

2015 FACTBOOK

February 2015

# Sustainable Energy in America



**Bloomberg**  
NEW ENERGY FINANCE

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

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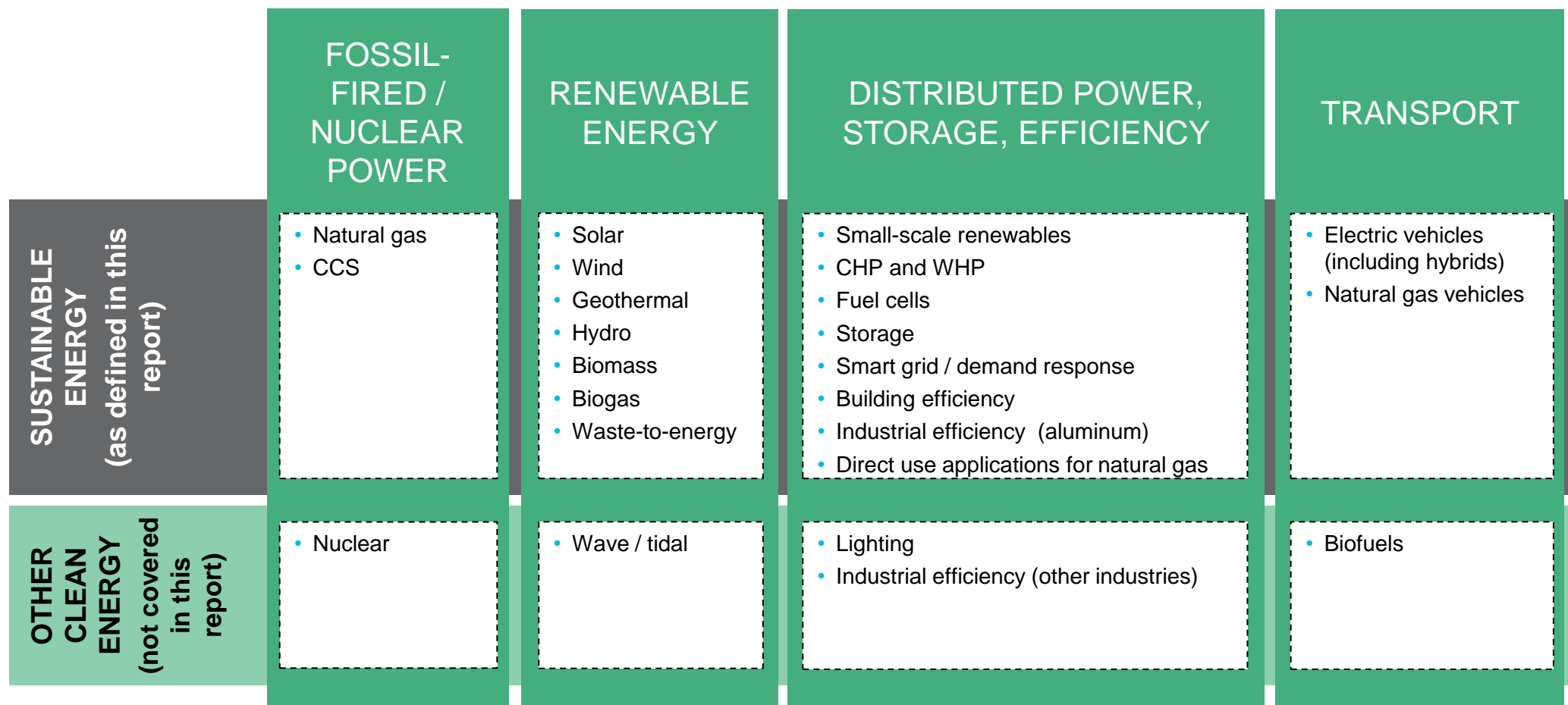
## What is it?

- Aims to augment existing, reputable sources of information on US energy
- Focuses on **renewables, efficiency, natural gas**
- **Fills important data gaps** on areas (eg, investment flows by sector, contribution of distributed energy)
- Is **current through 2014** 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 **third edition** (first published in January 2013)

## What's new?

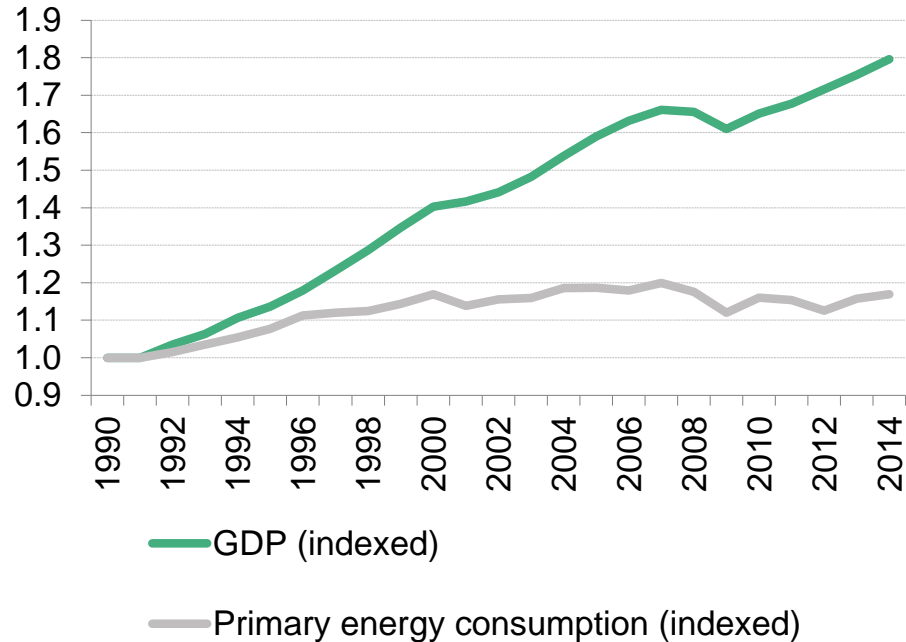
- **Format**
- **Updated analysis**
- **2014 developments**
- **New coverage:** US energy productivity, non-hydro storage policies by geography, smart meter prices, utility investment in natural gas-related efficiency by state, potential impact of EPA Clean Power Plan, global comparisons of energy costs

# About the Factbook: Understanding terminology for this report

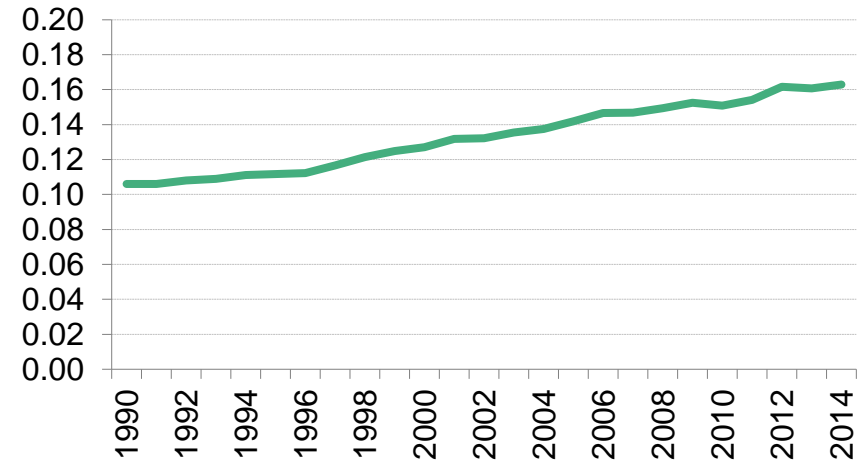


# US energy overview: Economy's energy productivity

## US GDP and primary energy consumption (indexed to 1990 levels)



## US energy productivity (\$ trillion of GDP / quadrillion Btu of energy)

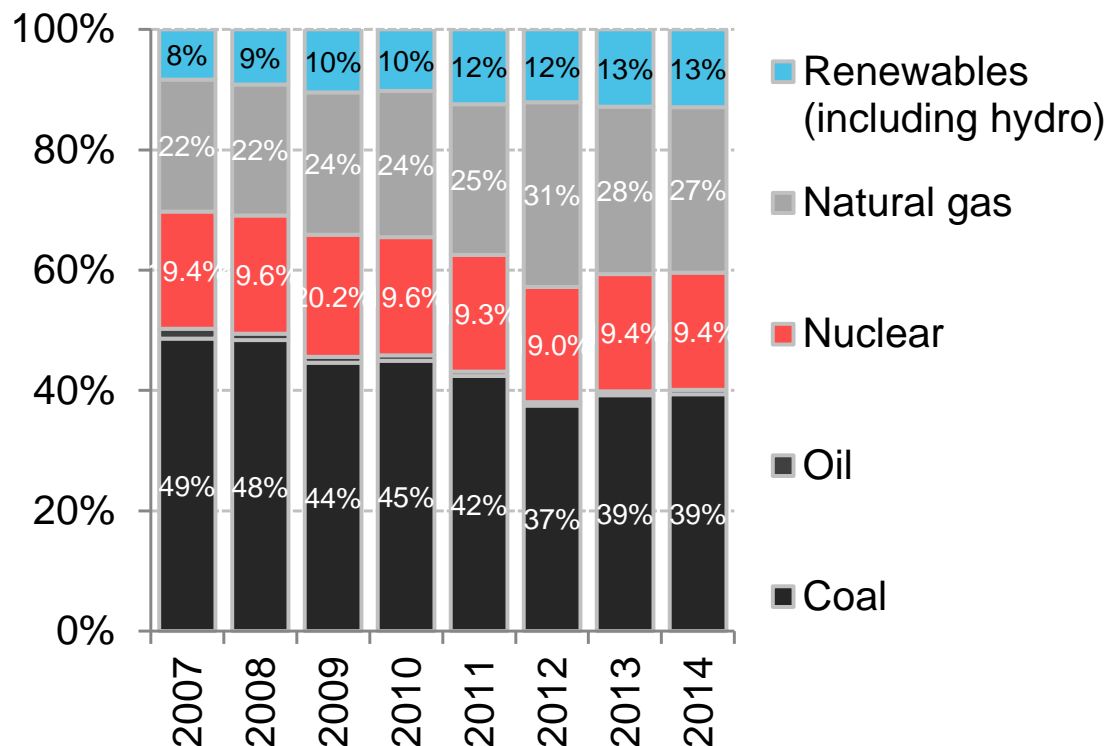


- The US economy is becoming more energy productive. By one measure (US GDP per unit of energy consumed), productivity has increased by 54% since 1990, by 11% since 2007, and by 1.4% from 2013 to 2014

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

Notes: Values for 2014 energy consumption are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2014). GDP is real and chained (2009 dollars); annual growth rate for GDP for 2014 is based on consensus of economic forecasts gathered on the Bloomberg Terminal as of January 2015.

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

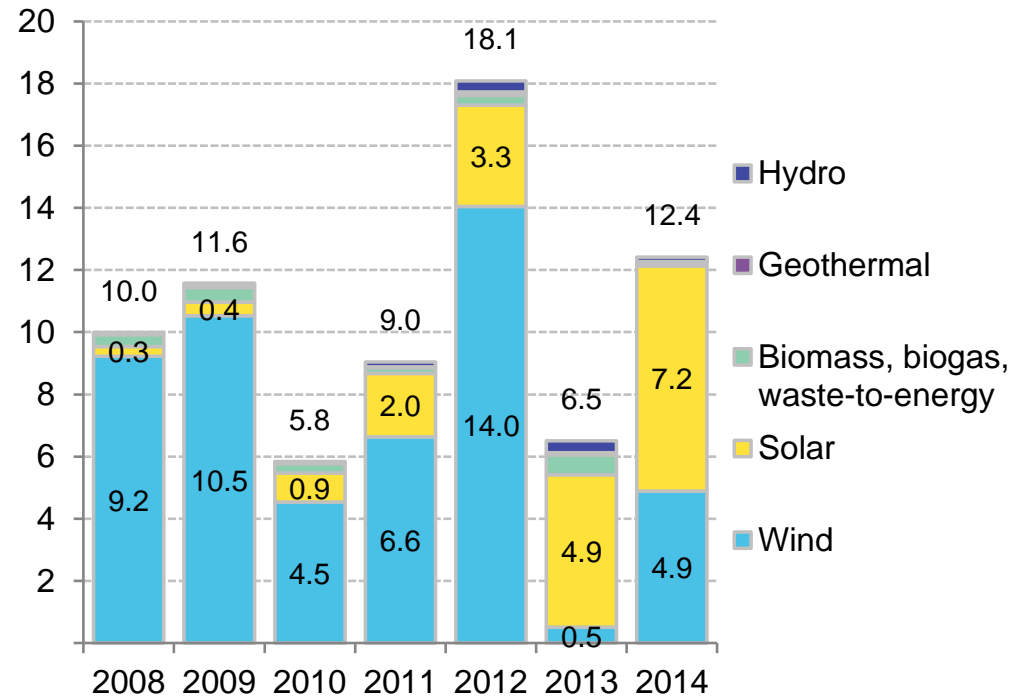


- The US electricity mix in 2014 was nearly identical to 2013 levels
- Longer term, though, larger *structural* trends are afoot

Source: EIA

Notes: Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2014). 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. In chart at right, contribution from CHP is indicated by a shaded bar in each of the columns. The hydropower portion of 'Renewables' includes negative generation from pumped storage.

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

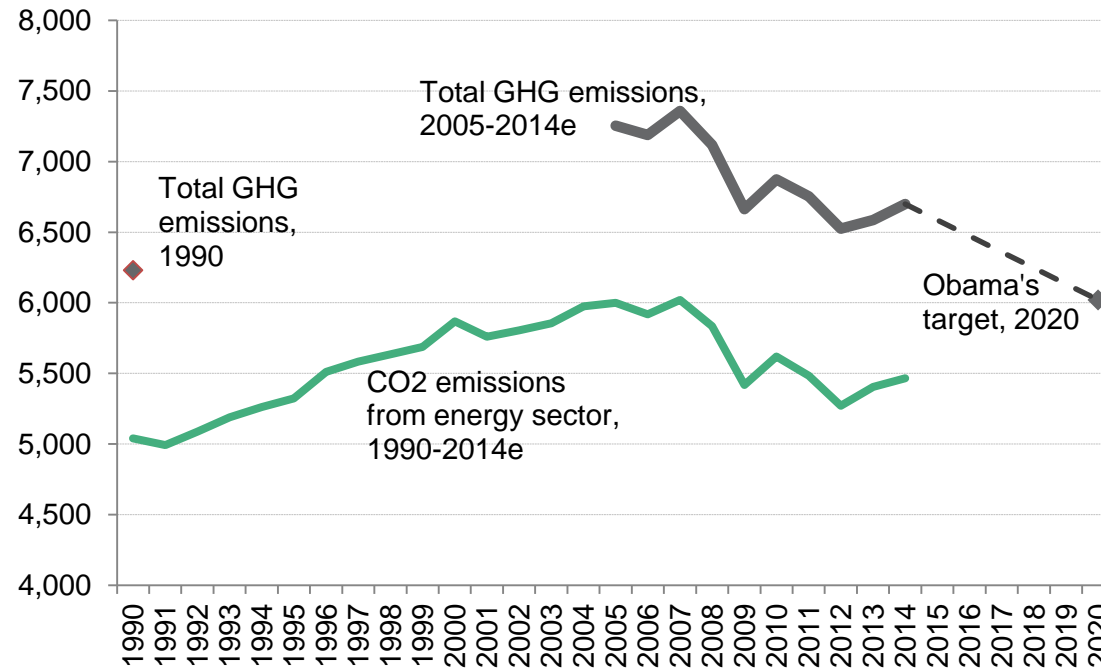


- Wind and solar both saw increased levels of build in 2014, relative to 2013 levels, but for different reasons
- Other sectors – biomass, biogas, waste-to-energy, geothermal, hydro – are languishing without long-term policy certainty

Source: Bloomberg New Energy Finance, EIA

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

## Greenhouse gas emissions, energy sector and economy-wide (MtCO<sub>2</sub>e)



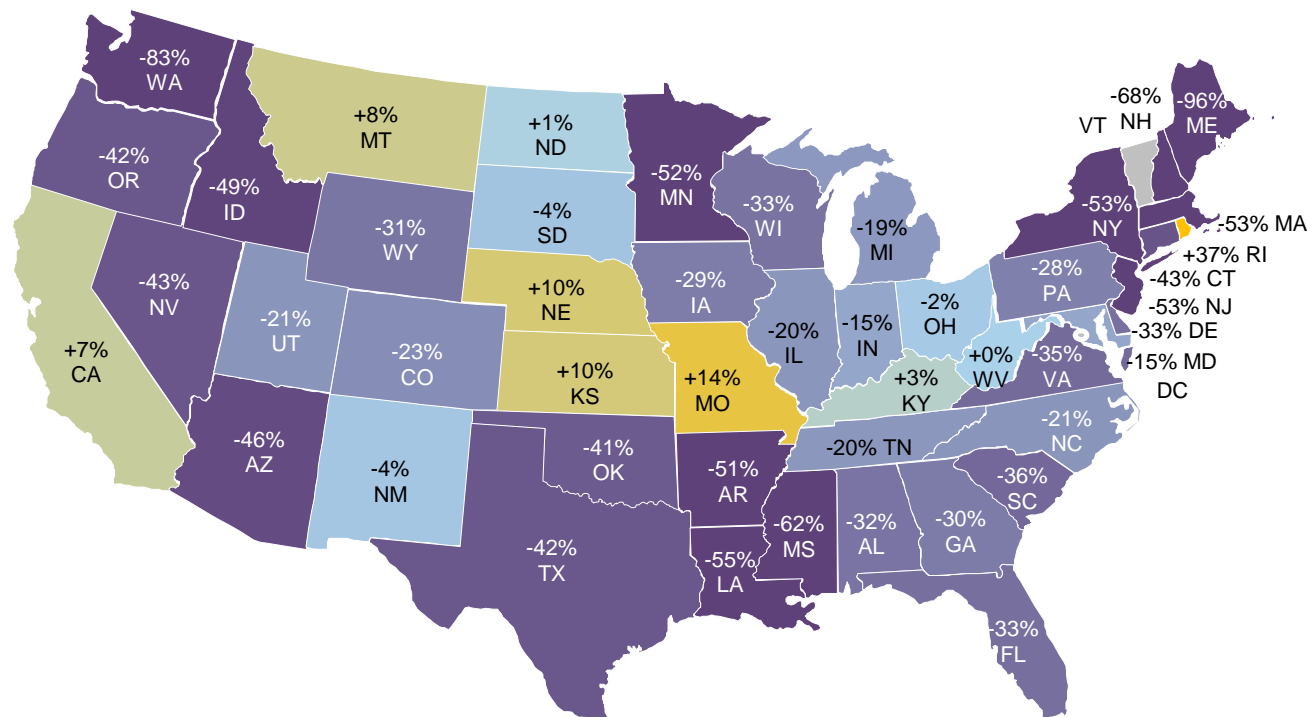
- Over the past decade, CO<sub>2</sub> emissions from the energy sector have been trending down: ~9.2% decrease since 2007
- The short-term results show a different trend: ~3.7% increase since 2012, owing partly to increased coal generation

Source: Bloomberg New Energy Finance, EIA, EPA

Notes: Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2014). 'Obama's target' refers to a pledge made in Copenhagen climate talks in 2009. The target shown here assumes 17% reduction by 2020 on 2005 levels of total GHG emissions, but the actual language of the announcement left vague whether the reductions applied to economy-wide emissions or just emissions of certain sectors. Data for total GHG emissions comes from EPA's Inventory of US Greenhouse Gas Emissions and Sinks (1990-2012), published April 2014. Data for CO<sub>2</sub> emissions from the energy sector comes from the EIA's Monthly Energy Review.

# Policy – key sustainable energy policy developments in 2014 (1 of 5): EPA Clean Power Plan

Change in power sector emissions by state from 2012 to 2030 under one potential compliance scenario from the EPA's Clean Power plan



- The EPA announced the Clean Power Plan on June 2014; the agency is currently reviewing comments submitted in response to the Plan, and is due to finalize the plan by summer 2015
- It calls on states to implement their own programs (or band with other states) for reducing carbon emissions intensity of its existing power fleet. This could result in the most ambitious US policy ever for natural gas, renewables, and energy efficiency
- According to one scenario in the EPA's modelling, the Plan could lead to 30% reductions from 2005 levels by 2030
- The legal and political debates, including lawsuits by states and negatively impacted generators, have just begun

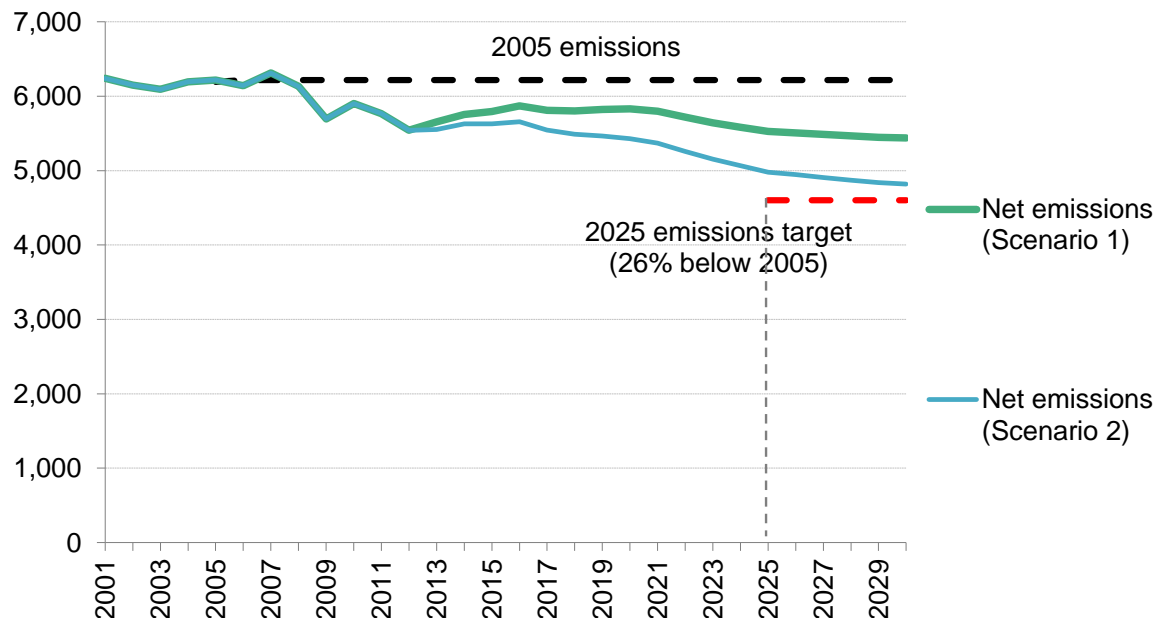
Source: Bloomberg New Energy Finance, based on analysis of EPA Clean Power Plan's modelling

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 – key sustainable energy policy developments in 2014 (2 of 5): US-China climate pact

US net GHG emissions, historical and forecast under two scenarios, relative to 2025 target agreed upon in US-China climate pact



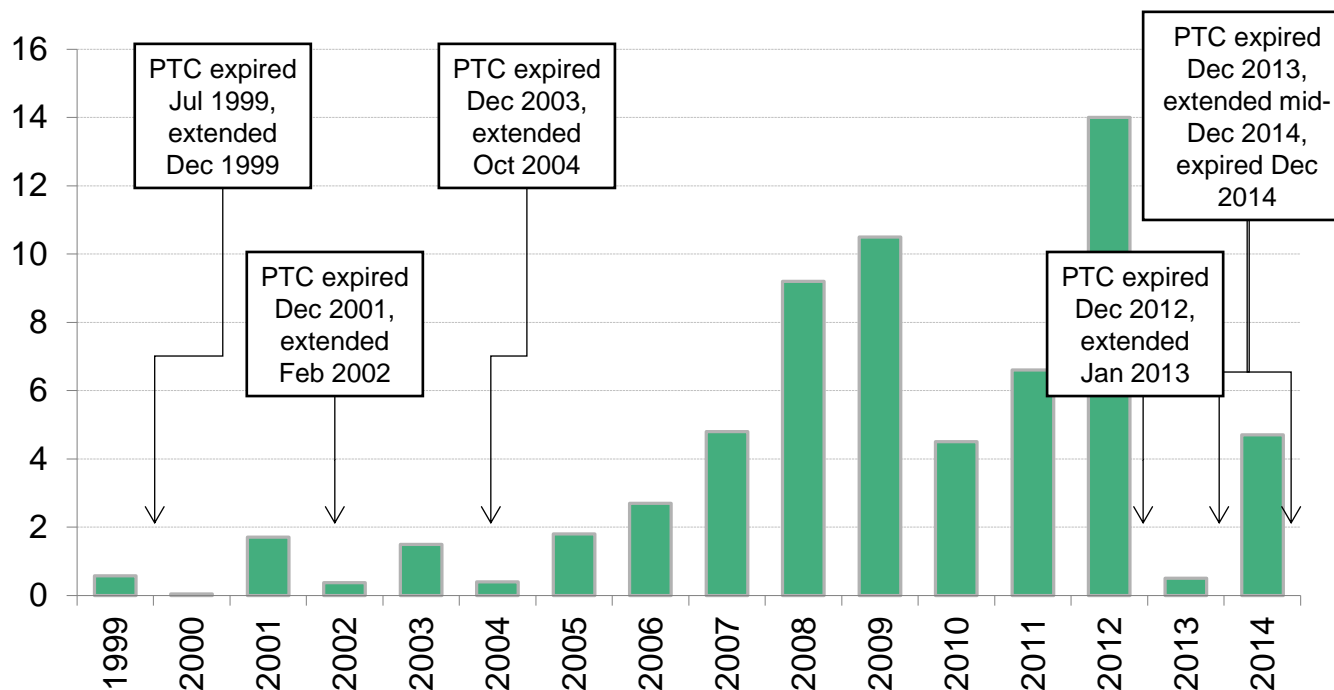
- On 11 November 2014, the US and China announced a pact to curb their greenhouse gas emissions
- The US pledged to reduce its net GHG emissions by 26-28% below 2005 levels by 2025; China pledged its CO2 emissions will cease to increase by 'around' 2030 and that 20% of its primary energy will be derived from zero-carbon sources by 2030
- For the US, the new pledge builds off of 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 includes total emissions less sequestration. 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 AEO2014 reference case and assuming existing CAFE standards. Scenario 1 assumes residential, commercial, and industrial sectors' energy growth as per the EIA AEO2014 reference case; and agricultural, waste, and forestry and land use sectors' growth as per the 2014 US Climate Action report. Scenario 2 assumes historical decline rate for the residential and commercial sectors; assumes the industrial, agricultural, and waste sectors' emissions level remain constant from 2013 levels; and assumes forestry and land use emissions follow the 'high sequestration case' in the 2014 US Climate Action report.

# Policy – key sustainable energy policy developments in 2014 (3 of 5): Federal legislative inaction

## US wind build (GW) mapped to PTC status



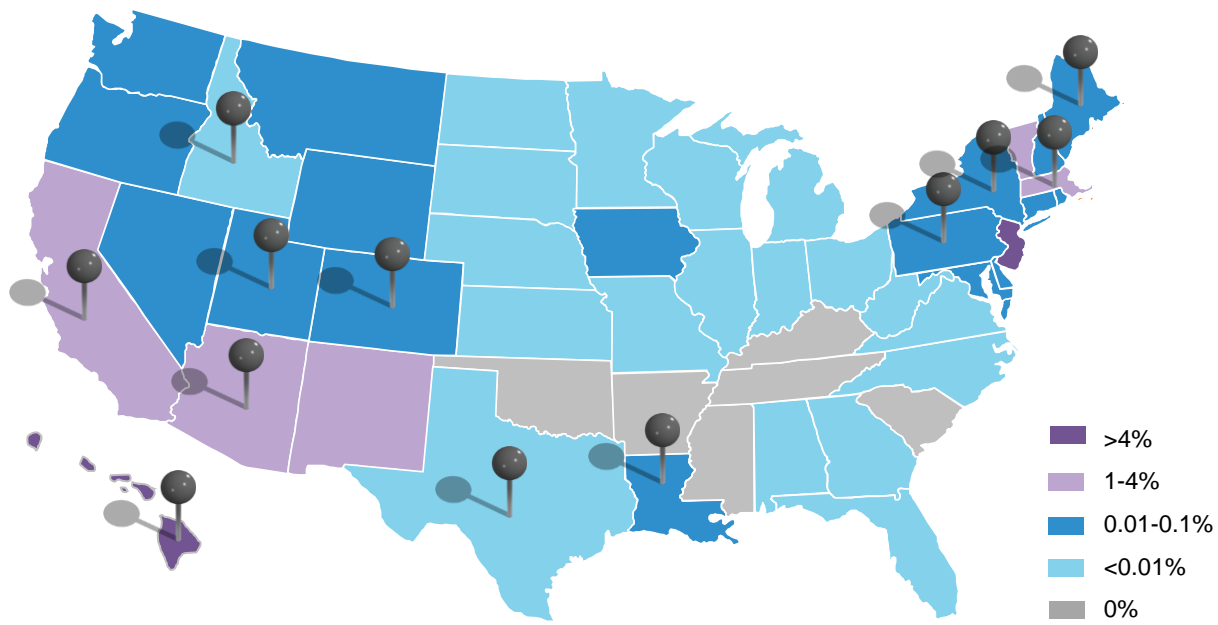
- Congress made no major energy decisions in 2014, save for a last-gasp approval of a tax extenders package in December
- Included in that package was a retroactive extension of the Production and Investment Tax Credits (PTC, ITC). But this extension came too late for most developers, as it only had a two-week lifetime before expiring

Source: Bloomberg New Energy Finance

Notes: For more on the PTC and ITC (their history, how they work, which technologies are applicable), see Sections 2.2 and 4.1 of the 2014 edition of the Factbook.

# Policy – key sustainable energy policy developments in 2014 (4 of 5): State regulatory debates

Net metering penetration by state (as % of capacity, 2013) and locations of NEM disputes (pin location) that occurred in 2012-14

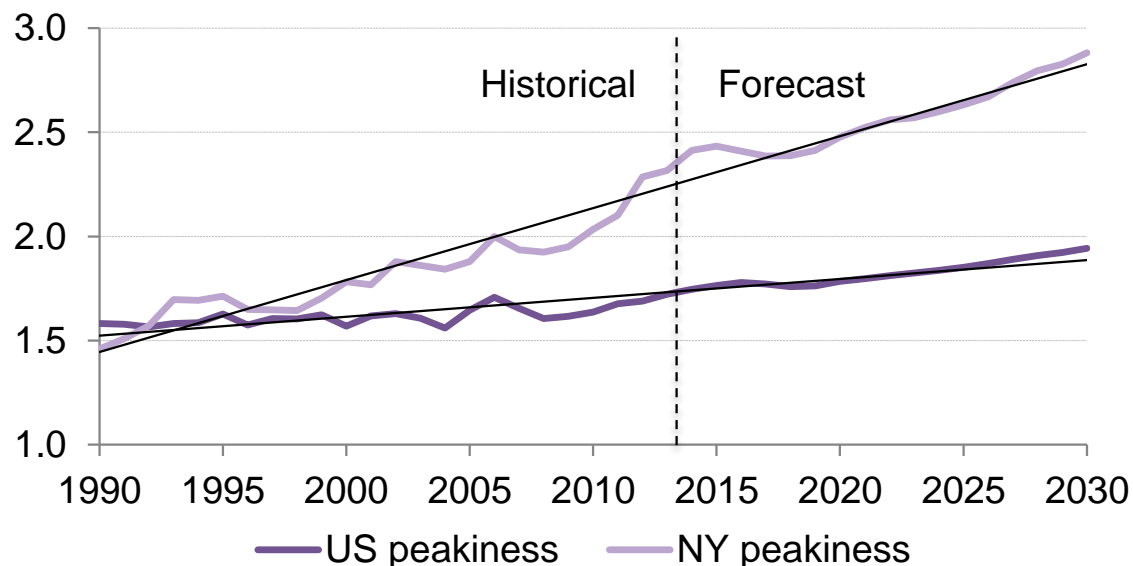


- Sustainable energy-related policy is heading in varying directions, depending on the state and the regulatory issue
- Natural gas: continued support for production in many key markets, banned in New York State
- Renewables: fierce debates around 'net metering' pitting regulated utilities vs. the solar industry (see chart above); renewable portfolio standards (RPS) have mostly held up, though Ohio has frozen its RPS program
- Energy efficiency: adoption of EERS has been slowing; eliminated in Indiana and rolled back in Ohio; regulators in Florida approved utilities' request to reduce energy efficiency targets

Source: Bloomberg New Energy Finance, EIA

Notes: Accounts for net-metered capacity across all technology types. Penetration is measured relative to summer peak demand. Pins denote states that have had recent disputes regarding net metering.

Ratios of peak to average electricity demand in US and New York

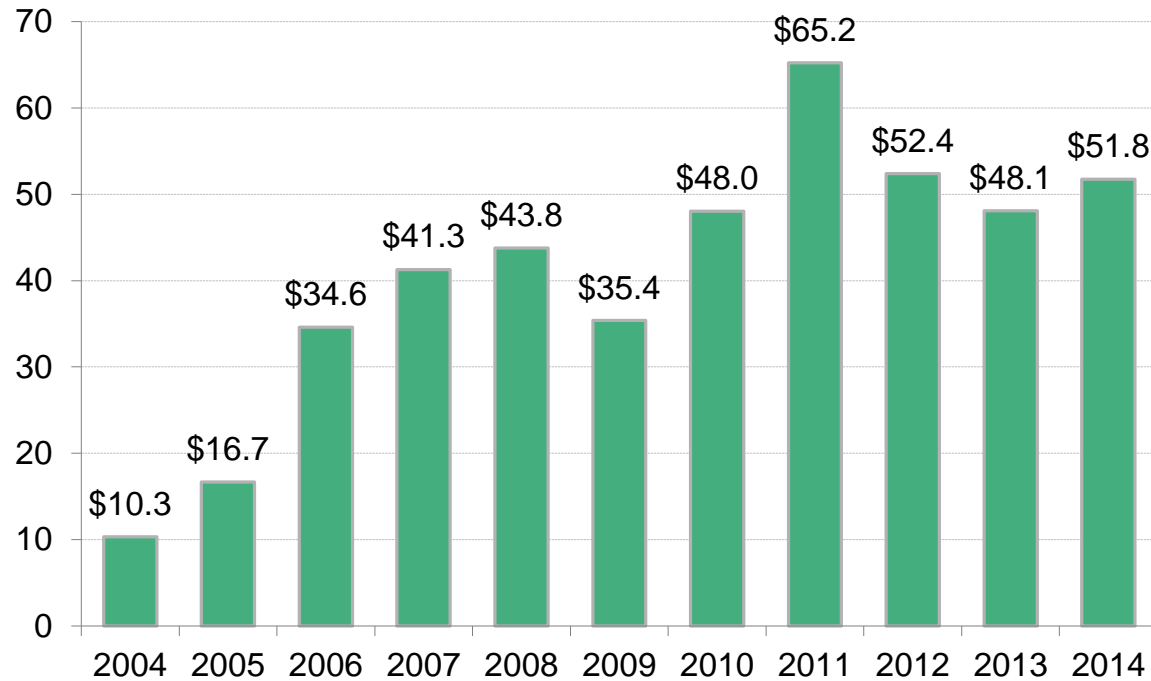


- In April 2014, New York State released its Reforming the Energy Vision (REV) proposal, which aims to reshape the state’s electricity sector. The core goals of the policy include:
  - Enhanced customer knowledge; better use of ratepayer funds; increased system-wide efficiency (including reducing peak demand); fuel diversification; improved system reliability and resilience; and reduced carbon emissions
- Demand in US (and especially New York) is growing increasingly ‘peakier’ (high peak demand relative to average demand)
- The policy is expected to facilitate greater penetration of distributed energy resources (eg, CHP, rooftop solar), smart grid technologies, demand response, energy storage, microgrids, and energy efficiency
- Several states have said they are watching the New York model closely

Source: Bloomberg New Energy Finance, NERC

Notes: Straight black lines are best-fit lines for the corresponding graphs.

# Finance: US clean energy investment (1 of 2) – total new investment, all asset classes (\$bn)



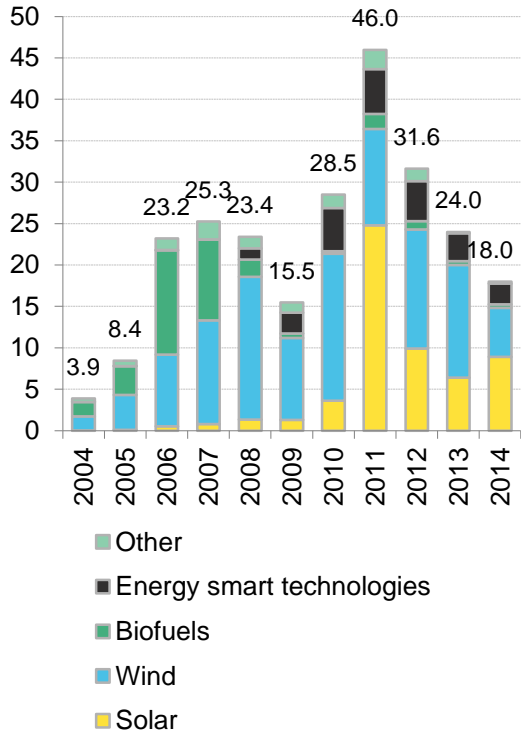
- Clean energy investment in the US since 2007 has been \$386bn
- Investment in 2014 rebounded by 7% from 2013 levels, and is 5x higher than a decade ago

Source: Bloomberg New Energy Finance

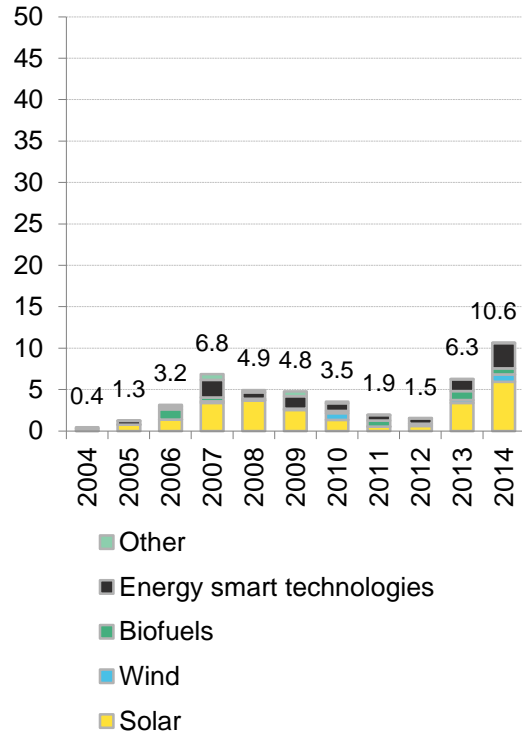
Notes: Shows total clean energy investment in the US across all asset classes (asset finance, public markets, venture capital / private equity) as well as corporate and government R&D, and small distributed capacity (rooftop solar). The definition of 'clean energy' used here is: renewable energy, energy smart technologies (digital energy, energy storage, electrified transportation), and other low-carbon technologies and activities (carbon markets value chain, companies providing services to the clean energy industry). Values in both charts include estimates for undisclosed deals and are adjusted to account for re-invested equity. Values are in nominal dollars.

# Finance: US clean energy investment (2 of 2) – new investment by asset class by sector (\$bn)

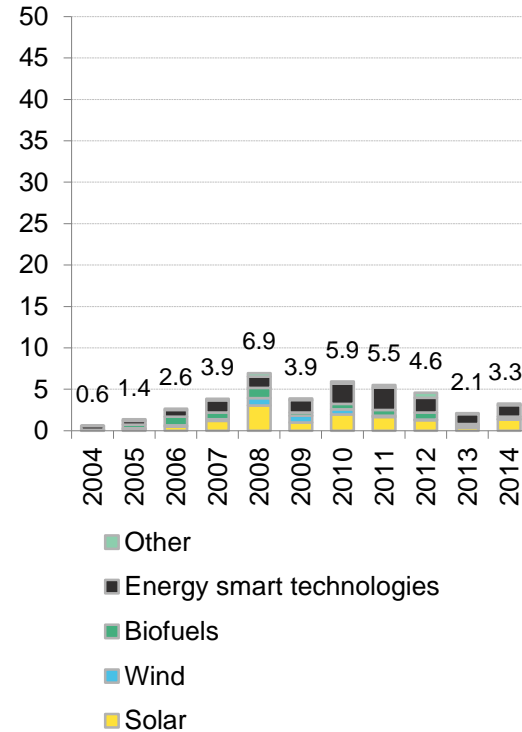
Asset finance



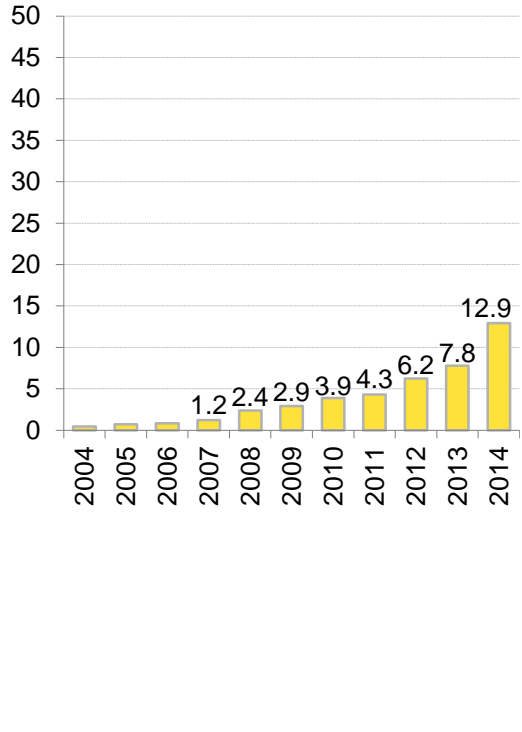
Public markets



Venture capital / private equity



Small distributed capacity (ie, rooftop solar)

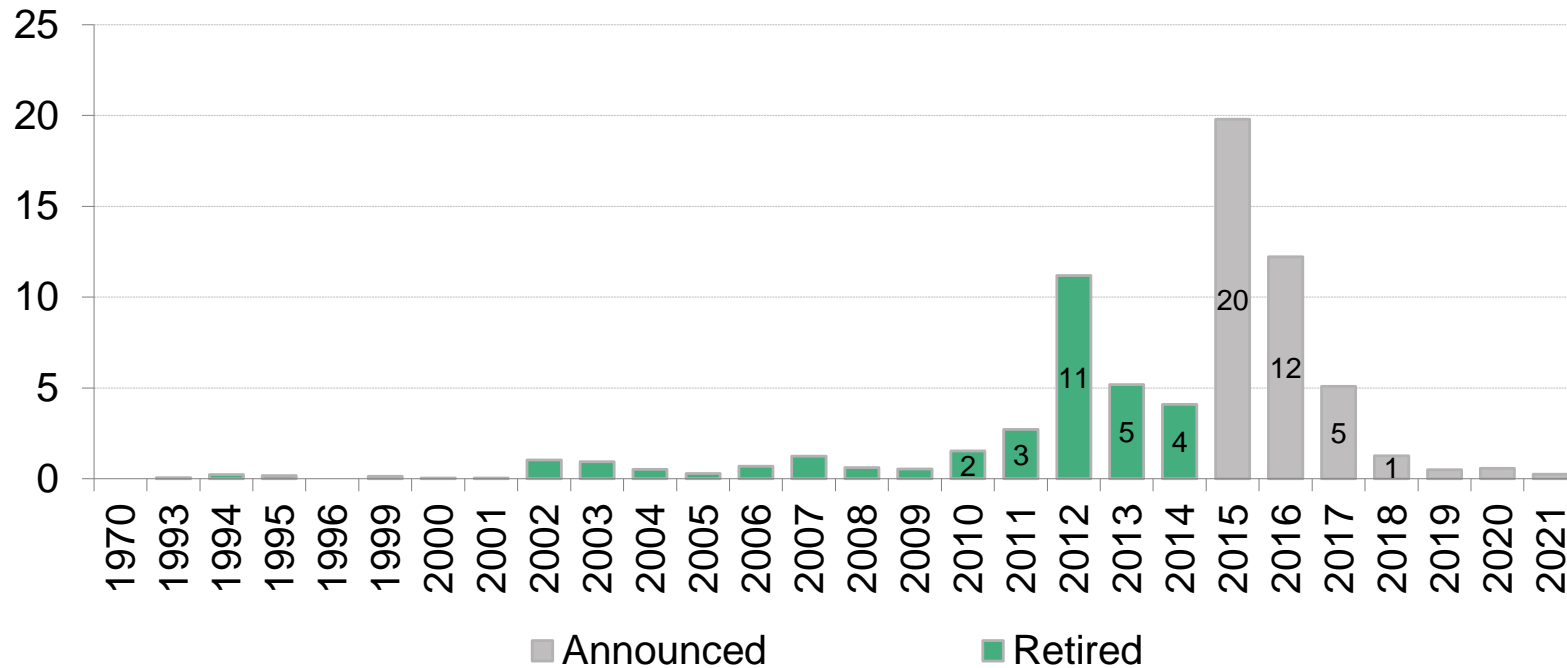


- The largest areas of investment in 2014 were:
  - Asset finance for utility-scale solar and wind (including wind projects seeking PTC eligibility before the incentive expired)
  - Public markets activity – particularly equity raises for electric vehicles maker Tesla Motors and IPOs and secondary offerings for ‘yieldcos’ (publicly-traded companies comprised of mostly operating renewable energy assets)
  - Funding for rooftop solar installations

Source: Bloomberg New Energy Finance

Notes: See previous slide for definition of ‘clean energy’. Values are in nominal dollars. Values for VC/PE include estimates for undisclosed deals.

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

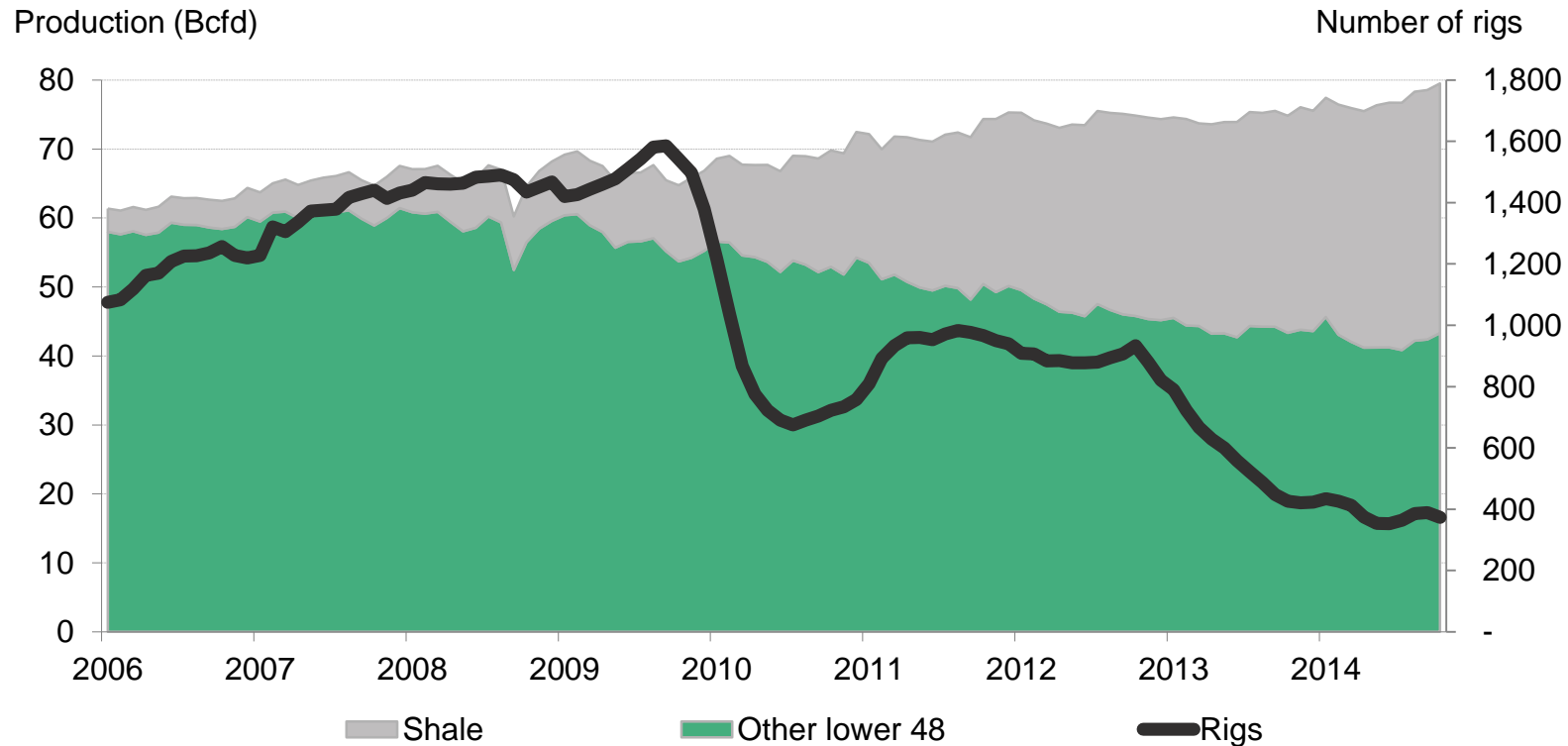


- EPA regulations covering sulfur, nitrogen, and mercury emissions from power plants will require coal units to install costly retrofit technologies. With low gas prices cutting at the margins of coal generators, many units are being forced to retire rather than install emissions controls
- The majority of announced retirements are for 2015, when the Mercury and Air Toxics Standard (MATS) takes effect
- Many of the boilers retiring represent the oldest and least efficient coal units in the power stack

Source: Bloomberg New Energy Finance

Notes: Retirements includes conversions of plants from coal to natural gas.

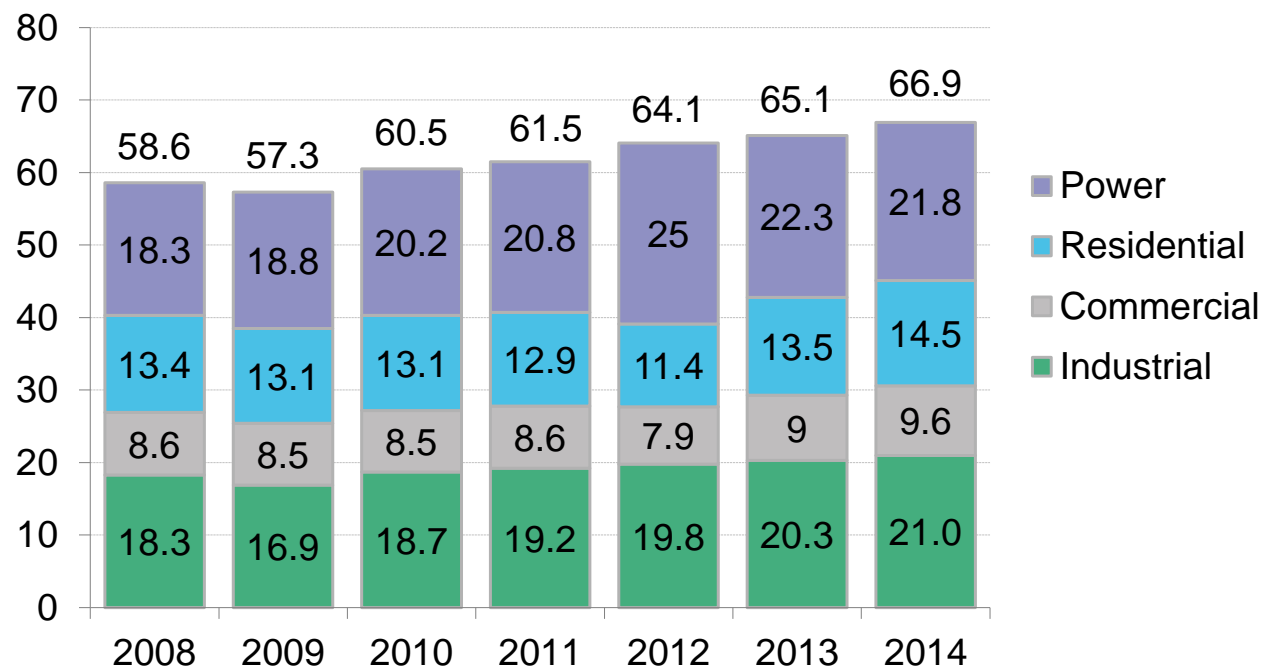
# Deployment: US natural gas production and gas-directed rig count (Bcfd, rigs)



- Despite falling rig counts, total US natural gas production, driven by shale gas drilling, continued to grow (5.7% year-over-year growth in 2014; 25% growth from 2007 to 2014)



# Deployment: US natural gas demand by end use (Bcfd)

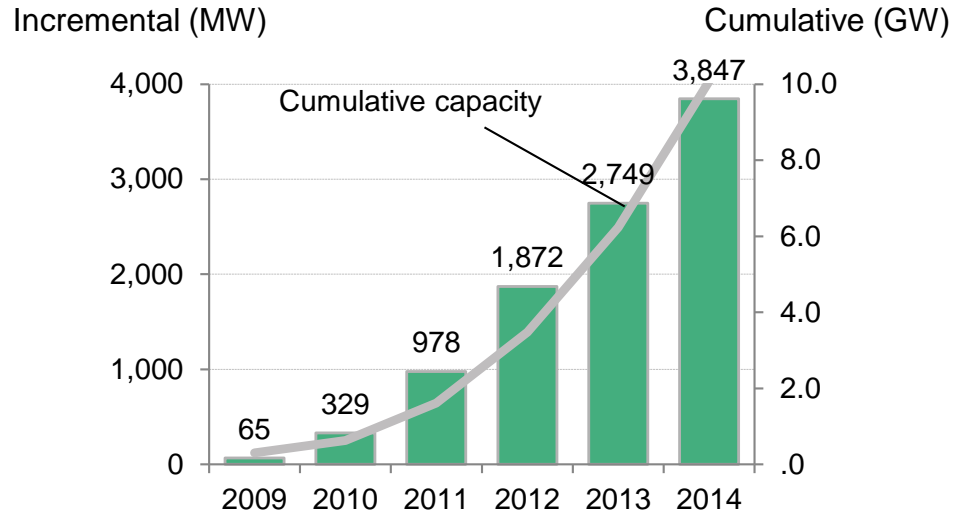


- Total US annual gas demand has grown by 14% since 2008, and an estimated 2.8% over the past year (2013-14)
- The 2014 increase was largely driven by last winter's 'polar vortex'
- More structural demand ahead in the power, industrial, and export (LNG) sectors

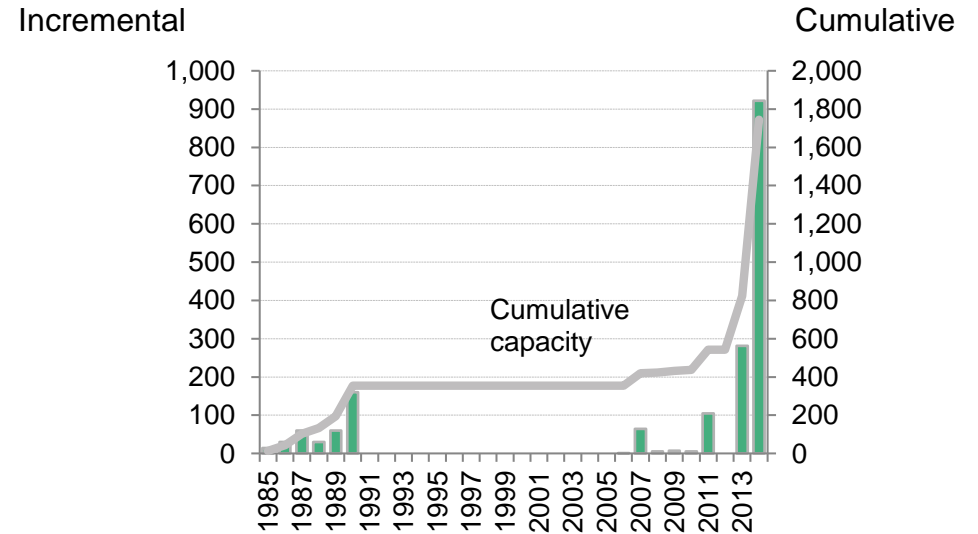
Source: EIA, Bloomberg New Energy Finance

Notes: Values for 2014 are approximated from BNEF estimates and EIA data.

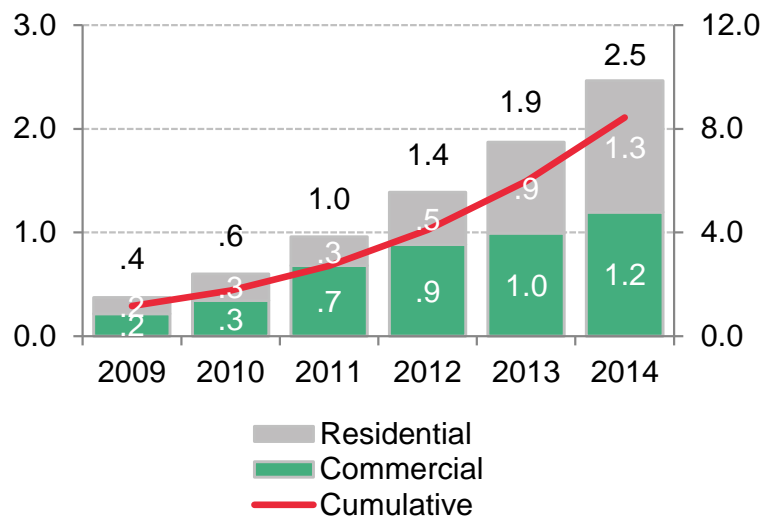
## US utility-scale photovoltaic (PV) build



## US concentrating solar power (CSP) build (MW)



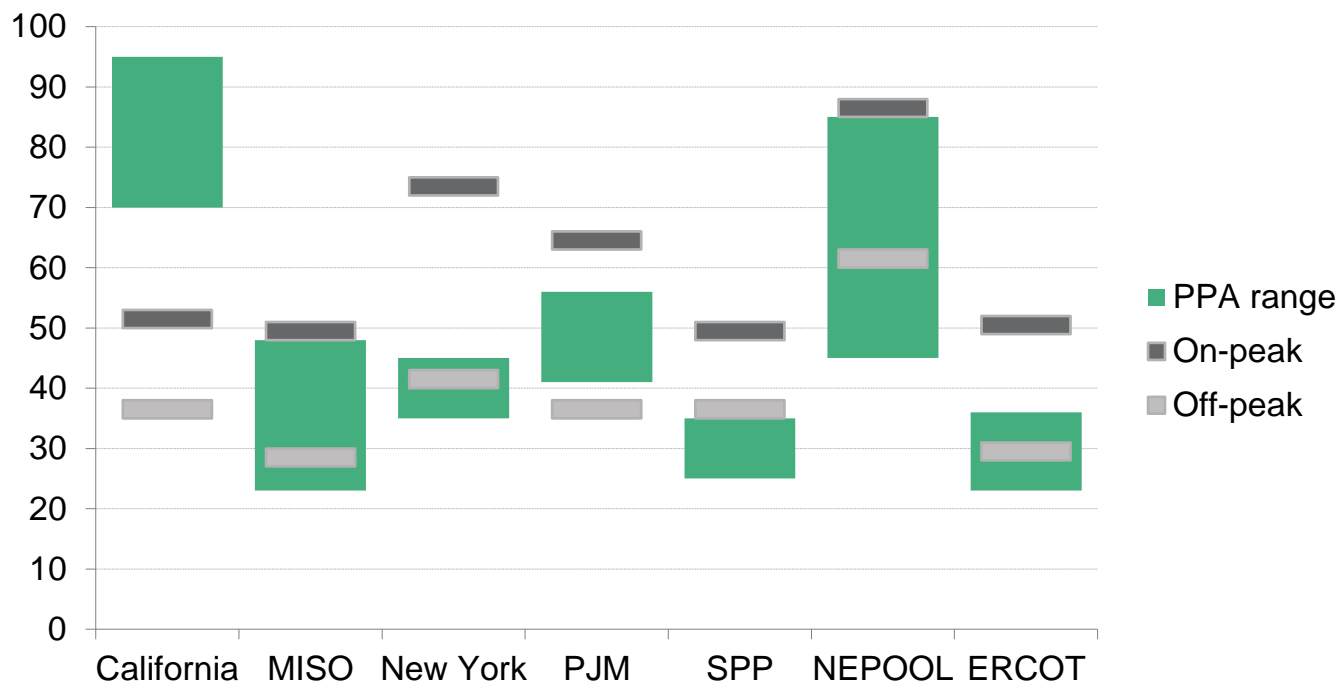
## US small-scale solar build (GW)



Source: Bloomberg New Energy Finance

Notes: 2014 PV build represents an average of optimistic and conservative analyst estimates.

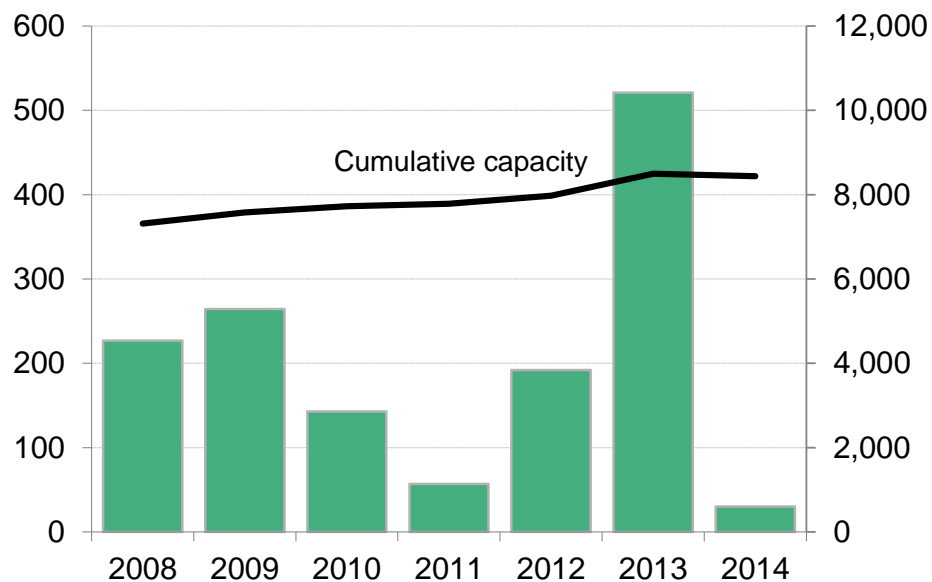
# Economics: US wind PPA prices compared to wholesale power prices in selected markets (\$/MWh)



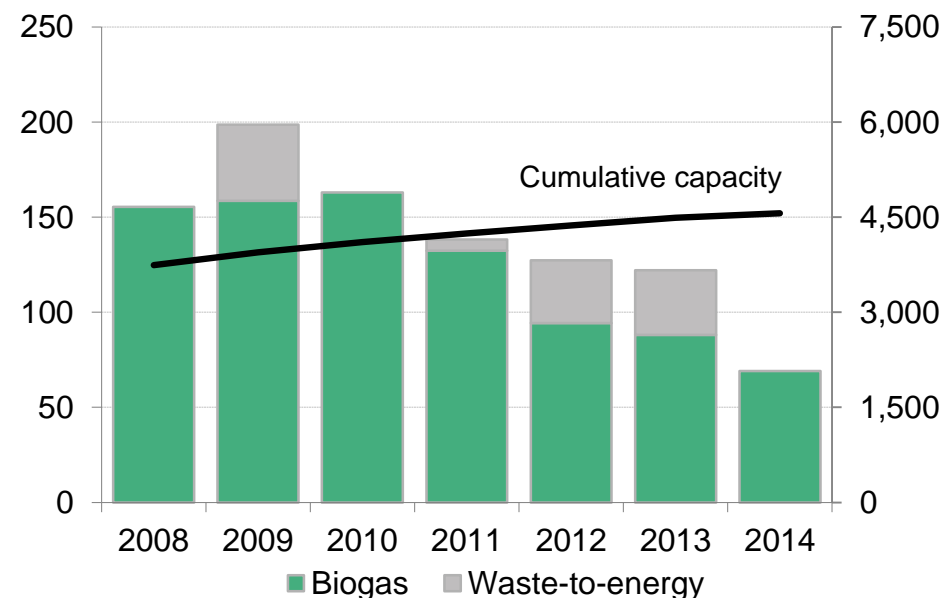
Source: Bloomberg New Energy Finance, Federal Energy Regulatory Commission, SEC filings, analyst estimates

Notes: MISO is the Midwest region; PJM is the Mid-Atlantic region; SPP is the Southwest Power Pool, covering the central southern US; NEPOOL is the New England region; ERCOT is most of Texas. Wholesale power price is average of quarterly future power prices (based on Bloomberg Commodity Fair Value curve) maturing in calendar year 2015 for selected nodes within the region.

## US biomass-to-power build (MW)



## US biogas and waste-to-energy build (MW)



- Policy support measures led to a spike in biomass installations in 2013 at 521MW, falling sharply to 30MW in 2014
- These incentives are closed to new entrants, which will probably lead to less new capacity in the next few years
- New biogas capacity has been declining since 2010; there were no new waste-to-energy installations in 2014

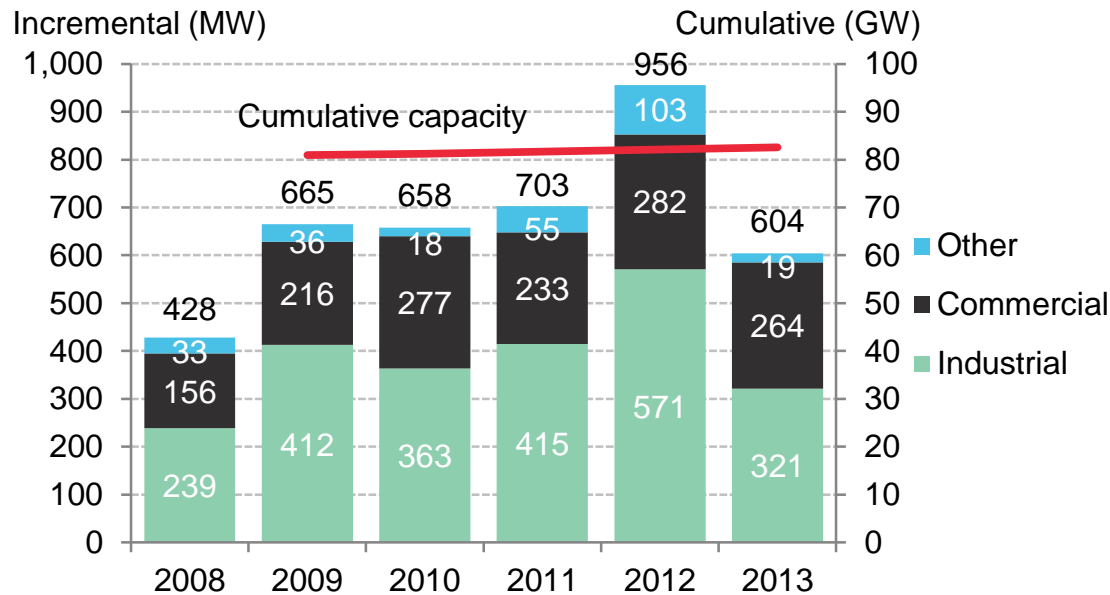
Source: Bloomberg New Energy Finance, EIA

Notes: Includes black liquor. 2014 results are as of end-October 2014.

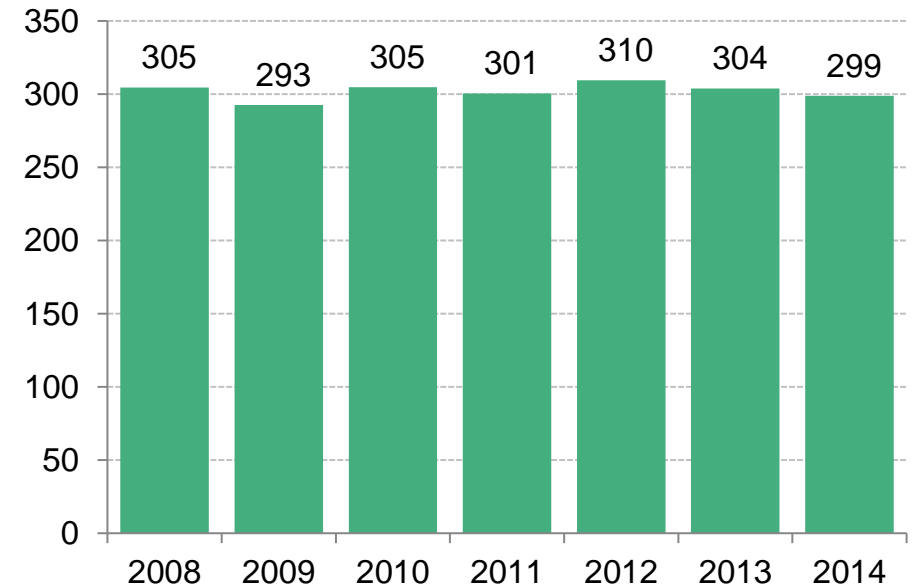
Source: Bloomberg New Energy Finance, EIA

Notes: Biogas category includes anaerobic digestion (projects 1MW and above except wastewater treatment facilities) and landfill gas power. 2014 results are as of end-October 2014.

## US CHP build



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



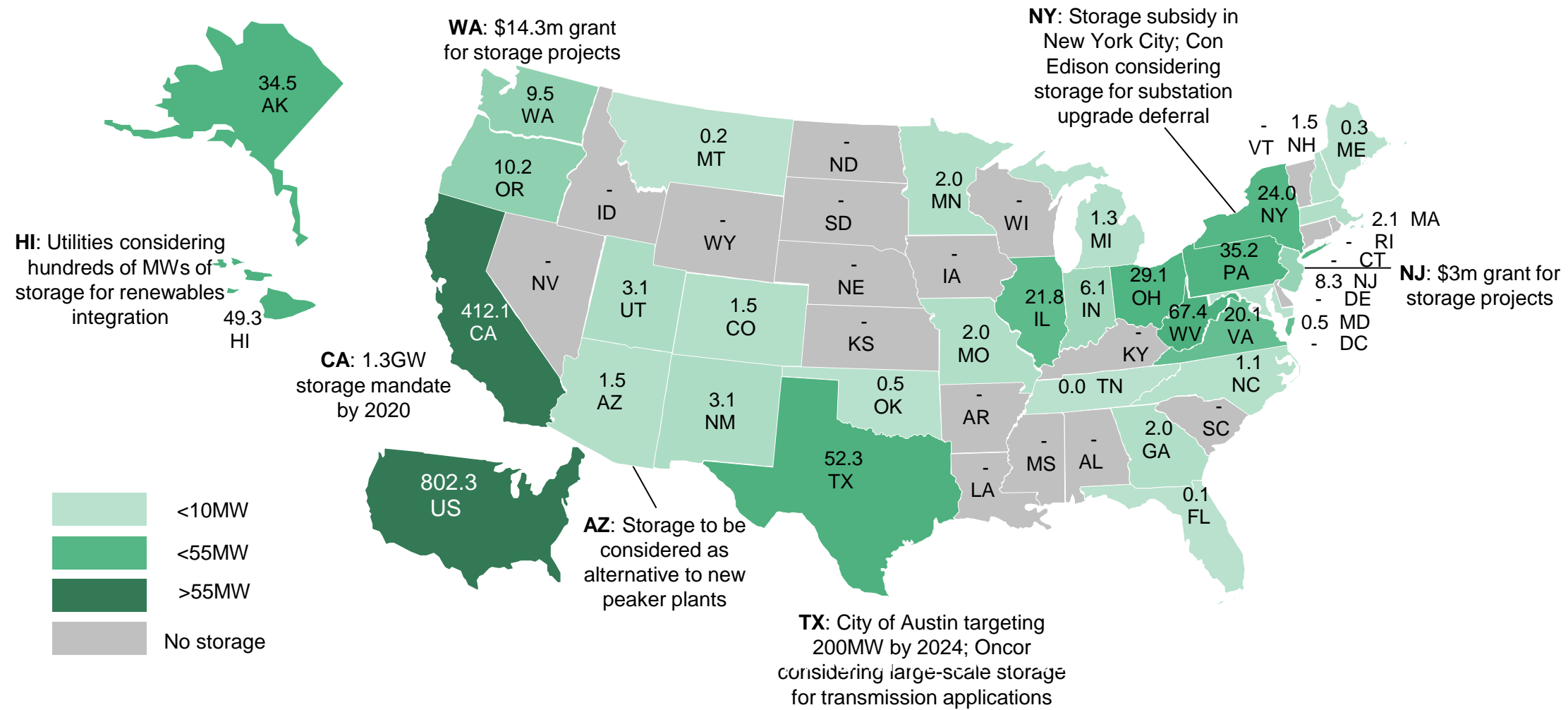
- Annual installations for combined heat and power (CHP) peaked in 2012
- Data may underestimate total CHP production because it does not reflect some newer, smaller installations
- Micro-CHP (<50kW) is a small yet growing portion the total industry

Source: EIA

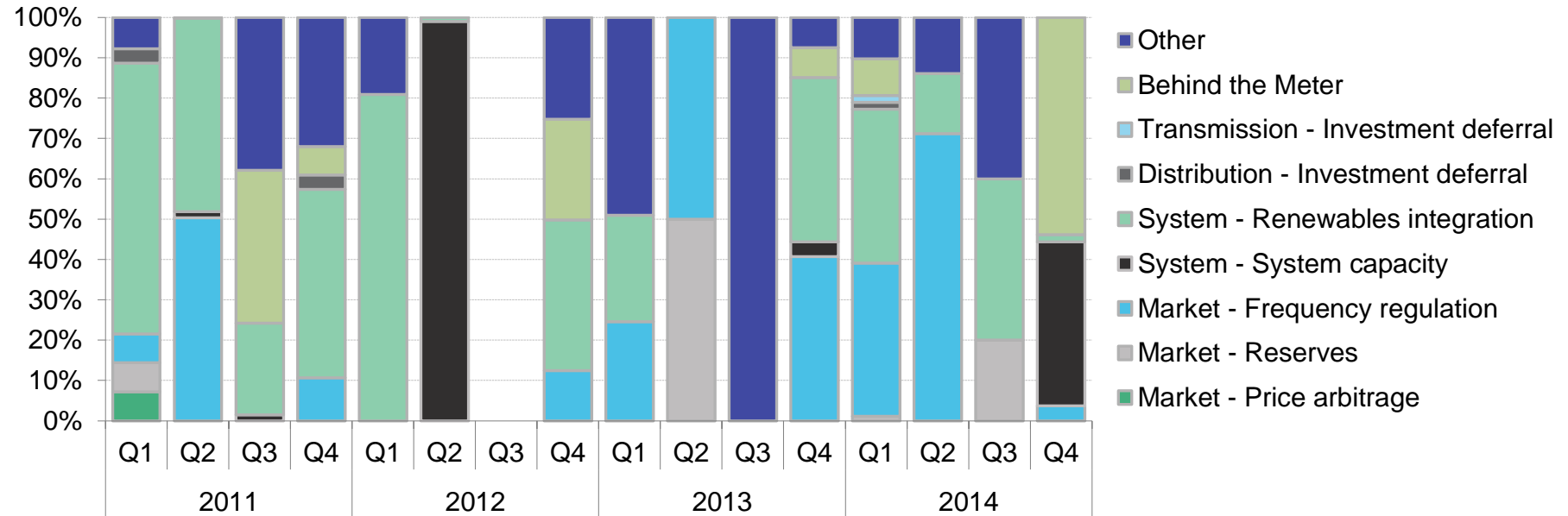
Notes: EIA is the best available source for generation data. However, EIA data on CHP is not comprehensive and so the generation figures are underestimated. Specifically, EIA does not collect data for sites <1MW; EIA may not be aware of certain installations and thus may not send these sites a survey 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 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2014).

Source: Bloomberg New Energy Finance, CHP Installation Database. Maintained by ICF International for Oak Ridge National Laboratory.

# Deployment: US announced and installed energy storage capacity (MW)



# Deployment: Mix of *applications* for US non-hydropower energy storage for announced projects (% by MW)



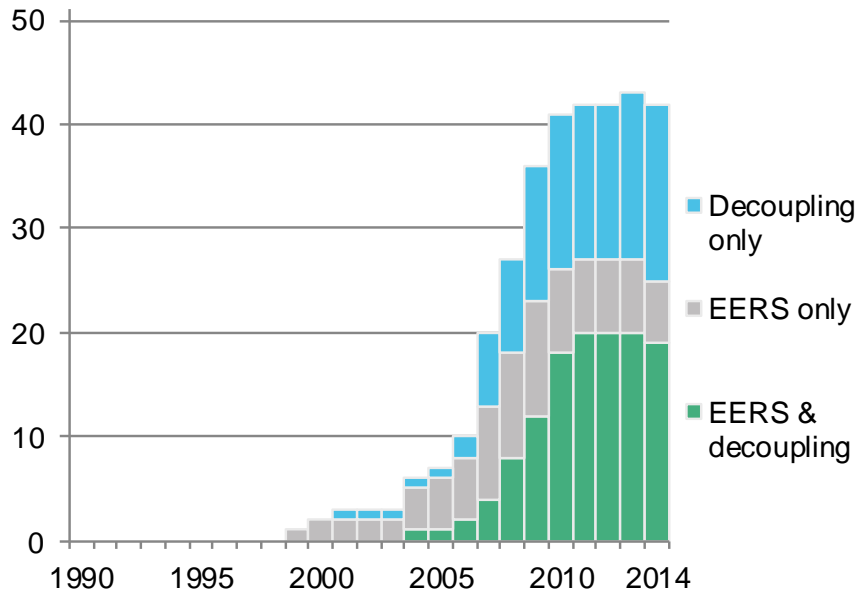
- Key applications for storage have been:
  - Frequency regulation in PJM
  - Transmission and distribution upgrade deferral
  - Behind the meter demand charge management at commercial and industrial end user facilities

Source: Bloomberg New Energy Finance

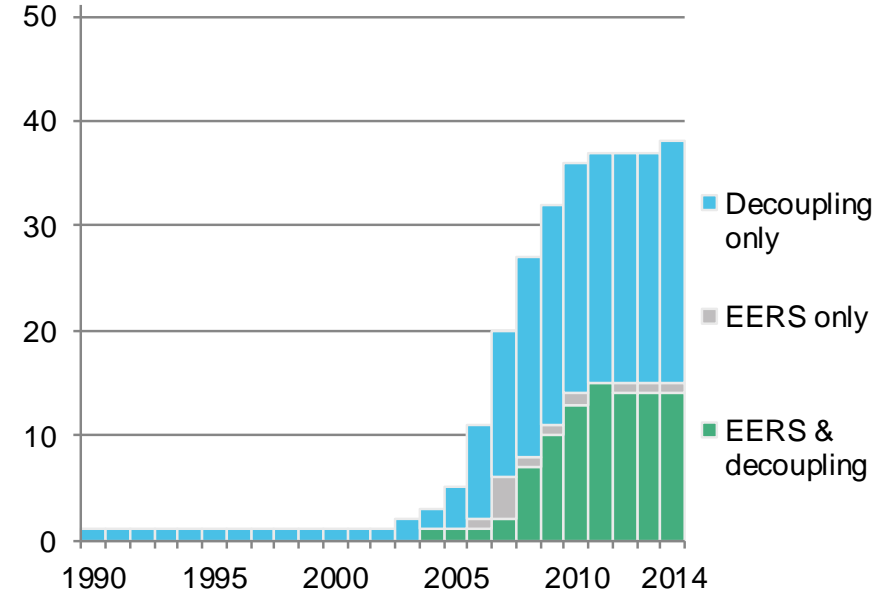
Notes: Pumped hydropower storage is not included in this chart as it would dwarf all other technologies. Empty columns represent quarters in which there were no new projects announced. 'Other' refers to applications not represented in the legend; many of these are government funded technology testing or pilot projects to prove concepts. The application categories have been revised since last year's edition of the Factbook to better represent market terminology and trends.

# Policy: US states with EERS and/or decoupling legislation (number of states)

## Electricity



## Natural gas



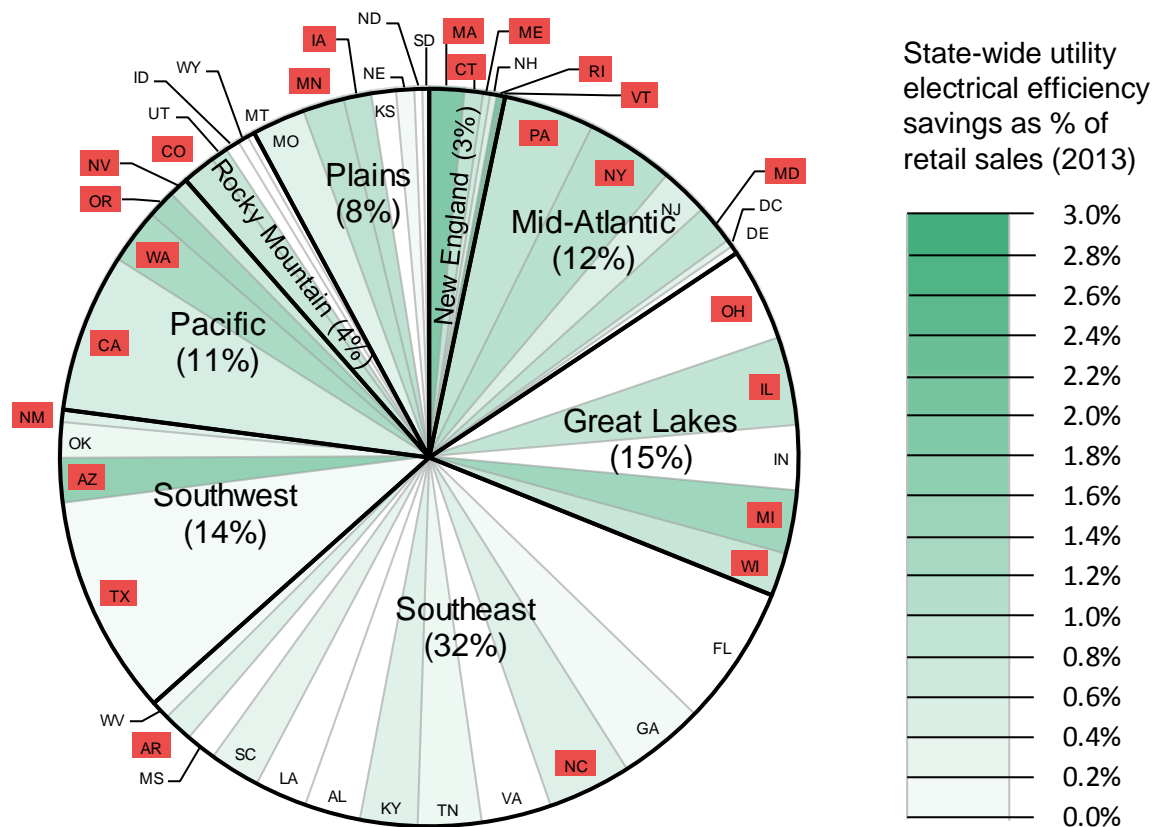
- The key policy story of the past decade has been the uptake of targets for energy efficiency resource standards (EERS) and of decoupling legislation among US states
- Momentum has slowed since 2010, and notable negative developments in 2014 include:
  - Indiana – elimination of EERS
  - Ohio – freezing of EERS, which essentially amounts to a rollback of the policy, as it disables long-term planning potential
  - Florida – state regulator approved the state’s utilities’ proposal to cut energy efficiency targets by more than 90%
- The proposed EPA Clean Power Plan may encourage a new wave of EERS

Source: ACEEE, Bloomberg New Energy Finance

Notes: Decoupling includes all mechanisms for lost-revenue adjustments.



# Policy: Share of total electricity consumption by US state and region, and electric efficiency savings by state, 2013 (%)

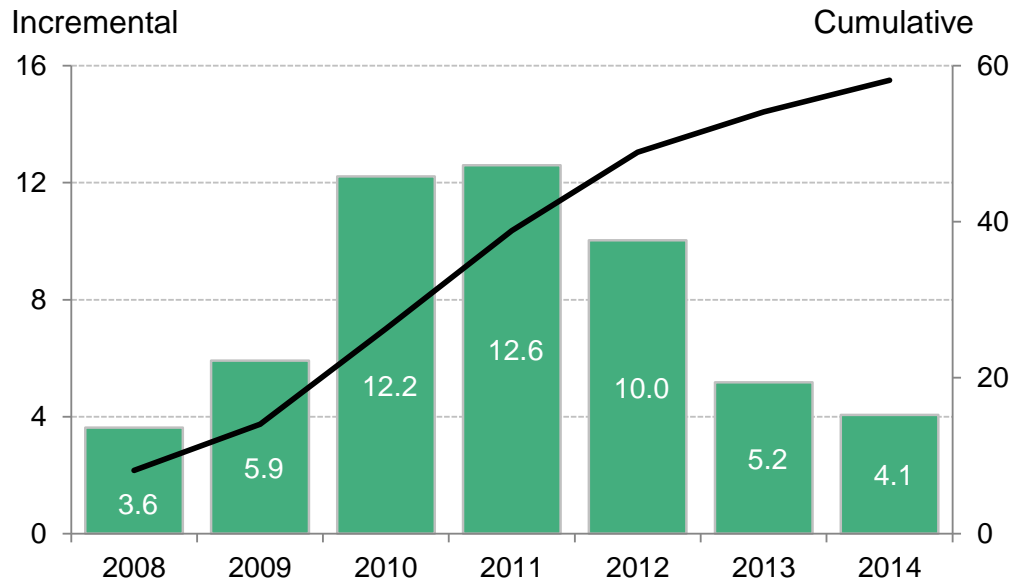


- The majority of states in the Pacific, Mid-Atlantic and New England regions have adopted EERS legislation, and it is in these regions where savings account for the largest percentage of retail sales
- The Southeast remains a market with untapped potential for energy efficiency, and had no major policy developments in 2014

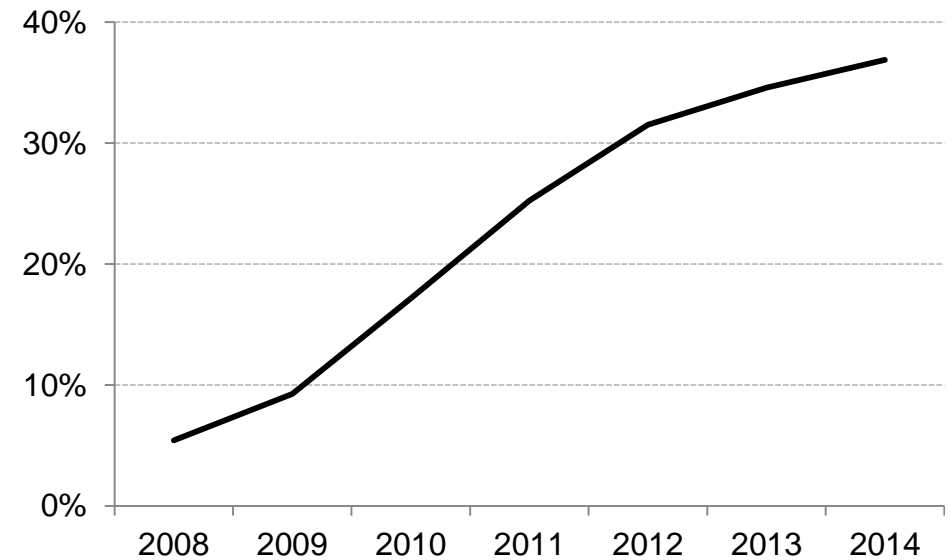
Source: ACEEE, EIA, Bloomberg New Energy Finance

Notes: The shading for individual states indicates savings from utility electrical efficiency programs as a fraction of retail sales. State codes highlighted in red indicate EERS requirements for electric utilities. Hawaii and Alaska not depicted.

## US smart meter deployments (million units)



## Smart meters deployed as a percentage of US electricity customers

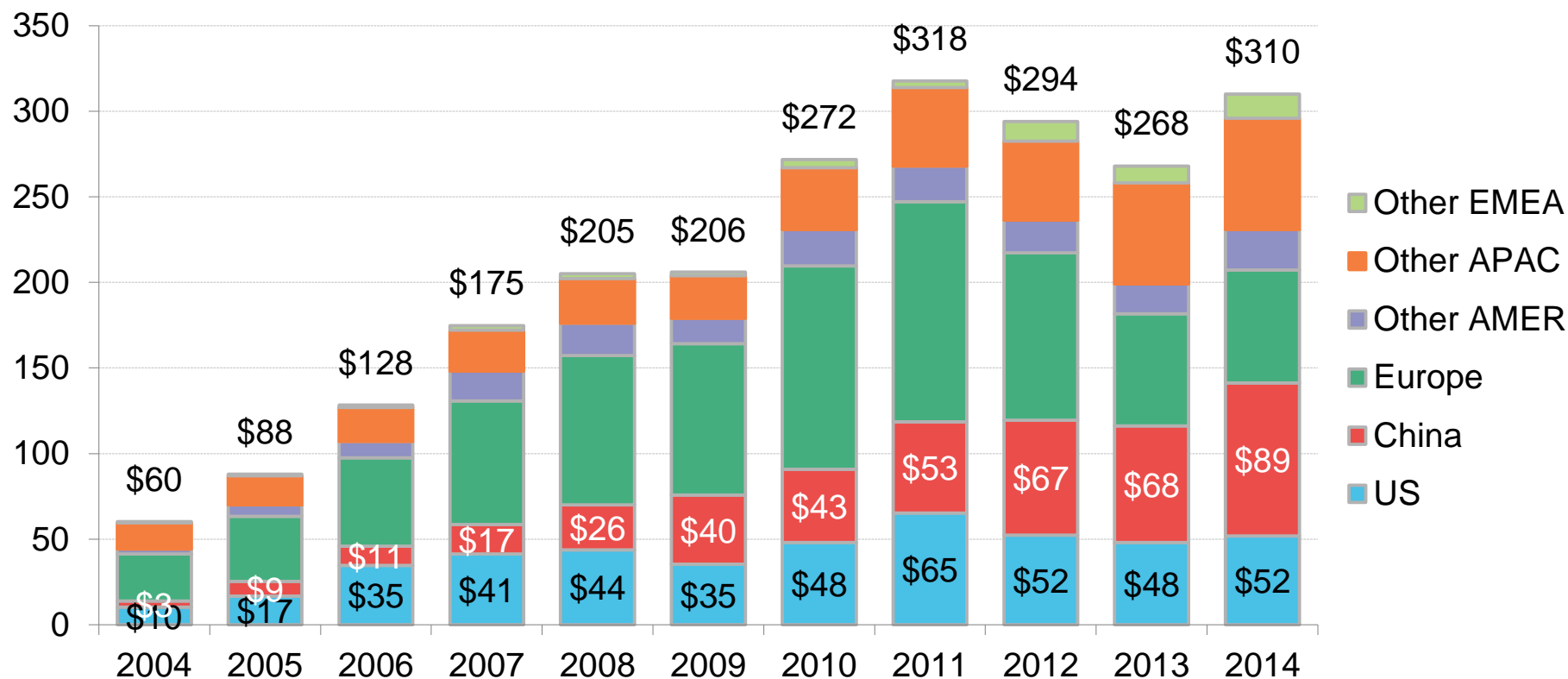


- Smart meter deployments hit a peak in 2010 and 2011, making use of a burst of stimulus funding awarded in 2009
- Smart meters have been deployed to 39% of electricity customers
- Another type of advanced meters – those used to automate billing, or automatic meter readers (AMR) – have been deployed to another 35% of US customers

Source: Bloomberg New Energy Finance, EIA

Notes: Charts above show values for smart meters and exclude AMR deployments. Smart meters are defined as those capable of 'two-way communication' (ie, grid communicates with meter and vice versa), whereas AMRs provide one-way communication (ie, meter delivers automated readings). Some historical numbers may have changed as a result of updates to meter deployment timelines.

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

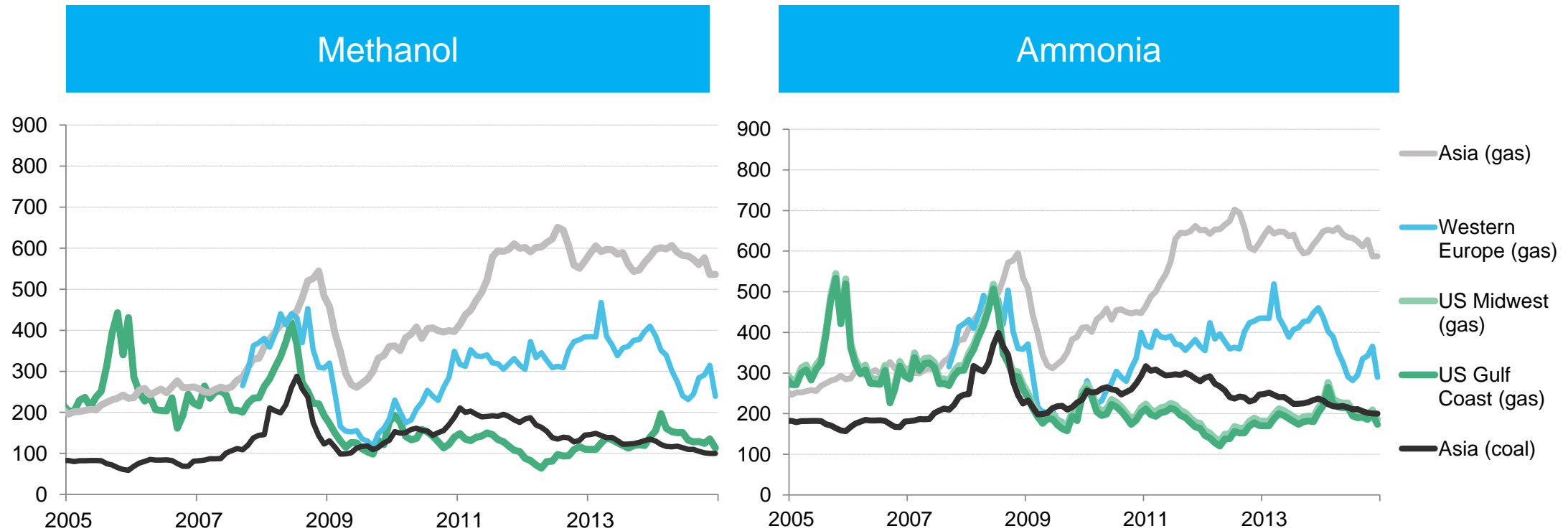


- Total new investment in clean energy globally increased for the first time in three years and is near its 2011 peak
- US investment levels were up in 2014 and are second highest in the world on a country basis

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.

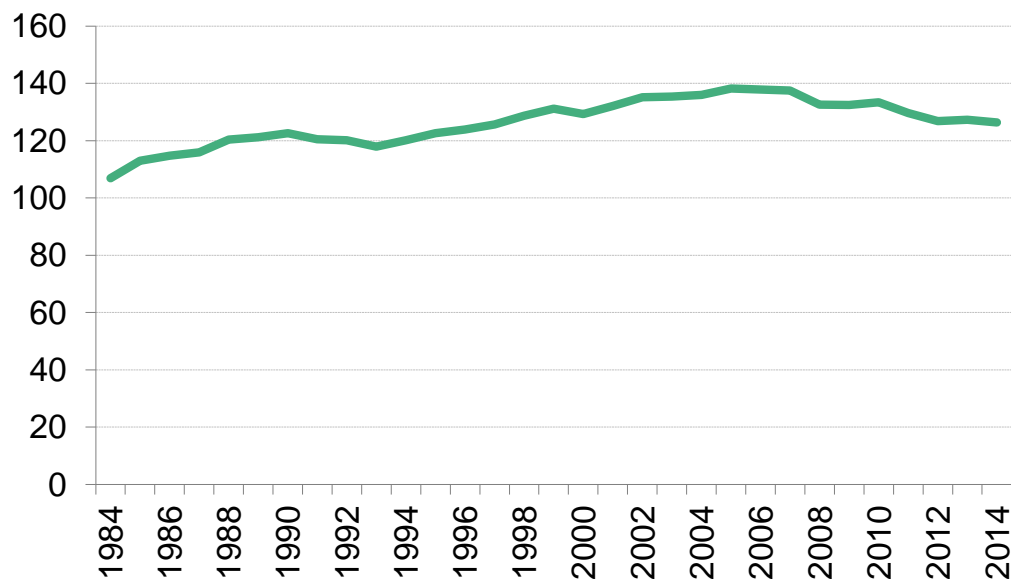
# Global context: Energy prices – production costs of gas-intensive industries by region and feedstock (\$/t)



- Low natural gas prices have given a comparative advantage in operating costs to US chemical sector operations, such as production of methanol and ammonia
- In 2014, gas-intensive industries brought online 10 new projects that make use of low-cost gas (and proposed another 32 projects)
- The only region-feedstock combination with comparable economics is coal gasification in Asia

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

## US gasoline consumption (bn gallons per year)



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



- Gasoline use in the US continues to trend down (126.4bn gallons per year in 2014, an 8.6% reduction from the peak in 2005)
- Tightening corporate average fuel economy (CAFE) standards and emissions targets are pushing carmakers to release more fuel efficient vehicle models
- Other factors driving down gasoline consumption are: changing driving patterns (miles driven per vehicle, and total number of vehicles on the road, have peaked and are slowly declining) and the introduction of alternative fuels

Source: EIA

Notes: Analysis is based on daily averages of 'total gasoline all sales / deliveries by prime supplier'. Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2014).

Source: UMTRI, Bloomberg New Energy Finance

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

- **Long-term trend shows evidence of transformation. Over 2007-14:**
  - US carbon emissions from energy sector dropped 9%
  - US natural gas production rose 25%
  - Total US investment in clean energy (renewables, advanced grid, storage, electrified transport) totalled \$386bn
- **2014 was notable in terms of two key developments that occurred in the backdrop:**
  - US economy has been gaining steam
  - Oil prices collapsed – no direct link for most technologies, but some ‘second-order’ effects
- **Some deviations from the long-term trend, but there’s a ‘silver lining’ to each:**
  - Coal generation and carbon emissions up from 2012 levels (but significant portion of coal fleet is retiring soon)
  - Energy efficiency policy has been slowing (but EPA’s proposed plan would ask for new policies to play a big role)
- **Broader US ecosystem is preparing for a sustainable energy future:**
  - Critical new policies introduced (EPA CPP, US-China pledge NY State REV)
  - Industries with significant energy-related cost exposure gravitated to the US as a base for operations
  - Major new infrastructure projects advanced (natural gas pipelines, smart grid technologies)
  - More capital flowed to financial vehicles aimed at sustainable energy development (eg, yieldcos, green bonds)

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