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OHIO'S ELECTRICITY FUTURE

Assessment of Context and Options

Analysis Group

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This Report presents a review of the current challenges facing Ohio with respect to electricity markets, regulation and policy, and an evaluation of potential options for moving forward. This is an independent report by Analysis Group, supported by funding from Advanced Energy Economy (AEE). The authors wish to thank AEE for its interest in electric issues in Ohio, and for its support of the analysis presented in this report. In addition, the authors would like to thank Anne Williams of Analysis Group for research assistance throughout the project.

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Analysis Group's energy and environment practice is distinguished by expertise in economics, finance, market analysis, regulatory issues, and public policy, as well as significant experience in environmental economics and energy infrastructure development. The practice has worked for a wide variety of clients including energy producers, suppliers and consumers; utilities; regulatory commissions and other public agencies; tribal governments; power system operators; foundations; financial institutions; and start-up companies, among others.

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1. EXECUTIVE SUMMARY

Ohio is at a crossroads. Few states face so strong and challenging a connection between energy, economic, and climate goals: the health and well-being of the state's residents rest in part on the strength of its economy, and the state's economy – its output, jobs, and tax revenues – is historically tilted towards energy and electricity-intensive industrial activity. Electricity generation, in turn, has traditionally been dependent on fossil fuels, which face increasing costs to address environmental impacts. The links between energy, economy, climate, and the environment are more evident in Ohio than almost anywhere across the United States.

Not surprisingly, the discourse around energy and environmental policy in the state is a difficult one. It involves long-standing capital intensive investments in traditional energy resource production and use, the emergence of new energy production and consumption models and technologies, the shifting economics of fuels for electricity generation, and the growth of federal and state efforts to mitigate the environmental impacts of energy production and use. These shifts are beginning to significantly affect the electric industry business model in some states and regions, and are changing the discourse over electricity resources nearly everywhere. To some extent, the pace of technological change – whether it allows for the more economic extraction of traditional fuels for electricity generation, or for consumers to take matters into their own hands through energy efficiency ("EE"), advanced energy controls, and distributed generation – has the potential to outstrip our ability to keep up with its impact on the electric industry structure and policy, and on utility rates.

In this report we review the current context for decision-making at the state level on policies that influence which resources will be used to meet the electricity needs of Ohio consumers in the coming years. We focus on the interaction of state policy with the wholesale markets within which Ohio producers operate, and consider various leading technologies and approaches on the table over the next five to ten years. We highlight the relative impact of electricity resource technologies and investment options on a wide range of economic, energy and environmental policy interests, including reliability, cost, in-state economic activity, state control over resource mix decisions, and environmental impacts and costs. Finally, we identify a number of potential future state approaches to meeting the electricity needs of Ohio's business and residential consumers, and draw out observations that policy makers may consider in setting a path forward.

Our analysis is not meant to identify the "right" path forward, or to identify a particular strategy or group of strategies that Ohio *should* adopt going forward. Instead, we attempt to outline the context for decision-making within the state, to identify plausible technologies and policy approaches to meeting Ohio's future needs, and to present an objective evaluation of various criteria that may be of interest to Ohio's legislators, policy makers, market participants,

and other stakeholders. In the end, though, we believe there are some fairly straight-forward conclusions to draw about the risks and benefits of certain resources, and note these below.

In short, based on our analysis we come to the following observations:

Over the next five to ten years, Ohio will likely add significant new supply and/or demand resources to replace existing, aging infrastructure, meet electrical demand growth, and meet environmental compliance obligations, a circumstance that is driven by load growth, the changing economics of fuel supply, and the need for investment in existing resources to maintain operational capability and meet current and emerging environmental compliance obligations.

There is a broad set of circumstances driving the need for Ohio to clearly – and without delay – evaluate its approach to meeting electricity resource needs in the coming years, including at least the following factors:

- The expected growth in demand for electricity and the likely investment in – and impact on growth of – demand response and energy efficiency programs and measures;
- Ohio's electric industry, its commitment to and pace of movement towards full wholesale and retail competition, and reliance (in part) on regional wholesale markets to meet the electric resource and reliability needs of Ohio's business and residential customers;
- Ohio's reliance on coal-fired resources, and how the full scope of changes in the industry and integration with regional bulk power systems and markets is likely to influence Ohio's resource mix;
- The implementation of existing – and emergence of new – emission control obligations promulgated by the Environmental Protection Agency ("EPA"), and the implications of Ohio's resource mix for compliance actions and costs; and
- The changing costs and technological growth in electricity generation and demand response resources, and in the fuels that power generation resources.

In considering alternatives, Ohio will need to use evaluation criteria that focus on the State's collective economic and energy/environmental policy objectives and priorities, including factors such as:

- *Reliability* – the fundamental obligation to maintain reliable power supplies for the convenience of Ohio's residents, promotion of economic activity, and public health and safety. Resource alternatives affect the reliability of electricity supply in Ohio in their overall quantity, location, and operational characteristics (e.g., their ability to ramp up or down quickly, and the controllability of their power output).
- *Cost* – the need to seek resource alternatives that minimize the cost to Ohio's business and residential electricity consumers, subject to the various constraints on resource

development and operation, such as maintaining reliability, and meeting regulatory and compliance obligations.

- *Capacity investment risks* – reflecting the degree of financial risk borne by Ohio's captive ratepayers associated with selecting resources for development, completing the permitting, siting and construction process, and operating the resources over time in the regional wholesale markets.
- *Ohio's jurisdiction and control* – the ability of Ohio's legislators and policy makers to influence the resource mix in the state over time.
- *Economic impacts in Ohio* – the impact of resource decisions on Ohio's economic activity, imports/exports, jobs, and tax revenues.
- *Health and environment impacts* – the impact of resource decisions on the public health and safety of Ohio's residents, on Ohio's environment, and on the social, economic and environmental risks associated with climate change.
- *Emission control obligations* – the impact of resource decisions on the costs to Ohio for complying with current and emerging emission control requirements on power plants.

There are a wide variety of potential resources and energy policy options that may be considered with respect to meeting Ohio's future needs, including energy efficiency and demand response measures and programs, gas-fired capability (increase utilization of existing, and/or building new), dual-fuel capability (adapt existing or build new), coal-fired capability (extend the life of existing, and/or build new), renewable resources (grid connected and/or distributed behind-the-meter), and imports (increase power imported from outside Ohio).

Consideration of policy options and objectives need to be viewed through the lens of the interaction of state policy with competitive wholesale market outcomes – Ohio sits within the PJM Interconnection, a region where identified demand for electric generating resources is met through regional capacity market auctions. PJM's capacity market auctions – conducted three years prior to the year of need – strongly influence which resources – whether inside or outside the state – will be used to meet Ohio's demand for electricity, and the price paid for that capacity.

Ohio can influence regional market outcomes with respect to resources in Ohio through one or a combination of several basic economic/environmental policy approaches including, for example:

(1) State support or requirements for investment in energy efficiency, demand response, and behind-the-meter generation, all of which reduce the quantity of capacity procured by Ohio suppliers and utilities – and the price paid for such capacity – in PJM's capacity market;

(2) State support or requirements for the purchase of in-state or out-of-state renewable and combined heat and power ("CHP") resources, which could lead to more such resources

being developed, displacing resources that otherwise would be procured in PJM's capacity market;

(3) State support for the continued operation of Ohio generating assets such as coal or nuclear capacity (as recently proposed by American Electric Power ("AEP Ohio")) through long-term contracts paid for by Ohio electricity consumers, keeping in service resources that otherwise may retire and be replaced through PJM's auctions with lower-cost resources; and/or

(4) State determination to let PJM's regional wholesale markets determine the resources developed – inside and outside of Ohio – to meet Ohio customer needs, through the participation of Ohio suppliers and utilities in the regional wholesale markets. In this instance, the most likely outcome would include retirement of significant older generating capacity within the state, replaced primarily by merchant natural gas-fired and wind resources inside or outside the state.

A number of key observations follow from a review of the options available using the evaluation criteria discussed above, that warrant consideration by Ohio policy makers and stakeholders when charting a path for Ohio's future electric industry:

- The electric industry is changing in fundamental ways driven primarily by changing fuel economics, the accelerated development and commercialization (and improving economics) of distributed demand- and supply-side resources and technologies, and the advancement of both state and federal energy and environmental policies. Prudent development and administration of Ohio's energy policies and regulations should explicitly evaluate and reflect changes in the industry and incorporate lessons learned from other states and regions.

- In-state economic development, the cost of electricity supply to Ohio's businesses and residents, and the opportunity to mitigate the impact of wholesale market outcomes on Ohio's consumers suggests a concerted effort to capitalize on cost-effective deployment of energy efficiency, demand response, and renewable resources within the state. This approach may provide an effective economic hedge against the advancement of current and future state and federal laws and regulations addressing the public health, environmental, and climate risk impacts of traditional fossil-fueled power plant operations.

- The PJM region will continue to undergo significant transformation over the next decade in response to economic and regulatory factors governing the prudence of and financial incentives for continued operation of existing assets, and investment in new electricity infrastructure. The transformation will likely involve a meaningful shift away from less efficient coal and other fossil-fired resources, and towards more new natural gas combustion turbine and combined cycle plants and wind-powered resources. The degree of change associated with this transition will be determined primarily by

wholesale market economics, but will also be influenced by state actions and policies governing in-state resources.

- Left to wholesale market outcomes, while still heavily dependent on its dominant fuel – coal – Ohio will likely see a continued shift in capacity and generation away from coal towards more efficient and less carbon-intensive natural gas and other resources. The investment risk associated with this shift will largely be borne not by Ohio ratepayers, but by competitive wholesale market investors and developers.
- To the extent that Ohio establishes policies to continue operation of existing coal-fired assets that otherwise would be uneconomic, the cost risk associated with this approach may be shifted to captive ratepayers, and the overall cost of wholesale supply to consumers may be higher.

Table 1
Resource Alternatives and Evaluation Criteria

Resource Alternative	Reliability	Cost	Ratepayer Risk	State Resource Selection	State Economic Impact	Public Health & Environmental Impact	Environmental Compliance
Increase existing and develop new, natural gas-fired/dual-fuel and wind resources	✓	✓	✓	–	–	–	–
Extend life of existing coal-fired resources, and/or build new ones, through contracts	✓	–	X	✓	–	X	X
Concerted expansion of energy efficiency and demand response resources	✓	✓	✓	✓	✓	✓	✓
Concerted expansion of renewable and CHP resources	–	–	–	✓	✓	✓	✓

2. OHIO'S ELECTRICITY CONTEXT

Introduction

Historically, Ohio's electricity context has been characterized by (1) a strong industrial and manufacturing make-up of Ohio's economy, and an associated strong dependence on reliable energy supply; (2) the total domination of coal as the primary source for power generation; and (3) a constant and stable electric industry structure based primarily on vertically-integrated, investor-owned electric utilities subject to state cost-of-service regulation.

Some of these factors – in particular the strong links between energy, industry, and the state's economy, and between coal use and climate risks – present formidable challenges when considering the path forward for the electric industry, challenges that complicate the discourse on the approach to energy policy within the state. Regardless of where one stands in the debate over the future of Ohio's electric industry, one thing cannot be avoided and should not be ignored: the electric industry in Ohio is undergoing a period of major change, change that is due, to a significant extent, to forces external to Ohio's legislative and regulatory efforts. Key forces include the underlying economics of traditional power supply, the emergence of new technologies for electric supply and demand management, the presence of competitive market forces, structural changes in the electric industry, and the influence of existing and emerging environmental regulatory obligations.

The strong links between energy, industry, and the state's economy, and between coal use and climate risks, complicate the discourse on state energy policy.

In order to "set the table" for our review of options going forward, in this section we review some of the background of the electric industry in the state. We start with a summary of the current players and technologies in Ohio's electricity supply. We then provide an overview of recent changes in the structure of the industry, and specifically review recent legislation and policies focused on electricity supply and demand.

Overview

Electric customers of Ohio are provided with transmission and distribution services from one of the state's Investor-Owned Utilities ("IOU"), or fully-bundled electric service from a variety of municipal light companies and electric cooperatives. As summarized in **Table 2** below, there are four large IOUs that provide bundled or delivery-only electricity service to approximately 88 percent of Ohio consumers: AEP Ohio, FirstEnergy, Duke Energy Ohio, and Dayton Power and Light. Cooperative and municipal electric companies each provide electricity to 5 percent of Ohio electric customers. The other two percent of electric sales are from unregulated utilities within the state.

Table 2
Top Five Utilities Retail Sales, Revenues, and Customers in Ohio by Ownership Type, 2012

#	Utility	Retail Sales (MWh)	Revenues ('000)	Customers
Investor Owned Utilities				
1	Ohio Power Co (AEP Ohio)	46,904,916	3,345,723	1,460,393
2	Ohio Edison Co (FirstEnergy)	24,440,821	1,184,237	1,031,761
3	Duke Energy Ohio Inc	19,929,527	997,245	689,045
4	Cleveland Electric Illum Co (FirstEnergy)	18,772,312	835,525	745,326
5	Dayton Power & Light Co	13,997,161	933,819	513,073
	Top 5 Total	*124,044,737*	*7,296,550*	*4,439,598*
	IOUs Total	*134,633,906*	*7,696,561*	*4,747,746*
	Top 5 as a Percentage of Total IOUs	*92%*	*95%*	*94%*
Cooperative				
1	South Central Power Company	2,230,108	241,114	115,463
2	Pioneer Rural Elec Coop, Inc - (OH)	589,197	57,725	16,515
3	Union Rural Electric Coop, Inc	473,542	43,824	8,490
4	Consolidated Electric Coop Inc	361,552	40,019	16,459
5	Licking Rural Electric Inc	358,642	47,969	24,495
	Top 5 Total	*4,013,041*	*430,650*	*181,422*
	Cooperatives Total	*7,619,825*	*861,701*	*376,206*
	Top 5 as a Percentage of Total Cooperatives	*53%*	*50%*	*48%*
Municipal				
1	City of Cleveland - (OH)	1,617,570	165,216	73,110
2	City of Columbus - (OH)	792,433	89,029	12,603
3	City of Hamilton - (OH)	583,773	61,675	28,979
4	City of Bowling Green - (OH)	492,669	42,068	14,615
5	City of Westerville - (OH)	488,548	45,712	16,317
	Top 5 Total	*3,974,993*	*403,700*	*145,624*
	Municipals Total	*8,501,732*	*818,464*	*311,316*
	Top 5 as a Percentage of Total Municipals	*47%*	*49%*	*47%*

Notes & Sources:
[1] EIA Form 861.
[2] Analysis limited to top five utilities based on total retail sales with a service type of bundled and delivery. Total does not include sales, revenues, or customers from the transportation sector.
[3] 'Top 5 as a Percentage of Total IOUs/Cooperatives/Municipals' represents the portion of total sales, revenues, and customers made up by the top five utilities for the given ownership type.
[4] Ohio Power Co is a subsidiary of AEP Ohio. Ohio Edison Co and Cleveland Electric Illum Co are subsidiaries of FirstEnergy.

Structural Change in the Ohio Electric Industry

Like many other states, Ohio has restructured its electric industry to introduce competition in generation. Ohio began restructuring its electric market in 1999 with the passage of Amended Substitute Senate Bill 3 ("SB3"). Prior to 1999, the distribution, transmission, and generation service from electric utilities was provided to customers as a bundled service primarily by several vertically-integrated utilities under cost of service rates. SB3 took effect in January 2001 with a market development program that, between 2001 and 2005, froze electric rates and required utilities to unbundle and separate the generation portion of their businesses from the distribution and transmission segments, establishing retail markets.[1] Also in this time period, Ohio companies became part of the PJM Interconnection, integrating Ohio's power generation and transmission within PJM's open access transmission and wholesale market structures.

Competitive retail markets failed to develop as quickly in Ohio between 2001 and 2005 as had been envisioned under SB3. At the end of 2005, there were a limited number of competitive electric suppliers and a relatively low degree of market activity in the state. Concerned that an immediate shift to market-based rates in 2006 would not be in the best interest of consumers and could cause "rate shock," policymakers enacted a rate stabilization period from 2006 through 2009. During this time the Public Utilities Commission of Ohio ("PUCO") worked with the state's electric utilities to develop Rate Stabilization Plans that would gradually transition customers to market-based rates.[2]

The restructuring process continued in Ohio with the passage of Amended Substitute Senate Bill 221 ("SB221") in 2008. In addition to establishing a renewable portfolio standard ("RPS") and an energy efficiency resource standard ("EERS") for the state (discussed further below), requirements for separating corporate entities were strengthened under the law.[3] SB221 required the state's electric utilities to provide for energy supply to customers through either an Electric Security Plan (similar to a traditional rate plan for the supply and pricing of electric generation service) or a Market Rate Option (a rate plan that uses a competitive bidding process to set generation prices, and gradually transition customers to full market-based pricing).[4]

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[1] In the Matter of the Commission's Investigation of Ohio's Retail Electric Service Market, Before the Public Utilities Commission of Ohio, Case No. 12-3151-EL-COI, December 12, 2012.

[2] Todd A. Snitchler, "The Emerging Ohio Market," presented at 21st Century Manufacturing Task Force, November 26, 2012.

[3] In the Matter of the Commission's Investigation of Ohio's Retail Electric Service Market, Before the Public Utilities Commission of Ohio, Case No. 12-3151-EL-COI, December 12, 2012.

[4] Todd A. Snitchler, "The Emerging Ohio Market," presented at 21st Century Manufacturing Task Force, November 26, 2012. The ESP is similar to a traditional rate plan for the supply and pricing of electric generation service, while the MRO is a rate plan that uses a competitive bidding process to set generation prices and gradually transition customers to full market-based pricing.

SB221 also increased the number of pricing and technology options available to customers choosing non-traditional suppliers, including time-differentiated pricing, advanced metering infrastructure, demand-side management, distributed generation, and programs sourcing electricity from advanced and alternative energy sources.[5] Since the passage of SB221, the state's four largest IOUs have all filed Energy Security Plans, approved by the PUCO: FirstEnergy in 2010 (with a revised plan in 2012); Duke Energy Ohio in 2011; AEP Ohio in 2012; and Dayton Light and Power in 2013.[6]

In December 2012, the PUCO opened a docket to investigate "where the market is working, [where it is] in need of improvement, and how the retail market could be improved for the benefit of consumers." In January 2014, the PUCO staff shared their findings and recommendations, including that electric investor-owned utilities be structurally separated from their retail sales arms, and be required to procure electricity for their standard offer service load through a competitive process.[7] Under the separation timeline, the Ohio IOUs were (or will be) structurally separated according to the following schedule: AEP Ohio by January 2014; Duke Energy Ohio by December 2014; and Dayton Power & Light by May 2017. First Energy structurally separated in 2009.[8]

Resource Portfolio Standards

In 2008, as part of SB221, Ohio adopted resource portfolio standards requiring the implementation of energy efficiency and the purchase/development of renewable energy

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[5] In the Matter of the Commission's Investigation of Ohio's Retail Electric Service Market, Before the Public Utilities Commission of Ohio, Case No. 12-3151-EL-COI, December 12, 2012.

[6] "FirstEnergy's Electric Security Plan," Public Utilities Commission of Ohio, available at http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/firstenergye28098s-electric-security-plan/#sthash.6yBcTpRC.dpbs; "Duke Energy Ohio's Electric Security Plan," Public Utilities Commission of Ohio, available at http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/duke-energy-ohio-s-electric-security-plan/#sthash.Ri9hqQtM.dpbs; "AEP Ohio's Electric Security Plan," Public Utilities Commission of Ohio, available at http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/aep-ohio-s-electric-security-plan/#sthash.cbnA9PxZ.dpbs; "Dayton Power & Light's Electric Security Plan," Public Utilities Commission of Ohio, available at http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/dayton-power-lighte28098s-electric-security-plan/#sthash.jC72rC3B.dpbs.

[7] For example, in response to this docket, First Energy announced its proposed "Powering Ohio Progress" plan in August 2014. The plan asks the PUCO to approve a power purchase agreement between its regulated Ohio distribution utility and their unregulated generation affiliate, FirstEnergy Solutions. Under the proposal, First Energy would buy all the electricity from certain of its coal and nuclear plants, and would then sell the output of those power plants into the competitive markets. See Kowalski, Kathiann M., "FirstEnergy touts benefits of plan critics decry as 'bailout," Midwest Energy News, August 14, 2014, available at http://www.midwestenergynews.com/2014/08/14/firstenergy-touts-benefits-of-plan-critics-decry-as-bailout/

[8] Andrew R. Thomas, "Electricity Markets in Ohio," Cleveland State University, July 2014.

resources. SB221 established both an RPS and an EERS for electric distribution utilities (municipal utilities and electric cooperatives were excluded from the requirements).[9] The bill received wide support from lawmakers, passing in the Ohio Senate by a vote of 32-0 and in the Ohio House by 93-1.[10]

The EERS required a reduction in both total annual sales of energy and peak demand for electricity. Specifically, the bill required a cumulative goal of annual energy savings of 22 percent by 2025. Annual savings goal were set each year from 2009 through 2025. Goals included a reduction of 0.3 percent in sales for 2009, increasing to 0.5 percent in 2010, 0.7 percent in 2011, and 0.8 percent in 2012, with the baseline for sales calculated as average sales from the previous three years. The EERS also required a reduction in peak demand of 1 percent in 2009, and 0.75 percent annually for the years 2010 through 2018.[11]

The RPS required that all Ohio electric distribution and service utilities procure 25 percent of generation from alternative energy resources by the end of 2024. Under the standard, 12.5 percent is to be met with "any new, retrofitted, refueled, or repowered generation facility located in Ohio" including fossil fuels, and the other 12.5 percent is to be met with renewable energy generation, 0.5 percent of which must be solar.[12]

In May 2014, Ohio passed Amended Substitute Senate Bill 310 ("SB310"), which made significant changes to the state's EERS and RPS. Changes to the EERS included a freeze on energy savings requirements for 2015 and 2016, allowing large customers to opt out of the energy efficiency requirements, and an expansion of the types of activities that qualify as savings. With respect to the RPS, the final date for renewable energy procurement of 12.5 percent was delayed from 2024 to 2026, and the requirement that the energy be generated in Ohio was removed.[13] Additional changes to the resource standards may happen in 2015 as a result of further study – the Energy Mandates Study Committee, created in SB310, is tasked with studying Ohio's renewable energy, energy efficiency, and peak demand reduction

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[9] "Amended Sub. SB 221 Implementation Timeline Goals," Public Utilities Commission of Ohio, April 24, 2009, available at http://www.puco.ohio.gov/emplibrary/files/media/publications/sb221%20timeline.pdf.

[10] Terrence O'Donnell, Kurt Tunnell and Brett Breitschwerdt, "Ohio Senate Bill 221: a summary of its advanced energy and energy efficiency provisions," Bricker & Eckler LLP, April 28, 2008, available at http://www.lexology.com/library/detail.aspx?g=4b586faa-2f34-4e79-aeac-faab8c1de67d.

[11] Database of State Incentives for Renewables & Efficiency, "Energy Efficiency Portfolio Standard," December 23, 2014, available at http://programs.dsireusa.org/system/program/detail/4542, accessed March 6, 2014.

[12] Database of State Incentives for Renewables & Efficiency, "Alternative Energy Portfolio Standard," July 24, 2014, available at http://programs.dsireusa.org/system/program/detail/2934, accessed March 6, 2014.

[13] Database of State Incentives for Renewables & Efficiency, "Alternative Energy Portfolio Standard," July 24, 2014, available at http://programs.dsireusa.org/system/program/detail/2934, accessed March 6, 2014.

mandates. As stated in SB310, "…the intent of the Committee will be to better understand how energy mandates impact jobs and the economy in Ohio."[14]

3. CURRENT ELECTRIC CONTEXT IN OHIO

As described above, over the past few decades Ohio has undergone fundamental shifts in the structure of the electric industry. Most significantly, the resources that are developed to meet the electricity needs of Ohio's customers are no longer necessarily dictated by utility construction and contracting under cost of service regulation. Instead, Ohio sits in a competitive wholesale market *region*, where the resources developed to meet customers' needs may flow from competitive market outcomes and arrangements between retail suppliers (including distribution utilities for default service customers) and independent power producers. Reliance on *regional* wholesale markets opens the door to competitively-sourced development but removes – to a certain extent – the control that legislators, regulators, and local utilities have over which resources are developed to meet electricity demand.

Ohio is not alone with this industry structure. Many states in wholesale market regions have explicitly decided to allow competitive market outcomes determine what resources are developed – and when and where they are developed – to meet the electricity needs of businesses and retail consumers within the states.[15] Doing so shifts investment risks away from consumers and towards resource developers, placing risks with those entities most qualified to absorb and manage them. In the long run, competitive wholesale markets are thus expected to lead to lower investment risks for ratepayers.

However, states rarely *completely* leave resource decisions to competitive markets. States generally retain – and regularly exercise – the right to influence the resource mix used to meet consumer demand for economic and energy/environmental policy reasons. As discussed above with respect to Ohio's energy policies, this influence can take the form of resource portfolio standards, energy efficiency standards or investment requirements, and requirements around how utilities procure resources to meet the needs of default or standard offer service customers.

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[14] Database of State Incentives for Renewables & Efficiency, "Energy Efficiency Portfolio Standard," December 23, 2014, available at http://programs.dsireusa.org/system/program/detail/4542, accessed March 6, 2014.

[15] Such decisions by states are not necessarily irrevocable. In effect, the restructuring of a state's electric industry in competitive wholesale market regions is an explicit decision by the state to let competitive markets select resource outcomes. In theory a state could decide to reverse that decision (if, for example, it no longer thought wholesale markets were producing competitive outcomes), and require that regulated utilities meet all customer needs through resources specifically built, purchased or contracted for by the utility, subject to cost of service regulation. To date, states have not seriously considered this "putting the genie back in the bottle" given the potential costs and risks of doing so.

Many other forms of this state control over resource development exist, including state siting standards; system benefit charges for funding non-traditional resource development; "clean energy" standards and purchase alternatives; requirements that utilities enter into long-term contracts for specific resources (e.g., local resources or renewable resources); tax incentives and "green banks"; and so on. Finally, utilities generally may make proposals to the public utilities commission for specific approval of any resource procurement or strategy on a case-by-case basis, and states always have authority to accept or reject such proposals based on state law, precedent, and policy goals.

It is in this context that Ohio deliberates its policies towards electricity generation, resource development, and energy/environmental policy. The current review of renewable portfolio standards, energy efficiency investments, support for other forms of generation development, and consideration of utility proposals to meet standard service needs through long-term contracts should draw on the state's economic, energy and environmental policy goals, and should also reflect the regional, competitive wholesale context. But it must also consider how the circumstances and risks surrounding various alternatives are changing, due to internal and external forces. In the remainder of this section we highlight several key elements of change and challenge in Ohio to consider when evaluating options, which are discussed in greater detail in Appendix A:

- With the exception of 2006, Ohio has historically sold more electricity than has been generated within the state, meaning that Ohio relies on importing electricity generated from out-of-state resources to fill this gap. This gap has grown in recent years to be 14.1 percent and 17.5 percent of total retail sales in 2011 and 2012, respectively.
- Annual peak electric load within Ohio is expected to grow in the coming years. Between 2009 and 2019, peak load is expected to increase by 16 percent.
- On the supply side, the mix of resources in Ohio is changing in a significant way. Coal has historically dominated Ohio's resource mix, and still does. But in just the past several years that picture has begun to change, due to resource turnover, the economics of coal vs. gas-fired generation, and the introduction of new renewable resource capacity. Recent capacity additions have been dominated by natural gas-fired capacity.
- Ohio could experience a net reduction in generating capability over the next ten years, as more capacity retires than new capacity added. This means that Ohio's reliance on regional wholesale markets and out-of-state resources may increase further over time.
- Significant investment is needed in coming years to improve, build, and repair transmission infrastructure in the state.
- Currently, most electricity generated in Ohio is from non-renewable resources, including coal, natural gas, oil and nuclear plants. Renewable resources currently make up a small amount of Ohio's electric mix, representing approximately 2 percent of electric

generation in 2013. Ohio's RPS currently requires that 12.5 percent of electricity sold be generated from renewable energy by the end of 2026.[16]

- Presently over 400 MW out of the 2,500 MW of planned capacity additions through 2018 are from renewable resources that qualify for the state's RPS. In order to fully comply with its RPS requirements, Ohio will need to fill the substantial remaining resource gap by either attracting entry of additional in-state qualifying resources (yet to be announced) or through the purchase of qualifying renewable energy credits produced by out-of-state resources, assuming that sufficient quantities are available.
- There are a number of recently proposed or finalized federal regulations issued by the EPA that will affect certain power plants in Ohio, and in the broader PJM region, including: (1) the Mercury and Air Toxics Standard ("MATS") for hazardous air pollutants; (2) the Cross State Air Pollution Rule ("CSAPR") for the reduction of sulfur dioxide ("SO_2") and nitrogen oxide ("NO_x") emissions in 28 eastern states, and the Clean Air Interstate Rule ("CAIR") which will continue in place until CSAPR is implemented; (3) the Cooling Water Intake Structures rule under section 316(b) of the Clean Water Act; (4) the disposal of Coal Combustion Residuals regulation; and (5) and the requirements for reductions in carbon dioxide ("CO_2") emissions from existing power plants under EPA's proposed Clean Power Plan.

4. EVALUATION OF OHIO'S ELECTRICITY RESOURCE OPTIONS

Overview and Evaluation Criteria

Section 3 and Appendix A highlights the context for Ohio electricity policy developments, including high-level overviews of major demand, infrastructure and policy factors to consider. The most striking observation that flows from a review of the context for deliberating Ohio's electricity future at this time is the degree of change likely to occur over the next five to ten years in Ohio's resource base, in its compliance obligations, in the structure of the industry and nature of retail supply, and ultimately in the mix of electricity resources in the state. Given both internal policymaking and external factors, Ohio's electricity landscape could look very different in ten years.

Based on our review of supply and demand conditions in the state, and expectations around resource additions and retirements, one thing seems clear: *over the next five to ten years Ohio will*

[16] "Where does Ohio's electricity come from?" the Public Utilities Commission of Ohio, available at http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/where-does-ohioe28099s-electricity-come-from/#sthash.c31nAhsx.dpbs, accessed January 1, 2015.

likely add significant new supply and/or demand resources to replace existing, aging infrastructure, meet electrical demand growth, and meet environmental compliance obligations.[17] This, then, is a period of significant change – one where Ohio policy makers may select from among many different traditional and emerging resource options and approaches.

As state policy makers consider how to influence the evolution of the industry over the next several years, resource and policy decisions in Ohio should consider the broad set of circumstances reviewed in Section 3 and Appendix A including, at least, the following:

- The expected growth in demand for electricity, and the likely investment in – and impact on growth of – demand response and energy efficiency programs and measures;
- Ohio's electric industry, its commitment to and pace of movement towards full wholesale and retail competition, and reliance (in part) on regional wholesale markets to meet the electric resource and reliability needs of Ohio's business and residential customers;
- Ohio's reliance on coal-fired resources, and how the full scope of changes in the industry and integration with regional bulk power systems and markets is likely to alter Ohio's resource mix over the next five to ten years;
- The implementation of existing – and emergence of new – emission control obligations promulgated by EPA, and the implications of Ohio's resource mix for compliance actions and costs; and
- The details of changing costs and technological growth in electricity generation and demand response resources, and in the fuels that power generation resources.

All of these factors play into the social, economic and environmental impacts of electricity supply and consumption on the businesses and residents of Ohio. In this section, we consider a number of different potential resources and resource paths, and evaluate these options against a set of objectives that reflect both traditional electricity policy objectives, and the current circumstances within the state. The key objectives, organized and summarized in **Table 3**, include the following:

- *Reliability* – the fundamental obligation to maintain reliable power supplies for the convenience of Ohio's residents, promotion of economic activity, and public health and safety. Resource alternatives affect the reliability of electricity supply in Ohio in their

[17] For example, SNL Financial reports that over 3,700 MW of new capacity from wind, solar, and natural gas combined cycle units are in early development. In December 2014, the Ohio House passed House Bill 319 which creates guidelines for natural gas companies to apply for rider assistance in increasing natural gas infrastructure throughout the state. See "Rep. Grossman Applauds Passage of Bill Expanding Economic Development Infrastructure Opportunities," December 4, 2014, The Ohio House of Representatives 131st General Assembly.

overall quantity, location, and operational characteristics (e.g., their ability to ramp up or down quickly, and the controllability of their power output).

- *Cost* – the need to seek resource alternatives that minimize the cost to Ohio's business and residential electricity consumers, subject to the various constraints on resource development and operation, such as maintaining reliability, and meeting regulatory and compliance obligations.
- *Capacity investment risks* – reflecting the degree of financial risk borne by Ohio's captive ratepayers associated with selecting resources for development, completing the permitting, siting and construction process, and operating the resource over time in the regional wholesale markets.
- *Ohio's jurisdiction and control* – the ability of Ohio's legislators and policy makers to influence the resource mix in the state over time.
- *Economic impacts in Ohio* – the impact of resource decisions on Ohio's economic activity, imports/exports, jobs, and tax revenues.
- *Health and environment impacts* – the impact of resource decisions on the public health and safety of Ohio's residents, on Ohio's environment, and on the social, economic and environmental risks associated with climate change.
- *Emission control obligations* – the impact of resource decisions on the costs to Ohio for complying with current and emerging emission control requirements on power plants.

We do not mean to suggest these are the only factors that should be considered when evaluating electricity resource options. But we focus on them in order to capture a wide range of economic considerations, consumer and business interests in reliable and affordable electricity supply, the social and environmental impacts that stem from all forms of electricity production, and the reality of emissions control obligations that are or may soon be a legal obligation on the state of Ohio and the owners of affected power plants, and that will affect the cost of electricity supply within the state.

Table 3
Electricity Resource Evaluation Criteria

Issue	Objective	Ohio Context
Power System Reliability (Bulk Power System)	· Maintain sufficient resources to meet peak load (plus reserve margin) · Ensure that resource mix is flexible enough to meet all system reliability and resiliency needs (voltage, frequency, load-following) · Meet reliability requirements in all load pockets	· Reliability of bulk power supply and transmission starts with the integration of Ohio in the broader regional power system · Ohio's internal resources may diminish relative to load provided there is sufficient import capability · Ohio's resources contribute to regional reliability, but also support local reliability needs · Changing resource mix requires close attention to potential local system reliability and resiliency impacts · Gas-fired generation provides both capacity and system reliability and resiliency reliability attributes · Renewable resources currently provide limited contributions to power system reliability
Cost	· Minimize the cost (level and volatility) of electric service subject to reliability constraints and policy goals	· Ohio has historically enjoyed relatively low and stable power production costs, due to historical fuel price advantage of coal · Costs and risks of coal-fired generation are increasing due to age/heat rate of generating assets, changing fuel price circumstances, and costs of compliance with emission control requirements · Energy efficiency is highly cost-effective but faces market barriers to widespread adoption · Costs and risks of gas-fired generation are decreasing due to NGCC efficiencies and abundant, low-priced natural gas resources; new pipeline investment proposed in response to increasing demand. · Certain grid-connected and behind-the-meter renewable resources are declining rapidly in price
Capacity Investment Risk	· Minimize the investment risk borne by utility ratepayers · Shift risks to those entities most qualified to manage and price such risks	· Wholesale and retail competition structures in Ohio shift investment risk away from ratepayers, and to the appropriate market entities · Potential for revised long-term contractual agreements proposed by regulated utilities for locking in generation resources shifts risk back to ratepayers
State Jurisdiction Over Resource Mix	· State has the authority to determine how and what resources are developed to meet the electricity needs of Ohio customers	· Ohio retains authority over resource mix, and allows resource development to be driven by regional competitive market outcomes · Ohio has exercised its authorities to allow or require the operation/development of specific resources (utility assets) or resource types (energy efficiency, renewables, in-state resources)
State Economic Activity	· Meet electricity needs as much as possible through resources that generate jobs and economic activity within the state	· Ohio has abundant fossil fuel-fired capacity , but is a net importer of fossil fuels for electricity generation · Certain resources promoted by Ohio policy (energy efficiency, distributed renewables, in-state resources) tend to spur local investment and economic activity
Environmental Impacts	· Meet electricity needs with minimum possible impact on human health and the environment	· Ohio's electricity generation is dominated by coal, which has elevated health and environmental impacts, and elevated contribution to climate risk, relative to other resource options · Ohio's resource mix is diversifying towards greater gas-fired and renewable resources, improving the environmental footprint of the state's electric industry · Ohio's energy efficiency and renewable policies promote resources with relatively low environmental impacts
Environmental Rule Compliance	· Meet current and emerging federal and state emission control requirements at the lowest possible cost	· Ohio faces challenges in complying with recent and proposed EPA requirements related to power plant emissions, due to the prevalence of coal-fired generation in its resource mix · Significant capacity retirements are anticipated in the coming years, due in part to the cost of meeting current and proposed standards at older coal-fired facilities

Resource Alternatives

Any forward-looking assessment of resource options and outcomes will suffer from the uncertainty of future economic and industry conditions, cost drivers, policy changes, and the uncertainty associated with the future mix of technologies and resources used to supply electricity to customers. In this report, we do not try to determine the "right" path for Ohio going forward; instead, our review is focused on drawing out the potential benefits and drawbacks of various resource alternatives. The purpose is to provide an informational base that Ohio's policy makers, industry participants, and other electric industry stakeholders may draw on to help inform the decision making process.

As infrastructure turns over in the next several years, Ohio's resource needs will be met by a mix of market outcomes and in-state resource development. While this may not be a complete list, the following specific resource alternatives are likely to be in the mix, or at least the subject of consideration by the state's policy makers:

- Energy efficiency and demand response measures and programs
- Gas-fired capability (increase utilization of existing, and/or build new)
- Dual-fuel capability (adapt existing or build new)
- Coal-fired capability (extend the life of existing, and/or build new)
- Renewable resources (grid connected and/or distributed behind the meter ("BTM"))
- Imports (increase power imported from outside Ohio)
- Energy storage (increase use of renewable generation)

In **Table 4** we provide a summary of the benefits and drawbacks of these resource alternatives, considering the broad spectrum of evaluation criteria identified in the previous section.

Table 4
Key Benefits and Drawbacks of Resource Alternatives

Resource Alternative	Benefits	Drawbacks
Energy Efficiency (EE) & Demand Response (DR)	· Abundant and low-cost relative to generation alternatives · DR can improve reliability as targeted resource during peaks, contingencies · Lowers total bills for participants · Reduces peak load and annual energy demand · Suppresses wholesale prices for energy and capacity, potentially lowering bills for both participants and non-participants · Reduces environmental impact of energy supply and consumption · Increases local economic activity for goods and services (installation, products) · Reduces money flowing out of state to import fuels, power · Can be used to achieve compliance with environmental requirements	· Suffers from market barriers to self-installation · EE typically requires ratepayer subsidization and targeted utility-driven programs to achieve widespread adoption · Creates inequities between participants and non-participants · Funding for EE could increase rates · Reduces utility sales and revenues; inherent disincentive requiring ratemaking adjustments (e.g., lost base revenues, decoupling)
Natural Gas-Fired and Dual-Fuel (Oil/Gas) Capability	· Abundant domestic (and Ohio) resource in shale gas · Both combustion turbine and combined cycle technologies are highly-effective resources in helping achieve resource adequacy and system reliability and resiliency · Relatively low and stable pricing in recent years, and expected to remain so by some analysts · Lower CO_2 emissions (and other health/environmental impacts) per MWh than coal, state average · Significant room for increased utilization at existing units · Relatively straightforward permitting, siting, construction of new capacity · Plant operational capabilities can help manage variation in net load associated with integration of variable renewable resources · Can help meet Clean Power Plan compliance obligations · Supports local economic activity · Dual-fuel capability allows for fuel switching in situations where one fuel type is in short supply and/or relatively more expensive	· Historically volatile pricing · Requires fracking activities, processing, and transportation infrastructure · Must ensure sufficient transportation to meet combined heating, processing, and electricity generation needs · Despite abundant gas in state, Ohio is still an importer of natural gas to meet all needs · Gas delivered "just in time;" constraints or outages on interstate pipeline system or near delivery point can disrupt operations and increase prices · Emits greenhouse gases and other pollutants · Dual-fuel capability requires additional cost of fuel storage

Resource Alternative	Benefits	Drawbacks
Coal-Fired Capability	· Abundant domestic (and Ohio) resource · Relatively stable historical fuel pricing · Existing capacity effective as baseload resources in helping achieve resource adequacy · Supports local economic activity · Assets are in place; can avoid construction of and investment in new capacity resources	· Existing assets aging, somewhat inefficient (relative to newer capacity) · Despite abundant coal in state, Ohio is still an importer of coal to meet all needs · Emits greenhouse gases and other pollutants · Faces substantial costs associated with compliance with EPA air and water emission control requirements · Extending life of existing assets – if done through longer-term contracts – may impose operational, cost, and compliance risks on captive ratepayers
Renewable Resources	· Can contribute – albeit at only a fraction of nameplate capacity – to resource adequacy needs, and is controllable to a certain extent (e.g., ramping down or disconnecting if needed). · In certain applications (grid-scale wind and solar) can lower energy costs · Minimal environmental impacts relative to other generating resources, during both construction and operation · Low or no impacts per MWh of criteria pollutants, CO_2, water, etc. · Increases local economic activity for goods and services (installation, maintenance, products) · Lowers need to import fuel for power generation, lowers money flowing out of state for imported fuel · Can assist with compliance with environmental requirements · When deployed behind the meter (e.g., solar PV), can reduce strain on transmission/distribution infrastructure	· May provide lower contribution to reliability objectives than many traditional resources, and can – at high levels of penetration –exacerbate reliability concerns through increasing net load variability in local areas and potentially at the system level · Can require additional back up and reserve capacity · Can require investment in transmission (e.g., wind resources distant from load) · In some applications can increase costs
Imports	· Can help meet reliability objectives · Avoids new construction and local environmental impacts within state · Likely lower per-MWh environmental impact than Ohio's current resource mix · Can in effect "export" environmental compliance by reducing in-state obligations	· Reduces local economic activity · Reduces state control over resource mix to meet Ohio's needs; no control over type of resource · Minimal ability of Ohio to influence prices, which are dictated by competitive wholesale markets
Energy Storage	· Increase utilization of renewable energy generation; potential reduction in system reliability infrastructure costs · Can quickly respond to grid signals supporting reliability objectives, yet also discharge energy slowly over time · Emissions free and operates silently	· Products and technology are still in development

Approaches to Meet Ohio's Resource Needs

Overview: Scenario Analysis and the Role of Markets vs. State Policy

Considering the attributes of various resources discussed above, we present below the implications of a number of potential approaches or "scenarios" to meeting resource needs in the coming years that are likely to be "on the plate" as legislators and policy makers consider laws, regulations, and utility proposals going forward. The scenarios are constructed based on combinations of the various resource alternatives discussed above. We want to stress that the scenarios presented are neither exclusive nor necessarily complete – there may be many other ways to depict what may happen on a going-forward basis. Our focus in providing observations on these potential paths forward is to help stakeholders explore the implications of various outcomes or choices that *may be* made in the state. Ultimately, future resource needs in Ohio will be met through some mix of approaches and resources that do not necessarily fit neatly in any of the scenarios discussed below, but rather include elements of several of them.

Importantly, all scenarios should be viewed through the lens of *the interaction of state policy with competitive wholesale market outcomes*. Ohio sits within PJM, a region where identified demand for electric generating resources is met through regional capacity market auctions. PJM's capacity market auctions – conducted three years prior to the year of need – generally determine *which resources* – whether inside or outside the state – will be used to meet Ohio's demand for electricity, and the price paid for that capacity. Ohio, however, can influence these outcomes with respect to resources in Ohio by, for example,

(1) Supporting or requiring investment in energy efficiency, demand response, and behind-the-meter generation, all of which reduce the quantity of capacity procured by Ohio utilities in PJM's capacity market;
(2) Supporting or requiring the purchase of in-state or out-of-state renewable/CHP resources, which could lead to more such resources being developed, displacing resources that otherwise would be procured in PJM's capacity market; and
(3) Supporting the continued operation of Ohio generating assets such as coal or nuclear capacity (as recently proposed by AEP) through long-term contracts paid for by Ohio electricity consumers, keeping in service resources that otherwise may retire and be replaced through PJM's auctions with lower-cost resources.

State actions that affect capacity market outcomes thus can in effect alter which resources operate to meet Ohio's needs, displacing what otherwise would result from competitive market auctions. In fact, some scenarios are more likely if Ohio steps back and lets regional markets

dictate outcomes, while others are more likely with the intervention of the state through laws, regulations, and policy mechanisms that can be used to encourage certain types of resource development in Ohio.[18]

For example, leaving the development of resources entirely to competitive wholesale market outcomes, would likely continue the trend of (1) retirement of assets rendered uneconomic due to market shifts and environmental policy (e.g., older, less-efficient, and coal-fired resources), and (2) shifting the resource mix developed to replace retiring assets and meet load growth towards natural gas-fired and utility-scale wind facilities. Alternatively, Ohio could influence capacity market outcomes, resulting in scenarios that include continued operation of existing coal-fired assets that would otherwise economically retire, or shift the resource mix towards accelerated investment in energy efficiency, grid-connected renewable resources, CHP, and customer-sited renewable resources (e.g., solar photovoltaic).

Below, we do not attempt to specifically identify policy or market mechanisms that may lead to different resource scenarios; but we develop our scenarios considering possible future actions (e.g., reliance on markets vs. possible state policy decisions), and discuss the implications of future electricity resource pathways in the state. Specifically, we review four scenarios, involving (1) the retirement of uneconomic assets and growth in (primarily) gas-fired and wind resources consistent with wholesale market outcomes; (2) state actions to sustain the operation of existing (coal-fired) assets that may otherwise be uneconomic; (3) concerted state actions leading to investment in energy efficiency and demand-response resources; and (4) concerted state actions leading to investment in renewable and CHP resources. The impact of each of the scenarios from the perspectives of the key criteria discussed above are represented at a high level in **Table 5** at the end of this section, and are described qualitatively in the sections that follow.

1. Retirement of Uneconomic Assets Replaced by Increased Reliance on Existing and New Natural Gas-Fired and Grid-Connected Renewable Resources

One potential scenario for the evolution of the resource mix to meet Ohio's electricity demand is through operation of the prevailing market financial signals for generating asset investment and

[18] Ohio will, of course, *always* have authority over state and local siting, zoning and permitting of small and large electricity infrastructure. Consequently, in granting or denying infrastructure proposals, the state of Ohio will be exercising its siting/permitting jurisdiction consistent with Ohio laws, regulations, precedent, and policy. In this sense, no in-state resources may be developed without the express approval of state regulators. Instead, in distinguishing between market outcomes versus state-driven resource outcomes, we are focused on the key financial drivers and regulatory signals for developers to *pursue* the development of resources inside or outside the state to meet the state's needs, recognizing that any successful in-state resources would need to successfully navigate Ohio's siting, zoning, and permitting processes.

retirement decision-making. In this case, one would expect the evolution of resources to occur on a regional basis, with uneconomic assets retiring over time (as has been announced for a number of older coal facilities already), and have load growth met and retired capacity replaced primarily through natural gas-fired capacity (with or without dual-fuel capability), with additional contributions from grid-connected wind. In this scenario, state influence over resource mix outcomes is limited, in the sense that resource mix outcomes are driven by the operation of competitive markets subject to the jurisdiction of the Federal Energy Regulatory Commission. Reliance on market outcomes based on investment decisions by merchant power producers would leave investment and operational risk with those entities (rather than ratepayers), and in the long-run, through the operation of competitive market forces, likely produce lower costs to operate the system. Finally, the impact on in-state economic activity is hard to know – this would be based ultimately on whether in-state operation of resources ceases and is replaced by generation resources inside or outside the state, and the relative labor-intensity of the different resources (construction, operation, fuel supply).

From an energy standpoint, this scenario would also likely involve increased utilization of existing natural gas-fired capacity. Output at natural-gas fired combined-cycle power plants averaged approximately 55 percent in 2012 and as a general rule, for every MWh generated at a gas-fired power plant, there will be one-half the greenhouse gas emissions as generation at a coal-fired power plant (given the relative carbon content of the two fuels and the relative heat rates).[19] The retirement of coal-fired capacity and addition of gas-fired and wind capability would further improve the average carbon emission rate on the system beyond increased utilization at existing units. These facets of this scenario would likely reduce human health and environmental impacts of system operations, and help the state of Ohio to comply with current and emerging EPA air quality and CO_2 emission requirements.

Resource decisions resulting from PJM market outcomes would by definition maintain resource adequacy and the operational reliability of the system. As needed, unit retirements or an expansion of variable resources that create needs in local areas would be met through local market signals, and the development of resources in amounts and with the right operational capabilities (e.g., natural gas-fired combustion turbine ("CT") or combined cycle ("CC") plants) to maintain system reliability.

[19] Susan Tierney, "Greenhouse Gas Emission Reductions From Existing Power Plants: Options to Ensure Electric System Reliability," Analysis Group, May 2014.

2. Sustaining the Operation of Existing – Primarily Coal-Fired – Generating Assets

As noted above, one potential outcome of relying primarily on the operation of regional markets is the retirement of some existing, aging coal-fired resources in Ohio. This outcome would be driven, for example, by the changing economics of competing fuels (i.e., the combined effect of natural gas vs. coal fuel prices and the difference in efficiency between old and newer assets), and the need for capital and operating cost increases at existing coal units to meet current and emerging environmental regulations. Nevertheless, Ohio may determine for energy or economic policy reasons to maintain the operation of existing assets that otherwise would be uneconomic. This could be accomplished using mid- or long-term contracts between regulated utilities and the owners of such facilities, with ratepayers paying the cost of the contracts. In this scenario, state influence over resource mix outcomes is expanded through state regulatory decisions to support continued operation of resources that would otherwise be uneconomic. This would likely increase costs to Ohio ratepayers relative to fully competitive market outcomes, and would shoulder ratepayers with the risks associated with the economics of future operation of such resources, including potentially major investments or operational expenses to comply with future emission control requirements. Finally, the impact on in-state economic activity is hard to know – this would be based ultimately on whether in-state economic activity of the existing resources that otherwise would retire is greater or less than the construction and operation of new/replacement generation and capacity, and whether such replacement activity occurs within Ohio (as opposed to other states in the market region).

The retention of coal-fired capacity that would otherwise retire would likely increase emissions of criteria pollutants and CO_2 relative to the retirement scenario (Scenario 1), which would increase human health and environmental impacts of system operations, and could increase the costs to the state of Ohio to comply with current and emerging EPA air quality and CO_2 emission requirements.

In this scenario, baseload coal-fired resources would contribute to resource adequacy and resource procurements resulting from PJM market outcomes would by definition maintain resource adequacy and the operational reliability of the system. However, the system may not necessarily have the same operational flexibility (e.g., to handle variations in load due to variable renewable output) as in the scenario where baseload coal resources retire and are replaced with newer more flexible (CT or CC) natural gas-fired capability.

3. Concerted implementation of energy efficiency and demand response; encourage active consumer load management

Ohio has historically influenced resource mix outcomes through requirements tied to investment in energy efficiency and demand response resources. While such investments have been temporarily suppressed, and the impact of future investments is under study, the state has the capability to increase EE/DR activity should it decide to do so for energy or economic policy

reasons. In this scenario, state influence over resource mix outcomes is expanded through the operation of state regulatory decisions for EE/DR that suppress the amount of capacity and energy purchased in wholesale markets to meet Ohio's needs.

The potential magnitude of such investments, and of state influence over resource mix, is significant. Since 2009, Ohio has required electric distribution utilities to implement energy efficiency programs that both reduce sales and peak demand.[20] Soon after SB221 took effect, annual energy efficiency savings increased dramatically within the state.[21] **Figure 1** illustrates the annual incremental savings from energy efficiency programs in Ohio between 2006 and 2012.[22] Savings in the two years following the enactment of SB221 increased eight-fold (400 GWh) between 2008 and 2009, and nearly three-fold (900 GWh) between 2009 and 2010. This represents an achieved ramp rate over this same time period of 0.27 percent and 0.29 percent of annual retail sales, respectively. Furthermore, savings levels were maintained or increased from 2010 to 2012. In addition to the increased savings, the state's utilities saved significantly more GWh than required by SB221 in every year.

Behind these aggregate state-wide energy efficiency savings, individual utilities achieved significant savings after the adoption of the EERS policy. In particular, AEP Ohio (which provides service to approximately 1.5 million customers in Ohio and is located in 61 of the 88 counties in the state[23]) dramatically increased annual savings from its energy efficiency programs beginning in 2009. **Figure 2** illustrates AEP's annual EE savings as a percentage of its annual retail sales, and the change in percentage savings, from 2009 through 2013. AEP tripled annual EE savings from 106 GWh to 333 GWh between 2009 and 2010, which corresponds to a ramp rate of 0.5 percent for this period. Between 2009 and 2012 the average increase in ramp rate was 0.34 percent. This upward trend continued through 2013, where incremental annual savings reached 1.31 percent of annual retail sales.

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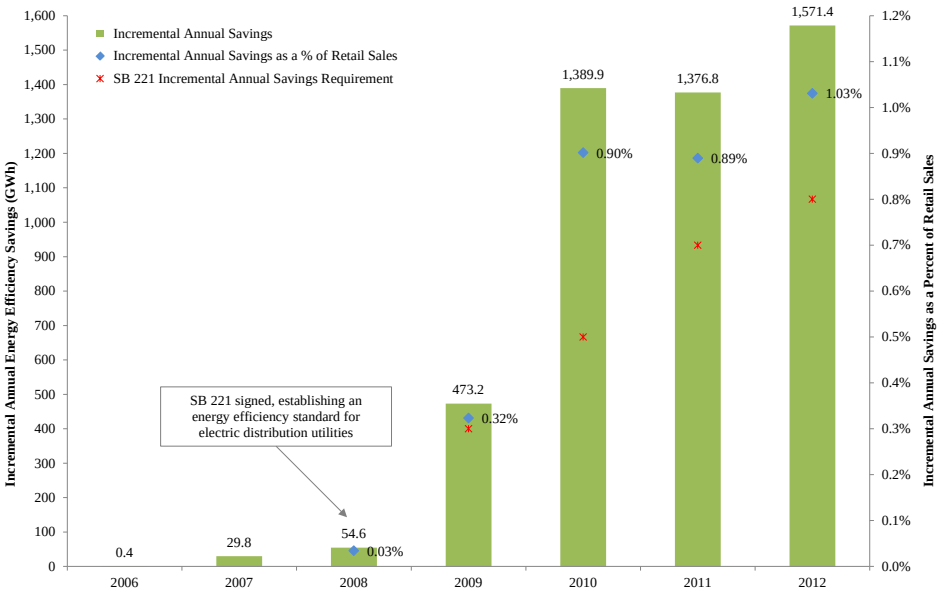
[20] Amended Substitute Senate Bill Number 221, Section 4928.66 (A)(1)(a)-(b), 127th General Assembly, available at http://archives.legislature.state.oh.us/BillText127/127_SB_221_EN_N.pdf.

[21] Amended Substitute Senate Bill Number 221, 127th General Assembly, available at http://archives.legislature.state.oh.us/BillText127/127_SB_221_EN_N.pdf. See also "Amended Sub. SB 221 Implementation Timeline Goals," Public Utilities Commission of Ohio, April 24, 2009, available at http://www.puco.ohio.gov/emplibrary/files/media/publications/sb221%20timeline.pdf.

[22] Savings data for 2006 to 2008 as reported in ACEEE State Energy Efficiency Scorecards, 2008-2010. Savings data for 2009 to 2012 as reported in "Benefits of Energy Efficiency in Ohio," Midwest Energy Efficiency Alliance, available at http://www.mwalliance.org/sites/default/files/uploads/MEEA_2014_Ohio-EE-Expo_Fact-Sheet.pdf. Retail sales from EIA-861 used to calculate incremental annual savings as a percent of retail sales.

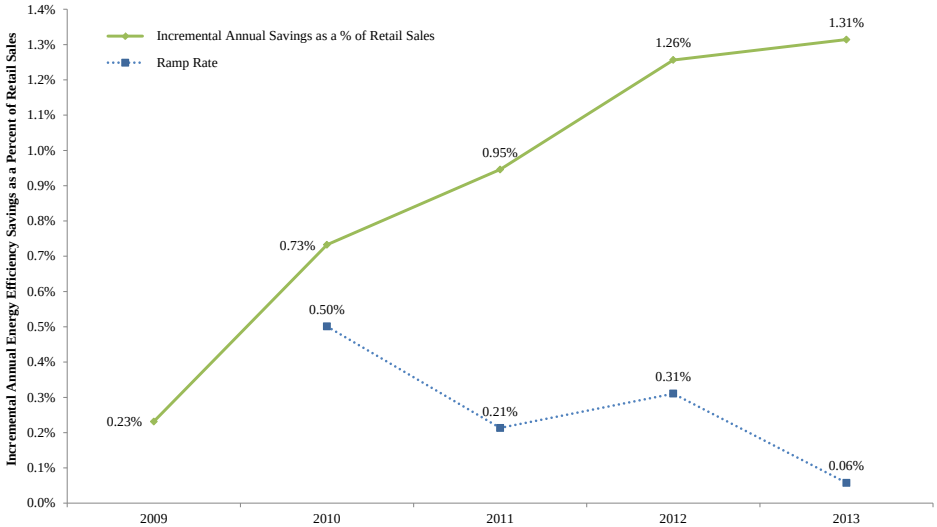
[23] "About AEP Ohio," American Electric Power Ohio, accessed November 19, 2014, available at https://www.aepohio.com/info/facts/.

Figure 1
Ohio's Annual Energy Efficiency Savings and Ramp Rates, 2006 – 2012



Notes & Sources:
[1] Savings data for 2006 to 2008 as reported in ACEEE State Energy Efficiency Scorecards, 2008-2010. Savings data for 2009 to 2012 as reported in "Benefits of Energy Efficiency in Ohio," Midwest Energy Efficiency Alliance, available at http://www.mwalliance.org/sites/default/files/uploads/MEEA_2014_Ohio-EE-Expo_Fact-Sheet.pdf.
[2] Retail sales from EIA-861 used to calculate incremental annual savings as a percent of retail sales.

Figure 2
AEP Ohio's Annual Energy Efficiency Savings and Ramp Rates, 2009 – 2013



Notes & Sources:
[1] Annual energy efficiency savings as a percentage of retail sales is calculated as the incremental savings divided by baseline sales for a given year. Savings exclude self-direct program savings. Data are from AEP's portfolio status reports. See 2009 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs, Volume 1, March 15, 2010; 2010 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs, Volume 1, March 15, 2011; 2011 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs, Volume 1, May 15, 2012; 2012 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs, Volume 1, May 15, 2013; and 2013 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs, Volume 1, May 15, 2014.
[2] Ramp rate is calculated as the change in percentage savings between two years.

Energy efficiency reduces costs to Ohio consumers in several ways. First, over time as more and more consumers participate in EE/DR programs, they directly experience the cost savings associated with reduced bills for electric service, due to lower energy consumption and peak demand. Second, implementation of EE/DR reduces the overall peak load and capacity requirements for the state of Ohio, decreasing capacity costs to the state. Finally, EE/DR can strongly suppress wholesale prices – specifically, lower hourly energy consumption translates into lower regional prices for energy, lowering the energy costs for all Ohio business and residential customers (whether or not such customers have participated in the EE/DR programs).

EE/DR activity has been demonstrated to generate strong in-state economic benefits through the production of goods used in such programs, employment of contractors to conduct EE/DR installations, and increased consumer spending as they have more discretionary income available due to lower electricity bills.[24] On the other hand, implementation of energy efficiency programs tends to create consumer inequities, as some customers participate in the program while others do not (although this is offset by the system-wide benefits described above).

Investment in EE/DR reduces emissions of all pollutants to meet Ohio's electricity needs, decreasing the human health and environmental impacts of system operations. Further, under the Clean Power Plan, EPA has opened the door to states to meet compliance obligations through state plans that rely in whole or in part on EE/DR investments; thus, EE/DR could help lower the costs to the state of Ohio for compliance with the Clean Power Plan as well as other current and emerging EPA air and water quality requirements.

Finally, EE/DR improves the reliability of system operations by directly lowering the quantity of electrical load that needs to be met, and by programs that allow for immediate reductions (through demand response) as needed to address system contingency conditions.

4. Concerted Pursuit of the Development of Grid-Connected and/or BTM Renewable and CHP Resources

Ohio has historically influenced resource mix outcomes through requirements tied to investment in renewable resources. While such investments have been temporarily suppressed, and the impact of future investments is under study, the state has the capability to increase renewable investment, should it decide to do so for energy or economic policy reasons, through increasing the RPS or otherwise establishing policy mechanisms providing economic benefits

[24] Ohio has a number of programs aimed at increasing energy efficiency and demand response resources among low-income customers. See for example, LIHEAP FY2014/2015 Low-Income Energy Programs, available at http://www.liheapch.acf.hhs.gov/profiles/Ohio.htm.

for development of grid-scale or distributed renewable resources (e.g., net metering). In this scenario, state influence over resource mix outcomes is expanded through the operation of state regulatory decisions for renewables that suppress the amount of capacity and energy otherwise purchased in wholesale markets to meet Ohio's needs.

This would likely increase costs to Ohio ratepayers relative to fully competitive market outcomes, as the cost of renewable requirements are reflected in rates. On the other hand, investment in renewable resources would tend to lower the costs paid to meet Ohio's capacity needs, and in operation would suppress wholesale prices in the same way as EE/DR, since most renewable resources have low/zero variable costs. Finally, renewable programs – particularly ones that lead to in-state construction (e.g., either through in-state requirements or in the case of customer-sited resource development) would tend to increase in-state economic activity through the production of goods and construction/installation. The degree to which they would increase in-state economic activity is hard to know; this would be based ultimately on whether resources that, if not for the renewable programs, would otherwise be developed in the state.

Investment in renewable energy reduces emissions of all pollutants to meet Ohio's electricity needs, decreasing the human health and environmental impacts of system operations. Further, under the Clean Power Plan, EPA has opened the door to states to meet compliance obligations through state plans that rely in whole or in part on renewable investments; thus, renewables could help lower the costs to the state of Ohio for compliance with the Clean Power Plan as well as other current and emerging EPA air and water quality requirements.

Renewable resources can provide some contribution to resource adequacy requirements, and can include operational devices that allow their output to be adjusted as needed to address system reliability needs. However, renewable resource output is variable and not fully predictable; therefore, large quantities of renewable resources on the system can increase the variability of net load that system operators must respond to on a second-to-second, hour-to-hour basis. Consequently, renewable resources can either somewhat degrade power system reliability or – more likely – require additional costs to ensure the regional power systems operate with sufficient cycling and reserve capability to address the impact of renewable resource variability on the system. As has been demonstrated in other states and regions, a wide range of tools exist for system operators and planners to address net load variability, and experience suggests that systems can operate reliably even with significant variable renewable penetration rates.

Table 5
Resource Alternatives and Evaluation Criteria

Resource Alternative	Reliability	Cost	Ratepayer Risk	State Resource Selection	State Economic Impact	Public Health & Environmental Impact	Environmental Compliance
Increase existing and develop new, natural gas-fired/dual-fuel and wind resources	✓	✓	✓	–	–	–	–
Extend life of existing coal-fired resources, and/or build new ones, through contracts	✓	–	X	✓	–	X	X
Concerted expansion of energy efficiency and demand response resources	✓	✓	✓	✓	✓	✓	✓
Concerted expansion of renewable and CHP resources	–	–	–	✓	✓	✓	✓

5. CONCLUSION

Ohio is at a crossroads. Over the next five to ten years, the state is likely to see a tremendous amount of change in its electric resource base, in its compliance obligations, in the structure of the industry and nature of retail supply, and ultimately in the mix of electricity resources in the state. Given both internal policymaking and external factors, Ohio's electricity landscape could look very different in ten years than it does today.

Based on our review of Ohio's electricity context, we draw the following observations:

- ***Over the next five to ten years, Ohio will likely add significant new supply and/or demand resources to replace existing, aging infrastructure, meet electrical demand growth, and meet environmental compliance obligations.***
- ***There is a broad set of circumstances driving the need for Ohio to clearly – and without delay – evaluate its approach to meeting electricity resource needs in the coming years,*** including at least the following factors: expected growth in demand for electricity, the changing economics of fuel supply, and the need for investment in existing resources to maintain operational capability and meet current and emerging environmental compliance obligations.
- ***In considering alternatives, Ohio will need to use evaluation criteria that focus on the State's collective economic and energy/environmental policy objectives and priorities,*** including factors such as: reliability, cost, capacity investment risks, Ohio's jurisdiction

and control, economic impacts in Ohio, health and environmental impacts, and emission control obligations.

- ***There are a wide variety of potential resources and energy policy options that may be considered with respect to meeting Ohio's future needs,*** including energy efficiency and demand response measures and programs, gas-fired capability, dual-fuel capability, coal-fired capability, renewable resources, and imports.
- ***Consideration of policy options and objectives need to be viewed through the lens of the interaction of state policy with competitive wholesale market outcomes.***
- ***Ohio can influence regional market outcomes with respect to resources in Ohio through one or a combination of several basic economic/environmental policy approaches*** including, for example: state support or requirements for investment in EE, DR, and BTM generation; state support or requirements for the purchase of in-state or out-of-state renewable and CHP resources; state support for the continued operation of Ohio generating assets such as coal or nuclear capacity through long-term contracts paid for by Ohio electricity consumers; and/or state determination to let PJM's regional wholesale markets determine the resources developed – inside and outside of Ohio – to meet Ohio customer needs, through the participation of Ohio suppliers and utilities in the regional wholesale markets.
- ***A number of key observations follow from a review of the options available using the evaluation criteria discussed above, that should be considered by Ohio policy makers and stakeholders when charting a path for Ohio's future electric industry:***
    - Prudent development and administration of Ohio's energy policies and regulations should explicitly evaluate and reflect changes in the industry and incorporate lessons learned from other states and regions.
    - In-state economic development, the cost of electricity supply to Ohio's businesses and residents, and the opportunity to mitigate the impact of wholesale market outcomes on Ohio's consumers suggests a concerted effort to capitalize on cost-effective deployment of EE, DR, and renewable resources within the state. This approach may provide an effective economic hedge against the advancement of current and future state and federal laws and regulations addressing the public health, environmental, and climate risk impacts of traditional fossil-fueled power plant operations.
    - The PJM region will continue to undergo significant transformation over the next decade and will likely involve a meaningful shift away from less efficient coal and other fossil-fired resources, and towards more new natural gas combustion turbine and combined cycle plants and wind-powered resources. The degree of change associated with this transition will be determined primarily by wholesale

market economics, but will also be influenced by state actions and policies governing in-state resources.

- Left to wholesale market outcomes, while still heavily dependent on its dominant fuel – coal – Ohio will likely see a continued shift in capacity and generation away from coal towards more efficient and less carbon-intensive natural gas and other resources. The investment risk associated with this shift will largely be borne not by Ohio ratepayers, but by competitive wholesale market investors and developers.
- To the extent that Ohio establishes policies to continue operation of existing coal-fired assets that otherwise would be uneconomic, the cost risk associated with this approach may be shifted to captive ratepayers, and the overall cost of wholesale supply to consumers may be higher.

APPENDIX A

Additional Detail – Current Electric Challenges Facing Ohio

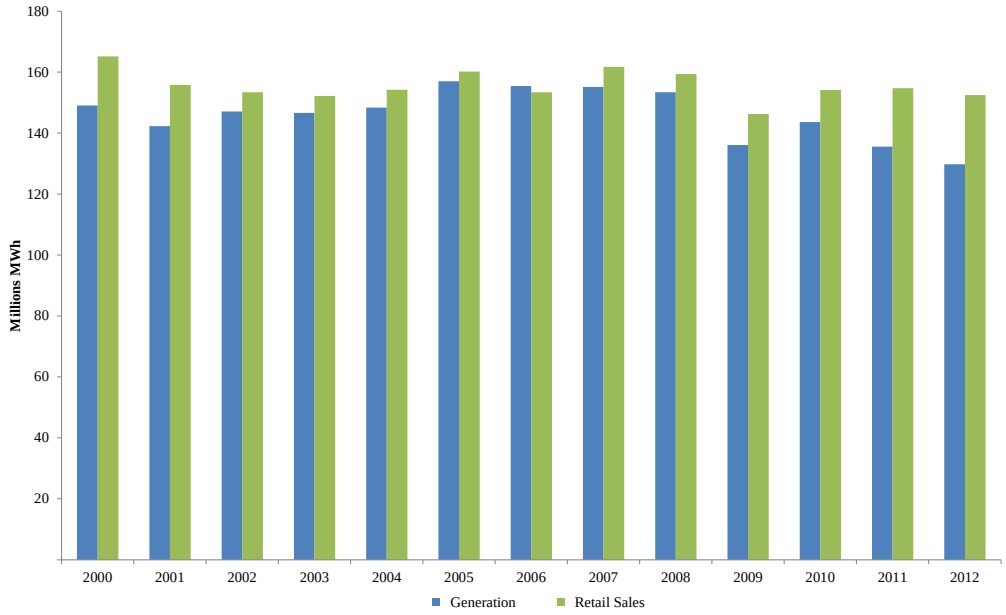
Load-Resource Balance and Status of Historical Infrastructure

With the exception of 2006, Ohio has historically sold more electricity than has been generated within the state, going back to the year 2000. During this time, retail sales within the state have been on average 7.4 percent higher than the electricity generated in that year from in-state resources, meaning that Ohio relies on importing electricity generated from out-of-state resources to fill this gap. This gap has grown in recent years to be 14.1 percent and 17.5 percent of total retail sales in 2011 and 2012, respectively. **Figure 3** below depicts the difference between generation and retail sales within Ohio over time, while **Figure 4** illustrates the difference between total retail sales and in-state generation for each of the states in the PJM interconnection in 2012.

Annual peak electric load within Ohio is expected to grow in the coming years. Between 2009 and 2019, peak load is expected to increase by 16 percent. **Figure 5** illustrates Ohio's historical peak load for the years 2005 through 2010, and forecasted peak load through 2029.

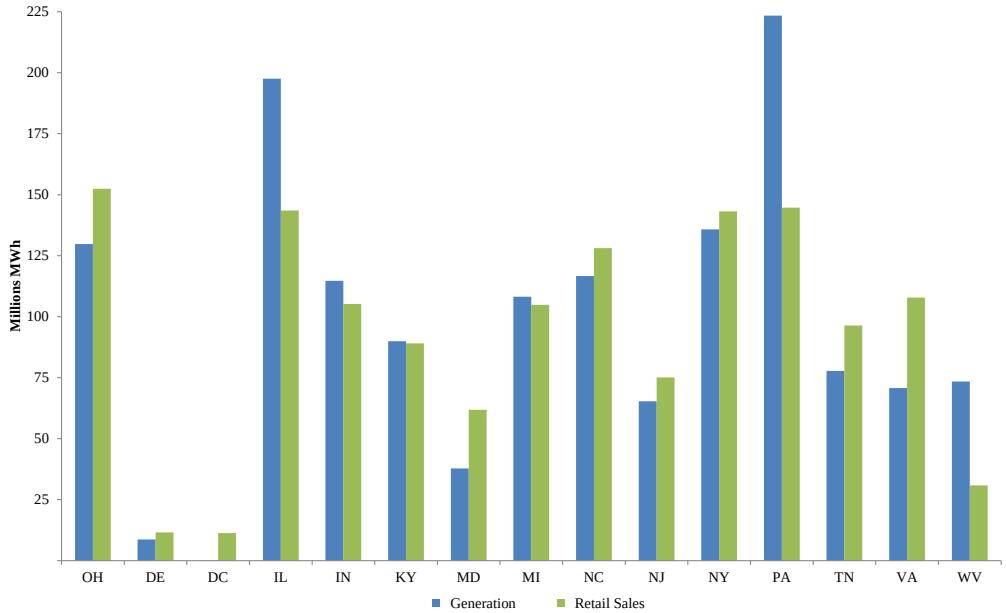
On the supply side, the mix of resources in Ohio is changing in a significant way. Coal has historically dominated Ohio's resource mix, and still does. But in just the past several years that picture has begun to change, due to resource turnover, the economics of coal vs. gas-fired generation, and the introduction of new renewable resource capacity. **Figure 6** shows how the generation mix in Ohio has changed since 1990. Coal has decreased in the resource mix by 23 percent in 24 years, down from its peak contribution of 92 percent over this time period. Over the same time, gas-fired generation has increased by 17 percent, and new renewable resources are now 2 percent of the generation mix. **Figure 7** shows how recent capacity additions have been dominated by natural gas-fired capacity, in a state that previously added almost exclusively coal-fired resources.

Figure 3
Ohio Generation and Retail Sales, 2000-2012



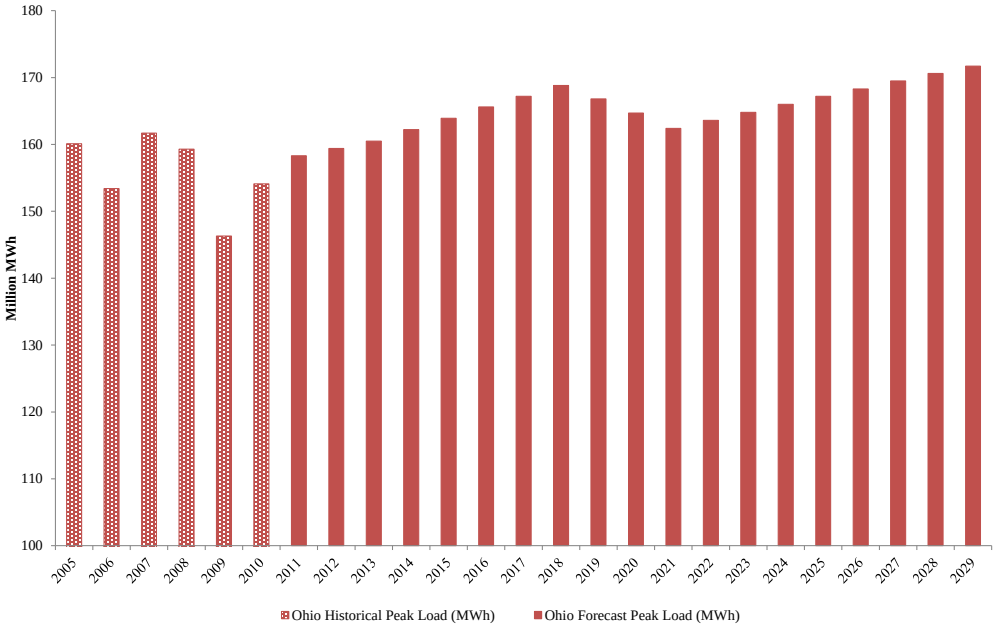
Notes & Sources:
[1] Generation data are from Net Generation by State by Type of Producer by Energy Source, available at http://www.eia.gov/electricity/data/state/, accessed December 30, 2014.
[2] Generation data include MWh from electric generators and combined heat and power units.
[3] Sales data are from Retail Sales of Electricity by State by Sector by Provider, available at http://www.eia.gov/electricity/data/state/, accessed December 30, 2014.
[4] Sales data include MWh from full-service and energy only providers.

Figure 4
Electric Generation and Retail Sales in PJM States, 2012



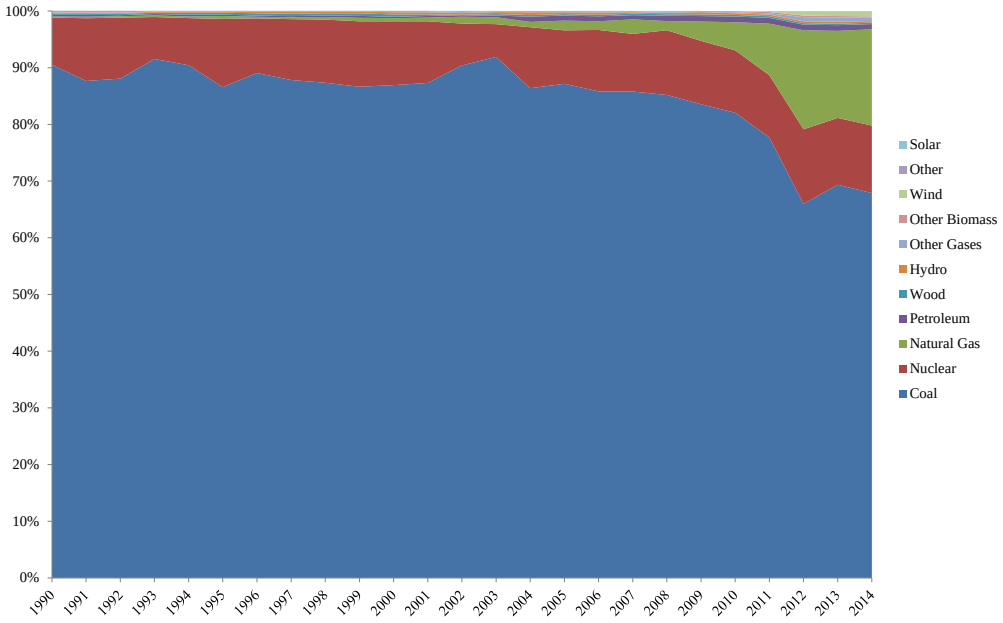
Notes & Sources:
[1] Generation data are from Net Generation by State by Type of Producer by Energy Source, available at http://www.eia.gov/electricity/data/state/, accessed December 30, 2014.
[2] Generation data include MWh from electric generators and combined heat and power units.
[3] Sales data are from Retail Sales of Electricity by State by Sector by Provider, available at http://www.eia.gov/electricity/data/state/, accessed December 30, 2014.
[4] Sales data include MWh from full-service and energy only providers.

Figure 5
Ohio Actual and Forecast Annual Peak Load, 2005-2029



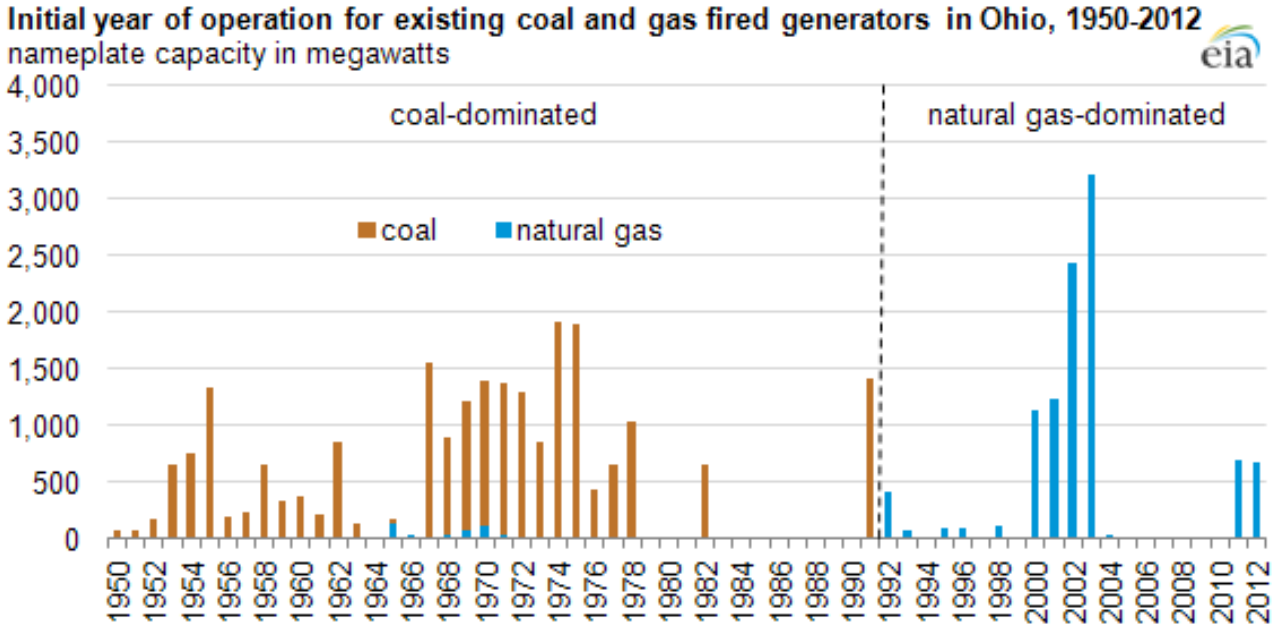
Notes & Sources:
[1] "A Report by the Staff of the Public Utilities Commission of Ohio - Ohio Long Term Forecast of Energy Requirements 2011-2030," the Public Utilities Commission of Ohio, March 31, 2012.
[2] Ohio data are from Table 4.1.1 Summary of Electricity Requirements in Ohio by End Use Sectors.

Figure 6
Ohio Generation by Fuel Type, 1990-2014



Notes & Sources:
[1] Generation data are from U.S. Department of Energy Energy Information Administration, Detailed State Data: Net Generation by State by Type of Producer by Energy Source, available at http://www.eia.gov/electricity/data/state/, accessed February 16, 2015.
[2] Generation data are for the total power electric industry, and reported on an annual level for 1990 through 2012, and monthly level for 2013 and 2014.
[3] Data for 2013 and 2014 are preliminary. For 2014, generation data were only available through November. December data were estimated as the average of January and November 2014 generation by fuel type.

Figure 7



Source: http://www.eia.gov/todayinenergy/images/2012.02.16/OhioGenVintage.png

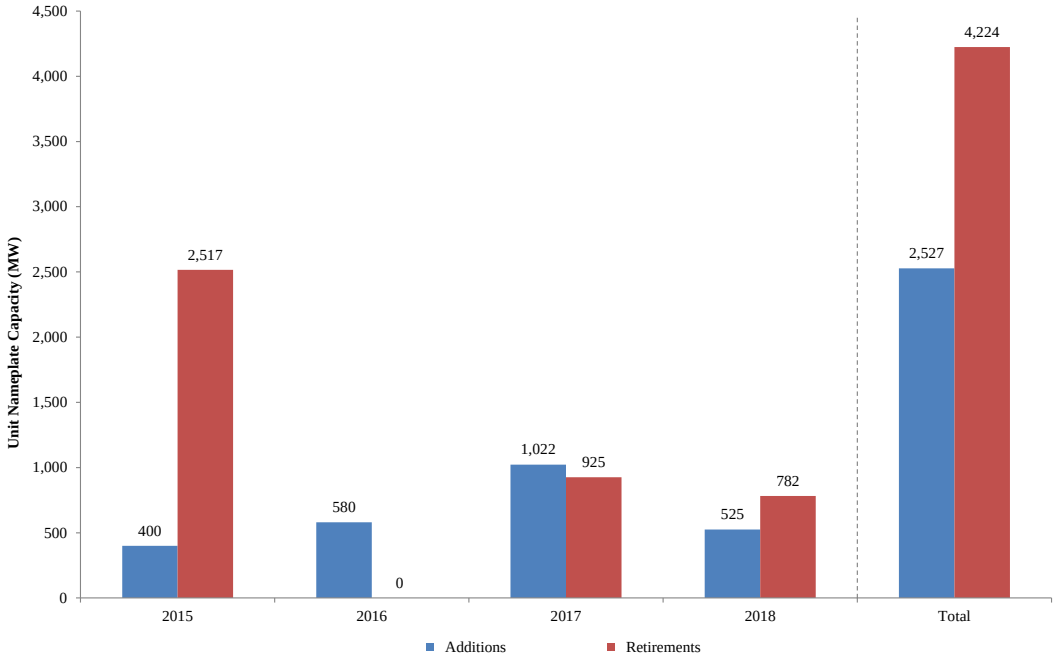
The addition of gas-fired and renewable capacity, and an increase in imported power, has begun to improve the generating resource diversity in Ohio, and this trend is likely to continue and even accelerate over the next ten years. Planned additions and retirements mean that Ohio could experience a net reduction in generating capability over this time frame. This means that Ohio's reliance on regional wholesale markets and out-of-state resources may increase further over time. Planned capacity additions and retirements within the state are summarized in **Figure 8** below, which shows that more than 4,200 MW of installed capacity in Ohio is expected to retire between 2015 and 2018, while approximately 2,500 MW of new capacity will be added to the generation mix. Of the 4,200 MW of capacity expected to retire, approximately 60 percent is from coal-fired units, with another 20 percent each from nuclear and natural gas units respectively. If the Davis-Besse nuclear unit is assumed to be relicensed, the quantity of expected retirements would be lower by approximately 900 MW, to 3,300 MW.

In addition to a turnover in generating assets, utilities in Ohio are spending billions of dollars on the state's electricity infrastructure. AEP Ohio has committed over $1 billion between 2013 and 2015 to improve, build, and repair transmission projects throughout the state.[25] FirstEnergy is spending over $900 million to upgrade their system's transmission system to increase

[25] "Committed to Keeping Ohio Shining Brightly," AEP Ohio, available at http://aepohioanswers.com/2014/07/07/committed-to-keeping-ohio-shining-brightly/, accessed February 11, 2015.

customers' electric reliability, and in 2014 alone, over $690 million was spent in the Ohio Edison Service area.[26] The 2013 PJM Regional Transmission Expansion Planning identified 25 system upgrades in Ohio with project costs greater than $5 million that received approval from the PJM Board during 2013. The total costs of these individual projects range from $5 million to $45 million, and total over $345 million.[27] These additional investments will likely improve the ability of the interstate transmission system to efficiently move power into, out of, and around the state as the resource mix changes.

Figure 8
Ohio Planned Capacity Additions and Retirements, 2015-2018



Notes & Sources:
[1] SNL Financial.
[2] Analysis of additions limited to units in development with a current operating status of 'advanced development' and 'under construction'.
[3] Nuclear plants are considered to retire in the years that the operating license expires unless the operating license has been renewed.

[26] "FirstEnergy Invested $690 Million in 2014 in the Ohio Edison Service Area," Transmission and Distribution World, January 26, 2015 available at http://tdworld.com/distribution/firstenergy-invested-690-million-2014-ohio-edison-service-area and "Ohio Transmission Projects," FirstEnergy, available at https://www.firstenergycorp.com/about/transmission_projects/ohio.html, accessed February 11, 2015.

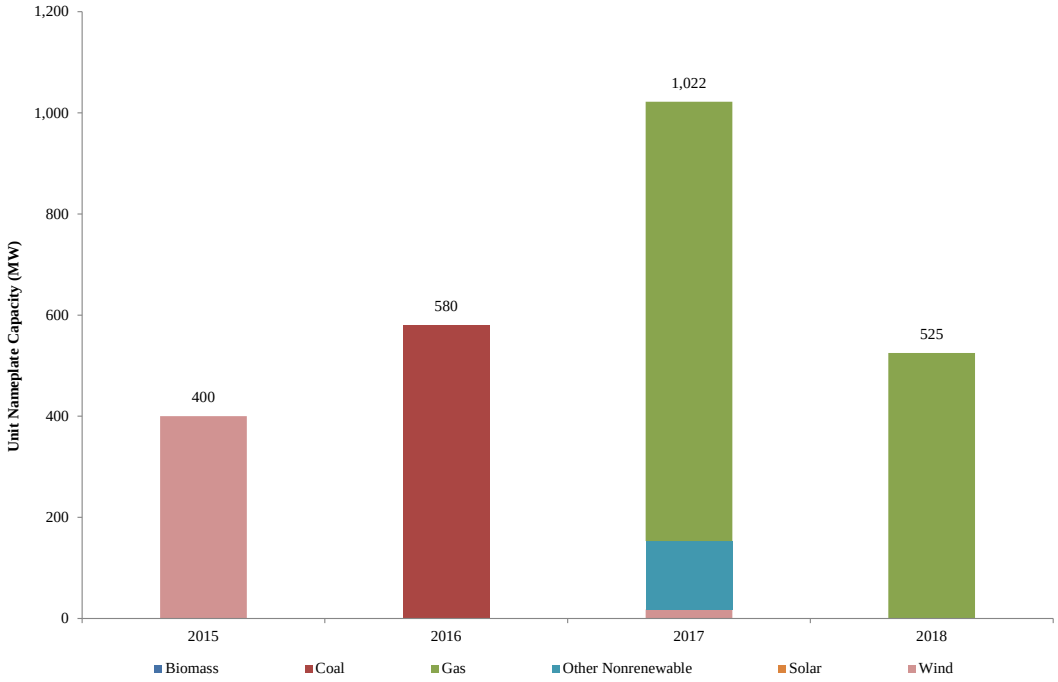
[27] "2013 PJM RTEP Regional Transmission Expansion Plan, Book 5, State RTEP Summaries" PJM Interconnection, February 28, 2014.

The Contribution of Renewable Generation Due to Ohio's RPS

Currently, most electricity generated in Ohio is from non-renewable resources, including coal, natural gas, oil and nuclear plants. As noted above, in 2013, coal-fired plants generated approximately 70 percent of the electricity produced in Ohio, while natural gas and nuclear generated 16 and 12 percent, respectively. Renewable resources currently make up a small amount of Ohio's electric mix, representing approximately 2 percent of electric generation in 2013. Ohio's RPS currently requires that 12.5 percent of electricity sold be generated from renewable energy by the end of 2026.[28] SB310 has frozen renewable generation levels for 2015 and 2016, which require 2.5 percent of electricity sold to be generated from renewable energy. Under current law, in 2017, the original renewable benchmark schedule set out in SB221 resumes. Renewable generation would need to be 6.5 percent and 10.5 percent of electricity sold in 2020 and 2024, respectively as part of meeting the RPS by the end of 2026. The solar benchmark was also frozen at 0.12 percent in 2015 and 2016, but resumes its normal schedule in 2017 in order to meet the final goal of 0.5 percent of total generation from solar in 2026. Presently over 400 MW out of the 2,500 MW of planned capacity additions through 2018 are from renewable resources that qualify for the state's RPS (see **Figure 9** below). In order to fully comply with these requirements, Ohio will need to fill the substantial remaining resource gap by either attracting entry of additional in-state qualifying resources (yet to be announced) or through the purchase of qualifying renewable energy credits produced by out-of-state resources, assuming that sufficient quantities are available.

[28] "Where does Ohio's electricity come from?" the Public Utilities Commission of Ohio, available at http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/where-does-ohioe28099s-electricity-come-from/#sthash.c31nAhsx.dpbs, accessed January 1, 2015.

Figure 9
Ohio Planned Capacity Additions by Fuel Type, 2015-2018



Notes & Sources:
[1] SNL Financial.
[2] Analysis limited to units in development with a current operating status of 'advanced development' and 'under construction'.

Upcoming EPA Rulemakings

There are a number of recently proposed or finalized federal regulations issued by the EPA that will affect certain power plants in Ohio, and in the broader PJM region, including: (1) the MATS rule covering hazardous air pollutants; (2) the CSAPR rule for the reduction of SO_2 and NO_x emissions in 28 eastern states, and the CAIR rule which will continue in place until CSAPR is implemented; (3) the Cooling Water Intake Structures rule under section 316(b) of the Clean Water Act; (4) the disposal of Coal Combustion Residuals regulation; and (5) and the requirements for reductions in CO_2 emissions from existing power plants under EPA's proposed Clean Power Plan.

The MATS rule will limit emissions of mercury and air toxics through the use of uniform national standards for hazardous air pollutants from coal and oil fueled steam generators with a nameplate capacity of 25 MW or more. The rule is considered technology-based in that its requirements are based on maximum achievable control technology and typically are met through emission controls installed at affected power plants rather than achieved through emissions trading. Compliance requirements begin in March 2015 with a possible extension through March 2017 for certain qualifying units (reliability critical units).

EPA's CSAPR tightens the limits on the amount of SO_2 and NO_x pollution that fossil-fuel power plants in 28 states in the eastern U.S. are able to emit. The rule came under Clean Air Act section 110(a)(2)(D) prohibiting air pollutants from being emitted in an upwind state that "contribute significantly" to poor air quality in a downwind state. The rule establishes a new allowance system for units with at least 25 MW nameplate capacity or more and affected generators will need one allowance for each ton of covered pollutant emitted in a year. On August 21, 2012, the United States Court of Appeals for the D.C. Circuit vacated CSAPR and ordered the EPA to continue to administer CAIR while it worked on the replacement rule. The EPA and various environmental groups petitioned the Supreme Court to review the D.C. Circuit Court's decision on CSAPR. The Supreme Court heard oral arguments in the case on December 10, 2013, and on April 29, 2014, a decision by the Supreme Court reversed the D.C. Circuit's ruling and remanded the case. On October 23, 2014, the D.C. Circuit Court lifted the stay of CSAPR and scheduled March 11, 2015, to hear oral arguments on the remand. Until that proceeding is complete, the earlier rule covering these pollutants at lower limits (CAIR) will remain in effect.

The Cooling Water Intake Structures rule under section 316(b) of the Clean Water Act ("CWA") is intended to reduce environmental harm from existing power plant cooling water systems (e.g., impingement and entrainment of aquatic life). The EPA proposed the revised cooling water intake structures rule on March 28, 2011, with the final rule issued in May 2014. The final rule establishes requirements for all existing power generating facilities and existing manufacturing and industrial facilities that withdraw more than 2 million gallons per day of water from waters of the U.S. and use at least 25 percent of the water they withdraw exclusively for cooling purposes. This rule covers roughly 1,065 existing facilities – 544 of which are power plants. To ensure flexibility, the owner or operator of the facility will be able to choose one of seven options for meeting best available technology requirements for reducing impingement. Facilities that withdraw very large amounts of water – at least 125 million gallons per day – are required to conduct studies to help the permitting authority determine what site-specific entrainment mortality controls, if any, will be required. New units at an existing facility that are built to increase the generating capacity of the facility will be required to reduce the intake flow to a level similar to a closed cycle, recirculation system.[29]

On December 19, 2014, the EPA issued a final rule that for the first time establishes a comprehensive set of requirements for the disposal of coal combustion residuals ("CCRs" or coal ash) in landfills and surface impoundments generated by coal combustion at electric power

[29] "Water: Cooling Water Intakes (316b)," United States Environmental Protection Agency, available at http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/, accessed February 7, 2015.

plants. The CCR rule was finalized under the solid waste provisions, subtitle D, of the Resource Conservation and Recovery Act and establishes requirements for both existing and new CCR landfills and surface impoundments, including lateral expansions of any existing facility. The final rule addresses the risk of improperly constructed or managed coal ash disposal facilities that could leak contaminants into groundwater by adding new requirements for coal ash surface impoundments and landfills including:

- Groundwater monitoring around surface impoundments and landfills;
- Liner requirements for new surface impoundments and landfills to protect groundwater;
- Groundwater cleanup from coal ash contamination;
- The closure of unlined surface impoundments that are polluting groundwater;
- The closure of surface impoundments that fail to meet engineering and structural standards or are located too close to a drinking water source;
- Restrictions on the location of new surface impoundments and landfills so that they cannot be built in sensitive areas such as wetlands and earthquake zones; and
- Proper closure of all surface impoundments and landfills that will no longer receive CCRs.[30]

In June 2014, the EPA issued its proposed Clean Power Plan, designed to reduce CO_2 emissions from existing fossil-fuel power plants in the United States. Once finalized, as now anticipated in mid-2015, the rule would require the 49 states where affected power plants are located to prepare and submit plans for how they propose to reduce emissions from existing power plants in their states. Although the features of the final regulation will undoubtedly change in light of the many comments filed on the EPA's proposal, the EPA proposed a two-part timeline for control requirements: an "interim goal" that states must meet on average over the ten-year period from 2020-2029 and a "final goal" that states must meet at the end of that period in 2030 and thereafter. This new policy will eventually affect over half of the nation's power plants – roughly three-quarters of total electric generating capacity and all but the smallest fossil generating units, as summarized in **Table 6** below.

[30] United States Environmental Protection Agency, 2014 Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities, available at http://www2.epa.gov/coalash/coal-ash-rule.

Table 6
Electric Generating Units Estimated to be Subject to EPA's Clean Power Plan

	Generating Units Likely to be Directly Covered by Section 111(d)*		Total Grid-Connected Generating Capacity in the U.S. (GW)	111(d) Capacity as Share of Total Capacity (%)
	(# Units)	Summer Capacity (GW)	Summer Capacity (GW)	Summer Capacity (GW)
Coal	922	300	303	99%
Natural Gas	2,137	334	464	72%
Oil	62	17	39	44%
Total Fossil	3,121	651	806	81%
All Capacity			1,151	57%

*Includes all existing or under development steam turbines and combined cycle units greater than 25 MW, and any natural gas combustion turbines with generation greater than 219,000 MWh.
Source: SNL Financial, Power Plant Unit Database as of February 2015.

The EPA's proposal sets state-specific standards, in pounds of CO_2 emitted per megawatt-hour (MWh) of electricity produced at affected facilities. In setting its state-specific standards, the EPA considered four "building blocks" that can be used to reduce carbon emissions. The EPA then analyzed historical data about emissions and the power sector to create a consistent national formula for reductions that reflects these four building blocks. The formula applies the building blocks to each state's specific circumstances, yielding a carbon intensity rate for each state in pounds of CO_2 per MWh. These building blocks and assumptions are as follows:

1. *Improved Heat Rates.* Fossil fuel power plants can undergo improvements in equipment and processes to use less fossil fuel to create the same amount of electricity, thus lowering carbon emissions per MWh. In setting its state emissions goals, EPA assumed that coal steam electric generating units in each state would undergo an average heat rate improvement of six percent.
2. *Increased Dispatch of Existing Low-Emitting Power Sources.* Less carbon pollution can be generated by using lower-emitting power plants more frequently to meet demand and using the most carbon-intensive power plants less frequently. The EPA assumed that existing and under-construction natural gas combined cycle ("NGCC") plants would be dispatched to achieve an average capacity factor of up to 70 percent.
3. *Expanded Use of Zero and Low-Emitting Power Sources.* Expanding renewable generating capacity, such as solar and wind, and using low-emitting nuclear facilities can lower carbon emissions. EPA assumed that new clean generation, including new nuclear generation under construction, moderate deployment of new renewable generation, and

continued use of existing nuclear generation would occur in each state, based on the assumption that under-construction and existing nuclear capacity would achieve an average capacity factor of 90 percent, as well as state-specific assumptions about renewable generation growth.

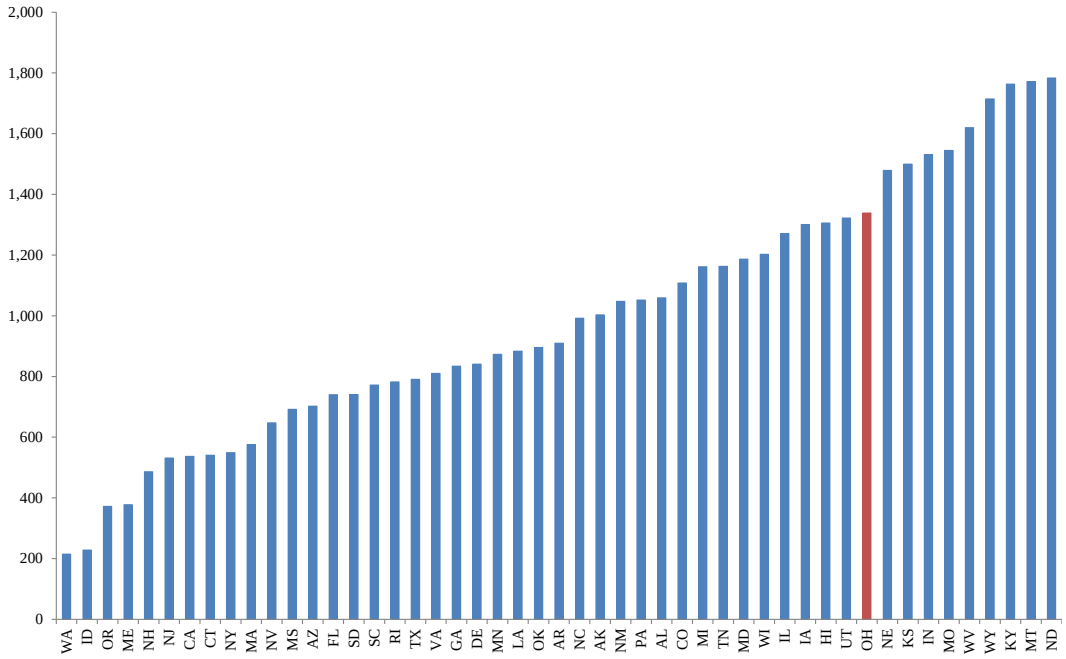
4. *Increased Deployment of Demand-Side Energy Efficiency.* Reducing demand for electricity will reduce the amount of generation required, lower carbon emissions, and will reduce costs for those consumers and businesses who consume less power through efficiency investments. The EPA assumed that states can scale their energy efficiency programs at a rate of 0.2 percent of total electric retail sales beginning in 2017, until that state achieves a savings rate of 1.5 percent of total electric retail sales in that year. States are then assumed to maintain or this 1.5 percent savings level through the compliance period. [31]

While EPA's "building blocks" were used to set state-specific CO_2 standards, each state's implementation plan will define the set of actions that will work together to reduce emissions from fossil power plants. States may shape their implementation plans in ways that are quite different from the "building block" assumptions that the EPA used to set their CO2 targets.

Under the proposed rule, Ohio's emissions rate for CO_2 would fall from its current average of 1,897 pounds per MWh to 1,338 pounds per MWh by 2030, a drop of approximately 30 percent, which would result in the state having the 10th highest average emissions rate across affected U.S. states (see **Figure 10** below).

[31] See, Paul Hibbard, Andrea Okie, and Katherine Franklin, "The Economic Potential of Energy Efficiency: A Resource Potentially Unlocked by the Clean Power Plan," Analysis Group, December 2014.

Figure 10
Proposed Final CO_2 Emissions Rates by 2030, lbs/MWh



Notes & Sources:
[1] "Technical Support Document: Goal Computation," EPA Clean Power Plan Technical Support Documents, accessed January 27, 2015, available at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.
[2] "Data File: Goal Computation - Appendix 1 and 2 (XLS)," EPA Clean Power Plan Technical Support Documents, accessed January 27, 2015, available at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents.