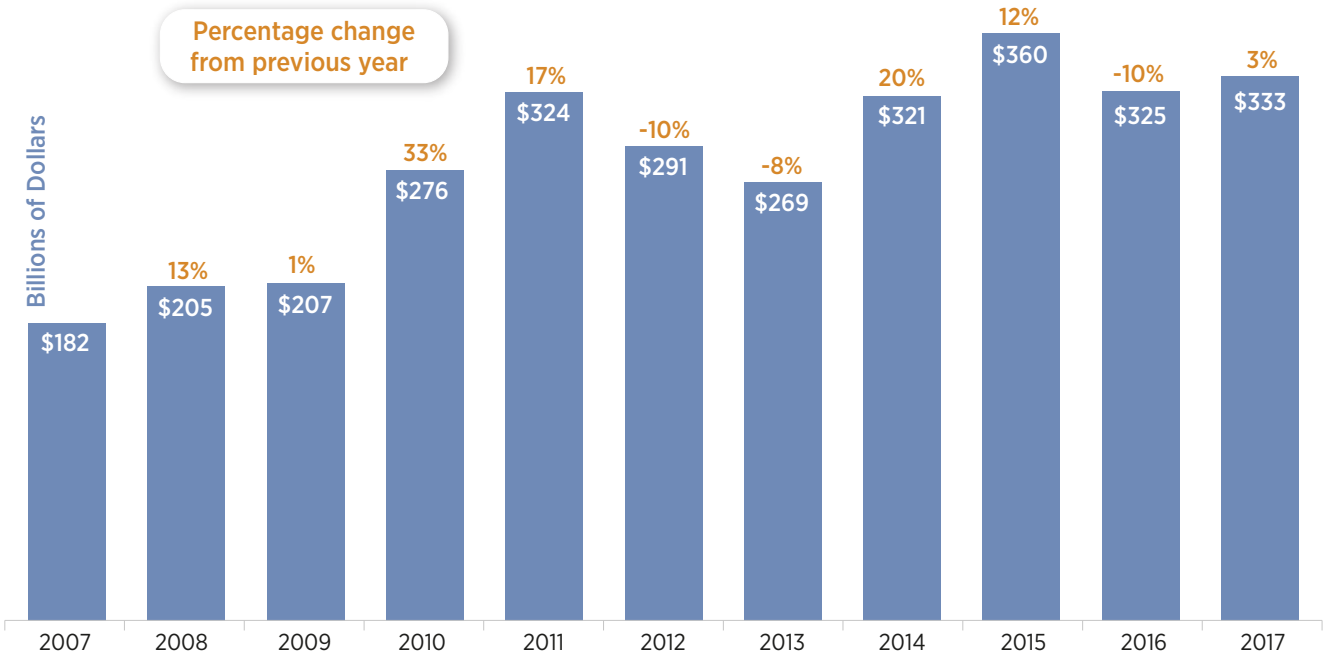
Source: BNEF

Total values include estimates for undisclosed deals.

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

[1]AF = asset finance; RD&D = research, development, and demonstration; SDC = small distributed capacity.

New Investment in Clean Energy – Global



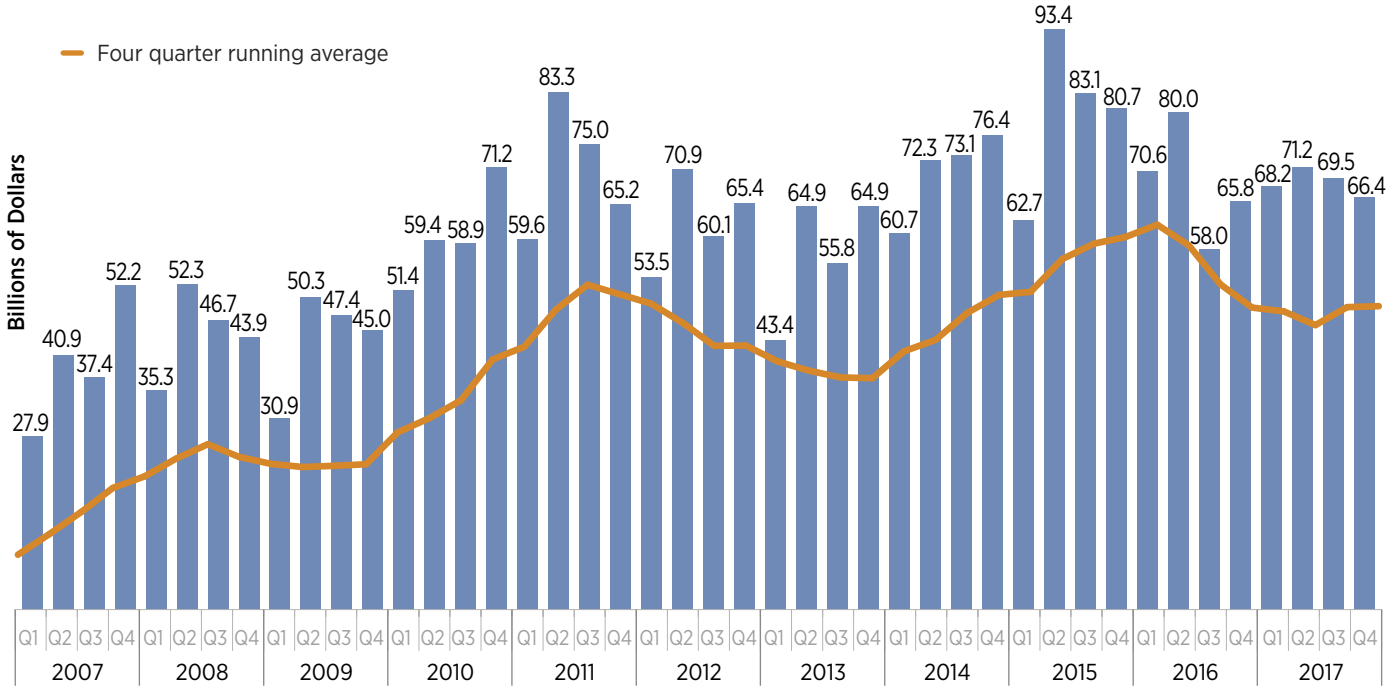
XIV

Source: BNEF

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

Total values include estimates for undisclosed deals, corporate and government R&D, and energy-smart technology spending (not reported in quarterly statistics). Energy-smart technologies include digital energy, smart grids, power storage, hydrogen and fuel cells, advanced transportation, and energy efficiency on both the demand side and the supply side.

New Investment in Clean Energy – Global



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Source: BNEF

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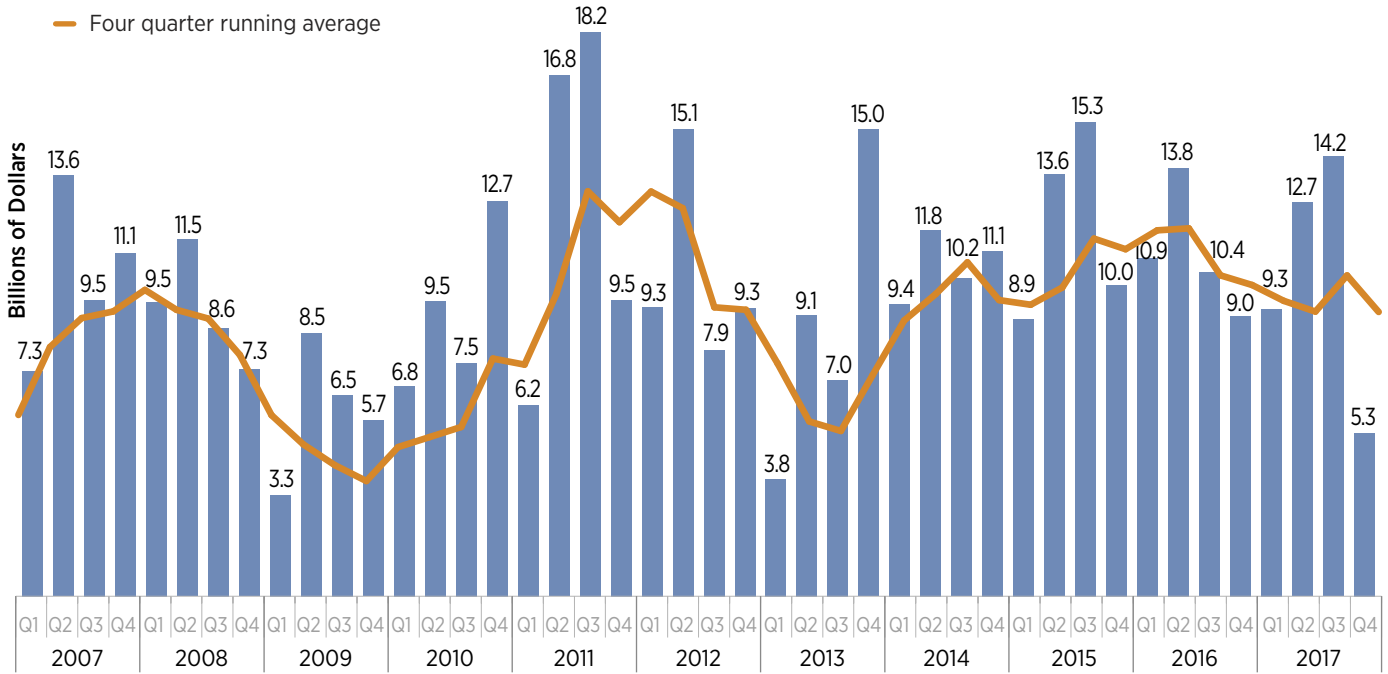
Total values include estimates for undisclosed deals, and they exclude corporate and government R&D and asset finance for energy-smart technology (not reported in quarterly statistics); thus, the sum of the quarterly estimates may not equal annual totals; energy-smart technologies include digital energy, smart grids, power storage, hydrogen and fuel cells, advanced transportation, and energy efficiency on both the demand side and the supply side.

New Investment in Clean Energy – United States



XIV

Source: BNEF

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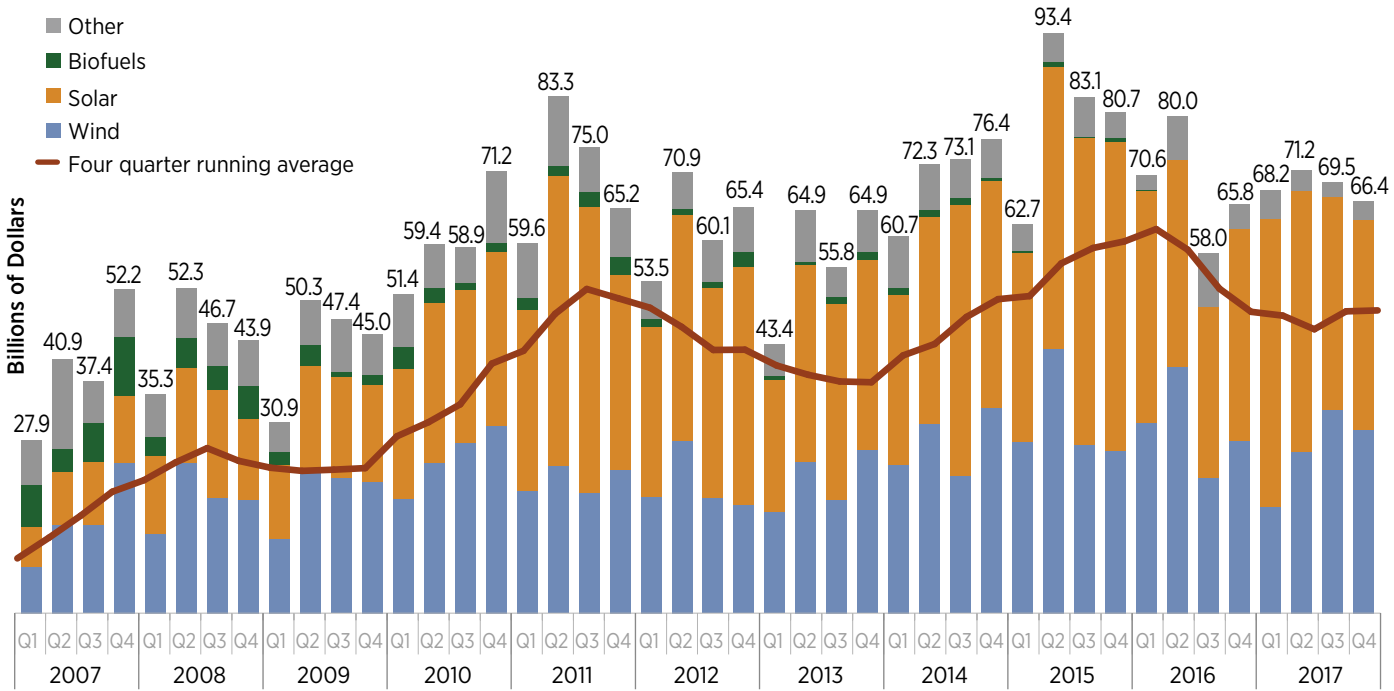
New Investment in Clean Energy by Technology – Global

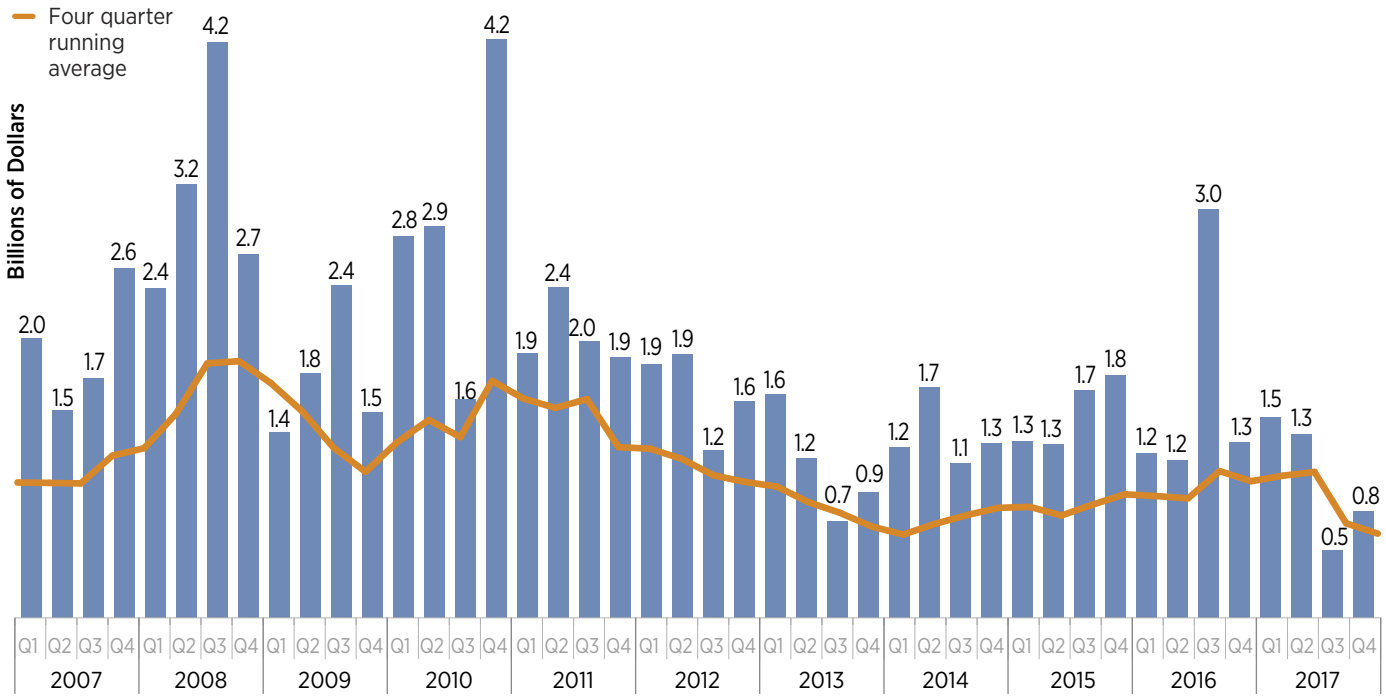


Source: BNEF

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

Total values include estimates for undisclosed deals, and they exclude corporate and government R&D and asset finance for energy- smart technology (not reported in quarterly statistics); thus, the sum of the quarterly estimates may not be equivalent to annual totals; energy-smart technologies include digital energy, smart grids, power storage, hydrogen and fuel cells, advanced transportation, and energy efficiency on both the demand side and the supply side.

Venture Capital and Private Equity New Investment in Clean Energy – Global



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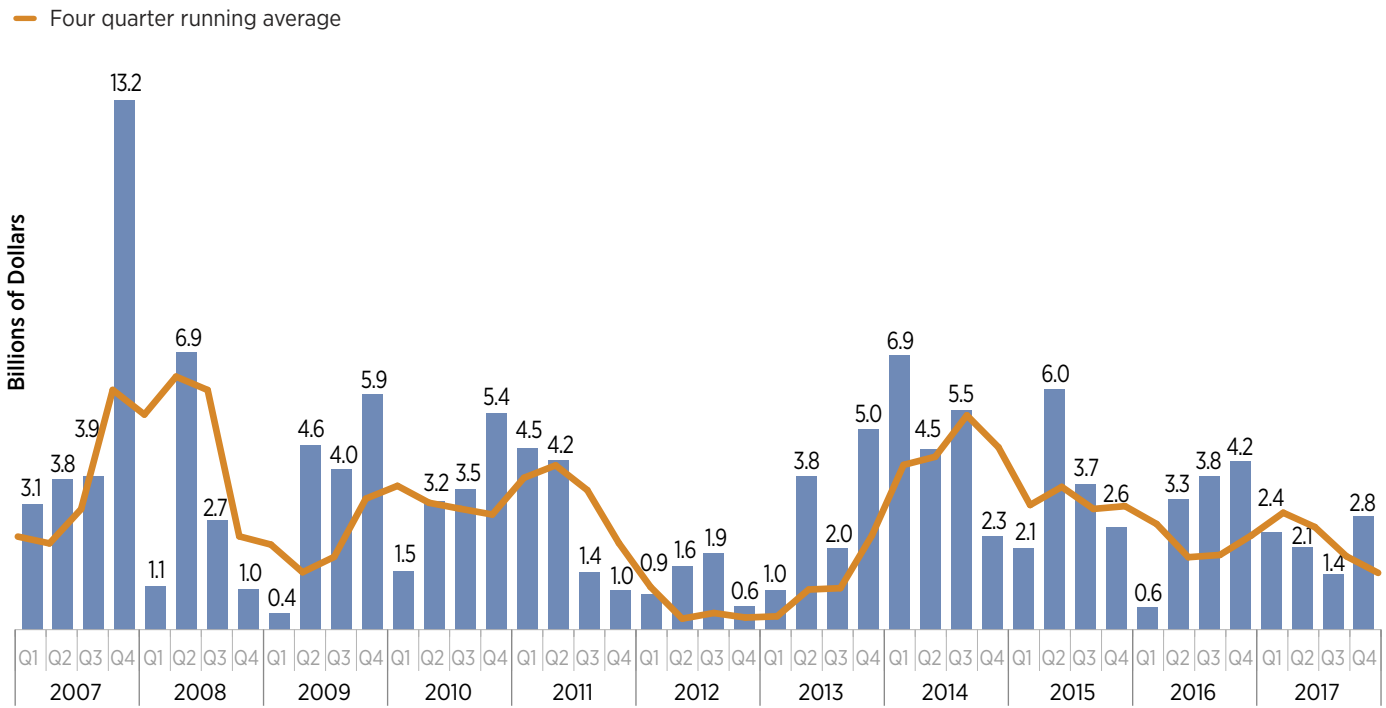
Source: BNEF

Reported values may vary from those included in previous editions of the data book due to retroactive changes in source data.

Total values include estimates for undisclosed deals, and they exclude corporate and government R&D and asset finance for energy- smart technology (not reported in quarterly statistics); thus, the sum of the quarterly estimates may not be equivalent to annual totals; energy-smart technologies include digital energy, smart grids, power storage, hydrogen and fuel cells, advanced transportation, and energy efficiency on both the demand side and the supply side.

Public Market New Investment in Clean Energy – Global

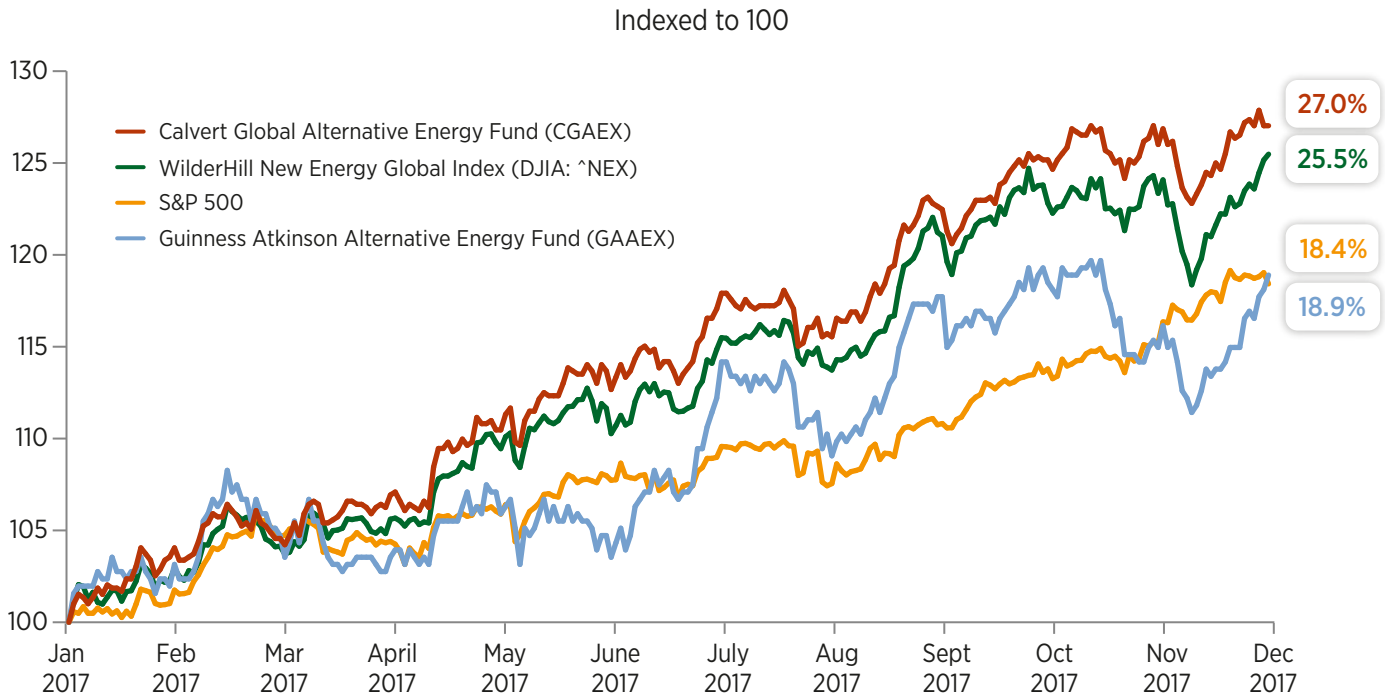


XIV

Source: BNEF

Total values include estimates for undisclosed deals, and they exclude corporate and government R&D and asset finance for energy-smart technology (not reported in quarterly statistics); thus, the sum of the quarterly estimates may not be equivalent to annual totals; energy-smart technologies include digital energy, smart grids, power storage, hydrogen and fuel cells, advanced transportation, and energy efficiency on both the demand side and the supply side.

Public Renewable Energy Index Performance (2017)



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Source: Public data, downloaded from Alpha Vantage (https://www.alphavantage.co/)

Glossary

Alternating Current (AC)

An electrical current that periodically reverses the directional flow of electrons. The electric grid infrastructure, including most conventional and renewable utility-scale generation sources (other than solar photovoltaics [PV]) operates in AC. PV systems must use an inverter to convert DC into AC in order to operate within the grid. For the purpose of this report, an overall DC-to-AC de-rate factor of 0.77 was assumed.

Asset Financing

Using balance sheet assets (such as accounts receivable, short-term investments or inventory) to obtain a loan or borrow money—the borrower provides a security interest in the assets to the lender. This differs from traditional financing methods, such as issuing debt or equity securities, as the company simply pledges some of its assets in exchange for a quick cash loan.

B20

A fuel containing a mixture of 20% biodiesel and 80% 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 those derived from 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.

Community Solar

Community solar is a solar power installation that provides proportional output and financial payoff to individual members of a community.

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.

Concentrating 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. CSP (but not solar thermal power) may also refer to a system that focuses solar rays on a PV cell to increase conversion efficiency.

Crude Oil

A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities.

Digital Energy

The integration of digital communication technologies into energy systems, especially the electrical grid. Smart meters, along with other digital communication devices embedded in electrical transmission and distribution systems, allow for a two-way flow of information between utilities and their customers as well as greater digital control of the electrical grid, a concept known as the Smart Grid.

Direct Current (DC)

An electrical current that has unidirectional flow. DC is the type of electrical current often seen in batteries and PV cells. PV modules are commonly rated under standardized testing conditions in terms of DC output. For the purpose of this report, an overall DC-to-AC de-rate factor of 0.77 was assumed.

E85

A fuel containing a mixture of 85% ethanol and 15% 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% concentration). Ethanol can also be used in high concentrations (E85) in vehicles designed for its use.

Federal Energy Regulatory Commission (FERC)

The U.S. 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 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% petroleum-based fuels, or (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.

Gasoline Gallon Equivalent (GGE)

The amount of alternative fuel it takes to equal the energy content of one liquid gallon of gasoline. GGE allows consumers to compare the energy content of competing fuels against a commonly known fuel—gasoline.

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 (Ground Source) 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 1,000 MW or 1 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 kW (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.

Mergers and Acquisitions
A general term used to refer to the consolidation of companies. A merger is a combination of two companies to form a new company, while an acquisition is the purchase of one company by another in which no new company is formed.

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 kW on a nameplate physically attached to the generator.

Non-Powered Dam Project
A dam that does not produce electricity and provides a variety of services ranging from water supply to inland navigation.

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

Petroleum
A broadly defined class of liquid hydrocarbon mixtures. Included are crude oil, lease condensate, unfinished oils, refined products obtained from the processing of crude oil, and natural gas plant liquids.

Photovoltaic (PV) Cell
PV cells convert incident light directly into electricity (DC). 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.

Private Equity
Equity capital that is not quoted on a public exchange. Private equity consists of investors and funds that make investments directly into private companies or conduct buyouts of public companies that result in a delisting of public equity. Capital for private equity is raised from retail and institutional investors and can be used to fund new technologies, expand working capital within an owned company, make acquisitions, or strengthen a balance sheet.

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, hydropower, 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.

Venture Capital
Money provided by investors to startup firms and small businesses with perceived long-term growth potential. This is a very important source of funding for startups that do not have access to capital markets. It typically entails high risk for the investor, but it has the potential for above-average returns.

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

Principal Data Sets

DATA PROVIDER	Data Set/Report	Geographic Scope	Technologies Addressed	Date Available/ Accessed
American Wind Energy Association (AWEA)	*Fourth Quarter 2017 Market Report*	United States	wind	August 2018
	U.S. Wind Industry Annual Market Report 2017	United States	wind	April 2018
Argonne National Laboratory	EV Technology	United States	electric vehicles	November 2018
Bloomberg New Energy Finance (BNEF)	*Global Trends in Clean Energy Investment*	Global	biofuels, solar, wind, energy storage, and digital energy	July 2018
Energy Information Administration (EIA)	Form 860	United States	biopower, geothermal, hydropower, solar, wind[1]	September 2018
	Monthly Energy Review	United States	biopower, coal, geothermal, hydropower, natural gas, nuclear, petroleum, solar, and wind[2]	September 2018
	Distributed Generation National Energy Modeling System	United States	solar	September 2018
	Electric Power Monthly	United States	biopower, geothermal, hydropower, solar, and wind	September 2018
Global Wind Energy Council (GWEC)	*Global Wind Report 2017: Annual Market Update*	Global	wind	April 2018
Lawrence Berkeley National Laboratory (LBNL)	*2017 Wind Technologies Market Report*	United States	wind	September 2018
Renewable Energy Policy Network for the 21st Century (REN21)	*Renewables 2017 Global Status Report*	Global	biomass, geothermal, hydropower, solar, and wind	April 2018
Renewable Fuels Association (RFA)	*2017 Ethanol Industry Outlook*	United States	ethanol	July 2018
Sandia National Laboratory	DOE-OE Global Energy Storage Database	Global	storage	2018
Solar Energy Industries Association and GTM Research (SEIA/GTM)	*2017 Solar Industry Year in Review*	United States	solar	May 2018

[1]Includes installed capacity, planned capacity additions, and planned capacity retirements.

[2]Includes production and consumption by end-use sector and electricity.

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DOE/GO-102019-5113
January 2019

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