

2016

SUSTAINABLE ENERGY IN AMERICA

Factbook



Energy —
— Efficiency



Natural —
— Gas



Renewable —
— Energy

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The Business Council for
 **Sustainable
Energy**[®]

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What is it?

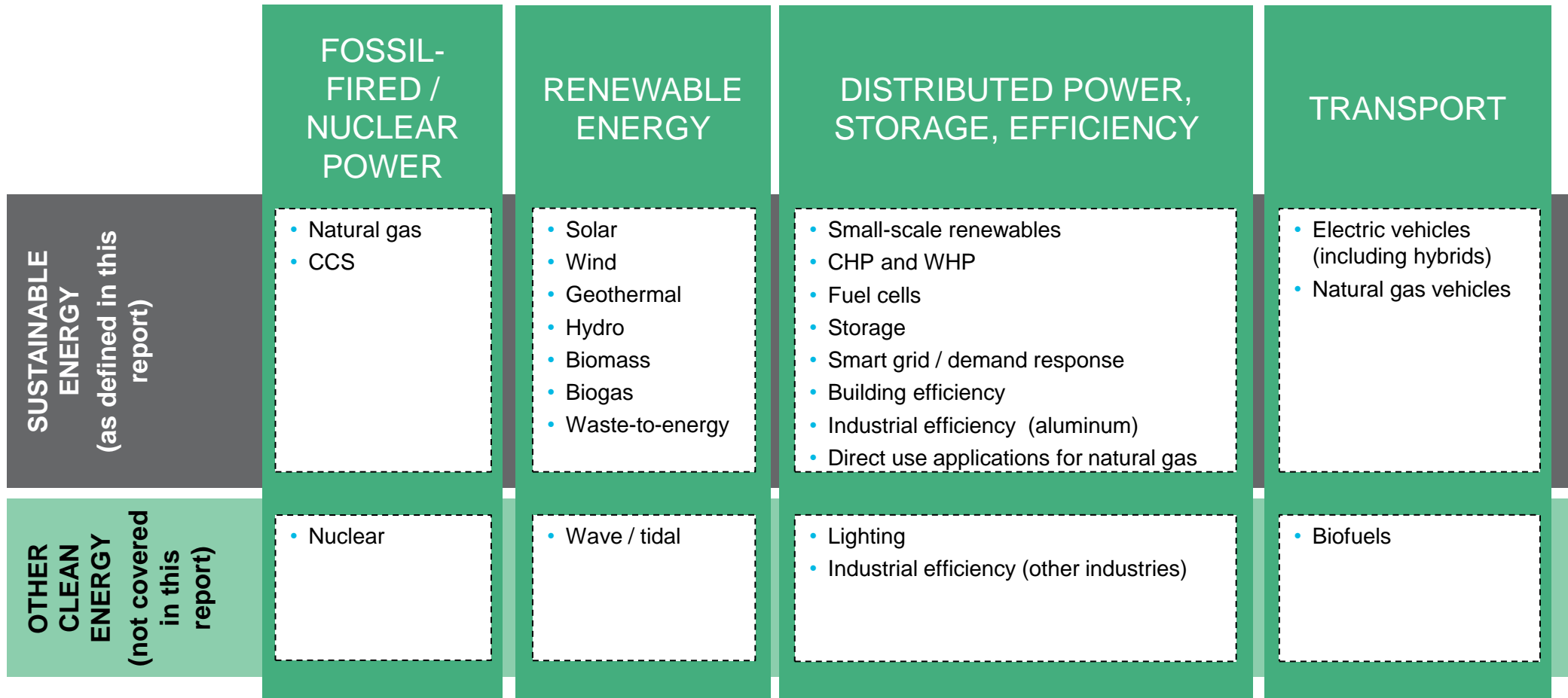
- Aims to augment existing, reputable sources of information on US energy
- Focuses on **renewables, efficiency, natural gas**
- **Fills important data gaps** in certain areas (eg, investment flows by sector, contribution of distributed energy)
- Contains data through the end of 2015 wherever possible
- Employs **Bloomberg New Energy Finance data** in most cases, augmented by EIA, FERC, ACEEE, ICF International, LBNL, and other sources where necessary
- Contains the very **latest information on new energy technology costs**
- Has been graciously underwritten by the **Business Council for Sustainable Energy**
- Is in its **fourth edition** (first published in January 2013)

What's new?

- **Format:** This year's edition of the Factbook (this document) consists of Powerpoint slides showing updated charts. For those looking for more context on any sector, the 2014 edition⁽¹⁾ can continue to serve as a reference. The emphasis of this 2016 edition is to *capture new developments that occurred in the past year*.
- **Updated analysis:** Most charts have been extended by one year to capture the latest data.
- **2015 developments:** The text in the slides highlights major changes that occurred over the past year.
- **New coverage:** This report contains data shown for the first time in the Factbook, including analyses of US levelized costs of electricity, corporate renewables procurement, US transmission build, small-scale CHP generation and additional energy efficiency data.

(1) The 2014 Factbook can be found here: <http://www.bcse.org/factbook/pdfs/2014%20Sustainable%20Energy%20in%20America%20Factbook.pdf>

About the Factbook (2 of 2): Understanding terminology for this report





2015: A YEAR OF MILESTONES

US ENERGY IN TRANSITION

AN ERA OF LOW ENERGY PRICES

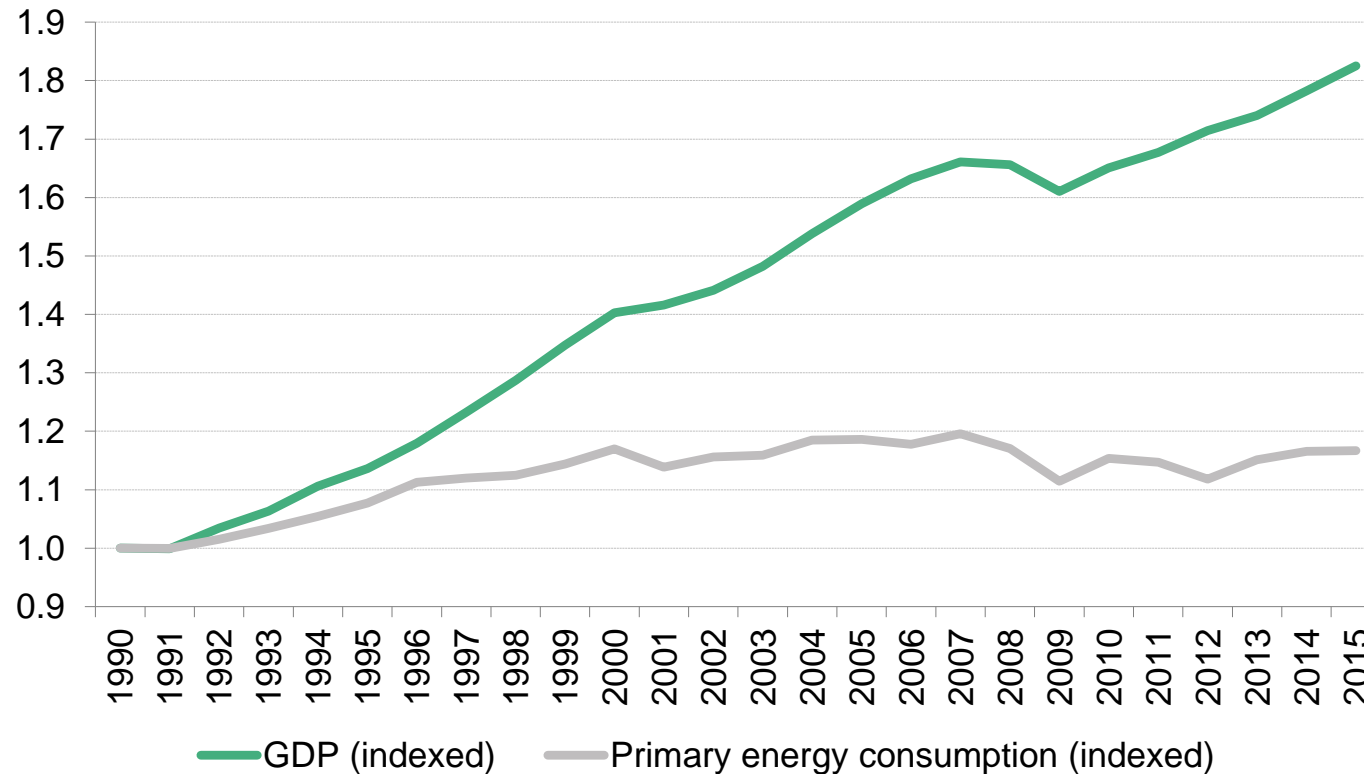
OUTLOOK

WRAP-UP



**2015: A YEAR OF
MILESTONES**

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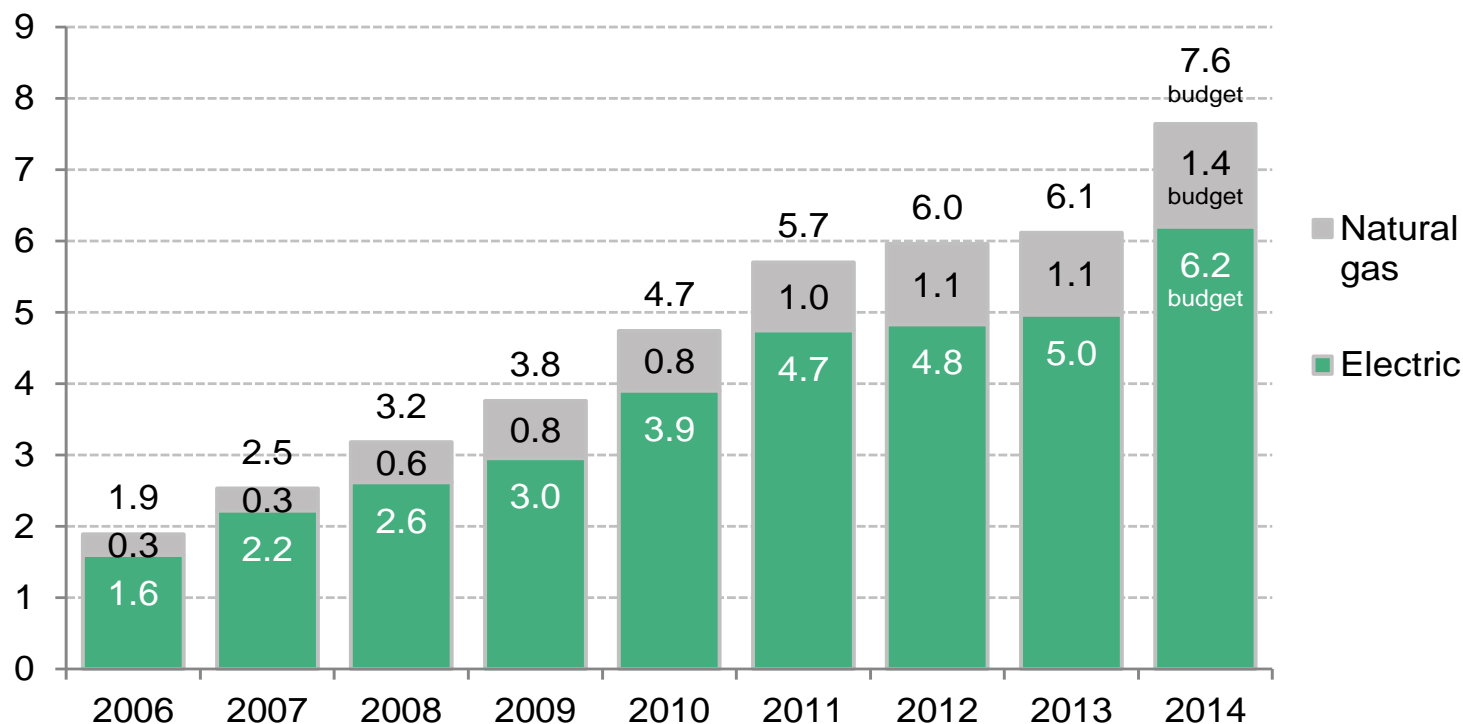


- The US economy is increasingly energy productive, resulting in a decoupling between growth in GDP and growth in energy consumption. As US GDP expanded 83% over the last 25 years, energy consumption only ticked up 17%.
- By one measure (US GDP per unit of energy consumed), productivity has improved 56% since 1990, 13% since 2007, and 2.3% between 2014 and 2015.

Source: US Energy Information Administration (EIA), Bureau of Economic Analysis, Bloomberg Terminal

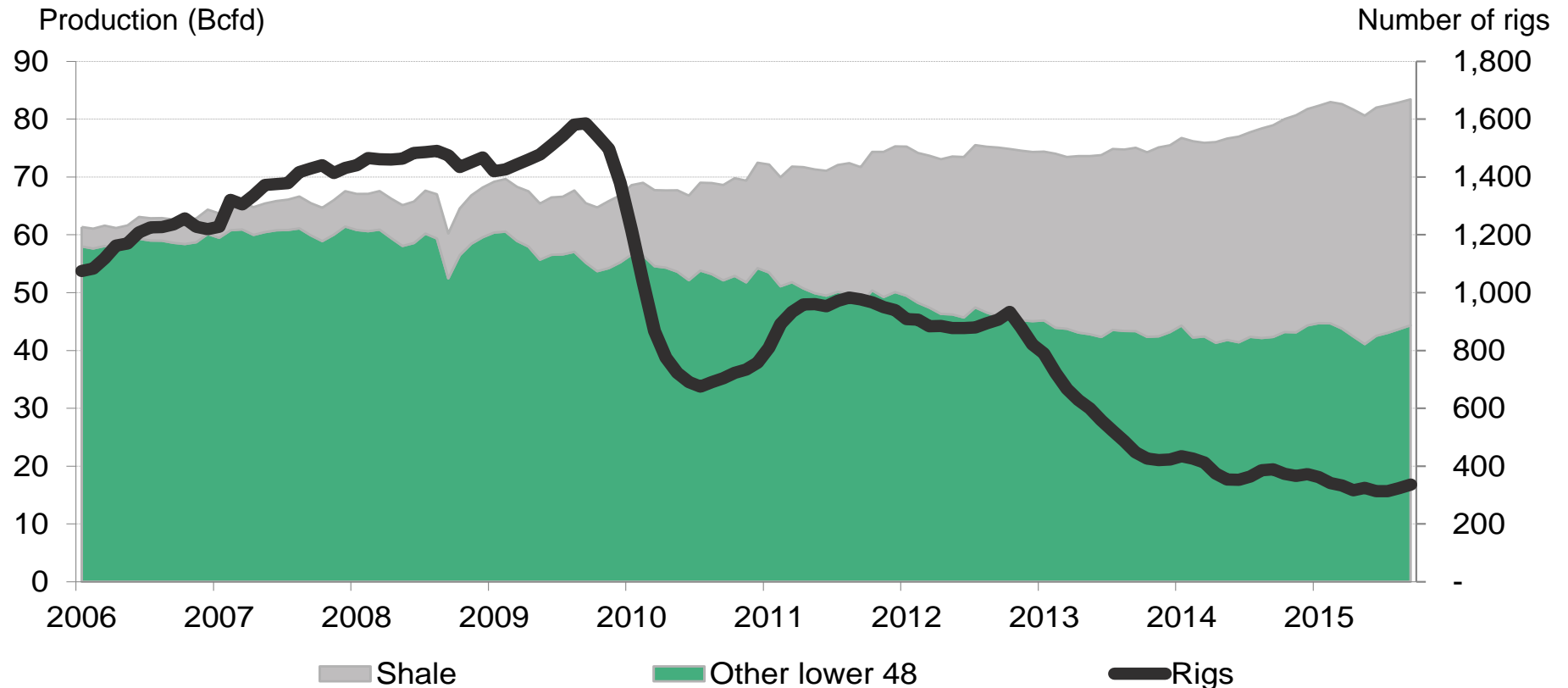
Notes: Values for 2015 energy consumption are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2015). GDP is real and chained (2009 dollars); annual growth rate for GDP for 2015 is based on consensus of economic forecasts gathered on the Bloomberg Terminal as of January 2016.

Financing: US utility energy efficiency spending and budgets (\$bn)



- From 2006 to 2011, US utility expenditure for energy efficiency grew 25% per year.
- The budgeted amount for 2014 would represent a 25% growth between 2013 and 2014.
- Maryland was the state with the largest increase in utility budgets for energy efficiency, with an increase from \$119m in 2013 to \$292m in 2014.
- In December 2015, US Congress renewed the energy-efficient commercial buildings tax deduction and nonbusiness (ie, residential) Energy-efficient Property Credit that retroactively reinstates tax credits for projects completed in 2015 and 2016.

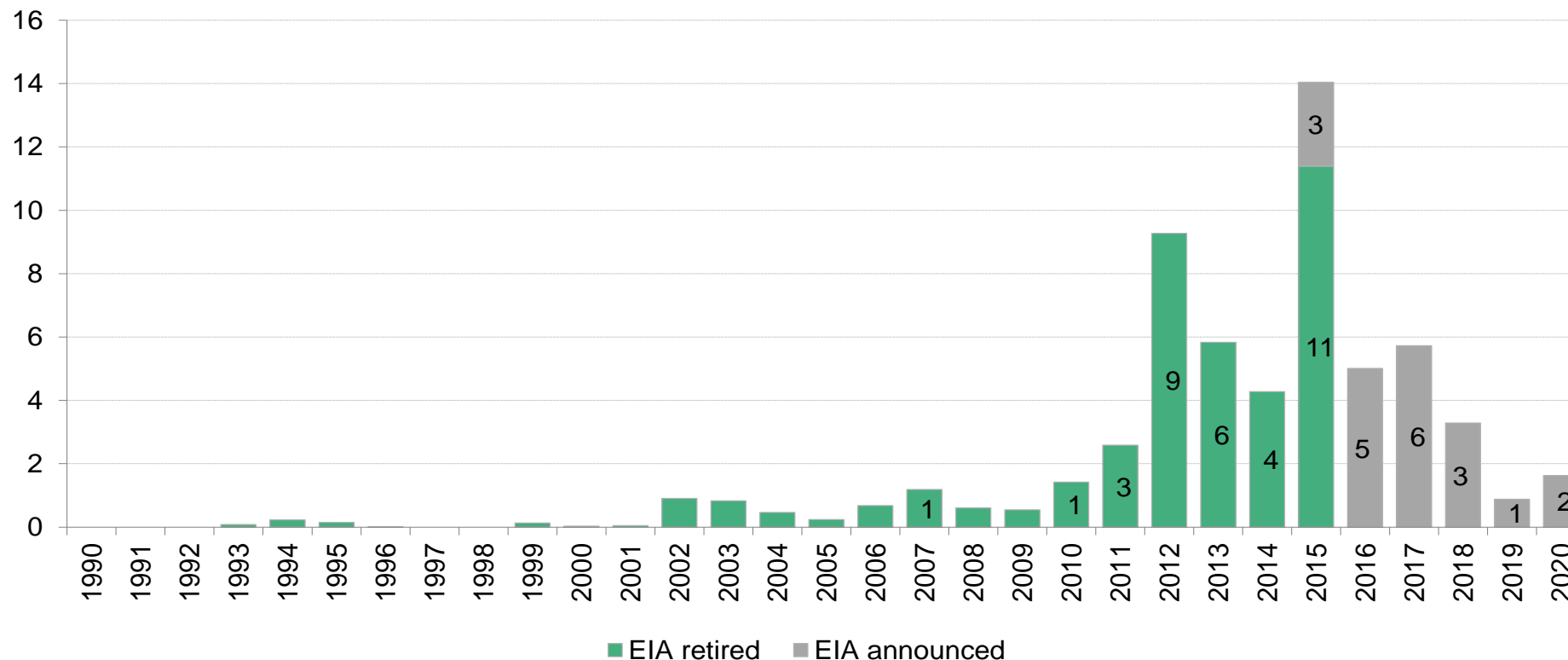
Deployment: US natural gas production and gas-directed rig count (Bcfd, rigs)



- Natural gas production in 2015 was up 7% from 2014 levels, 26% from 2007 levels. Shale production now accounts from almost half of total.
- Technological improvements in efficiencies (like pad drilling and longer laterals) and drilling in productive “sweet spots” has allowed production to increase even as rig counts drop.

Source: Bloomberg New Energy Finance, EIA, Baker Hughes. Data up through the latest comprehensive numbers available (September 2015).

Policy: US coal power plant retirements completed and announced by year (GW)



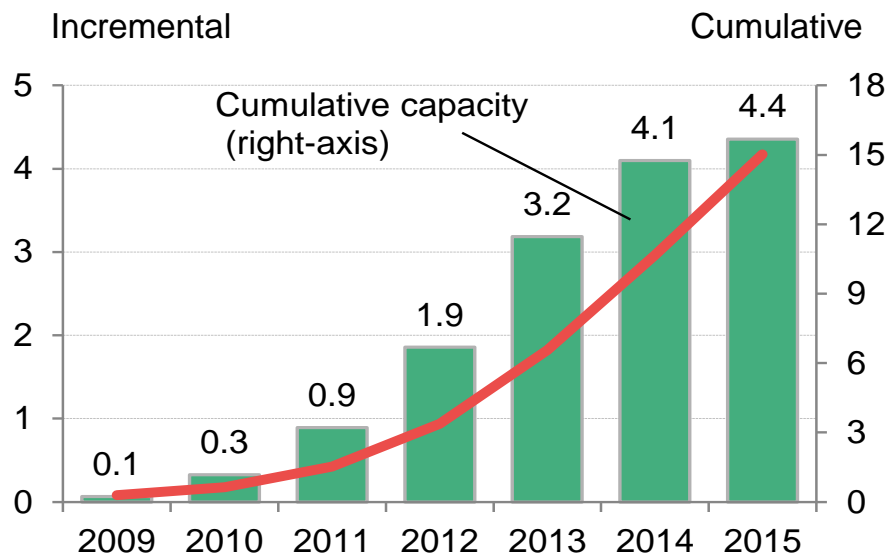
- 2015 saw the largest wave of coal retirements ever, with 11GW going offline through October 2015 and another 3GW of retirements announced. An additional, undetermined number of plants (likely less than 5GW in total) also converted from coal to burn natural gas and, in a few cases, biomass.
- Record low gas prices, old age, and increasing operating costs – partly due to US Environmental Protection Agency (EPA) regulations covering sulfur, nitrogen, and mercury emissions from power plants – have forced many coal plants to retire earlier than originally planned.

Source: Bloomberg New Energy Finance

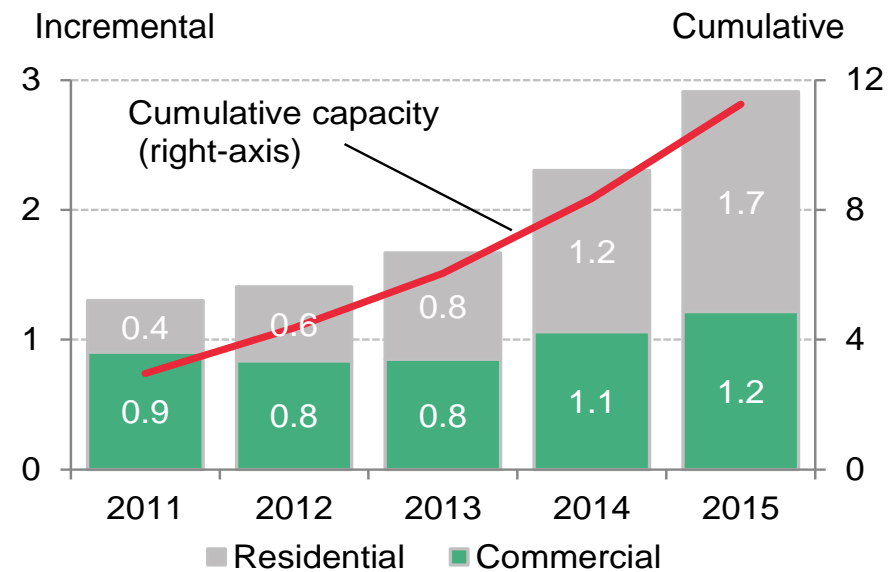
Notes: “Retirements” does not include conversions from coal to natural gas or biomass; retirement numbers through end-October 2015.

Deployment: US solar PV build

US utility-scale photovoltaic build (GW)



US small-scale photovoltaic build (GW)



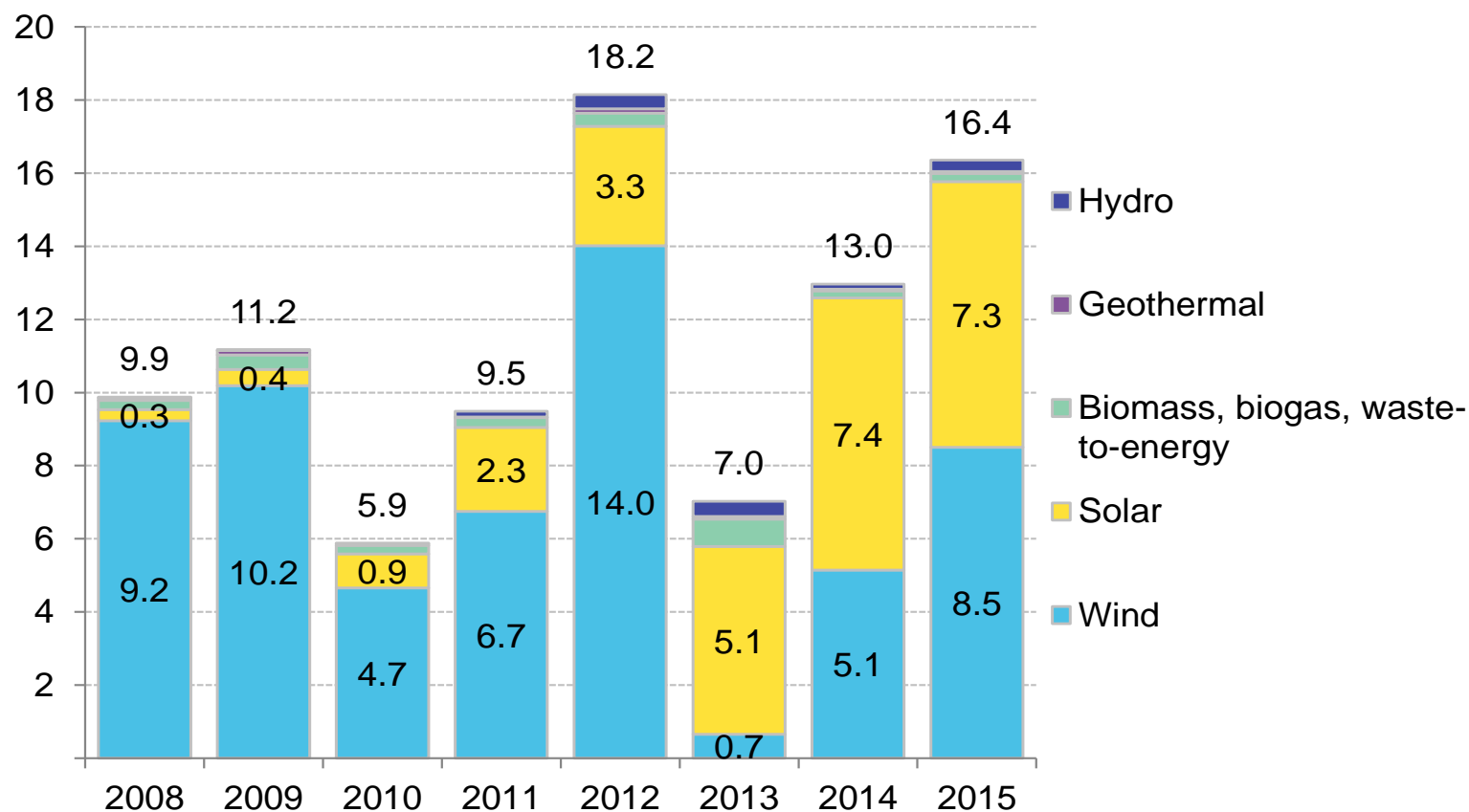
- After six years of dramatic growth, utility-scale PV build began to level off in 2015, although installations still increased 6% over the previous year.
- Distributed PV had yet another record-year in 2015, driven by growth in both the residential and commercial segments.
- The economics for both segments benefit from premium retail electricity rates (compared to wholesale power for utility-scale projects), and a secondary, behavioral driver of consumer dynamics – ie, the more people go solar near you, the more likely you are to consider it.



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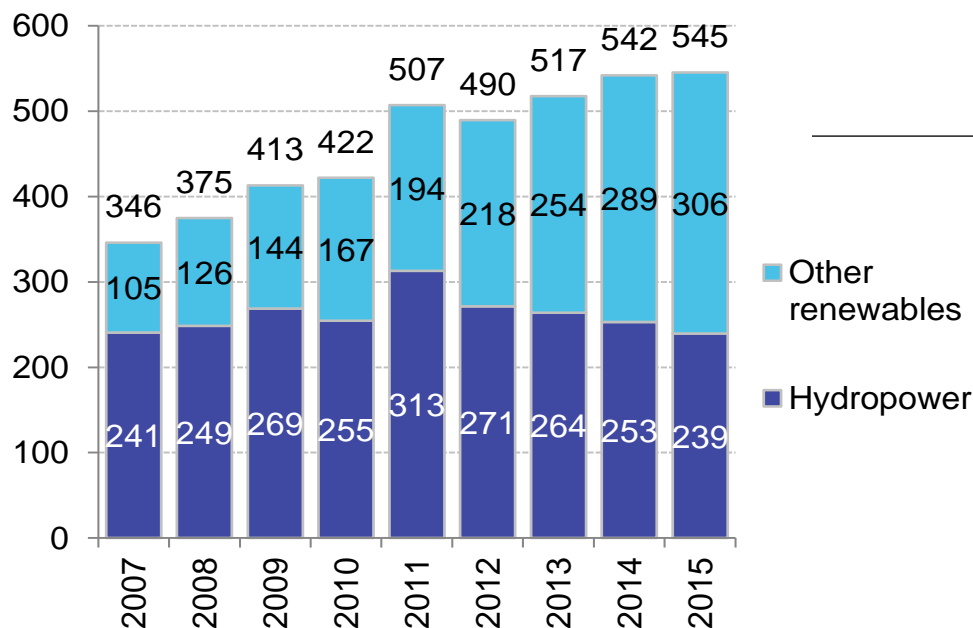
Renewable energy capacity build by technology (GW)



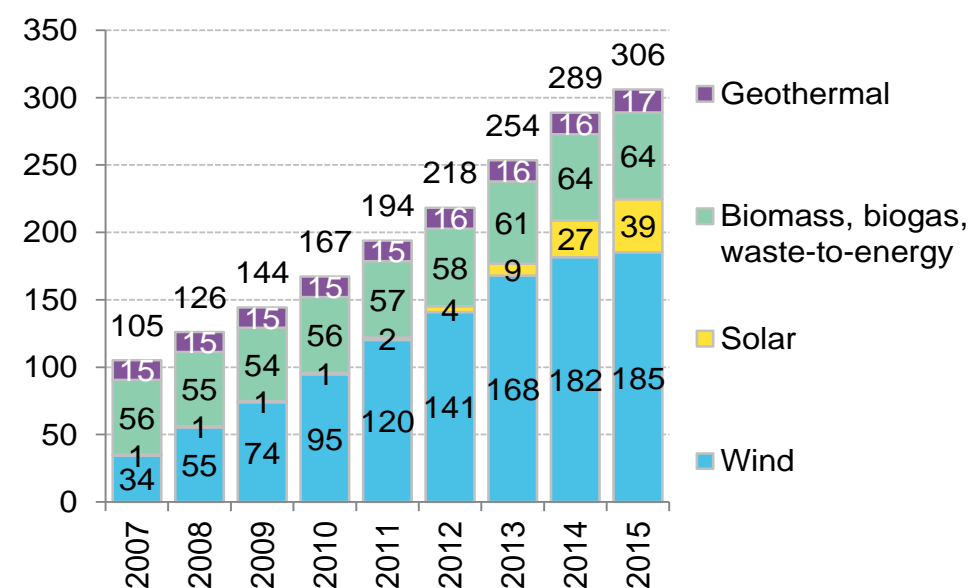
- Solar experienced another year of strong build, adding 7.3GW of PV in 2015 – a record.
- Small-scale solar continues to grow as the economics make it a viable alternative to retail rates in many regions of the country.
- Wind build surged to 8.5GW in 2015 as developers rushed to capture the Production Tax Credit (PTC) before it was due to expire at the end of 2016.
- Other sectors (biomass, biogas, waste-to-energy, geothermal, hydro) are idling without long-term policy support.

US energy overview: Renewable energy generation by technology

US renewable generation by technology
(including hydropower) (TWh)



US non-hydropower renewable generation
by technology (TWh)

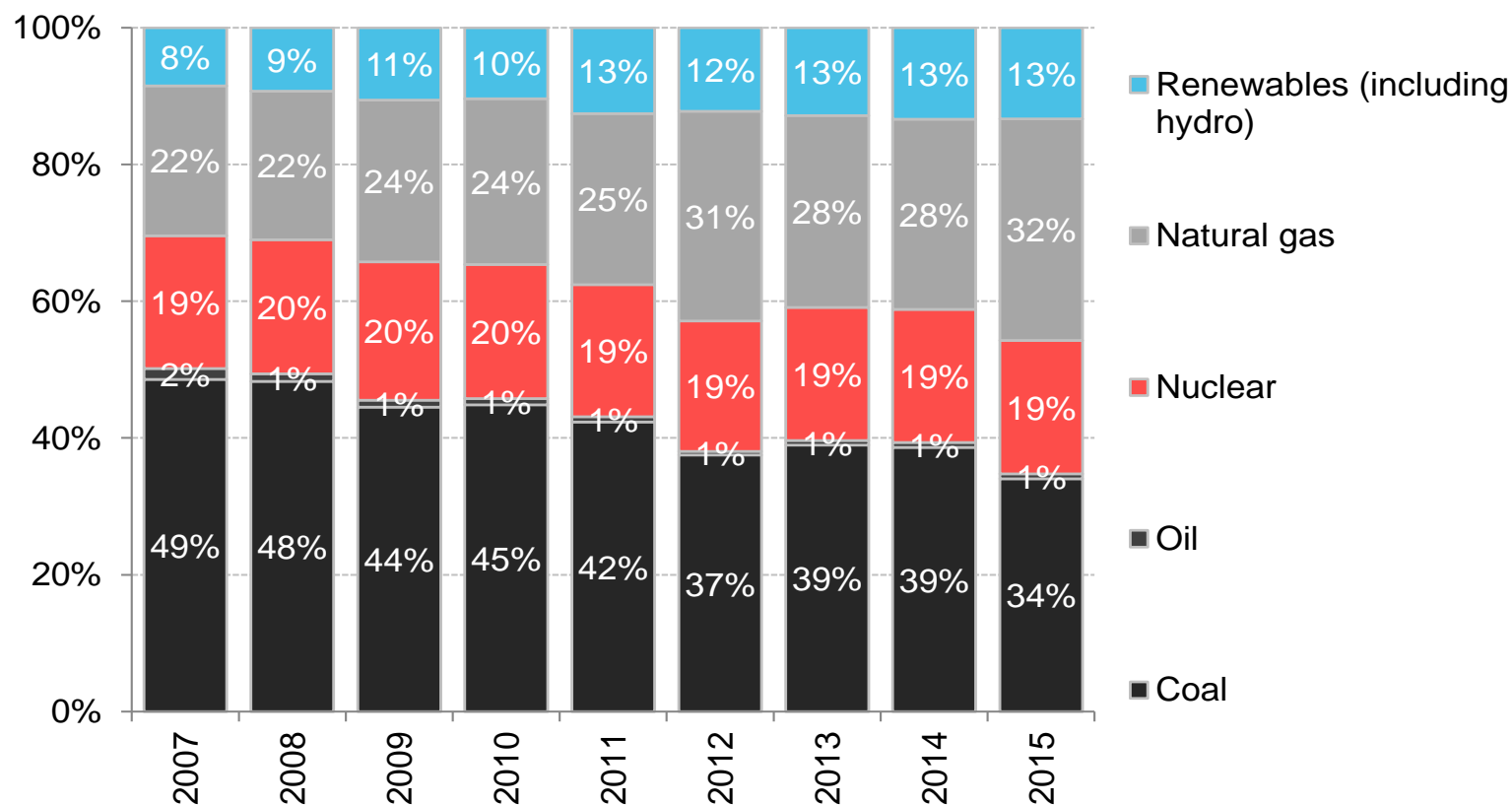


- Generation from non-hydropower renewables grew to 306TWh in 2015, up from 289TWh in 2014. Wind continues to make up the bulk of this generation (185TWh, or 61%) but the growth in 2015 came primarily from a 45% surge in generation from solar.
- Hydro generation has decreased since 2011 due to the ongoing droughts in the West Coast states.
- Non-hydropower renewables now account for 7.4% of US electricity, up from 7.0% the previous year. This figure has grown every year since 2005, when non-hydro renewables generated only 2.2% of US electricity.

Source: Bloomberg New Energy Finance, EIA

Notes: Values for 2015 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2015). Includes net energy consumption by pumped hydropower storage facilities. Totals may not sum due to rounding. Beginning in 2014, numbers include estimated generation from distributed solar; generation from other distributed resources are not included.

US energy overview: US electricity generation by fuel type (%)

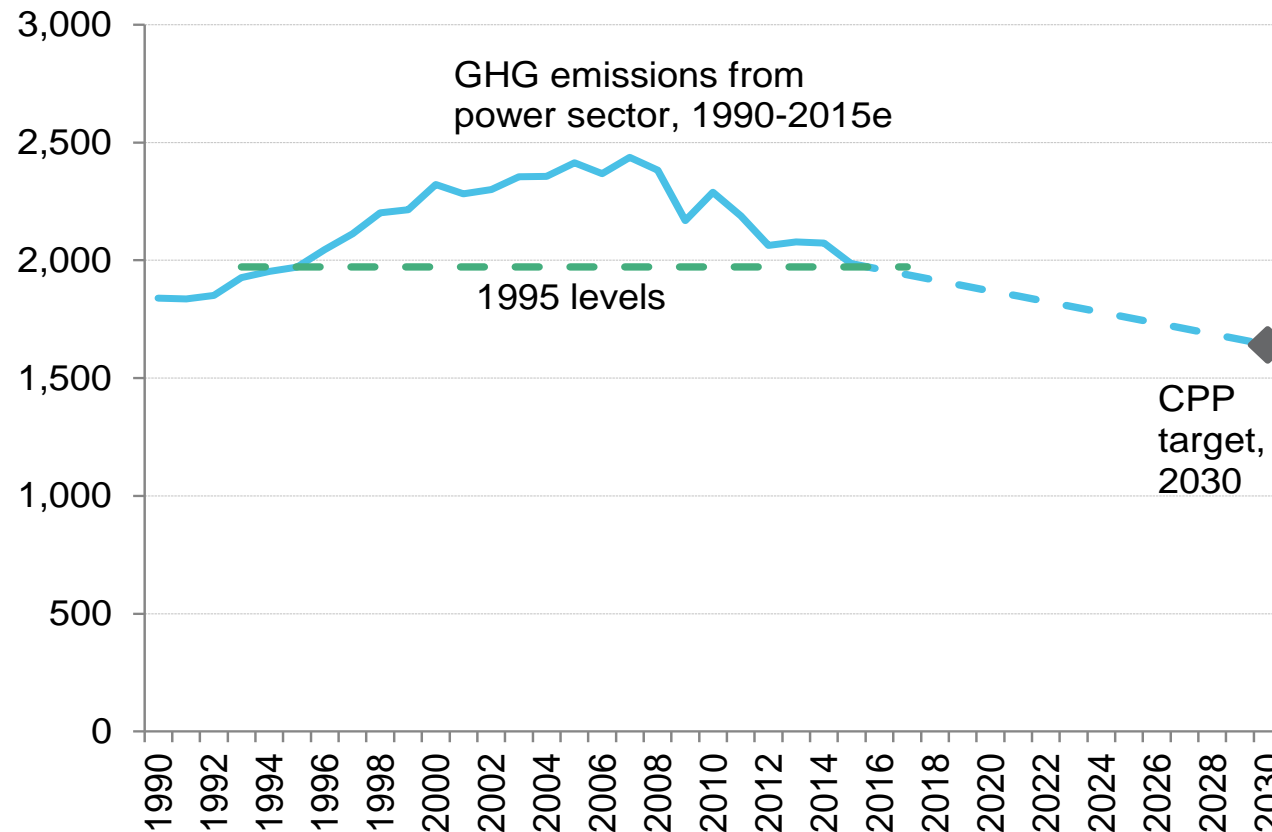


- Generation from natural gas plants increased by 17% from 2014 to 2015, while coal generation fell by 11%.
- The US power sector is gradually decarbonizing. From 2007 to 2015, natural gas increased from 22% to 32% of electricity generation, and renewables climbed from 8% to 13%. Coal's share slipped from 49% in 2007 to only 34% in 2015.

Source: EIA

Notes: Values for 2015 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2015). In chart at left, contribution from 'Other' is not shown; the amount is minimal and consists of miscellaneous technologies including hydrogen and non-renewable waste. The hydropower portion of 'Renewables' includes negative generation from pumped storage.

US energy overview: Greenhouse gas emissions from the power sector (MtCO₂e)



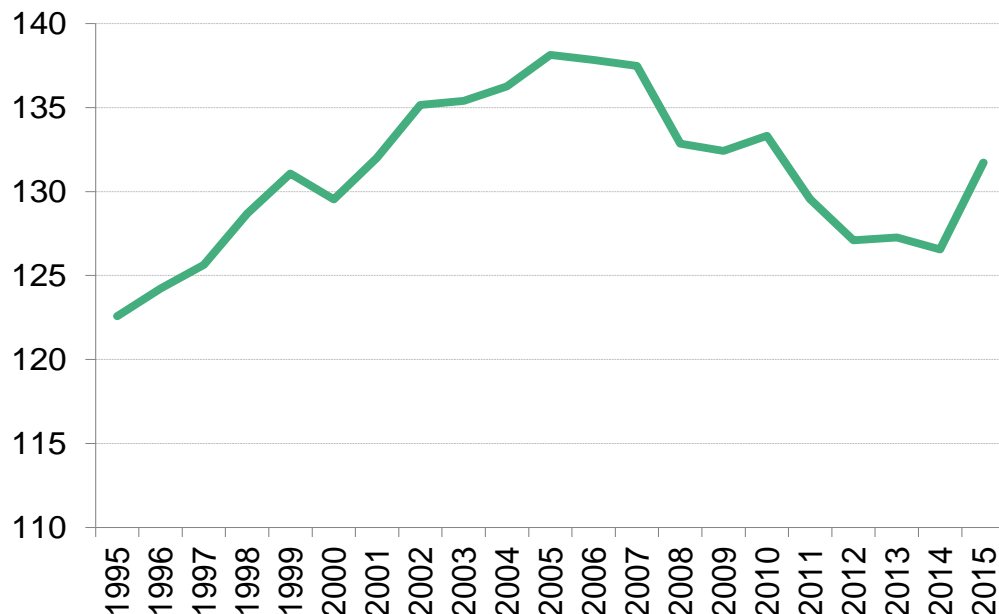
- In 2015, power-sector emissions sunk to their lowest levels (1,985Mt) since 1995 as cleaner-burning natural gas has displaced generation from coal-fired power plants.
- Emissions are 18% below 2005 levels.
- The Clean Power Plan targets a 32% cut from 2005 levels by 2030.

Source: Bloomberg New Energy Finance, EIA, EPA

Notes: Values for 2015 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2015).

Global context: US-related causes and implications of falling oil prices

US gasoline consumption (bn gallons per year)



US average fuel-economy rating (weighted by sales) of purchased new vehicles (MPG)



- Gasoline consumption in the US is estimated to have ticked up to 132bn gallons per year in 2015, marking a 4% increase from the low seen in 2014.
- However, consumption is still 4.6% below the 2005 peak, and both corporate average fuel economy (CAFE) standards and emissions targets have tightened over the past decade.
- Average US fuel economy of new vehicle sales flatlined from 2014 to 2015, ending the trend of steady improvement seen in 2007-2013.

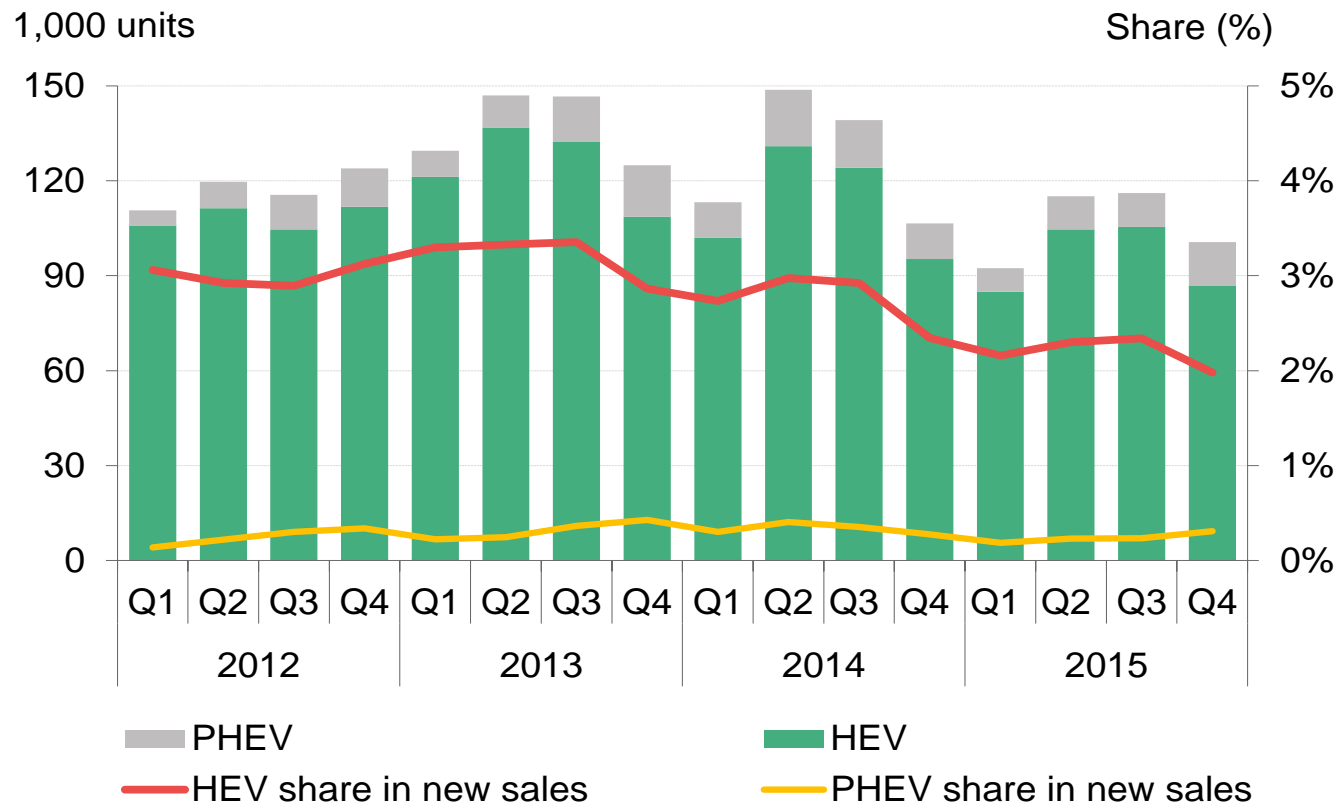
Source: EIA

Notes: Analysis is based on daily averages of 'total gasoline all sales / deliveries by prime supplier'. Values for 2015 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2015).

Source: UMTRI, Bloomberg New Energy Finance

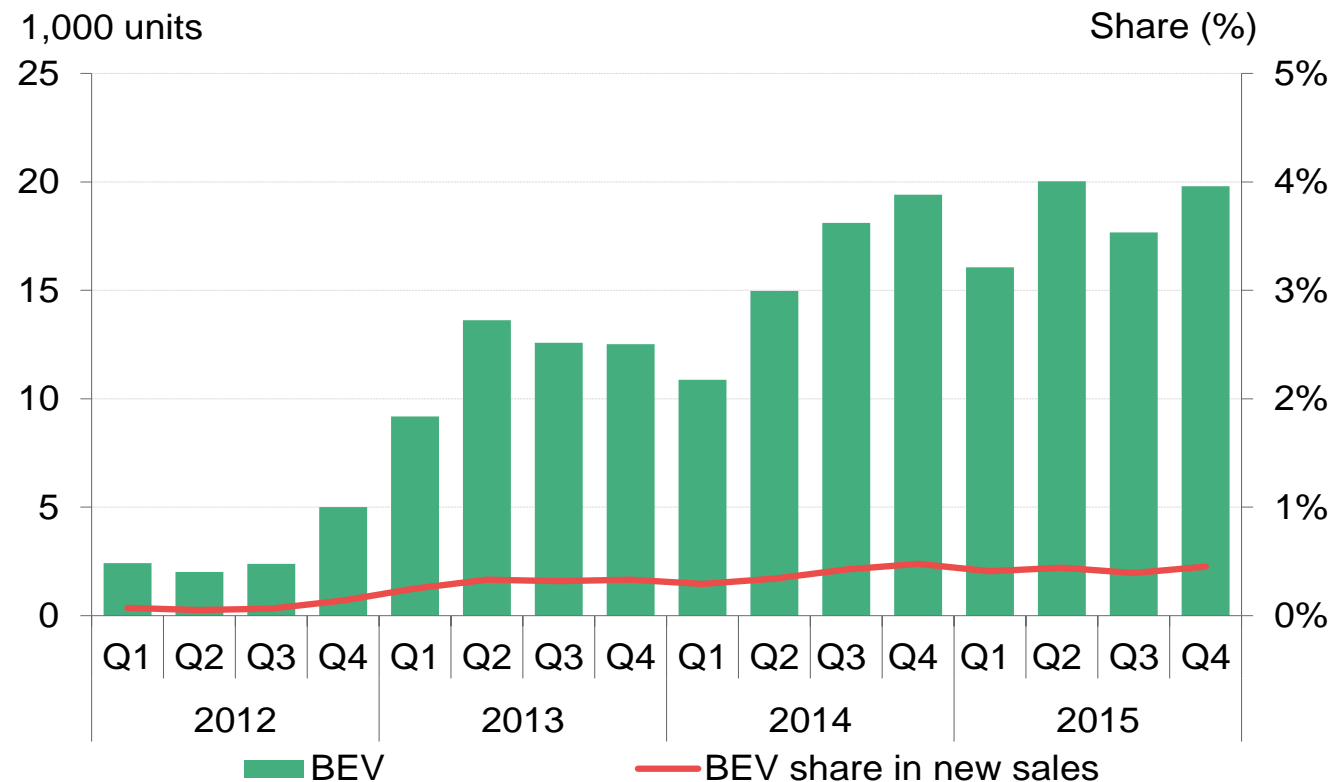
Notes: Relies on combined city/highway EPA fuel economy ratings.

Deployment: US hybrid electric vehicle sales



- Sales of plug-in hybrid electric vehicles (PHEV) and hybrid electric vehicles (HEV) declined in 2015, even as Americans bought 6% more cars than in 2014.
- PHEV sales collapsed 24%, and HEV sales declined 16%. HEV sales were relatively slow this year amid low gasoline prices.
- Low gasoline prices, restricted model availability, a high number of EVs coming off-lease and a delay in the introduction of some highly anticipated models contributed to the decline.

Deployment: US battery electric vehicle sales



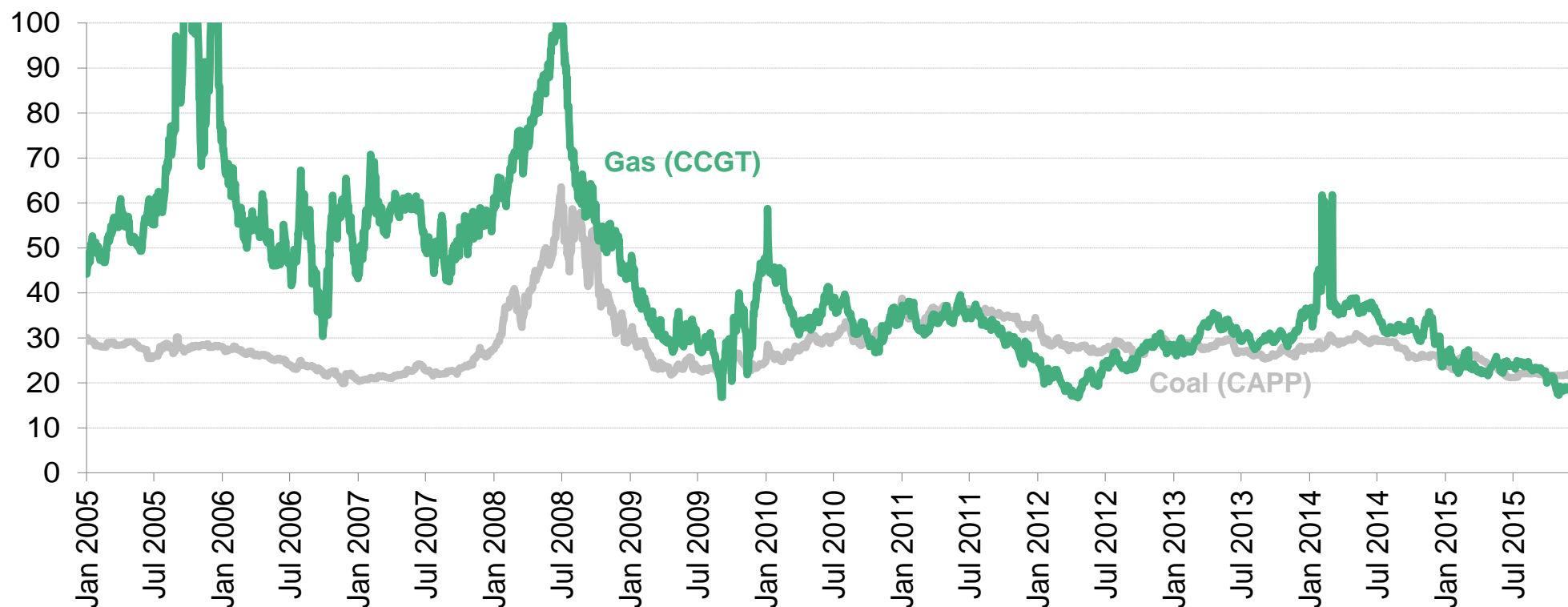
- Only sales of battery electric vehicles (BEVs), such as Teslas, proved immune: BEVs actually saw a 16% jump from 2014 to 2015.
- Tax credits for BEVs reduce lifetime costs, and many sales continue to be driven by non-economic factors.



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Economics: Cost of generating electricity in the US from natural gas vs coal (\$/MWh)

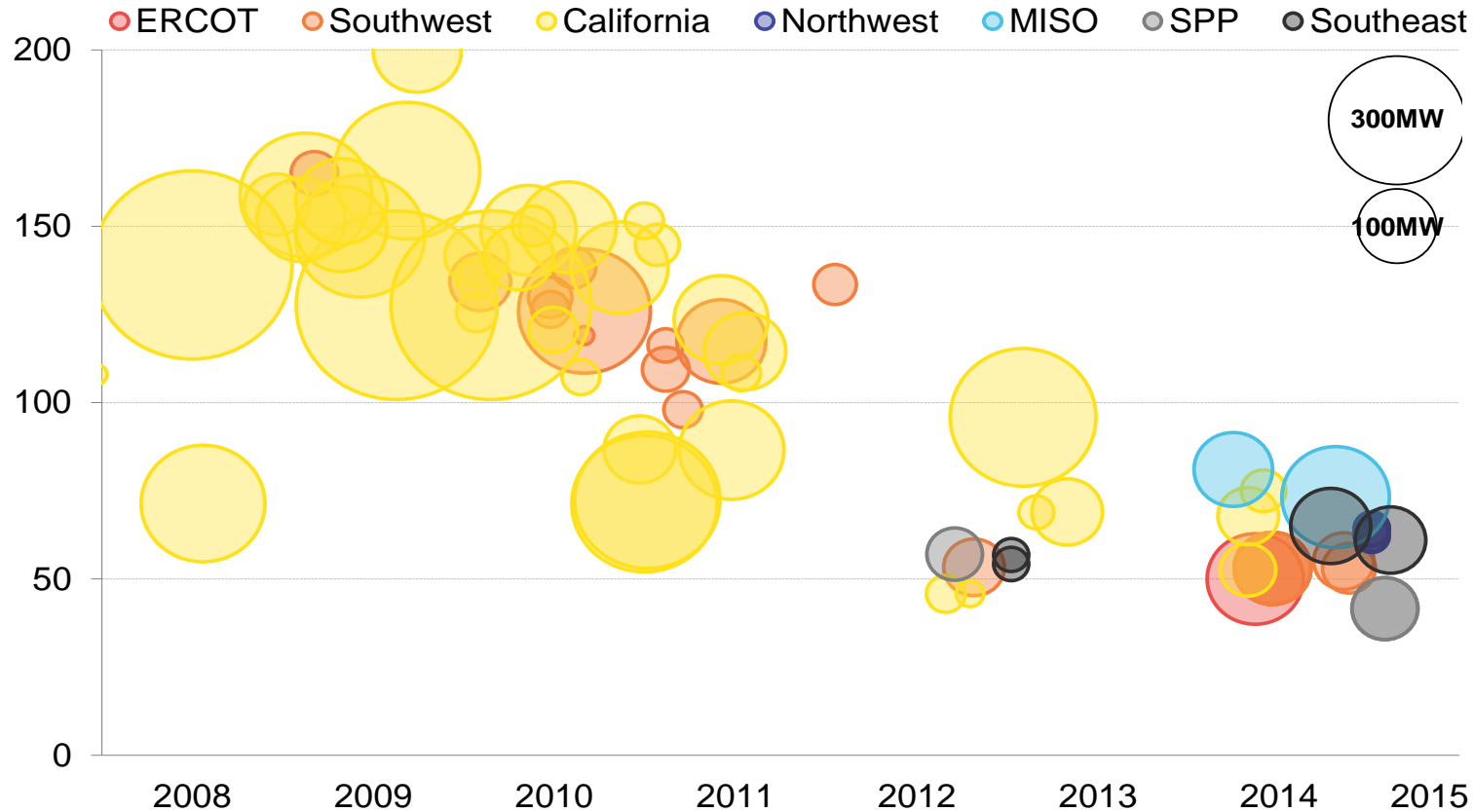


- The so-called 'shale revolution' has lowered gas prices significantly, enabling gas plants in many parts of the country to compete head-to-head with coal-fired plants.
- In some regions (eg, the Mid-Atlantic and Southeast) in 2012 and again in 2015, gas was the cheaper resource. Competition from natural gas was a key factor in 2015's record level of coal retirements.

Source: Bloomberg New Energy Finance

Notes: Assumes heat rates of 7,410Btu/kWh for CCGT and 10,360Btu/kWh for coal (both are fleet-wide generation-weighted medians); variable O&M of \$3.15/MWh for CCGT and \$4.25/MWh for coal. Gas price used is Henry Hub. CCGT stands for a combined-cycle gas turbine. CAPP represents Appalachian coal prices.

Economics: US utility-scale solar PPA prices by signing date, 2008-H1 2015 (\$/MWh)



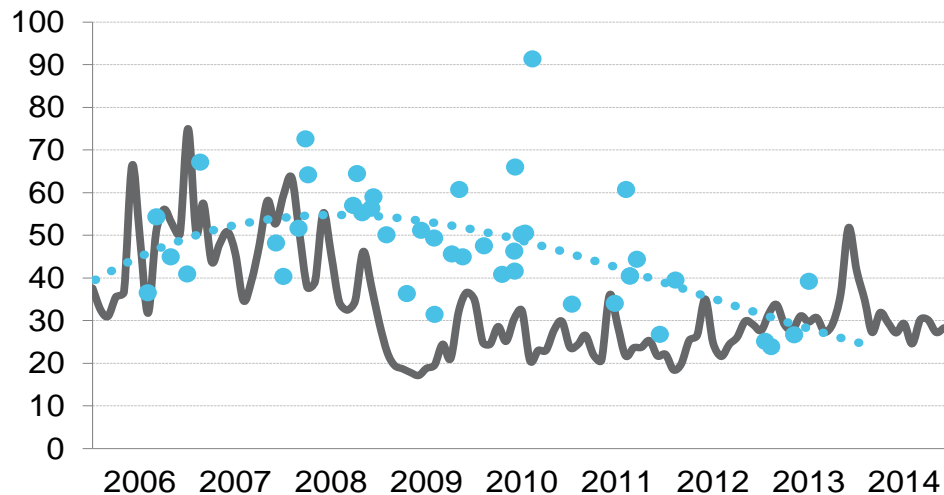
- Prices for long-term contracts for utility-scale PV continue to decline – from over \$100/MWh in 2008-9 to consistently in the \$40-60/MWh range in 2015, driven by falling system costs
- The threat of an ITC step-down drove particularly aggressive (<\$40/MWh) PPA bids in 2015

Source: Bloomberg New Energy Finance, FERC EQR, public disclosures and analyst estimates

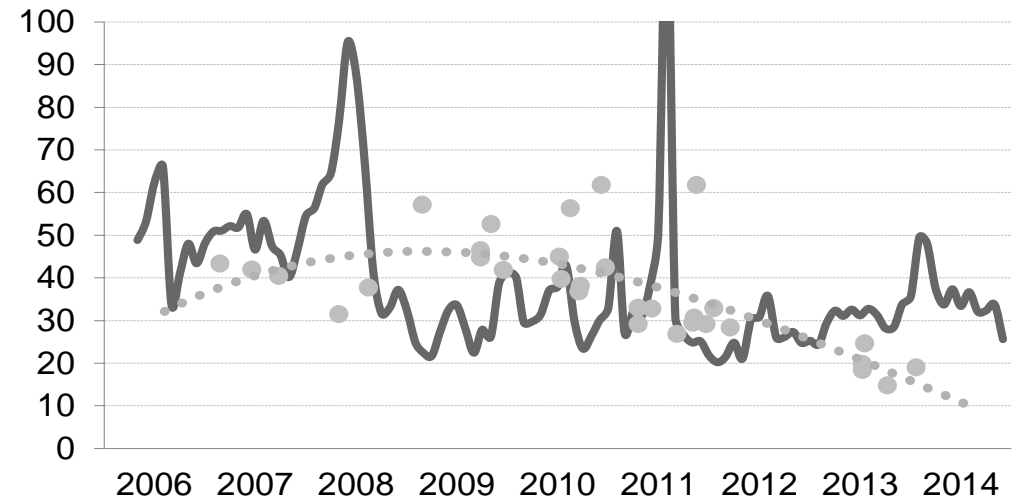
Notes: Does not include PPAs under 5MW. 'PPA price' is calculated as the average offtake price over the period of project operation.

Economics: US onshore wind PPA prices by signing date, relative to wholesale power prices, 2006-2014 (\$/MWh)

MISO



SPP



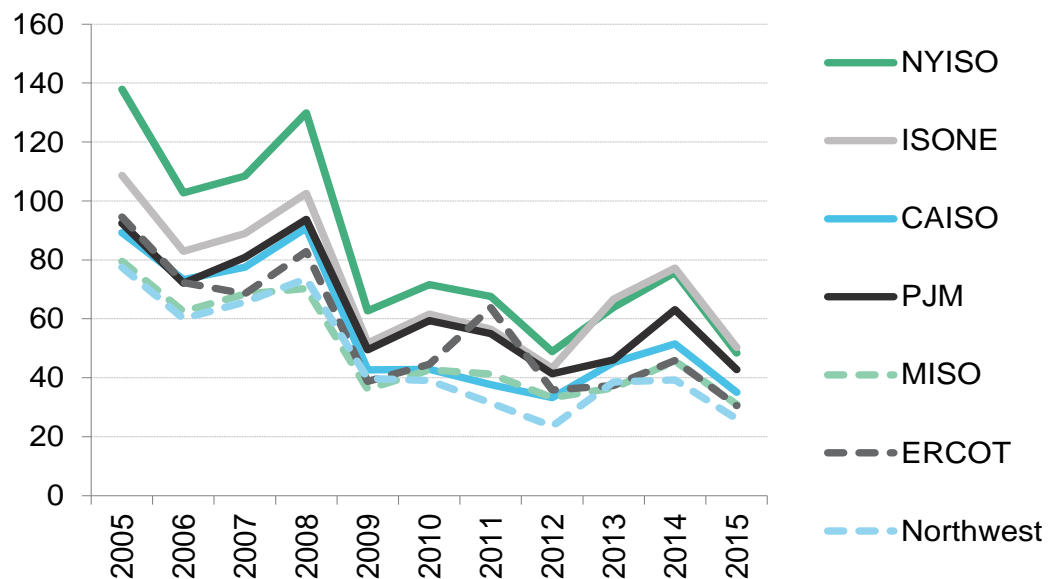
- Prices for long-term contracts for onshore wind also have declined (reaching the \$20-30/MWh range), driven by improvements in technology and decreasing financing costs
- In the Midwest (MISO) and Central southern states (SPP), wind PPAs are competitive with wholesale power prices

Source: Bloomberg New Energy Finance, FERC EQR, public disclosures and analyst estimates

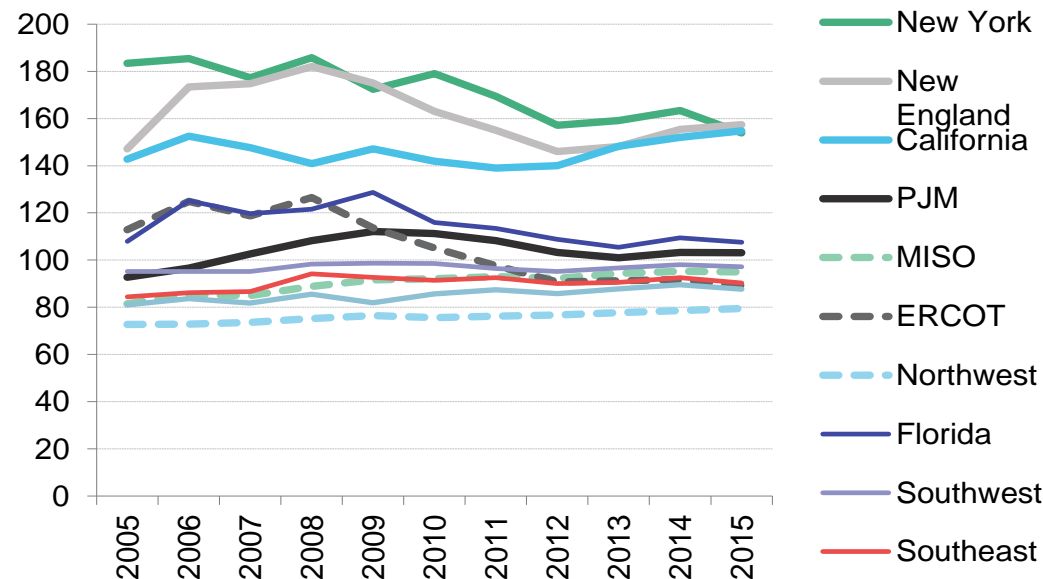
Notes: Does not include PPAs under 5MW. 'PPA price' is calculated as the average offtake price over the period of project operation.

US energy overview: Retail and wholesale power prices

Wholesale power prices (\$/MWh)



Average retail power prices (\$/MWh)



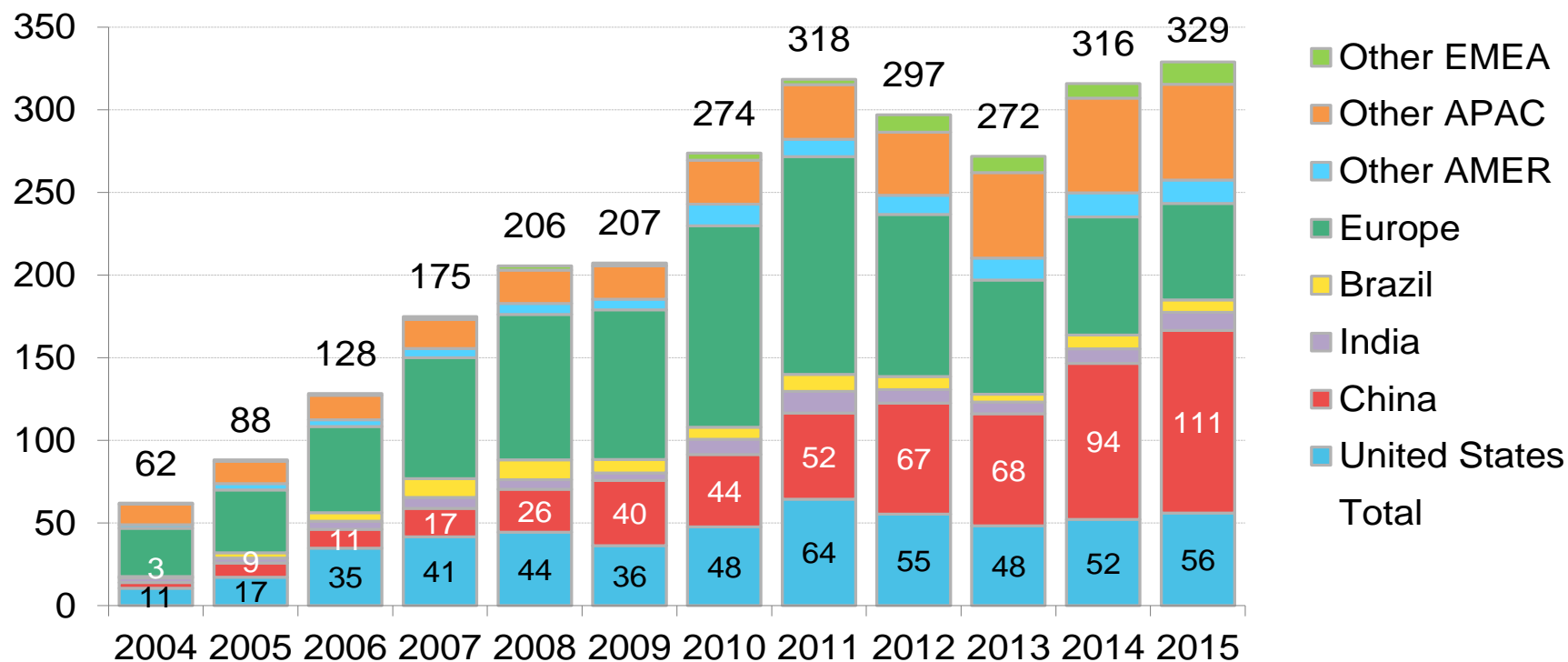
- Wholesale prices fell by about a third in 2015, as natural gas prices fell and more renewables connected to the grid.
- Retail power prices in most regions remain well below the peak prices seen in 2008-09.
- In 2015, retail electricity rates fell by 1.3% on average nationwide. New York (-5.8%) and Texas (-2.7%) saw the biggest year-on-year declines.
- Exceptions included California and New England where retail prices rose marginally (1.8% and 1.3%, respectively).



OUTLOOK

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Global context: Total new investment in clean energy by country or region (\$bn)



- Total new investment in clean energy set a new record high at \$329bn in 2015.
- Investments climbed 8% in the US, mostly in wind and solar. The US currently makes up 17% of world investment in clean energy.
- China was #1 again, investing \$111bn.

Source: Bloomberg New Energy Finance

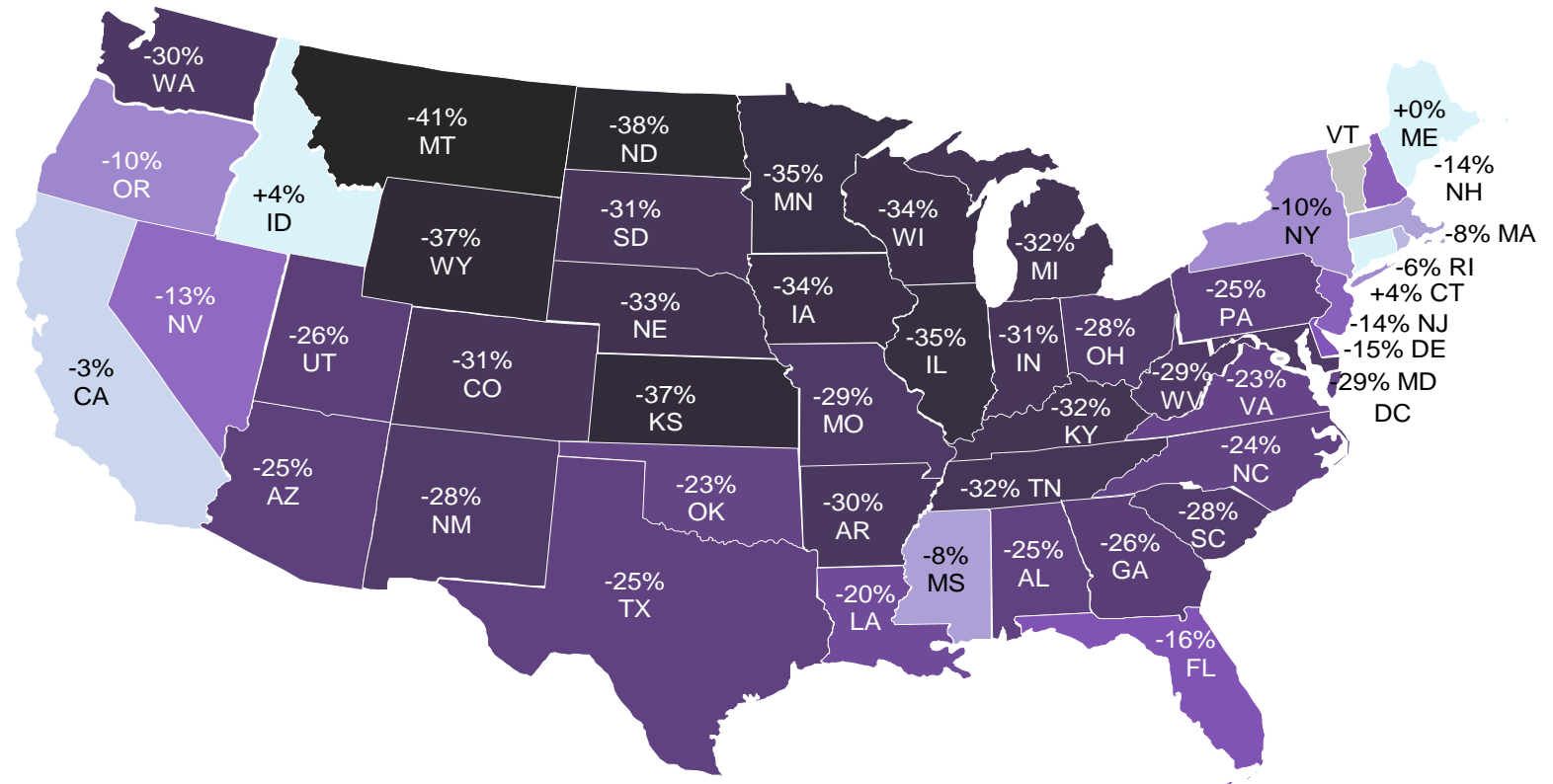
Notes: For definition of clean energy, see slide in Section 2.2 of this report titled 'Finance: US clean energy investment (1 of 2) – total new investment, all asset classes (\$bn)'. AMER is Americas; APAC is Asia-Pacific; EMEA is Europe, Middle East, and Africa.

Policy: Federal support of clean energy

- At the end of 2015, Congress enacted major subsidy extensions for clean energy projects.
- The Production Tax Credit (PTC) for wind projects was extended through the end of 2019. The credit is \$23/MWh for projects beginning construction in 2015 and 2016, then steps down through 2019.
- The Investment Tax Credit (ITC) for solar projects was extended and now applies to projects beginning construction before 2022. The credit begins at 30% for projects breaking ground before 2020, then steps down gradually to 10%.
- Extensions were also granted for the production of second-generation biofuels and energy from geothermal, biomass and landfill gas, hydroelectric projects and ocean energy; however, the majority of these technologies received extensions of only two years, compared to five year for wind and solar.
- Deductions and credits were extended for energy efficiency building improvements and the construction of efficient homes.

Policy: EPA Clean Power Plan

Emissions reductions required by the Clean Power Plan between 2012 and 2030, under mass-based compliance

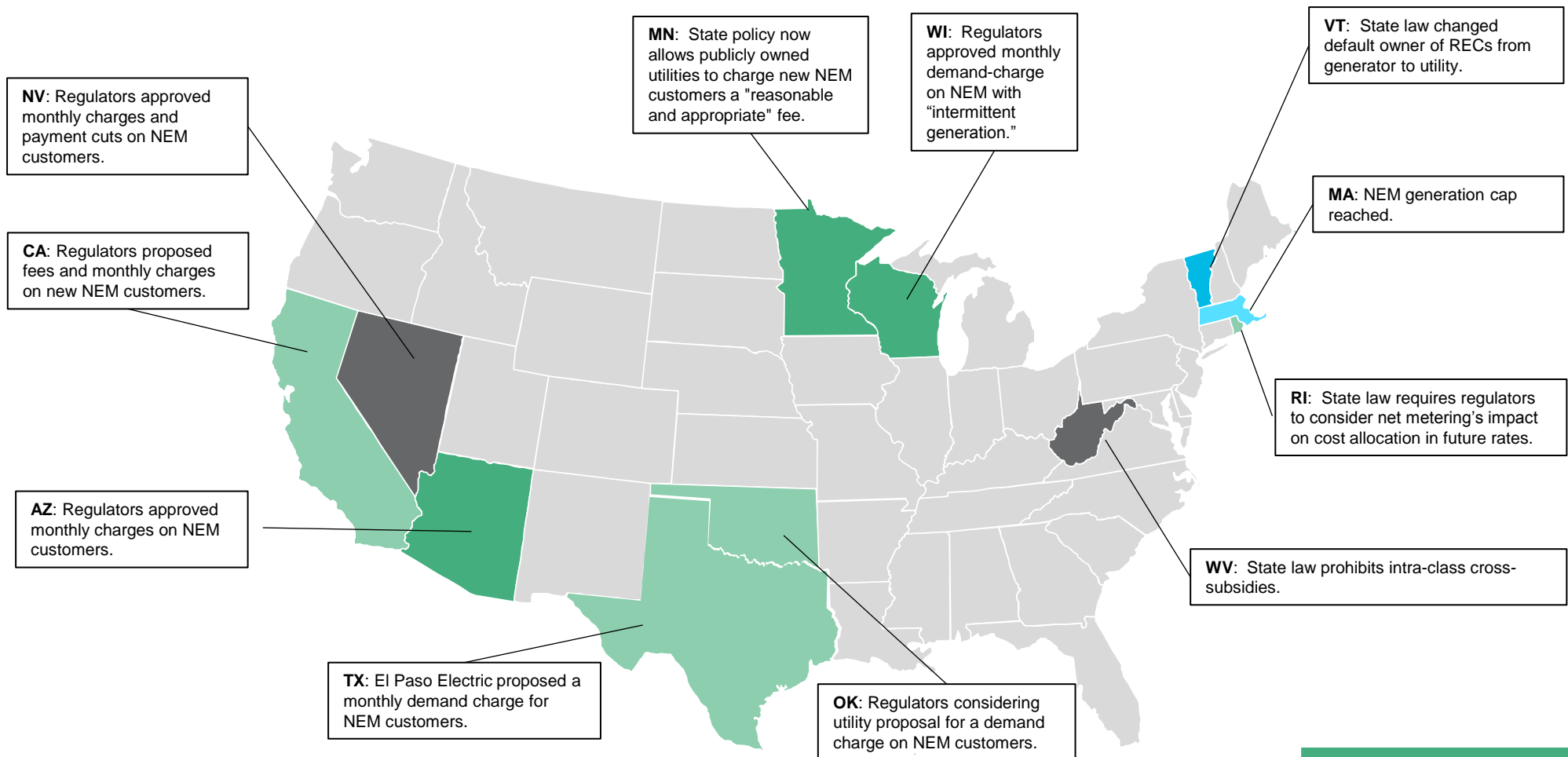


- EPA finalized the Clean Power Plan (CPP), its regulation on carbon emissions from the existing power fleet, in August 2015
- The Plan could cut power-sector emissions 32% from 2005 levels by 2030.

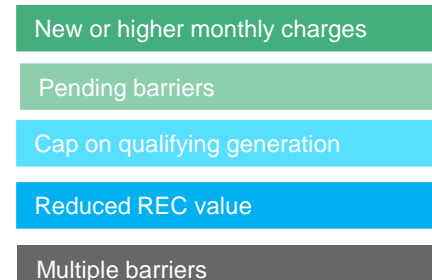
Source: Bloomberg New Energy Finance, based on analysis of EPA Clean Power Plan

Notes: Darker colors indicate deeper emissions cuts. Yellow states may actually increase their overall emissions, while remaining in compliance with the EPA's Clean Power Plan. Data is not available for Alaska and Hawaii; Vermont and DC are not covered by the EPA's regulations. Data is based on EPA modelling and EPA historical emissions inventories.

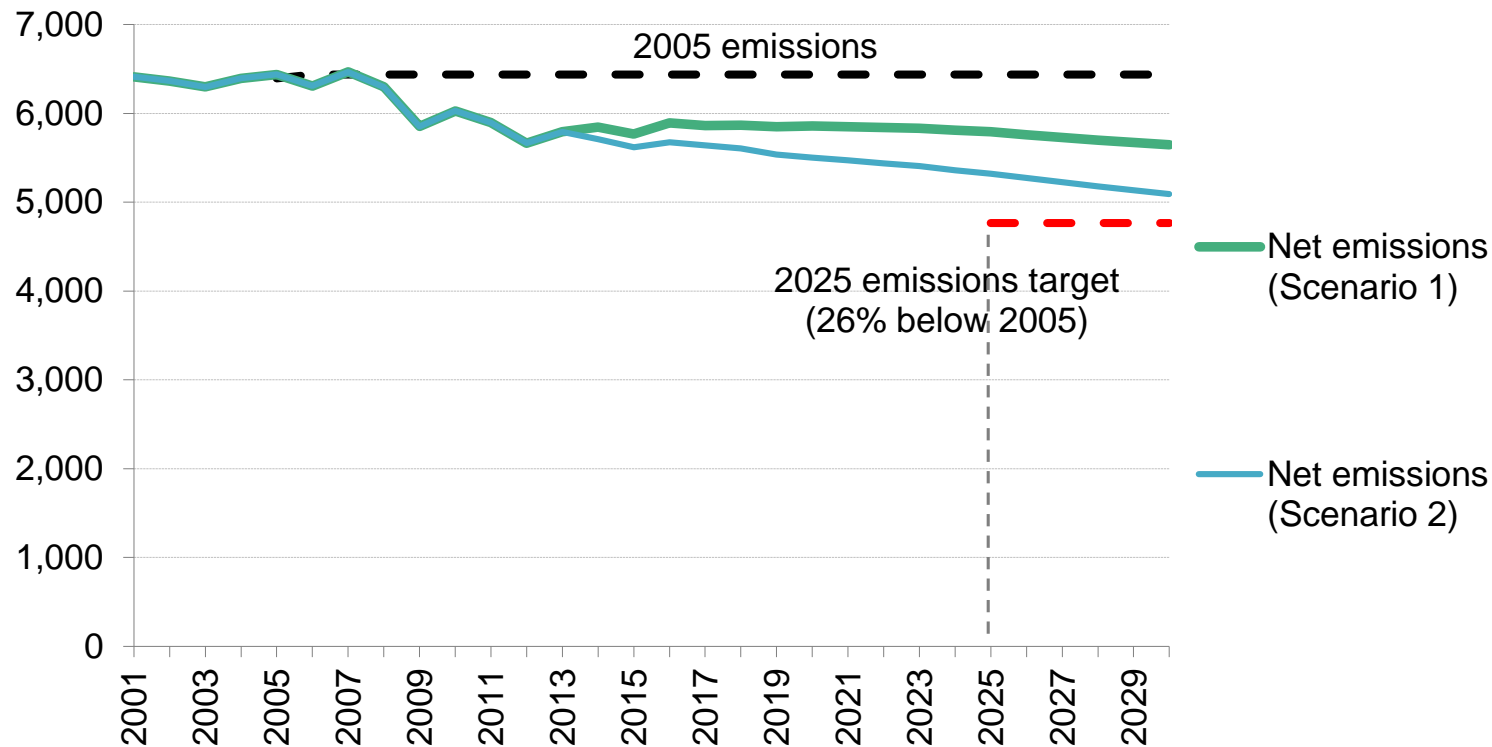
Policy: State policy barriers to net energy metering erected in 2015



- States across the country imposed policies against net energy metering (NEM), a practice key to the economics of distributed generation.
- For example, Nevada regulators approved higher fixed charges and lower compensation for surplus generation from NEM customers. In response, SolarCity and Sunrun announced plans to leave the state. State regulators are now considering grandfathering in existing NEM customers so that they are not subject to the new rule.



Policy: US emissions pledge in Paris



- On March 31, 2015, the US released its official pledge for US emissions cuts as part of the United Nations climate negotiations: to reduce emissions to 26-28% below 2005 levels by 2025. An earlier target proposed by President Obama set a 2020 goal of 17% below 2005 levels.
- In 2013, the last year with complete data, net emissions (ie, including sinks) stood 10% below 2005 levels.
- The new pledge builds off existing and coming programs (eg, CAFE standards, EPA Clean Power Plan), but more policy may be needed to achieve the targets.

Source: Bloomberg New Energy Finance, EIA, EPA, US Department of State Notes: Net GHG emissions include total emissions less sequestration. Full data only available through 2013. Scenarios 1 and 2 show two trajectories for US emissions growth, based on a combination of Bloomberg New Energy Finance (BNEF) forecasts and EPA, EIA and US Department of State analyses. Both scenarios use BNEF's forecast for US power-sector emissions, assuming full compliance with the EPA Clean Power Plan. Both scenarios assume transportation growth as per the EIA's AEO2015 reference case and assuming existing CAFE standards. Scenario 1 assumes residential, commercial and industrial sectors' energy growth as per the EIA AEO2015 reference case; and agricultural, waste and forestry and land use sectors' growth as per the 2014 US Climate Action report. Scenario 2 assumes the historical decline rate for the residential and commercial sectors; assumes the industrial, agricultural and waste sectors' emissions level remain constant from 2013; and assumes forestry and land use emissions follow the "high sequestration case" in the 2014 US Climate Action report.



WRAP-UP

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- **2015 was a watershed year for sustainable energy in the US:**
 - GDP grew 2.4%, while energy consumption grew only 0.1%
 - Record natural gas production and consumption
 - Record coal retirements (14GW+)
 - Record solar PV build (7.3GW)
- **These changes are signs of a permanent shift:**
 - Natural gas has been displacing coal within the power sector
 - Renewables (excluding hydro) provided 7.4% of power, up from 2.2% in 2005
 - Power sector emissions 18% below 2005 levels
 - Hybrid vehicle sales fell and gasoline consumption rose, but long-term trend still positive
- **Meanwhile, energy prices remain low:**
 - Natural gas prices hit lowest levels since 1999, allowing gas to outcompete coal
 - Solar, wind costs continue to decline
 - Retail power prices 6% below 2008 peak
- **And the outlook is strong:**
 - US remains key destination for clean energy investment
 - Critical policy developments (Paris, Clean Power Plan, tax credit extensions)

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sales.bnef@bloomberg.net

Analyst Name

support.bnef@bloomberg.net

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