Union of Concerned Scientists
Science for a Healthy Planet and Safer World

December 1, 2014

To: Administrator Gina McCarthy
cc: Janet McCabe, Acting Assistant Administrator, Office of Air and Radiation;
Joseph Goffman, Associate Assistant Administrator & Senior Counsel, Office of Air and Radiation

Docket ID No. EPA-HQ-OAR-2013-0602

Proposed Clean Power Plan for Existing Power Plants

Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule Vol. 79, Federal Register, No. 117, Wednesday, June 18, 2014 Environmental Protection Agency 40 CFR Part 60.

Environmental Protection Agency, EPA Docket Center (EPA/DC), Mailcode 28221T, Attention Docket ID No. OAR–2013-0602, 1200 Pennsylvania Avenue, NW, Washington, DC 20460.

Submitted via email to A-and-R-Docket@epa.gov

Dear Administrator McCarthy,

The Union of Concerned Scientists (UCS) commends the Environmental Protection Agency (EPA) for issuing a draft carbon pollution standard for existing fossil-fired power plants under the authority of the Clean Air Act (CAA) section 111(d). The EPA's draft Clean Power Plan (CPP), released on June 2, 2014 and published in the Federal Register on June 18, 2014, will help ensure reductions in power plant carbon dioxide (CO_2) emissions and a transition to cleaner generation sources. This standard is a critical first step in helping to slow the pace of climate change and limit its impacts.

We appreciate the opportunity to submit comments on this proposal and hope to see our views incorporated in the final standard when it is issued in June 2015. UCS is the nation's leading science-based nonprofit working for a healthy planet and a safer world. We work on behalf of our more than 450,000 supporters and network of nearly 18,000 scientists to advance public awareness of both the science of climate change and the solutions available to help lower emissions and mitigate some of the worst impacts of climate change.

UCS strongly supports the EPA's efforts to regulate carbon emissions from existing fossil fuel-fired power plants under the CAA. The EPA's actions are firmly grounded in science. The threat posed by unchecked climate change, which is driven primarily by carbon emissions from human activities, has been clearly articulated by numerous national and international scientific organizations, including the U.S. National Academy of Sciences[1], the U.S. Global Change Research Program,[2] and the Intergovernmental Panel on Climate Change.[3] In 2012, CO_2 emissions from power plants were the largest single source of U.S. CO_2 emissions, responsible for approximately 38 percent of these emissions.[4] Taking action to reduce emissions from the electricity sector is therefore crucial to our overall efforts to tackle climate change.

We take this opportunity to provide detailed comments on several issues raised by the proposal published in the Federal Register on June 18, 2014, in the Notice of Data Availability (NODA) issued on October 28, 2014, and in associated Technical Support Documents (TSDs). We would particularly like to call your attention to our comments on an approach to strengthening the renewable energy provisions of the Clean Power Plan. We recommend modifications to EPA's approaches that would nearly double EPA's 2030 renewables target from 12 percent to 23 percent of U.S. electricity sales by 2030. UCS modeling shows that strengthening the renewables building block to these levels is affordable and would increase the total emissions reductions achieved by the CPP from 30 percent to approximately 40 percent below 2005 levels by 2030.

We request that the EPA take these comments into consideration as it works to finalize the Clean Power Plan by June 1, 2015.

Sincerely,

On behalf of the Union of Concerned Scientists:

Kenneth Kimmell, *President*

Prepared by:

Rachel Cleetus *Senior Climate Economist*	Steve Clemmer *Director, Energy Research & Analysis*	Jeff Deyette *Asst. Director, Energy Research & Analysis*	Brenda Ekwurzel *Senior Climate Scientist*
Julie McNamara *Energy Research Associate*	Jeremy Richardson *Senior Energy Analyst*	John Rogers *Senior Energy Analyst*	

[1] G8+5 Academies' Joint Statement: Climate Change and the transformation of energy technologies for a low carbon future. 2009. http://www.nationalacademies.org/includes/G8+5energy-climate09.pdf. UCS incorporates by reference all of the materials cited in these comments and ask that they be included in the official record of this proceeding.
[2] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.
[3] Intergovernmental Panel on Climate Change. 2014. Fifth assessment synthesis report. Online at http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_LONGERREPORT.pdf
[4] U.S. Environmental Protection Agency. 2014. Inventory of US Greenhouse Gas Emissions and Sinks, 1990-2012. http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Main-Text.pdf

Executive Summary of UCS Technical Comments

1. Strong Support for the Clean Power Plan

- UCS supports the Clean Power Plan as a significant opportunity to achieve cost-effective emissions reductions in the power sector, which is the single largest source of U.S. CO2 emissions, and help slow the pace of climate change.

- UCS supports the flexible framework in the draft rule, including a role for renewable energy and energy efficiency, which puts states in a leadership role in deciding how best to make cost-effective emission reductions. However, UCS analysis and expertise in the power sector lead us to the conclusion that there are significant opportunities to strengthen the rule, especially by increasing the contribution from renewable energy.

- We commend the EPA for the extensive stakeholder process it has conducted leading up to the release of the draft rule, and for its continued outreach to all affected parties including through this comment period. We strongly support the timeline to finalize the rule by June 1, 2015, and the deadlines for state compliance.

2. Climate Science Imperative to Act

- According to the Third National Climate Assessment, scientific evidence "unequivocally shows that our climate is changing and that the warming of the past 50 years is primarily due to human-induced emissions of heat-trapping gases."[1] The Intergovernmental Panel on Climate Change Fifth Assessment Report states that many of the observed changes such as the warming of the atmosphere and ocean, loss of snow and ice and sea level rise are "unprecedented", and that a continued rise in emissions will increase the risk of "severe, pervasive and irreversible impacts for people and ecosystems."[2]

- In light of the urgent need to cut our global warming emissions to help slow the pace of climate change and limit its impacts, UCS strongly recommends that the EPA finalize a strong rule to cut carbon emissions from power plants in June 2015 as part of a national effort to limit U.S. emissions and provide communities more time to prepare.

- UCS also notes that a strong Clean Power Plan is critical to ensuring a robust U.S. contribution to global efforts to limit emissions, including delivering on the upper end of the range of the 26 to 28 percent reduction in 2005 levels of net U.S. GHG emissions by 2025 announced by the Obama Administration in its joint climate change announcement with China.

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[1] Melillo, J. M., T.C. Richmond, and G. W. Yohe (Eds.) 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2. Online at http://nca2014.globalchange.gov/.

[2] Intergovernmental Panel on Climate Change (IPCC). 2014. Fifth Assessment Synthesis Report. Online at http://ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_LONGERREPORT.pdf.

3. The Best System of Emissions Reductions (BSER)

- UCS supports the scope of, and flexibility in, the BSER for the Clean Power Plan, which reflects the many cost-effective options available to reduce power sector carbon emissions.

- UCS opposes the option of setting the BSER as only the first two building blocks, i.e. increasing the efficiency of existing coal-fired power plants and shifting power generation from existing coal-fired power plants to underutilized natural gas combined cycle (NGCC) plants, because that would exclude the potential for renewables and efficiency to deliver significantly greater emissions reductions at reasonable cost.

- We especially support the flexible choices provided to states, the inclusion of a role for renewable energy and energy efficiency in reducing emissions, the option to form multi-state compliance plans, and the inclusion of market-based emissions trading approaches—all of which will help drive down emissions at a lower cost.

- We recommend that the EPA strengthen, and regularly update, the CPP to reflect the full potential of affordable real-world emission reduction opportunities, and commensurate with the urgent need to address climate change. Our analysis shows that emission reductions of at least 40 percent below 2005 levels by 2030 are technically and economically feasible, and this level therefore corresponds with the best system of emission reduction.[3]

4. Heat Rate Improvements: Building Block 1

- UCS supports the EPA's determination of a 6 percent heat rate improvement (HRI) at existing coal-fired power plants as part of the BSER because several recent engineering studies support the conclusion that this level is technically feasible and economically reasonable.

- UCS supports the EPA's methodology for determining the HRI potential at coal-fired power plants to reduce carbon emissions because studying the variability in heat rates across the fleet is a sound way to gauge the potential for HRI.

- UCS recommends including biomass and natural gas co-firing in setting the BSER because there are states and regions where these options are cost-effective.

5. Coal to Gas Switching: Building Block 2

- UCS supports using generation from excess capacity at existing NGCC plants to displace generation from coal and oil/gas steam units, as part of the Clean Power Plan's Building Block 2. The state re-dispatch targets set by the EPA are achievable in the 2020

[3] Our analysis showed that simply strengthening the renewables building block, as described in detail in section 6, would result in an additional 10 percent increase in emission reductions above the 30 percent reduction from 2005 levels by 2030 that the proposed rule achieves.

timeframe, especially when accounting for the large number of coal units already planned for retirement between 2013 and 2020. However, given the growing evidence that an overreliance on natural gas poses significant and complex risks to consumers, public health, and the climate, we recommend the EPA consider ways to avoid incentivizing natural gas generation and overbuilding infrastructure at the expense of other cost-effective, lower carbon resource alternatives.

- UCS recommends that the EPA maintain its proposed 70 percent target utilization rate for existing NGCC in determining the BSER for Building Block 2.

- UCS recommends that the EPA increase the amount of generation from under construction NGCC units that is incorporated in the BSER re-dispatch calculation. The EPA's assumption that 79 percent of the total generation from under construction NGCC plants (e.g., a 55 percent capacity factor out of a total 70 percent capacity factor) would be utilized to meet new demand—and is therefore unavailable for re-dispatch purposes—overestimates the generation from these units likely to be used for new power demand rather than replacing generation from retiring coal units. We recommend reversing the EPA's proposed allocation of generation from under construction NGCC units so that a capacity factor of 55 percent is available for re-dispatch purposes, and a capacity factor of 15 percent is unavailable.

- UCS recommends that the EPA use a regional—rather than state—method for determining potential for gas re-dispatch, noting that regionalization generally leads to lower costs and more accurately aligns with the construct and operation of power grids across the nation.

- UCS recommends that the EPA also set standards to directly curb methane emissions from the oil and gas sector and update its GWP to 34 to more accurately conform to the latest science.

6. Renewable Energy: Building Block 3

- UCS strongly supports the inclusion of renewable energy as a compliance option in the Clean Power Plan, but recommends modifications to strengthen Building Block 3 that would use the most up-to-date data on renewable energy, set renewable energy growth rates at levels already being achieved by leading states, incorporate full compliance with current state renewable electricity standards, and reflect expected renewable energy growth between 2013 and 2017. UCS analysis shows nearly doubling EPA's renewable target to 23 percent of U.S. electricity sales by 2030 is affordable and would lead to greater emission reductions. This level corresponds with the best system of emission reduction (BSER), in contrast with the EPA's proposal which is more of an "average system of emission reduction."

- UCS also recommends improvements to strengthen EPA's Alternative Approach including eliminating the technical potential benchmarks, relying primarily on economic potential to set state and regional targets, using more up-to-date renewable energy cost and performance assumptions, and reflecting regional differences and existing state commitments.

- UCS recommends using and, where necessary, expanding on existing regional renewable energy credit (REC) tracking systems as the most effective mechanism for tracking state compliance, accounting for interstate effects, and preventing double counting. We also recommend requiring adjustments to take into account the emissions reductions associated with voluntary renewable energy purchases (RECs or "green power") to preserve the integrity of that market and the emissions reductions sought by voluntary institutional, commercial, and private purchasers, allowing such consumers to achieve reductions beyond those required under statutes and regulations.

- UCS recommends the EPA include the emission reductions from new renewables in the emission rate formula as a more consistent and equitable approach with how natural gas fuel switching is treated in Building Block 2, and exclude existing renewable energy and at-risk nuclear generation if the EPA opts to change the formula, given that their emission reductions are already embedded in the baseline emissions and generation mix.

- UCS supports incentives for early action, prior to 2020, to encourage investments in renewables and energy efficiency after a state compliance plan has been approved by the EPA, as long as these incentives do not undermine the overall level of emissions reductions achieved by the CPP.

7. Nuclear Power: Building Block 3

- UCS supports the EPA's proposal to include new nuclear reactors that are under construction in setting state emission reduction targets and for compliance, which is consistent with the EPA's treatment of new natural gas combined cycle plants and UCS's recommendation for new renewables that are under construction.

- UCS recommends excluding existing "at-risk" nuclear generation from the formula for setting state emission reduction targets, as the number of at-risk reactors is limited, site specific, and will likely decline over time as natural gas and wholesale electricity prices rise.

- UCS does not support allowing existing plants that may receive a license extension beyond 60 years to be counted as new generation for the purposes of compliance, given important safety issues that are outside of the EPA's jurisdiction.

8. Energy Efficiency: Building Block 4

- UCS recommends that the EPA use a target for incremental annual energy efficiency of at least 2.0 percent of electricity sales for each state, based on inclusion of a broader suite of energy efficiency policies, measures, and technologies in its calculation of state targets.

- UCS similarly recommends that the EPA use a target of at least 0.25 percent per year for the ramp-up rate, based on the broader suite of opportunities, and incorporate a differential approach for states at the lowest annual levels, to better reflect opportunities for states at low levels of efficiency development.

- UCS recommends that the EPA update its baseline year for energy efficiency targets to 2013 and update cost and performance assumptions for efficiency technologies and measures to reflect the most recent data on state-level energy efficiency programs, and incorporate a range of other strategies to ensure the integrity and effectiveness of Building Block 4, including with respect to interstate trading, voluntary actions, and improvements in transmission and distribution.

9. Regional and Market-Based Approaches to Compliance with the Clean Power Plan

- UCS supports the flexibility in the Clean Power Plan that allows states to comply with the emissions reductions requirements called for by the CPP on a regional or multi-state basis if they so choose because this can lead to lower cost emission reductions.

- We also support the inclusion of market-based approaches to compliance, including emissions trading programs, carbon caps and carbon revenue-raising options, as long as the emissions reductions achieved are equivalent to the state goals in the CPP.

- UCS recommends that EPA provide guidance, in the case of states that choose to use market-based approaches that generate carbon revenues, on using such revenues, in part, to support or retrain displaced workers, invest in renewable energy and energy efficiency programs, and provide assistance to low-income and environmental justice communities.

10. Timing of Implementation and Compliance Dates for the Clean Power Plan

- UCS supports the EPA's proposal for the implementation timeline of the Clean Power Plan, the deadlines for state and multi-state compliance plans, and the dates for compliance with interim and final state goals.

- We strongly recommend that the EPA review and update state goals and other aspects of the Clean Power Plan no later than 2025, to reflect technology improvements that can contribute to a Best System of Emission Reduction (BSER) determination and opportunities for cost-effective emissions reductions.

- UCS does not support a change in the glide path for emissions reductions that would potentially delay emissions reductions.

11. Need and Cost-effective Potential to Strengthen the Clean Power Plan

- Given the urgent need to cut global warming emissions, UCS recommends that the EPA ensure that the CPP achieves the full potential of cost-effective emissions reductions available in the power sector, and that these reductions take place in a timely manner. Strengthening the CPP is also a critical component of the US contribution to international efforts to cut global emissions and slow the pace of climate change.

- Based on our analysis, we recommend several ways to cost-effectively strengthen the Clean Power Plan in keeping with the BSER criteria, including by:

  - Increasing the contribution from the renewable energy and energy efficiency building blocks;

  - Implementing a change in the goal computation formula to ensure that new and incremental renewable energy (RE), energy efficiency (EE) and nuclear generation explicitly replaces generation from fossil fuel-fired sources, which is a better representation of the BSER and consistent with the treatment of incremental NGCC; simultaneously, we recommend a formula change to remove existing generation resources (renewable energy and "at risk" nuclear energy) from the denominator of the formula used to calculate state goals since the associated emission reductions are already embedded in the baseline emissions and generation mix.

  - Including both the generation and emissions impacts of new NGCC units in the state goal calculation;

  - Ensuring that there are no changes to the 2020-2029 glide path that result in a delay in the interim and final goals for emissions reductions achieved by the CPP.

12. Environmental and Economic Justice Concerns

- UCS recognizes that, unless state compliance plans include specific worker transition provisions, the proposed standard for carbon emissions at existing power plants may have disproportionately negative impacts among certain coal-heavy geographic regions, coal-dependent communities, and coal-related workers.

- UCS recommends that the EPA work in conjunction with other federal and state agencies to leverage existing programs and resources that can be brought to bear in addressing impacts to coal communities and assisting displaced workers. States should consider a variety of policy mechanisms, both within the context of state compliance plans and through complementary policies enacted by state legislatures, to address these needs.

- UCS recommends that EPA require states to conduct environmental justice analyses of their compliance plans, and provide guidance to states on how to assess changes in criteria pollutants, water quality, and other environmental damage that may result from their compliance plans and assess the potential impacts on neighboring or downwind communities.[4]

- UCS recommends that states prioritize the development of renewable energy resources and the expansion of energy efficiency programs in overburdened and impacted communities, including low-income, minority, disadvantaged, and coal-heavy populations.

13. Guidance to States

- UCS recommends that the EPA provide clear guidance to states in developing their compliance plans to ensure that states are able to develop and submit robust plans in a timely way, and that such guidance cover issues such as treatment of certain energy options, best practices, methodologies, non-compliance penalties, processes, and options for addressing worker transition and environmental justice concerns.

[4] For example, the EPA should integrate the technical guidance in Plan EJ 2014 into its guidance for state compliance plans for the CPP to help states comply with the requirement for an environmental justice analysis of those plans. (EPA. N.d. Plan EJ 2014. Online at http://www.epa.gov/environmentaljustice/plan-ej/)

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1. Strong Support for the Clean Power Plan

- **UCS supports the Clean Power Plan as a significant opportunity to achieve cost-effective emissions reductions in the power sector, which is the single largest source of U.S. CO_2 emissions, and help slow the pace of climate change.**

- **UCS supports the flexible framework in the draft rule, including a role for renewable energy and energy efficiency, which puts states in a leadership role in deciding how best to make cost-effective emission reductions. However, UCS analysis and expertise in the power sector lead us to the conclusion that there are significant opportunities to strengthen the rule, especially by increasing the contribution from renewable energy.**

- **We commend the EPA for the extensive stakeholder process it has conducted leading up to the release of the draft rule, and for its continued outreach to all affected parties including through this comment period. We strongly support the timeline to finalize the rule by June 1, 2015, and the deadlines for state compliance.**

1.1. The Clean Power Plan represents an historic opportunity to cut power sector emissions.

The Clean Power Plan is being promulgated in the context of the biggest shift in the U.S. power sector has experienced in the last half century. Our nation's dependence on coal-fired power is decreasing as aging and polluting power plants are becoming increasingly uncompetitive relative to cleaner generation sources. Coal power accounted for more than half of our nation's electricity supply as recently as 2008 but had declined to just 39 percent by 2013. Since 2009, utilities have announced plans to close or convert to natural gas more than 430 coal generators in 37 states. These retirements of coal-burning plants total approximately 70,000 megawatts (MW) of power capacity, or about 20 percent of the total 2008 U.S. coal fleet.[5]

A combination of market and policy factors is driving these changes. The cost of coal is rising, and many coal generators have well-exceeded their intended design and economic lifespan. If older units are to remain in service, owners must add the cost of upgrading pollution controls to the cost of general refitting.[6] Other market factors making coal less attractive include low natural gas prices, reduced growth in electricity demand, and the falling costs of renewable energy. In addition, the successful implementation of state and federal policies supporting renewable energy and energy efficiency has cut into coal's market advantage over other power sources.[7]

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[5] Fleischman, L., R. Cleetus, J. Deyette, S. Clemmer, and S. Frenkel. 2013. Ripe for retirement: An economic analysis of the U.S. coal fleet. *The Electricity Journal* 26(10):51-63. Online at dx.doi.org/10.1016/j.tej.2013.11.005.

[6] Cleetus, R., S. Clemmer, E. Davis, J. Deyette, J. Downing, and S. Frenkel. 2012. Ripe for retirement: The case for closing America's costliest coal plants. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/assets/documents/clean_energy/Ripe-for-Retirement-Full-Report.pdf.

[7] *Ibid.*

The electric power sector is the largest single contributor to U.S. global warming pollution, accounting for approximately one-third of total emissions and nearly 40 percent of carbon dioxide (CO_2) emissions. And coal plants alone were responsible for almost 80 percent of electric sector CO_2 emissions in 2011. The EPA's draft Clean Power Plan provides a flexible framework under which states will cut CO_2 emissions by choosing from among a number of emissions-reducing options. These options include increasing generation from renewable energy, nuclear, and natural gas power plants, and investing in energy efficiency at fossil fuel plants and in buildings and industry.

As coal power's dominance wanes, the United States has a valuable opportunity to accelerate the transition to an economy powered by clean, affordable, and reliable energy sources, while protecting public health and cutting CO_2 emissions. In the last few years, electricity from natural gas power plants has largely stepped in where coal plants have backed out. Driven largely by low prices, the natural gas power industry's share of the U.S. electricity mix increased nearly 30 percent from 2008 to 2013. This surge in natural gas generation has resulted in important near-term benefits, including reduced harmful air and water emissions from power plants, less water use, greater flexibility of the power grid, and renewed economic development in gas-rich regions of the country. However, a number of complex risks—economic, environmental, public health, and climate risks—accompany the country's increasing dependence on natural gas.

Ramping up investments in renewable energy and energy efficiency is critical to ensuring a transition to a diversified, clean electricity system. These clean energy resources are already ramping up quickly across the country, demonstrating that they can deliver affordable, reliable, and low-carbon power. Advances in technology and decreases in costs are driving tremendous growth—wind power capacity, for example, increased by 75 percent and solar capacity by 473 percent from 2009 to 2013.[8,9] The national average cost of wind power has dropped more than 60 percent since 2009, making it competitive with new fossil fuel plants in many regions.[10] Solar photovoltaic system costs fell by about 40 percent from 2008 to 2012, and by another 15 percent in 2013.[11,12]

Nationally, the share of non-hydro renewable resources doubled from 3 percent in 2008 to more than 6 percent of the U.S. power supply in 2013. Numerous studies have found that with existing technologies and measures, renewable energy can reliably and affordably increase to much

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[8] American Wind Energy Association (AWEA). 2014. U.S. wind industry annual market report 2013. Washington, DC: AWEA.

[9] Solar Energy Industries Association (SEIA). 2014. Solar energy facts: 2013 year in review. Washington, DC: SEIA. Online at www.seia.org/sites/default/files/YIR%202013%20SMI%20Fact%20Sheet.pdf.

[10] Wiser, R., and M. Bolinger. 2014. 2013 wind technologies market report. Washington DC: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Online at http://eetd.lbl.gov/sites/all/files/2013_wind_technologies_market_report_final3.pdf.

[11] Kann, S., M.J. Shiao, S. Mehta, C. Honeyman, N. Litvak, and J. Jones. 2014. U.S. solar market insight report 2013. Washington, DC: Solar Energy Industries Association.

[12] Barbose, G., N. Darghouth, S. Weaver, and R. Wiser. 2013. Tracking the sun VI: An historical summary of the installed price of photovoltaics in the United States from 1998 to 2012, LBNL-6350E. Berkeley, CA: Lawrence Berkeley National Laboratory. Online at http://emp.lbl.gov/sites/all/files/lbnl-6350e.pdf.

higher levels—reaching up to 25 to 30 percent of the total U.S. power supply or more—over the next two decades. Indeed, many states and regions are already achieving these levels today.[13]

1.2. The proposed Clean Power Plan is flexible and cost-effective.

The flexible framework of the Clean Power Plan provides significant opportunities for states to make smart energy choices to help them reduce emissions cost-effectively. The Best System of Emission Reduction (BSER) proposed by the EPA takes advantage of the many affordable choices to help reduce emissions by shifting to cleaner generation sources. Importantly, it includes a role for renewable energy and energy efficiency. Choosing a path leading to a diverse supply of low-carbon sources—a mix made up primarily of renewable energy and energy efficiency but also including a more balanced role for natural gas—will help ensure a more consumer-friendly, resilient, and diversified electricity system, deliver cost-effective CO_2 emissions reductions, and minimize the risks that an over-reliance on natural gas would present. The energy choices we make in the next few years will have major consequences for our economy, health, and climate for many decades to come.

1.3. The EPA must strengthen and finalize the Clean Power Plan by June 2015

Our analysis shows that there are significant opportunities to strengthen the Clean Power Plan, particularly by increasing the role of renewables in cutting emissions (see section 6). We urge the EPA take advantage of this and other opportunities to strengthen and improve the rule so that it delivers emission reductions of at least 40 percent below 2005 levels by 2030. We also call upon the EPA to ensure that it is finalized by June 1, 2015, in accordance with the Presidential Memorandum on Power Sector Carbon Pollution Standards.[14]

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[13] Union of Concerned Scientists (UCS). 2013. Ramping up renewables. Cambridge, MA: UCS. Online at www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/Ramping-Up-Renewables-Energy-You-Can-Count-On.pdf.

[14] The White House. 2013. Presidential Memorandum — Power Sector Carbon Pollution Standards. Online at http://www.whitehouse.gov/the-press-office/2013/06/25/presidential-memorandum-power-sector-carbon-pollution-standards.

2. Climate Science Imperative to Act

- **According to the Third National Climate Assessment, scientific evidence "unequivocally shows that our climate is changing and that the warming of the past 50 years is primarily due to human-induced emissions of heat-trapping gases."[15] The Intergovernmental Panel on Climate Change Fifth Assessment Report states that many of the observed changes such as the warming of the atmosphere and ocean, loss of snow and ice and sea level rise are "unprecedented", and that a continued rise in emissions will increase the risk of "severe, pervasive and irreversible impacts for people and ecosystems."[16]**

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- **UCS also notes that a strong Clean Power Plan is critical to ensuring a robust U.S. contribution to global efforts to limit emissions, including delivering on the upper end of the range of the 26 to 28 percent reduction in 2005 levels of net U.S. GHG emissions by 2025 announced by the Obama Administration in its joint climate change announcement with China.**

2.1. Carbon emissions are driving climate change with accelerating pace.

Evidence of the heat-trapping role of carbon dioxide (CO_2) in the atmosphere was established in 1859 and by the end of that century the discovery emerged that fossil fuel emissions could cause a shift in Earth's climate.[17] The first confirmation that these emissions were already changing Earth's temperature emerged during the 1930s.[18]

The accelerating pace of emissions after these discoveries is alarming, with over half emitted since 1970 of the total human CO_2 emissions between 1750 and 2010.[19] The annual atmospheric CO_2 increase (2.9 ppm) over 2012-2013 was the highest over the 1984 to 2013 period of

[15] Melillo, J. M., T.C. Richmond, and G. W. Yohe (Eds.) 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2. Online at http://nca2014.globalchange.gov/.

[16] Intergovernmental Panel on Climate Change (IPCC). 2014. Fifth Assessment Synthesis Report. Online at http://ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_LONGERREPORT.pdf.

[17] Fleming, J.R. 1998. Historical Perspectives on Climate Change, Oxford University Press.

[18] Callendar, G.S. 1938. The artificial production of carbon dioxide and its influence on temperature. Quarterly J. Royal Meteorological Society 64:223-240.

[19] IPCC, 2014: Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

record.[20] Accelerating emissions has occurred despite the worldwide trend, since 1850, in the mix of primary energy supply shifting away from less carbon intensive fuels from primarily biomass to primarily coal to more oil and gas in the mix.[21] The latest tracking for each country's share of CO_2 emissions ranks China (27 percent) and the United States (17 percent) as the top two in 2011.[22] The bulk of 2012 U.S. heat-trapping emissions was in the form of CO_2 (82 percent) with nearly a third of all U.S. emissions that year coming from electricity generation (32 percent).[23] Carbon standards aimed at reducing emissions from existing U.S. power plants tackles one of the largest current sources of global CO_2 emissions in the world.

2.2. Future risks of catastrophic climate outcomes add urgency for emissions reductions.

Certain catastrophic climate outcomes are a growing risk unless substantial progress in global heat-trapping emissions occurs. The northern permafrost soil organic carbon pool is estimated to be around 1672 petagrams carbon (PgC).[24] This is larger than the anthropogenic budget of around 1,000 PgC emissions to stay below a global mean temperature rise of 2°C above the 1861–1880 period; half (445-585 PgC) has already been emitted by 2011.[25]

Keeping this region cold enough to prevent the release of these vast stores of carbon in the form of methane (CH_4) and CO_2, trapping heat and warming Earth even faster, is a key factor in the urgency for substantial emissions reductions. Reasons include the processes that lead to amplified warming in the Arctic which pose risks of increased permafrost degradation rates.[26] The loss of the upper few meters of permafrost is projected to decrease 37 percent to 81 percent by the end of this century under RCP2.6 and RCP8.5 future scenarios respectively.[27] Carbon released from permafrost is irreversible for millennia.[28]

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[20] WMO. 2014. WMO Greenhouse Gas Bulletin: The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2013. World Meteorological Organization. ISSN 2078-0796.
[21] Blanco G. et al., Chapter 5: Drivers, Trends, and Mitigation, in Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
[22] U.S. Energy Information Administration. Indicators CO_2 Emissions Tables for 2011. Online at http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=90&pid=44&aid=8&cid=regions&syid=2007&eyid=2011&unit=MTCDPP.
[23] EPA. 2014. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2012. U.S. Environmental Protection Agency, Washington D.C. The EPA 430-R-14-003.
[24] Kuhry, P., Grosse, G., Harden, J. W., Hugelius, G., Koven, C. D., Ping, C.-L., Schirrmeister, L. and Tarnocai, C. 2013. Characterisation of the Permafrost Carbon Pool. Permafrost Periglac. Process., 24:146–155. doi: 10.1002/ppp.1782
[25] Collins, M., R. Knutti, J. Arblaster, J.-L. Dufresne, T. Fichefet, P. Friedlingstein, X. Gao, W.J. Gutowski, T. Johns, G. Krinner, M. Shongwe, C. Tebaldi, A.J. Weaver and M. Wehner. 2013. Long-term Climate Change: Projections, Commitments and Irreversibility. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[26] Lawrence, D.M., Slater, A.G., Tomas, R.A., Holland, M.M., and Deser, C. 2008. Accelerated Arctic land warming and permafrost degradation during rapid sea ice loss. Geophys. Res. Lett. 35 DOI 10.1029/2008GL033985
[27] IPCC. 2013. Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[28] *Ibid.*

Another catastrophic climate outcome, that is irreversible for millennia, is ice sheet collapse.[29] Long before total collapse, significant ice sheet shrinking would transform coastlines of the world to a degree that would be unrecognizable to many coastal residents of today. Paleoclimate evidence from the last interglacial period, around 130,000 years ago, occurred with the combined shrinking of the perimeter of the Greenland ice sheet and the West Antarctic Ice Sheet with an associated sea level rise of more than 4 to 6 meters above current sea level.[30] Today's CO_2 levels in the atmosphere are much higher than when these changes occurred over the last interglacial. At 6 meters additional sea level rise, south Florida and the Mississippi Delta regions of Louisiana would be severely inundated as well as large portions of other coastlines around the world.[31]

2.3. Climate change impacts in the U.S. are growing.

Already, people living in the U.S. are exposed to climate change impacts that vary in severity depending on the season, location, socioeconomic factors as well as local, regional, and national resilience policies.[32] Land ice and warming oceans both contribute to global sea level rise with the former at a much higher increasing pace than the latter.[33,34] This combined with local land elevation shifts and the loss of natural barriers has increased so-called "nuisance flooding" in areas of the U.S. with more than 300 percent increase (Norfolk, VA, San Francisco, CA, and Washington DC) to more than 900 percent increase (Baltimore, MD, and Annapolis, MD) in the number of flood days in recent years (2007–2013) compared to around 50 years earlier (1957–1963).[35] The future risk of nuisance flooding is directly tied to the rate at which the U.S. and the world choose the pace of emissions going forward. Emissions really matter to many coastal communities. For example, in Annapolis, MD, which currently experiences nearly 50 tidal flood events per year, the community could face over 220 such events under an intermediate-low scenario or over 380 such events under the highest emissions scenario.[36] Since there are only 365 days a year, that means tidal flooding twice a day at current Annapolis locations or for all practical purposes—inundation.

The growing risk of extreme events that lead to too much water (or snow) or too little water (and associated consequences) have cost lives, property and at times transformed local communities

[29] *Ibid.*
[30] Overpeck J.T., B.L. Otto-Bliesner, G.H. Miller, D.R. Muhs, R.B. Alley, and J.T. Kiehl. 2006. Paleoclimatic Evidence for Future Ice-Sheet Instability and Rapid Sea-Level Rise. Science:311:1747-1750.
[31] Overpeck, J.T. and J.L. Weiss. 2009. Projections of future sea level becoming more dire. PNAS. 106: 21461–21462.
[32] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds. 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.
[33] Church, J.A., N.J. White, L.F. Konikow, C.M. Domingues, J.G. Cogley, E. Rignot, J.M. Gregory, M.R. van den Broeke, A.J. Monaghan, and I. Velicogna. 2011. Revisiting the Earth's sea-level and energy budgets from 1961 to 2008. Geophys. Res. Lett. 38. doi:10.1029/2011GL048794.
[34] Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville. 2014. Appendix 3: Climate Science Supplement. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 735-789. doi:10.7930/J0KS6PHH.
[35] Sweet, W., J. Park, J. Marra, C. Zervas, S. Gill. 2014. Sea Level Rise and Nuisance Flood Frequency Changes around the United States. NOAA Technical Report NOS CO-OPS 073 and online at http://www.noaanews.noaa.gov/stories2014/20140728_nuisanceflooding.html.
[36] Spanger-Siegfried, E., M.F. Fitzpatrick, and K. Dahl. 2014. Encroaching tides: How sea level rise and tidal flooding threaten U.S. East and Gulf Coast communities over the next 30 years. Cambridge, MA: Union of Concerned Scientists.

when severe enough to permanently displace a critical number of residents. The fundamental consequence of more water vapor in the atmosphere from global warming, has led to an increase in precipitation volume in the heaviest annual events, in Alaska and the Continental U.S. (e.g., Northeast (71 percent); Midwest (37 percent).[37]

Higher temperatures increase soil and surface water evaporation and plant transpiration rates leading to increased drought risk in some regions, seasons or time periods.[38] Warmer temperatures in the Western U.S. have brought earlier snowmelt leaving high mountain forests hotter and drier, especially comparing the dry La Niña years compared with La Niña years decades earlier, increasing the risk of large wildfires.[39] Federal fire suppression costs, in 2012 dollars, have increased from around $440 million in 1985 to around 1.7 billion in 2013.[40]

Significantly reducing U.S. existing power plant emissions in the next decade and beyond can help reduce the risks of negative consequences from climate change in the U.S. and the world. As part of the global effort to reduce emissions, in 2009 the U.S. committed to reducing emissions 17 percent below 2005 levels by 2020,[41] and recently announced a commitment to further reduce emissions 26 to 28 percent below 2005 levels by 2025.[42] These commitments would put the U.S. on a path to the goal of reducing emissions by at least 80 percent by 2050, a goal consistent with international agreements. Scientists conclude that to meet international goals to limit warming to 2°C above preindustrial levels,[43] the world must stay within a budget of around 1,000 PgC emissions.[44] For the U.S. to make good on those commitments, the power sector will need to cut emissions by more than the estimated reductions from the Clean Power Plan of 30 percent below 2005 levels by 2030.

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[37] Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville. 2014. Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 19-67. doi:10.7930/J0KW5CXT.
[38] *Ibid.*
[39] Westerling A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfireactivity. Science 313:940–943.
[40] Cleetus, R., and K. Mulik. 2014. Playing with fire: How climate change and development patterns are contributing to the soaring costs of western wildfires. Cambridge, MA: Union of Concerned Scientists.
[41] United States. 2010. Copenhagen Accord submission. Online at http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/unitedstatescphaccord_app.1.pdf
[42] The White House. 2014. U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation. Fact sheet. Online at http://www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c
[43] National Research Council. 2010. Limiting the magnitude of future climate change. Washington, DC: National Academies Press.
[44] Collins, M., R. Knutti, J. Arblaster, J.-L. Dufresne, T. Fichefet, P. Friedlingstein, X. Gao, W.J. Gutowski, T. Johns, G. Krinner, M. Shongwe, C. Tebaldi, A.J. Weaver and M. Wehner. 2013. Long-term Climate Change: Projections, Commitments and Irreversibility. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

3. The Best System of Emissions Reductions (BSER)

- **UCS supports the scope of, and flexibility in, the BSER for the Clean Power Plan, which reflects the many cost-effective options available to reduce power sector carbon emissions.**

- **UCS opposes the option of setting the BSER as only the first two building blocks, i.e. increasing the efficiency of existing coal-fired power plants and shifting power generation from existing coal-fired power plants to underutilized natural gas combined cycle (NGCC) plants, because that would exclude the potential for renewables and efficiency to deliver significantly greater emissions reductions at reasonable cost.**

- **UCS supports the flexible choices provided to states, the inclusion of a role for renewable energy and energy efficiency in reducing emissions, the option to form multi-state compliance plans, and the inclusion of market-based emissions trading approaches—all of which will help drive down emissions at a lower cost.**

- **UCS recommends that the EPA strengthen, and regularly update, the CPP to reflect the full potential of affordable real-world emission reduction opportunities, and commensurate with the urgent need to address climate change. Our analysis shows that emission reductions of at least 40 percent below 2005 levels by 2030 are technically and economically feasible, and this level therefore corresponds with the best system of emission reduction.**[45]

UCS applauds the EPA for proposing a flexible standard for carbon emissions at existing power plants, and for including the potential for renewable energy and energy efficiency as compliance mechanisms. The BSER defined by the EPA takes advantage of multiple cost-effective options already in use and available across the country to help shift our electricity system from more fossil fuel-intensive generation sources toward cleaner, less polluting options. It also allows states to choose and combine the options they prefer, including joining together with other states to form multi-state compliance plans.

The proposed standard, however, would deliver approximately 30 percent reductions in carbon emissions from the power sector by 2030, a level that is not commensurate with the scale of the climate problem and is inconsistent with reaching at least 80 percent reductions by 2050. UCS therefore urges strengthening the standard and offers specific ways in which the proposal can achieve emissions reductions of at least 40 percent below 2005 levels by 2030. These include an improved methodology for determining the state targets for renewable energy (Building Block 3), using the most recent generation and technology cost and performance data in calculating

[45] Our analysis showed that simply strengthening the renewables building block, as described in detail in section 6, would result in an additional 10 percent increase in emission reductions above the 30 percent reduction from 2005 levels by 2030 that the proposed rule achieves.

state targets, and improving the EPA's formula for setting the emission rate targets. Strengthening the CPP will provide public health, environmental and economic benefits, alongside helping to reduce heat trapping emissions.

3.1. UCS supports the inclusion of cost-effective "outside the fence line" approaches, including renewable energy and energy efficiency, to reduce carbon dioxide emissions.

A framework that recognizes the interconnected nature of the electricity grid will capture greater emissions reductions at a lower cost per ton, particularly by including non-emitting renewable energy and reducing electricity demand through end-use energy efficiency.[46] Renewables have grown tremendously in recent years as costs decline. From 2009 to 2013, wind capacity increased by 75 percent[47] and solar capacity by 473 percent.[48] Average costs of wind power dropped more than 60 percent since 2008; solar photovoltaic systems costs fell by about 40 percent from 2008 to 2012, and another 15 percent in 2013.[49,50]

3.2. UCS supports the flexibility inherent in the proposed framework that allows states to decide how best to meet the standard.

States may use the building blocks in any combination or at any level of ambition they choose, so long as they meet the state-specific targets established by the EPA's determination of the BSER. This is critical to the cost-effectiveness of the emissions reductions achieved by the standard.[51] It also puts states in the driver's seat in deciding which options suit their specific circumstances.

3.3. The reduction targets proposed by the EPA are insufficient to meet the level of reductions required by the scale of the climate problem.

With Americans already facing worsening risks of climate impacts, clearly outlined in the National Climate Assessment,[52] the EPA's Clean Power Plan is an important step forward in the effort to limit those risks, discussed at length in section 2 of our comments. We offer a systematic and consistent methodology for calculating more aggressive targets for renewable

[46] Cleetus, R., S. Clemmer, J. Deyette, and S. Sattler. 2014. Climate Game Changer: How a carbon standard can cut power plant emissions in half by 2030. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Carbon-Standards-Analysis-Union-of-Concerned-Scientists.pdf.

[47] American Wind Energy Association (AWEA). 2014. U.S. wind industry annual market report 2013. Washington, DC: AWEA.

[48] Solar Energy Industries Association (SEIA). 2014. Solar energy facts: 2013 year in review. Washington, DC: SEIA. Online at www.seia.org/sites/default/files/YIR%202013%20SMI%20Fact%20Sheet.pdf, accessed on September 15, 2014.

[49] Kann, S., M.J. Shiao, S. Mehta, C. Honeyman, N. Litvak, and J. Jones. 2014. U.S. solar market insight report 2013. Washington, DC: Solar Energy Industries Association.

[50] Barbose, G., N. Darghouth, S. Weaver, and R. Wiser. 2013. Tracking the sun VI: An historical summary of the installed price of photovoltaics in the United States from 1998 to 2012, LBNL-6350E. Berkeley, CA: Lawrence Berkeley National Laboratory. Online at http://emp.lbl.gov/sites/all/files/lbnl-6350e.pdf, accessed on September 15, 2014.

[51] See, for example: Fowlie, M., L. Goulder, M. Kotchen, S. Borenstein, J. Bushnell, L. Davis, M. Greenstone, C. Kolstad, C. Knittel, R. Stavins, M. Wara, F. Wolak, C. Wolfram. 2014. An economic perspective on the EPA's Clean Power Plan: Cross-state coordination key to cost-effective CO_2 reductions. *Science*, 346(6211): 815-816. DOI: 10.1126/science.1261349.

[52] Melillo, J. M., T.C. Richmond, and G. W. Yohe (Eds.) 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2. Online at http://nca2014.globalchange.gov/.

energy generation (see section 6) that achieves 10 percent greater emission reductions than the EPA's proposed method, i.e., emission reductions of 40 percent below 2005 levels by 2030. Our methodology is a logical outgrowth of the EPA's approaches but does not rely on applying state renewable electricity standards (RES) to states without such policies, and it achieves greater reductions in emissions in all regions and in all but four states.

3.4. UCS recommends that the EPA clarify the look-back provisions of the Clean Air Act and review and update the standard appropriately.

The EPA carbon standard is only the first step in curbing harmful emissions, and that emissions must continue to decline beyond 2030. The agency should clarify the look-back provisions of the Clean Air Act, specifically designating when the targets will be updated to reflect new information. We recommend that the agency review and update the standard at least every eight years, with the first update by 2025. With the costs and performance of low carbon technologies improving rapidly, this type of review will be essential for ensuring we achieve the full potential for cost-effective emission reductions. We note the experience of the nine states participating in the Regional Greenhouse Gas Initiative (RGGI), which recently tightened the cap[53] on carbon emissions based on new data on cost and impacts of the program. Based on the recent dramatic growth of renewable energy and corresponding precipitous drop in costs, it seems reasonable to assume that the economic calculations will have changed by the end of the compliance period, and that additional cost-effective reductions in CO_2 should be included in the BSER.

3.5. UCS supports strengthening the emission reduction targets for the states.

The EPA offers several alternatives in establishing the BSER for each state and solicits comments on all of them. For example, the EPA offers a second option for compliance levels and times, which establishes less stringent emissions reduction targets but requires compliance by 2025[54]. The EPA also lays out several options for establishing the BSER using combinations of the building blocks. UCS strongly opposes the option of setting the BSER as only the first two building blocks[55] (p.34836), because it would exclude the potential for renewables and efficiency to deliver significantly greater emissions reductions at reasonable cost.

3.6. UCS recommends establishing the BSER based on the most recent generation and technology cost and performance data available.

By the time the rule is finalized, the EPA should have access to final 2014 data and the agency should use that information in establishing state targets. Building from the most recent data on renewable generation is critical, given the rapid growth in deployment of these resources in recent years. In addition, the agency should use the most recent cost and performance data for renewable energy technologies, such as wind and solar. The EPA's assumptions should be

[53] http://www.rggi.org/design/overview/cap
[54] https://www.federalregister.gov/articles/2014/06/18/2014-13726/carbon-pollution-emission-guidelines-for-existing-stationary-sources-electric-utility-generating#p-240
[55] https://www.federalregister.gov/articles/2014/06/18/2014-13726/carbon-pollution-emission-guidelines-for-existing-stationary-sources-electric-utility-generating#p-743

updated to reflect new NREL resource assessments, more recent data from actual projects, and credible studies projecting continued cost reductions and technology improvements through 2030. These studies and data sources are discussed in more detail in section 6. The data and calculations in these technical comments are based on data from 2013, unless otherwise noted.

3.7. UCS recommends that the EPA improve the consistency in the emissions rate formula by treating Building Blocks 3 and 4 similar to Building Block 2.

The formula the EPA developed for calculating the adjusted emissions rate is inconsistent in its treatment of zero-carbon generating sources and does not adequately account for expected emissions reductions from developing those resources. See section 11 for our specific guidance on improving the formula and other issues raised by the October 28, 2014, Notice of Data Availability.[56]

3.8. UCS recommends that the EPA include market-based approaches, such as emissions trading programs or carbon fees, in the definition of the BSER for the Clean Power Plan.

The EPA should provide specific guidance to states on how to demonstrate equivalence for market based approaches, so that they can take advantage of those options if they so choose. Market-based approaches can provide flexibility and low cost options to reduce emissions, as well as revenues for addressing worker transition and environmental justice considerations (see sections 9 and 12).

[56] http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-notice-data-availability

4. Heat Rate Improvements: Building Block 1

- **UCS supports the EPA's determination of a 6 percent heat rate improvement (HRI) at existing coal-fired power plants as part of the BSER because several recent engineering studies support the conclusion that this level is technically feasible and economically reasonable.**

- **UCS supports the EPA's methodology for determining the HRI potential at coal-fired power plants to reduce carbon emissions because studying the variability in heat rates across the fleet is a sound way to gauge the potential for HRI.**

- **UCS recommends including biomass and natural gas co-firing in setting the BSER because there are states and regions where these options are cost-effective.**

4.1. UCS supports the EPA estimate of the potential for HRI across the coal fleet as appropriately conservative.

The EPA considered two HRI components: operational best practices and equipment upgrades. The agency reviewed the technical literature and analyzed real-world data to determine the potential for HRI. It concluded that best practices for operations and maintenance (O&M) could lead to a 4 percent improvement and that equipment upgrades could achieve another 2 percent. As described[57] in the Technical Support Document, the EPA reduced its estimates below what it found to be technically and economically feasible to allow for differences among individual EGUs and across states. Thus, according to the agency's own analysis, the overall 6 percent HRI target is conservative.

4.2. UCS supports the EPA's contention that a 6 percent HRI target is technically plausible on a fleet-wide basis.

The EPA identified a number of measures that could improve efficiencies at coal-fired power plants and quantified the level of improvement each could achieve.[58] While some stakeholders have raised concerns about the viability of this level of HRI (especially for newer plants) several technical studies[59] support the conclusion that higher improvements are possible and cost effective over the entire fleet. Resources for the Future (RFF) analyzed[60] performance data for coal plants in 2008, sorted by boiler type, and found the average HRI would be 5.5 percent if each plant matched the best performing (top 10 percent) plants in its class. RFF concluded that the 6 percent figure is technically plausible and economically reasonable. The National Energy Technology Lab has laid out a vision for improving the nation's coal fleet from 32.5 percent efficiency to 36 percent.[61]

[57] EPA. 2014. Technical Support Document for GHG Abatement Measures.
[58] EPA. 2014. Technical Support Document for GHG Abatement Measures. Table 2-3.
[59] See, for example: Sargent & Lundy LLC. 2009. Coal-fired power plant heat rate reductions. Chicago: Report SL-009597.
[60] Burtraw, D. http://www.rff.org/centers/climate_and_electricity_policy/Pages/6-Increasing-Efficiency-at-Coal-Plants.aspx
[61] NETL 2010. Improving the efficiency of coal-fired power plants for near-term greenhouse gas emissions reductions.

4.3. UCS concludes that a 6 percent HRI is cost effective on a fleet-wide basis.

Recognizing that economic calculations vary from plant to plant, UCS agrees with the EPA that a six percent HRI across the coal fleet is cost effective. Moreover, UCS emphasizes that retirement of older, less efficient, and dirtier coal plants will help states achieve their targets. The average age of the nation's coal fleet is 38 years,[62] compared to an average expected lifetime of 30 years. By 2013, 24 GW of coal-fired generation, with an average age of 51 years,[63] had already been announced for retirement. By 2020, the start of the compliance period, more existing plants will have outlasted their expected lifetimes. Thus for some EGUs, investments in HRI may not make sense because of the age of the facility. For others, however, HRI may make sense and may even extend their useful lifetimes.[64] States will have to consider their own individual generating fleets to determine the most cost-effective way to meet their targets. Case law affirms that reduced usage of covered entities (including retirement) is consistent with complying with air pollution regulations.[65] States have been given maximum flexibility to comply with their individual state targets, but as noted by the RGGI states,[66] that flexibility should not extend to setting the targets. (See section 5 for a deeper discussion of coal retirements as part of our comments on Building Block 2.)

4.4. UCS supports the EPA's concept of considering heat rate variability to estimate potential for HRI from plant operation and maintenance.

The EPA looked at variability of heat rates in coal fired power plants as a method to assess the potential for improvements in operation and maintenance (O&M). Heat rate is the principal metric by which the quality of electric generation is measured, and high variability indicates potential for improvement.[67] UCS supports this concept as a valid way of gauging the performance of EGUs. The EPA's methodology also adjusted for ambient and operating conditions, which can affect heat rates at individual units. Adjusting for boiler size, design, vintage, and presence of pollution control equipment, an independent analysis of heat rate variability over 25 years concluded that a 6 percent HRI represents the upper bound of technical feasibility, ignoring costs.[68] Their findings support the EPA's claim that costs are low, at least for modest HRI of 1-2 percent. That analysis also noted factors influencing heat rates, including poor management support, lack of engineering expertise on site, the threat of New Source Review, and fuel cost pass-through to customers, can limit implementation of HRI. The Sierra

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[62] Cleetus, R., et al. 2012. Ripe for retirement: the case for closing America's costliest coal plants. Cambridge, MA: Union of Concerned Scientists.

[63] Fleischman, L., R. Cleetus, J. Deyette, S. Clemmer, and S. Frenkel. 2013. Ripe for retirement: An economic analysis of the U.S. coal fleet. *The Electricity Journal* 26(10):51-63. Online at dx.doi.org/10.1016/j.tej.2013.11.005.

[64] Ellerman, D. 1998. Note on the seemingly indefinite extension of power plant lives, a panel contribution. *The Energy Journal* 19(2):129.

[65] https://www.federalregister.gov/articles/2014/06/18/2014-13726/carbon-pollution-emission-guidelines-for-existing-stationary-sources-electric-utility-generating#p-872.

[66] See technical comments submitted by the RGGI states on the Clean Power Plan (Docket ID EPA-HQ-OAR-2013-0602).

[67] EPA. 2014. Technical Support Document for GHG Abatement Measures, p.2-26.

[68] Linn et al. 2014. Regulating greenhouse gasses of coal power plants under the Clean Air Act. Journal of the Association of Environmental and Resource Economists, 1:97-134.

Club has similarly studied variability in heat rates over 11 years and concludes[69] that the EPA should set the HRI target at 10 percent.

4.5. UCS recommends that the EPA include biomass co-firing as part of the BSER.

If developed in a sustainable manner, biomass can supply increasing amounts of low carbon electricity, as discussed in more detail in section 6.4.1.1. Recent modeling by NREL,[70] EIA,[71] and UCS,[72] shows that biomass co-firing is a cost-effective option in certain cases and does represent a portion of additional renewable energy sources expected to come on line by 2030.

We agree, as the EPA noted in the draft CPP, that the source of the biomass is critical to ensuring that co-firing decreases total CO_2 emissions on a lifecycle basis. The EPA notes that the CO_2 reduction potential for biomass co-firing depends on a wide variety of factors, including land-use practices, the type of biomass, moisture content, and the type of coal it replaces.[73] Cost estimates are highly site-specific, and may be driven primarily by collection and transportation costs, in particular the distance over which the feedstock must be transported. UCS suggests that biomass co-firing be evaluated on a regional or state basis for inclusion in the BSER (see section 6). Finally, biomass co-firing can also help stimulate local and regional economies, particularly in the Midwest,[74] the Southeast, and in Appalachia.[75]

The EPA's ongoing work on the *Framework for Assessing Biogenic Carbon Dioxide for Stationary Sources* is critical to understanding the role that sustainable biomass can play in reducing GHG emissions, and establishing the safeguards necessary to ensure robust accounting of lifecycle emissions and other impacts from the use of biomass.[76] UCS will continue to review and assess the findings in the latest report as it undergoes review by the Science Advisory Board.[77]

[69] See comments to be submitted by the Sierra Club on the Clean Power Plan (Docket ID EPA-HQ-OAR-2013-0602).
[70] National Renewable Energy Laboratory (NREL). 2012a. Renewable electricity futures study, NREL/TP-6A20-52409. Golden, CO: NREL. Online at www.nrel.gov/analysis/re_futures/, accessed on September 15, 2014.
[71] Energy Information Administration (EIA). 2014. *Annual Energy Outlook 2014*. Washington, DC: U.S. Department of Energy. Online at http://www.eia.gov/forecasts/aeo/pdf/0383(2014).pdf
[72] Cleetus, R., S. Clemmer, J. Deyette, and S. Sattler. 2014. Climate Game Changer: How a carbon standard can cut power plant emissions in half by 2030. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Carbon-Standards-Analysis-Union-of-Concerned-Scientists.pdf.
[73] EPA. 2014. Technical Support Document for GHG Abatement Measures, p.6-15.
[74] Martinez et al. 2011. A bright future for the heartland. Cambridge, MA: Union of Concerned Scientists.
[75] Richardson, L. J., R. Cleetus, S. Clemmer, and J. Deyette. Economic impacts on West Virginia from projected future coal production and implications for policymakers. *Environmental Research Letters* 9(2): 024006. doi:10.1088/1748-9326/9/2/024006.
[76] EPA. 2014. Framework for Assessing Biogenic CO_2 Emissions from Stationary Sources. United States Environmental Protection Agency, Office of Air and Radiation Office of Atmospheric Programs, Climate Change Division. Washington, DC. Online at http://www.epa.gov/climatechange/ghgemissions/biogenic-emissions.html
[77] http://www.epa.gov/climatechange/downloads/Biogenic-CO2-Emissions-Memo-111914.pdf

5. Coal to Gas Switching: Building Block 2

- **UCS supports using generation from excess capacity at existing NGCC plants to displace generation from coal and oil/gas steam units, as part of the Clean Power Plan's Building Block 2. The state re-dispatch targets set by the EPA are achievable in the 2020 timeframe, especially when accounting for the large number of coal units already planned for retirement between 2013 and 2020. However, given the growing evidence that an overreliance on natural gas poses significant and complex risks to consumers, public health, and the climate, we recommend the EPA consider ways to avoid incentivizing natural gas generation and overbuilding infrastructure at the expense of other cost-effective, lower carbon resource alternatives.**

- **UCS recommends that the EPA maintain its proposed 70 percent target utilization rate for existing NGCC in determining the BSER for Building Block 2.**

- **UCS recommends that the EPA increase the amount of generation from under construction NGCC units that is incorporated in the BSER re-dispatch calculation. The EPA's assumption that 79 percent of the total generation from under construction NGCC plants (e.g., a 55 percent capacity factor out of a total 70 percent capacity factor) would be utilized to meet new demand—and is therefore unavailable for re-dispatch purposes—overestimates the generation from these units likely to be used for new power demand rather than replacing generation from retiring coal units. We recommend reversing the EPA's proposed allocation of generation from under construction NGCC units so that a capacity factor of 55 percent is available for re-dispatch purposes, and a capacity factor of 15 percent is unavailable.**

- **UCS recommends that the EPA use a regional—rather than state—method for determining potential for gas re-dispatch, noting that regionalization generally leads to lower costs and more accurately aligns with the construct and operation of power grids across the nation.**

- **UCS recommends that the EPA also set standards to directly curb methane emissions from the oil and gas sector and update its GWP to 34 to more accurately conform to the latest science.**

5.1. UCS supports using generation from excess capacity at existing NGCC plants to displace generation from coal and oil/gas steam units, as part of the Clean Power Plan's Building Block 2.

Increasing generation from excess capacity at existing natural gas power plants is a sensible and cost-effective near-term action for displacing generation from higher carbon emitting sources. When combusted in an efficient, combined-cycle (NGCC) power plant, natural gas emits approximately 800 pounds of CO_2 per megawatt-hour (MWh)—an amount some 50 to 60 percent less than the amount emitted from a typical new coal plant.[78] Burning natural gas instead of coal also results in a number of immediate public health and environmental co-benefits. Natural gas combustion releases much smaller amounts of soot and smog-forming pollutants, including nitrogen oxides, sulfur dioxide, and fine particulates, which contribute to asthma and a variety of other lung, and heart, conditions. Moreover, unlike coal, natural-gas-fired electricity generation does not emit appreciable levels of mercury, arsenic, and other toxic substances that can cause adverse neurological effects in children and other health problems.[79]

Utilities and power producers across the country are already increasing output from natural gas power plants largely to replace aging coal plants that have become less and less economic. As a result of abundant supplies and low prices, generation from natural gas increased by nearly 30 percent between 2008 and 2013; at which time natural gas accounted for 27 percent of the total U.S. power supply.[80] Even historically heavy coal power-producing states are demonstrating the ability to rapidly shift from coal to natural gas. For example, between 2008 and 2013, natural gas generation in Georgia increased from 10 percent to 34 percent of the state's power mix. Similar jumps in natural generation during this period occurred in more than a dozen states, including North Carolina (3 percent to 22 percent), Virginia (13 percent to 29 percent), Ohio (2 percent to 15 percent), and Pennsylvania (9 percent to 22 percent).[81]

Despite the recent shift toward natural gas, there is still plenty of excess capacity in the U.S. natural gas power fleet that can be used to displace the coal and oil/gas steam generation embedded in the state targets under Building Block 2. For example in 2012, the NGCC fleet experienced capacity factors averaging between 44 percent and 46 percent. That is well below the 85 percent or higher capacity factors at which NGCC units are capable of producing. In fact, a recent analysis by the Union of Concerned Scientists found that in nearly every NERC region[82], the capacity factor needed for existing NGCC plants to replace both coal units already

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[78] National Energy Technology Laboratory. 2010. Cost and performance baseline for fossil energy plants, Volume 1: Bituminous coal and natural gas to electricity, Revision 2. DOE/NETL-2010/1397. Washington, DC: U.S. Department of Energy. Online at www.netl.doe.gov/energy-analyses/pubs/Bituminous%20Baseline_Final%20Report.pdf.

[79] Environmental Protection Agency (EPA). 2012a. Mercury: Basic information. Washington, DC: EPA. Online at www.epa.gov/mercury/about.htm. Clean Air Task Force. 2010. The toll from coal: An updated assessment of death and disease from America's dirtiest energy source. Boston, MA. Online at www.catf.us/resources/publications/view/138. Environmental Protection Agency. 2010. Federal implementation plans to reduce interstate transport of fine particulate matter and ozone; proposed rule. 40 CFR Parts 51, 52, 72, et al. Federal Register 75, August 2. Online at www.gpo.gov/fdsys/pkg/FR-2010-08-02/pdf/2010-17007.pdf. Gentner, B., and M. Bur. 2010. Economic damages of impingement and entrainment of fish, fish eggs, and fish larvae at the Bay Shore Power Plant. Silver Spring, MD: Gentner Consulting Group. Online at switchboard.nrdc.org/blogs/tcmar/BSSP.damages.final.pdf. National Research Council. 2010. Hidden costs of energy: Unpriced consequences of energy production and use. Washington, DC: National Academies Press. Online at www.nap.edu/catalog.php?record_id=12794. Trasande, L., P.J. Landrigan, and C. Schechter. 2005. Public health and economic consequences of methyl mercury toxicity to the developing brain. Environmental Health Perspectives 113(5):590–596. Online at www.ncbi.nlm.nih.gov/pmc/articles/PMC1257552/.

[80] Energy Information Administration. 2014. Electric power monthly Table 1.1. Washington, DC: U.S. Department of Energy. Online at www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_01.

[81] *Ibid.*

[82] The North American Electric Reliability Corporation (NERC) oversees reliability for a bulk power system that includes the United States and Canada. In this effort, NERC coordinates with eight regional entities to maintain and improve the reliability of the power system. These entities are composed of utilities, federal power agencies, rural cooperatives, independent power marketers, and end-use customers. For more information, see http://www.nerc.com.

planned for retirement and those units deemed economically vulnerable (105 gigawatts, or GW, of coal capacity in total) is well below 85 percent. On average across NERC regions, retiring coal can be replaced by boosting the existing NGCC national average capacity factor to about 58 percent.[83] All this evidence suggests that the state re-dispatch targets set by the EPA are achievable well within the 2020 timeframe, especially when accounting for the nearly 47 GW of coal units either already closed or planned for retirement between 2013 and 2020.

5.2. The EPA should consider ways to avoid incentivizing natural gas generation and overbuilding infrastructure at the expense of other cost-effective, lower carbon resource alternatives.

Despite its potential near-term economic and carbon benefits, there is growing evidence that an overreliance on natural gas poses significant and complex risks to consumers, the economy, public health and safety, land and water resources, and to the climate. For example, while its smokestack emissions are significantly cleaner than coal's, the extraction, distribution, and combustion of natural gas present serious environmental, public health, and climate change challenges.[84]

Replacing coal plants with natural gas plants will likely reduce the amount of CO_2 emitted for each megawatt-hour of U.S. electricity generated; however, a number of recent studies have concluded that abundant natural gas will do little to reduce overall heat trapping emissions.[85] Extensive modeling of future scenarios has found that, in addition to replacing coal, increased reliance on natural gas could delay the deployment of clean renewable energy. As demand for electricity grows and generating capacity is added to the system to meet it, demand that could have been met by new renewable energy resources might instead be met by natural gas. As a result, total carbon emissions will fail to approach the level of reductions needed to meet U.S. targets. Under certain scenarios, global warming emissions may actually increase.

Direct smokestack pollutants are not the only global warming emissions associated with natural gas. The drilling and extraction of the fuel from wells, and its distribution in pipelines, also results in the leakage of methane—a primary component of natural gas that is 34 times stronger than carbon dioxide at trapping heat over a 100-year period and 86 times stronger over 20 years.[86] While there is still uncertainty about the precise quantity of these so-called fugitive

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[83] Fleischman, L., R. Cleetus, J. Deyette, S. Clemmer, and S. Frenkel. 2013. Ripe for Retirement: An Economic Analysis of the U.S. Coal Fleet. The Electricity Journal 26(10):51-63. Online at dx.doi.org/10.1016/j.tej.2013.11.005.

[84] Fleischman, Lesley, Sandra Sattler, and Steve Clemmer. Gas ceiling: Assessing the climate risks of an overreliance on natural gas for electricity. Cambridge, MA: Union of Concerned Scientists, September 2013. Online at http://www.ucsusa.org/assets/documents/clean_energy/climate-risks-natural-gas.pdf.

[85] Shearer, C., Bistline, J., Inman, M. and Davis, J.D. 2014. The effect of natural gas supply on US renewable energy and CO_2 emissions. Environmental Research Letters 9(9):1–8. Online at iopscience.iop.org/1748-9326/9/9/094008/.

Energy Modeling Forum (EMF). 2013. Changing the game?: Emissions and market implications of new natural gas supplies. Stanford, CA. Online at web.stanford.edu/group/emf-research/docs/emf26/Summary26.pdf.

Newell, R.G. and Raimi, D. 2014. Implications of shale gas development for climate change. Environmental Science & Technology 48(15):8360–8368. Online at pubs.acs.org/doi/abs/10.1021/es4046154.

[86] Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang. 2013. Anthropogenic and Natural Radiative Forcing. In: Climate

methane emissions, preliminary studies and field measurements range from 1 to 9 percent of total natural gas production.[87] EPA should set standards to directly limit these methane emissions (see recommendation below).

Over the long-term, natural gas power plants are far less attractive from a climate standpoint than cleaner and much lower-carbon alternatives such as energy efficiency and renewable energy. And continuing to increase the nation's dependence on natural gas—as EIA forecasts project under current policy and market conditions[88]—could ultimately undermine progress toward long-term climate emission reduction goals while delaying the transition to a diverse and truly low-carbon electric power system. Consequently, we recommend the EPA consider ways—within the Clean Power Plan and using other regulatory authority as appropriate—to avoid incentivizing natural gas generation and overbuilding infrastructure at the expense of other cost-effective, lower carbon resource alternatives.

5.3. UCS recommends that the EPA maintain its proposed 70 percent target utilization rate for existing NGCC in determining the BSER for Building Block 2.

We find that the 70 percent capacity factor is a reasonable benchmark for NGCC usage, since many of these plants were designed to run at much higher rates, above 85 percent.[89] Also, a regionalized approach to setting gas re-dispatch targets (see below) would help alleviate concerns that some stakeholders have raised about the infrastructure needed to provide higher volumes of natural gas to these plants.

Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. .

[87] Tollefson, J. 2013. Methane leaks erode green credentials of natural gas. Nature 493(7430):12. Online at www.nature.com/news/methane-leakserode-green-credentials-of-natural-gas-1.12123#/ref-link-5. Cathles, L.M., L. Brown, M. Taam, and A. Hunter. 2012. A commentary on "The greenhouse-gas footprint of natural gas in shale formations" by R.W. Howarth, R. Santoro, and A. Ingraffea. Climatic Change 113(2):525–535. Online at cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/FINAL%20Short%20Version%2010-4-11.pdf. Howarth, R.W., D. Shindell, R. Santoro, A. Ingraffea, N. Phillips, and A. Townsend-Small. 2012. Methane emissions from natural gas systems. Background paper prepared for the National Climate Assessment, reference number 2011–0003. Online at www.eeb.cornell.edu/howarth/Howarth%20et%20al.%20--%20National%20Climate%20Assessment.pdf. Petron, G., G. Frost, B.R. Miller, A.I. Hirsch, S.A. Montzka, A. Karion, M. Trainer, C. Sweeney, A.E. Andrews, L. Miller, J. Kofler, A. Bar-Ilan, E.J. Dlugokencky, L. Patrick, C.T. Moore, Jr., T.B. Ryerson, C. Siso, W. Kolodzey, P.M. Lang, T. Conway, P. Novelli, K. Masarie, B. Hall, D. Guenther, D. Kitzis, J. Miller, D. Welsh, D. Wolfe, W. Neff, and P. Tans. 2012. Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study. Journal of Geophysical Research: Atmospheres 117(D4). Online at onlinelibrary.wiley.com/doi/10.1029/2011JD016360/abstract. Skone, T. 2012. Role of alternative energy sources: Natural gas power technology assessment, DOE/NETL-2011/1536. Washington, DC: U.S. Department of Energy. Weber, C., and C. Clavin. 2012. Life cycle carbon footprint of shale gas: Review of evidence and implications. Environmental Science and Technology 46:5688−5695. Online at pubs.acs.org/doi/abs/10.1021/es300375n.

[88] Energy Information Administration (EIA). 2014a. Annual Energy Outlook 2014. Online at www.eia.gov/forecasts/aeo/.

[89] See, e.g., North American Electric Reliability Corp., 2008-2012 Generating Unit Statistical Brochure—All Units Reporting, http://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx; Higher Availability of Gas Turbine Combined Cycle, Power Engineering (Feb. 1, 2011), http://www.power-eng.com/articles/print/volume-115/issue-2/features/higher-availability-of-gas-turbine-combined-cycle.html.

5.4. UCS recommends that the EPA increase the amount of generation from under construction NGCC units that is incorporated in the BSER re-dispatch calculation.

EPA has assumed that under construction NGCC plants are being built mostly to meet new electricity demand. Assuming those plants operate at 70 percent capacity factor, the agency assumes that a larger portion (a 55 percent capacity factor, meaning 79 percent of a new plant's generation) meets new demand, while the remaining 15 percent is available to displace existing fossil. However, this overestimates the amount of generation that will be utilized to meet new power demand because many of these plants are being built to replace retiring coal generation deemed uneconomic[90] due to age, lack of pollution controls, and cheaper alternatives.

Of the nine states with under construction NGCC units incorporated into the Building Block 2 target methodology, all except for California have significant planned coal generator retirements scheduled between 2012 and 2018 (Table 5-1). In fact, the total capacity of planned coal retirements in these states outweighs the capacity of under construction NGCC plants by nearly a factor of 2 to 1 (16,366 MW vs 8,938 MW). In some case, these under construction NGCC units are being built explicitly to replace the generation from retiring coal plants. For example, the 620 MW NGCC plant that Kentucky Utilities is building at Cane Run will replace the generation from coal units the utility is retiring at its Cane Run, Green River, and Tyrone facilities.[91]

Table 5-1. Comparison of Under Construction NGCC Capacity in Building Block 2 with Capacity of Planned Coal Retirements, by State.

	Under Construction NGCC Capacity (MW)*	Planned Coal Retirement Capacity (MW)*
California	1,855	0
Colorado	200	690
Florida	1,157	1,062
Kentucky	640	3,187
Mississippi	150	877
North Carolina	2,249	2,409
Ohio	539	5,971
Virginia	1,928	2,114
Wyoming	220	56
Total	8,938	16,366

*Under construction NGCC capacity is based on data included in the EPA Clean Power Plan. Planned coal retirement capacity data is from: Fleischman, L., R. Cleetus, J. Deyette, S. Clemmer, and S. Frenkel. 2013. Ripe for Retirement: An Economic Analysis of the U.S. Coal Fleet. The Electricity Journal 26(10):51-63. Online at dx.doi.org/10.1016/j.tej.2013.11.005; updated as needed with information from SNL Energy.

[90] Cleetus, R., S. Clemmer, E. Davis, J. Deyette, J. Downing, and S. Frenkel. 2012. Ripe for retirement: The case for closing America's costliest coal plants. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/assets/documents/clean_energy/%20Ripe-for-Retirement-Full-Report.pdf.

[91] Bandyk, M. 2013. "Kentucky Utilities facing new controls at coal plant under EPA settlement". SNL Energy, January 2. Online at https://www.snl.com/InteractiveX/article.aspx?ID=16707547&KPLT=2.

While it is difficult to precisely determine how much generation from new NGCC capacity will go toward displacing retiring coal, it is clear that the EPA's estimate is overly conservative. As a result, we recommend reversing the EPA's proposed allocation of generation from under construction NGCC units by allocating a capacity factor of 55 percent as available for re-dispatch purposes (and a capacity factor of 15 percent as unavailable), instead of the 15 percent available (versus 55 percent unavailable) that is assumed in the draft proposal.

5.5. UCS recommends that the EPA use a regional method for determining potential for gas re-dispatch, noting that regionalization generally leads to lower costs and more accurately aligns with the construct and operation of power grids across the nation.

As described in the October 28, 2014, Notice of Data Availability, the EPA is soliciting comment on whether to define the targets for Building Block 2 on the basis of the regional availability of additional NGCC capacity up to the 70 percent capacity factor. UCS validates this methodology as a way of making the targets for Building Block 2 more equitable across states; it would increase targets for states with little existing NGCC capacity (such as West Virginia and Kentucky) and ameliorate targets for states with large excess capacity (such as Texas and Florida). A regional approach would also more consistently align with ongoing grid operations and electricity dispatch decisions. Finally, regionalization of the gas re-dispatch targets would be more consistent with how the EPA calculates the renewable energy building block targets. We note that while our proposed stronger renewable energy targets (see part 7) are developed on a bottom-up approach from the state level, they can be easily regionalized in a similar manner for consistency.

5.6. UCS recommends that the EPA also set standards to directly curb methane emissions from the oil and gas sector, the second largest industrial contributor to greenhouse gas emissions.

To ensure that fuel switching from coal to natural gas results in significant emission reductions under the CPP, the EPA should also simultaneously implement strong standards to reduce fugitive methane emission from the production and distribution of natural gas. The natural gas industry is the largest industrial source of methane emissions at 23 percent of the total, and emissions are projected to increase as a result of the hydraulic fracturing boom.[92] The Obama Administration's recently released multi-sector strategy to cut methane emissions from agriculture, landfills, coal mines, and oil and gas production is an important step to reduce the climate risks of natural gas.[93] A recent study by Clean Air Task Force, NRDC and the Sierra Club estimates that the EPA could reduce the sector's methane pollution in half in a just few years by issuing nationwide methane standards that require common sense, low-cost pollution controls for the sector's top emitting sources including: regular leak detection and repair

[92] EPA. 2014. Inventory of U.S. greenhouse gas emissions and sinks, 1990-2012. Online at http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Main-Text.pdf.
[93] White House. 2014. Climate action plan: Strategy to reduce methane emissions. Online at http://www.whitehouse.gov/sites/default/files/strategy_to_reduce_methane_emissions_2014-03-28_final.pdf.

programs from all equipment at wellheads and processing and distribution points, upgrading older equipment, and capturing any natural gas that is released instead of flaring or venting it.[94]

5.7. UCS recommends that the EPA update its assumed global warming potential (GWP) for methane.

In its Regulatory Impact Analysis, the EPA assumes that methane has a GWP of 25 over 100 years,[95] as calculated in the IPCC's Fourth Assessment Report.[96] However, the recently released Fifth Assessment Report[97] puts that value at 34. This will allow a more accurate calculation (in terms of CO_2-equivalent) of avoided upstream methane emissions as a result of this rulemaking and other rules to directly regulate methane emissions.

[94] CATF, NRDC and Sierra Club. 2014. Waste Not: Common sense ways to reduce methane pollution from the oil and natural gas industry. Online at http://www.catf.us/resources/publications/files/WasteNot_Summary.pdf.
[95] EPA 2014. Regulatory Impact Analysis, p.3A-6.
[96] Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland. 2007. Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. (Table 2.14).
[97] Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang. 2013. Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. (Table 8.7).

6. Renewable Energy: Building Block 3

- **UCS strongly supports the inclusion of renewable energy as a compliance option in the Clean Power Plan, but recommends modifications to strengthen Building Block 3 that would use the most up-to-date data on renewable energy, set renewable energy growth rates at levels already being achieved by leading states, incorporate full compliance with current state renewable electricity standards, and reflect expected renewable energy growth between 2013 and 2017. UCS analysis shows nearly doubling EPA's renewable target to 23 percent of U.S. electricity sales by 2030 is affordable and would lead to greater emission reductions. This level corresponds with the best system of emission reduction (BSER), in contrast with the EPA's renewable energy proposal which is more of an "average system of emission reduction."**

- **UCS also recommends improvements to strengthen the EPA's Alternative Approach including eliminating the technical potential benchmarks, relying primarily on economic potential to set state and regional targets, using more up-to-date renewable energy cost and performance assumptions, and reflecting regional differences and existing state commitments.**

- **UCS recommends using and, where necessary, expanding on existing regional renewable energy credit (REC) tracking systems as the most effective mechanism for tracking state compliance, accounting for interstate effects, and preventing double counting. We also recommend requiring adjustments to take into account the emissions reductions associated with voluntary renewable energy purchases (RECs or "green power") to preserve the integrity of that market and the emissions reductions sought by voluntary institutional, commercial, and private purchasers, allowing such consumers to achieve reductions beyond those required under statutes and regulations.**

- **UCS recommends the EPA include the emission reductions from new renewables in the emission rate formula as a more consistent and equitable approach with how natural gas fuel switching is treated in Building Block 2, and exclude existing renewable energy and at-risk nuclear generation if the EPA opts to change the formula, given that their emission reductions are already embedded in the baseline emissions and generation mix**.

- **UCS supports incentives for early action, prior to 2020, to encourage investments in renewables and energy efficiency after a state compliance plan has been approved by the EPA, as long as these incentives do not undermine the overall level of emissions reductions achieved by the CPP.**

6.1. UCS strongly supports including renewable energy as a compliance option.

The EPA's decision to include renewable energy as an eligible compliance option for states to reduce power plant carbon emissions is sensible and meets the criteria for the BSER. Technologies such as wind and solar already deliver safe, reliable, and affordable power to millions of U.S. consumers, emit no carbon in their operation, and are an economically viable alternative to fossil fuels. All states have significant and diverse renewable energy resources that can be developed. And as a result of falling costs, advances in technology, and strong state policies, renewable energy technologies are in an excellent position to compete with the other emissions-reduction strategies allowed under the Clean Power Plan.

The U.S. power sector has experienced a tremendous growth in renewable energy, driven largely by advances in technology, decreases in costs, and state and federal policies. Wind capacity increased by 75 percent and solar capacity by 473 percent from 2009 to 2013.[98] The national average cost of wind power has dropped more than 60 percent since 2009, making it competitive with new fossil fuel plants in many regions.[99] Solar photovoltaic systems costs fell by about 40 percent from 2008 to 2012, and by another 15 percent in 2013.[100] Looking ahead, several studies project these two trends of improved technologies and reduced costs to continue.[101]

This growth in renewable energy has helped most utilities comply with their state RES requirements at little or no cost to consumers, and in some cases even providing them with net savings.[102] As highlighted in the EPA's GHG abatement measures technical support document (TSD), a recent federal government study, relying primarily on actual data from utilities and state regulators, found that between 2010 and 2012 the cost of complying with RESs in 25 states ranged from a net savings of 0.2 percent of retail rates to a net cost of 3.8 percent, with a weighted average cost of 0.9 percent.[103] The EPA also includes several other credible studies in

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[98] American Wind Energy Association (AWEA). 2014. U.S. wind industry annual market report 2013. Washington, DC: AWEA. Solar Energy Industries Association (SEIA). 2014. Solar energy facts: 2013 year in review. Washington, DC: SEIA. Online at www.seia.org/sites/default/files/YIR%202013%20SMI%20Fact%20Sheet.pdf, accessed on September 15, 2014.

[99] Wiser, R., and M. Bolinger. 2014. 2013 wind technologies market report. Washington, DC: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Online at http://eetd.lbl.gov/sites/all/files/2013_wind_technologies_market_report_final3.pdf, accessed on September 22, 2014.

[100] Kann, S., M.J. Shiao, S. Mehta, C. Honeyman, N. Litvak, and J. Jones. 2014. U.S. solar market insight report 2013. Washington, DC: Solar Energy Industries Association. Barbose, G., N. Darghouth, S. Weaver, and R. Wiser. 2013. Tracking the sun VI: An historical summary of the installed price of photovoltaics in the United States from 1998 to 2012, LBNL-6350E. Berkeley, CA: Lawrence Berkeley National Laboratory. Online at http://emp.lbl.gov/sites/all/files/lbnl-6350e.pdf, accessed on September 15, 2014.

[101] For example, see Bloomberg New Energy Finance (BNEF). 2014. 2030 market outlook. Online at http://bnef.folioshack.com/document/v71ve0nkrs8e0, accessed on September 15, 2014. International Renewable Energy Agency (IRENA). 2014. REthinking Energy: Towards a new power system**.** Online at www.irena.org/rethinking/Rethinking_FullReport_web.pdf, accessed on September 15, 2014. National Renewable Energy Laboratory (NREL). 2012a. Renewable electricity futures study, NREL/TP-6A20-52409. Golden, CO: NREL. Online at www.nrel.gov/analysis/re_futures/, accessed on September 15, 2014. Lantz, E., R. Wiser and M. Hand. 2012. IEA Wind Task 26: The Past and Future Cost of Wind Energy. National Renewable Energy Laboratory. NREL/TP-6A20-53510. Online at: http://www.nrel.gov/docs/fy12osti/53510.pdf. U.S. Department of Energy (DOE). 2012. Sunshot vision study. Online at http://www1.eere.energy.gov/solar/pdfs/47927.pdf.

[102] Union of Concerned Scientists (UCS). 2013. How renewable electricity standards deliver economic benefits. Cambridge, MA: UCS. Online at www.ucsusa.org/assets/documents/clean_energy/Renewable-Electricity-Standards-Deliver-Economic-Benefits.pdf, accessed on September 15, 2014.

[103] Heeter, J., G. Barbose, L. Bird, S. Weaver, F. Flores-Espino, K. Kuskova-Burns, and R. Wiser. 2014. A survey of state-level cost and benefit estimates of renewable portfolio standards. Golden, CO: National Renewable Energy Laboratory. Online at www.nrel.gov/docs/fy14osti/61042.pdf, accessed on September 19, 2014.

the TSD that demonstrate the cost-effectiveness of increasing renewable energy at the state and regional level and highlight the recent cost reductions for wind and solar.[104]

6.2. The EPA's proposed renewable energy targets fall well short of the BSER.

While the EPA draft rule sensibly allows states to use renewable energy as an affordable way to meet their emissions reduction targets, it significantly *underestimates*, in several ways, the potential role of renewable energy in setting state targets as part of the BSER. The Clean Power Plan does not adequately capture renewable energy deployment rates that states are already achieving. The plan also fails to reflect the continued growth and falling costs of renewable energy projected by market experts. Indeed, the EPA's proposal falls short of the national renewable energy generation levels that the U.S. Energy Information Administration (EIA) projects would occur in 2020 under a business-as-usual approach without the CPP, and is only marginally higher than the EIA's projections by 2030 (Figure 6-1).[105]

The EPA's proposed approach for setting state renewable energy targets based on the regional average of state renewable electricity standards in 2020 does not represent the CAA-required "best" system of emission reduction, but more of a "average" or even "below-average" system for many states. The EPA's proposed approach results in the following anomalies:

- In seven states, actual renewable energy generation levels in 2013 exceed the EPA's renewable energy targets in 2030.
- Seventeen of the 29 states with RES policies have lower targets under the EPA approach than what is required under their respective state laws, which is due both to the EPA's averaging of state RES targets in given region and not including RES targets that continue to ramp-up after 2020 in many states.
- The national level of renewable energy generation included in the EPA's state targets is lower than the EIA's business-as-usual projections in 2020, and only marginally greater in 2030 (Figure 6-1).
- The average annual national renewable energy growth rate under the EPA proposal is 0.65 percent of total sales between 2017 and 2030. By contrast, 15 states have already been achieving average annual growth rates of more than 1 percent over the last five years.

[104] See pp. 4-30 to 4-32 of the EPA's GHG Abatement Measures Technical Support Document, June 2014.

[105] Energy Information Administration (EIA). 2014. Annual energy outlook 2014. Washington, DC: U.S. Department of Energy. Environmental Protection Agency (EPA). 2014. Technical support document (TSD) for carbon pollution guidelines for existing power plants: Emission guidelines for greenhouse gas emissions from existing stationary sources: Electric utility generating units, EPA-HQ-OAR-2013-0602. Washington, DC: EPA. Online at www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-ghg-abatement-measures.pdf, accessed on September 15, 2014.

- Although the EPA's methodology aims to have states ramp up their renewable energy level toward reaching their respective regional targets, as many as 25 states do not actually reach the EPA's targets by 2030 because of the low annual growth rates assumed under the agency's proposed approach.

- The EPA does not assume any growth in renewable generation between 2012 and 2017.

The EPA's alternative approach for the renewable energy building block, which is based on technical and economic potential, also underestimates the potential for renewable energy to cut carbon emissions. Nationally, it results in virtually the same renewable energy target as the EPA's proposed approach, though the distribution of renewable energy differs at the state and regional level. (See section 6.4 for other suggested improvements to the EPA's alternative approach.)

Most states have the technological and economic potential to raise their renewable energy use to much higher levels than what the EPA is proposing in the Clean Power Plan. By specifying a larger role for renewable energy in setting state targets, the EPA could ensure that the Clean Power Plan achieves greater overall carbon emissions reductions.

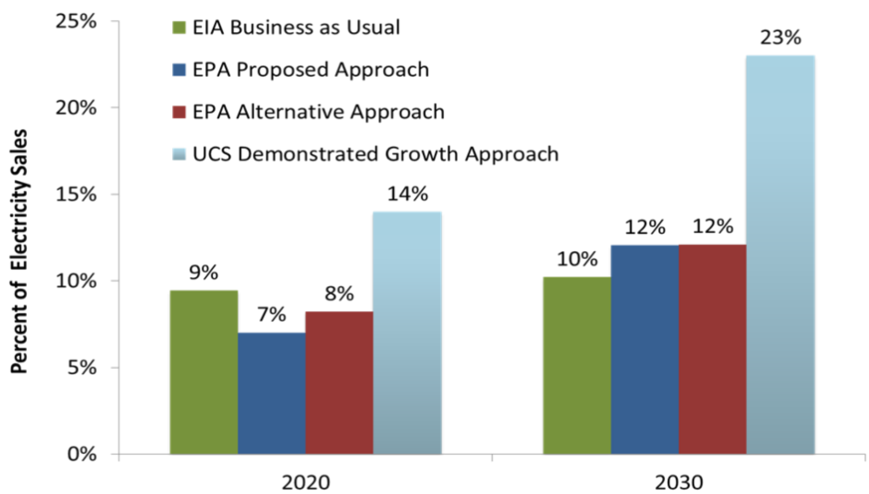

Figure 6-1. The EPA's Renewable Energy Targets Under Its Proposed Clean Power Plan Are Modest.[106] *The renewable energy targets under the EPA's Proposed and Alternative Approaches significantly underestimate the potential of these resources, and result in barely any additional renewable energy beyond what would have occurred under business as usual (i.e., without the proposed rule). By contrast, if the EPA adopted*

[106] Environmental Protection Agency (EPA). 2014a. Technical support document (TSD) for carbon pollution guidelines for existing power plants: Emission guidelines for greenhouse gas emissions from existing stationary sources: Electric utility generating units, EPA-HQ-OAR-2013-0602. Washington, DC: EPA. Online at www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-ghg-abatement-measures.pdf, accessed on September 15, 2014. EIA 2014.

a modified Union of Concerned Scientists proposal for setting state targets—the UCS Demonstrated Growth Approach—grounded in states' actual experience in deploying renewable energy, the renewable energy targets within the plan would nearly double at the national level.

6.3. UCS recommends strengthening the renewable energy building block by adopting the UCS Demonstrated Growth Approach.

UCS recommends modifications to the renewable energy building block that are a logical outgrowth of the EPA's approaches for determining the BSER for the renewable energy building block. Specifically, the EPA should revise its methodology regarding the renewable energy building block's contribution to state targets, by setting renewable energy growth rates that are already being achieved by many states. The EPA should also incorporate full compliance with current state RES laws. In addition, the EPA should use actual generation data from 2013 (or the most recent year available) and include recent and planned renewable energy development between 2013 and 2017. Finally, the EPA should commit to reviewing and strengthening state emissions reduction targets, as well as state renewable energy targets, by 2025, to ensure that the Clean Power Plan is updated to reflect the latest opportunities for cutting CO_2 emissions.[107]

The modified approach that we recommend for setting state renewable energy targets, called the UCS Demonstrated Growth Approach, builds on and improves both of the EPA's approaches by incorporating the following core components:

- Setting a national renewable energy growth rate benchmark based on demonstrated growth in the states from 2009 to 2013;
- Assuming full compliance with current state RES policies, as set by law, that require certain percentages of electricity to come from renewable sources; and
- Accounting for actual and expected renewable energy growth between 2013 and 2017.

As under the EPA approaches, we assume state-level renewable energy targets begin in 2017, the proposed start date for state compliance plans, and ramp up through 2030. To determine each state's 2017 baseline generation levels, we use EIA's actual renewable generation data from 2013[108] (the EPA's approach uses 2012 data) and add projected generation from wind and utility-scale solar projects known to be under construction through 2016.[109]

To calculate state renewable energy targets for 2030, we employ a four-step approach:

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[107] UCS. 2014. Strengthening the EPA's Clean Power Plan: Increasing renewable energy use will achieve greater emission reductions. Online at http://www.ucsusa.org/renewablesandcleanpowerplan.
[108] Energy Information Administration (EIA). 2014. Electricity data browser. Washington, DC: U.S. Department of Energy. Online at www.eia.gov/electricity/data/browser/, accessed on September 15, 2014.
[109] Wind projects under construction are based on data from the American Wind Energy Association's U.S. Wind Industry Second Quarter 2014 Market Report, online at: http://awea.files.cms-plus.com/FileDownloads/pdfs/2Q2014%20AWEA%20Market%20Report%20Public%20Version%20.pdf. Utility solar PV projects under construction are based on data from SNL Energy's Power Projects Database.

1. First, we use EIA data to calculate each state's average renewable energy growth rate over the five-year period from 2009 to 2013.[110] We find that, on average, states increased their renewable share of electricity sales by 1 percent annually. This growth rate serves as our national benchmark. The 2009–2013 benchmark period accounts for the recent rapid growth in wind and solar technologies; it eases fluctuations in development due to uncertainty around federal tax credit expirations and extensions; and it captures much of the historic development spurred by state RES policies—a key driver of renewables growth. Eleven of the 15 leading states that have achieved growth rates at or above the national benchmark from 2009 to 2013 have also achieved a 1 percent or higher average annual growth rate over a 10-year period from 2004 to 2013.

2. For states below the 1 percent national benchmark, we assume that they gradually ramp up to that rate from 2017 to 2020 in a similar way that the EPA assumes energy efficiency targets would ramp up in Building Block 4. This period serves as an opportunity for states that have not been as active in deploying new renewable energy sources to catch up to the national benchmark. Renewable energy is assumed to grow after 2020 in these states at an annual rate of 1 percent of total sales through 2030.

3. For the 15 leading states among those that have been deploying renewable energy at or above the national benchmark, we increase their respective renewable energy targets from 2017 to 2030 at each state's average annual growth rate during the five-year benchmark period, up to a maximum of 1.5 percent per year. We view this as a reasonable limit that can be sustained over time in states with strong renewable energy potential. This is supported by the fact that seven states have achieved annual average growth rates of 1.5 percent or more over a 10-year period from 2004 to 2013 based on EIA data. Moreover, a 1.5 percent growth rate is consistent with renewable energy targets set by leading RES states.

4. Finally, to account for full compliance with mandatory state RES laws, we assume that states achieve the greater of two measures: the generation projected by our growth rate approach; or the level needed to meet states' respective RES targets for each year from 2017 to 2030, as projected by the Department of Energy's Lawrence Berkeley National Laboratory.[111] To ensure reasonably achievable renewable energy penetration rates during the compliance period, we also cap the total share of renewable generation for any state at 40 percent of total state electricity sales, a level that several studies by grid operators, utilities, and government agencies have shown can be achieved at the state and

[110] EIA 2014.

[111] Lawrence Berkeley National Laboratory (LBNL). 2013. Renewables portfolio standards resources. Online at http://emp.lbl.gov/rps, accessed on September 15, 2014.

regional level in this timeframe while maintaining reliability.[112] Only seven states hit this cap prior to 2030.

Key constraints included in our proposal, such as the 1.5 percent annual growth rate cap and the 40 percent cap on the overall target, are reflective of current conditions and thus should be flexible over time. As the EPA undertakes regular reviews of the Clean Power Plan, which should occur at least every eight years as allowed by the Clean Air Act, these constraints could be adjusted upward or eliminated to reflect improvements in renewable energy technologies, grid integration techniques, and falling costs.

6.3.1. The UCS Demonstrated Growth Approach delivers more renewable energy in every region and nearly every state.

The UCS proposal leads to stronger renewable energy targets for states than those proposed in the EPA's draft Clean Power Plan. If all states met these targets, the nation's electricity coming from renewable energy in 2020 would double compared with the EPA's proposal—from 7 percent of total U.S. electricity sales to 14 percent. By 2030, it would result in a 23 percent share of renewable energy, as compared with 12 percent under the current the EPA proposal. All regions of the country, as defined by the EPA in the proposed standard, would see higher renewable energy targets under our improved methodology (Figure 6-2), with higher targets in all but four states (Figure 6-3).

[112]For example, see GE Energy Consulting. 2014. Minnesota Renewable Energy Integration and Transmission Study Final Report. Prepared for the Minnesota Department of Commerce. Online at https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId=%7bD607FB96-F80C-49EE-A719-39C411D5D7C3%7d&documentTitle=201411-104466-01. GE Energy Consulting. 2014. PJM Renewable integration study. Schenectady, NY: General Electric International, Inc. Online at http://pjm.com/~/media/committees-groups/task-forces/irtf/postings/pris-executive-summary.ashx, accessed on September 23, 2014. National Renewable Energy Laboratory (NREL). 2012a. Renewable electricity futures study, NREL/TP-6A20-52409. Golden, CO: NREL. Online at www.nrel.gov/analysis/re_futures/, accessed on September 15, 2014. National Renewable Energy Laboratory (NREL). 2012b. Integrating wind and solar energy in the U.S. bulk power system: Lessons from regional integration studies. Golden, CO: NREL. Online at http://variablegen.org/wp-content/uploads/2012/11/55830-LessonsfromEWITSandWWSIS.pdf, accessed on September 19, 2014. Wiser and Bolinger, 2014.

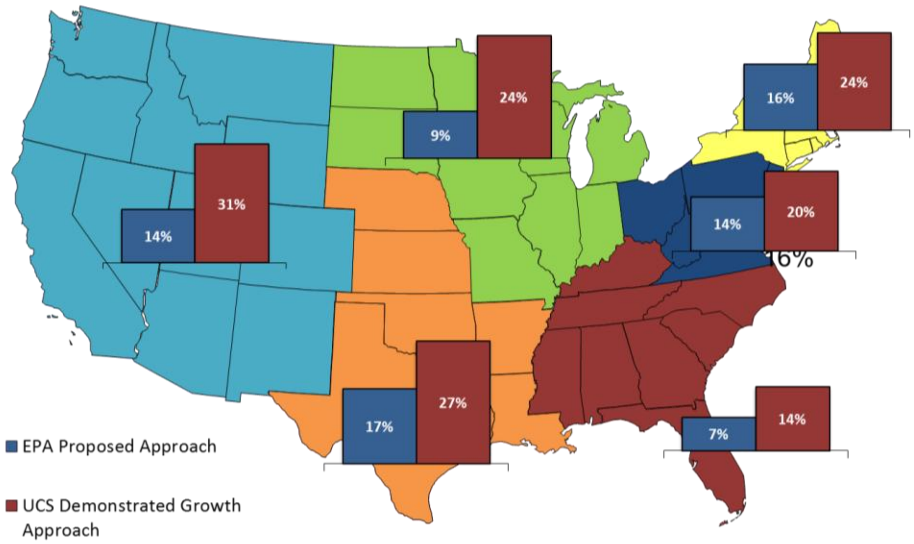

Figure 6-2. Regional Comparison of Renewable Energy Targets, 2030.[113] *The UCS Demonstrated Growth Approach for setting state targets under the Clean Power Plan's renewable energy building block leads to higher targets for 2030 than does the EPA's Proposed Approach, and in every region of the country, as defined by the EPA. In the upper Midwest, West, and Southeast regions, the amount of cost-effective renewable energy generation included in the targets at least double.*

Some of the largest increases in renewable energy targets occur in the leading renewable energy states of the Upper Midwest and the West. Under the EPA's approach, many of the renewable energy targets in these states reflect little, if any, more renewable energy than what they have already achieved. By contrast, our approach encompasses the reasonable expectation that these states will continue to grow at rates similar to what they are currently demonstrating. Further, we assume that full compliance with current state RES policies—a legal requirement, where they exist—should be incorporated into state renewable energy targets. This assumption has the greatest effect among Northeast and Mid-Atlantic States.

[113] EPA 2014a. Technical support document (TSD) for carbon pollution guidelines for existing power plants: Emission guidelines for greenhouse gas emissions from existing stationary sources: Electric utility generating units, EPA-HQ-OAR-2013-0602. Washington, DC. Online at www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-ghgabatement-measures.pdf.

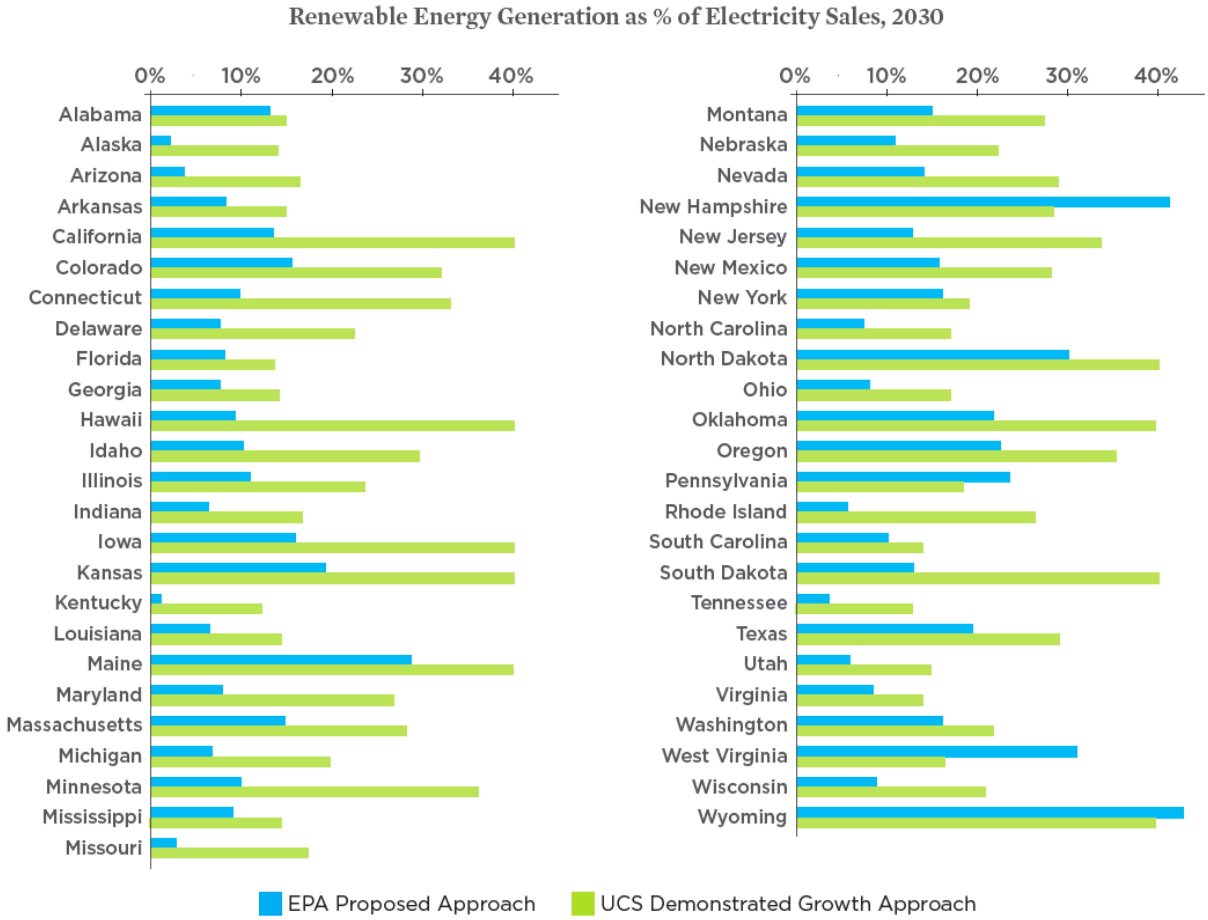

Figure 6-3. Comparison of State Renewable Energy Targets, 2030.[114] *This chart compares the EPA's proposed 2030 renewable energy targets for each state with those of the modified approach recommended by the UCS. As the chart illustrates, the EPA has underestimated the level of renewable energy that can cost-effectively contribute to state emission reduction targets. Nationally, the UCS approach nearly doubles the proportion of renewable energy included in the state targets.*

Table 6-1. Renewables Generation in GWh by State under the UCS Demonstrated Growth Approach.*

State	2020	2025	2030
Alabama	5,711	10,872	16,246
Alaska	322	671	1,036
Arizona	6,762	11,297	16,120
Arkansas	2,927	5,604	8,403
California	92,177	106,506	121,294
Colorado	12,371	17,213	22,360

[114] Cleetus, R., S. Clemmer, J. Deyette, S. Mullendore, and J. Richardson. 2014. Strengthening the EPA's Clean Power Plan. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/sites/default/files/attach/2014/10/Strengthening-the-EPA-Clean-Power-Plan.pdf.

Connecticut	7,329	8,896	10,473
Delaware	1,741	2,377	3,046
Florida	10,688	23,218	36,391
Georgia	7,252	14,703	22,538
Hawaii	2,619	3,149	4,485
Idaho	4,774	6,931	9,224
Illinois	20,146	29,773	37,889
Indiana	8,129	13,821	19,643
Iowa	20,313	21,063	21,558
Kansas	14,893	17,982	18,405
Kentucky	3,403	9,845	16,553
Louisiana	4,950	9,860	14,993
Maine	4,950	5,023	5,033
Maryland	12,758	16,262	19,946
Massachusetts	10,618	13,493	16,387
Michigan	11,573	17,211	22,979
Minnesota	19,041	23,623	28,341
Mississippi	2,871	5,728	8,701
Missouri	6,922	11,842	16,580
Montana	2,577	3,727	4,951
Nebraska	4,138	5,921	7,756
Nevada	7,471	10,232	13,166
New Hampshire	2,161	2,741	3,325
New Jersey	18,562	22,432	26,328
New Mexico	5,564	6,953	8,430
New York	13,860	21,320	28,828
North Carolina	11,621	18,959	26,674
North Dakota	6,870	7,123	7,290
Ohio	12,141	20,328	28,703
Oklahoma	17,906	22,989	28,304
Oregon	11,616	15,574	19,711
Pennsylvania	12,882	20,329	27,825
Rhode Island	1,367	1,777	2,191
South Carolina	4,091	8,557	13,252
South Dakota	3,727	4,735	5,584
Tennessee	3,821	9,444	15,299
Texas	81,548	105,000	129,521
Utah	2,092	3,910	5,842
Virginia	5,932	12,159	18,707
Washington	13,212	18,398	23,818
West Virginia	2,581	4,358	6,226

Wisconsin	8,605	12,389	16,259
Wyoming	5,567	7,101	8,731
National	**555,154**	**773,416**	**995,343**

*For more information on annual targets, see Appendix 2 and the attached spreadsheet.

6.3.2. Achieving higher levels of renewable energy generation under the UCS Demonstrated Growth Approach is technically feasible.

We compared the levels of renewable energy called for under our approach relative to the renewable energy technical potential available at the regional level, using the same data from NREL that the EPA relied on for its alternative approach.[115] In every CPP-region, our approach requires only a small fraction of the vast renewable energy resources that are technically available (Figure 6-4). The technical potential based on the EPA's methodology includes utility and distributed solar photovoltaics, onshore wind, geothermal, and bioenergy.

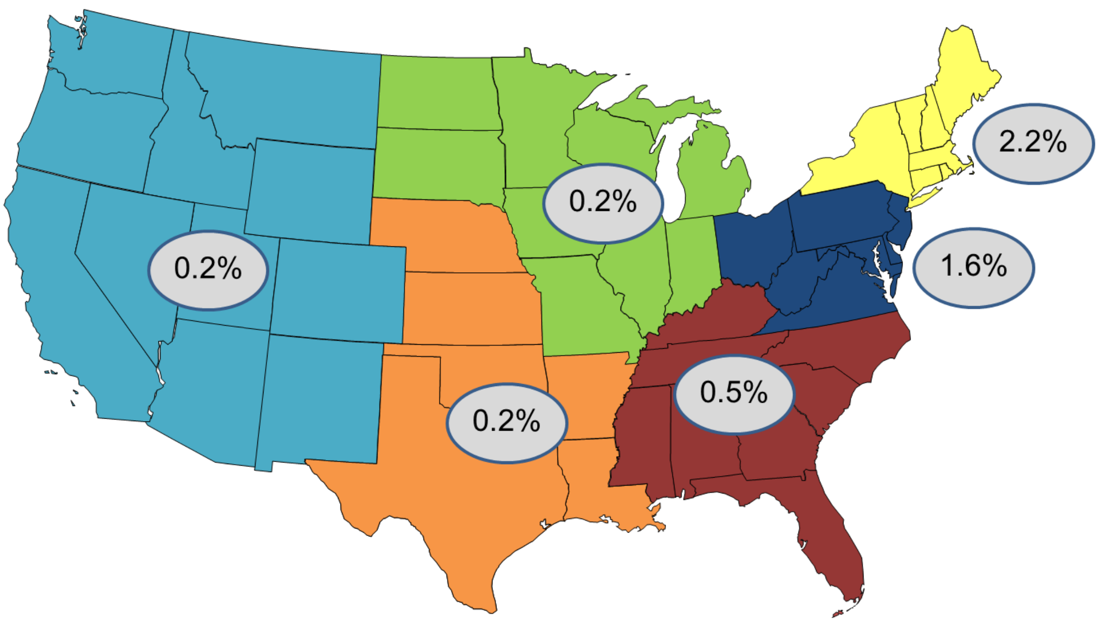

Figure 6-4. Regional Renewable Targets under the UCS Demonstrated Growth Approach as a Percent of Regional Renewable Energy Technical Potential.

Notably, these estimates do not include the tremendous offshore wind potential in the U.S., which the EPA excluded because they claimed that the technology has not been adequately demonstrated to qualify for the BSER. A recent DOE report shows 14 offshore wind projects totaling 4.9 GW are in advanced stages of development in nine states and the Virgin Islands.[116] Given the status of these projects, and the likelihood that states will include them in their state

[115] Lopez et al. 2012. U.S. renewable energy technical potentials: A GIS-based analysis. (July 2012). Golden, CO: National Renewable Energy Laboratory. Online at http://www.nrel.gov/gis/re_potential.html.
[116] Wiser and Bolinger, 2014.

compliance plans, we recommend that the EPA consider including a contribution from offshore wind as a potential BSER option over time.

6.3.3. The UCS Demonstrated Growth Approach is affordable and will result in greater emission reductions.

Using the National Renewable Energy Laboratory's Regional Energy Deployment System (ReEDS) model, we analyzed the impacts on CO_2 emissions, electricity and natural gas prices, and the electricity generation mix of achieving the state renewable energy targets under the UCS approach compared with business as usual. We believe our analysis is a reasonable approximation of the incremental costs and impacts of increasing renewables under the Clean Power Plan. We did not analyze the full impacts of implementing the entire draft rule, but focused exclusively on the renewable energy building block. Our analysis also included updates to technology cost and performance assumptions that reflected data from recent project installations and mid-range projections from several recent studies as discussed in more detail below and a separate technical appendix.[117]

Under the UCS approach, total CO_2 reductions achieved by the Clean Power Plan could increase from 30 percent below 2005 levels to nearly 40 percent. The ReEDs modeling showed that the additional renewable energy generation would displace mostly natural gas. If more coal were displaced, total emissions reductions could increase above these levels. And of course, improvements in other building blocks within the Clean Power Plan, as well as states' decisions to deploy renewable energy beyond their targets, could further increase the total level of emissions reductions.

Achieving higher renewable energy targets under the Clean Power Plan is also affordable. Diversifying the electricity mix with renewable energy would help reduce the economic risks associated with an overreliance on natural gas.[118] Reducing the demand for natural gas would also lead to lower and more stable natural gas and electricity prices.

Under the UCS proposed approach, national average consumer electricity prices were a maximum of 0.3 percent higher per year than business as usual through 2030 (Figure 6-5). As a result, a typical household (using 600 kWh per month) would see a maximum increase of 18 cents on their monthly electricity bill on average at the national level. Under the UCS proposal, the national average price of natural gas delivered to the electricity sector would be 9 percent lower than business as usual by 2030 (Figure 6-5). At the regional level, average consumer electricity prices would range from a 3.7 percent reduction to a 3.4 percent increase, while power sector natural gas price reductions would range from 8 percent to 17 percent by 2030.

[117] See Appendix 1 for documentation on the ReEDs methodology and assumptions.
[118] Bolinger, M. 2013. Revisiting the long-term hedge value of wind power in an era of low natural gas prices. Golden, CO: Lawrence Berkeley National Laboratory. Online at http://emp.lbl.gov/sites/all/files/lbnl-6103e.pdf, accessed on October 2, 2014. Fagan, B., P. Lucklow, D. White, and R. Wilson. 2013. The net benefits of increased wind power in PJM. Cambridge, MA: Synapse Energy Economics, Inc. Mercurio, A. 2013. Natural gas and renewables are complements, not competitors. Washington, DC: Energy Solutions Forum, Inc.

Previous studies have shown that reducing natural gas use in the electricity sector with renewables and energy efficiency can also help reduce consumer natural gas prices and bills for heating, manufacturing, and other uses.[119] For example, a 2007 EIA analysis found that implementing a national RES of 25 percent by 2025 would lower cumulative (from 2009 through 2030) consumer natural gas bills by $17 billion (or 1 percent), more than offsetting the cumulative $15 billion (0.4 percent) increase in consumer electricity bills.[120] These benefits are not captured in our analysis, which uses an energy model that focuses only on the power sector.

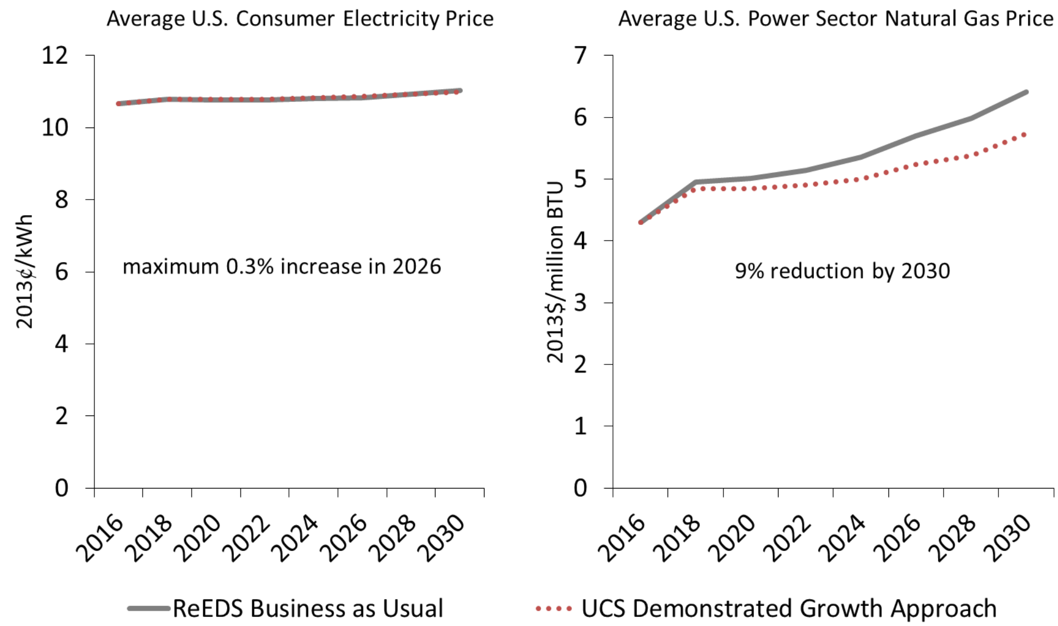

Figure 6-5. UCS Renewable Energy Targets are Affordable.

We also found that the incremental cost of increasing renewables under the UCS proposal was at or below $30/MWh, the range that the EPA identifies as meeting the BSER cost criteria under the Clean Power Plan.[121] These results assume national trading of renewable energy credits

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119 Cleetus, R., S. Clemmer, and D. Friedman. 2009. Climate 2030: A national blueprint for a clean energy economy. Cambridge, MA: Union of Concerned Scientists. Online at www.ucsusa.org/global_warming/solutions/big_picture_solutions/climate-2030-blueprint.html, accessed on September 19, 2014. Union of Concerned Scientists (UCS). 2009. Clean power, green jobs. Cambridge, MA: UCS. Online at www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/Clean-Power-Green-Jobs-25-RES.pdf, accessed on October 2, 2014. EIA. 2007. Energy and economic impacts of implementing both a 25-percent Renewable Portfolio Standard and a 25-percent Renewable Fuel Standard by 2025. Washington, DC: US Department of Energy. Online at http://www.eia.gov/analysis/requests/2007/eeim/pdf/sroiaf(2007)05.pdf. Wiser R., M. Bolinger and M. Clair. 2005. Easing the natural gas crisis: Reducing natural gas prices through increased deployment of renewable energy and energy efficiency. Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory.

120 See p. 17 of: EIA. 2007. Energy and economic impacts of implementing both a 25-percent Renewable Portfolio Standard and a 25-percent Renewable Fuel Standard by 2025. Washington, DC: US Department of Energy. Online at http://www.eia.gov/analysis/requests/2007/eeim/pdf/sroiaf(2007)05.pdf.

121 Environmental Protection Agency (EPA). 2014b. Clean Power Plan proposed rule: Alternative renewable energy approach: Technical support document. Washington, DC: EPA. Online at www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-alternative-renewable-energy-approach, accessed on September 15, 2014. Environmental Protection Agency (EPA). 2014c. Carbon pollution emission guidelines for existing stationary sources: Electric utility generating units, 79 FR 34829, pp. 34829–34958. Online at https://federalregister.gov/a/2014-13726, accessed on September 15, 2014.

(RECs). RECs represent the energy and environmental attributes of renewable electricity and serve as the basis for documenting ownership rights and trading transactions across the United States in both RES and voluntary markets. RECs and existing REC tracking systems would also be effective in accounting for the contribution of renewable energy within the Clean Power Plan framework, as discussed in more detail section 6.5.

If there are any limits placed on trading between regions, experience with renewable energy markets suggests that REC prices would likely be higher in some regions and lower in other regions of the country.[122] Furthermore, increasing renewable energy, in combination with other technologies and measures to cut carbon emissions—such as greater investments in energy efficiency or more fuel switching from coal to natural gas—would lead to different impacts on energy prices and consumer bills.

Our modeling results also show a diverse mix of renewable energy resources being deployed, including significant increases in onshore wind and solar energy and more modest contributions from geothermal and biomass (Figure 6-6). We should note that our methodology is technology neutral and there could be significant regional variation in the actual renewable energy resources deployed. Of course, state policies that are implemented to help achieve compliance with the rule could also impact what renewable resources get developed. For example, this could result in more offshore wind development on the east coast.

[122] Heeter, J., G. Barbose, L. Bird, S. Weaver, F. Flores-Espino, K. Kuskova-Burns, and R. Wiser. 2014. A survey of state-level cost and benefit estimates of renewable portfolio standards. Golden, CO: National Renewable Energy Laboratory. Online at www.nrel.gov/docs/fy14osti/61042.pdf, accessed on September 19, 2014.

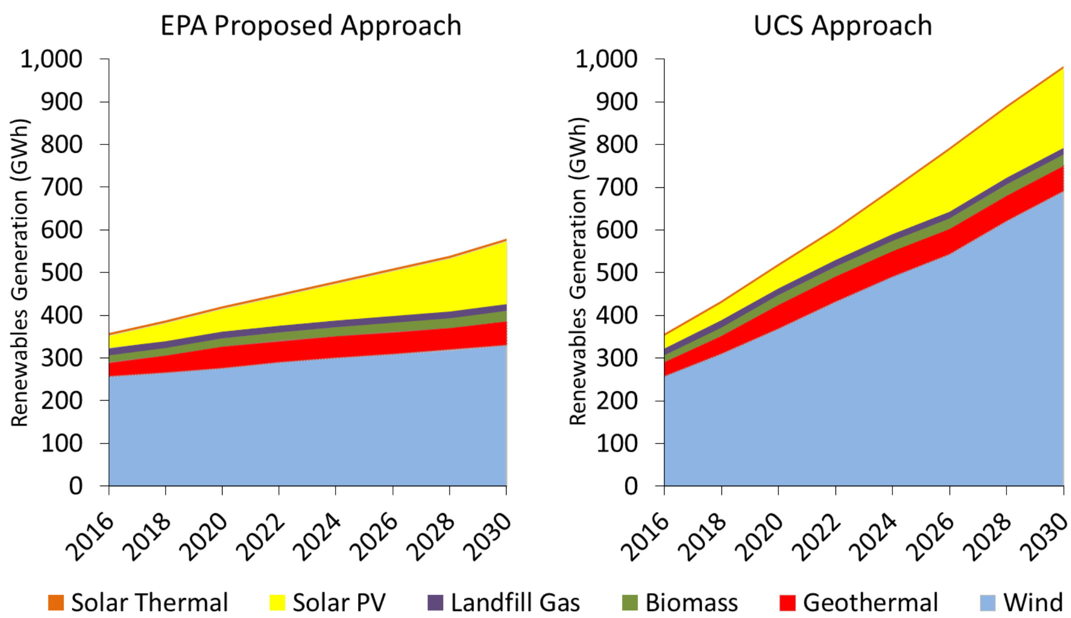

Figure 6-6. U.S. Renewable Generation Mix Under the EPA Proposed Approach vs. the UCS Demonstrated Growth Approach, Based on UCS ReEDs Modeling.

6.3.4. The UCS Demonstrated Growth Approach is robust across a range of assumptions.

We analyzed sensitivities related to key parameters in our approach and found that it is robust to these changes. The sensitivities we analyzed included:

- Setting all states growth rate at 1 percent, instead of allowing leading states to grow at a higher rate up to 1.5 percent;
- Capping the share of electricity sales from renewable energy at 33 percent, instead of 40 percent;
- Removing the requirement that states would need to increase renewable energy by at least the level needed to meet states' respective RES targets for each year from 2017 to 2030; instead only the growth rate of 1 to 1.5 percent would apply;
- Removing the 40 percent cap on the share of electricity sales from renewable energy;
- Removing the 1.5 percent cap on a state's annual renewable energy growth rate and assuming it will continue to increase at the average annual growth rate from 2009-2013;
- Removing both the 40 percent cap and the 1.5 percent cap.

Compared with our core approach which delivered 23 percent renewable energy by 2030, these sensitivities resulted in a range of 20.3 percent to 25.3 percent (Figure 6-7).

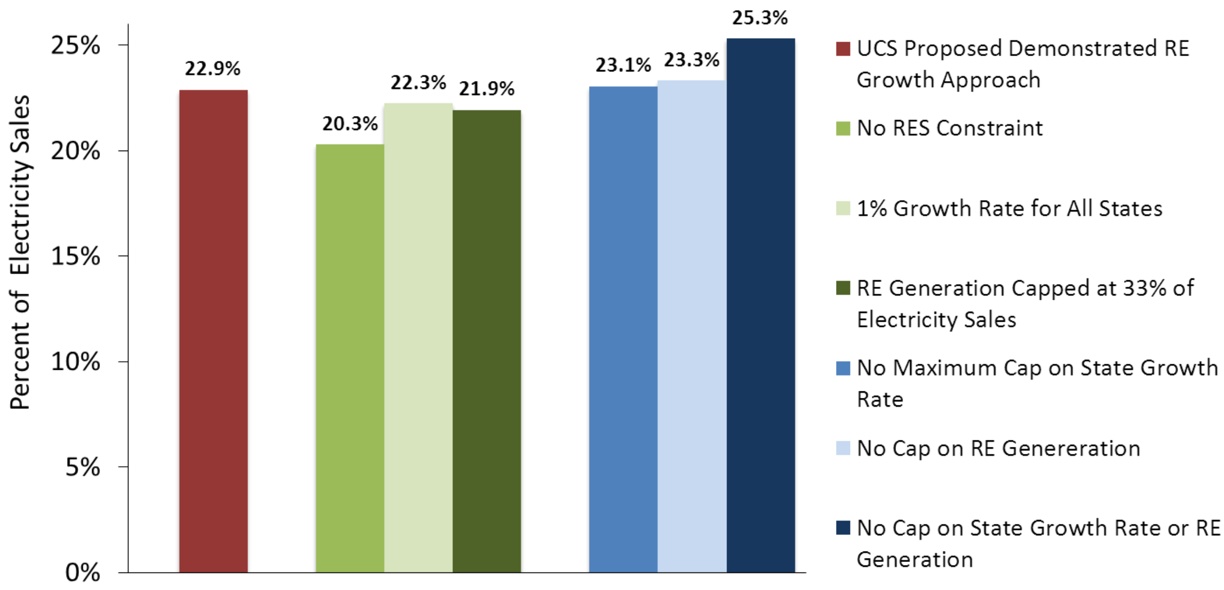

Figure 6-7. UCS Demonstrated Growth Approach Sensitivity Analysis. *Note: The underlying data are included in the UCS State Level Data spreadsheet uploaded as an attachment to these comments.*

6.4. UCS recommends that the EPA, if it adopts its Alternative Approach, eliminate the technical potential benchmarks, rely primarily on economic potential to set state and regional targets, use updated renewable energy cost and performance assumptions, and reflect regional differences and existing state commitments.

While the UCS Demonstrated Growth Approach is our preferred approach for strengthening the renewable energy building block, we also offer two other options that are focused on improving the EPA's Alternative Approach. Under this approach, the EPA set state targets based on the lesser of an assessment of the economic/market potential as projected by their own Integrated Planning Model (IPM) modeling, or a national benchmark rate for renewables deployment informed by data on existing renewable energy generation and resource technical potential.[123] This approach significantly underestimates the potential for renewable energy to cut carbon emissions. Nationally, it results in virtually the same renewable energy target as the EPA's Proposed Approach (Figure 6-1), though the distribution of renewable energy differs at the state and regional level.

The first option for strengthening the EPA's Alternative Approach relies primarily on the economic potential of renewable energy to set state and regional targets, but recommends several improvements to the EPA's methodology and modeling assumptions to develop a more realistic estimate of economic potential. The second, less preferred, option incorporates regional differences in renewable energy market penetration rates. Similar to the UCS Demonstrated

[123] Environmental Protection Agency (EPA). 2014. Clean Power Plan Proposed Rule: Alternative renewable energy approach: Technical support document. Washington, DC: EPA. Online at www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-alternative-renewable-energy-approach, accessed on September 15, 2014.

Growth Approach, both of these approaches assume full compliance with existing state RESs laws as a floor, which is consistent with the EPA's "no backsliding" policy principle.[124]

6.4.1. The EPA should eliminate technical potential benchmarks and rely primarily on economic potential to set state and regional renewable energy targets.

We have several concerns with the EPA's use of technical potential benchmarks that are based on the recent deployment of specific renewable energy technologies in leading states as a fraction of the estimated technical potential for each technology. This approach effectively imposes an arbitrary cap on the share of the renewable energy potential that can be developed in a given state or region. The technical potential benchmark rates captures a moment in time, and do not incorporate projected cost reductions and improved performance for many technologies that would likely result in even faster growth. Using 2012 data on renewable generation in the top states to define the benchmark deployment rate in 2030 does not capture the projected growth in renewable energy between those years that would result in significantly higher state and regional renewable energy targets.

In fact, more recent data show much faster growth than the EPA assumed in their technical potential benchmark cap. The American Wind Energy Association (AWEA) and the Solar Energy Industries Association (SEIA) cite several examples in their comments showing how the EPA's approach underestimates the recent and projected growth of wind and solar. The EPA even acknowledges in the technical support document that many states have already exceeded their benchmark rate and some of the limitations of using technical potential data in general.[125] This provides further evidence that their approach is overly conservative.

Some of the assumptions the EPA used for the technical potential estimates based on a 2012 NREL report are also outdated.[126] For example, NREL's capacity factors (CF) and land area assumptions for wind are low and do not reflect the recent and projected improvements in wind technology, as discussed in more detail below.[127] While NREL's estimates demonstrate the enormous technical potential for wind, solar and other technologies to produce significantly more electricity than the U.S. currently needs, they do not reflect important cost considerations of developing different sites or from increasing the penetration of renewables.

Using a technical potential benchmark rate is also redundant with the EPA's IPM modeling of economic potential. The IPM model includes assumptions on renewable resource availability, the cost and performance of different renewable energy technologies, and transmission and integration costs that may occur as the penetration of renewable energy increases over time. It also takes into account changes in the cost and performance of conventional technologies and the

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[124] Proposed Rule, 34917.

[125] For example, see p. 2 of the EPA's Alternative RE Approach Technical Support Document.

[126] Lopez et al., 2012.

[127] Wiser and Bolinger, 2014; and Roberts, J.O. New National Wind Potential Estimates for Modern and Near-Future Turbine Technologies. National Renewable Energy Laboratory. Poster presentation at the 2014 Wind Project Siting Seminar, January 29-30, 2014, New Orleans, LA. NREL/PO-5000-60979.

impacts of state and federal policies, which can impact the costs and penetration of renewable energy. With some updates and improvements to the EPA's IPM modeling assumptions for renewables and other technologies suggested below and in the attached UCS ReEDs methodology and assumptions document, we believe the EPA can eliminate the technical potential benchmark caps and rely entirely on modeling results from IPM and other energy models to set state or regional renewable energy targets.

6.4.1.1. The EPA should use more up-to-date cost and performance assumptions for renewable energy technologies in its economic modeling

Many of the EPA's cost, performance, and resource availability assumptions used in their IPM modeling are pessimistic and outdated. They are based primarily on assumptions from EIA's Annual Energy Outlook 2013 that don't reflect recent improvements in wind and solar technologies. They should be updated to reflect new NREL resource assessments, more recent data from actual projects, and credible studies projecting continued cost reductions and technology improvements through 2030. These studies and data sources are discussed in more detail in the following sections for each renewable energy technology.

We also recommend that the EPA request from NREL updated renewable resource assessments and cost and performance assumptions that will be included in the forthcoming DOE Wind Vision study. This report and the assumptions developed for the modeling went through an extensive peer-review process involving more than 300 energy experts, representing grid operators, the wind industry, science-based organizations, academia, governmental agencies, and environmental organizations. UCS served on the Senior Peer Review Advisory Group and several stakeholder task forces for this study.

While the full Wind Vision report isn't scheduled to be released until early next year, DOE issued an early release of the Executive Summary and Roadmap chapter on November 19, 2014.[128] The early release shows that increasing wind power from 4.5 percent of U.S. electricity use in 2013 to 10 percent in 2020, 20 percent in 2030, and 35 percent in 2050 is technically and economically feasible. Achieving these targets would require less than 5 percent of the country's available wind resource potential and would result in a less than 1 percent (0.1 cents/kWh) increase in electricity costs by 2030, and a 2 percent *reduction* in electricity costs by 2050. In addition, the study found that achieving the Wind Vision (compared to a baseline scenario) would result in cumulative (2013-2050) savings of:

- $400 billion in avoided global climate change damages from reducing power plant carbon emissions by 12.3 gigatons of CO_2-equivalent (a 14 percent reduction);

[128] U.S. Department of Energy (DOE). 2014. Wind Vision: A New Era for Wind Power in the United States (Industry Preview). DOE/GO-102014-4557. Online at http://energy.gov/eere/wind/downloads/draft-industry-preview-wind-vision-brochure.

- $108 billion in avoided health and economic damages from reducing particulate matter, nitrous oxide, and sulfur dioxide emissions; and
- $280 billion in lower consumer natural gas bills and total electric system costs that are 20 percent less sensitive to natural gas price fluctuations.[129]

Onshore wind. Improvements in low wind speed turbines are also opening new areas in the U.S. for potential development that were previously not considered to be economically viable. A recent GIS analysis by NREL shows that these improvements would increase the deployable area for potential onshore wind development in the U.S. by more than 50 percent at sites with gross CFs greater than 30 percent.[130] This represents an additional 3,907 GW of installed wind capacity potential compared to previous estimates. For example, they show that the Southeast has the potential to develop 134 GW onshore wind capacity at sites with gross CFs above 40 percent (net CF of ~34 percent) at hub heights of 140 meters. NREL also found that raising the hub height from just 96 meters to 110 meters would increase the windy land area above a 30 percent gross CF by 320,000 km^2, representing 1,000 GW of additional wind capacity mostly in the Eastern and Southeastern U.S.

We recommend updating the IPM cost and performance assumptions for onshore wind using recent data on actual projects from DOE's 2013 Wind Technologies Market report.[131] The EPA's modeling assumes capital costs of $2,258/kW (in 2011$) for wind projects installed in 2016, declining to $2,039/kW in 2030.[132] The EPA's 2016 costs are more reflective of average installed costs from actual wind projects installed in 2009 and 2010, and are nearly 40 percent higher than capacity-weighted average installed costs of $1,630/kW (in 2013$) for actual U.S. projects installed in 2013.[133] However, the sample size of projects installed in 2013 was limited and heavily weighted by low cost projects installed in the interior region of the country. A larger sample of 16 projects representing 2,000 MW that are under construction and anticipated to be completed in 2014 have average installed costs of approximately $1,750/kW. However, these projects are also weighted toward lower cost projects in the interior region. Thus, we would recommend using national average capital costs of $1,940/kW (in 2013$) for current projects based on average costs from a much larger sample of recent projects installed in 2012 and 2013.[134]

[129] Cumulative figures from the study are calculated based on the present value of costs and savings between 2013 and 2050, using a 3 percent discount rate.
[130] Roberts, 2014. Also see Figure 6 and Figure 8 in Cotrell, J., T. Stehly, J. Johnson, J.O. Roberts, Z. Parker, G. Scott, and D. Heimiller. 2014. Analysis of transportation and logistical challenges affecting the deployment of larger wind turbines: Summary of results. National Renewable Energy Laboratory. Technical Report: NREL/TP-5000-61063.
[131] Wiser and Bolinger, 2014.
[132] See Chapter 4, Table 4-16, on p. 29 of the EPA IPM model documentation.
[133] Wiser and Bolinger, 2014. See Figure 39, on p. 49.
[134] These regional differences are illustrated in Figure 42 of the DOE report (Wiser and Bolinger 2014). Because the sample size for the Southeast only reflects one project, we would suggest using assuming national average installed costs for that region.

We recommend basing capacity factors for new wind projects on data from recent projects and studies that reflect recent technology advances, as described in the DOE report.[135] We also recommend basing future increases in capacity factors and reductions in capital costs on the DOE Wind Vision study, which projects the average levelized cost of electricity (LCOE) from onshore wind projects to decline 24 percent by 2020, 33 percent by 2030 and 37 percent by 2050.[136] These are mid-range projections based primarily on a recent NREL literature review of 13 independent studies and 18 scenarios.[137] Based on these assumptions, the ReEDs model projects that 110 GW of onshore wind capacity would be installed in the U.S. by 2020, and 200 GW by 2030, to meet the Wind Vision targets.

Offshore wind. The EPA excluded offshore wind arguing that the technology has not been adequately demonstrated in the U.S. and little cost information is available to qualify for the BSER. However, a recent DOE report by Navigant Consulting[138] shows 14 offshore wind projects totaling 4,900 MW are in advanced stages of development in nine states (Delaware, Massachusetts, Maine, New Jersey, Ohio, Oregon, Rhode Island, Texas, Virginia) and the Virgin Islands. According to the report, this includes projects that "have a signed power purchase agreement (PPA), have received approval for an interim limited lease or a commercial lease in state or federal waters, and/or have conducted baseline or geophysical studies at the proposed site with a meteorological tower erected and collecting data, boreholes drilled, or geological and geophysical data acquisition systems in place."[139] In addition, considerable information on the costs of developing offshore wind is available from recent projects in developed in Europe and proposed in the U.S.[140]

We recommend using the DOE Wind Vision cost and performance assumptions for offshore wind, and the sources listed in the technical appendix of the UCS ReEDs modeling. The DOE Wind Vision report assumes that the LCOE from offshore wind projects will decline 22 percent by 2020, 43 percent by 2030, and 51 percent by 2050. The report also assumes that 3 GW of offshore wind capacity will be installed in the U.S. by 2020 and 20 GW by 2030. As discussed above, when combined with the projected deployment of onshore wind, these levels of offshore wind can be achieved at a modest increase in electricity costs of less than 1 percent by 2030,

[135] See Chapter 5 in the DOE report starting on p. 38. In particular, see the trend over time of increasing capacity factors in different wind regimes shown in Figure 35, and the regional variation in capacity factors for projects installed in 2012 in Figure 36.
[136] U.S. Department of Energy (DOE). 2014. Wind Vision: A New Era for Wind Power in the United States (Industry Preview). DOE/GO-102014-4557. Online at http://energy.gov/eere/wind/downloads/draft-industry-preview-wind-vision-brochure.
[137] Lantz, E., R. Wiser and M. Hand. 2012. IEA Wind Task 26: The Past and Future Cost of Wind Energy. National Renewable Energy Laboratory. NREL/TP-6A20-53510. Online at http://www.nrel.gov/docs/fy12osti/53510.pdf.
[138] U.S. Department of Energy. 2014. Offshore Wind Market and Economic Analysis: 2014 Annual Market Assessment. Prepared by Navigant Consulting, DE-EE0005360 (September 8, 2014). Online at http://energy.gov/sites/prod/files/2014/09/f18/2014 percent20Navigant percent20Offshore percent20Wind percent20Market percent20 percent26 percent20Economic percent20Analysis.pdf.
[139] Wiser and Bolinger, 2014.
[140] Schwartz, M., D. Heimiller, S. Haymes, and W. Musial. 2010. Assessment of offshore wind energy resources for the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-500-45889.

while saving hundreds of billions in avoided climate, health and economic damages and lower natural gas bills.

Solar. The EPA's IPM modeling assumes overnight capital costs for utility-scale PV of \$3,364/kW_{ac} (2011\$) in 2016, declining to \$2,859/kW_{ac} in 2030. These costs are 32-55 percent higher than recent projects reported in SEIA's *Solar Market Insight Q2 2014 Report*, which shows national average installed system prices of \$1,810/kW_{dc} (~\$2,170/kW_{ac})—representing a 14 percent drop in costs from last year and 61 percent from 2010 levels.[141] We recommend using SEIA and the Lawrence Berkeley National Laboratory (LBNL)[142] data on the costs of recent projects and projections of future costs for utility and distributed PV and concentrating solar power (CSP) from the 2012 DOE Sunshot Study's 62.5 percent cost reduction scenario through 2020 and the 75 percent cost reduction scenario through 2040, as reasonable mid-range projections.[143]

We also recommend including distributed solar PV generation in the baseline renewable generation based on data from EIA forms 860, 861, and 826, as recommended in SEIA's technical comments. We also agree with SEIA's comments that distributed solar PV should be considered in the BSER. With cumulative U.S. capacity more than doubling over the past two years to 7,220 MW through the first half of 2014, distributed solar PV has clearly been adequately demonstrated, can be implemented at reasonable costs, and has the potential to significantly reduce carbon emissions. Since the IPM model does not include distributed PV, we would recommend using projections from NREL's SolarDS model based on the Sunshot study's 62.5 percent cost reduction scenario through 2020 and the 75 percent cost reduction scenario through 2040. SEIA also provides several credible options for tracking and verifying generation and emission reductions from distributed solar that the EPA should adopt.

Biopower. The EPA should include updated assumptions for biopower in its assessment of meeting state renewable energy generation targets. New stand-alone biopower projects, efficient combined heat and power (CHP) plants, and biomass co-firing in existing coal plants all have the technical and economic potential to provide additional low carbon electricity, when combined with strong sustainability criteria. However, if not managed carefully, biomass for energy can be harvested at unsustainable rates, damage ecosystems, produce harmful air pollution, consume large amounts of water, and produce net greenhouse emissions. Most scientists believe there is a wide range of biomass resources that can be produced sustainably and with minimal harm, and cut overall carbon emissions, while reducing the overall impacts and risks of our current energy

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[141] Solar Energy Industries Association (SEIA). 2014. U.S. Solar Market Insight Q2 2014 Report. Online at www.seia.org/smi.
[142] Barbose, G., N. Darghouth, S. Weaver, and R. Wiser. 2013. Tracking the sun VI: An historical summary of the installed price of photovoltaics in the United States from 1998 to 2012, LBNL-6350E. Berkeley, CA: Lawrence Berkeley National Laboratory. Online at http://emp.lbl.gov/sites/all/files/lbnl-6350e.pdf, accessed on September 15, 2014.
[143] U.S. Department of Energy (DOE). 2012. Sunshot vision study. Online at http://www1.eere.energy.gov/solar/pdfs/47927.pdf.

system.[144] Implementing proper policy is essential to securing the benefits of biomass and avoiding its risks.

To capture the benefits of beneficial biomass and avoid the risks of harmful biomass, federal and state policies should distinguish between beneficial and harmful biomass resources by including a definition of eligible biomass resources. This definition should make beneficial biomass resources eligible, exclude harmful biomass resources and practices, and include practical, reasonable sustainability standards to ensure that harvests of biomass do not degrade soils, wildlife habitat, biodiversity and water quality.

Taking these factors into account, a 2012 UCS analysis of data from DOE's Updated Billion Ton study found that biomass resources totaling nearly 680 million tons could be made available, in a sustainable manner, each year within the United States by 2030.[145] This is enough biomass to produce approximately 730 billion kilowatt-hours or 18 percent of U.S. electricity generation in 2013. The study showed that biomass resources are readily available in large parts of the country, with the most potential in the southern Plains, Southeast, Midwest, and California. The vast majority (82 percent) of this potential is from energy crops (primarily switchgrass) and agricultural residues, while the potential from biomass wastes (15 percent) such as urban and mill residues, and forest residues (3 percent) is relatively small. In addition, we completely excluded forest biomass from whole trees, thinnings, clearings, and pulp-wood harvesting due to sustainability concerns

As shown in Figure 6-6, our ReEDs modeling projects biopower to make a fairly small contribution to achieving the renewable targets from our Demonstrated Growth Approach at the national level. However, other studies by NREL,[146] EIA,[147] and UCS,[148] have shown that biopower could make a more meaningful contribution, particularly in some parts of the country that have strong potential, such as the Southeast and Midwest. For example, NREL's 2012 *Renewable Electricity Futures* study found that biopower could provide nearly 6 percent of U.S.

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[144] UCS supports the use of strong sustainability criteria for biomass. For example, in 2011, UCS and eleven other national groups signed on to the following *Principles for Sustainable Biomass*, online at http://www.cleanenergy.org/wp-content/uploads/Principles-for-Sustainable-Biomass-FINAL.pdf. Also see UCS. 2009. A Balanced Definition of Renewable Biomass. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/balanced-biomass-definition.pdf. UCS's Bioenergy Principles. Online at http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-biomass-energy-works.html#c2

[145] Union of Concerned Scientists (UCS). 2012. The promise of biomass: clean power and fuel—if handled right. Online at http://www.ucsusa.org/assets/documents/clean_vehicles/Biomass-Resource-Assessment.pdf. Oak Ridge National Laboratory—U.S. Department of Energy (ORNL). 2011. U.S. billion-ton update: Biomass supply for a bioenergy and bioproducts industry. ORNL/TM-2011/224. Oak Ridge, TN. Online at http://www1.eere.energy.gov/bioenergy/pdfs/billion_ton_update.pdf.

[146] National Renewable Energy Laboratory (NREL). 2012a. Renewable electricity futures study, NREL/TP-6A20-52409. Golden, CO: NREL. Online at www.nrel.gov/analysis/re_futures/, accessed on September 15, 2014.

[147] Energy Information Administration (EIA). 2014. *Annual Energy Outlook 2014*. Washington, DC: U.S. Department of Energy. Online at http://www.eia.gov/forecasts/aeo/pdf/0383(2014).pdf

[148] Cleetus, R., S. Clemmer, J. Deyette, and S. Sattler. 2014. Climate Game Changer: How a carbon standard can cut power plant emissions in half by 2030. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Carbon-Standards-Analysis-Union-of-Concerned-Scientists.pdf.

generation by 2030 and 15 percent by 2050, making a meaningful contribution to achieving overall renewable electricity targets of 80 percent by 2050.[149]

The EPA's ongoing work on the *Framework for Assessing Biogenic Carbon Dioxide for Stationary Sources* is critical to understanding the role that sustainable biomass can play in reducing GHG emissions, and establishing the safeguards necessary to ensure robust accounting of lifecycle emissions and other impacts from the use of biomass.[150] UCS will continue to review and assess the findings in the latest report as it undergoes review by the Science Advisory Board.[151]

Geothermal and Hydro. The potential for new geothermal and hydropower development is very site specific. We recommend using updated supply curves for new geothermal and hydropower from NREL's ReEDs model that reflect site specific costs and resource potential.

6.4.1.2. The EPA should eliminate the cap on variable wind and solar used in the IPM modeling, or use a cap based on recent studies by utilities, grid operators, and government agencies.

We agree with AWEA's comment that the EPA should not impose a firm cap on the percentage of variable (wind and solar) renewable energy that can be deployed in a state or region, but rather should economically model the cost of curtailment that could occur at extremely high renewable energy penetrations. However, if the EPA continues to impose a cap, it should rely on the results of recent renewable integration studies done by utilities, grid operators, NREL and other government agencies. These studies have found that penetrations of variable renewable energy resources of 40-50 percent are achievable on a state and regional level, with modest integration costs.

For example, NREL's *Renewable Energy Futures* study examined a case in which wind and solar provide nearly 50 percent of total U.S. electricity generation by 2050.[152] The Nebraska Power Association wind integration study found minimal integration costs and no reliability concerns associated with wind providing 40 percent of electricity in the Southwest Power Pool.[153] The Minnesota Department of Commerce just released a comprehensive study that found no challenges to integrating 40 percent wind and solar energy in Minnesota, including a detailed examination of power system dynamics and other essential reliability services. The study also found no challenges associated with accommodating the variability with wind and solar providing 50 percent of electricity in the state, though due to time constraints the study did

[149] NREL, 2012a.
[150] EPA. 2014. Framework for Assessing Biogenic CO_2 Emissions from Stationary Sources. United States Environmental Protection Agency, Office of Air and Radiation Office of Atmospheric Programs, Climate Change Division. Washington, DC. Online at http://www.epa.gov/climatechange/ghgemissions/biogenic-emissions.html
[151] http://www.epa.gov/climatechange/downloads/Biogenic-CO2-Emissions-Memo-111914.pdf
[152] NREL, 2012a.,.
[153] http://www.nepower.org/Wind_Study/final_report.pdf.

not include a full analysis of power system dynamics in that case.[154] NREL's analysis of over 30 percent renewable energy penetrations in the Eastern and Western U.S. by 2030 also found no reliability problems or economic barriers.[155] If the EPA does decide to impose such a cap, non-variable renewables, such as biomass and geothermal, should not count towards such a cap.

6.4.1.3. The EPA should drop or modify the short-term capital cost adders that raise the cost of renewables by an unreasonable amount.

The EPA also applies unrealistically high short-term capital cost adders to renewable and conventional generation technologies if the new capacity developed in a specific year exceeds a certain upper bound. The adder is designed to reflect potential short-term cost increases due to competition for equipment and labor, based on EIA assumptions. For example, in 2016, the EPA assumes wind capital costs will increase by $694/kW after 11,618 MW are developed, and utility solar PV increases by $1,025/kW after only 286 MW are deployed, over a two-year period.

We do not believe these assumptions are supported by actual experience or credible peer-reviewed research. For example, the capacity-weighted average capital cost of wind projects installed in the U.S. dropped by 10 percent in 2012, despite installing a record 13,131 MW that year.[156] Similarly, the costs of solar PV have continued to drop over the past several years as new records are set nearly every year in the U.S., including adding over 2,000 MW of utility-scale PV just last year.[157] With more than 15,600 MW of wind projects and 3,160 MW of utility scale solar PV currently under construction between 2014 and 2016 in the U.S.[158], the EPA's assumed upper bounds for these technologies will likely be exceeded in the next few years, resulting in a significant overestimate of the cost of developing renewables in IPM. We recommend replacing IPM's short-term capital cost adders for renewables based on detailed regional renewable resource supply curve data from NREL's ReEDs model that account for transmission, integration, and other costs as the penetration of renewables increase.

6.4.1.4. The EPA should re-run the IPM modeling using updated assumptions for renewable technologies and consider different modeling approaches from other sources that use similar assumptions.

The EPA modeled the economic potential of renewables at the state level in IPM by reducing the costs of new renewable builds by $30 per MWh, which is a proxy for the estimated cost of the proposed approach (up to $40 per metric ton CO_2). The EPA should re-run this scenario in the IPM model using more up-to-date assumptions for renewable energy technologies described above to develop new state and regional renewable energy targets. The EPA's modeling should

[154] https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId=%7bD607FB96-F80C-49EE-A719-39C411D5D7C3%7d&documentTitle=201411-104466-01.

[155] http://www.nrel.gov/docs/fy11osti/47078.pdf, http://www.nrel.gov/electricity/transmission/western_wind.html

[156] Wiser and Bolinger, 2014.

[157] SEIA 2014.

[158] Wind projects under construction are based on data from the American Wind Energy Association's U.S. Wind Industry Second Quarter 2014 Market Report, online at http://awea.files.cms-plus.com/FileDownloads/pdfs/2Q2014%20AWEA%20Market%20Report%20Public%20Version%20.pdf. Utility solar PV projects under construction are based on data from SNL Energy's Power Projects Database.

also reflect existing state and federal renewable policies, including but not limited to state RESs, consistent with the EPA's "no backsliding" policy principle.[159]

We support the Natural Resource Defense Council's (NRDC) analysis of the EPA's Alternative Approach using an updated version of the IPM model, which addresses many of these concerns. NRDC's analysis uses updated cost and performance assumptions for renewables that are similar to the assumptions used in the DOE Wind Vision study and the UCS ReEDs modeling described above. They also ran the scenario in the same way as the EPA, by applying a $30/MWh cost reduction to new renewable builds. Under this scenario, renewable generation increased to 973 TWh by 2030 (including 94 TWh of distributed solar) at the national level. This is similar to the levels of renewable generation achieved under the UCS Demonstrated Growth Approach (995 TWh), but considerably more than the EPA Alternative Approach (527 TWh) and the EPA's IPM modeling (358 TWh). However, the state and regional distribution of renewables varies considerably across the different approaches.

It is also worth noting that the EPA's IPM modeling of meeting the state emission rate reduction targets completed for the regulatory impact analysis (RIA) resulted in a much lower level of renewables than either their Proposed Approach or Alternative Approach. At the national level, total non-hydro renewable generation reached 356 terawatt-hours (TWh) by 2030 in the RIA, which is 32 percent lower than the EPA's renewable energy targets under the Proposed and Alternative Approaches (525 TWh by 2030), only 2 percent above the EPA's base case, and nearly 20 percent lower than EIA's business-as-usual projection (Figure 6-8). In other words, the EPA's results imply that the Clean Power Plan would take us backwards and result in less renewable generation than we would expect to see under existing state and federal policies without the CPP. Even the EPA's base case greatly underestimates the potential contribution from renewables compared to EIA's BAU projections, despite using EIA's assumptions for most technologies.

[159] Proposed Rule, 34917.

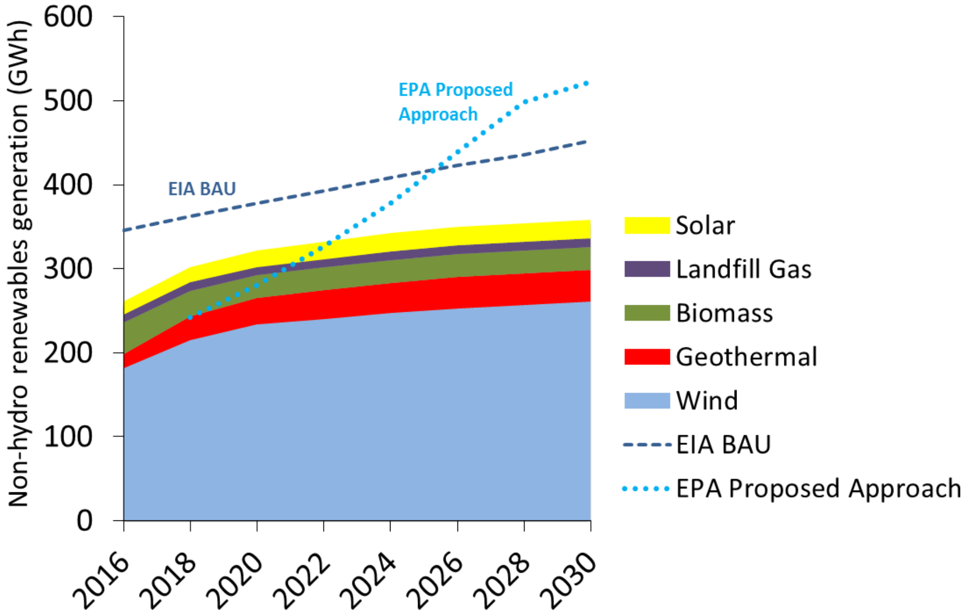

Figure 6-8. The EPA's IPM Modeling Does Not Achieve the Renewable Energy Targets from the EPA's Proposed Approach or EIA's Business As Usual Projection. *The generation from different renewable energy technologies included in the stacked bars is based on the results of the EPA's IPM modeling completed for the Regulatory Impact Analysis (RIA). The overall level of non-hydro renewable generation from the EPA's Proposed Approach is taken directly from the EPA's building block spreadsheet that is used to calculate state emission rate reduction targets, except 2029 levels are shown in 2030, as the EPA did not report values for 2030. EIA's BAU is based on projections from Annual Energy Outlook 2014.*

While the EPA's pessimistic results for renewables are due in large part to their use of outdated and pessimistic assumptions for renewables described above, they are also due to how the EPA modeled the scenarios in the RIA and the EPA's modest state emission reduction targets. The EPA modeled these scenarios by hard-wiring the estimated demand reductions from the energy efficiency building block (because energy efficiency is not explicitly represented in the model) and then letting the model decide what technologies to deploy to achieve the remaining emission reductions in the most cost-effective way.[160] Because the vast majority of the CO_2 reductions appear to have come from energy efficiency, the model only needed to achieve a fairly modest amount of additional CO_2 reductions, which came primarily from fuel switching to existing new natural gas combined cycle plants (NGCC) and from new NGCC plants added by 2020. Combined, efficiency and NGCC generation primarily displaced existing coal and some older oil and gas steam generation.[161] However, the level of efficiency savings by 2030 was high enough to displace generation from new NGCC plants that were built under the base case.

While this approach may have achieved the EPA's state emission reduction targets, it does not capture the economic potential for deploying renewables at higher levels to cost-effectively

[160] EPA Regulatory Impact Analysis, p. 3-9.
[161] EPA Regulatory Impact Analysis, Table 3-11.

achieve even deeper emission reductions. The EPA modeling for the Alternative RE Approach clearly demonstrates that it is cost-effective to deploy more renewables even using pessimistic assumptions, while UCS and NRDC modeling of the renewable energy building block shows we can go much further using more reasonable updated assumptions. This makes a strong case for why the EPA's state emission reduction targets should be strengthened. In addition to updating the cost and performance assumptions for renewable energy technologies, we recommend that the EPA conduct additional modeling scenarios to better understand the costs and benefits of increasing renewables to achieve deeper CO_2 reductions. These scenarios could include:

- Requiring the model to at least meet the renewable energy targets from the EPA's Proposed, Alternative or any updates of these approaches; the UCS Demonstrated Growth Rate Approach or Market Penetration Approach (see below); NRDCs Alternative RE Approach; or other approaches. This could also be done in combination with the energy efficiency building block targets and achieving higher state emission reduction targets.

- Including a national or regional carbon price that increases gradually over time to achieve the EPA's existing state emission rate targets as well as higher targets, instead of reducing the cost of new renewable builds by $30/MWh.

- Conducting sensitivity runs to the scenarios above that assume higher and lower natural gas prices, given the high level of uncertainty in projecting future natural gas prices. We would recommend using EIA's high and low gas price projections from AEO 2014.

UCS ReEDs modeling was conducted by requiring the model to meet the renewable energy targets from our Demonstrated Growth Approach to analyze the impacts on CO_2 emission, electricity and natural gas prices, and the generation mix, as discussed in more detail above. An important benefit of this approach is that it more fully captures the energy diversity benefits of renewables displacing natural gas and lowering natural gas prices and bills, which in turn can offset modest increases in electricity prices. Reducing the economic risks of a potential overreliance natural gas by increasing renewables and efficiency is an important issue to many states that can justify adopting higher renewable energy targets compared to using the EPA's more conservative economic criteria. Some states have also been willing to pay higher incremental costs for renewables in the near-term to encourage technology innovation, attract new industries, and achieve economies of scale that will help drive down costs over the long-term. This approach has clearly been effective over the past 5-10 years in driving down the costs of both wind and solar.

We also recommend that the EPA work with NREL to run these scenarios in the latest version of the ReEDs model. The ReEDs model was specifically designed to more accurately model the costs and benefits of increasing renewables and overcome some of the limitations of other modeling platforms like IPM and NEMS that have a more simplistic representation of renewables.

6.4.2. The EPA should recognize regional differences in renewable energy market penetration rates and account for existing state commitments to deploy renewable energy.

As a second option for improving the EPA's Alternative Approach, UCS developed a modified approach for calculating state renewable energy targets based on technical potential and market penetration called the UCS "Market Penetration Approach." This approach differs from the EPA's Alternative Approach primarily by considering regional differences in renewable energy technology market penetration rates, and assuming states with RES policies achieve full compliance with these laws, like the UCS Demonstrated Growth approach. It also utilizes the most current renewable generation data available from EIA for 2013 (instead of 2012), including generation from distributed solar PV, which the EPA did not include.[162]

To calculate 2030 state renewable energy targets, we first divide 2013 renewable generation by NREL's estimated resource technical potential for the following technologies: utility scale PV, distributed PV, concentrating solar power (CSP), onshore wind, and conventional geothermal. These renewable market penetration percentages are then used to establish national and regional technology benchmarks. As in the EPA Alternative Approach, national benchmarks are calculated based on the average of the top third highest performing states for each technology (16 states). Due to the low number of states currently generating power with geothermal and CSP, the benchmarks for these technologies are based on a smaller subset of states, 6 states and 3 states, respectively.

Next, we calculate regional benchmark penetration rates based on the average of the top three performing states within each of the regions as defined by the EPA. Regional benchmarks are established to account for the variation in resource potential and utilization across different areas of the country, such as the relatively high market penetration of wind and solar resources in leading states located in the East Central region. Then, we calculate 2030 renewable energy targets by multiplying each state's technical potential for each technology by the greater of either the national or regional benchmark for that technology.

In addition to the technologies described above, we include existing biopower and new hydropower generation, using the EPA's methodology for assessing the potential contribution of these technologies. The potential for new hydropower in 2030 is estimated by subtracting 2013 hydro generation from NREL's estimate of hydropower potential for each state. Biopower and hydropower generation are added to the benchmarked technologies in order to calculate combined 2030 renewable energy targets.

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[162] Energy Information Administration (EIA). 2014. Electricity data browser. Washington, DC: U.S. Department of Energy. Online at www.eia.gov/electricity/data/browser/, accessed on September 15, 2014.

As in our Demonstrated Growth Approach, the share of each state's renewable energy generation is capped at 40 percent of total electricity sales. Consistent with the EPA's proposed approach, state renewable energy targets for the Market Penetration Approach begin in 2017. EIA renewable generation data from 2013 and projected generation from wind and utility scale solar projects known to be under construction are used to estimate 2016 baseline generation.[163] Linear renewable energy growth is assumed beginning in 2017 through 2030 to achieve final renewable energy generation targets. Finally, in each year, it is assumed that states will achieve the greater of either the calculated renewable generation or the level needed to meet their mandatory RES target for that year as projected by LBNL[164], consistent with the EPA's "no backsliding" policy approach.[165]

The UCS Market Penetration Approach results in a 2030 national renewable energy target of 912,660 GWh (excluding existing hydropower) or 21 percent of total U.S. electricity sales in 2030. This is a significant increase over either the EPA proposed or alternative approach, both of which result in approximately 520,000 GWh of renewable generation or 12 percent of U.S. electricity sales. The UCS approach leads to higher renewable generation targets than the EPA Alternative Approach in the majority of states. However, by imposing the renewable generation cap of 40 percent of electricity sales, it also avoids placing an undue burden on states with high renewable potential and low electricity sales. For example, under the EPA's Alternative Approach, Kansas and South Dakota have 2030 renewable targets that are higher than 100 percent of their projected electricity sales.

We also recommend further consideration of offshore wind and new biopower generation, which are not included in the either the UCS Market Penetration Approach or the EPA Alternative Approach. Improvements to these and other renewable energy technology cost, performance, and resource potential assumptions are discussed in more detail in section 6.4.1.1.

Table 6-2. UCS Market Penetration Target Renewable Generation, Excluding Existing Hydropower (GWh).

State	2020	2025	2030
AL	3,250	3,250	3,250
AK	943	1,943	2,943
AZ	5,302	7,985	8,867
AR	3,305	5,365	7,424
CA	92,177	96,810	101,203

[163] Wind projects under construction are based on data from the American Wind Energy Association's U.S. Wind Industry Second Quarter 2014 Market Report, online at http://awea.files.cms-plus.com/FileDownloads/pdfs/2Q2014%20AWEA%20Market%20Report%20Public%20Version%20.pdf. Utility solar PV projects under construction are based on data from SNL Energy's Power Projects Database.

[164] Lawrence Berkeley National Laboratory (LBNL). 2013. Renewables portfolio standards resources. Online at http://emp.lbl.gov/rps, accessed on September 15, 2014.

[165] Proposed Rule, 34917.

CO	14,213	20,993	27,773
CT	7,193	7,260	7,224
DE	1,713	2,220	2,270
FL	4,805	4,908	5,011
GA	3,704	3,704	3,704
HI	2,619	3,543	4,467
ID	5,805	9,087	12,369
IL	26,158	45,046	63,934
IN	15,490	29,376	43,261
IA	19,668	20,573	21,478
KS	14,048	16,192	18,337
KY	749	1,273	1,797
LA	2,721	2,846	2,971
ME	4,890	4,960	5,031
MD	11,903	13,224	13,525
MA	10,575	13,197	15,636
MI	11,341	15,085	18,829
MN	19,041	25,156	31,272
MS	2,225	3,120	4,015
MO	11,832	24,949	38,065
MT	3,293	5,253	7,214
NE	5,938	9,904	13,870
NV	6,235	7,241	8,248
NH	2,154	2,687	2,674
NJ	18,562	19,501	20,093
NM	6,685	9,318	11,952
NY	10,546	10,546	10,546
NC	9,385	10,009	10,554
ND	6,791	7,027	7,263
OH	14,880	27,062	39,244
OK	18,218	23,383	28,548
OR	9,840	11,362	12,885
PA	11,939	12,311	12,592
RI	1,289	1,301	1,294
SC	1,965	1,965	1,965
SD	3,696	4,630	5,563
TN	1,142	1,145	1,149
TX	96,395	136,990	177,585
UT	3,647	6,740	9,832
VA	4,291	6,074	7,856
WA	12,436	13,089	13,623

WV	2,227	3,254	4,281
WI	12,350	21,362	30,374
WY	5,670	7,233	8,797
Total	**565,244**	**741,453**	**912,660**

*For more information on annual targets, see Appendix 1 and the attached spreadsheet.

6.5. UCS recommends the EPA use and, where necessary, expand on existing regional renewable energy credit (REC) tracking systems for compliance with the CPP and to help prevent double counting.

Under the State Plans section of the Proposed Rule, the EPA requests comment on several options for accounting for the interstate effects of implementing renewable energy technologies and for avoiding potential double counting of CO_2 reductions.[166] We support the EPA's proposed approach of assigning the CO_2 reductions and other attributes to the purchaser of renewable energy or RECs, regardless of where the renewable generation is physically located. We also support the use of existing regional REC and generation tracking systems (Figure 6-8) as best approach for tracking renewable energy compliance with the CPP and to help prevent potential double counting of renewable generation and CO_2 reductions.

[166] Proposed Rule, pp. 34921-34922.

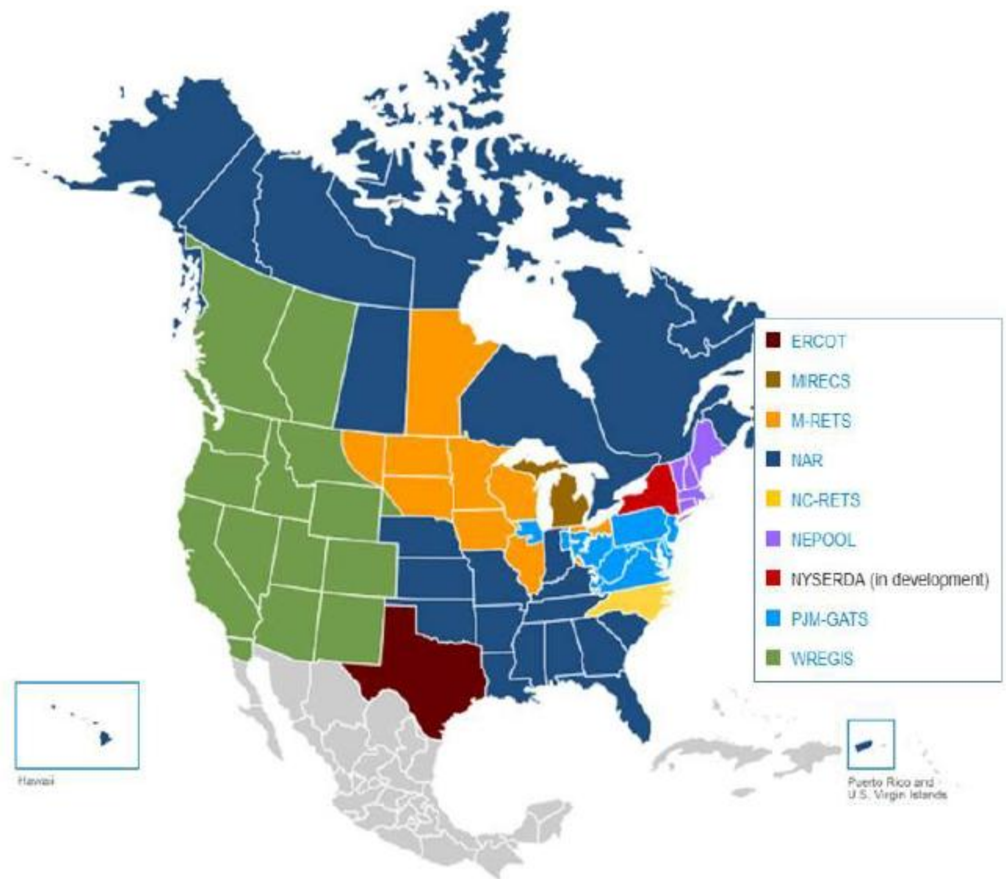

Figure 6-8. North American Renewable Energy Credit and Generation Tracking Systems.[167]

An important advantage of using these systems is that they are already set up to track compliance with existing state RES laws and verify claims for emission reductions and other attributes of RECs that are purchased through voluntary markets.[168] In addition, the NEPOOL GIS and PJM-GATS systems in the Northeastern U.S. are set-up to track all generation sources to support power source disclosure programs and to track CO_2 emissions, other pollutants, and other power attributes. These all generation tracking systems are also designed to match the emissions and other attributes of electricity supply with demand within a region and for imports into a region, which could also help facilitate compliance with state implementation plans. Some systems (NEPOOL GIS, NAR, and NC-RETS) are also being used to track energy savings from energy efficiency projects.

[167] APX Research, 2014. Using tracking systems with the implementation of Section 111d State Plans. Online at http://www.narecs.com/wp-content/uploads/sites/2/2014/10/APXAnalytics_1_Section111d.pdf.

[168] For more details on how regional REC tracking systems can be used for compliance with the CPP and to avoid double counting, see APX Research. 2014 andQuarrier, R. and D. Farnsworth. 2014. Tracking renewable energy for the U.S. The EPA's Clean Power Plan: Guidelines for states to use existing REC tracking systems to comply with 111(d). Prepared by the Center for Resource Solutions and Regulatory Assistance Project. Online at http://www.resource-solutions.org/pub_pdfs/Tracking%20Renewable%20Energy.pdf.

Under this approach, every megawatt-hour of eligible renewable generation would be assigned a tradable REC that could be used for state compliance with the CPP. The RECs could either be bundled with the physical delivery of the electricity, as required by some state RES laws, or unbundled and sold separately, which is also allowed for at least partial compliance in some state RESs (e.g., North Carolina). If the RECs are bundled with the delivery of the power to the state or regional power pool, it is reasonable to assume that the CO_2 reductions will occur within the state or region and to allocated those reductions to the purchasing state based on their regional share of the total REC purchases. This approach would also work well for states that are part of multi-state plans. If the RECs are unbundled and sold to a state outside of the region where the renewable generation is located, an adjustment would be needed to transfer the emission reductions from the generating state or region to the purchasing state. Several tracking systems already have the ability to track unbundled REC imports and exports between regions and tracking systems.

While allowing the use of unbundled RECs for state compliance with the CPP introduces some accounting complexities, it has the important advantages of giving states more flexibility in complying with the rule and lowering the cost of compliance, as shown by our ReEDS modeling of our proposed approach. And while states that sell RECS to other states would not be able to use those RECs or the associated renewable generation installed in their state for compliance, they would receive important economic benefits such as revenue from the sale of RECs as well as the construction, operation and manufacturing jobs and other local economic development benefits.

Voluntary renewables/green power. We also recommend making an adjustment for the emission reductions associated with REC purchases by the voluntary renewables/green power market. Customers who voluntarily purchase renewable energy want to know that they are achieving incremental emission reductions and other environmental benefits that go beyond what is required under existing laws. To ensure the validity of these claims and avoid double counting, states should not be allowed to use these RECs or emission reductions for compliance with the CPP. We suggest using a similar approach as the NEPOOL GIS and WREGIS tracking systems that makes an adjustment for the voluntary market related to the implementation of RGGI and California's cap and trade markets.

While we believe participation in an existing REC or generation tracking system is the most effective means for demonstrating compliance and avoiding double counting, there are at least two other approaches that could also be acceptable in addition to REC tracking. This includes renewable generation from 1) power purchase agreements and 2) facilities owned by utilities that are being used for compliance with state RESs or to meet voluntary state renewable energy goals, but are not part of REC tracking systems. However, to be eligible for compliance with the rule, the EPA should require states to demonstrate that the renewables generation and associated CO_2 reduction from these approaches is not being claimed by another state. As stated above, the general principle should be that the renewable generation and the associated CO_2 reductions and other attributes should go to purchaser of this generation, regardless of where the generation is located. The CO_2 reductions could be estimated by either using a marginal or average emissions rate for the power pool.

6.6. UCS recommends the EPA set renewable energy targets at the state level, but allow states to comply at a regional level.

In the Notice of Data Availability (NODA) from October 28, 2014, the EPA requested comment on whether to set renewable energy targets at a regional level and then assign shares of those regional targets to individual states in recognizing the interstate nature of the electricity system. Our recommendation is to set targets at the state level, but allow those targets to be met with renewable generation or RECs that are purchased from other states both within and outside a given region, as discussed in section 6.5. We are also supportive of implementing multi-state regional approaches as a more flexible, low cost way of complying with the rule, as discussed in more detail in section 9 of our comments.

Our recommended Demonstrated Growth Approach can easily be implemented on a regional level, by aggregating state targets to whatever regions provide greatest congruence with the organization of the electricity grid and simplify state implementation. As an example, Figure 6-2 above aggregates the state targets from our approach to the regions specified in the EPA's Proposed Approach.[169] We also support aggregating state targets to regions defined by NERC, Regional Transmission Organizations (RTOs), or Independent System Operators (ISOs), with some adjustments, as those regions do not coincide with state boundaries in most cases. A recent UCS report discusses the benefits of regional grid coordination and highlights several recent studies by grid operators showing that renewable energy can significantly lower CO_2 emissions while maintaining reliable and affordable electricity.[170] As with state targets, allowing nationwide trading of RECs for compliance would give states the option to find the lowest cost compliance options.

6.7. UCS supports the EPA's proposed approach for counting emissions reductions from new and incremental renewable energy, nuclear energy, and energy efficiency, and for only allowing new and incremental hydro to count for compliance.

The EPA also requested comment in the NODA on whether Building Blocks 3 and 4 should be treated in the same manner as natural gas fuel switching in Building Block 2 by counting the emission reductions for renewables, nuclear, and efficiency in the numerator of the emission rate formula rather than just the generation in the denominator. We strongly agree with this approach as these technologies are clearly reducing CO_2 by displacing fossil generation and it's a more consistent and equitable approach with how natural gas fuel switching is treated. However, only the CO_2 reductions from new and incremental renewables (including hydro), nuclear and efficiency should be counted, as the CO_2 reductions from existing renewables (including hydro),

[169] The underlying data from this approach are included in the attached spreadsheet.

[170] UCS. 2014. Renewable energy on regional power can help states meet federal carbon standards. Online at http://www.ucsusa.org/renewablesandregionalgrids.

nuclear and efficiency are already embedded in the baseline emissions and generation mix. As discussed in more detail in section 11, we believe that the incremental generation from zero carbon options should be assumed to displace fossil fuels (and the associated CO_2 emissions) on a pro-rata basis, which is a better representation of the BSER and consistent with the treatment of incremental NGCC.

The EPA also requested comments on whether to include 2012 hydropower generation from each state under the proposed approach, and whether and how to consider year-to-year variability in hydropower generation.[171] We support the EPA's approach that excludes existing hydro in the state goal setting, but allows new and incremental hydro to count toward compliance. Like existing nuclear generation, existing hydro is a mature technology that doesn't need economic support under the CPP in most cases. If the EPA decides to include existing hydro in the state renewable targets, we would suggest basing it on a rolling average of three most recent years of data to smooth year-to-year variability.

6.8. UCS recommends that the EPA include incentives for early action.

We support incentives for early action to encourage investments renewables and energy efficiency and a shift away from fossil-fired generation, including in the pre-2020 period after a state compliance plan has been approved by the EPA, as long as these incentives do not undermine the overall level of emissions reductions achieved by the CPP. The quicker we can cut emissions, the better from a climate perspective.

6.9. UCS recommends that the EPA use the most recent renewable generation data available, include renewable energy projects that are under construction through 2016, and assume states with RESs at least meet their mandatory targets.

The EPA is requesting comments on whether each state's goal should be modified to include a floor based on reported 2012 renewable generation to address the problem that some state targets in the EPA's proposed approach are less than 2012 levels.[172] While this would be an improvement, assuming some states won't increase renewable generation over current levels doesn't go far enough. We addressed this problem under our recommended approaches described above in several ways, including: 1) using 2013 renewable generation data from EIA as the starting point, 2) including wind and utility solar under construction from 2014-2016, and 3) assuming states with RESs at least meet their mandatory targets as projected by LBNL, which is consistent with the EPA's "no backsliding" policy principle.[173]

[171] Proposed Rule, 34869.
[172] Proposed Rule, 34868.
[173] Proposed Rule, 34917.

7. Nuclear Power: Building Block 3

- **UCS supports the EPA's proposal to include new nuclear reactors that are under construction in setting state emission reduction targets and for compliance, which is consistent with the EPA's treatment of new natural gas combined cycle plants and UCS's recommendation for new renewables that are under construction.**

- **UCS recommends excluding existing "at-risk" nuclear generation from the formula for setting state emission reduction targets, as the number of at-risk reactors is limited, site specific, and will likely decline over time as natural gas and wholesale electricity prices rise.**

- **UCS does not support allowing existing plants that may receive a license extension beyond 60 years to be counted as new generation for the purposes of compliance, given important safety issues that are outside of the EPA's jurisdiction.**

UCS believes that the cuts in heat-trapping emissions that the U.S. and the rest of the world need to make to limit the worst consequences of global warming are so large, and the need to take action is so urgent, that we need to consider all potential options for reducing emissions, as described in our 2007 *Nuclear Power in a Warming World* report.[174] Nuclear power does not produce carbon emissions during operation, and has relatively low lifecycle carbon emissions that are comparable to many renewable technologies. But these benefits need to be weighed against the safety and security risks, the waste disposal challenges, and the water requirements of nuclear power. The high cost and long lead time required for large-scale deployment of new nuclear plants must also be considered. Other low- and zero-carbon technologies like energy efficiency and renewable energy have fewer risks, are already cost-effective in many places, and can be deployed more quickly at a large scale.

UCS is particularly concerned about the potential impacts of the rule's treatment of nuclear power on the safety and security of both operating nuclear plants and the five reactors currently under construction. While we understand that nuclear safety is not within the EPA's jurisdiction, the agency cannot ignore the potential indirect effects of the rule in providing incentives to keep "at risk" plants operating. An operating nuclear plant's "at risk" status depends on many factors, but one of them is the extent to which a plant's bottom line is affected by evolving safety and security requirements. For instance, the NRC increased security requirements after the 9/11 attacks, but it is well known that the industry lobbied heavily to keep them to a minimum because of their cost.[175] Similarly, in the wake of the 2011 Fukushima accident, the industry has pushed back on certain proposed additional safety requirements such as filtered venting systems

[174] Gronlund, L., D. Lochbaum, and E. Lyman. 2007. Nuclear Power in a Warming World: Assessing the Risks, Addressing the Challenges. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/nuclear-power-in-a-warming-world.pdf.

[175] Lyman, E. 2010. Security since September 11th. Nuclear Engineering International. May. Online at http://www.neimagazine.com/features/featuresecurity-since-september-11th/.

for boiling-water reactors.[176] The NRC has also waived certain post-Fukushima safety requirements for the AP1000 reactors now under construction based on a faulty assumption that those plants will be safer than current plants. The EPA needs some mechanism—perhaps through a memorandum of understanding with the NRC—to help ensure that in mitigating the risk of climate change it does not increase the risk of a catastrophic nuclear accident or terrorist attack.

7.1. UCS supports the EPA's inclusion of new nuclear reactors that are under construction in setting state emission reduction targets and for compliance.

Recognizing the potential for nuclear to reduce carbon emissions from existing fossil fuel power plants, we support the EPA's proposal to include new nuclear reactors that are currently under construction in setting state emission reduction targets and for compliance. This approach is consistent with the EPA's treatment of new natural gas combined cycle plants and UCS' recommendation for new renewables that are under construction. However, while these technologies are currently cost-effective to deploy on a larger scale for the purposes of the BSER (as discussed elsewhere in our comments), new nuclear plants are not. Thus, we agree with the EPA's approach for not including any additional new nuclear reactors beyond the ones that are under construction for setting state targets because of their current high costs and long lead times. However, states would have the flexibility to include additional nuclear plants for compliance under the proposed rule. We also believe the incremental generation from uprates, at existing plants that meet important safety standards, such as those described above, should be eligible for compliance.

7.2. UCS recommends that the EPA exclude existing "at-risk" nuclear generation from the formula for setting state emission reduction targets.

Existing nuclear reactors have been facing economic pressures due primarily to low natural gas and wholesale electricity prices, and expensive age- or safety-related repairs. As the EPA highlights in its GHG abatement measures technical support document, five reactors representing 4.2 GW of capacity were recently shut down for these reasons. These include the Kewaunee plant in Wisconsin and the Vermont Yankee plant, which were closed primarily for economic reasons, and Crystal River 3 in Florida and San Onofre 2 and 3 in California, which were closed primarily due to expensive repairs and safety concerns. In addition, the Oyster Creek plant in New Jersey is expected to close by 2019. UCS recommends excluding existing "at-risk" nuclear generation from the state emission reduction target formula, as the number of at-risk reactors is limited, site specific, and will likely decline over time as natural gas and wholesale electricity prices rise.

[176] Lipton, E. and M. Wald. 2013. Post-Fukishima, Arguments for Nuclear Safety Bog Down. *The New York Times*. February 26. Online at http://www.nytimes.com/2013/02/27/business/energy-environment/a-divisive-debate-on-need-for-more-nuclear-safeguards.html.

7.2.1. The economic pressure due to low natural gas and wholesale electricity prices is not unique to nuclear power.

The economic competitiveness of coal and oil-fired power plants, renewable energy facilities, and even energy efficiency investments are also affected by low market prices. Like nuclear, many older coal plants have needed to make expensive capital investments to replace aging equipment, improve plant efficiency, and install pollution control and other equipment to reduce air pollution and water use, and were forced to retire. However, unlike existing nuclear plants, which have been experiencing increasing costs over the past 10 years,[177] the costs of renewable energy technologies like wind and solar have been falling rapidly. This has allowed renewables to remain competitive with new natural gas plants in states with high quality resources.

For example, a recent DOE report shows that the cost of new wind projects dropped by over 60 percent between 2009 and 2013, allowing them to remain competitive with declining wholesale electricity prices in some parts of the country, as shown in Figure 7-1 below.[178] However, this varies greatly by region, with weighted average wind power purchase agreement (PPA) prices between 2011 and 2013 within the range of average annual wholesale electricity prices in 2013 in the interior region of the country (i.e., Plains states), and slightly higher than average wholesale prices in the Northeast, Great Lakes and Western regions.[179]

[177] Based on data from the Electric Utility Cost Group on p.7, "Nuclear Energy 2014: Status and Outlook," Nuclear Energy Institute Annual Briefing for the Financial Community, February 13, 2014. Online at http://www.nei.org/CorporateSite/media/filefolder/Policy/Wall%20Street/WallStreetBriefing2014.pdf?ext=.pdf.

[178] Wiser, R., and M. Bolinger. 2014. 2013 wind technologies market report. Washington DC: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Online at http://eetd.lbl.gov/sites/all/files/2013_wind_technologies_market_report_final3.pdf, accessed on September 22, 2014.

[179] Wiser and Bolinger, 2014. See Figure 48 on p. 61.

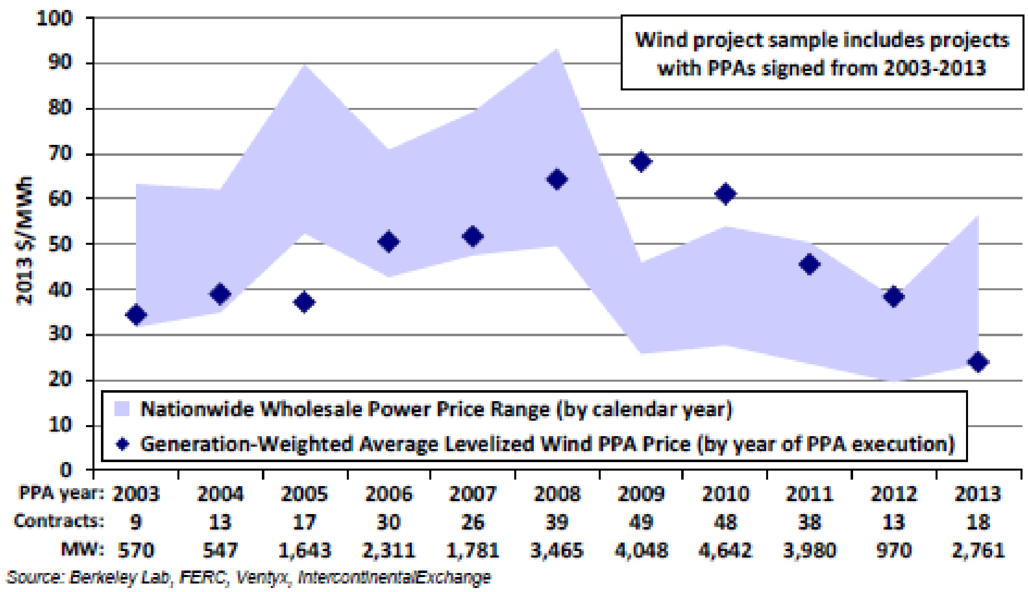

Figure 7-1. Average Levelized Long-term Wind PPA Prices and Yearly Wholesale Electricity Prices Over Time. *Source: Berkeley Lab, FERC, Ventyx, Intercontinental Exchange.*

7.2.2. Determining whether an existing plant is "at risk" is very plant specific.

As discussed in a 2013 paper by Amory Lovins,[180] determining whether an existing nuclear plant is at-risk economically "depends on complex and shifting set of both market and plant-specific considerations, so no comparison of average conditions in a specific year can support conclusions about any individual plant." These considerations include the location, size, age, condition, and ownership of the plant. As shown in the figure above, wholesale prices vary widely across the country and over time. They also reflect the existing generation mix, which could shift over time. Nuclear plants located in states with below average market prices, excess capacity, high quality wind and solar resources, or strong energy efficiency programs tend to be more vulnerable. Merchant plants located in restructured markets tend to be more vulnerable than plants owned by regulated utilities. Smaller, single unit plants tend to be more expensive to operate than larger multi-unit plants, which are better able to spread out the costs of capital investments. The age and condition of the plant also makes a big difference, as older reactors tend to have higher operating costs and face more costly repairs to replace aging and damaged equipment.

Nuclear industry operating cost data that divides the 104 operating U.S. reactors into quartiles shows that at least three-quarters of U.S. reactors have 3-year average total generating costs that are within the lower to middle end of the range of 2013 wholesale electricity prices.[181] While the average costs of the remaining 25 percent have been higher than wholesale prices since 2009,

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[180] Lovins, A. 2013. The economics of a U.S. civilian nuclear phase-out. Bulletin of the Atomic Scientists 69(2):44-65, doi:1177/0096340213478000. Online at http://bos.sagepub.come/content/69/2/44.full.

[181] Based on data from the Electric Utility Cost Group on p.6, "Nuclear Energy 2014: Status and Outlook," Nuclear Energy Institute Annual Briefing for the Financial Community, February 13, 2014.

they are in the middle of the range of wholesale prices between 2005 and 2008 when natural gas prices were higher.

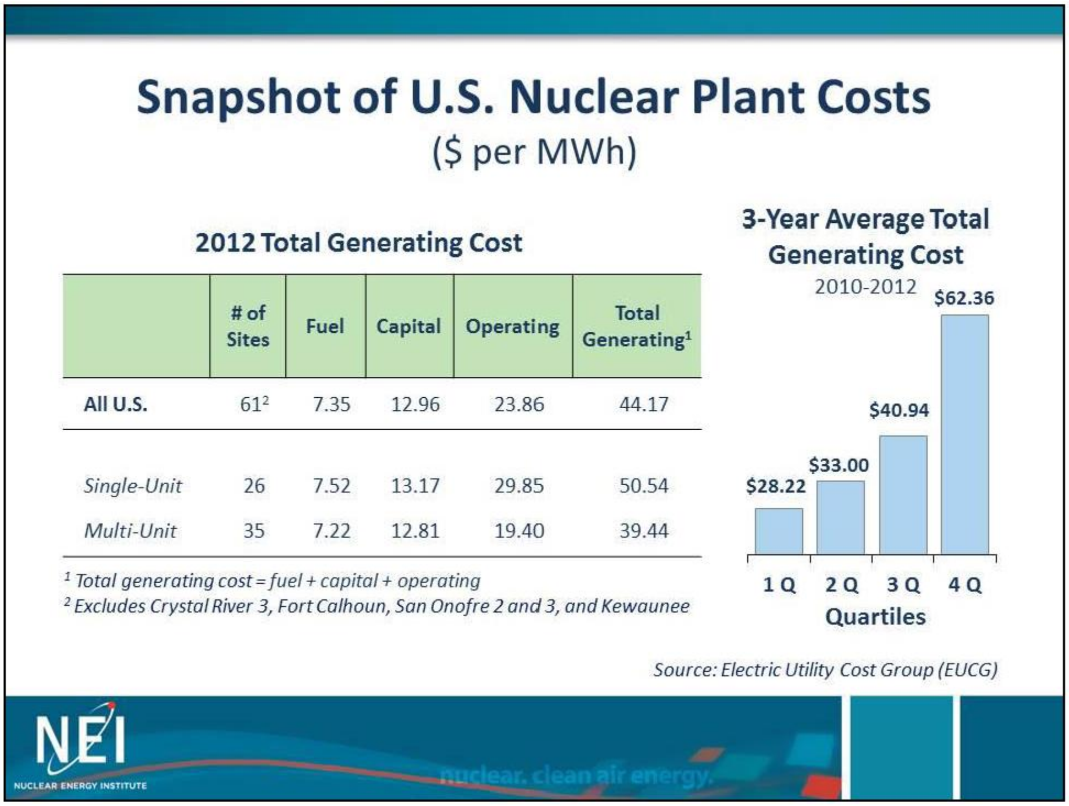

Figure 7-2. U.S. Nuclear Plant Generating Costs. *Data from the Electric Utility Cost Group and the Nuclear Energy Institute shows that the costs of generating electricity from existing nuclear plants can vary greatly by location, size, age, condition, and ownership of the plant.*

7.2.3. The EPA's methodology of applying EIA's estimate of at-risk nuclear plants to the states is flawed.

The EPA's methodology for quantifying at-risk nuclear generation is based on EIA projections from its Annual Energy Outlook 2014 reference case.[182] EIA's analysis assumed an additional 6 GW of generic retirements would occur between 2012 and 2019, and represented this by assuming a reduced capacity for all existing plants in vulnerable regions (primarily in restructured markets with merchant plants). EIA did not assume retirements of specific plants. It also did not assume plants are at-risk of early retirement in every state that has existing nuclear plants, which the EPA does assume in its methodology. EIA also does not clearly explain how it came up with the additional 6 GW of retirements. However, EIA does indicate that they did not include any retirements after 2020 because natural gas prices in its reference case are projected

[182] See pp. IF34-IF38 of Energy Information Administration (EIA) 2014. *Annual Energy Outlook 2014*. Washington, DC: U.S. Department of Energy.

to be high enough to "support the continued operation of the U.S. nuclear fleet and limit retirements from 2020 through 2040."

Additional fuel switching from coal to natural gas under the Clean Power Plan could increase natural gas prices above EIA's reference case projections before 2020, which in turn would increase the profitability of existing nuclear plants and potentially offset EIA's assumed retirements. In fact, under the CPP, the EPA's IPM modeling projects a 10.2 percent to 14.3 percent increase in power sector natural gas use in 2020 that results in a 7.5 percent to 11.5 percent increase in delivered natural gas prices to the electric power sector by 2020.[183] The EPA's modeling also does not show any difference in nuclear generation or capacity in 2020, 2025, or 2030 under any of the CPP scenarios compared to their Base Case.[184] Thus, the EPA's own modeling does not show that existing nuclear generation is at risk of early retirement, which is consistent with EIA's projections after 2020.

Recent UCS modeling using a modified version of EIA's AEO 2013 National Energy Modeling System (NEMS) and NREL's 2014 version of the Regional Energy Deployment System (ReEDs) model also does not project any near-term or long-term retirements of existing nuclear plants beyond the six reactors that recently closed or are projected to close in the next few years.[185] This is not surprising as both the EPA and UCS modeling use EIA's natural gas price projections.

The spikes in natural gas and wholesale electricity prices last winter due to extremely cold weather and the competition for natural gas for electricity generation and home heating are another example of how natural gas prices have already exceeded EIA projections. It is also worth noting that existing nuclear plants made considerable profits between 2005 and 2008 when annual wholesale electricity prices ranged from $43-93/MWh (2013$) due to record high natural gas prices.[186] This is illustrated in Figure 7-3 below from Exelon, which shows a strong correlation between their share price and natural gas prices over the past decade.[187]

[183] See Tables 3-16, 3-19, and 3-20 on pp. 3-36 to 3-38 of the EPA's *Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants*. June 2014.

[184] See Tables 3-11 and 3-12 on pp. 3-25 to 3-34 of the EPA's *Regulatory Impact Analysis for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants*. June 2014.

[185] Cleetus, R., S. Clemmer, J. Deyette, and S. Sattler. 2014. Climate Game Changer: How a carbon standard can cut power plant emissions in half by 2030. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Carbon-Standards-Analysis-Union-of-Concerned-Scientists.pdf. UCS. 2014. Strengthening the EPA's clean power plan: Increasing renewable energy use will achieve greater emission reductions. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/renewablesandcleanpowerplan.

[186] Wiser 2014.

[187] Goggin, M. 2014. The facts about wind energy's impact on electricity markets: Cutting through Exelon's claims about "negative prices" and "market distortion." American Wind Energy Association.

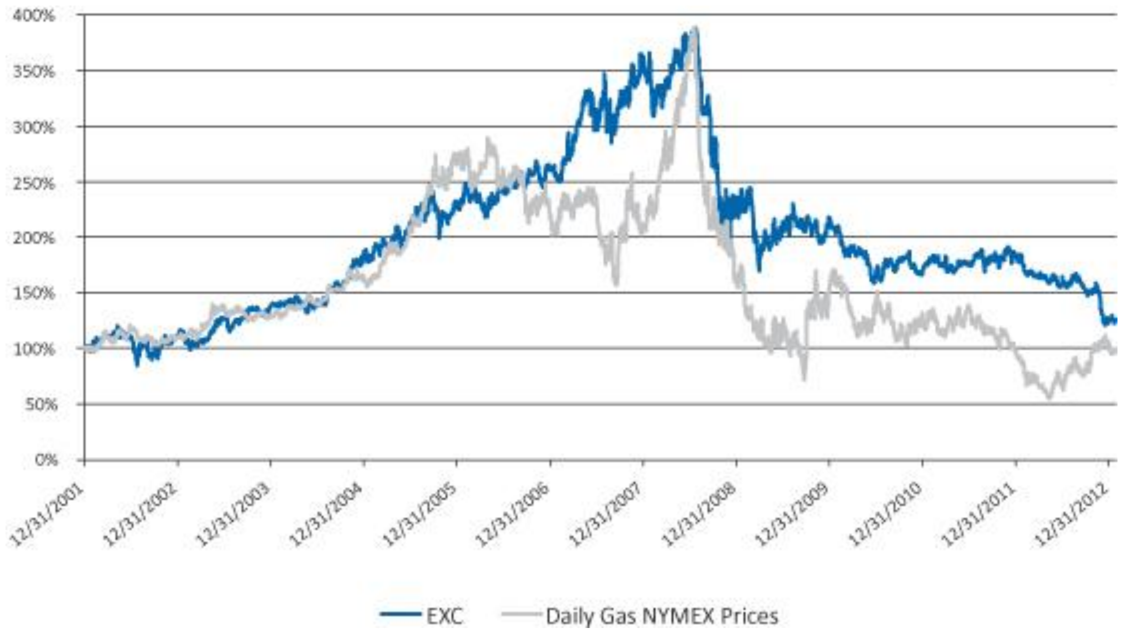

Figure 7-3. Exelon's (EXC) Stock Value is Highly Correlated with Natural Gas Prices.
Source: Exelon Generation.[188]

Because early retirements of nuclear plants appear to be a temporary issue, and would likely be limited to a few specific plants and locations, we do not believe the EPA should include "at-risk" nuclear generation in the formula for setting state emission reduction targets. In addition, the emission reductions from existing plants are already reflected in state's base emissions and generation mix. For similar reasons, we are also recommending that existing renewables be excluded from the EPA's formula for setting state targets, as discussed in more detail in section 11.5 of our comments.

However, if a limited number of existing nuclear plants are retired early and replaced with natural gas, it could result in net increase in a state's emissions, all other things being equal. But it's also possible that existing plants could be replaced with a combination of new renewables and energy efficiency without increasing emissions. Recent analyses by UCS, the National Renewable Energy Laboratory (NREL), and Rocky Mountain Institute all show that the U.S. could gradually phase out existing nuclear reactors by the time they reach 60-years of operation and replace them primarily with renewables and energy efficiency, while saving consumers money, maintaining reliability, and significantly reducing carbon emissions and water use.[189] Thus, we believe the determination of existing at-risk nuclear plants should be addressed on a case by case basis in state compliance plans and supported by a comprehensive analysis of the

[188] Exelon Corporation. 2013. Schedule 14A, U.S. Securities and Exchange Commission. Online at http://www.sec.gov/Archives/edgar/data/1109357/000119312513107079/d474444ddef14a.htm.

[189] See Lovins 2013, and Clemmer, S., J. Rogers, S. Sattler, J. Macknick, and T. Mai. 2013. Modeling low-carbon US electricity futures to explore impacts on national and regional water use. *Environmental Research Letters* 8 (2013) 015004. Online at http://iopscience.iop.org/1748-9326/8/1/015004/.

costs and benefits of keeping existing plants open vs. retiring and replacing them with other low and zero carbon generation.

This approach would also help limit the potential for providing additional subsidies and windfall profits to existing nuclear plants that do not need them to continue operating. A 2011 UCS report shows that existing nuclear plants have already received generous subsidies that have cost taxpayers more than the market price of power they helped generate, and they continue to receive ongoing subsidies ranging from 1 to 6 cents/kWh.[190] When nuclear power was an emerging technology, public support made sense. But more than 50 years (and two public bailouts) after the opening of the first U.S. commercial nuclear plant, nuclear power is a mature industry that should be expected to stand on its own. UCS believes that the best policy mechanism to value the low carbon benefits of nuclear power is to put a price on carbon. This would remove a market price distortion by internalizing a cost currently not factored into the price of coal and natural gas that would benefit nuclear, renewables and other low carbon options equally.

7.3. UCS recommends that the EPA not allow any existing nuclear reactors that receive a license extension beyond 60 years to be counted as new generation for the purposes of compliance.

According to EIA, the nuclear power industry is considering submitting applications to extend the operating licenses of existing plants for an additional 20 years that would allow them to continue operating beyond 60 years. To date, no reactor has applied for or received a license extension from the Nuclear Regulatory Commission (NRC) beyond 60 years, as most U.S. reactors will not reach this point until after 2030. Extending reactor licenses beyond 60 years raises important safety issues that will need to be carefully considered by the NRC, and are outside of the EPA's jurisdiction in this venue. If any existing reactors do receive an additional license extension, we do not believe they should be counted as new generation for the purposes of compliance.

[190] Koplow, D. 2011. Nuclear power: Still not viable without subsidies. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/nuclear_subsidies_report.pdf.

8. Energy Efficiency: Building Block 4

- **UCS recommends that the EPA use a target for incremental annual energy efficiency of at least 2.0 percent of electricity sales for each state, based on inclusion of a broader suite of energy efficiency policies, measures, and technologies in its calculation of state targets.**

- **UCS similarly recommends that the EPA use a target of at least 0.25 percent per year for the ramp-up rate, based on the broader suite of opportunities, and incorporate a differential approach for states at the lowest annual levels, to better reflect opportunities for states at low levels of efficiency development.**

- **UCS recommends that the EPA update its baseline year for energy efficiency targets to 2013 and update cost and performance assumptions for efficiency technologies and measures to reflect the most recent data on state-level energy efficiency programs, and incorporate a range of other strategies to ensure the integrity and effectiveness of Building Block 4, including with respect to interstate trading, voluntary actions, and improvements in transmission and distribution.**

The EPA's inclusion of energy efficiency as an eligible compliance option for states to reduce power plant carbon emissions is sensible and meets the criteria for the BSER. Energy efficiency, as a plentiful resource for meeting electricity needs and one that is almost always the lowest cost, can appreciably improve the economics of reducing carbon, providing sustained reductions in energy use for consumers and businesses. As the EPA rightly notes, "there is considerable experience with the states and the power sector in designing and implementing demand-side energy efficiency improvement strategies and programs."[191]

The EPA also notes that:

> *"…demand-side energy efficiency supports not only reduced CO_2 emissions and carbon intensity of the power sector, but also reduced criteria pollutant emissions, cooling water intake and discharge, and solid waste production associated with fossil fuel combustion."*[192]

Those benefits are well documented. Regarding the cooling water issue, for example, research under the UCS-led Energy and Water in a Warming World initiative (EW3) found that high use of energy efficiency and renewable energy could lead to deep reductions in water impacts:

> *"A pathway focused on renewable energy and energy efficiency, we found, could deeply cut both carbon emissions and water effects from the power sector. Water withdrawals would drop 97 percent by 2050—much more than under business as usual. They would also drop faster, with 2030 withdrawals only half those under business as usual. And*

[191] Proposed Rule, 34906.
[192] *Ibid.*, 34871-2.

> *water consumption would decline 85 percent by 2050. This pathway could also curb local increases in water temperature from a warming climate."*[193]

The EPA and others have also documented the even broader range of benefits that energy efficiency offers, such as locally sourced jobs, increased productivity, heightened comfort, higher property values, reduced price volatility, and greater energy security.[194]

Even without monetization of all those additional benefits, many analyses have documented the cost-effectiveness of energy efficiency and shown the potential for efficiency to dramatically reduce the costs of achieving given levels of carbon reductions. Consistent with the EPA's observations in the draft rule,[195] many analyses have found that high levels of energy efficiency, paired with high levels of renewable energy, can reduce costs or even produce consumer savings, with gains from efficiency offsetting any rate increases from other measures.[196]

The economics and potential of energy efficiency are such that the data support energy efficiency playing a much larger role in achieving the goals of the Clean Power Plan than currently proposed, and more inclusive assessments of efficiency costs and opportunities would allow the EPA to set stronger state targets. Analysis by the American Council for an Energy-Efficient Economy (ACEEE), for example, showed that energy efficiency alone could achieve CO_2 reductions of 26 percent below 2012 levels by 2030—at no net cost to the economy.[197]

Along with highlighting data and resources that support the EPA's proposals for including an appreciable role for energy efficiency in the BSER, we offer recommendations for strengthening Building Block 4.

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[193] Rogers J., K. Averyt, S. Clemmer, M. Davis, F. Flores-Lopez, et al. 2013. Water-smart power: Strengthening the U.S. electricity system in a warming world. Cambridge, MA: Union of Concerned Scientists, Energy and Water in a Warming World Initiative. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/Water-Smart-Power-Full-Report.pdf.

[194] See, for example, the GHG Abatement Measures Technical Support Document (p. 5–9), and technical comments submitted by the Southwest Energy Efficiency Project (SWEEP) and the American Council for an Energy-Efficient Economy (ACEEE) on the Clean Power Plan (Docket ID EPA-HQ-OAR-2013-0602).

[195] "By reducing electricity usage significantly, energy efficiency also commonly reduces the bills of electricity customers" (Proposed Rule, 34871-2).

[196] See, for example: Cleetus, R., S. Clemmer, and J. Deyette. 2014. Climate Game Changer: How a carbon standard can cut power plant emissions in half by 2030. Cambridge, MA: Union of Concerned Scientists: May 2014. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Carbon-Standards-Analysis-Union-of-Concerned-Scientists.pdf. Rogers J., K. Averyt, S. Clemmer, M. Davis, F. Flores-Lopez, et al. 2013. Water-smart power: Strengthening the U.S. electricity system in a warming world. Cambridge, MA: Union of Concerned Scientists, Energy and Water in a Warming World Initiative. Online at http://www.ucsusa.org/sites/default/files/legacy/assets/documents-/clean_energy/Water-Smart-Power-Full-Report.pdf. Cleetus R., S. Clemmer, and D. Friedman. 2009. Climate 2030: A national blueprint for a clean energy economy. Cambridge, MA: Union of Concerned Scientists. May 2009. Online at http://www.ucsusa.org/global_warming/solutions/reduce-emissions/climate-2030-blueprint.html#.VG-jEGcQPpw.

[197] Hayes, S., G. Herndon, J. Barrett, J. Mauer, M. Molina, M. Neubauer, D. Trombley, and L. Ungar. 2014. Change is in the air: How states can harness energy efficiency to strengthen the economy and reduce pollution. Washington, D.C.: American Council for an Energy-Efficient Economy. http://aceee.org/research-report/e1401.

8.1. UCS recommends that the EPA include a broader suite of existing energy efficiency policies, measures, and technologies, including building codes, state appliance efficiency standards, and combined heat and power.

Including a broader suite of tools and technologies in the Clean Power Plan, such as building codes, state appliance efficiency standards, and combined heat and power (CHP), is both consistent with current energy efficiency practice at the state level and appropriate given the demonstrated effectiveness of such approaches in achieving cost-effective energy reductions.[198] Some 40 states have mandatory statewide residential energy codes, for example, and around 42 states have commercial energy codes.[199] For CHP, studies demonstrate its cost effectiveness, and 23 states already include CHP in their energy efficiency or renewable energy standards.[200]

8.2. UCS recommends that the EPA use a target for incremental annual energy efficiency of at least 2.0 percent of electricity sales for each state, based on inclusion of the broader suite of energy efficiency policies discussed above.

Data suggest that the EPA is being overly conservative in its estimation of energy efficiency potential in assuming a 1.5 percent per year figure for incremental energy efficiency. Many leading states and utilities are achieving reductions at levels above 1.0 percent, and some are already meeting or exceeding the proposed rate of 1.5 percent.[201] Further, the EPA cites 11 states with state policies requiring annual reductions of at least 1.5 percent on or before 2020, for example.[202]

Incorporation of a fuller suite of energy efficiency tools such as those discussed above will better reflect current state practice and allow the EPA to set stronger state targets. The EPA itself notes the potential of incorporating a broader suite of energy efficiency opportunities:

> *"If we were to capture the potential for additional policies, such as the adoption and enforcement of state or local building energy codes, to contribute additional reductions in electricity demand beyond those resulting from energy efficiency programs, we could reasonably increase the targeted annual incremental savings rate beyond 1.5 percent."*[203]

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[198] See, for example, the technical comments submitted by ACEEE and SWEEP, and Cleetus et al. 2014.

[199] Online Code Environment & Advocacy Network (OCEAN). 2014. Residential Code Status. Online at http://energycodesocean.org/code-status-residential, last accessed November 2014; see the technical comments submitted by ACEEE.

[200] US Department of Energy and US Environmental Protection Agency. 2012. Combined heat and power: A clean energy solution. Washington, D.C.: US Department of Energy and US Environmental Protection Agency. Online at http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf.

[201] For example, eight states (AZ, CO, ME, MD, MA, MN, RI, and VT) achieved incremental savings as a percent of retail sales of at least 1.5 percent in 2013, or the most recent available year (Gilleo, A., A. Chittum, K. Farley, M. Neubauer, S. Nowak, D. Ribeiro, and S. Vaidyanathan. 2014 State energy efficiency scorecard. Washington, D.C.: American Council for an Energy-Efficient Economy. http://www.aceee.org/sites/default/files/publications/researchreports/u1408.pdf.).

[202] By 2020, for example, AZ, CO, IL, IN, MA, MN, NY, OH, RI, VT, and WA are expected to meet or exceed an incremental savings of 1.5 percent according to state policies currently in place (GHG Abatement Measures TSD, p. 5–33).

[203] Proposed Rule, 34872; the EPA notes that studies show that building codes alone could account for 13-18 percent of projected reductions (GHG Abatement Measures TSD, p. 5–11).

Analysis by ACEEE has shown that such a multi-policy approach would indeed lead to significantly higher levels of efficiency. While they project that energy savings targets themselves would yield much of the electricity savings, adding even conservative levels of building energy codes, CHP, and state equipment efficiency standards would lead to 925 million MWh of savings—one-third more than with energy savings targets alone, as shown in the table below.[204] Such an approach would be equivalent to moving from a target of 1.5 percent to 2.0 percent.

Table 8-1. Electricity Savings in 2030 Based on Four-Policy Approach.

	Annual electricity savings (MWh)	Cumulative electricity savings (MWh)	Avoided capacity (GW)	Percent avoided electricity consumption relative to 2012
Energy savings target	692,200,000	5,470,500,000	185	18.8%
Building codes	155,400,000	1,100,100,000	41	4.2%
Combined heat and power	68,300,000	564,500,000	18	1.9%
Equipment standards	9,400,000	112,100,000	3	0.3%
National total for all four policies	925,400,000	7,247,200,000	247	25.1%

Source: Hayes et al. 2014.

UCS recommends that the EPA adopt an assumption of annual incremental improvements of 2.0 percent or higher, and increase the state targets accordingly.

UCS also recommends that the EPA take into account additional progress from leadership states in calculating state targets, as with renewable energy. Some states are set to be already achieving energy efficiency reductions at annual rates higher than the level the EPA proposes to use as the default.[205] The EPA should assume full compliance with current state energy efficiency policies, as set by law, including energy efficiency resource standards that require certain improvements in energy efficiency over time; the EPA should include those levels of efficiency in its plans for such states. That is, the EPA's default should be a floor, not a set point, as states with the most forward-leading EERS policies should not be projected to decrease their levels.

[204] Hayes, S., G. Herndon, J. Barrett, J. Mauer, M. Molina, M. Neubauer, D. Trombley, and L. Ungar. 2014. Change is in the air: How states can harness energy efficiency to strengthen the economy and reduce pollution. Washington, D.C.: American Council for an Energy-Efficient Economy. http://aceee.org/research-report/e1401.

[205] For example, AZ, ME, MD, MA, RI, and VT have now all achieved incremental savings at levels greater than 1.5 percent (Gilleo, A., A. Chittum, K. Farley, M. Neubauer, S. Nowak, D. Ribeiro, and S. Vaidyanathan. 2014 State energy efficiency scorecard. Washington, D.C.: American Council for an Energy-Efficient Economy. http://www.aceee.org/sites/default/files/publications/researchreports/u1408.pdf.).

8.3. UCS recommends that the EPA update its baseline year for energy efficiency targets to 2013, in place of 2012.

As with the renewable energy targets under Building Block 3, the EPA should use the most recent data available on state progress—2013, rather than 2012—as its baseline year.[206]

8.4. UCS recommends that the EPA use a target ramp-up rate of at least 0.25 percent per year, and incorporate a differential approach that assumes that states currently at the lowest annual levels rise more quickly to the target annual levels, to better reflect opportunities for states at low levels of efficiency development.

The experiences of leading states suggest that here, too, the EPA is being overly conservative in assuming a 0.20 percent ramp-up, particularly if the EPA incorporates the broader suite of energy efficiency policies in its target-setting. SWEEP and ACEEE, for example, document multiple cases of utilities achieving ramp-up rates of 0.25 percent or higher.[207] UCS recommends that the EPA adopt a minimum ramp-up rate of 0.25 percent to reflect the best data on recent experience at the state level, and incorporation of the broader suite of energy efficiency policies.[208]

UCS also recommends that the EPA adopt the proposal in the RGGI states' comments that the EPA use differential ramp-up rates based on the current status of state energy efficiency efforts, to provide for faster ramp-ups for states that have developed their efficiency potential less. As the RGGI states suggest, for such states that:

> *"…by year-end 2012 had not met or exceeded either the average U.S. total incremental savings as a percentage of retail sales (2012) or the average U.S. total cumulative savings as a percentage of retail sales (2012)…[,] the goal computation… should reflect* ***a targeted 0.38 percent rate of improvement of incremental annual savings per year****, as opposed to the 0.20 percent per year ramp-up schedule identified by the EPA in the current proposed goal computation."*[209]

8.5. UCS recommends that the EPA update its cost and performance assumptions for efficiency technologies and measures to reflect the most recent data on state-level energy efficiency programs.

In its calculations of the cost of projected activities under Building Block 4, the EPA assumes cost and performance estimates for energy efficiency measures and programs that do not reflect

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[206] In this, UCS concurs with, for example, the Advanced Energy Economy (AEE): "When finalizing the Clean Power Plan, the EPA should use the most up-to-date data available on energy savings rates as the starting point. The Clean Power Plan should then apply the growth factor to that rate for all years after finalization. This will more accurately capture the level of savings that would occur even before states adopt compliance plans, and will thus more accurately predict the quantity of savings achievable during the compliance period" (AEE technical comments submitted on the Clean Power Plan [Docket ID EPA-HQ-OAR-2013-0602]).

[207] See technical comments submitted by ACEEE and SWEEP.

[208] In this, UCS concurs again with the technical comments submitted by AEE: "AEE believes the 0.2 percent growth rate is conservative and encourages the EPA to adopt the more aggressive 0.25 percentage growth rate."

[209] See technical comments submitted by the Regional Greenhouse Gas Initiative (RGGI) states on the Clean Power Plan (Docket ID EPA-HQ-OAR-2013-0602); emphasis added.

the latest data, resulting in unduly high cost assessments. Those estimates cover areas such as first-year program costs, product lifetimes, program costs over time, and levelized cost of saved energy (LCSE).

First-year program costs. The EPA uses a national average first-year program cost of $275/MWh (2011$) for its accounting, based on a 2009 ACEEE report.[210,211] However, the EPA subsequently refers to lower values from two much more recent and comprehensive studies, from ACEEE and LBNL. The updated ACEEE report supports a figure of $230/MWh (2011$), based on analysis of utility programs in 20 states.[212] The LBNL report, drawing on findings from more than 1,700 individual programs studied for up to three years, supports a figure equivalent to approximately $175/MWh (2011$).[213]

Product lifetimes. The EPA's assumptions about measure lives—with uniform distribution of impacts across the projected lifetime—is clearly at odds with data from analyses of state energy efficiency programs, such as that by LBNL (Billingsley et al. 2014), as noted by AEE:

> *"Measures are significantly more likely to last between 10 and 15 years than to last between 0 and 5 years. Moreover, some passive efficiency improvements to home and building envelopes (e.g., insulation and air sealing) can be expected to have much longer measure lives. By assuming a uniform distribution, the Proposed Rule overestimates the amount of energy savings that expire in early years and therefore underestimates the amount of achievable savings over the Interim compliance period. The Proposed Rule should utilize the distribution of measure lives included in the LBNL study rather than the inaccurate assumption that measure lives are uniformly distributed."*[214]

Program cost increases. The EPA assumes program costs increase at higher levels of incremental annual savings, yet data suggest that an assumption of no increases would better match experiences with existing energy efficiency programs, as noted by ACEEE.[215]

LCSE. The EPA notes the conservative nature of its cost assumptions repeatedly, and the impact of this reserved approach on its final calculation of LCSE:

> *"The EPA has taken a conservative approach to each of these factors, selecting values that are at the higher-cost end of reasonable ranges of estimated values. The combination*

[210] GHG Abatement Measures Technical Support Document, p. 5–50.
[211] Friedrich, K., M. Eldridge, D. York et al. 2009. Saving energy cost-effectively: A national review of the cost of energy saved through utility-sector energy efficiency programs. Washington, D.C.: American Council for an Energy-Efficient Economy. http://aceee.org/research-report/u092.
[212] Molina, M. 2014. The best value for America's energy dollar: A national review of the costs of utility energy efficiency programs. Washington, D.C.: American Council for an Energy-Efficient Economy. http://www.aceee.org/sites/default/files/publications/researchreports/u1402.pdf.
[213] Billingsley, M.A., I. M. Hoffman, E. Stuart, S. R. Schiller, C. A. Goldman, K. LaCommare, Lawrence Berkeley National Laboratory. March 2014. The program administrator cost of saved energy for utility customer-funded energy efficiency programs. http://emp.lbl.gov/sites/all/files/cost-of-saved-energy-for-ee-programs.pdf.
[214] See technical comments submitted by AEE.
[215] See technical comments submitted by ACEEE.

> *of these factors is reflected in the value the EPA has derived for the levelized cost per MWh of saved energy."*[216]

The EPA's overly conservative assumptions lead to higher levelized costs for energy savings than experiences seem to warrant. The EPA's approach leads to an LCSE of $85-$90/MWh, substantially higher than the $54/MWh cited by ACEEE.[217] As the Natural Resources Defense Council (NRDC) notes, "the EPA used extremely conservative energy efficiency costs that are 68–81 percent higher than current average costs," and "Numerous state programs have demonstrated consistently that energy efficiency programs cost significantly less than the estimate the EPA relied on in its analysis."[218]

UCS recommends that the EPA adopt for its projections and goal setting the most recent published data with regard to energy efficiency costs and lifetimes.[219]

8.6. UCS recommends that the EPA incorporate a range of other strategies to ensure the integrity and effectiveness of Building Block 4, including with respect to credit for efficiency actions in net-importing states, accounting for voluntary energy efficiency actions, prohibitions against double-counting, and credit for improvements in transmission and distribution.

UCS recommends that:

- **The EPA award full credit for energy efficiency measures implemented by net-importing states**, rather than discounting them based on percentage of imported energy.[220]
- **The EPA appropriately account for voluntary energy efficiency actions** by private actors not covered by the rule, so that such actions are not double counted by reducing any state's obligations under the rule.[221]
- **The EPA not allow double-counting of efficiency-based reductions**, including between a state using a rate-based and one using a mass-based approach.[222]
- **The EPA grant credit for improvements in transmission and distribution efficiency**.[223]

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[216] Proposed Rule, 34874.
[217] Molina, M. 2014. The best value for America's energy dollar: A national review of the costs of utility energy efficiency programs. Washington, D.C.: American Council for an Energy-Efficient Economy. Online at http://www.aceee.org/sites/default/files/publications/researchreports/u1402.pdf.
[218] Natural Resources Defense Council (NRDC). 2014. The EPA's Clean Power Plan could save up to $9 billion in 2030. IB: 14-11-A. Online at http://www.nrdc.org/air/pollution-standards/files/clean-power-plan-energy-savings-IB.pdf.
[219] See, for example, the technical comments submitted by ACEEE.
[220] *Ibid.*
[221] This case is analogous to the voluntary renewable energy situation discussed in section 6.5.
[222] Per the recommendations of the RGGI states in their joint comments: "While a mass-based approach provides many advantages, for those states that elect to utilize a rate-based approach, the EPA should explicitly prohibit 'double-counting' of emission reductions from energy efficiency ('EE') and renewable energy ('RE') measures."
[223] See the technical comments submitted by SWEEP.

- **Municipal utilities and rural electric cooperatives be subject to the rule in the same manner** (no special treatment), consistent with the performance of leading municipal utilities and cooperatives.[224]

[224] *Ibid.*

9. Regional and Market-Based Approaches to Compliance with the Clean Power Plan

- **UCS supports the flexibility in the Clean Power Plan that allows states to comply with the emissions reductions requirements called for by the CPP on a regional or multi-state basis if they so choose because this can lead to lower cost emission reductions.**

- **We also support the inclusion of market-based approaches to compliance, including emissions trading programs, carbon caps and carbon revenue-raising options, as long as the emissions reductions achieved are equivalent to the state goals in the CPP.**

- **UCS recommends that EPA provide guidance, in the case of states that choose to use market-based approaches that generate carbon revenues, on using such revenues, in part, to support or retrain displaced workers, invest in renewable energy and energy efficiency programs, and provide assistance to low-income and environmental justice communities.**

9.1. UCS supports the EPA's inclusion of regional compliance options as a cost-effective, proven way to provide numerous benefits.

Regional compliance options allow states to find the most cost-effective compliance options across a number of states instead of being restricted to whatever resources may be available within a single state.[225] This could lower the costs of compliance with the standard. Allowing multi-state compliance takes account of the fact that the electricity grid already functions on a regional basis in order to secure greater benefits at lower cost for the states served. A multi-state approach builds on the experience and progress made by the Northeast states under the Regional Greenhouse Gas Initiative (RGGI). The existing REC-trading programs around the country are also models for how states across the nation cooperate in tracking and procuring zero-carbon resources and meet renewable electricity standards (RES).

Regional compliance options are a proven success. For example, the RGGI states have collectively lowered their emissions 40 percent below 2005 levels, and have raised more than $1.6 billion in carbon revenues that have benefitted the states' residents. The carbon cap prescribed by the program functions together with complementary energy efficiency and renewable energy programs in the states to deliver greater benefits at a lower cost.

[225] See, for example: Fowlie, M., L. Goulder, M. Kotchen, S. Borenstein, J. Bushnell, L. Davis, M. Greenstone, C. Kolstad, C. Knittel, R. Stavins, M. Wara, F. Wolak, C. Wolfram. 2014. An economic perspective on the EPA's Clean Power Plan: Cross-state coordination key to cost-effective CO_2 reductions. *Science* 14 November 2014: Vol. 346 no. 6211 pp. 815-816. DOI: 10.1126/science.1261349.

9.2. UCS recommends that the EPA provide clear guidance to enable more states and regions to take advantage of the benefits of multi-state compliance options, should they so choose.

Support for multi-state/regional approaches was echoed in numerous stakeholder comments to the EPA. Most recently the RGGI states have submitted comments to the EPA welcoming "…the CPP's acceptance of multi-state and mass-based programs as a means of compliance with the EPA's proposed emission guidelines. RGGI has demonstrated that, by working together, groups of states can achieve greater emission reductions at a lower cost, all while creating jobs, maintaining grid reliability, and improving the regional economy".[226]

The flexibility provided by the EPA creates incentives for states join existing programs like RGGI, the program which implements the California's Global Warming Solutions Act (or AB32), the Pacific coast collaborative or form new regional alliances in the Midwest, Southeast and elsewhere. States do not need to be adjoining to set up joint programs. EPA should provide clear guidance to help enable states to take advantage of these opportunities, if they so choose.

The electricity system is already structured in a way that allows for multi-state compliance. States and regions should work with regional grid operators (including but not limited to ISOs and RTOs), who routinely coordinate on a regional basis the production and tracking of electric energy, as well as the fuel inputs and other costs. Grid operators have extensive experience with integrating new resources onto the grid and can help coordinate the changes necessary to bring on line cleaner resources like renewable energy and energy efficiency reliably and affordably.[227] The expansion of regional power grids such as PJM, Midcontinent ISO, and Southwest Power Pool has resulted in fossil fuel savings and related CO_2 reductions.[228] Their regional power plant coordination and use of grid connections between plants also smooth the integration of renewable energy. Furthermore, the Energy Imbalance Market (EIM), a new institutional approach to managing the regional grid operations of utilities in five western states, provides additional fuel savings, renewable energy integration, and associated emissions reductions.[229]

A recent study by PJM shows that it is much more cost-effective for the PJM power region to achieve compliance with the CPP at a regional level than it would be on a state-by-state basis.[230]

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[226] RGGI. 2014. RGGI states' comments on proposed carbon pollution emission guidelines for existing stationary sources: electric utility generating units, 79 FR 34830. Online at http://www.rggi.org/docs/PressReleases/PR110714_CPP_Joint_Comments.pdf

[227] Union of Concerned Scientists (UCS). 2014. Renewable energy on regional power grids can help states meet federal carbon standards. Online at https://s3.amazonaws.com/ucs-documents/clean-energy/Renewables-Regional-Power-Grids.pdf.

[228] IRC. 2014. The EPA CO_2 Rule: ISO-RTO Council Reliability Safety Valve and Regional Compliance Measurement and Proposals. January 28. Online at http://www.isorto.org/Documents/Report/20140128_IRCProposal-ReliabilitySafetyValve-RegionalComplianceMeasurement_EPA-C02Rule.pdf.

[229] NREL. 2013. Examination of potential benefits of an energy imbalance market in the Western Interconnection. Golden, CO: National Renewable Energy Laboratory. Online at http://www.nrel.gov/docs/fy13osti/57115.pdf.

[230] PJM. 2014. The EPA's Clean Power Plan proposal: Review of PJM analyses preliminary results. Online at http://www.pjm.com/~/media/committees-groups/committees/mc/20141117-webinar/20141117-item-03-carbon-rule-analysis-presentation.ashx.

The study shows that load payments would be approximately $8 billion to 9 billion higher under a state-by-state approach as compared to a regional approach.

An additional opportunity for interstate collaboration exists through the implementation of the Federal Energy Regulatory Commission's (FERC's) Order 1000, which requires all public utility transmission providers to participate in a regional planning process.[231] They are required to consider the impacts of state and federal energy and environmental policies, such as renewable energy standards, state energy efficiency resource standards, and the CPP, on transmission system needs. Order 1000 creates a mechanism for neighboring states and regions to plan and pay for new transmission in a way that is mutually beneficial and can help ramp up wind and solar power and energy efficiency.

A number of states already participate in renewable energy trading systems to help meet their state RESs or other environmental goals.[232] The Clean Power Plan should leverage these existing tracking systems to provide greater flexibility to states to demonstrate compliance on a multi-state basis, while ensuring that there are safeguards in place to ensure accurate, common standards for emissions accounting (see section 6 above for more detail).

A strong Clean Power Plan, with ambitious and fair emission reduction targets, will itself create incentives for multi-state cooperation to meet those targets in a cost-effective manner. On the other hand, if the EPA sets weak targets that would dilute the incentive for states to join together. We agree with the RGGI states' comment that: "because the primary driver of interstate collaboration will be the need for significant emission reductions, revisions that affect parity will best support regional collaboration if they maintain or increase the total amount of emission reductions required nationally".[233]

9.3. UCS supports the inclusion of market-based approaches to demonstrate compliance and recommends that the EPA offer additional guidance on these options.

One option for market-based compliance for a single state or multiple states is to set up emissions trading programs, such as cap-and-trade programs. States could also choose to set a carbon tax or fee.[234] We support these types of option in states/regions that choose them, with the

[231] FERC. 2011. Order No. 1000. Final Rule on Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities.

[232] There are currently nine regional renewable energy certificate (REC) tracking systems in operation: the Texas Renewable Energy Credit Program (run by ERCOT, the NEPOOL-Generation Information System in New England, the PJM-Generation Attribute Tracking System (PJM-GATS), Western Renewable Energy Generation Information System (WREGIS), Midwest Renewable Energy Tracking System (M-RETS), North American Renewables Registry (NARR), Michigan Renewable Energy Certification System (MIRECS), Nevada Tracks Renewable Energy Credits (NVTREC) and the North Carolina Renewable Energy Tracking System (NC-RETS). The New York Generation Attribute Tracking System (NYGATS) is under development.

[233] RGGI. 2014. RGGI states' comments on proposed carbon pollution emission guidelines for existing stationary sources: electric utility generating units, 79 FR 34830. Online at http://www.rggi.org/docs/PressReleases/PR110714_CPP_Joint_Comments.pdf

[234] Wara, Michael W. and Morris, Adele C. and Darby, Marta, How the EPA Should Modify Its Proposed 111(D) Regulations to Allow States to Comply by Taxing Pollution (October 28, 2014). Stanford Public Law Working Paper No. 2516456; Stanford

requirement that the emissions reductions from affected sources must be equivalent to that specified under the CPP, and that all emission reductions must come from the power sector (i.e., offsets from other sectors would not count toward compliance). There are considerable benefits to these types of approaches: They are cost-effective tools to meet the emissions reduction target; they create market incentives for investments in low-carbon energy; there is ease of tracking, monitoring, and reporting; these types of programs can raise carbon revenues that can help fund transition assistance for workers or energy bill assistance for low-income and fixed-income homeowners disproportionately affected by energy price increases. The cap-and-trade structure has been a demonstrated success in a number of cases, including RGGI, California's AB32 program, and the Acid Rain Program.[235]

Other innovative market-based options have also been offered by stakeholders, including a proposal by Great River Energy that would translate the state emission reduction targets to the regional power market level, meet the target by applying an ISO-administered carbon price to electric generation and refund the carbon revenues to load serving entities. The EPA should provide guidance on how these types of programs could demonstrate equivalence and compliance with the CPP.[236]

Additionally, some stakeholders have requested a model rule that lays out the details of an emissions trading program that would be considered compliant with the CPP. Since the EPA has now issued methodologies for calculating mass-based emission reduction targets for states, it should be relatively straightforward to provide this type of guidance. We recommend that the EPA provide guidance on elements of a model rule that would show states how to demonstrate equivalence for a market-based program and other criteria for compliance.

9.4. UCS recommends that the EPA provide guidance for the use of carbon revenues generated under market-based approaches.

Market based approaches create the opportunity to generate carbon revenues that can be used for transition assistance for displaced workers, help with energy bills for low income and fixed income households, investments in low carbon technologies targeted especially to Environmental Justice (EJ) communities, and other public interests. The EPA should provide guidance for those states that choose to use carbon revenue-raising programs to include these types of expenditures to compensate for the potential disproportionate impact of the CPP on these communities (see section 12 for recommendations on this issue).

Law and Economics Olin Working Paper No. 468. Available at SSRN: http://ssrn.com/abstract=2516456 or http://dx.doi.org/10.2139/ssrn.2516456.

[235] The Acid Rain Program, part of the 1990 Clean Air Act Amendments, limits emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x). The SO_2 reductions are being implemented via a cap on emissions combined with an allowance trading program. More information available at http://www.epa.gov/airmarkets/progsregs/arp/s02.html

[236] Chang, J., J. Weiss and Y. Yang. 2014. A Market-based Regional Approach to Valuing and Reducing GHG Emissions from Power Sector: An ISO-administered carbon price as a compliance option for the EPA's Existing Source Rule. A discussion paper prepared for Great River Energy by the Brattle Group. Online at http://www.brattle.com/system/news/pdfs/000/000/616/original/A_Market-based_Regional_Approach_to_Valuing_and_Reducing_GHG_Emissions_from_Power_Sector.pdf?1397501081.

For example, to date, the RGGI program has invested $700 million in energy efficiency, renewable energy and direct bill assistance programs that are projected to save more than $2 billion for 3 million households and 12,000 businesses in the Northeast (RGGI 2014).[237]

California's state budget for FY 2014–15 appropriates $832 million in auction proceeds for funding programs that will reduce GHG emissions, provide direct investments and benefits in disadvantaged communities, and provide additional environmental and economic co-benefits.[238]

9.5. UCS recommends that EPA require that multi-state compliance plans contain some key elements to ensure their robustness.

Multi-state compliance plans should include: an aggregated emissions reduction target that is equivalent to the combined emissions reductions that would accrue from the individual states' targets and otherwise meets the EPA guidance, a multi-state tracking and reporting system for emissions that meets standards set by the EPA, multi-state enforceability provisions (for example, if the combined group of states falls short of the target, then all states must cut emissions proportionally to ensure compliance), and a multi-state plan for ensuring adequate low-carbon resources, and the transmission to support them, is being planned, built and deployed.

Regional compliance will require translation of state rate-based targets or mass-based targets to multi-state targets to determine compliance on a regional/multi-state basis. The EPA's guidance to states on methods to convert rate-based targets to mass-based targets is a helpful step forward. More guidance will need to be provided to states to help them demonstrate equivalence and understand how multi-state compliance options would work across rate and mass-based boundaries.

Multi-state plans should include incentives for increasing renewable energy and energy efficiency, which can help lower the costs of reducing emissions. Where possible, these incentives should be targeted to EJ communities and communities where there is a need to diversify employment opportunities. Multi-state plans should also include incentives for reducing emissions as quickly as possible on a multi-state basis.

We support the recommendation that states that want to create multi-state compliance plans should be allowed additional time to submit them (up to a year extra, June 30, 2018, instead of June 30, 2017, as provided in the draft rule). The EPA's guidance for multi-state compliance plans should also include incentives for early action to encourage investments in renewables and energy efficiency and a shift away from fossil-fired generation after a state compliance plan has been approved by the EPA, as long as these incentives do not undermine the overall level of emissions reductions achieved by the CPP.

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[237] The Regional Greenhouse Gas Initiative (RGGI). 2014. Regional Investment of RGGI CO_2 Allowance Proceeds, 2012. Feb. 2014. Online at http://www.rggi.org/docs/Documents/2012-Investment-Report.pdf.
[238] California Air Resources Board. N.d. Online at http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/budgetappropriations.htm.

10. Timing of Implementation and Compliance Dates for the Clean Power Plan

- **UCS supports the EPA's proposal for the implementation timeline of the Clean Power Plan, the deadlines for state and multi-state compliance plans, and the dates for compliance with interim and final state goals.**

- **UCS strongly recommends that the EPA review and update state goals and other aspects of the Clean Power Plan no later than 2025, to reflect technology improvements that can contribute to a BSER determination and opportunities for cost-effective emissions reductions.**

- **UCS does not support a change in the glide path for emissions reductions that would potentially delay emissions reductions.**

10.1. UCS supports the EPA's timeline for implementing the Clean Power Plan as fair.

The EPA's proposal provides fair and adequate time for states to devise compliance plans, and to meet their interim and final emission reduction goals. The proposal was announced on June 2, 2014 and is expected to be finalized in June 2015. States already have sufficient information to start work on their compliance plans, employing readily-available, commonsense measures to encourage low-carbon electricity generation. There is a 15-year period between the time the rule is expected to be finalized and its final compliance date, adequate time for the modest transition to cleaner generation sources required by the rule especially in light of the rapid market changes already underway that favor such a transition. The dramatically falling costs of renewable energy resources like wind and solar energy and the eroding economics of coal-fired power are among the reasons the CPP goals are eminently achievable and affordable.

The EPA has also proposed an optional two-phase process for state compliance plans, which we support. This approach allows for the requisite amount of certainty that states are making progress on their plans, while allowing for the time it may take for completing detailed analytic work to inform state plans, to pass or update legislation in support of state goals, and to coordinate with the diverse stakeholders needed to achieve a successful outcome. We agree with the requirement that states must file an initial plan by June 30, 2016, "that documents the reasons the state needs more time and includes commitments to concrete steps that will ensure that the state will submit a complete plan by June 30, 2017 or 2018, as appropriate." Further, we agree with the EPA's position that "To be approvable, the initial plan must include specific components, including a description of the plan approach, initial quantification of the level of emission performance that will be achieved in the plan, a commitment to maintain existing measures that limit CO_2 emissions, an explanation of the path to completion, and a summary of the state's response to any significant public comment on the approvability of the initial plan." A final state plan would then be due by June 30, 2017, or by June 30, 2018, in the case of a multi-state plan.

We agree that providing more time for multi-state compliance plans is reasonable. Multi-state approaches create greater flexibility and can help achieve emission reductions at a lower cost. Giving states additional time to coordinate could encourage more states to take this approach, driving greater benefits to all.

10.2. UCS does not support changing the trajectory of emissions reductions to weaken near-term targets, given that it would send the wrong market signal, and be contrary to climate goals.

In its October 28, 2014, Notice of Data Availability (NODA),[239] the EPA requested comment on a potential change in the "glide path" for emissions reductions that would make the 2020 interim state goals less stringent but keep the 2030 goals the same. In light of the many cost-effective, quickly-deployed options to cut emissions (including renewable energy and energy efficiency) and the urgent need to make deep cuts in our global warming emissions, UCS does not support any delay in achieving the emission reductions specified in the draft rule.

Delaying emissions reductions could also result in more stranded assets with utilities making investments to meet near-term targets that may be unsuitable for meeting the longer term targets.

We also strongly believe the EPA should strengthen both the interim and final emission reduction goals (see section 6 on the renewable energy building block for a specific proposal for how to do this). Doing so is technically and economically feasible, and also necessary to help limit global warming emissions. Furthermore, to meet the 2025 goal of a 26 to 28 percent reduction in net U.S. GHG emissions from 2005 levels, as agreed in the recent U.S.-China joint climate announcement, it will be necessary for the Clean Power Plan to be strong and deliver emission reductions in a timely way.[240]

10.3. UCS recommends that the EPA commit to reviewing and updating the Clean Power Plan by 2025.

The EPA should commit to reviewing and updating key aspects of the rule, including state goals and timelines, by 2025. The Clean Air Act requires the EPA to review New Source Performance Standards (NSPS) issued under Section 111 at least every eight years, and update standards at its discretion.[241] There are good reasons to anticipate that the BSER as currently established for existing power plants will be out-of-date by 2025, primarily because of the rapidly changing clean technology landscape (see below). Thus we strongly recommend that the EPA send a clear signal to states at the time of finalization of this rule that it is committed to this review and update process.

[239] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. Notice of Data Availability (NODA). 28 Oct 2014. 79 FR 64543. Online at https://www.federalregister.gov/articles/2014/10/30/2014-25845/carbon-pollution-emission-guidelines-for-existing-stationary-sources-electric-utility-generating.

[240] The White House. 2014. U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation. Fact sheet. Online at http://www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c.

[241] Standards of performance for new stationary sources. 42 U.S.C. § 7411(b)(1)(B).

The electricity market is in a very dynamic period and we have seen tremendous changes just within the last five years in terms of the cost-competitiveness of cleaner generation sources. We expect that these changes will continue, especially with the incentives provided by the Clean Power Plan. It is critical that the CPP be updated by 2025 to take account of technological and market advances, with the aim of achieving even deeper emission reductions in 2030 and beyond.

By 2025, it is also likely that our scientific understanding of the risks of worsening climate impacts will have advanced, creating a greater demand for steep emissions reductions. By 2025, the EPA should also establish emission reduction targets for the post-2030 period, for at least 2035 and 2040, to signal the continued need to drive down emissions.

10.4. UCS supports the EPA's proposal for tracking of state compliance plan performance and true-up provisions, and recommends that the EPA require annual tracking and regular true-ups.

We support the EPA's proposal in the draft rule as excerpted below and further recommend that the EPA require states to undertake annual tracking of actual plan performance during implementation:

> *"In addition to demonstrating that projected plan performance will meet the interim and final state goals, the EPA proposes that state plans must contain requirements for tracking actual plan performance during implementation. For plans that do not include enforceable requirements for affected EGUs that ensure achievement of the full level of required emission performance and interim progress, the state plans would be required to include periodic program implementation milestones and emission performance checks, and include corrective measures to be implemented if mid-course corrections are necessary."*[242]

UCS also recommends that the EPA require that the state compliance plans include true-up provisions to ensure that they are on track to meet the interim and final compliance goals. This could take the form of true-ups, at least every 3 to 5 years, for the individual programs that contribute to state compliance goals, or an overall true-up of the achieved state emissions reductions. This type of regular review will help prevent situations where states fall short of the emission reduction goals and have to rapidly make up deficits. Policy and investment changes in the power sector require some time to implement or adjust, so advance notice will be key to ensuring they are well aligned with the goals of the Clean Power Plan.

One example of the importance of this type of review comes from the RGGI states, which, in 2012, undertook a program review of the CO_2 budget.[243] On the basis of changing market conditions, which showed a significant excess supply of allowances relative to actual emission

[242] Proposed Rule, 34905.
[243] RGGI. 2012 Program Review. Online at http://www.rggi.org/design/program-review.

levels in the region, the states chose to take advantage of the additional cost-effective emissions achievable and reduce the level of the carbon cap.

We support the EPA's proposal that states provide Regular review of the performance of state implementation plans could provide important information to the EPA as it reviews and updates the whole Clean Power Plan prior to 2025, as mentioned above.

11. Need and Cost-effective Potential to Strengthen the Clean Power Plan

UCS recommends that the EPA ensure that the CPP achieves the full potential of cost-effective emissions reductions available in the power sector, and that these reductions take place in a timely manner, given the urgent need to cut global warming emissions. Strengthening the CPP is also a critical component of the US contribution to international efforts to cut global emissions and slow the pace of climate change.

UCS recommends, based on our analysis, that the EPA adopt several ways to cost-effectively strengthen the Clean Power Plan in keeping with the BSER criteria, including:

- **Increasing the contribution from the renewable energy and energy efficiency building blocks;**
- **Implementing a change in the goal computation formula to ensure that new and incremental renewable energy, energy efficiency, and nuclear generation explicitly replace generation from fossil fuel-fired sources, which is a better representation of the BSER and consistent with the treatment of incremental NGCC; simultaneously, we recommend a formula change to removing existing generation resources (renewable energy and "at risk" nuclear energy) from the denominator of the formula used to calculate state goals since the associated emission reductions are already embedded in the baseline emissions and generation mix.**
- **Including both the generation and emissions impacts of new NGCC units in the state goal calculation;**
- **Ensuring that there are no changes to the 2020-2029 glide path that result in a delay in the interim and final goals for emissions reductions achieved by the CPP.**

11.1. Increasing the contribution from renewable energy and energy efficiency.

As described in detail in section 6, UCS has developed an approach that builds on and improves the EPA's methodologies for calculating state renewable energy targets. The UCS Demonstrated Growth Approach uses the latest available market data, demonstrated rates of growth in renewable energy, and existing state commitments to deploy renewables. Using our recommended modifications, the EPA could nearly double the amount of cost-effective renewable energy in their state targets—from 12 percent of total 2030 U.S. electric sales to 23 percent. The EPA should adopt a similar approach.

Similarly, in section 8, we indicate our support for increasing the annual targets and ramp-up rates for energy efficiency deployment, based on current state and utility performance data and the range of policies and technologies that should be included in the EPA's assessments. UCS also recommends that the EPA update its cost and performance assumptions for efficiency and renewable energy technologies and measures to reflect current data and updated projections.

Our analysis shows that incorporating higher levels of renewable energy and energy efficiency in the state goals is both feasible and affordable. At the same time, this can provide a pathway to increase the overall emissions achieved by the standard. For example, we show that just by increasing the contribution from renewable energy, the standard would deliver emissions reductions of at least 40 percent below 2005 levels by 2030 instead of 30 percent as specified in the draft rule (see section 6 for more detail on our modeling results).

Separately, a June 2014 analysis by UCS shows that it is cost-effective to go even further by implementing a limit on carbon combined with energy efficiency and renewable energy policies. In that analysis we showed a cost-effective pathway to reduce US power sector emissions 60 percent below 2005 levels by 2030 through expanded use of renewable energy and energy efficiency.[244] Other studies have also shown that we can both reduce carbon emissions and lower electricity bills by deploying more energy efficiency and renewable energy through a combination of policies.[245,246,247]

11.2. UCS recommends that the EPA appropriately account for the emission reductions from displacement of fossil-fired generation sources by incremental renewable energy and energy efficiency.

We recommend that the EPA implement a change in the goal computation formula to ensure that incremental renewable energy and energy efficiency and nuclear generation explicitly replace generation from fossil fuel-fired sources on a pro-rata basis, which is a better representation of the BSER and consistent with the treatment on incremental NGCC. We support the alternative approach described in the NODA that establishes greater consistency across Building Blocks 2, 3 and 4, and results in greater CO_2 emissions reductions.

The EPA's formula for calculating state emissions goals does not account for the fossil-fired generation that would be displaced by incremental renewable energy, energy efficiency, and nuclear generation. We agree with stakeholders who, as described in the October 28 Notice of Data Availability,[248] have pointed out the discrepancy in the BSER formula for calculating state goals in the way that the emissions reductions attributable to Building Block 2 (re-dispatch to

[244] Cleetus, R., S. Clemmer, J. Deyette and S. Sattler. 2014. Climate game changer: How a carbon standard can cut power plant emissions in half by 2030. Online at http://blog.ucsusa.org/cut-power-plant-carbon-by-50-percent-new-epa-climate-rules-real-global-warming-solutions-552?_ga=1.7656945.2136133040.1407434157.

[245] Electric Power Research Institute (EPRI). 2010. The power to reduce CO_2 emissions. Palo Alto, CA. Online at www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001020142.

[246] Cleetus, R., S. Clemmer, and D. Friedman. 2009. Climate 2030: A national blueprint for a clean energy economy. Cambridge, MA: Union of Concerned Scientists. Online at ucsusa.org/global_warming/solutions/big_picture_solutions/climate-2030-blueprint.html.

[247] Energy Information Administration (EIA). 2009. Energy market and economic impacts of H.R. 2454, the American Clean Energy and Security Act of 2009. Washington, DC: U.S. Department of Energy. Online at www.eia.gov/oiaf/servicerpt/hr2454/.

[248] Environmental Protection Agency (EPA). 2014. Notice of Data Availability. 79 FR 64543, pages 64543 -64553. Online at https://federalregister.gov/a/2014-25845.

natural gas combined cycle) is calculated as compared to Building Blocks 3 and 4 (incremental renewables and efficiency).

We agree with the description of the inconsistency in the treatment of Building Blocks 3 and 4, compared with building 2 detailed in the NODA:[249]

> *"The goal calculation for building block 2 not only reflects an increase in less carbon-intensive generation, but also applies an equal downward adjustment to each state's total existing fossil steam generation level in 2012, reflecting a generation shift away from higher-emitting fossil steam generation and toward lower-emitting NGCC generation. The result is that total generation is held constant, with only the mix of more and less carbon-intensive generation changing. In contrast, the approach in the proposal for incorporating building blocks 3 and 4 in the goal calculations does not reflect shifting generation away from fossil units because the total amount of generation is increased (including "megawatts" from EE as "generation") without any offsetting decrease in generation from 2012 fossil generation levels. By holding existing fossil generation at 2012 levels for purposes of goal calculation and estimating building blocks 3 and 4 independent of the interaction with those existing fossil generation levels, the state goals do not reflect the potential for added generation from building block 3 and avoided generation from building block 4 to shift generation away from existing fossil steam generation below the 2012 level and, therefore, do not reduce generation, and thus emissions, from affected fossil fuel-fired generation in keeping with the EPA's proposed approach to the BSER.*
>
> *"The formula in the draft rule simply adds incremental RE and EE to 2012 baseline generation levels (in the denominator of that formula) but does not reduce the 2012 baseline levels of fossil generation (in the denominator of the formula) by that incremental RE and EE, or remove the corresponding emissions (in the numerator of that formula)."*

As a solution, we recommend the alternative approach described in the NODA that establishes greater consistency in the treatment of Building Blocks 2, 3 and 4, and results in greater CO_2 emissions reductions. In the formula for goal computation, incremental renewable energy, energy efficiency, and nuclear generation should explicitly replace generation from fossil fuel-fired sources, which is a better representation of the BSER since it better reflects the likely reductions in fossil generation (and corresponding reduction in emissions) that can be achieved by affected sources.

We support the option in the NODA that would assume that incremental generation from Building Blocks 3 and 4 would directly replace 2012 fossil generation (i.e., fossil steam and gas

[249] Environmental Protection Agency (EPA). 2014. Notice of Data Availability. 79 FR 64543, pages 64543 -64553. Online at https://federalregister.gov/a/2014-25845.

turbine) and the corresponding emissions in proportion to their historical generation across generation types. Under the approach in the June 2014 proposal, incremental renewables and efficiency could replace a generation increase from existing fossil sources that would otherwise occur after 2012, while under this alternative approach, incremental renewables and efficiency could replace historical fossil generation below 2012 levels.

Furthermore, if the EPA adopts a formula in which renewables and energy efficiency displace NGCC and coal-fired generation on a pro rata basis, it must also ensure that it corrects the potential emission reductions from building block 2. When renewables and energy efficiency displace NGCC generation, this will lower the capacity factor of NGCC plants and create additional potential reductions from building block 2. These additional reductions can be achieved either by displacing fossil generation from blocks 3 and 4 before calculating block 2 or by doing a true-up to block two to ensure that NGCC plants remain at a 70 percent capacity.[250]

11.3. UCS recommends that the EPA appropriately account for emissions changes from substituting existing fossil-fired generation with new natural gas generation.

The state goal computation formula in the draft proposal does not appropriately account for emissions resulting from substitution of existing fossil fired generation by new natural gas generation. In states where there is a significant increase in new NGCC generation, this could result in a significant increase in emissions that are not accounted for in state emissions goals. We recommend that this loophole be closed.

We agree with comments from AWEA on this issue (excerpted with small modifications below): If new natural gas plants are used for compliance purposes, they should be factored into the establishment of the targets to ensure symmetry between the resources considered in setting the target and resources allowed for compliance. Incorrectly treating new gas generators as if they have zero carbon emissions would result in less overall carbon emission reductions, as the actual emissions associated with operating the new gas generators would not be bound by the limit created by 111(d).[251] A failure to account for the emissions associated with new gas generators would effectively allow a state to treat new gas facilities as if they were zero-emission resources, skewing investment and dispatch decisions away from true zero-emission resources and even creating a strong distortionary incentive to substitute new gas generation for existing combined cycle generation in investment and dispatch decisions. The EPA should also periodically reevaluate, such as during the eight-year review process, to provide a mechanism for updating the fleet of facilities subject to the regulation in order to ensure that the 111(d) regulations continue to achieve significant emission reductions from fossil-fuel power plants, consistent with the no- backsliding policy.

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[250] See comments from the Environmental Defense Fund and the Natural Resources Defense Council for further details on this issue.

[251] Note that new electricity generating units (EGUs), including new NGCC plants, are regulated under Section 111(b) of the Clean Air Act, and in September 2013 EPA issued a draft carbon standard for new power plants (available online at https://federalregister.gov/a/2013-28668).

11.4. UCS supports ensuring that the 2020-2029 glide path for state goals for emissions reductions remains as it is in the draft proposal and is not delayed in any way.

In the NODA, the EPA has solicited comment on changing the 2020-2029 glide path in a manner that would allow states to delay emissions reductions toward the end of that period, although the 2030 final goal would remain unchanged. We do not support this change to the glide path since the draft proposal already allows significant flexibility to states in the timing for reaching their interim goals. Further delays in achieving emissions reductions are contrary to the overall goals of the CPP to make a significant contribution to reduce US global warming emissions in a timely way. Nevertheless, if the EPA were to decide to make any change in the glide path, it should only be done in conjunction with strengthening the state emissions reduction goals required by CPP.

EPA has indicated that stakeholders have expressed particular concerns about the shift in generation by 2020 from the implementation of Building Block 2. Our analysis shows that the shift in generation away from coal-fired power is already under way for a variety of reasons including low natural gas prices, the cost-competitiveness of renewable energy and energy efficiency and health-based pollution standards.[252] As we point out in section 1, since 2009, utilities have announced plans to close or convert to natural gas more than 430 coal generators in 37 states. For many states this is already a significant portion of the switch away from coal to NGCC calculated in their Building Block 2 (see section 5). Many additional coal plants are economically vulnerable and should be considered for retirement. There are many cost effective options for replacing this generation with cleaner generation sources available in every region of the country (see section 6).

UCS does not support a phase-in of Building Block 2 because these trends are already underway and therefore already being phased in in the market place and states will have additional time to phase in changes prior to the first year of the interim goal compliance period (2020) and during the compliance period for interim goals of 2020-2029. We also do not agree with comments that states will face undue challenges from implementing this building block should they choose to use it. Furthermore, any state that does face constraints in implementing this building block has the flexibility to use other cost-effective building blocks to meet its overall interim and final targets.

Incentives for early action. UCS supports incentives for early action to encourage investments in renewables and energy efficiency and a shift away from fossil-fired generation after a state compliance plan has been approved by the EPA, as long as these incentives do not undermine the overall level of emissions reductions achieved by the CPP. The quicker we can cut emissions, the better from a climate perspective.

[252] Fleischman, L., R. Cleetus, J. Deyette, S. Clemmer, and S. Frenkel. 2013. Ripe for retirement: An economic analysis of the U.S. coal fleet. *The Electricity Journal* 26(10):51-63. Online at dx.doi.org/10.1016/j.tej.2013.11.005.

11.5. UCS recommends that the EPA remove existing generation resources (renewable energy and nuclear energy) from the denominator of the formula used to calculate state goals.

The EPA's adjusted emissions rate formula includes existing renewable energy generation and 6% "at risk" nuclear generation in the denominator of the formula used to calculate state emission reduction goals. This results in a formula that is not truly measuring the emissions rate reduction. Removing these components from the formula would result in a goal that is a better representation of the BSER and would also result in a more consistent treatment of all zero-carbon emitting generation sources.

11.6. UCS recommends that the EPA strengthen the CPP as a critical component of the U.S. contribution to international climate efforts.

The next year, leading up to the United Nations Framework Convention on Climate Change (UNFCCC) negotiations in Paris in December 2015, is a critical one for reaching a fair and ambitious global climate agreement. On November 11, 2014, President Obama and President Xi Jinping of China made a historic joint announcement committing both countries to serious steps to lower their emissions.[253] The U.S. has set a goal of a 26 to 28 percent cut in its net GHG emissions by 2030, while China intends to reach a peak in its CO_2 emissions by 2030 and has signaled that its use of coal will peak in 2020 at 4.2 billion tons.[254] China also plans to increase the share of non-fossil fuels in primary energy consumption to around 20 percent by 2030. This agreement between the two major emitting nations represents a significant breakthrough and can help unlock equivalent actions by other nations in the lead-up to the Paris meeting.

Strengthening the CPP is critical to reaching the upper end of the current U.S. offer of a 28 percent reduction in emissions from 2005 levels by 2030. Analysis by UCS and other experts shows that there are many near-term, cost-effective options to cut power sector emissions, which are a major portion of total U.S. emissions. [255] Furthermore, in our judgment, the US offer can and should be more ambitious in light of the many affordable opportunities to further reduce emissions, and the grave threat posed by climate change. If the CPP is strengthened in the ways we have described in sections 11.1 to 11.5, we estimate that it would be possible, in conjunction

[253] The White House. 2014. U.S.-China Joint Announcement on Climate Change. Washington DC: Office of the Press Secretary. Online at http://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change

[254] The State Council of China. 2014. Energy Development Strategy Action Plan (2014-2020). Online at http://news.xinhuanet.com/english/china/2014-11/19/c_133801014.htm

[255] Williams, J.H., B. Haley, F. Kahrl, J. Moore, A.D. Jones, M.S. Torn, H. McJeon. 2014. Pathways to deep decarbonization in the United States. The U.S. report of the Deep Decarbonization Pathways Project of the Sustainable Development Solutions Network and the Institute for Sustainable Development and International Relations. Online at https://ethree.com/publications/index_US2050.php.
Clemmer, S., J. Rogers, S. Satttler, J. Macknick, and T. Mai. 2013. Modeling low-carbon US electricity futures to explore impacts on national and regional water use. Environmental Research Letters 8; doi:10.1088/1748-9326/8/1/015004.
Cleetus, R., S. Clemmer, and D. Friedman. 2009. Climate 2030: A National Blueprint for a Clean Energy Economy. Cambridge, MA: Union of Concerned Scientists. Online at http://www.ucsusa.org/global_warming/solutions/big_picture_solutions/climate-2030-blueprint.html.
Fawcett A.A., V.C. Katherine, F.C. de la Chesnaye, J.M. Reilly, and J.P. Weyant. 2009. Overview of EMF 22 US transition scenarios. Energy Economics 3:S198–211.

with CO_2 emission reductions in other sectors and in non-CO_2 global warming emissions, to raise the US offer. Ambitious reductions in carbon emissions are critical if we are to limit the impacts of climate change. The current rate of rising global CO_2 emissions is cause for great concern. The IPCC Fifth Assessment Synthesis Report states that:

> *"…limiting total human-induced warming to less than 2°C relative to the period 1861-1880 with a probability of >66% would require cumulative CO_2 emissions from all anthropogenic sources since 1870 to remain below about 2900 $GtCO_2$ (with a range of 2550-3150 $GtCO_2$ depending on non-CO_2 drivers). About 1900 $GtCO_2$ had already been emitted by 2011."*[256]

The stark math of that limited carbon budget makes clear that, ultimately, we will need to cut emissions much more than what may be possible under the Clean Power Plan, but a strong CPP is a critical step along that path.

[256] IPCC. 2014. Fifth Assessment Synthesis Report. Online at http://ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_LONGERREPORT.pdf.

12. Environmental and Economic Justice Concerns

- **UCS recognizes that, unless state compliance plans include specific worker transition provisions, the proposed standard for carbon emissions at existing power plants may have disproportionately negative impacts among certain coal-heavy geographic regions, coal-dependent communities, and coal-related workers.**

- **UCS recommends that the EPA work in conjunction with other federal and state agencies to leverage existing programs and resources that can be brought to bear in addressing impacts to coal communities and assisting displaced workers. States should consider a variety of policy mechanisms, both within the context of state compliance plans and through complementary policies enacted by state legislatures, to address these needs.**

- **UCS recommends that EPA require states to conduct environmental justice analyses of their compliance plans, and provide guidance to states on how to assess changes in criteria pollutants, water quality, and other environmental damage that may result from their compliance plans and assess the potential impacts on neighboring or downwind communities.[257]**

- **UCS recommends that states prioritize the development of renewable energy resources and the expansion of energy efficiency programs in overburdened and impacted communities, including low-income, minority, disadvantaged, and coal-heavy populations.**

The EPA and states must pay particular attention to both environmental and economic justice issues. Overburdened communities, including low-income and minority populations, often face the greatest impacts from criteria air pollutants; conversely, coal workers may face the loss of their livelihoods in the transition to a clean energy economy. The impacts of climate change will disproportionately affect certain communities, such as the poor, the elderly, and the very young, who are most vulnerable to health impacts, as well as minority and disadvantaged communities, which notably already face significantly greater health impacts due to poor air quality. Similarly, without foresight and planning, policies to address the threat of climate change could negatively impact communities that depend on fossil-related industries for economic activity and jobs.

In its proposal, the EPA outlined specific elements of an approvable state compliance plan. Given the complex nature of the proposed standard, the agency should specify a menu of options that states could use to address both environmental and economic justice concerns. State compliance plans should direct resources to the most impacted communities, while reducing emissions, protecting workers, and mitigating direct health impacts. Shutting down old,

[257] For example, the EPA should integrate the technical guidance in Plan EJ 2014 into its guidance for state compliance plans for the CPP to help states comply with the requirement for an environmental justice analysis of those plans. (EPA. N.d. Plan EJ 2014. Online at http://www.epa.gov/environmentaljustice/plan-ej/)

inefficient, and polluting coal plants[258] can help reduce health impacts in overburdened communities[259] while investments in renewable energy and energy efficiency can help create jobs and strengthen local economies, which is of critical importance to communities heavily reliant on coal and related industries.

Economic Justice: Job Creation and Worker Transition

12.1. UCS recommends that the EPA emphasize—and provide guidance to states on—the potential for job creation and economic development from investments in renewable energy and energy efficiency and in supporting industries, especially manufacturing.

With the rapid decline in cost and corresponding increase in deployment of renewable energy resources like wind[260] and solar,[261] fossil generation is under increasing competition from cleaner alternatives for electricity. The proposed standard for carbon emissions represents an opportunity for states to amplify or jumpstart investments in both renewables and efficiency and to stimulate local economies. Many studies have demonstrated the job growth and economic benefits of such investments. Most recently, a report looking at California as a case study[262] demonstrates how federal, state, and construction industry policies have led to the development of nearly 5000 MW and the creation of more than 15,000 jobs.[263] Thanks to strong labor agreements, not only are workers well-paid and receive solid health and pension benefits, but also contractors have contributed $17.5 million for training programs. Solar development in California "is preparing a new generation of California blue collar workers for a future of skilled and productive work and a life of financial security."[264]

12.2. UCS recommends that the EPA require that states assess impacts of their compliance plans on workers and communities that will be disproportionately affected.

In its Regulatory Impact Analysis (RIA), the agency projects that the standard would cause total U.S. coal production to fall by 25 to 27 percent in 2020[265] (and from 35 to 37 percent in the Appalachian region) and that employment in coal extraction would decline by 13,700 to 14,300

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[258] Cleetus, R., S. Clemmer, E. Davis, J. Deyette, J. Downing, and S. Frenkel. 2012. Ripe for retirement: The case for closing America's costliest coal plants. Cambridge, MA: Union of Concerned Scientists, November 2012. Online at http://www.ucsusa.org/assets/documents/clean_energy/Ripe-for-Retirement-Full-Report.pdf.

[259] Wilson, A. et al. 2012. Coal blooded: Putting people before profits. Online at http://www.naacp.org/page/-/Climate/CoalBlooded.pdf.

[260] American Wind Energy Association (AWEA). 2014. U.S. wind industry annual market report 2013. Washington, DC: AWEA.

[261] Solar Energy Industries Association (SEIA). 2014. Solar energy facts: 2013 year in review. Washington, DC: SEIA. Online at www.seia.org/sites/default/files/YIR%202013%20SMI%20Fact%20Sheet.pdf, accessed on September 15, 2014.

[262] Philips, P. 2014. Environmental and economic benefits of building solar in California. Donald Vial Center on Employment in the Green Economy. Institute for Research on Labor and Employment, UC Berkeley. Online at http://laborcenter.berkeley.edu/environmental-and-economic-benefits-of-building-solar-in-california-quality-careers-cleaner-lives/.

[263] Includes 10,200 construction jobs, 136 permanent O&M jobs, and over 3,700 additional jobs (induced).

[264] Philips 2014.

[265] Table 3.15, Regulatory Impact Analysis.

job years annually by 2020.[266] Importantly, however, the future of the coal industry, even without this rule, is uncertain at best,[267] and it has already declined, particularly in Central Appalachia,[268] due to cheap and abundant natural gas, competition with other coal mining regions, decreasing labor productivity (and increasing costs), and earlier environmental regulations. Although the RIA concludes that the proposed standard likely will result in an increase in net jobs nationally, it must be recognized that job impacts will be unevenly dispersed—some regions and states will be winners, and others will experience economic consequences from a shift away from coal. Although the agency has no authority under the CAA to provide assistance to states facing negative impacts, it can and should offer guidance to those states on ways to help to address such concerns. Coal-heavy states, in turn, should consider using compliance plans to help diversify their economies.

12.3. UCS recommends that the EPA highlight—provide guidance to states on considering—a variety of policy mechanisms, both within the context of state compliance plans and through complementary policies enacted by state legislatures, to retrain workers and invest in economic diversification.

Many such policies have the potential to generate revenue that the state can then invest as they see fit. Policies could include:

- **Market-Based Mechanisms.** The Regional Greenhouse Gas Initiative (RGGI) offers an example of how state collaboration on market-based solutions could generate revenue for states as they lower carbon emissions. For example, in 2012 RGGI states invested 73 percent of auction revenue in energy efficiency programs, which is expected to save participants $1.8 billion on electricity bills over the lifetime of the measures.[269] During the first compliance period from 2009-2012, RGGI auctions generated $912 million in proceeds and produced $1.6 billion in net present value to the (then) ten-state region, corresponding to almost $33 per capita spread throughout the region.[270] Cumulatively, from 2009-2012, 65 percent of proceeds went to energy efficiency, 17 percent to direct bill assistance, 6 percent to clean and renewable energy, and 6 percent to GHG abatement—but states direct their own auction revenue as they see fit. Coal-heavy states that join regional programs could decide to direct auction revenue to worker retraining and economic diversification, and should be encouraged to do so. California's AB 32 similarly sets up a market-based mechanism for reducing emissions that generates revenue for the state (see below).

[266] Tables 6.4 and 6.5, Regulatory Impact Analysis.
[267] Richardson, L. J., R. Cleetus, S. Clemmer, and J. Deyette. 2014. Economic impacts on West Virginia from projected future coal production and implications for policymakers. Environmental Research Letters, 18 Feb 2014. 9(2): 024006. doi:10.1088/1748-9326/9/2/024006.
[268] McIlmoil, R., E. Hansen, N. Askins, and M. Betcher. 2013. The continuing decline in demand for Central Appalachian coal: Market and regulatory influences. Downstream Strategies, 2013. Online at http://www.downstreamstrategies.com/documents/reports_publication/the-continuing-decline-in-demand-for-capp-coal.pdf.
[269] RGGI 2014. Regional Investment of RGGI CO_2 Allowance Proceeds, 2012.
[270] Hibbard et al. 2011. The economic impacts of the Regional Greenhouse Gas Initiative on ten Northeast and Mid-Atlantic states. The Analysis Group.

- **Carbon Fees.** Sub-national governments have enacted prices on carbon emissions. British Columbia, for example, enacted a carbon tax[271] in 2008; the revenue neutral program in fiscal year 2013-14 is expected to generate $1.2 billion in proceeds to offset other taxes. Such policies can be used to generate revenue that could be directed to affected workers and communities. The EPA should explicitly identify carbon fees that drive down emissions as an allowable state compliance mechanism[272] (see section 9).

- **Permanent Mineral Trust Funds.** Many resource-rich states have enacted permanent mineral trust funds, which levy a special tax on companies for right to remove resources from the ground.[273] Wyoming, for example, enacted its program in 1974, and as of 2013, the fund was worth $5.88 billion.[274] In March 2014, West Virginia established the Future Fund,[275] similarly designed to direct a fraction of severance tax revenue from mineral resources (notably, including coal) to economic diversification and development focusing on regions where the extraction takes place. Although no revenue is currently being directed toward the Future Fund due to other budget priorities, the legislation specifically allows for other sources of revenue to be deposited into the fund.

- **Renewable Electricity Standards**. In addition to helping states meet their carbon reduction goals, RES policies[276] can spur renewable development. Some states have even defined their RESs to designate a portion of RE development from in-state resources to support local job creation. Studies find limited cost impacts from such policies, and some states have quantified measurable economic benefits from the programs.[277]

- **Energy Efficiency Resource Standards**. Similarly, policies that promote energy efficiency in homes and businesses can not only help states meet the EPA targets, but also create local jobs that cannot be outsourced, while saving consumers money on their electricity bills.[278]

- **Worker Training Programs**.

- **Economic Development and Economic Diversification**.

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[271] http://www.fin.gov.bc.ca/tbs/tp/climate/carbon_tax.htm.

[272] Wara, M., W. Adele, C. Morris, and M. Darby. 2014. How the EPA should modify its proposed 111(d) regulations to allow states to comply by taxing pollution. SSRN 2014. Online at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2516456.

[273] Boettner T., J. Kriesky, R. McIlmoil, and E. Paulhus. 2012. Creating an economic diversification trust fund: Turning nonrenewable natural resources into sustainable wealth for West Virginia. West Virginia Center on Budget and Policy, January 2012. Online at http://www.wvpolicy.org/downloads/WVEconomicDiversificationTrustFundRpt013012.pdf.

[274] Gordon, M. 2013. Wyoming State Treasurer Annual Report for the Period July 1, 2012 through June 30, 2013. Online at http://treasurer.state.wy.us/pdf/annualweb2013.pdf.

[275] Bill Text, as passed, March 10, 2014: http://www.legis.state.wv.us/Bill_Status/Bills_history.cfm?input=461&year=2014&sessiontype=RS&btype=bill.

[276] See Lawrence Berkeley National Laboratory, http://emp.lbl.gov/rps.

[277] Heeter, J., G. Barbose, L. Bird, S. Weaver, F. Flores-Espino, K. Kuskova-Burns, and R. Wiser. 2014. A survey of state-level cost and benefit estimates of Renewable Portfolio Standards. Online at http://www.ourenergypolicy.org/wp-content/uploads/2014/06/nrel.pdf.

[278] Alliance to Save Energy. 2013. Energy Efficiency Resource Standard. Online at https://www.ase.org/sites/ase.org/files/resources/Media%20browser/eers_fact_sheet_9-13.pdf.

12.4. UCS recommends that the EPA engage with other federal agencies on addressing worker transition concerns.

Recognizing that the proposed standard may disproportionately impact coal communities, the agency should work in conjunction with other federal agencies to leverage existing programs to support displaced workers. The federal government already has a number of programs to support worker retraining and community development, all of which are currently funded and not reliant on further action from Congress. In particular, the Department of Agriculture's Rural Development program, the Department of Commerce's Economic Development Administration, the Department of Labor's Economic Training Administration, and the Appalachian Regional Commission all have programs in place to support workers and communities. By leveraging existing authority, the federal government can direct targeted resources to affected communities and help coal states diversify their economies. For example, the Obama Administration designated southeastern Kentucky as a federal Promise Zone[279] to focus on poverty alleviation by establishing a partnership between federal agencies and local institutions. Together, federal agencies should work with Congress to develop targeted legislation to address displaced workers in coal mining, coal fired power plants, and related industries. Numerous examples in recent history serve as a roadmap for successful worker retraining programs, including the Trade Adjustment Act and the Workforce Reinvestment Act. More recently, a bipartisan bill was introduced in the 113th Congress specifically directed at coal workers.[280]

12.5. UCS recommends that the EPA work with stakeholders to help protect workers as the rule is implemented.

With foresight and planning, states can develop implementation plans that lead to net job creation nationally. As the BlueGreen Alliance[281] emphasizes, it is critical to provide direct support to workers and communities—extending to ancillary and support sectors as well as the utility sector—if and when a power plant shuts down, by providing wages, benefits, training, education, and the recognition of basic workers' rights. Communities will need resources to diversify their economies and create high-paying jobs that can match or exceed those that may have been lost. The private sector, including utilities, and all levels of government must work in tandem with communities to make these transitions a success. Regulated entities should not be allowed to skirt commitments made to workers—as power plants and coal mines close or idle, owners should honor the commitments they made to workers, including pensions and health benefits.

[279] http://www.nytimes.com/2014/01/10/us/politics/obama-announces-promise-zones-in-5-stricken-areas.html.
[280] http://blogs.rollcall.com/218/in-a-partisan-climate-two-lawmakers-try-to-talk-past-climate-change/.
[281] http://www.bluegreenalliance.org/news/publications/testimony-of-the-bluegreen-alliance-at-public-hearing-on-EPAs-clean-power-plan.

Environmental Justice and Overburdened Communities

12.6. UCS recommends that the EPA require states to conduct an environmental justice analysis of their compliance plans.

Executive Order 12898[282] requires federal agencies to "identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law."[283] The agency considered the negative impacts on vulnerable communities of greater utilization of certain EGUs.[284] The EPA determined that it is “not practicable” to conduct a detailed analysis of environmental justice impacts of the proposed rule, due to the nature of the electricity grid and uncertainty surrounding which plants would operate more or less frequently or close altogether. This implies that states, especially if working in the context of regional agreements, would be better positioned to conduct an environmental justice analysis of the impacts of their compliance plans. In doing so, states must assess the impacts of the changes in utilization rate of specific plants on criteria pollutants on overburdened communities, both surrounding and downwind of the plant. In implementing the rule, states should take steps to ensure that polluting facilities are not provided incentives for operating more frequently and therefore exacerbating pollution "hot spots" in low-income and minority communities.

12.7. UCS recommends that the EPA offer states data, methodology, and tools to conduct effective EJ analyses.

The EPA is engaged in a process to integrate environmental justice into is programs, policies, and activities. Called Plan EJ 2014, the agency finalized its overarching EJ strategy in 2011 after public input on key issues of overburdened communities. Under Plan EJ 2014, the agency is currently finalizing technical guidance for assessing environmental justice in regulatory analyses.[285] EPA should integrate this technical guidance in Plan EJ 2014 into the guidance document it issues for state compliance plans for the CPP to help states comply with the requirement for an environmental justice analysis of its compliance strategy.[286]The implementation of California’s AB 32 (Global Warming Solutions Act) and follow-up bill (SB 535) also provide important examples of how to address EJ concerns.[287]

12.8. UCS supports prioritizing the development of renewable energy and energy efficiency in overburdened communities as part of state compliance plans.

The EPA should offer examples to states of how compliance plans could be used to support these communities, particularly through revenue streams. Both California and RGGI offer examples of

[282] 59 FR 7629, February 16, 1994.
[283] http://www2.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.
[284] https://www.federalregister.gov/articles/2014/06/18/2014-13726/carbon-pollution-emission-guidelines-for-existing-stationary-sources-electric-utility-generating#p-1445.
[285] http://epa.gov/environmentaljustice/resources/policy/plan-ej-2014/plan-ej-progress-report-2014.pdf.
[286] EPA. N.d. Plan EJ 2014. Online at http://www.epa.gov/environmentaljustice/plan-ej/.
[287] Truong, V. 2014. Addressing Poverty and Pollution: California’s SB 535 Greenhouse Gas Reduction Fund. Harv. CR-CLL Rev. 49 (2014): 493–569.

how to invest revenue to support low-income communities. Some funds from these revenues should be rebated to overburdened communities. In addition to direct bill assistance,[288] RGGI states have channeled auction revenue specifically to low-income households; Delaware, for example, has invested approximately 21 percent of its cumulative-to-date auction revenue into low-income home weatherization and heating assistance.[289] Development of community scale renewables, energy efficiency investments, net metering policies, and local hiring provisions can support building a green economy in disadvantaged communities.[290] States could also fund weatherization programs and leverage federal Department of Energy funding for these activities.

12.9. UCS recommends that the EPA encourage states to solicit input on state compliance plans from a wide variety of stakeholders.

Outreach efforts should include robust and extensive dialogues with community leaders and the public, with particular attention to EJ communities.[291]

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[288] Cumulatively, RGGI states have invested 17 percent of auction revenue in direct bill assistance.
[289] http://www.rggi.org/rggi_benefits/program_investments/delaware.
[290] Patterson, J. et al. 2014. Just Energy Policies: Reducing Pollution and Creating Jobs. Online at http://www.naacp.org/pages/just-energy-policies-report.
[291] We recommend that the EPA solicit feedback and participation from EJ groups like WE ACT and National Environmental Justice Advisory Council (NEJAC) to help formulate guidance on including EJ concerns in state compliance plans.

13. Guidance to States

UCS recommends that the EPA provide clear guidance to states in developing their compliance plans to ensure that states are able to develop and submit robust plans in a timely way, and that such guidance cover issues such as treatment of certain energy options, best practices, methodologies, non-compliance penalties, processes, and options for addressing worker transition and environmental justice concerns.

Clear guidance to states from the EPA will help ensure that compliance plans are robust and timely. The Clean Power Plan's flexibility provides many cost-effective options for states to reduce emissions. At the same time, there are some complex issues raised by the interaction of these options, and the need to ensure states are on track to achieve emissions reduction goals. The EPA should provide clarity on some key issues mentioned below, many of which were raised in stakeholder comments and the NODA.

UCS recommends in particular that the EPA provide guidance on, for example:

- **Treatment of new natural gas combined cycle (NGCC) plants.** As discussed in section 11.3 above, in the final rule the EPA should provide clear guidance to states on how to treat new NGCC plants, both in the state emissions rate formula and for compliance purposes. UCS recommends that, if new NGCC plants are used for compliance, it will be important to ensure that the resulting emissions are appropriately accounted for.

- **Treatment of out-of-state renewable energy generation.** As discussed in section 6 above, renewable energy will be a key component of state compliance plans and the EPA should provide clear guidance on how states should track and account for renewable energy that is traded across state boundaries. UCS recommends that the EPA clarify for states how they should treat out-of-state renewable energy generation for compliance plan purposes to encourage development of cost-effective renewable energy resources nationwide, avoid double-counting, and ensure synchronization with existing energy trading and tracking systems.

- **Evaluation, measurement, and verification (EM&V).** Robust protocols for EM&V for electricity generation, energy efficiency, and other components of state compliance plans must guard against double-counting to provide for robust emissions accounting across all building blocks. UCS recommends that the EPA provide states "best practices" and sample methodologies for conducting EM&V with regard to these issues, and provide certification protocols for methodologies developed by other parties.

- **Criteria for enforceability.** State compliance plans that incorporate state programs must contain federally enforceable components to ensure that the emissions reduction goals are met. UCS recommends that the EPA provide clear guidance to states on incorporation of such components for demonstrating compliance.

- **Multi-state or regional compliance.** As discussed in section 9 above, multi-state or regional strategies may be attractive to states as the least-cost compliance option. UCS recommends that the EPA provide robust methodologies for demonstrating compliance under such multi-state approaches.

- **Market-based approaches**. As discussed in section 3.8 above, states may also choose market-based approaches as a least-cost compliance option. UCS recommends that the EPA provide robust methodologies for demonstrating compliance under such market-based approaches.

- **Equivalence of state/regional programs.** States may incorporate existing or new state or regional programs into their compliance plans. UCS recommends that the EPA provide states with clear methodologies for determining the equivalence of the emissions reductions achieved by such programs with the requirements of the CPP.

- **Rate-to mass-based conversions.** In a November 6 Technical Support Document (TSD), the EPA provided guidance for states on converting between emission rate- and mass-based goals.[292] UCS recommends that the EPA provide further clarification on key considerations for such conversions, especially if the EPA implements any changes to the formula for calculating state emissions rate goals in the draft CPP.

- **Penalties for non-compliance.** Penalties for non-compliance will be an important component of a successful CPP. UCS recommends that the EPA provide clear guidance to states about penalties.

- **State compliance plan tracking.** As discussed in section 10.4 above, UCS supports the EPA's proposal in the draft rule with regard to state plan compliance tracking, and recommends that the EPA require states to undertake annual tracking of actual plan performance during implementation, and that the EPA require state compliance plans to include true-up provisions to ensure that they are on track to meet the interim and final compliance goals.

- **Review and updating process for the CPP**. As discussed in section 10.3 above, UCS recommends that the EPA provide clear guidance to states about the timing of future updates to the CPP, and ensure that a review and update process takes place by 2025.

- **Worker transition assistance.** As discussed in section 12 above, compliance with the CPP may cause localized negative economic impacts. UCS recommends that the EPA offer guidance to states on ways to address concerns about such impacts, require that states assess impacts of their compliance plans on workers and communities, and

[292] EPA. 2014. Notice of additional information regarding the translation of emission rate-based CO2 goals to mass-based equivalents. 79 FR 67406. Online at https://federalregister.gov/a/2014-26900.

highlight for states a variety of policy mechanisms for worker retraining and economic diversification.

- **Environmental justice (EJ).** As discussed in section 12 above, UCS recommends that the EPA require states to conduct an EJ analysis of the state's proposed compliance plan, offer states data, methodology, and tools to conduct effective EJ analyses; and offer examples of how compliance plans could be used to support EJ communities.

Appendix 1. ReEDS Methodology

Methodology and assumptions for UCS modeling of strengthening the EPA's Clean Power Plan: Increasing renewable energy use will achieve greater emission reductions.

UCS used the National Renewable Energy Laboratory's (NREL) Regional Energy Deployment System (ReEDS) model to analyze the technical and economic feasibility of adopting higher renewable energy targets under the Environmental Protections Agency's (EPA) proposed Clean Power Plan (CPP). This document describes the methodology and assumptions that were used for that analysis. The ReEDS modeling of the UCS proposed "Demonstrated Growth Approach" shows that doubling EPA's 2030 renewable energy target from 12 percent to 23 percent of U.S. electricity sales by 2030 is affordable and would increase the total emissions reductions achieved by the CPP from 30 percent to approximately 40 percent below 2005 levels by 2030 (UCS 2014).

ReEDS is a computer-based, long-term capacity-expansion model for the deployment of electric power generation technologies in the United States. ReEDS is designed to analyze the impacts of state and federal energy policies, such as clean energy and renewable energy standards or reducing carbon emissions, in the U.S. electricity sector. ReEDS provides a detailed representation of electricity generation and transmission systems and specifically addresses issues related to renewable energy technologies, such as transmission, resource quality, variability, and reliability. UCS used the 2014 version of ReEDS for our analysis. However, we did make some changes to NREL's assumptions for renewable and conventional energy technologies based on project-specific data and mid-range estimates from recent studies, as described in more detail below.

Scenarios

To analyze the impacts of adopting higher state renewable energy targets under the CPP, we compared the UCS Demonstrated Growth Approach to a Business as Usual (BAU) scenario. The BAU scenario assumes no new state or federal policies beyond those which existed at the end of 2013. This scenario establishes a baseline for the analysis using project-specific technology cost and performance assumptions benchmarked to recent studies.

UCS's Demonstrated Growth Approach analyzes the impacts of stronger state renewable energy targets than those proposed in EPA's draft Clean Power Plan. As a proxy for the draft rule, we focused on the renewable energy building block and modeled impacts of achieving the state targets aggregated up to the national level, which ramped up to 23 percent of electricity sales coming from renewable energy nationally in 2030. We also assumed unrestricted national trading of renewable energy credits, which would allow states to meet their targets at the lowest costs. If there are any policy constraints placed on trading between regions, experience with renewable energy markets suggest REC prices will likely be higher in some regions and lower in other regions of the country.[293]

Assumptions

The cost and performance assumptions for electric generating technologies that UCS used in the 2014 version of NREL's Regional Energy Deployment System (ReEDS) are shown in Tables A1.1-A1.3 below, compared to EIA's AEO 2014 assumptions (EIA 2014). We also describe our assumptions for energy efficiency investments that were not included in the model. For conventional technologies, NREL uses EIA's AEO 2014 cost and performance assumptions. We did not make any changes to EIA's assumptions for natural gas and coal prices, fixed and variable O&M costs, and heat rates, with a few exceptions noted below (EIA 2014). However, we did make several changes to EIA's capital cost assumptions and wind and solar capacity factors based on project specific data for recently installed and proposed projects, supplemented with estimates from recent studies, when project data was limited or unavailable. The cost and performance assumptions for renewable energy technologies are mostly consistent with the assumptions that were developed for the forthcoming DOE Wind Vision report (DOE 2014). These changes we made include:

- **Learning**. We do not use EIA's learning assumptions that lower the capital costs of different technologies over time as the penetration of these technologies increase in the U.S. (EIA 2014). This approach does not adequately capture growth in international markets and potential technology improvements from research and development (R&D) that are important drivers for cost reductions. Instead, we assume costs for mature technologies stay fixed over time and we hard wire cost reductions for emerging technologies.

- **Natural gas and coal**. For plants without carbon capture and storage (CCS), we use EIA's initial capital costs, but do not include EIA's projected cost reductions due to learning because we assume they are mature technologies. For new IGCC and supercritical pulverized coal plants, we use EIA's higher costs for a single unit plant (600-650 MW) instead of dual unit plants (1200-1300 MW), which is more consistent with data from proposed and recently built projects (SNL 2013). For plants with CCS, we assume: 1) higher initial capital costs than EIA based on mid-range estimates from recent studies (Black & Veatch 2012, Lazard 2013, NREL 2012, EIA 2014), 2) no cost reductions through 2020 as very few plants will be operating by then, and 3) EIA's projected cost reductions by 2040 will be achieved by 2050 (on a percentage basis).

- **Nuclear**. We assume higher initial capital costs than EIA for new plants based on mid-range estimates from recent studies and announced cost increases at projects in the U.S.

[293] For more details on the UCS approach and the modeling results, see UCS. 2014. Strengthening the EPA's Clean Power Plan: Increasing renewable energy use will achieve greater emission reductions. Online at http://www.ucsusa.org/sites/default/files/attach/2014/10/Strengthening-the-EPA-Clean-Power-Plan.pdf.

that are proposed or under construction (Black & Veatch 2012, Henry 2013, Lazard 2013, Penn 2012, SNL 2013, Vukmanovic 2012, Wald 2012). We did not include EIA's projected capital cost reductions, given the historical and recent experience of cost increases in the U.S. We also assume existing plants will receive a 20-year license extension, allowing them to operate for 60 years and will then be retired due to safety and economic issues. In addition, we include 4.7 GW of retirements at five existing plants (Vermont Yankee, Kewaunee, Crystal River, San Onofre, Oyster Creek) based on recent announcements and closures, and 5.5 GW of planned additions (Vogtle, V.C. Summer, and Watts Bar).

- **Onshore Wind**. We assume lower initial capital costs than EIA based on data from a large sample of recent projects from DOE's *2013 Wind Technologies Market Report* (Wiser and Bolinger 2014). This report shows that capacity-weighted installed capital costs for U.S. projects declined 13 percent from $2,262/kW (in 2013$) in 2009 to $1,960/kW in 2012. While costs dropped again to $1,630/kW in 2013 and are expected to average $1,750/kW in 2014, these projects are heavily weighted toward lower cost projects in the interior region of the U.S. Thus, we conservatively assume that average U.S. installed costs will stay fixed at 2012 levels over time based on a larger sample of projects, and assuming the wind industry invests in technology improvements that result in increases in capacity factors. Current capacity factors are based on data from recent projects and studies that reflect recent technology advances (Wiser 2014). We assume capacity factors will increase over time to achieve a reduction in the overall cost of electricity based on mid-range projections from 13 independent studies and 18 scenarios (Lantz 2013). We also assume higher fixed O&M costs than EIA based on mid-range estimates (EIA 2014, Wiser 2012, Black & Veatch 2012, NREL 2012).

- **Offshore wind**. Initial capital costs are based on data from recent and proposed projects located in shallow water in Europe and the U.S. from NREL's offshore wind database (Schwartz 2010). We assume capital costs decline and capacity factors increase over time based on mid-range projections from several studies (Lantz 2013, EIA 2014, NREL 2012, Black & Veatch 2012, BVG 2012, Prognos 2013). We also assume higher fixed O&M costs than EIA based on mid-range estimates (EIA 2014, Wiser 2012, Black & Veatch 2012, NREL 2012).

- **Solar photovoltaics (PV)**. We assume lower initial capital costs than EIA based on data from a large sample of recent utility scale and rooftop PV projects installed in the U.S. through the second quarter of 2014 (SEIA 2014). We assume future solar PV costs for utility scale, residential, and commercial systems will decline over time based on mid-range projections from the DOE Sunshot Vision Study's 62.5 percent by 2020 and 75 percent by 2040 price scenarios. In addition, we use slightly lower capacity factors for solar PV than EIA based on NREL data (NREL 2012).

- **Solar CSP**. We assume concentrating solar plants will include six hours of storage and used the price projection and O&M costs from the DOE Sunshot Vision Study's 62.5 percent by 2020 and 75 percent by 2040 price scenarios.

- **Biomass**. We use EIA's initial capital costs for new fluidized bed combustion plants, but do not include EIA's projected cost reductions due to learning because we assume it's a mature technology. However, we assume that biopower technology transitions to more efficient integrated gasification combined cycle plants over time, resulting in a gradual decline in the heat rate from 13,500 Btu/kWh to 9,500 Btu/kWh by 2035. For biomass co-firing in coal plants, we reduce EIA's co-firing limit from 15 percent to 10 percent to reflect potential resource supply constraints near clusters of coal plants, and assume higher capital costs based on data from Black & Veatch (2012). We also use a slightly different biomass supply curve than EIA based on a UCS analysis of data from DOE's Updated Billion Ton study that includes additional sustainability criteria, resulting in a potential biomass supply of 680 million tons per year by 2030 (UCS 2012, ORNL 2011).

- **Geothermal and hydro**. We didn't make any changes to NREL's assumptions for geothermal and hydro, which are site specific.

- **Energy efficiency**. We estimated future electricity savings from existing state energy efficiency resource standards (EERS) and implemented this savings as a demand reduction in ReEDS.

Table A1.1. Comparison of Overnight Capital Costs for Electric Generation Technologies (2013$/kW). Abbreviations are as follows: combined-cycle (CC), combustion turbine (CT), carbon capture and storage (CCS), pulverized coal (PC), integrated gasification and combined-cycle (IGCC) and photovoltaic (PV).

	UCS 2014					EIA AEO 2014			
Technology	2010	2020	2030	2040	2050	2010	2020	2030	2040
Natural Gas CC	1,036	1,036	1,036	1,036	1,036	1,043	1,036	914	826
Natural Gas-CC-CCS	n/a	3,005	2,723	2,513	2,407	n/a	2,052	1,777	1,559
Natural Gas CT	689	689	689	689	689	688	670	575	515
Coal-Supercritical PC	3,306	3,306	3,306	3,306	3,306	2,988	3,051	2,802	2,562
Coal-IGCC	n/a	4,482	4,482	4,482	4,482	n/a	3,828	3,412	3,067
Coal-PC-CCS	n/a	6,166	5,808	5,548	5,372	n/a	5,272	4,736	4,231
Nuclear	n/a	6,529	6,529	6,529	6,529	n/a	4,905	4,376	3,831
Biomass	4,187	4,187	4,187	4,187	4,187	4,188	3,862	3,492	3,112
Solar PV-Utility		1,925	1,604			3,943	3,334	2,963	2,625
Solar PV-Residential	Used NREL's Sunshot scenarios,					7,636	3,850	2,823	2,823
Solar PV-Commercial	Used NREL's Sunshot scenarios,					6,545	2,951	2,567	2,567
Solar CSP-With Storage		3,299			2,496	n/a	n/a	n/a	n/a
Wind-Onshore	2,280	1,969	1,969	1,969	1,969	2,254	2,301	2,113	1,932
Wind-Offshore	n/a	5,329	4,620	4,249	3,557	6,343	6,330	5,608	4,932

Table A1.2. Operation and Maintenance (O&M) and Heat Rate Assumptions. Abbreviations are as follows: Combined-cycle (CC), combustion turbine (CT), carbon capture and storage (CCS), pulverized coal (PC), photovoltaic (PV), integrated gasification and combined-cycle (IGCC).

Technology	Fixed O&M ($/kW-yr)	Variable O&M ($/MWh)	Heat Rate (Btu/kWh)	
			2010	2050
Natural Gas-CC	15.65	3.33	6430	6333
Natural Gas-CC-CCS	32.36	6.90	7525	7493
Natural Gas CT	7.17	10.56	9750	8550
Coal-Supercritical PC	31.75	4.55	8800	8740
Coal-IGCC	52.32	7.35	8700	7450
Coal-IGCC-CCS	67.68	4.53	10700	8307
Nuclear	94.98	2.18	10452	10452
Biomass	107.56	5.36	13500	9500
Solar PV-utility	16.30	0.00	n/a	n/a
Solar PV-Residential	NREL	0.00	n/a	n/a
Solar PV-Commercial	NREL	0.00	n/a	n/a
Solar CSP-With Storage	68.49	0.00	n/a	n/a
Wind-Onshore	51.82	0.00	n/a	n/a
Wind-Offshore	103.63	0.00	n/a	n/a

Table A1.3. Comparison of Solar Capacity Factors.

Technology	UCS 2014	EIA AEO 2014
Solar PV-utility	16-28%	21-32%
Solar CSP-With Storage	27-54%	n/a

Table A1.4. Comparison of Wind Capacity Factors.

	UCS 2014					EIA AEO 2014			
Technology	2012	2020	2030	2040	2050	2010	2020	2030	2040
Wind-Onshore Class 3	31%	35%	37%	39%	40%	28%	29%	29%	29%
Wind-Onshore Class 4	35%	39%	41%	43%	45%	32%	33%	33%	33%
Wind-Onshore Class 5	40%	45%	48%	50%	51%	39%	39%	39%	39%
Wind-Onshore Class 6	44%	50%	53%	53%	53%	45%	46%	46%	46%
Wind-Offshore Class 5	36%	38%	40%	42%	44%	27%	27%	27%	27%
Wind-Offshore Class 6	45%	47%	49%	51%	53%	34%	34%	34%	34%
Wind-Offshore Class 7	52%	52%	53%	53%	53%	40%	40%	40%	40%

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Appendix 2. State and Regional Renewable Energy Generation under the UCS Demonstrated Growth Approach, 2017 to 2030

	EPA Proposed Renewables Approach (GWh)		UCS Demonstrated Renewables Growth Approach (GWh)															
State	2020	2030	2020	2030	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Alabama	4,597	14,293	5,711	16,246	3,484	3,970	4,712	5,711	6,722	7,744	8,777	9,820	10,872	11,933	13,002	14,078	15,159	16,246
Alaska	62	163	322	1,036	171	204	254	322	390	459	529	600	671	743	816	889	962	1,036
Arizona	2,151	3,663	6,762	16,120	4,414	5,039	5,894	6,762	7,644	8,539	9,446	10,366	11,297	12,240	13,195	14,160	15,136	16,120
Arkansas	2,288	4,709	2,927	8,403	1,778	2,029	2,411	2,927	3,450	3,980	4,516	5,057	5,604	6,155	6,711	7,272	7,836	8,403
California	37,968	41,151	92,177	121,294	73,005	79,337	86,055	92,177	94,981	97,818	100,686	103,582	106,506	109,456	112,431	115,431	118,451	121,294
Colorado	7,845	10,840	12,371	22,360	9,641	10,531	11,444	12,371	13,312	14,267	15,236	16,218	17,213	18,219	19,238	20,269	21,310	22,360
Connecticut	1,071	3,114	7,329	10,473	5,674	6,186	7,019	7,329	7,640	7,953	8,267	8,581	8,896	9,211	9,527	9,842	10,158	10,473
Delaware	248	1,038	1,741	3,046	1,363	1,503	1,619	1,741	1,866	1,991	2,119	2,247	2,377	2,508	2,641	2,775	2,910	3,046
Florida	7,490	22,110	10,688	36,391	5,295	6,473	8,268	10,688	13,138	15,616	18,123	20,657	23,218	25,805	28,419	31,056	33,713	36,391
Georgia	5,428	12,231	7,252	22,538	4,045	4,745	5,813	7,252	8,709	10,183	11,674	13,181	14,703	16,242	17,797	19,365	20,945	22,538
Hawaii	1,047	1,047	2,619	4,485	1,643	1,718	1,819	2,619	2,723	2,828	2,934	3,041	3,149	3,258	3,368	3,479	3,591	4,485
Idaho	3,186	3,197	4,774	9,224	3,559	3,955	4,362	4,774	5,194	5,619	6,051	6,488	6,931	7,379	7,833	8,292	8,756	9,224
Illinois	10,563	17,818	20,146	37,889	14,589	16,408	18,285	20,146	22,067	23,983	25,896	27,840	29,773	31,385	33,004	34,630	36,258	37,889
Indiana	4,474	7,547	8,129	19,643	5,074	5,902	7,013	8,129	9,253	10,385	11,523	12,669	13,821	14,977	16,139	17,305	18,473	19,643
Iowa	8,566	8,566	20,313	21,558	19,522	19,977	20,180	20,313	20,468	20,622	20,758	20,921	21,063	21,181	21,303	21,406	21,478	21,558
Kansas	7,239	8,885	14,893	18,405	12,957	13,597	14,243	14,893	15,549	16,209	16,873	17,543	17,982	18,083	18,187	18,276	18,337	18,405
Kentucky	551	1,714	3,403	16,553	623	1,229	2,155	3,403	4,665	5,941	7,230	8,532	9,845	11,169	12,504	13,846	15,196	16,553
Louisiana	3,349	6,892	4,950	14,993	2,844	3,303	4,004	4,950	5,910	6,882	7,865	8,858	9,860	10,871	11,891	12,919	13,953	14,993
Maine	3,612	3,612	4,950	5,033	4,834	4,931	4,937	4,950	4,967	4,987	4,998	5,010	5,023	5,029	5,031	5,033	5,031	5,033
Maryland	1,698	5,982	12,758	19,946	9,790	11,579	12,081	12,758	13,443	14,136	14,838	15,546	16,262	16,986	17,717	18,454	19,198	19,946
Massachusetts	2,962	8,613	10,618	16,387	8,894	9,466	10,049	10,618	11,190	11,763	12,338	12,915	13,493	14,071	14,650	15,229	15,808	16,387

Michigan	4,776	8,056	11,573	22,979	9,095	9,642	10,467	11,573	12,686	13,808	14,935	16,070	17,211	18,357	19,508	20,663	21,820	22,979
Minnesota	7,889	7,889	19,041	28,341	15,153	16,034	16,925	19,041	19,944	20,854	21,770	22,693	23,623	24,557	25,497	26,442	27,390	28,341
Mississippi	2,499	5,458	2,871	8,701	1,639	1,908	2,318	2,871	3,431	3,997	4,568	5,145	5,728	6,315	6,906	7,501	8,100	8,701
Missouri	1,638	2,764	6,922	16,580	2,698	5,352	6,022	6,922	8,149	9,062	9,982	10,909	11,842	12,781	13,725	14,673	15,625	16,580
Montana	1,599	2,723	2,577	4,951	1,928	2,139	2,356	2,577	2,800	3,027	3,258	3,491	3,727	3,967	4,209	4,454	4,701	4,951
Nebraska	1,856	3,819	4,138	7,756	3,100	3,443	3,790	4,138	4,490	4,844	5,200	5,559	5,921	6,284	6,650	7,017	7,386	7,756
Nevada	3,761	6,406	7,471	13,166	5,915	6,422	6,943	7,471	8,008	8,552	9,105	9,665	10,232	10,805	11,386	11,974	12,568	13,166
New Hampshire	2,220	4,822	2,161	3,325	1,812	1,928	2,046	2,161	2,277	2,392	2,508	2,625	2,741	2,858	2,975	3,091	3,208	3,325
New Jersey	2,421	10,147	18,562	26,328	13,729	15,333	16,985	18,562	19,331	20,104	20,879	21,655	22,432	23,210	23,989	24,769	25,548	26,328
New Mexico	3,261	4,722	5,564	8,430	4,781	5,036	5,298	5,564	5,834	6,108	6,386	6,668	6,953	7,242	7,534	7,830	8,129	8,430
New York	8,344	24,262	13,860	28,828	10,546	11,283	12,386	13,860	15,342	16,833	18,327	19,822	21,320	22,819	24,321	25,824	27,326	28,828
North Carolina	4,477	11,668	11,621	26,674	5,489	9,152	10,203	11,621	13,055	14,507	15,975	17,459	18,959	20,474	22,005	23,550	25,106	26,674
North Dakota	5,460	5,460	6,870	7,290	6,602	6,756	6,825	6,870	6,922	6,974	7,020	7,075	7,123	7,163	7,204	7,239	7,263	7,290
Ohio	3,287	13,776	12,141	28,703	7,571	9,050	10,535	12,141	13,758	15,386	17,023	18,671	20,328	21,992	23,663	25,340	27,020	28,703
Oklahoma	11,743	15,579	17,906	28,304	15,008	15,959	16,926	17,906	18,899	19,906	20,924	21,951	22,989	24,036	25,092	26,156	27,226	28,304
Oregon	9,132	12,567	11,616	19,711	9,345	10,091	10,849	11,616	12,390	13,174	13,966	14,766	15,574	16,389	17,211	18,039	18,874	19,711
Pennsylvania	8,430	35,331	12,882	27,825	9,494	10,309	11,410	12,882	14,361	15,849	17,341	18,834	20,329	21,826	23,325	24,826	26,325	27,825
Rhode Island	164	476	1,367	2,191	1,027	1,155	1,285	1,367	1,448	1,530	1,612	1,695	1,777	1,860	1,943	2,025	2,108	2,191
South Carolina	3,549	9,676	4,091	13,252	2,169	2,589	3,229	4,091	4,964	5,847	6,741	7,644	8,557	9,479	10,410	11,350	12,297	13,252
South Dakota	1,819	1,819	3,727	5,584	3,139	3,333	3,529	3,727	3,926	4,126	4,327	4,531	4,735	4,941	5,148	5,356	5,563	5,584
Tennessee	1,385	4,306	3,821	15,299	1,395	1,924	2,732	3,821	4,923	6,036	7,162	8,298	9,444	10,600	11,765	12,937	14,115	15,299
Texas	46,880	85,963	81,548	129,521	68,178	72,562	77,028	81,548	86,131	90,777	95,471	100,212	105,000	109,831	114,703	119,611	124,551	129,521
Utah	1,393	2,373	2,092	5,842	1,320	1,487	1,744	2,092	2,445	2,804	3,168	3,536	3,910	4,287	4,670	5,057	5,448	5,842
Virginia	4,459	11,192	5,932	18,707	3,252	3,837	4,729	5,932	7,149	8,381	9,627	10,887	12,159	13,445	14,744	16,055	17,376	18,707
Washington	10,408	17,726	13,212	23,818	10,238	11,215	12,209	13,212	14,227	15,254	16,292	17,340	18,398	19,465	20,542	21,628	22,720	23,818
West Virginia	2,451	11,704	2,581	6,226	1,648	1,899	2,238	2,581	2,928	3,280	3,635	3,995	4,358	4,725	5,095	5,469	5,846	6,226
Wisconsin	4,066	6,859	8,605	16,259	6,942	7,310	7,863	8,605	9,352	10,105	10,861	11,623	12,389	13,158	13,930	14,705	15,482	16,259
Wyoming	5,536	9,428	5,567	8,731	4,702	4,984	5,273	5,567	5,865	6,168	6,475	6,786	7,101	7,419	7,742	8,069	8,399	8,731
National	**281,295**	**524,154**	**555,154**	**995,343**														

	EPA Proposed Renewables Approach (GWh)		UCS Demonstrated Renewables Growth Approach (GWh)															
Clean Power Plan Region	**2020**	**2030**	**2020**	**2030**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Alaska	62	163	322	1,036	171	204	254	322	390	459	529	600	671	743	816	889	962	1,036
East Central	22,994	89,170	66,597	130,780	46,847	53,509	59,598	66,597	72,837	79,129	85,462	91,835	98,246	104,693	111,175	117,689	124,223	130,780
Hawaii	1,047	1,047	2,619	4,485	1,643	1,718	1,819	2,619	2,723	2,828	2,934	3,041	3,149	3,258	3,368	3,479	3,591	4,485
North Central	49,251	66,777	105,325	176,122	82,813	90,715	97,109	105,325	112,768	119,919	127,073	134,330	141,578	148,500	155,458	162,419	169,351	176,122
Northeast	18,373	44,900	40,285	66,237	32,788	34,949	37,723	40,285	42,864	45,459	48,050	50,648	53,250	55,848	58,446	61,045	63,638	66,237
South Central	73,355	125,847	126,364	207,382	103,867	110,892	118,401	126,364	134,429	142,598	150,849	159,181	167,355	175,261	183,235	191,251	199,288	207,382
Southeast	29,974	81,455	49,459	155,654	24,139	31,987	39,430	49,459	59,605	69,871	80,250	90,736	101,326	112,018	122,808	133,684	144,632	155,654
West	86,239	114,795	164,183	253,647	128,847	140,236	152,428	164,183	172,700	181,330	190,067	198,905	207,841	216,869	225,989	235,203	244,492	253,647