Bricker & Eckler
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Ohio Senate Bill 221/Senate Bill 315 / SB 310
Alternative Energy Portfolio Standard

Alternative Energy Technologies	2025 R.P.S. Benchmarks	In-State Requirements	Renewable Energy Credits	Enforcement/ Compliance Payments
Renewable ORC 4928.01(A)(35) • Solar – Photovoltaic • Solar – Thermal • Wind • Hydropower • Certain Solid Waste • Biomass • Bio-Methane Gas • Fuel Cells • Wind Turbines – Lake Erie • Off Peak Storage Facilities Utilizing Renewables • Distributed Generation Facilities Utilizing Renewables • Waste Energy Recovery Systems • Certain University CHP	**Renewable and Solar Benchmarks: 12.5% +** ORC 4928.64(B)(2) Y R S 2009: .25% .004% 2010: .50% .010% 2011: 1.0% .030% 2012: 1.5% .060% 2013: 2.0% .090% 2014: 2.5% .120% 2017: 5.5% .220% 2018: 6.5% .260% 2019: 7.5% .300% 2020: 8.5% .340% 2021: 9.5% .380% 2022: 10.5% .420% 2023: 11.5% .460% 2024: 12.5% .500% 2025 2026	At least ½ of renewable energy resources to be implemented by the utilities shall be met through facilities located in Ohio. The remainder shall be met with resources that can be shown to have been delivered into this state. ORC 4928.64(B)(3)	Utilities may use R.E.C.s in any of the 5 calendar years following acquisition to comply with both the renewable and solar energy resource requirements. 1 R.E.C. shall equal 1 Mw Hour of electricity from renewable resources. ORC 4928.65	**1) Annual PUCO Review** ORC 4928.64(C)(1) **2) If Not in Compliance:** ORC 4928.64(C)(2) **A) Solar Benchmark** $ per Mw hour : 2009: $450 2010: $400 2012: $350 2014: $300 2016: $250 2018: $200 2020: $150 2022: $100 2024: $50 **B) Renewable Benchmark** 2009: $45 Adjusted annually per CPI
Advanced ORC 4928.01(A)(34) • Clean Coal • Advanced Nuclear • Energy Efficiency • Fuel Cells • Co-gen • Certain Solid Waste • Retrofitted or Refueled Generating Facilities • Updated Capacity from Advanced Technology **Mercantile Sited** ORC 4928.01 (A)(1) • Real/Reactive Power • Waste Heat Efficiency • Demand/Load storage • Advanced/Renewable	Advanced Energy Requirement: 12 [illegible] ORC 4928.64(B)(1)			

Key A.E.P.S. Cost Containment Mechanisms

3% Cost Cap	Force Majeure Provision
Utilities not required to comply with benchmark to the extent compliance will result in 3+% increase in electricity production or acquisition costs. ORC 4928.64(C)(3)	Utility may request PUCO to determine whether renewable resources are sufficiently available to enforce R.P.S. benchmark requirement. If utility shows good faith effort to comply with renewable benchmarks but cannot, PUCO may reduce obligation. Modification does not automatically reduce future benchmarks. ORC 4928.64(C)(4)

History of Ohio's Renewable Portfolio Standard (RPS) and Energy Efficiency Resource Standard (EERS)

2008

- Ohio establishes the Alternative Energy Portfolio Standard (AEPS) in Senate Bill 221
- Standard requires the state's investor-owned utilities to procure 12.5 percent of their energy from renewable sources by 2025
- Standard calls for at least ½ of renewable resources to be procured from in-state facilities ("in-state requirement")

2012

- Ohio Senate Bill 315 adds co-generation and waste heat to list of "qualified renewable energy resources" to meet Ohio's RPS

2014

- Senate Bill 310 freezes standards at 2014 level
- Eliminates the 50% in-state requirement. Any renewable energy project in Ohio or shown to be "deliverable" to Ohio (interpreted as located in an adjacent state) can now satisfy the RPS.
- Creates the 13-member Energy Mandates Study Committee and requires the Committee to submit a report to the General Assembly by September 30, 2015
- Expands the list of qualified renewable energy projects to include hydropower projects built as far back as 1980
- Creates an "industrial" opt-out of the EERS, allowing energy consumers of a certain size to opt out and run their own EE programs; waters down the EERS by making changes to "counting provisions"

2015

- Ohio's Energy Mandate Study Committee meets and releases its findings – Including recommendation of indefinite freeze

2016

- Ohio Legislature passes Ohio House Bill 554 which was subsequently vetoed by Governor John Kasich
- Legislation would have effectively made RPS voluntary

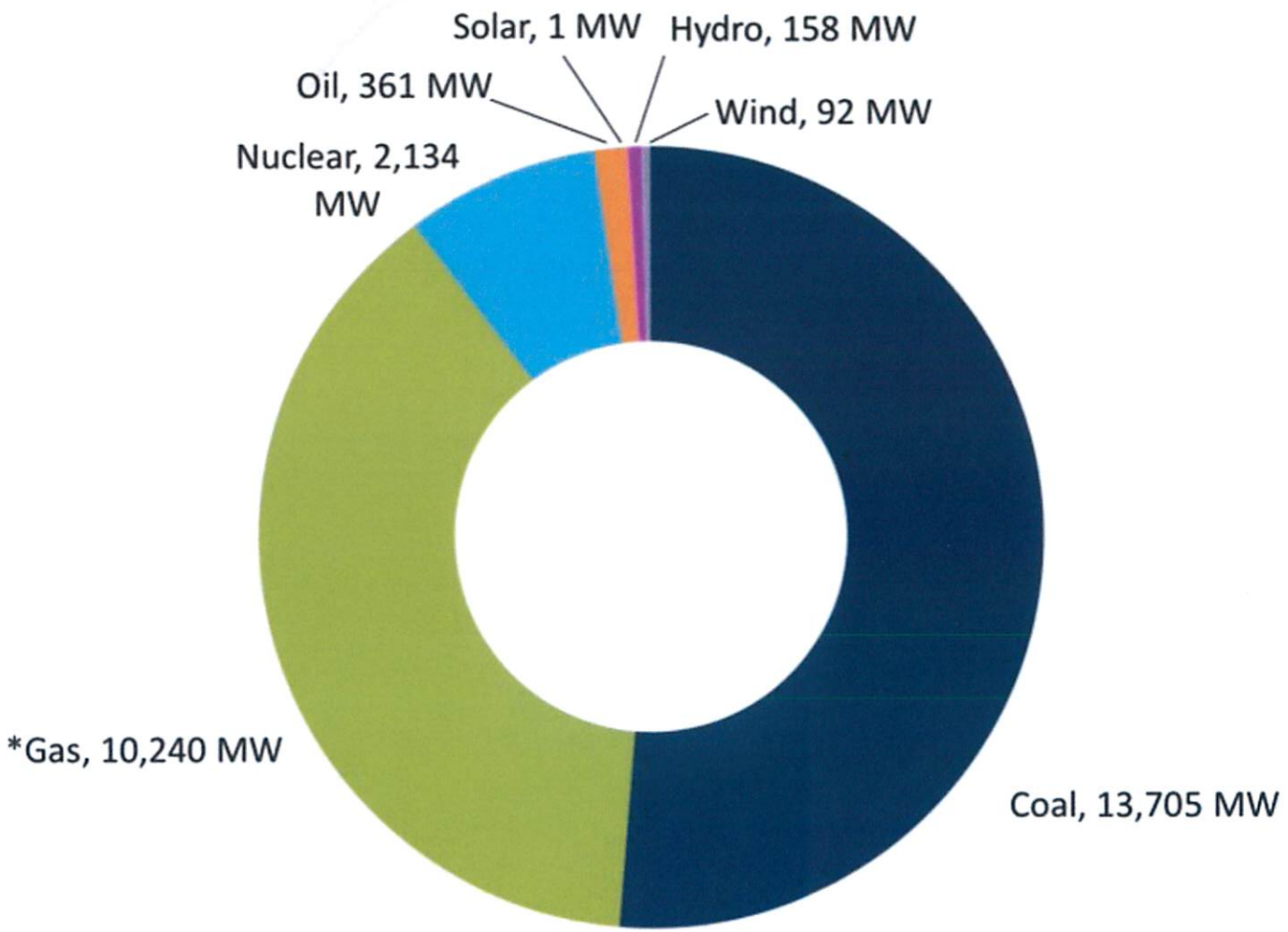
2017

- January 1 – Renewable Portfolio Standard resumes
- House introduces and passes House Bill 114
- Eliminates requirement for utilities to procure renewable energy resources and instead makes the benchmarks "goals"
- Expands the industrial opt-out (customers over 45 million kwh) to include a "mercantile" opt-out for customers over 700,000 kwh and further waters down the EERS with additional counting provisions

2018

- Ohio Senate considers House Bill 114
- Senate's version of H.B. 114 reinstates the requirement for utilities to procure renewable energy (eliminates "goals") BUT only a cumulative total of 8.5% (as opposed to the original 12.5%)
- Improves the House's counting provision, but maintains the expanded "mercantile" opt-out

Ohio's current installed generation



Source: PJM 2017 RTEP

Ohio | Public Utilities Commission

Renewable Portfolio Standard / Rate Impacts 1st Quarter 2019

*** While every effort is made to assure accuracy, the information presented here does not supersede filed tariffs ***

Ohio's electric distribution utilities (EDUs) recover the costs of complying with the state's renewable portfolio standard (RPS) requirement through a rider frequently referred to as an alternative energy rider (AER).

The AERs are currently updated quarterly and they are bypassable, meaning that a customer who switches to a competitive retail electric service (CRES) provider would not pay the EDU's AER. Because the PUCO does not regulate the generation charges of CRES providers, this sheet does not attempt to estimate any RPS compliance costs charged to customers of CRES providers.

The EDU's AERs are designed to be a volumetric charge, so the actual bill impact depends on the volume of electricity for which a customer is charged.[1]
The table below shows the AER rates, by EDU, for the first quarter of 2019. The average monthly bill impact in the table is for residential customers, and assumes monthly usage of 750 kWh. By clicking on the hyperlink in the source column, you can view the EDU's filing pertaining to its AER rate(s).

1st Quarter 2019

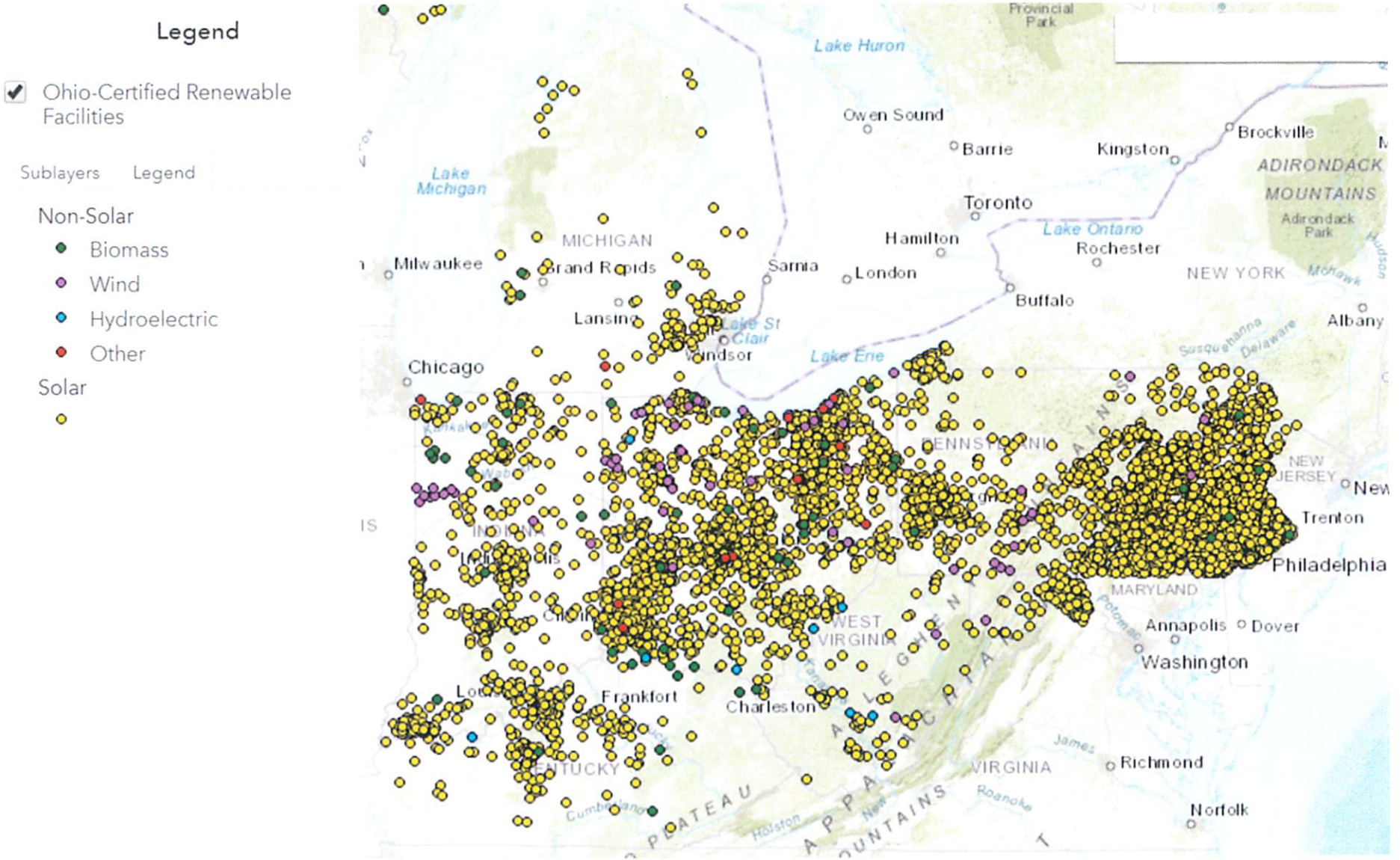
EDU	Source	AER Rate ($/kWh)	Average Monthly Bill Impact
Cleveland Electric Illuminating	AER Filing	0.0003650	$0.27
Dayton Power & Light[2]	Revised Tariff Filing	0.0001354	$0.10
Duke Energy – Ohio	AER Filing	0.0003980	$0.30
Ohio Edison Company	AER Filing	0.0004900	$0.37
Ohio Power Company	AER Filing	0.0009147	$0.69
Toledo Edison Company	AER Filing	0.0008830	$0.66

[1] A customer that consumes a larger volume of electricity (i.e., an industrial customer) would experience a larger average bill impact than would a residential customer with a relatively small electricity usage.
[2] Per 16-0395-EL-SSO, Dayton Power & Light's alternative energy component charge has been included as a component of the Standard Offer Rate instead of as a separate AER Tariff. The alternative energy component charge will be updated and reconciled on an annual basis. See Eighteenth Revised Tariff Sheet No. G10, effective June 1, 2018.

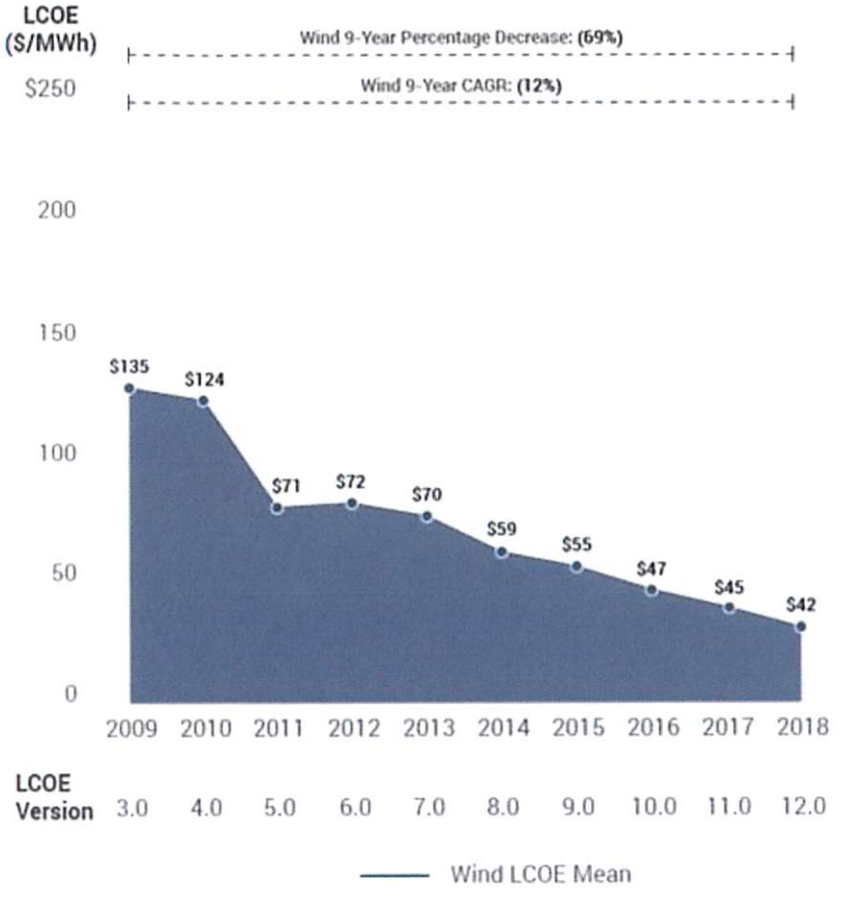
Ohio | Public Utilities Commission

Ohio-Certified Renewable Facilities

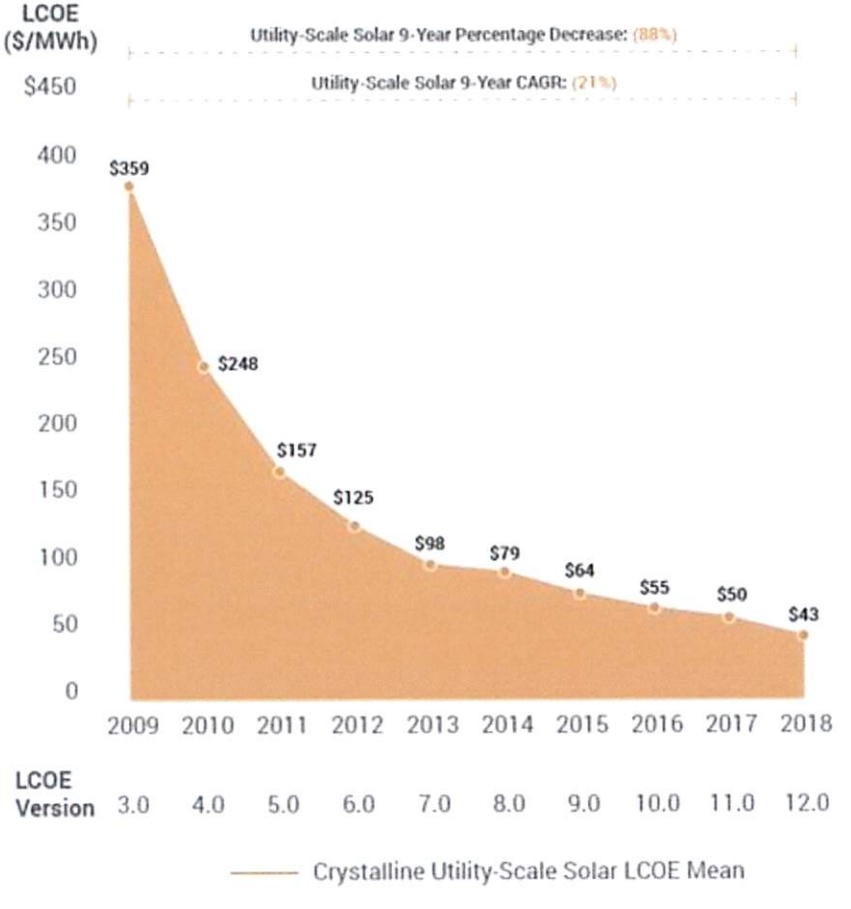
The map includes all facilities certified by the PUCO under Ohio's Renewable Energy Portfolio Standard. Data source is the PUCO renewable certification database as of Jan. 11, 2017.



Unsubsidized Wind LCOE



Unsubsidized Solar PV LCOE



Levelized Cost of Energy Comparison—Unsubsidized Analysis

Certain Alternative Energy generation technologies are cost-competitive with conventional generation technologies under certain circumstances[1]

Source: *Lazard estimates.*

Note: Here and throughout this presentation, unless otherwise indicated, the analysis assumes 60% debt at 8% interest rate and 40% equity at 12% cost. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital" for cost of capital sensitivities.

(1) Such observation does not take into account other factors that would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this analysis. These additional factors, among others, could include: import tariffs; capacity value vs. energy value; stranded costs related to distributed generation or otherwise; network upgrade, transmission, congestion or other integration-related costs; significant permitting or other development costs, unless otherwise noted; and costs of complying with various environmental regulations (e.g., carbon emissions offsets or emissions control systems). This analysis also does not address potential social and environmental externalities, including, for example, the social costs and rate consequences for those who cannot afford distribution generation solutions, as well as the long-term residual and societal consequences of various conventional generation technologies that are difficult to measure (e.g., nuclear waste disposal, airborne pollutants, greenhouse gases, etc.).

(2) Unless otherwise indicated herein, the low end represents a single-axis tracking system and the high end represents a fixed-tilt design.

(3) Represents the estimated implied midpoint of the LCOE of offshore wind, assuming a capital cost range of approximately $2.25 – $3.80 per watt.

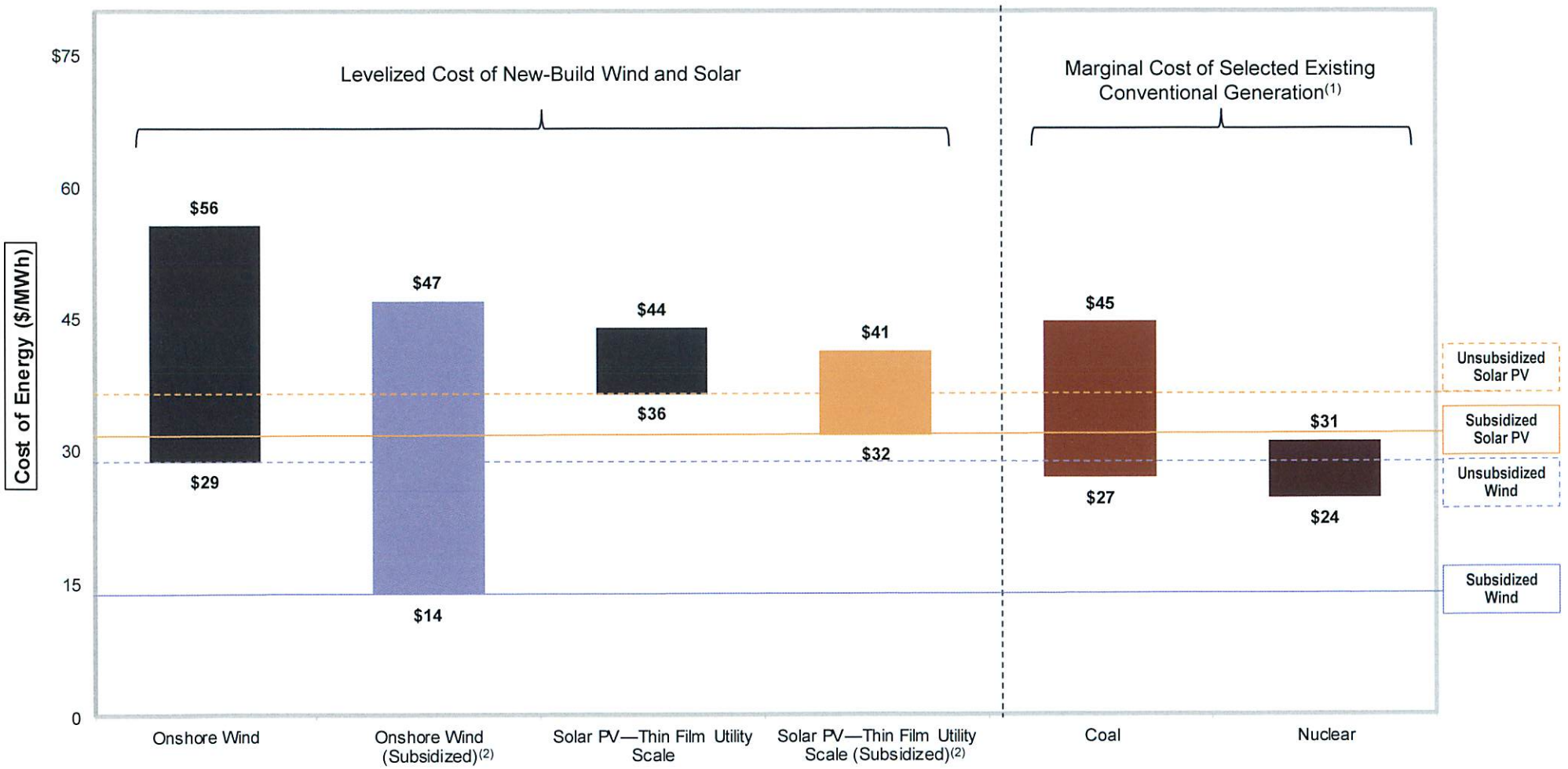
(4) Unless otherwise indicated, the analysis herein does not reflect decommissioning costs or the potential economic impacts of federal loan guarantees or other subsidies.

(5) Represents the midpoint of the marginal cost of operating fully depreciated coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned coal plant is equivalent to the decommissioning and site restoration costs. Inputs are derived from a benchmark of operating, fully depreciated coal and nuclear assets across the U.S. Capacity factors, fuel, variable and fixed operating expenses are based on upper and lower quartile estimates derived from Lazard's research. Please see page titled "Levelized Cost of Energy Comparison—Alternative Energy versus Marginal Cost of Selected Existing Conventional Generation" for additional details.

(6) Unless otherwise indicated, the analysis herein reflects average of Northern Appalachian Upper Ohio River Barge and Pittsburgh Seam Rail coal. High end incorporates 90% carbon capture and compression. Does not include cost of transportation and storage.

Levelized Cost of Energy Comparison—Alternative Energy versus Marginal Cost of Selected Existing Conventional Generation

Certain Alternative Energy generation technologies, which became cost-competitive with conventional generation technologies several years ago, are, in some scenarios, approaching an LCOE that is at or below the marginal cost of existing conventional generation technologies



Source: Lazard estimates.

(1) Represents the marginal cost of operating, fully depreciated coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned coal plant is equivalent to the decommissioning and site restoration costs. Inputs are derived from a benchmark of operating, fully depreciated coal and nuclear assets across the U.S. Capacity factors, fuel, variable and fixed operating expenses are based on upper and lower quartile estimates derived from Lazard's research.

(2) The subsidized analysis includes sensitivities related to the TCJA and U.S. federal tax subsidies. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies" for additional details.

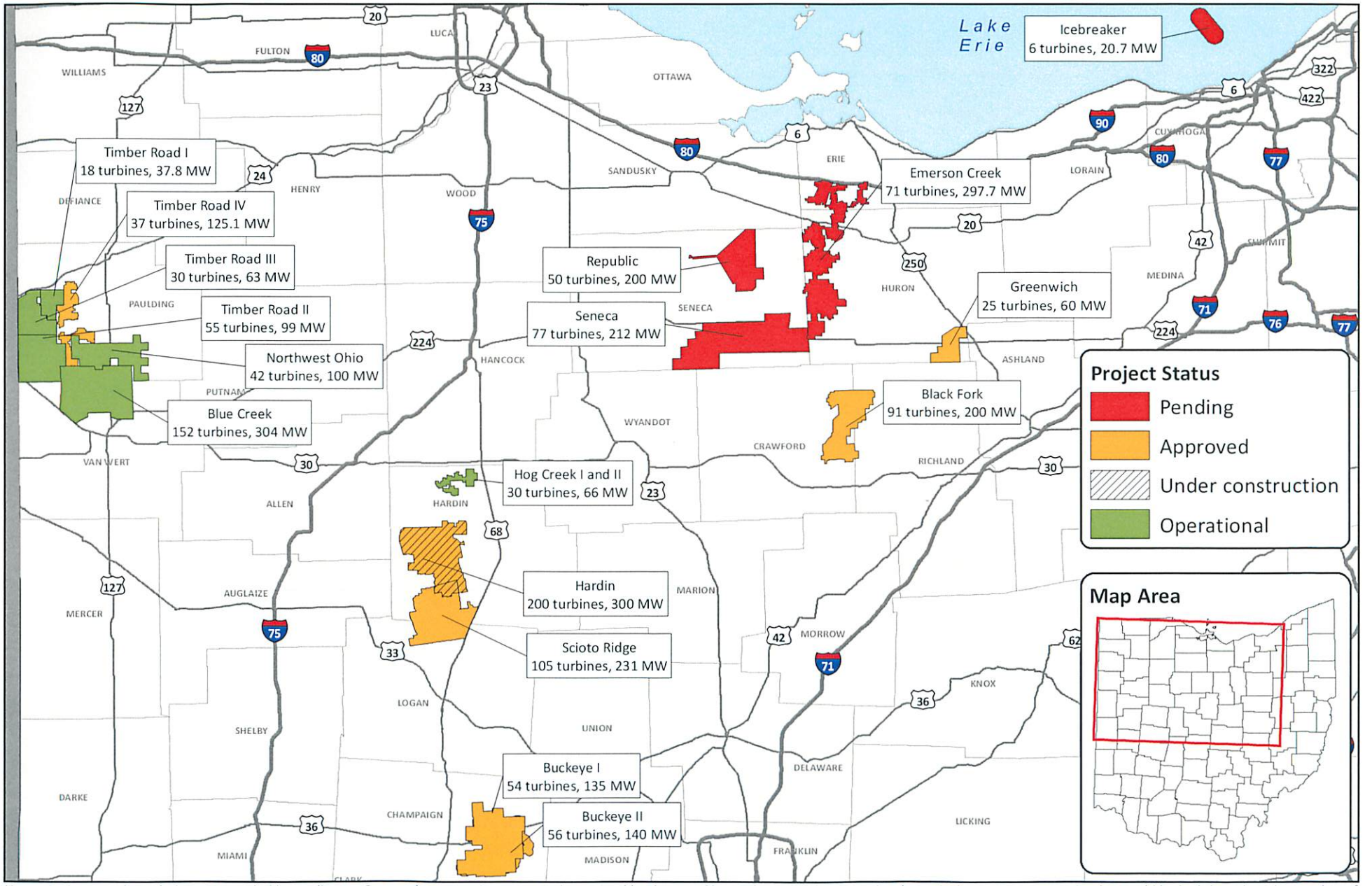
Economic Benefits from Ohio's Operating Wind Farms

Operational Wind Farm	*Counties*	*MWs*	*Capital Investment*	*Annual Local Tax Revenue*	*Annual Landowner Revenue*	*Construction labor(hours)*	*Number of Ohio Companies Utilized During Construction*	*Amount Spent during construction in local economy*
Blue Creek (Iberdrola Renewables)	Van Wert, Paulding	304	$600M	$2.7M	$2M	665,000	30	$25M
Timber Road II(EDP Renewables)	Paulding	100	$180M*	$1M*	$1M	225,000*	46*	$15M*
Timber Road III – Amazon(EDP Renewables)	Paulding	99	$175M	$1M	$1M	220,000	46	$10M
Hog Creek	Hardin	66	$120M*	$850,000*	$850,000*	146,000*	45*	$10M*
Timber Road IV – Microsoft (EDP Renewables)	Paulding	125	$200M*	$1.1M	$1.25M*	330,000*	50*	$98M
Northwest Ohio - GM	Paulding	100	$200M*	$900,000	$1M*	N/A	N/A	$12M*
Total		**794**	**$1.48B**	**$7.6M**	**$7.1M**	**1,586,000**	**217**	**$170M**

Ohio | Power Siting Board

Power Siting Wind Case Status

As of 2/21/2019



Notes: Project area boundaries are provided by applicants. Case and construction status is determined by the case filings. The nameplate capacity shown is the maximum capacity that could be built based on the number of approved turbines and the highest nameplate capacity of the approved turbine models. Map produced on 2/21/2019. Prepared by: Adam Bargar

Operational Wind Facilities		Potential Wind Facilities (Approved, Pending and Pre-application)	
Operational Megawatts (MW):	669.8	Potential Megawatts (MW):	1,921.5
Operational Turbines:	327	Potential Turbines:	772

Operational Wind Facilites

Case Number	Related Cases	Project Name	Online Date	County	Turbines	MW
09-1066-EL-BGN	11-1995-EL-BGA 11-3644-EL-BGA	Blue Creek	6/14/12	Paulding, Van Wert	152	304
09-0980-EL-BGN	15-2031-EL-BGA	Timber Road I	12/8/16	Paulding	18	37.8
10-0369-EL-BGN	10-3128-EL-BGA	Timber Road II	7/19/11	Paulding	55	99
10-0369-EL-BGN	15-2030-EL-BGA	Timber Road III	12/8/16	Paulding	30	63
09-0277-EL-BGN	11-0757-EL-BGA 11-5542-EL-BGA 16-1422-EL-BGA	Hog Creek I	12/19/17	Hardin	30	66
10-0654-EL-BGN	11-5543-EL-BGA 16-1423-EL-BGA 17-0627-EL-BGA	Hog Creek II	withdrawn			
13-0197-EL-BGN	16-0343-EL-BGA 16-1687-EL-BGA 17-1099-EL-BGA	Northwest Ohio	9/10/18 withdrawn 9/10/18	Paulding	42	100
				TOTALS:	327	669.8

Approved Wind Facilities

Case Number	Related Cases	Project Name	Approval Date	County	Turbines	MW
08-0666-EL-BGN	13-0360-EL-BGA 17-2516-EL-BGN	Buckeye I	3/22/10 2/18/14 pending	Champaign	54	135
09-0479-EL-BGN	11-3446-EL-BGA 14-1030-EL-BGA 16-0469-EL-BGA 16-2404-EL-BGA 18-0677-EL-BGA	Hardin[1]	3/22/10 12/5/16 withdrawn 2/2/17 3/2/17 6/21/2018	Hardin	200	300
10-2865-EL-BGN	14-1591-EL-BGA 17-1148-EL-BGA 18-1346-EL-BGA	Black Fork	1/23/12 8/27/15 12/7/17 pending	Crawford, Richland	91	200
12-0160-EL-BGN	17-2517-EL-BGA	Buckeye II	5/28/13 pending	Champaign	56	140
13-0990-EL-BGN	15-1921-EL-BGA	Greenwich	8/25/14 5/19/16	Huron	25	60
13-1177-EL-BGN	14-1557-EL-BGA 16-0725-EL-BGA 16-1717-EL-BGA 17-0759-EL-BGA 17-2108-EL-BGA 18-1473-EL-BGA	Scioto Ridge	3/17/14 11/12/15 5/19/16 10/25/16 7/6/17 3/15/18 withdrawn	Hardin, Logan	105	231
18-0091-EL-BGN		Timber Road IV	2/21/2019	Paulding	37	125.1
[1] under construction				TOTALS:	568	1,191.1

Pending Wind Facilities

Case Number	Project Name	Filing Date	County	Turbines	MW
16-1871-EL-BGN	Icebreaker	2/1/2017	Cuyahoga	6	20.7
17-2295-EL-BGN	Republic	2/2/2018	Seneca, Sandusky	50	200
18-0488-EL-BGN	Seneca	7/16/2018	Seneca	77	212
18-1607-EL-BGN	Emerson Creek	1/31/2019	Erie, Huron	71	297.7
			TOTALS:	204	730.4

Economic Benefits of Ohio's Certified and Pending Wind Farms

- 1,921 MWs
- $3.84 BILLION in Capital Investment
- $17.2 MILLION in annual local tax revenue OR $519 MILLION over the life of the projects
- $16.9 MILLION in annual landowner revenue OR $506 MILLION over the life of the projects

History of Ohio's Wind Turbine Setback Laws

2008

The Ohio Legislature passes Senate Bill 221, creating Ohio's AEPS

Property line setback: 1.1 times the height of the turbine from its base to vertical blade tip (approximately 550 feet)

Habitable structure setback: 750 feet plus blade length (approximately 925 feet)

Important –Wind farm development is Ohio is regulated by the Ohio Power Siting Board (OPSB)

2011

Blue Creek Wind Farm and Timber Road Wind Farms are operational

2012

Habitable structure setback: increased to 1,125 plus blade length, or approximately 1,300 feet

2014

Property line setback: increased to the same as the habitable structure setback –1,300 feet – increasing the distance more than 2.5 times

Applications for new wind farms halt

2015-2016

Ohio House considers House Bill 190

Proposal

Give individual counties which wanted wind farms to have the authority to choose to revert to the habitable structure setback of 1,125 plus blade length

H.B. 190 dies in 131st General Assembly

2017

Industry and Partners working to get solution into Biennial Budget

Proposal

Property line setback 1.2 times height of turbine from base to vertical blade tip

Increases habitable structure setback to 1,225 feet from the tip of the turbine's nearest blade at 90°

Codify public notification provisions

2018

Ohio Senate considers Senate Bill 238

Proposal

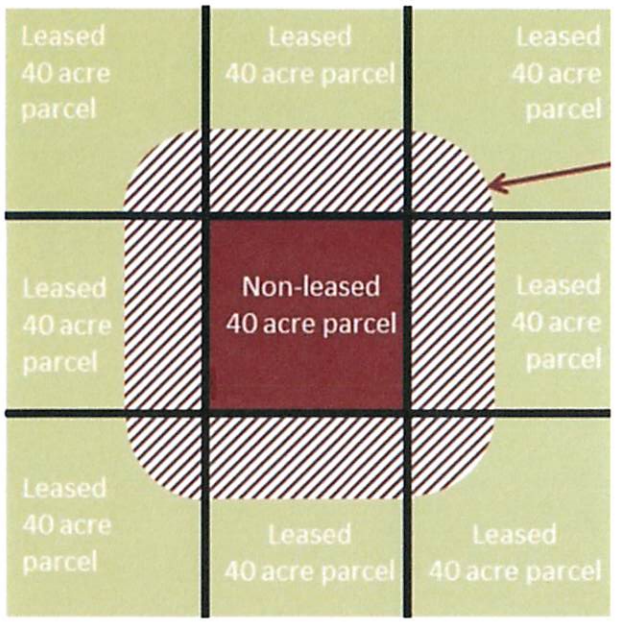
Property line setback 1.2 times height of turbine from base to vertical blade tip

Increases habitable structure setback to 1,225 feet from the tip of the turbine's nearest blade at 90°

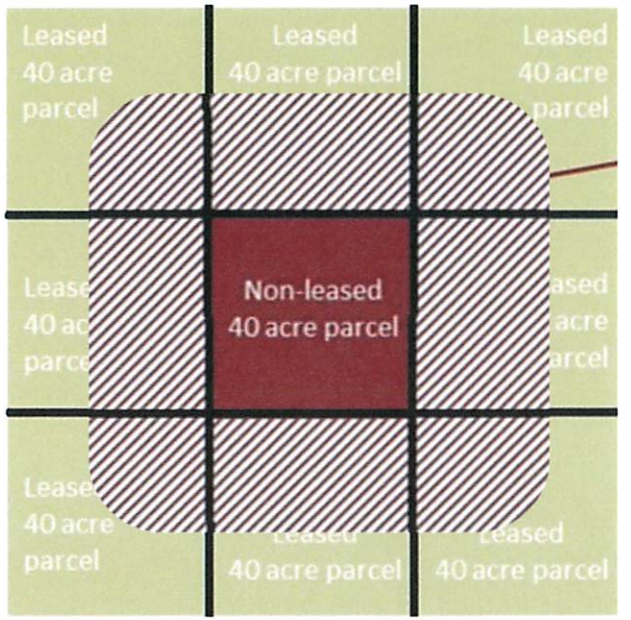
Requires the OPSB to require applicants to hold a public meeting and provide notice via newspaper and by letter to neighbors

S.B. 238 dies in 132nd General Assembly

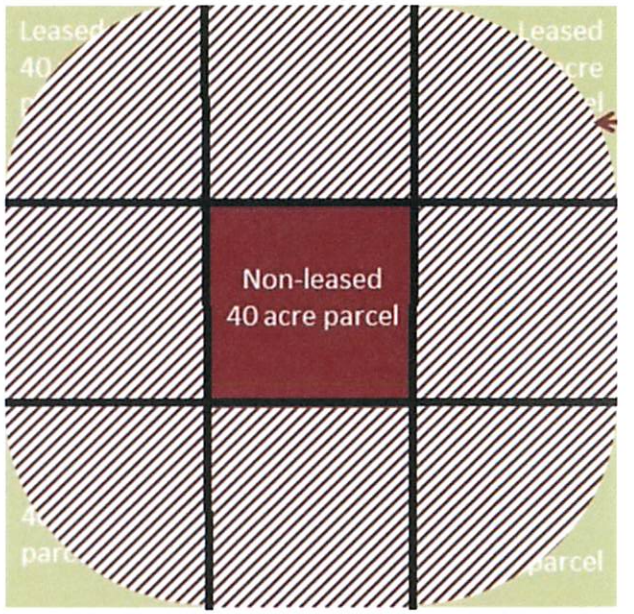
Private Property Rights and Siting in Ohio



Under previous setback requirements (1.1 times height of turbine from base to tip of highest blade – approx. 550 ft.), setbacks onto neighbors' property totaled **87 acres**, protecting neighbors' rights while still allowing wind development.



Under the proposed setback requirement (1.2 times height of turbine from base to tip of highest blade) neighboring properties have an **112 acre** buffer — an **additional 25 acres** from pre– 2014 setbacks.



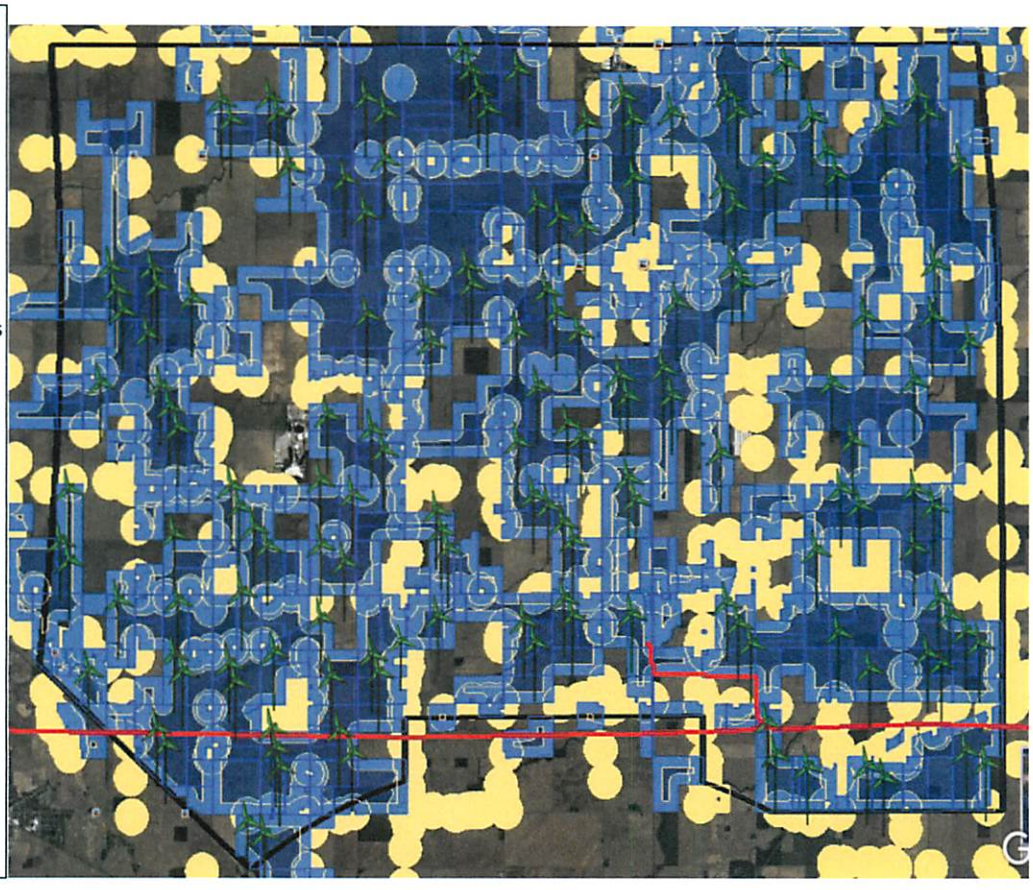
Current law created in 2014 by HB 483 (1125 ft. plus length of blade – approx. 1300 ft.) blocks wind development with setbacks onto neighbors' property totaling **283 acres**.

Blue Creek Wind Farm (Northwest Ohio)

Google Earth Snapshots

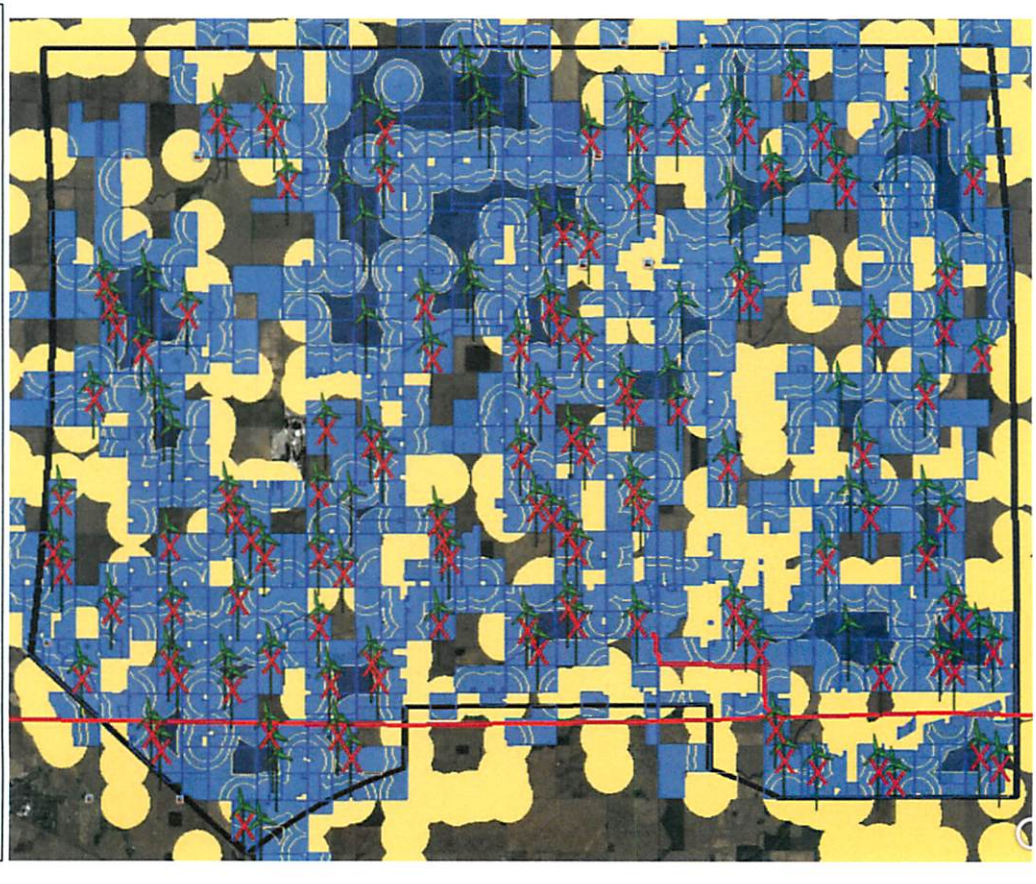
Wind Farm built under 2008 property line setbacks

- Wind Farm Boundary
- Property Line Setbacks (525 Feet)
- Available land to construct turbines
- Habitable structure setback
- Existing turbines



Wind farm (simulated) *IF* constructed under 2014 property line setbacks

- Wind Farm Boundary
- Property Line Setbacks (1,300 Feet)
- Available land to construct turbines
- Habitable structure setback
- Existing turbines
- Eliminated turbines



Corporate Purchasers of Wind

Wind is a "No-Regrets" Investment for Non-Utility Customers

Corporate and other non-utility customers are setting ambitious targets for renewable energy procurement, and are choosing wind energy more than any other source. Wind energy provides a cost-competitive solution for companies seeking to power their businesses with clean, renewable energy at a long-term stable price.

More than 9,100 megawatts (MW) of U.S. wind power were procured through the end of 2017 by corporate and other non-utility customers. Corporate customers can purchase wind energy in a number of ways, including wholesale or retail transactions, making a direct investment in a wind project, or purchasing renewable energy credits (REC).

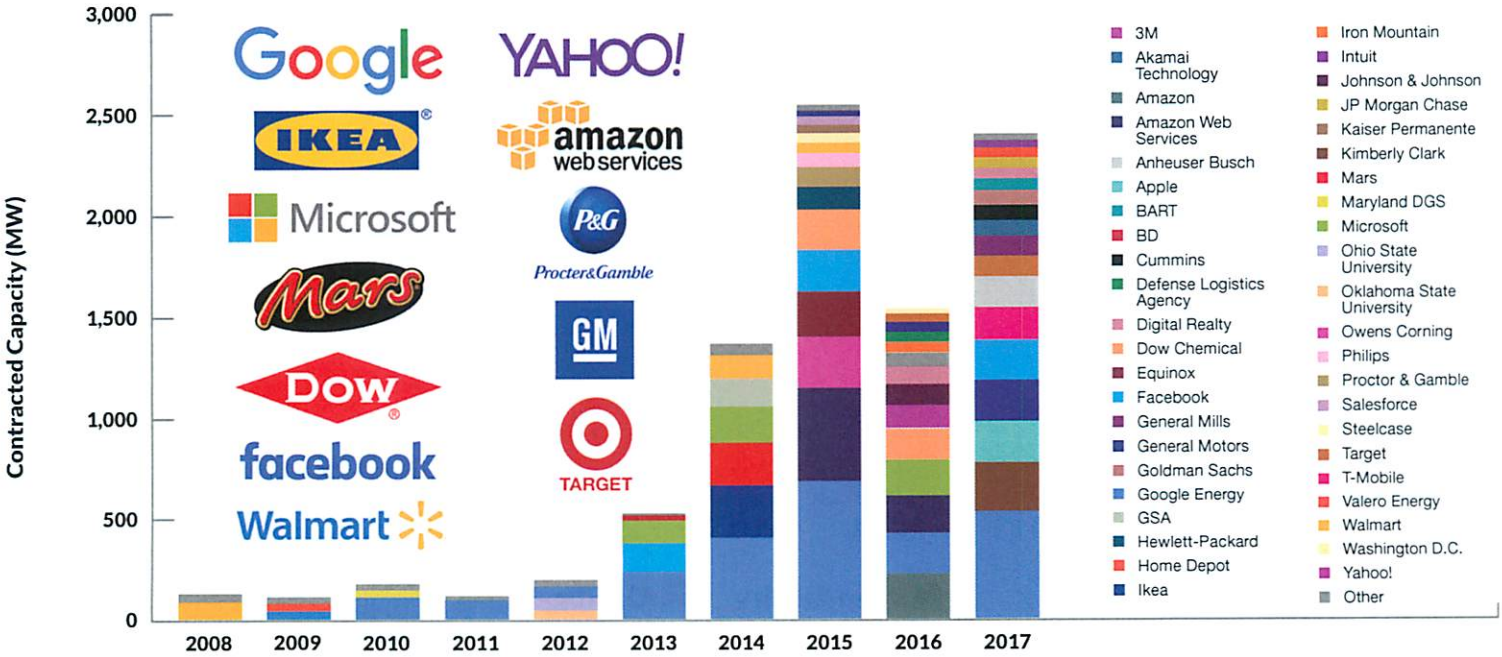
Power purchase agreements (PPA) remain one of the most popular tools available, allowing companies to buy electricity from a specific wind project over time at a stable rate.

In addition, states with attractive renewable energy policies can spur economic investment from corporate customers and wind project developers alike. Companies investing in wind energy prefer to site new facilities near the wind projects where their energy is procured.

Companies Recognize the Value of Wind

"New wind projects generate clean power and new jobs and economic growth in communities from coast to coast, and every state in between, all while lowering the carbon footprint of the U.S."
— Microsoft, August 2018

WIND POWER PURCHASES BY NON-UTILITY CUSTOMERS



Note: Data include publicly announced physical and virtual power purchase agreements (PPA), direct ownership of onsite or offsite wind projects, and large-scale REC purchases associated with specific wind projects. Data is recorded at the time of announcement and does not indicate when the associated wind project is placed into operation.

AWEA AMERICAN WIND ENERGY ASSOCIATION

"Wind in the US ... has tremendous economics. With cost parity to the fossil fuel alternative it makes sense."
— Mars Inc., 2/2015

"Dow is always looking for win-win solutions – good for the environment and good for business. By entering into this agreement, Dow is taking a serious approach to our future energy needs in Texas and cost-competitive wind energy is a great opportunity."
— Dow Chemical, 3/2015

"We look for [wind projects] because in addition to creating more renewable energy and strengthening the local economy, they also make for smart investments. They offer attractive returns relative to the risks and allow us to invest in a broad range of assets."

— Google Energy, 1/2013

"The US has amazing wind and sun resources that will never run out. We are delighted to make this investment – it is great for jobs, great for energy security, and great for our business ... We invest in our own renewable energy sources so that we can control our exposure to fluctuating electricity costs."
— IKEA, 4/2014

"A power purchase agreement allows Walmart to save on utility costs and purchase green energy without requiring up-front capital expense."
— Walmart, 9/2015

"At Target, we're always on the lookout for sustainable ways to operate our facilities. We're thrilled to make our start with wind power in Texas, a leading market for wind energy."
— Target, 7/2016

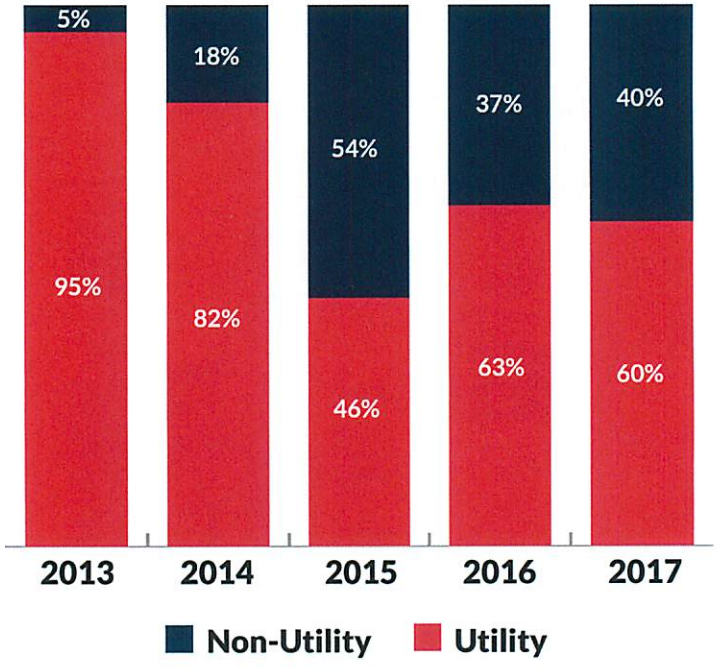
"When looking at wind deals, cost savings are one attribute I can bring up when I talk to our finance and accounting department. Have you ever seen your electric bill go down for multiple years at a time?
—General Motors, 5/2016

"Even more than saving money, [PPAs are] about protecting against future volatility."
— Yahoo!, 10/2015

"We're far from being done. We'll continue pursuing projects that deliver clean energy to the various energy grids that serve AWS data centers, we'll continue working with our power providers to increase their renewable energy quotient."
— Amazon Web Services, 7/2015

"Where possible, we would like to procure renewable energy from projects near our operations and / or on the regional energy grids that supply our facilities so our efforts benefit local economies and communities as well as enhance the resilience and security of the local grid."
— Corporate Renewable Energy Buyers' Principles, 12/2015

POWER PURCHASE AGREEMENTS SIGNED OVER TIME, BY TYPE OF POWER PURCHASER



For more information go online to: www.awea.org/2Q2018 *or* www.awea.org/amr2017 *or* www.awea.org/corporate-purchasers

AWEA AMERICAN WIND ENERGY ASSOCIATION

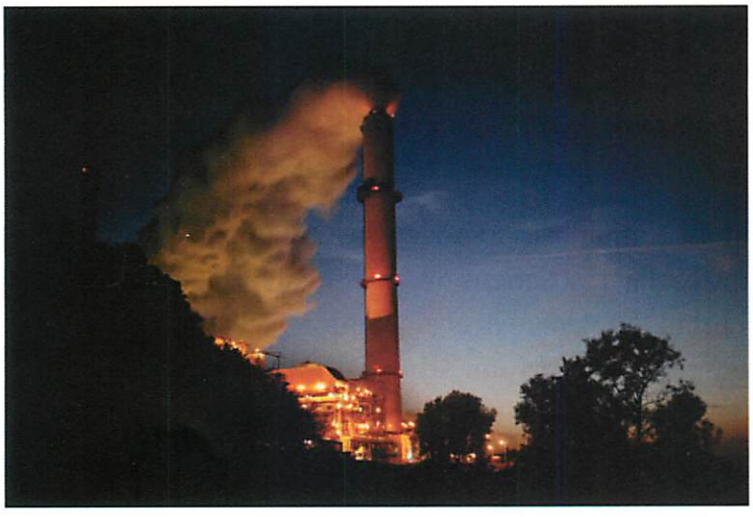
THE WALL STREET JOURNAL.

https://www.wsj.com/articles/utilities-speed-up-closure-of-coal-fired-power-plants-11547035201

BUSINESS

Utilities Speed Up Closure of Coal-Fired Power Plants

Wind, solar and natural gas become more cost-competitive, driving shift to new energy sources



A Northern Indiana Public Service generating station in 2015. The Midwestern utility plans to close all five of its remaining coal-fired power plants within the next decade. PHOTO: LUKE SHARRETT/BLOOMBERG NEWS

By Katherine Blunt

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Just last summer, Northern Indiana Public Service Co. NI -0.25% ▼ planned to retire two of its five remaining coal-fired power plants by 2023. Now, it plans to do away with all of them over the next decade, and buy more solar and wind power instead.

The Midwestern utility's decision is part of a broader shift among American utilities toward less costly energy sources. The companies are accelerating the closure of coal plants, as wind and solar power become more economical alternatives, aided by federal subsidies, and natural gas continues to be a cheap fuel for electricity in the U.S., thanks to the shale-drilling boom.

Northern Indiana Public Service, part of NiSource Inc., concluded that phasing out coal sooner was worth it because it would move the company to what is becoming a cheaper source of power, and ultimately reduce costs for its 470,000 customers by as much as $4 billion over 30 years. The transition would require raising average rates by a proposed $11 a month starting later this year, because of higher short-term costs associated with closing the plants, but the company expects the shift would reduce its overall generation costs starting in 2023.

"We'll continue to see renewables and other technology become more cost competitive," said Joe Hamrock, NiSource's chief executive. "There's recognition that the market is changing in a fundamental and permanent way."

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>
> —Joe Hamrock, CEO of NiSource, the parent company of utility Northern Indiana Public Service

The shift is taking place as the Trump administration tries to revive the coal industry by rolling back environmental regulations and easing restrictions on building new plants. Those efforts have done little thus far to curtail the closure of coal plants, which account for the majority of U.S. coal demand. The Energy Information Administration estimated that domestic coal consumption in 2018 fell to 691 million tons, the lowest level since 1979, and expects it to continue dropping this year.

Xcel Energy Inc. said last month that it plans to shift entirely to 100% carbon-free power generation by 2050, becoming the first major U.S. utility to make such a pledge.

The company, which covers parts of Colorado, Minnesota and six other states, says that coal could account for as little of 10% of its power mix by 2030. It was more than one-third of the mix in 2017. Xcel expects lower fuel and production costs will eventually offset some initial rate increases.

Xcel CEO Ben Fowke said improvements in technology have enabled his company to purchase wind and solar power at a fraction of the prices it paid a decade ago. He expects renewables to account for more than half of the company's power generation by 2024.

"I would never have thought we could have achieved anything near that five or 10 years ago while keeping our prices affordable," he said.

Last summer, Colorado regulators approved Xcel's plans to retire two coal units in 2022 and 2025, respectively, with each roughly a decade ahead of schedule. Xcel plans to replace them with renewable energy and battery storage, a shift the company says will at first be cost-neutral with longer-term benefits. Retiring the units more quickly is likely to reduce Xcel's costs by as much as $215 million by 2054, the company says.

The moves are leading some experts to step up estimates for the phaseout of coal power in the U.S. In 2017, research firm Wood Mackenzie projected that companies would retire 46 gigawatts of coal-generating capacity by 2027. Last year, it raised that projection to 57 gigawatts.

"Several years ago, even though a company might have wanted to go to renewables, they knew it was going to be expensive," said Matt Preston, a Wood Mackenzie coal analyst. "It has become clear that the cost is coming down."

Not all utilities are retiring coal plants faster than expected. The changes vary by region and depend on a number of factors, including proximity to coal mines and wind-producing regions and the age and efficiency of the plants.

Still, coal's decline has raised concerns among regulators that a rapid shift to natural gas and renewables could come at the expense of power-grid reliability. Coal plants have historically served as generation workhorses, running nonstop to serve demand for power. Wind and solar farms, and some natural-gas plants, run more intermittently.

Within PJM Interconnection, a sprawling power grid and wholesale electricity market that serves 13 states from Virginia to Illinois, coal-fired electricity generation in the first nine months of 2018 fell 5.2% from the same period a year earlier. Natural-gas-fired generation, meanwhile, rose 19% during the same period.

Andrew Ott, PJM's chief executive, said he expects the pace of coal retirements to remain steady in the system. But for the first time last year, PJM did an analysis that included determining where a loss of generation capacity could disrupt the grid. The study found it would take a substantial loss of plants to cause reliability problems, but emphasized the importance of maintaining adequate resources.

"Fuel security is not something we would have looked at in the past," Mr. Ott said.

Northern Indiana Public Service, located within another regional electricity grid, the Midcontinent Independent System Operator, decided to retire four coal units within the next five years and its final one by 2028, after soliciting bids from wholesale power providers last year.

It received 90 proposals for a range of technologies, including wind and solar generation priced at roughly $27 to $40 per megawatt hour. By comparison, the company estimated that continuing to operate its coal fleet would cost between $57 and $82 per megawatt hour.

"We were certainly surprised," said Mr. Hamrock, the CEO of the utility's parent. "We're in a very different moment with renewables dramatically more competitive for our customers in our region."

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