



# Natural Gas & CHP:

## *State of the Market & Implications for the Future*

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# Who We Are

“The Alliance for Industrial Efficiency is a coalition of business, labor and environmental organizations that are committed to encouraging the use of CHP and WHP to enhance U.S. manufacturing competitiveness, increase energy efficiency, and improve the environment.”

Visit us at [alliance4industrialefficiency.org](http://alliance4industrialefficiency.org)

Follow us on twitter at [@AllianceIndEff](https://twitter.com/AllianceIndEff)



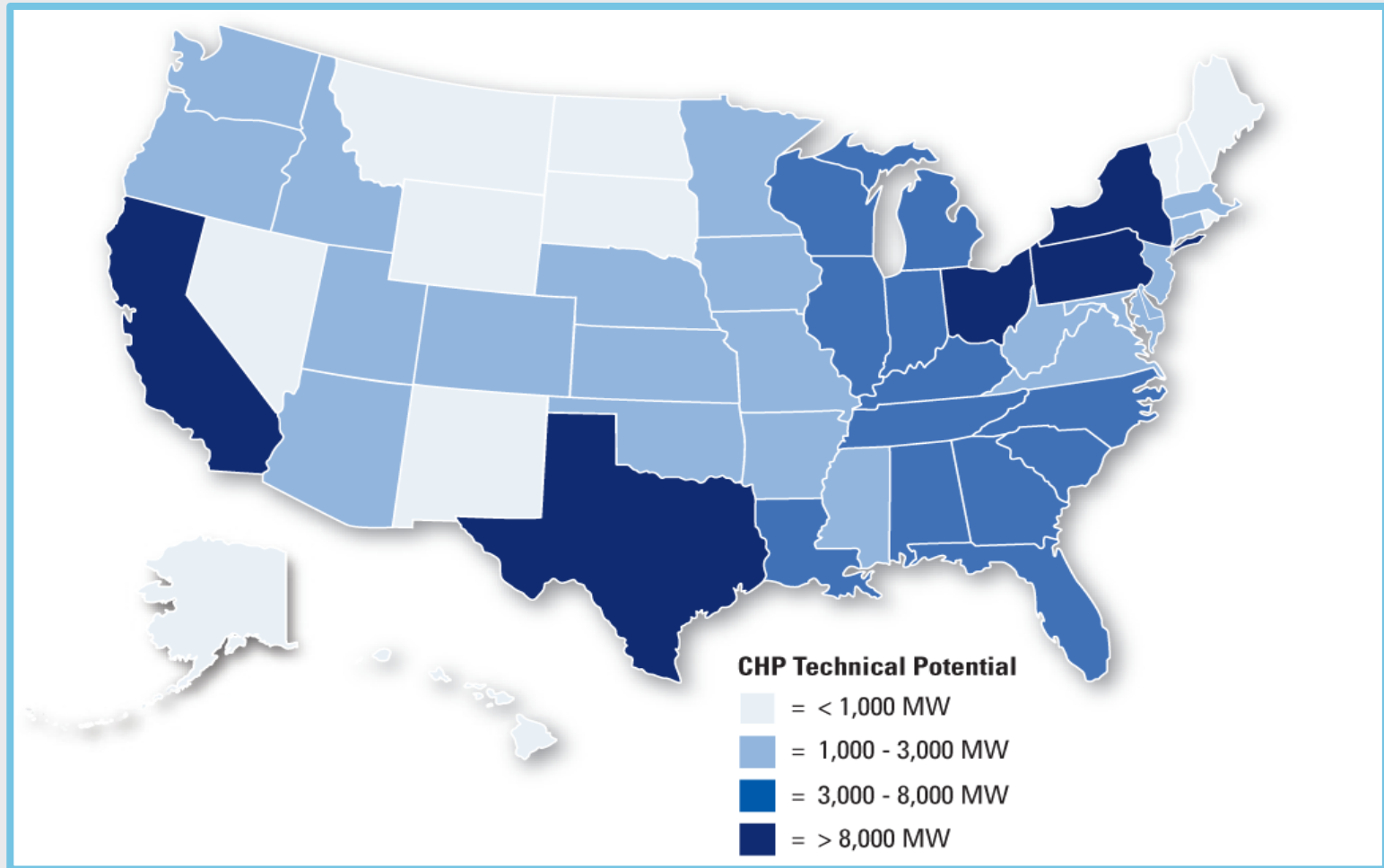
# Current CHP Projects



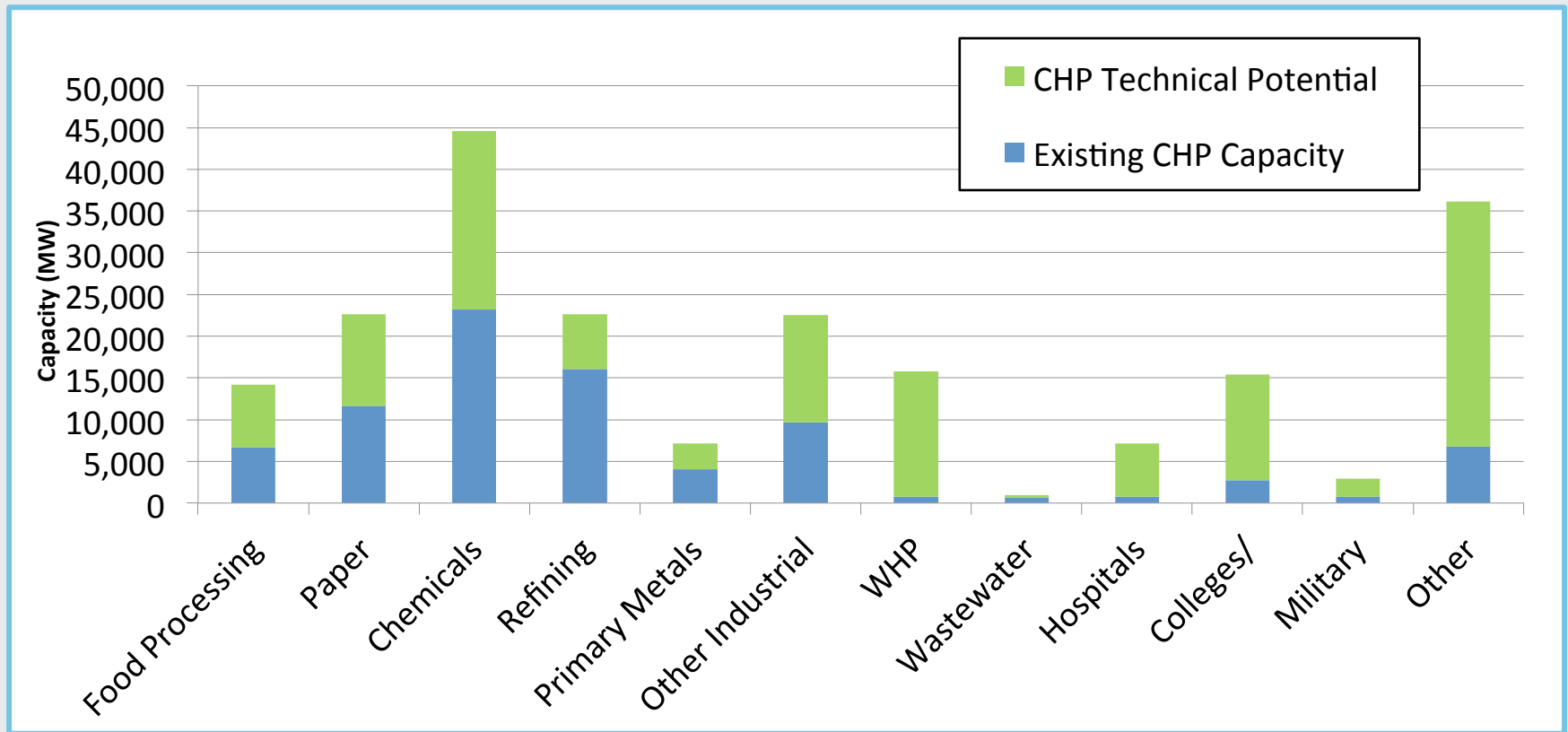
Source: CHP Installation Database, March 2014

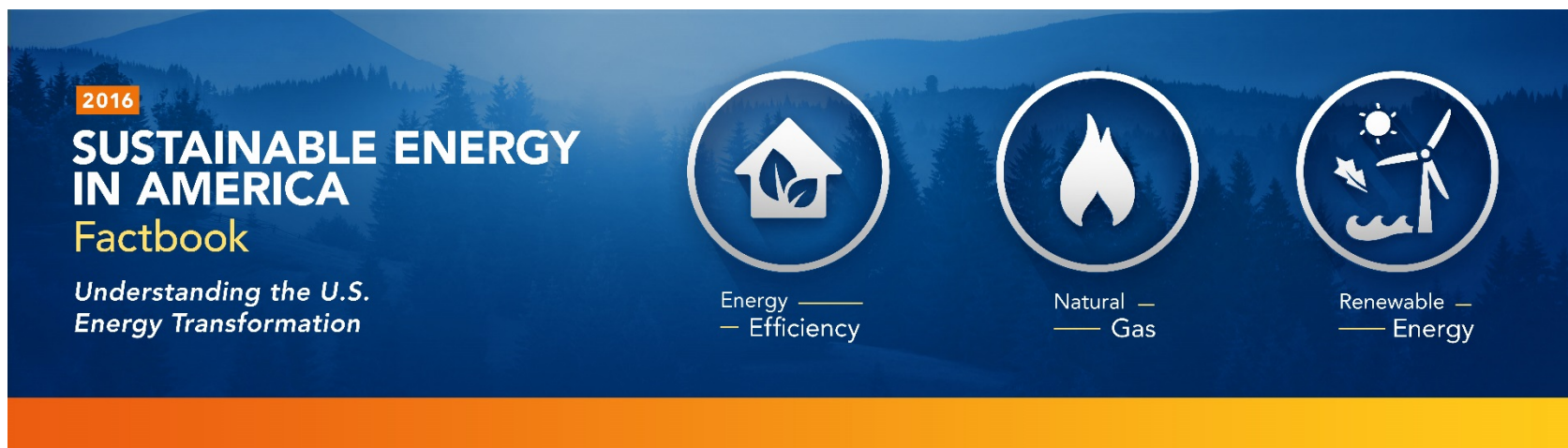


# CHP Technical Potential



# Remaining Potential for CHP





## Natural Gas and CHP: State of the Market and Implications for the Future

*March 9, 2016*

GET THE FACTS: <http://www.bcse.org/sustainableenergyfactbook>

#Factbook

# About the BCSE

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- The Business Council for Sustainable Energy (BCSE) is a coalition of companies and trade associations from the energy efficiency, natural gas and renewable energy sectors.
  - The Council advocates for policies at state, national and international levels that:
    - increase the use of commercially-available clean energy technologies, products and services
    - support an affordable, reliable power system
    - reduce air pollution & greenhouse gas emissions
-

# 2016 BCSE Members





# Clean Energy Coast to Coast

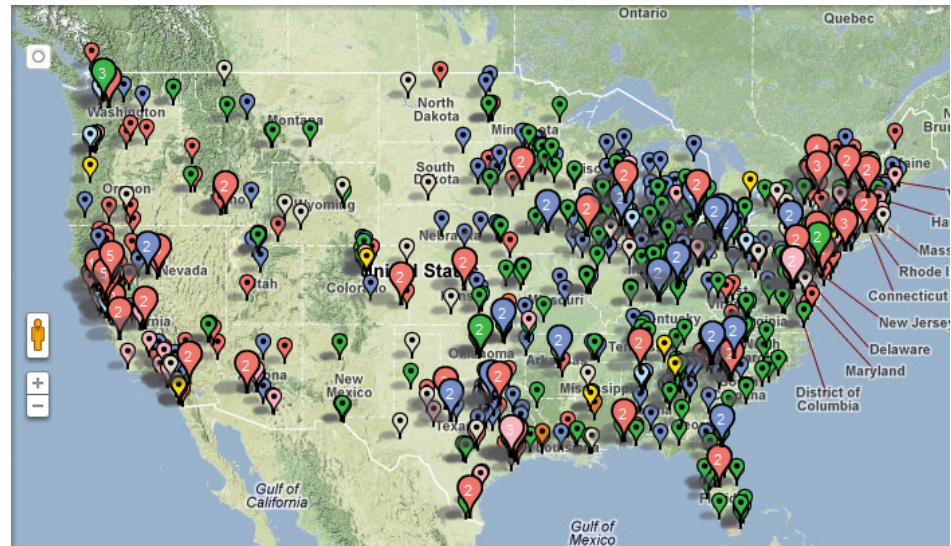


## U.S. Clean Energy Jobs from Coast to Coast

The Council's members are strengthening America's energy future and creating American jobs in every state of the country.



Visit [www.bcse.org](http://www.bcse.org) to  explore the interactive map.



2016

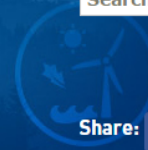
# SUSTAINABLE ENERGY IN AMERICA

Factbook

Understanding the U.S. Energy Transformation

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It is a new era for American energy. In 2015, increased use of sustainable energy set the stage for a U.S. triple play of carbon reductions, cost savings and economic growth.

The 2016 edition of the Sustainable Energy in America Factbook – produced for the Business Council for Sustainable Energy by Bloomberg New Energy Finance, provides up-to-date, accurate market information about the broad range of industries – energy efficiency, renewable energy and natural gas – that are contributing to the country’s move towards cleaner energy production and more efficient energy usage.

## THE SUSTAINABLE ENERGY TRANSFORMATION



Get the **2016** Factbook



See State Spotlight

Browse the Brochure →



Watch the Video →



View the Slideshow →



## Infographic



## Get the Facts

- American energy productivity has increased by 13% from 2007 to 2015.
- 2015 was a record year for natural gas production, consumption, flows to power generation and volumes into storage.
- Renewable energy is a prominent part (20%) of the U.S. 2015 capacity mix, with 221GW installed across the country, a 57% increase over 2008 levels.
- Total U.S. investment in clean energy topped \$56 billion in 2015, the second highest level in the world.
- 2015 U.S. power sector carbon emissions fell to their lowest annual level since 1995.

## Executive Summary



### Industry Focus:

Energy Efficiency  
Natural Gas  
Renewable Energy

### Quick Facts On:

Alternative Fuel Vehicles  
Biomass/ Waste-to-Energy  
Carbon Capture & Storage

Combined Heat & Power  
Fuel Cells  
Hydropower

## State Spotlight

Learn about clean energy in the following states:

- [Minnesota](#)
- [Nevada](#)
- [Pennsylvania](#)
- [Virginia](#)
- [See 2016 Factbook State & Regional Slides](#)

## Previous Factbook Editions

Download previous editions of the Factbook here.

2013



2014



2015



## About the Factbook Partners

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 The Business Council for  
**Sustainable Energy**

**Bloomberg New Energy Finance (BNEF)** provides unique analysis, tools and data for decision makers driving change in the energy system. With unrivalled depth and breadth, BNEF helps clients stay on top of developments across the energy spectrum from our comprehensive web-based platform. BNEF has 200 staff based in London, New York, Beijing, Cape Town, Hong Kong, Munich, New Delhi, San Francisco, São Paulo, Singapore, Sydney, Tokyo, Washington D.C., and Zurich.

**The Business Council for Sustainable Energy (BCSE)** is a coalition of companies and trade associations from the energy efficiency, natural gas and renewable energy sectors. The Council membership also includes independent electric power producers, investor-owned utilities, public power, commercial end-users and project developers and service providers for energy and environmental markets.

2016

# SUSTAINABLE ENERGY IN AMERICA

## Factbook

The Business Council for  
 **Sustainable Energy**<sup>®</sup>

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## About the Factbook (1 of 2): What is it and what's new

### 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<sup>(1)</sup> 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>

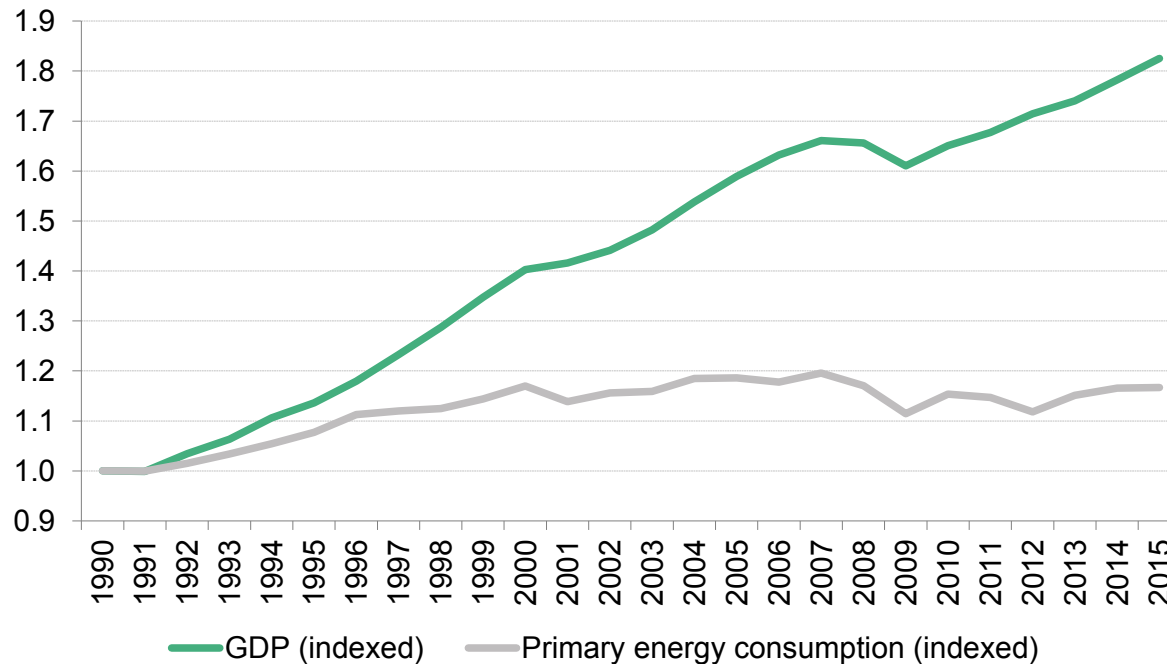


**2015: A YEAR OF  
MILESTONES**

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NEW ENERGY FINANCE

## US energy overview:

# Economy's energy productivity: GDP and primary energy consumption (indexed to 1990 levels)

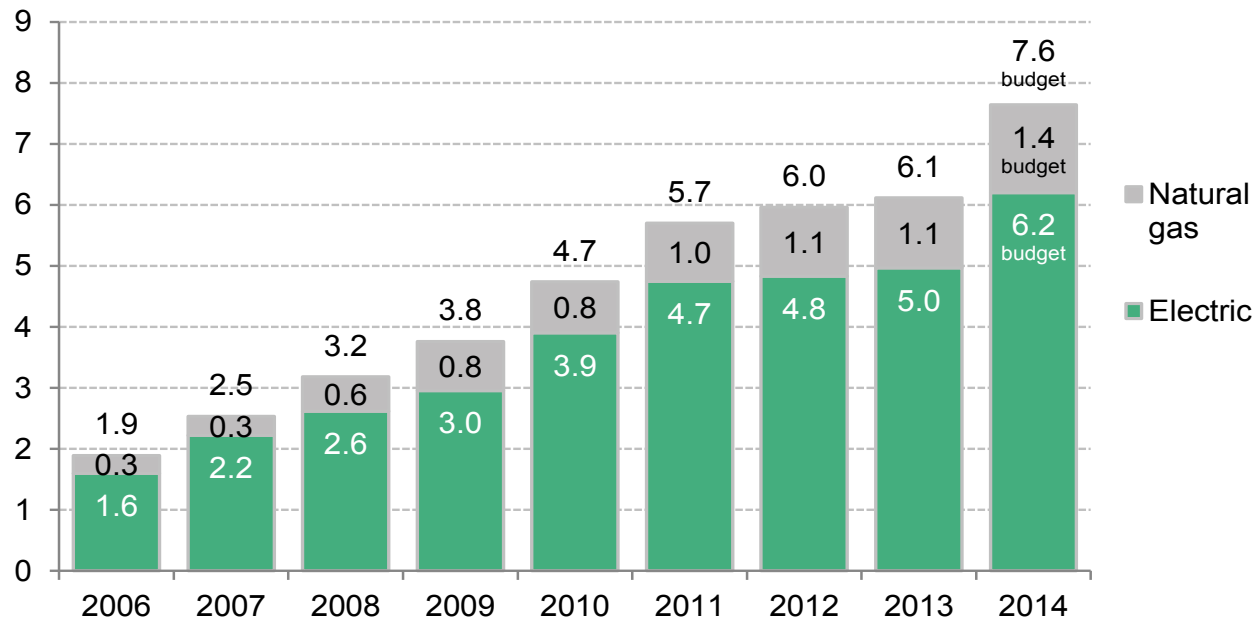


- The US economy is increasingly energy productive, resulting in a decoupling between growth in GDP and growth in energy consumption. As US GDP expanded 83% over the last 25 years, energy consumption only ticked up 17%.
- By one measure (US GDP per unit of energy consumed), productivity has improved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

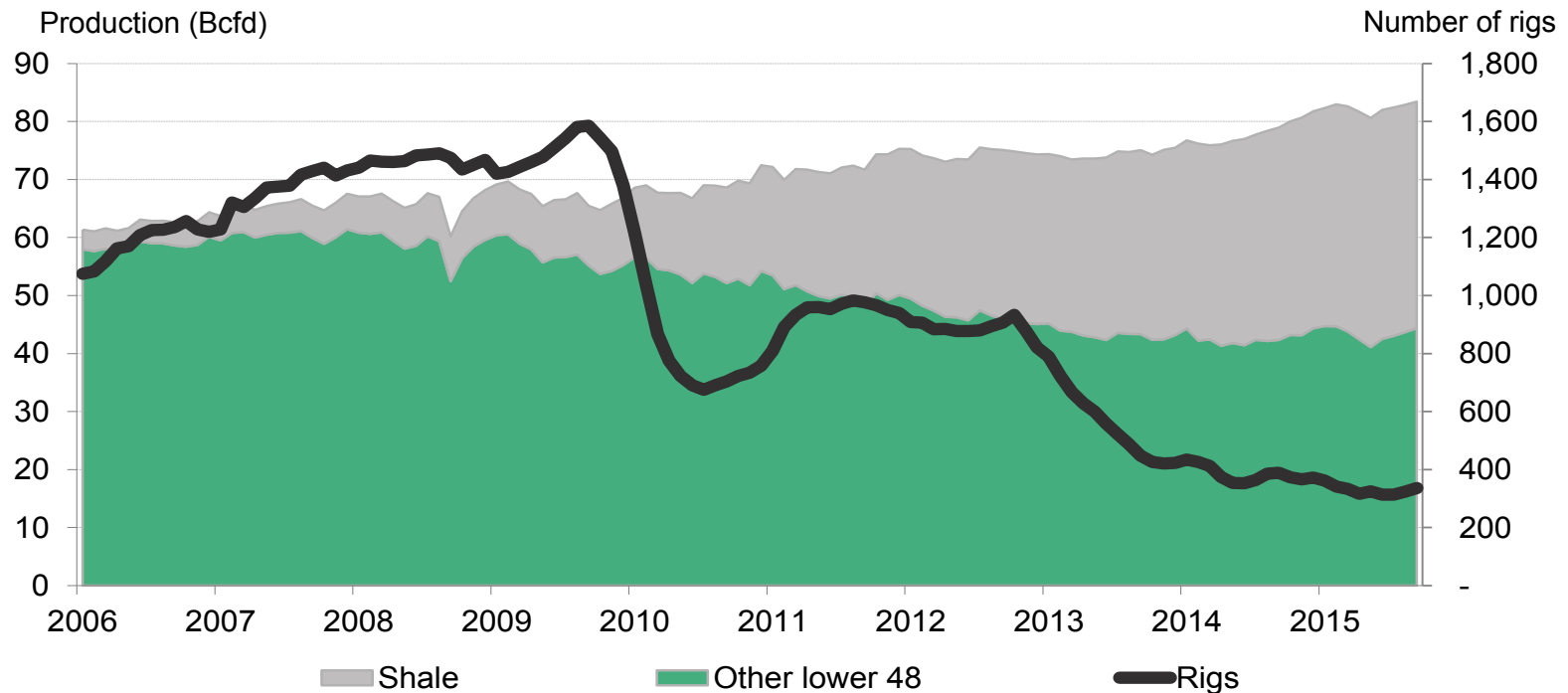
# Financing: US utility energy efficiency spending and budgets (\$bn)



- 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.



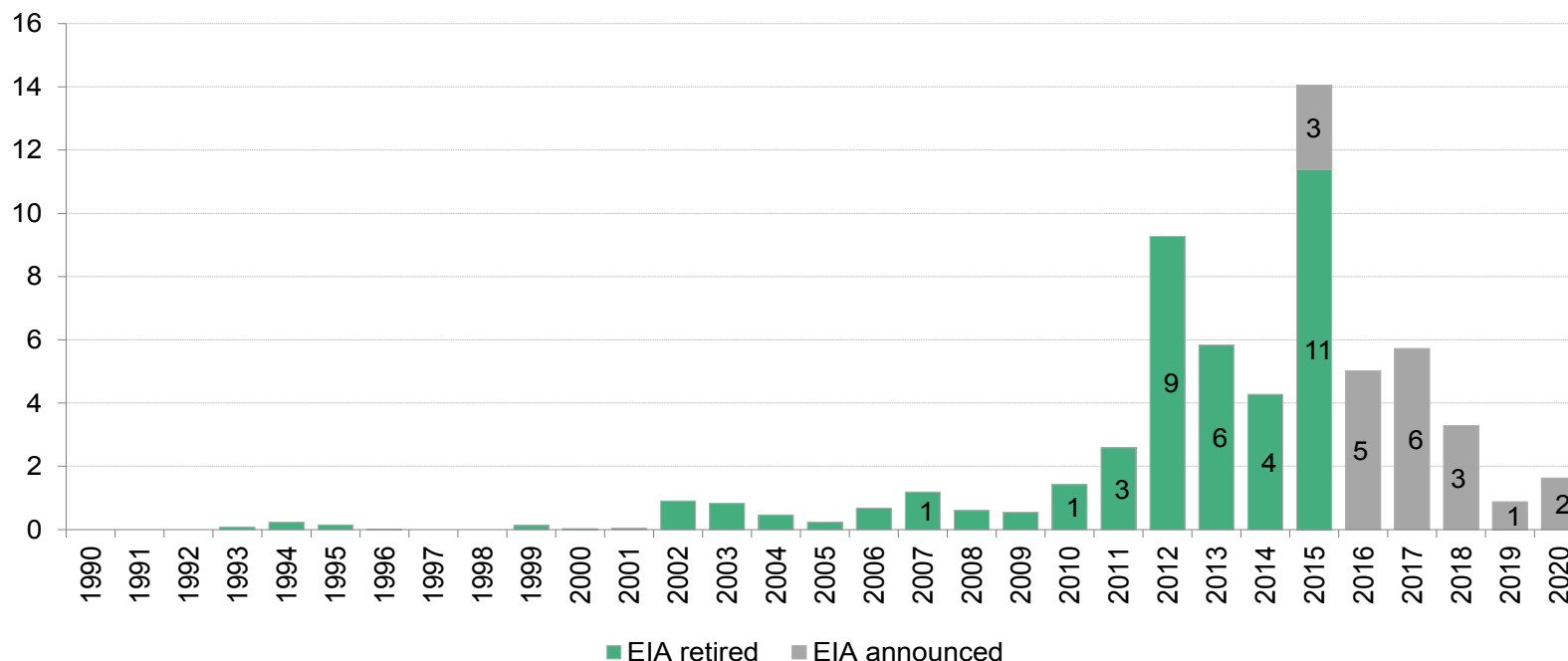
# Deployment: US natural gas production and gas-directed rig count (Bcfd, rigs)



- 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

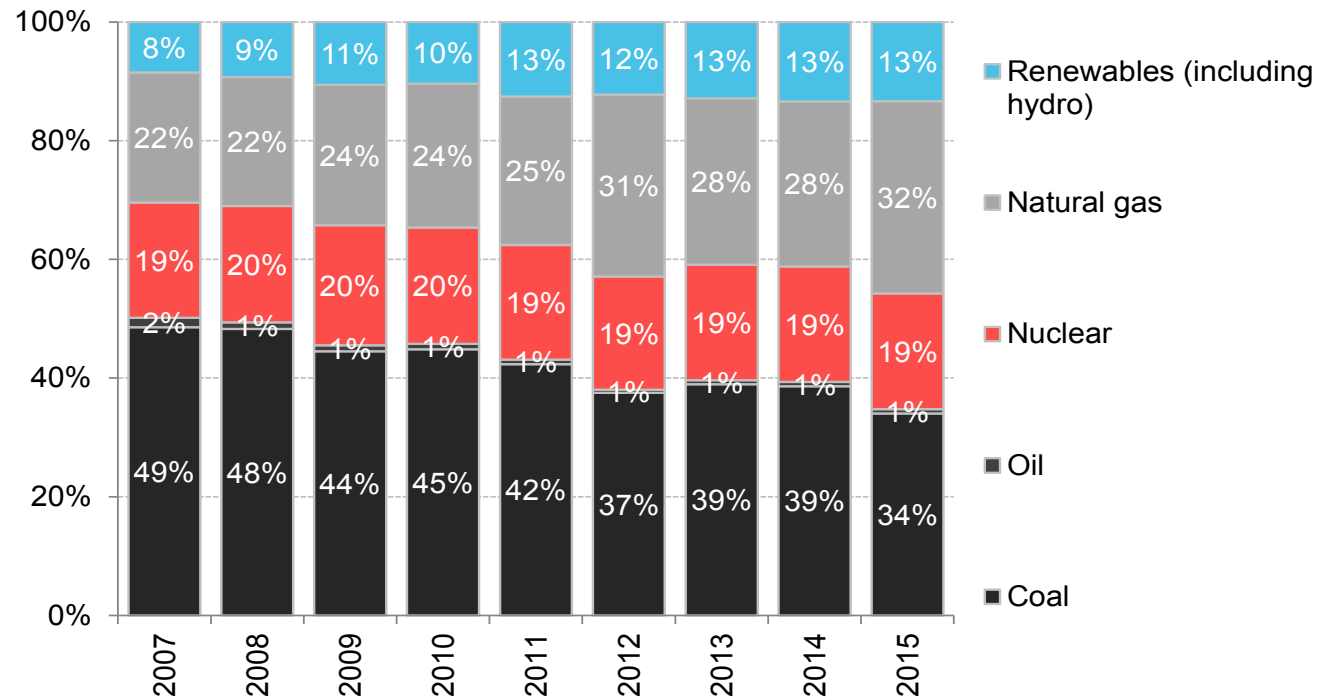
Notes: "Retirements" does not include conversions from coal to natural gas or biomass; retirement numbers through end-October 2015.



**US ENERGY IN  
TRANSITION**

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



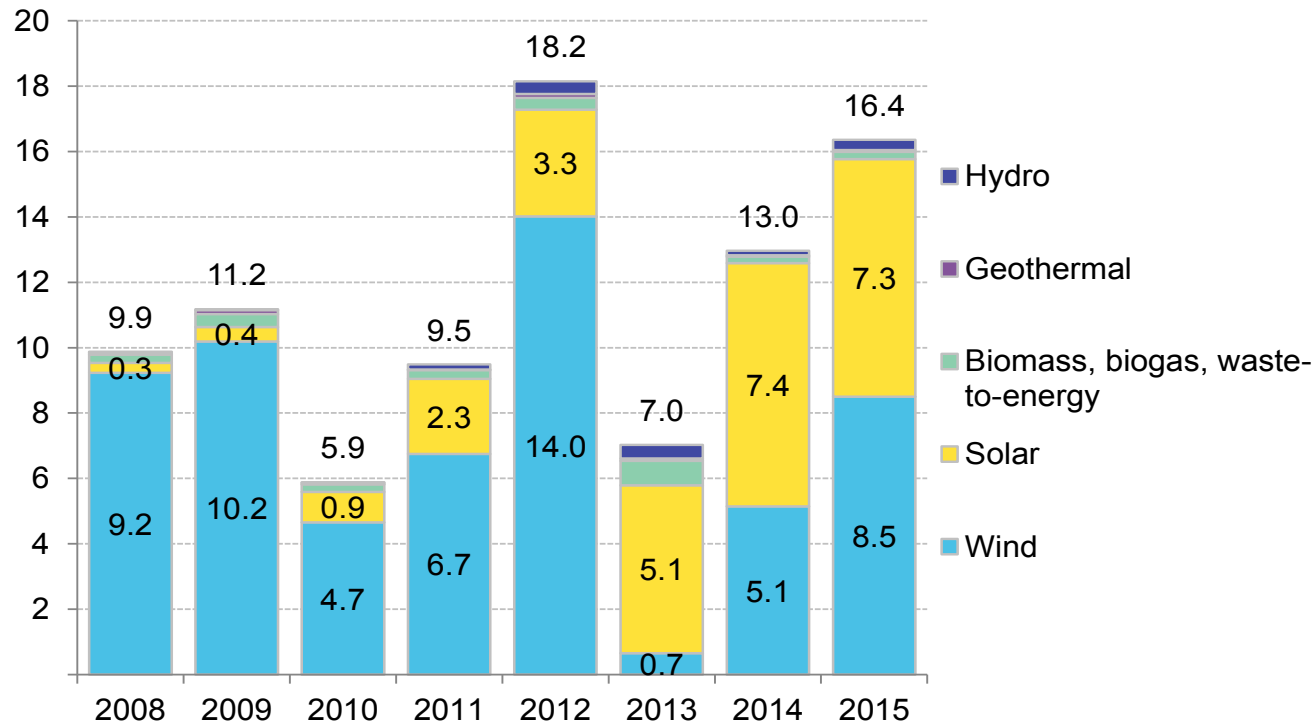
- Generation from natural gas plants increased by 17% from 2014 to 2015, while coal generation fell by 11%.
- The US power sector is gradually decarbonizing. From 2007 to 2015, natural gas increased from 22% to 32% of electricity generation, and renewables climbed from 8% to 13%. Coal's share slipped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

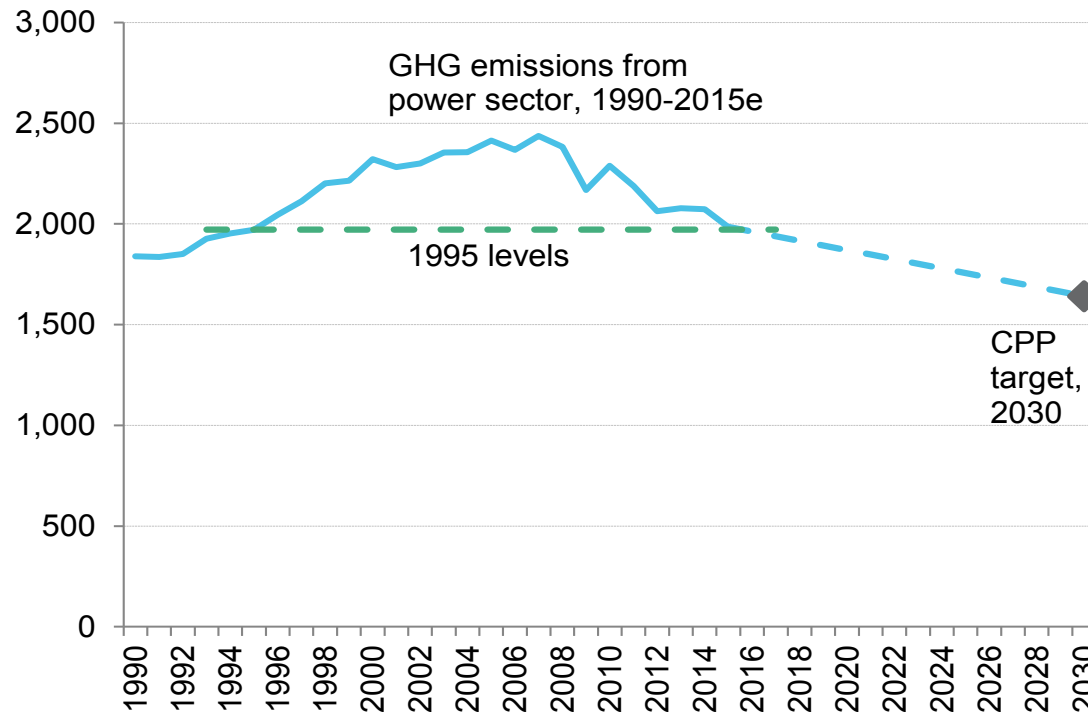
# Renewable energy capacity build by technology (GW)



- 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.

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: Greenhouse gas emissions from the power sector (MtCO<sub>2</sub>e)



- 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).

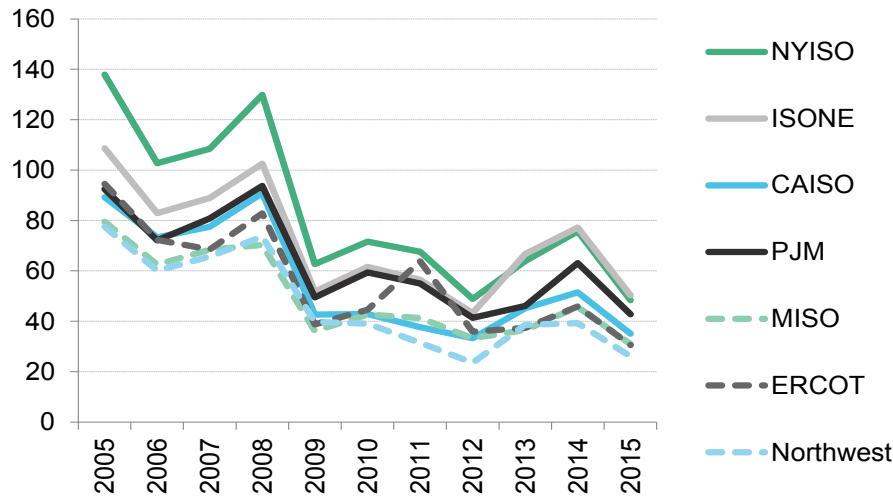


**AN ERA OF LOW PRICES**

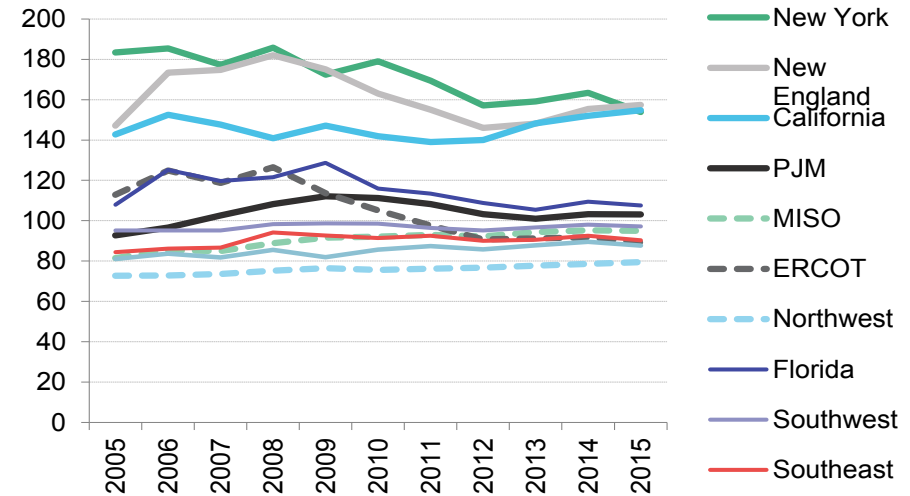
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# US energy overview: Retail and wholesale power prices

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).

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.

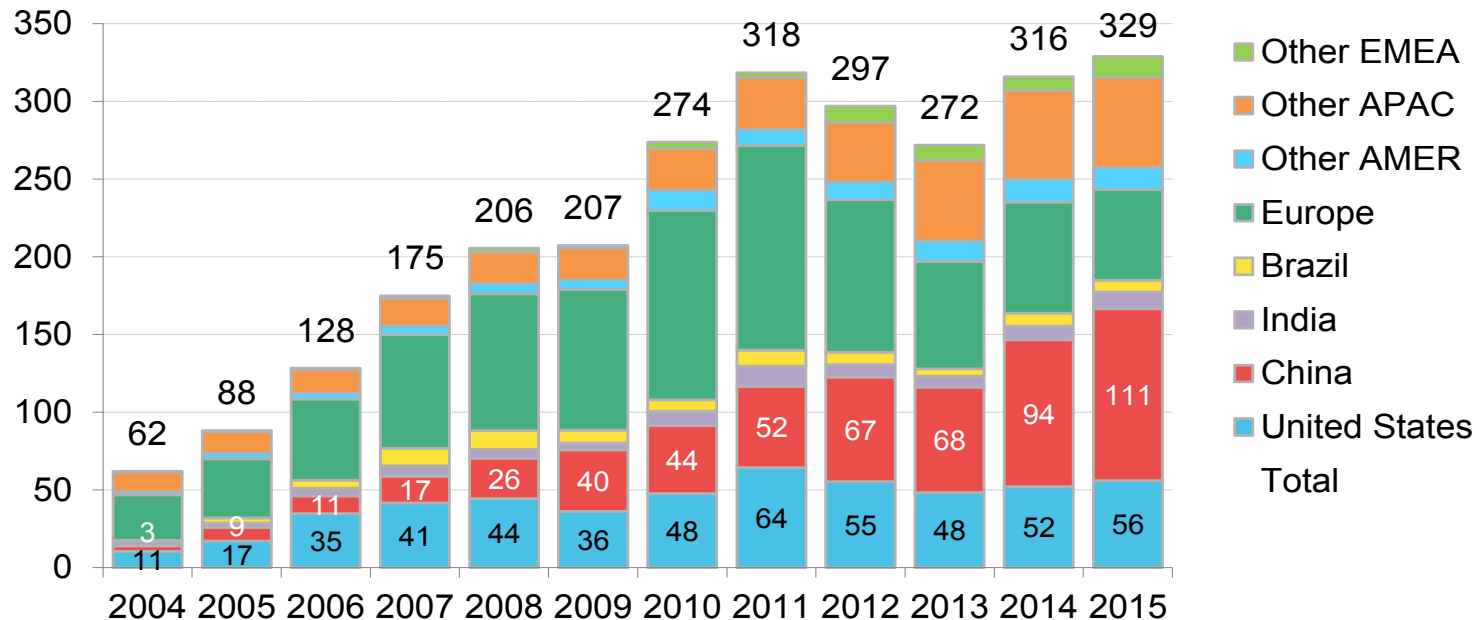




# OUTLOOK

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



- 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.

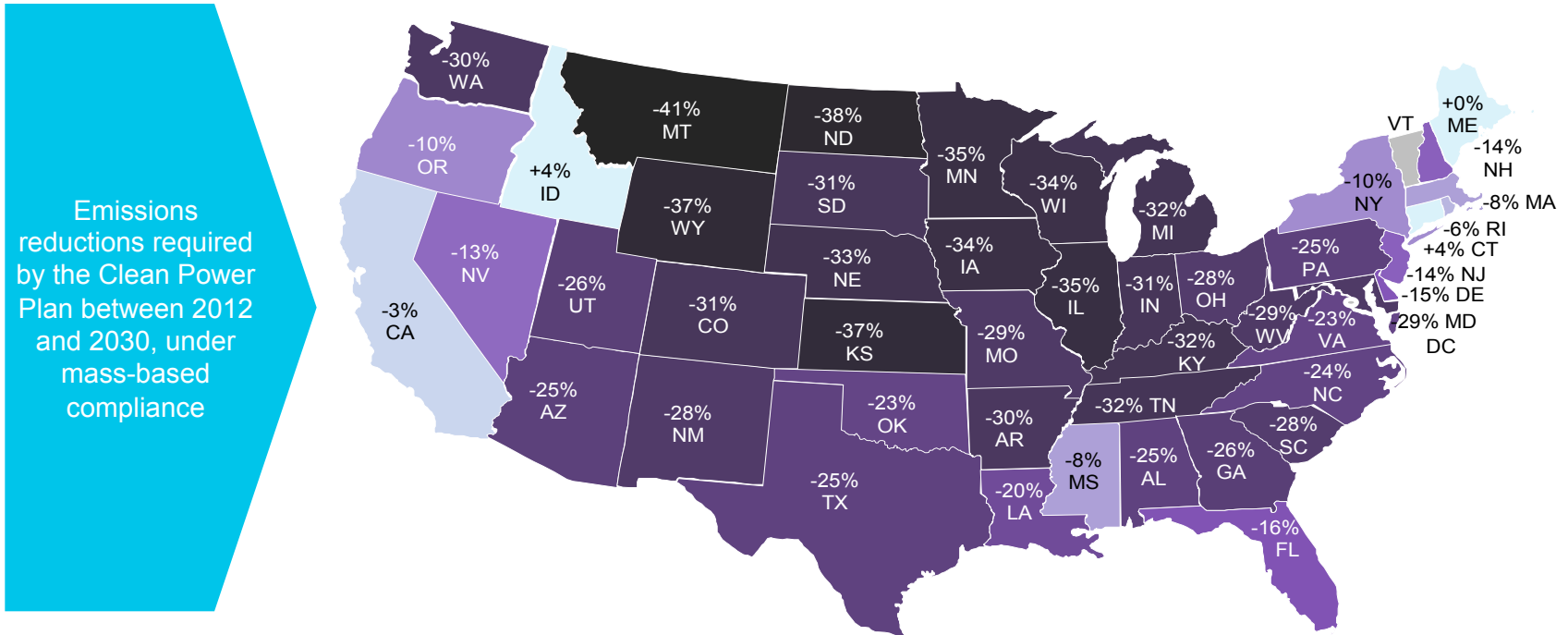
Source: Bloomberg New Energy Finance

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

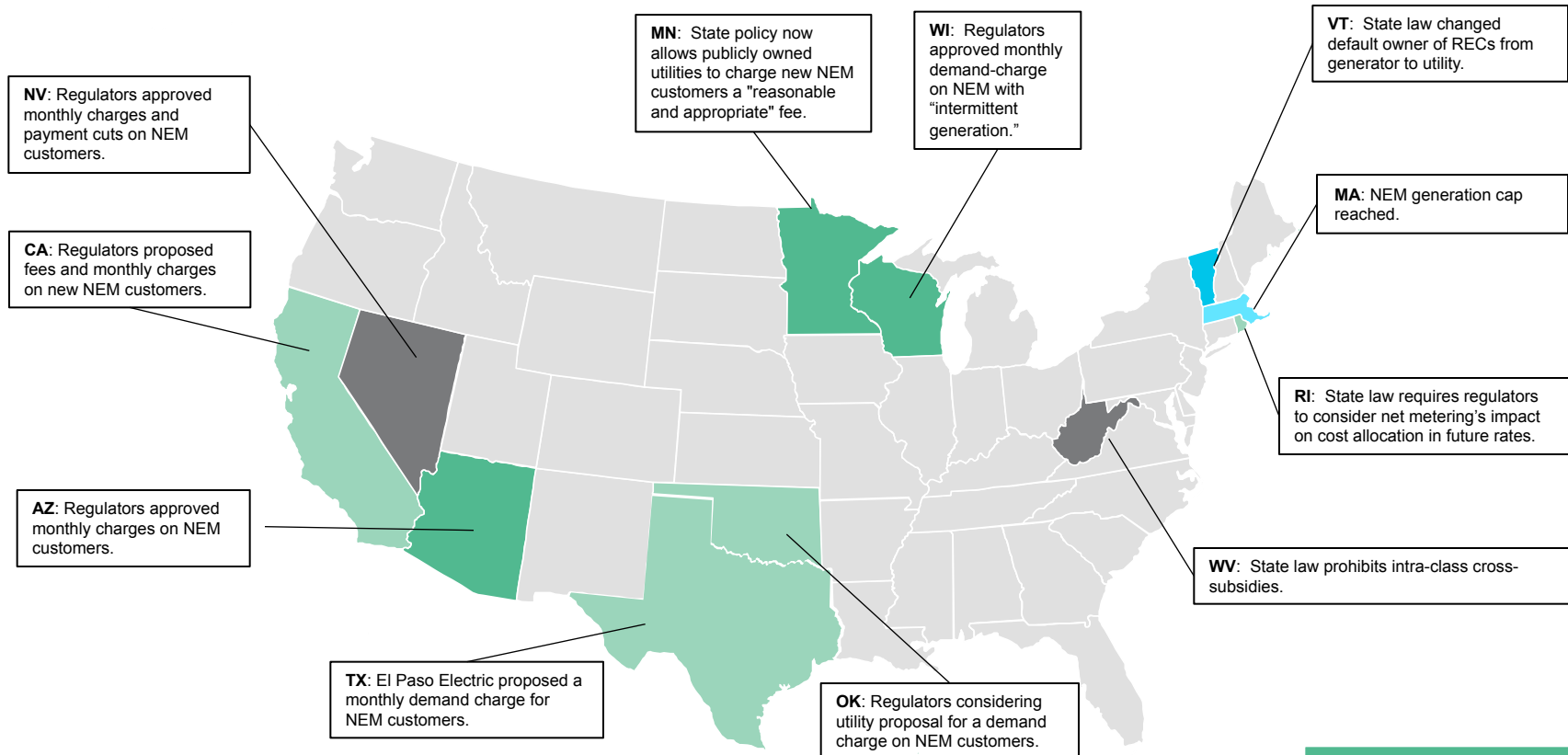


- EPA finalized the Clean Power Plan (CPP), its regulation on carbon emissions from the existing power fleet, in August 2015
- The Plan could cut power-sector emissions 32% from 2005 levels by 2030.

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

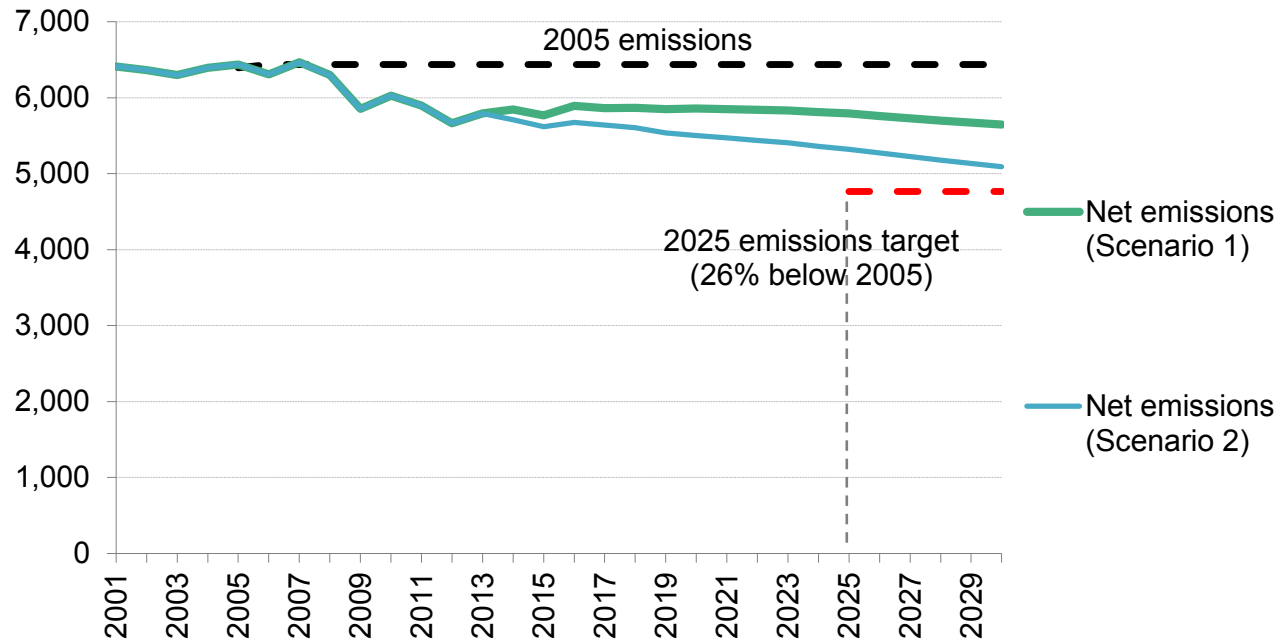
Notes: Darker colors indicate deeper emissions cuts. Yellow states may actually increase their overall emissions, while remaining in compliance with the EPA's Clean Power Plan. Data is not available for Alaska and Hawaii; Vermont and DC are not covered by the EPA's regulations. Data is based on EPA modelling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

- **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)





March 2016

# The Shifting Sands of Natural Gas Abundance

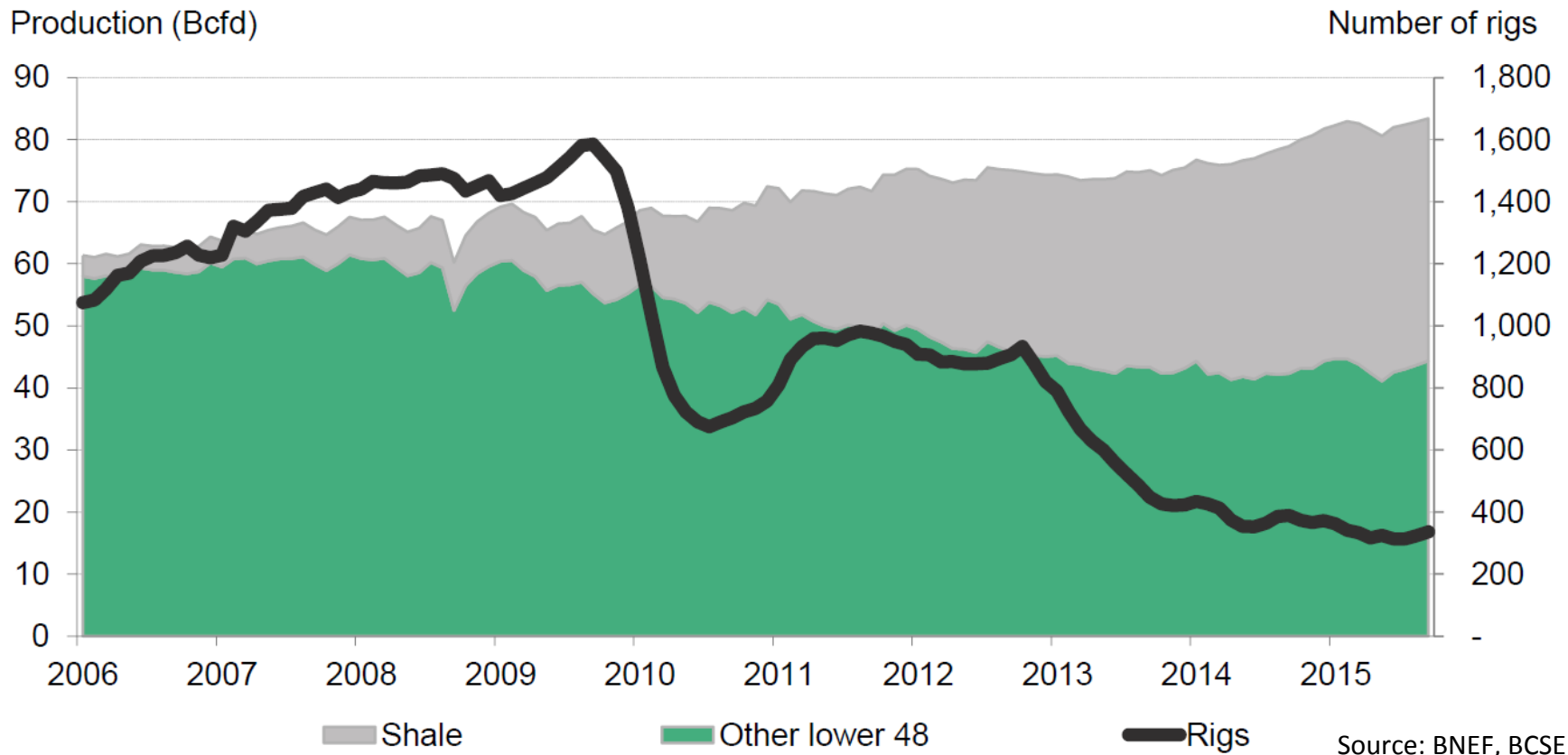


# Natural Gas Records in 2015

- **Domestic Annual Production** – 27.1 Tcf
- **Proved Reserves** – 368 Tcf (dry)
- **Undiscovered Gas Resources** – more than 2,500 Tcf
- **Domestic Natural Gas Consumption** – 27.4 Tcf
- **Natural Gas Consumed for Power Gen** – 9.4 Tcf
- **Working Gas in Underground Storage** – 4,009 Bcf

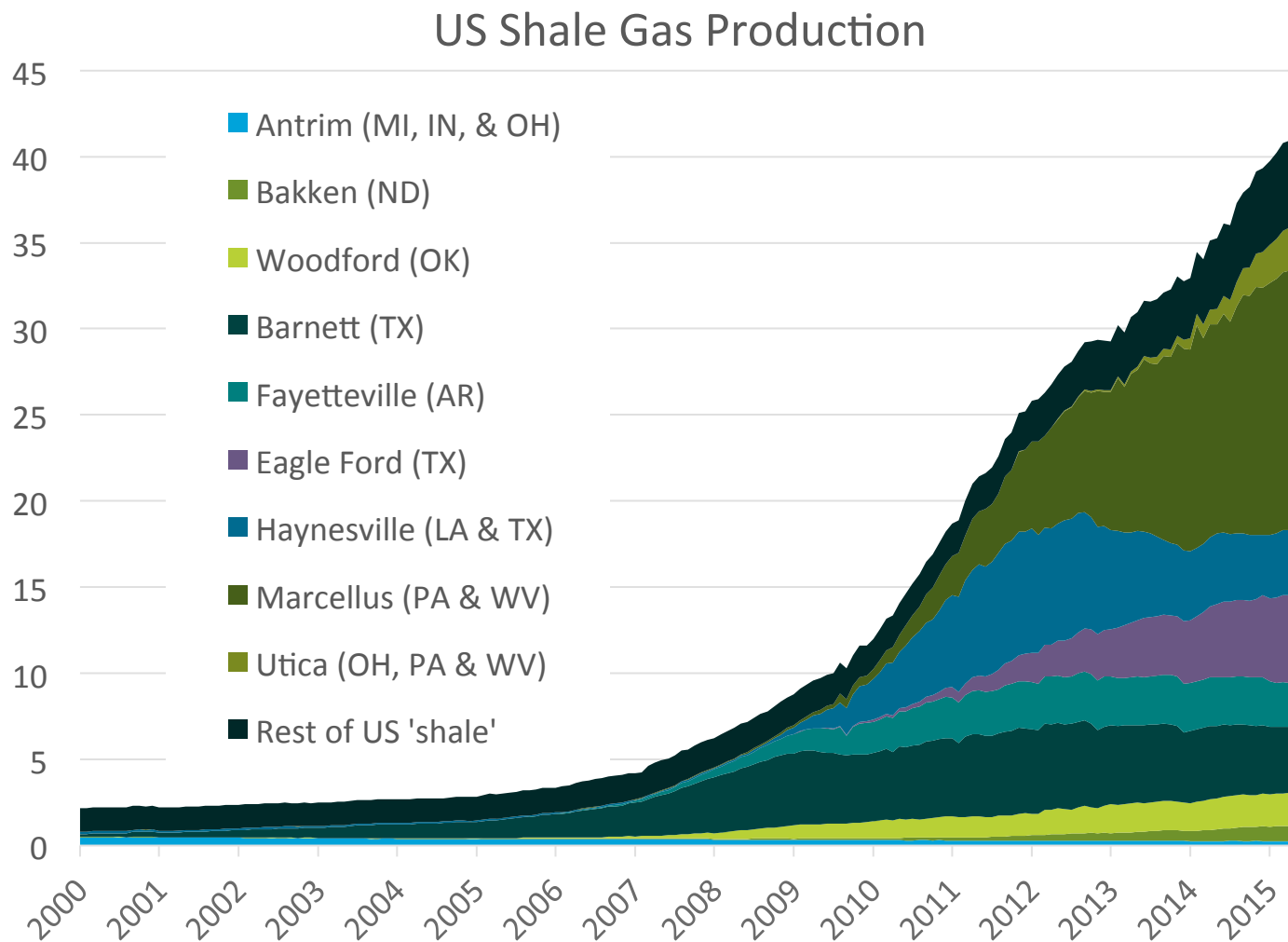
Sources: Bentek Energy, Energy Information Administration, Potential Gas Committee

# Despite falling rig counts, natural gas production continues to grow.



US dry gas production record: February 19, 2016 – 73.8 Bcfd (Bentek)

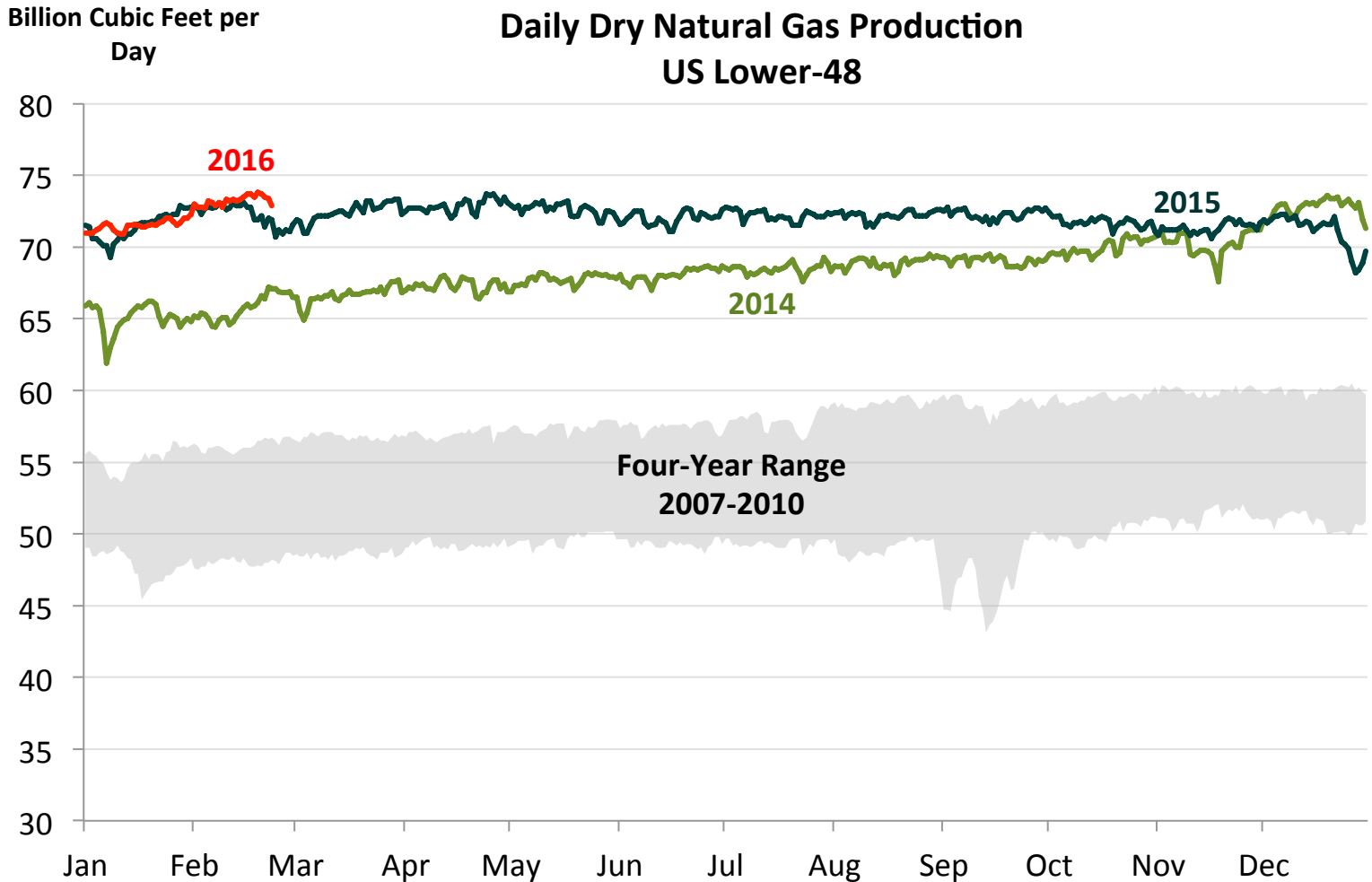
# Huge shale gas production begins to level



Source: US Department of Energy, Energy Information Administration.

# Record annual production in 2015

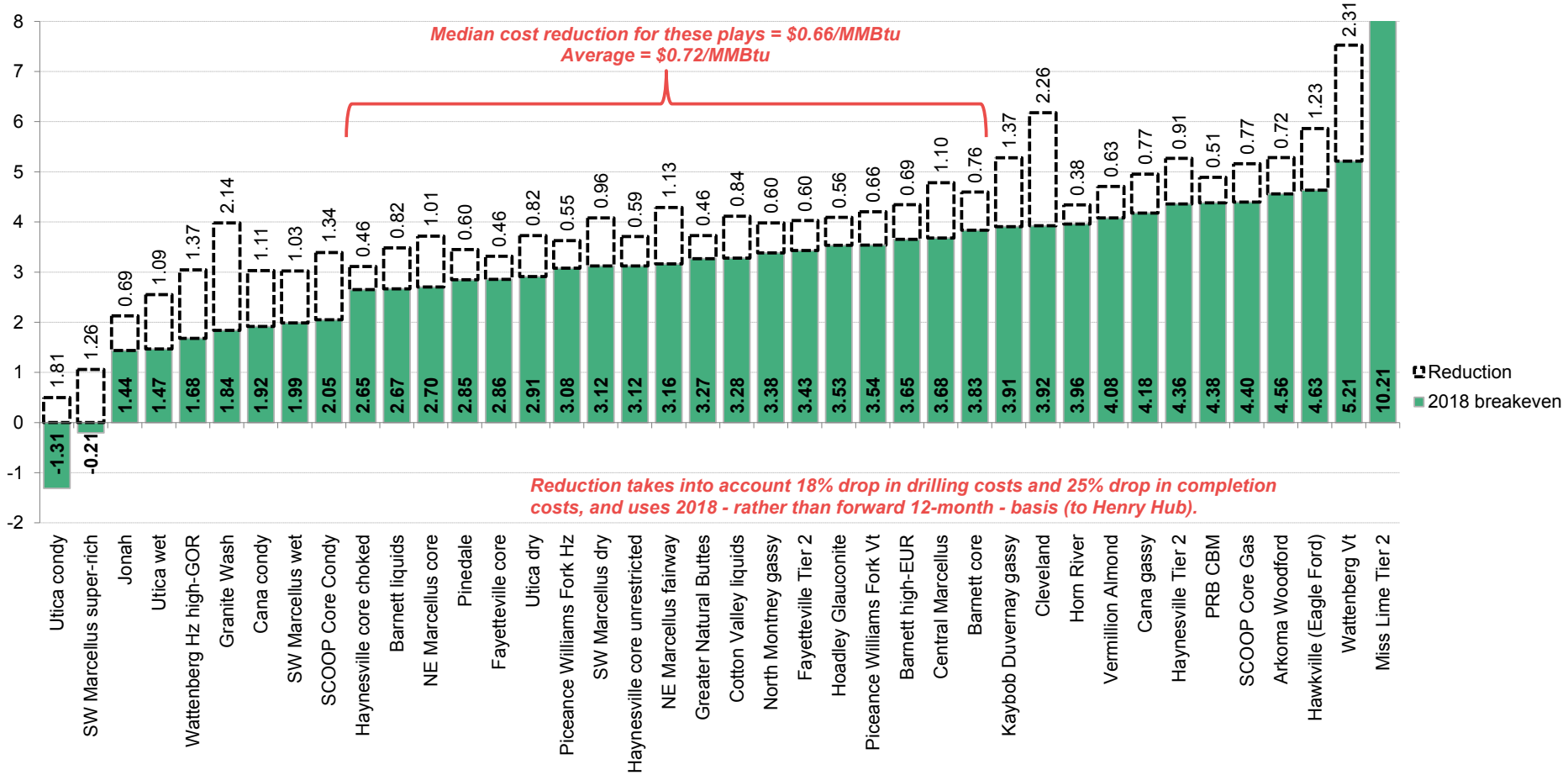
## New daily records already in 2016



Source: Bentek Energy LLC

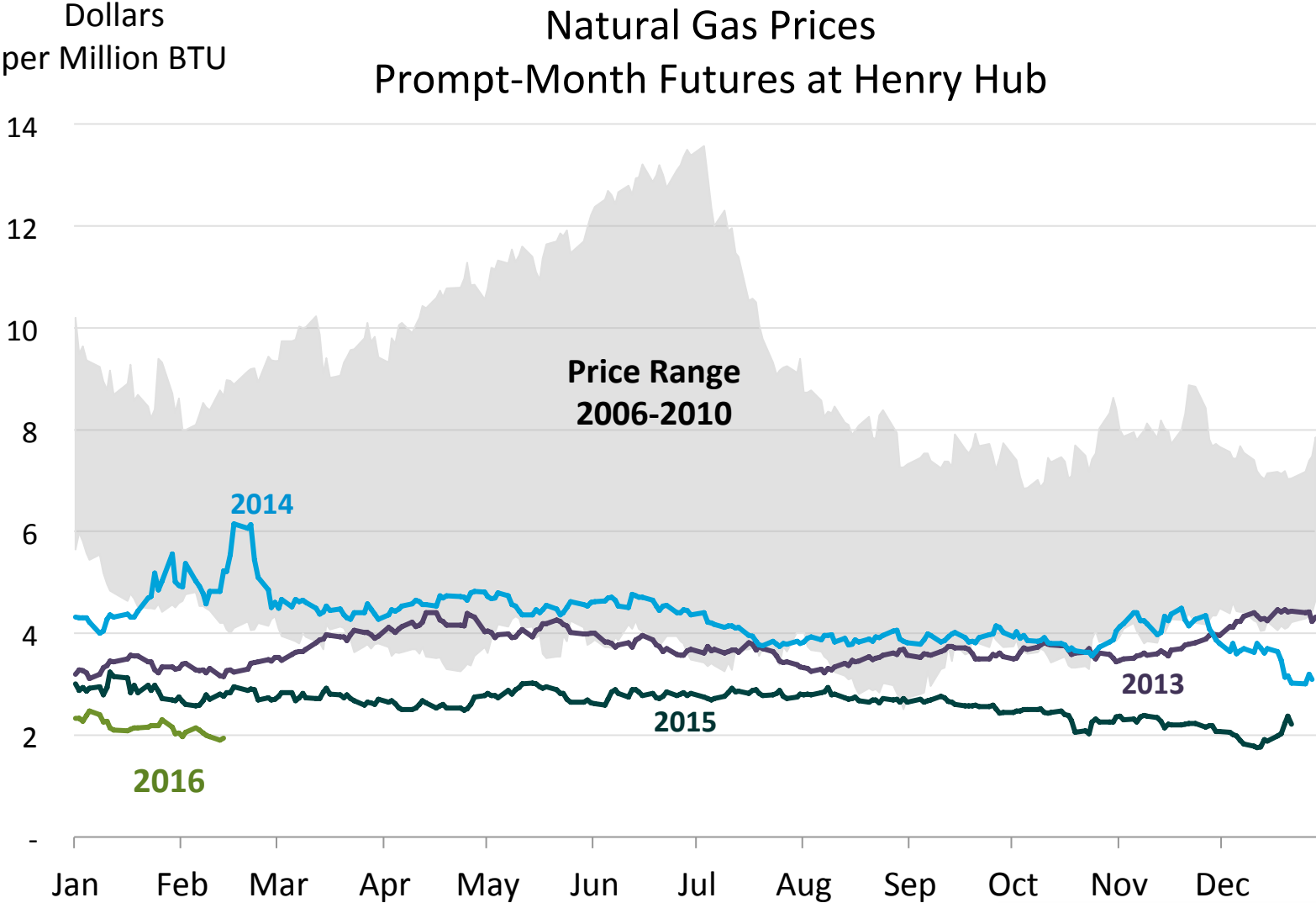
# Gas Breakevens Before and After the Oil Rout

(\$/MMBtu Henry Hub)



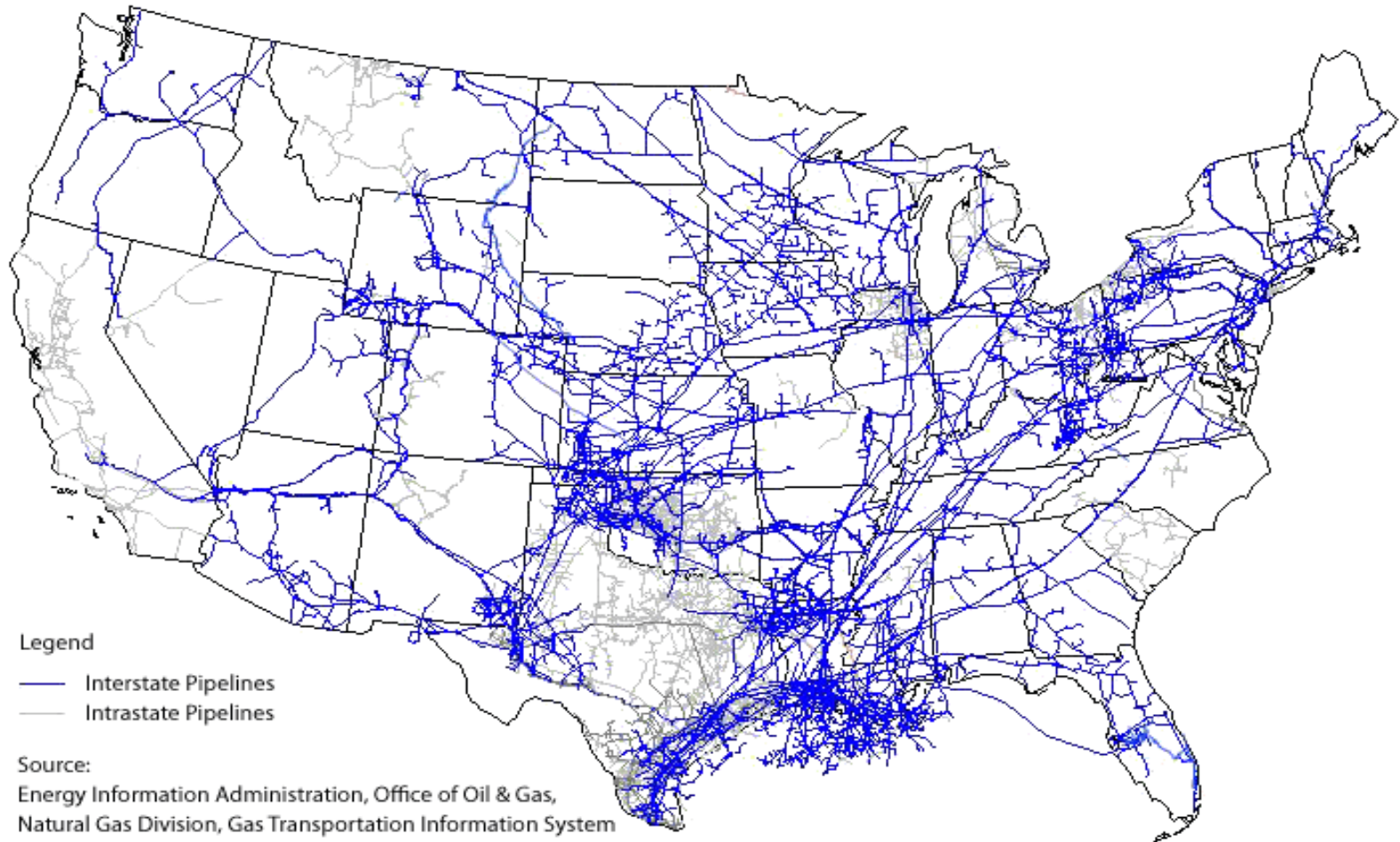
Source: Bloomberg New Energy Finance

# Relatively Low and Stable Natural Gas Prices



Source: Energy Information Administration

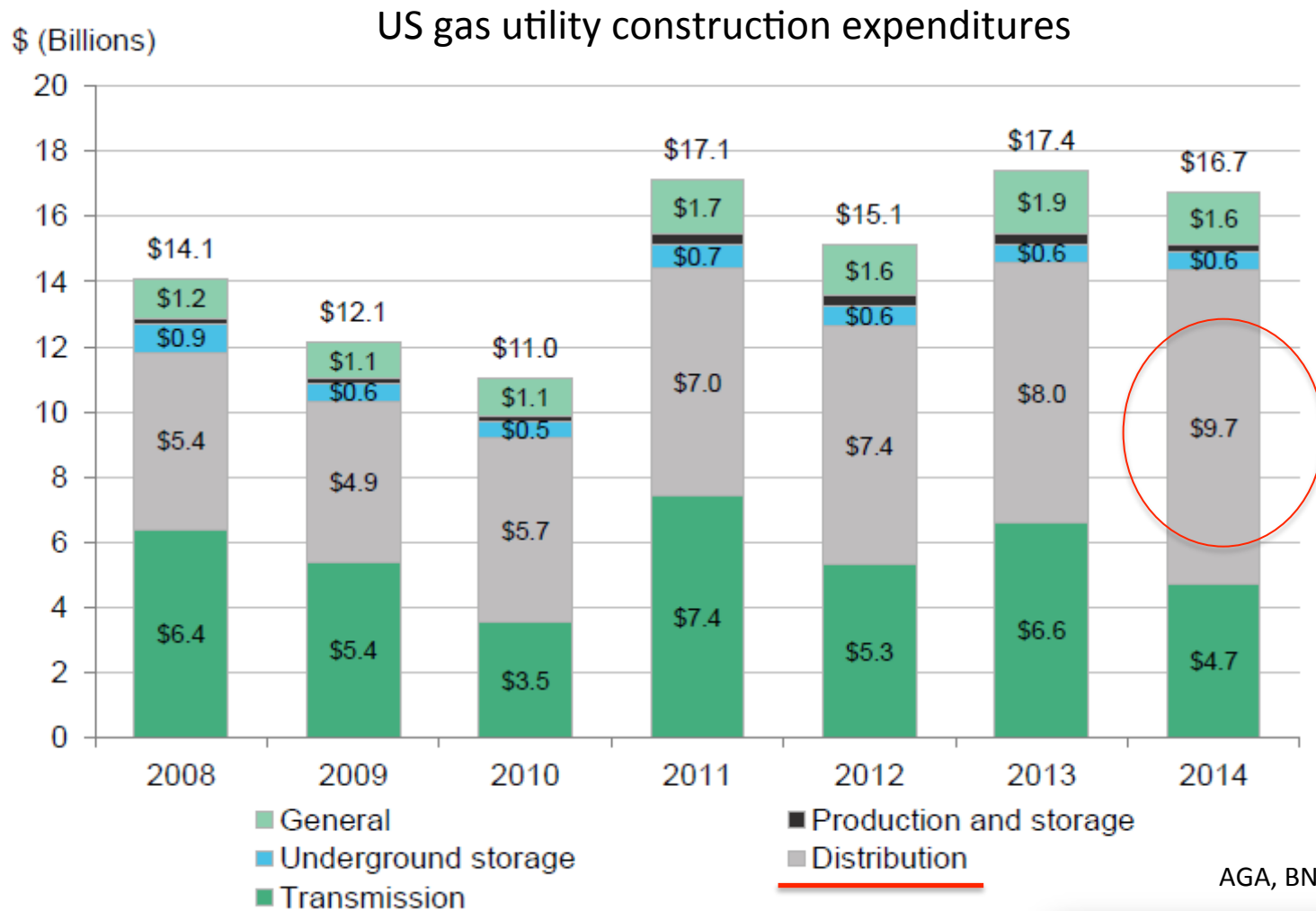
# US Natural Gas Pipeline Infrastructure



Source: Energy Information Administration.

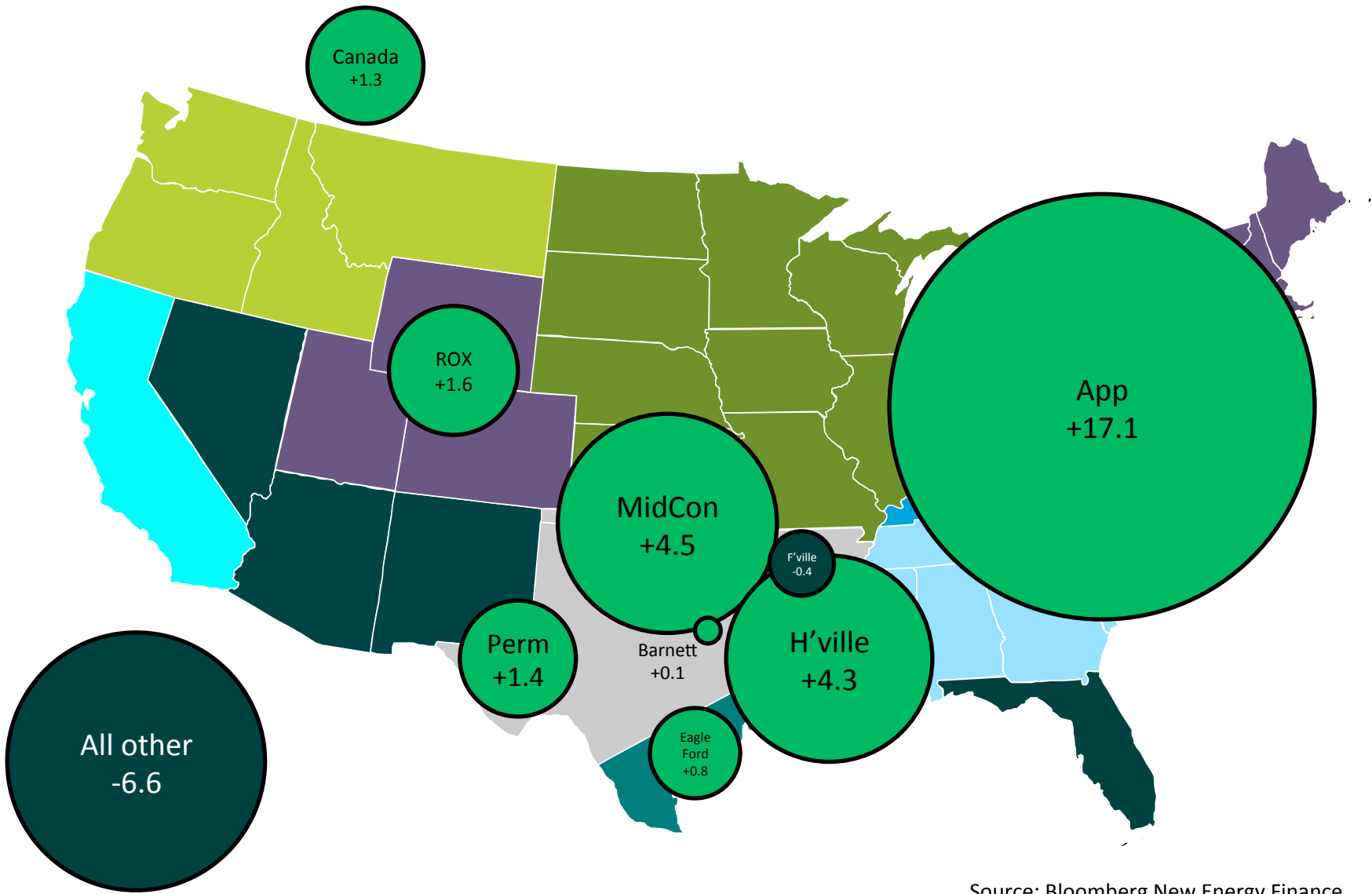


# US distribution expenditures reached nearly \$10 billion in 2014.



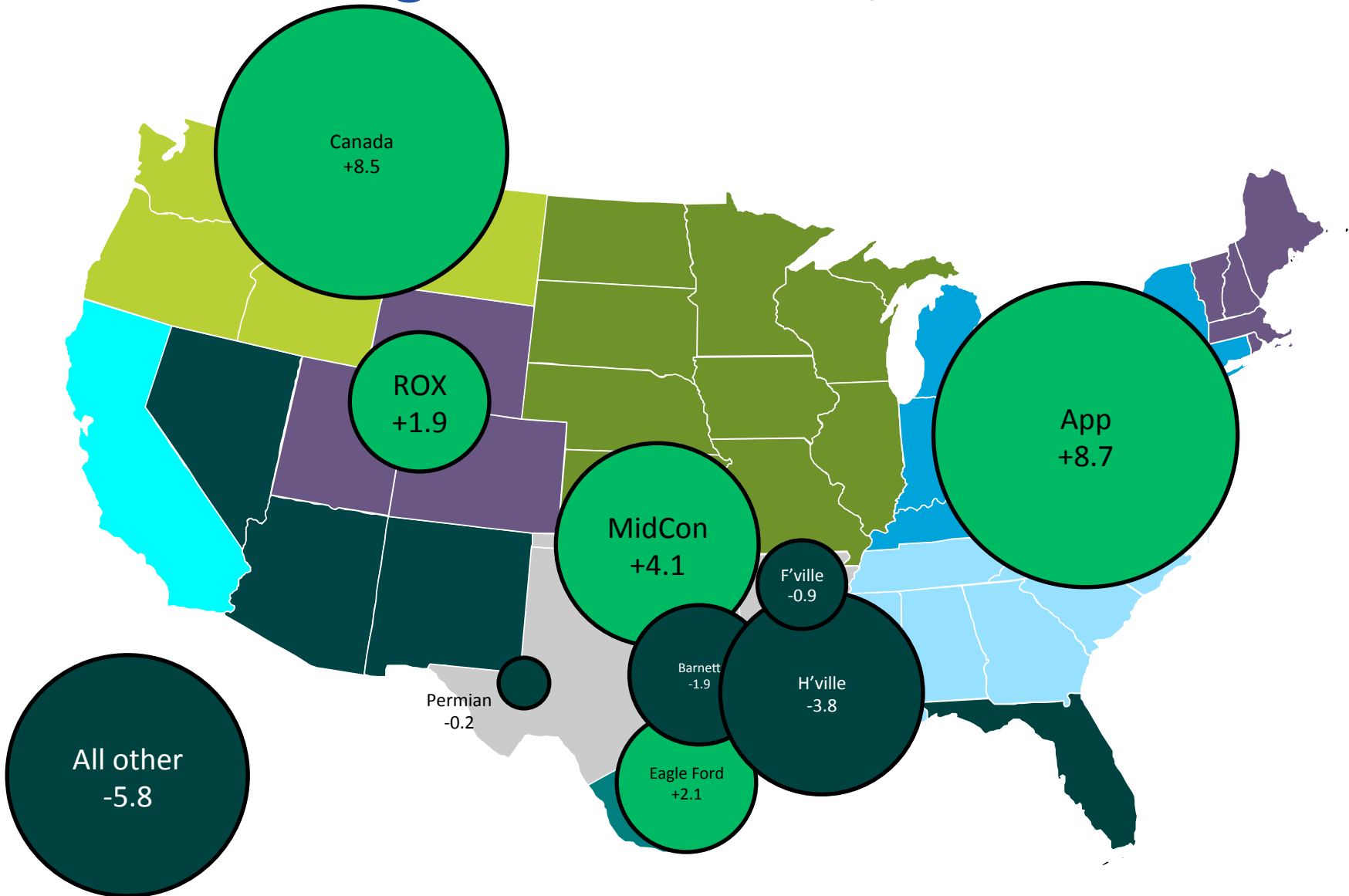
AGA, BNEF

# Change in Production, 2014-2020



Source: Bloomberg New Energy Finance.

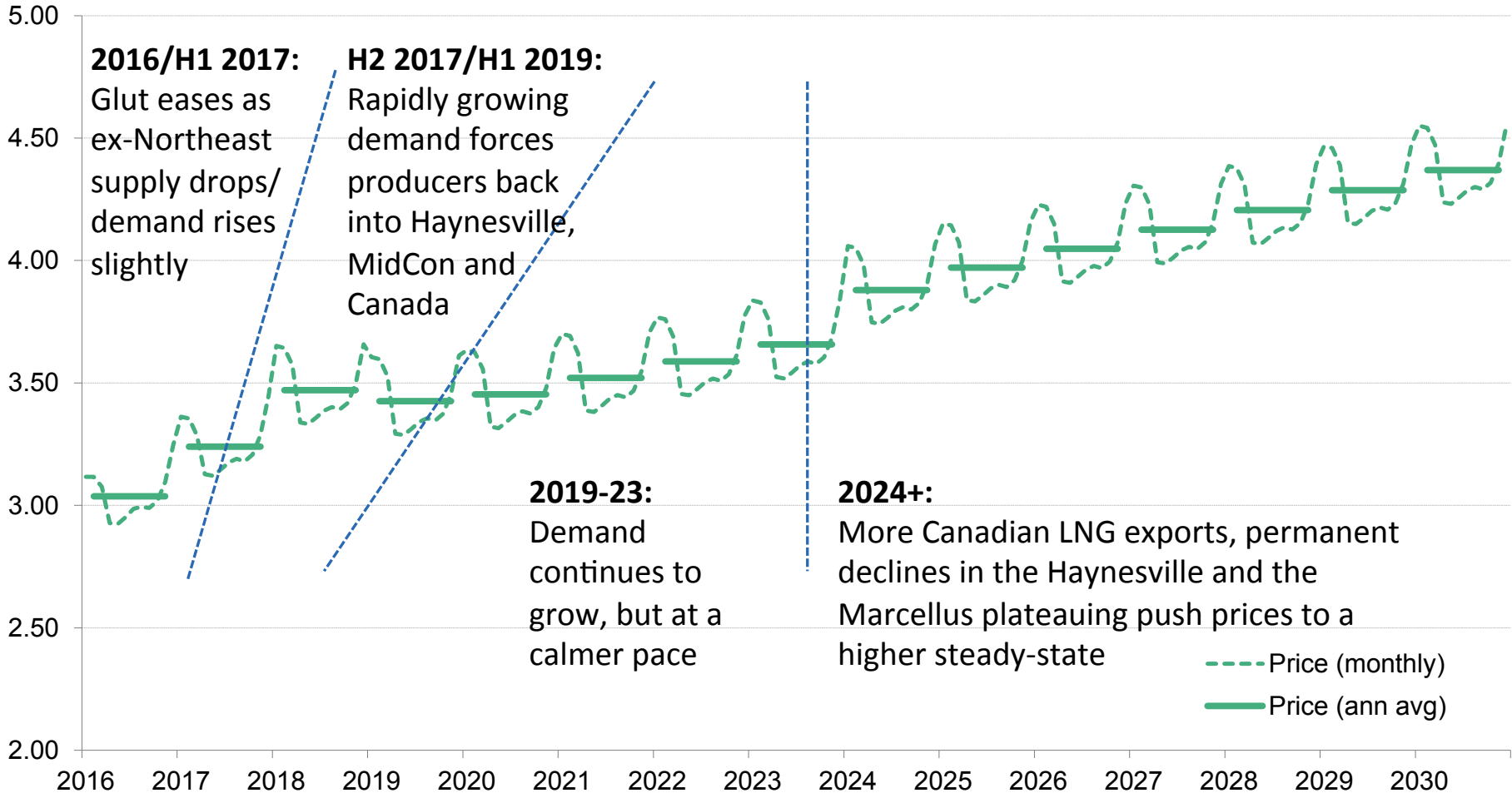
# Change in Production, 2020-2030



Source: Bloomberg New Energy Finance.

# BNEF Long-Range Henry Hub Gas Price

(real 2015\$/MMBtu)



Source: Bloomberg New Energy Finance.



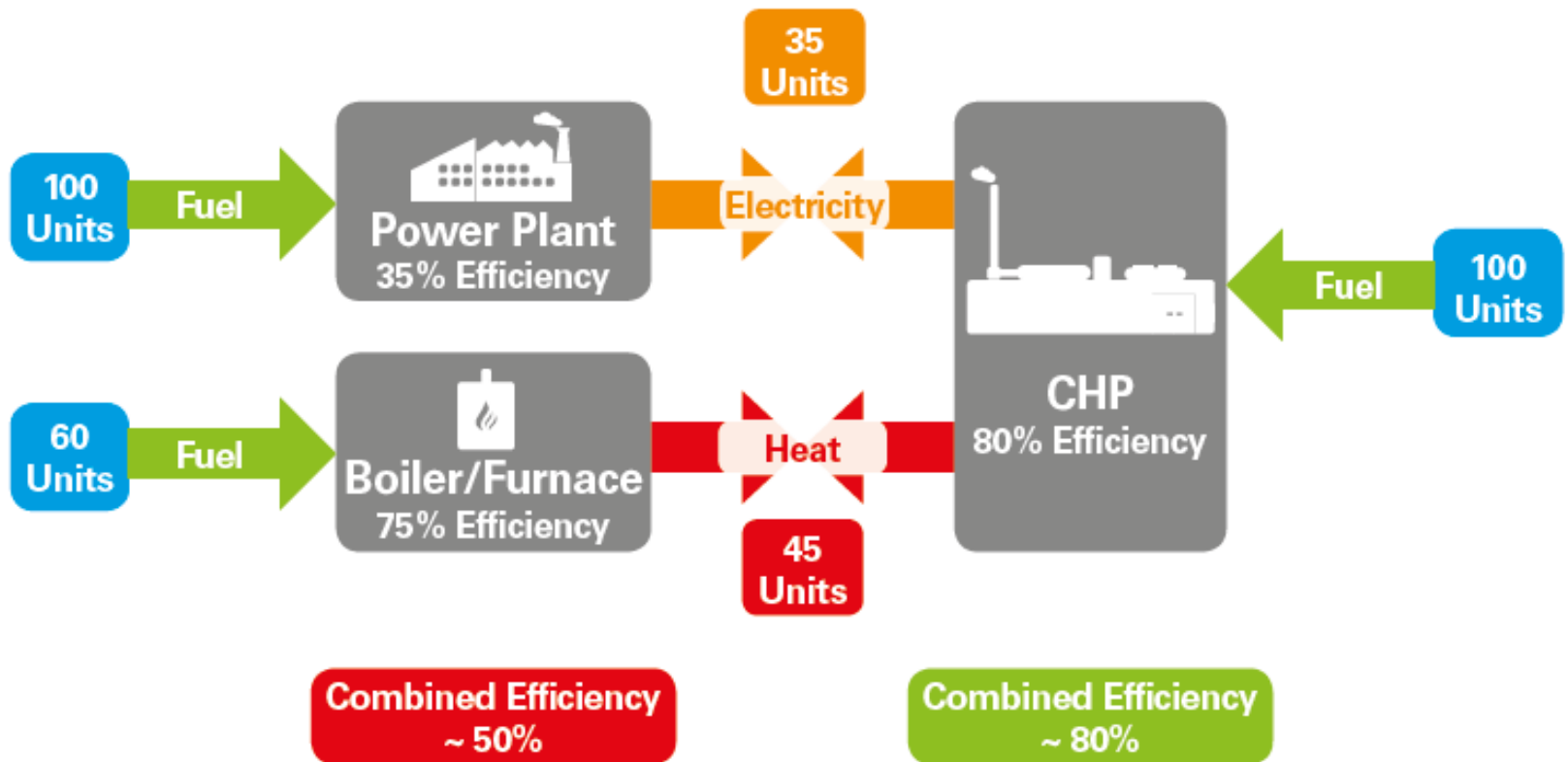
# CHP: State of the Market and Implications for the Future

Alliance for Industrial Efficiency Webinar

9 March 2016

# CHP Value Proposition

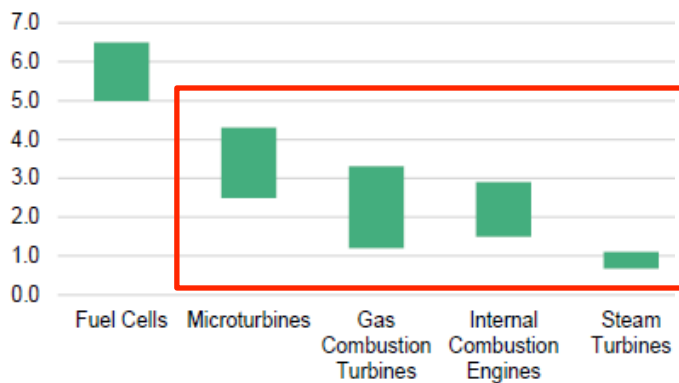
## Comparison of Energy Efficient CHP to Typical Utility



Fuel Savings = Financial Savings and Emission Reduction

# CHP: Attractive Capital Cost

Capital cost of CHP by technology (\$/W)

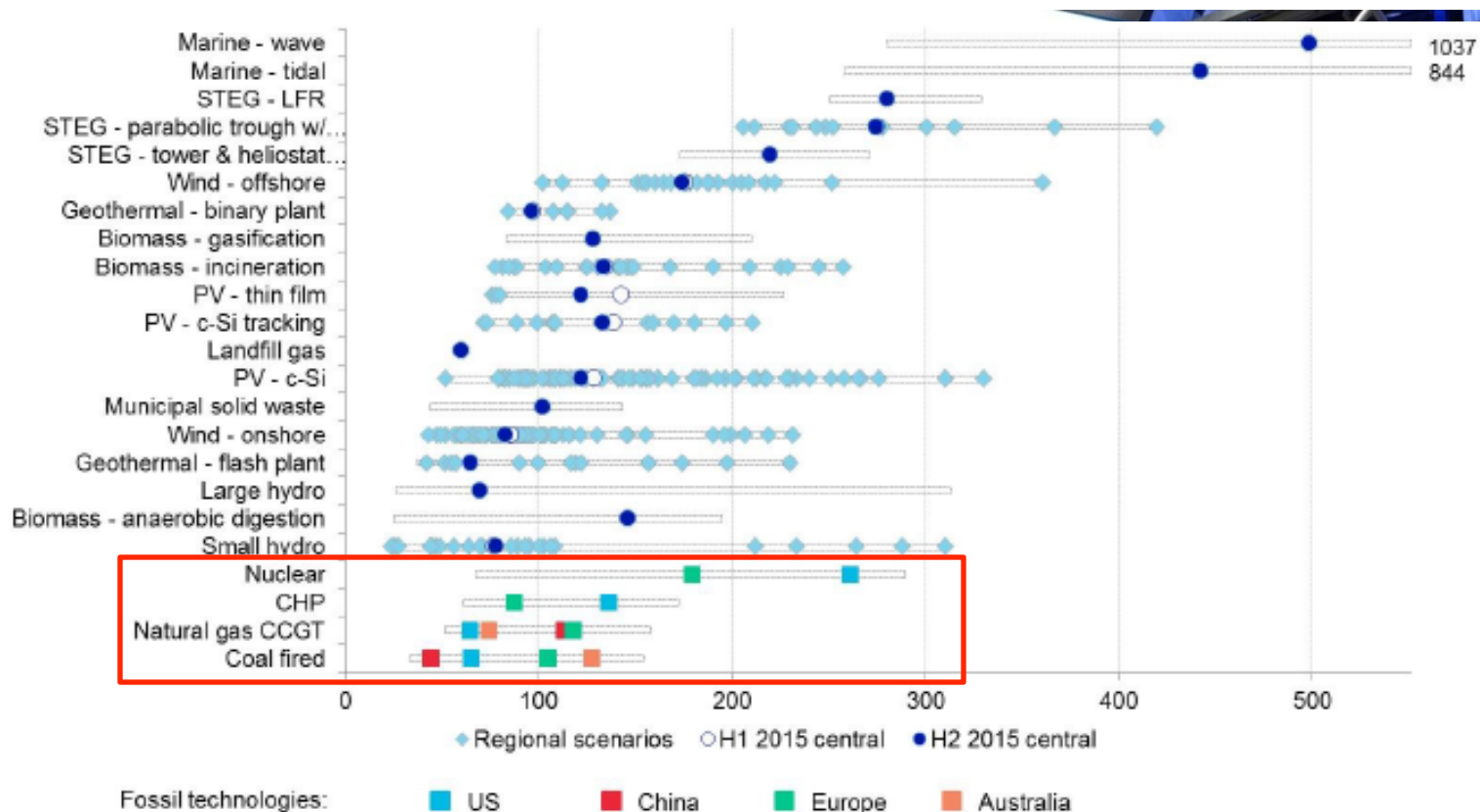


Initial Capital Cost of Generation Technologies (\$/kW)



SOURCE: Northwest Power and Conservation Council

# Competitive LCOE – but US lags Europe



- A number of renewable energies have comparable and, at times, cheaper LCOEs than “conventional” power sources.

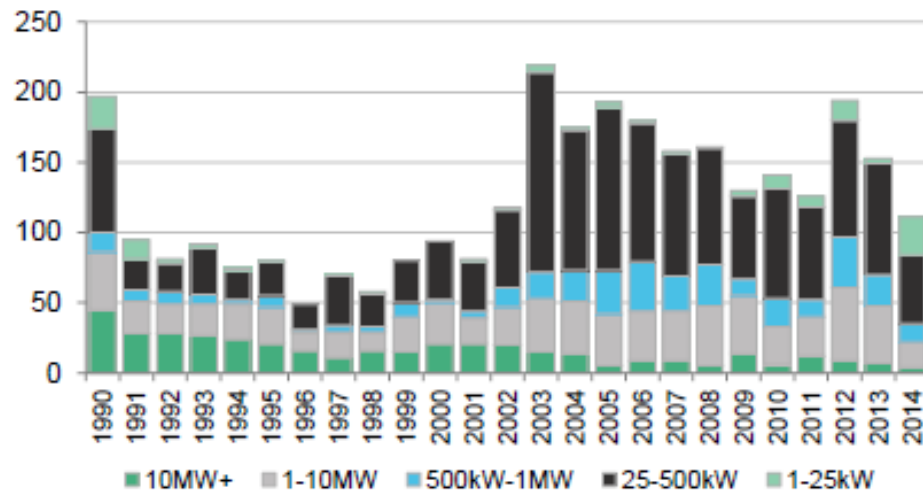
Source: Bloomberg New Energy Finance, EIA

Notes: LCOE is the per-MWh inflation-adjusted lifecycle cost of producing electricity from a technology assuming a certain hurdle rate (ie, after-tax, equity internal rate of return, or IRR). The target IRR used for this analysis is 10% across all technologies. All figures are derived from Bloomberg New Energy Finance analysis. Analysis is based on numbers derived from actual deals (for inputs pertaining to capital costs per MW) and from interviews with industry participants (for inputs such as debt/equity mix, cost of debt, operating costs, and typical project performance). Capital costs are based on evidence from actual deals, which may or may not have yielded a margin to the sellers of the equipment; the only ‘margin’ that is assumed for this analysis is 10% after-tax equity IRR for project sponsor. The diamonds correspond to the costs of actual projects from regions all over the world; the hollow circles correspond to ‘global central scenarios’ (these central scenarios are made up of a blend of inputs from competitive projects in mature markets). For nuclear, gas, and coal, the light blue squares correspond to US-specific scenarios. ‘CHP’ stands for combined heat and power; ‘CCGT’ stands for combined cycle gas turbine; ‘c-Si’ stands for crystalline silicon; ‘CSP’ stands for concentrated solar power; ‘LFR’ stands for linear Fresnel reflector. EIA is source for capex ranges for nuclear and conventional plants.

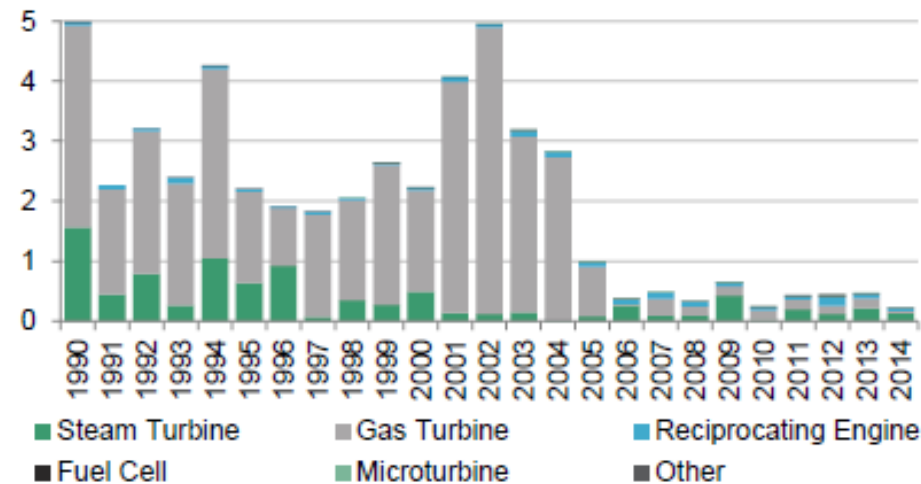


# New CHP Installations Down

## US Annual CHP build by system size (# of projects)



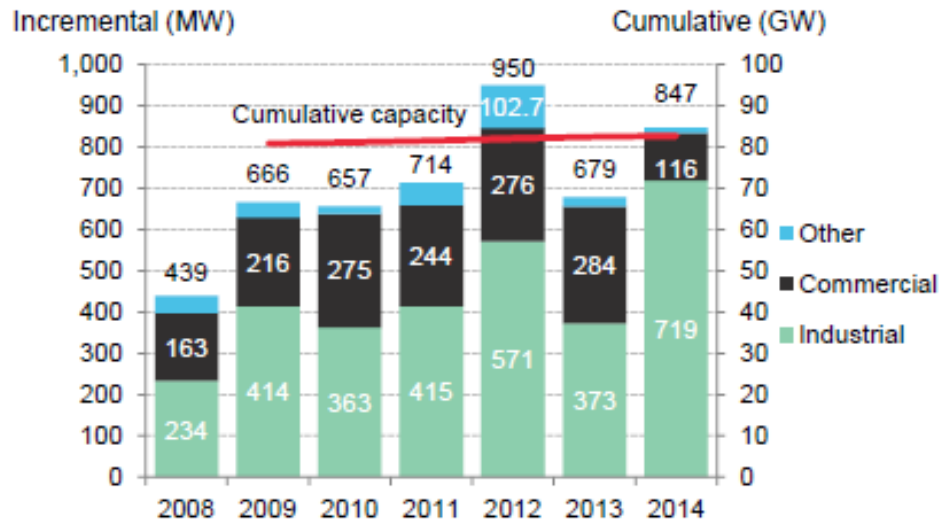
## US Annual CHP build by technology (MW)



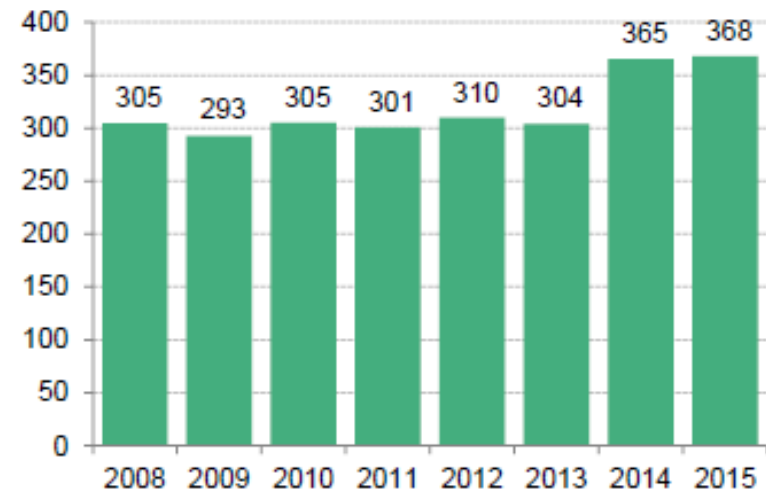
- Over the past twenty years, the average size of a CHP system shrank, suggesting a lack of market incentives for large-scale projects. 2003 saw total construction starts nearly double from the previous year (from 118 to 219 projects) amid an increase in projects sized between 500 and 1000 kilowatts.
- In the past decade, annual new build has been muted. Absent any financial enticements, facility owners appeared reluctant to upgrade to newer small-scale technologies like fuel cells and microturbines, when conventionally reliable technologies provide cheaper power at a larger scale.

# Existing CHP Installations More Productive

## US CHP build (MW) and capacity (GW)



## US CHP generation (from plants tracked by EIA generation data) (TWh)



- 2014 saw a jump in installations from 679MW to 847MW, including the most industrial CHP build of the past seven years. However, cumulative capacity remains static as CHP systems using dirtier fuels have been retired. Overall, growth is still stymied due to a lack of supportive policies at the federal or state level and demanding standby charges that undermine system economics.
- Annual generation has been notably higher in 2014 and 2015 than in the previous five years. Higher utilization of CHP may be due to cheaper gas.
- Data may underestimate total CHP production because they do not reflect some newer installations, which tend to be smaller in size and excluded from EIA estimates (see notes below).

Source: Bloomberg New Energy Finance, DOE CHP Installation Database (maintained by ICF International) Notes: EIA is the best available source for generation data. However, EIA data on CHP is not comprehensive and so the generation figures are underestimated. Specifically, EIA does not collect data for sites <1MW; EIA may not be aware of certain installations and thus may not send these sites a survey for reporting; and EIA categorizes some CHP systems as 'electric power' rather than 'industrial CHP', if these systems sell power to the grid while providing steam to an adjacent facility. Values for 2015 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2015).

# Please Email Questions to [Jennifer@dgardiner.com](mailto:Jennifer@dgardiner.com)



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