

2015 FACTBOOK

FEBRUARY 2015

Sustainable Energy in America

EXECUTIVE SUMMARY



Bloomberg
NEW ENERGY FINANCE

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

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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.

2015 FACTBOOK KEY FINDINGS

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 renewable projects.
- 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.

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.
- *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.
- *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.

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.

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