# The EPA's Clean Power Plan Could Save Up to $9 Billion in 2030

## Up-to-Date Cost Data For Clean Energy Resources Mean Lower Costs, Greater Potential for Carbon Reductions

### INTRODUCTION

The U.S. Environmental Protection Agency's (EPA) Clean Power Plan is an essential step toward ending unlimited dumping of carbon pollution into our atmosphere from the largest source in the United States—existing power plants. It sets the first-ever limits on how much carbon pollution the country's existing power plants can release, and is a groundbreaking step toward combating climate change before it's too late to avoid the worst impacts. Still, the EPA can and should strengthen the proposal by requiring more reductions of dangerous carbon pollution. It can accomplish this at reasonable costs with stronger contributions from energy efficiency and renewable energy.

The EPA's Clean Power Plan establishes state-specific emission rate targets based on a technical and economic assessment of each state's opportunities to reduce carbon emissions from its electricity sector. The EPA found that by 2020, the power sector could reduce its emissions by 26 percent below 2005 levels under the Clean Power Plan, costing between $5.5 billion and $7.5 billion annually.[1,2] But because the EPA uses conservative and outdated assumptions, the agency overstates the costs of compliance—the amount the power sector would pay to implement the Clean Power Plan—by $9 billion in 2020—a correction would turn compliance costs into savings. These savings mean the power sector would spend less to meet the Clean Power Plan targets, which would result in utility bill savings for customers. There are large net savings after accounting for the significant health and environmental benefits in both the EPA's analysis as well as the one presented here. Moreover, by overstating the costs, the EPA missed an opportunity to make even deeper carbon reductions at a much lower cost than its projections suggested were attainable.

Simply by making the cost and performance parameters for renewable generation and energy efficiency consistent with today's technologies, NRDC has found that compliance with EPA's proposed limits could be achieved at a savings of between $1.8 and $4.3 billion in 2020. Using the same model as the EPA, NRDC constructed the "Updated Costs and Performance" runs, reproducing the EPA's compliance scenarios with updated assumptions to reflect current trends in energy efficiency and renewable energy technologies. Additionally, our analysis improved on the EPA's approach of subtracting pre-determined energy efficiency savings from the load forecast by using a simplified supply curve, allowing the model to choose energy efficiency on an economic basis.

In summary our findings are:

- The EPA used outdated renewable energy cost and performance numbers, including levelized costs for both wind and solar energy that are 46 percent above current average costs.[3]
- The EPA used extremely conservative energy efficiency costs that are 68–81 percent higher than current average costs.
- NRDC updated these cost and performance numbers and provided the data to ICF International. NRDC engaged ICF to run the Integrated Planning Model (IPM®), the same model that EPA uses, with the updated data. IPM® determines a least cost compliance pathway through both re-dispatch of existing resources and capacity expansion of new resources. The analysis showed:
  - Total savings of $1.8 billion to $4.3 billion in 2020, compared to the EPA's estimated compliance costs of $5.5 billion and $7.5 billion;

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- Total savings of $6.4 billion to $9.4 billion in 2030, compared to the EPA's estimated costs of $7.3 billion and $8.8 billion;
- A national total of 469 TWh of renewable generation compared with the EPA's 278 TWh in 2030; and
- Energy efficiency savings of 609 TWh in 2030, compared with 469 TWh in the EPA's analysis.

These results —which used the most recent publicly available cost and performance data for renewable energy and energy efficiency—show that the EPA can strengthen its state-by-state carbon pollution targets and achieve more pollution reductions at lower cost than projected in the original proposal.

This issue brief provides an overview of these topics, which will be addressed in further detail along with many other recommendations in NRDC's technical comments in response to the Clean Power Plan (planned for submission on December 1, 2014).

*The **$9 billion dollar** difference between the 2020 savings in the Updated Costs and Performance assessment and the EPA's estimates indicates that the proposal could achieve significantly greater carbon reductions at a reasonable cost.*

## THE JUNE 2014 EPA ANALYSIS OVERESTIMATES THE COMPLIANCE COSTS OF THE PROPOSED CLEAN POWER PLAN, LARGELY DUE TO OUTDATED DATA ON COSTS AND PERFORMANCE OF EFFICIENCY AND RENEWABLES

In its Integrated Planning Model (IPM®) Base Case v5.13,[4] the EPA adopts load forecasts and new technology costs from the Energy Information Administration's (EIA) Annual Energy Outlook 2013 (AEO2013).[5] More recent industry data demonstrate that modeling assumptions used for the cost and performance characteristics of new generating technologies are significantly out of date. The cost estimates are especially important because the costs for new generation technologies drive the costs of the overall compliance costs of the Clean Power Plan Proposal.

AEO2013's assumptions were based on projects completed in 2012, and may reflect pricing contracts signed several years prior to project completion.[6] Since 2010, the cost of building utility-scale solar projects has declined by about 50 percent from $3400/kW to $1500–1800/kW in 2014.[7] The capital cost of developing onshore wind turbines has also declined, from $2260/kW to $1750/kW on average.[8] Moreover, technology improvements have produced taller wind turbines, enhancing performance through faster and steadier wind speeds at higher elevation. As a result of these advances, Lawrence Berkeley National Laboratory (LBNL) researchers have indicated that average capacity factor has increased by 10 percent across all wind classes since 2012.[9]

In its analysis, the EPA estimates the cost of energy efficiency savings as 8.5 to 9.0 cents/kWh—an overly conservative estimate. In discussing the costs of energy efficiency programs, the EPA directly acknowledged that the "range of LCOSE [Levelized Cost of Saved Electricity] is notably conservative (leading to higher costs) in comparison with most utility and state analysis."[10] EPA overstated the cost of energy efficiency by almost twice what has been demonstrated; NRDC corrects for this by incorporating costs that accurately reflect current practice. Numerous state programs have demonstrated consistently that energy efficiency programs cost significantly less than the estimate EPA relied on in its analysis. The Updated Costs and Performance analysis presented here relies on costs ranging from 4.7 cents/kWh to 6.4 cents/kWh[11] based on estimates from Synapse Energy Economics (Synapse) and supported by LBNL. LBNL researchers found a savings-weighted average LCOSE for energy efficiency of 4.4 cents/kWh.[12]

Additionally, the EPA represents energy efficiency in the model by reducing the assumed load forecast by the amount of energy savings delivered by efficiency programs. The Updated Costs and Performance analysis reflects the available energy savings from efficiency programs at three different costs. Using this method, energy efficiency is an available technology and the model determines whether to include efficiency in the economically optimized generation mix. Table 2 compares the EPA and Updated Costs and Performance approaches to reflecting energy efficiency in the model assumptions.

In order to accurately reflect the costs and performance of energy efficiency programs, wind, and solar technologies, NRDC asked ICF to reconstruct the EPA's base case scenario in IPM® based on publicly available assumptions, replacing AEO2013 wind and solar cost and performance estimates with more up-to-date publicly available estimates as described above. Table 1 below compares these updated estimates with those in AEO2013. The Updated Costs and Performance analysis assumed that states will begin making additional investments in energy efficiency in 2017. The model can choose energy savings up to 2 percent of previous year's sales at an average utility program cost of 2.7 cents/kWh.[13] Energy efficiency participant costs were assumed to be equal to utility program costs, and are included in the total cost calculations in the Updated Costs and Performance analysis.

The EPA analyzed its proposed Clean Power Plan in two compliance scenarios[14]: Option 1 State (in which states comply individually) and Option 1 Regional (in which states form regional compliance agreements).[15] The EPA projects its proposal could lead the power sector to reduce its dangerous carbon emissions by 26 percent below 2005 levels to 1959 million short tons by 2020 in the Option 1 State scenario, at a cost of $7.5 billion with net benefits valued at $27 to

| Table 1: Comparison of Wind and Solar Cost and Performance Characteristics: Updated Costs and Performance vs. AEO2013 | | | | |
|---|---|---|---|---|
| **Renewable Energy Cost and Performance Assumptions** | | | | |
| | Installed Costs ($/kW) | | Average Capacity Factor | |
| | Onshore Wind | Solar PV[17] | Onshore Wind | Solar PV[18] |
| EIA AEO 2013[19] | 2213 | 3098 | 35% | 20% |
| Updated Costs and Performance | 1750[20] | 1770[21] | 45%[22] | 16%[23] |

| Table 2: Comparison of Energy Efficiency Approaches from EPA analysis and Updated Costs and Performance Assessments | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Efficiency Assumptions** | | | | | | |
| | Modeling Approach | Start Year | Ramp-up | Average Cost ($/MWh) | | |
| | | | | 2020 | 2025 | 2030 |
| EPA | Hard-wired | 2017 | 1.5%/year | 8.5 | 8.9 | 9.0 |
| Updated Costs and Performance[24] | Supply Curve | 2017 | 2%/year | 4.7 | 5.3 | 5.3 |

$50 billion.[16] The Option 1 Regional scenario was projected to lead to a similar level of carbon pollution reductions and associated benefits, but with compliance costs of about $5.5 billion by 2030—or $2.0 billion less than if states were to comply independently.

The Updated Costs and Performance cases evaluated the state emissions-rate targets the EPA has proposed and used the same modeling framework as the EPA's "Option 1 State" and "Option 1 Regional" policy cases. It is important to note that all modeling outcomes discussed throughout the remainder of this issue brief are based on NRDC analysis, and results based on EPA assumptions may still differ from those reported in EPA's RIA due to variations in modeled regions.

Simply by making the cost and performance parameters for renewable generation and energy efficiency consistent with today's data, NRDC has found that compliance with EPA's proposed targets could be achieved at a savings of $1.8 billion (Option 1 State) to $4.3 billion (Option 1 Regional) by 2020. For 2030, the savings are even larger: $6.4 billion (Option 1 State) or $9.4 billion (Option 1 Regional). There is a $10 billion difference in 2020 and a $17 billion difference in 2030 between model runs using EPA's assumptions and the Updated Costs and Performance assumptions. These substantial savings indicate that the standards could be strengthened and achieve significantly greater carbon reductions at a reasonable cost.

Figure 1 illustrates the impact of updated cost and performance data on the incremental system cost of compliance with the proposed standard in 2020. Using the EPA's cost assumptions for energy efficiency and renewable energy technologies, the policies result in incremental costs of $8.4 billion in 2020 for Option 1 State and $6.9 billion for Option 1 Regional (shown in gray). After updating the Energy Efficiency and Renewable Energy cost assumptions, the total system costs of the Reference Case decline. This is shown by the dotted horizontal line labeled, "Cost-Adjusted Baseline" in Figure 1. Compared to the updated Reference Case (shaded green), the policy cases still result in savings of $1.8 billion for Option 1 State and $4.3 billion for Option 1 Regional. The conservative AEO2013 assumptions led the EPA to overestimate compliance costs by $9 billion dollars. The EPA could use the proposed Clean Power Plan to achieve even more significant emission reductions from the power sector while maintaining compliance costs within the predicted range.

**Figure 1: 2020 Incremental Compliance Costs (+) or Savings (-) ($ Billion) of Clean Power Plan Proposal[25]**

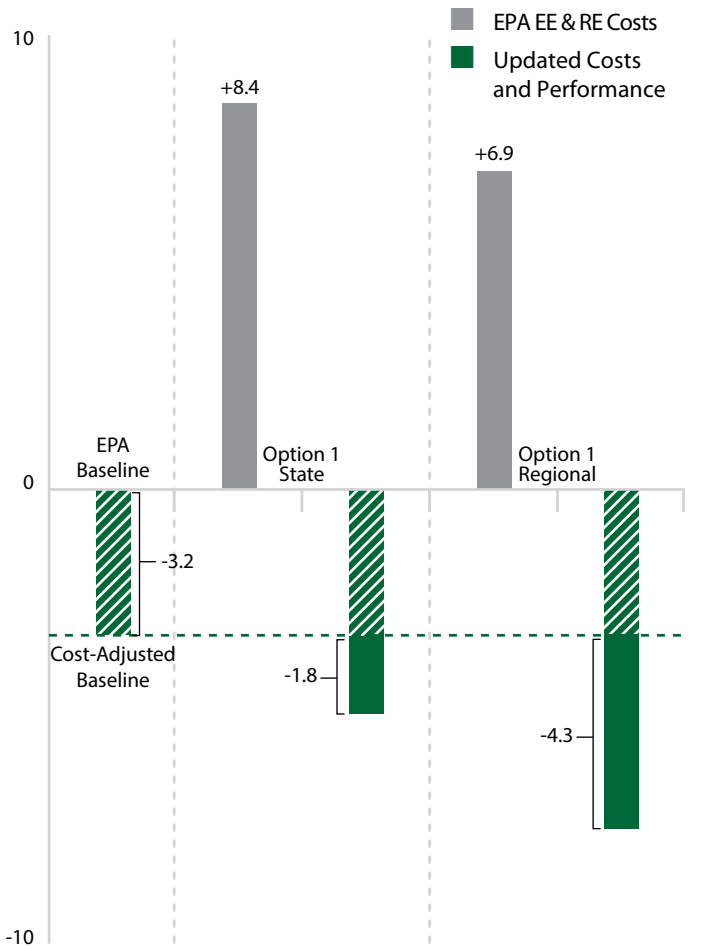


**Table 3: Comparison of Incremental Compliance Costs (+) or Savings (-) of Clean Power Plan Proposal with EPA assumptions vs. Updated Costs and Performance assumptions**

| Incremental System Costs ($ Billion)[26] | | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | | 2025 | | 2030 | |
| | Option 1 State | Option 1 Regional | Option 1 State | Option 1 Regional | Option 1 State | Option 1 Regional |
| EPA EE & RE Costs | 8.4 | 6.9 | 3.4 | 2.4 | 10.5 | 9.2 |
| Updated Costs and Performance | -1.8 | -4.3 | -4.6 | -6.6 | -6.4 | -9.4 |

## ENERGY EFFICIENCY AND RENEWABLE ENERGY COULD FEATURE MORE HEAVILY IN THE COMPLIANCE FUEL MIX THAN THE EPA'S REGULATORY IMPACT ANALYSIS SUGGESTS

Using the outdated costs and performance characteristics assumed in AEO2013 in the EPA's modelling of the Clean Power Plan proposal results in underestimating the role of energy efficiency and renewable generation technologies in meeting the EPA's proposed state targets. Renewable energy generation in the Updated Costs and Performance assessment exceeds EPA case by 60 percent by 2020 and 44 percent by 2030. Figure 2 shows the difference between generation trajectories for renewable energy (wind and solar combined)[27] using EPA's assumptions compared to the same policy scenario using the Updated Cost and Performance assumptions, relative to the historical growth of renewable energy.

**Figure 2: Renewable Energy Generation Projections in EPA and Updated Costs and Performance Assessments[28]**

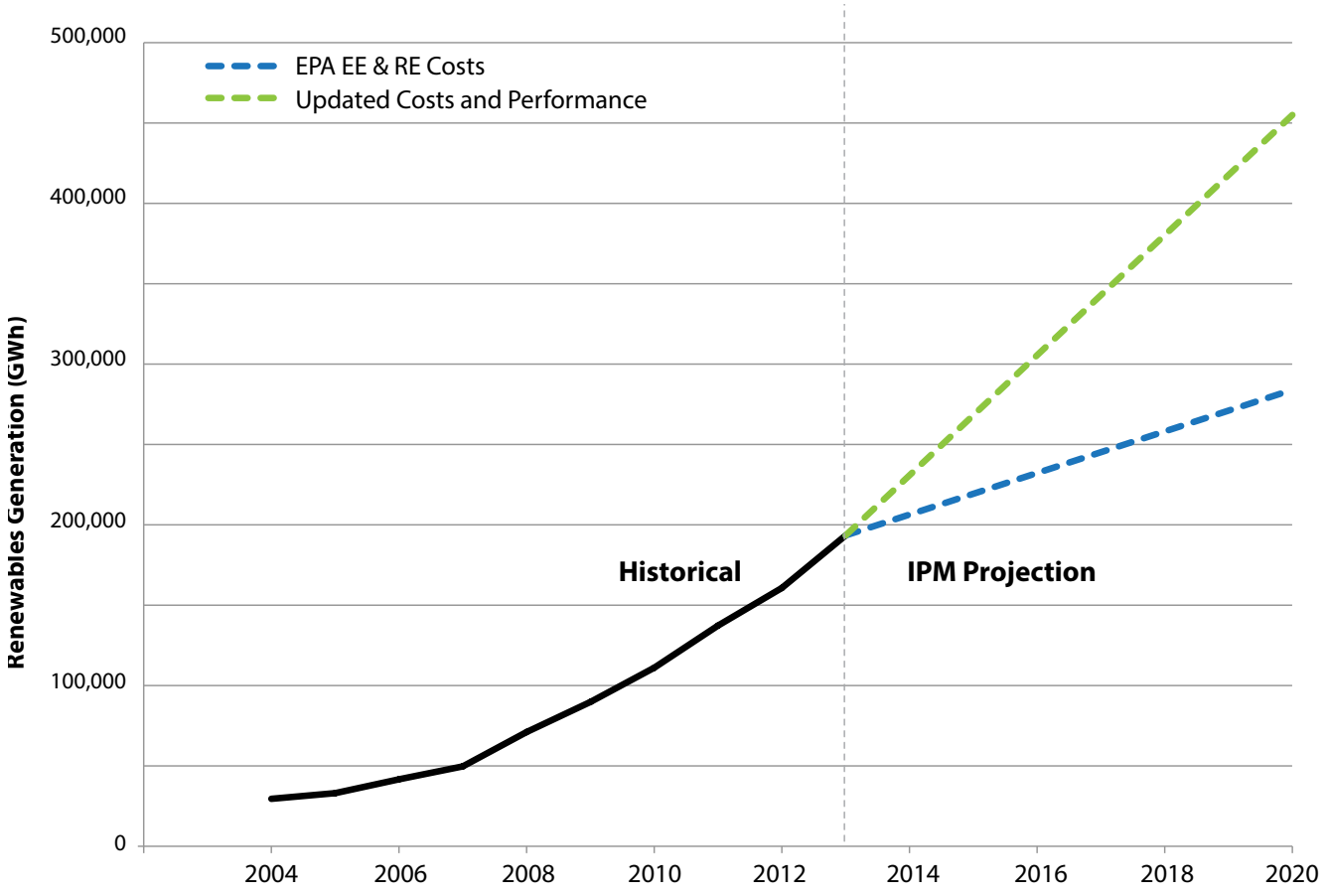


**Table 4: Comparison of Total Renewable Generation[29]**

| Generation - All Renewables (TWh) | | | |
|---|---|---|---|
| Scenario | 2020 | 2025 | 2030 |
| EPA Reference Case | 272 | 301 | 320 |
| EPA Option 1 State | 284 | 308 | 326 |
| EPA Option 1 Regional | 282 | 305 | 322 |
| Reference Case - Updated Costs and Performance | 428 | 445 | 453 |
| Option 1 State - Updated Costs and Performance | 455 | 465 | 469 |
| Option 1 Regional - Updated Costs and Performance | 432 | 441 | 441 |

Total renewable generation in the Updated Cost and Performance case exceeds the EPA case by 171 TWh in 2020, an amount equivalent to the annual electricity consumption of about *16 million homes*.[30]

Correcting the efficiency and renewables assumptions to match current data shows that renewable energy is a viable and economical compliance option. Figure 3 illustrates the compliance generation mixes in the EPA and Updated Costs and Performance cases. Note the more prominent role of energy efficiency and renewable generation in 2030.

## CONCLUSION

The EPA's analysis of its Clean Power Plan proposal relies on outdated estimates of the costs and performance of renewable energy-generating technologies and an overly conservative outlook on the cost of energy efficiency. As a result, the EPA overestimates the costs of compliance and undervalues the potential for resources like renewable energy and energy efficiency as compliance pathways.

NRDC re-evaluated the Clean Power Plan proposal using the same model that the EPA uses to reproduce its base case and policy cases, updating cost and performance assumptions for energy efficiency, wind and solar energy-generating technologies. We found that the Clean Power Plan would actually save the power sector between $1.8 and $4.3 billion in 2020, and $6.4 and $9.4 billion in 2030, with energy efficiency, wind energy, and solar energy occupying a greater share of the generation mix than in the EPA's analysis. While the EPA estimates the net benefits to be valued at $27 to $50 billion in 2020 and $49 to $84 billion in 2030, this analysis shows that compliance with the proposed targets will actually produce a savings rather than a cost for the electricity system and that the net benefits will be even higher than what EPA estimates by $9 billion in 2020, and $15 billion in 2030.[31] The EPA has room to strengthen the proposed Clean Power Plan while keeping costs reasonable, and can count on clean generation technologies to lead the way toward substantially reducing emissions of climate-changing carbon pollution from the nation's largest emitting sector. We can do so and save money even as we protect our health, our communities and future generations.

**Figure 3: 2030 Generation Mix (TWh) in EPA and Updated Costs and Performance Assessments[32]**

**Figure 3a: EPA Base Case**

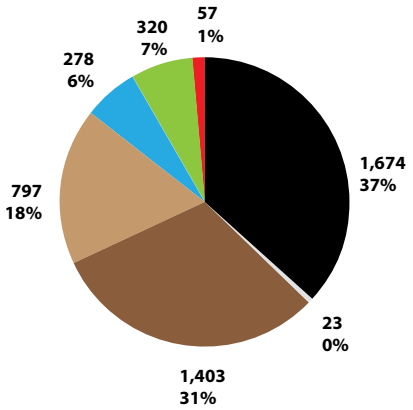



**Figure 3b: EPA Option 1 State**

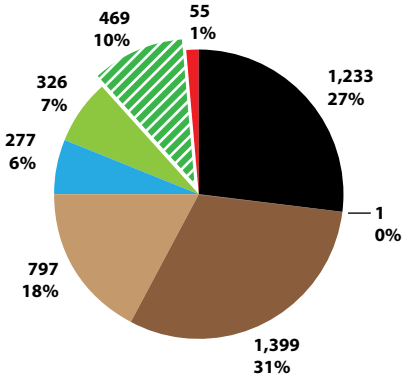
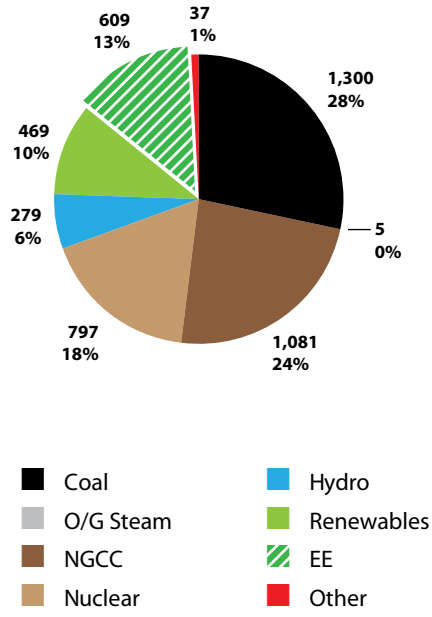



**Figure 3c: Updated Costs and Performance Option 1 State**



## ENDNOTES

1 All compliance costs throughout this issue brief are reported in 2011$.

2 EPA Regulatory Impact Analysis of the Clean Power Plan, June 2014. Available at: http://www2.epa.gov/sites/production/files/2014-06/documents/20140602ria-clean-power-plan.pdf.

3 EPA's cost and performance assumptions lead to an average LCOE of $224/MWh for solar and $95/MWh for wind. Updating those assumptions (see table 1) leads to an average LCOE of $153/MWh for solar and $65/MWh for wind.

4 EPA's Base Case v5.13, based on EPA's application of the Integrated Planning Model (IPM), is the basis for analysis of the impact of air emission standards on the U.S. electric sector. It serves as a starting point against which policy scenarios are compared. Base Case v5.13 is a projection of electricity sector activity that takes into account only those Federal and state air emission laws and regulations whose provisions were either in effect or enacted and clearly delineated at the time the base case was finalized in August 2013. Documentation describing assumptions, updates, and changes are available at: http://www.epa.gov/powersectormodeling/BaseCasev513.html.

5 The projections in EIA's Annual Energy Outlook focus on long term trends in the U.S. energy system. The AEO 2013 Reference Case assumes that current non–expiring laws and regulations remain unchanged through 2040, the end of the forecast period. The Production Tax Credit (PTC) and 30% Investment Tax Credit (ITC) for renewables are not extended past their current end date. AEO 2013 is available at: http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf.

6 EIA reports and other government-issued reports typically have an 18-month or greater time lag due to the comprehensive nature of acquiring, reviewing and reporting on energy data from contributing energy generation, delivery and consumption for the entire country. LBNL has emphasized that reported installed price data "may reflect transactions that occurred several or more years prior to project completion" and therefore are often unable to accurately reflect current prices in such a rapidly changing industry. (LBNL, Tracking the Sun VII). NRDC will include more detail on this matter in its technical comments.

7 Range of estimates based on data from the following sources. *See* Bottom-up modeling estimates in: U.S. DOE Sunshot, "Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections." October 2014; "Bloomberg New Energy Finance. "H1 2014 Levelized Cost of Electricity – PV." February 2014; Lazard. "Levelized Cost of Energy – v. 8.0; Bloomberg New Energy Finance/World Energy Council. "World Energy Perspective: Cost of Energy Technologies." 2013; Solar Energy Industries Association. *Personal Communications*. August 14, 2014. The above sources are available at: http://www.nrel.gov/docs/fy14osti/62558.pdf; https://www.iea.org/media/workshops/2014/solarelectricity/bnef2lcoeofpv.pdf; http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf; http://www.worldenergy.org/wp-content/uploads/2013/09/WEC_J1143_CostofTECHNOLOGIES_021013_WEB_Final.pdf.

8 Lawrence Berkeley National Laboratory. "2013 Wind Technologies Market Report". August 2014, available at: http://emp.lbl.gov/publications/2013-wind-technologies-market-report.

9 Discussions with American Wind Energy Association and updated industry data, and: Trabish, H. "Experts: The Cost Gap Between Renewables and Natural Gas 'Is Closing'." *Greentech Media*. May 6, 2014, available at: http://www.greentechmedia.com/articles/read/The-Price-Gap-Is-Closing-Between-Renewables-and-Natural-Gas.

10 EPA, "GHG Abatement Measures," Technical Support Document at page 5-51, available at: http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-ghg-abatement-measures.pdf.

11 This refers to the total resource cost of energy efficiency programs, including two components: utility program costs and participant costs.

12 Lawrence Berkeley National Laboratory. "The Total Cost of Saving Electricity Through Utility Customer-Funded Energy Efficiency Programs." November 17, 2014 Presentation, available at: http://emp.lbl.gov/cost-saved-energy.

13 Based on Synapse Energy Economics, "Toward a Sustainable Future for the U.S. Power Sector: Beyond Business as Usual 2011," available at: http://www.civilsocietyinstitute.org/media/pdfs/Toward%20a%20Sustainable%20Future%2011-16-11.pdf and LBNL, "The Total Cost of Saving Electricity Through Utility Customer-Funded Energy Efficiency Programs." November 17, 2014 Presentation, available at: http://emp.lbl.gov/cost-saved-energy.

14 In its Clean Power Plan proposal, EPA sets forth a Best System of Emission Reduction (BSER) goal approach referred to as Option 1, and takes comment on a second approach referred to as Option 2. Each of these goal approaches uses the four building blocks at different levels of stringency. Option 1 involves higher deployment of the four building blocks but allows a longer timeframe to comply (2030) whereas Option 2 has a lower deployment over a shorter timeframe (2025). This discussion focuses on Option 1. NRDC will address Option 2 in its comments.

15 EPA proposes as part of the Clean Power Plan that states would have the discretion to choose between regional or state compliance approaches. In a state compliance approach, states are assumed to comply with the guidelines by implementing measures solely within the state and emissions rate averaging is limited to intrastate affected sources. Under the regional approach, groups of states collaborate to comply with the guidelines.

16 EPA Regulatory Impact Analysis of the Clean Power Plan, June 2014. EPA estimates using the Administration's estimate for the Social Cost of Carbon. Estimates for both climate benefits and health co-benefits use a discount rate of 3%.

17 Cost and performance assumptions for solar are given in terms of kWdc. EIA's assumptions are converted from AC to DC using a 0.8 derate factor.

18 *Ibid.*

19 The projections in EIA's Annual Energy Outlook focus on long term trends in the U.S. energy system. The AEO 2013 Reference Case assumes that current non –expiring laws and regulations remain unchanged through 2040, the end of the forecast period. The Production Tax Credit (PTC) and 30% Investment Tax Credit (ITC) for renewables are not extended past their current end date. AEO 2013 is available at: http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf.

20 Lawrence Berkeley National Laboratory. "2013 Wind Technologies Market Report". August 2014.

21 Range of estimates based on data from range of bottom-up modeling sources. See Endnote 7.

22 Discussions with American Wind Energy Association and updated industry data.

23 Solar performance estimates are based on the simple average of performance at each TMY3 weather station in each state as modeled using PVWatts in NREL's System Advisor Model (SAM). Data provided by Solar Energy Industries Association. Through innovation such as oversized inverters, individual projects have reported capacity factors of up to 30%, but we are not aware of publicly available data that captures this trend at a national level. Our performance data relies on NREL's PVWatts model, which has been recently updated to better reflect today's capacity factors. We performed a sensitivity case using these updated performance numbers, but it did not significantly affect results.

24 LBNL and Synapse.

25 Lawrence Berkeley National Laboratory. "2013 Wind Technologies Market Report". August 2014.

26 All system costs in Table 4 and in Figure 1 are developed using NRDC's IPM results. Due to variations in modeled regions, cost estimates using EPA assumptions differ from those reported in EPA's Regulatory Impact Analysis.

27 This also includes marginal amounts of solar thermal and geothermal energy generation.

28 Endnote 21 also applies for Figures 2 and 3, and Table 4: The EPA trajectory and generation mix represents NRDC's analysis of EPA's proposal using the same assumptions as EPA, but results may differ from EPA's own IPM results due to variation in modeled regions.

29 Id at 28.

30 *See* Energy Information Administration Average Annual Household Electricity Consumption, available at: *http://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3*.

31 The comparison here is between the EPA's estimates in its RIA and our Updated Costs and Performance modeling for Option 1 State.

32 Id at 28.