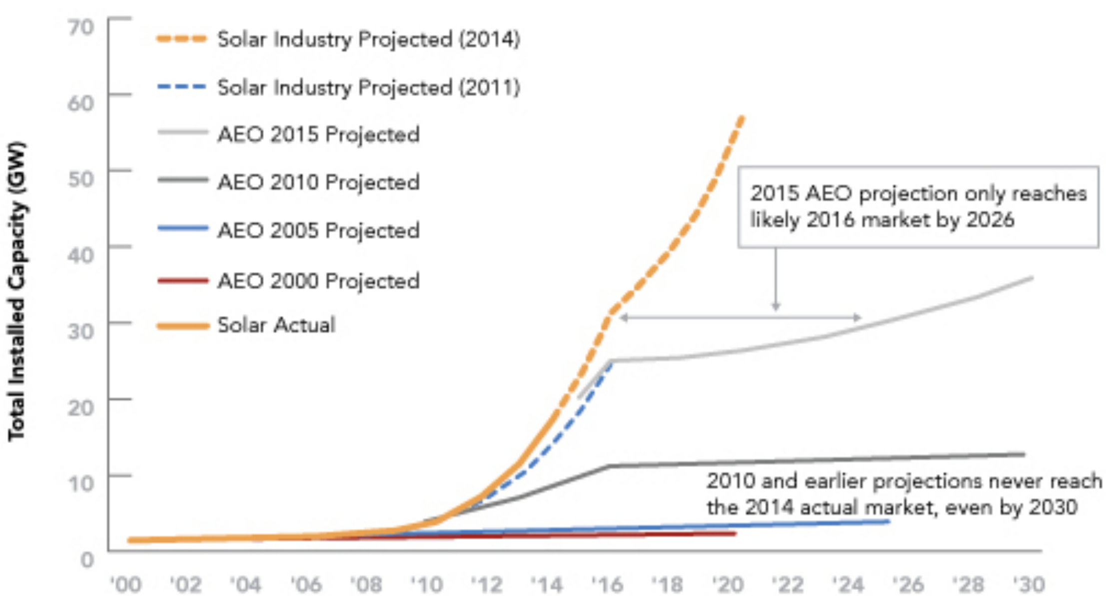
RENEWABLE ENERGY AND ENERGY EFFICIENCY ARE COMPETITIVE IN U.S. MARKETS

Questions have been raised about whether renewable energy (RE) and energy efficiency (EE) resources can provide substantial emission reductions at reasonable cost under EPA's proposed Clean Power Plan (CPP). These concerns reflect fundamental misperceptions about the performance and cost of today's renewable energy and energy efficiency technologies, rooted in outdated information and perpetuated by inaccurate official market projections. This paper shows that RE and EE are competitive resources in today's marketplace that will not only be cost-effective mechanisms for CPP compliance but should also be expected to grow strictly on the basis of competitiveness.

EIA Forecasts Consistently Underestimate RE and EE Compared to Market Realities

Official U.S. government energy forecasts are widely used by policymakers and other stakeholders for analyzing energy supply and demand for long-term planning and policy development purposes. But the RE projections bear little resemblance to market realities. The U.S. Energy Information Administration's *Annual Energy Outlook* (AEO), the primary source of information on U.S. power market projections, consistently and significantly underestimates RE growth. For example, the installed generating capacity of solar power is likely to double between 2014 and 2016, based on market analyses that take into account actual projects in the pipeline. Yet in the AEO 2015 forecast, solar capacity does not double until 2026. Similarly, U.S. wind installations have averaged about 6.5 GW per year from 2007 to 2014, but the 2015 AEO projects a total of 6.5 GW of new wind capacity will be added between 2017 and 2030, less than one-tenth the average rate in recent years.

Figure A. Actual vs. Projected U.S. Installed Solar Power Capacity



Sources: *Solar Actual* data are from Interstate Renewable Energy Council, and SEIA/Greentech Media, and include PV and CSP. *Solar Industry Projected* are SEIA/GTM projections from 2011 and 2015 Solar Market Insight (SMI) Reports, and include PV and CSP. Solar actual and industry data were converted from DC to AC using a factor of 0.77 for utility-scale and 0.87 for residential and commercial. *AEO Projected* data are for the EIA Reference Case.

This underestimation of RE growth is nothing new. AEO 2010 projected that the solar market would grow from about 2.5 GW in 2010 to about 13 GW in 2030, yet the solar market surpassed this level in 2014. Similarly, AEO 2010 projected that the wind market would grow from about 40 GW in 2010 to 69 GW by 2030, but with 8-10 GW of new wind power expected in 2015, installed capacity will reach about 75 GW by year's end. As these examples show, AEO forecasts are consistently off by a wide margin, always underestimating – and never overestimating – future deployment of renewables. Such persistent inaccuracy is indicative of a more fundamental problem in understanding the dynamics of growth for these technologies, as well as constraints on how the EIA is required to conduct its modeling.

Comparing market realities to projections for energy efficiency is more challenging. To quantify EE, you need to measure something that was avoided, namely the energy that would have been used absent the energy efficiency measures. Still, official projections are inconsistent with trends in EE implementation and the impact of efficiency improvements on electricity consumption. The trend in overall electric demand growth has been consistently downward in recent years, in parallel with the rise in EE spending, which more than tripled from 2005 to 2013. Retail electricity sales have also been flat to slightly declining since 2010, even as the economic recovery gained momentum and the U.S. economy grew about 9% in real terms from 2010 to 2014. Yet the AEO 2015 projection shows future demand growth steady at a little less than 1% per year out to 2040, apparently discounting the potential, or likelihood, that EE improvement – through investment and innovation – would continue to reduce demand growth in the coming years.

Renewable Energy is Increasingly Cost Competitive with Other Power Sources

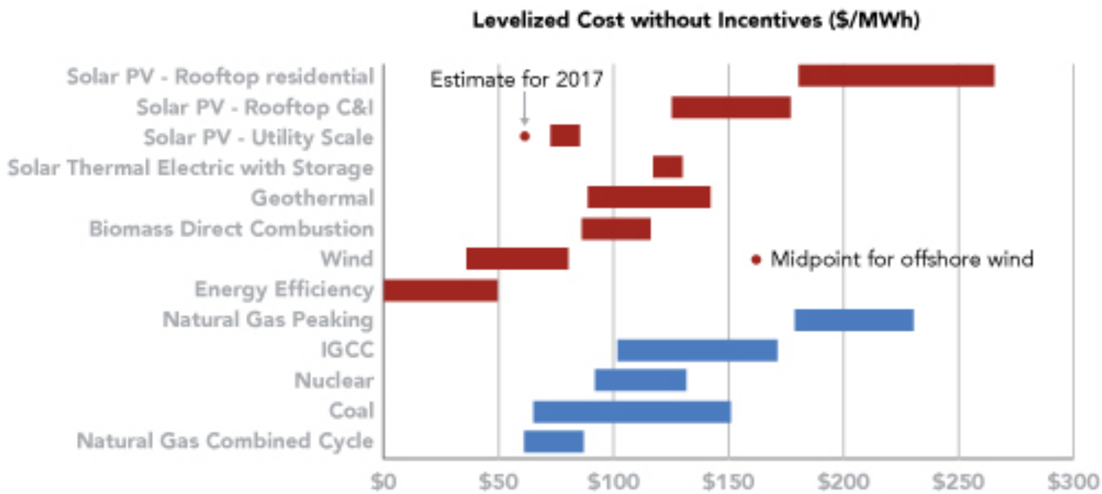
There is every reason to believe that renewable energy will continue to grow in the United States based on economic competitiveness. The most basic indicator of power technology competitiveness is the levelized cost of energy (LCOE), which measures the average cost of electricity over the life of a project, including the costs of upfront capital, operations and maintenance, fuel, and financing. Since 2007, Lazard, a financial advisory and asset management firm, has tracked the LCOE of power technologies using a consistent methodology. Lazard's annual analyses show that from 2009 to 2014, the LCOE for utility-scale wind and solar power has declined by 58% and 78%, respectively, such that RE technologies are increasingly competitive with other power sources.

Market data in the form of power purchase agreement (PPA) prices confirm these LCOE estimates, with wind projects offering competitive PPA prices relative to wholesale prices for most of the past decade. In 2013, the average wind power PPA price was $24/MWh. Similarly, solar PPAs, which provide utilities with peaking power, have declined from $125-$150/MWh in 2008 to current levels of $50-$75/MWh, driven in part by a 40% drop in the installed cost of utility-scale PV systems over five years, from $\$5/W_{DC}$ in 2008 to $\$3/W_{DC}$ in 2013. Today, the best-in-class utility-scale solar projects are being installed for about $\$1.50/W_{DC}$, which is about half the cost assumed by the EIA in its AEO 2015 for a 2016 year-in-service date. Hydropower, geothermal and biomass technologies are also competitive in some parts of the country. Although their markets are smaller than solar or wind, capacity continues to be added at a rate of several hundred megawatts per year among them.

Utility RE purchases that were once driven primarily by state policies (e.g., renewable portfolio standards) are now increasingly made based on economics. In Texas, Austin Energy signed a 20-year contract in 2014 for 150 MW of solar energy at a price estimated at less than $50/MWh. In 2013, American Electric Power (AEP) bought three times more wind power in Oklahoma than it originally intended because of its value to ratepayers. None of this is lost on corporate America, which is directly purchasing a growing share of RE. In 2014, more than 23% of wind power contracts were with large corporate or non-utility groups.

The market for residential and commercial building PV systems, usually installed on rooftops, is also expanding in response to declining costs, rising retail electricity rates, new financing options, and increased customer demand for choice and control over energy use and costs. Prices for residential and small commercial PV systems dropped by almost 60% between 2002 and 2013, with most of that occurring since 2009. As the solar supply chain achieves scale (about 2 GW of distributed PV was installed in the United States in 2014), the industry is driving down so-called "soft costs" such as permitting, customer acquisition, and installation.

Figure B: Levelized Cost of Energy (LCOE), All Sources, 2014



Source: *Lazard's Levelized Cost of Energy Analysis—Version 8.0.* "C&I" = Commercial & Industrial; "IGCC" = Integrated Gasification Combined Cycle. High end of range for *IGCC* and *Coal* includes 90% carbon capture and compression. See original report for additional assumptions.

Energy Efficiency Costs Less than Electric Supply

This report shows that EE is even more competitive. Indeed, in most cases, it is the least-cost option for meeting electricity needs. As a result, EE investment should continue to grow and have a downward impact on electricity load growth beyond official projections, based on its economic value. There are two main ways in which EE is delivered today, each representing about half of the U.S. market: utility-run programs and performance-based contracting offered by Energy Service Companies (ESCOs). Both markets have exhibited strong growth over the last decade, with the ESCO market driven principally based on the value (i.e., cost reduction) of saved energy in the marketplace. ESCOs, which typically serve institutional, government, and larger commercial/industrial customers, use a financing model where energy savings pay for EE investments over time – by definition, therefore, these projects must be cost effective if they are to generate the necessary cash flow to make the project financially viable. The ESCO market grew from about $2.5 billion in 2005 to about $6 billion in 2013, and is projected to reach $11-$15 billion by 2020.

At the same time, utility-run EE programs continue to demonstrate cost effectiveness and value to utility ratepayers. Lawrence Berkeley National Laboratory estimates the U.S. average "total cost of saved energy" for customer-funded utility EE programs at $46/MWh, based on an analysis of programs in 20 states over a five-year period. This is less than half the average cost of retail power in the United States and lower than the levelized cost of new supply options, with the possible exception of wind power in some markets. The total cost of saved energy varies by state, ranging from a low of $29/MWh in New Mexico to $79/MWh in Massachusetts, but is consistently less expensive than retail electric supply in the local market.

Utility programs effectively split the cost of EE between utilities and program participants, providing economic benefits for both. The utility cost of providing EE programs is significantly less than the cost of acquiring new generation, whereas participants see immediate reductions in their monthly utility bills. On a system level, since the total cost of EE is below the LCOE of new supply options, its implementation also lowers the total cost of providing electricity to all customers, thereby benefitting EE program participants and non-participants alike. Over time, EE investments can avoid or defer other investments in utility infrastructure, thereby increasing the net benefits.

The basic framework under which EE is delivered via utility-sponsored programs ensures that only cost-effective EE is pursued: utility-run EE programs cannot be implemented unless they have a benefit-to-cost ratio greater than one. Simply put, if customer-funded utility programs are not cost-effective, state utility commissions will not authorize their funding. States that are leading on EE are consistently demonstrating the ability to achieve 2% or more annual EE savings while still meeting cost-effectiveness criteria.

RE and EE Will Play an Increasing Role Based on Economic Value

The electric power industry has entered a period of fundamental change. Underpinning this change is the emergence of RE and EE as competitive options for meeting system and customer needs at scale. Along with other advanced energy technologies, including flexible and efficient natural gas generation and increasingly intelligent hardware and software for the grid, RE and EE are transforming the way electricity is generated and used. Recent cost analyses and market data show that this transformation is well under way and that RE and EE technologies are cost competitive and offer compelling value propositions to a range of stakeholders.

RE already represents roughly 50% of all new capacity additions in the United States, and is likely to exceed this figure for 2015. At the same time, EE markets have more than tripled in size since 2005. Continuous technological improvements coupled with product and service innovation create ongoing opportunities to increase deployment and reduce costs, even while many states have barely scratched the surface with respect to EE and RE potential. We expect RE and EE technologies to be an important part of grid modernization efforts as well. RE and EE will become increasingly important tools for mitigating rate increases associated with replacing older "poles and wires," or from investments in resilience. Thus there is every reason to believe that RE and EE will continue to play an increasing role in our changing electric power system strictly on the basis of the economic value they provide. In addition, as states consider ways to comply with EPA's Clean Power Plan between now and 2030, RE and EE measures will be competitive with other options and available to provide substantial emission reduction opportunities.[1]

[1] In May 2015, the EIA released it first analysis of the CPP: Analysis of the Impacts of the Clean Power Plan. Their main conclusions support the findings in this paper, that RE and EE are the main options for achieving compliance, although EE still appears underrepresented by the EIA relative to other options. Their analysis also shows very modest electricity price impacts of 3%-4% in 2030, relative to the no CPP scenario.