February 2015

2015 FACTBOOK

Sustainable Energy in America

Bloomberg NEW ENERGY FINANCE

The Business Council for Sustainable Energy®

Developed in partnership with the Business Council for Sustainable Energy.

Overview

For the last three years, the Sustainable Energy in America Factbook has documented the revolution transforming how the US produces, delivers, and consumes energy. In 2014, that revolution continued, and the long-term implications of these changes are coming into sharper focus.

To single out just a few tell-tale headlines from the hundreds of statistics presented in this report: over the 2007-14 period, US carbon emissions from the energy sector dropped 9%, US natural gas production rose 25%, and total US investment in clean energy (renewables and advanced grid, storage, and electrified transport technologies) totalled $386bn.

This third edition of the Factbook presents the latest updates on those trends, with special emphasis on 2014 happenings. The year was a notable one not just in terms of progress achieved by some sustainable energy sectors but also in terms of two key developments in the broader context. The first is the growth of the US economy, which has increased by 8% since 2007 and has been gaining steam in the past few quarters. The Factbook shows that advances in sustainable energy have been concurrent with this growth, and have partially fuelled it. The second is the collapse of oil prices. While there is no explicit link between oil (which in the US is used mostly for transport) and most sustainable energy technologies (which are used mostly in the power sector), the oil price shock has a profound global impact and may result in 'second-order' effects which could impact US sustainable energy.

Finally, the Factbook evidence brings into focus one unmistakable theme: *the broader US ecosystem is clearly preparing for a future in which sustainable sources of energy play a much larger role*. As evidence, consider these developments that surfaced or accelerated in 2014:

- **Critical new policies were introduced** that hinge on the promise of sustainable energy technologies. Most momentous were the Obama administration's power sector regulation and bilateral climate pact with China. But other key policies were rolled out that take the long view on clean energy integration, including New York State's plan to overhaul regulation of its electric industry to better accommodate more flexible and cleaner sources of energy.
- **Industries with significant energy-related cost exposure gravitated to the US** as a base for operations. Companies for whom feedstock or energy is a fundamental cost driver, such as firms in natural-gas-intensive industries and data centers with big electricity footprints, recognize that the economics here are among the most attractive in the world from the perspective of energy buyers.
- **Major new infrastructure projects advanced** to accommodate the immense influx of these technologies. This included major expansions of natural gas pipelines and deployments of smart grid technologies.
- **More capital flowed to financial vehicles** specifically aimed at sustainable energy development. This included 'yieldcos' and green bonds, which should pave the way toward raising huge sums of capital needed for the sustainable energy future to come to fruition.

The Sustainable Energy in America Factbook provides a detailed look at the state of US energy and the role that a range of new technologies are playing in reshaping the industry. The Factbook is researched and produced by Bloomberg New Energy Finance and commissioned by the Business Council for Sustainable Energy. As always, the goal is to offer simple, accurate benchmarks on the status and contributions of new sustainable energy technologies.

Table of contents

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** 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**: Previous editions of the Factbook have been in the form of 100-page PDF documents. 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, last year's edition(1) can continue to serve as a reference. The emphasis of this 2015 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
- **2014 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 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

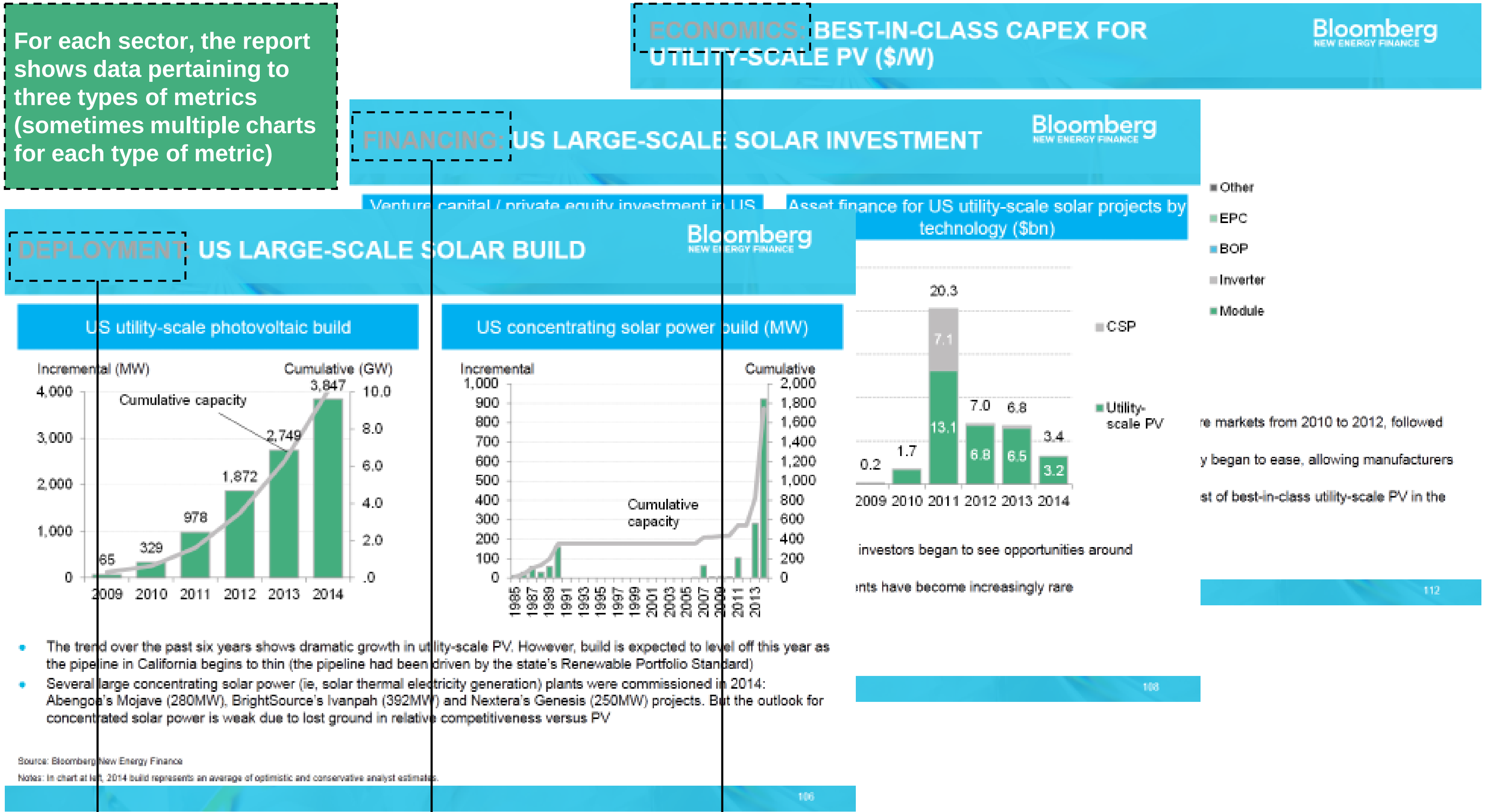
(1) Last year's edition (the 2014 Factbook) can be found here: http://www.bcse.org/factbook/pdfs/2014%20Sustainable%20Energy%20in%20America%20Factbook.pdf

About the Factbook (2 of 4): Understanding terminology for this report

	FOSSIL-FIRED / NUCLEAR POWER	RENEWABLE ENERGY	DISTRIBUTED POWER, STORAGE, EFFICIENCY	TRANSPORT
SUSTAINABLE ENERGY (as defined in this report)	• Natural gas • CCS	• Solar • Wind • Geothermal • Hydro • Biomass • Biogas • Waste-to-energy	• Small-scale renewables • CHP and WHP • Fuel cells • Storage • Smart grid / demand response • Building efficiency • Industrial efficiency (aluminum) • Direct use applications for natural gas	• Electric vehicles (including hybrids) • Natural gas vehicles
OTHER CLEAN ENERGY (not covered in this report)	• Nuclear	• Wave / tidal	• Lighting • Industrial efficiency (other industries)	• Biofuels

About the Factbook (3 of 4):
The sub-sections within each sector

For each sector, the report shows data pertaining to three types of metrics (sometimes multiple charts for each type of metric)



Deployment: captures how much activity is happening in the sector, typically in terms of new build, or supply and demand

Financing: captures the amount of investment entering the sector

Economics: captures the costs of implementing projects or adopting technologies in the sector

Notes: A small number of sectors do not have slides for each of these metrics, due to scarcity of data. The section on energy efficiency also includes a set of slides dedicated to policy.

Sponsorship of this report

The Business Council for Sustainable Energy

- 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. Since 1992, the Council has been a leading industry voice advocating for policies at the state, national and international levels that increase the use of commercially-available clean energy technologies, products and services.

Executive summary (1 of 5)

The long-term transformation of how the US produces and consumes energy continues…

- The US economy is becoming more energy-productive (ie, less energy-intensive). 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% over the past year (2013 to 2014). In the case of electricity, there has been an outright decoupling between electricity growth and economic growth. Between 1950 and 1990, electricity demand grew at an annual rate of just below 6%. Between 1990 and 2007, it grew at an annual of 1.9%. Between 2007 and 2014, annualized electricity demand growth has been… zero.
- The US power sector is decarbonizing. Natural gas is gradually displacing coal; production and consumption of natural gas hit record highs in 2014. The contribution of renewable energy (including large hydro projects) to the country's electricity mix rose from 8% in 2007 to an estimated 13% in 2014. Since 2000, 93% of new power capacity built in the US has come in the form of natural gas, wind, solar, biomass, geothermal, or other renewables.
- The US clean energy sector has seen $35-65bn of investment each year since 2007 and has totalled $386bn over that period. These annual investment tallies are much higher than the levels a decade ago ($10.3bn in 2004), indicating that the industry has greatly matured. Investment in 2014 was $51.8bn, a 7% increase from 2013 levels. The key drivers behind these numbers were: the brief window of renewed policy support for wind, the acceleration of the rooftop solar business; and the emerging phenomenon of 'yieldcos' (publicly listed companies that own operating renewable energy assets).
- The US transportation sector's dependence on oil has been decreasing. Gasoline consumption is down by 8.6% since 2005, largely due to increasing vehicle efficiency prompted by federal policy, increasing consumer preference for less thirsty vehicles, changing driving patterns (declining number of vehicles on the road, declining miles per vehicle), and increased biofuels blending. Meanwhile, new vehicle technologies are emerging, and are only just starting to leave what could be a large and lasting dent on oil use. At the same time, on the back of advances in shale drilling, US oil production is up 41% since 2007, and has returned to levels not seen since the 1980s.

But in three key metrics, results of the last two years have wavered from long-term trends – though there is a silver lining to each...

- After a record year in 2012, natural gas's contribution to the US electricity mix has slipped the last two years, and coal generation has regained some market share. Natural gas prices have risen from historic lows seen in 2012, allowing coal to be somewhat more cost-competitive. Coal generation dropped from 49% of US electricity in 2007 to 37% in 2012, but has since ticked up to 39% in 2013 and 2014. Nevertheless, 'structural' trends – especially the retirement of coal plants – are underway that will probably lead to long-term increased market share for natural gas.
- Largely driven by this trend, US carbon emissions from the energy sector have risen since 2012, after having been on a mostly downwards trajectory since 2007. However, as enacted and proposed policies (such as regulations on existing power plants and fuel economy standards for cars) begin to bite, emissions are projected to go on a downward trajectory according to official US estimates.
- Uptake of key energy efficiency policies is slowing. States' adoption of decoupling legislation and energy efficiency resource standards (EERS) has been mostly flat since 2010 (with some exceptions), and some states have even begun to retreat from these policies. Yet a decisive federal policy (more on this below) could, if enacted, prompt a new round of EERS-like adoptions and expansions across many states.

Executive summary (2 of 5)

Still, across most sectors, the momentum for a sustainable energy future continues to build.

- *Through two major policy proposals unveiled in 2014, the Obama administration signalled it is serious about tackling greenhouse gas emissions.* In June, the Environmental Protection Agency (EPA) announced a proposed policy targeting CO2 reductions in the existing power fleet. The Clean Power Plan, which calls on states to implement their own programs for reducing carbon emissions intensity, could be the most ambitious policy ever proposed for incentivizing the deployment of natural gas, renewable energy, 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 Plan is analyzed in further depth in Section 8.1 of the report.) In November, the White House announced that it had reached a historic climate agreement with China, with the US pledging to reduce greenhouse gas emissions by 26-28% relative to 2005 levels by 2025, and China promising to peak CO2 emissions around 2030. Neither policy will come easy. Legal challenges to the EPA's proposal are underway, and achievement of the 2025 pledge will require new policy action.
- *Supply and demand for natural gas are hitting all-time highs.* Natural gas production has increased by 25% since 2007, driven by the emergence of technologies and techniques to extract unconventional natural gas resources at a low cost. Sectors with demand for natural gas have been capitalizing on this supply. In the midst of the 'polar vortex', in January 2014, the natural gas delivery system set daily, weekly, and monthly all-time records. Since 2010, owners of electricity generation have retired 25GW of coal plants and have announced plans to retire another 38GW by 2018 (to some extent driven by regulation), with much of this to be offset by increased natural gas usage. In 2014, natural-gas-intensive industries brought online 10 new projects that make use of low-cost gas (and proposed another 32 projects). To send part of the gas abroad, the industry is currently building four terminals for the export of liquefied natural gas (LNG), three of which began construction in 2014, and many more are in the works. Natural gas demand in 2014 hit 66.9Bcfd in 2014, up by 14% since 2008 and by an estimated 2.8% since 2013.
- *And the natural gas industry is building and reconfiguring infrastructure, to reflect the changes of this shifting and speedily expanding market.* For the last 50 years, natural gas pipelines have tended to move gas in a nearly uniform south-to-north direction, from production centers on the Gulf Coast to demand centers in the Northeast and Midwest. The prolific production coming out of two key shale plays in the Pennsylvania and Ohio area, the Marcellus and Utica, have upset these dynamics. 'Takeaway' pipelines (the ones that get natural gas out of production areas) in the Northeast region of the US, the home to these emergent shales, accounted for over half of transmission pipeline capacity additions in the US since 2012.

Executive summary (3 of 5)

Still, across most sectors, the momentum for a sustainable energy future continues to build (continued from previous slide)

- *Renewable energy occupies a prominent part of many states' capacity mix, with 205GW installed across the country.* Wind and solar have been the fastest growing technologies, having more than tripled in capacity since 2008 (from 27GW to 87GW in 2014). Hydropower is the largest source of US renewable energy at 79GW (excluding pumped storage). Geothermal, biomass, biogas, and waste-to-energy collectively represent 17GW of renewable energy capacity in the US. Yet new build across geothermal and bioenergy-based power has been relatively low the past two years. These technologies provide a steady flow of power regardless of external conditions and have comparable economics (in terms of unsubsidized levelized costs) to some technologies that have seen wider deployment. However, hydropower, geothermal, and bioenergy-based power are suffering from not having access to the same incentives received by faster-growing sectors and, more generally, from an absence of long-term policy certainty.
- *Wind energy is the lowest cost option for utilities in some parts of the US, and solar energy beats the retail electricity prices paid by homeowners in many states.* With the support of subsidies, wind developers have been able to offer power purchase agreements (PPAs) to utilities at prices in the $20-30/MWh range in the Midwest, Southwest, and Texas, well in the territory of 'grid parity' – that is to say, below the levelized cost of electricity for fossil-fired power and below the price of wholesale power. Third-party providers of solar energy, again with the help of federal and state incentives, are able to offer PPAs or leases to homeowners below the residential retail electricity price, achieving 'socket parity.' To fund these third-party systems, these providers raised another $2.6bn in 2014, same as 2013 levels, to continue driving this business forward. At a larger scale, utility-scale solar plants in Texas and Utah secured PPAs to sell power at $50-55/MWh (with the help of incentives), among the lowest ever recorded globally. Corporations and other large electricity users, such as Microsoft, Yahoo!, and Washington DC-based universities, have demonstrated appetite for renewable procurement, motivated as much by the economics as by the environmental benefits.
- *Wind and solar both saw increased levels of build in 2014, but for different reasons.* Solar build in 2014 was almost 50% higher than in 2013 and 24 times higher than in 2008. The industry is ramping up briskly, and project pipelines today suggest even bigger numbers for 2015 and 2016. Wind build bounced back from only 0.5GW in 2013 to 4.9GW in 2014 and the industry is poised for bigger years in 2015 and 2016, based on current pipelines. The ups-and-downs can be attributed to policy meanderings: the Production Tax Credit has experienced five expirations or renewals since December 2012 (the language of these renewals has enabled projects to be completed even after the legislation expires). Similar policy programs supporting a broader range of renewable energy technologies could yield an increase in deployment of those technologies as well. Many states have access to the feedstocks (eg, biomass, waste) needed to produce power from these technologies.
- *Distributed energy is prompting a rethink of grids, business models, and buildings.* In April 2014, New York State proposed reforms to its electricity market that could reposition utilities as coordinators of distributed energy resources (which include energy efficiency, demand response, and distributed generation). Other states have said they are watching with great curiosity. The home has become a competitive battleground, with utilities, device vendors, third-party solar providers, and even telecom companies indicating that they may have a role to play in intelligent residential energy systems. The fastest growing form of distributed energy is rooftop solar. The commercial and industrial sector has also demonstrated continued appetite for combined heat and power (about 700MW per year since 2009) and continued interest in microgrids. Fuel cell activity is heavily dependent on five states, each with supportive policies for the sector.

Executive summary (4 of 5)

Still, across most sectors, the momentum for a sustainable energy future continues to build (continued from previous slide)

- *A grid operator's dream is slowly coming into focus.* Utilities are investing in a smarter grid that gives granular insight into electricity supply and consumption – enabling higher reliability, less volatile power prices, more efficient use of assets, and a cleaner electricity profile. Investments by investor-owned utilities and standalone transmission companies into transmission and distribution infrastructure totalled a record-high $37.7bn in 2013. Smart meters have been deployed to 39% of US electricity customers, and demand response accounts for 34GW of capacity across US markets. Almost all of the country's energy storage is in the form of pumped hydropower, but other forms of energy storage, such as grid-scale batteries, are experiencing growth thanks to policies such as state procurement targets. Widespread use of storage helps grids in numerous ways, including addressing issues such as frequency regulation, enabling penetration of intermittent renewables, deferring investments in transmission and distribution, providing flexible resources, and alleviating the need for 'oversizing' (ie, sizing the grid to meet rare moments of peak usage, resulting in underutilization of assets).
- *The regions seeing the greatest measurable strides in energy efficiency are New England and the Pacific states; and the buildings seeing the most energy efficiency efforts are commercial structures.* In contrast, the regions that offer the greatest untapped opportunities are the Southeast and Southwest of the country, and the building types that present new opportunities include small office buildings, warehouses, and storage facilities. This comparison of leaders and laggards is based on metrics presented in this report, such as: state-wide utility efficiency savings as a percentage of retail sales, state-by-state scorecards for energy efficiency policies, Energy Star-certified floor space for different types of buildings, and investment flows by type of framework. Energy efficiency investment in the US through formal frameworks (mostly, investments by utilities and investments under energy savings performance contracts) totalled an estimated $14bn in 2013. Advances in technology and policies to increase the efficiency of appliances and buildings have played a role in reducing emissions and increasing the economy's energy productivity. On the policy front, for example, through 2014, 6.0bn square feet of commercial floor space (around 7% of total US commercial sector floor space) was covered under energy efficiency benchmarking or disclosure policies.
- *The US has been a leader globally in carbon capture and storage (CCS), but investment is far below its peak from 2010, as government support has waned*. The country has accounted for 56% of global asset finance in CCS since 2007. Investment levels picked up again in 2014 due to the financial close of one project, NRG's 1.6MtCO2/year Parish power project. A significant project, Mississippi Power's 563MW Kemper project, is making progress and is slated to commission in 2016, but the project has faced problems with cost overruns and delays through construction.
- *Policy, driving patterns, new technologies, consumer adoption trends, and fuel economics are among the factor driving change in the transport sector, though the inflection point is probably yet to come.* Tightening fuel economy standards are pushing carmakers to release more efficient vehicles; these standards will demand a doubling in fuel economy by 2025. Sales of battery and plug-in hybrid electric vehicles increased 25% in the first three quarters of 2014, relative to that period last year, and comprised just less than 1% share of the market for new vehicle sales towards the end of the year. On an energy-equivalent basis, electricity has been the most competitive transport fuel in the US for over a decade, but upfront costs can still be higher for electric vehicles than for comparable conventional vehicles. Natural gas use in vehicles has grown 6.5% per year since 2001 but was flat from 2013 to 2014, at around 33Bcfd. The fuel can be more economical than gasoline and an attractive option for heavy-duty vehicles in particular.

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The changing energy picture in this US has profound geopolitical implications

- *The US finished the year as the second highest-ranked country in terms of total new dollars attracted for clean energy investment; China was first.* Global investment in the sector was $310bn in 2014, up 16% on 2013 levels, and near its 2011 peak of $318bn. Among the largest drivers of these investment figures are the categories of asset financing for wind and financing for small distributed capacity – essentially, rooftop solar. In 2014, the US was the world's second-largest market for new wind installations, behind China, and third-largest for solar, behind China and Japan.
- *The US is one of the most attractive markets in the world for companies whose operations entail significant energy-related costs.* At 6.87¢/kWh, the retail price of electricity for the industrial sector in the US is lower than that in other major economies, such as Europe, China, and Mexico. Natural-gas-intensive industries have also been flocking to the US; domestically-sourced feedstock in the form of natural gas makes the US one of the most economical regions for producing chemicals such as methanol and ammonia.
- *Policy actions taken by the US in 2014 have set the stage for a potentially momentous global climate summit at Paris in December 2015.* The US-China pact was the most notable achievement in the global climate negotiations process in 2014. In the first quarter of 2015, other nations are expected to present their long-term commitments to addressing climate change. Such public pledges from China and the US (the world's first and second biggest emitters, respectively) have the potential to challenge other nations to do more as well. The summit to be held in Paris at the end of 2015 will be the most significant multilateral climate negotiations since the discussions in Copenhagen in 2009. The growth of sustainable energy is a critical part of achieving any targets that might be struck under diplomatic deals on greenhouse gas emissions.
- *The crude oil price collapse, which made headlines at the end of 2014, has been partially driven by factors in the US: surging production and declining demand.* US oil production has hit levels not seen since the 1980s and is up 41% since just 2007. Meanwhile, US consumption of gasoline has dropped 8.6% since 2005 as US consumers drive more fuel-efficient vehicles, travel fewer miles, or use more public transportation. Crude prices hit an annual high of $107/barrel in June 2014 then collapsed below $50 per barrel as of late January 2015. The price drop is all the more noteworthy in the face of a strong US economy, which might otherwise have contributed to a price spike. The oil price shock is de-stabilizing regimes such as Russia, Venezuela, and Iran.
- *There is no direct link between oil prices and most sustainable energy technologies in the US.* Sustainable energy transportation technologies, such as hybrid electric vehicles, are impacted directly by what is happening in the global oil markets. But most technologies covered in the Factbook play a role in the power sector, whereas oil is mostly used for transportation and only rarely for power. Nevertheless, there may be 'second-order' impacts from the oil price turmoil. For example, investors in the public markets tend to lump together diverse energy technologies, which may explain why clean energy stocks have taken a hit since oil prices began falling. And the drop in cost of oil could serve as an indirect stimulus into the US economy, which could propel industrial growth and thus perhaps even more use of natural gas and renewable energy.

The 2015 Factbook in context of previous editions

The first edition of the Sustainable Energy in America Factbook, published in January 2013, captured five years' worth of changes that had seen a rapid decarbonization of the US energy sector. From 2007 to 2012, natural gas's contribution to electricity had grown from 22% to 31%; installed renewable energy capacity (excluding hydropower) had doubled; and total energy use had fallen by 6%, driven largely by advances in energy efficiency.

The second edition of the report, published February 2014, compared developments in 2013 to the longer-term trends described in the first edition. In some cases, the tendencies had continued: natural gas production, small-scale solar installations, policy-driven improvements in building efficiency, and electric vehicle usage had continued to gain ground, cementing five-year patterns. Other measures – total energy consumed (up in 2013 relative to 2012), the amount of emissions associated with that energy consumption (up), and the amount of new investment into renewable energy (down) – had bucked the longer-term trends.

This year's Factbook documents 2014, a year in which the US economy continued to gain traction, in which some metrics deviated from the long-term trends, and in which, overall, momentum for a sustainable energy future continued to build.

Table of contents

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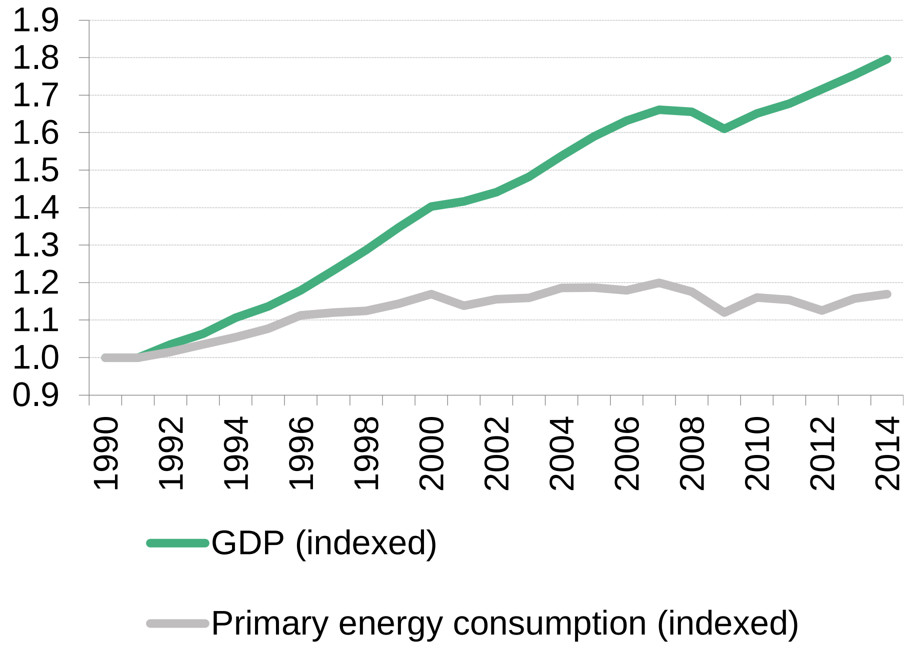
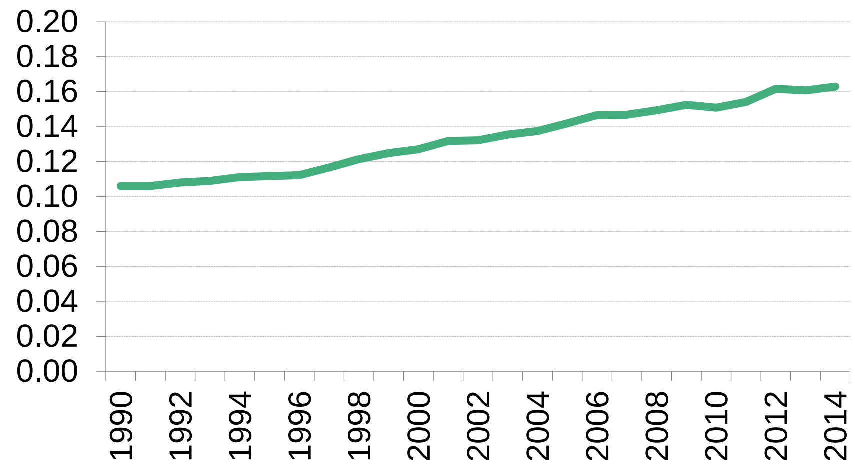
US energy overview:
Economy's energy productivity

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



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



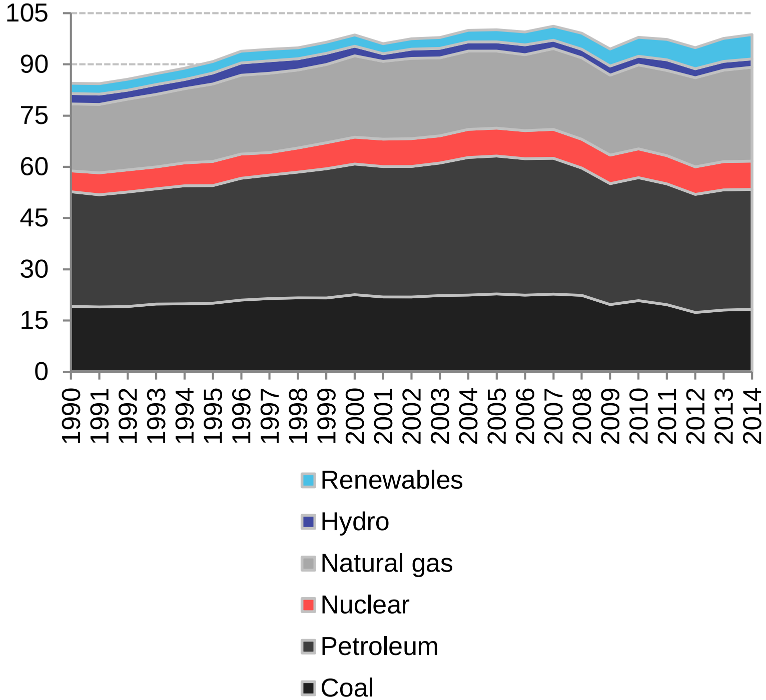
- The US economy is becoming more energy productive. By one measure (US GDP per unit of energy consumed), productivity has increased by 54% since 1990, by 11% since 2007, and by 1.4% from 2013 to 2014

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

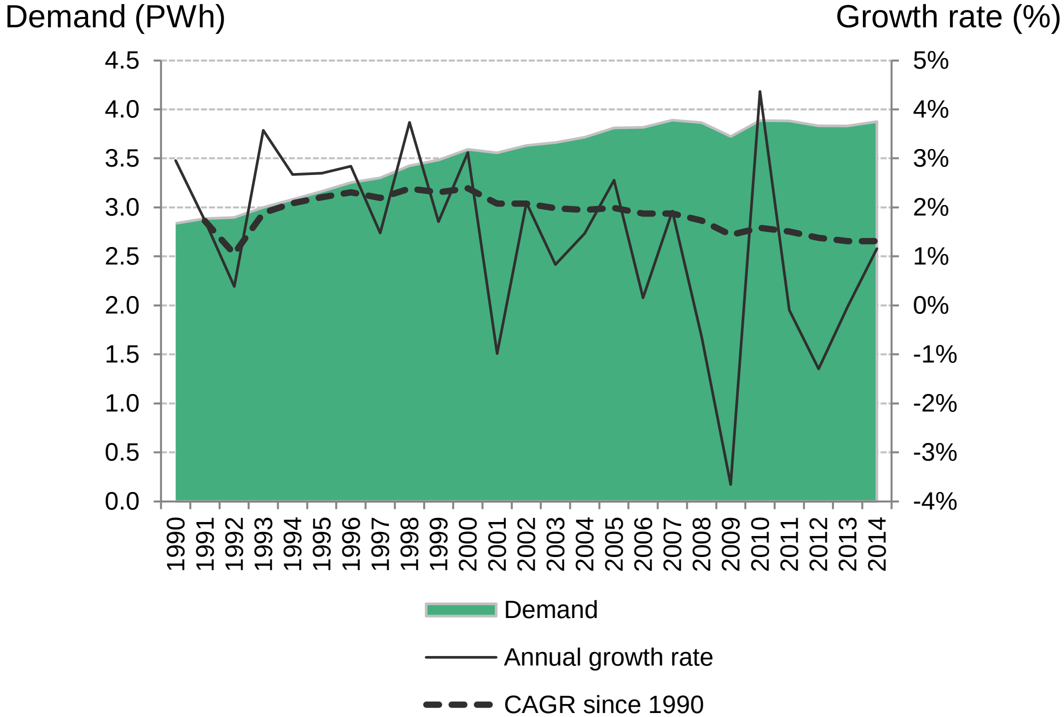
Notes: Values for 2014 energy consumption are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2014). GDP is real and chained (2009 dollars); annual growth rate for GDP for 2014 is based on consensus of economic forecasts gathered on the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

US energy overview:
Energy and electricity consumption

US primary energy consumption by fuel type (Quadrillion Btu)



US electricity demand



- Energy consumption increased by 1.0% from 2013 to 2014 (lower than GDP growth) and is down 2.4% relative to 2007 levels
- The mix of energy consumption is also changing, towards lower-carbon sources: petroleum's share of total energy has fallen from 39% to 36%; coal has dropped from 22% to 19%; natural gas has risen from 23% to 28%, and renewables (including hydropower) have climbed from 6% to 10%
- Annualized electricity growth (CAGR) has been declining: 5.9% from 1950 to 1990, 1.9% from 1990 to 2007, 0% since 2007

Source: EIA

Notes: Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2014)

Source: EIA

Notes: PWh stands for petawatt-hours (billion MWh). CAGR is compounded annual growth rate. Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2014)

US energy overview:
Electricity generation mix

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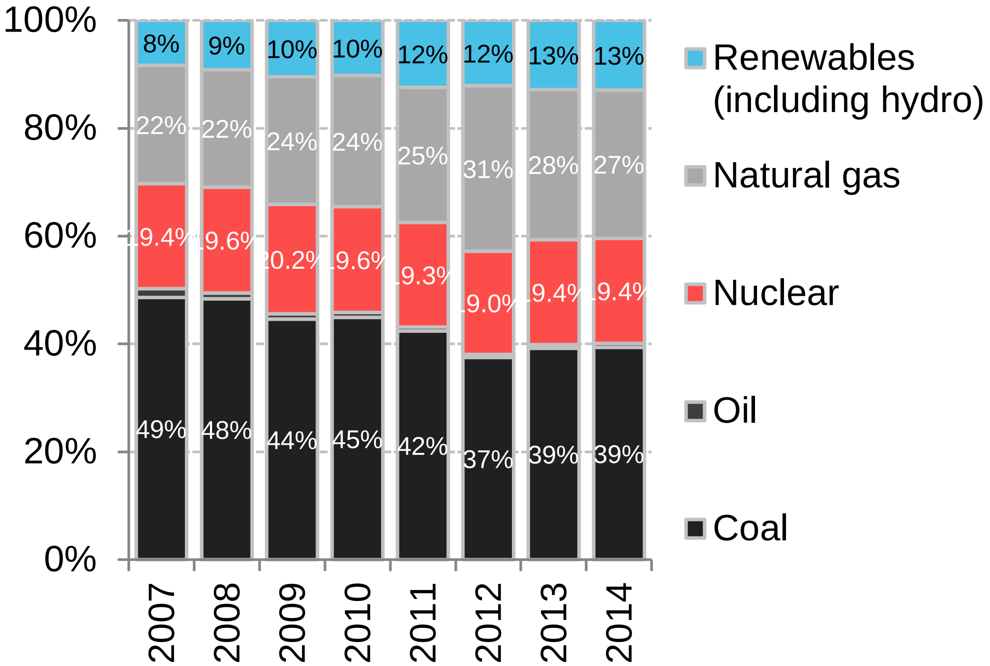
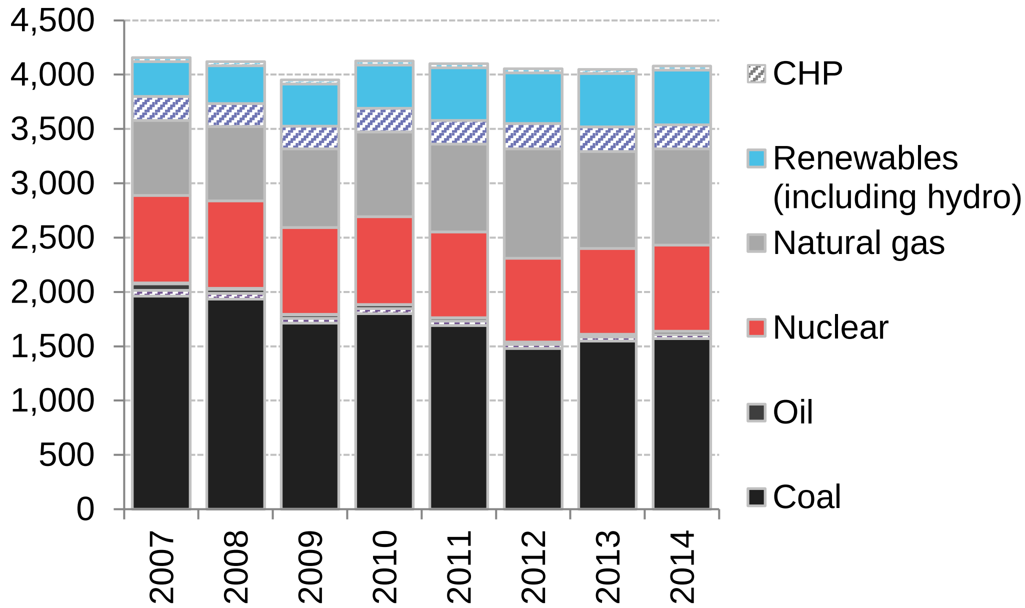
US electricity generation by fuel type (%)



US electricity generation by fuel type (TWh)



- The US electricity mix in 2014 was nearly identical to 2013 levels. Natural gas's contribution is off of the record high achieved in 2012, when the fuel's prices sank to historic lows. This up-and-down in natural gas's market share is a *cyclical* effect
- Longer term, though, larger *structural* trends are afoot: the US power sector is gradually decarbonizing. Coal plants are being retired, and natural gas and renewables are gaining ground: from 2007 to 2014, natural gas increased from 22% to 27% of the mix, and renewables climbed from 8% to 13%

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:
Electric generating capacity build by fuel type (GW)

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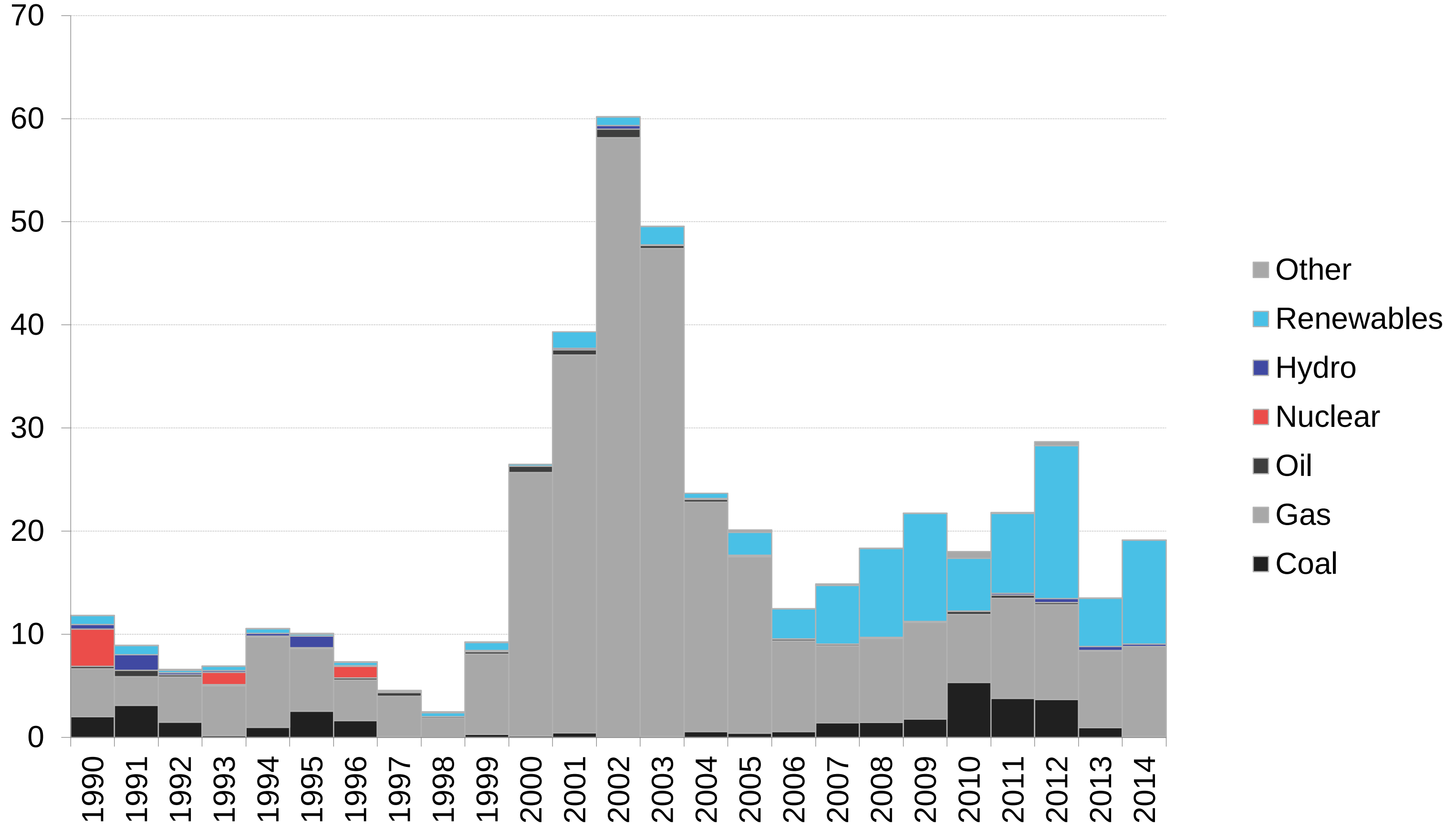
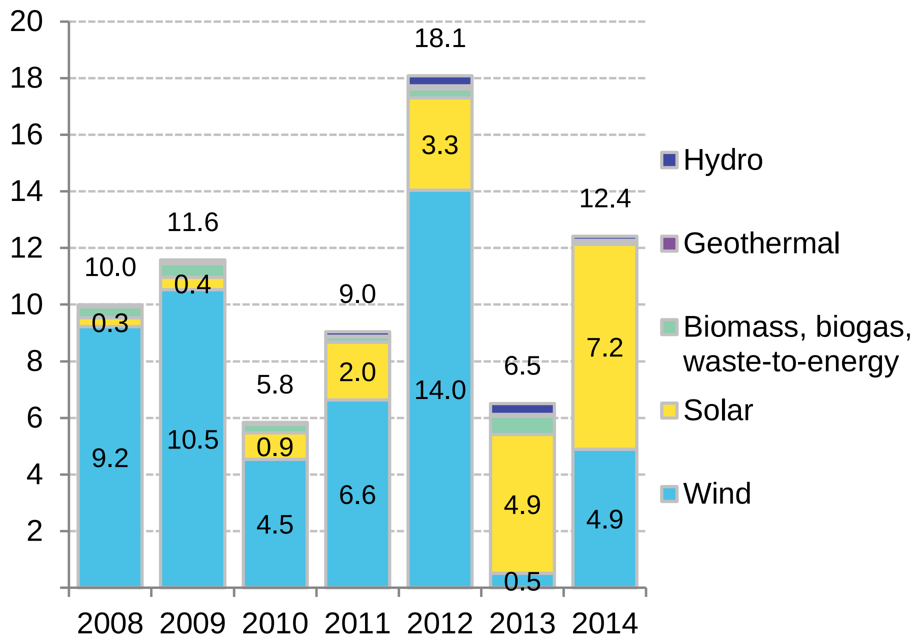


- Since 2000, 93% of new power capacity built in the US has been natural gas plants or renewable energy projects

Source: EIA

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:
- Solar build increased by almost 50% from 2013 to 2014. The utility-scale side of the industry brought online projects that have been driven by state renewable energy mandates and by the long-standing federal Investment Tax Credit (ITC). (The ITC is due to drop in value at the end of 2016.) The small-scale side capitalized on economics that increasingly make solar an attractive alternative to retail rates in much of the US
- Wind build bounced back due to policy swings. The Production Tax Credit expired at the end of 2012, dampening build in 2013. The incentive was renewed at the beginning of 2013, and it took the industry a year to reconstruct pipelines and bring projects to completion, hence the uptick in 2014. The pipelines show strong years in 2015-16
- 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.

US energy overview:
Cumulative renewable energy capacity by technology

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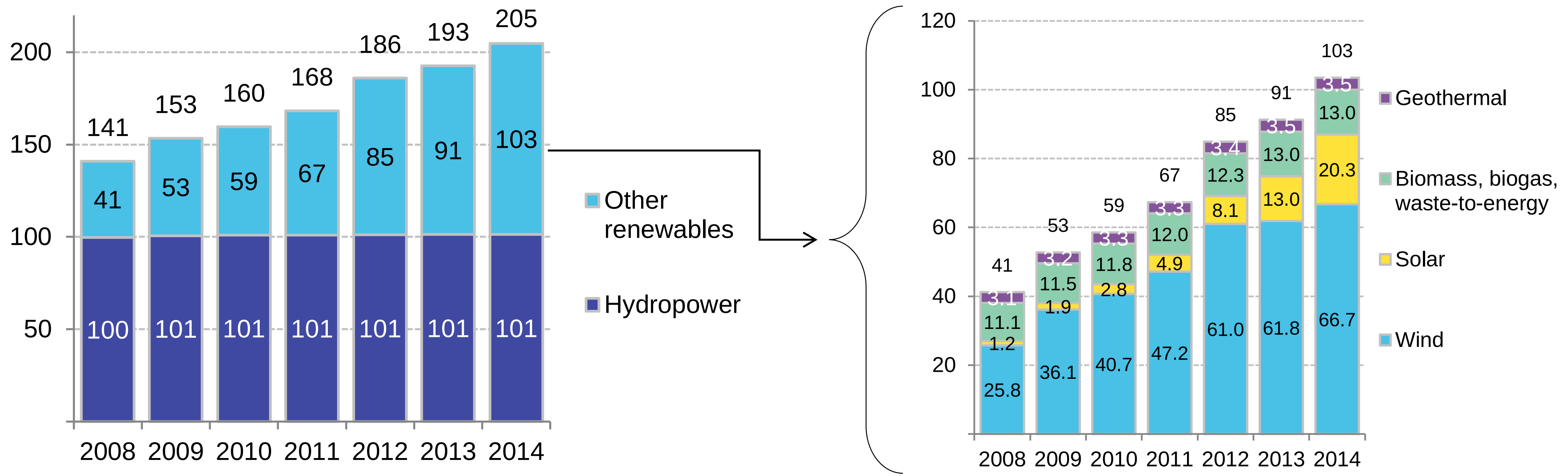
US cumulative renewable capacity by technology (including hydropower) (GW)

US cumulative non-hydropower renewable capacity by technology (GW)



- Power-generating capacity of non-hydropower renewables surpassed hydropower capacity for the first time
- US non-hydropower renewable capacity has increased by 2.5x since 2008, mostly due to new wind and solar

Source: Bloomberg New Energy Finance, EIA

Notes: Hydropower capacity includes pumped hydropower storage facilities.

US energy overview:
Renewable energy generation by technology

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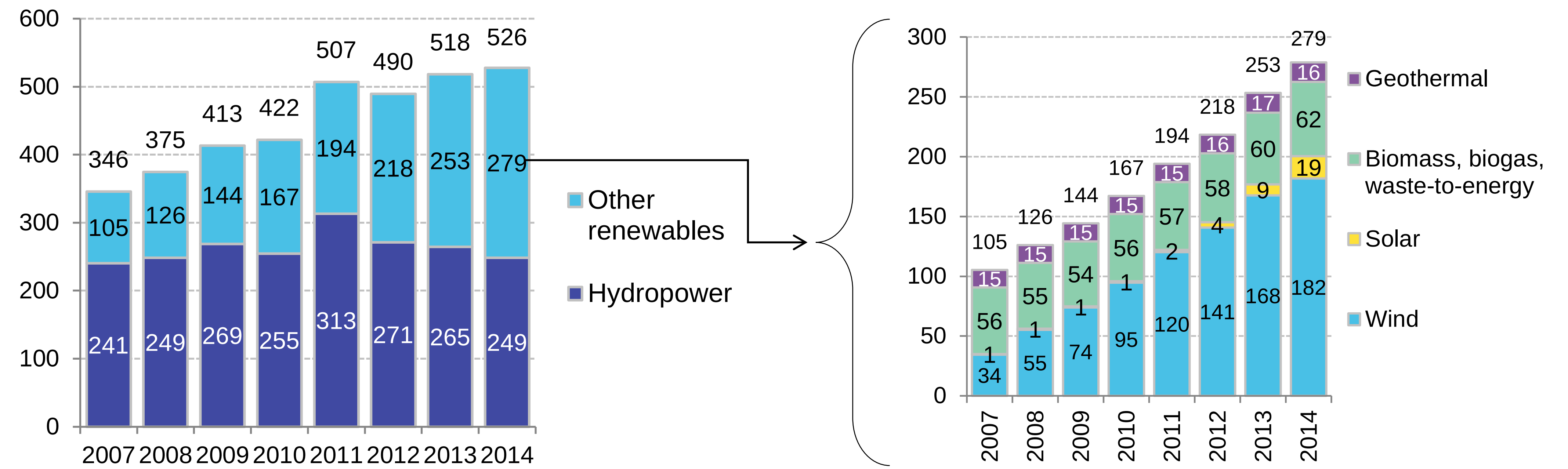
US renewable generation by technology (including hydropower) (TWh)

US non-hydropower renewable generation by technology (TWh)



- Generation from non-hydropower renewables surpassed hydropower generation for the first time
- Hydropower generation dropped in 2014, partly due to an acute drought in the western US
- Non-hydropower renewables (279TWh in 2014) now account for 6.8% of US electricity, up from 2.5% in 2007

Source: Bloomberg New Energy Finance, EIA

Notes: Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through September 2014). Includes net energy consumption by pumped hydropower storage facilities. Does not include generation from small distributed resources, such as rooftop solar.

Greenhouse gas emissions, energy sector and economy-wide (MtCO2e)

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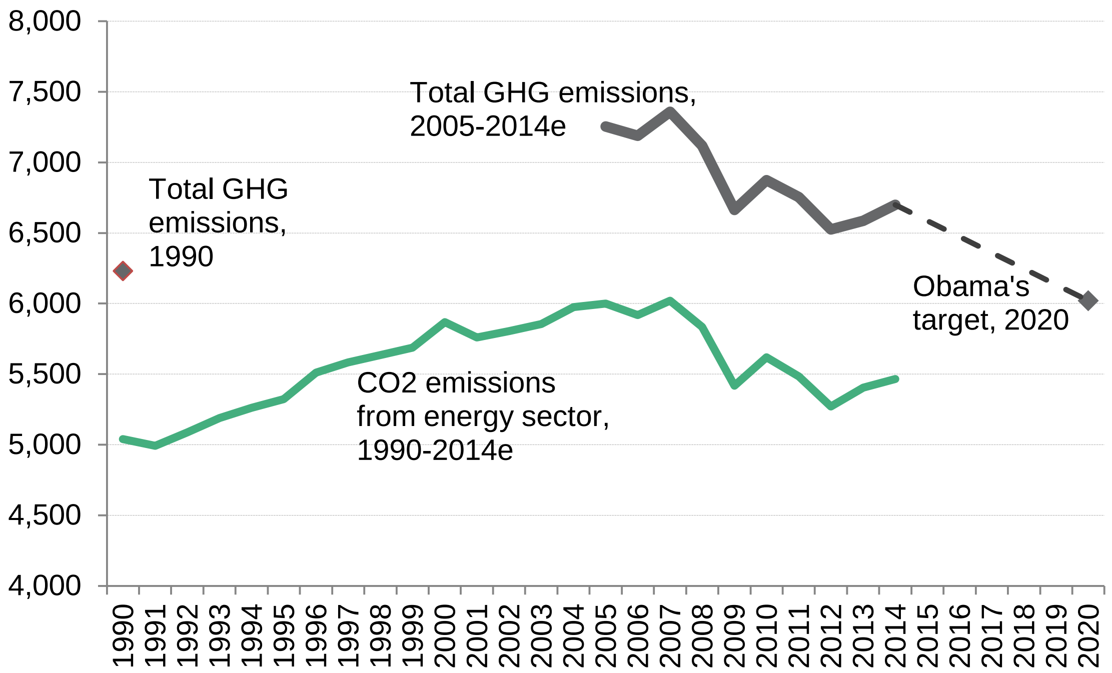


- Over the past decade, CO_2 emissions from the energy sector have been trending down: ~9.2% decrease since 2007
- The short-term results show a different trend: ~3.7% increase since 2012, owing partly to increased coal generation
- CO_2 emissions from the energy sector make up a large portion (~83%) of total economy-wide GHG emissions, which are down 7.6% from 2005 levels, the baseline year cited by the White House in its climate-related policy commitments
- The Obama administration has made more ambitious, long-term commitments to climate reductions as part of its pact with China (see slide in Section 2.2)

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 form EPA's Inventory of US Greenhouse Gas Emissions and Sinks (1990-2012), published April 2014. Data for CO2 emissions from the energy sector comes from the EIA's Monthly Energy Review.

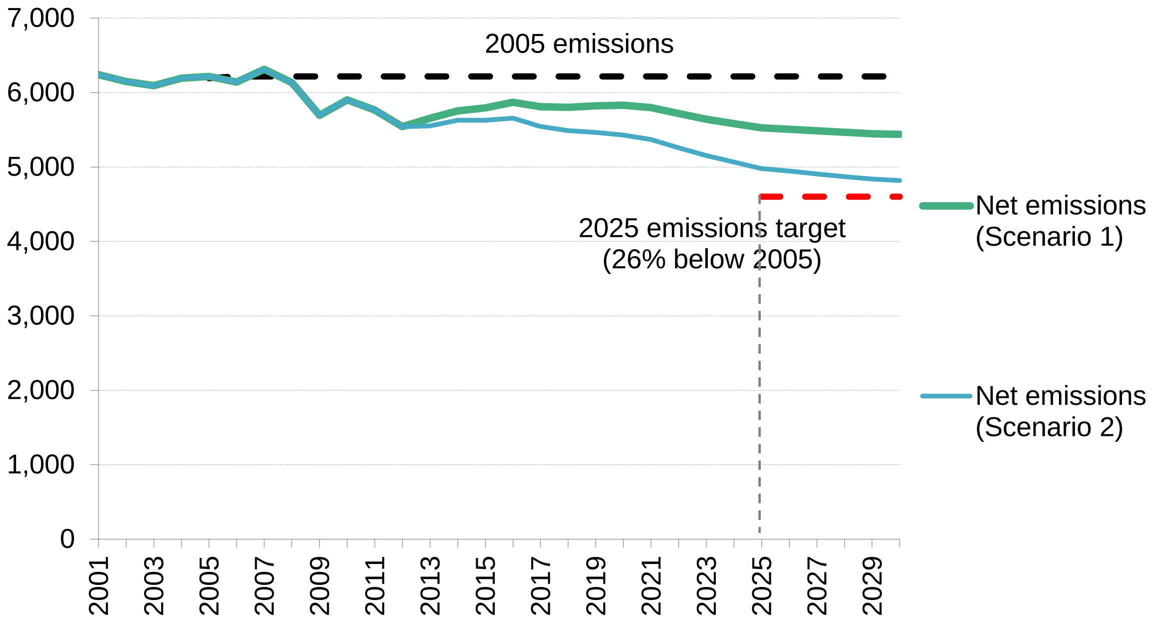
Table of contents

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

- For analysis on the EPA Clean Power Plan, see Section 8.1 of this report

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



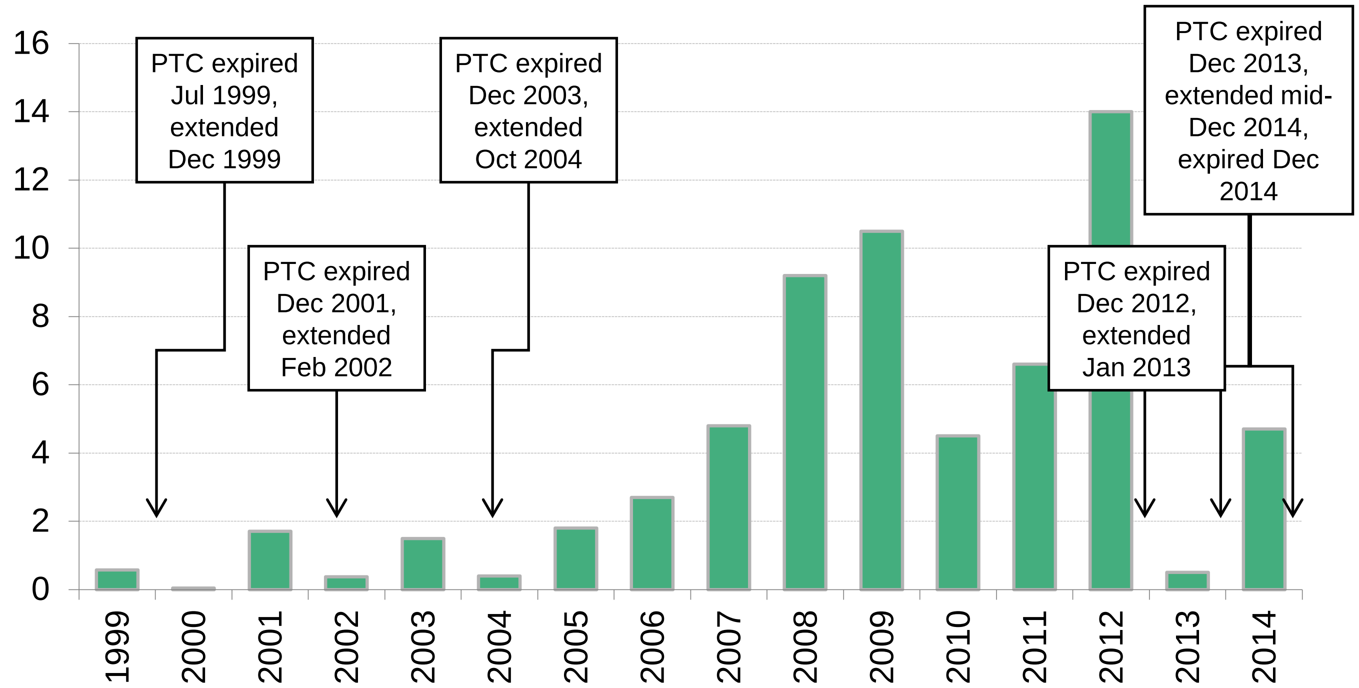
- On 11 November 2014, the US and China announced a pact to curb their greenhouse gas emissions
- The US pledged to reduce its net GHG emissions by 26-28% below 2005 levels by 2025; China pledged its CO2 emissions will cease to increase by 'around' 2030 and that 20% of its primary energy will be derived 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



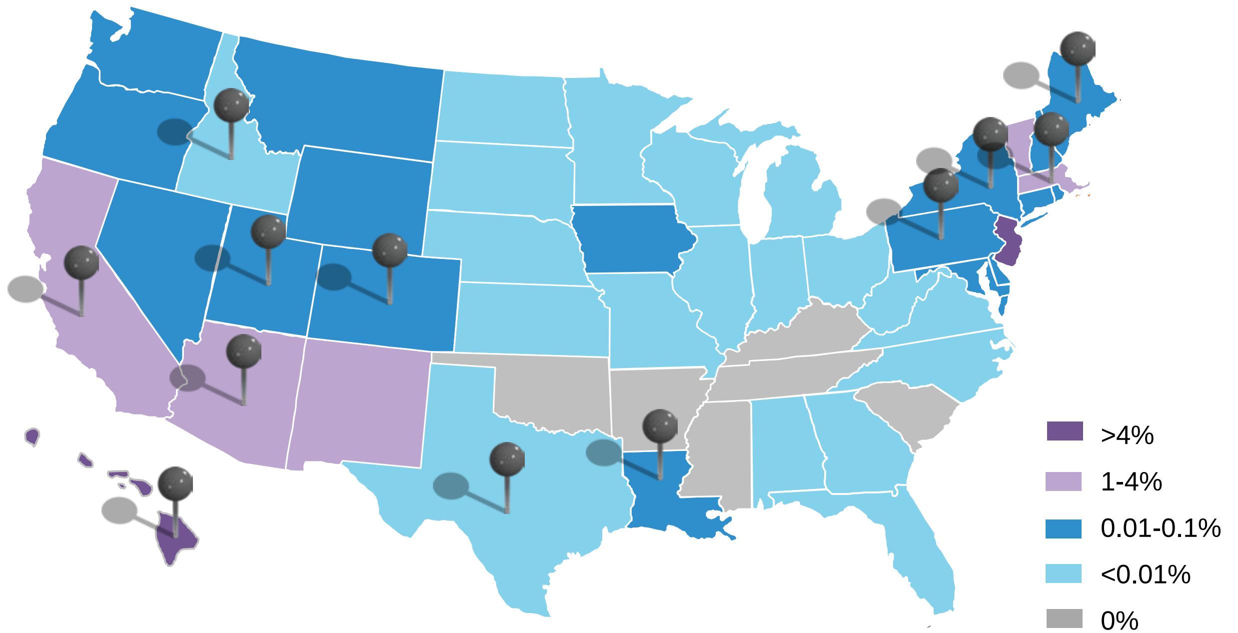
- Congress made no major energy decisions in 2014, save for a last-gasp approval of a tax extenders package in December
- Included in that package was a retroactive extension of the Production and Investment Tax Credits (PTC, ITC). But this extension came too late for most developers, as it only had a two-week lifetime before expiring. This now means that the PTC has expired or been extended five times since December 2012
- The only other legislation that showed potential for Congressional passage, the Shaheen-Portman bill for energy efficiency, was blocked during the final days of the 113th Congress (December 2014). The chairwoman of the Senate Energy and Natural Resources Committee, Lisa Murkowski (R-Alaska), has pledged to move this long-stalled legislation in 2015

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



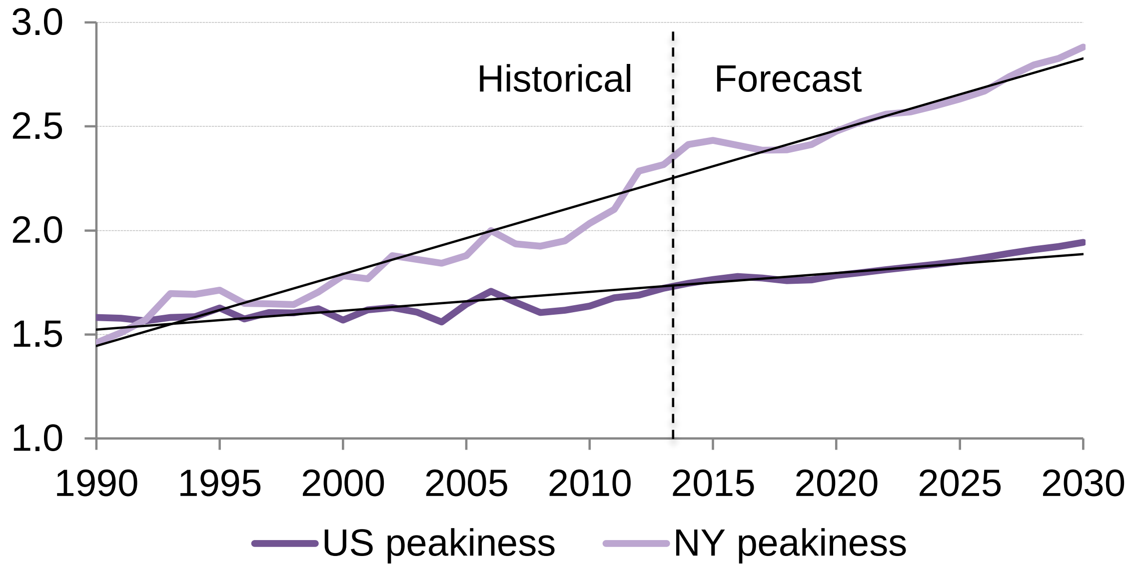
- Sustainable energy-related policy is heading in varying directions, depending on the state and the regulatory issue
- Natural gas: continued support for production in many key markets, while in December 2014, New York State declared a ban on fracking as the state's health department had found "insufficient scientific evidence to affirm the safety of fracking"
- 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 and other states have debated loosening or strengthening their programs
- Energy efficiency: adoption of energy efficiency resource standards (EERS) has been slowing; the EERS has been 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.

Policy – key sustainable energy policy developments in 2014 (5 of 5): New York's 'Reforming the Energy Vision'

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

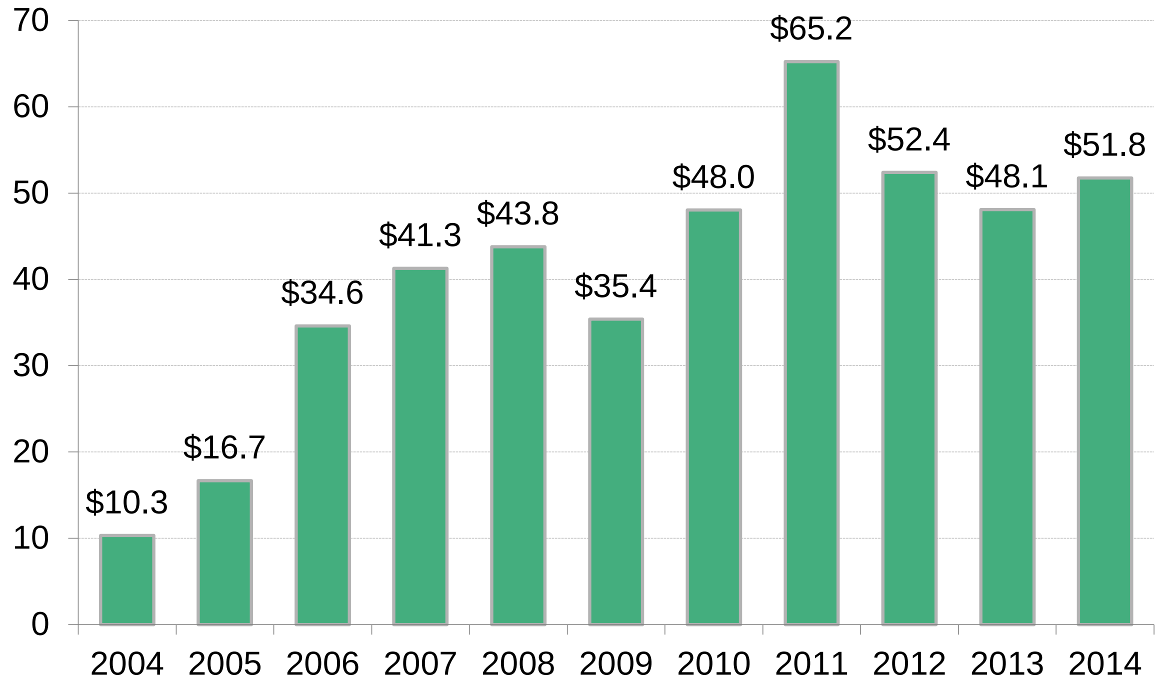


- In April 2014, New York State released its Reforming the Energy Vision (REV) proposal, which aims to reshape the state's electricity sector. The core goals of the policy include:
  - Enhanced customer knowledge; better use of ratepayer funds; increased system-wide efficiency (including reducing peak 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)

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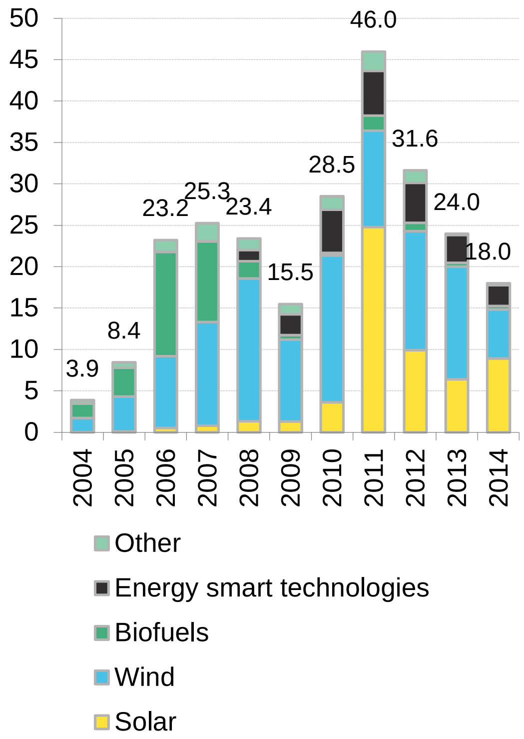
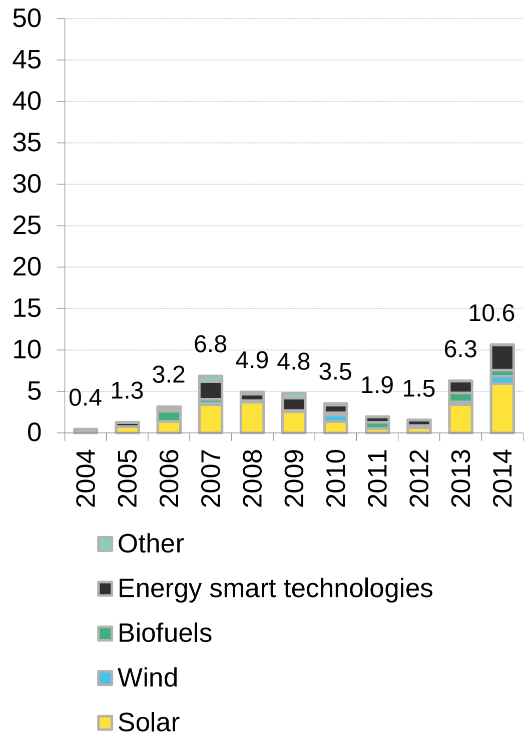
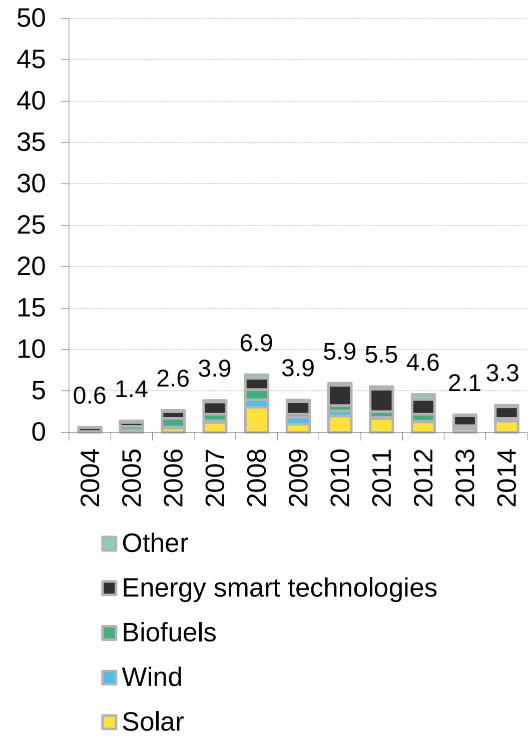
Asset finance



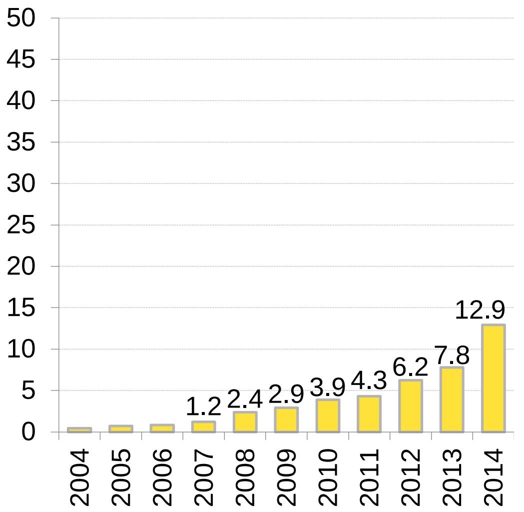
Public markets



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.

Finance: Returns of global clean energy indices relative to benchmarks

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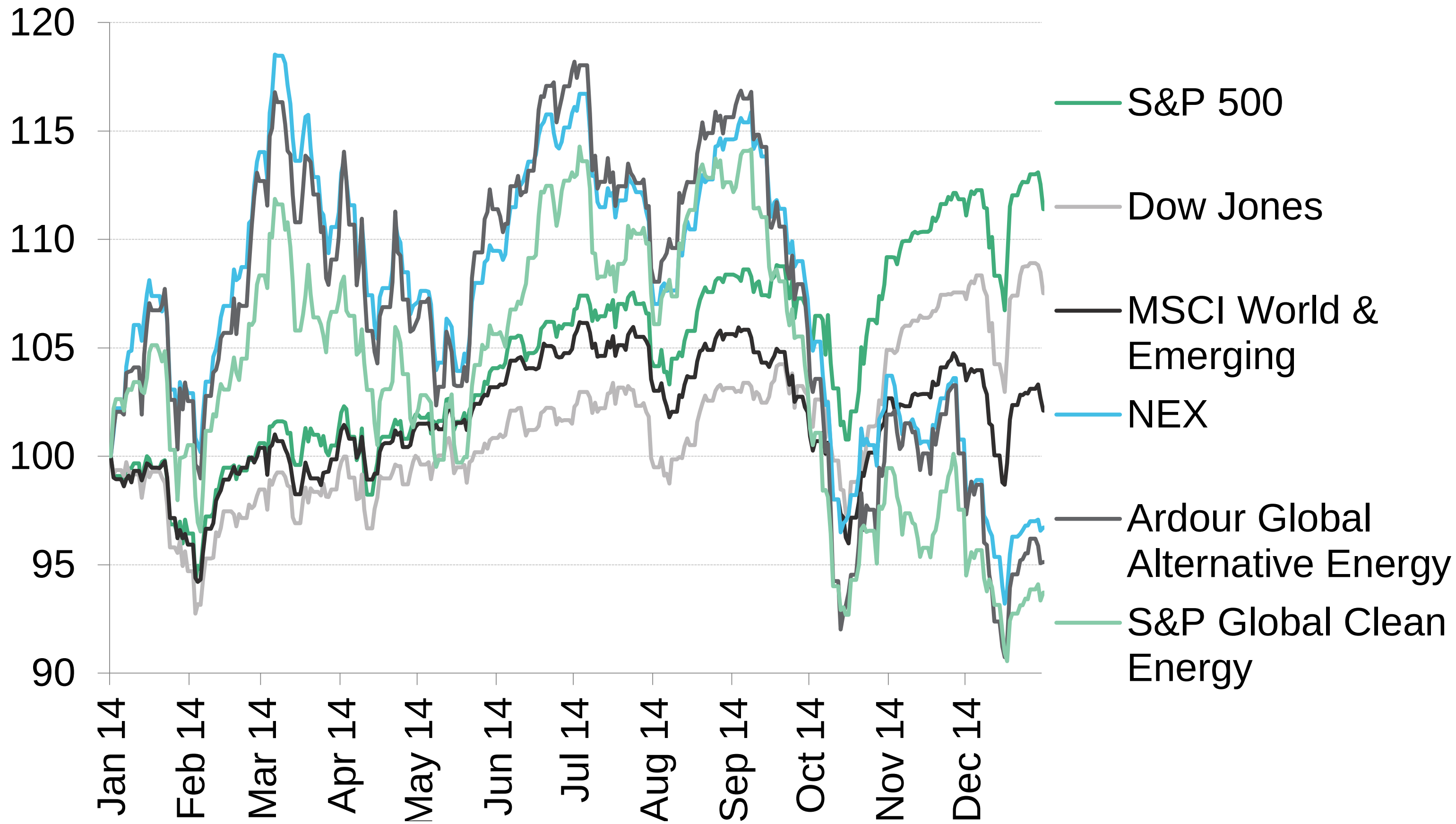

- Clean energy indices (exemplified here using the NEX, S&P Global Clean Energy, and Ardour Global Alternative Energy Index) underperformed the broader market (represented here by global benchmarks S&P 500, Dow Jones and MSCI World & Emerging)
- The NEX, a global index of publicly traded companies active in renewables and low-carbon energy, ended the year down 2%
- The volatile clean energy indices were hit hard by geopolitical uncertainty, economic stagnation in Europe, and falling oil prices (though there is no direct link between oil and most clean energy technologies)

Source: Bloomberg New Energy Finance, Bloomberg Terminal

Notes: Indices normalised to 100 on 1 January 2014

Economics: Levelized cost of electricity (unsubsidized across power generation technologies, H2 2014 ($/MWh)

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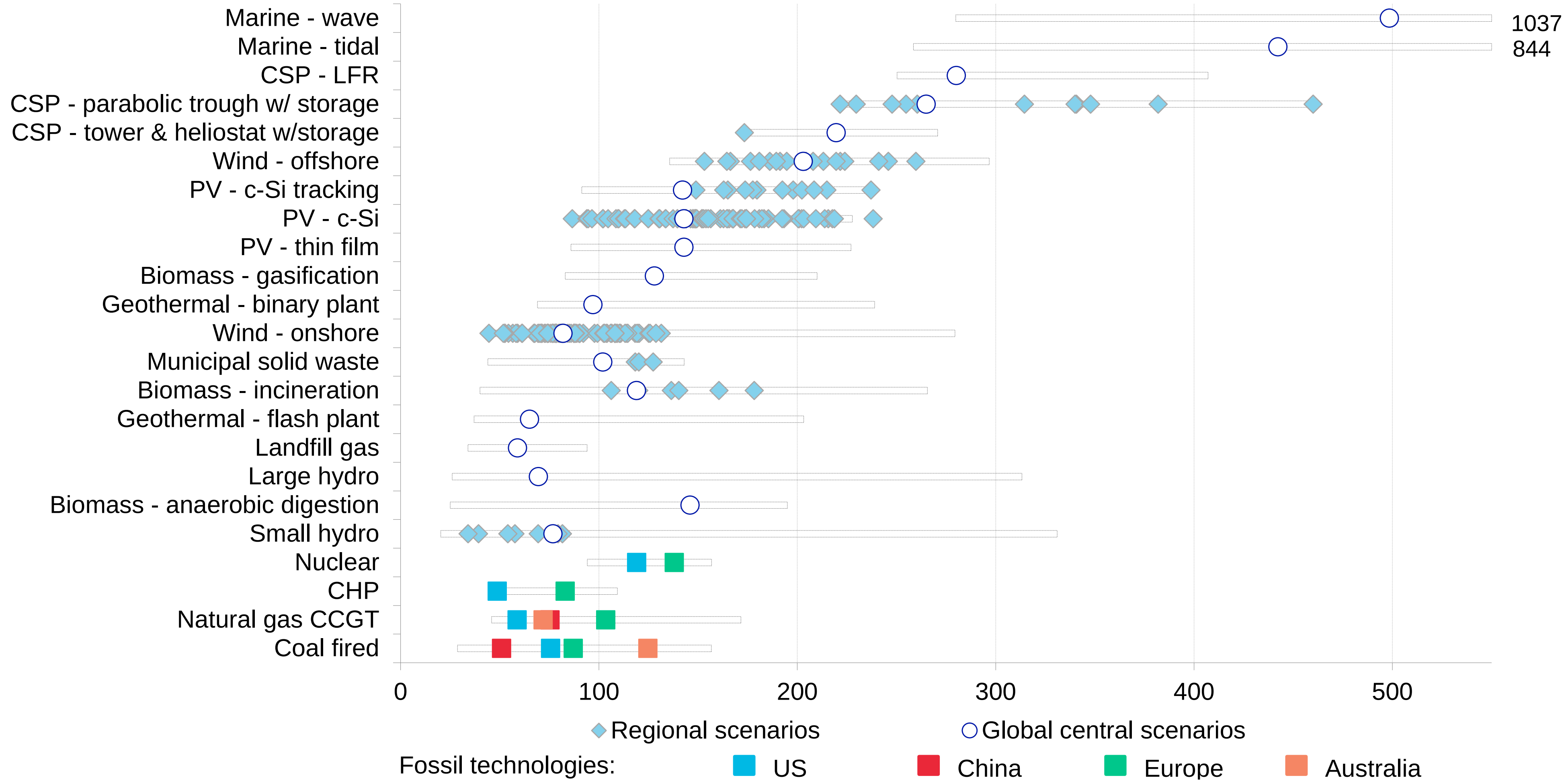


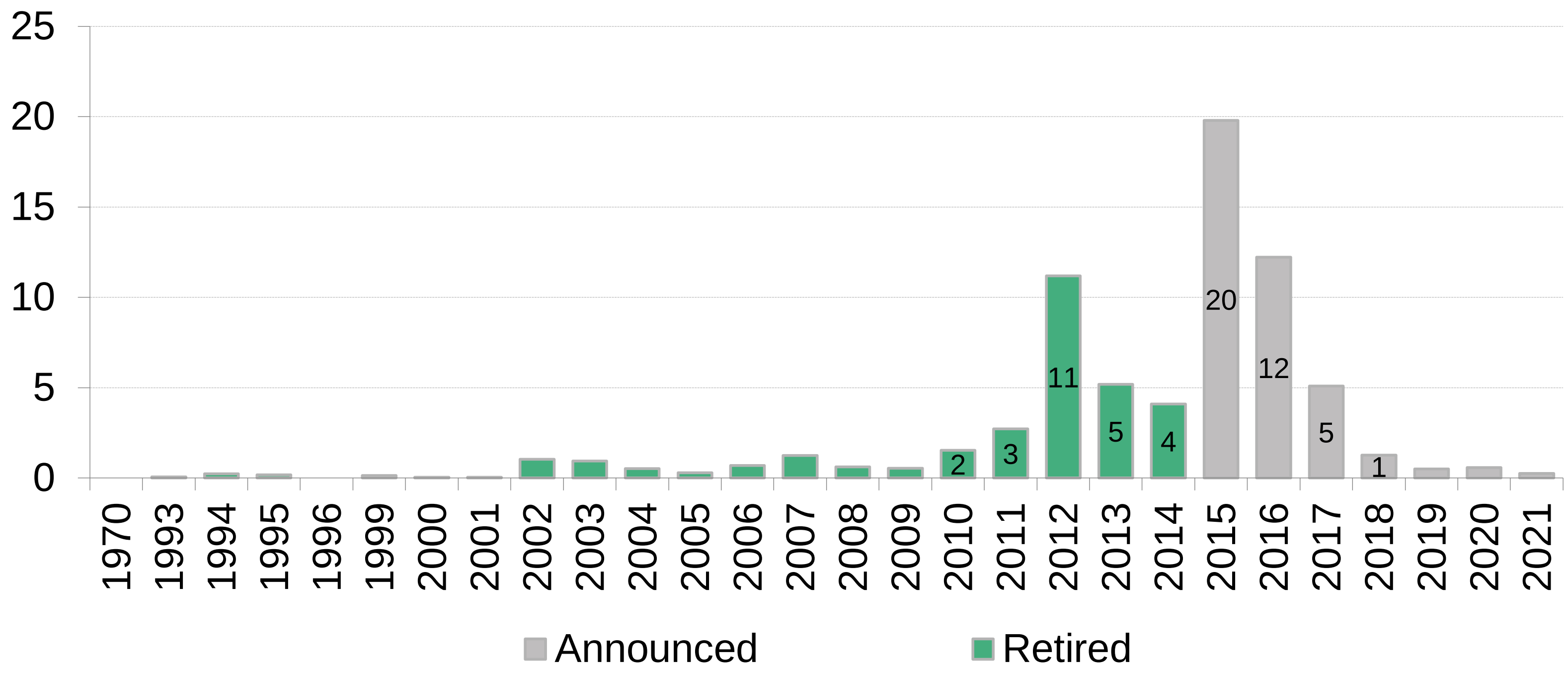
- A number of renewable energies have comparable and, at times, cheaper LCOEs than conventional power

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.

Table of contents

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

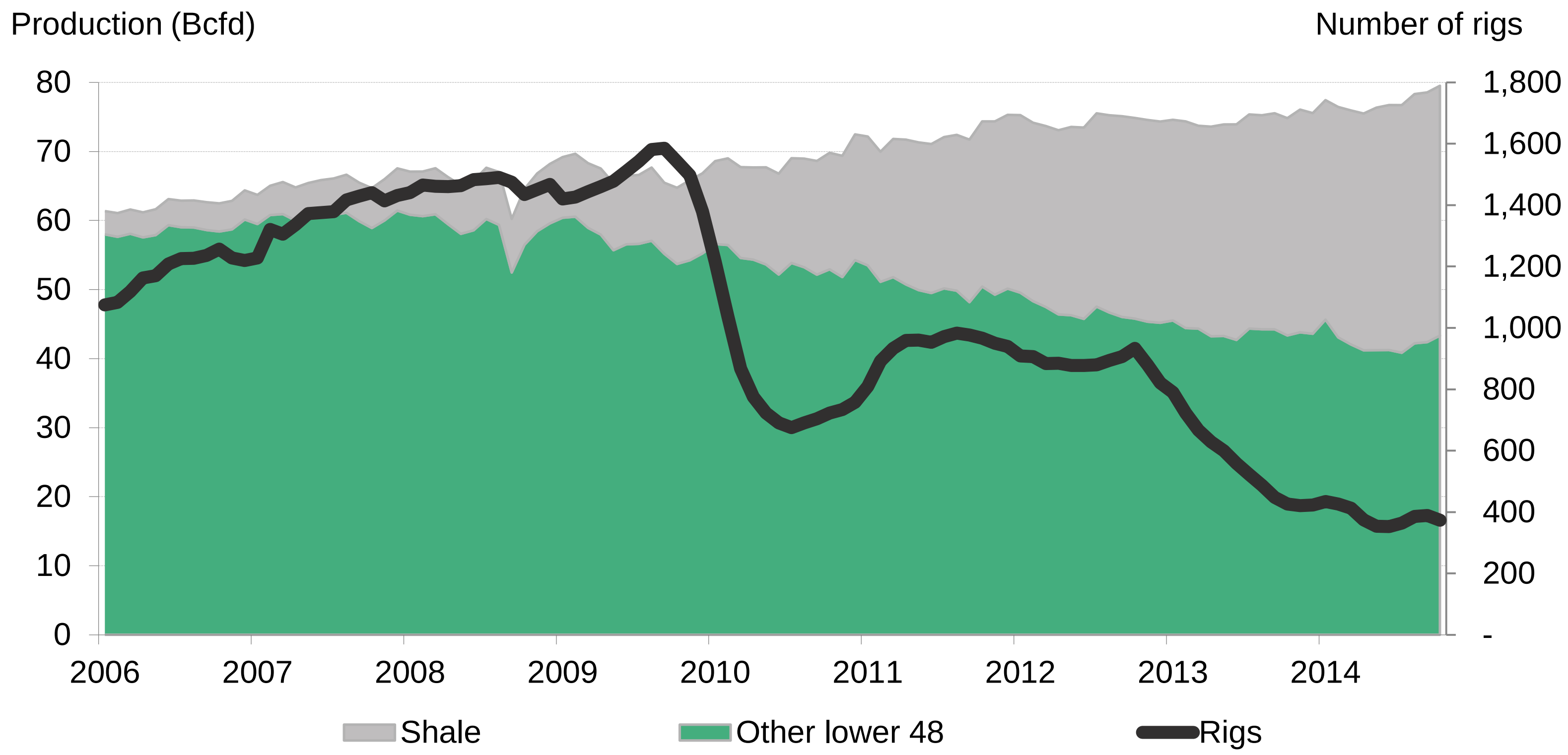


- US Environmental Protection Agency (EPA) regulations covering sulfur, nitrogen, and mercury emissions from power plants will require coal units to install costly retrofit technologies. With low gas prices cutting at the margins of coal generators, many units are being forced to retire rather than install emissions controls
- The majority of announced retirements are for 2015, when the Mercury and Air Toxics Standard (MATS), which limits the emissions of mercury and acid gases from power generators, 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.

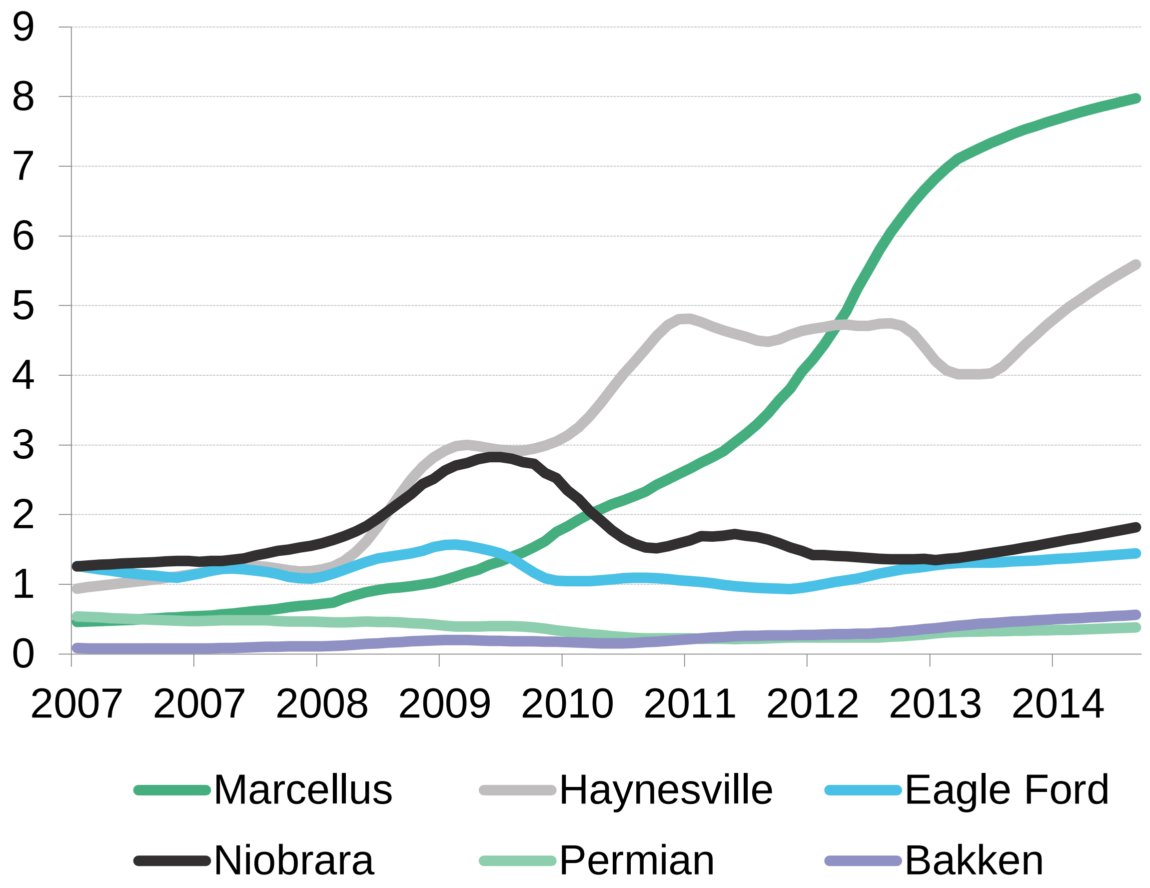
Deployment: US natural gas production and gas-directed rig count (Bcfd, rigs)



- 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). This is thanks to efficiency improvements in upstream production techniques, such as pad drilling – in which multiple wells are drilled from the same site – which has become common practice, and leads to more wells with fewer rigs
- There is still a backlog of drilled but uncompleted wells in the Marcellus which have been waiting on pipeline takeaway capacity (and, to some extent, on gathering and processing capacity). As more pipelines expand capacity or reverse direction, this is becoming less of an issue

Source: Bloomberg New Energy Finance, EIA, Baker Hughes

Deployment: US natural gas productivity (production per rig) by shale formation (MMcfd)



- The Marcellus stands out above all gas plays in the country and singlehandedly offsets declining dry gas production from elsewhere in the US. It houses the most economical dry gas areas and has seen the greatest improvement in rig productivity

Source: Bloomberg New Energy Finance, EIA

Deployment: Gas production in the continental US (Bcfd)

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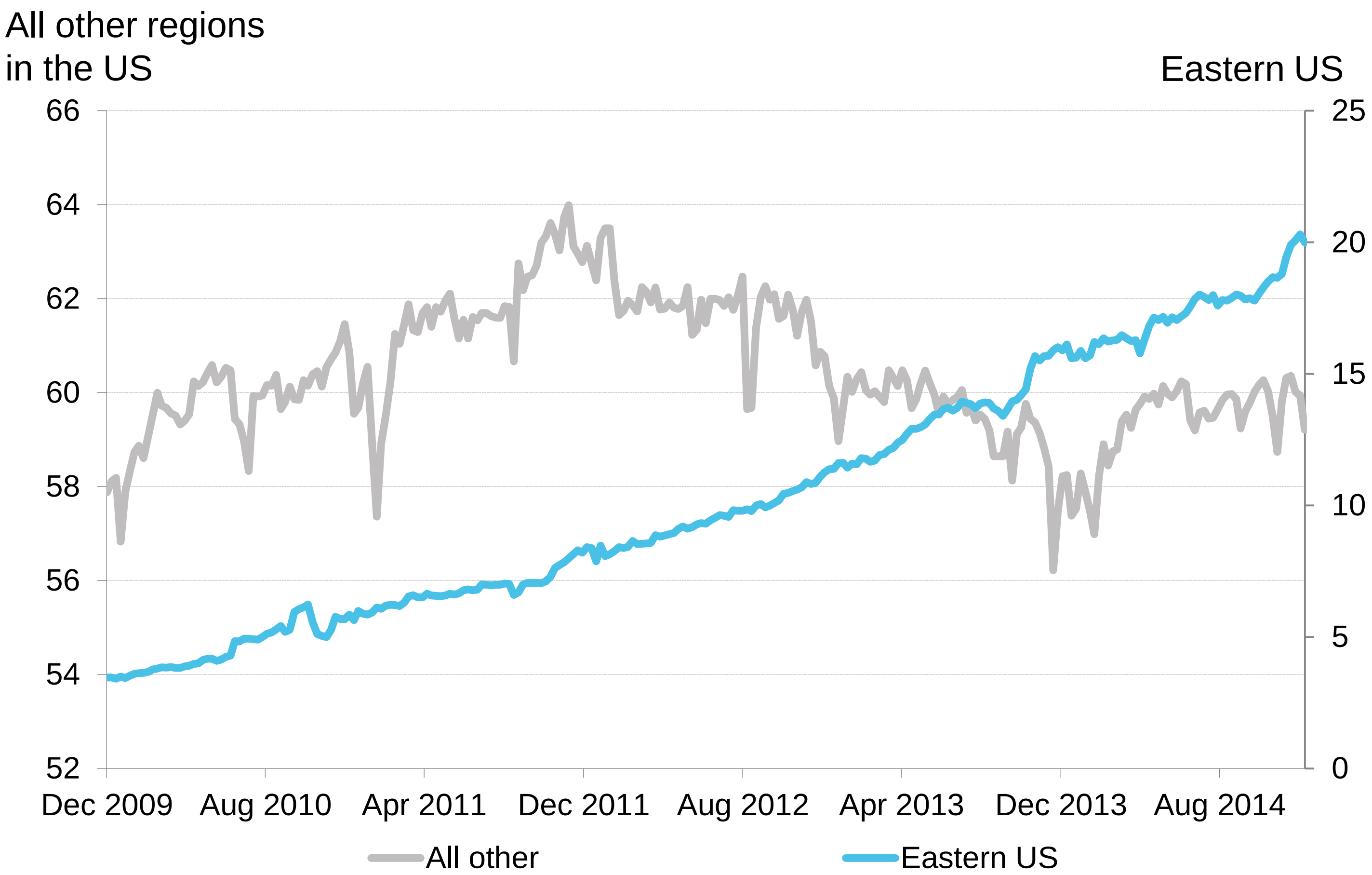


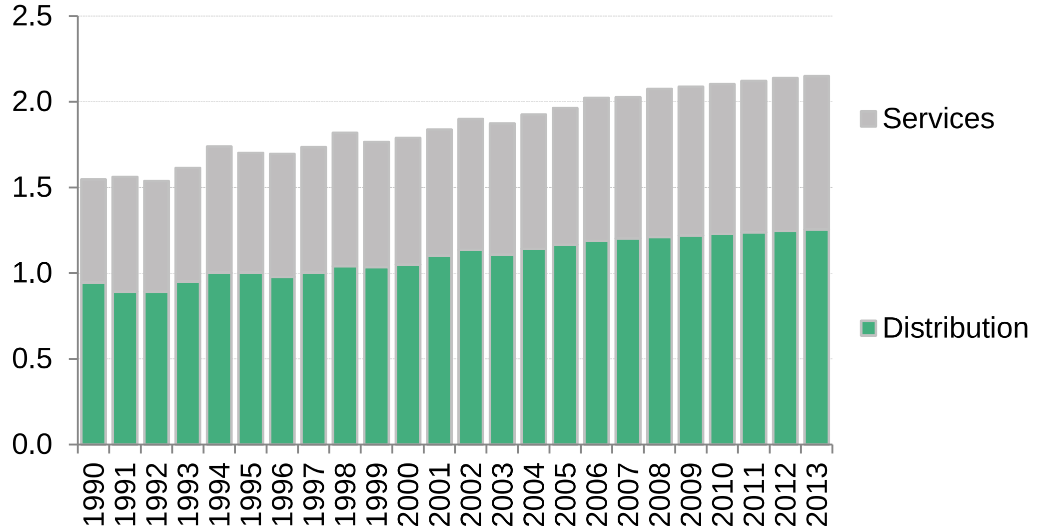
- Eastern US natural gas production continues increasing, immune to the factors that have caused declines elsewhere
- Declines in other plays were primarily brought about by:
  - Producers switching from dry gas plays into liquids-rich plays like Eagle Ford and Bakken
  - Reduced conventional gas production

Source: Bloomberg New Energy Finance, LCI Energy

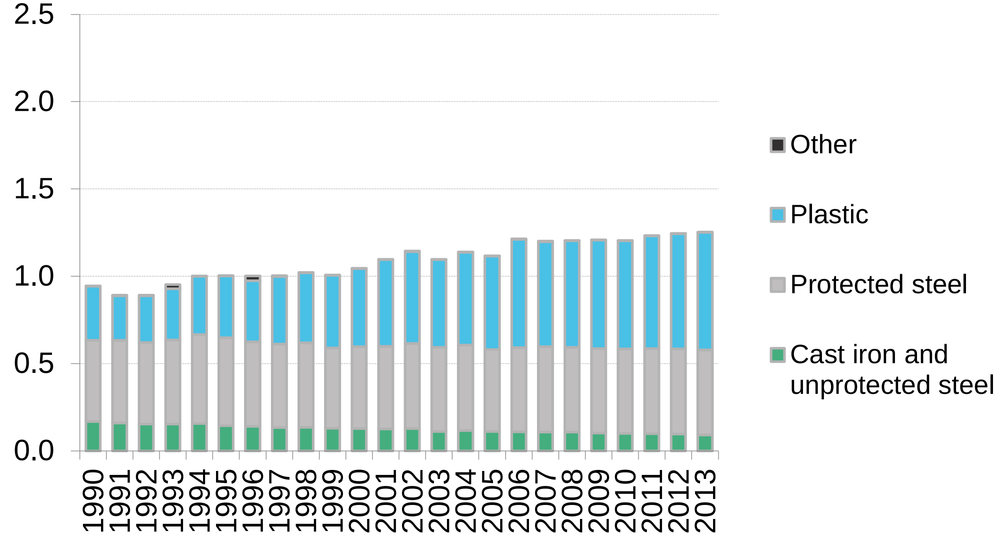
Notes: Eastern US production is mostly comprised of output from the Marcellus and Utica shales.

Deployment: US natural gas pipeline installations and materials

US existing natural gas distribution pipeline (million miles)



US natural gas distribution mainline material (million miles)

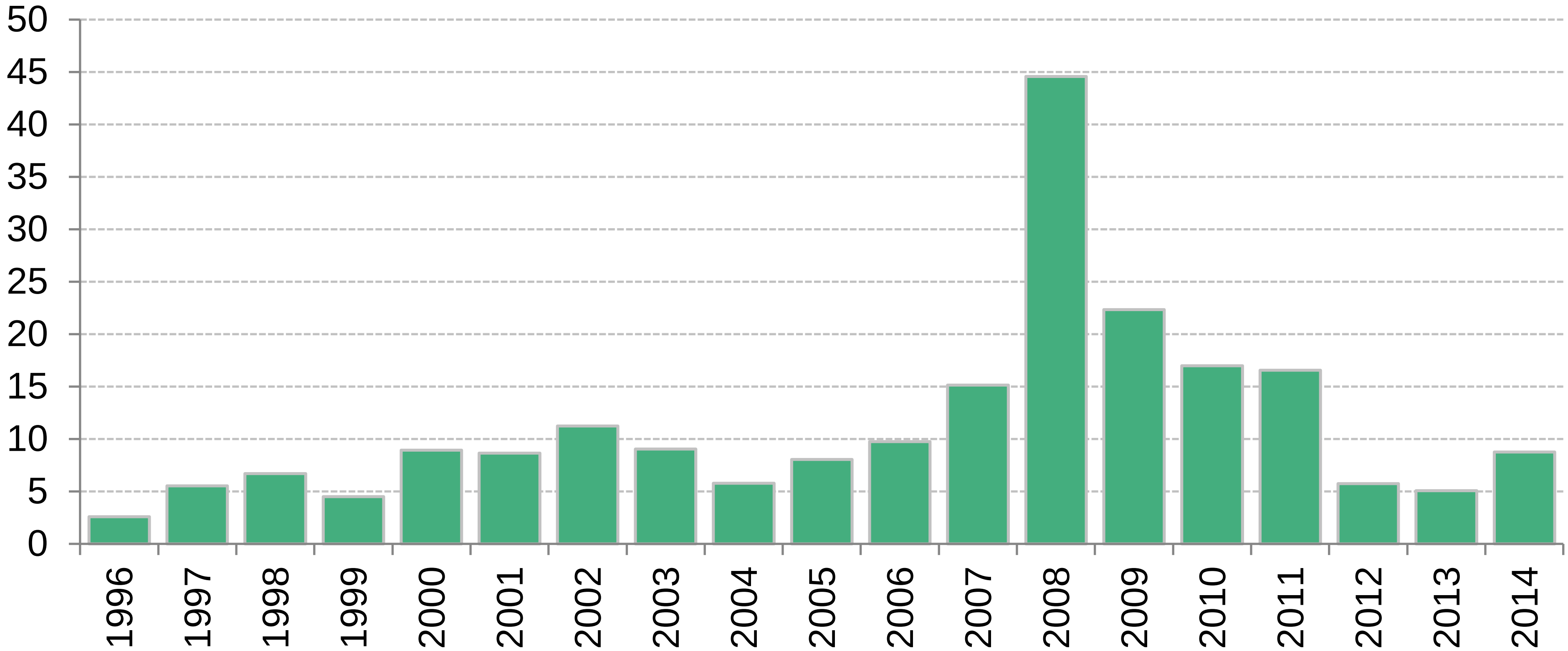


- Service and distribution pipelines – which bring gas from transmission lines to end-users – are growing at a steady pace. Much of the additions represent not new lines but pipeline upgrades, as companies remove older networks which are made from cast iron and unprotected steel and replace them with newer plastic / protected steel pipes that are less susceptible to leaks

Source: Bloomberg New Energy Finance, US Department of Transportation, American Gas Association

Notes: 'Distribution' refers to pipelines to which customers' service lines are attached; 'Services' refer to pipes which carry gas from the distribution pipelines to the customer's meter. Numbers are not available for 2014.

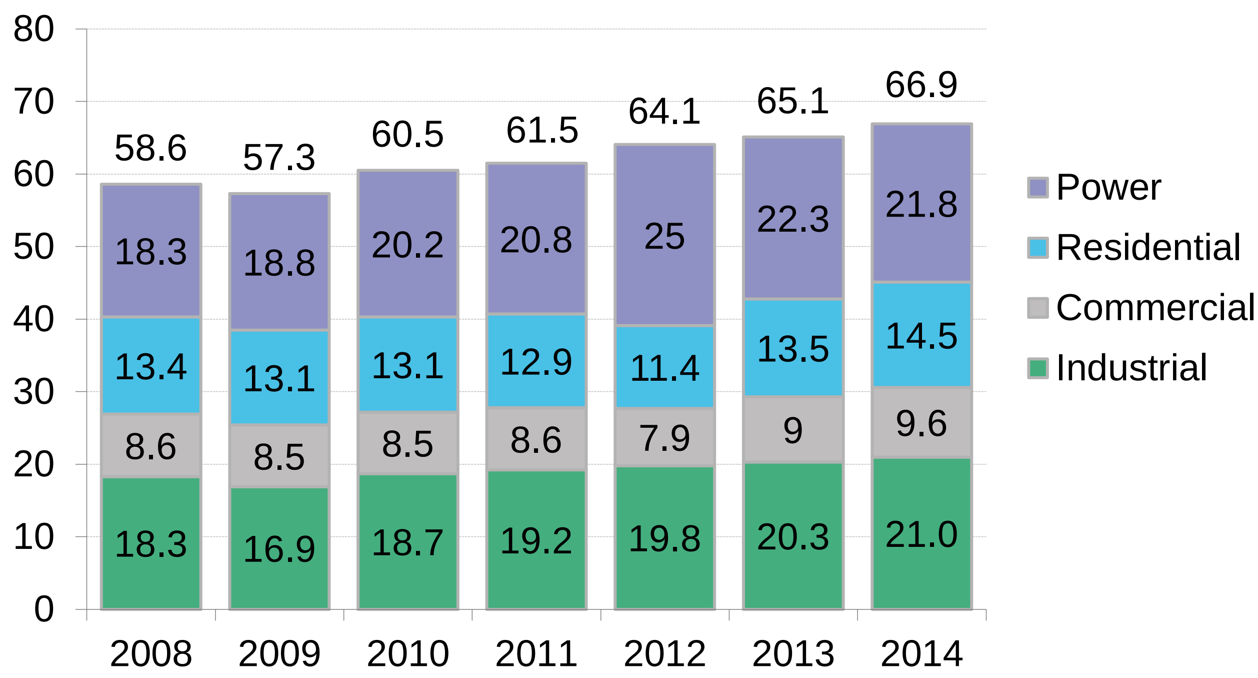
Deployment: US transmission pipeline capacity additions (Bcfd)



- Since 2012, high-pressure interstate transmission pipeline capacity additions have shifted away from large, greenfield networks and towards discrete, targeted projects
- In 2014, first-mile takeaway pipelines in the northeastern US, to handle growing production from the Marcellus and Utica basins, was the largest driver of new pipeline installations. Northeast takeaway lines have accounted for over half of transmission pipeline capacity additions since 2012
- New interconnection capacity from the US to Mexico was the second largest reason for new pipeline additions

Source: Bloomberg New Energy Finance, EIA

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

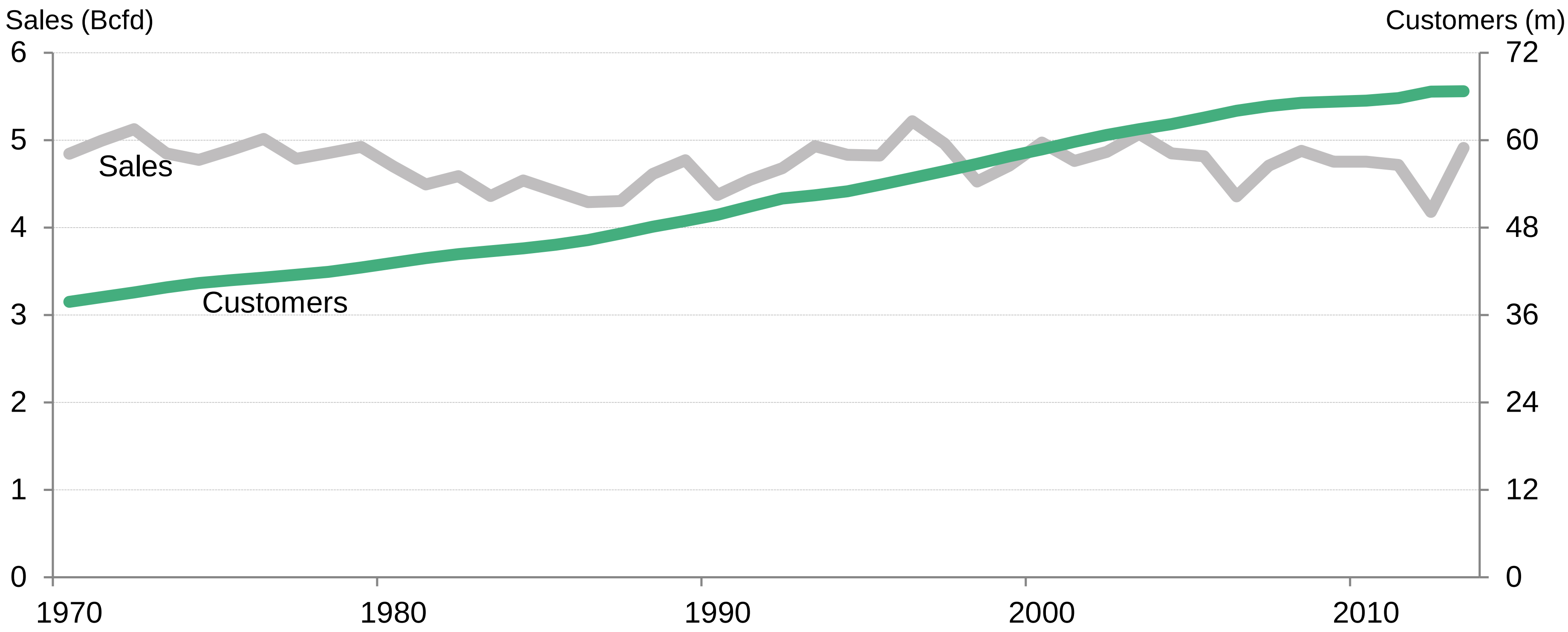


- Total US annual gas demand has grown steadily, though not rapidly: 14% increase since 2008, and an estimated 2.8% increase over the past year (2013-14)
- While 2014 demand was notably higher, very little of this growth was structural. Rather, it was driven by last winter's 'polar vortex', which drove up heating-related gas demand in the residential, commercial, and industrial sectors. In the midst of the polar vortex, in January 2014, the natural gas delivery system set daily, weekly, and monthly all-time records
- Power demand was on the lower end of the historical 5-year average in response to higher natural gas prices coming out of the harsh winter
- For structural demand, 10 new industrial projects (largely expansions of existing facilities) came online in 2014

Source: EIA, Bloomberg New Energy Finance

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

Deployment: US natural gas residential customers vs. residential consumption

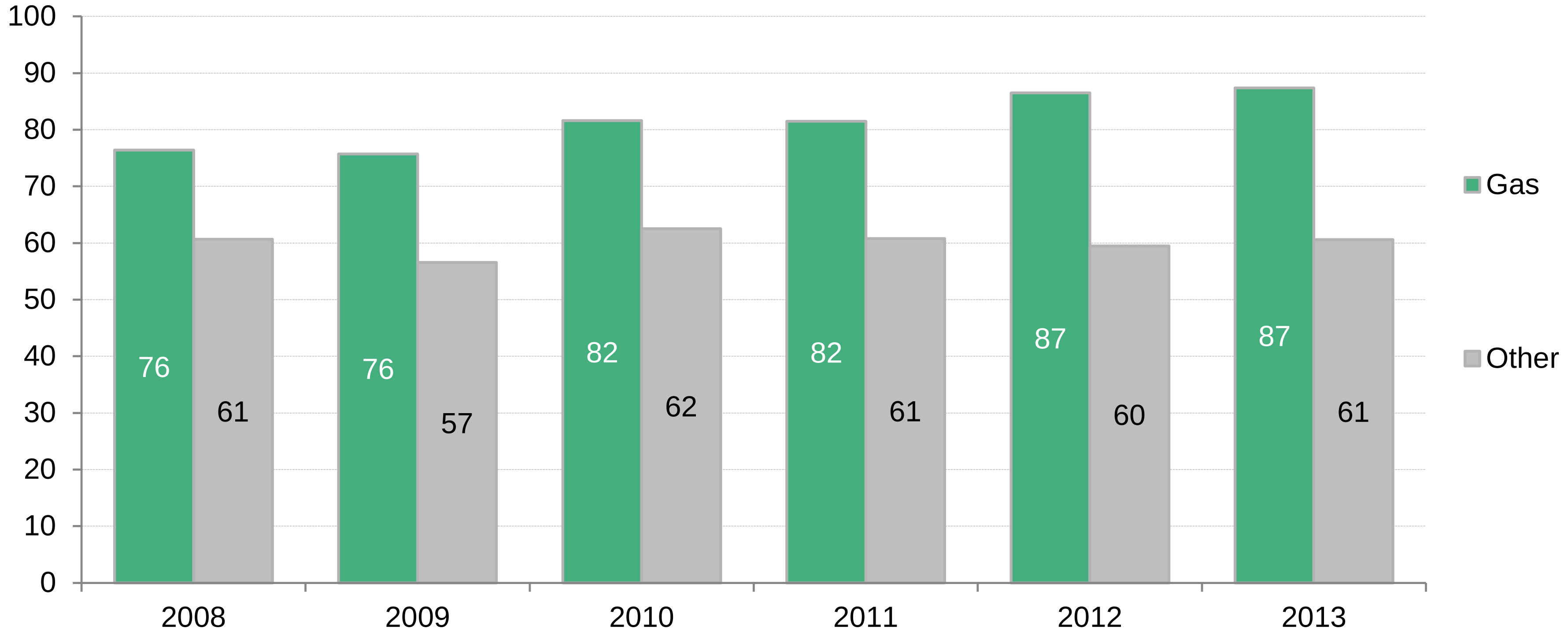


- Energy efficiency has kept residential consumption down even as more customers are added to the gas network, resulting in an overall reduction in consumption per capita since the mid-1990s
- The 2011-12 winter was abnormally mild; the higher consumption in 2013 represents a return-to-normal in winter temperatures

Source: EIA

Notes: Data for 1970-2013 only.

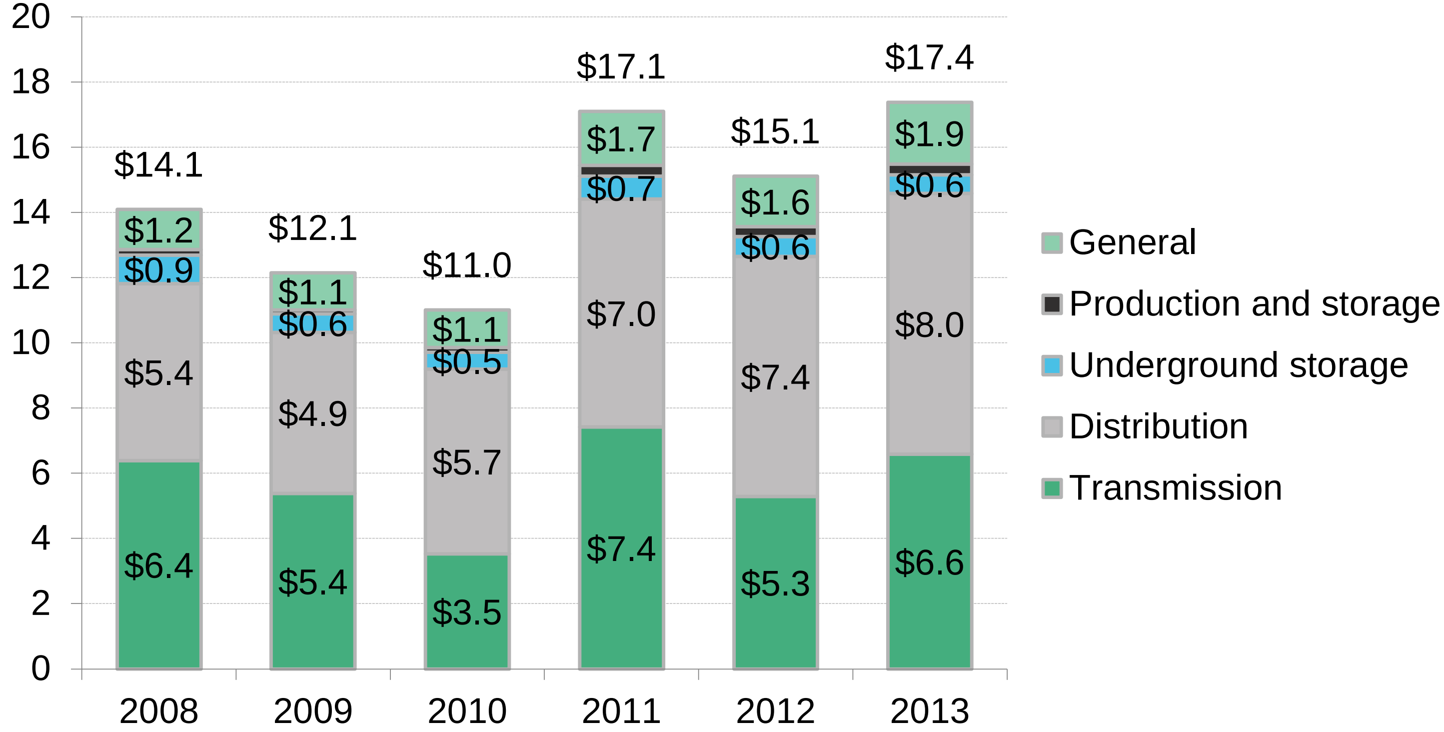
Deployment: US industrial electricity production from on-site generation by source (TWh)



- Industrial sector on-site generation has contributed significantly to the growth in electric sector gas consumption since 2008
- Growth in industrial sector on-site generation has slowed over the last few years, across all fuels
- The majority of gas-fired capacity additions in 2013-14 were from converting facilities away from coal/petcoke, rather than new-build facilities
- There continues to be fuel-switching to natural gas at existing on-site generation facilities

Source: EIA

Financing: US midstream gas construction expenditures ($bn)

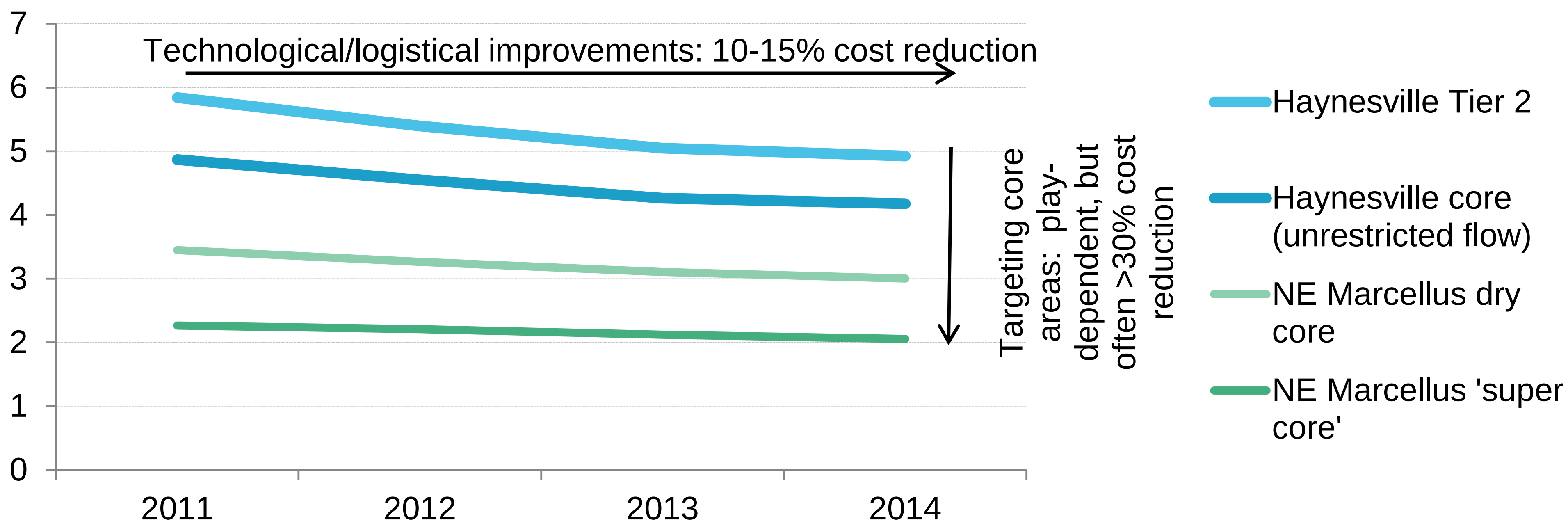


- Investment in natural gas infrastructure has clearly jumped since 2010, hitting a high in 2013 (the last year with available data), with more than $17bn invested across transmission, distribution, and other infrastructure
- The largest investments have been directed towards pipelines for distribution

Source: American Gas Association

Notes: Values reflect expenditures reported to the AGA by different types of companies across the supply chain, including transmission companies, investor-owned local distribution companies, and municipal gas utilities. 'General' includes miscellaneous expenditures such as construction of administrative buildings.

Economics: Cost of supply evolution for two regions within the Haynesville and Marcellus ($/MMBtu)



- There are two drivers bringing down unit costs for gas production
- The first driver is technological / logistical improvements which have reduced unit costs substantially over the past several years. These improvements include reducing cycle times through pad drilling, drilling longer laterals, and choke management
- The second and more important driver has come from delineating the ‘core’ of plays and shifting development capital towards these higher-priority plays and away from ‘Tier 2’ areas, where ultimate recoveries of gas are lower

Source: Bloomberg New Energy Finance

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

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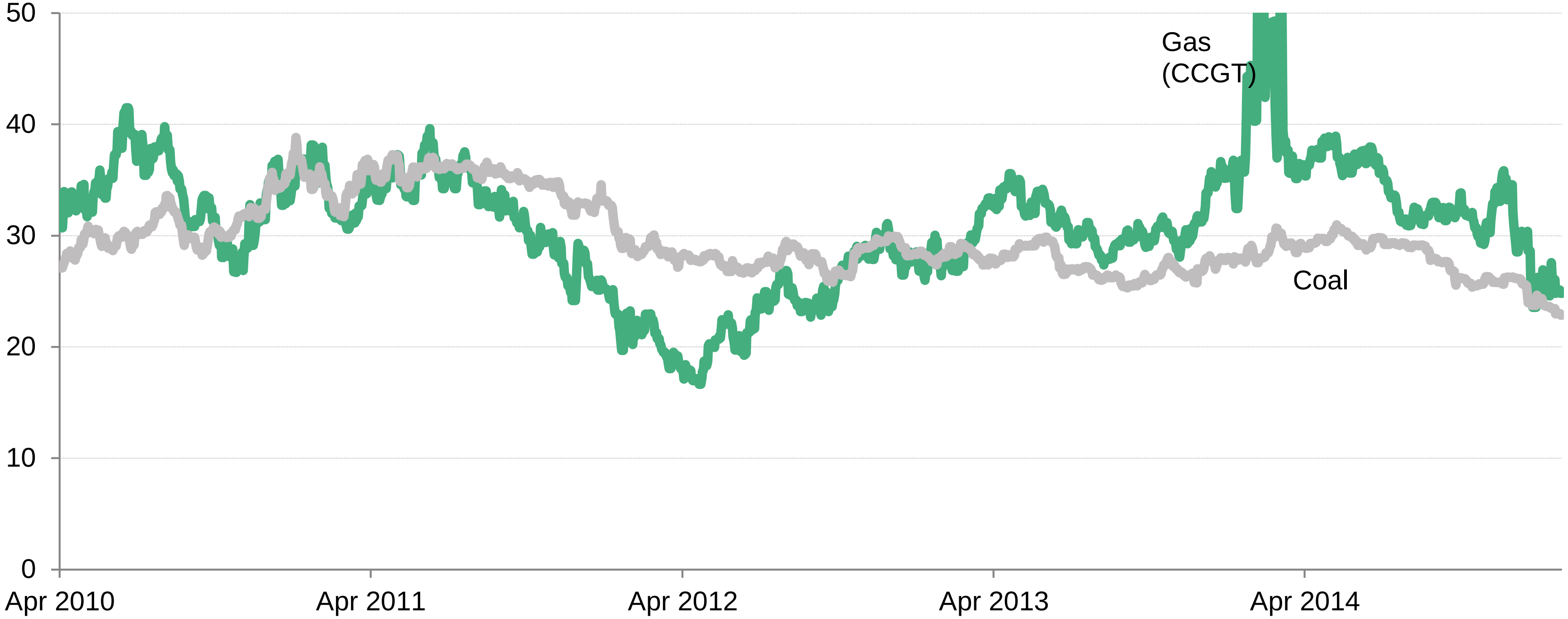
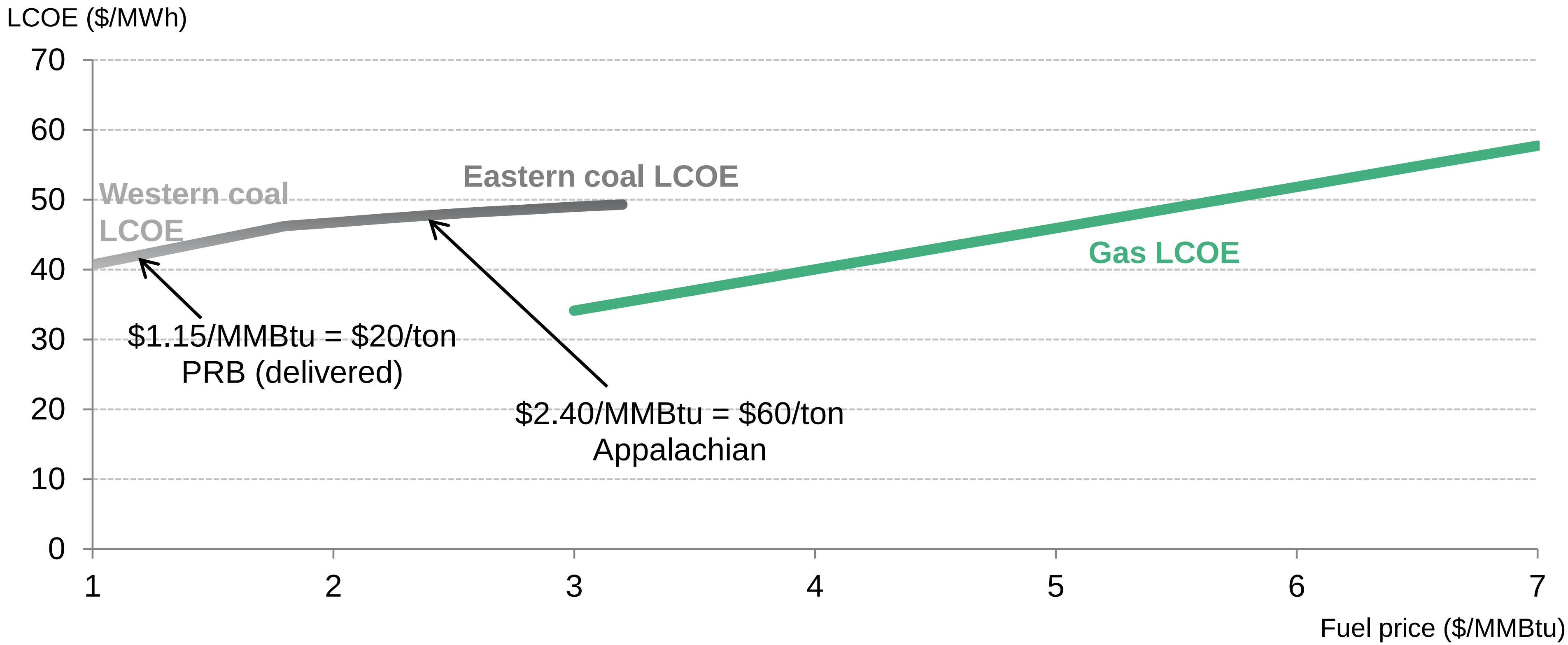


- Power has served as the swing demand source for natural gas: when prices fall too low, gas burn rises until the differential (in $/MWh) between the two fuels closes.
- In 2014, the cold winter drove gas prices to regional highs, giving coal a comparative advantage across the US
- The differential was particularly high in the northeast, where pipeline constraints resulted in especially high winter prices

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.

Economics: LCOE comparison for us natural gas vs. coal ($/MWh) as a function of fuel price ($/MMBtu)

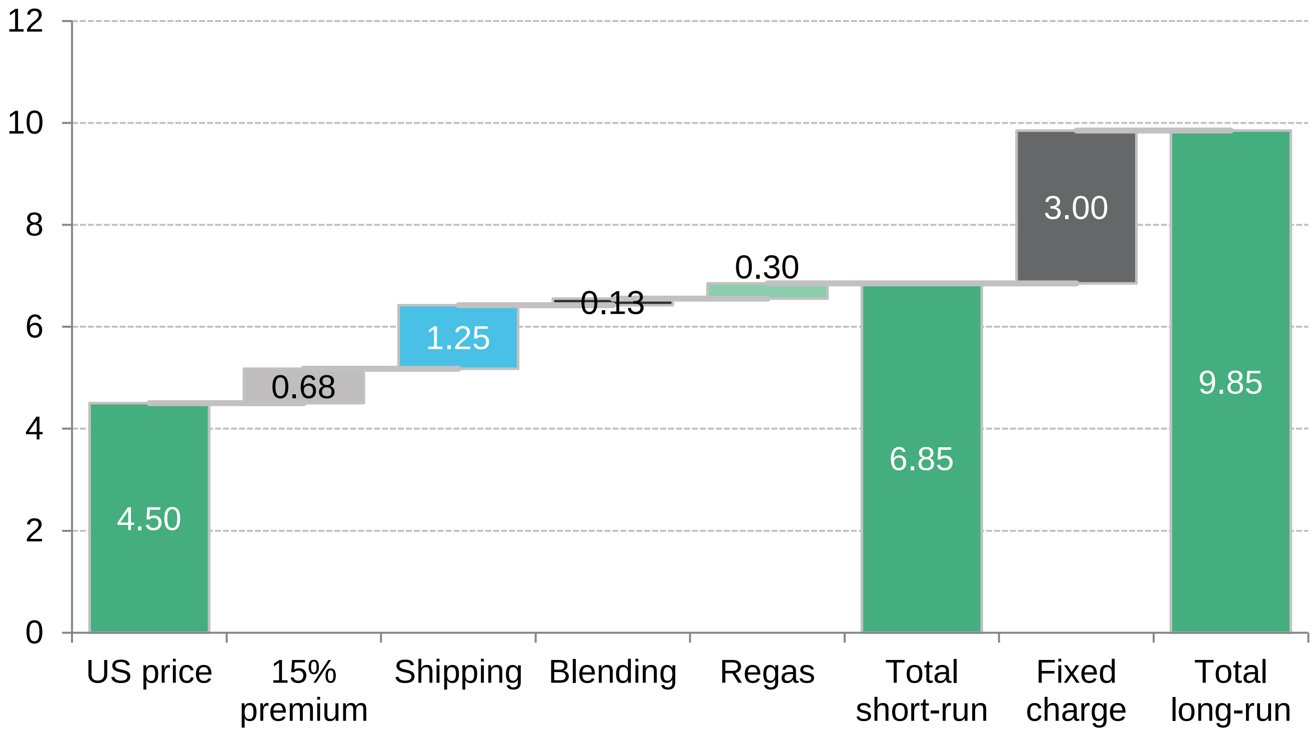


- With gas prices below $4.50/MMBtu, new natural gas plants have a lower levelized cost of electricity than new coal power plants anywhere in the country
- The EPA's New Source Performance Standards for carbon indicates that no new coal units could be built without carbon capture and sequestration (CCS); that technology would push coal LCOEs even higher
- At 2014 prices, economics favored new natural gas plants new coal plants (even without accounting for CCS)
- With futures prices suggesting gas may rise above $5/MMBtu, LCOEs for natural gas and non-CCS coal will be close in value

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.

Economics: LNG cost build, US Gulf Coast to Europe ($/MMBtu)



- US LNG exports are expected to be priced competitively with current global spot prices
- US exports will be sold at a mark-up from Henry Hub; that mark-up captures O&M costs and a fixed charge to recuperate sunk costs
- Four US LNG export terminals are currently under construction, three of which began construction in 2014. Together, these facilities will bring over 44MMtpa of LNG export capacity to the US by end-2019

Source: Bloomberg New Energy Finance

Notes: 'Regas' is regasification, or the process in which imported LNG is expanded and reconverted into gas that can be injected into the pipeline distribution network. 'Fixed charge' is the cost associated with recouping upfront costs (the other costs shown here are short-run marginal costs).

Table of contents

Deployment: Global PV supply and demand

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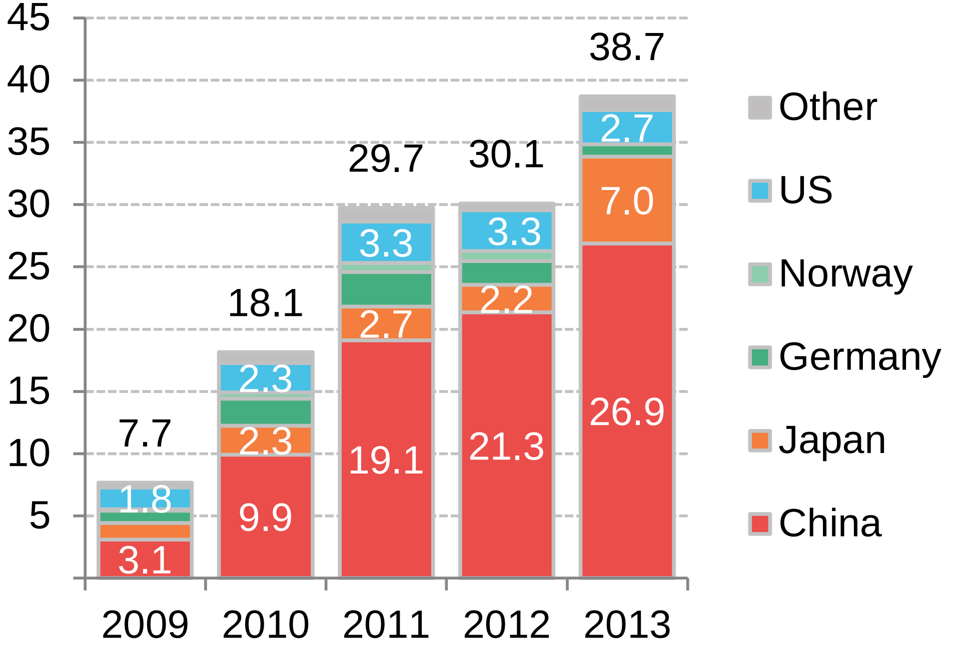
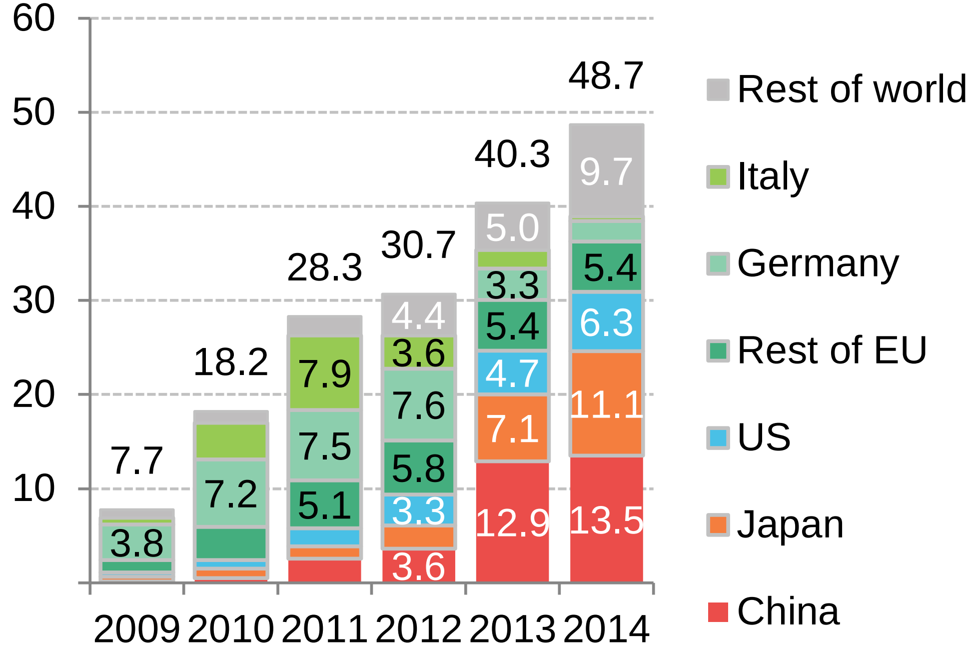
Global PV module production by country (GW)



Global PV demand by country (GW)



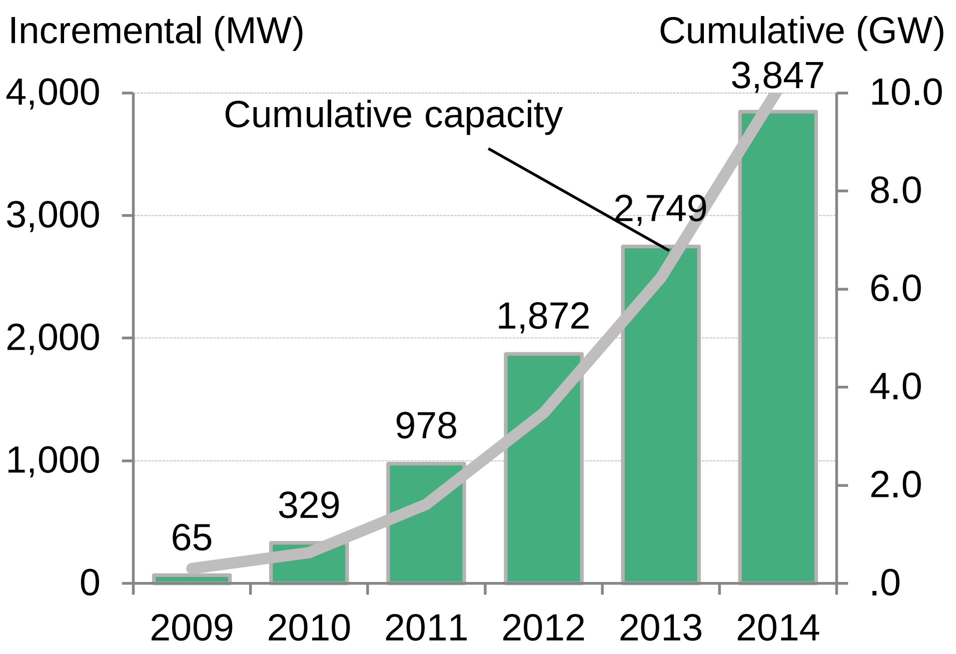
- Bolstered by strong uptake in China and Japan, demand for solar photovoltaic (PV) modules rose strongly, as the global market again reduced its reliance on European demand centers
- Trade disputes raged on, as the US took steps to applying tariffs on Chinese and Taiwanese solar products (which still account for much of the market). The US tariff regime to date has increased modules prices by roughly ~$0.15, but so far low-cost Chinese producers have largely held onto market share in the US by accepting slimmer margins

Source: Bloomberg New Energy Finance

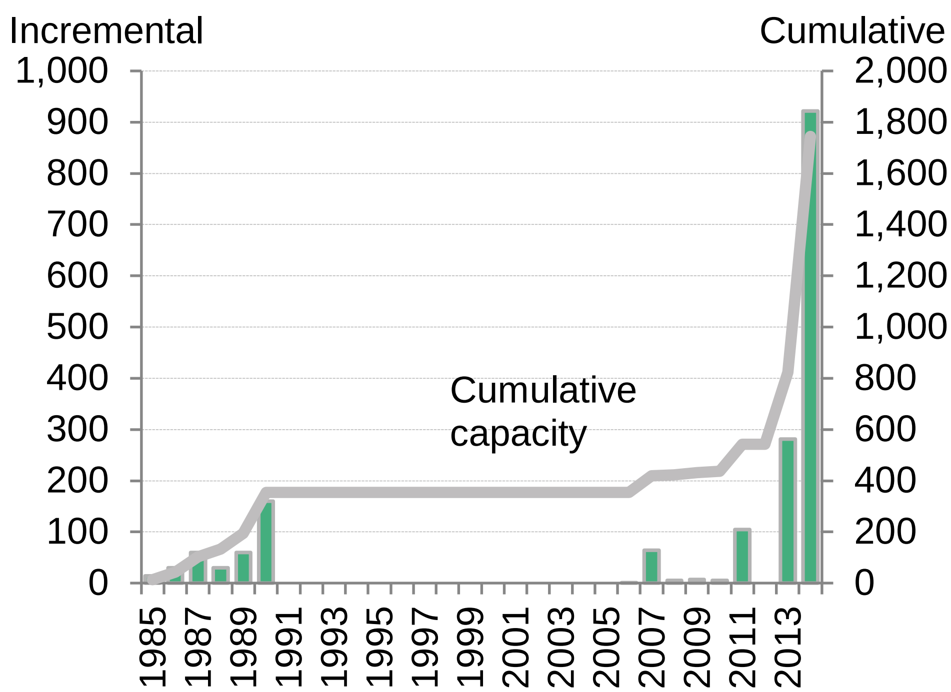
Notes: In chart at right, 2014 values represent an average of optimistic and conservative analyst estimates.

Deployment: US large-scale solar build

US utility-scale photovoltaic build



US concentrating solar power build (MW)



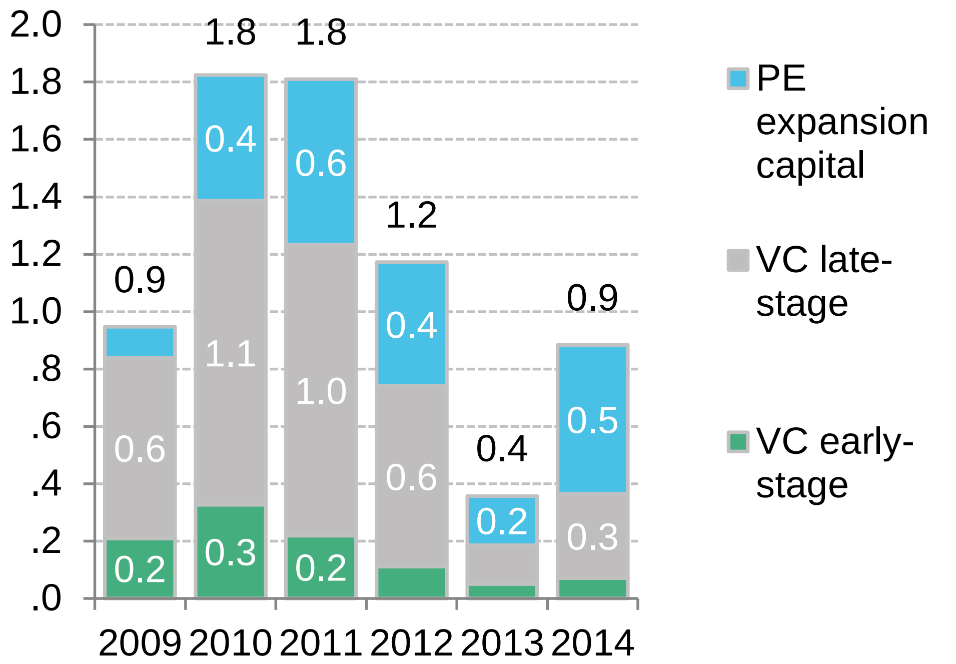
- The trend over the past six years shows dramatic growth in utility-scale PV. However, build is expected to level off this year as the pipeline in California begins to thin (the pipeline had been driven by the state's Renewable Portfolio Standard)
- Several large concentrating solar power (ie, solar thermal electricity generation) plants were commissioned in 2014: Abengoa's Mojave (280MW), BrightSource's Ivanpah (392MW) and NextEra's Genesis (250MW) projects. But the outlook for concentrated solar power is weak due to lost ground in relative competitiveness versus PV

Source: Bloomberg New Energy Finance

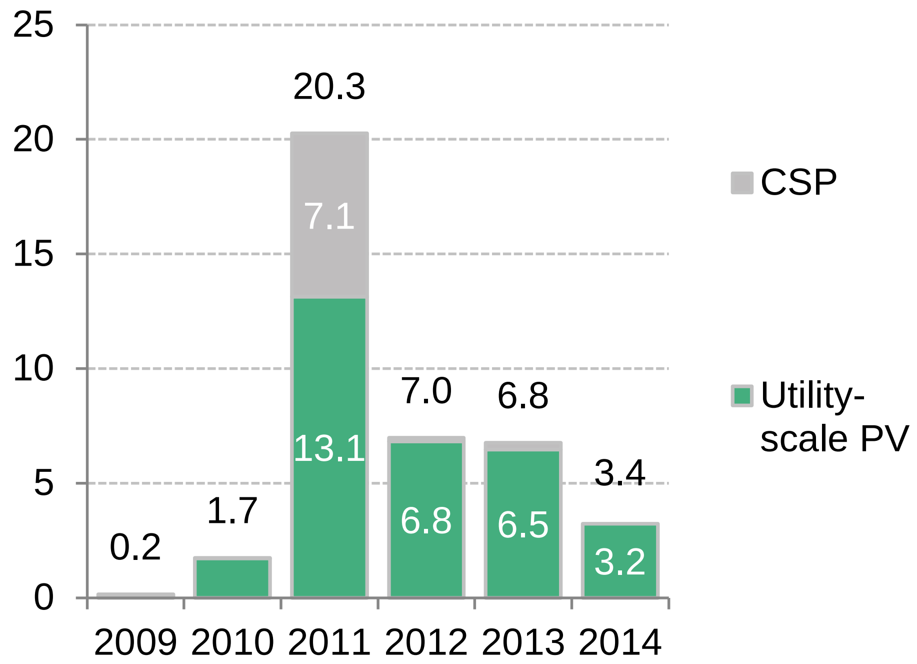
Notes: In chart at left, 2014 build represents an average of optimistic and conservative analyst estimates.

Financing: US large-scale solar investment

Venture capital / private equity investment in US solar by type of investment ($bn)



Asset finance for US utility-scale solar projects by technology ($bn)



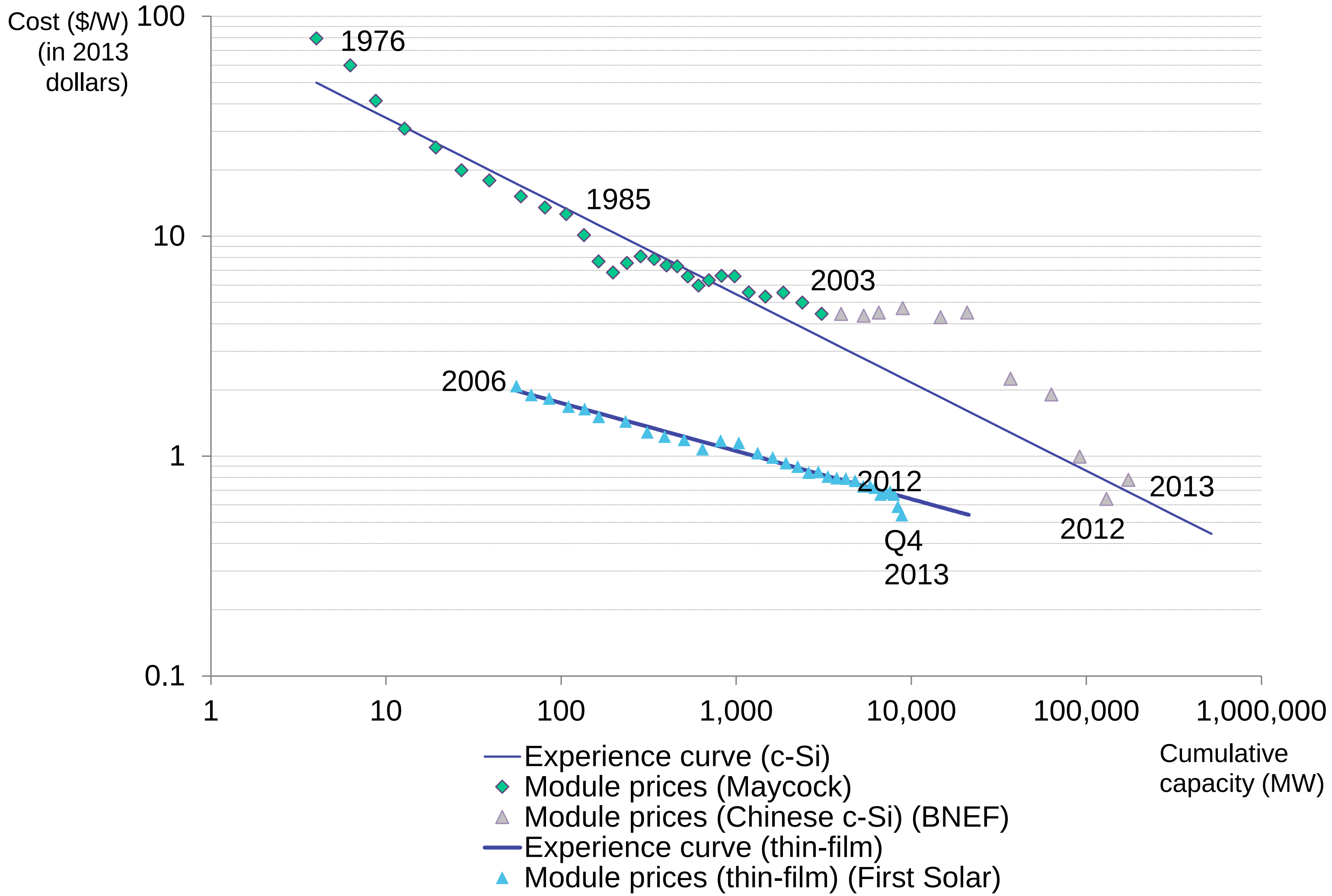
- Venture capital and private equity activity ramped up after a quiet 2013, as investors began to see opportunities around rooftop PV (more on this in Section 5.1 of this report)
- Asset finance deals for utility-scale PV continued to fall as large procurements have become increasingly rare

Source: Bloomberg New Energy Finance

Notes: Only includes electric generating assets; does not include solar thermal water heaters.

Economics: Price of solar modules and experience curve ($/W as function of global cumulative capacity)

Bloomberg NEW ENERGY FINANCE

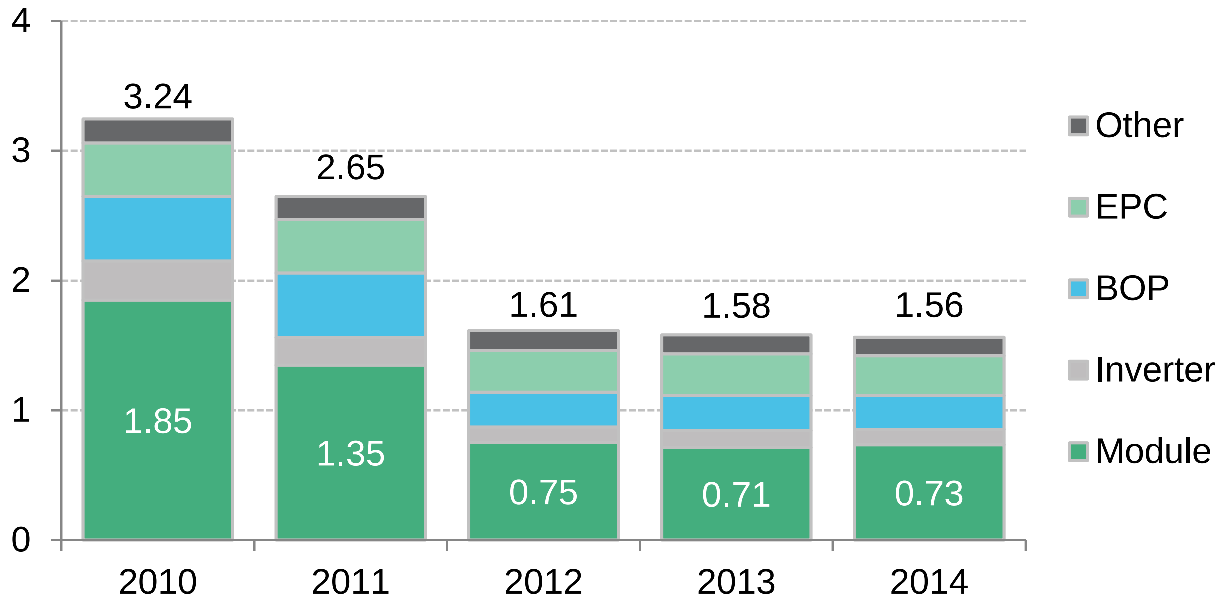


- Module pricing has broadly followed the experience curve for costs for the past few decades. Prices dropped in 2012 due to manufacturing overcapacity, but then ticked back up in 2013 as oversupply began to ease
- Module prices are down by more than 80% relative to 2007 levels

Source: Bloomberg New Energy Finance, Paul Maycock, company filings

Notes: Prices in 2013 USD.

Economics: Best-in-class capex for utility-scale PV ($/W)

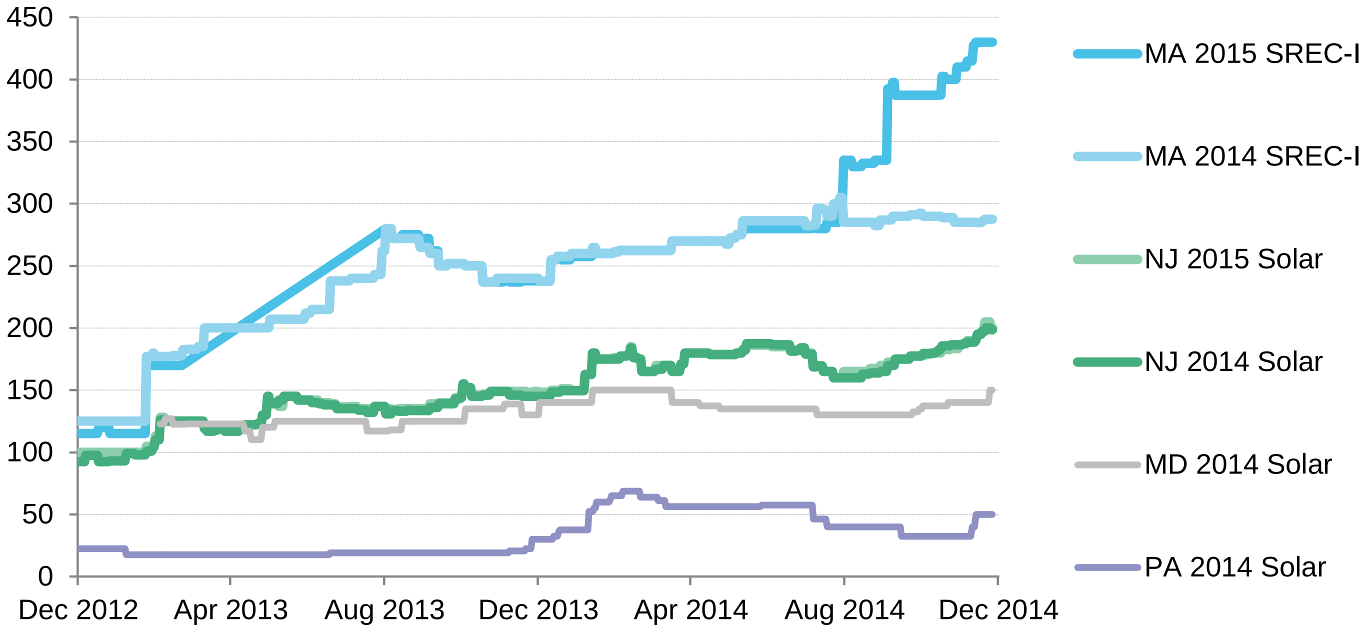


- The trend shows a dramatic decline in global benchmark for the cost of solar in mature markets from 2010 to 2012, followed by a leveling out as module prices stayed relatively flat from 2012-2014
- Modules prices ticked higher as the dominant theme of excess upstream overcapacity began to ease, allowing manufacturers to eke out a profit
- The best-in-class capex reflects the costs in mature market such as Germany; the cost of best-in-class utility-scale PV in the US is in this range as well
- Utility-scale solar plants in Texas and Utah have secured PPAs to sell power at $50-55/MWh (with the help of incentives), among the lower prices ever seen globally for contracted solar power

Source: Bloomberg New Energy Finance

Economics: Solar REC prices in selected US state markets by vintage year ($/MWh)

Bloomberg NEW ENERGY FINANCE



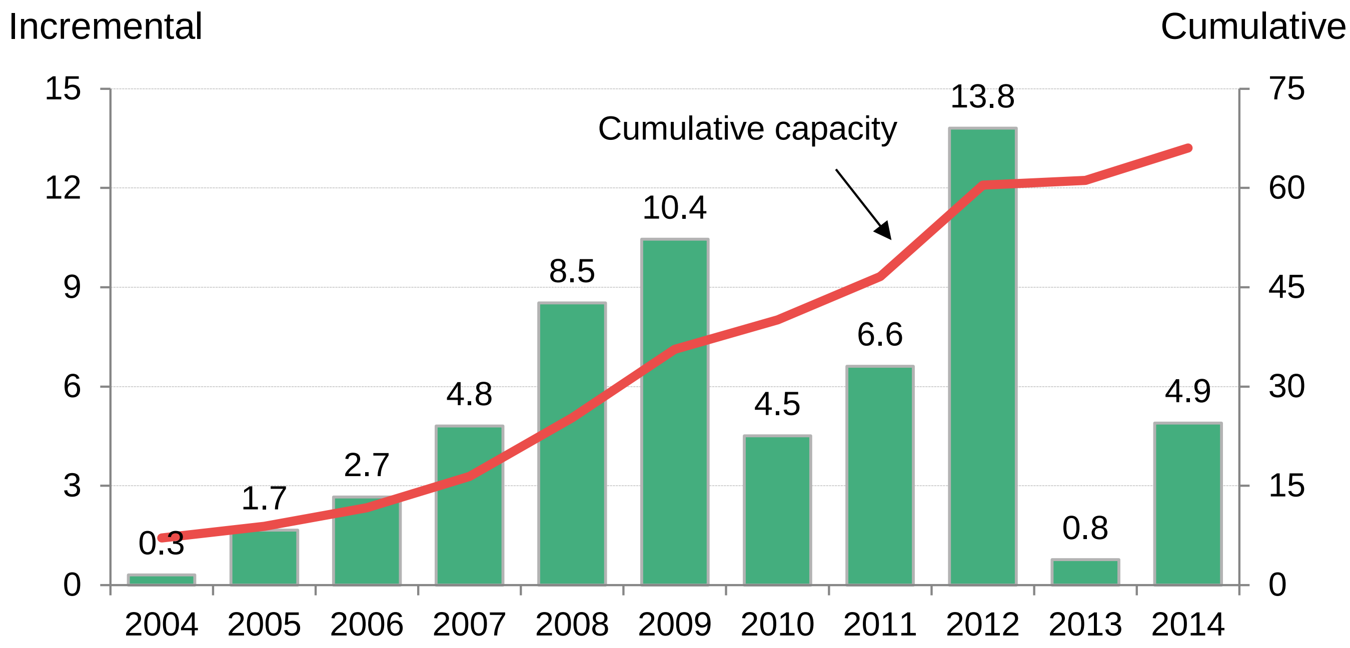
- Solar projects in some parts of the country also generate revenue through the sale of solar renewable energy credits (SRECs), procured by utilities to comply with solar carve-out programs within their states' RPS
- In 2014, Massachusetts closed its SREC-I program, and state regulators launched a new program (SREC-II) which will push the state to 1,600MW of cumulative solar by 2020. New Jersey SRECs moved steadily higher as new build in the state was much weaker than expected

Source: Bloomberg New Energy Finance, ICAP

Notes: *Data in the charts above ("SREC prices") are the sole property of ICAP United, Inc. Unauthorized disclosure, copying or distribution of the Information is strictly prohibited and the recipient of the information shall not redistribute the Information in a form to a third party. The Information is not, and should not be construed as, an offer, bid or solicitation in relation to any financial instrument. ICAP cannot guarantee, and expressly disclaims any liability for, and makes no representations or warranties, whether express or implied, as to the Information's currency, accuracy, timeliness, completeness or fitness for any particular purpose.*

Table of contents

Deployment: US large-scale wind build (GW)



- New build in 2014 rebounded six-fold from 2013 levels, from 0.8GW to 4.9GW
- The increase was driven by the one-year extension of the Production Tax Credit (PTC) in 2013, the key federal incentive for wind in the US. The PTC expired at the end of December 2012, was renewed January 2013, expired December 2013 (but wind projects qualified for the incentive by starting construction in 2013), was 'retroactively' renewed in December 2014 and expired again two weeks later, at the end of 2014. The current pipeline suggests healthy build for 2015-16
- A majority of the build is occurring in Texas. The state recently completed a $7bn transmission build-out to connect windy regions in the Panhandle and West Texas to demand centers. Wind in Texas is among the cheapest in the country, with an unsubsidized levelized cost of electricity of around $50/MWh, due to high capacity factors (>50%) and low cost to build

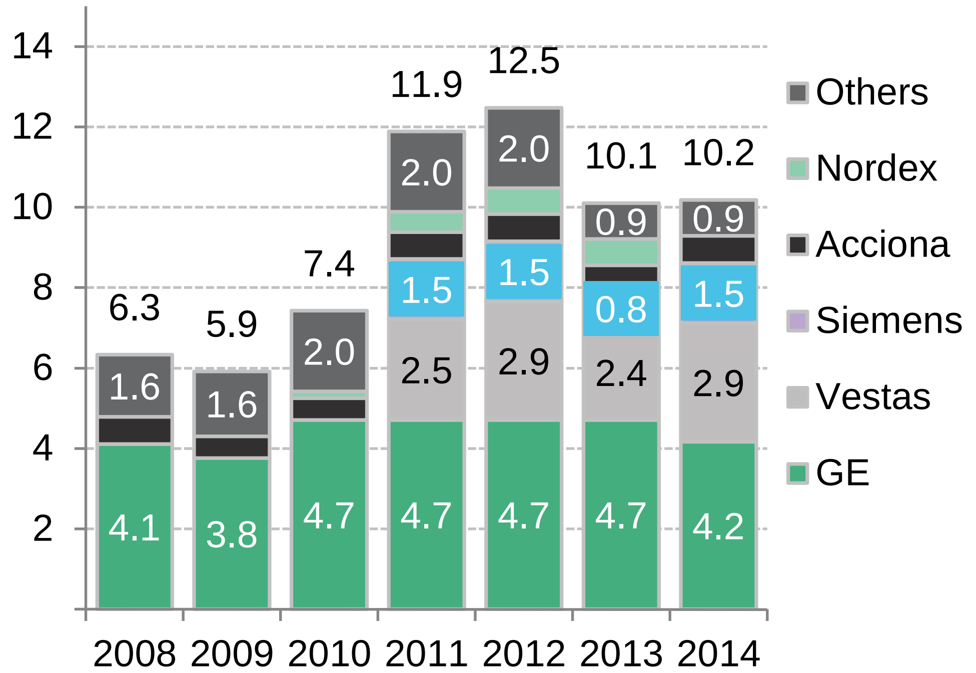
Source: Bloomberg New Energy Finance

Notes: Includes all utility-scale wind development, including distributed turbines that are above1MW (Bloomberg New Energy Finance threshold for utility-scale).

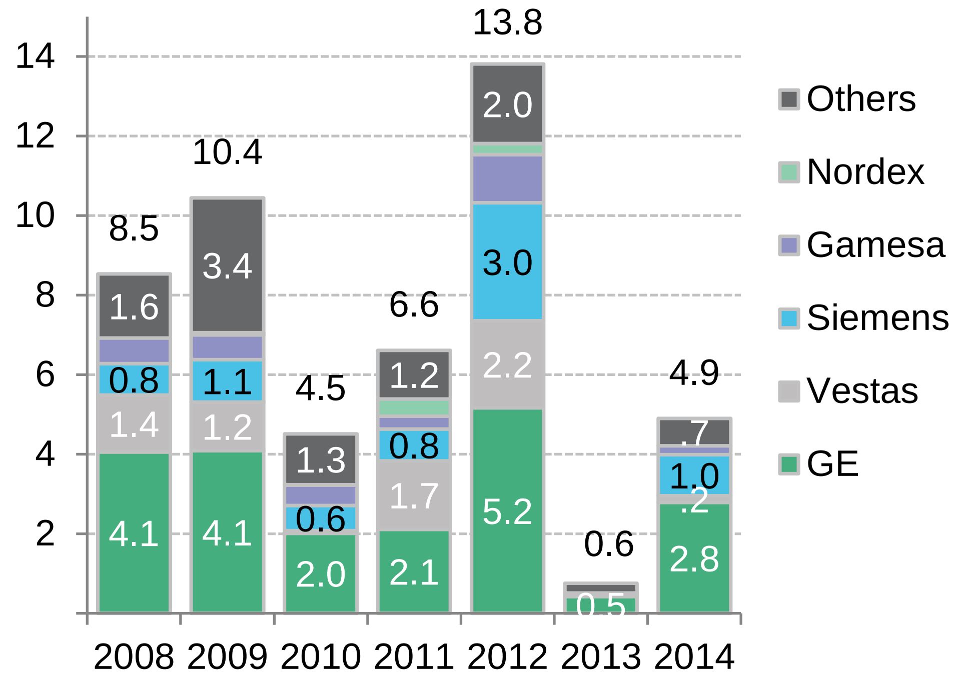
Deployment: US wind turbine production and contracting

Bloomberg NEW ENERGY FINANCE

US wind turbine production capacity by manufacturer (GW)



US wind turbine supply contracts for commissioned projects by commissioning year, by manufacturer (GW)



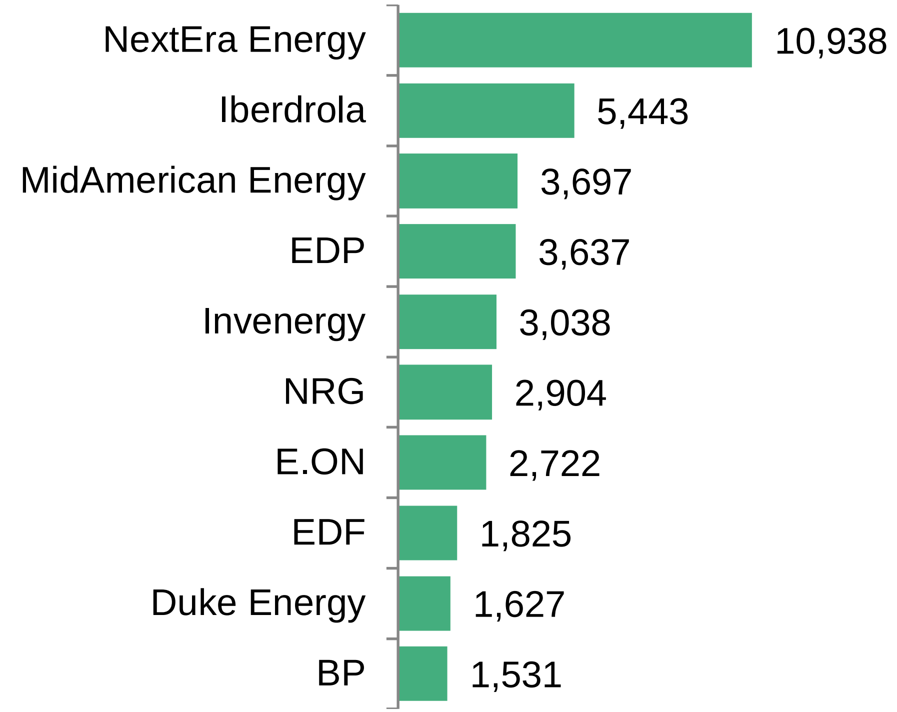
- Several manufacturers have closed nacelle assembly facilities in the US since 2012. These include Clipper (which was sold by UTC to Platinum Equity and no longer manufacturers turbines), Nordex, and Mitsubishi. Several others laid off workers in 2012 and rehired them in 2013 after the PTC was extended
- GE, Vestas and Siemens are the dominant manufacturers in the US market. Asian manufacturers, including Sinovel, Goldwind, and Sany, which entered the market in 2012 when cash-based incentive was available, have not been able to compete in a PTC environment due to their inability to secure risk-averse tax equity financing

Source: Bloomberg New Energy Finance

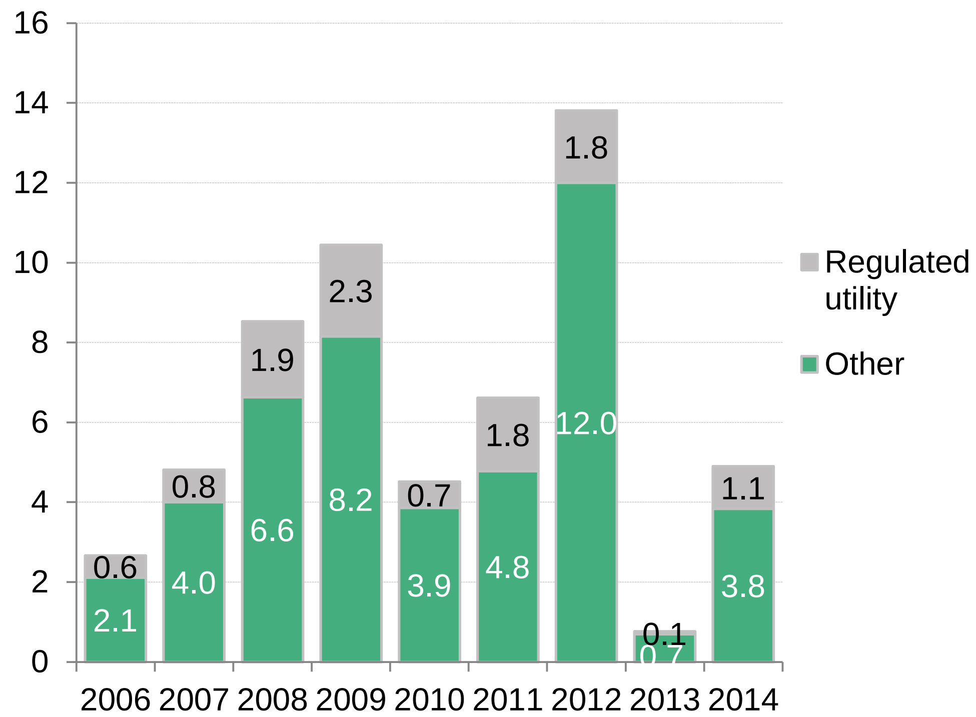
Notes: Production capacity measured by nacelle assembly on US soil

Deployment: US wind ownership and development

Top 10 US wind owners, as of end-2014 (MW)



US wind capacity commissioned by type of developer (MW)

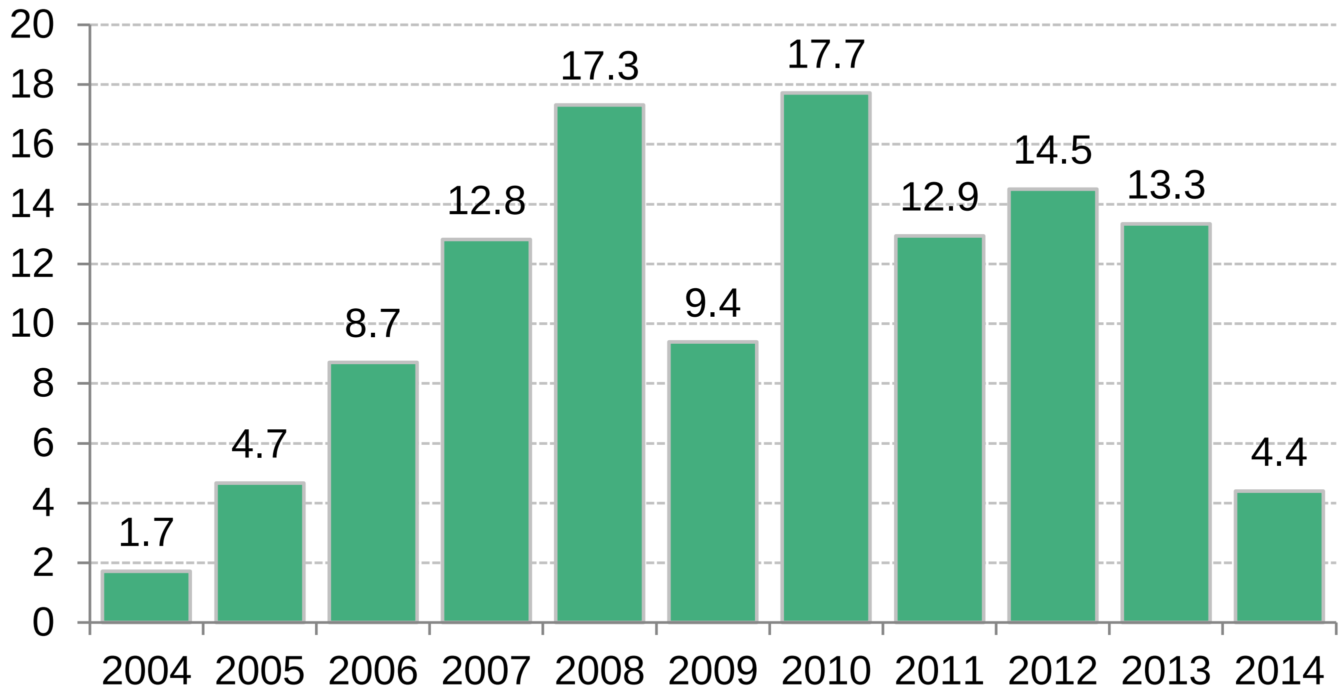


- NextEra Energy is still the dominant wind developer in the US market. It is followed by Iberdrola (Spanish utility) and MidAmerican Energy (the utility holding company owned by Warren Buffett's Berkshire Hathaway)
- Regulated utilities have built only a small portion of the wind assets in the country. Most utilities prefer to sign power purchase agreements with independent generators rather than build and own the projects themselves

Source: Bloomberg New Energy Finance

Notes: In chart at left, ownership is based on 'net ownership' as opposed to 'gross ownership', to account for co-ownership. Values are based primarily on data directly from company websites. In chart at right, 'Other' includes projects built by non-utilities such as independent power producers and also includes projects built by the non-regulated development arms of utilities such as Duke or NextEra; in those cases, the projects are not supplying power to the regulated utilities' ratepayers but rather to a third party.

Financing: Asset finance for US large-scale wind projects ($bn)



- The pipeline for wind looks healthy for 2015-16: much of the financing secured in 2013-14 is for wind projects to be commissioned in the coming two years
- After a rush to secure construction financing in 2013 to qualify projects for the PTC, financing for new wind in 2014 declined
- Investment levels were somewhat boosted in the second half of the year, following clarification issued by the Internal Revenue Service in August regarding the level of construction needed to achieve PTC eligibility

Source: Bloomberg New Energy Finance

Notes: Values include estimates for undisclosed deals.

Economics: Wind turbine price index by turbine type and delivery date ($m/MW)

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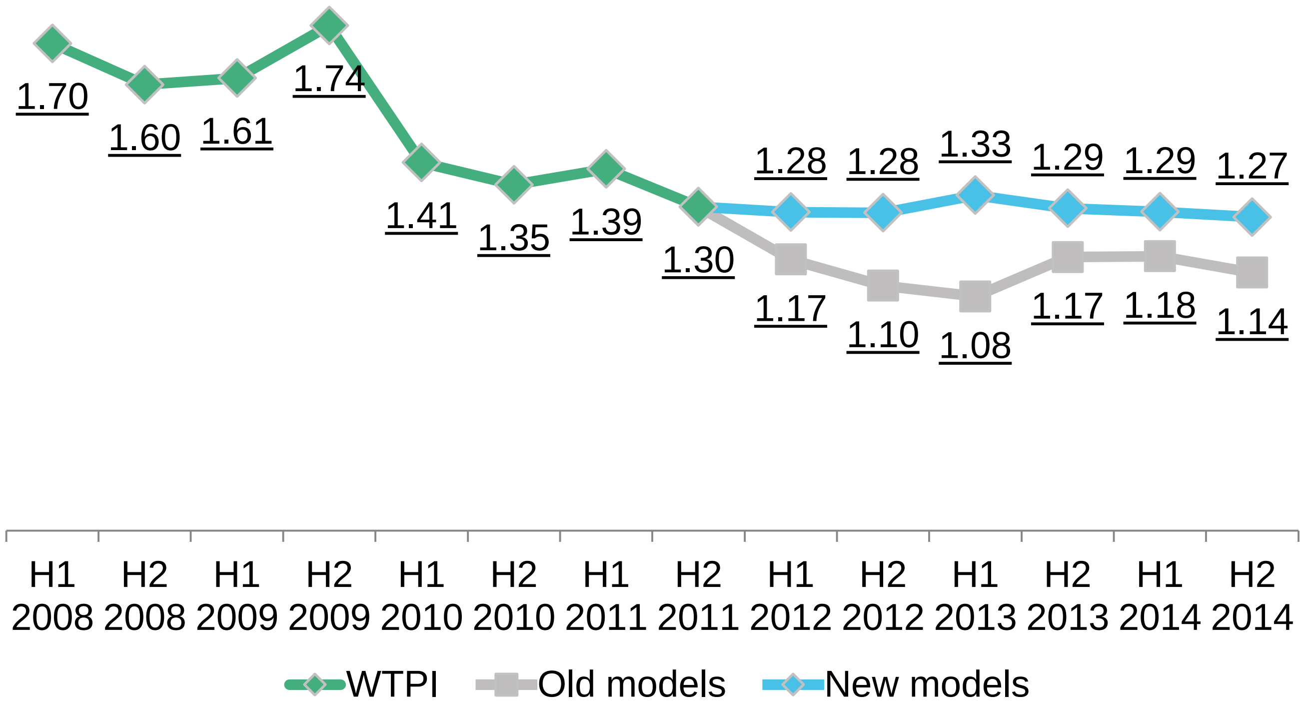


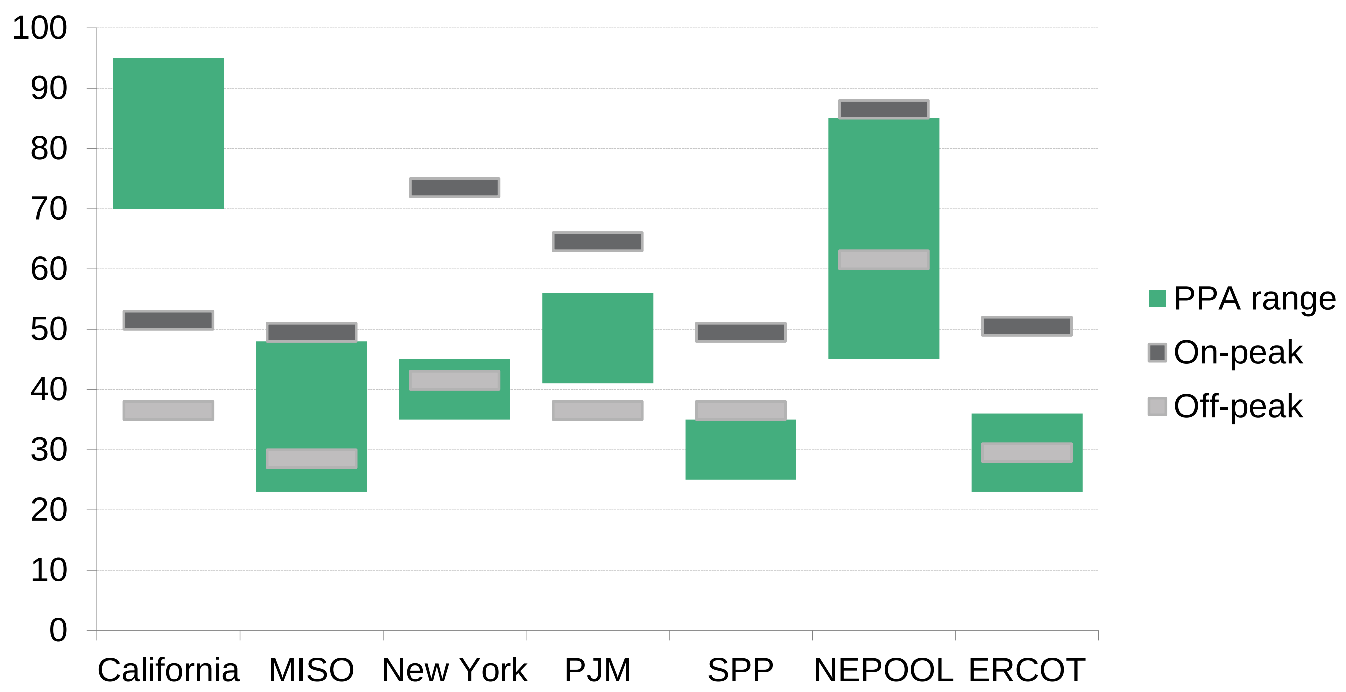
- Turbine prices have leveled off in recent years compared to the steep declines in 2009-10
- Turbines with larger rotor diameters (>95m), which tend to be the newer models, are priced higher than those with smaller rotor diameters (<95m), which tend to be the older models
- Developers in most regions are electing the newer, more expensive turbines over the older models due to the increased production from the turbine. Despite the increase in cost in *per MW* terms, the cost of energy in *per MWh* terms is lower

Source: Bloomberg New Energy Finance

Notes: Values based on Bloomberg New Energy Finance's Global Wind Turbine Price Index. Values from the Index have been converted from EUR to USD by the average EUR/USD rate for the half year of turbine delivery.

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

Bloomberg NEW ENERGY FINANCE



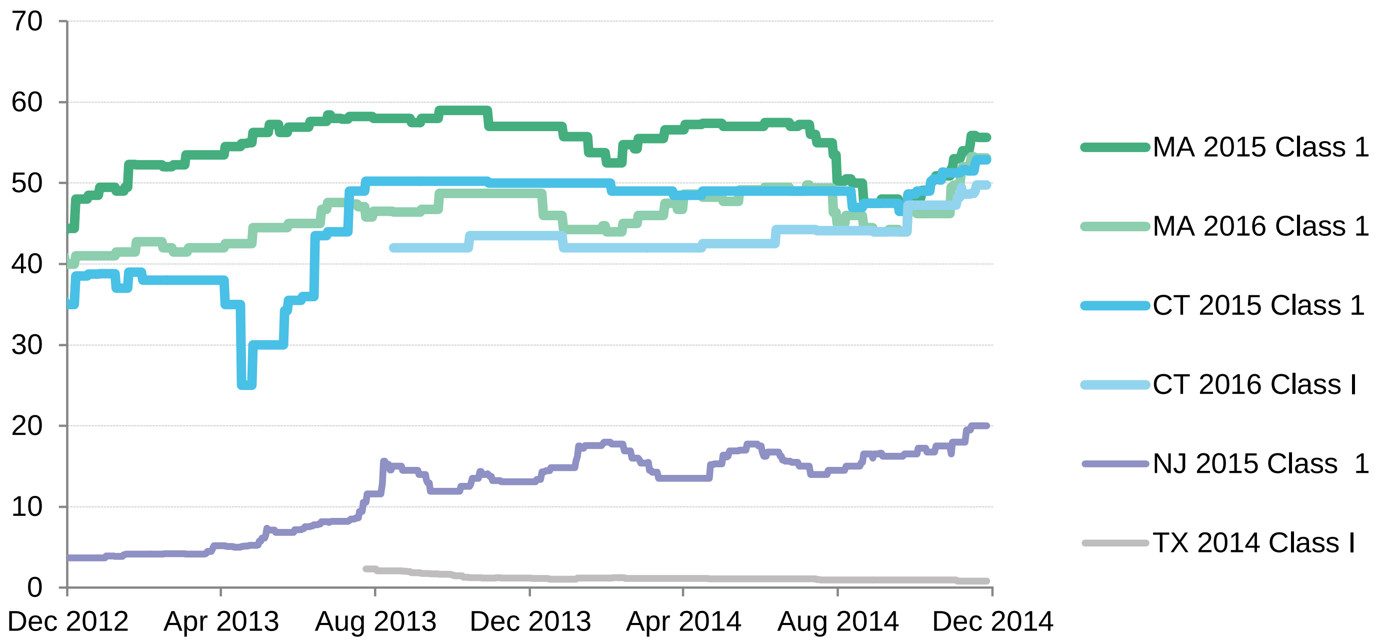
- For projects commissioned in 2014, most power purchase agreements (PPAs) were signed in 2013. Pricing for those PPAs varies by region. The cheapest PPAs were signed in the Midwestern regions of SPP (Oklahoma, Kansas, Nebraska), other parts of the Midwest, and ERCOT (Texas). Pricing in these regions was $20-30/MWh, with reports of some PPAs starting in the mid-teens. Many of these projects (but not all) have escalators, which increase the price 2-3% per year
- Prices for PPAs signed in New England averaged around $80/MWh. This is due to higher construction costs, lower capacity factors, and scarcity of wind projects (limited land for development, difficult permitting due to local opposition)
- PPA offtakers need not only be utilities; other non-utility entities that signed PPAs for wind in 2014 included Microsoft, Yahoo!, and a consortium of Washington DC-based organizations (universities and a hospital)

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.

Economics: 'Class I' REC prices in selected US state markets ($/MWh)

Bloomberg NEW ENERGY FINANCE



- New England REC prices remain high due to the difficulty with siting wind in the region. With high electricity prices, and high REC prices, wind economics could work without the PTC
- Texas, the state with the highest amount of wind capacity in the country, has the lowest REC prices due to substantial oversupply of the credits

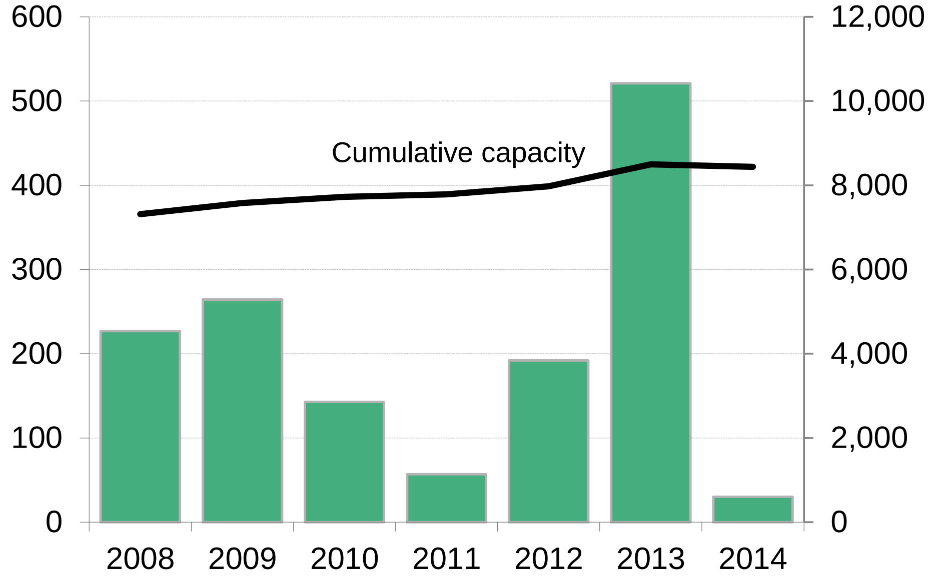
Source: Bloomberg New Energy Finance, Evolution, Spectron Group

Notes: 'Class I' generally refers to the portion of REC markets that can be served by a variety of renewables, including wind. In contrast, solar REC (SREC) markets are not Class I, as these can only be met through solar. The 'Class I' component is usually the bulk of most states' renewable portfolio standards.

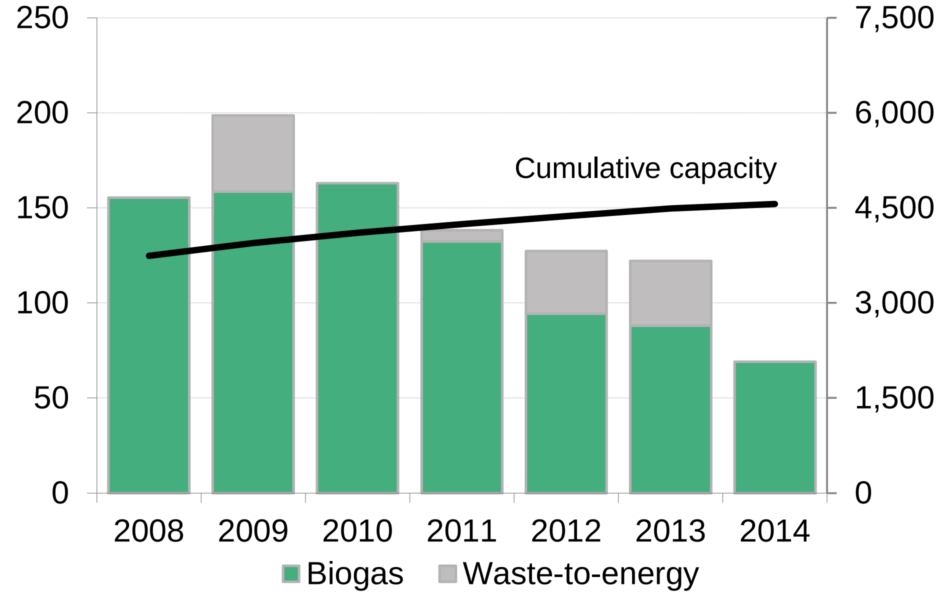
Table of contents

Deployment: US bioenergy build

US biomass-to-power build (MW)



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



- Policy support measures (the Production and Investment Tax Credits) 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
- In 2014, there was more biomass capacity retired (89MW) than installed (30MW), taking cumulative capacity down to 8.4GW
- Congress enacted the Agriculture Act in 2014, which will match cost per ton (ie, 907kg) for biomass production, collection and transport to conversion facilities up to $20/ton

Source: Bloomberg New Energy Finance, EIA

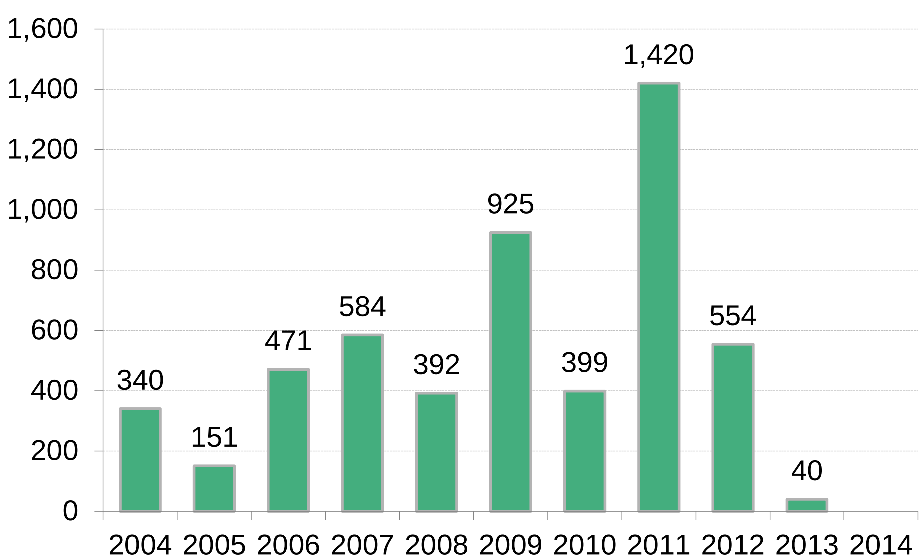
Notes: Includes black liquor. 2014 results are as of end-October 2014.

Source: Bloomberg New Energy Finance, EIA

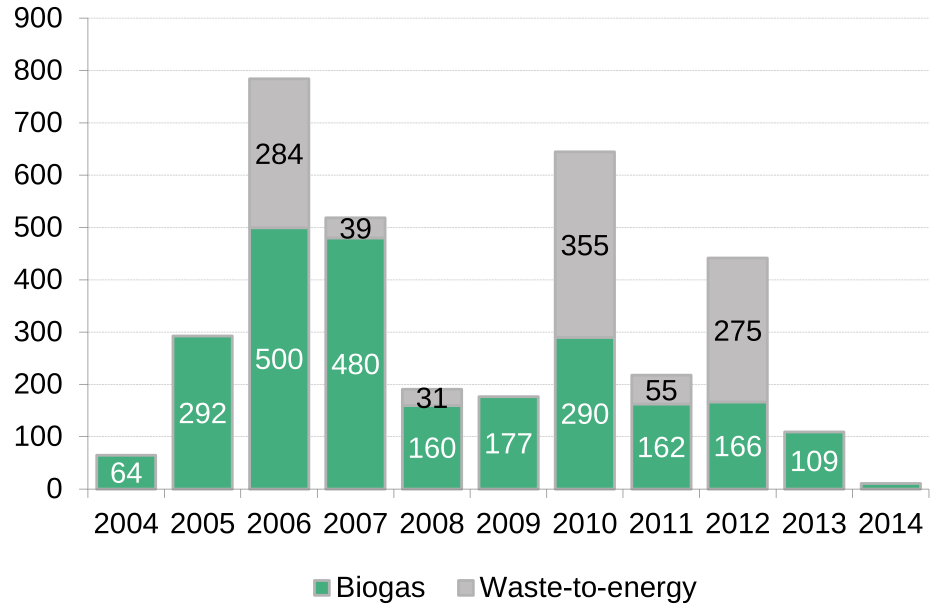
Notes: Biogas category includes anaerobic digestion (projects 1MW and above except wastewater treatment facilities) and landfill gas power. 2014 results are as of end-October 2014.

Financing: US bioenergy asset finance

Asset finance for US biomass ($m)



Asset finance for US biogas and waste-to-energy ($m)



- Asset finance for new-build biomass, biogas and waste-to-energy fell to very low levels for 2013 and 2014 (<$50m for biomass, just over $100m for biogas and zero for waste-to-energy). For biomass this was caused by the expiration of the Production Tax Credit. Waste-to-energy and biogas are generally smaller sectors with fewer deals
- Low levels of investment in 2013 and 2014 mean we expect to see a relatively low level of new-build for the next few years. This is because plants take two to four years to complete construction and be commissioned; investment acts as a leading indicator for capacity

Source: Bloomberg New Energy Finance, EIA

Notes: Includes black liquor.

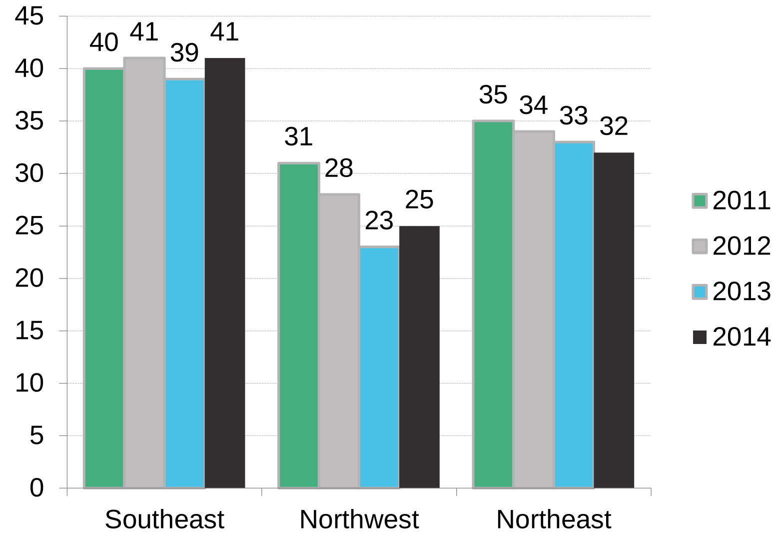
Source: Bloomberg New Energy Finance, EIA

Notes: Biogas category includes anaerobic digestion (projects 1MW and above except wastewater treatment facilities) and landfill gas power.

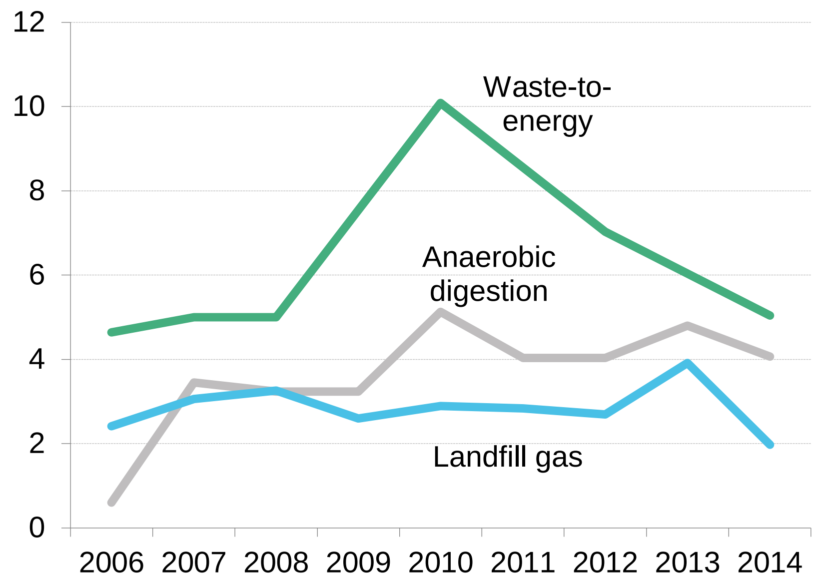
Economics: Biomass feedstock prices; biogas and waste-to-energy capex

Bloomberg NEW ENERGY FINANCE

Biomass feedstock prices in selected US markets, 2011–14 ($/dry tonne)



Capex for biogas and waste-to-energy projects by type ($m/MW)

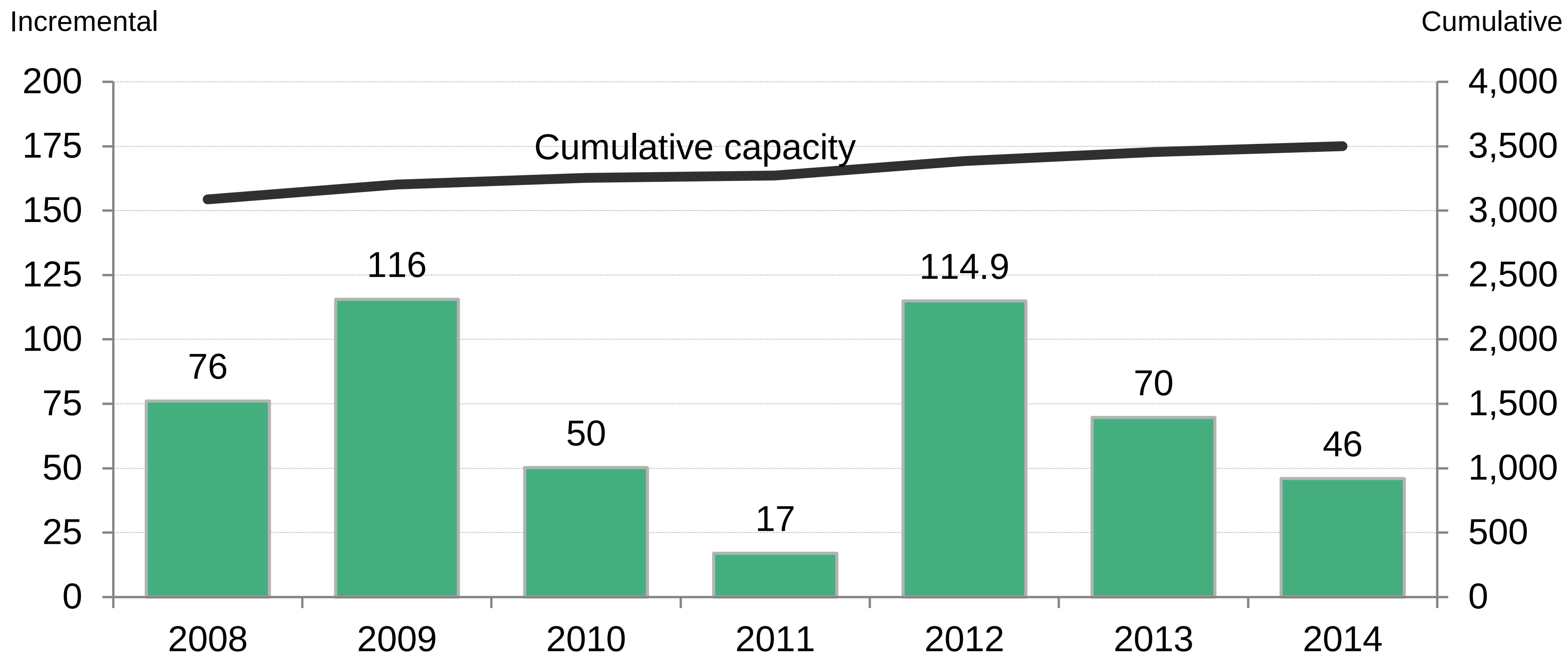


- Biomass feedstock prices stayed roughly even with 2013 levels. Demand for lumber has been increasing steadily, but is below 2008 levels, and timber harvests in the US and Canada have also increased over the last four years, increasing supply
- Investment cost for waste-to-energy, anaerobic digestion and landfill gas decreased slightly in 2014. Annual changes in these figures can be strongly influenced by costs in individual projects; there is less capacity under development in biogas and waste-to-energy than in other renewable sectors

Source: Bloomberg New Energy Finance, US Department of Agriculture

Table of contents

Deployment: US geothermal build (MW)

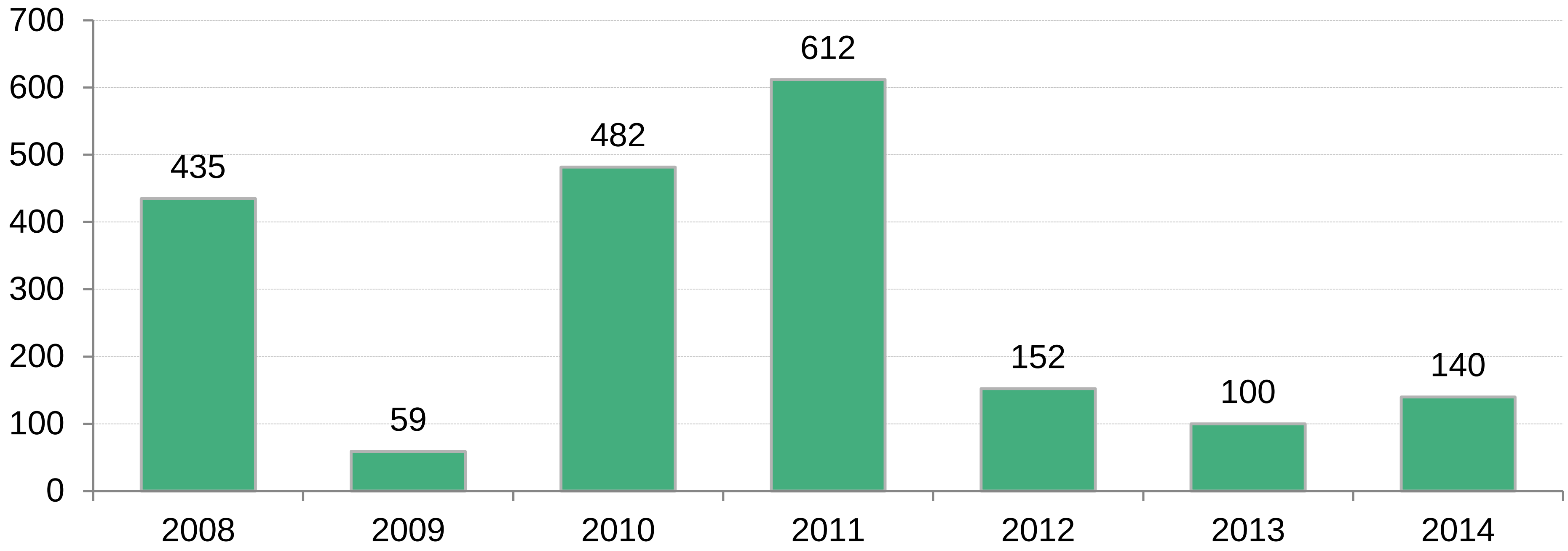


- Geothermal development has lagged behind other renewables (namely wind and solar), due to long project completion periods (4-7 years) and high costs of development
- Two projects were commissioned in 2014, totaling 46MW. Both projects are located in Nevada and have PPAs with California municipal utilities, who can use the electricity for compliance with California's Renewable Portfolio Standard (RPS)

Source: Bloomberg New Energy Finance

Financing: Asset finance for US geothermal projects ($m)

Bloomberg NEW ENERGY FINANCE

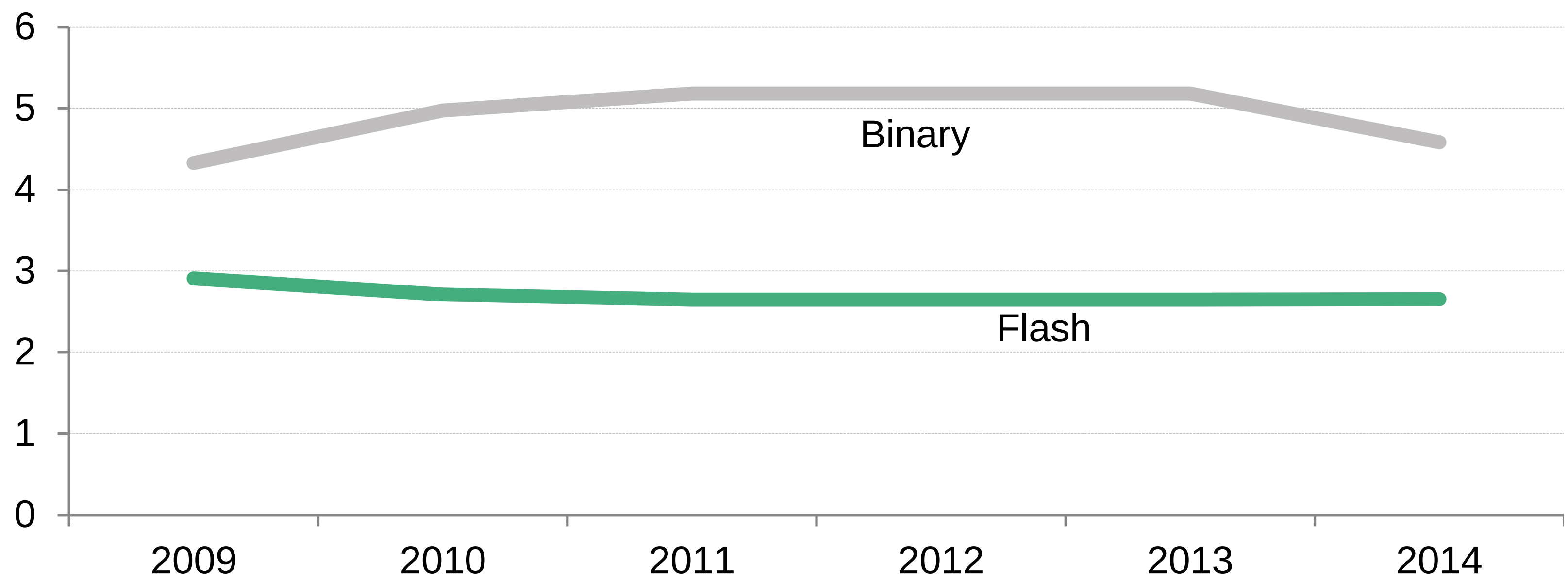


- One project, the 45MW Ormat McGinness Hill II plant located in Nevada, secured financing this year and is slated to be commissioned in 2015. It has a PPA with NV Energy, a Nevada utility
- Financing of US geothermal projects ramped significantly during 2010-11, as developers benefited from the US Treasury cash grant program and strove to complete projects prior to the expiration of the Production Tax Credit (PTC) in end-2012
- Since the expiration of the PTC, only three projects have gained financing – one each year from 2012-14.

Source: Bloomberg New Energy Finance

Notes: Values include estimates for undisclosed deals.

Economics: Capex for geothermal projects by type ($m/MW)



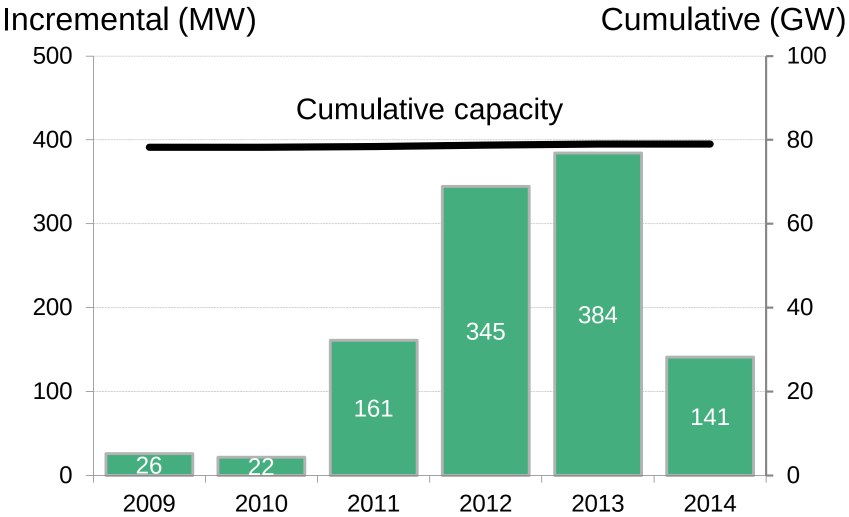
- Flash (ie steam turbines) continues to be the primary turbine choice for geothermal plants worldwide. In the US, however, over half of the projects commissioned since 2012 have used binary turbines – which allow for geothermal production from lower-temperature steam
- Global average capex for binary production declined over the last year, not because of fundamental declines in the turbine prices but because of comparatively cheaper debt in 2014 relative to 2013

Source: Bloomberg New Energy Finance

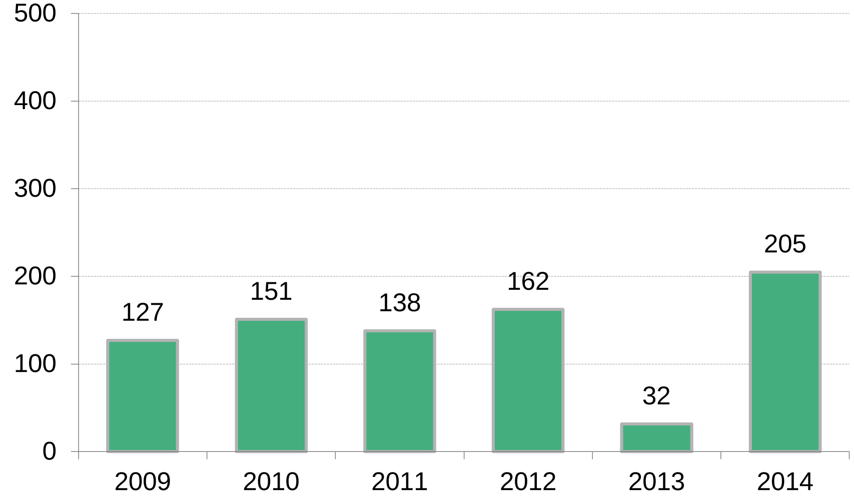
Table of contents

Deployment: US hydropower build and licensed capacity

US hydropower build



US new hydropower capacity licensed or exempted by FERC (MW)



- New commissioned capacity in hydropower fell to 141MW, down 95% on 2013. Policies that have since closed to new entrants (cash grant, the Investment and Production Tax Credits) supported the wave of projects in 2011–13
- New licenses and exemptions rebounded to 205MW in 2014; this should result in some financing and construction
- 2014 saw more activity in pumped storage (eg, FERC awarded a license to the 1.3GW Eagle Mountain facility in Southern California, which would be the fifth-largest pumped storage plant in the US). The $2-2.6bn project seeks to capitalize on the region’s need to integrate renewable energy
- FERC started testing a two-year licensing process at a 5MW project, Free Flow Power Project 92. (The normal licensing route can take over four years and is a major time commitment for developers.)
- There is relatively little potential for building new large dams in the US. The industry hopes to unlock the potential in existing non-powered dams. According to the Department of Energy, the largest 100 such dams could offer as much as 8GW

Source: Bloomberg New Energy Finance, EIA

Notes: 2014 results are as of end-October 2014. Excludes pumped storage.

Source: Bloomberg New Energy Finance, FERC
Notes: The licensing figures exclude 152MW of pumped storage licensed in 2012 and 1,736MW of pumped storage licensed in 2014. 2014 results are as of end-November 2014.

Table of contents

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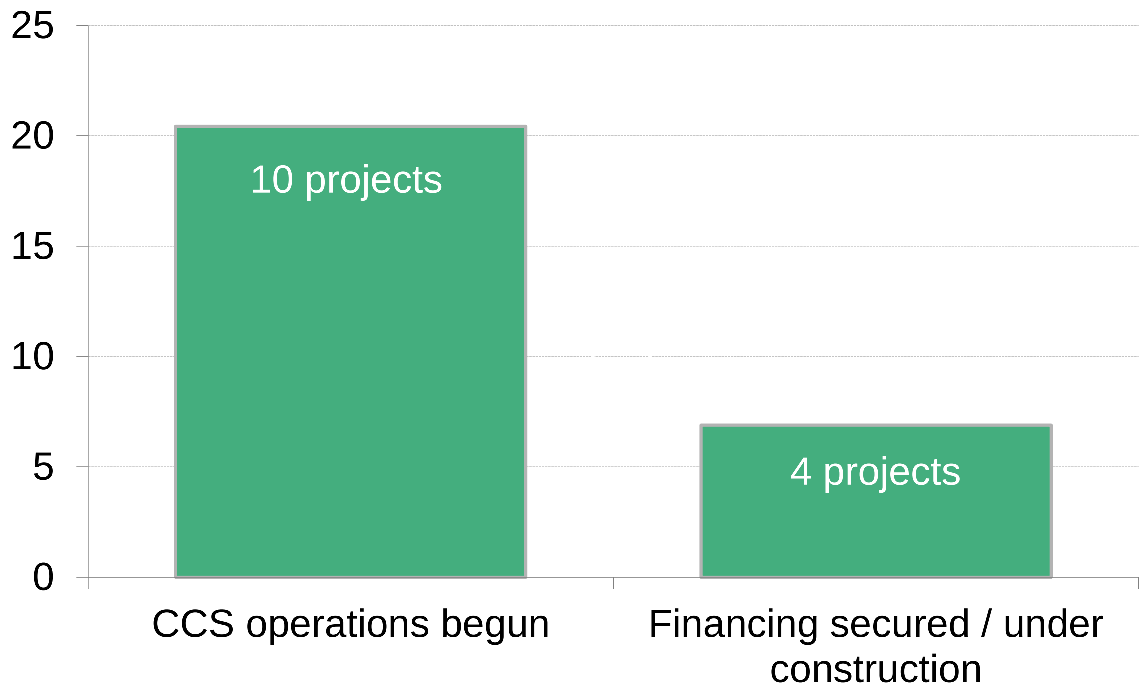
Deployment: Total CO2 injection rate by current status of US CCS projects (MtCO2/year)



- There are an estimated 14 large-scale (at least 100MW capacity or at least 0.5MtCO2/yr injection rate) projects operating globally, 10 of which are in the US
- Most operational US CCS projects are at natural gas processing facilities
- Three projects that have passed final investment decision, or that are under construction, are at power plants
- The first CCS power project of a size above 100MW was commissioned in Canada in 2014: SaskPower Boundary Dam. Mississippi Power's 563MW Kemper project in the US should be the next to commission. The utility has faced problems with cost overruns and delays through construction: costs were first estimated under $2bn for the plant and CO2 capture, but this has since risen to $4.9bn. The developers initially expected to commission the plant in 2015; they now predict commissioning in Q2 2016. The problems have to do with the complexity of building a large project, rather than with CCS-specific concerns, but Kemper's challenges may make it harder to finance similar projects in the future

Source: Bloomberg New Energy Finance

Financing: Asset finance for US CCS projects that are post-financial investment decision ($m)

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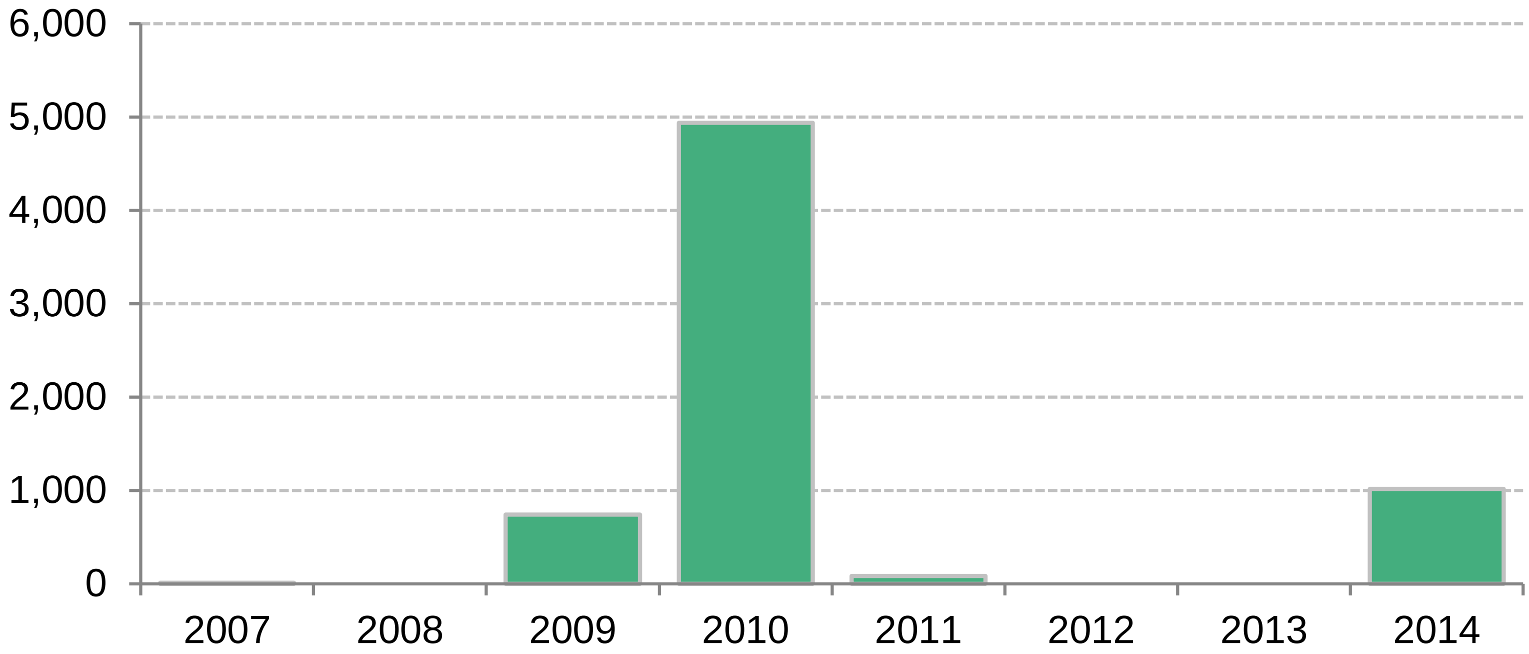
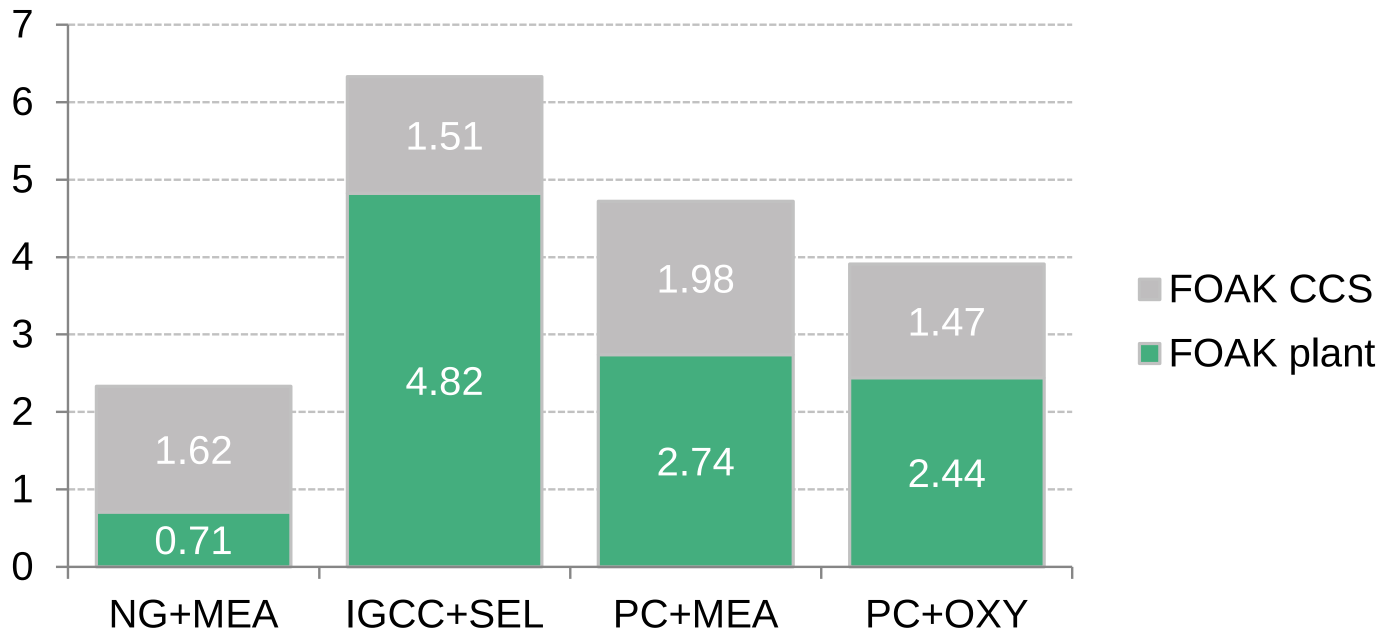


- Asset financing for CCS projects that have passed final investment decision peaked in 2010. The lumpy distribution owes to the high cost and low number of projects financed
- Investment levels picked up again in 2014 due to the financial close of one project (NRG's 1.6MtCO2/yr Parish power project)
- Over the period shown here, 56% of global asset finance into CCS occurred in the US

Source: Bloomberg New Energy Finance

Notes: Includes demonstration and commercial scale projects (projects above 100MW or 1MtCO2/yr) post-final investment decision only. Values do not include estimates for undisclosed deals.

Economics: Estimated first-of-a-kind (FOAK) capital cost for CCS projects ($m/MW)



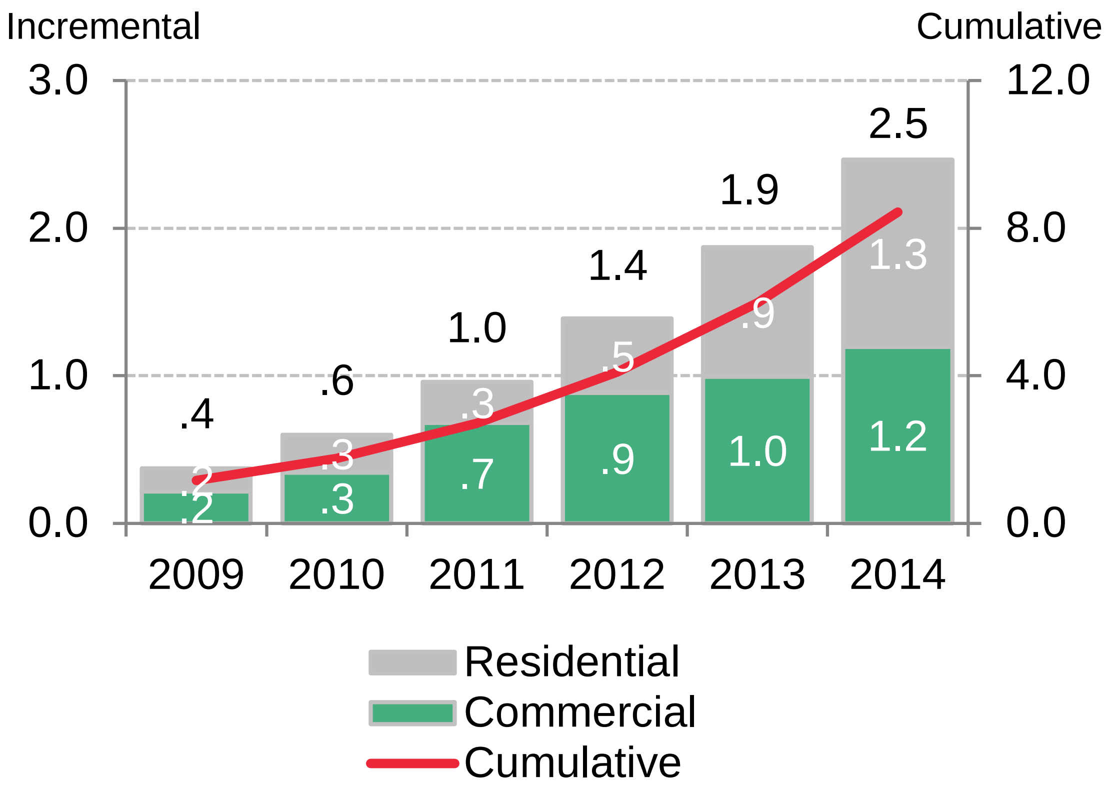
- First-of-a-kind (FOAK) costs are estimated to be significantly higher than ‘mature’ costs, depending on the technology
- Yet estimates of ‘mature’ costs could be far off; deployment in the tens of gigawatts could be needed to widely lower technology costs
- One large-scale government supported project came online in Q4 2014 (SaskPower’s 110MW post-combustion Boundary Dam power unit in Saskatchewan, Canada); the developer announced it expected 20-30% lower costs if it builds a second project, due to engineering efficiencies

Source: Bloomberg New Energy Finance

Notes: Based on same analysis as in 2014 Factbook. Costs are based on 250MWe base plant and capture. NG+MEA is natural gas combined-cycle plant with post-combustion (amine) capture, IGCC+SEL is integrated gasification combined cycle plant with pre-combustion (Selexol) capture, PC+MEA is pulverized coal with post-combustion (amine) capture, and PC+OXY is coal oxycombustion plant with cryogenic CO_2 capture.

Table of contents

Deployment: US small-scale solar build by type (GW)

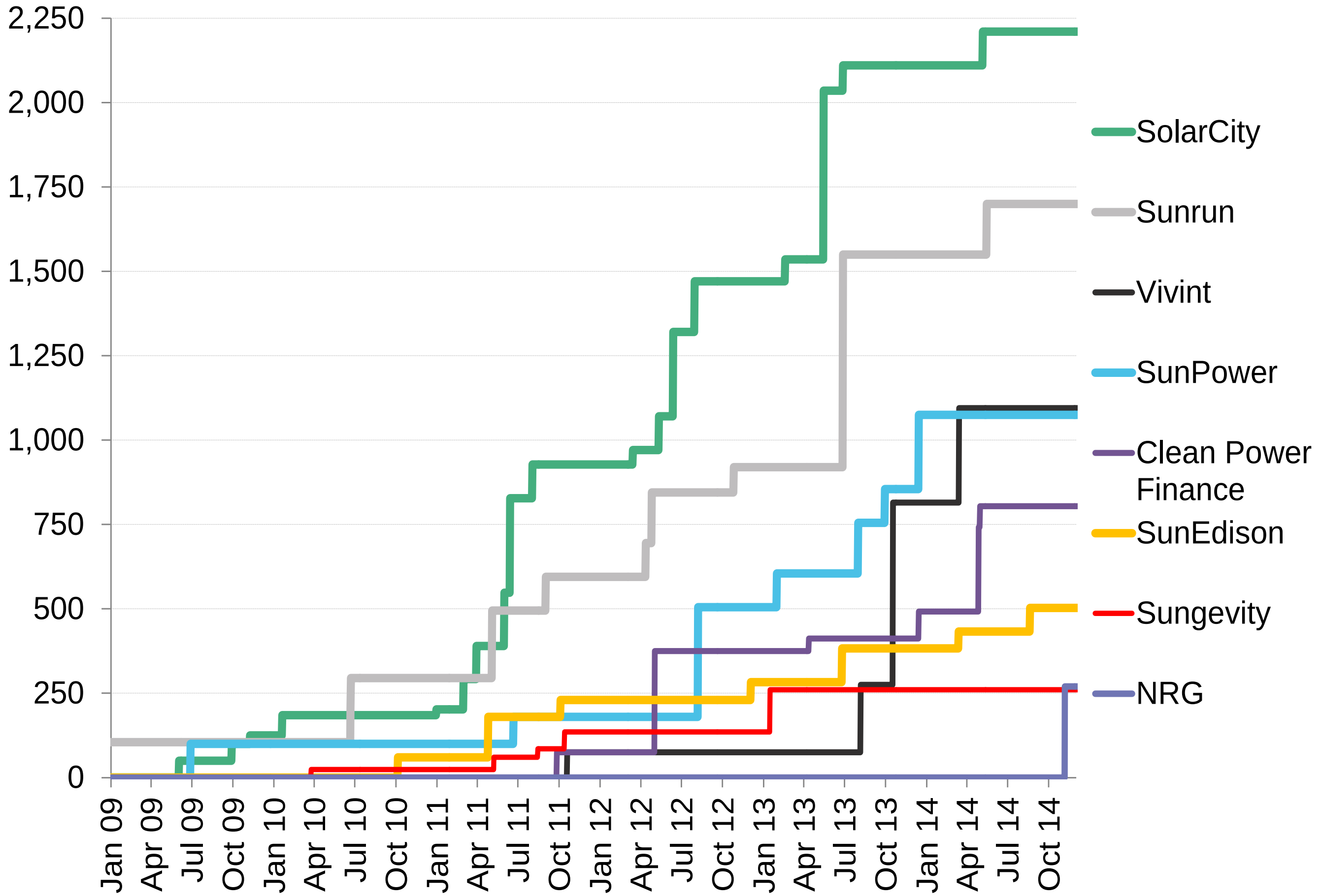


- Rooftop PV had a banner year in 2014, driven by strong growth in both the residential and commercial segments
- Asset finance for this sector also saw a big jump ($7.8bn in 2013 to $12.9bn in 2014), despite declining systems prices (chart for this is shown in Section 2.2, under new investments in 'small distributed capacity')

Source: Bloomberg New Energy Finance

Notes: Figures for 2014 are on average of optimistic and conservative analyst estimates

Financing: Cumulative funds closed by selected US third-party PV financiers ($m)



- In 2014, tax equity funds totalled an estimated $2.64bn, nearly equivalent to 2013 levels ($2.59bn). There have been some high-profile tax equity investments announced in 2014, including a number of funds larger than $100m raised by NRG Home Solar, SolarCity, and Vivint

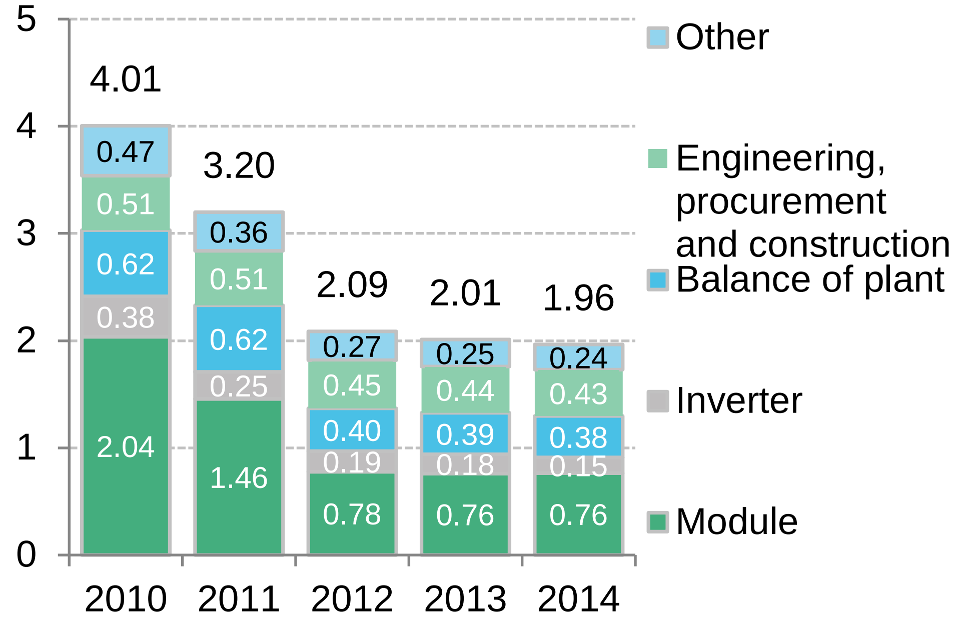
Source: Bloomberg New Energy Finance

Notes: This represents fund size; actual capital invested is lower and non-public. Data is from publicly available documents and submissions from investors; this figure does not capture any undisclosed deals. Each fund contains an unknown combination of equity, tax equity, or debt (or an absence of tax equity or debt). Vivint and Clean Power Finance totals include cash equity.

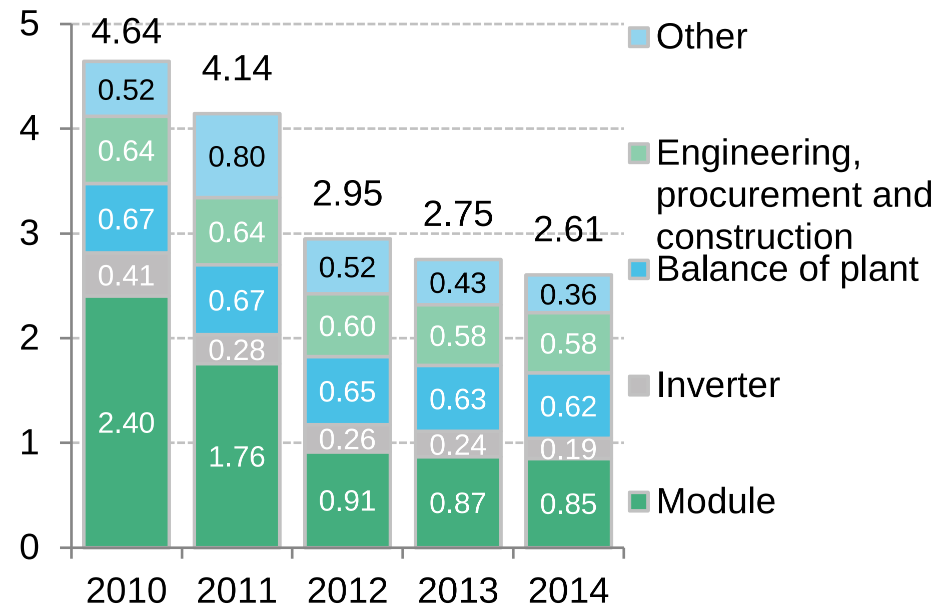
Economics: Best-in-class capex of small-scale solar ($/W)

Bloomberg NEW ENERGY FINANCE

Best-in-class global capex of commercial-scale PV



Best-in-class global capex of residential PV



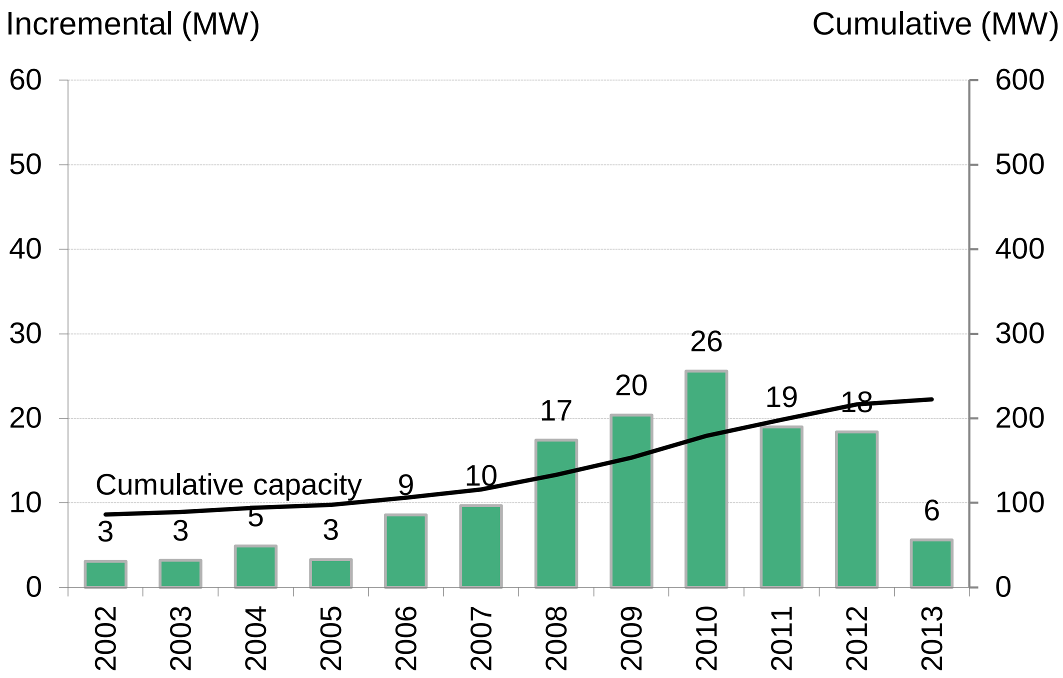
- Capex for commercial-scale PV, according to the global benchmark, has leveled off close to $2/W as module prices have stayed relatively steady
- Capex for residential PV continues to see strong declines
- The values shown here reflect best-in-class benchmarks for PV in mature markets such as Germany. In the US, capex is often higher than the global benchmark for many reasons, including fragmented regulatory regimes, the prevalence of third-party owned solar, longer build time, higher acquisition costs and greater profit margins

Source: Bloomberg New Energy Finance

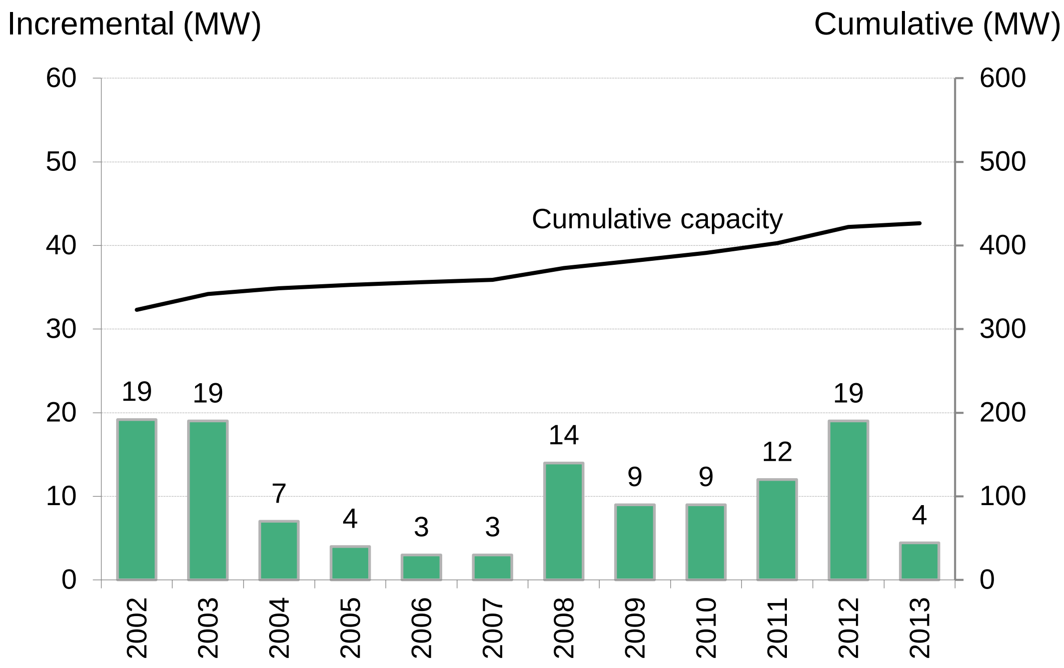
Table of contents

Deployment: US small- and medium-scale wind build

US small-scale (≤100kW) wind build



US medium-scale (101kW-1MW) wind build

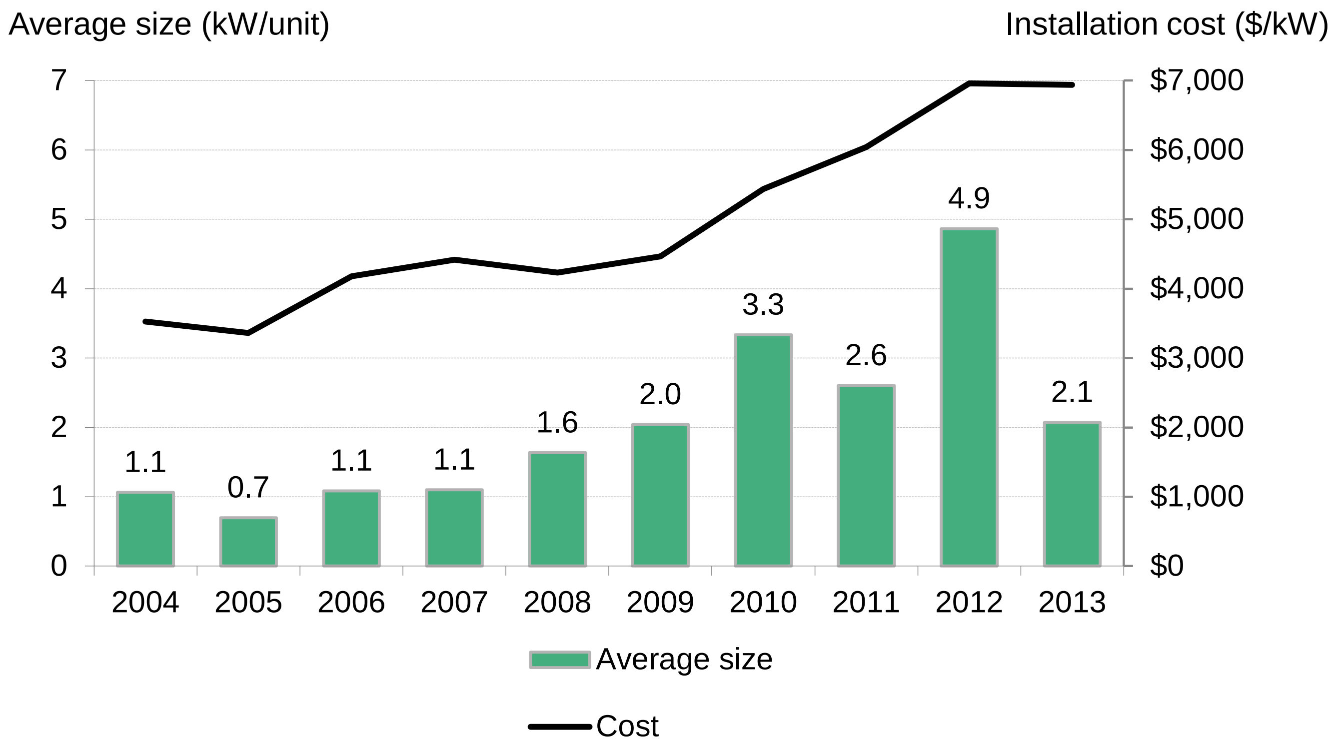


- Deployments of distributed wind (small- and medium-scale installations) declined in 2013, mirroring the trend on the utility-scale side

Source: US DOE 2013 Distributed Wind Market Report, published August 2014 (and previous editions of this report)

Notes: Previous editions of the Distributed Wind Market Report explicitly break out the medium-scale (>100kW) wind category into two segments: 101kW-1MW, and >1MW. The 2013 edition of this report does not explicitly provide this breakout, but the authors of that report have separately provided that breakout: there was 24.8MW of deployment of >100kW installations in 2013, of which 4.4MW was in the 101kW-1MW segment.

Economics: US small-scale (≤100kW) wind turbine average size and installed cost



- Costs have generally risen as average size of small-scale wind turbine installations has also gone up. But in 2013, average size of the installations dropped, while costs stayed flat
- There can be wide variation in costs based on location (eg, foundation requirements vary by terrain), local labor costs, and tower types and heights
- According to the US Department of Energy's report on distributed wind (on which all this data is based), the average levelized cost of electricity for distributed wind installations in the 2006-13 period is 14¢/kWh (~$140/MWh) (based on 5.3MW sample analyzed)

Source: US DOE 2013 Distributed Wind Market Report, published August 2014 (and previous editions of this report)

Table of contents

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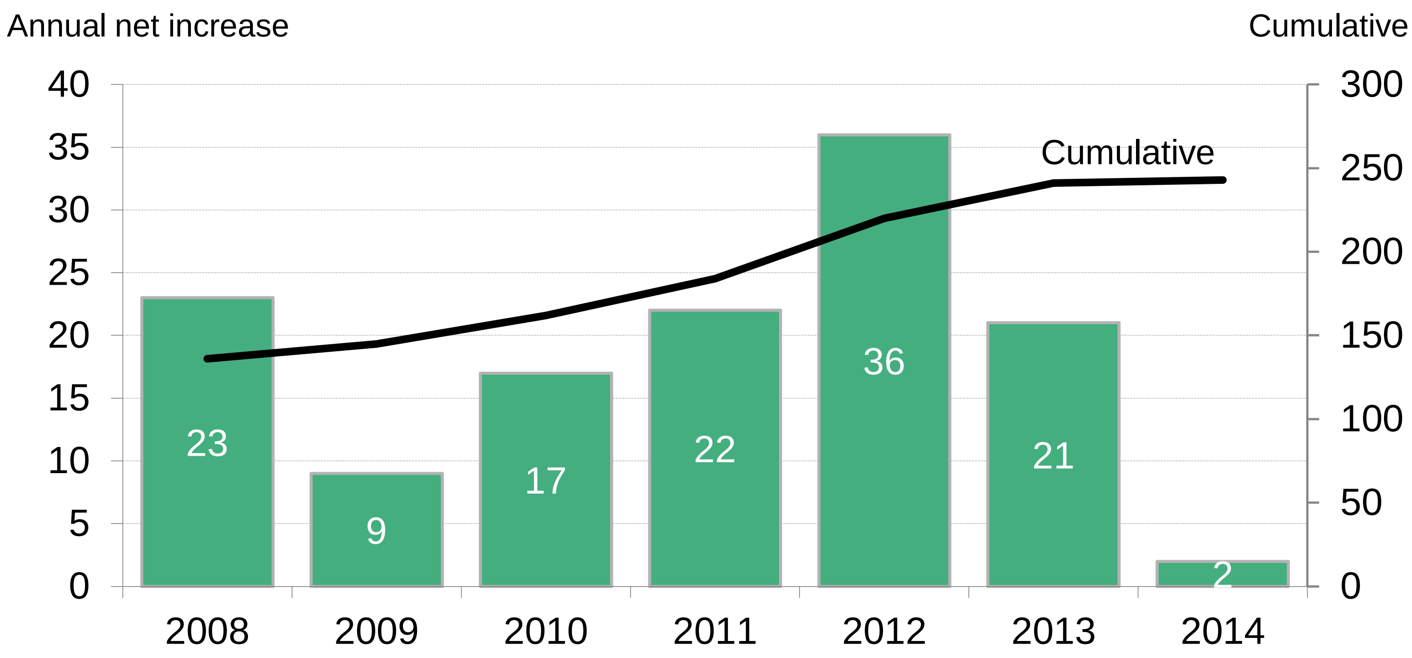
Deployment: US anaerobic digester operational projects at commercial livestock farms (number of projects)



- New activity in small-scale anaerobic digestion has dropped to very low levels. Since 2008, the number of small anaerobic digester projects at agricultural facilities has grown. In each of the years 2008–13, there were between 20 and 36 new operational projects, while 29 projects closed shop over that period. In the last two years, development of small anaerobic digester projects has tailed off with only two new projects in 2014
- There are currently 243 operational anaerobic digester projects at farms in the US. These facilities are generally small – with an average size of 707kW. Of the total, 169 of these were smaller than 1MW, representing 59MW in capacity

Source: US EPA AgSTAR program

Notes: Columns show annual net increase (accounting for retirements).

Table of contents

Deployment: US CHP build and generation

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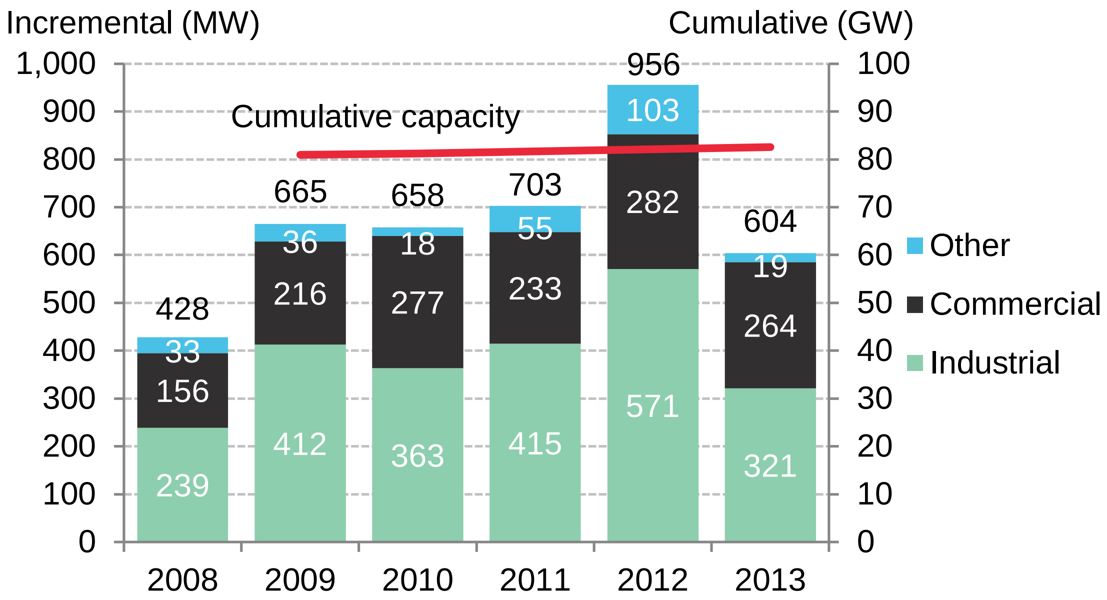
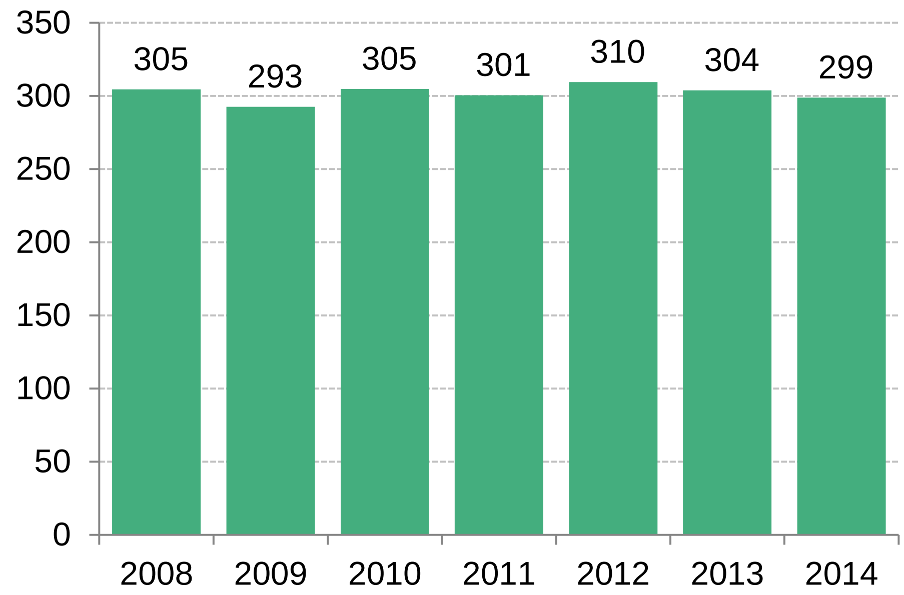
US CHP build



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 installations, which tend to be smaller in size and not calculated in EIA estimates (see notes below)
- Micro-CHP (<50kW systems installed at residences or small businesses) is a small yet growing portion the total industry. Efforts by the EIA and a new catalog of commercializable small-scale engines might catalyze growth

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

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).

Deployment: US CHP deployment by fuel and by sector, 2013

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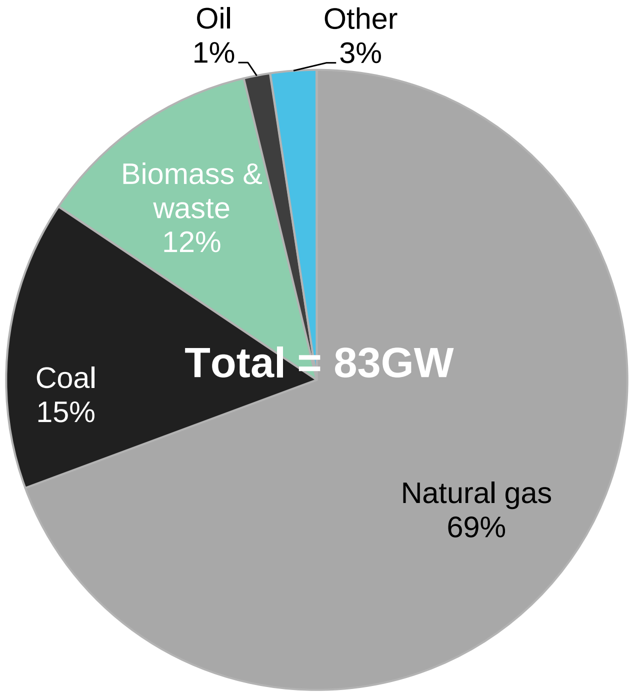
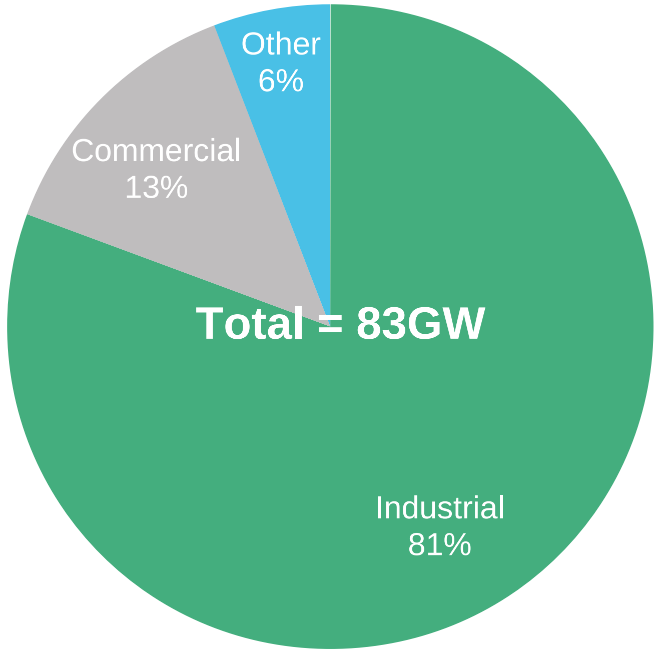
US CHP deployment by fuel source



US CHP deployment by sector

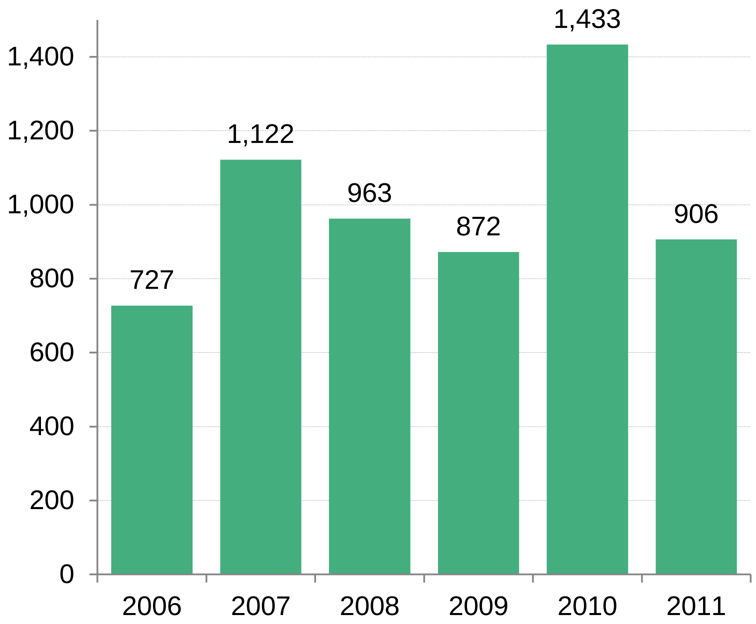


- Natural gas remains the most common fuel source. Many large CHP plants are located close to petrochemical plants and refineries along the Gulf Coast, where gas is both cheap and easy to access
- The majority of CHP is used for industrial applications. CHP offers clear benefits when heat demand is high in relation to electric demand, such as in a factory. However, while industrial uses makes up the majority by installed capacity, the commercial sector is the leader by number of projects, with an equally high growth rate for new build (not pictured)
- While industrial uses make up the majority of the market by installed capacity, the commercial sector is the leader by number of projects (not pictured)

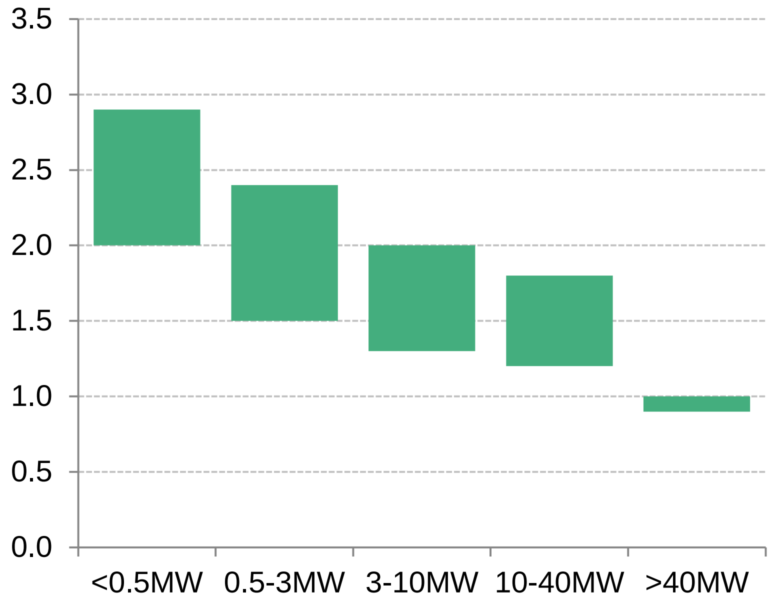
Source: Bloomberg New Energy Finance, CHP Installation Database. Maintained by ICF International for Oak Ridge National Laboratory.

Financing and economics: US CHP asset finance and capex

Asset finance for US CHP ($m)



Capex for CHP installations ($/W)



- Since capital costs have remained steady, ups and downs in asset finance are driven by installed capacity
- Capex varies significantly depending on system size and primary technology used, starting at $2-2.57/W for smaller systems and decreasing as sizes increase. Overall, installation prices have remained stable so system economics rely heavily on the 'spark' spread, or the difference between electricity prices and fuel sources. Lower natural gas prices and higher electricity prices make CHP more attractive

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

Notes: Values are estimated assuming a two-year lag between financing and deployment, and assuming a weighted average capex of $1.7m/MW in 2006, falling to $1.4m/MW by 2009, and then increasing to $1.5m/MW in 2010 to reflect a recent trend toward smaller systems. Financing figures are only available through 2011 since deployment figures are only available through 2013 (and there is an assumed two-year lag between financing and deployment).

Source: Bloomberg New Energy Finance; EPA Combined Heat and Power Partnership, Catalogue of CHP Technologies, prepared by ICF International.

Notes: ICF International reports that CHP capex has remained fairly constant since 2008. BNEF data reflect capex for small CHP facilities powered by gas-fired reciprocating engines, gas turbines and microturbines and are based on an internal survey among industry participants.

Table of contents

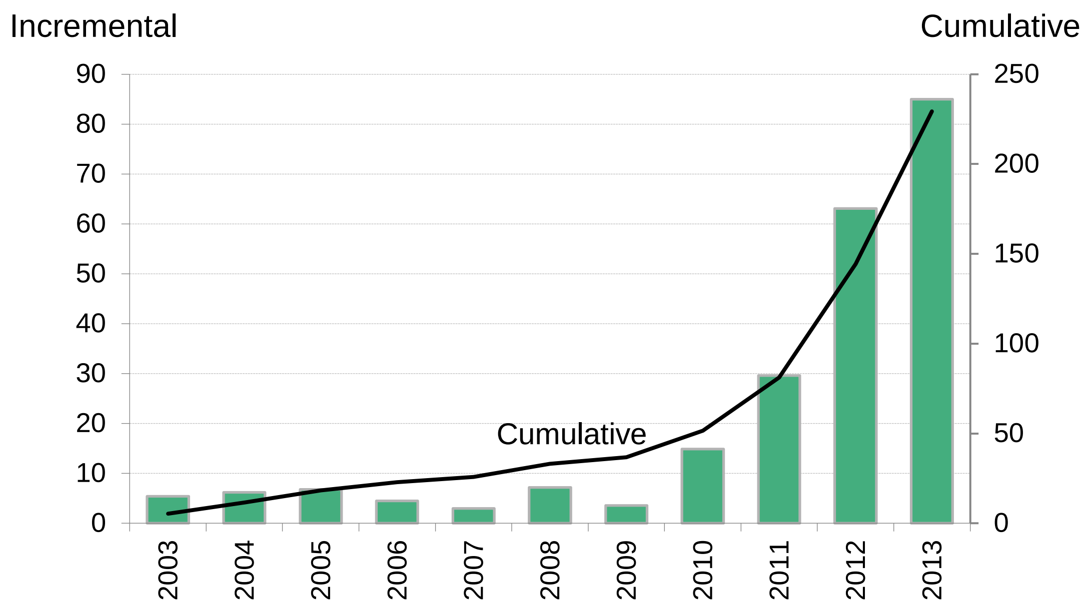
Deployment: Comparison of fuel cell technology performance and applications

Fuel cell technology	Typical system size (kW)	Fuel type	Electrical efficiency	Combined heat and power capable	Applications	Notable US vendors
Molten carbonate (MCFC)	300-3,000	Natural gas, hydrogen, biogas	45-50%	Yes	Distributed generation, utility	FuelCell Energy
Solid oxide (SOFC)	200-2,800	Natural gas, hydrogen, biogas	52-60%	Yes, but typically heat is used internally with the system to increase electrical efficiency	Distributed generation, utility	Bloom Energy
Phosphoric acid (PAFC)	100-400	Natural gas, hydrogen, biogas	42%	Yes	Distributed generation	Doosan Fuel Cell America
Alkaline (AFC)	10-100	Hydrogen	60%	No	Military, space	
Polymer electrolyte membrane (PEM)	1-100	Hydrogen	35-60%	No	Backup power, distributed generation, transportation, telecom	Plug Power (using Ballard stacks), Altergy
Direct methanol fuel cell (DMFC)	<10	Methanol	<40%	No	Auxiliary power, telecom	Oorja Protonics, PolyFuel

Source: Bloomberg New Energy Finance, US Department of Energy, vendors

Notes: Most stationary fuel cells, regardless of fuel or chemistry, have capacity factors of 40-50% with over 99% availability. Fuel cells are scalable, and installation sizes can be very big; the sizes shown here are typical numbers and in some cases reflect product sizes.

Deployment: US stationary fuel cell build (MW)



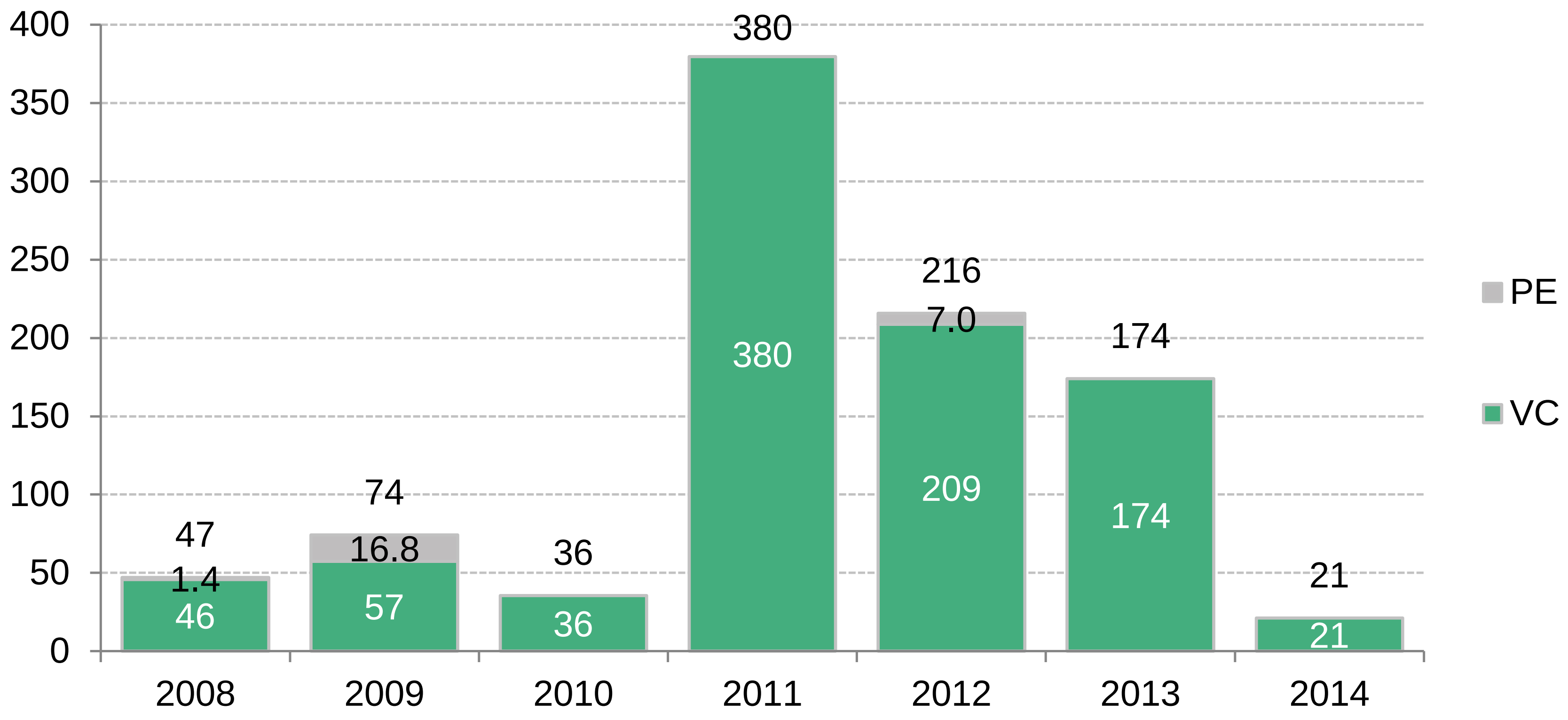
- Fuel cell projects in the US saw a noticeable uptick from 2011 to 2013 due to the announcements of several very large projects (complete data for 2014 is not yet public). Key developments in 2014 included:
  - Exelon announced it would fund 21MW of Bloom Energy projects at 75 sites in four states for commercial customers
  - ClearEdge Power declared bankruptcy and was acquired by South Korean industrial firm Doosan
- Most fuel cell activity in the US is concentrated in five states:
  - California's Self-Generation Incentive Program (SGIP) provides projects with subsidy ($1.83/W in 2014, $1.65/W in 2015)
  - Connecticut's fuel cell supportive policies include tax credits, net metering, and low-emission energy credits (LRECs)
  - In 2011, Bloom Energy committed to build a manufacturing facility in Delaware at the site of an old factory. As part of that agreement, Bloom entered into a deal with Delmarva Power and Light to install 30MW at Delmarva substations
  - New York's high retail electricity prices have opened the door for project development
  - North Carolina's capacity is based on a 10MW Bloom project which uses biogas to power an Apple data center

Source: Fuel Cells 2000, SGIP, Bloomberg New Energy Finance

Notes: Fuel cells installed before 2003 are excluded due to the expected 10-year lifetime of these installations. 'Planned' refers to projects which are announced and at various stages of development.

Financing: Venture capital / private equity investment in US fuel cell companies ($m)

Bloomberg NEW ENERGY FINANCE



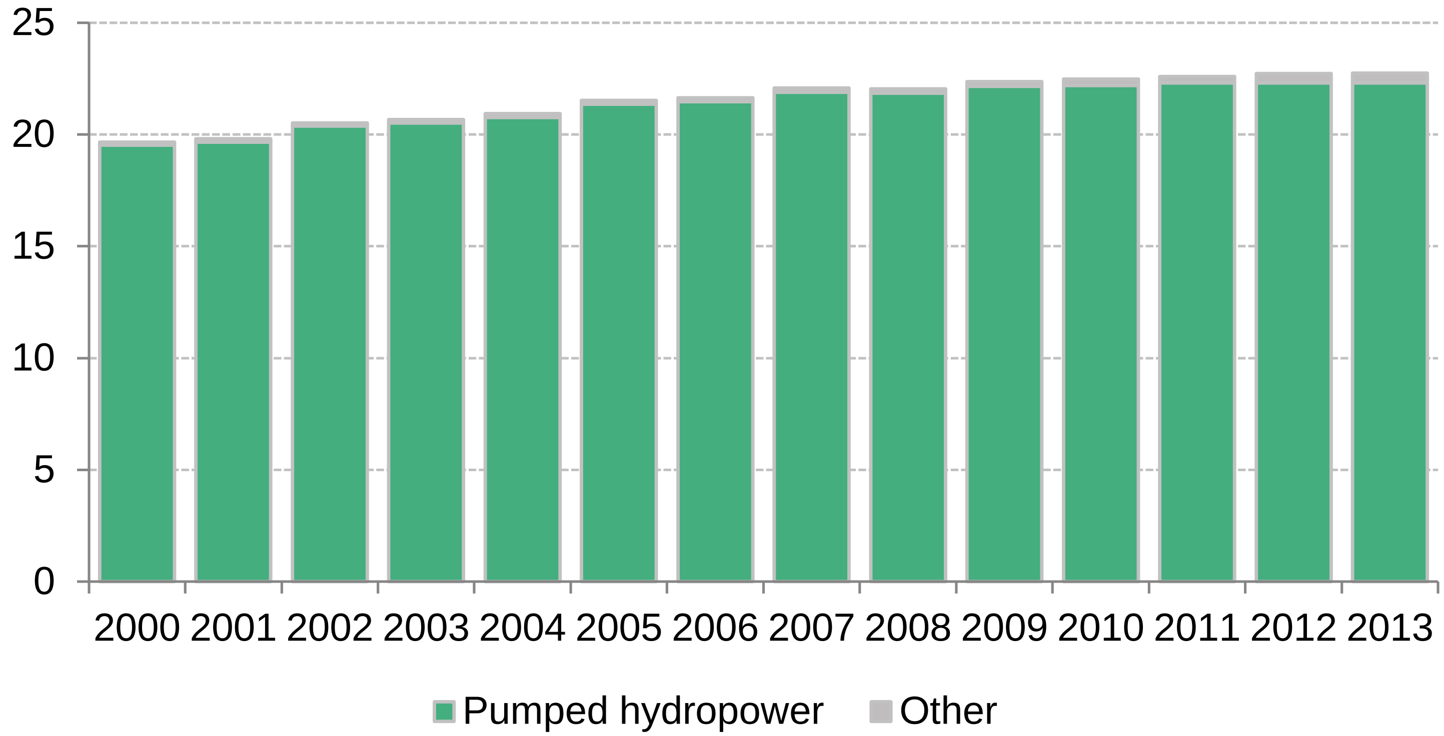
- In 2011, there was a record investment of $380m, with $250m funding for Bloom Energy
- Venture capital investment fell after 2011 but remained higher than in prior years. Bloom once again led the pack in 2013, raising $130m from Credit Suisse. The other large investment in 2013 was a $36m round raised by ClearEdge Power; that company was acquired by Doosan in July 2014, after raising $5m of VC funding earlier in the year
- Asset financing has been small relative to renewable sectors such as wind and solar. Because fuel cell projects generate substantial tax credits, tax equity financing has been popular

Source: Bloomberg New Energy Finance

Notes: Values include estimates for undisclosed deals.

Table of contents

Deployment: US cumulative energy storage (GW)

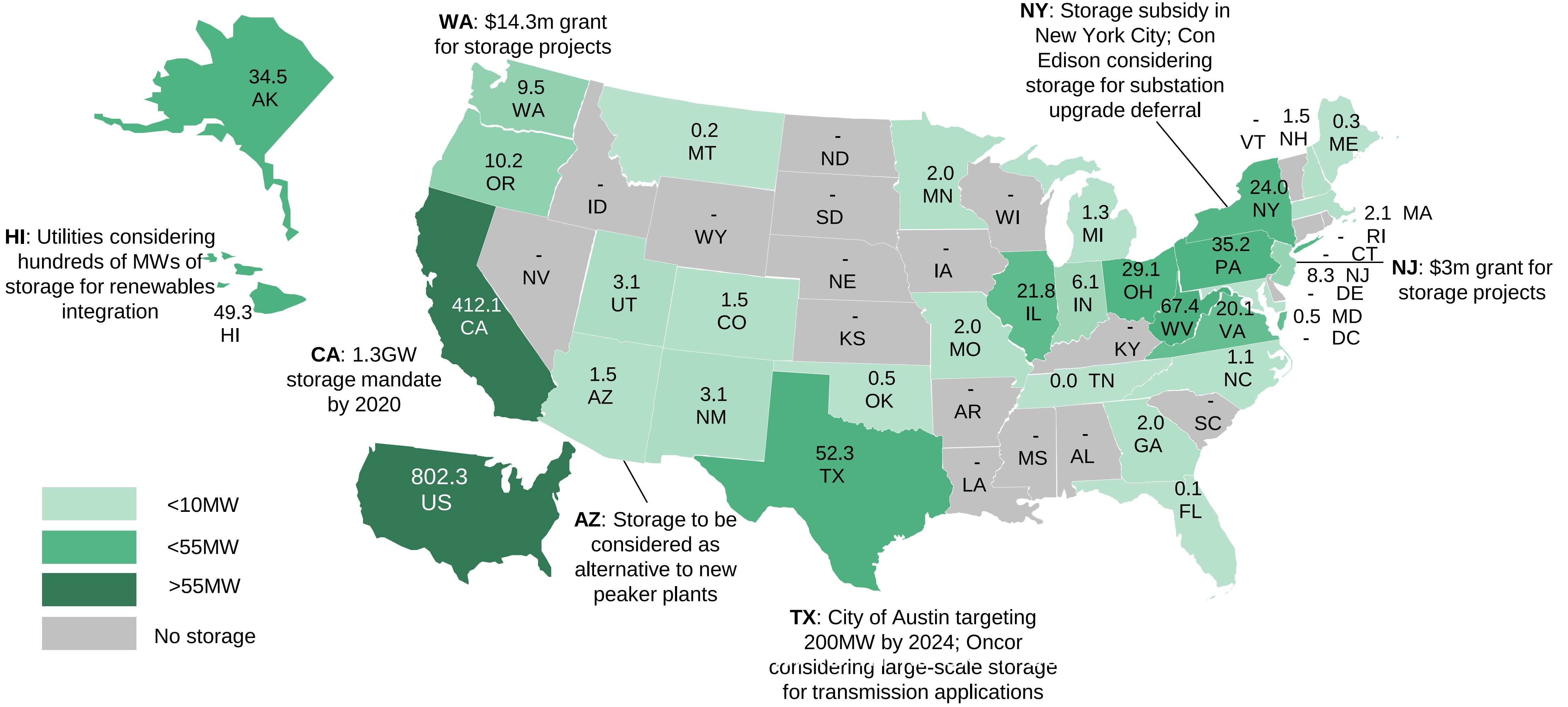


- Pumped hydropower storage projects account for over 95% of installed energy storage capacity in the US. The Federal Energy Regulatory Commission (FERC) has 3.2GW of pending licenses for new pumped storage projects (for more, see Section 4.5)
- Pumped storage is generally excluded from state-level energy storage mandates or solicitations

Source: EIA, FERC, Bloomberg New Energy Finance

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

Bloomberg NEW ENERGY FINANCE

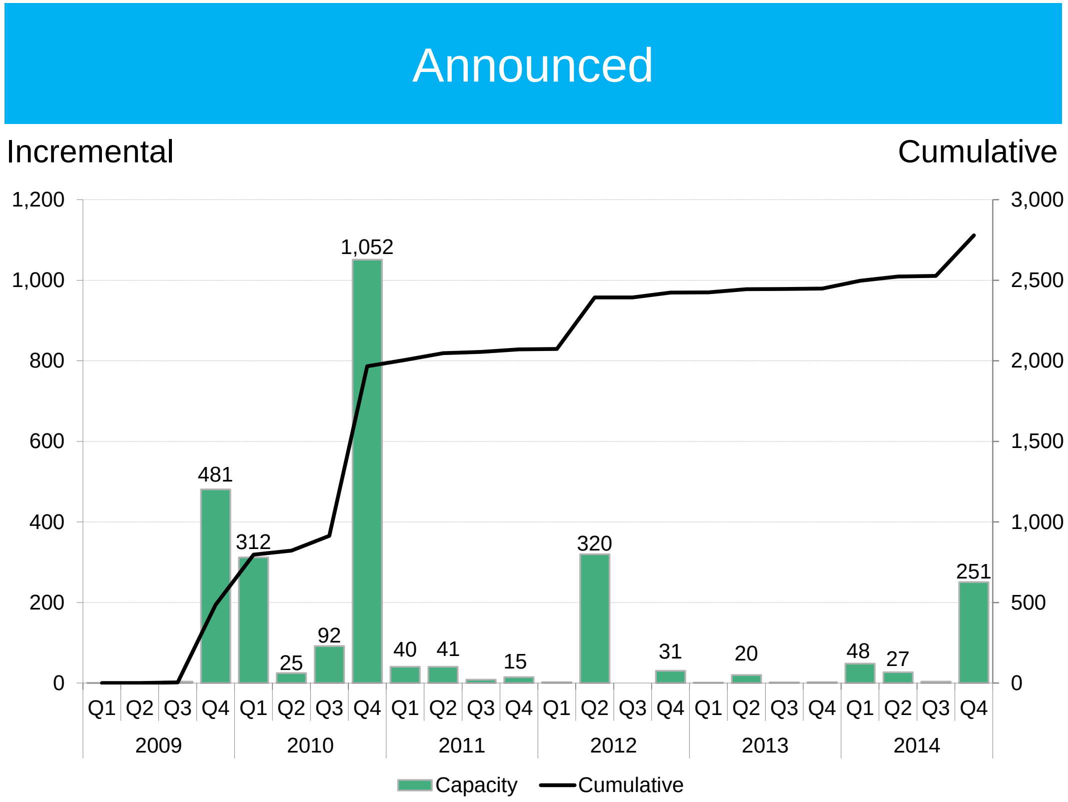


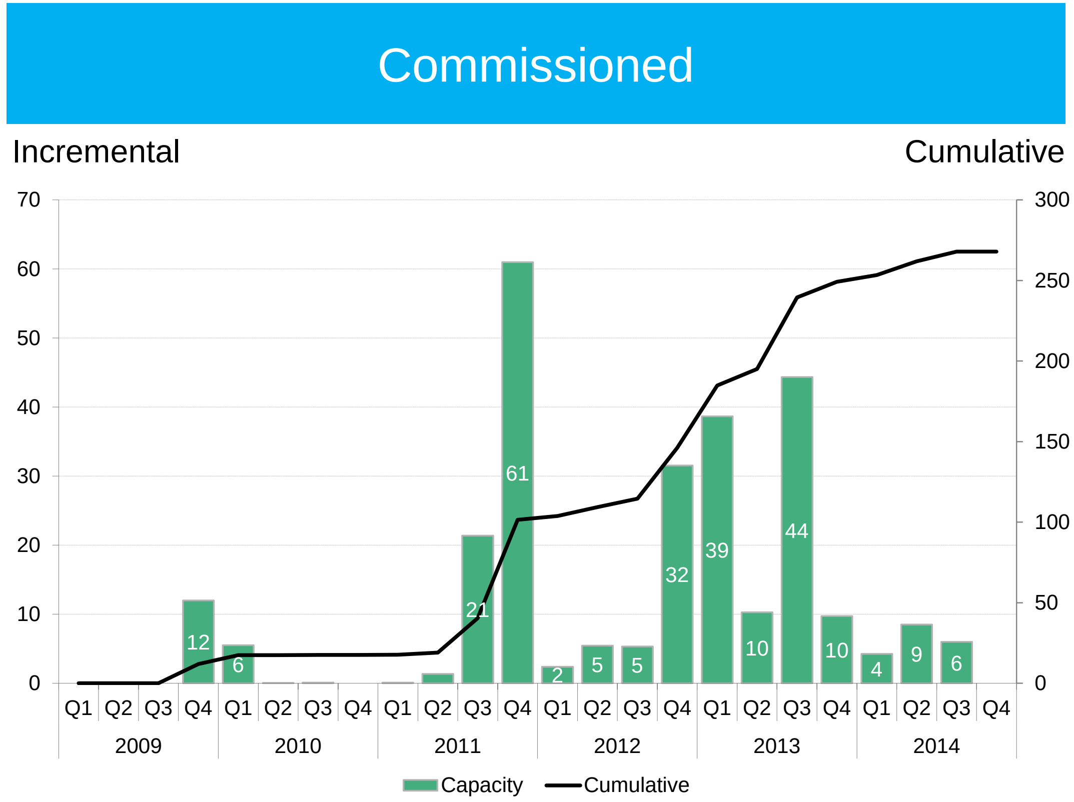
Source: Bloomberg New Energy Finance

Notes: Does not include pumped hydropower, underground compressed air energy storage, or flooded lead-acid batteries. Minimum project size for inclusion in this analysis is 100kW or 100kWh.

Deployment: US non-hydropower energy storage capacity (MW)

Bloomberg NEW ENERGY FINANCE





- The US storage sector has had many bold announcements but few projects that have actually come to fruition
- Policy has driven much of the activity: The 2009 American Recovery and Reinvestment Act (ARRA) funded most of the projects that were commissioned from 2011 to the middle of 2014. The 1.3GW California energy storage mandate drove several utilities to issue solicitations for over 565MW of storage in 2014, to be commissioned between 2015 and 2020. There have been other storage-related policy developments elsewhere (see previous slide). In many states, storage must now be considered by utilities in their long-term strategies to meet demand

Source: Bloomberg New Energy Finance

Notes: Does not include pumped hydropower, underground compressed air energy storage, or flooded lead-acid batteries. Minimum project size for inclusion in this analysis is 100kW or 100kWh.

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

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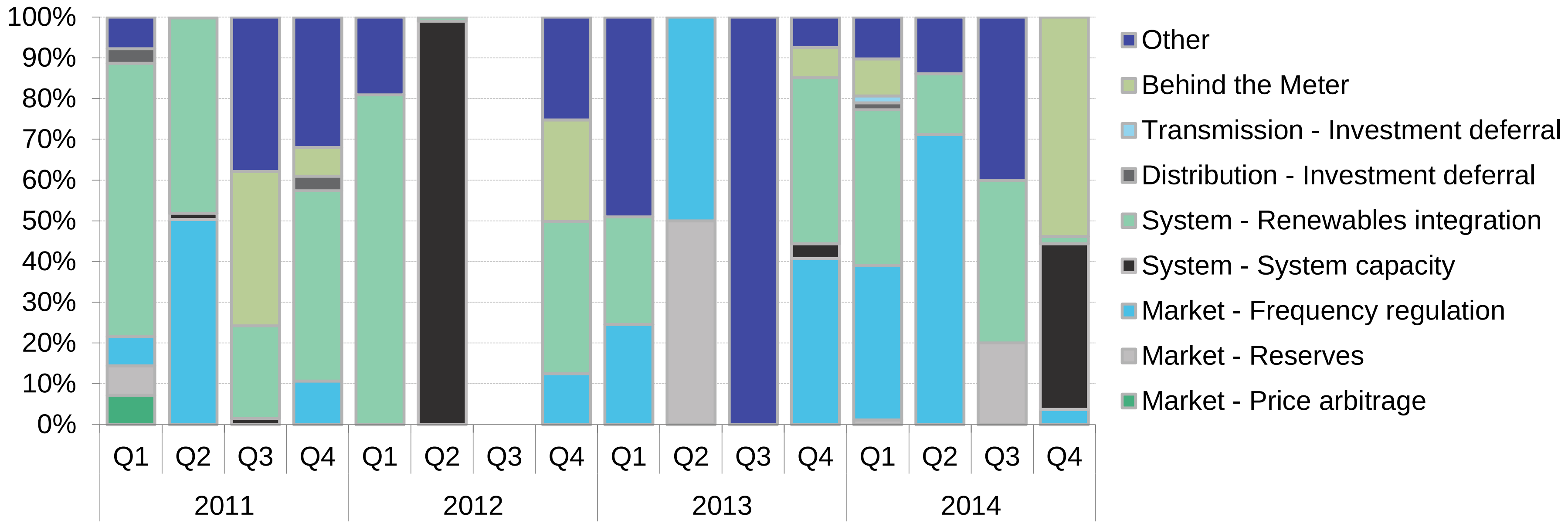


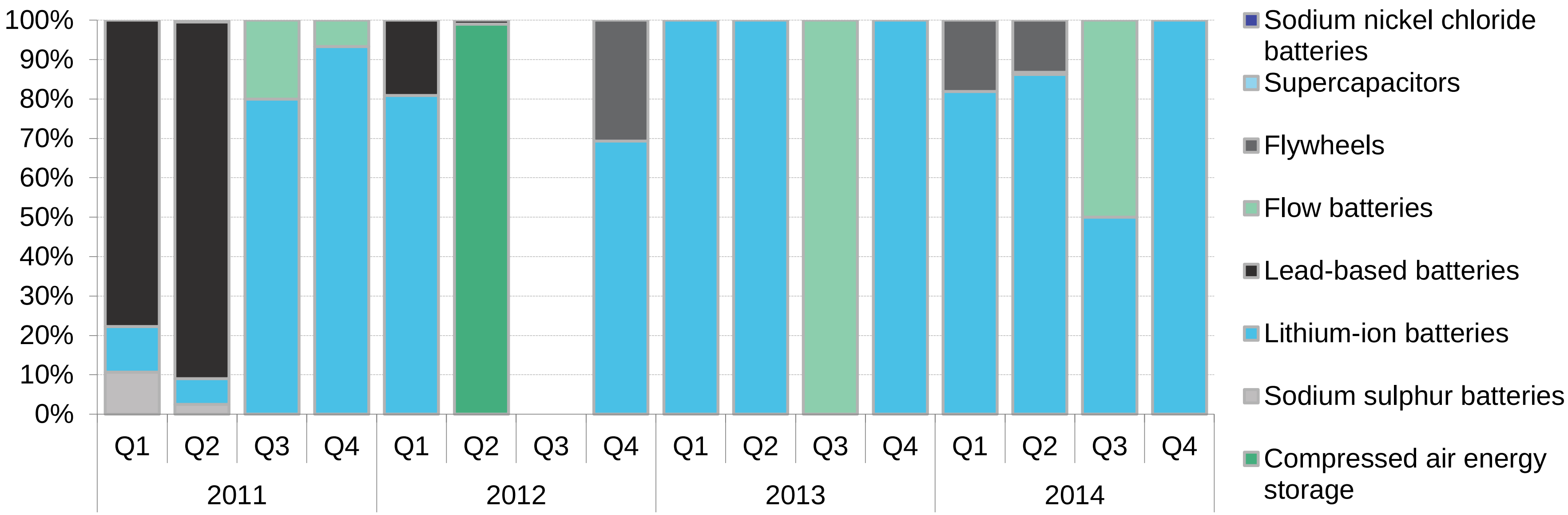
- The chart shows the mix of applications for energy storage projects – ie, what is the main objective of the projects
- Many announced projects received government funding for testing or proof of concept (these are marked as ‘Other’)
- Despite the intuitive connection between the potential for storage to facilitate the integration of wind and solar projects, most market-based projects have not had a renewable energy component. Instead, the key applications have been:
  - Frequency regulation in PJM
  - Transmission and distribution upgrade deferral
  - Behind the meter demand charge management at commercial and industrial end user facilities
- Several large frequency regulation projects have been or are being developed by AES Energy Storage, Beacon Power, Ecoult, RES Americas, and Invenergy in the PJM region to benefit from high frequency regulation prices

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.

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

Bloomberg NEW ENERGY FINANCE

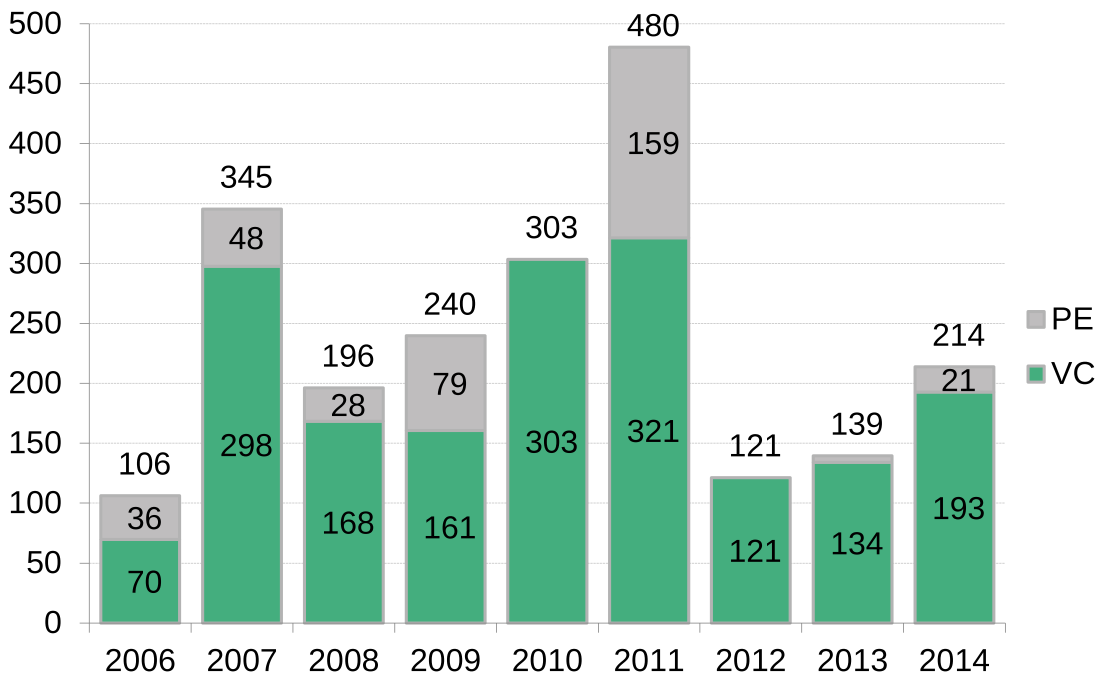


- Lithium ion batteries have been the technology of choice by project developers, large and small, because:
  - It is widely available and mass produced all over the world
  - It can provide high power for short-duration applications (eg frequency regulation) and up to about four hours of energy capacity for longer-duration applications (eg investment deferral, arbitrage)
  - It has a proven track record for reliability and performance
- New technologies have been tested in pilot projects supported by government stimulus funding but were announced before 2011 and are not on this chart
- Many start-ups are developing new technologies for energy applications, but these companies are still developing early-stage pilot projects or are in the earliest stage of commercial development

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.

Financing: Venture capital / private equity investment in US energy storage companies ($m)



- There has been over $2.3bn invested by VC/PEs in US energy storage companies since 2006, including $214m in 2014
- The top investments for stationary storage in 2014 were:
  - $47m for Aquion Energy, a sodium-ion battery company in Pennsylvania ramping up production
  - $40m for Ambri, a liquid-metal battery company developing its first pilot projects in 2014 and 2015
  - $29m for Primus Power, a flow battery company developing its first large-scale projects
- The most notable investments in the energy storage sector in 2014 have been funds raised to develop behind-the-meter projects for demand charge management at commercial and industrial buildings. The projects typically require no upfront investment from the building owner and operate in a leasing structure similar to some rooftop solar projects. For these types of projects, Stem raised $105m, Green Charge Networks raised $66m, and Coda raised $6.4m, all in 2014

Source: Bloomberg New Energy Finance

Notes: Values include estimates for undisclosed deals.

Table of contents

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

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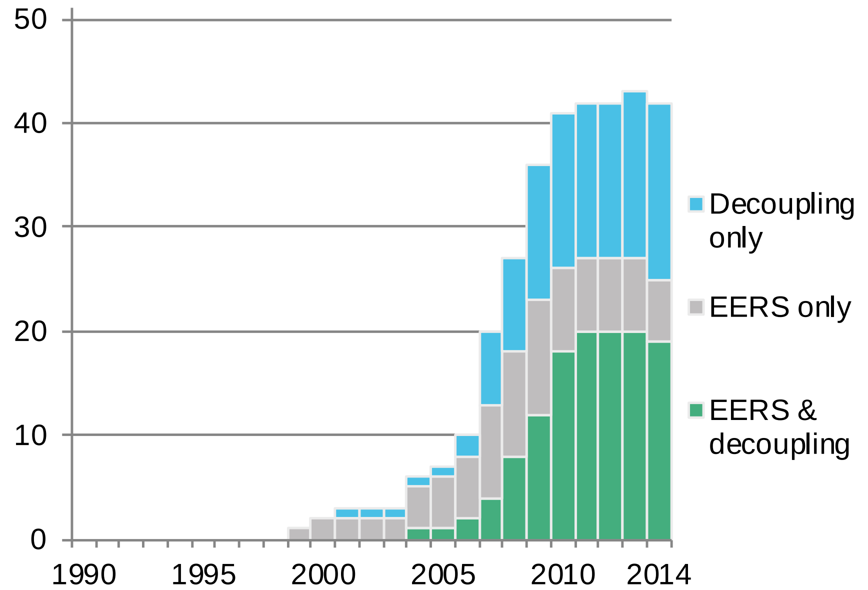
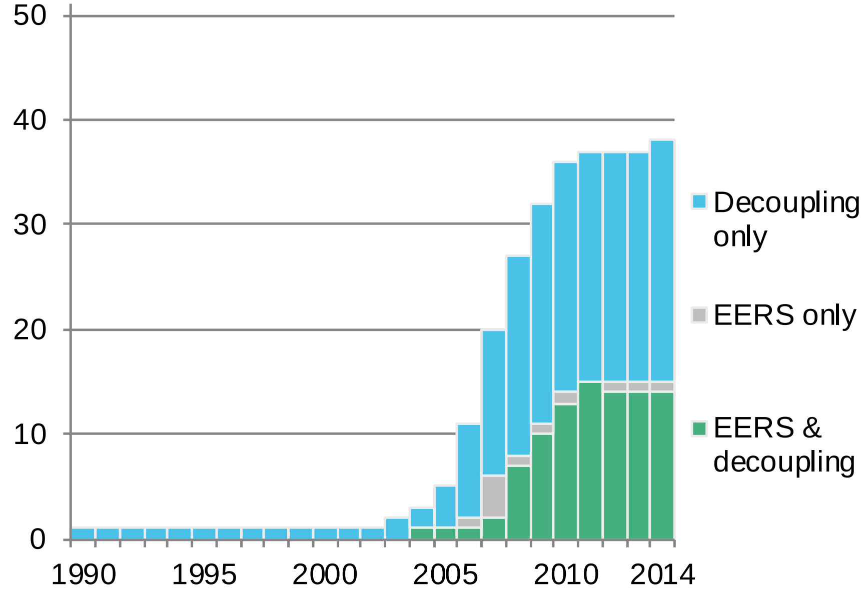
Electricity



Natural gas

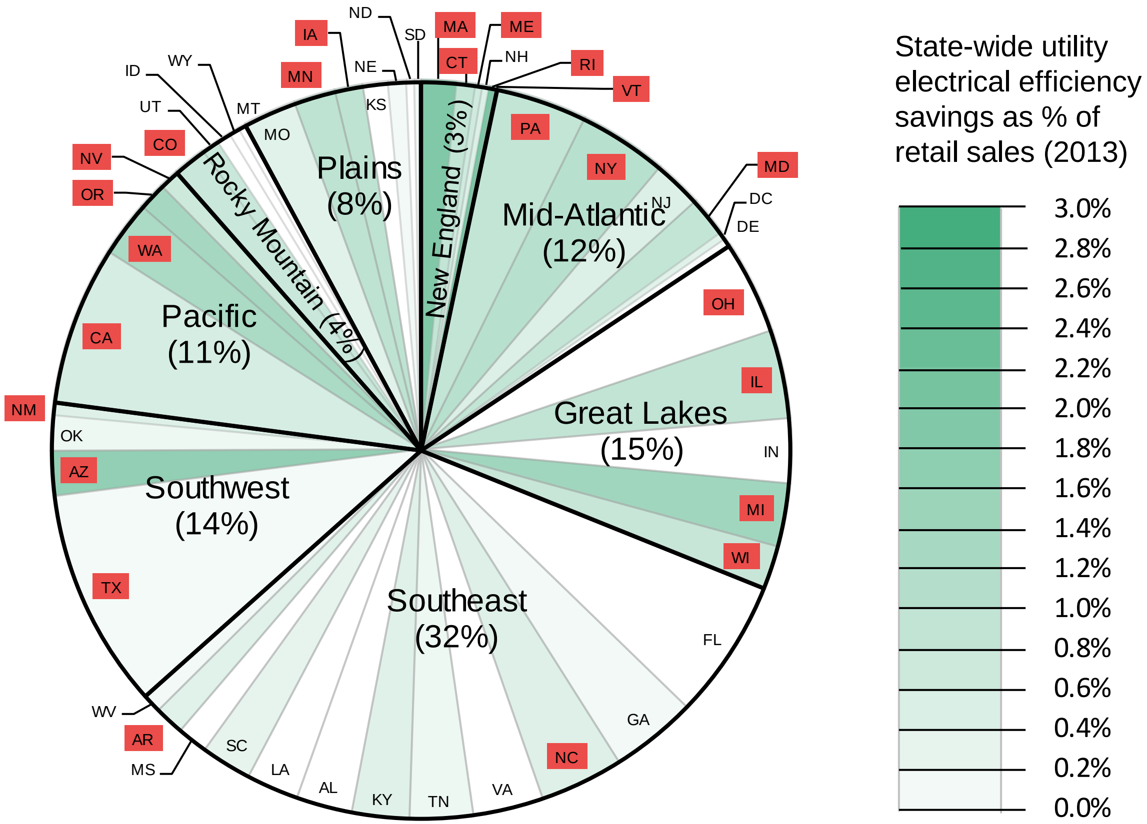


- The key policy story of the past decade has been the uptake of targets for energy efficiency resource standards (EERS) and of decoupling legislation among US states
- Momentum has slowed since 2010, and notable negative developments in 2014 include:
  - Indiana – elimination of EERS
  - Ohio – freezing 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 if demand-side energy efficiency is perceived as a cheaper alternative to renewable or nuclear generation in meeting requirements

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 (%)

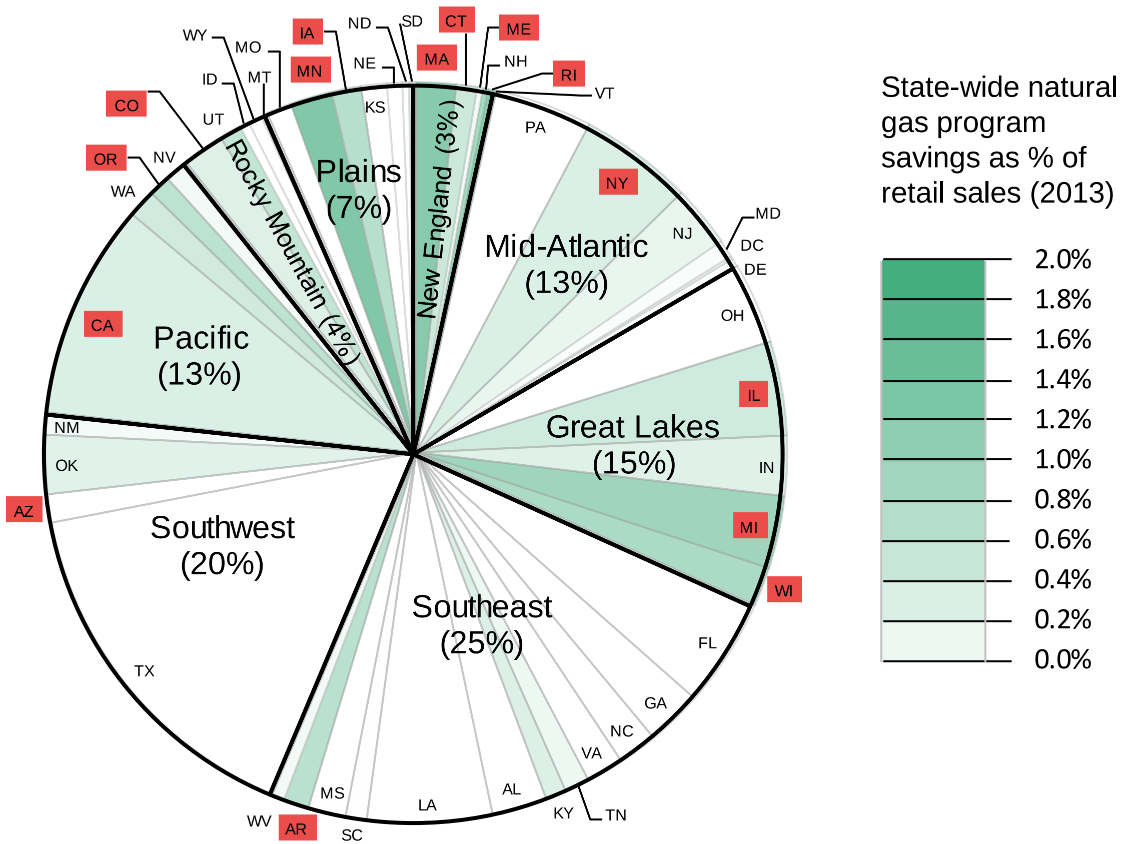


- The majority of states in the Pacific, Mid-Atlantic and New England regions have adopted EERS legislation, and it is in these regions where savings account for the largest percentage of retail sales
- The Southeast remains a market with untapped potential for energy efficiency, and had no major policy developments in 2014
- All states in the Great Lakes region had EERS policies as of 2013. But in 2014, Indiana passed legislation repealing the policy, and in Ohio, the policy has essentially been rolled back; these are the two states in the region with the lowest level of savings relative to retail sales

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.

Policy: Share of total natural gas consumption by US state and region, and natural gas program savings by state, 2013 (%)

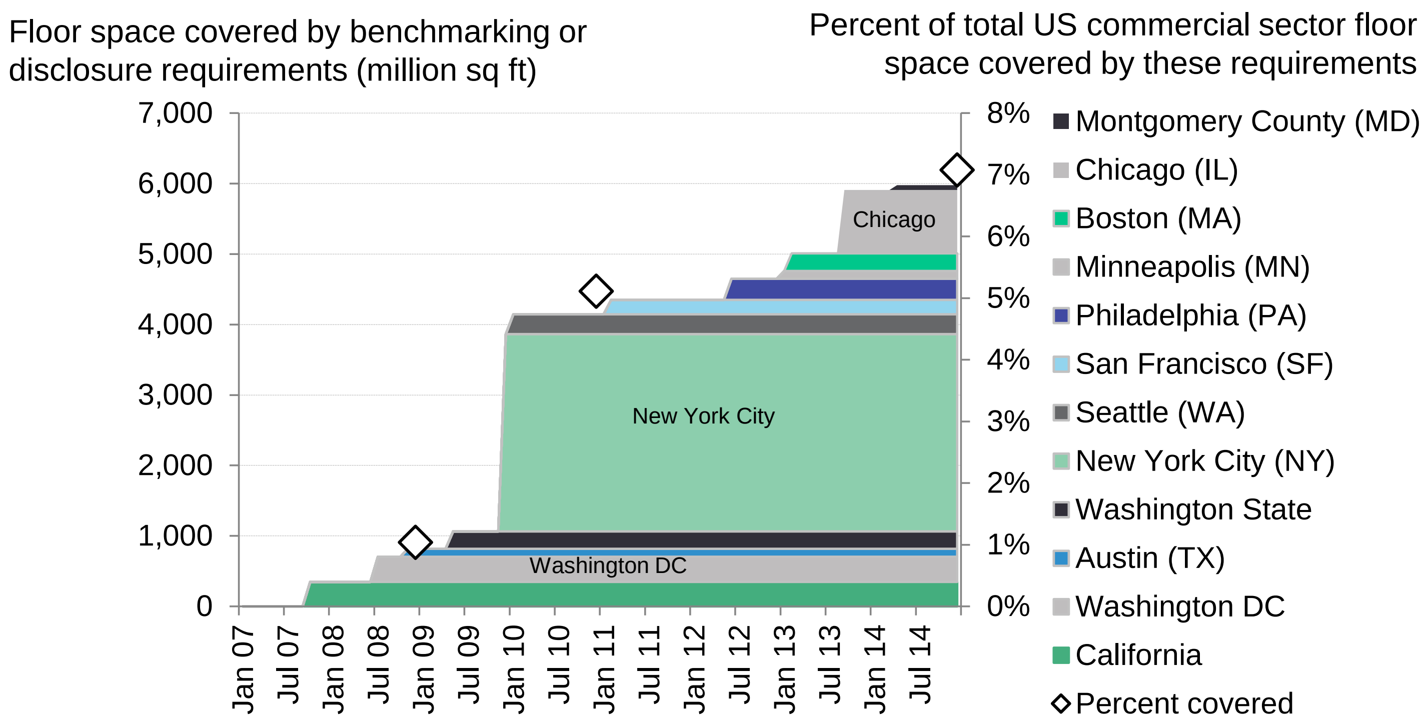


- As with electricity, the Southeast remains an important area for potential natural gas savings. The Southwest, particularly Texas, is also a region with untapped potential
- Generally speaking, the level of energy savings as a proportion of energy consumption is lower for natural gas than it is for electricity, reflecting the fact that utility budgets for natural gas-saving programs are lower than they are for electricity

Source: ACEEE, EIA, Bloomberg New Energy Finance

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

Policy: US building floor space covered under state or local building benchmarking / disclosure policies

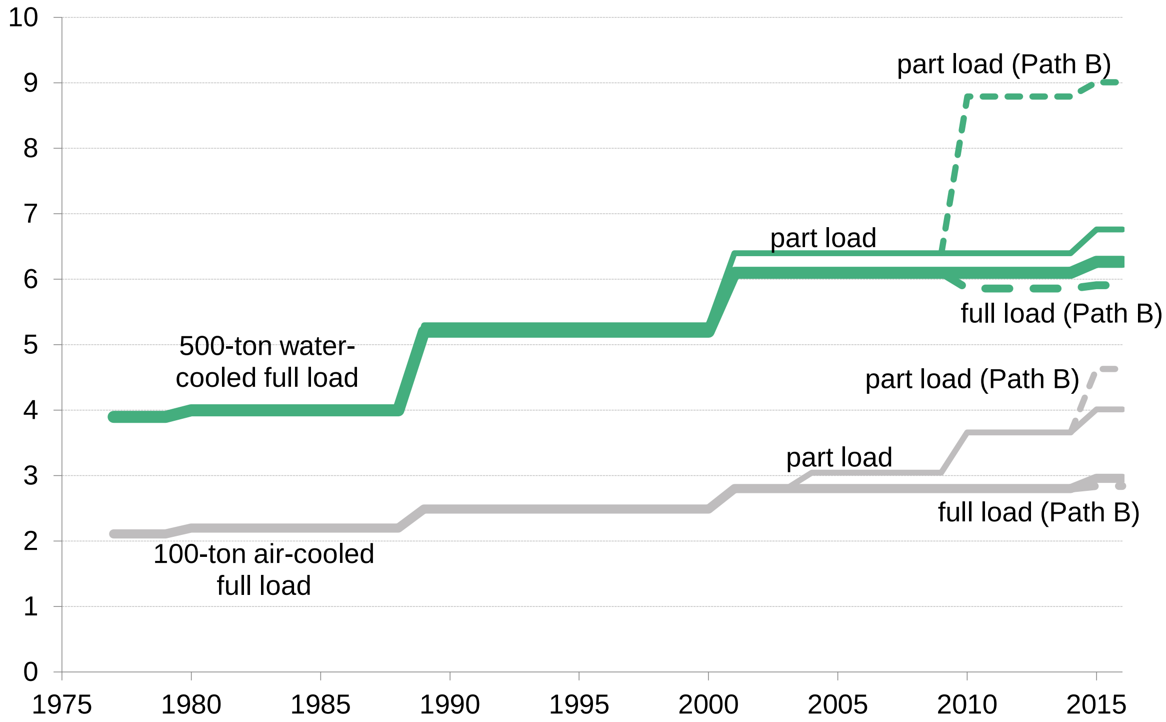


- State and cities have been establishing policies around building energy use. These policies can include requiring buildings to achieve certain energy efficiency benchmarks or mandating that buildings disclose their energy consumption
- Through 2014, 6.0bn square feet of commercial floor space, or around 7% of total US commercial sector floor space, was covered under these kinds of policies
- New developments in 2014 included: (i) Montgomery County (MD) passing a bill requiring annual benchmarking for large non-residential buildings; and (ii) Cambridge (MA) city council approving an ordinance to require benchmarking and disclosure of building energy performance for large commercial, institutional, and multifamily buildings

Source: Institute for Market Transformation (IMT), US DOE's Buildings Energy Data Book, Bloomberg New Energy Finance

Notes: Cambridge's policy not shown in chart, as the square footage numbers for the city are still being tallied. Accounts for overlap between cities and states (eg, no double-counting between Seattle and Washington State numbers). Assumes that the Buildings Energy Data Book's definition of floor space covered at least roughly corresponds to IMT's definition. Shaded areas show amount of floor space covered, diamonds represent percentage of US commercial sector floor space covered. Diamonds are spaced out in irregular intervals since data about the denominator (total commercial sector floor space in the US) is available at irregular periods (2008, 2010, 2015e). The diamond for December 2014 assumes linear growth in the denominator over 2010-15.

Policy: Stringency of performance for chillers (as per ASHRAE Standard 90.1 requirements) (y-axis measures coefficient of performance)



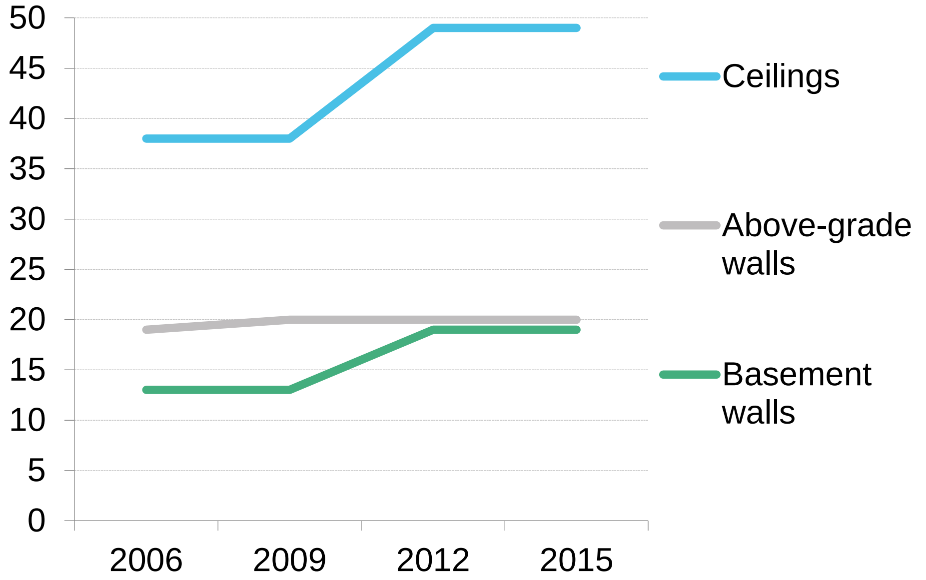
- Appliance standards help drive the improvement of technologies over time
- The chart shows how the standards for chillers have evolved since the late 1970s in terms of 'coefficient of performance'
- It illustrates not only the improvements in efficiency required by the standard, but the increasing level of nuance: in the early 2000s the standards began to require that systems exhibit a higher performance when operating at partial load. Since 2010, a provision has been made within the standards to recognize the different usage profiles for systems. In the case of 'Path B' (as marked on the chart), systems can have a lower performance at full load, so long as their partial load performance is substantially higher – reflecting a different requirement for systems which will be operating primarily at part-load conditions

Source: ASHRAE 90.1-2013 Standard

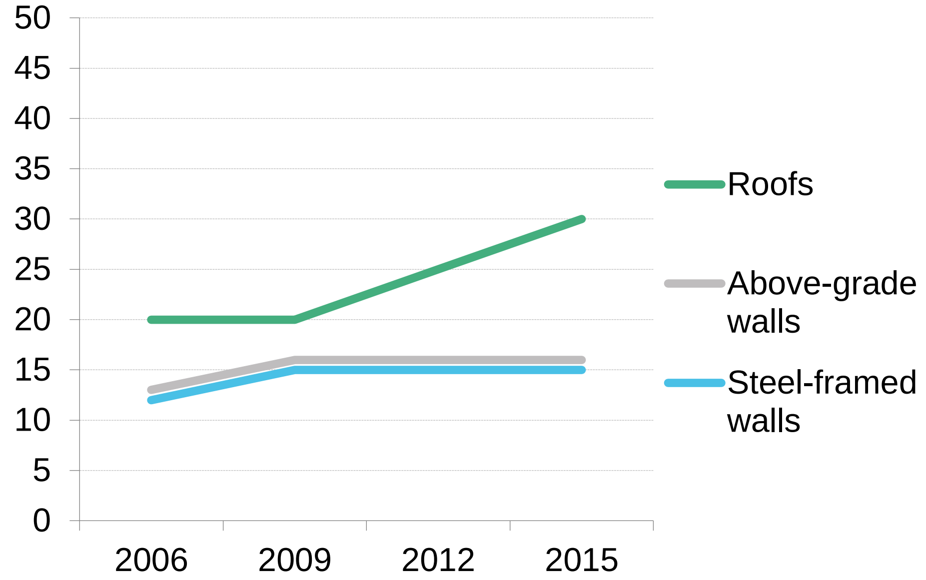
Notes: ASHRAE was formerly the American Society of Heating, Refrigerating and Air Conditioning Engineers. The standard shown in the chart is part of Standard 90.1, which dictates minimum requirements for energy efficient designs for buildings. The standard is on "continuous maintenance", allowing it to be updated based on changes in technologies and prices. Coefficient of performance is a measure of efficiency, based on the ratio of useful energy acquired versus energy applied; the higher the coefficient, the more efficient the system.

Policy: Thermal performance standards by building placement (R-values)

Residential buildings



Commercial buildings

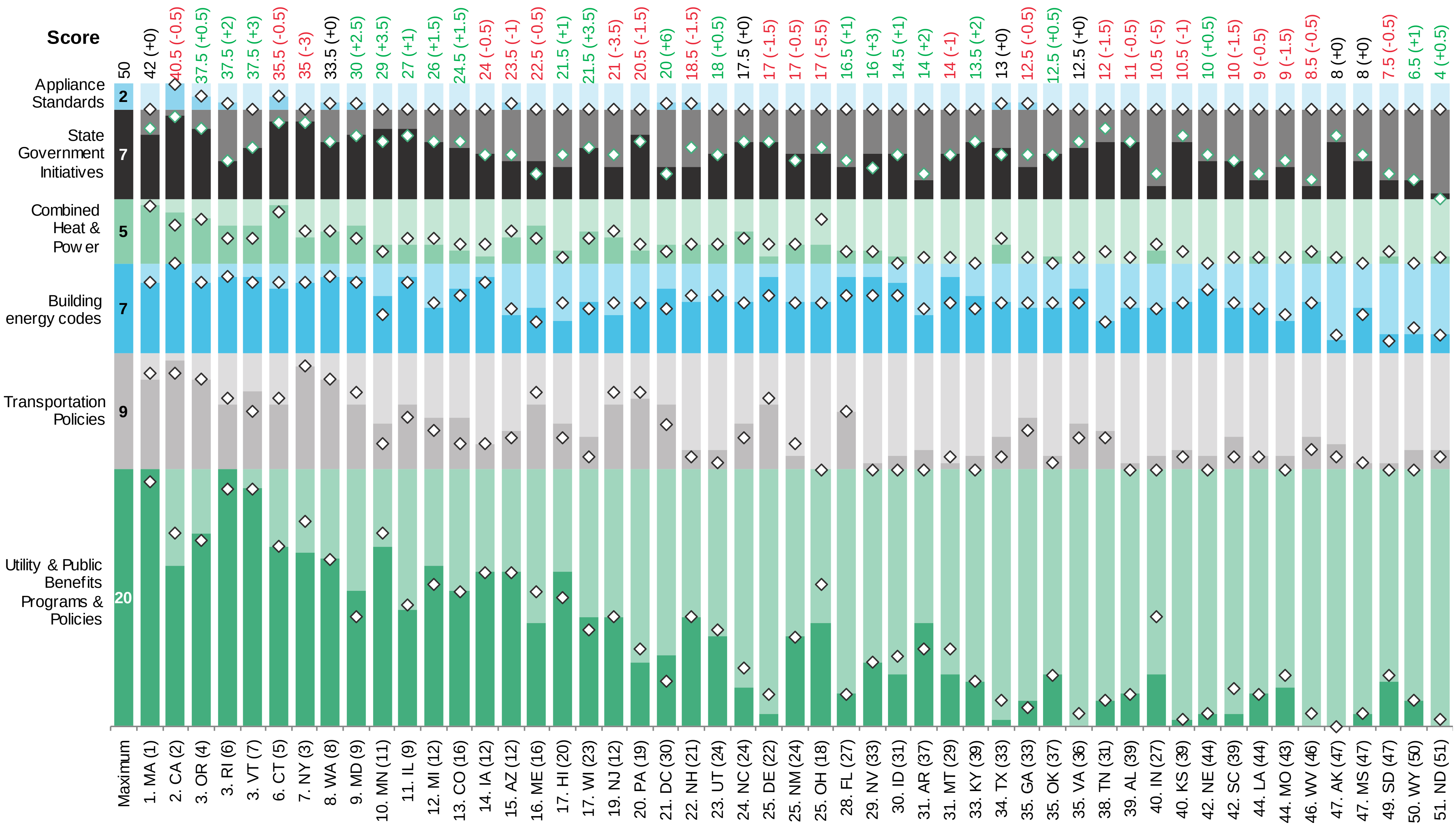


- Higher energy efficiency standards, in the form of increased insulation requirements, are now in place for new buildings
- There is also increased attention on the energy efficiency opportunity in existing buildings. In their most recent standards updates, both ICC and ASHRAE incorporated language around required insulation upgrades when existing roofs are replaced. This increased attention has the potential to impact building energy use faster than changes to new construction requirements, due to the market size for 're-roofing'
- In 2014, 10 states adopted more stringent residential and commercial building codes
- In Texas, where code adoption occurs at the local level, 39 of the state's largest metro areas adopted higher codes
- Adoption of more stringent codes drives demand for products, such as insulation, which support energy efficiency

Source: PIMA (Polyisocyanurate Insulation Manufacturers Association), NAIMA (North American Insulation Manufacturers Association), based on standards from ASHRAE and ICC

Notes: Thermal performance standards as established by ASHRAE and ICC are given in R-values, a measure of a component's resistance to the transfer of heat (greater R-value means more resistance – ie, better insulation). ICC is the International Code Council. ASHRAE was formerly the American Society of Heating, Refrigerating and Air Conditioning Engineers.

Policy: ACEEE state-by-state scorecard for energy efficiency policies, 2014

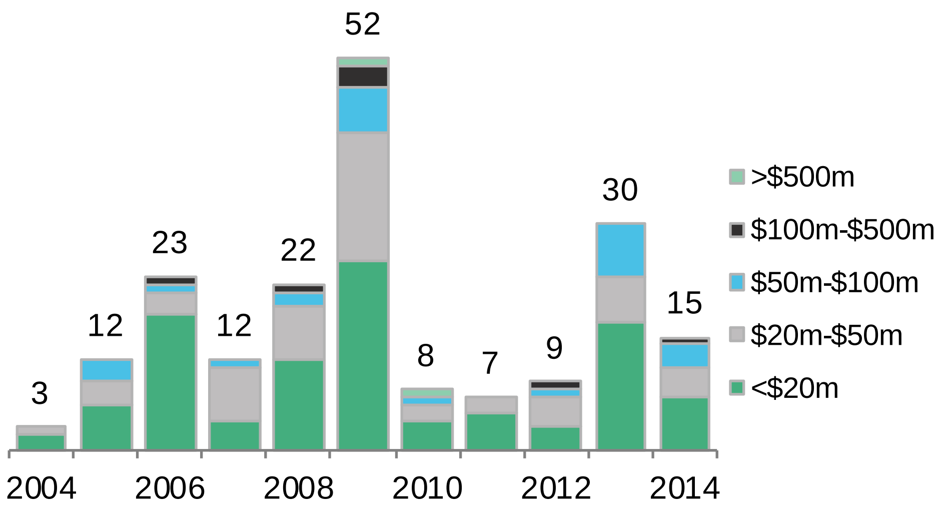


Source: ACEEE, EIA, Bloomberg New Energy Finance

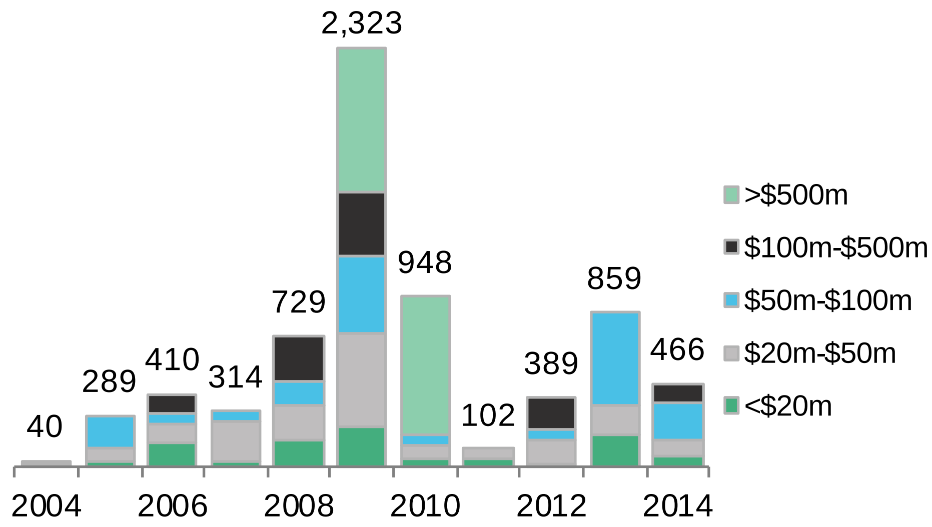
Notes: Numbers in parentheses at the bottom of the chart indicate 2013 ranking and at the top of the chart change in score from 2013 levels. Diamond symbols indicate 2013 score within each category.

Policy: US federal ESPCs executed through the DOE's umbrella agreement, by year and deal size

Number of ESPCs



Total contract value of the ESPCs ($m)

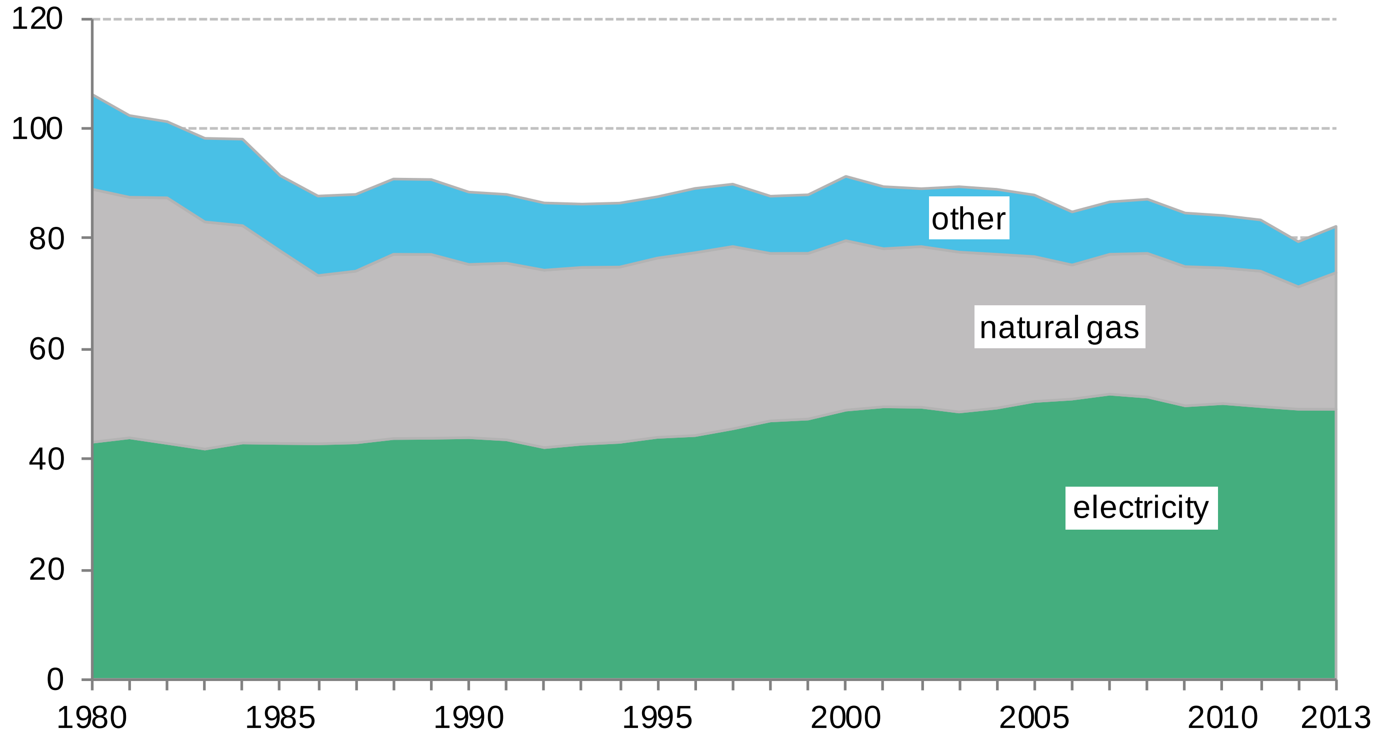


- Federal facilities can play an exemplary role for other sectors on the benefits of energy savings performance contracts (ESPCs) as a way of financing energy upgrades
- In May 2014 President Obama issued a memorandum extending a target that had been set at the end of 2011 ($2bn worth of contracts entered in the period 2012-13; target was extended to $4bn over the period 2012-16)
- Utility energy service contracts are also a suitable vehicle for federal energy efficiency, but there is limited data on their impact

Source: Federal Energy Management Program (FEMP), US Department of Energy (DOE), Bloomberg New Energy Finance

Notes: DOE's umbrella agreement refers to indefinite-delivery, indefinite-quantity (IDIQ) contracts between the DOE and energy service companies. Totals are summed in terms of calendar years in order to facilitate comparison with government targets, whereas DOE sources commonly sum over fiscal years.

Deployment: US commercial building energy intensity (kBtu/sq-ft)



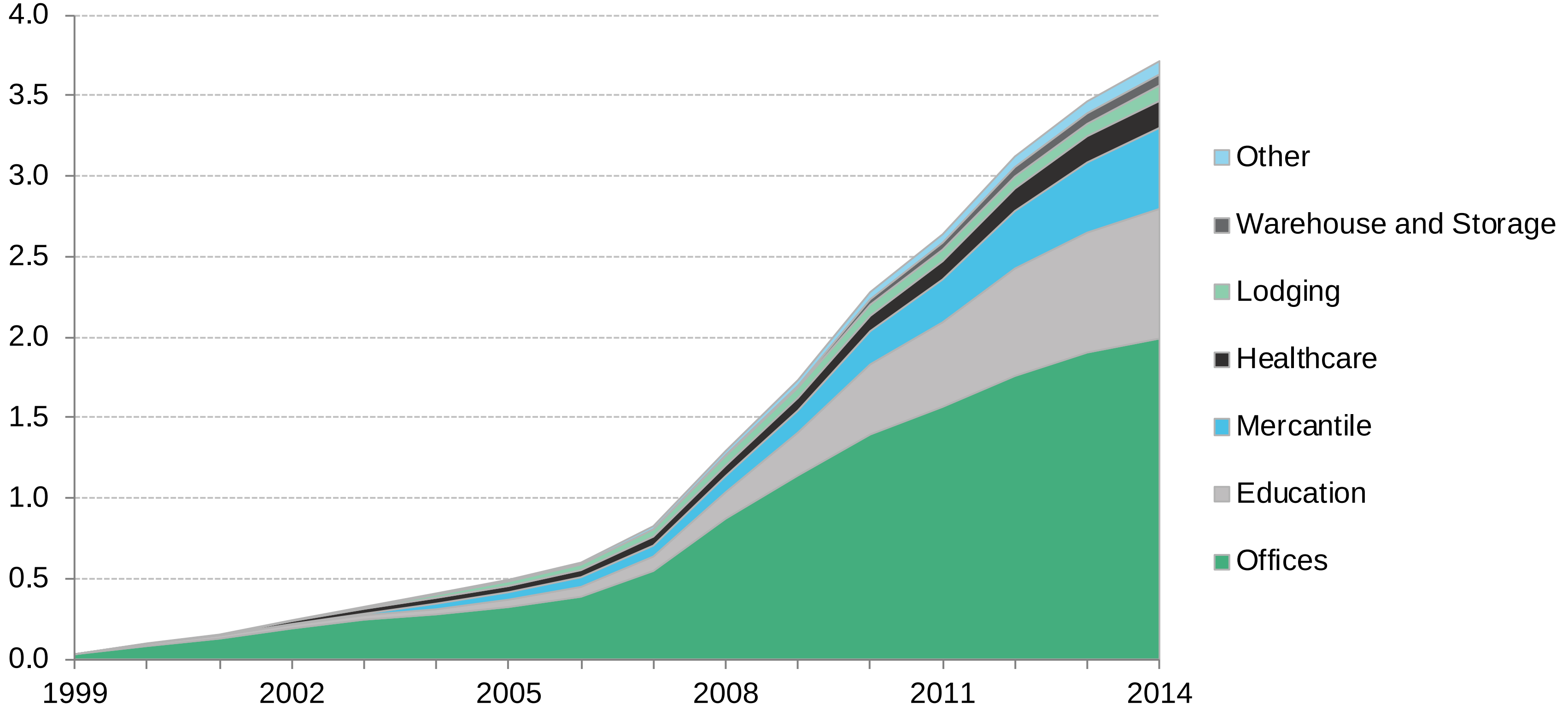
- The figures here are based on EIA data for the overall consumption of the commercial sector combined with the latest information on total commercial floor space and other estimates based on previous editions of the Commercial Buildings Energy Consumption Survey (CBECs) on the consumption profile of the commercial sector
- Estimates suggest a slight increase in efficiency (slight decrease in energy intensity) since 2000; the overall trend will be clearer once the next CBECs survey is published, expected mid-2015

Source: EIA, Bloomberg New Energy Finance

Notes: This analysis is based on (i) EIA data on US commercial building energy consumption and floor space for the years 1979, 1983, 1986,1989, 1992, 1995, 1999, 2003 and (ii) EIA data for total US commercial sector energy consumption for every year between 1979-2013.

Deployment: Energy Star-certified floor space in US non-residential buildings by building type (bn sq-ft of floor space)

Bloomberg
NEW ENERGY FINANCE

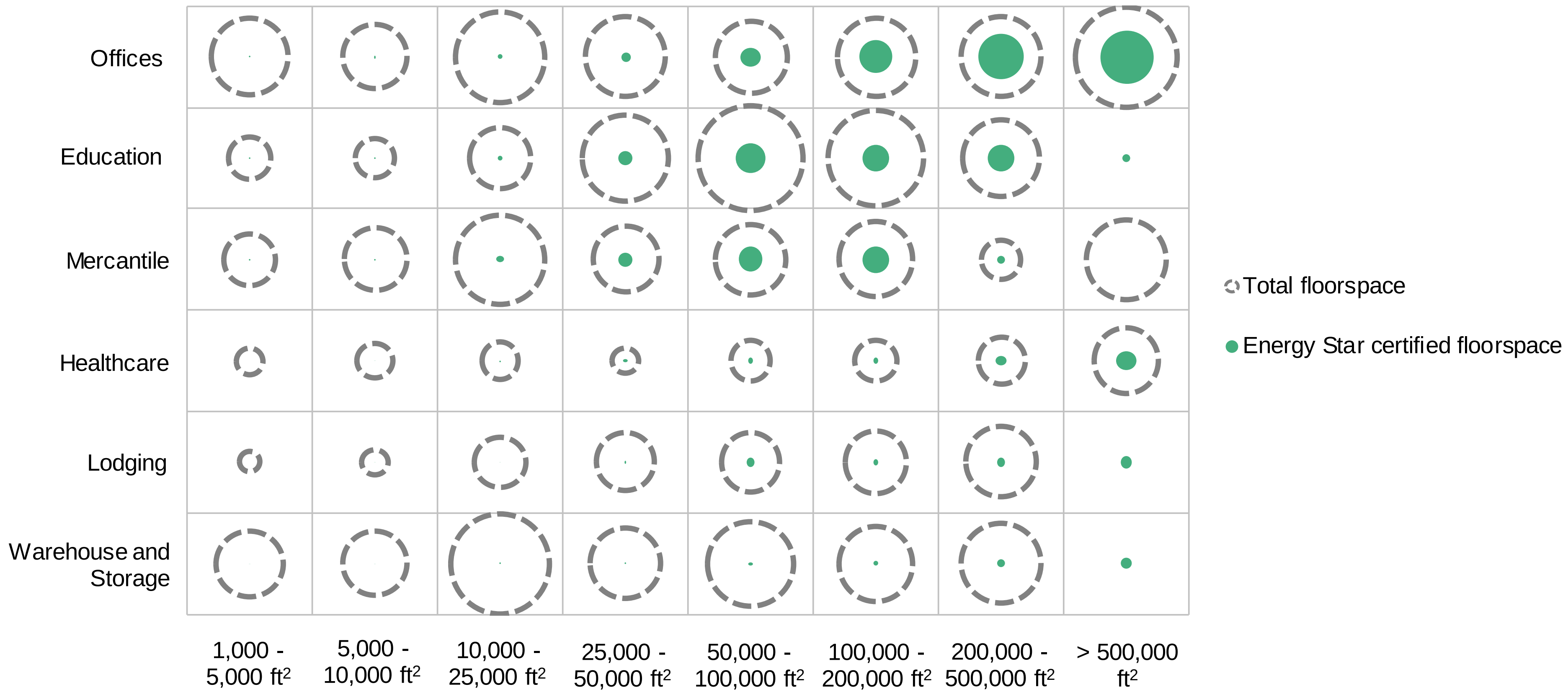


- The number of buildings being certified has increased dramatically since 2006, mainly due to adoption by office buildings
- Since 2009 the rate at which new buildings are being certified, across all sectors, has slowed

Source: EPA, Bloomberg New Energy Finance

Deployment: Energy Star-certified floor space and total floor space for US commercial buildings by sector and size, 2014

Bloomberg NEW ENERGY FINANCE



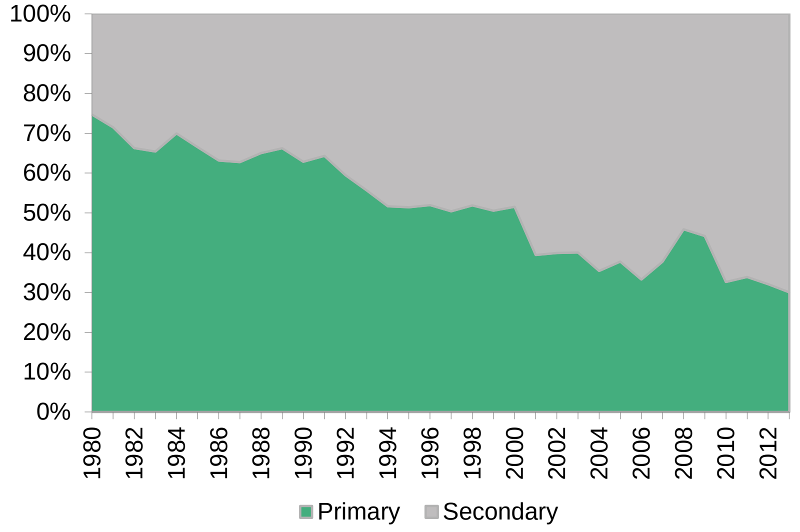
- The building type with the highest proportion of certified buildings is offices, followed by education and mercantile
- Outside of these segments, a negligible proportion of buildings has been certified
- Virtually no buildings smaller than 50,000 ft^2 have been certified

Source: EPA, EIA, Bloomberg New Energy Finance

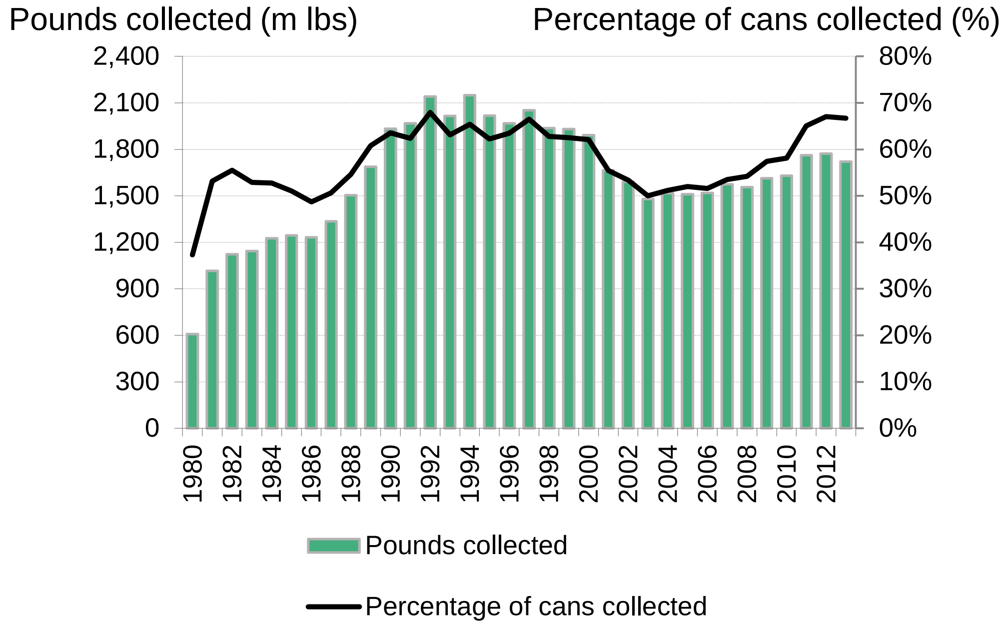
Notes: There is not enough data for total US floor space of warehouses, lodging and educational buildings with floor space in excess of 500,000ft^2.

Deployment: US aluminum recycling trends

US production of primary vs. secondary aluminum



US aluminum cans collected for recycling and % of total cans collected



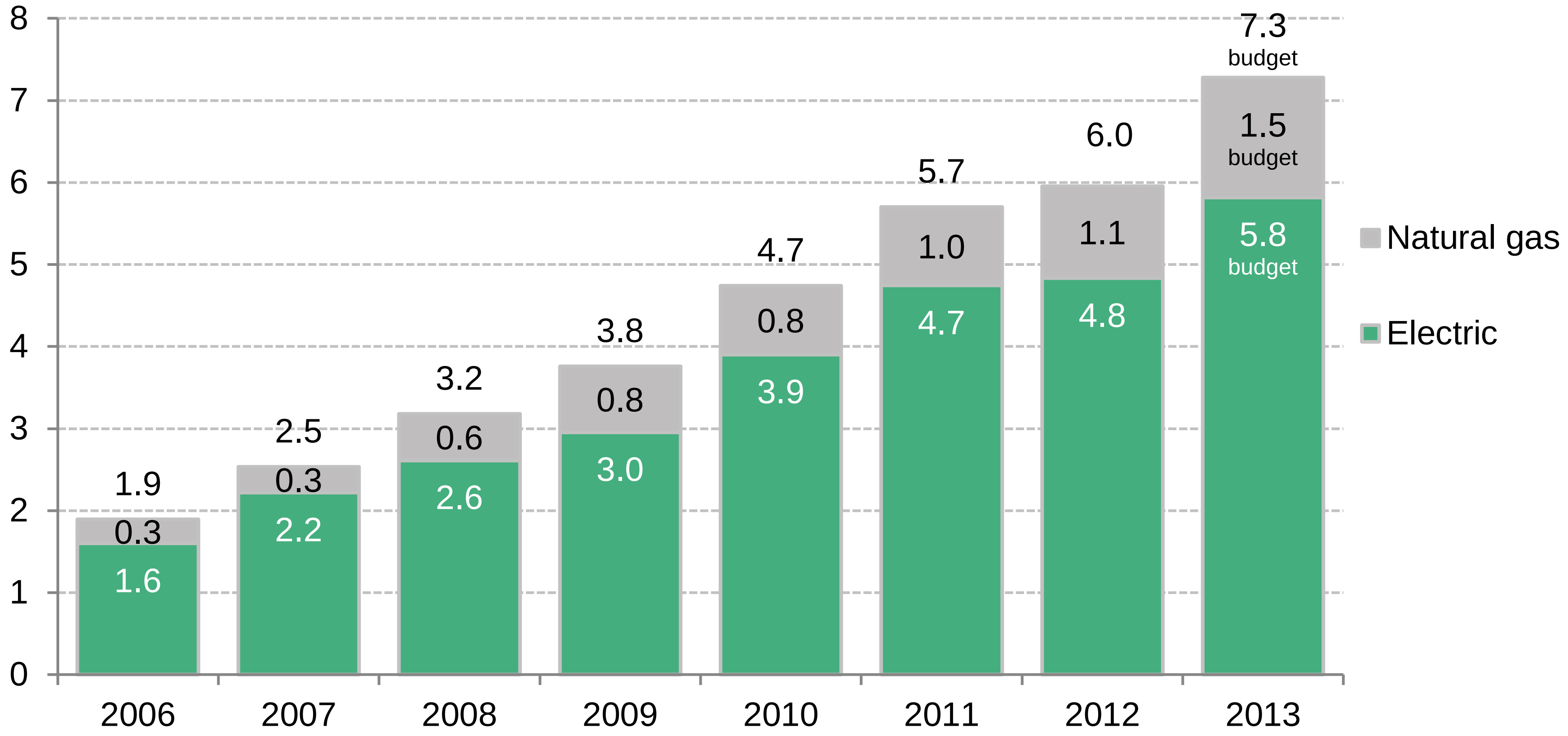
- The aluminum industry provides a case study for efficiency adoption in the industrial sector: production of aluminum from secondary sources (recycled post-consumer and industrial scrap) consumes much less energy than producing new aluminum
- Secondary sources have accounted for an increasing portion of US aluminum production, reaching around 70% in 2013
- Recycling of aluminum has also been increasing, driven largely by the addition of imported cans into the US recycling stream
- The carbon footprint of primary (new) aluminum production in the US has declined by 37% (not shown in these charts), driven by advances in efficiency technology, increased reliance on hydropower, and voluntary efforts on the parts of the industry to reduce emissions from their facilities (according to a 2014 report from The Aluminum Association)

Source: The Aluminum Association, US Geological Survey, US Department of Interior, US Department of Commerce

Notes: Not shown here is the considerable share of aluminum imports consumed in the US, which have historically met around 40% of US demand.

Source: The Aluminum Association, Can Manufacturers Institute, Institute of Scrap Recycling Industries

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

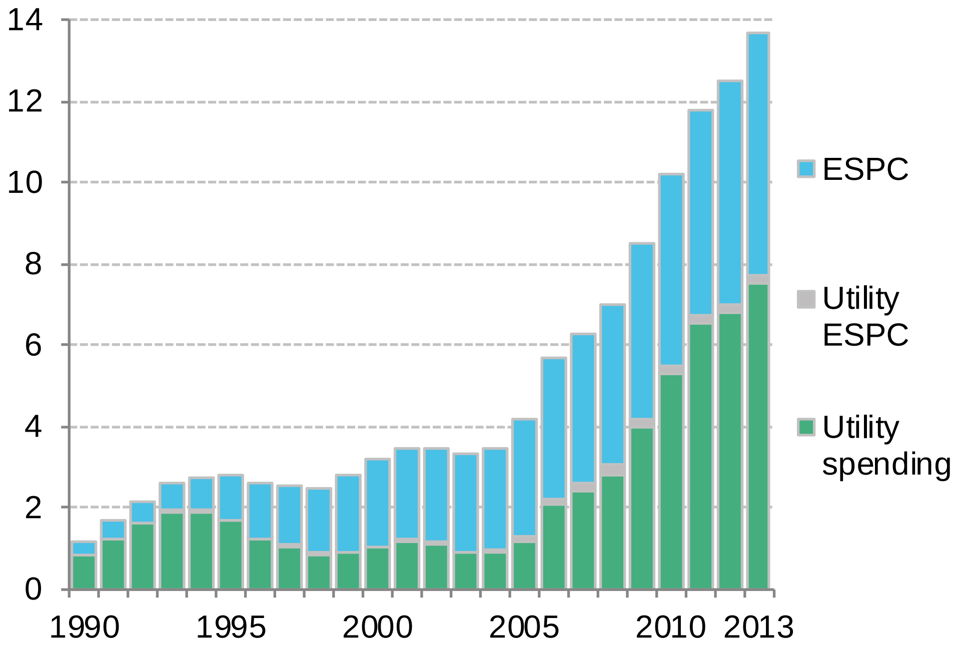


- From 2006 to 2011, US utility expenditure for energy efficiency sustained annual growth of over 25%
- Since 2011, as the uptake of state-level policies slowed, so has growth in expenditure, growing just 5% 2011-12 (though the budgeted amount shows potentially strong growth in 2013)
- New Jersey was the state with the largest increase in utility budgets for energy efficiency, with an increase from $416m in 2012 to $592m in 2013

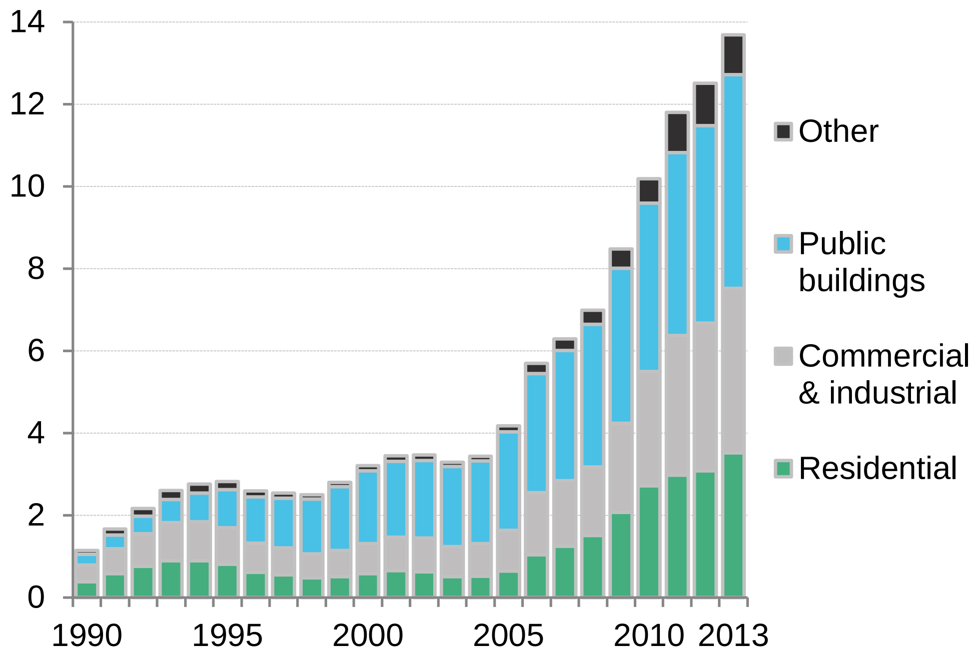
Source: CEE, ACEEE, Bloomberg New Energy Finance

Financing: US *estimated* investment in energy efficiency through formal frameworks ($bn nominal)

By framework



By sector



- Utility spending on energy efficiency remains the fastest-growing framework driving investment in energy efficiency. This is driven primarily by state EERS targets and decoupling legislation
- Utility spending will continue to increase if more states adopt EERS targets in response to the EPA Clean Power Plan
- Energy savings performance contracts (ESPCs) are mainly focused on public buildings

Source: ACEEE, NAESCO, LBNL, CEE, IAEE, Bloomberg New Energy Finance

Notes: The value for the 2013 ESPC market size shown here, $6.2bn, is an estimate. The most recent published data from LBNL puts reported revenues at $5.3bn. In the same report, the forecast for 2013 was >$6.5bn. The $6.2bn estimate, based on a continuation of 2008-11 growth rates, sits between the most recently reported data and LBNL's forecast.

Economics: US federal ESPC activity executed through the DOE's umbrella agreement, grouped by cost of saved energy (x-axis), 1998-2013

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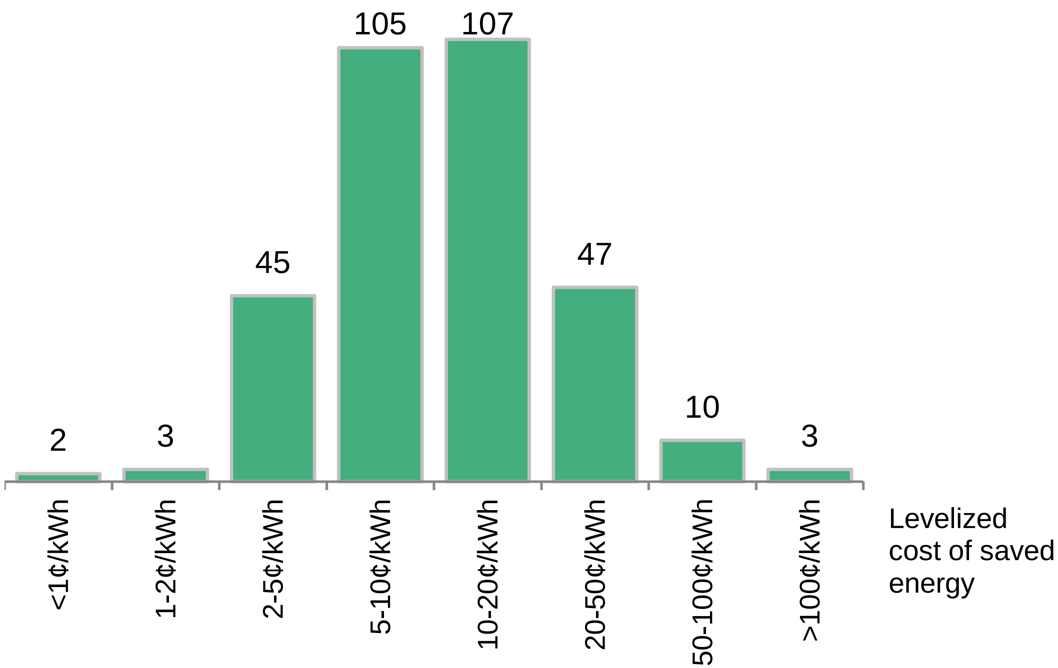
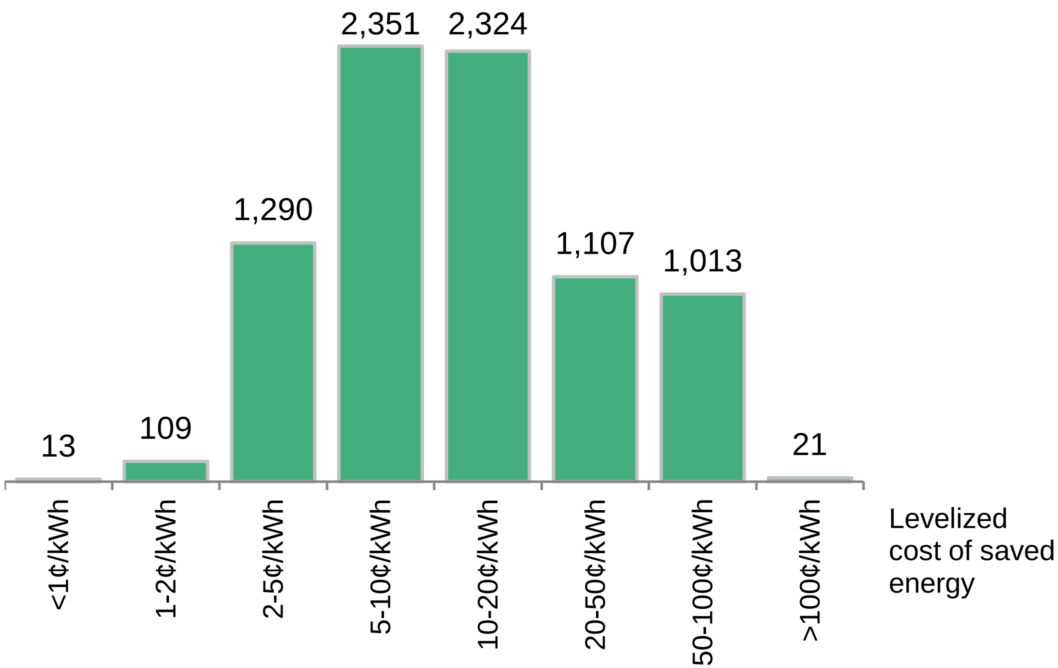
Number of ESPCs



Total contract value of the ESPCs ($m)



- There is a broad range in the cost of energy saved under energy savings performance contracts (ESPCs). This reflects:
  - differences in the type of energy being saved
  - differences in the price of energy being saved
  - the fact that energy savings are sometimes used as a means of paying for a project rather than as an economic goal in their own right
- In most cases the cost of energy savings were in the range of 5-20¢/kWh

Source: Federal Energy Management Program (FEMP), US Department of Energy (DOE), Bloomberg New Energy Finance

Notes: DOE's umbrella agreement refers to indefinite-delivery, indefinite-quantity (IDIQ) contracts between the DOE and energy service companies. LCOE is calculated using 5% discount rate.

Table of contents

Deployment: Incentive-based demand response capacity by US ISO/RTO by delivery year (GW)

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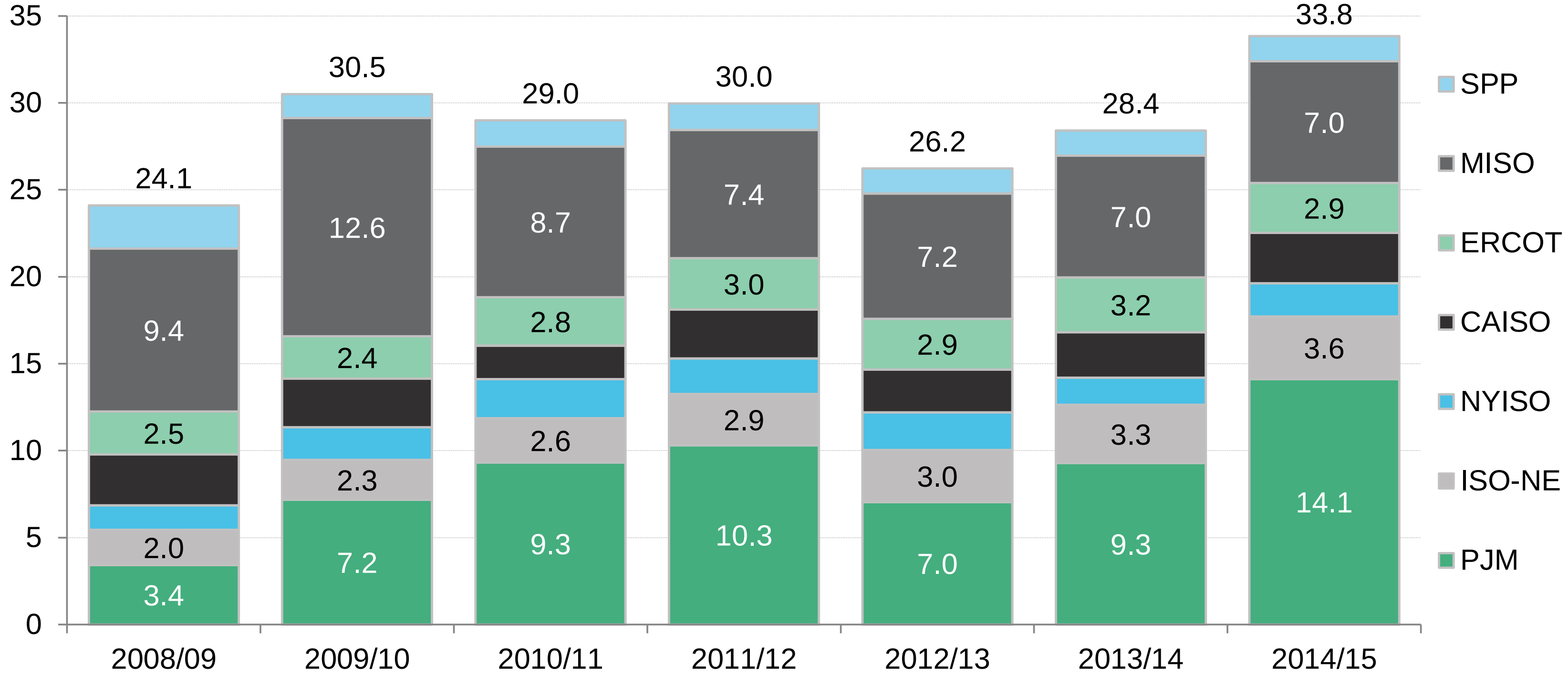


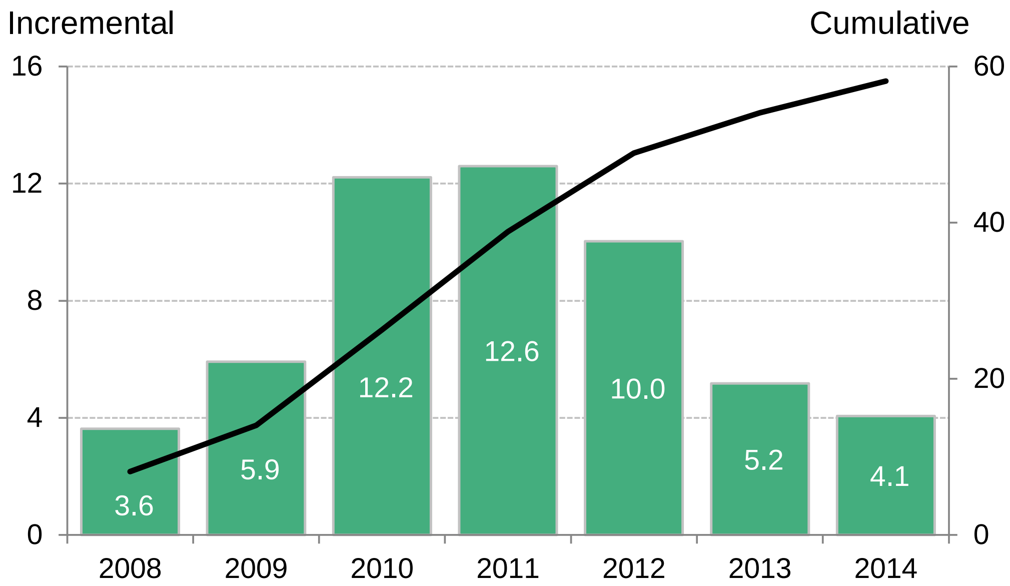
- Most of the demand response (DR) capacity is driven by the capacity market in PJM, sold via three-year ahead auctions
  - The 14.1GW of PJM DR capacity for the 2014/15 delivery year was sold in a May 2011 auction.
  - PJM DR capacity sold in the 2014 auction for delivery year 2017/18 is 11GW (not shown), a marked drop in capacity from previous years. This is due to rule changes passed by PJM making it more difficult for DR resources to quality (the motivation for these rules is to increase the reliability and availability of DR resources throughout the year)
- DR’s future in US capacity markets is in jeopardy due to a case brought up to the Supreme Court in late 2014 that will restrict DR capacity from participation in future auctions.

Source: Bloomberg New Energy Finance, data from various independent system operators (ISOs) and regional transmission organizations (RTOs)

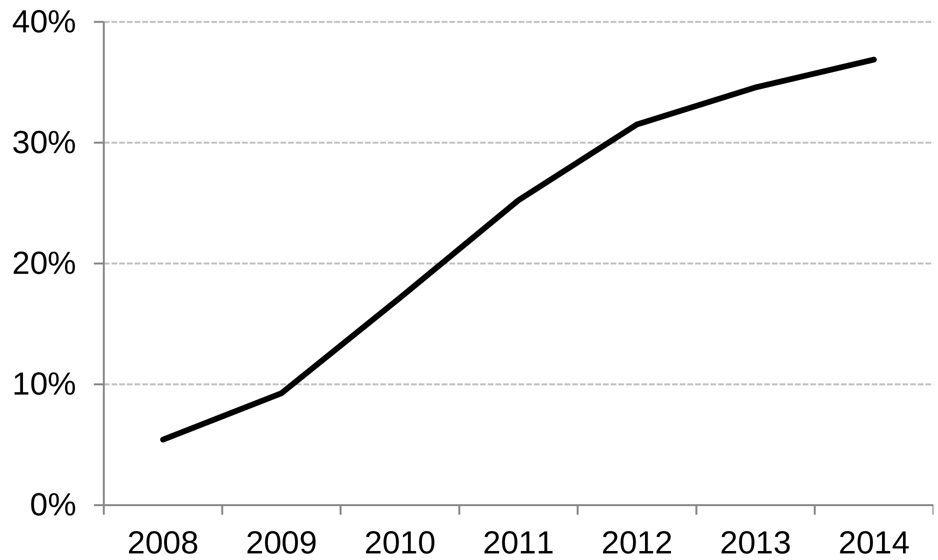
Notes: These figures include demand response activity driven by customer curtailment as well as behind-the-meter generation because some ISOs do not separate the two demand response sources. This figure does not include residential demand response programs not bid into capacity markets. Years shown are in ‘delivery years’ which typically run from June to May instead of the calendar year.

Deployment: US electric smart meter deployments

US smart meter deployments (million units)



Smart meters deployed as a percentage of US electricity customers

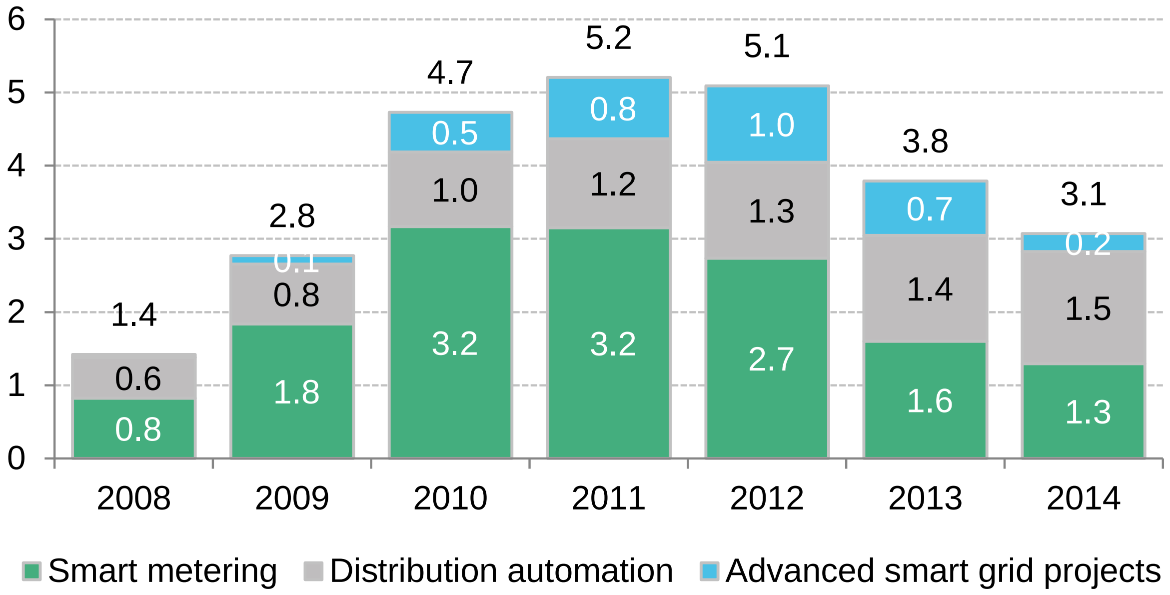


- Smart meter deployments hit a peak in 2010 and 2011, making use of a burst of stimulus funding awarded in 2009 (most of the largest utilities in the US deployed smart meters using this funding). Smart meters in 2013 and 2014 have been deployed more slowly, as smaller utilities receive approval one at a time to pay for projects using ratepayer funds
- While smart meters have only 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
  - Automating the meter reading process (which can be performed by both smart meters and AMRs) is the largest cost saving line-item for utilities when upgrading from old meters
  - The deployment of smart meters and AMR meters, totaling 74% of customers, is approaching a saturation point in the market that will continue to slow deployment of new projects in the US

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.

Financing: US smart grid spending by segment ($bn)

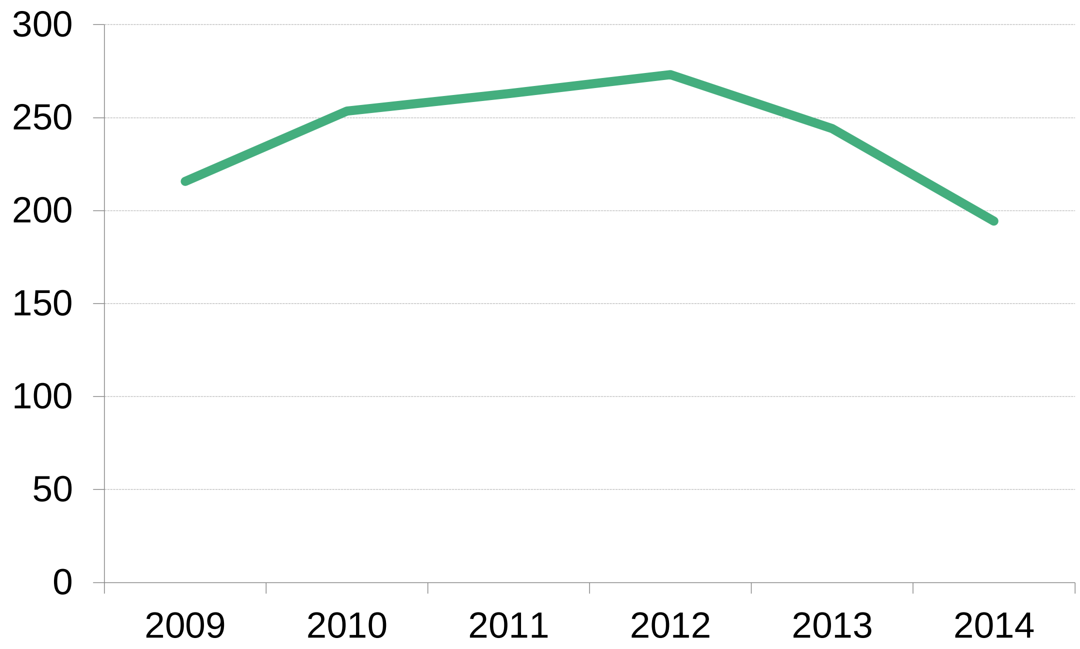


- Smart meter deployments, which accounted for most of the overall US smart grid spending from 2010 to 2012 and which were driven by the government stimulus in 2009, has largely dropped off due to a reduction in smart meter projects (as the stimulus funds have run out) and due to cheaper meters being deployed
- Distribution automation spending has remained fairly constant. These investments represent utility projects within the distribution system to reduce outage frequency and durations and to more efficiently manage electricity flow within the grid
- Investor-owned utilities and standalone transmission companies have been making record levels of investment into improving the grid: $37.7bn in transmission and distribution infrastructure in 2013, according to the Edison Electric Institute. The factors behind these investments include: “new technologies for improved system reliability,… interconnection of new sources of generation (including renewable resources), and support for production of shale gas.” (This $37.7bn total is not explicitly shown in the chart above, though a portion of those investments may overlap with financing that is captured in the chart.)

Source: Bloomberg New Energy Finance, Edison Electric Institute

Notes: The ‘Advanced smart grid projects’ category includes projects that are cross-cutting, including elements such as load control, home energy management and EV charging.

Economics: US average smart meter sale price ($ per meter installed)



- Meter prices increased from 2009 to 2012, probably due to increasing technical capabilities of the meters as well as the willingness of utilities to pay for higher-priced meters (the majority of projects funded after 2009 were supported by stimulus funding)
- By 2014, stimulus-funded projects had been exhausted, and smart meters became less differentiated from one another; this, along with competition from Chinese and Indian meter manufacturers, resulted in increasing pricing pressure
- Many companies that were metering pure-plays are now differentiating into other smart grid products for transmission and distribution infrastructure and are providing managed services, including smart grid data analytics platforms, for utilities

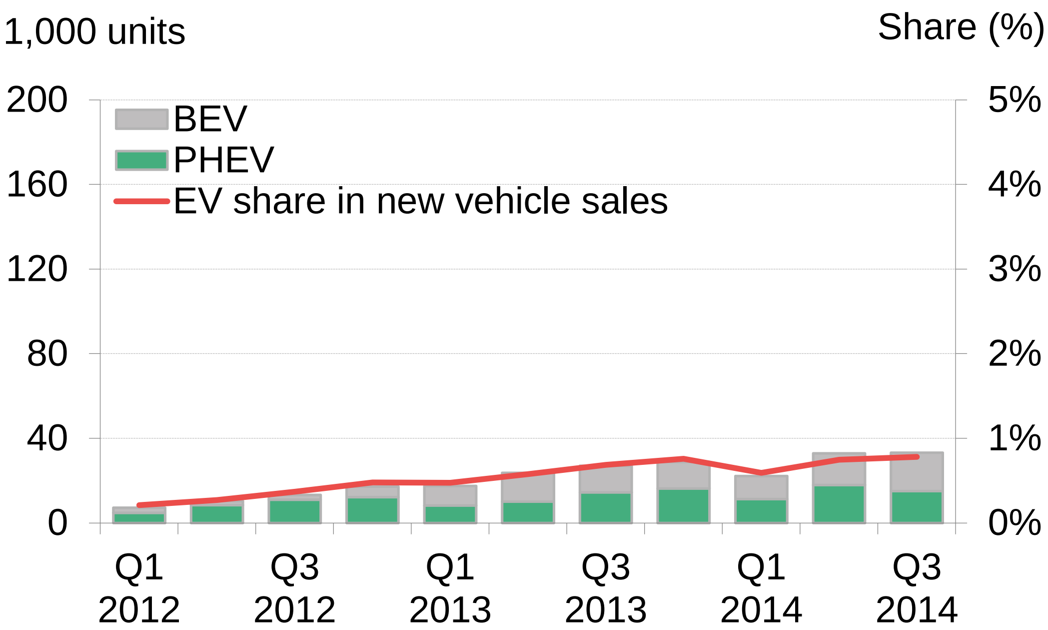
Source: Bloomberg New Energy Finance

Notes: Price per meter includes meters, advanced metering infrastructure communications network, associated IT spending and installation costs. Data based on total annual smart meter investment market size and total smart meters installed in a given year; results may vary as many deployments are based on a fixed cost per meter but the meters are deployed over several years.

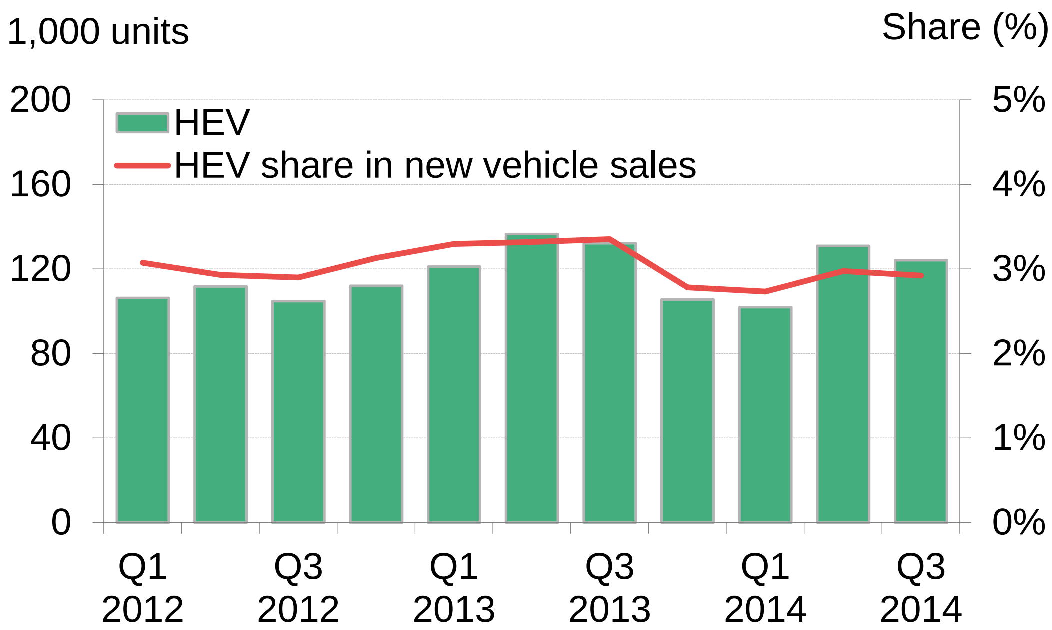
Table of contents

Deployment: US electric vehicle and hybrid electric vehicle sales

US EV sales



US HEV sales



- Sales of battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) increased 25% relative to a comparable period last year (from 77,944 in Jan-Oct 2013 to 97,501 in Jan-Oct 2014)
- Sales of hybrid electric vehicles (HEV) were 387,741 units for Jan-Oct 2014; HEV sales were relatively slow this year amid low gasoline prices
- As of November 2014, there are 49 HEV models on sale in the US (same number as in 2013) compared to 8 PHEV models (5 in 2013) and 11 BEV models (8 in 2013)

Source: Bloomberg New Energy Finance

Deployment: US public electric vehicle charging stations (number of stations)

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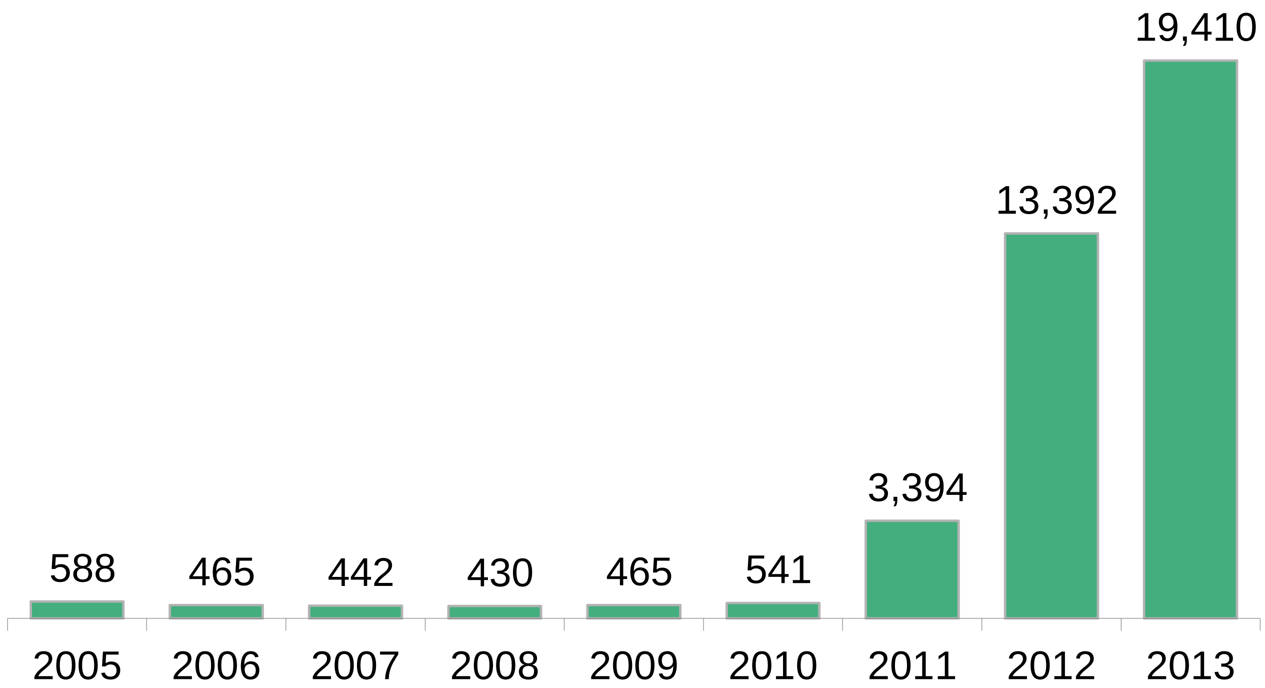

- The number of public EV charging stations in the US has increased rapidly since early 2011
- The Alternative Fuel Infrastructure Tax Credit, which included support for public and private EV charging stations, expired at the end of 2013, was retroactively extended through the end of 2014, and has since expired
- In 2014, a key player, Car Charging Group, switched its Blink Network from time-based pricing to a per-kWh fee in states that allow this type of pricing system

Source: Alternative Fuels Data Center, Bloomberg New Energy Finance

Notes: Electric charging units, or EVSE, are counted once for each outlet available, even when multiple outlets are present at a single location. Includes legacy chargers, but does not include residential electric charging infrastructure.

Financing: Investment in US electric vehicle companies ($m)

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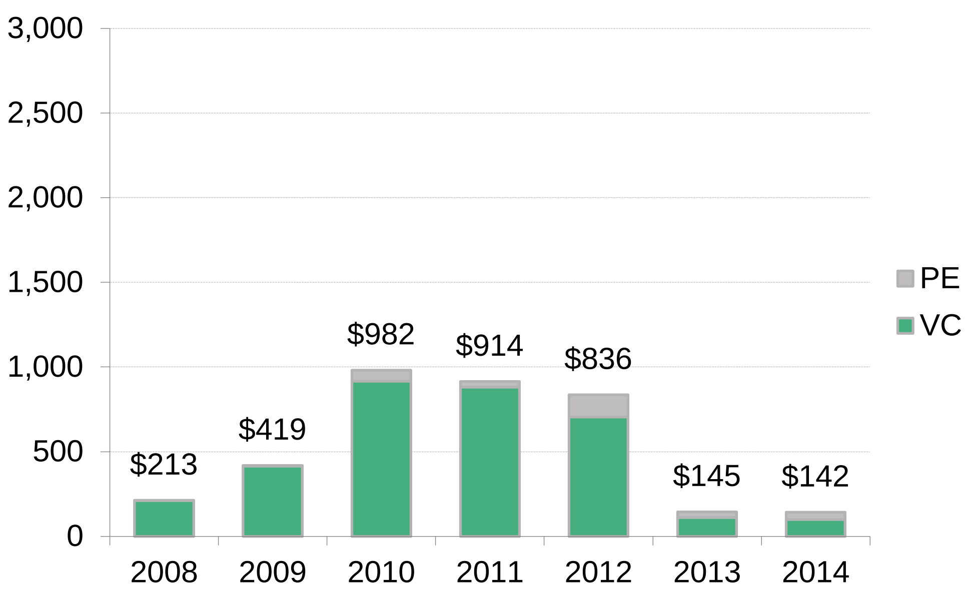
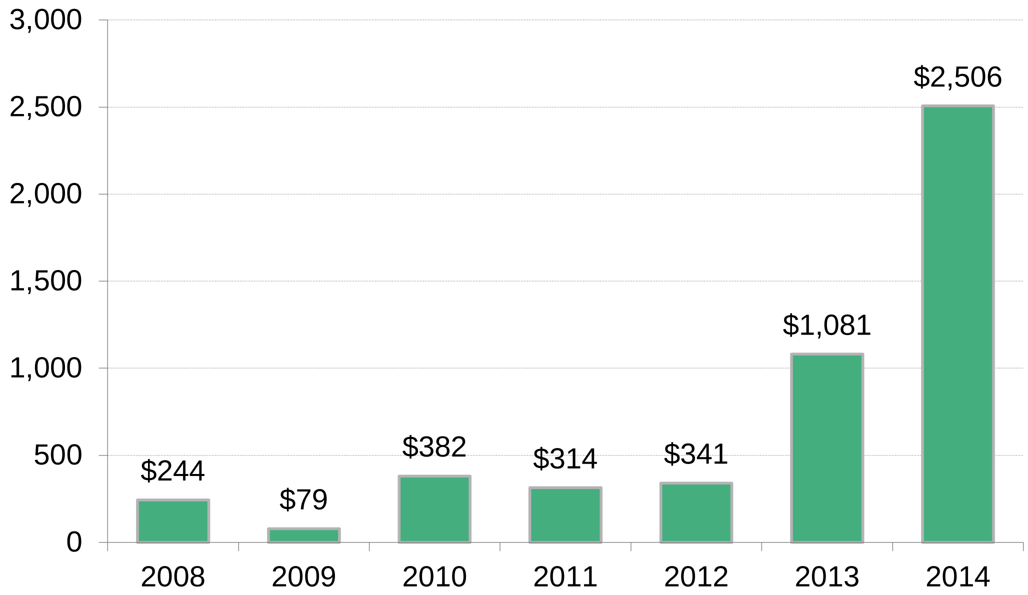
Venture capital / private equity



Public markets

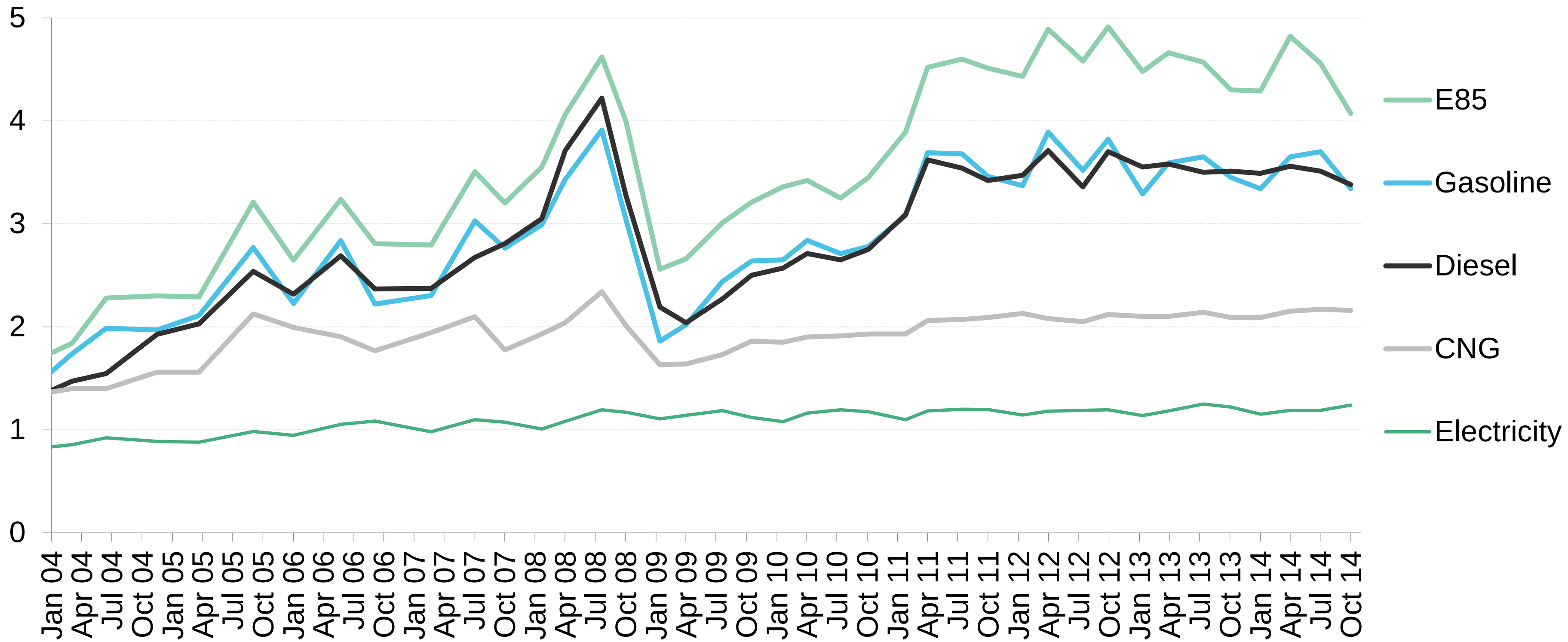


- Venture capital and private equity firms invested over $3.6bn of private capital in the US electrified transport sector since 2008. Public markets investment stands at $4.9bn over the same period
- Notable deals in 2014 included:
  - Tesla offering $2bn in convertible bonds to fund the construction of a 35GWh ‘Gigafactory’ (to make lithium ion batteries) in Nevada
  - Smith Electric Vehicles raising $42m in private equity expansion capital from Sinopoly Battery Limited

Source: Bloomberg New Energy Finance

Notes: Includes battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV), hybrid electric vehicles (HEV), fuel cell EVs (FCEV), and related infrastructure companies

Economics: US average monthly retail fuel prices ($/GGE)

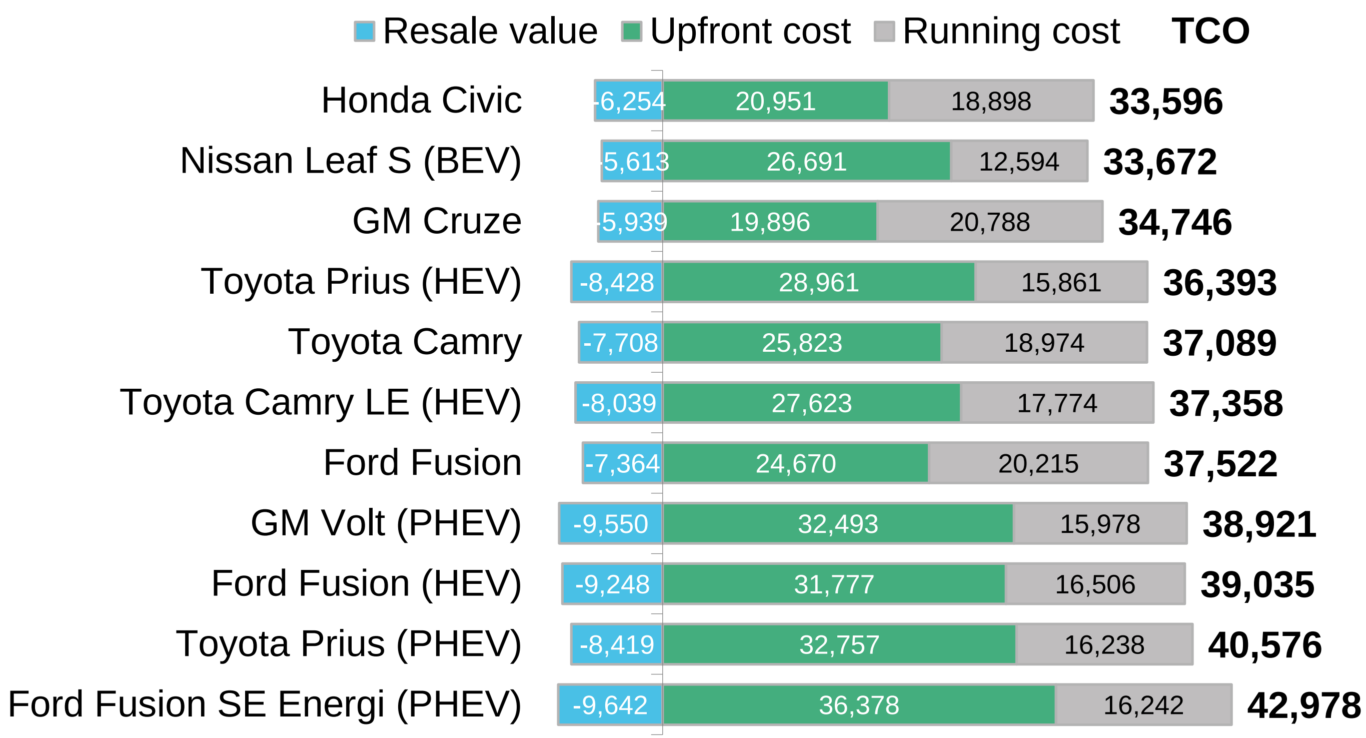


- Compared on a $/GGE basis, electricity has been the most competitive transport fuel in the US or over a decade – though vehicle economics is not just about fuel price but also about upfront cost (see next slide)
- US regular gasoline prices, including taxes, started to fall in the second half of the year, on the back of plummeting oil prices

Source: Alternative Fuels Data Center

Notes: Fuel prices per gasoline-gallon equivalents (GGEs). Electricity prices are reduced by a factor of 3.4 because electric motors are 3.4 times more efficient than internal combustion engines. Latest available data at time of publication was through October 2014; more updated data will undoubtedly show gasoline prices falling markedly after October.

Economics: US total cost of ownership (subsidized) for select vehicle models, 2014 ($ per vehicle)



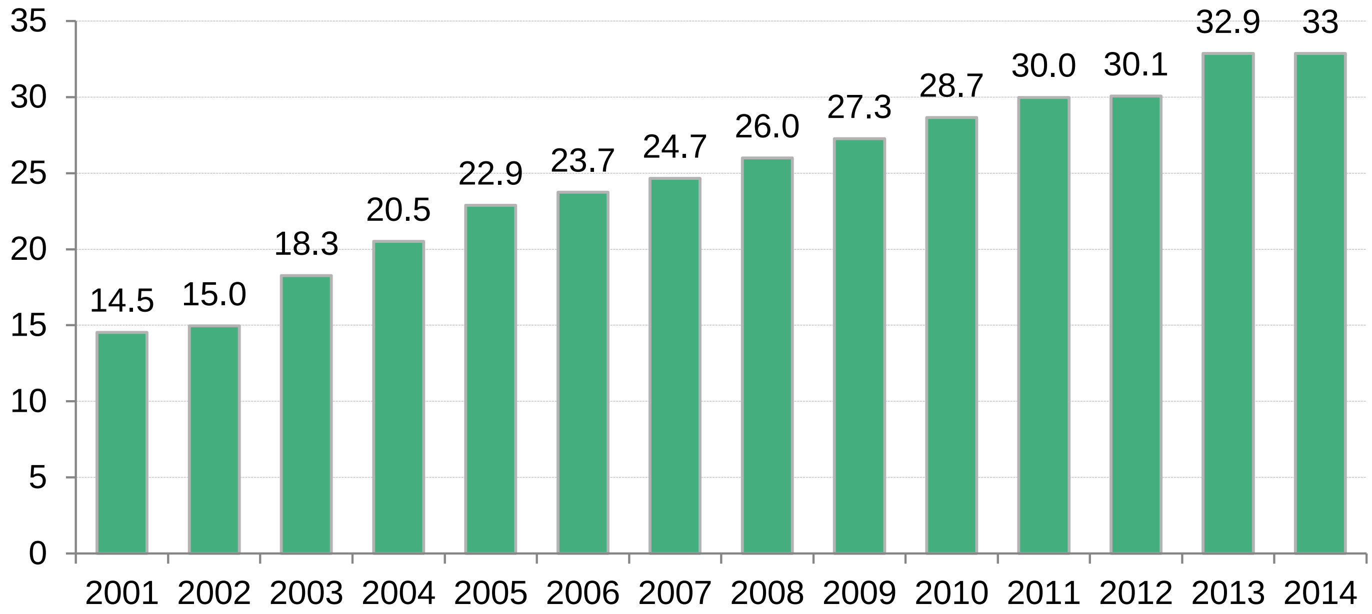
- Federal purchase incentives enable BEVs to compete with gasoline-powered vehicles; HEVs are competitive without support
  - Running costs for EVs are very cheap
  - However, upfront prices are higher than for conventional vehicles (even with subsidies) and resale values are lower
- Electric vehicles in the US receive federal incentives in the form of tax credits worth between $2,500 to $7,500 per vehicle (the range is based on the kWh of battery capacity)

Source: Bloomberg New Energy Finance

Notes: TCO calculations assume: 10,100 miles travelled per year, 5% discount rate, 5-year use (the assumptions differ slightly from previous TCO calculations by Bloomberg New Energy Finance that examined a 12-year vehicle life). Upfront costs shown in this chart account for federal incentive (ie, this is the upfront cost net of the applicable tax credit). BEV stands for battery electric vehicles; PHEV stands for plug-in hybrid electric vehicles; HEV stands for hybrid electric vehicles.

Table of contents

Deployment: US natural gas demand from natural gas vehicles (Bcf)



- Natural gas use in vehicles probably stayed flat from 2013 to 2014, at around 33Bcf
- Compressed natural gas (CNG) remains more widely used than liquefied natural gas (LNG)
- The number of new CNG and LNG stations is also relatively flat from 2013 levels:
  - 170 new CNG fuelling stations in 2013, compared to 179 new stations as of mid Q4 2014
  - 26 new LNG fuelling stations in 2013; compared to 19 new stations as of mid Q4 2014

Source: EIA

Notes: Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through July 2014). Data excludes gas consumed in the operation of pipelines.

Financing: Capex investments by US-based Clean Energy Fuels Corp., mostly for new natural gas fuelling stations ($m)

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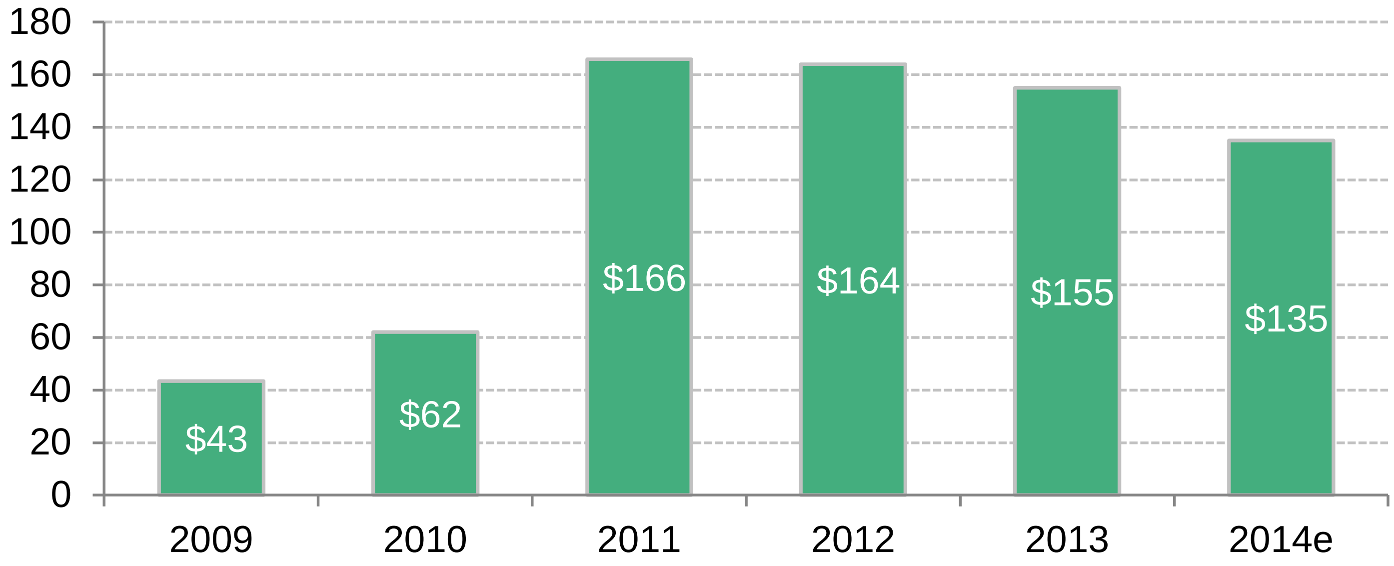
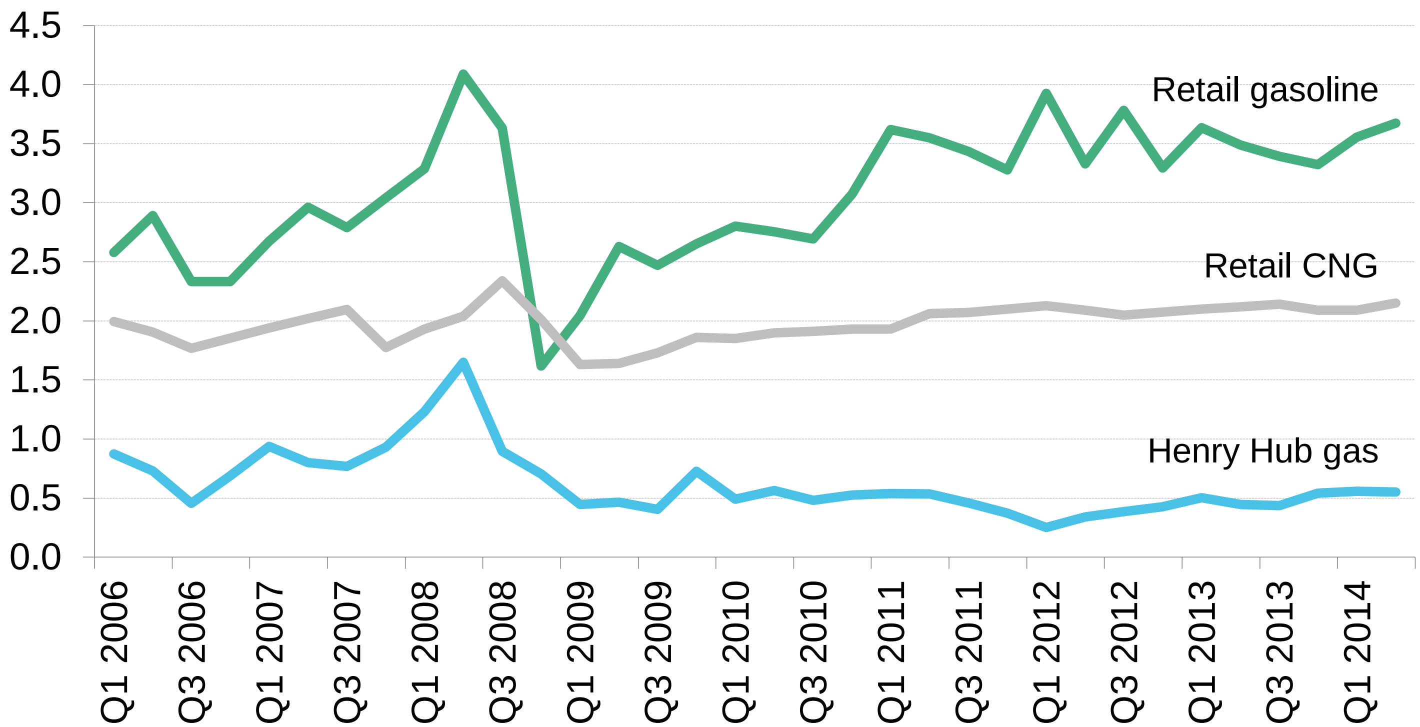


- Clean Energy Fuels is a leading natural gas fuel supplier, owning about 15% of US retail and private CNG and LNG fuelling stations. The company's spending plans are used here as a proxy for financing flows into the natural gas vehicle sector
- The company's spending on asset financing, most of which is poured into building fuelling infrastructure, has declined since 2012
- The biggest market for LNG fuel – heavy-duty trucks – has been slow to evolve, likely contributing to the company's reduced expenditures

Source: Clean Energy Fuels 2013 annual report

Notes: Figures from 2009-13 reflect 'net cash used in investing activities' as per company's cash flow statement. The amount for 2014 is based on company plans ("Our business plan calls for approximately $135 million in capital expenditures in 2014").

Economics: US CNG prices compared with gasoline and Henry Hub natural gas prices ($/GGE)



- Natural gas engines function almost identically to gasoline/diesel engines, but new fuelling systems are needed (a fuel-price discount is therefore needed to incentivize consumers to convert)
- Retail CNG has remained discounted to retail gasoline over 2014, and is less volatile
- Retail LNG is not shown, as too few fuelling stations exist to provide average prices; however, it generally sells at a discount to diesel, around $2.96/GGE in 2014

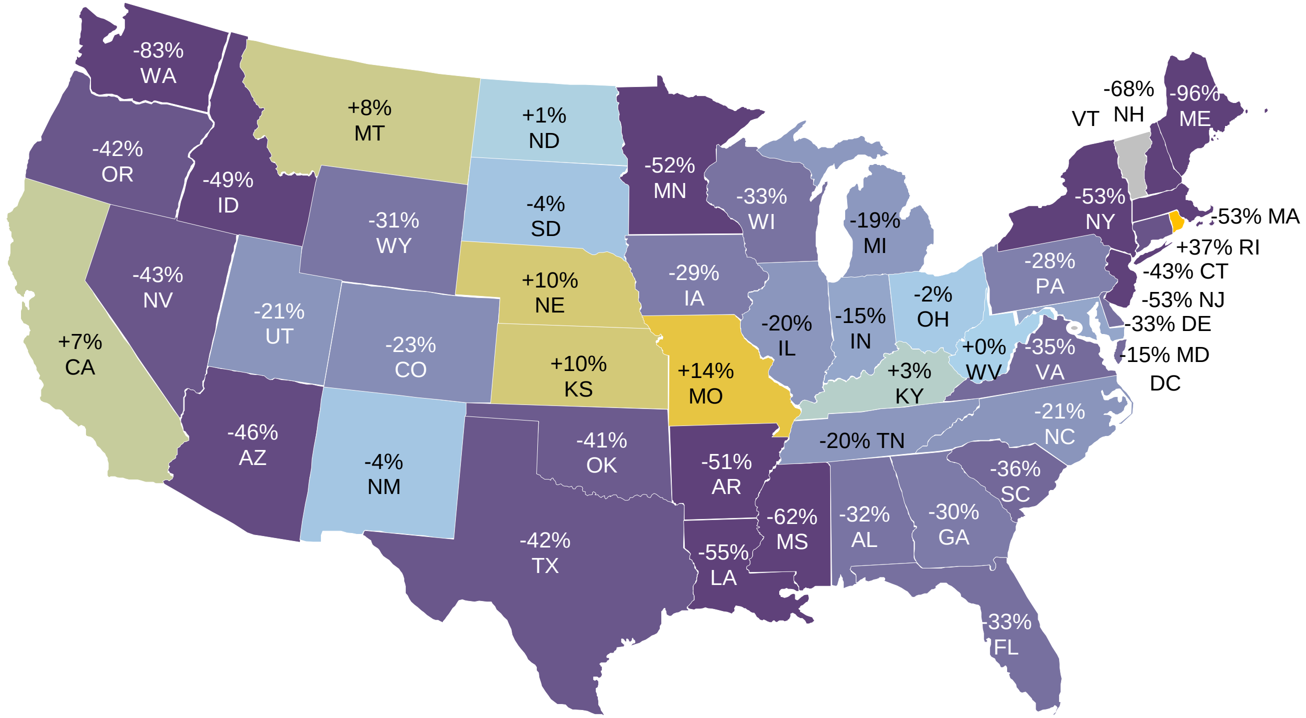
Source: Bloomberg New Energy Finance, Alternative Fuels Data Center

Table of contents

EPA Clean Power Plan (1 of 4): Overview

Bloomberg
NEW ENERGY FINANCE

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

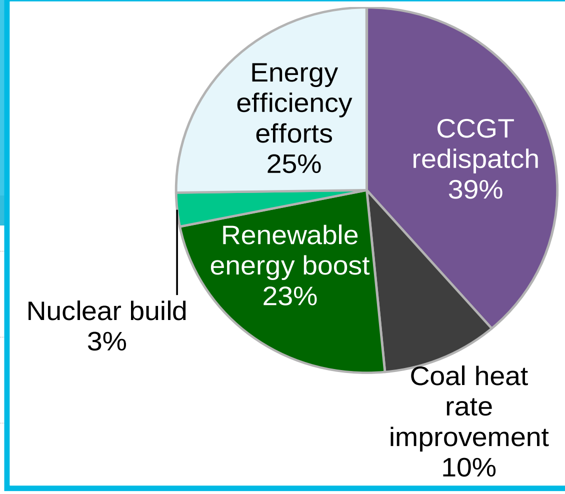


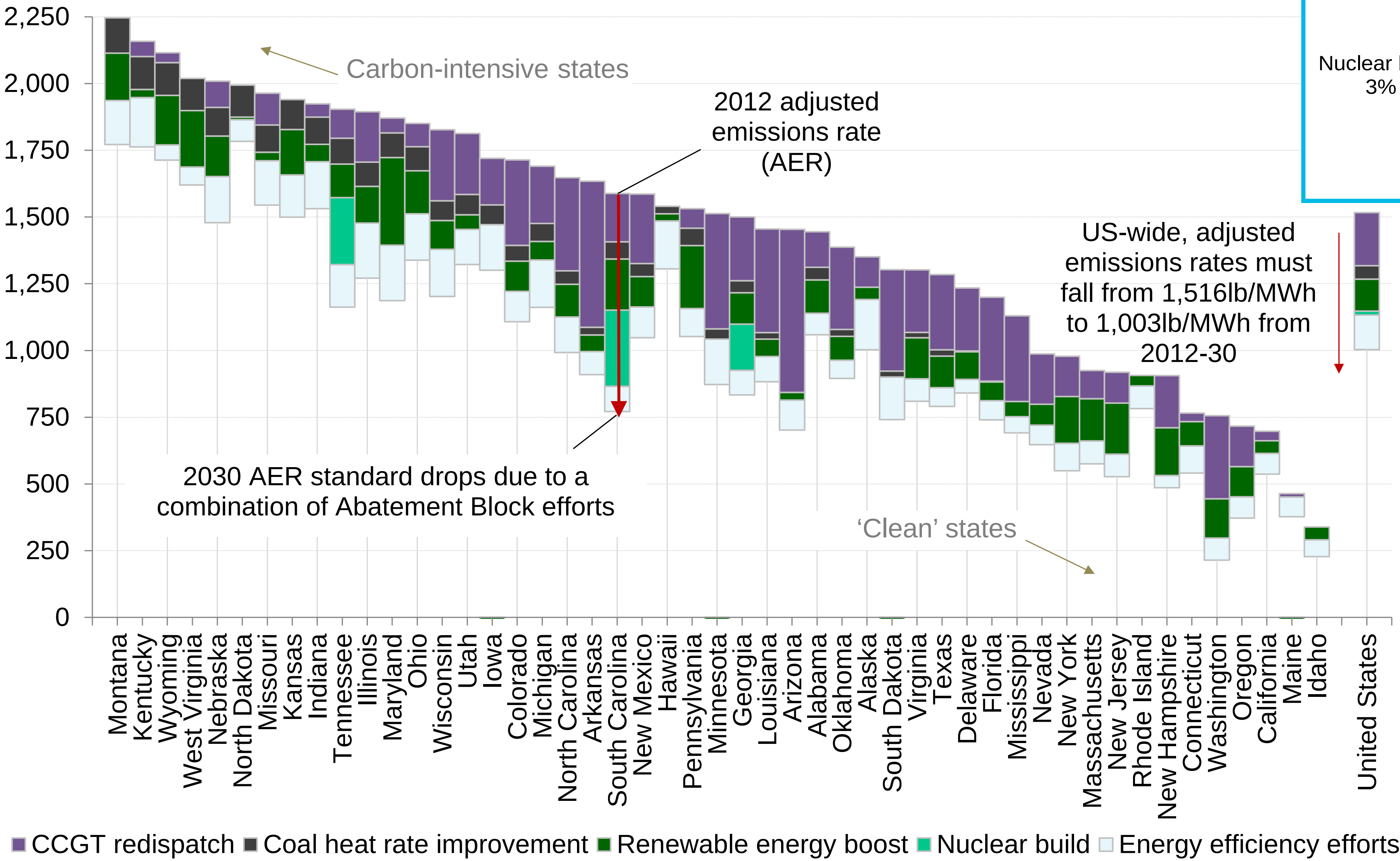
- The EPA announced the Clean Power Plan on June 2014; the agency is currently reviewing comments submitted in response to the Plan, and is due to finalize the plan by summer 2015
- It calls on states to implement their own programs (or band with other states) for reducing carbon emissions intensity 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
- The following slides present analysis on state-specific potential compliance paths; power generation forecasts; and energy efficiency implications under the Plan (a detailed description of how the Plan would work is beyond the scope of this report)

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.

EPA Clean Power Plan (2 of 4): How EPA crafted(*) the 2012-2030 reduction targets for adjusted emission rates (AERs**) for each state

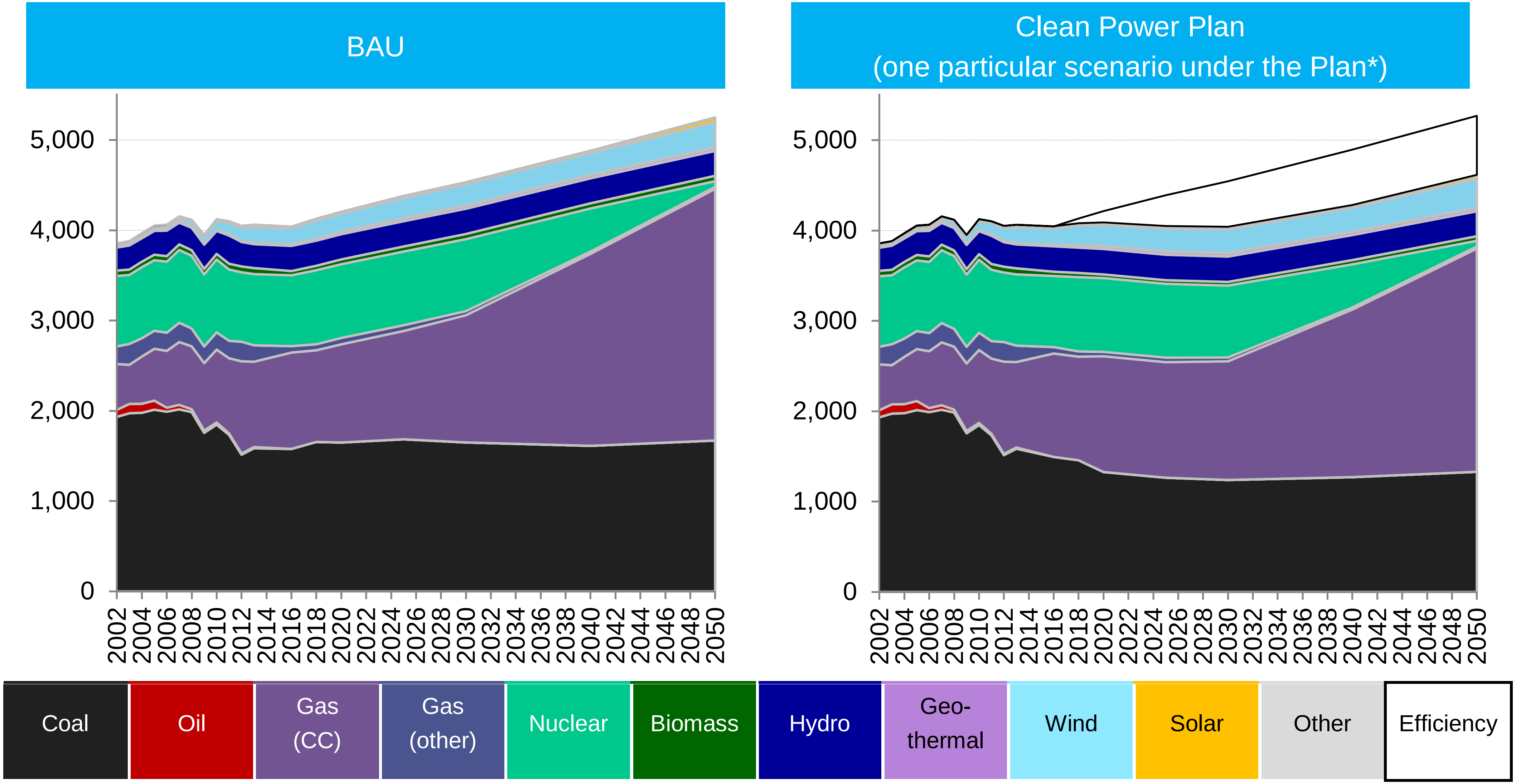




Source: EPA Clean Power Plan, EPA eGRID data, Bloomberg New Energy Finance

Note: CCGT is combined cycle gas turbine. (*) In coming up with these AER reduction targets, the EPA devised a methodology for each abatement block and applied that to each state to come up with one potential path for compliance; this analysis shown here reflects that compliance path. However, states would be able to choose other paths for compliance, so long as the reduction targets are achieved. (**) The Clean Power Plan is based on reductions of emissions intensity ratio (units of greenhouse gas emissions per unit of power generated). However, due to regulatory scope limitations and other factors, the particular metric that the Clean Power Plan targets is an adjusted version of that ratio. Explanation of that ratio is beyond the scope of this report.

 US power generation mix by technology under two scenarios according to the EPA (TWh)

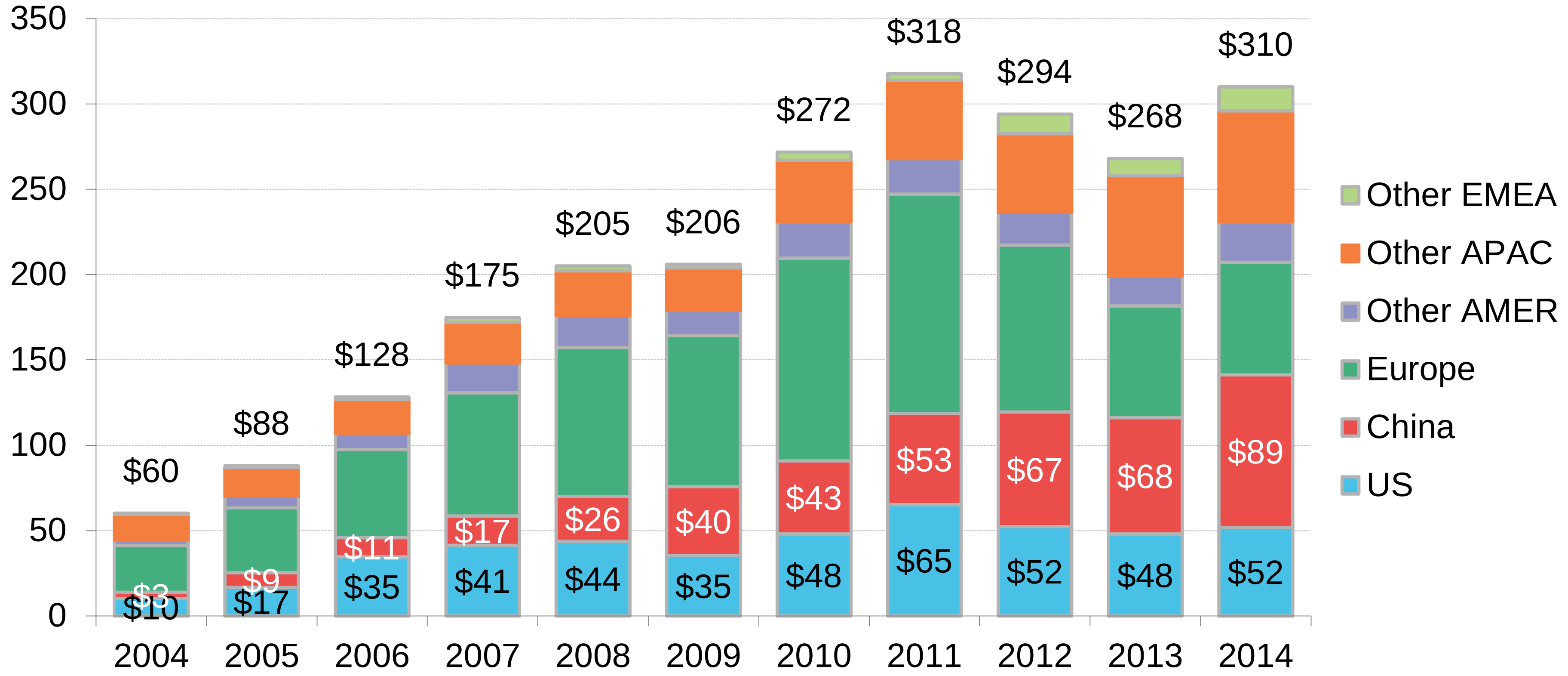


Source: EIA historical data, results from the EPA-licensed Integrated Planning Model (IPM), Bloomberg New Energy Finance

Note: BAU is business-as-usual (ie, forecasts assuming no new policy). Gas CC is combined cycle gas turbines. (*) The scenario shown here for the Clean Power Plan is one of various scenarios modelled by the EPA that would achieve Clean Power Plan compliance; this scenario corresponds to the one referred to as 'Option 1 – State'.

Table of contents

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
- Among the largest drivers of these investment figures are the categories of asset financing for wind and financing for small distributed capacity – essentially, rooftop solar. In 2014, the US was the world's second-largest market for new wind installations, behind China, and third-largest for solar, behind China and Japan

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 (1 of 2) – average electricity rates for the industrial sector by country (USD/MWh)

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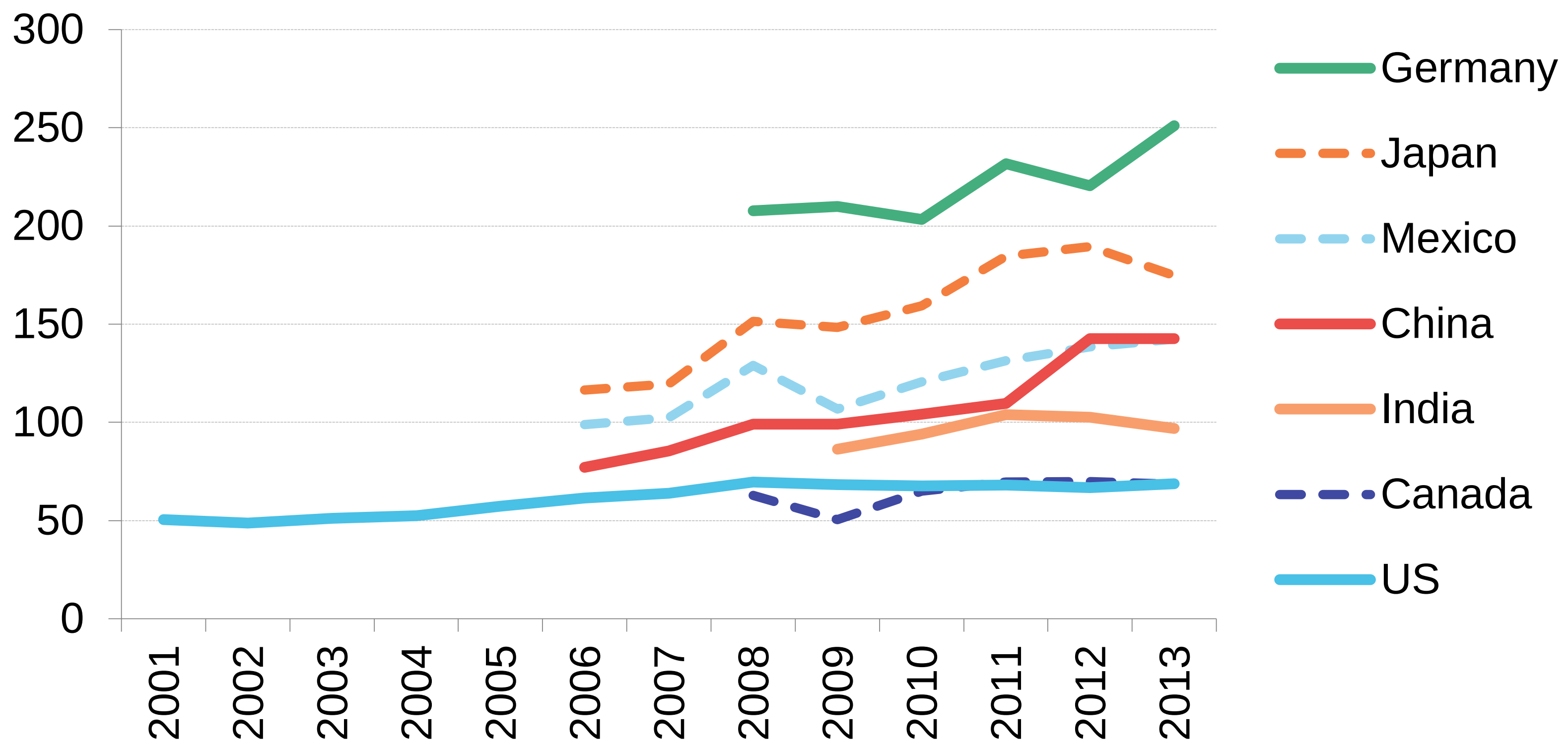

- US, and North America broadly, has among the lowest costs of electricity in the world for industrial customers (6.87¢/kWh for the US industrial sector in 2013, according to the EIA)
- Regions in the US with especially low costs of power include the Midwest, Southwest, and Northwest

Source: Bloomberg New Energy Finance, government sources (EIA for the US)

Notes: Prices are averages (and in most cases, weighted averages) across all regions within the country.

Global context: Energy prices (2 of 2) – production costs of gas-intensive industries by region and feedstock ($/t)

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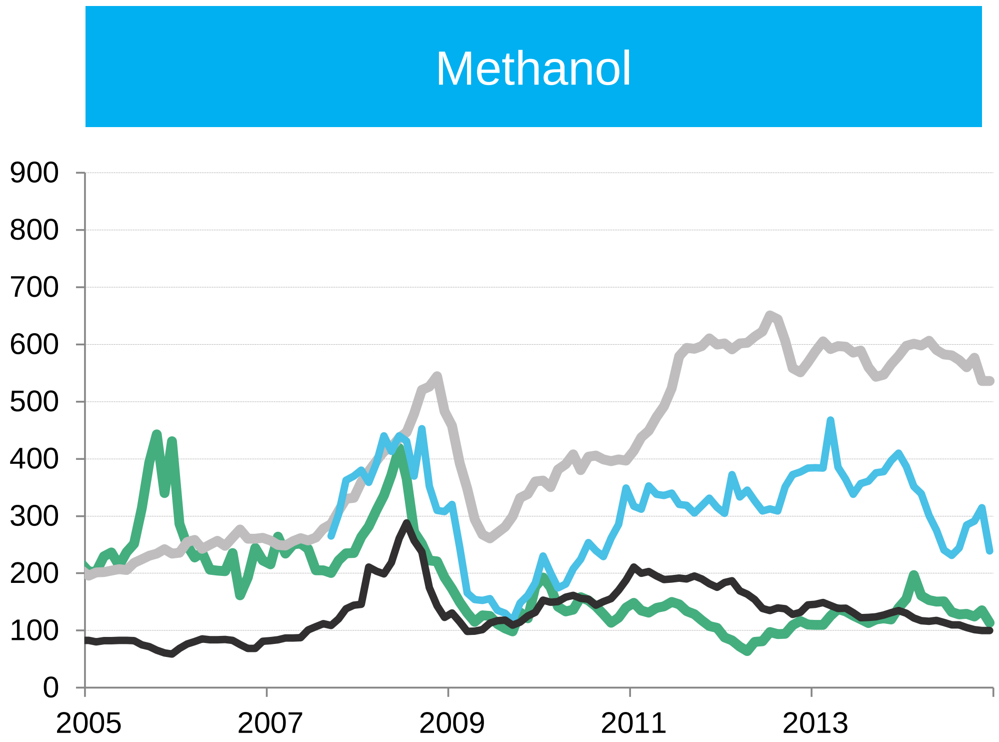

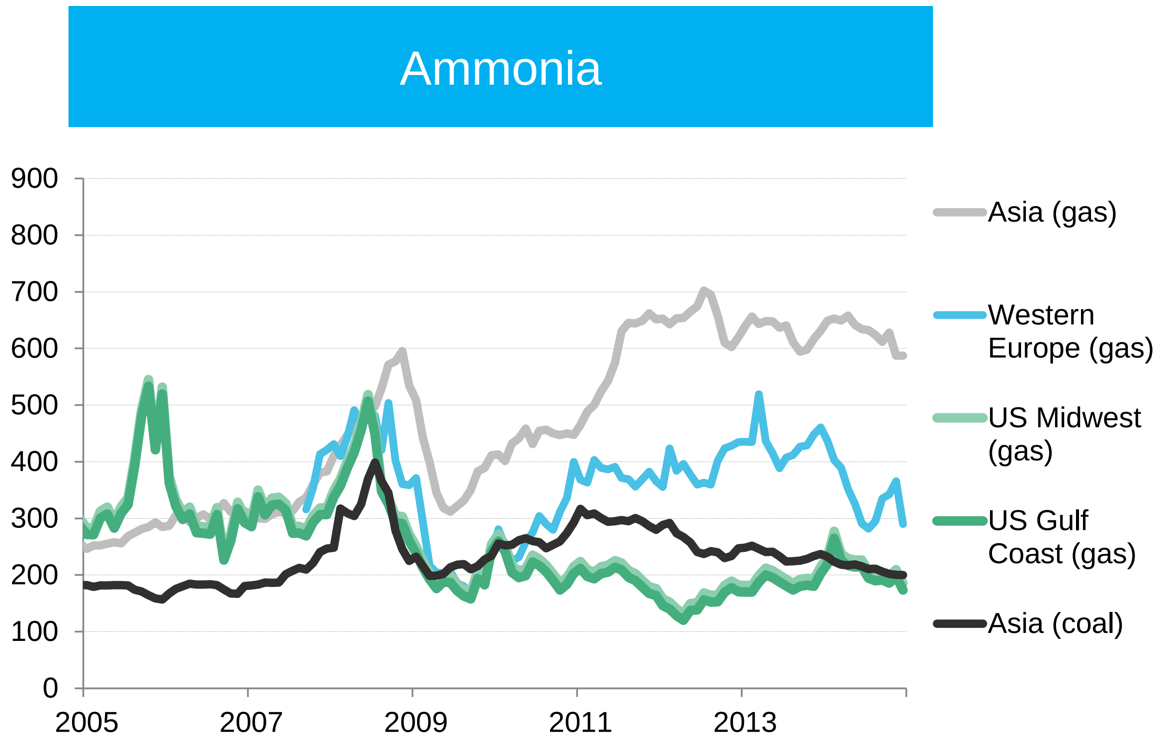

- Low natural gas prices have given a comparative advantage in operating costs to US chemical sector operations, such as production of methanol and ammonia
- In 2014, gas-intense industries brought online 10 new projects that make use of low-cost gas (and proposed another 32 projects)
- The only region-feedstock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

Source: Bloomberg New Energy Finance

Global context: Climate negotiations – comparative emissions and GDP by region

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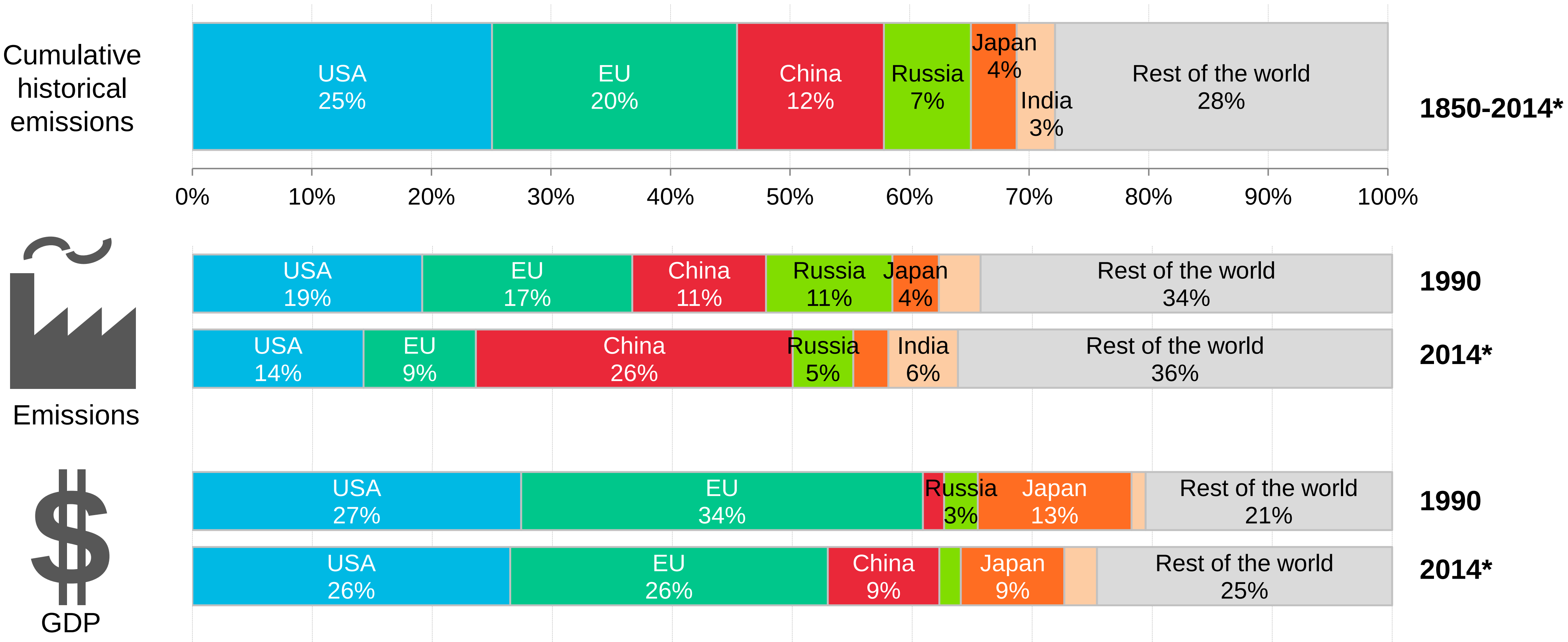

- Policy actions taken by the US in 2014 (including the EPA Clean Power Plan proposal and the US-China climate pact) have set the stage for a potentially momentous global climate summit at Paris in December 2015
- In the first quarter of 2015, other nations are expected to present their long-term commitments to addressing climate change. Hopes for some kind of comprehensive deal are higher than they have been since Copenhagen in 2009

Source: Bloomberg New Energy Finance, World Bank, IMF, WRI

Notes: GDP measured in constant 2005 USD, emissions are total CO2e. Data used in BNEF estimates have been sourced from the World Economic Outlook Database (IMF), World Bank Data Catalogue, CAIT 2.0 (WRI). (*) indicates estimate.

Global context: US-related causes and implications of falling oil prices (1 of 2) – demand

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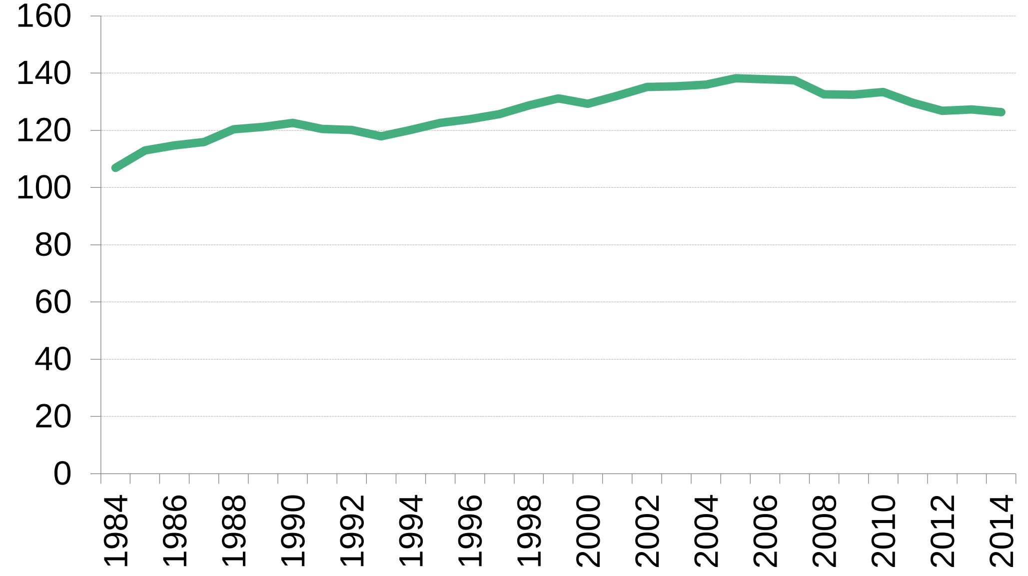
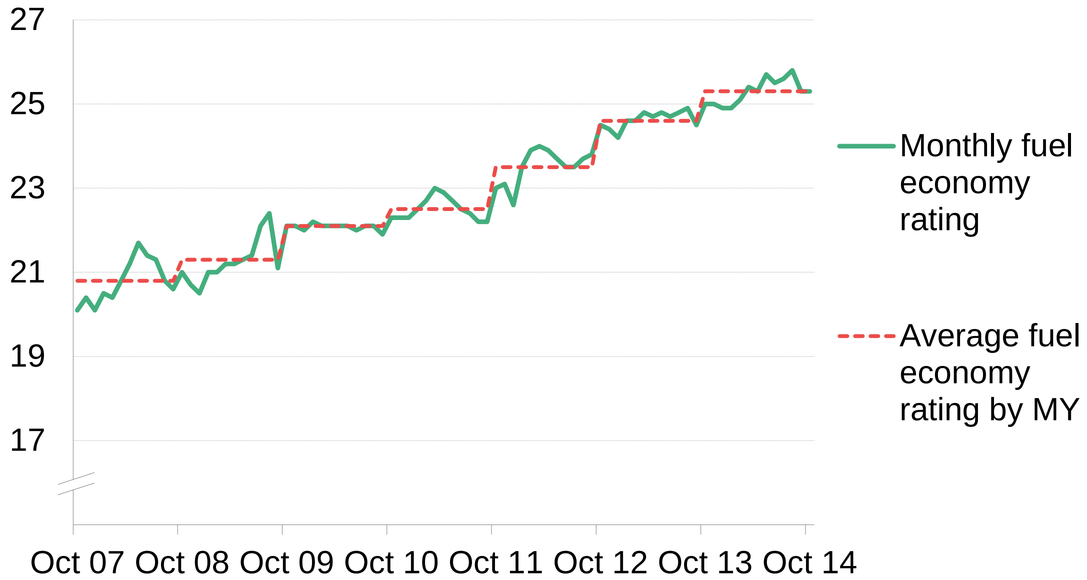
US gasoline consumption (bn gallons per year)



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. CAFE regulations have already fostered a significant increase in the sales-weighted average fuel economy of newly purchased vehicles. These regulations demand a further doubling in fuel economy by 2025
- In addition to improved efficiency, 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

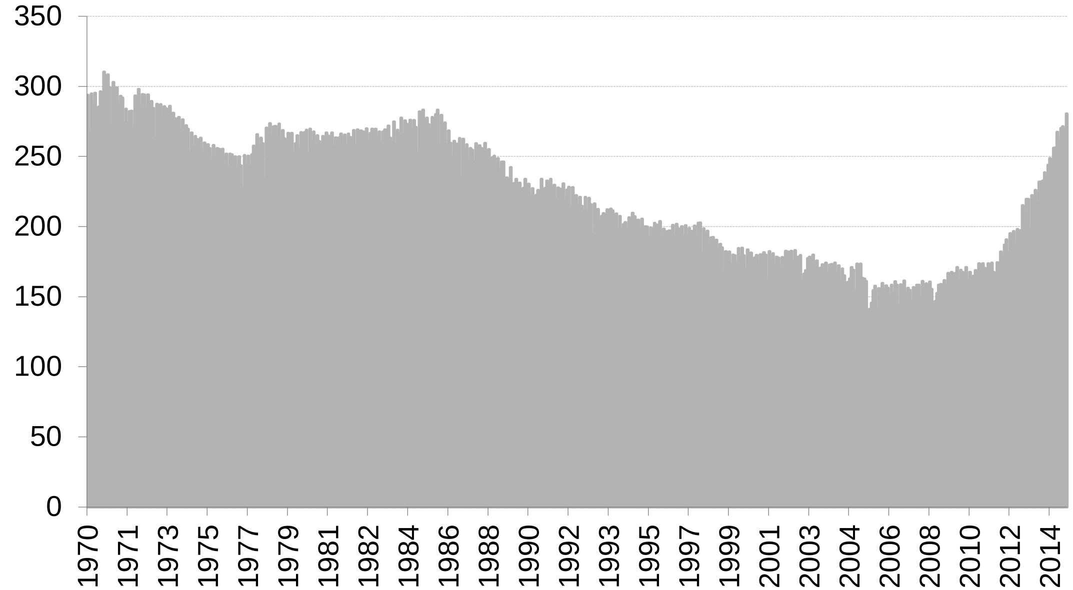
Notes: Analysis is based on daily averages of 'total gasoline all sales / deliveries by prime supplier'. Values for 2014 are projected, accounting for seasonality, based on latest monthly values from EIA (data available through October 2014).

Source: UMTRI, Bloomberg New Energy Finance

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

Global context: US-related causes and implications of falling oil prices (2 of 2) – supply

US monthly crude oil production (million barrels per month)



- The US is producing its own supply of crude oil at a level not seen since the 1980s; production has zoomed from 5.1m barrels per day on average in 2007 to 9.0m barrels per day in October 2014, a 41% increase
- Supply (this slide) and demand (previous slide) factors in the US have been among the drivers behind falling oil prices, which collapsed below $50 per barrel as of mid-January 2015.
- The price drop is especially noteworthy given the strong US economy, which might otherwise have contributed to a price spike
- Lower oil prices are placing repressive foreign regimes – such as Russia, Venezuela, and Iran – under substantial pressure
- There is no direct link between oil prices and most sustainable energy technologies in the US. Most of those technologies play a role in the power sector, whereas oil is mostly used for transportation and only rarely for power in the US. Nevertheless, there may be 'second-order' impacts from the oil price turmoil. The drop in cost of oil could serve as an indirect stimulus into the US economy, which could propel even more use of natural gas and renewable energy

Source: EIA

Notes: Data through October 2014.

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