

Progress on Hold

**The Freeze on Ohio's Clean Energy Law
Could Mean Big Costs and Dirtier Air**



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Executive Summary

Ohio's Clean Energy Law, passed in 2008, put Ohio on the fast track toward more clean energy and more energy efficiency – boosting the economy and providing big electricity bill savings for consumers. The law set requirements for energy efficiency and renewable energy for each of the state's four investor-owned utilities (IOUs), led to the launch of creative programs to update old technologies with new energy-saving devices, set Ohioans up for long-term energy savings, and helped Ohio transition away from its reliance on dirty energy sources to a clean energy economy.

Over just six years, the Clean Energy Law made Ohio a national leader for clean energy manufacturing, while reducing carbon emissions and reducing energy waste. **Yet despite this record of success, in 2014, the Ohio Legislature and Gov. John Kasich watered down and stalled the law by passing Senate Bill 310 (SB 310), the clean energy freeze.**

SB 310 froze energy efficiency and renewable energy standards at their 2014 rates for two years, while crippling key provisions of the efficiency standard. Just days after the passage of SB 310, House Bill 483 was passed, which made new wind farms dramatically harder to develop.

Ohio has a great deal to lose from the freeze and rollback of the Clean Energy Law – and stands to lose even more if the law is permanently frozen or repealed. In just the second year of the freeze, according to this report's analysis, Ohioans will miss out on energy savings worth as much as \$218 million, while the state will produce up to an additional 3.7 million metric tons of carbon dioxide pollution. If the freeze is left in place, the costs will rise, leading potentially to an extra 27.7 million metric tons of carbon dioxide emissions in 2025.

Ohio officials should move quickly to reinstate Clean Energy Law programs and otherwise support the growth of clean energy in Ohio. Restoring the Clean Energy Law will reduce pollution, save Ohioans money, and grow the economy. It will also help bring Ohio into compliance with the Environmental Protection Agency's draft Clean Power Plan, which calls for Ohio to reduce carbon emissions from electric power plants by 28 percent by 2030.

The Clean Energy Law has delivered economic and environmental benefits to Ohio.

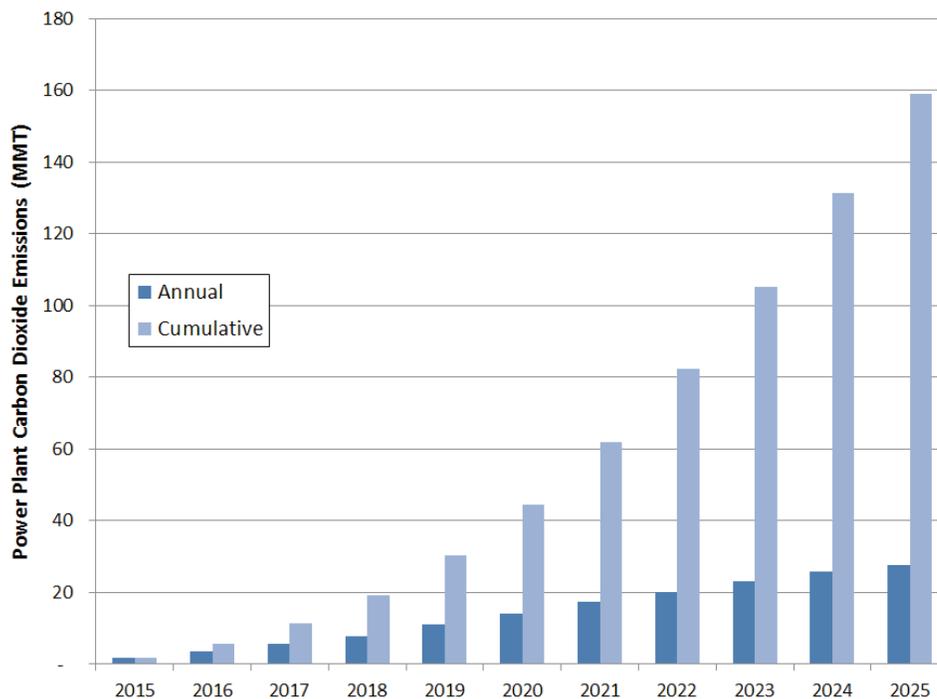
- According to a study by Ohio State University and the Advanced Energy Economy Ohio Institute, the law has already reduced Ohioans' energy bills by 1.4 percent and stimulated \$160 million in economic activity.

- The same study found that without the law, Ohio would have emitted an extra 4.3 million metric tons of carbon dioxide in 2012, equivalent to putting nearly 900,000 vehicles on the road for a year.
- Ohio now leads the nation in wind manufacturing, with more than 60 facilities. And according to the Solar Energy Industries Association, \$72 million was invested in Ohio for solar power installations in 2013. One state-commissioned study found that Ohio's alternative energy economy accounted for more than 31,000 jobs in 2012.
- In 2013, Clean Energy Law energy efficiency programs saved more than 6,000 gigawatt-hours of electricity, enough to power more than one in 10 Ohio homes.
- The Clean Energy Law has helped drive the installation of 432 MW of wind energy capacity, which would generate enough electricity to power 100,000 homes.

The clean energy freeze could reverse Ohio's recent growth in renewable energy, while almost completely erasing Ohioans' opportunities to save energy – and money – through energy efficiency programs. According to the analysis in this report, the freeze will bring significant costs to Ohio consumers and the environment. And under a scenario in which the freeze is extended through 2025, those costs would grow dramatically:

- In just the second year of the freeze, in 2016, Ohioans will miss out on more than 1,900 GWh of energy efficiency savings, and 2,600 GWh of additional renewable energy, leading to an extra 3.7 million metric tons of carbon dioxide emissions.
- If the freeze is extended through 2025, stagnant growth of renewable energy and energy efficiency could mean an extra 27.7 million metric tons of carbon dioxide in that year alone, and an extra 159 million metric tons of carbon dioxide emitted cumulatively between 2015 and 2025.

Figure ES 1. Through 2025, Ohio Could Miss Out on Reducing Carbon Dioxide Pollution by 159 Million Metric Tons



- If the freeze on renewables is extended to 2025, Ohioans could miss out on the generation of enough clean, renewable energy to power more than 1 million typical Ohio homes, as well as the installation of more than 38,000 solar roofs across the state.
- If the freeze on efficiency is extended to 2025, Ohioans could miss out on more than 17,500 GWh of energy efficiency savings in that year alone, electricity worth more than \$2.5 billion at today's rates.

Under a permanent freeze, Ohioans would miss out on big energy savings in every corner of the state.

- The Cleveland metropolitan area could miss out on 7,226 GWh of electricity savings by 2025. That much electricity costs \$841 million at today's rates.
- The Cincinnati metropolitan area could miss out on 4,026 GWh of electricity savings by 2025. That much electricity costs \$431 million at today's rates.
- The Dayton metropolitan area could miss out on 1,877 GWh of electricity savings by 2025. That much electricity costs \$251 million at today's rates.
- The Toledo metropolitan area could miss out on 1,185 GWh of electricity savings by 2025. That much electricity costs \$136 million at today's rates.

The rollback of the Clean Energy Law has already stalled Ohio's progress on clean energy. FirstEnergy

has announced the elimination of most of its programs to help consumers use energy more efficiently, while the solar energy market in the state has been "coming to a halt," according to one solar business owner.

These costs and missed opportunities are avoidable. To continue Ohio's progress toward a 21st century clean energy economy, the Energy Mandates Study Committee should recommend fully reinstating the clean energy standards passed in the original Clean Energy Law legislation (SB 221).

State leaders should:

- Restore Ohio's commitment to increased use of renewable energy and energy efficiency by restoring the clean energy policies originally passed in SB 221.
- Take clean energy to the next level by setting a goal of getting 25 percent of their energy from renewables by 2025, including three percent from solar energy.
- Expand the state's commitment to reducing wasted energy through measures that ensure the capture of all cost-effective energy efficiency.

In order to achieve the full benefits of clean energy, the Ohio EPA should also develop a robust State Implementation Plan to meet the U.S. EPA standards limiting global warming from power plants.

Introduction

The Melink Corporation, based in Milford, represents what's possible in a 21st century clean energy economy. Started in 1987 as a provider of HVAC commissioning services for national chains, today the company also manufactures energy-saving controls for commercial kitchen hoods and develops large-scale solar PV projects across the U.S.¹ In 2011, the company installed a 1.56 MW solar canopy at the Cincinnati Zoo & Botanical Garden that provides the zoo with 20 percent of its electricity needs.² In 2012 and 2013, the company installed solar PV modules for Urbana and Cedarville universities in Ohio that help those schools power 10-15 percent of their energy needs.³

The company has also integrated renewable energy into its own operations. In 2011, the company's headquarters went "net-zero energy," which means it generates enough solar and wind power on its campus to serve its needs on average over the course of each year.⁴ In 2011, the company won the Green Jobs Award from the Ohio Environmental Council by offering clean energy benefits (such as financial help for installing solar energy systems at home) to all of its employees in addition to traditional benefits.⁵

Following a decade in which there has been little good news for Ohio's economy, the success of clean energy firms like Melink – and the energy and monetary savings enjoyed by those who benefit from the services they provide – have been a rare bright spot. The state's Clean Energy Law, passed in 2008, has

played a major role in the growth of firms like Melink through policies that encourage Ohio homeowners and businesses to save energy and promote the growth of renewable energy that cleans our air and supports new economic activity.

Unfortunately, the state's clean energy industry is at risk, just at the moment when it is helping to invigorate Ohio's economy. Senate Bill 310, signed into law in June 2013, froze the Clean Energy Law's renewable energy standards for two years, and permanently weakened standards for energy efficiency and in-state development of renewable energy.⁶ House Bill 483, passed soon after, will make it more difficult to install wind turbines in Ohio. These laws create obstacles for companies like Melink that are building Ohio's clean energy economy.

For the past four years, Environment Ohio Research & Policy Center has documented the successes of the Clean Energy Law, tallying the energy saved and pollution avoided, and telling the stories of residents and businesses that are saving energy and money thanks to the law.

This report documents the benefits that Ohio will miss out on without its Clean Energy Law. By comparing a scenario in which the 2008 law is restored with a scenario in which the freeze is left in place, this report aims to provide an account of some of the costs, both to consumers and the environment, of the clean energy freeze.

As Steve Melink, CEO of Melink Corporation, said in a September 2014 article: “Indianapolis, a city just two hours away in driving time from Columbus and Cincinnati, is one of the largest markets for solar; and here in Ohio we’re saying, ‘Oh, we can’t do it.’ It shows, I think, that Ohio is heading backward.”⁷

It is not too late to get Ohio back on track. Instead of being number one in the nation for emissions of air

pollutants like sulfur dioxide from power plants, we can regain our reputation as a leader in wind and solar energy, as well as energy efficiency.⁸ By reinstating the Clean Energy Law and its renewable energy and energy efficiency standards, the state can avoid going back to the days of dirty air that threatened the health of residents and visitors and move toward a vibrant economy based on clean, renewable energy.

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A Halt in Progress towards a Clean Energy Future

In 2008, Ohio had one of the dirtiest energy sectors in the country. That year, coal power generated 85 percent of Ohio's electricity, while Ohio sent \$1.87 billion out of state to import coal – more than all but four other states in the country.⁹ Ohio's electric power sector ranked first in the nation for the emission of nitrogen oxides, a major component of smog, emitting 222,000 metric tons of those pollutants.¹⁰ And in 2009, Ohio's power plants emitted over 9,500 pounds of the toxic heavy metal mercury, the third most of any state.¹¹

Ohio's reliance on dirty energy created an opportunity for Ohio lawmakers: the chance to end Ohio's re-

liance on dirty and expensive coal, while boosting the economy and keeping more energy investment within the state. And they responded by passing the bipartisan Clean Energy Law, one of the strongest laws of its kind in the country.

SB 310, the Clean Energy Freeze, signed on June 13, 2014, threatens to halt or reverse the enormous progress made over the last five years. The freeze, if fully carried out or extended, will leave Ohio stuck with the dirty energy of its past, while halting a booming renewable energy sector in its tracks, and robbing consumers of energy efficiency and big electricity bill savings.

Photo: U.S. Dept. of Justice

Coal plant in Conesville, Ohio



In 2008, coal power generation helped give Ohio one of the dirtiest energy sectors in the country.

The Clean Energy Law Has Improved Ohio's Environment and Economy, and Lowered Electric Bills

When the Clean Energy Law passed in 2008, it was a dramatic step forward for Ohio, promising reduced emissions, more renewable energy and in-state jobs, and increased energy efficiency. The adoption of the law marked a break with Ohio's history of overreliance on dirty fossil fuels and represented a bold step toward a cleaner future.

Specifically, the law:

- Required Ohio's investor-owned utilities to obtain a gradually increasing amount of energy from renewable sources: 12.5 percent from renewables and half a percent from solar by 2025.
- Set strong energy efficiency goals. Through a gradual increase in incremental energy efficiency savings, the law was designed to build up toward a more than 22 percent reduction in electricity use by 2025, meaning big savings on electric bills for Ohio consumers.

- Ensured that clean energy was developed here in Ohio by requiring that half of all renewable energy had to be generated in-state. The in-state requirement assured that Ohio businesses and workers would have the opportunity to participate in the transition to a clean energy economy.

Over its five-year history, Ohio's 2008 Clean Energy Law has made Ohio a cleaner and more prosperous state. Without the law, Ohio would have emitted an extra 4.3 million metric tons of carbon dioxide in 2012, equivalent to putting nearly 900,000 vehicles on the road for a year.¹²

The Clean Energy Law Boosted Renewables and Created a Thriving Clean Energy Economy

The 2008 law's renewable portfolio standard helped drive the growth of renewable electricity generation, while creating a thriving clean energy economy. Over

the past five years, Ohio utilities have been almost entirely successful in meeting the renewable energy goals created by the Clean Energy Law. In 2012, the latest year for which full data are available, Ohio electricity providers generated 99.8 percent of their renewable energy goal, and beat their requirement for in-state solar generation.¹³

The Clean Energy Law spurred enormous growth in in-state renewable energy. Ohio now has 432 MW of wind capacity, with more than 420 MW added just since 2011.¹⁴ Ohio is also now home to 99 MW of solar capacity, which has been growing quickly with the aid of the Clean Energy Law's solar carve out.¹⁵ And in 2014, Ohio utilities and electricity providers generated or purchased more than 3 million MWh of renewable energy, including 157,000 MWh of solar energy.¹⁶

Increases in renewable generation have been accompanied by a booming clean energy sector. Ohio is now home to 62 wind-related manufacturing facilities, the most in the nation, as well as 202 solar companies.¹⁷ In 2013, \$72 million was spent in Ohio on solar energy installations for home, business, and utility use.¹⁸ And today, Ohio's alternative energy economy supports more than 31,000 jobs.¹⁹

As renewable energy surged in the United States, the Clean Energy Law positioned Ohio to become a leader in both the generation and manufacture of wind and solar power.

The Clean Energy Law Increased Energy Savings and Reduced Electric Bills

The 2008 law's energy efficiency standard has led to big energy savings, while saving Ohio consumers money. The standard was designed to gradually ramp up efficiency savings, and the law's cost-effectiveness provisions ensured that efficiency increases would

go hand in hand with decreased overall costs.²⁰ The standard led to the creation of programs like Dayton Power & Light's Residential Lighting Program, which offered big discounts on energy-efficient light bulbs.²¹ Another DP&L efficiency program, the Non-Residential Prescriptive Rebate Program, gave businesses rebates for replacing power-sapping equipment with energy-efficient equivalents.²²

From 2009 to 2012, energy efficiency programs like these reduced Ohio's overall electricity use by 2.6 percent.²³ According to a study by the Advanced Energy Economy Ohio Institute and the Center for Resilience at Ohio State University, as a result of increased energy efficiency Ohio consumers and businesses saw energy bill savings of 1.4 percent and \$190 million in 2012.²⁴ Efficiency programs have also helped businesses save money, and were used by big companies doing business in Ohio, like Honeywell and Honda.²⁵

Ohio's four investor-owned utilities have also successfully met their energy efficiency savings goals, and their cumulative annual energy savings of more than 6,000 GWh of electricity in 2013 is equivalent to 4.6 percent of all 2013 Ohio electricity sales, and is enough electricity to power more than 580,000 Ohio homes for a year.²⁶

Recent Legislation Devastated Ohio's Clean Energy Law

In the spring of 2014, at the behest of a lobbying campaign spearheaded by the utility FirstEnergy, the Ohio Legislature passed and Gov. John Kasich signed SB 310, now often called the clean energy freeze. The legislation rolled back key elements of the Clean Energy Law while halting all progress toward renewable energy and energy efficiency for two years (ostensibly so that the Ohio Legislature can study the law's effects). While the law has been referred to as a "freeze," many of the changes it made to the Clean Energy Law are permanent, including a watering down of energy efficiency standards. The freeze also ended the in-state requirement for renewable energy, which will hurt Ohio's renewable energy sector, and make the installation of wind turbines and solar panels in Ohio less financially viable.²⁷ SB 310 also created an Energy Mandates Study Committee to make recommendations on the future of Ohio's clean energy standard – and nine out of the 12 members eventually appointed to the committee voted in favor of the freeze.²⁸

The clean energy freeze isn't the only setback to Ohio's clean energy future. HB 483, signed just days after SB310, changed the laws regulating the locations of wind farms in Ohio. While wind turbines were previously required to be sited 1,125 feet (a bit less than a quarter mile) away from "the nearest, habitable residence," the new law requires them to be 1,125 feet away from the nearest property line, which "basically zones new wind projects out of Ohio," according to Eric Thumma, Director of Policy and Regulatory Affairs for Iberdrola Renewables, Inc., a wind energy company.²⁹ According to the American Wind Energy Association, this new wind power restriction will make it impossible to proceed with \$2.5 billion of wind projects currently under development.³⁰

If Ohio fails to overturn the freeze and fully reinstate Ohio's Clean Energy Law (along with other attacks on Ohio's clean energy sector), Ohioans will see damage to their environment, their energy bills, and the economy.

Key Damaging Provisions of the Clean Energy Freeze (SB310):

- Freezes Ohio's renewable portfolio standard through 2016.
- Freezes Ohio's energy efficiency standard through 2016.
- Permanently removes the requirement for in-state renewable generation.
- Permanently waters down the energy efficiency standard, and gives Ohio utilities credit for unearned efficiency savings.

The Freeze Could Halt the Growth of Renewable Energy in Ohio

The clean energy freeze has already hindered Ohio's progress as a clean energy leader and threatens further damage in the years to come. Among other setbacks, the freeze halts the rise in renewable and solar standards for 2015 and 2016, and permanently removes the in-state requirement for renewable energy generation.

Using utility distribution sales forecasts, this report estimates the renewable generation that Ohioans will miss out on in 2016 as a result of the clean energy freeze, as well as the amount Ohio could miss out on in 2025 if the clean energy freeze were to be made permanent.

In just the next two years, Ohio stands to lose out on significant renewable electricity generation. In 2015 and 2016, the Clean Energy Law's renewable standard was set to grow to 3.5 percent and 4.5 percent. With the freeze in place, the standard will remain at 2.5 percent, and Ohio will miss out on an additional 2,600 GWh of renewable generation in 2016, enough to power more than 245,000 Ohio homes for a year.³¹

Ohio will also miss out on continued expansion of solar energy. Under the Clean Energy Law, the solar energy requirement was due to rise to 0.18 percent of all electricity generation in 2016 (included in the renewable generation requirement). Under the freeze, it will be stuck at 0.12 percent, and Ohio will miss out on 79 GWh of solar generation in 2016, equivalent to more than 6,400 solar roofs statewide.³²

While the freeze delays renewable standards growth for just two years (along with permanently watering down the renewable requirement), language in the law reveals intent "to enact legislation in the future... that will reduce the mandates in section 4928.64 [the alternative energy section of the law]."³³ If growth of the renewable standard is stopped permanently, Ohio could see its transition to a clean energy economy slow to a crawl.

Under a scenario in which Ohio's renewable energy requirement remains permanently frozen at 2.5 percent, Ohio could miss out on more than 12,500 GWh of renewable electricity generation in 2025, enough to power more than 1 million Ohio homes for a year, or a quarter of all households in Ohio.³⁴ That year, Ohio could also miss out on more than 475 GWh of solar energy, equivalent to more than 38,000 solar roofs.³⁵ Ohio cities could also each miss out on significant solar electricity generation:

- The Cleveland metro area could miss out on solar generation equivalent to 12,354 solar roofs.
- The Cincinnati metro area could miss out on solar generation equivalent to 6,956 solar roofs.
- The Columbus metro area could miss out on solar generation equivalent to 3,471 solar roofs.
- The Dayton metro area could miss out on solar generation equivalent to 3,539 solar roofs.

- The Toledo metro area could miss out on solar generation equivalent to 1,988 solar roofs.

Figure 1 contains a map of solar roof equivalents missed by county. Under the 2008 law, half of all this renewable generation would have occurred in-state.

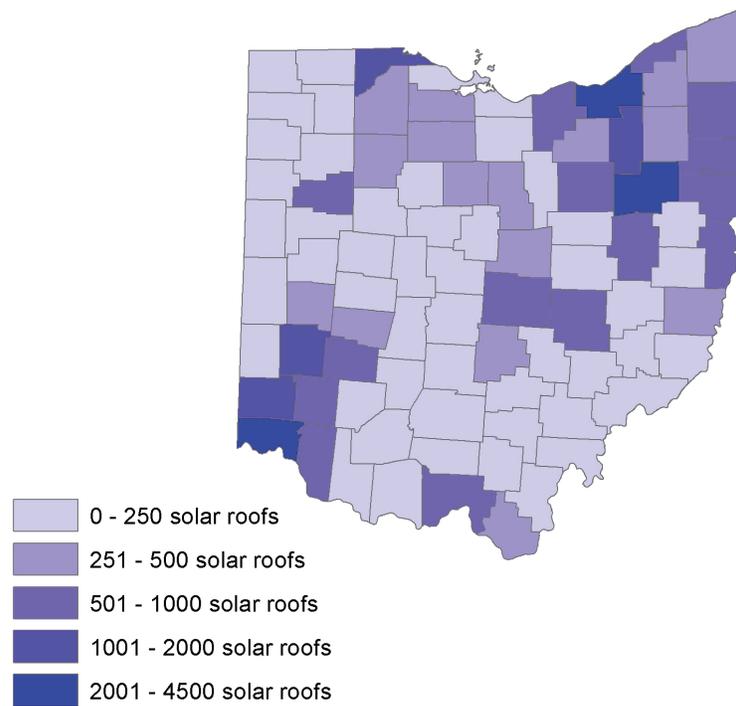
Before the freeze, utilities were required to generate or purchase half of their renewable energy credits in-state, ensuring the growth of renewable businesses in Ohio. For example, the Blue Creek Wind Farm in Van Wert and Paulding counties was originally going to be built in Indiana, but the passage of the Clean Energy Law caused the developers to change plans and build in Ohio.³⁶ The Blue Creek Wind Farm created more than 180 construction jobs, and brought a \$600 million investment to the state.³⁷ In 2013 alone, \$72 million was invested in Ohio for the installation of solar energy systems.³⁸

SB 310 sends Ohio’s clean energy economy backward. In 2012, Kent State University built a 1,716-panel solar

PV system. Bob Misbrener, project manager from Kent State’s Office of the University Architect, says that the clean energy freeze could “make it tougher for installations of new solar panels to be economically viable in the future” at the university.³⁹

It is important to note that with the price of renewable energy continuing to drop, even a permanent freeze of the clean energy law may not completely kill renewable energy in Ohio. In a few U.S. markets, wind and solar electricity generation is already cheaper than generation from conventional sources like coal and natural gas, and renewable energy will likely become increasingly cost-competitive in the years to come.⁴⁰ The clean energy freeze, however, will severely delay the emergence of renewable energy in Ohio, hindering the state’s ability to compete for renewable energy businesses, increasing pollution, and wasting a golden opportunity to ease compliance with standards such as the draft federal Clean Power Plan.

Figure 1. Lost Solar Roofs By County Under The Clean Energy Freeze in 2025⁴¹



Under the Freeze, Ohioans Will Miss Out on Big Energy Efficiency Savings

By freezing and watering down the energy efficiency requirements of the Clean Energy Law, SB 310 will stop energy efficiency savings across Ohio, and bring higher costs to Ohio consumers.

Because SB 310 froze energy efficiency standards at levels below what utilities have already achieved, Ohio utilities will not be required to make additional efficiency improvements in 2015 and 2016. Yet SB 310 went beyond merely freezing the standard; it also watered down critical energy efficiency provisions of the Clean Energy Law:

- The law now credits utilities for energy savings that they had nothing to do with – for example, energy efficiency savings that come under federal standards.⁴²
- Utilities can now retroactively get credit for these unearned savings that happened in past years.⁴³
- Large utility customers, including big industrial facilities, can now “opt out” of energy efficiency programs with little accountability.⁴⁴ According to the American Council for an Energy-Efficient Economy, this will “reduce total savings impacts, and raise rates for all consumers.”⁴⁵

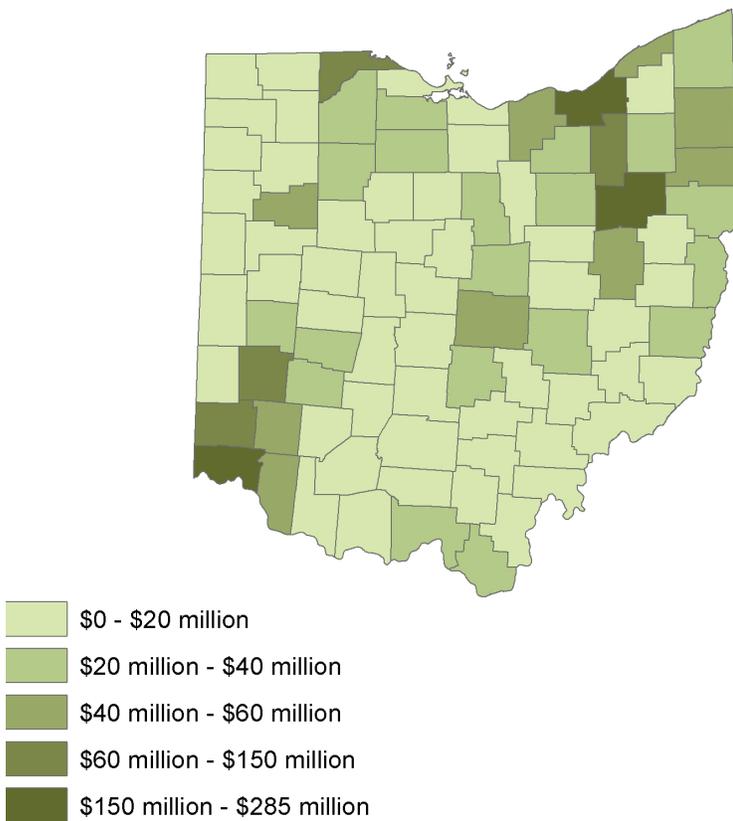
These new statutes could bring future growth in energy efficiency savings down to almost zero, even if the efficiency standards resume. According to the American Council for an Energy-Efficient Economy, the annual savings target is now turned “into a ‘ceiling,’ rather than a floor,” and “the effect of these weakening amendments could quite plausibly lead to a situation where a utility would not need to implement any actual customer end-use efficiency programs and still be in ‘compliance’ with the EERS [Energy Efficiency Resource Standard] through the end of this decade.”⁴⁶

The clean energy freeze has already damaged programs that help Ohio residents and businesses to save energy. Within two weeks of the law’s passage, FirstEnergy announced that it would be eliminating most of its energy efficiency programs for homeowners and businesses.⁴⁷

Frozen energy efficiency programs will hurt Ohio consumers:

- In the second year of the freeze, Ohioans will miss out on 1,900 GWh of guaranteed energy efficiency savings. That energy costs more than \$218 million at current Ohio electric rates.⁴⁸

Figure 2. Value of Missed Energy Efficiency Savings by County in 2025 Under Clean Energy Freeze



- If the legislature were to make the freeze permanent through 2025, the environmental and economic costs would rise dramatically. If the cumulative energy efficiency standard remained at 4.2 percent (versus the more than 22 percent mandated under the 2008 law), Ohioans would miss out on energy savings of 21,500 GWh in

2025, worth more than \$2.5 billion at today's electricity prices. That is enough to power more than 2 million Ohio households for a year, or 44 percent of all households in the state in 2012.

The effects of the clean energy freeze will be widespread across Ohio, and will cost consumers in Ohio's four biggest metro areas nearly \$2 billion in 2025:

- The Cleveland metropolitan area could miss out on 7,226 GWh of electricity savings in 2025 alone, worth \$841 million at current rates.⁴⁹ That is the equivalent of the annual electricity use of more than 670,000 typical Ohio homes.
- The Cincinnati metropolitan area could miss out on 4,026 GWh of electricity savings in 2025, worth \$431 million. That is the equivalent of the annual electricity use of more than 374,000 homes.
- The Columbus metropolitan area could miss out on 1,879 GWh of electricity savings in 2025, worth \$232 million. That is the equivalent of the annual electricity use of nearly 175,000 homes.
- The Dayton metropolitan area could miss out on 1,877 GWh of electricity savings in 2025, worth \$251 million. That is the equivalent of the annual electricity use of nearly 175,000 homes.
- The Toledo metropolitan area could miss out on 1,185 GWh of electricity savings in 2025, worth \$136 million. That is the equivalent of the annual electricity use of more than 110,000 homes.

Table 1. Value of Missed Energy Efficiency Savings by Metro Area under Clean Energy Freeze (Millions)

Metropolitan Area	2016	2025
Cleveland-Akron-Canton	\$99	\$841
Cincinnati-Wilmington	\$36	\$431
Columbus-Marion-Zanesville	\$13	\$232
Dayton-Springfield-Sidney	\$7	\$251
Toledo-Port Clinton	\$18	\$136

The Freeze Will Increase Pollution and Harm the Environment and Our Health

Ohio's electric power plants are notoriously dirty, producing vast amounts of pollution that threaten the climate and harm our health. Ohio is the nation's fourth-leading emitter of the carbon pollution that contributes to global warming, with power plants as the leading source of those emissions.⁵⁰ Indeed, Ohio power plants produce as much carbon pollution as Greece or the Czech Republic.⁵¹

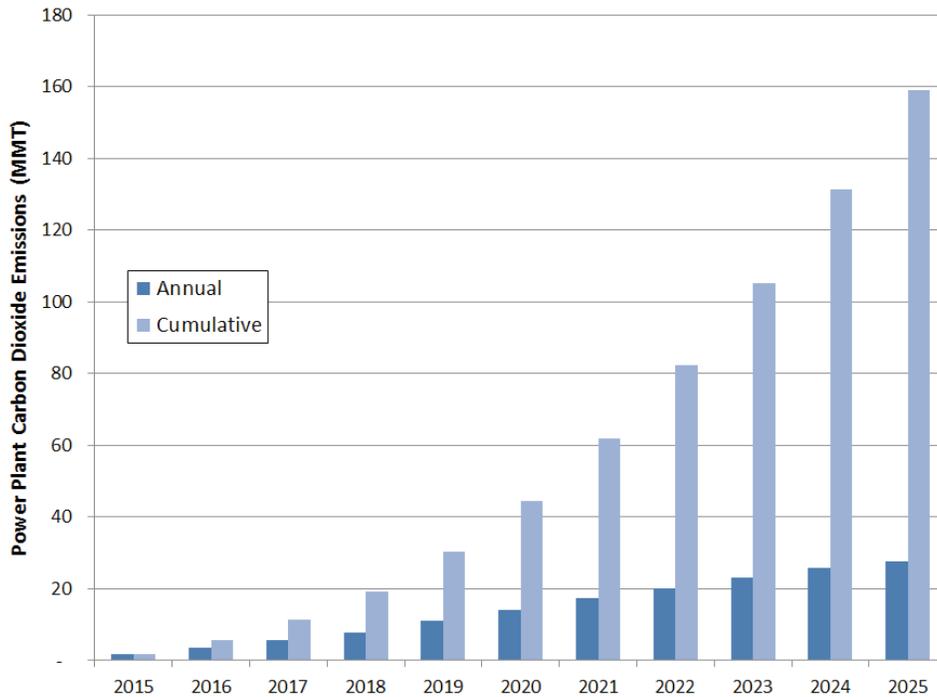
The Clean Energy Law had set Ohio on a course to finally clean up its electric power plants by reducing the growth of electricity demand and increasing the use of clean, emission-free renewable sources of energy. Electricity generated by a wind turbine or solar panel, or saved through efficiency measures, is electricity that does not have to be generated by burning coal or gas. In Ohio, which generates more of its electricity from coal than nearly any other state (burning 37 million short tons of coal in 2012), each unit of fossil fuel electricity averted delivers a greater emissions-reduction benefit than electricity savings in other parts of the country. In 2014, the efficiency and renewable standards cut Ohio's electricity generation pollution by approximately 7 percent, averting as much as 8.5 million metric tons of CO₂.⁵²

If energy efficiency and renewable energy requirements remain frozen through 2025, Ohio will miss out on large amounts of carbon dioxide pollution, and emissions of other power plant pollutants that threaten our health:

- In 2016, Ohio could see an extra 3.7 million metric tons of carbon dioxide emitted as a result of energy savings and renewable energy installations that will not occur due to the clean energy freeze. That is equivalent to putting an extra 785,000 vehicles on the road for a year.
- In 2025, Ohio could see an extra 27.7 million metric tons of carbon dioxide emitted – 29 percent of Ohio's carbon emissions from electricity generation in 2012.⁵³
- In total, cumulatively from 2015 to 2025, Ohio could emit an extra 159 million metric tons of CO₂. That's more than 1.6 times the total carbon dioxide emitted by Ohio electricity generation in 2012.⁵⁴

These missed carbon dioxide reductions will do real environmental damage at a time when the country and the world are fighting to slow the already accelerating effects of climate change. But the increased

Figure 3. Through 2025, Ohio Could Miss Out on Reducing Carbon Dioxide Pollution by 159 Million Metric Tons



emissions will also make it harder for Ohio to meet federal standards for carbon dioxide emission reductions.

On June 2, 2014, the EPA released its proposal for the Clean Power Plan (CPP). The CPP will be the biggest step ever taken by the U.S. to limit global warming pollution, and the current proposal will require Ohio to achieve a 28 percent reduction in power plant car-

bon dioxide emissions per megawatt hour of electricity produced by 2030.⁵⁵ Fully restoring the 2008 Clean Energy Law would help bring Ohio into compliance with the CPP, and should reduce Ohio’s total carbon emissions by more than a third. At a time when Ohio should be gearing up for a new era of clean energy and reduced emissions, the clean energy freeze represents a big step backward.

The Clean Power Plan

The Clean Power Plan is designed to “cut carbon emission from the power sector by 30 percent nationwide below 2005 levels, which is equal to the emissions from powering more than half the homes in the United States for one year.”⁵⁶

The Clean Power Plan sets state-by-state targets for the carbon intensity of electric power plants in each state and empowers the states to choose their compliance path: using tools ranging from increased use of renewable energy, to improved energy efficiency, to expansion of natural gas or nuclear power. The EPA estimates that the plan should “shrink electricity bills roughly 8 percent by increasing energy efficiency and reducing demand in the electricity system.”⁵⁷

Policy Recommendations: Revive and Strengthen Ohio's Clean Energy Law to Ensure a Safe and Healthy Future for Ohio

Freezing the Clean Energy Law was a step backward for Ohio. The freeze, if fully carried out, will result in millions of tons of additional carbon dioxide emissions, higher electric bills for Ohioans, and a debilitated Ohio renewable energy sector.

Ohio should fully reverse course, and the Energy Mandates Study Committee should recommend fully reinstating the clean energy policies originally contained in SB 221. For Ohio to take full advantage of its vast renewable energy resources, while reducing pollution and boosting its clean energy economy even more, the legislature should pass a newly strengthened Clean Energy Law to boost renewable standards even further.

Ohio should immediately restore clean energy and energy efficiency targets.

Ohio has vast potential to generate electricity from clean renewable sources like wind and solar, and to save energy through improved energy efficiency.

- Ohio could host up to 55,000 MW of onshore wind energy capacity, which could generate 151,000 GWh a year, more than Ohio's total current annual electric power consumption.⁵⁸
- A 2012 study conducted for the National Renewable Energy Laboratory concluded that by 2015, Ohio would have the potential to install more than 27,000 MW of solar generating capacity just on residential and commercial rooftops.⁵⁹ Those panels could produce 36 million MWh of electricity annually, more than half the amount of electricity consumed by all Ohio homes in a year.⁶⁰
- According to a study by the American Council for an Energy-Efficient Economy, Ohio has the economic potential to save more than 64,000 GWh through energy efficiency – equal to a third of projected total electricity usage in 2025.⁶¹ These savings are achievable using exclusively cost-effective energy efficiency policies.

Ohio should adopt renewable energy and energy efficiency targets that tap this enormous potential



Ohio has vast potential to generate electricity from clean renewable sources like wind and solar, and to save energy through improved energy efficiency.

for clean energy. A good start would be changing the renewable goal to a full 25 percent of Ohio's electricity sales by 2025 (instead of the current 12.5 percent), and changing the solar energy goal from 0.5 percent to 3 percent. Ohio should also ramp up its commitment to energy efficiency to ensure that all cost-effective energy efficiency measures are adopted. These goals would dramatically reduce carbon dioxide emissions from current levels, while spurring additional growth in Ohio's renewable energy sector.

In order to achieve the full benefits of clean energy, the Ohio EPA should develop a robust State Implementation Plan to meet the U.S. EPA standards limiting global warming from power plants.

A previous Environment Ohio Research & Policy Center analysis found that, if the EPA allows distributed generation as a compliance strategy for states, solar electricity generation that meets at least 10 percent of Ohio's electricity needs would enable the state to achieve more than one-third of its 2030 emissions reduction goal under the Clean Power Plan.⁶³

Methodology

Creating Renewable and Energy Efficiency Scenarios

Scenarios for missed renewable energy generation and missed energy efficiency savings are based on requirements set in the original Clean Energy Law (SB 221), as follows:

1. Ohio's four investor owned utilities – Duke, DP&L, AEP, and FirstEnergy – forecast future electricity sales in submissions to the Public Utilities Commission of Ohio (PUCO).⁶⁴ Each utility's estimates go out to at least 2022. We projected baselines through 2025 using simple linear trends based on the latest possible forecasts from each utility.
2. To predict renewable generation and efficiency that would occur under the original Clean Energy Law, we multiplied the projected baseline (which is an average of the three prior year's electricity sales) by the renewable energy and energy efficiency requirements.
3. To create scenarios for renewable generation and efficiency that would occur under the freeze, we assumed that: a) the renewable generation requirement would stay frozen at the 2014 level of 2.5 percent through 2025; and b) the energy

efficiency requirement would stay frozen at 4.2 percent through 2025. It is possible that some Ohio utilities may continue their energy efficiency programs even under the freeze. Nevertheless, in our freeze scenarios for 2016 and 2025, we assumed that utilities achieve only the bare minimum compliance with the law, illustrating the *guaranteed* clean energy benefits that Ohioans could miss out on should the freeze continue. In the freeze scenario, we gave utilities full credit for any efficiency savings already achieved through 2013. Energy efficiency measures do not last forever – we assumed an average 12 year lifetime of efficiency measures, and subtracted efficiency savings from any given year 12 years later.

Estimating Missed Efficiency Savings for Ohio and by County

This report estimated the total energy efficiency savings and renewable generation that would be lost under a scenario in which the clean energy freeze is carried out and extended through 2025, versus a scenario in which the 2008 law is immediately and fully restored.

To find the dollar values of efficiency savings missed for Ohio and by county, we:

1. First found total value of the “missed out on” energy efficiency savings for Ohio, by multiplying savings under each scenario (detailed above) by each utility’s price per MWh, and subtracting the value of electricity saved under the freeze scenario from value of electricity saved under the Clean Energy Law scenario. Utility price per MWh was based on the Energy Information Administration’s most recent data, *2012 Utility Bundled Retail Sales-Residential*.⁶⁵
2. To find savings per county, we multiplied households in each county by the average savings per household for each utility. We then subtracted total savings under the freeze from the total savings under the Clean Energy Law to come up with the change, which we presented in this report. The total number of households in each utility’s coverage was found by overlaying GIS map data of county households with utility coverage data, provided by the U.S. Census and PUCO respectively.

Estimating Carbon Dioxide Emissions

To estimate carbon dioxide emission reductions, we used a set of emission factors that take into account Ohio’s overall electricity generation mix. When a renewable energy source generates electricity, or efficiency reduces energy use, energy produced by fossil fuel power plants is reduced. The type of electricity production that is reduced depends on several factors: regional variations in the electricity resource mix, the degree to which renewable energy offsets new versus existing generation capacity, and the relative price of competing forms of electricity generation (including marginal prices), among others.

To estimate carbon dioxide emissions reductions, we assumed that increases in efficiency and renewable energy would primarily offset electricity produced

by fossil fuel energy sources. The assumption that renewable energy overwhelmingly offsets fossil fuel generation, even at high levels of penetration, is based on recent analyses of high renewable energy penetration scenarios in both the western and eastern U.S.⁶⁶

Emissions reductions were based on the actual and forecast electricity generation mixes for the Reliability First Corporation/West, the Energy Information Administration Electricity Market Module (EMM) region of which Ohio is a part. The EIA’s *Annual Energy Outlook 2014*, Tables 73-94, provided data on annual electricity generation and emissions for coal and natural gas power plants in the region. We assigned the region to the ReliabilityFirst Corporation interconnection regions identified by the North American Electric Reliability Corporation (NERC), using maps of EMM regions and NERC regions. We then estimated an emissions factor for fossil fuel-fired generation for the NERC region, using the generation and emissions data for the constituent EMM regions.

To arrive at emissions factors for Ohio, we determined the percentage of electricity sales from within its NERC regions, using data from U.S. Department of Energy, Energy Information Administration, Electric Power Sales, Revenue, and Energy Efficiency Form EIA-861, 29 October 2013. Emission factors were then created by multiplying Ohio’s percentage of sales per NERC region by that region’s emission factor.

To estimate total emissions savings, we multiplied scenarios for fossil fuel energy savings delivered by renewable generation and efficiency generation in 2016 and 2025 by the emission factors for Ohio in 2016 and 2025. This report focused primarily on the difference in carbon dioxide emissions between the Clean Energy Law and the freeze – to estimate the difference we subtracted estimated emissions under our freeze scenario from estimated emissions under our Clean Energy Law scenario.

Appendix

Table 2. Missed Energy Efficiency Savings Under Freeze, By County

Note: For the most part, counties with negligible missed savings get their electricity primarily from sources other than electric distribution utilities.

County	2016			2025		
	Energy savings missed (MWh)	Ohio homes equivalent	Cost of electricity (millions of dollars)	Energy savings missed (MWh)	Ohio homes equivalent	Cost of electricity (millions of dollars)
Adams	15	1	\$0	306	29	\$0
Allen	20,895	1,945	\$2.6	425,983	39,663	\$52.6
Ashland	9,168	854	\$1.1	70,607	6,574	\$8.1
Ashtabula	24,423	2,274	\$2.8	178,234	16,595	\$20.4
Athens	-	-	\$0	-	-	\$0
Auglaize	3,066	285	\$0.4	86,189	8,025	\$11.1
Belmont	13,149	1,224	\$1.6	268,067	24,960	\$33.1
Brown	7,233	673	\$0.8	85,367	7,949	\$9.1
Butler	68,673	6,394	\$7.3	808,980	75,324	\$86.1
Carroll	3,488	325	\$0.4	68,015	6,333	\$8.4
Champaign	733	68	\$0.1	45,016	4,191	\$6.1
Clark	31,603	2,943	\$3.6	249,790	23,258	\$29.1
Clermont	40,108	3,734	\$4.3	472,057	43,953	\$50.2
Clinton	2,086	194	\$0.2	76,704	7,142	\$10
Columbiana	25,316	2,357	\$3	287,432	26,763	\$34.3
Coshocton	5,343	498	\$0.7	108,936	10,143	\$13.4
Crawford	9,417	877	\$1.1	160,367	14,932	\$19.6
Cuyahoga	338,182	31,488	\$38.8	2,467,991	229,794	\$282.9
Darke	1,534	143	\$0.2	81,766	7,613	\$11
Defiance	8,131	757	\$0.9	81,032	7,545	\$9.6
Delaware	1,846	172	\$0.2	14,932	1,390	\$1.7
Erie	19,613	1,826	\$2.2	143,129	13,327	\$16.4
Fairfield	11,638	1,084	\$1.4	237,271	22,092	\$29.3
Fayette	727	68	\$0.1	49,164	4,578	\$6.7

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County	2016			2025		
	Energy savings missed (MWh)	Ohio homes equivalent	Cost of electricity (millions of dollars)	Energy savings missed (MWh)	Ohio homes equivalent	Cost of electricity (millions of dollars)
Franklin	442	41	\$0.1	3,276	305	\$0.4
Fulton	8,743	814	\$1	63,803	5,941	\$7.3
Gallia	238	22	\$0	4,847	451	\$0.6
Geauga	21,259	1,979	\$2.4	155,146	14,446	\$17.8
Greene	4,637	432	\$0.6	280,496	26,117	\$38.1
Guernsey	6,379	594	\$0.8	130,049	12,109	\$16
Hamilton	179,364	16,701	\$19.1	2,111,066	196,561	\$224.6
Hancock	12,970	1,208	\$1.6	264,423	24,620	\$32.6
Hardin	4,936	460	\$0.6	101,178	9,421	\$12.5
Harrison	2,796	260	\$0.3	56,994	5,307	\$7
Henry	5,166	481	\$0.6	42,975	4,001	\$5
Highland	334	31	\$0	18,422	1,715	\$2.5
Hocking	3,738	348	\$0.5	76,211	7,096	\$9.4
Holmes	3,038	283	\$0.4	61,242	5,702	\$7.6
Huron	10,924	1,017	\$1.3	105,912	9,861	\$12.5
Jackson	322	30	\$0	6,572	612	\$0.8
Jefferson	15,626	1,455	\$1.9	318,568	29,662	\$39.3
Knox	8,431	785	\$1	168,804	15,717	\$20.8
Lake	58,419	5,439	\$6.7	426,335	39,696	\$48.9
Lawrence	10,938	1,018	\$1.3	223,003	20,764	\$27.5
Licking	22,086	2,056	\$2.7	450,274	41,925	\$55.6
Logan	871	81	\$0.1	62,009	5,774	\$8.5
Lorain	65,901	6,136	\$7.6	480,933	44,780	\$55.1
Lucas	111,642	10,395	\$12.8	814,743	75,861	\$93.4
Madison	6,442	600	\$0.7	49,347	4,595	\$5.7
Mahoning	61,295	5,707	\$7	447,322	41,650	\$51.3
Marion	13,575	1,264	\$1.6	121,315	11,296	\$14.2
Medina	37,148	3,459	\$4.3	271,098	25,242	\$31.1
Meigs	1,498	140	\$0.2	30,546	2,844	\$3.8
Mercer	776	72	\$0.1	56,770	5,286	\$7.7
Miami	2,189	204	\$0.3	160,133	14,910	\$21.9
Monroe	186	17	\$0	3,791	353	\$0.5

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County	2016			2025		
	Energy savings missed (MWh)	Ohio homes equivalent	Cost of electricity (millions of dollars)	Energy savings missed (MWh)	Ohio homes equivalent	Cost of electricity (millions of dollars)
Montgomery	13,888	1,293	\$1.9	999,909	93,101	\$136.4
Morgan	3,003	280	\$0.4	61,228	5,701	\$7.6
Morrow	3,724	347	\$0.4	38,948	3,626	\$4.6
Muskingum	15,801	1,471	\$1.9	322,143	29,995	\$39.8
Noble	1,168	109	\$0.1	23,803	2,216	\$2.9
Ottawa	10,860	1,011	\$1.2	79,253	7,379	\$9.1
Paulding	2,818	262	\$0.3	57,448	5,349	\$7.1
Perry	5,195	484	\$0.6	105,905	9,861	\$13.1
Pickaway	31	3	\$0	2,283	213	\$0.3
Pike	1,099	102	\$0.1	22,407	2,086	\$2.8
Portage	38,606	3,595	\$4.4	281,739	26,233	\$32.3
Preble	970	90	\$0.1	62,542	5,823	\$8.5
Putnam	4,781	445	\$0.6	96,587	8,993	\$11.9
Richland	27,684	2,578	\$3.2	278,909	25,969	\$33
Ross	4	0	\$0	290	27	\$0
Sandusky	14,109	1,314	\$1.7	173,953	16,197	\$20.9
Scioto	14,044	1,308	\$1.7	286,319	26,659	\$35.3
Seneca	9,484	883	\$1.2	186,924	17,404	\$23
Shelby	821	76	\$0.1	60,026	5,589	\$8.2
Stark	88,272	8,219	\$10.5	1,269,111	118,167	\$154
Summit	138,230	12,871	\$15.8	1,008,779	93,927	\$115.6
Trumbull	53,366	4,969	\$6.1	389,454	36,262	\$44.6
Tuscarawas	18,182	1,693	\$2.2	369,828	34,435	\$45.6
Union	2,308	215	\$0.3	46,940	4,371	\$6.1
Van Wert	5,365	499	\$0.7	110,544	10,293	\$13.7
Vinton	-	-	\$0	-	-	\$0
Warren	38,142	3,551	\$4.1	472,469	43,992	\$51.1
Washington	11	1	\$0	227	21	\$0
Wayne	20,761	1,933	\$2.5	299,285	27,866	\$36.3
Williams	7,032	655	\$0.8	51,320	4,778	\$5.9
Wood	27,937	2,601	\$3.2	227,584	21,190	\$26.4
Wyandot	3,652	340	\$0.4	73,360	6,831	\$9
TOTAL	1,900,037	176,912	\$218.5	21,494,456	2,001,346	\$2534.6

Table 3. Missed Solar Under Freeze, By County

	2016		2025	
	Solar Generation Missed (MWh)	Equivalent in Solar Roofs	Solar Generation Missed (MWh)	Equivalent in Solar Roofs
Adams	1	0	7	1
Allen	1,622	131	9,804	794
Ashland	260	21	1,511	122
Ashtabula	654	53	3,789	307
Athens	-	-	-	-
Auglaize	335	27	2,016	163
Belmont	1,021	83	6,169	500
Brown	280	23	1,833	148
Butler	2,653	215	17,365	1,406
Carroll	259	21	1,562	127
Champaign	181	15	1,078	87
Clark	924	75	5,369	435
Clermont	1,548	125	10,132	820
Clinton	298	24	1,804	146
Columbiana	1,077	87	6,392	518
Coshocton	415	34	2,507	203
Crawford	608	49	3,660	296
Cuyahoga	9,055	733	52,472	4,249
Darke	327	26	1,951	158
Defiance	302	24	1,782	144
Delaware	55	4	322	26
Erie	525	43	3,043	246
Fairfield	904	73	5,461	442
Fayette	198	16	1,179	95
Franklin	12	1	70	6
Fulton	234	19	1,357	110
Gallia	18	1	112	9
Geauga	569	46	3,299	267
Greene	1,127	91	6,715	544
Guernsey	495	40	2,993	242
Hamilton	6,922	561	45,309	3,669
Hancock	1,007	82	6,086	493

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	2016		2025	
	Solar Generation Missed (MWh)	Equivalent in Solar Roofs	Solar Generation Missed (MWh)	Equivalent in Solar Roofs
Hardin	386	31	2,329	189
Harrison	217	18	1,312	106
Henry	159	13	928	75
Highland	73	6	439	36
Hocking	290	24	1,754	142
Holmes	233	19	1,409	114
Huron	394	32	2,323	188
Jackson	25	2	151	12
Jefferson	1,213	98	7,332	594
Knox	643	52	3,882	314
Lake	1,564	127	9,064	734
Lawrence	849	69	5,132	416
Licking	1,715	139	10,363	839
Logan	249	20	1,488	120
Lorain	1,764	143	10,225	828
Lucas	2,989	242	17,322	1,403
Madison	182	15	1,056	86
Mahoning	1,641	133	9,510	770
Marion	450	36	2,640	214
Medina	995	81	5,764	467
Meigs	116	9	703	57
Mercer	229	19	1,363	110
Miami	645	52	3,844	311
Monroe	14	1	87	7
Montgomery	4,023	326	23,993	1,943
Morgan	233	19	1,409	114
Morrow	145	12	860	70
Muskingum	1,227	99	7,414	600
Noble	91	7	548	44
Ottawa	291	24	1,685	136
Paulding	219	18	1,322	107
Perry	403	33	2,437	197

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	2016		2025	
	Solar Generation Missed (MWh)	Equivalent in Solar Roofs	Solar Generation Missed (MWh)	Equivalent in Solar Roofs
Pickaway	9	1	55	4
Pike	85	7	516	42
Portage	1,034	84	5,990	485
Preble	251	20	1,497	121
Putnam	368	30	2,222	180
Richland	1,040	84	6,140	497
Ross	1	0	7	1
Sandusky	654	53	3,892	315
Scioto	1,091	88	6,589	534
Seneca	711	58	4,296	348
Shelby	242	20	1,441	117
Stark	4,792	388	28,689	2,323
Summit	3,701	300	21,448	1,737
Trumbull	1,429	116	8,280	671
Tuscarawas	1,409	114	8,511	689
Union	184	15	1,090	88
Van Wert	421	34	2,546	206
Vinton	-	-	-	-
Warren	1,570	127	10,212	827
Washington	1	0	5	0
Wayne	1,130	92	6,767	548
Williams	188	15	1,091	88
Wood	840	68	4,903	397
Wyandot	279	23	1,687	137

Table 4. 2025 Missed Solar Roof Equivalents and Energy Savings by Metropolitan Area under Clean Energy Freeze

	Solar Roof Equivalents	Energy Efficiency Savings (Millions)
Cleveland-Akron-Canton	12,647	841
Cincinnati	7,017	431
Columbus-Marion-Zanesville	3,488	232
Dayton-Springfield-Sidney	3,595	251
Toledo-Port Clinton	2,046	136

Table 5. Incremental Energy Efficiency Savings by Year, by Utility (MWh)⁶⁷

	AEP	DP&L	Duke Energy	FirstEnergy
2009	253,000	115,279	86,402	22,614
2010	365,000	178,000	310,000	75,074
2011	527,665	179,586	215,699	1,024,819
2012	593,500	186,526	262,439	568,615
2013	566,400	160,372	125,983	444,937
TOTAL	2,305,565	819,763	1,000,523	2,136,059

Notes

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4. Green Jobs Award, SJF Institute, *Melink Corporation*, accessed at www.greenjobsaward.org/melink-corporation, 16 October 2014.
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19. Development Agency Services of Ohio (prepared by ICF International), *Renewable Energy and Energy Efficiency Job Impact Study*, January 2013.

20. Ohio Administrative Code Chapter 4901:1-39 [Energy Efficiency Programs]

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36. See note 21.
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49. See methodology for more details. Electricity costs are based on: U.S. Energy Information Administration, *2012 Utility Bundled Retail Sales- Residential*, accessed at http://www.eia.gov/electricity/sales_revenue_price/pdf/table6.pdf on 15 January 2015.
50. Energy Information Administration, *State CO₂ Emissions*, accessed at www.eia.gov/environment/emissions/state/state_emissions.cfm on 5 November 2014.
51. Energy Information Administration, *International Energy Statistics*, accessed at www.eia.gov/cfapps/ipdbproject/iedindex3.cfm on 6 November 2014.
52. Energy efficiency programs reduced energy use by 4.6 percent, and renewable energy standards reduced traditional electricity generation by 2.5 percent, adding up to 7.1 percent total. Carbon dioxide pollution averted was estimated using emission factors detailed in the methodology.
53. Ohio emitted 95 MMT of CO₂ emissions in 2012: US Energy Information Administration, *Ohio State Profile Data*, 18 December 2014, available at <http://www.eia.gov/state/data.cfm?sid=OH>.
54. Ibid.
55. Deirdre Shesgreen and Maureen Groppe, "New EPA power plant rules affect Ohio more than most," *Associated Press*, 3 June 2014.
56. US Environmental Protection Agency, *EPA Proposes First Guidelines to Cut Carbon Pollution from Existing Power Plants...(Press release)*, 6 February 2014.
57. Gina McCarthy, U.S. Environmental Protection Agency, *Our Clean Power Plan Will Spur Innovation and Strengthen the Economy (Blog post)*, available at <http://blog.epa.gov/epaconnect/2014/06/our-clean-power-plan-will-spur-innovation-and-strengthen-the-economy/>, 2 June 2014.
58. This is the potential for 80 meter wind turbines, in areas with more than a 30 percent capacity factor, taken from: National Renewable Energy Laboratory, *Estimates of Windy Land Area and Wind Energy Potential*, available at www.apps2.eere.energy.gov/wind/windexchange/wind_resource_maps.asp?stateab=oh, 4 February 2010.
59. J. Paidipati, et al., Navigant Consulting, for the National Renewable Energy Laboratory, *Rooftop Photovoltaics: Market Penetration Scenarios*, February 2008.

60. Assuming a capacity factor of 15 percent for installed solar facilities: see note 1. 53,687,000 MWh of energy were consumed by Ohio households in 2011, see *Electric Power Monthly with Data for December 2012*, note 1.

61. Max Neubauer et al., American Council for an Energy-Efficient Economy, *Shaping Ohio's Energy Future: Energy Efficiency Works*, March 2009.

63. Judee Burr and Lindsey Hallock, Frontier Group, and Rob Sargent, Environment America Research & Policy Center, produced for Environment Ohio Research & Policy Center, *Star Power The Growing Role of Solar Energy in Ohio*, November 2014.

64. We found energy sale forecasts in the following PUCO case files: AEP: 14-501-EL-FOR; FirstEnergy: 14-0625-EL-FOR; DP&L: 14-0536-EL-FOR; Duke: 13-398-EL-FOR.

65. U.S. Energy Information Administration, *2012 Utility Bundled Retail Sales- Residential*, accessed at www.eia.gov/electricity/sales_revenue_price/pdf/table6.pdf on 14 January 2015.

66. The use of a constant emission masks hourly variations in the carbon intensity of electricity on the grid, meaning that the estimates in this report do not fully reflect the ways in which additional renewable energy or energy efficiency might affect hourly dispatch of different electricity generators. Our assumption is based on: Western U.S.: D. Lew et al., National Renewable Energy Laboratory, *The Western Wind and Solar Integration Study Phase 2*, September 2013; Eastern U.S.: EnerNex Corp. (prepared for National Renewable Energy Laboratory), *Eastern Wind Integration and Transmission Study*, February 2011.

67. Energy savings calculated from utility submissions to PUCO.