Union of Concerned Scientists

FACT SHEET

Meeting the Clean Power Plan in Pennsylvania

A Robust Pathway for Securing a Clean Energy Future

HIGHLIGHTS

The Clean Power Plan presents a historic opportunity to reduce global warming pollution from the U.S. electricity sector. The plan sets state-specific targets for cutting power plant carbon pollution, leading to a nationwide reduction of approximately 32 percent below 2005 levels by 2030. It also provides a valuable near-term opportunity to accelerate the transition to a clean energy future—already under way in Pennsylvania—by spurring investment in greater amounts of renewable energy and energy efficiency.

New analysis by the Union of Concerned Scientists shows that strengthening Pennsylvania's clean energy policies, together with a robust carbon emissions trading program, provides a cost-effective pathway for the state to not only cut global warming emissions but also deliver significant health and economic benefits for all *of its residents.*

The Clean Power Plan (CPP), finalized in August 2015 by the U.S. Environmental Protection Agency (EPA), sets the nation's first-ever limits on carbon dioxide (CO_2) emissions—the primary contributor to global warming—from power plants (see Box 1, p. 3). Each state is assigned its own goal, and Pennsylvania is required to reduce its emissions by 29 million tons, or 24 percent below 2012 levels, by 2030 (EPA 2015a). Pennsylvania is well positioned to meet this target, given its current transition from coal generation and growing investments in renewable energy and energy efficiency.

New analysis by the Union of Concerned Scientists shows that this transition—based on strong renewable energy and energy efficiency policies together with a vigorous carbon emissions trading program—constitutes a cost-effective pathway, or what we call a "Clean Path Case," for Pennsylvania. This course toward a clean energy future will not only help cut global warming emissions but also deliver significant health and economic benefits for all Pennsylvanians.

For example, we find that our Clean Path Case will:

- Yield more than 10,700 megawatts (MW) of new wind and solar capacity in Pennsylvania by 2030, which stimulates more than $10 billion in total new capital investments[1]
- Prompt the investment of some $4.3 billion in energy efficiency improvements to benefit Pennsylvania consumers

Wind power—including Duke Energy's North Allegheny Windpower Project, above—has roughly doubled in capacity in Pennsylvania since 2011. Increased renewable energy development will help the state meet Clean Power Plan targets while also delivering economic benefits.

- Generate more than $804 million in average annual revenue from 2022 to 2030, from the sale of carbon allowances, for investments in Pennsylvania's economy
- Avoid the emission of 131 million tons of CO_2 through 2030
- Provide health and economic benefits worth an estimated $4.5 billion cumulatively through 2030 by reducing CO_2, sulfur dioxide (SO_2), and nitrogen oxides (NO_x) pollution

Pennsylvania's Clean Energy Transition

In 2014, 38 percent of Pennsylvania's electricity generation came from nuclear power, 36 percent from coal, and 22 percent from natural gas. Hydropower and wind, as well as some solar, accounted for most of the state's remaining generation (4 percent) (EIA 2015a).

As in many other states, the economic competitiveness of Pennsylvania's coal power plants is in decline. The fraction of generation supplied by coal has steadily decreased from 56 percent in 2006 to 36 percent today, while during the same period natural gas grew from 5 percent of total generation to 22 percent (EIA 2015a). Historically low natural gas prices—driven by the development of Marcellus shale gas—have put pressure on aging and dirty coal plants to close down (Cassar 2015). Because much of western and north-central Pennsylvania falls in Marcellus shale territory, the state has become the nation's second-largest producer of natural gas, having doubled its production from 2012 to 2014 (EIA 2015b). In Pennsylvania, 27 coal generators were retired between 2012 and 2015, representing more than 5,100 MW of generating capacity (SNL Financial 2015; Fleischman et al. 2013).

U.S. Department of Agriculture

Pennsylvania ranked 12th nationally for cumulative installed solar capacity in 2014, thanks to both residential rooftop and large-scale solar installations (such as this one at Brubaker Farms in Mount Joy). Accelerating the growth of renewable energy to help meet the state's emissions reduction targets will also reduce electricity bills for residents and businesses in the long run.

The economic potential for renewable energy in Pennsylvania—led mostly by solar and wind—is equivalent to about half of the state's current electricity generation.

Pennsylvania was one of the first states to adopt renewable electricity standards. Its Alternative Energy Portfolio Standard (AEPS), established in 2004, requires utilities to generate 8 percent of their electricity from renewable sources[2] by 2021. Moreover, the AEPS establishes a solar carve-out, requiring that 0.5 percent of electricity come from solar by 2021 (Pennsylvania General Assembly 2004). Twenty-eight other states have also adopted renewable electricity standards, which have proven to be one of the most successful and cost-effective means for driving renewable energy development in the United States (Heeter et al. 2014).

Pennsylvania's diverse mix of renewable energy sources is growing. In 2014, the state ranked 12th nationally for cumulative installed solar capacity, with a total of 249 MW (SEIA 2015). Pennsylvania also has 1,340 MW of installed wind power, ranking 16th nationally (AWEA 2015). Wind capacity has roughly doubled since 2011, and solar has similarly increased since 2012 (EIA 2015a).

Despite this recent growth, much of the state's renewable energy resources remain untapped. According to the U.S. Department of Energy, the economic potential for renewable energy in Pennsylvania—led primarily by solar and wind—is as much as 113 terawatt-hours of electricity, equivalent to about half of the state's current electricity generation (Brown et al. 2015).

Pennsylvania has also promoted energy efficiency in homes, businesses, and industry as another effective and affordable strategy for reducing the use of carbon-intensive fossil fuels. Act 129—the energy efficiency resource standard (EERS) that the state adopted in 2008—requires electricity providers with more than 100,000 customers to implement efficiency programs that reduce electricity demand by 1.6 to 2.9 percent by 2016; targets for Phase III, which runs from 2016 to 2021, are currently under development (Pennsylvania General Assembly 2008). Utilities have achieved their earlier (2013) mandatory targets, reporting benefit-cost ratios greater

BOX 1.

The Clean Power Plan

The CPP, developed by the EPA under the authority of the federal Clean Air Act, aims to reduce CO_2 emissions from the U.S. electricity sector—the nation's largest contributor to such global warming emissions—by an estimated 32 percent below 2005 levels by 2030. The EPA set differing targets among the states, however, because each state has a unique mix of electricity generation resources—and also because local technological feasibility, cost, and emissions-reduction potential vary across the country.

The plan provides a number of options for cutting carbon emissions so that each state can develop a compliance strategy most suited to its own electricity-supply mix, resource availability, and policy objectives. These options include investing in renewable energy, energy efficiency, natural gas, or nuclear power, while shifting from coal-fired power. States are free to combine these carbon-reduction options in a flexible manner to meet their targets. States can also join together in multistate or regional agreements to find the lowest-cost options for reducing their CO_2 emissions, including through emissions-trading programs.

The EPA has given states a choice between a rate-based emissions target (measured in pounds of CO_2 per megawatt-hour of electricity generated) and a mass-based target (measured in short tons of CO_2 emitted by generating units). To avoid undermining the environmental integrity of the target, states must also address the potential for "leakage," or emissions that might arise because of a shift from existing to new fossil fuel–fired power plants (which are not covered under the CPP). One way that the EPA suggests the states should address leakage is through the adoption of a mass-based target with a "new-source complement," which represents an increase in a state's emissions target based on an estimate of new power plants required to meet additional electricity demand after 2012. A mass-based target that includes CO_2 emissions from both new and existing power plants is the most straightforward way of bringing all power plants under an emissions cap and ensuring an accurate accounting of the emissions that contribute to climate change.

States must submit a final compliance plan, or an initial plan with a request for an extension of up to two years, by September 6, 2016. However, a February 2016 Supreme Court ruling put a stay on CPP implementation until legal challenges to the rule have been resolved. States may continue to develop their compliance plans in the interim.

than 2 to 1, and are 62 percent of the way toward meeting their 2016 targets (Serota 2015). Still, Pennsylvania will have significant untapped energy-efficiency potential; a 2014 analysis found that the state could cost-effectively cut electricity use at least 23 percent by 2020 (Hayes et al. 2014).

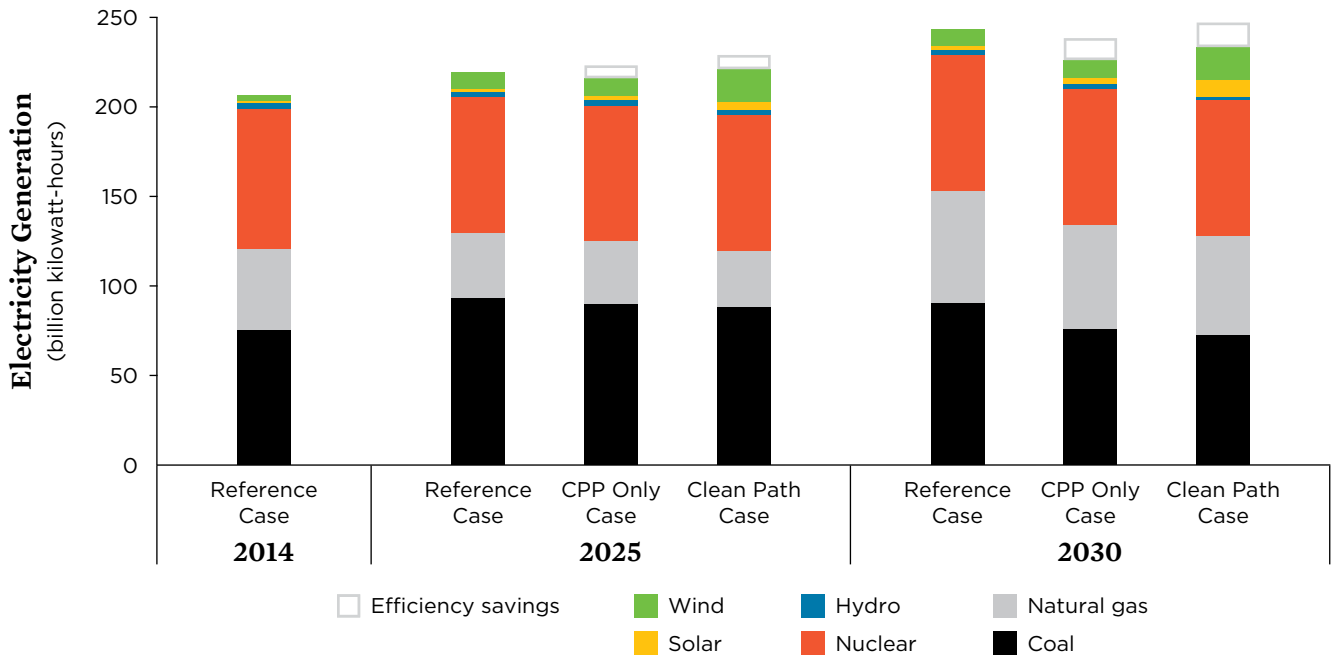
How Pennsylvania Can Meet Its Clean Power Plan Goals

Under the CPP, Pennsylvania's 2030 target is for the state's power sector (old and new power plants combined) to reduce total emissions in that year by 24 percent below the baseline year of 2012. This overall target translates into a series of targets: 101 million tons[3] per year on average in the interim period from 2022 through 2029, and 91 million tons in 2030 (EPA 2015b).[4]

Pennsylvania is well positioned to cost-effectively achieve its overall target by investing in many of the CPP's carbon-reduction options (as described in Box 1) and by participating with other states in a well-designed emissions trading program. Administering such a program by auctioning off emission allowances would also allow Pennsylvania to generate revenues that could be used to benefit all of its residents. Further, by complementing its CPP compliance plan with strengthened policies that support renewable energy and energy efficiency, Pennsylvania could accelerate its clean energy transition while increasing consumer, economic, and public health benefits.

The Union of Concerned Scientists examined the likely economic and environmental impacts of Pennsylvania's compliance with the CPP by modeling the above combination of robust policies. We found that this approach, called the Complementary Clean Energy Compliance Pathway, or "Clean Path Case," provides greater environmental, economic, and health benefits for the state, as compared with each of two other scenarios: a "Reference Case," in which no new state or federal policies (including the CPP) are implemented beyond those in place as of October 2015; and a Clean Power Plan Compliance Pathway, or "CPP Only Case," that includes interstate trading of allowances but no additional complementary renewable energy and energy efficiency policies (see Box 2, p. 6 for more details on our methods and assumptions).

FIGURE 1. The Clean Path Case Helps Diversify Pennsylvania's Electricity Mix



Compliance with the Clean Power Plan, complemented by renewable energy and energy efficiency policies—constituting the "Clean Path Case"—helps Pennsylvania build a more diversified portfolio of clean energy sources and achieve a quicker transition from coal and natural gas.

Clean Path Case Accelerates Pennsylvania's Transition to Low-carbon Electricity

With the CPP and stronger renewable energy and energy efficiency policies to complement it, Pennsylvania can accelerate its shift toward cleaner, low-carbon energy sources. But in the Reference Case scenario, Pennsylvania continues its dependence on coal-fired power generation, which in 2030 is 21 percent higher than in 2014 (Figure 1). Natural gas–fired power generation also increases—it is 35 percent higher—and renewable energy generation grows to 6 percent of generation by 2030. Meanwhile, Pennsylvania's electricity exports are 63 percent higher in 2030 than in 2014.[5]

By contrast, both the CPP Only Case and the Clean Path Case result in cleaner, more diversified generation mixes. Under the CPP Only Case, renewable energy increases slightly, to 7 percent of Pennsylvania's power supply in 2030, while savings from energy efficiency investments are equivalent to 9 percent of total electricity sales in that year.

Even greater clean energy deployment occurs under the Clean Path Case, spurred by the stronger AEPS and EERS policies combined with the CPP. By 2030, energy efficiency savings reach 10 percent of total electricity sales, while wind, solar, and landfill gas combine to supply 13 percent of Pennsylvania's total generation.[6] Relative to the Reference Case,

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An efficiency specialist examines the systems at a multifamily building to identify cost-effective energy-saving measures. A CPP compliance plan that prioritizes efficiency efforts such as this can benefit all Pennsylvania residents.

generation from coal and natural gas plants are 20 percent and 11 percent lower in 2030, respectively. Further, Pennsylvania maintains its status as an electricity-exporting state; compared with the Reference Case, electricity exports under the Clean Path Case are 4 percent higher by 2030.

To provide for the wind and solar generation under the Clean Path Case, Pennsylvania builds 4,370 MW of wind capacity and nearly 6,400 MW of solar capacity above current levels by 2030, including almost 2,000 MW of rooftop solar on homes and businesses. By 2030, the Clean Path Case cumulatively drives more than $10 billion in renewable energy investments in Pennsylvania, as well as $4.3 billion in energy efficiency improvements.[7]

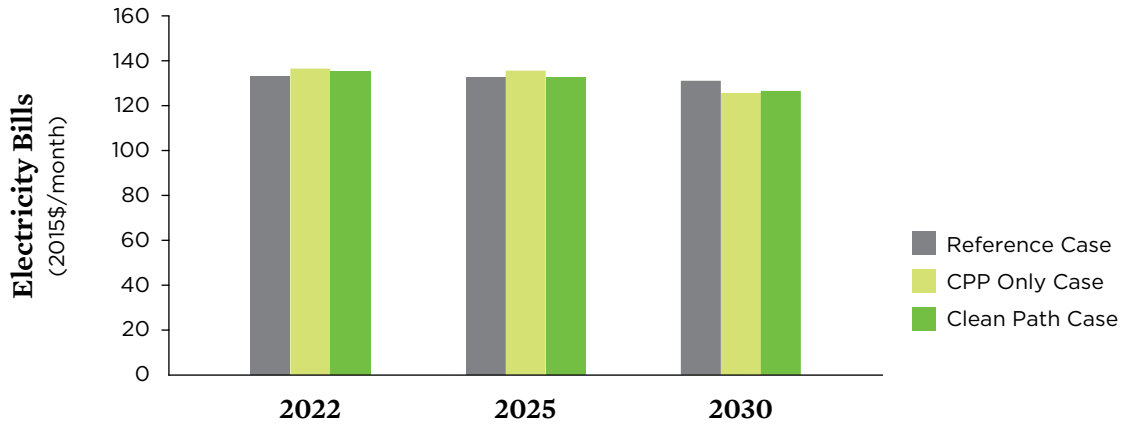
The Clean Path Case cumulatively drives more than $10 billion in renewable energy investments, as well as $4.3 billion in energy efficiency improvements, in Pennsylvania.

A Cleaner Energy Supply Is Affordable

The clean energy growth in Pennsylvania spurred by the Clean Path Case is not only achievable, but also affordable. The Clean Path Case policies (which focus on new renewable energy projects, energy efficiency programs, and carbon trading) even lead eventually to modest customer savings over the Reference Case. The average monthly electricity bill for a typical household under the Clean Path Case is 1.8 percent higher than the Reference Case in 2022, and virtually unchanged in 2025. But ultimately the Clean Path Case leads to financial savings, given that the cost to operate most renewable energy facilities is much lower than fossil-fuel plants and energy-efficient buildings and appliances cost less to operate. Thus in 2030, the clean energy policies lead to 3.4 percent lower electricity bills for a typical residential customer, saving the household nearly $54 in that year (Figure 2).

In our analysis of the three cases, we also examined some of the broader financial impacts on the electricity system in Pennsylvania—including net effects on electricity bills for all customer classes, investments by participants in energy efficiency programs, and net costs for power generators and distributors. In 2022, there is a net cost of $796 million, or 4.2 percent of total electricity system costs, to implement the policies outlined in the Clean Path Case (as compared with the Reference Case). But as in the residential example above, these policies generate financial savings over time and ultimately pay for themselves. In 2030, the net savings

FIGURE 2. Clean Energy Saves Pennsylvania Residents Money Over the Long Term



The Clean Path Case leads to consumer electricity bills in 2030 that on average are 3.4 percent lower than in the Reference Case. Energy efficiency helps consumers save electricity, and more renewable energy helps diversify the electricity mix and limit potential impacts from increases in natural gas prices.[8]

BOX 2.

Methodology

We used a modified version of the Regional Energy Deployment System (ReEDS)—a power-sector model developed by the National Renewable Energy Laboratory—to analyze various possible versions of Pennsylvania's compliance pathway. ReEDS determines through simulation the electricity-supply mix that would meet electricity demand in the future (through 2050) throughout the contiguous United States at the lowest overall system cost while meeting reliability, environmental, and other legal requirements. The assumptions in our version of the model are based on information used by the Energy Information Administration for the *Annual Energy Outlook 2015* (EIA 2015c), supplemented by data from the recent Wind Vision and SunShot Vision studies (DOE 2015; DOE 2012). We also updated the model's data for existing power plants to include recent retirements and plants under construction (see the technical appendix, online at *www.ucsusa.org/CleanPowerPlanPennsylvania*, for more information).

For this analysis, we first modeled a Reference Case with no new state or federal policies beyond those in place as of October 2015. Our Reference Case also does not include CPP compliance, which was finalized in August 2015. We then compared the Reference Case with two policy cases, each of which had achieved nationwide CPP compliance, and focused here on Pennsylvania-specific results. While the CPP offers flexible compliance options—i.e., a wide range of potential strategies—for each state (see Box 1), for our analysis we investigated just these two sets of options for CPP compliance: a Clean Power Plan Compliance Pathway—or "CPP Only"—Case; and a Complementary Clean Energy Compliance Pathway—or "Clean Path"—Case.

For the CPP Only Case, we modeled the CPP mass-based targets including both existing and new fossil fuel–fired power plants (see the discussion on leakage in Box 1). We assumed that each state has the option to meet its CPP target by trading carbon allowances with any other state. We also assumed that all states, as part of their compliance strategy, invest in energy efficiency at a level that achieves a decrease in electricity sales of at least 1 percent per year from 2022 to 2030.[9]

The Clean Path Case includes the same elements as the CPP Only Case, but in addition it complements CPP compliance with policies that explicitly support renewable energy and energy efficiency.[10] For Pennsylvania, we assumed that the state strengthens and extends both its mandatory energy-efficiency targets in Act 129 and its renewable energy targets in the AEPS such that:

- Energy efficiency savings gradually increase until they reach 1.5 percent of statewide electricity sales per year
- Renewable generation (excluding hydro) accounts for nearly 13 percent of sales in 2022 and grows to 20 percent of sales in 2030[11]

Under the Clean Path Case, we also assume that other states with policies to support renewable energy and energy efficiency will continue them and that a few states will add policies or expand their existing requirements.

are $332 million—a decrease of 1.7 percent in total electricity system costs—and these savings continue to grow substantially in the years that follow.

Our analysis also shows that a national mass-based emissions trading program with auctioned allowances would help Pennsylvania generate significant revenues. By setting a carbon cap and issuing allowances equal to its CPP targets, auctioning those allowances, and participating in an interstate carbon trading program, Pennsylvania could generate average annual revenues of $804 million per year from 2022 to 2030 under the Clean Path Case. These revenues could be used to further reduce consumer electricity bills or be reinvested for the benefit of the state's residents. Investment options could include: additional deployment of renewable energy and energy efficiency sources; assistance to communities for the purpose of environmental justice and equity; and worker training and other economic-transition support for communities adversely affected by the state's transition from coal.

A national emissions trading program would help Pennsylvania generate average annual revenues of $804 million per year from 2022 to 2030 under the Clean Path Case.

Public Health and Economic Benefits from Less Pollution

Under both the CPP Only Case and the Clean Path Case, Pennsylvania fully achieves its interim and final CO_2 emissions-reduction requirements set by the CPP. These two policy cases also help cut other air pollutants, including NO_x and SO_2. Under the Clean Path Case, NO_x emissions in 2030 are 21 percent lower than in the Reference Case, while SO_2 emissions are nearly 20 percent lower. In the CPP Only Case, both NO_x and SO_2 emissions in 2030 are 16 percent lower than in the Reference Case.

Reducing NO_x, SO_2, and CO_2 emissions leads to tangible health and economic benefits. NO_x and SO_2 are contributors to smog and soot, which exacerbate asthma and other heart and lung diseases and can result in significant disability and premature death from these causes (EPA n.d.). CO_2 emissions contribute to global warming, which leads to sea level rise, extreme weather such as droughts, heat waves, and heavy downpours, and to other climate impacts that can compromise human health and safety, with direct impacts on Pennsylvania (Shortle et al. 2015).

Using the same methodology applied by the EPA in its impact assessment for the CPP, we estimated Pennsylvania's monetary savings from reducing these pollutants.[12] The combined carbon and health dollar-benefits of the avoided emissions of CO_2, SO_2, and NO_x under the Clean Path Case are $921 million on average each year from 2022 to 2030. This stream of annual benefits add up to almost $4.5 billion[13] for the entire time period, which is more than double the total electric-system costs ($2.2 billion) of complying with Clean Path Case policies. Under the CPP Only Case, the combined carbon and health benefits of the avoided emissions are valued at an average of $611 million annually from 2022 to 2030, or $3.2 billion cumulatively.

With well-designed policies and careful planning and coordination, Pennsylvania can greatly increase its clean energy resources, cost-effectively comply with the emissions reductions required by the Clean Power Plan, and realize important economic and public health benefits in the process.

Recommendations

Achieving the Clean Path Case's full range of benefits will require policy makers and regulators to work together with utilities, generators, advocates, regional transmission organizations, and other stakeholders to develop a CPP compliance plan that prioritizes renewable energy and energy efficiency and generates benefits for Pennsylvania. Toward these ends, the Union of Concerned Scientists offers the following recommendations:

1. **The Pennsylvania Department of Environmental Protection (DEP) should develop a strong mass-based CPP compliance plan.** The DEP has already begun a process for gathering public comments and information to aid in the creation of a compliance plan that works for the state. In building this plan, the DEP should prioritize renewable energy and energy efficiency, and it should develop a mass-based emissions trading program that includes both new and existing sources and allows for interstate trading of carbon allowances. A mass-based approach offers a lower administrative burden, has a long history of successful implementation, and provides the greatest certainty for true achievement of emissions reductions. Such an approach is also better able to incorporate additional carbon-mitigation efforts that must eventually be undertaken for other parts of the economy.
2. **The Pennsylvania General Assembly should enact strong clean-energy and carbon-market policies.** The legislature should extend and expand its current AEPS, which is set to level off at 8 percent in 2021. Act 129 should also be strengthened beyond 2021, in conformance with several other EERS states, so that utilities are required to reduce electricity use by 1.5 to 2 percent each year. The legislature should also authorize the state to auction carbon allowances as part of the DEP's emissions trading program, with the revenues directed to specific programs that benefit all residents, reduce carbon emissions, and promote equitable approaches to transitioning to a low-carbon economy.
3. **Pennsylvania electricity utilities should work to diversify their electricity portfolios, prioritizing low-cost renewables and efficiency.** These steps will help cut consumer electricity bills and further curb harmful emissions from power plants.

Achieving the Clean Path Case's full range of benefits will require stakeholders to develop a CPP compliance plan that prioritizes renewable energy and energy efficiency and generates benefits for Pennsylvania.

4. **The state should make use of the PJM Interconnection to show utilities and stakeholders how to ensure reliability and invest in transmission networks to support low-carbon energy sources.** The PJM regional transmission organization, which coordinates the movement of electricity in the Mid-Atlantic states (including Pennsylvania) and in some Midwestern states, has found that adding higher levels of wind and solar to the electricity grid does not adversely affect service reliability (PJM 2015; GE Energy Consulting 2014).

With well-designed policies and careful planning and coordination, Pennsylvania could greatly enhance its clean energy resources, cost-effectively comply with the emissions reductions required by the Clean Power Plan, and realize important economic and public health benefits. And with a robust emissions trading program, Pennsylvania could generate significant carbon revenues that could be used to support high-quality jobs in renewable energy and energy efficiency, strengthen disadvantaged communities, make buildings and infrastructure more resilient, and boost economic development in regions dependent on the fossil-fuel economy. These benefits would help ensure a sound and prosperous future for all Pennsylvanians.

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ENDNOTES

1. *Unless otherwise indicated, all dollar amounts are expressed in 2015 dollars.*
2. *These sources include solar photovoltaic, solar thermal, wind, low-impact hydro, geothermal, biomass, biologically derived methane gas, coal-mine methane, and fuel cells (Pennsylvania General Assembly 2004).*
3. *"Tons" in this document refers to the U.S. short ton (2,000 pounds).*
4. *These calculations are based on adjustments, made by the EPA to each state's 2012 emissions, in order to account for significant unit-level outages, expected under-construction power plants, and other atypical conditions in 2012. The adjusted 2012 emissions for Pennsylvania are 120 million tons and the 2030 goal, including both new and existing sources, is 90.9 million short tons (OAR 2015a), which represents a 24 percent reduction. More details are available in OAR 2015b.*
5. *The generation mix, including the levels of imported and exported electricity, are the result of the model's calculations for meeting electricity demand in Pennsylvania and across the country at least cost, subject to reliability and other constraints, based on assumptions described in our technical appendix, online at* www.ucsusa.org/CleanPowerPlanPennsylvania.
6. *Note that these figures are for generation, not total electricity sales, as indicated by the AEPS assumption in Box 2 (p. 6).*
7. *Assuming a 7 percent discount rate, based on recommendations outlined in OMB 2014.*
8. *Electricity costs in the Reference Case are based on the monthly consumption of 854 kilowatt-hours (kWh) for a typical residential nonelectric heating customer in Pennsylvania (EIA 2014). In the CPP Only Case and Clean Path Case, average monthly consumption is lower in 2030 (783 kWh and 777 kWh, respectively) because of these cases' more extensive energy efficiency programs.*
9. *The energy efficiency assumption is a proxy for state or utility action; it is needed because the ReEDs model does not include choices on energy efficiency. States with stronger mandatory EERS policies are assumed to continue meeting their respective targets.*
10. *The CPP also includes a Clean Energy Incentive Program (CEIP), which offers states incentives for early development of renewable energy and energy efficiency. A portion of the generation that meets the AEPS and Act 129 requirements we modeled in the Clean Path Case may qualify for the CEIP, but we did not model the impact of the program or the benefits that early crediting would have on the cost-effectiveness of qualifying clean energy projects.*
11. *This level of renewable generation is based on the rate of growth of renewables in other states in recent years (UCS 2014).*
12. *The health benefits are calculated from the Regional Particulate Matter ($PM_{2.5}$) Benefit per Ton Estimates reported in OAQPS 2015. See the technical appendix, online at* www.ucsusa.org/CleanPowerPlanPennsylvania*, for values and additional information.*
13. *This is the net present value from 2015 through 2030 using a 7 percent discount rate, based on recommendations outlined in OMB 2014.*

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