CLEAN POWER PLAN IN WISCONSIN

An analysis of three ways Wisconsin can comply with the Clean Power Plan and what impacts those pathways may have on the state

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cleanwisconsin
Action Network
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EXECUTIVE SUMMARY

In August 2015, the Environmental Protection Agency (EPA) finalized the Clean Power Plan, which regulates carbon dioxide emissions (CO_2) under Section 111(d) of the Clean Air Act. The Clean Power Plan sets state targets for emissions reductions from large (>25 megawatt) existing fossil-fuel power plants, based on the "Best System of Emissions Reduction" (BSER) as determined by the EPA. Each state or regulated area is required to develop its own plan for meeting those targets on either a rate- or mass-basis, or follow a federal plan established by the EPA, by 2016 (with a possible extension to 2018). Interim targets then go into place starting in 2022, with final targets in 2030. For Wisconsin, the targets are:

Table ES-I: Wisconsin CO_2 Emissions Goals for Affected Units under the Clean Power Plan

Wisconsin CO_2 Emissions Goals for Affected Units under the Clean Power Plan					
	Interim Goal - Step 1 (2022-2024)	Interim Goal - Step 2 (2025-2027)	Interim Goal - Step 3 (2028-2029)	**Overall Average Interim Goal (2022 - 2029)**	**Final Goal (2030)**
Emissions Rate	1,479 lb/ MWh	1,335 lb/ MWh	1,236 lb/ MWh	**1,364 lb/ MWh**	**1,176 lb/ MWh**
Total Emissions	33.51 mil. tons	30.57 mil. tons	28.92 mil. tons	**31.26 mil. tons**	**27.987 mil. tons**

The BSER that EPA used to set those goals consisted of improvements in the efficiency of coal-fired power plants, increased use of natural gas combined cycle (NGCC) power plants to create electricity, and increased electricity generation from emissions-free renewable energy. States are not limited to those categories in meeting their goals, but can propose a wide variety of other measures to reduce emissions from affected units. For example, the EPA has provided a significant amount of information on how energy efficiency can be counted and used for compliance with the Clean Power Plan.

In this report, we describe and provide the results of a rigorous analysis of the potential for both emissions reductions and statewide electricity cost impacts of three separate but related paths that the state of Wisconsin could pursue to comply with the Clean Power Plan. Each path starts with an increase in energy efficiency in the state, then considers the potential for incremental reductions in emissions based on existing policies, such as expanding the state's Renewable Electricity Standard, and existing technologies, such as increasing the state's use of current natural gas plants and using current coal plants more efficiently. The compliance paths are not meant to be an exhaustive consideration of all potential emissions reduction measures, but instead provide information on the impacts of a subset of actions that could be taken, which together represent plausible ways the state of Wisconsin could meet the standards of the Clean Power Plan.

> Our analysis found that any of the paths assessed would be sufficient to meet the requirements of the Clean Power Plan for Wisconsin.

Our analysis found that any of the paths assessed would be sufficient to meet the requirements of the Clean Power Plan for Wisconsin. For example Path A, the Minimum Compliance Path that took the least aggressive steps toward emissions reduction, would result in a 35.7% reduction in carbon dioxide emissions from affected sources in 2030, going from 42.3 million tons per year to 27.2 million tons per year.

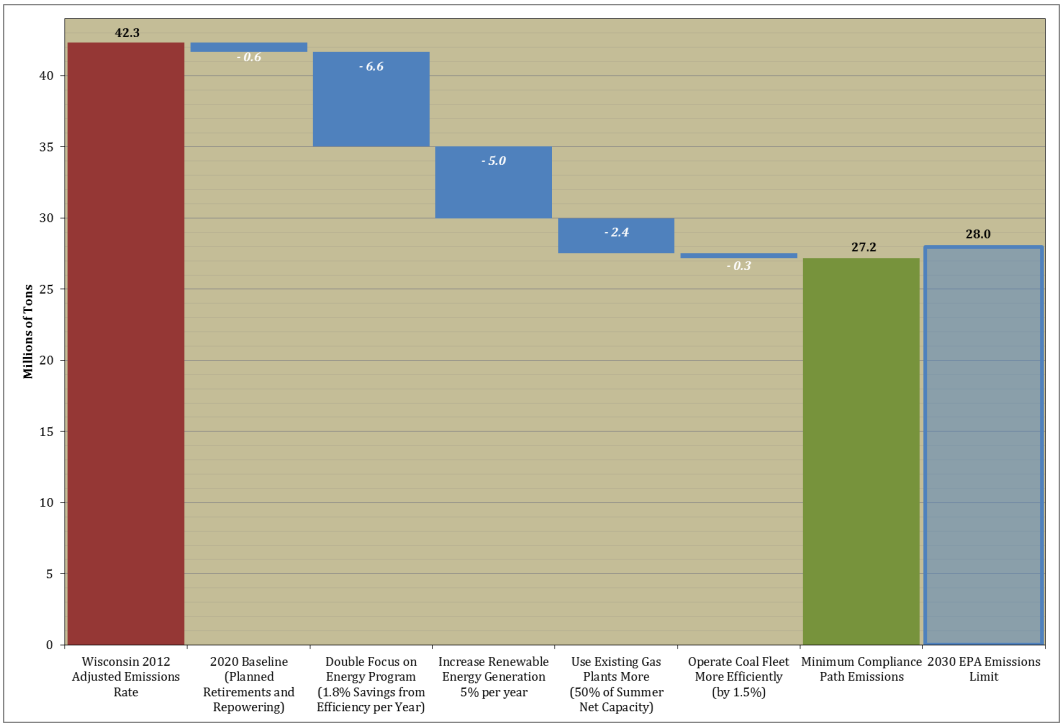

Figure ES-1: Wisconsin CO_2 Emissions Resulting from Compliance Path A - "Minimum Compliance"

We also found that either the Minimum Compliance Path (Path A) or Path B, the "Moderate Reductions Path" that consisted of slightly larger emissions reductions measures, would result in a net cost savings for the state compared to a baseline of taking no action to comply with the Clean Power Plan. Path C, or the "Easily Achievable Savings Path" offering the largest emissions reduction path considered in this analysis, would result in a 1.25% increase in total electricity costs statewide compared to that same baseline. For comparison, a path that minimally complies with the Clean Power Plan (as in Path A) but does not increase energy efficiency efforts in the state was found to cost the state $203.7 million more than the baseline.

Table ES-II: Costs of Compliance with the Clean Power Plan in Wisconsin

Costs of Compliance with the Clean Power Plan in Wisconsin			
	Path A: Minimum Compliance	**Path B: Moderate Reductions**	**Path C: Easily Achievable Savings**
Increase in Energy Efficiency	$117.6 million	$140.9 million	$160.5 million
Increase in Renewable Energy	$227.6 million	$305.6 million	$437.5 million
Increased Use of Natural Gas	$145.8 million	$233.7 million	$390.6 million
Reduced Fuel Use and Emissions Credits	*-$546.3 million*	*-$691.6 million*	*-$893.3 million*
Net Costs	***-$55.4 million***	***-$11.3 million***	**$95.3 million**
As percent of total costs	*-0.73%*	*-0.15%*	1.25%

This analysis demonstrates that compliance with the EPA's Clean Power Plan can be accomplished in a straightforward and cost-effective manner. Through the utilization and expansion of existing policy infrastructure and using only existing fossil fuel plants in the state, Wisconsin can reduce CO_2 emissions from affected units to an amount significantly below the goals set by EPA while simultaneously saving ratepayers in Wisconsin money compared to the baseline.

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BACKGROUND

The Clean Air Act and Carbon Emissions

The Clean Air Act is the primary federal law dealing with air pollution in the United States. It is largely overseen by the Environmental Protection Agency (EPA) and has been refined, revised and extended over time since it was first passed in 1963, including significant amendments in 1970, 1977, and 1990. Among other things, the Clean Air Act now regulates emissions of air pollutants from both mobile and stationary sources and sets national air quality standards to protect public health and public welfare. To ensure that the aim of protecting health and welfare is met, new regulations become required under the Clean Air Act as understanding of air pollution and its impacts increases. The regulation of carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions is one of the most recent additions.

The path toward CO_2 and GHG emission regulation began in 2007, when the U.S. Supreme Court held that emissions of those pollutants from new passenger vehicles were subject to regulation under the Clean Air Act. Specifically, that ruling established that those emissions met the legal definition of an "air pollutant" as defined by the Clean Air Act and required the EPA to study whether that pollution could endanger public health or welfare.[1] When EPA released its "Endangerment Finding" in 2009, it found that CO_2 and GHG emissions from motor vehicles threaten public health and welfare in a number of ways. As a result, EPA is required by the Clean Air Act to implement new regulations to mitigate the impact of that pollution.

The first of those limits, a limit on mobile sources like motor vehicles, went into effect in 2010. In turn, the regulation of mobile source CO_2 and GHG emissions triggered the regulation of stationary sources under the "New Source Review" permitting program of the Clean Air Act, leading to the requirement that new or modified large facilities (like power plants) use "best available control technologies" (BACT) as part of a "prevention of significant deterioration" program for CO_2 and GHG pollution. The EPA phased in permitting regulations on the largest sources of emissions in 2011. The same year, the U.S. Supreme Court affirmed that the Clean Air Act required EPA to regulate CO_2 and greenhouse gas emissions from fossil fuel-fired power plants specifically — the largest single source of emissions in the country.[2]

Cutting Greenhouse Gas Emissions from Existing Power Plants

Though there are a wide range of activities that emit CO_2 and other GHG pollution in the United States, the single biggest source of GHG pollution is our energy use, primarily burning fossil fuels for power, transportation, or heat. That energy use causes over 85% of all GHG pollution in the U.S., and electricity generation is the single largest component of those emissions at roughly 36% (a larger portion than burning fuels for industrial activities or transportation, or the various agricultural, commercial and residential practices that also emit greenhouse gases).[3] The story is much the same at the state level; in Wisconsin, the portion of all GHG emissions coming from electricity is 33%, and generation of electricity represents 41% of energy-related GHG emissions.[4]

Along with performance standards for CO_2 pollution from new or modified power plants, the EPA is required to regulate emissions from existing sources. It released a draft of proposed limits under Section 111(d) of the Clean Air Act, a proposal the EPA called the Clean Power Plan, in June 2014. The final Clean Power Plan was initially delayed to allow for additional public comments due to the large interest generated, and was finalized on August 3, 2015. It applies to "affected units," which are defined as power plants in operation as of 2012 that were over 25 megawatts (MW) in size and are rated to operate at greater than 250 million Btu per hour of heat input from fossil fuels. The CO_2 limits for those plants go into effect starting with interim levels in 2022 and final limits starting in 2030.

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1 Massachusetts v. EPA, 549 U.S. 497 (2007)
2 American Electric Power Co. v. Connecticut, 131 S. Ct. 2527 (2011)
3 Various Sources, via World Resources Institute, CAIT Climate Data Explorer, accessed 2015 at: http://cait.wri.org/
4 Ibid.

Section 111(d) of the Clean Air Act provides significant roles for both the EPA and individual states in regulating emissions. EPA first establishes procedures and guidelines for emissions reduction. Once those guidelines are established, states develop and submit plans to meet those guidelines. The EPA then approves or denies those plans, with the option to implement a federal plan if the state's submittal is not satisfactory. Depending on whether or not the state's plans are accepted, either the state or EPA goes on to oversee the emissions reduction.[5]

THE FINAL CLEAN POWER PLAN

Three Building Blocks

The Clean Power Plan represents the most important articles of guidance that EPA provides to states under 111(d): It establishes the best system of emissions reduction (BSER) for CO_2 from affected units, and it establishes the expectation for emissions limitations through the use of that BSER.[6] It does this while considering things such as costs of emission reductions, public health and environmental impacts, energy requirements, and a large number of other factors specific to the electricity system.[7] After years of analysis, outreach and over 4 million comments,[8] the EPA determined that the BSER for CO_2 from affected units was comprised of three "Building Blocks:"

1. Improved efficiency of coal-fired power plants
2. Increased use of natural gas combined cycle (NGCC) power plants to create electricity
3. Increased electricity generation from emissions-free renewable energy

The specific levels of each building block (e.g. how much potential there is for improving power plant efficiency) were analyzed and set separately for each of two source categories: coal & oil/ gas steam turbine plants, and natural gas combined cycle plants. Specific levels were also analyzed and set for each of the three general power grids in the continental United States: the Eastern Interconnection, generally east of the Rocky Mountains; the Western Interconnection; and the Texas Interconnection.

Building Block 1: Improved efficiency of coal-fired power plants

To determine the Building Block 1 portion of the BSER, EPA used three different approaches looking at historical heat rates on a unit-by-unit basis across each interconnect. Each of those approaches calculated potential improvements if power plants were to more consistently perform at or near high levels of efficiency they have demonstrated since 2002. After calculating the average improvements for generators in each interconnect using those approaches, EPA chose the most conservative values for the Building Block 1 BSER: a 2.1% increase in efficiency in the Western Interconnection, 2.3% in the Texas Interconnection, and 4.3% in the Eastern Interconnection.

Building Block 2: Increased use of NGCC power plants

For Building Block 2, EPA examined historical data and conducted modeling to analyze NGCC characteristics and operations. It also considered natural gas supply and deliverability issues, and determined that NGCC plants could, on average, achieve utilization of 75% of their net summer capacity, roughly 70% of nameplate capacity. EPA assumed a ramp-up to that utilization, based on historical increases in natural gas operations (5% per year).

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5 For information on the differences between compliance planning under Section 111(d) and that more common State Implementation Plan process (under Section 110), see e.g. http://www.raponline.org/featured-work/tackling-111d-compliance-planning-its-not-a-sip
6 42 USC §7411(a)(1)
7 U.S. EPA, "Background on Establishing New Source Performance Standards (NSPS) Under the Clean Air Act." (2013)
8 J McCabe, "EPA Connect - Clean Power Plan: Power Plant Compliance and State Goals" (Aug 4, 2015). Online at https://blog.epa.gov/blog/2015/08/clean-power-plan-power-plant-compliance-and-state-goals/

Building Block 3: Increased electricity generation from emissions-free renewable energy

Finally, for Building Block 3, EPA analyzed the demonstrated annual capacity additions for emissions-free renewable energy technologies (utility solar, wind, concentrating solar power, hydropower, and geothermal power) on the national level from 2010 through 2014. EPA considered both the average and largest changes over those years in the installed capacity for each technology, and determined average and maximum demonstrated additions of renewable energy generation based on capacity factors from the National Renewable Energy Laboratory. EPA then used modeling to determine how much renewable energy installation would happen by 2022 without the Clean Power Plan. Generation equal to the average demonstrated addition was added to that modeled 2022 amount for each of 2022 and 2023, and the maximum demonstrated addition was added for each of the years 2024-2030. Modeling was used again to apportion the new renewable generation for each year to the different interconnects.

With the final Building Blocks in hand, the EPA then applied them to historical generation and emissions rates for each interconnect to determine potential emissions rates for each year from 2022 to 2030, starting by reducing future emissions based on Building Block 1. Generation levels in each interconnect from coal & oil/gas steam turbine plants and NGCC plants, were then reduced by Building Block 3 proportional to the amount each of those categories historically generated electricity in each interconnect. Building Block 2 was applied last, reducing generation from coal & oil/gas steam turbine plants and increasing the generation from NGCC plants. Emissions rates for each interconnect were then determined for each year based on the amounts of generation and emissions after those steps, attributing incremental NGCC generation from Building Block 2 to the coal & oil/gas steam turbine category, since those are what is displaced.

Having arrived at emissions rates for each category and each interconnect, the EPA took the highest (least strict) set of rates from the different interconnects and set those as the final CO_2 emission performance rate goals that can be expected to be met through application of the BSER to electricity generation from each source category. The final performance rate goals in pounds of CO_2 per megawatt-hour of electricity generated are shown below.

Table III: Nationwide CO_2 Emission Performance Rate Goals for Affected Units (lb CO_2 / MWh)

Nationwide CO_2 Emission Performance Rate Goals for Affected Units (lb CO_2/ MWh)										
	2012	2022	2023	2024	2025	2026	2027	2028	2029	2030
Coal & Oil/Gas Steam Turbine	*2,167*	1,741	1,681	1,592	1,546	1,500	1,453	1,404	1,355	1,304
Reduction from baseline	--	*19.7%*	*22.4%*	*26.5%*	*28.7%*	*30.8%*	*32.9%*	*35.2%*	*37.5%*	*39.8%*
Natural Gas Comb. Cycle	*902*	898	877	855	836	817	798	789	779	770
Reduction from baseline	--	*0.4%*	*2.8%*	*5.2%*	*7.3%*	*9.4%*	*11.5%*	*12.5%*	*13.6%*	*14.6%*

State-by-State Analysis

After determining the performance rate goals from applying the BSER to electricity generation from each source category, EPA used those goals to find the expectation for emissions limitation on a state-by-state basis for each state that had affected units.[9] Specifically, the EPA looked at how much electricity generation came from coal & oil/gas steam turbines and NGCC plants in the baseline year of 2012 in each state. It then calculated what proportion of that generation was from each source category in each state and what the expected emissions would be if those plants met the CO_2 emissions performance rate goals from the BSER.

[9] *There are three states not regulated under the Clean Power Plan; Alaska and Hawaii are not covered due to their unique circumstances as non-contiguous states, and Vermont is not regulated because it has no affected units. In addition to the remaining 47 states, 3 other territories are covered: the Lands of the Fort Mojave Tribe, the Lands of the Navajo Nation, and the Lands of the Uintah and Ouray Reservation.*

For example, in Wisconsin, 76% of electrical generation from affected units was from the coal & oil/gas steam turbine category in the 2012 baseline. Therefore, Wisconsin's emissions rate goals reflect 76% of the coal & oil/gas steam turbine performance rate goal for each year and 24% of the NGCC performance rate goal.

Table IV: Wisconsin CO_2 Emission Performance Rate Goals for Affected Units (lb CO_2/ MWh)

Wisconsin CO_2 Emission Performance Rate Goals for Affected Units (lb CO_2/ MWh)										
	2012	2022	2023	2024	2025	2026	2027	2028	2029	2030
WI Emissions Rate Goal	*1,996*	1,537	1,486	1,414	1,375	1,335	1,295	1,256	1,216	1,176
Reduction from baseline	--	*23.0%*	*25.6%*	*29.2%*	*31.1%*	*33.1%*	*35.1%*	*37.1%*	*39.1%*	*41.1%*

Similarly, the final rate goals calculated around the country depended on individual state electrical generation portfolios and ranged from a goal of 771 pounds of CO_2 per megawatt-hour to 1,305 pounds of CO_2 per megawatt-hour. Wisconsin's emission performance goal of 1,176 is higher than some neighboring states and lower than others; Wisconsin's rate goal is the 32nd most stringent out of 50 regulated regions.

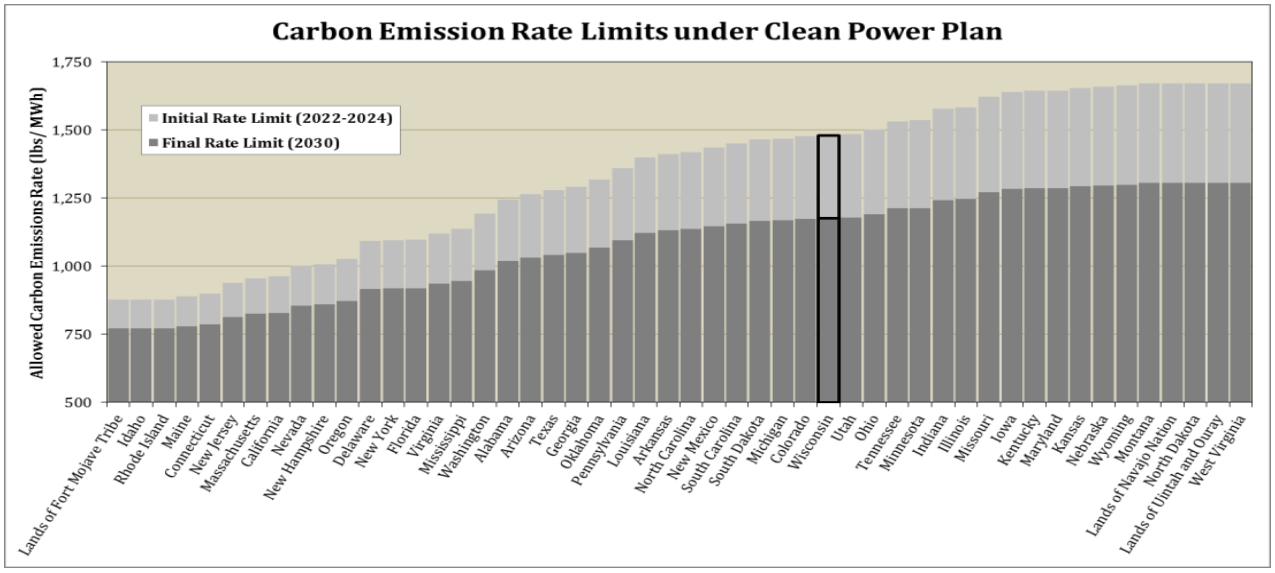

Figure 2: Initial Interim and Final Performance Rate Goals for Covered States and Lands (lb/ MWh)

To determine a *total emissions* goal for each state (on a "mass basis"), the rate goals for each year were first multiplied by the affected generation amount for each year. The EPA then accounted for the fact that not all achievable renewable energy under Building Block 3 was used in setting the rate goals, since the least stringent rate across interconnects was used. In particular, states could see an advantage under a rate-based compliance scenario versus a mass-based scenario by increasing renewable energy generation an additional amount to reach the full demonstrated potential. In a mass-based compliance regime, the total generation allowed for a state would only increase by that additional increment of renewable generation. Using rate-based compliance on the other hand, that renewable generation could effectively be used to offset a further increase in fossil fuel-based generation from affected units while meeting the same goal. Therefore, to level the playing field between mass- and rate-based compliance scenarios, EPA raised the mass goals for each state, making them less stringent, to account for the potential of each state to increase renewable energy generation.

For example, under a rate-based scenario, Wisconsin is expected to produce 42.4 terawatt-hours (TWh) of electricity from affected units in 2022. At the blended performance rate goal of 1,537 lb CO_2/MWh, that corresponds to 32.59 million tons of CO_2 emissions. Under a mass-based compliance plan, that limit would be a cap on emissions, unaffected by additional renewable generation. If Wisconsin were to generate the additional 1.48 TWh of renewable energy that the EPA determined was achievable in 2022 under that scenario, the end result would be 43.9 TWh of total generation from affected sources and new renewables. Under a rate-based compliance scenario, the state could instead generate an additional 3.61 TWh from affected sources at the state's baseline steam turbine emissions rate (2,167 lb/MWh), for a total of 47.49 TWh, while still meeting the overall rate goal.

Step 1: Calculate Additional Mass Emissions from Added Generation at Affect Units

$$1.48 \text{ TWh added renewable generation} \times 0 \frac{\text{lb}}{\text{MWh}} + 3.61 \text{ TWh } \textbf{added fossil fuel generation} \times 2{,}167 \frac{\text{lb}}{\text{MWh}} \div 2{,}000 \frac{\text{lb}}{\text{ton}} = 3.91 \textbf{ million tons additional } \mathbf{CO_2} \textbf{ emissions}$$

Step 2: Calculate Adjusted Emission Rate with Added Generation at Affect Units

$$\frac{(32.59 \text{ million tons } CO_2 \text{ emissions} + \mathbf{3.91 \text{ million tons additional } CO_2 \text{ emissions}})}{(42.4 \text{ TWh generation} + 1.48 \text{ TWh added renewable generation} + \mathbf{3.61 \text{ TWh added fossil fuel generation}})} \times 2{,}000 \frac{\text{lb}}{\text{ton}} = 1{,}537 \frac{\text{lb}}{\text{MWh}}$$

The adjustment factor that EPA determined to compensate for this effect was applied for each year from 2022 to 2030, and added to the amount of emissions that could be expected to come from regulated sources to arrive at total mass-based emissions goals.

Table V: Wisconsin Carbon Dioxide Total Emission Performance Goals

Wisconsin CO_2 Total Emission Performance Goals										
	2012	2022	2023	2024	2025	2026	2027	2028	2029	2030
Additional Potential Renewable Generation (TWh)	--	1.483	1.417	1.452	1.603	1.734	1.772	2.060	2.345	2.596
Emissions Goal (million tons)	*42.318*	34.871	33.621	32.025	31.351	30.622	29.741	29.207	28.628	27.987
Reduction from baseline	--	17.6%	20.6%	24.3%	25.9%	27.6%	29.7%	31.0%	32.4%	33.9%

Meeting Emissions Goals

Section 111(d) of the Clean Air Act gives individual states a significant role in regulating emissions, and provides flexibility to states in how they choose to comply with the Clean Power Plan. States are able to develop and submit their own plans for meeting the performance goals that EPA set. As long as those plans will meet the state's goals and are equivalent to the BSER determined by EPA, they don't have to follow the Building Blocks that EPA considered. Put simply, the Clean Power Plan does not require implementation of the Building Blocks; instead, a state could propose any of a wide variety of plans built on the measures EPA described or other measures. For example, end-use efficiency was not considered as part of the BSER by the EPA, but is the cheapest energy resource and is widely expected to be an essential component of a cost-effective compliance plan.

Measures that states could use for compliance include, but are not limited to:

- Efficiency improvements at existing coal power plants
- Co-burning natural gas or biomass at existing coal power plants
- Repowering existing coal power plants
- Retiring existing coal plants
- Re-dispatching electricity generation to more efficient power plants
- Capturing and sequestering carbon emissions at existing coal or natural gas plants
- Increasing use of existing natural gas plants
- Efficiency improvements at existing natural gas plants
- Increasing use of combined heat and power systems
- Increasing use of nuclear energy
- Increasing use of utility-scale renewable energy
- Increasing use of distributed renewable energy
- Increasing transmission and distribution efficiency
- Increasing end-use efficiency
- Increasing energy conservation measures
- Increasing industrial resource efficiency
- Purchasing or trading carbon credits with other states

Glide Path to Compliance

While the BSER analysis conducted by EPA provided emissions reduction estimates for each year from 2022 to 2030, compliance with the Clean Power Plan is fundamentally required at two points: first in an interim period from 2022 to 2029, and then at a final level that starts in 2030. However, one major piece of feedback EPA received on the proposed rule was that power plants would have trouble meeting the planned interim goals that were meant to reduce emissions and help guide the industry over time to the 2030 final levels.[10] Originally EPA had proposed that states must meet an overall average level of emissions for all the years from 2020 to 2029 before the final goals would come into place. In response to that feedback EPA reworked the interim goals in the final rule by pushing back the opening year for emissions goals two years, to 2022, and made multiple steps down to the final goal: a higher goal on average from 2022-2024, a slight reduction that from 2025-2027 and again from 2028-2029, and then the final goal from 2030 on. However, EPA still grants states flexibility to propose their own interim step goals as part of a state compliance plan, as long as the average interim goal over that entire time period is met.

In Wisconsin this reworking of the interim goals made the start date later and made the interim goals less strict on average than they were in the proposed rule, so power plants will have an easier time meeting them.

Table VI: Interim CO_2 Emission Performance Goals for Wisconsin under the Clean Power Plan

Wisconsin Interim CO_2 Emission Performance Goals						
	Proposed Interim Goal (2020 - 2029)	Final Interim Goal - Step 1 (2022-2024)	Final Interim Goal - Step 2 (2025-2027)	Final Interim Goal - Step 3 (2028-2029)	Final Average Interim Goal (2022 - 2029)	Change in Avg. (from Proposed)
Emissions Rate	1,281 lb/MWh	1,479 lb/MWh	1,335 lb/MWh	1,236 lb/MWh	1,364 lb/MWh	6.5% less strict
Total Emissions	32.07 million tons	33.51 million tons	30.57 million tons	28.92 million tons	31.26 million tons	0.9% less strict

At the same time, the new BSER calculations resulted in a slightly stricter final goal for Wisconsin from a rate perspective, and a slightly less strict goal from a mass perspective:

Table VII: Final CO_2 Emission Performance Goals for Wisconsin under the Clean Power Plan

Wisconsin Final CO_2 Emission Performance Goals			
	Proposed Final Goal (2030)	Final Goal (2030)	Change in Final (from Proposed)
Emissions Rate	1,203 lb/MWh	1,176 lb/MWh	2.2% stricter
Total Emissions	27.861 million tons	27.987 million tons	0.45% less strict

Credit for Early Action

In addition to establishing interim goals, EPA provided a further incentive to help states come into compliance with the Clean Power Plan by providing supplementary credit toward a state's interim goals for early action taken. Specifically, EPA established a voluntary Clean Energy Incentive Program (CEIP) to provide states with additional Emissions Reductions Credits (ERCs) that can be used toward state goal compliance for qualifying wind or solar energy projects and energy efficiency projects for low-income communities. Projects that qualify are those that begin construction (in the case of renewable energy) or operations (in the case of low-income energy efficiency) after a state submits a final compliance plan,[11] and

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[10] See, e.g., U.S. EPA "FACT SHEET: Clean Power Plan Key Changes and Improvements" (2015). Online at http://www.epa.gov/cleanpowerplan/fact-sheet-clean-power-plan-key-changes-and-improvements

[11] Projects can also qualify after a Federal Plan goes into effect for those states that do not submit their own compliance plan by the 2018 extension deadline (9/6/2018).

generate or save electricity in the two years prior to when the first interim goal takes effect (so in 2020 or 2021). States are allowed to provide 0.5 MWh of ERCs per MWh generated by renewable energy projects, which is then matched by an additional 0.5 MWh by the EPA (1 MWh total of credit for each MWh of renewable energy generated). For energy efficiency, states are allowed to provide 1 MWh of ERCs per MWh saved, which is matched by another 1 MWh of ERCs from the EPA, thus providing an added incentive for those kinds of projects (2 MWh total of credit for each MWh saved). Other renewable energy and energy efficiency projects not taking part in the Clean Energy Incentive Program but started after the baseline year of 2012 will count toward compliance to the extent that they reduce emissions during compliance years (2022 and later).

WISCONSIN'S GOALS

EPA set the carbon emissions goals for power plants by applying the BSER to each state. However, each state is allowed to separately decide the best way to meet those limits if desired. To give states more flexibility, EPA also gave each state a choice of two different options for what kind of goal to set. They can choose either a "rate" target that is pounds of pollution per megawatt-hour of electricity generated, or a "mass" target that is total tons of pollution per year for the state no matter how much electricity is produced.

Under a rate target, Wisconsin would be required to reduce carbon emissions from affected sources by 26% on average for the first interim compliance period (2022-2024) as compared to the baseline year of 2012 (see Table VI). The state would then have to continue making improvements to get to a 41% reduction from the 2012 baseline by 2030. Under a total mass target, Wisconsin's reduction goals are 21% by the first compliance period, and 34% by 2030 (see Table VII).

Fortunately, historical energy choices in Wisconsin have positioned the state well to meet the carbon pollution limits while still providing reliable and affordable energy. In fact, power plants in Wisconsin are already on a path of reduced carbon emissions, with emissions down by more than 10% between 2005 and 2012 according to data from the U.S. Energy Information Administration.[12] A more detailed look at the trend in carbon emissions from fossil fuel generators that would qualify for regulation under the Clean Power Plan shows a similar story; in 2005, there were 46 generators that would have been regulated under this rule if it had been in place then. Those generators together amounted to 50 million tons of CO_2 emissions at a combined emissions rate of 2,293 pounds per MWh. In 2012, there were 50 generators regulated under the Clean Power Plan, but total emissions from those generators were down to 42.3 million tons of CO_2 (at 1,996 pounds per MWh).[13] That amounts to a reduction of over 15% of total emissions, and about 13% in the emissions rate, between 2005 and 2012, putting Wisconsin on track to meet the Clean Power Plan goals if that trend were to continue.

Fortunately, historical energy choices in Wisconsin have positioned the state well to meet the carbon pollution limits while still providing reliable and affordable energy.

[12] *U.S. Energy Information Administration,* State Electricity Profiles, Wisconsin, *"Table 7. Electric power industry emissions estimates, 1990-2013" (2015). Online at https://www.eia.gov/electricity/state/wisconsin/*

[13] *U.S. Environmental Protection Agency,* Emissions & Generation Resource Integrated Database (eGRID). *Online at http://www.epa.gov/energy/egrid*

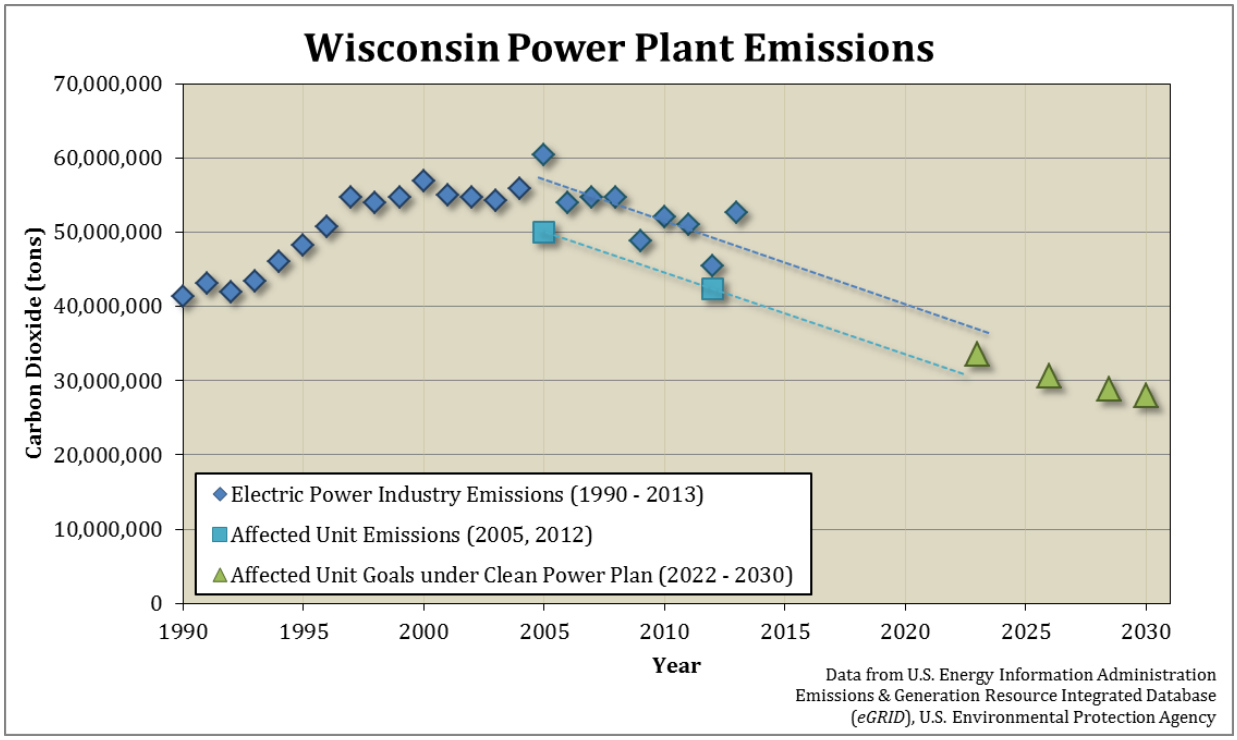

Figure 3: Historical Trends in Emissions from the Electric Power Industry in Wisconsin, and Affected Units and Affected Unit Goals in Wisconsin under the Clean Power Plan

An independent analysis in December 2013 by the World Resources Institute estimated that Wisconsin could reduce its CO_2 emissions from existing power plants 43% from 2011 levels by 2020 through modest increases in clean energy investments, dispatching cleaner, more efficient power plants in Wisconsin and expanding the state's Focus on Energy program.[14] Those steps would put Wisconsin in compliance with the final 2030 limits 10 years early, two years before even the interim limits of the Clean Power Plan take effect.

WISCONSIN'S PATH TO SUCCESS

Energy Efficiency

Energy efficiency is the single cheapest and most important way to reduce carbon dioxide emissions from power plants and to cost-effectively comply with the Clean Power Plan. While energy efficiency was not considered by EPA as part of the final BSER that sets carbon dioxide emissions goals, states have flexibility to include it as a key compliance option. Energy efficiency can take many forms, ranging from advanced measures like high-performance efficient building design or new technologies like LED lighting, to tried-and-true techniques like simply adding insulation. No matter the specific measure taken, the goal of energy efficiency is to use less energy while receiving the same or better services (e.g. products manufactured, well-lit rooms, hot showers and cold beverages) than before. As the cheapest energy resource, it saves people and businesses money while reducing the pollution that comes from burning fossil fuels.

Wisconsin has a long history of using energy efficiency to save electricity with its statewide Focus on Energy program. Funded through the state's energy utilities, the program assists more than 70,000 Wisconsin residents and businesses per year and has kept millions of pounds of emissions from being created.[15] It has already helped with measures that save hundreds of millions of dollars each year, and reduced the cost of energy across the state by making the electric system more reliable and reducing the

[14] *World Resources Institute,* Power Sector Opportunities for Reducing Carbon Dioxide Emissions: Wisconsin. *December, 2013.*
[15] *The Cadmus Group, Inc. "Focus on Energy Calendar Year 2014 Evaluation Report." May 2015.*

need for more power plants and transmission lines. Increasing the amount of energy saved through Focus on Energy or other similar programs has the largest potential for Wisconsin to cost-effectively meet the requirements of the Clean Power Plan. Without taking full advantage of energy efficiency first, Wisconsin would have to take much bigger steps to limit carbon emissions, such as spending much more to switch from burning coal to burning natural gas.

Renewable Energy

Another key way Wisconsin utilities can reduce CO_2 emissions is by using cleaner, renewable sources of electricity like wind turbines, solar energy systems, and biogas generators. Wisconsin has a large variety of renewable energy resources, with the technical resource potential that could generate hundreds or thousands of times more electricity than currently is used in the state.[16] Wisconsin utilities have been expanding their use of renewable energy resources since they were first required to generate power from renewable sources in 1998, and the state's first full-fledged Renewable Electricity Standard was passed in October 1999, requiring 2.2% of electricity sold in Wisconsin to come from renewable sources by 2012. That was expanded in 2006 to a goal of roughly 10% of electricity from renewable sources by 2015; overall, Wisconsin utilities achieved this in 2013, two years early.[17] While Wisconsin was one of the first states in the nation to pass a renewable energy requirement though, the final state standard of approximately 9.5%[18] is now among the lowest.[19] For example, Colorado requires that 30% of electricity provided by investor-owned utilities come from renewable sources by 2020. This includes Xcel Energy, which operates in numerous states, including Wisconsin and Minnesota, the latter of which has a goal of 30% by 2025. California also recently boosted its standard to 50% renewables by 2030.[20]

While Wisconsin has built little renewable energy generation in-state compared to other states, it has the resources and ability to get just as much power from renewable energy as peers and other Midwestern states. According to the National Renewable Energy Laboratory, Wisconsin has the technical potential to generate almost 100 times the amount of Wisconsin's retail electricity sales in 2013 from renewable electricity alone.[21] It also has over 500 companies involved in the wind and solar power industries, who employ nearly 7,000 people, according to a recent study,[22] which is more than Iowa, the third largest producer of non-hydroelectric renewable power in the nation after California and Texas. The more renewable energy generated in the state, the easier it will be for Wisconsin to comply with the Clean Power Plan.

While Wisconsin has built little renewable energy generation in-state compared to other states, it has the resources and ability to get just as much power from renewable energy as peers and other Midwestern states.

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[16] *Lopez et al. "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis." U.S. Department of Energy, National Renewable Energy Laboratory. Technical Report NREL/TP-6A20-51946. July 2012.*

[17] *Public Service Commission of Wisconsin, Memorandum June 3, 2014, Docket 5-GF-243, "2013 Renewable Portfolio Standard Summary Report."*

[18] Ibid. *Wisconsin's Renewable Electricity Standard is based on percentage increases over a baseline year; as of 2014, the requirement was estimated to lead to 9.45% of generation coming from renewable sources.*

[19] *Of the 35 states and 5 other areas (Washington DC and 4 territories) with standards or goals for the percentage of generation coming from renewable sources (not counting Iowa and Texas, two of the leading generators of renewable energy, that have capacity standards instead of generation goals), only South Carolina's is lower than Wisconsin's goal of approximately 9.5%. Four states have 10% renewable standards or goal. See DSIRE project of NC Clean Energy Technology Center and U.S. Department of Energy, available online at http://www.dsireusa.org.*

[20] Ibid.

[21] *Lopez et al. "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis." U.S. Department of Energy, National Renewable Energy Laboratory. Technical Report NREL/TP-6A20-51946 (July 2012)*

[22] *Environmental Law and Policy Center. "Wisconsin Clean Energy Supply Chain: Good for Manufacturing Jobs, Good for Economic Growth and Good for Our Environment" (February, 2015)*

Compliance with the Clean Power Plan

Given the great flexibility of Section 111(d), there are a wide range measures Wisconsin can use to reduce CO_2 emissions and meet the requirements of the Clean Power Plan. This flexibility provides the state with countless "paths" to compliance.

To consider the potential impact of the Clean Power Plan on Wisconsin, we developed three separate but incremental compliance paths. Each starts with an increase in energy efficiency in the state, since energy efficiency is the most cost-effective measure to reduce emissions. These compliance paths then examine the potential for incremental increases in emissions reductions based on existing policies, such as expanding the Renewable Electricity Standard, and technologies, such as increasing the use of existing natural gas plants and using existing coal plants more efficiently.

Path A: Minimum Compliance

This path considers minimum steps that could be taken using existing policies and technologies in Wisconsin to come into compliance with the Clean Power Plan. It assumes a doubling of savings from the Focus on Energy program while holding constant achievement from other energy efficiency efforts. It also includes an incremental increase of 1.05 times more renewable energy generation per year then the year before; an increase in natural gas generation to an overall 50% net summer capacity; and a 1.5% improvement in the emissions performance of the state coal fleet.

Path B: Moderate Reductions

This path assumes slightly larger steps that could be taken using the same policies and technologies as the Minimum Compliance Path (A). It is comprised of:

- A doubling of savings from all energy efficiency efforts in the state;
- Gradual increase in renewable energy generation to 20% of retail sales by 2030;
- Increase in natural gas generation to an overall 55% net summer capacity; and
- 4% increase in the emissions performance of the state coal fleet.

Path C: Easily Achievable Savings

The Easily Achievable Savings Path (C) demonstrates what the impacts would be if Wisconsin followed the lead of other states, but applied with regard to current policies and technologies in the state. It assumes:

- A savings goal of 2.5% per year from energy efficiency efforts in the Wisconsin;
- Gradual increase in renewable energy generation to 30% of retail sales by 2030
- Increase in natural gas generation to an overall 60% net summer capacity along with an increase in co-firing to 5% of overall generation from coal facilities; and
- A 5% increase in the emissions performance of the state coal fleet.

Our compliance paths were not intended to be an exhaustive consideration of potential emission-reduction measures, but instead provide information on the impacts of a specific subset of actions that could be taken to reduce carbon emissions. In addition, these paths were not meant to show the full range of pollution reductions possible based on the measures considered, but represent conservative approaches to potential pollution-reduction measures; even the strongest path (the Easily Achievable Savings Path C) was designed to take only modest steps toward emissions reduction. For example, a 2.5% savings from energy efficiency is the same as Arizona's energy efficiency goal, but less than the goals of Massachusetts or Rhode Island (2.6%). Similarly, 25% renewable energy by 2030 is less than many other states, including New York (30% by 2015); Colorado (30% by 2025); California (50% by 2030); and Vermont (75% by 2032).[23]

[23] *See, e.g., DSIRE project of NC Clean Energy Technology Center and U.S. Department of Energy, available online at http://www.dsireusa.org.*

Table VIII: Analyzed Clean Power Plan Compliance Paths for Wisconsin

Analyzed Clean Power Plan Compliance Paths for Wisconsin			
	Path A: Minimum Compliance	**Path B: Moderate Reductions**	**Path C: Easily Achievable Savings**
Description	This path takes the fewest steps needed to cut carbon and still meet the limits of the Clean Power Plan.	This path takes larger, but still relatively small steps to cut carbon in Wisconsin.	This path looks at the potential impact of steps that other states have taken when applied to existing policies and infrastructure in Wisconsin.
Energy Efficiency	*Double Focus on Energy Program to 1.8% savings from efficiency per year*	*Double statewide efficiency savings to 2.04% per year*	*Increase customer-side energy efficiency to 2.5% per year*
Renewable Energy	*Increase renewable energy generation by factor of 1.05/ year*	*Double renewable energy generation to 20% of sales by 2030*	*Increase renewable energy generation to 25% by 2030*
Use of Existing Gas Plants	*Use existing gas plants more (50% of summer capacity)*	*Use existing gas plants more (55% of summer capacity)*	*Use existing gas plants more (60% of summer capacity); co-fire 5% natural gas at existing coal plants*
Use of Existing Coal Plants	*Operate coal fleet more efficiently (by 1.5%)*	*Operate coal fleet more efficiently (by 4%)*	*Operate coal fleet more efficiently (by 5%)*

The increase in the use of existing gas plants was also conservative. While the BSER determined by EPA includes increasing the use of existing natural gas plants to 70% of net summer capacity, the pathways considered here range from using 50% to 60% (with a small amount of co-firing) of natural gas capacity in the state. These are relatively small increases from the 2012 baseline, when those plants already operated at an overall capacity factor of 45%. Finally, the overall increases in coal fleet efficiency ranging from 1.5% to 5% are similarly unambitious: Wisconsin's coal fleet already operated 2.6% more efficiently in 2014 than the 2012 baseline in terms of carbon dioxide emissions per MWh, and through September 2015 the fleet was operating 2.65% more efficiently, mainly due to decreased generation from lower efficiency units and an increased generation from those with lower emissions rates.[24]

Despite the conservative nature of the compliance paths, each one demonstrates a way in which Wisconsin can meet the requirements of the Clean Power Plan. The potential emissions reductions associated with these compliance pathways was calculated using a step-by-step process, based on data from EPA, U.S. Energy Information Administration, Wisconsin Public Service Commission, and Wisconsin's Focus on Energy program.[25] While the Clean Power Plan requires that Wisconsin produce 14.3 million fewer tons of CO_2 than 2012 from affected units by 2030 (resulting in an overall limit of 28 million tons of CO_2 emissions allowed annually), the Minimum Compliance Path (A) would result in a 15.1 million ton reduction (or 27.2 million tons of total remaining emissions annually). The other compliance paths analyzed each resulted in further emissions reductions commensurate with the increases in measures taken: Moderate Reductions Path B would result in a total of 22.6 million tons of emissions annually, and Easily Achievable Savings Path C would result in 16.2 million tons.

[24] *Baseline 2012 Fossil Steam emissions: 2,362 lb/MWh; 2014: 2,300 lb/MWh from EPA Air Markets Program Data and form EIA-923; 2015 Jan - Sep: 2,299 from EPA Air Markets Program Data and form EIA-923*
[25] *See Appendix A for emissions calculation details*

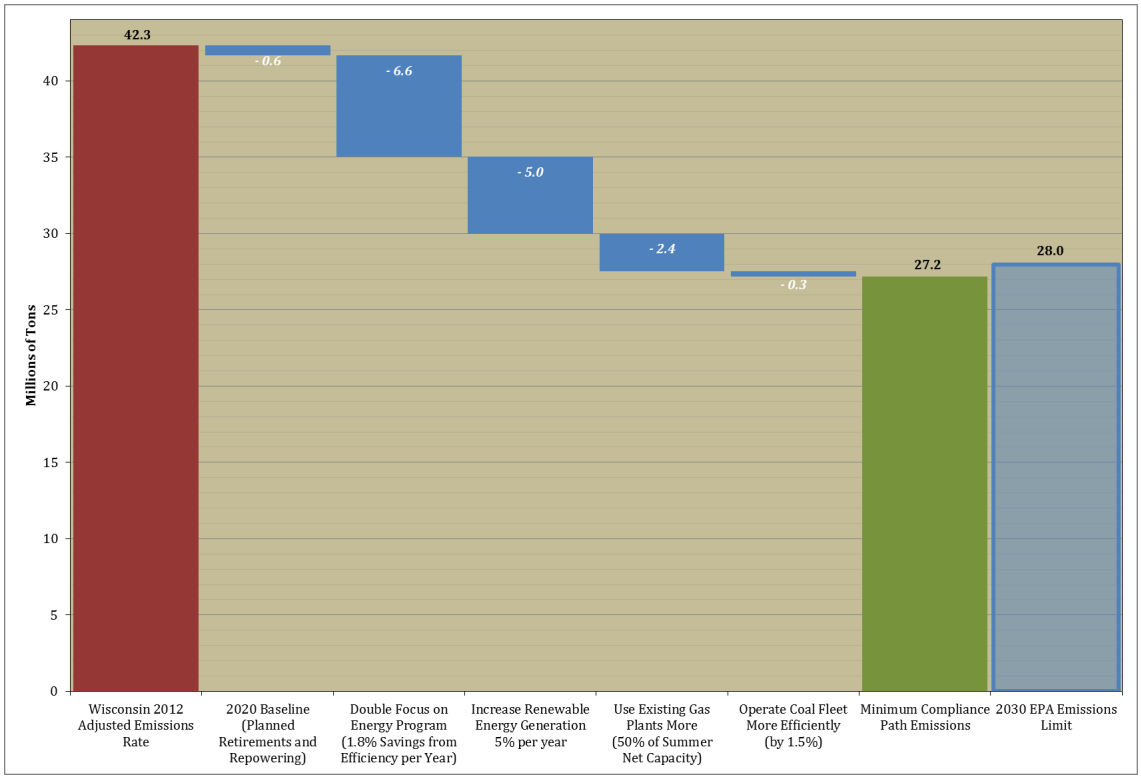

Figure 4: Emissions Reductions Steps, Achievement and Remaining Total Emissions in Wisconsin from Minimum Compliance Path A (millions of tons CO_2)

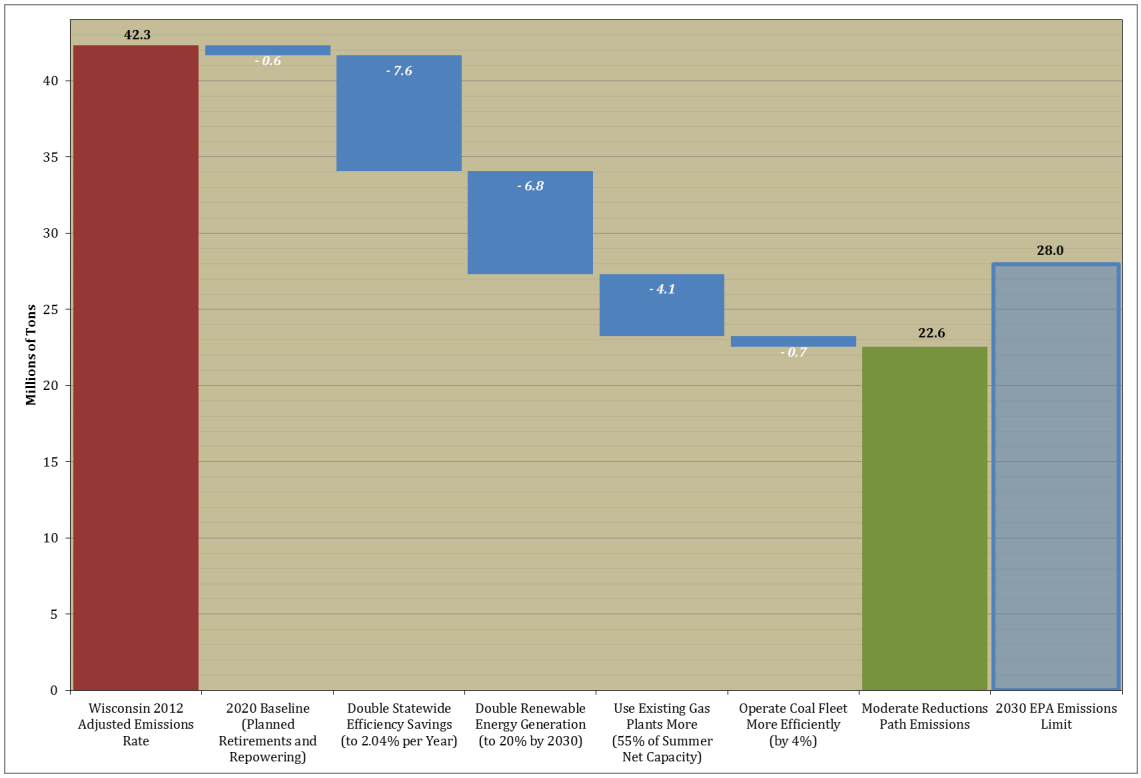

Figure 5: Emissions Reductions Steps, Achievement and Remaining Total Emissions in Wisconsin from Moderate Reductions Path B (millions of tons CO_2)

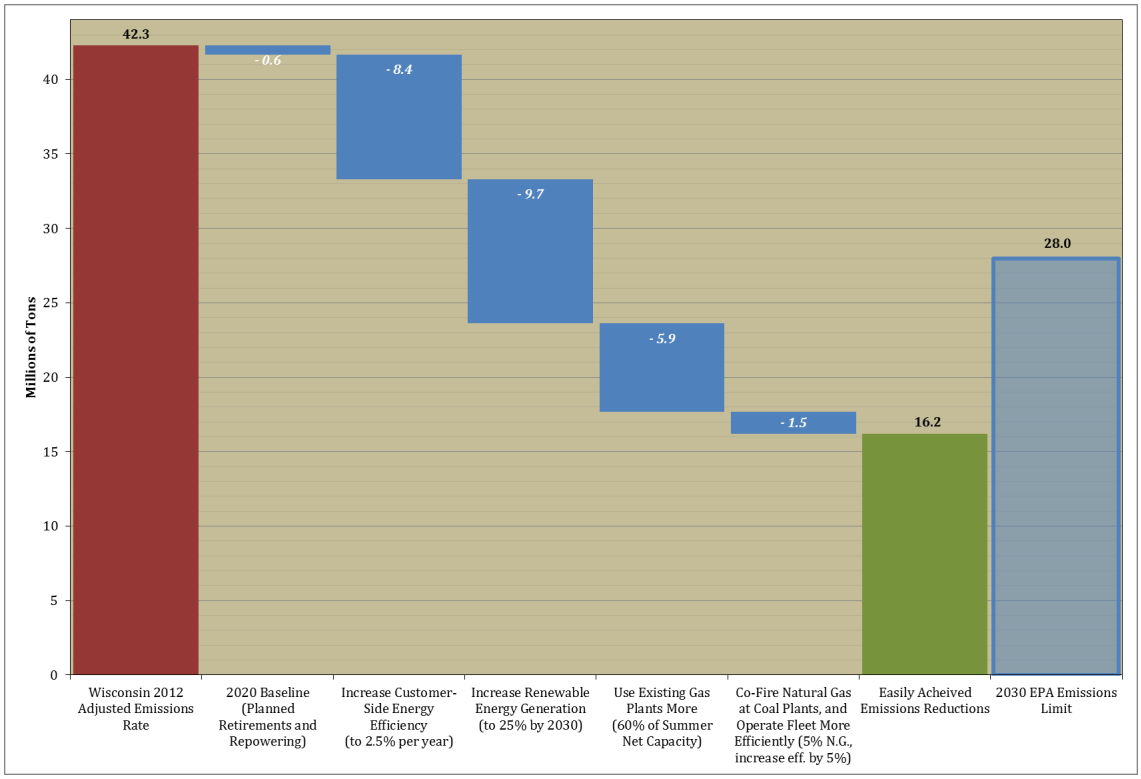

Figure 6: Emissions Reductions Steps, Achievement, and Remaining Total Emissions in Wisconsin from Easily Achievable Savings Path C (millions of tons CO_2)

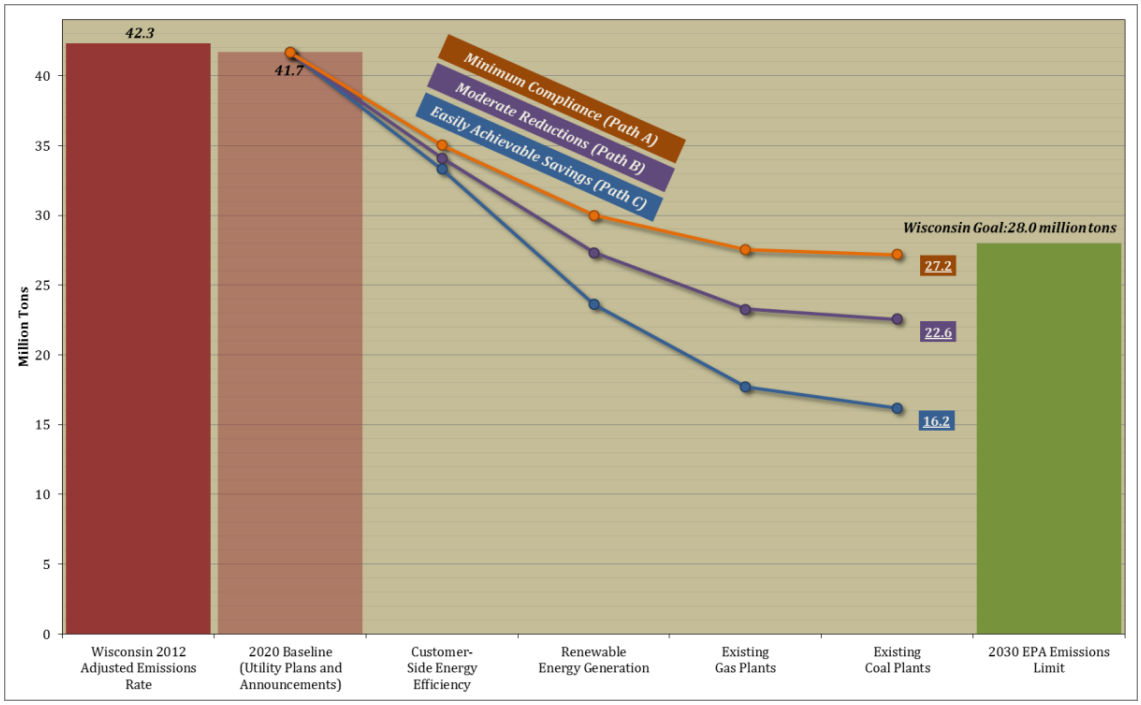

Figure 7: Comparison of Emissions Reductions and Remaining Total Emissions in Wisconsin from Clean Power Plan Compliance Paths A, B, C (millions of tons CO_2)

In conjunction with the emissions reductions achieved by each path, an economic analysis was conducted that considered the potential cost of following each compliance path. That analysis considered the potential costs associated with each emissions-reduction measure, along with potential cost savings from reduced fuel use and the sales of emissions credits. Each path was found to represent a cost-effective option to meet electricity demands while reducing emissions in Wisconsin.[26] In fact, the analysis shows following Minimum Compliance Path A or Moderate Reductions Path B would cost the state less money compared to doing nothing at all (that is, not complying with the Clean Power Plan), saving Wisconsin $55.4 million or $11.3 million per year, respectively. The larger emissions reductions of Easily Achievable Savings Path C would amount to a 1.25% increase in total costs by 2030.

Table IX: Estimated Costs of Paths A, B, C for Compliance with the Clean Power Plan in Wisconsin

Costs of Compliance with the Clean Power Plan in Wisconsin			
	Path A: Minimum Compliance	**Path B: Moderate Reductions**	**Path C: Easily Achievable Savings**
Increase in Energy Efficiency	$117.6 million	$140.9 million	$160.5 million
Increase in Renewable Energy	$227.6 million	$305.6 million	$437.5 million
Increased Use of Natural Gas	$145.8 million	$233.7 million	$390.6 million
Reduced Fuel Use and Emissions Credits	*-$546.3 million*	*-$691.6 million*	*-$893.3 million*
Net Costs	***-$55.4 million***	***-$11.3 million***	**$95.3 million**
As percent of total estimated costs	*-0.73%*	*-0.15%*	1.25%

In addition to showing that a path based on energy efficiency is easy and cost-effective, our analysis revealed how much more difficult it would be to limit Wisconsin's carbon pollution without relying on efficiency. For example, compared to Minimum Compliance Path A which just meets the requirements of the Clean Power Plan, a path without increased current efficiency efforts would require more use of natural gas plants (65% of summer capacity, instead of 50%) and cost the state $203.7 million more than the status quo. (By comparison, Path A costs $55.4 million less). If Wisconsin didn't use efficiency at all, it would need to use more renewable energy (20% by 2030), in addition to even more natural gas (70% summer capacity) to comply and at an added cost of $304.2 million. Similarly, if the state were to choose a compliance plan that relied on the addition of new nuclear power plants, the costs are expected to be much higher. For example, the most recent cost estimate to construct two AP1000 reactors at the Vogtle Electric Generating Plant in Georgia is $14 billion.[27]

WHAT IT MEANS FOR WISCONSIN

Health in Wisconsin

Climate change is already affecting Wisconsin, with the average temperature up more than a 1 degree Fahrenheit (°F) over the past century, and 2.5 °F in Northern Wisconsin.[28] The state is also seeing earlier spring seasons and different patterns of rain and water flow compared to years past. Unfortunately, the latest scientific projections show even more changes in the future, with temperatures that may be as much as 9 °F higher by 2050.[29]

These increased temperatures, and the extreme weather patterns and changes in precipitation and water levels that come along with them, will greatly impact the health and wellbeing of Wisconsinites. Some of

[26] *See Appendix B for economic calculation details*
[27] *Rob Pavey,* The Augusta Chronicle, *"Price of Vogtle expansion could increase $900 million.". May 11, 2012.*
[28] *Wisconsin Initiative on Climate Change Impacts. "Wisconsin's Changing Climate: Impacts and Adaptation." 2011.*
[29] Ibid.

the possible impacts include the spread of disease-carrying pests like ticks and mosquitos, more deadly heat waves, more and worse cases of both droughts and flooding, and worse air quality.[30] The Clean Power Plan will help to lessen some of these impacts in Wisconsin by reducing the greenhouse gases that cause climate change.

In addition, the Clean Power Plan will also have immediate health benefits by reducing the amount of other pollution released into the air alongside carbon, especially from coal power plants, including sulfur dioxide, nitrogen oxides, and particulate matter. These pollutants and the secondary pollutants they can create in the air, such as fine particulate matter and ozone (the primary constituent of smog), are responsible for hundreds of premature deaths in the state each year.[31] They also cause health problems that severely impact wellbeing in the state. For example, more than one in 10 adults and children in Wisconsin has been diagnosed with asthma, with more identified each year.[32] Air pollution like ozone makes asthma problems worse and contributes to the asthma attacks and problems that reduce the quality of life for these residents, as well as the nearly 20,000 emergency department visits in Wisconsin related to asthma each year.[33]

Electricity Bills in Wisconsin

In addition to the health benefits of the Clean Power Plan, properly planned compliance pathways have the potential to save money for Wisconsin families and businesses. This is because the best and easiest way to cut carbon emissions is to reduce the amount of electricity used in the state, whether by using less energy through energy conservation measures like turning off lights, or through a wide range of energy efficiency practices, such as replacing old light bulbs with more efficient ones. The EPA's modeling shows that while the changes needed in how electricity is generated may cause an increase in average Wisconsin electricity prices by 2030, reductions in total electricity use will result in a net 5% reduction in *total electricity costs* annually in the state by the time the final limits are in place in 2030. Our analysis similarly showed savings for Paths A and B, with a small net cost for Path C.

Wisconsin's Economy

Beyond the health and welfare benefits, the Clean Power Plan can have very clear and direct benefits to Wisconsin's economy. Every year, the state sends over $14 billion out of state to import fossil fuels.[34] This includes over $1 billion spent to import 25 million tons of coal annually.[35] The Clean Power Plan will help us move down a path to cut that spending and keep those energy dollars flowing in Wisconsin instead. In addition, energy efficiency not only saves money on the energy bills of families and businesses, a 2013 study found that the Focus on Energy program enhanced the overall state economy by over $7 for every $1 invested in 2012.[36] Similarly, the Union of Concerned Scientists projected that an increase in renewable energy generation to 25% by 2025 would add more than 2,500 jobs in the state.[37] Far from dragging it down, Wisconsin's economy could be boosted by the right compliance path for the Clean Power Plan.

Far from dragging it down, Wisconsin's economy could be boosted by the right compliance path for the Clean Power Plan.

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[30] Ibid.
[31] *F Caiazzo et al.,* Atmospheric Environment*, "Air pollution and early deaths in the United States. Part I: Quantifying the impact of major sectors in 2005. 79 (2013) 198-208.*
[32] *Wisconsin Department of Health Services, Division of Public Health, Bureau of Environmental and Occupational Health. "The Burden of Asthma in Wisconsin 2013." P-45055-2013 (Rev 05/2013).*
[33] Ibid.
[34] *Based on an average of most recent five years with available data (2008-2012) from Wisconsin State Energy Office. "2013 Wisconsin Energy Statistics Book." 2013.*
[35] Ibid.
[36] *The Cadmus Group, Inc. "Focus on Energy Calendar Year 2012 Economic Impacts Report." November, 2013.*
[37] *Union of Concerned Scientists. "Raising the Bar in Wisconsin." 2010.*

THE PATH AHEAD

The Clean Power Plan was finalized on August 3, 2015; it was then published in the Federal Register on October 23, starting a 60-day period in which it could be legally challenged. As of December 2015, 27 states[38] and a number of industry and other special interest trade groups have challenged the regulation in lawsuits that have been consolidated into a single case.[39] Eighteen states and many other interests, including environmental groups, have filed motions in support of EPA, meaning that only five states are not involved in the legal proceedings that will be ruled on by a three-judge panel at the D.C. Circuit Court of Appeals.

Unless a stay is granted by the Court while considering the case however, the Clean Power Plan will remain in effect under a timeline that provides states until September 6, 2016 to submit initial compliance plans to EPA. While states also have the option to ask the EPA for a two-year extension to 2018 if a few criteria are met, this timeline is such that states on both sides of the legal debate have recognized the need to start planning sooner rather than later. Many also appreciate that the additional credit for early action under the Clean Energy Incentive Program (CEIP) only applies to measures begun after states have submitted a final compliance plan, and that there are a limited number of credits available to all states through the CEIP, on a first-come first-served basis. This results in a clear a "first-mover" advantage, and as a result, many states have begun stakeholder processes that will help in drafting compliance plans even while actively participating in legal action.

Even more importantly, as this analysis shows, different compliance pathways will have significantly different costs. There are many forms of energy efficiency programs that could be used by states for compliance that would have the effect of reducing the cost of the plan for ratepayers. The details of what it will take for a state to get "credit" for any of those energy efficiency programs under rate- or mass-based approaches are not simple and will certainly take significant time and stakeholder engagement to work through.

States that do not submit initial or final plans in 2016 will be subject to a federal compliance plan developed by EPA. If the Clean Power Plan stays in place as it is written, affected electrical generation units will have to start reducing emissions toward the interim compliance goals by 2022, and meet the final goals by 2030. States will be required to report to and demonstrate compliance by July 1, 2025; July 1, 2028; and every two years thereafter.

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[38] *Alabama, Arizona, Arkansas, Colorado, Florida, Georgia, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Montana, Nebraska, New Jersey, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Texas, Utah, West Virginia, Wisconsin and Wyoming.*

[39] *A Childers,* Bloomberg BNA, *"Past Administrators Join EPA in Power Plant Lawsuit." December 4, 2015. Online at http://www.bna.com/past-administrators-join-n57982064344/; E&E Publishing, LLC,* E&E Power Plan Hub, *"Legal Challenges -- Overview & Documents." Online at http://www.eenews.net/interactive/clean_power_plan/fact_sheets/legal*

APPENDIX A: CALCULATION OF COMPLIANCE PATHWAY EMISSIONS

The calculation of emissions associated with each proposed compliance pathway began with the data that EPA used and provided for calculating emissions limits from the Clean Power Plan (eGRID – Emissions & Generation Resource Integrated Database – 2012 data). EPA's estimated electricity demand in Wisconsin (42.4 TWh in 2020, increasing to 44.25 TWh by 2030), was assumed to be met by some combination of generation and efficiency. Specifically, the steps of each compliance path were applied to the 2012 in the following order:

1. **Adjust for Planned Retirement and Repowering**
   2012 eGRID data was updated to reflect coal plant retirement or repowering projects that have been announced to date by utilities. Retired plants were assumed to contribute no generation or emissions; repowered plants were assumed to reflect the system-average NGCC emissions rates and capacity factors of other natural gas plants (see Step 4).

Table A.I: Net Summer Capacity (MW) of Wisconsin Generation Facilities

	Baseline (2012)	After Announced Retirements & Repowering
Coal	8,046.0 MW	6,562.0 MW
Natural Gas Combined Cycle	2,618.2 MW	2,957.1 MW
Other	100.1 MW	100.1 MW
Total	*10,764.*3 MW	*9,619.*2 MW

2. **Account for Energy Efficiency**
   The annual electricity demand (e.g. 42.4 TWh in 2020) was reduced by energy efficiency savings. Annual incremental electricity savings were calculated as a percentage of total demand (2012 incremental EE achievement is calculated by EPA to be 1.02% per year statewide;[40] 0.77% of this is assumed to come from Focus on Energy,[41] with the remaining 0.25% from other efforts). Cumulative savings were then calculated over time for measures starting in 2018, when the final compliance plan is due. The conservative methodology employed by EPA (assuming 10-year average measure life with linear reduction over time; see
   Figure A.1) was used, with cumulative savings for each year subtracted from the electricity demand for the year.
   a. *Path A: 1.79% incremental annual savings; 2.16 TWh (5.1%) cumulative savings in 2020, 7.06 TWh (16.0%) in 2030*
   b. *Path B: 2.04% incremental annual savings; 2.47 TWh (5.1%) cumulative savings in 2020, 8.05 TWh (18.2%) in 2030*
   c. *Path C: 2.5% incremental annual savings; 2.72 TWh (6.4%) cumulative savings in 2020, 8.88 TWh (20.1%) in 2030*

[40] *U.S. Environmental Protection Agency, "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." August 3, 2015. Docket ID No. EPA-HQ-OAR-2013-0602*

[41] *American Council for an Energy Efficiency Economy.* State and Local Policy Database, *"Wisconsin." Online at http://database.aceee.org/state/wisconsin*

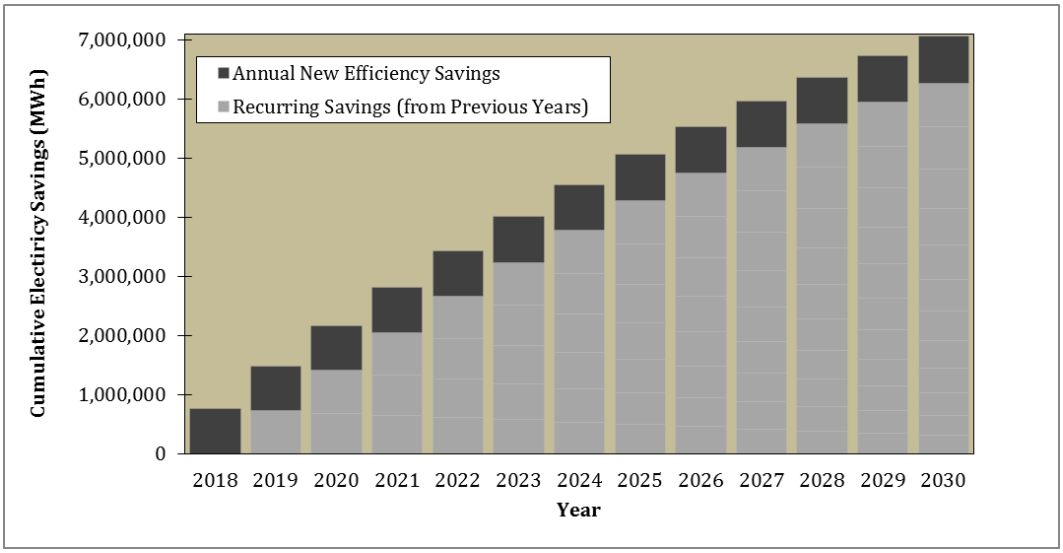

Figure A.1: Example Cumulative Savings from Energy Efficiency (Path A)

3. Increase Renewable Energy

Electricity generated from renewable emissions-free sources was increased from the baseline (the amount provided by Wisconsin utilities to meet their RPS obligations in 2012; 6.05 TWh). Although new renewable energy facilities installed in 2013 or after can be used to help meet the Clean Power Plan, a conservative assumption was made that none would be installed until after the final compliance plan is due in 2018. The incremental increase over the baseline was then assumed to meet the total generation need.

Starting in 2018, renewable energy facilities were assumed to be installed either at a factor of 1.05 increase per year starting from the baseline (Path A), or to 20% of retail electricity sales by 2030 (Path B) or 25% of retail electricity sales by 2030 (Path C). Total state electricity sales were assumed to increase at the rate estimated by EPA starting from 2012 levels (68.8 TWh/ year), less cumulative energy efficiency savings.

a. *Pathway A: increase renewable energy by factor of 1.05 per year from baseline (6.05 TWh), starting in 2018; total of 10.41 TWh by 2030; 10.41 – 6.05 = 5.36 TWh of new renewable generation.*
b. *Pathway B: increase renewable energy to 20% of sales by 2030, starting in 2018; total of 10.41 TWh by 2030; 10.41 – 6.05 = 7.2 TWh of new renewable generation.*
c. *Pathway C: increase renewable energy to 25% of sales by 2030, starting in 2018; total of 16.35 TWh by 2030; 16.35 – 6.05 = 10.3 TWh of new renewable generation.*

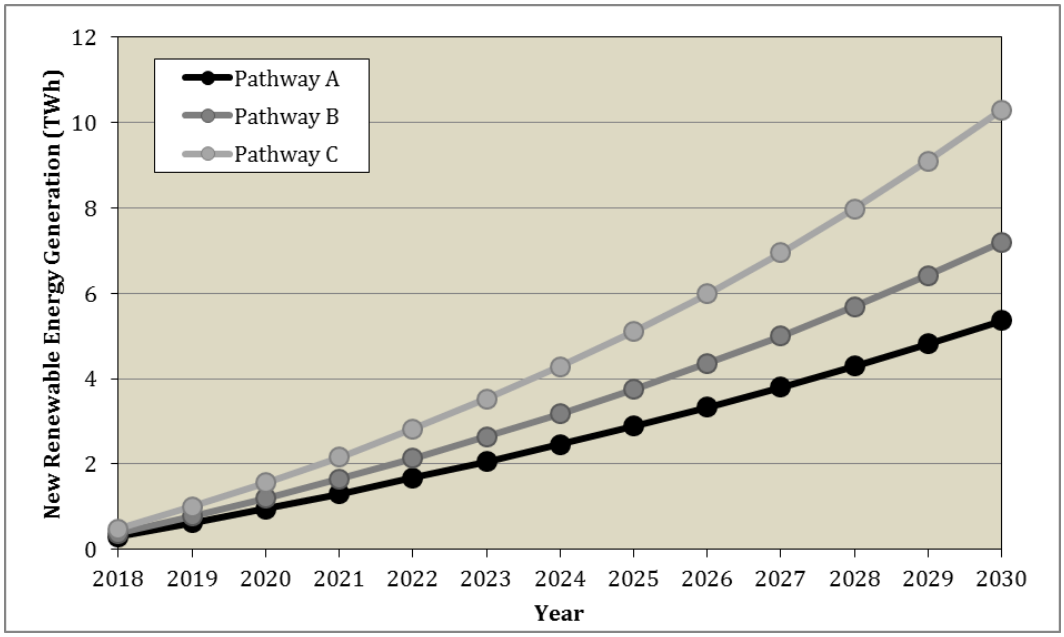

Figure A.2: Added Renewable Energy over Time (beyond 2012 baseline of 6.05 TWh)

4. **Increase Use of Natural Gas Combined Cycle Plants** Natural Gas Combined Cycle plants, including repowered coal plants, were assumed to ramp up production to 50, 55, or 60% of net summer capacity (for Pathway A, B, and C respectively).

Table A.II: Generation from Wisconsin Natural Gas Combined Cycle Facilities

	Net Summer Capacity (MW)	Capacity Factor	Annual Generation (GWh)
Baseline (2012)	*2,618*	*45%*	*10,244*
Minimum Compliance Path A	2,957	50%	12,952
Moderate Reductions Path B	2,957	55%	14,247
Easily Achievable Savings Path C	2,957	60%	15,543
EPA Building Block 2	2,618	75%	*17,202**

**EPA goals were calculated using capacity and capacity factors at an interconnect, not state, level*

5. **Increase Efficiency of Remaining Coal Fleet**
Emissions from the remaining (not retired or repowered) coal fleet were reduced to account for more efficient operation of the fleet as a whole (e.g. through increased dispatch of more efficient units). Increases in efficiency were assumed to result in reduced average CO_2 emissions/ MWh from coal plants of 1.5%, 4%, and 5% for Paths A, B, and C respectively. Additionally, in Path C, emissions were further reduced to reflect an average of 5% generation at coal plants coming from the co-firing natural gas (using fleet average emissions for natural gas generation).

The remaining demand after applying the previous steps was allocated to coal generation, thereby determining the final generation mix.

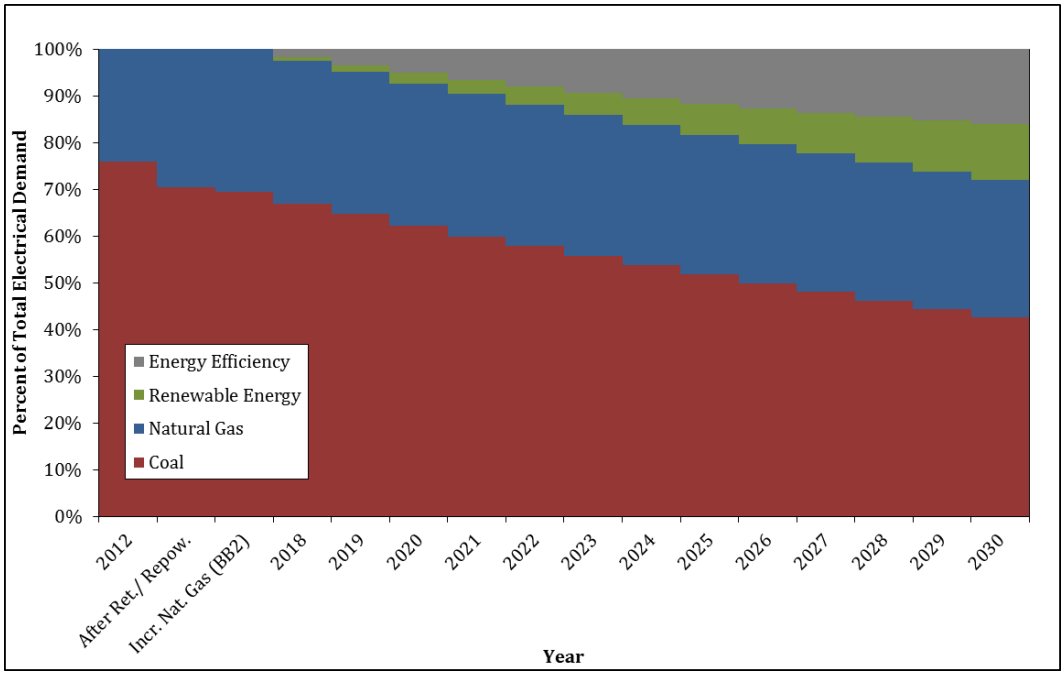

Figure A.3: Example Energy Generation Mix (Path A)

6. Calculate Total Emissions

Total emissions from generation at large fossil fuel plant operations in the state were calculated for each pathway, and compared to EPA goals.

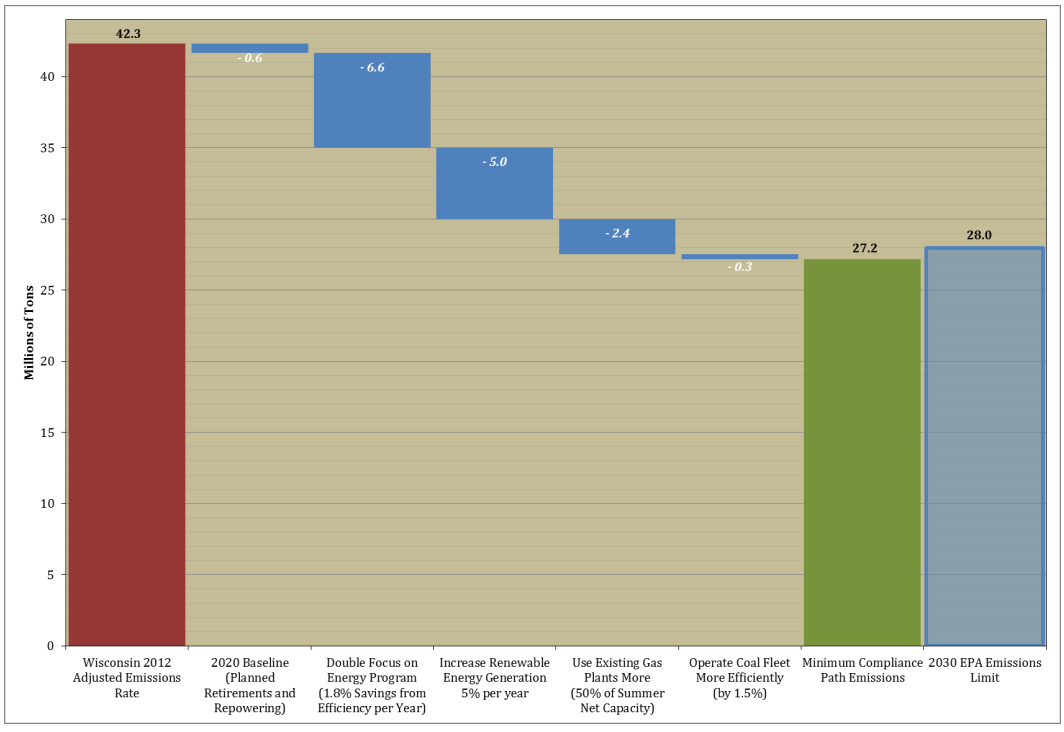

Figure A.4: Emissions Reductions Steps, Achievement, and Remaining Total Emissions in Wisconsin from Clean Power Plan Compliance Path A (millions of tons CO_2)

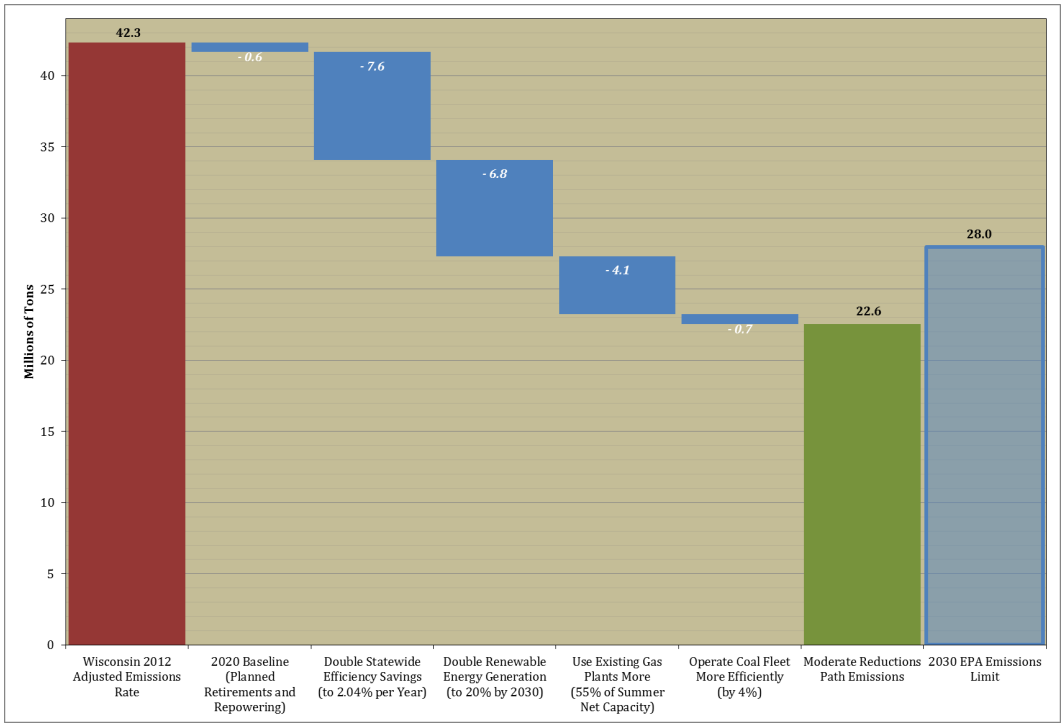

Figure A.5: Emissions Reductions Steps, Achievement, and Remaining Total Emissions in Wisconsin from Clean Power Plan Compliance Path B (millions of tons CO_2)

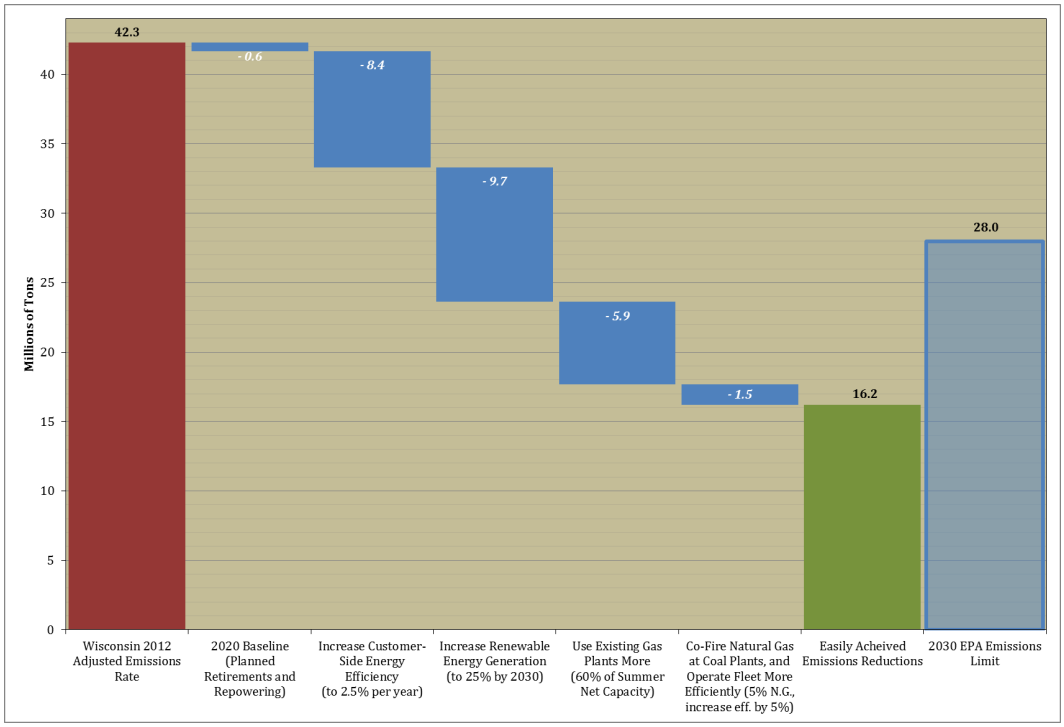

Figure A.6: Emissions Reductions Steps, Achievement, and Remaining Total Emissions in Wisconsin from Clean Power Plan Compliance Path C (millions of tons CO_2)

APPENDIX B: CALCULATION OF COMPLIANCE PATHWAY COSTS

The costs associated with each proposed compliance pathway were calculated on an annual basis for each step as follows:

1. **Coal Plant Retirement or Repowering**
   The announced retirement and repower of coal plants has no net cost attributable to the compliance pathways (the announcements were all made prior to, and for different reasons than, the Clean Power Plan).

2. **Increasing Energy Efficiency**
   While current efficiency efforts can be used to help meet the requirements of Clean Power Plan, those current efforts have no costs attributable to the compliance pathways (like the announced retirement and repower of coal plants those efforts were active prior to, and for different reasons than, the Clean Power Plan). The expense of increased energy efficiency savings above and beyond current efforts was calculated assuming similar costs to the current Focus on Energy program. In particular, the incremental costs associated with energy efficiency efforts from the 2014 calendar year were used (total non-incentive costs, including administrative and delivery costs).[42] Assuming electricity and natural gas cost-benefit ratios were similar, costs for Focus on Energy were proportionally distributed. The added costs for energy efficiency associated with each pathway were then calculated:

   a. *Path A: Additional $117.6 million annually to double electricity proportion of Focus on Energy*
   b. *Path B: Additional $140.9 million (doubling of electricity proportion of Focus on Energy, plus additional 110,625 MWh saved annually at same incremental cost of $211/MWh)*
   c. *Path C: Additional $160.5 million (doubling of electricity proportion of Focus on Energy, plus additional 203,550 MWh saved annually at same incremental cost of $211/MWh)*

3. **Increasing Renewable Energy**
   Although new renewable energy facilities installed in 2013 or after can be used to help meet the Clean Power Plan, generation from renewable energy facilities built in 2012 or before cannot be used for compliance. As a result, and since the conservative assumption was made that no new renewable energy projects would be completed in Wisconsin until 2018, unlike for energy efficiency all renewable energy generation used in the compliance pathways had an associated cost. That cost was assumed to be the same as the cost of renewable energy secured annually for compliance with Wisconsin's renewable electricity standard in 2012.[43] This is a conservative assumption, because renewable energy prices have been rapidly decreasing, and are projected to decrease in the future particularly as more renewable energy technology is installed in the lead-up to the Clean Power Plan increases economies of scale.[44] The cost of incremental MWh of renewable energy generated annually under each pathway was then calculated.

   a. *Path A: Additional $227.6 million to increase generation from renewable energy by factor of 1.05 per year*
   b. *Path B: Additional $305.6 million to increase generation from renewable energy to 20% of total retail sales annually by 2030*
   c. *Path C: Additional $437.5 million to increase generation from renewable energy to 25% of total retail sales annually by 2030*

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[42] *The Cadmus Group, Inc. "Focus on Energy Calendar Year 2014 Evaluation Report." May 2015.*
[43] *Public Service Commission of Wisconsin, "Report on the Rate and Revenue Impacts of the Wisconsin Renewable Portfolio Standard." July 1, 2014. Docket 5-GF-245.*
[44] *Indeed, whereas the 2012 cost assumed here is $42.48/MWh, the costs paid on 13 power purchase agreements for wind generated in Interior states in 2014 averaged less than $25/MWh (for Great Lakes states, the cost was roughly $35/MWh). From U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "2014 Wind Technologies Market Report." August 2-15.*

4. Increasing Natural Gas Generation

The increased cost of generation from natural gas was based on EPA modeled differences in fuel costs between natural gas and coal. In particular, delivered fuel costs to electric power sector (in $/MMBtu) were used, from the EPA's modeling of Clean Power Plan implementation. The energy generated from coal for each compliance pathway was multiplied by the average heat rate (in MMBtu/ MWh) from coal units in 2012 that are not announced to be retiring or repowering, and similar for natural gas combined cycle units. The required fuel input thus derived was then multiplied by the delivered fuel prices, and the difference taken between that total cost and a corresponding cost of fuel for a scenario where natural gas use was not increased.

a. *Path A: Additional $145.8 million in fuel costs to increase overall use of natural gas combined cycle plants to 50% of net summer capacity.*
b. *Path B: Additional $233.7 million in fuel costs to increase overall use of natural gas combined cycle plants to 55% of net summer capacity.*
c. *Path C: Additional $390.6 million in fuel costs to increase overall use of natural gas combined cycle plants to 60% of net summer capacity, plus 5% of total generation at coal plants (e.g. through co-firing).*

5. Increased Coal Fleet Efficiency

It is anticipated that the more efficient coal plants will have increased dispatch as the amount of generation from coal plants decreases due to increased energy efficiency, renewable energy, and natural gas generation in the future. Additional economic and other factors are also already at play that are further expected to result in a more efficient dispatch of the existing coal fleet. Thus, it is assumed that there will be no additional cost to increased coal generation efficiency.

6. Savings from Reduced Fuel Use and Sales of Emissions Credits

The fuel cost savings associated with each compliance path were calculated by first determining the fuel costs of a "business as usual" scenario, where announced retirements and repowering had taken place, but additional energy efficiency and renewable energy steps had not been taken. The increased fuel cost from increased natural gas generation was then added to that cost scenario, to arrive at a full hypothetical cost of generation without any fuel saving measures (energy efficiency and renewable energy). The savings from reduced fuel use were calculated as the difference between that hypothetical cost and the total fuel costs calculated with all steps taken for each compliance pathway. Additionally, to the extent that compliance pathways resulted in excess emissions reductions, those reductions were valued at the rate of the most recently available annual average per-ton costs of CO_2 allowances in the Regional Greenhouse Gas Initiative (2014).[45]

a. *Path A: $542.6 million in saved fuel costs due to energy efficiency and renewable energy generation, $3.7 million in saleable emissions reductions*
b. *Path B: $666.0 million in saved fuel costs due to energy efficiency and renewable energy generation, $25.6 million in saleable emissions reductions*
c. *Path C: $837.8 million in saved fuel costs due to energy efficiency and renewable energy generation, $55.5 million in saleable emissions reductions*

[45] *Potomac Economics, "Annual Report on the Market for RGGI CO2 Allowances: 2014." May 2015.*

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