

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

	FOSSIL-FIRED / NUCLEAR POWER	RENEWABLE ENERGY	DISTRIBUTED POWER, STORAGE, EFFICIENCY	TRANSPORT
SUSTAINABLE ENERGY (as defined in this report)	<ul style="list-style-type: none"> Natural gas CCS 	<ul style="list-style-type: none"> Solar Wind Geothermal Hydro Biomass Biogas Waste-to-energy 	<ul style="list-style-type: none"> Small-scale renewables CHP and WHP Fuel cells Storage Smart grid / demand response Building efficiency Industrial efficiency (aluminum) Direct use applications for natural gas 	<ul style="list-style-type: none"> Electric vehicles (including hybrids) Natural gas vehicles
OTHER CLEAN ENERGY (not covered in this report)	<ul style="list-style-type: none"> Nuclear 	<ul style="list-style-type: none"> Wave / tidal 	<ul style="list-style-type: none"> Lighting Industrial efficiency (other industries) 	<ul style="list-style-type: none"> Biofuels

2015: A YEAR OF MILESTONES

US ENERGY IN TRANSITION

AN ERA OF LOW ENERGY PRICES

OUTLOOK

WRAP-UP

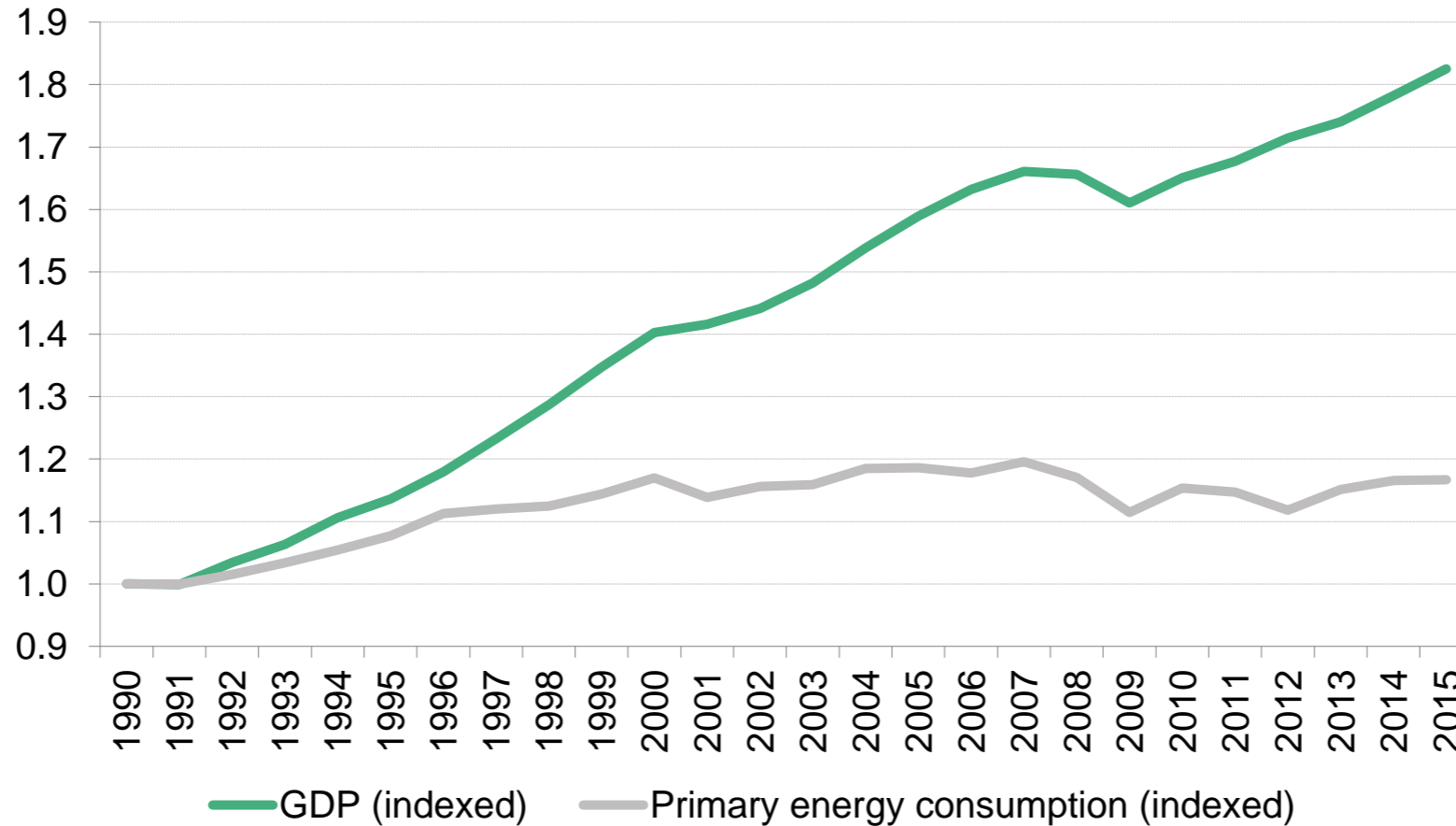


**2015: A YEAR OF
MILESTONES**

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US energy overview: Economy's energy productivity

GDP and primary energy consumption (indexed to 1990 levels)

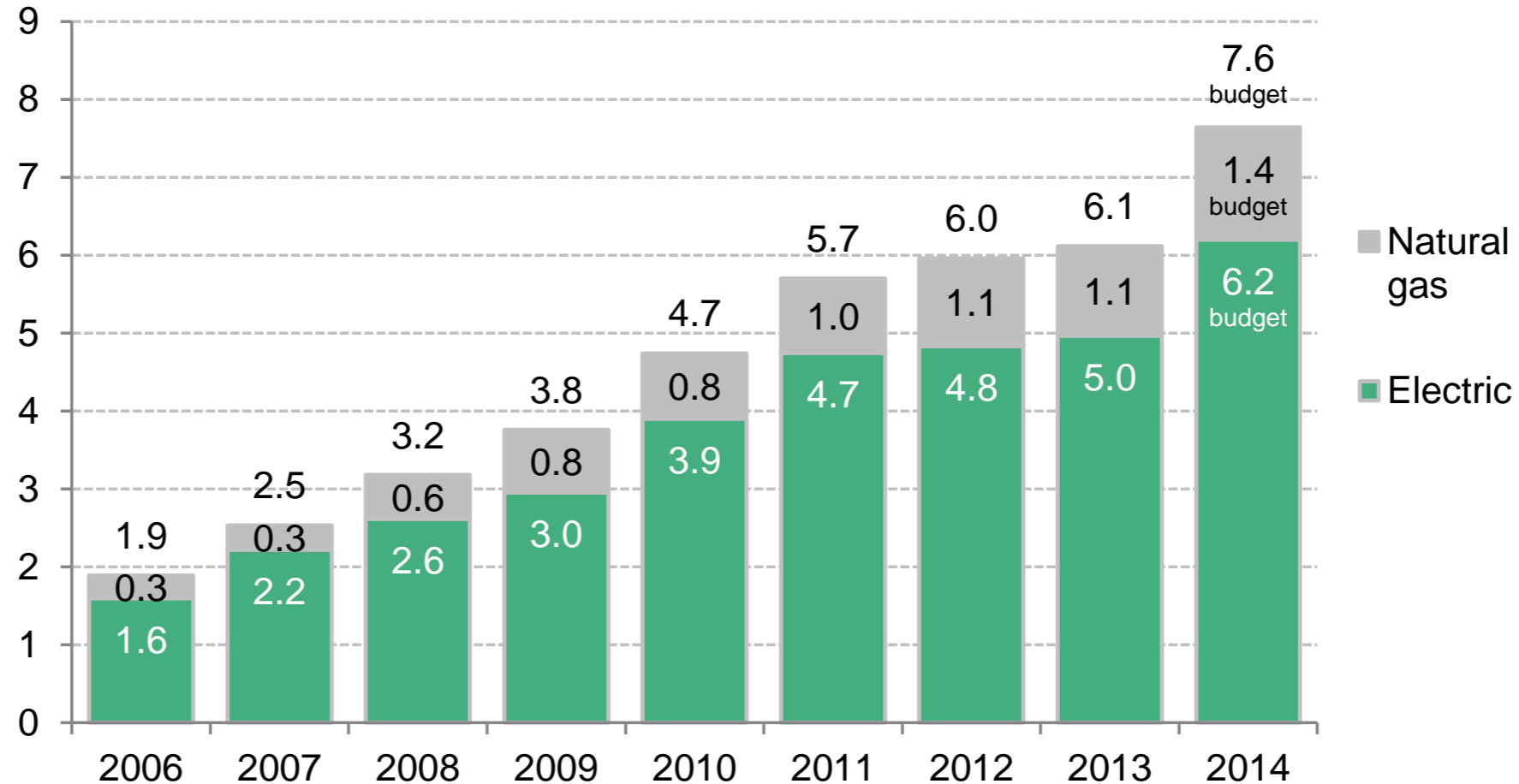


- US GDP expanded 83% over the last 25 years; energy consumption only ticked up 17%.

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

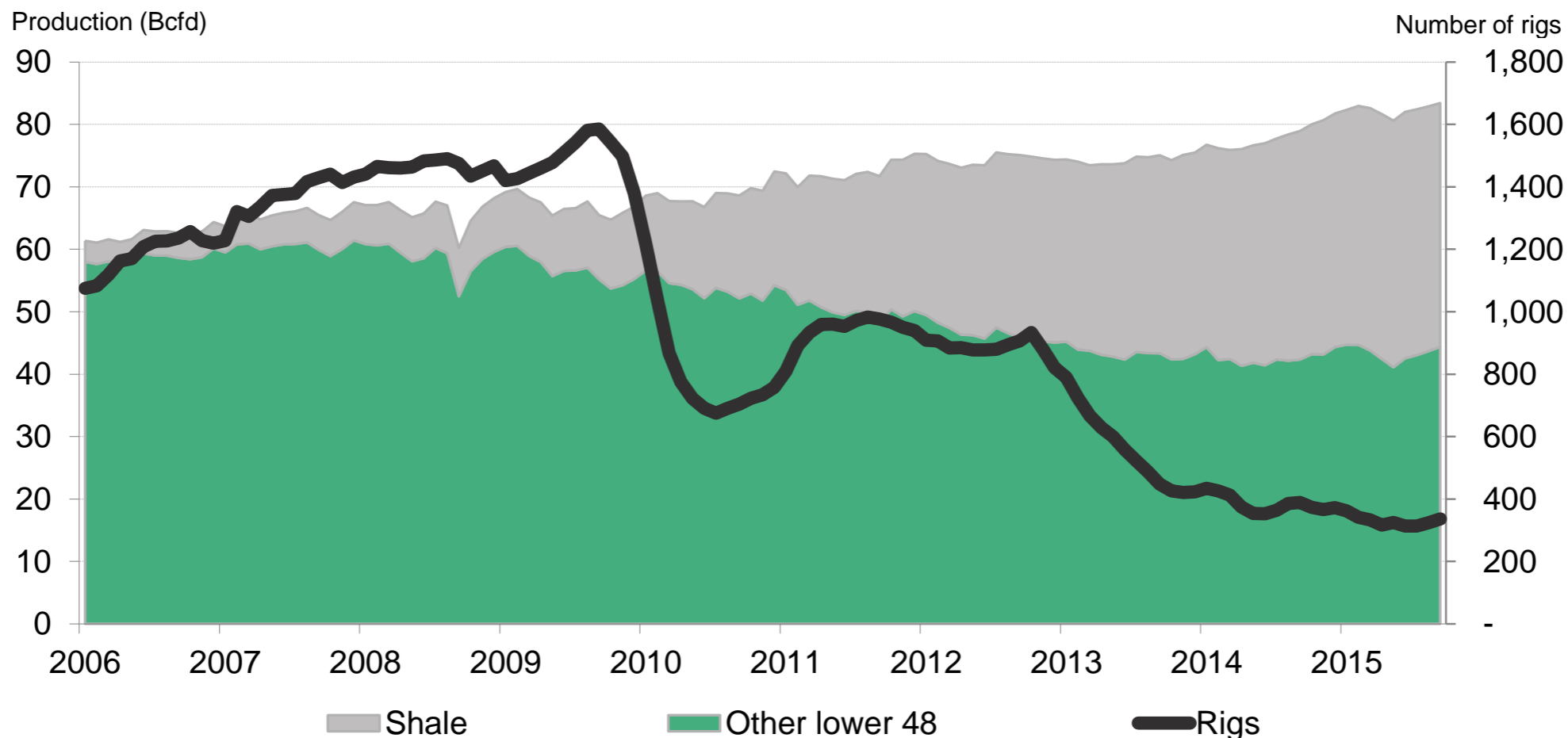
Notes: Values for 2015 energy consumption are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2015). GDP is real and chained (2009 dollars); annual growth rate for GDP for 2015 is based on consensus of economic forecasts gathered on the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

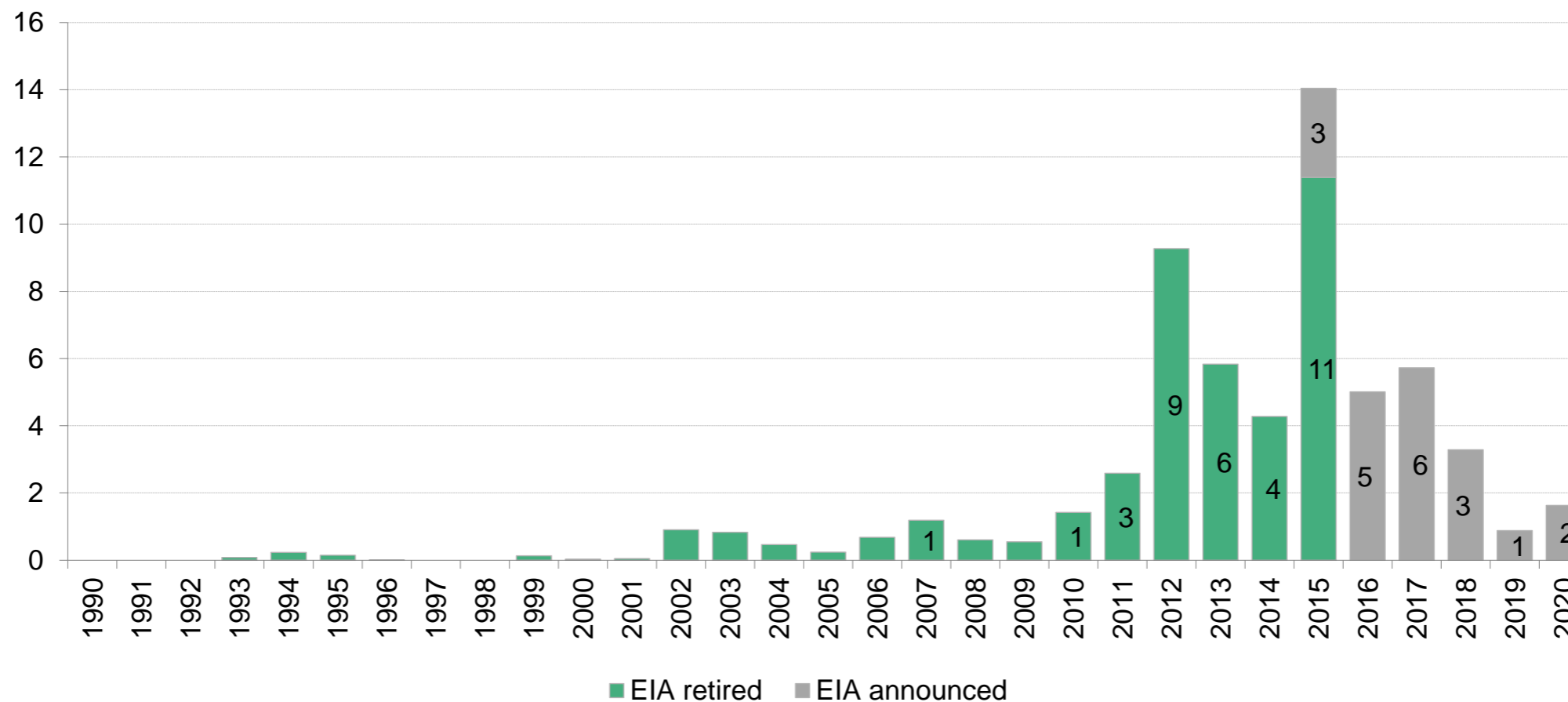
Deployment: US natural gas production and gas-directed rig count (Bcfd, rigs)



- Natural gas production in 2015 was up 7% from 2014 levels, 26% from 2007 levels.
- Technological improvements and drilling in “sweet spots” has improved productivity.

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)

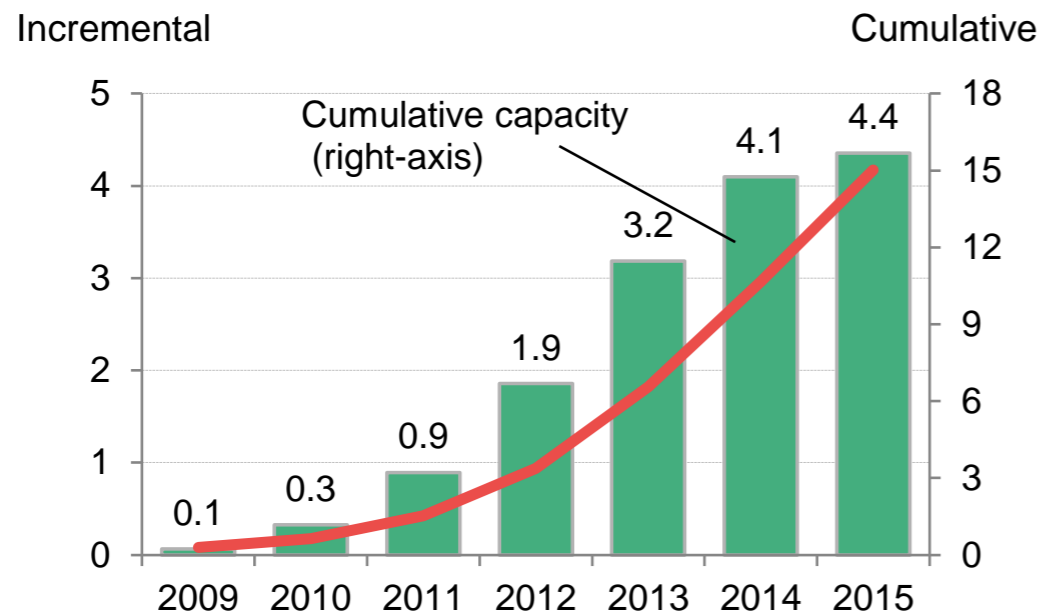


- 11GW going coal-fired plants retired through October 2015, with another 3GW of retirements scheduled through end of year.

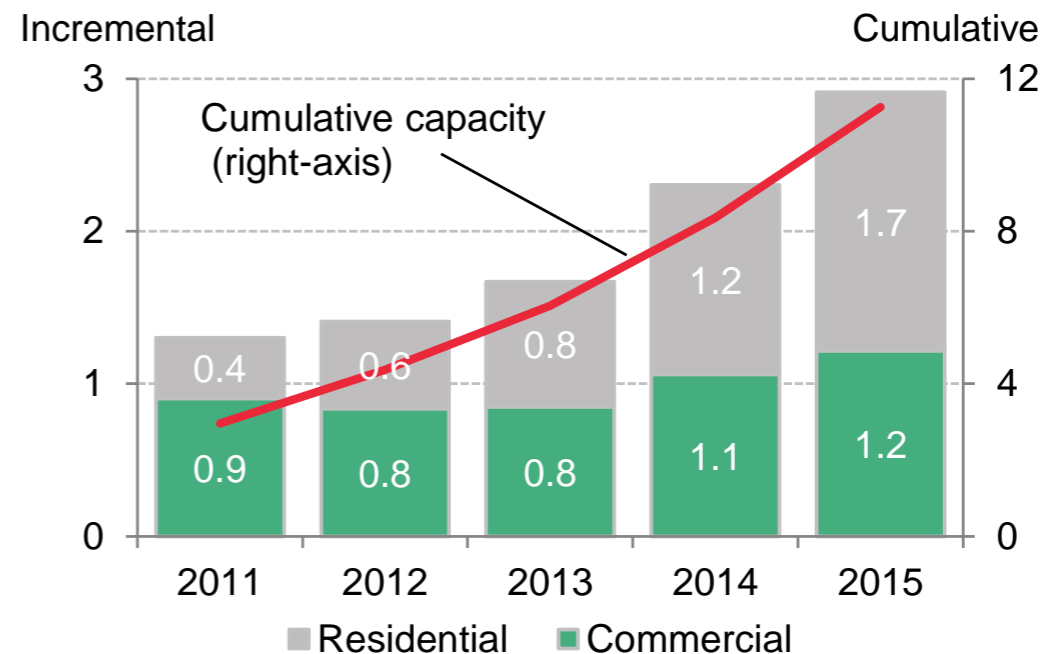
Source: Bloomberg New Energy Finance

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

US utility-scale photovoltaic build (GW)



US small-scale photovoltaic build (GW)



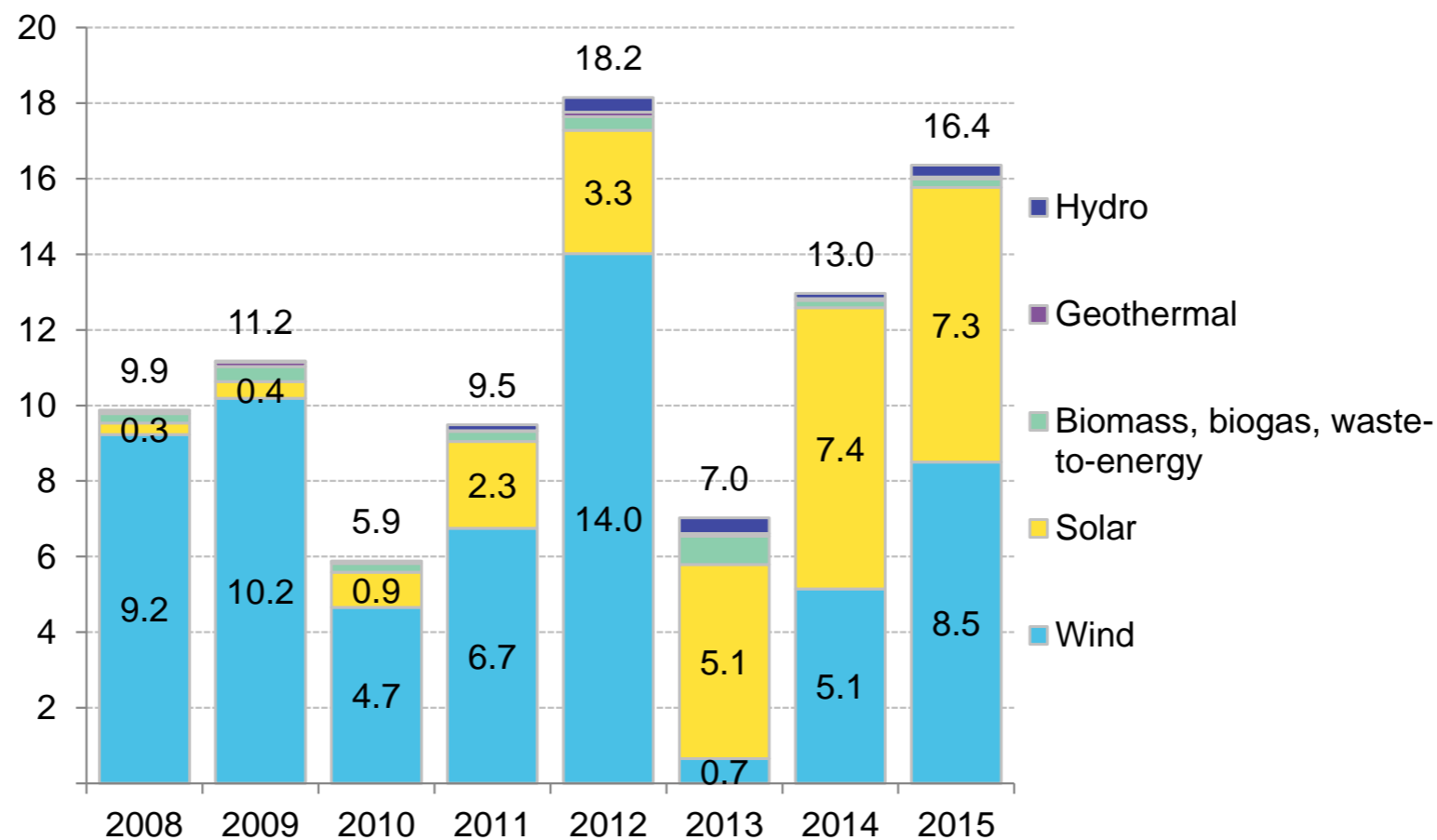
- The US set records in 2015 in utility-scale, residential and commercial build in solar PV.



US ENERGY IN TRANSITION

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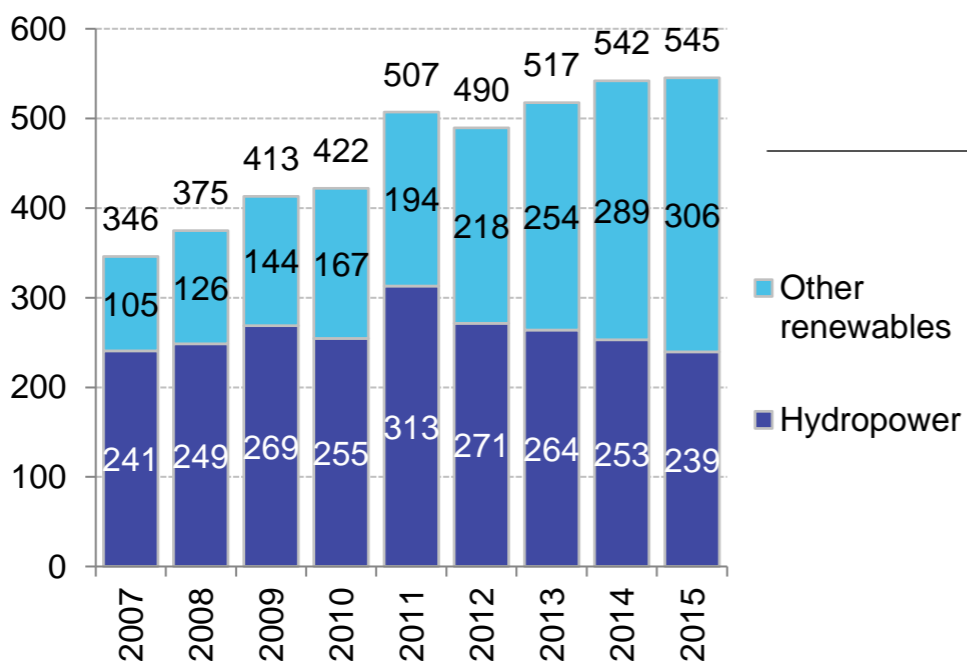
US energy overview: Renewable energy capacity build by technology (GW)



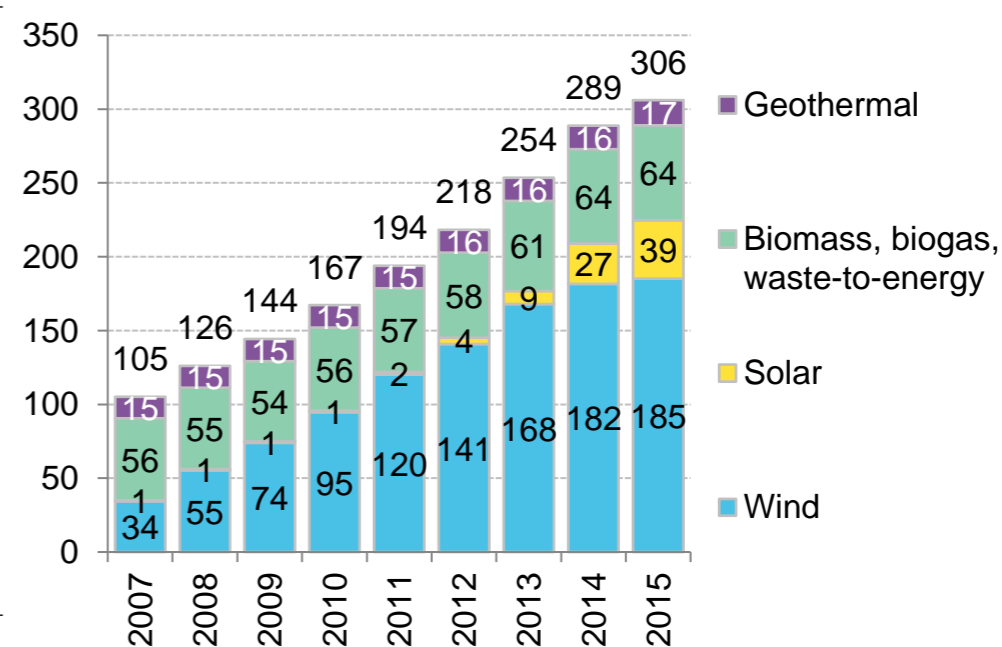
Source: Bloomberg New Energy Finance, EIA Notes: Numbers include utility-scale (>1MW) projects of all types, rooftop solar, and small- and medium-sized wind.

US energy overview: Renewable energy generation by technology

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



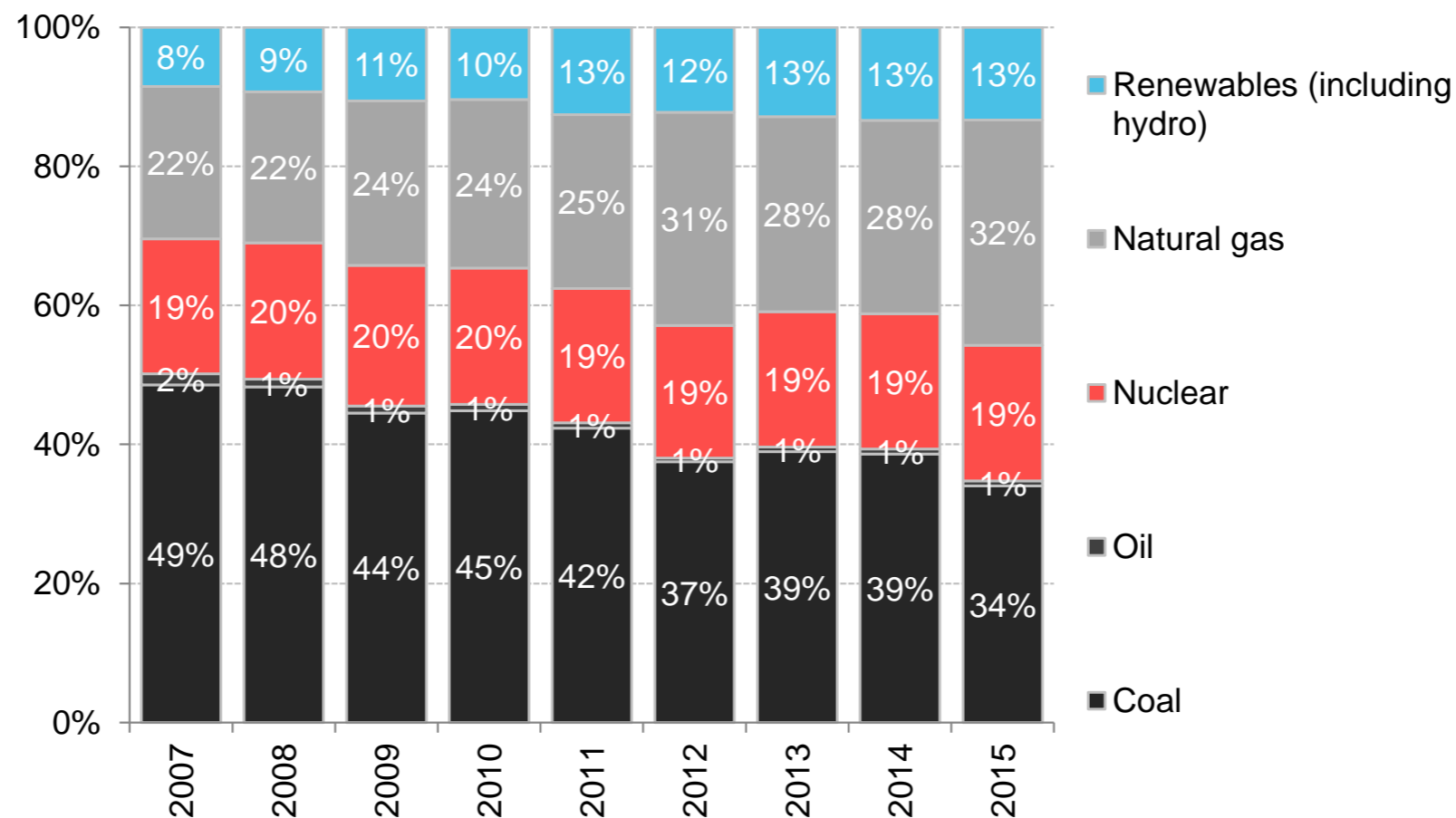
US non-hydropower renewable generation by
technology (TWh)



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.

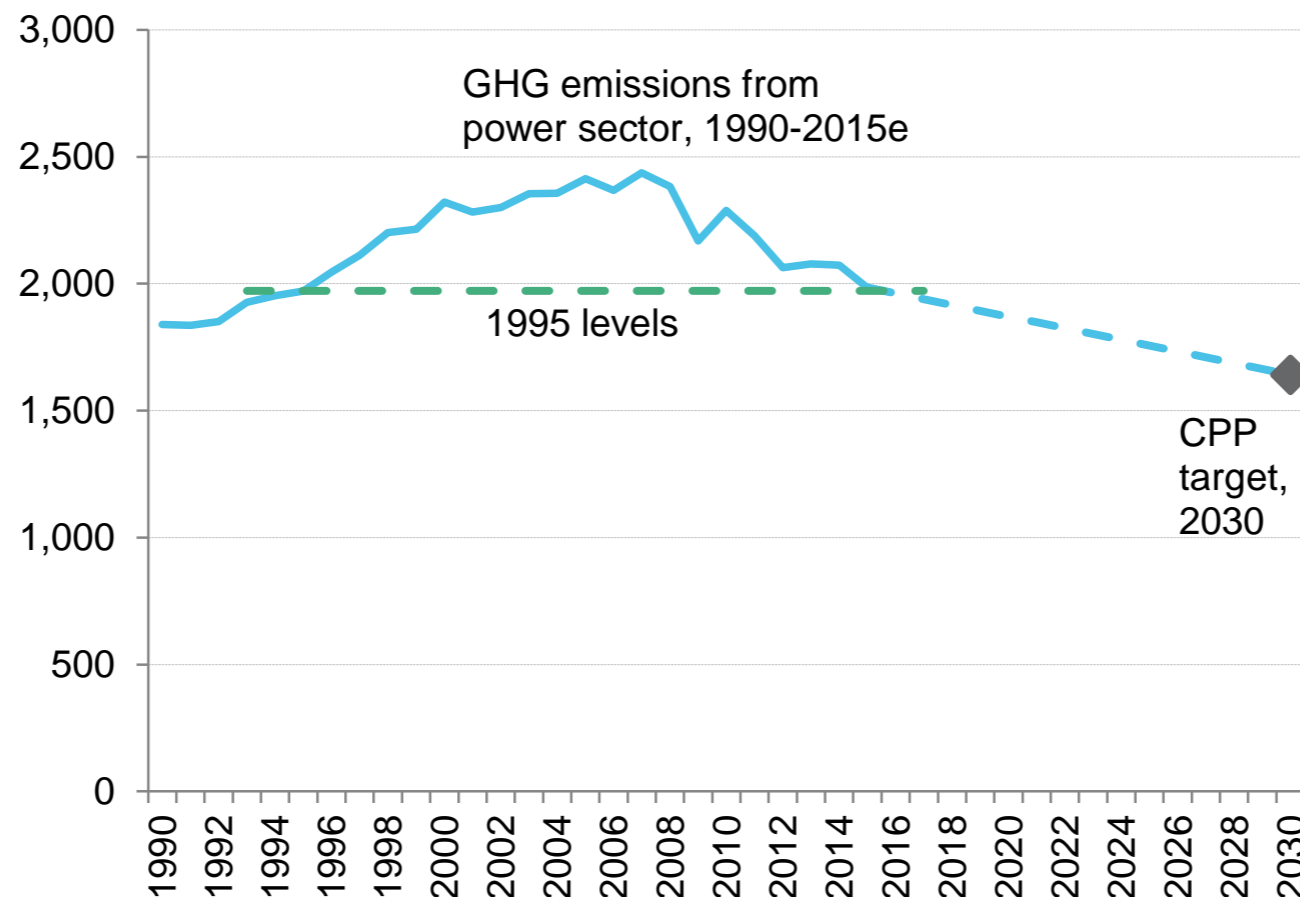
US energy overview: US electricity generation by fuel type (%)



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)

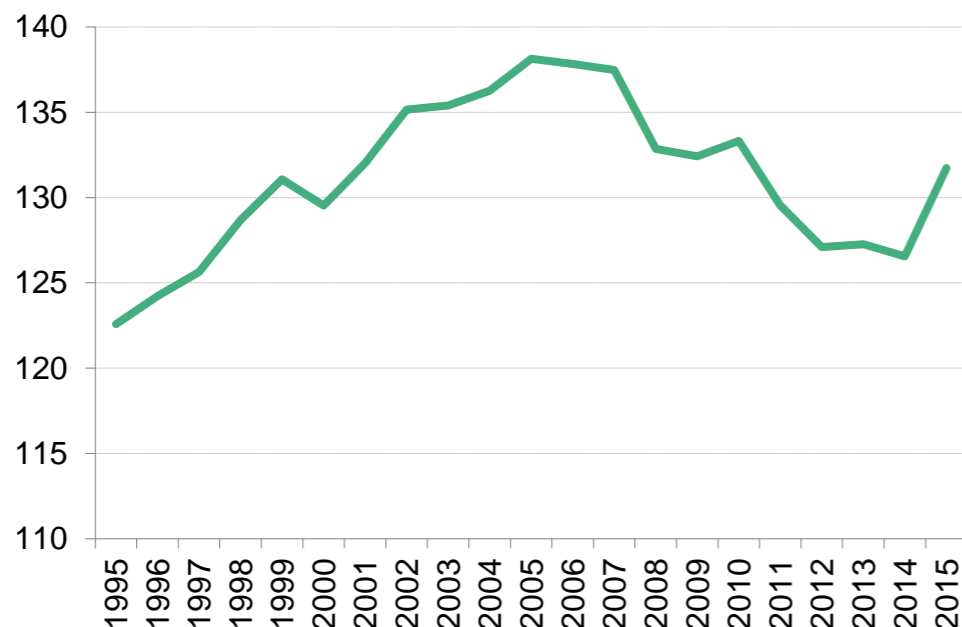


- Power-sector emissions are 18% below 2005 levels and the lowest since 1995.

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).

US gasoline consumption (bn gallons per year)



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



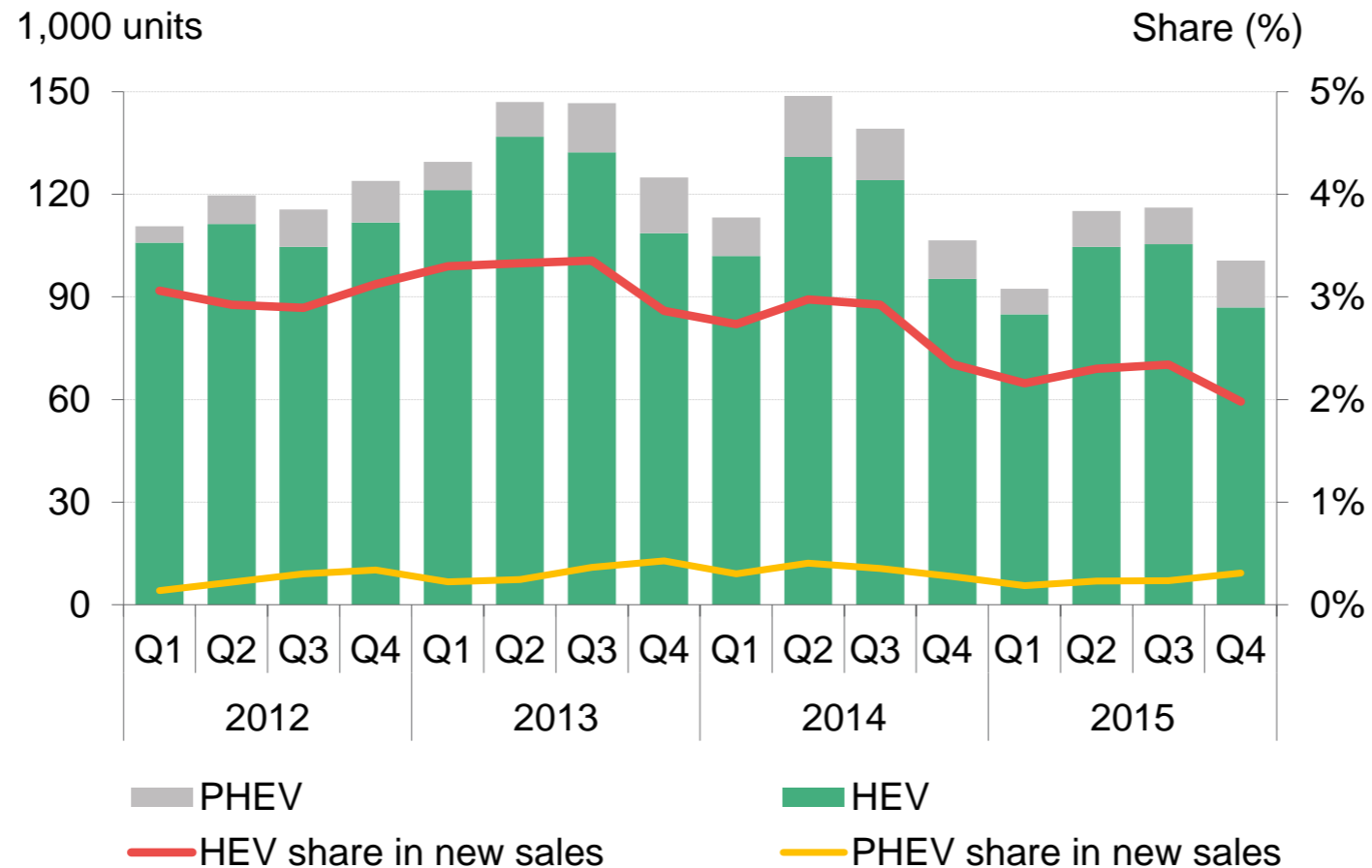
- Gasoline consumption increased 4% in 2015 but is still 4.6% below the 2005 peak
- Fuel-economy of new vehicles is 22% above 2008 levels

Source: EIA

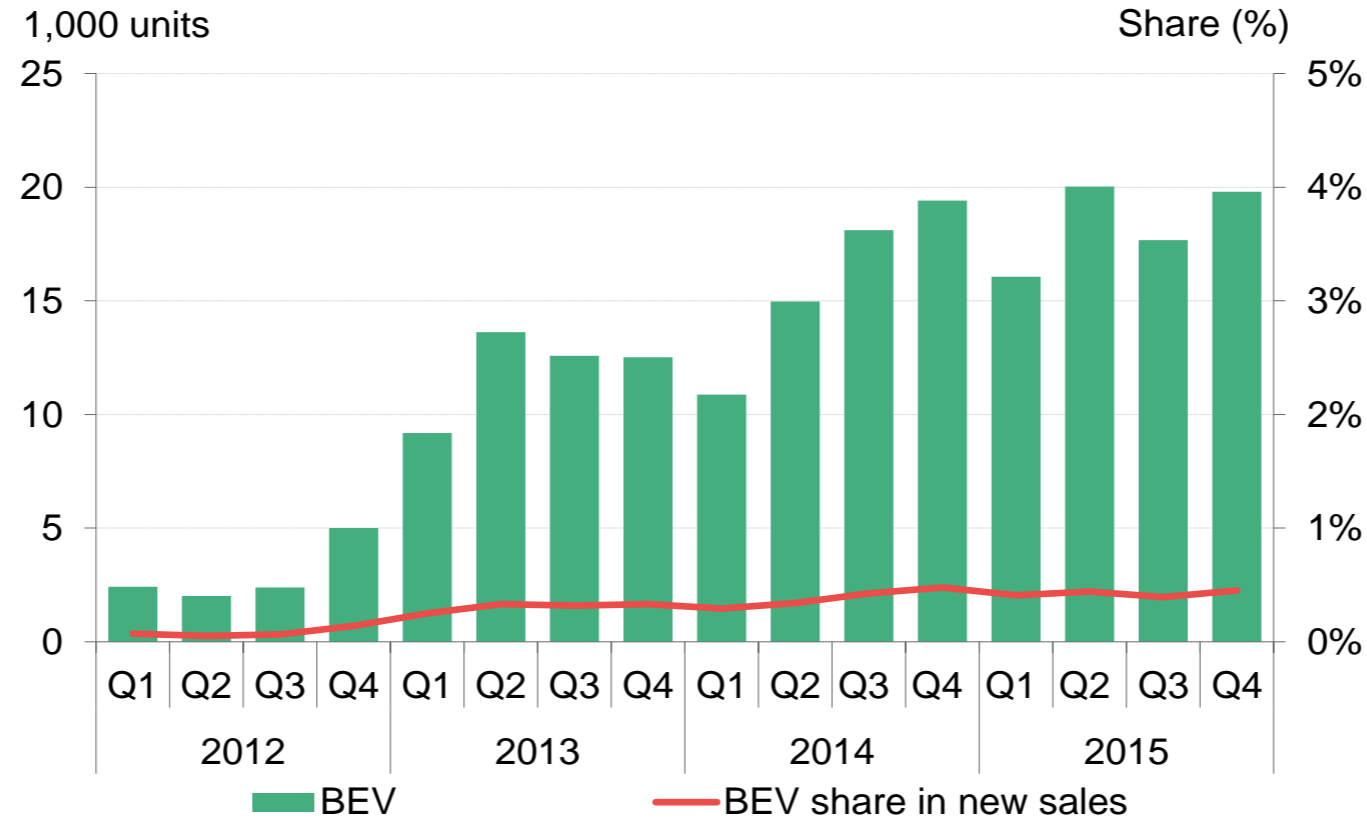
Notes: Analysis is based on daily averages of 'total gasoline all sales / deliveries by prime supplier'. Values for 2015 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2015).

Source: UMTRI, Bloomberg New Energy Finance

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



- PHEV sales collapsed 24%, and HEV sales declined 16% in 2015



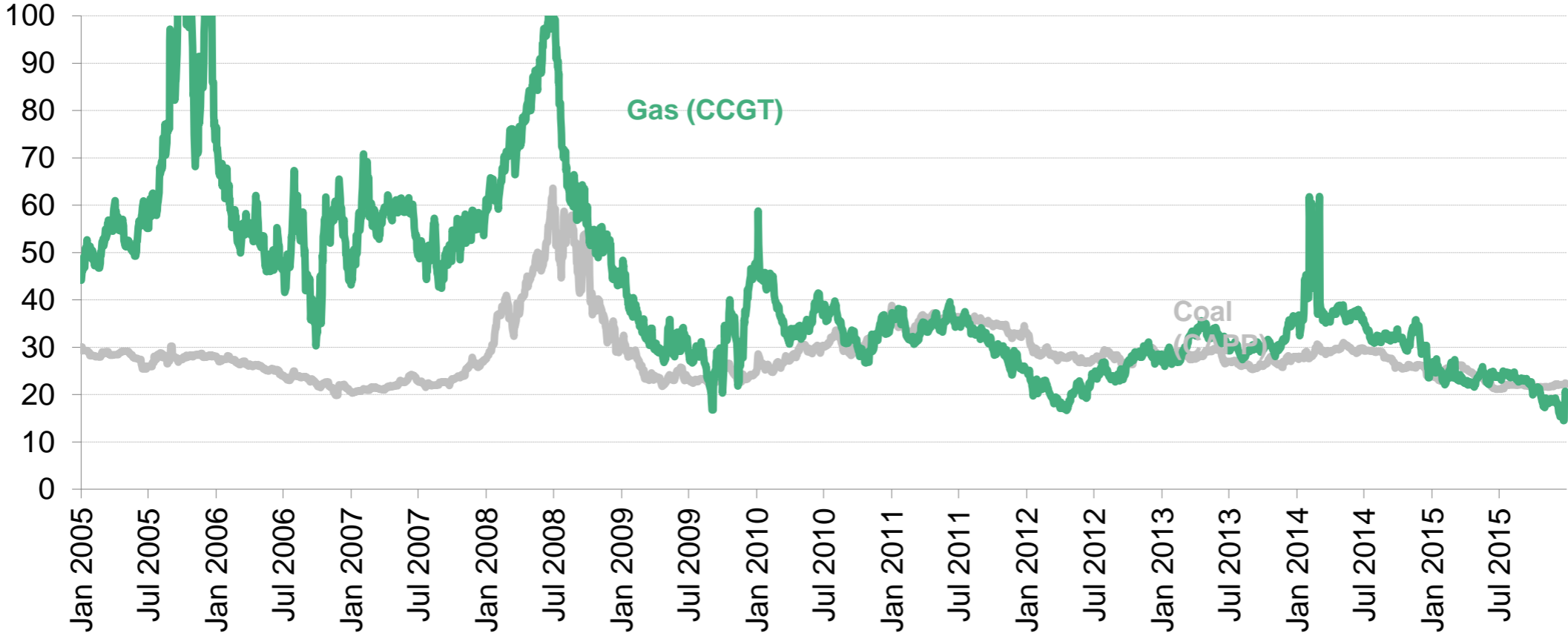
- BEV sales were resilient, climbing 16% in 2015



AN ERA OF LOW PRICES

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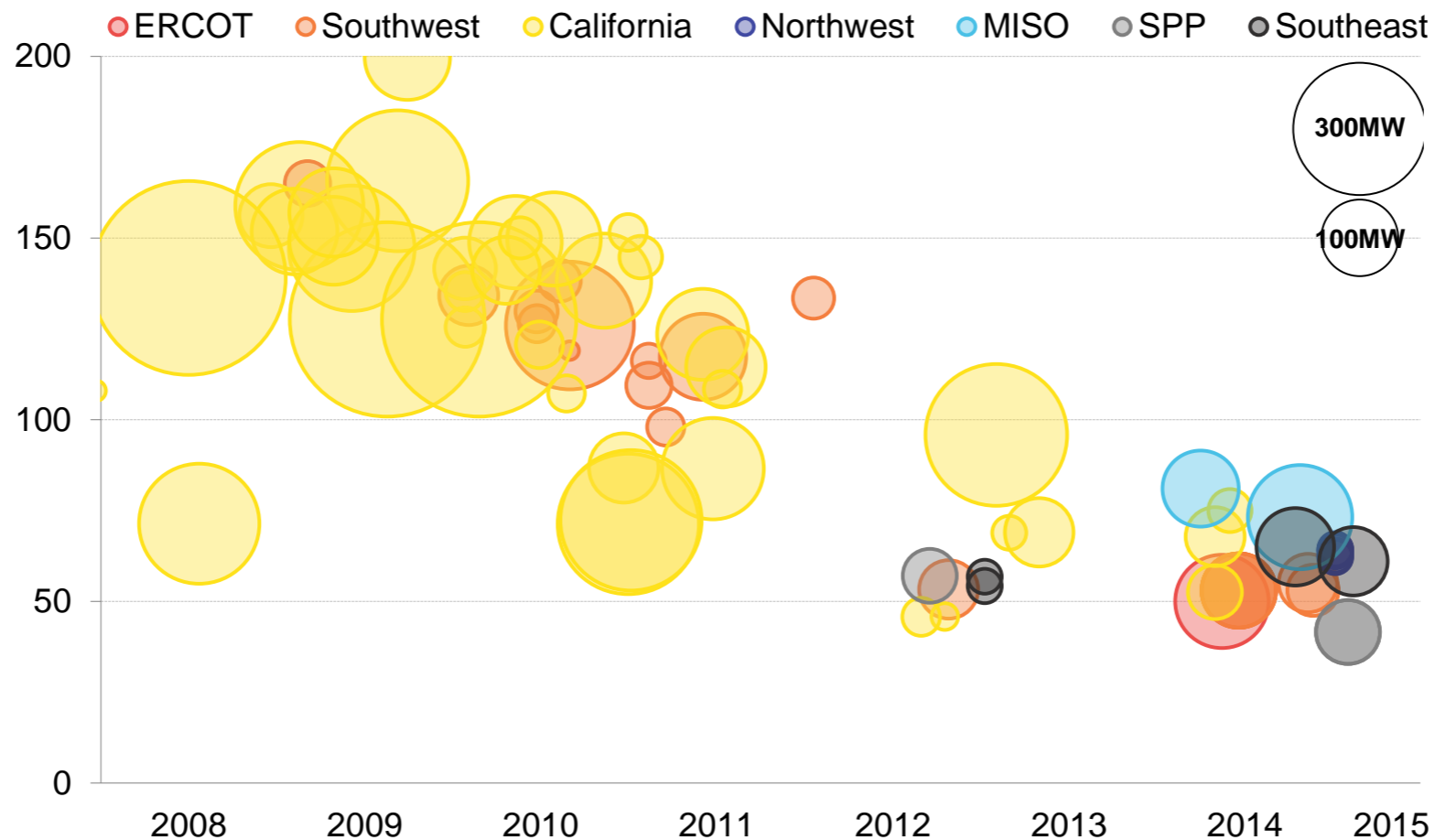
Economics: Cost of generating electricity in the US from natural gas vs coal (\$/MWh)



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)



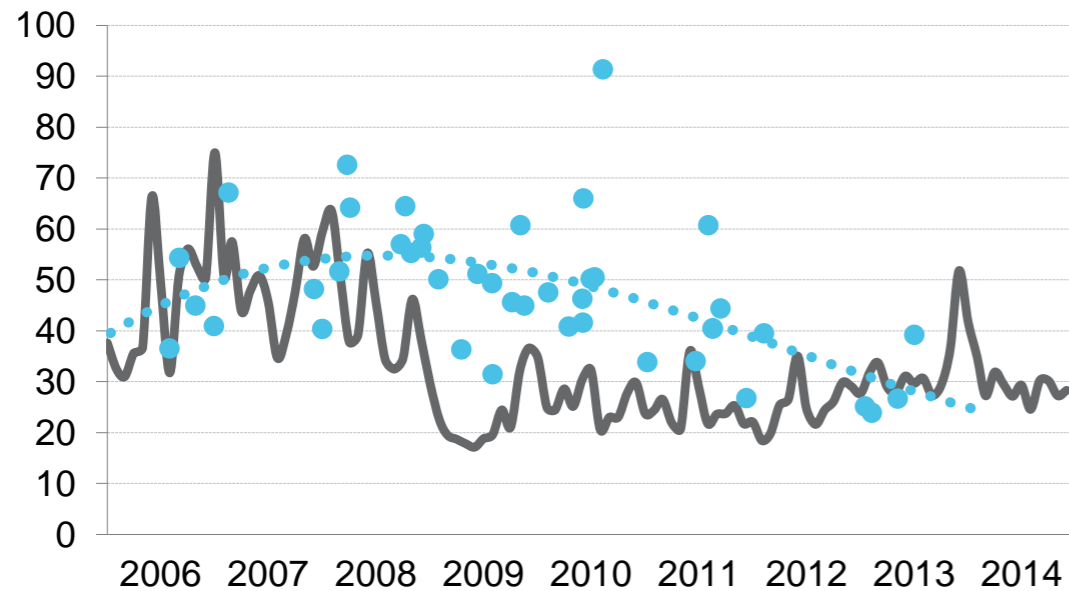
- Prices for long-term contracts for utility-scale PV continue to decline, reaching \$40-60/MWh range

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

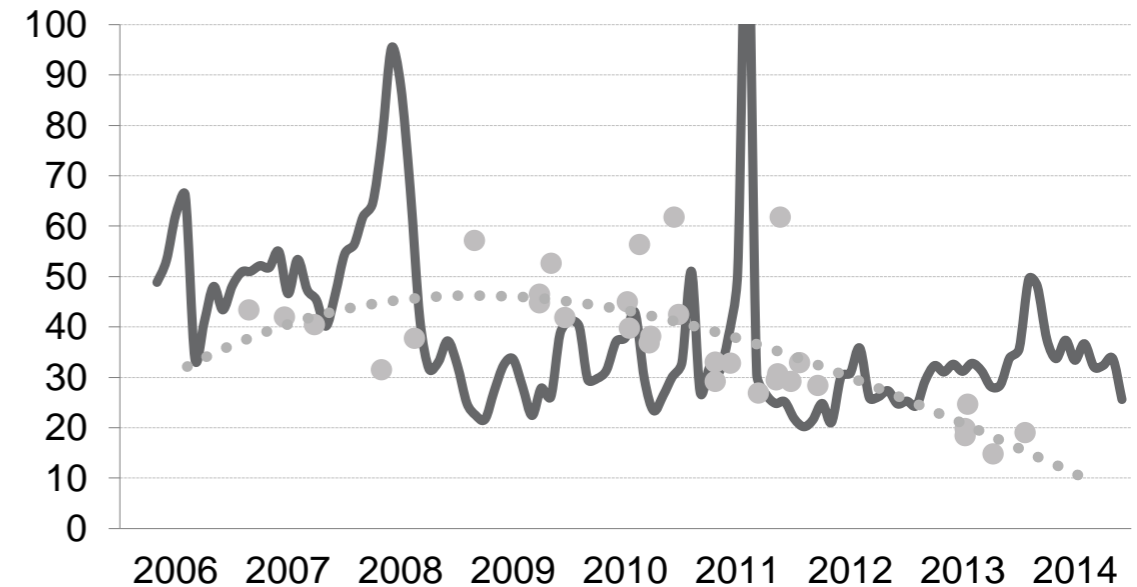
Notes: Does not include PPAs under 5MW. 'PPA price' is calculated as the average offtake price over the period of project operation.

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

MISO



SPP



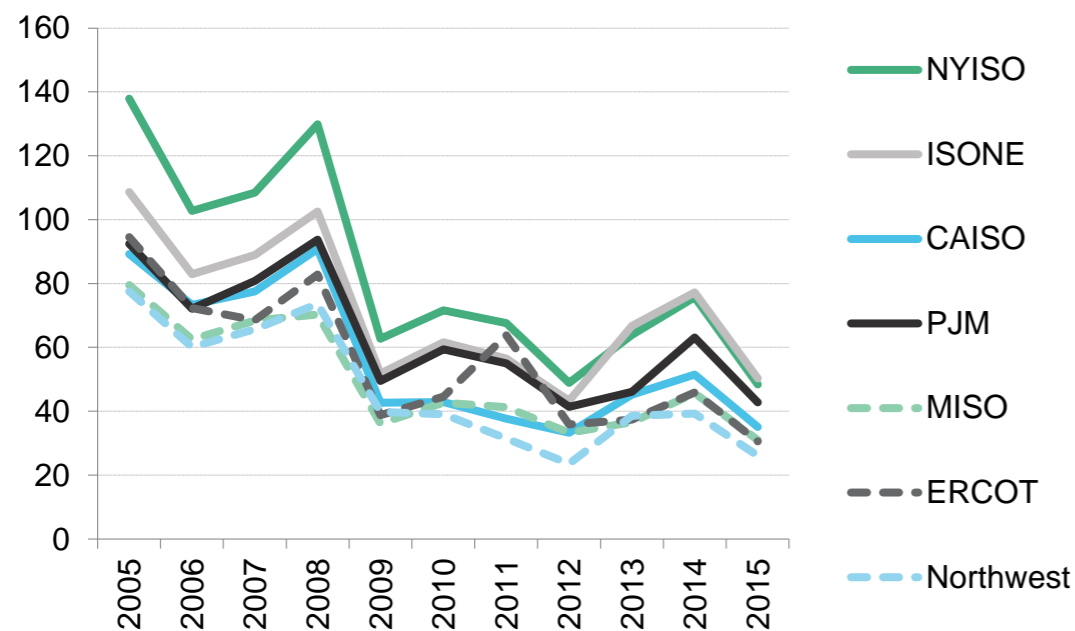
- Prices for long-term contracts for wind are also falling, and are below wholesale power prices in some regions of the country

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

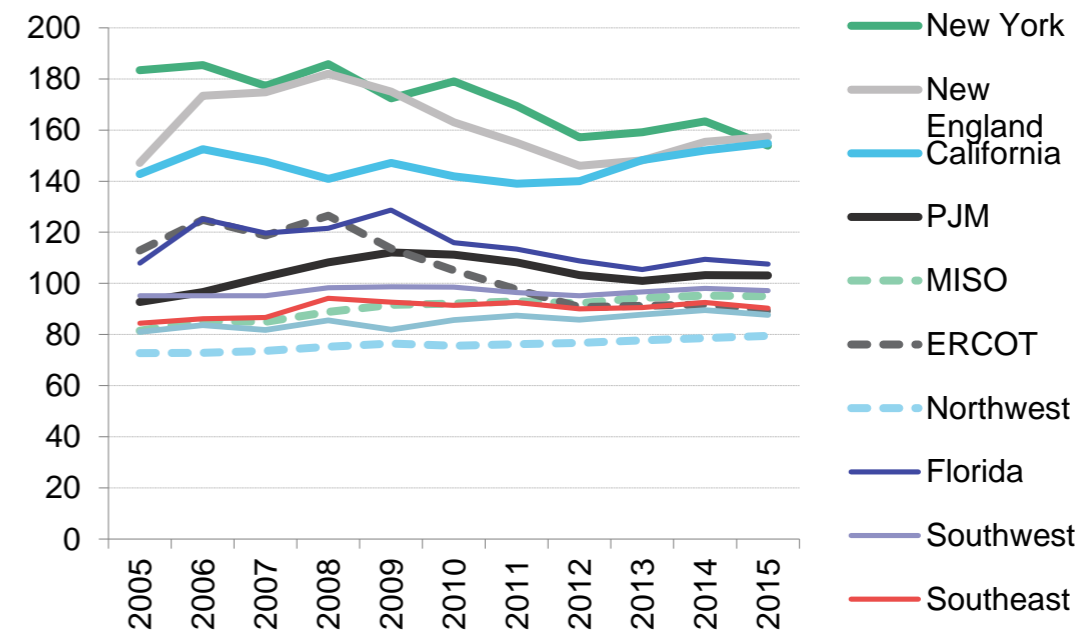
Notes: Does not include PPAs under 5MW. 'PPA price' is calculated as the average offtake price over the period of project operation.

US energy overview: Retail and wholesale power prices

Wholesale power prices (\$/MWh)



Average retail power prices (\$/MWh)



- 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.

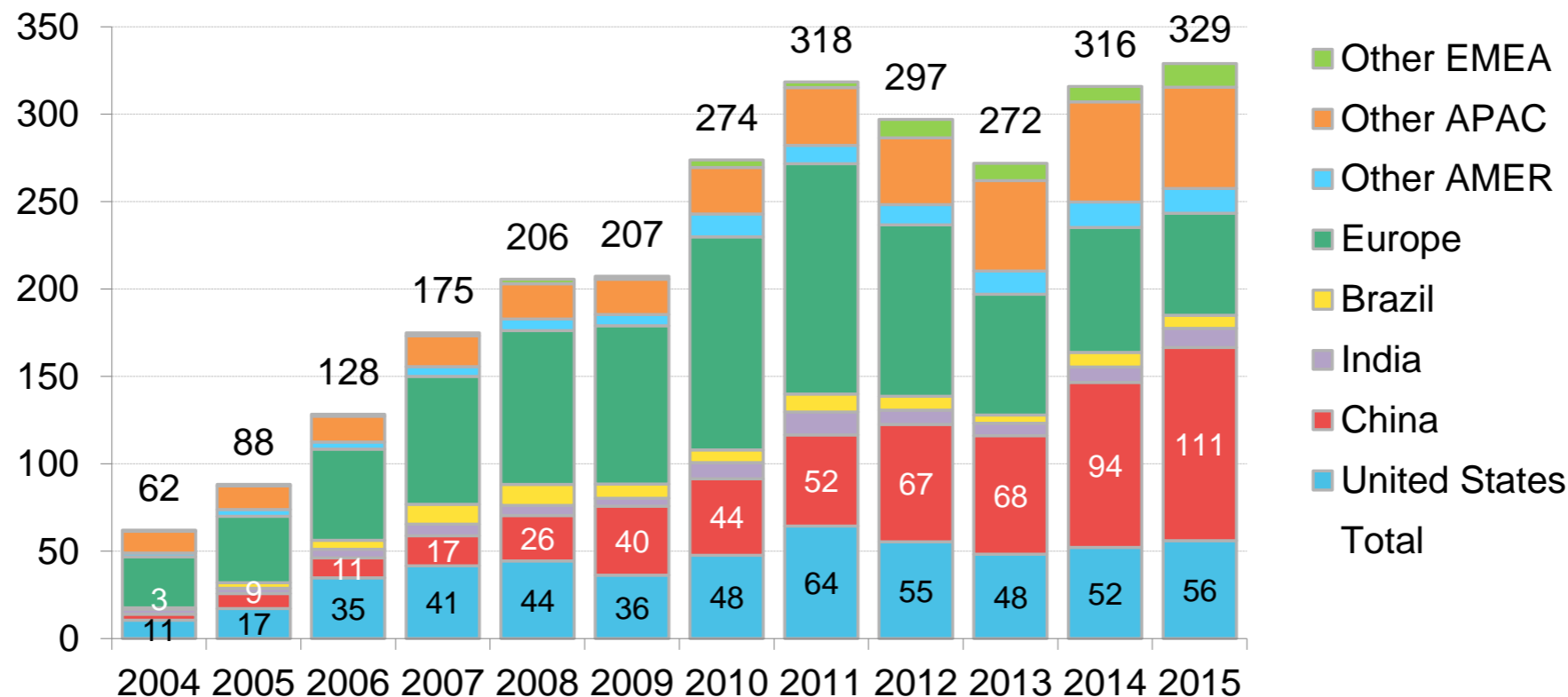
Source: Bloomberg New Energy Finance, EIA, Bloomberg Terminal Notes: Data through end-November 2015. Wholesale prices taken from proxy power hubs in each ISO. Prices are in real 2014 dollars.



OUTLOOK

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



- Clean energy investment climbed 8% in the US in 2015.
- The US currently makes up 17% of global investment in clean energy.

Source: Bloomberg New Energy Finance

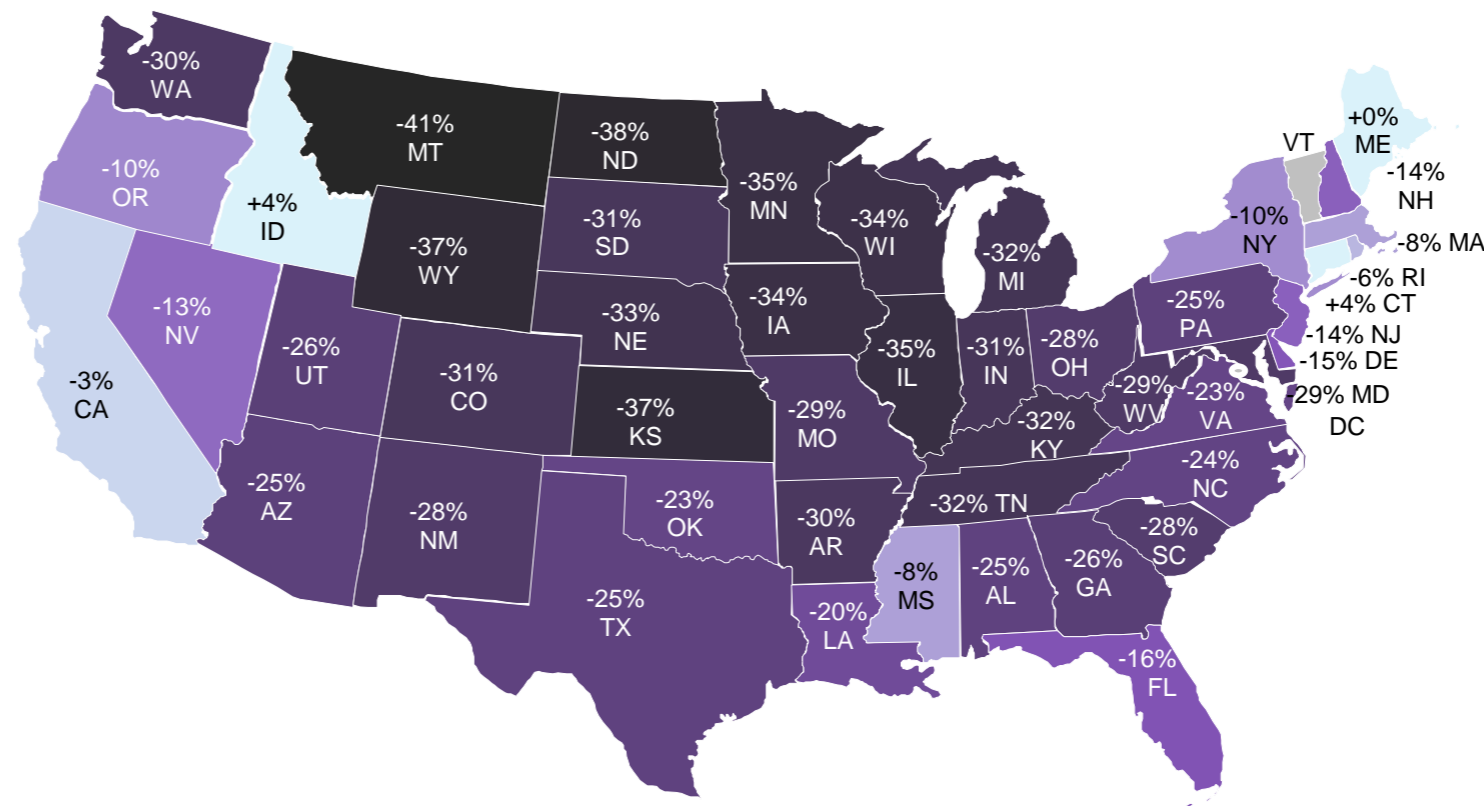
Notes: For definition of clean energy, see slide in Section 2.2 of this report titled 'Finance: US clean energy investment (1 of 2) – total new investment, all asset classes (\$bn)'. AMER is Americas; APAC is Asia-Pacific; EMEA is Europe, Middle East, and Africa.

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

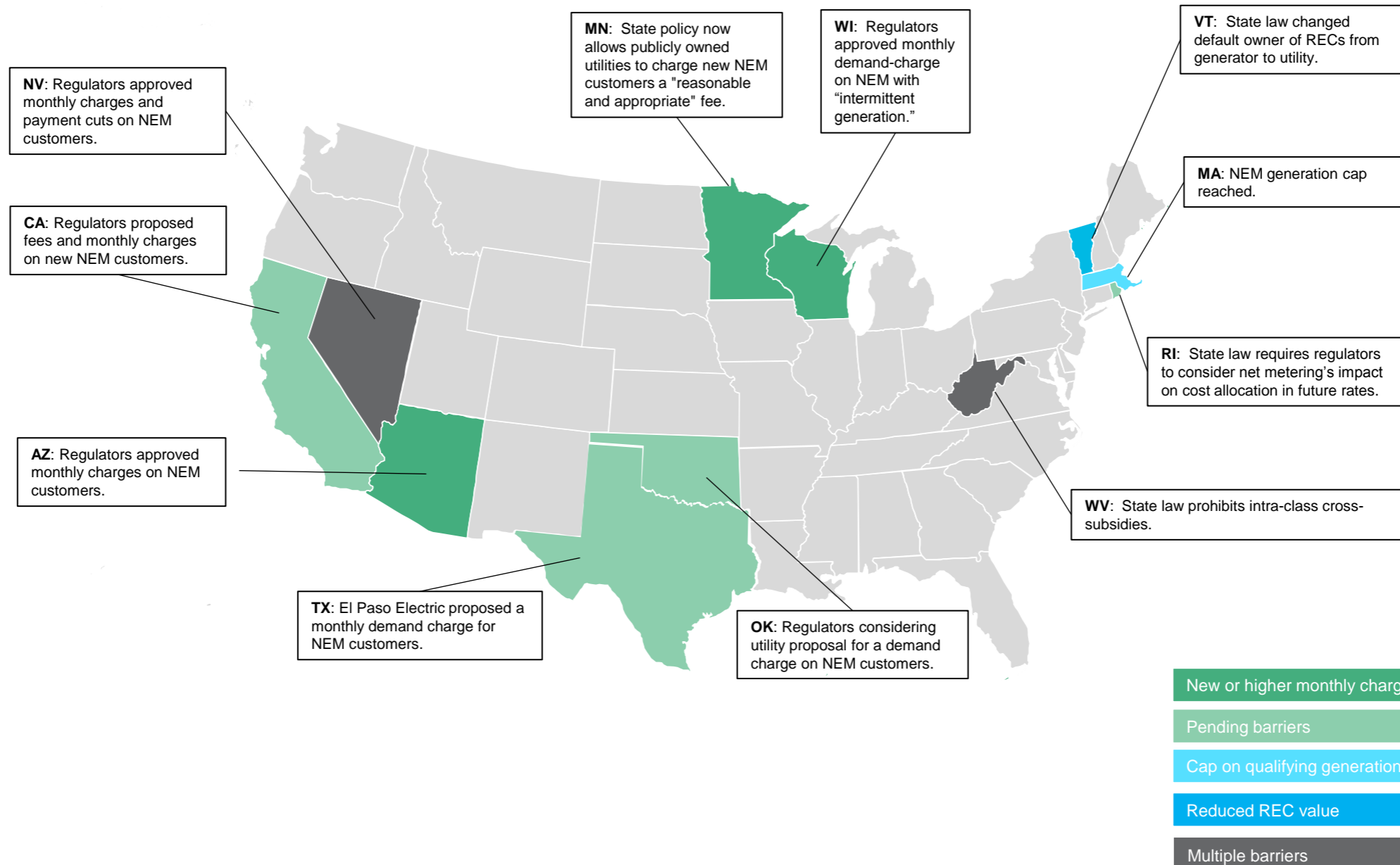


- EPA finalized the Clean Power Plan (CPP) in August 2015
- The Plan could cut power-sector emissions 32% from 2005 levels by 2030.

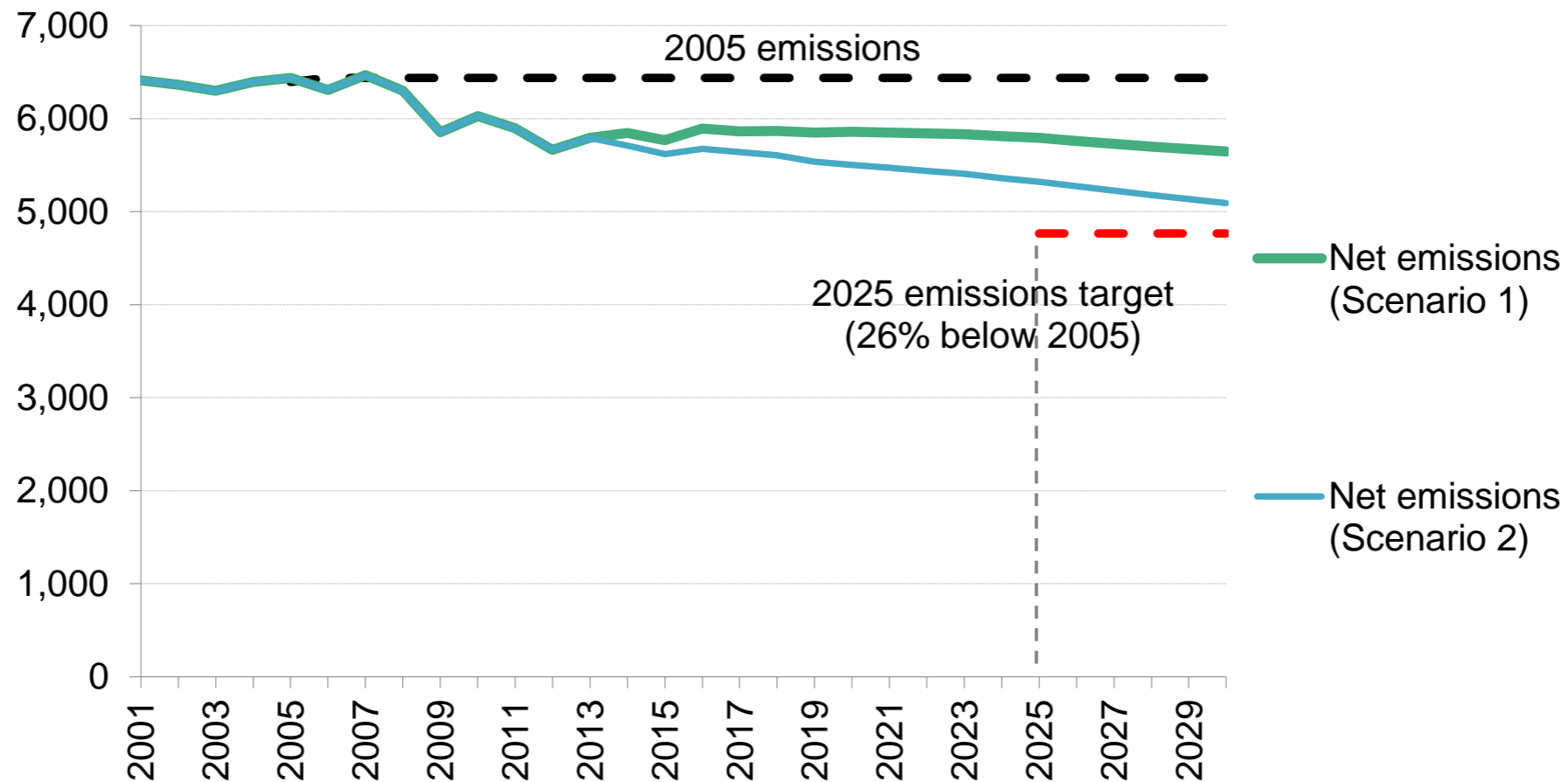
Source: Bloomberg New Energy Finance, based on analysis of EPA Clean Power Plan

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



Policy: US emissions pledge in Paris



- The US pledge in Paris was to reduce emissions to 26-28% below 2005 levels by 2025.
- 2013 emissions were 10% below 2005 levels.

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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