Ohio's Energy Efficiency Resource Standard: Impacts on the Ohio Wholesale Electricity Market and Benefits to the State

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Executive Summary

Utility energy efficiency programs generate significant financial benefits to Ohio's customers in four primary ways: (1) they help reduce customer demand for electricity, thereby directly reducing monthly electricity bills for participants; (2) they reduce customer demand, or load, which lowers wholesale energy prices, particularly in the short and medium term; (3) in a competitive wholesale capacity market, bidding in energy efficiency resources lowers wholesale capacity prices, and; 4) they provide revenue for utilities that bid energy efficiency resources into wholesale capacity auctions, which helps to offset energy efficiency program costs. Furthermore, these price mitigation impacts accrue to both participants and non-participants of utility-sponsored energy efficiency programs throughout the entire energy system.

In this analysis, we quantify the benefits that would accrue through the full implementation of the energy efficiency resource standard (EERS) in Ohio through 2020. Table ES-1 presents the results of our analyses. There is clearly an inextricable link between Ohio's energy policy and its economic health. Continuing Ohio's EERS could save customers a total of almost $5.6 billion in avoided energy expenditures and reduced wholesale energy and capacity prices by 2020: $3.37 billion from reduced customer expenditures on electricity; $880 million from wholesale energy price mitigation impacts, and; $1.3 billion from wholesale capacity price mitigation impacts from the 2017/2018 through 2020/2021 PJM capacity auctions. Table ES-1 also presents utility energy efficiency program administration costs, which we estimate at $2.8 billion. These program expenditures would be partially offset by revenues awarded to utilities through selling energy efficiency resources into the PJM auctions, however, which we estimate could total around $100 million in revenues from the same four PJM auctions, for a net effect of $2.7 billion.

Table ES-1. Summary of Wholesale Energy Cost Savings and Wholesale Energy and Capacity Price Mitigation Impacts from Ohio's EERS Through 2020

	Economic Savings (Million
Wholesale Energy Cost Savings	$3,370
Wholesale Energy Price Mitigation Savings	$880
Wholesale Capacity Price Mitigation Savings (Estimated, 2017-2020)	$1,320*
Total Savings	**$5,570**
Wholesale Capacity Price Mitigation Savings (Forgone, 2015/2016)	$500
Utility Program Administration Costs**	$2,800

*** Assumes that savings from the 2017/2018 through 2019/2020 auctions are equal to the estimates of savings from 2020/2021 auction. Does not include savings from 2016/2017 auction, which transpires in May 2013 and, hence, the potential savings have already been lost.**

**** Utility program investments will accrue savings over the life of the measures installed in each program year and, therefore, they will deliver savings beyond 2020. However, we only count program savings through 2020.**

Our estimates of the wholesale capacity price mitigation savings are conservative: they only include the potential effects of energy efficiency from the four capacity auctions between 2017/2018 and 2020/2021.[1] Table ES-2 shows the savings from the 2015/2016 auction that

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[1] Another important benefit to the electric system from investments in energy efficiency is transmission and distribution infrastructure savings. We did not attempt to quantify these benefits.

could have accrued had utilities bid all available energy efficiency resources into that auction, which we estimate to be almost $500 million, 90% of which would have come from energy efficiency resources bid from the American Transmission System, Inc. (ATSI) zone in northern Ohio.

Table ES-2. Potential Wholesale Capacity Cost Savings Had Maximum Available Energy Efficiency Resources Been Bid into the 2015/2016 BRA

Zone	Actual Auction Capacity Costs (M$)	Capacity Costs with Additional EE (M$)	Capacity Cost Savings (M$)	Capacity Cost Savings (M2012$)
ATSI	$1,368	$883	$484	$452
All Others	$717	$666	$51	$47
Ohio Total	$2,084	$1,549	$535	$499

Source: Synapse Energy Economics

Our estimates for the potential price mitigation savings during the 2020/2021 auction are approximately $330 million, although this assumes that utilities only save as much energy as required by the mandated targets and no more. Therefore, it is safe to say that the potential savings from that and the other three auctions will generate economic savings to customers of a similar order of magnitude, and even more so if utilities continue to surpass their annual targets. Ultimately, this means savings to non-participants of energy efficiency programs of at least $2.2 billion dollars, which, again, does not include savings lost from the 2015/2016 and 2016/2017 auctions.

ENERGY EFFICIENCY BENEFITS UTILITIES AND CUSTOMERS ALIKE

Energy efficiency has both direct and indirect benefits to utilities and customers:

- **Energy efficiency is the lowest-cost resource for utilities to meet the demand for electricity, even during a period of abundant shale gas and low natural gas prices**. Figure ES-1 indicates the range of the levelized cost[2] of new supply resources (Lazard 2012). The size of each bar represents the likely potential range in the cost to the utility of each resource, while the midpoint of each bar represents the best single estimate. The best estimate for energy efficiency is an average cost to the utility of less than 3 ¢/kWh. That is about one-third the cost of the next-cheapest set of electric resources and less than one-fourth the cost of the remaining conventional electricity generation options.

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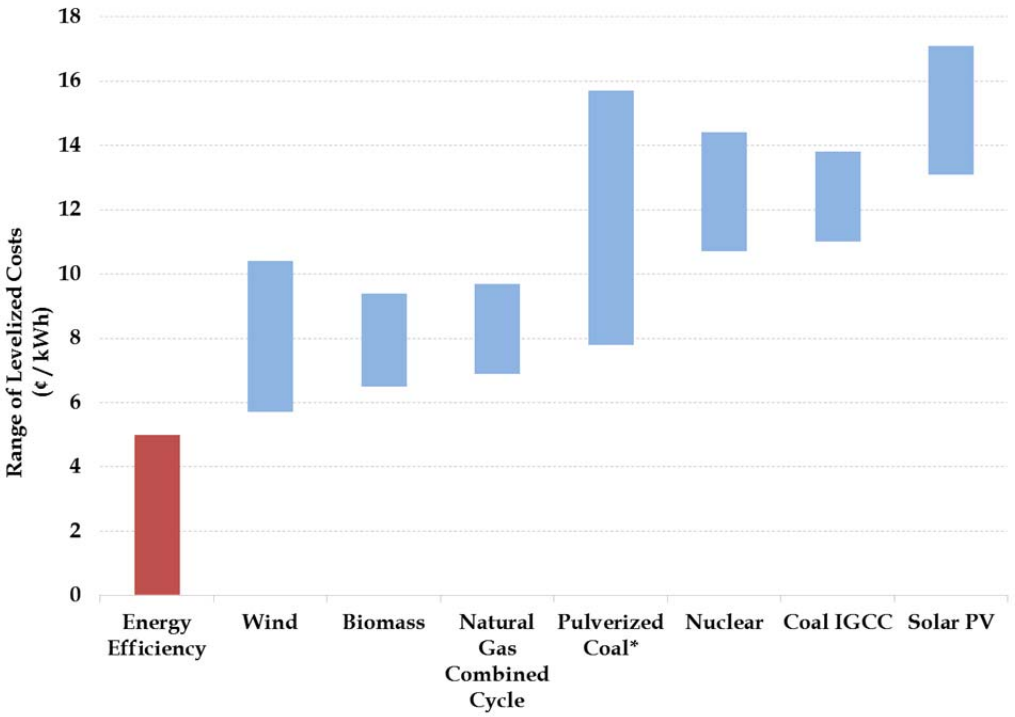
[2] "Levelized cost" refers to the cost per kilowatt-hour for electricity over the life of a generating resource, and includes capital, operations and maintenance, and fuel costs (or, in the case of energy efficiency, analogous program costs).

Figure ES-1. Levelized Utility Cost of New Energy Resources



*High-end range of advanced pulverized coal includes 90% carbon capture and compression.
Source: Lazard (2012)

- **Investments in energy efficiency allow utilities to defer costly investments in new generation resources and transmission and distribution infrastructure**. These deferred capital investments help to keep electricity rates low for all utility customers, whether they participate in energy efficiency programs or not.

- **Energy efficiency contributes to the optimal functioning of the wholesale capacity markets, putting downward pressure on the cost of electricity for all customers.** Capacity costs—which impact the cost of electricity— are set to dramatically increase in 2015 in the ATSI zone in northern Ohio.[3] As a utility system resource, energy efficiency can reduce the risk of unexpected capacity constraints and thereby suppress capacity prices should there be a delay in planned new generation or transmission projects.

- **Energy efficiency reduces financial risk to utilities, investors, and customers by diversifying the utility's portfolio of energy resources.** From a utility planning perspective, energy efficiency is the lowest-risk resource option (Binz et al. 2012): it is not capital intensive, can be deployed quickly, and generates savings perpetually over the life of the installed measures. Supply-side resources, on the other hand, are capital intensive, cannot be deployed as quickly and do not generate electricity 100%

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[3] FirstEnergy's service territory is in the ATSI zone, which represents 40% of the total energy load in Ohio.

of their operating lives, all of which increase the financial risk to utilities and customers.

- **For a given level of investment, energy efficiency creates more jobs than new generation.** A recent ACEEE study found that investments in energy efficiency create jobs in labor-intensive industries, such as manufacturing and construction, where a $1 million investment supports, on average, 14 and 20 jobs, respectively (Bell 2012). In the energy generation industry, the study found that a $1 million investment supports about 10 jobs. Energy savings from energy efficiency will be reinvested in the economy, supporting jobs in other industries.

Ohio's manufacturers will also reap these benefits, along with others, such as:

- A potential income source from selling energy efficiency to utilities to help utilities meet their energy savings goals.

- Co-benefits that are equivalent to 3-5 times the direct energy savings, such as improved worker safety, improved plant reliability, improved product quality, and reduced maintenance costs (Worrell et al. 2003).

- Burgeoning demand for Ohio-manufactured products that are energy efficient, such as insulation, heating and cooling equipment, variable frequency drives, etc. (because a greater portion of dollars invested in energy efficiency, as opposed to dollars invested in generation capacity, will remain in Ohio).

- Energy efficiency increases the availability of existing natural gas supply at a lower market price, providing manufacturers with expanded access to an affordable and plentiful supply of natural gas to use as a feedstock, such as in combined heat and power applications, which are qualified resources for meeting the mandated savings targets.

CONCLUSION

Energy efficiency is still the lowest-cost energy resource to meet burgeoning demand and can be deployed much more quickly than new capacity can be constructed. While natural gas prices have reached historically low levels and an abundance of shale gas has been discovered in the Marcellus Formation, neither of these phenomena preclude the need for investments in energy efficiency. The value proposition to businesses and manufacturers, participants and non-participants alike, is unequivocal: energy efficiency reduces customer energy costs, both directly through facility efficiency improvements and through downward pressure on market energy prices. Energy efficiency also reduces risks associated with volatile energy markets and, ultimately, enhances the competitiveness of Ohio's businesses.

Introduction

ACEEE's analysis of the potential impacts on wholesale energy expenditures and wholesale energy and capacity prices shows that there is an inextricable link between Ohio's energy policy and its economic health. To that end, in this report we demonstrate that Ohio's energy efficiency resource standard has been and will continue to economically benefit the state. To support this assertion, we:

1. Review the performance of Ohio's utility-administered energy efficiency programs during the 2009-2011 program years.

2. Estimate the direct economic savings and mitigation effects on wholesale electricity and capacity prices of continuing to meet the energy and peak demand savings targets through the bidding of energy efficiency resources into the PJM wholesale market.

3. Provide an assessment of the benefits to Ohio manufacturers that result from:
   a. Lower future electricity prices as a result of lower market prices;
   b. Reduced direct energy expenditures due to improvements in energy efficiency;
   c. Reduced risks due to decreased exposure to volatile energy markets; and
   d. Potential opportunities for industrial customers to sell energy efficiency resources to utilities to help meet their savings targets and into the competitive wholesale markets.

4. Offer suggestions on how to perpetuate these benefits through innovative program deployment.

The results of these analyses show that:

1. Growing investments in energy efficiency are economically justifiable despite the recent drop in the price of natural gas and the discovery of plentiful shale gas resources.

2. Utilities have been meeting and exceeding their annual savings targets mandated by Ohio's EERS and have done so cost-effectively.

3. Energy efficiency resources bid into a competitive market have the ability to depress electricity prices, generating economic benefits for participants and non-participants alike.

4. The financial benefits to customers from utility energy efficiency investments exceed the energy efficiency program costs by a substantial margin.

Following the analyses we provide a brief summary of the results, discussing the role that Ohio's EERS policy plays in delivering these benefits. We then conclude with a discussion of the implications of the results and some innovative policy options to ensure that Ohio's utilities are able to meet future savings targets.

Energy Efficiency and the Wholesale Electricity Market[4]

Markets for electricity have both retail and wholesale components. Retail markets involve the sale of electricity to customers, while wholesale markets involve the sale of electricity among utilities and other market participants prior to being sold to the customer.

In traditional regulated markets, utilities own and schedule generation, transmission, and distribution assets, while prices for retail electricity are set by a regulatory body. In contrast, in competitive markets utilities may not own generation or transmission assets; their use is typically scheduled by an Independent System Operator (ISO).

Prices in wholesale markets are typically set competitively rather than through regulation. This means that prices reflect supply and demand, which are in turn determined by many factors, including fuel prices, capital costs, transmission capacity, weather, economic activity, and demographics (FERC 2012).

Financial Impacts of Ohio's Energy Efficiency Standard on Ratepayers

In this section of the report we first provide utility program expenditures for the first three years (2009-2011) of Ohio's energy efficiency resource standard and produce high-level estimates of utility expenditures for the years 2012 through 2020. Understanding utility expenditures on energy efficiency programs gives us some perspective on the cost-effectiveness of the benefits delivered through these programs. One important caveat to note, however, is that these costs only represent those borne by the utility: the vast majority of energy efficiency programs require some sort of direct investment on the part of the customer in addition to utility program costs.

On the other hand, another important caveat is that there are additional benefits that accrue to customers from these investments that are not captured in this analysis. When energy efficiency measures are implemented in industrial, commercial, or residential settings, several "non-energy" benefits such as maintenance cost savings and revenue increases from greater production often result in addition to the anticipated energy savings. Often, the magnitude of non-energy benefits from energy efficiency measures is significant. These added savings or productivity gains range from reduced maintenance costs and lower waste of both water and chemicals to increased product yield and greater product quality.[5]

In order to keep the focus of this study specifically on the implications for utility customers of having energy efficiency programs as a utility system resource, we do not attempt to

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[4] A more detailed discussion of wholesale market dynamics can be found in Appendix A.1.

[5] In one study of 52 industrial efficiency upgrades, all undertaken in separate industrial facilities, Worrell et al. (2003) found that these non-energy benefits were sufficiently large that they lowered the aggregate simple payback for energy efficiency projects from 4.2 years to 1.9 years (Worrell et al. 2003). Unfortunately, these non-energy benefits from energy efficiency measures are often omitted from conventional performance metrics. This omission leads, in turn, to overly modest payback calculations and an imperfect understanding of the full impact of additional efficiency investments.

quantify either those direct customer costs for energy efficiency measures nor the additional benefits noted in those caveats above.

Next we present the results of our analysis of the impacts of continued investments in energy efficiency and demand response on wholesale energy and capacity prices for electricity, as well as the wholesale energy cost savings to customers from reduced demand. Our estimates of the direct energy savings and the savings from wholesale energy price mitigation impacts (as opposed to wholesale capacity prices) reflect savings achieved by utilities between 2010 and 2020, not just the first three years of programs under the EERS. Details on the methodology can be found in Appendix A. The analysis draws on an energy and peak load forecast that was developed for Ohio by Synapse Energy Economics, for which details can be found in Appendix B.[6]

The last caveat to note is that the financial savings we report are based on wholesale electricity prices, not retail, so there is some conservatism in these results as well.

UTILITY COSTS OF DELIVERING ENERGY EFFICIENCY PROGRAMS

In Table 1 we present a summary of utility energy efficiency program costs, savings, and the levelized cost of saved energy (CSE)[7] in Ohio for the 2009 through 2011 program years. We conduct this exercise to show that utility efforts to deliver cost-effective savings to customers have so far been successful, which we discuss further in the section below titled "Benchmarking Program Cost-Effectiveness." In this sub-section, we use this data to extrapolate utility program costs through 2020 so that we can provide a high-level comparison of the cumulative utility program costs with the direct and indirect benefits of Ohio's EERS, keeping in mind the caveats we cover above.

The results in Table 1 show that Ohio's utilities are generating energy efficiency savings at a levelized cost considerably lower than the levelized costs of new generation resources, as shown in Figure ES-1. During the first three years of Ohio's EERS policy, utilities achieved savings at a cost of $0.011 / kWh, compared to the next cheapest generation resource, wind, at around $0.06 / kWh. Ohio's utilities are generating these savings largely from energy efficient lighting programs, however, which are relatively inexpensive to administer. In the future, the leveled costs of Ohio's portfolios will rise modestly as the portfolios mature and become more comprehensive. As Figure ES-1 shows, though, the levelized cost of these comprehensive portfolios averages around $0.03 /kWh.

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[6] Another important benefit to the electric system from investments in energy efficiency is transmission and distribution infrastructure savings. We did not attempt to quantify these benefits.

[7] The levelized cost of saved energy is a metric that shows the level of annual payment necessary to recoup the costs of an energy efficiency measure or group of measures. It is a measure of cost-effectiveness and is usually compared to utility avoided costs. We assume a discount rate of 5% and an average portfolio measure life of 13 years for our calculations.

Table 1. Utility Program Costs, Savings, and Levelized Cost of Saved Energy, 2009-2011

Utility	Program Year	Program Savings (MWh)	Program Costs (Ths $)	Levelized CSE ($/kWh)
AEP	2009	250,600	$ 14,837	$ 0.008
Duke		86,353	$ 9,205	$ 0.014
DP&L		114,288	$ 7,648	$ 0.009
FirstEnergy*		22,614	$ 31,174	$ 0.179
Total		473,855	$ 62,865	$ 0.017
AEP	2010	364,000	$ 34,781	$ 0.012
Duke		310,553	$ 19,797	$ 0.008
DP&L		179,206	$ 12,157	$ 0.009
FirstEnergy*		534,486	$ 25,257	$ 0.006
Total		1,388,245	$ 91,992	$ 0.009
AEP	2011	502,000	$ 51,456	$ 0.013
Duke		215,699	$ 21,412	$ 0.013
DP&L		179,586	$ 13,980	$ 0.010
FirstEnergy*		461,158	$ 23,283	$ 0.007
Total		1,358,443	$ 110,131	$ 0.010
Grand Total		3,220,543	$ 264,988	$ 0.011

* Program costs for FirstEnergy are budgets, taken from their 2009 DSM Plan (FirstEnergy 2009)
Sources: AEP 2010, 2011b, 2012; Duke 2010, 2011, 2012; DP&L 2010, 2011, 2012; FirstEnergy 2009, 2010, 2011, 2012

To estimate utility program costs for program years 2012-2020, we calculate the average first-year cost of energy efficiency savings[8] in Ohio using the data above in Table 1 (program costs divided by savings). We use this value to represent the costs of achieving incremental annual energy savings for each future program year. The first-year cost was highest during the 2011 program year, \$0.093/kWh, so we used this value as a starting point to determine a rough estimate of future utility program costs.

Our estimate of the first-year cost for Ohio's energy efficiency programs (2009-2011) is lower than those of mature, comprehensive program portfolios in other states. This is likely due to a variety of factors, but largely because Ohio's IOUs have been fairly dependent upon savings from lighting programs to meet their annual targets. As Ohio's EERS targets ramp-

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[8] We use first-year energy efficiency program costs to calculate future program costs because these represent the incremental costs of program delivery in a particular year, allowing us to add these values over time to determine the total cost of utility program delivery between 2012 and 2020. We did not include data from FirstEnergy in this calculation because of the incongruity of program budgets (instead of actual program costs) and actual reported savings.

up, utilities will have to develop more comprehensive program portfolios to meet those targets, which will increase the first-year cost of achieving those savings. In order to best reflect the likely ramp-up in utility program costs over time, we assume that, by 2020, the first-year energy efficiency program costs will reflect the average first-year costs found in other states with more mature, comprehensive program portfolios.

A forthcoming study from ACEEE found that the first-year cost of energy efficiency programs in several other states is about $0.22/kWh. Based on this finding, we assume that first-year costs in Ohio begin at $0.093/kWh in 2012 and ramp-up linearly to $0.22/kWh by 2020 (see Table 2).

Table 2. Estimated Utility Program Administration Costs, 2012-2020

Program Year	Incr. Annual Savings Tgts from EERS (GWh)	Avg. First-Year Cost of EE in Ohio ($/kWh)	Estimated Annual Program Costs (Ths $)
2012	1,080	$0.093	$ 100,476
2013	1,244	$0.109	$ 135,478
2014	1,390	$0.125	$ 173,425
2015	1,390	$0.141	$ 195,483
2016	1,399	$0.157	$ 218,887
2017	1,411	$0.172	$ 243,173
2018	1,416	$0.188	$ 266,580
2019	2,834	$0.204	$ 578,400
2020	2,816	$0.220	$ 619,580
Total			$2,531,482

In total, we estimate that utilities could spend approximately $2.8 billion on administering energy efficiency programs through the year 2020, which is the sum of utility program costs incurred over the first three program years, 2009-2011, and our estimates in Table 2 above. These program expenditures would be partially offset by revenues awarded to utilities through selling energy efficiency resources into the PJM auctions. These costs are for the utility only and do not include customer costs.

Participation in the PJM auctions provides utilities with an opportunity to sell their energy efficiency resources in the wholesale capacity market, which can be used to offset energy efficiency program costs. In 2020, assuming a clearing price of $107/MW-day and energy efficiency reductions of 608 MW (see Table 6 below), utilities would earn almost $24 million in revenues. Assuming a similar order of magnitude for bid savings and approximately the same clearing price for the previous three auctions as for the 2020 PJM auction, utilities could earn almost $100 million from the wholesale capacity market auctions to help reduce program expenditures to $2.7 billion.

DIRECT BENEFITS OF ENERGY EFFICIENCY THROUGH ELECTRICITY EXPENDITURE SAVINGS

In 2012, Ohio customers spent about $4.5 billion in wholesale electric energy costs.[9] For our analysis of the direct wholesale energy cost savings, we account for the full energy efficiency programmatic impacts between 2010 and 2020 based on the savings delivered by meeting the annual EERS targets. We do not include peak demand savings. The annual energy savings created by the EERS reduce customer electricity requirements and, subsequently, wholesale purchases, which can be translated into cost savings. Estimates of the annual wholesale cost savings are simply the product of wholesale electric energy prices (see Table B-1, Appendix B) and the annual energy savings from the EERS (see Table 3).

Table 3. Estimated Wholesale Energy and Cost Savings, 2010-2020, M2012$

Year	Energy Sales Without EERS (GWh)	Incremental Annual Savings Targets (GWh)	Total Annual Energy Savings (GWh)	Annual Wholesale Cost Savings (M2012$)
2010	155,985	663	1,885	$74
2011	162,100	945	3,800	$151
2012	166,054	1,080	4,881	$153
2013	167,399	1,244	6,125	$188
2014	170,573	1,390	7,515	$235
2015	173,504	1,390	8,905	$279
2016	176,224	1,399	10,304	$327
2017	177,148	1,411	11,715	$382
2018	178,514	1,416	13,131	$430
2019	179,694	2,834	15,964	$526
2020	181,904	2,816	18,781	$623
Total		**18,781**	**18,781**	**$3,368**

Source: Synapse Energy Economics

In 2012, the incremental annual energy savings relative to the annual target was 1,080 GWh, or 4,881 GWh of cumulative savings since 2009, which represents a wholesale annual cost savings of $153 million.[10] As the EERS program continues and the targets ramp up, the annual savings will grow. By 2020, total annual savings will reach almost 18,800 GWh, around 10% of the state load, which will produce wholesale annual cost savings of $623 million in that year and $3.4 billion cumulatively (see Figure 1).

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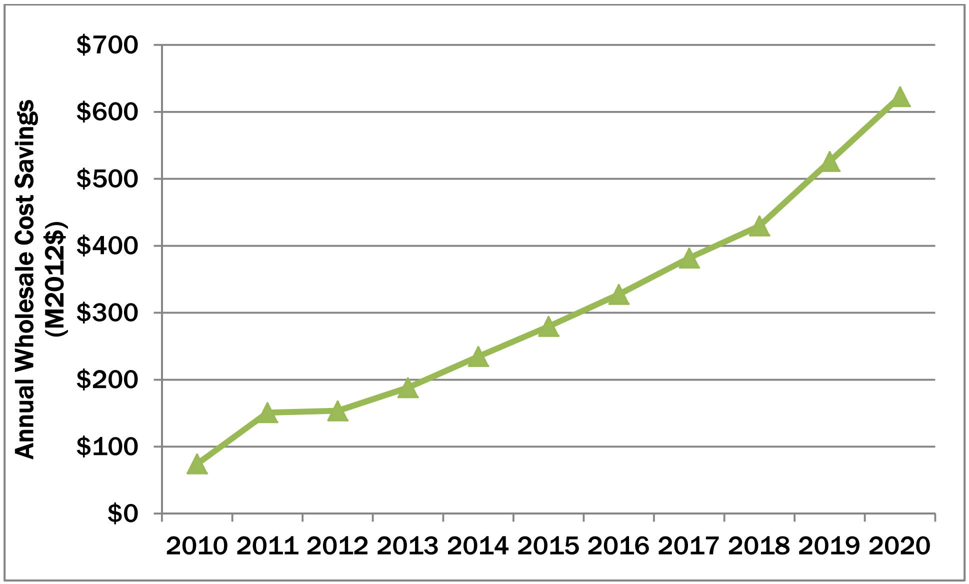
[9] Using the average wholesale price in Ohio in 2012 of $31.69/MWh (see Table B-1), absent EERS impacts, and assuming a 2012 load of approximately 141 million MWh, we estimate $4.463 billion in wholesale electric energy costs for 2012.

[10] The wholesale annual cost savings represent the economic savings to customers from efficient measures installed in that year and the previous years.

Figure 1. Estimated Annual Wholesale Cost Savings from Electric Energy Savings



Source: Synapse Energy Economics

ADDITIONAL BENEFITS OF ENERGY EFFICIENCY THROUGH WHOLESALE ELECTRICITY MARKET PRICE EFFECTS

For our analyses on wholesale energy price mitigation impacts, the full energy efficiency programmatic impacts are considered between 2010 and 2020 that arise from meeting the EERS targets. We limit the time period of the analysis on wholesale capacity price mitigation impacts due to the dynamics of competitive markets, which we elaborate upon below.

In this section we estimate reduction in wholesale energy and capacity prices in Ohio that would result from reductions in the quantity of energy and capacity required to meet future demand due to the impacts of incremental efficiency and demand response initiatives required by the EERS. This is known as "price mitigation" and is defined as the reduction in prices, caused by a reduction in the load to be supplied, relative to those that would otherwise prevail. This price mitigation reflects the value of efficiency to all retail customers in 2020, since reductions in wholesale prices are eventually passed on to all retail customers.[11]

Price mitigation is usually small when expressed as a percentage impact on the wholesale market prices of energy and capacity, but tends to be significant when expressed in absolute dollar terms. This is because small impacts on market prices, when applied to all energy and capacity being purchased in the wholesale market, translate to large absolute dollar amounts. Our estimates of price mitigation due to efficiency investments are limited to the

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[11] In contrast, avoided electric energy costs and capacity costs reflect the value of efficiency to the portion of customers who participate in DSM programs, in the form of a reduction in the quantity of energy that has to be bought to serve them in a given period.

absolute dollar impacts within Ohio, but there would be impacts throughout the entire PJM West market.[12]

Wholesale Energy Price Mitigation

In the short to medium term, or 1-5 years, the demand for electricity ("load") has an effect on energy prices: all else being equal, higher loads are associated with higher energy prices. This kind of general relationship tends to hold from year to year, although electric energy prices may change depending on fuel prices and overall load increases over time.

To represent the general relationship between load and price, we often calculate and use an energy price elasticity coefficient. This coefficient tends to be fairly stable from year to year even when prices and load levels change. This coefficient is represented as the percentage change in average price for a percentage change in average load. For 2011, using data we provide in Figure A-1 in Appendix A.2., we estimate a price elasticity coefficient of 1.17. This means that a 1% change in average annual load changes the average wholesale energy price by 1.17%.[13]

Looking forward to 2020 we expect a similar relationship to hold. While some older coal plants (with a lower capacity factor) are likely to retire, and newer, more efficient natural gas plants and renewable generation will be added, the vast majority of existing generation will still be operating under similar conditions as it is today.

RESULTS FOR THE ENERGY PRICE MITIGATION ANALYSIS

Table 4 below shows the savings calculations based on our load and price forecasts (see Appendix B). The savings reflect the full energy efficiency program effects of the EERS between 2010 and 2020. If the targets were to be capped in any year, the energy savings would remain at those levels (i.e., 1%, 2% of sales) and as the market adjusts over time,[14] the price mitigation savings will decline.

In Appendix A.1.1 we discuss the uncertainty surrounding the market response to changes in load under a continuation of the EERS, which required us to estimate a range of wholesale energy price mitigation effects due to load changes. We think a price effect somewhere in between is most likely, and the annual market price reduction percentage values in Table 4 below represent a response halfway between the low and high cases. This mid case would result in savings to Ohio customers of almost $880 million (2012$) by 2020 because of price suppression effects.

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[12] Ohio is located in the "western PJM" locational deliverability area (LDA) of the PJM wholesale market, which coordinates the movement of wholesale electricity in 13 states and the District of Columbia. The state is served by four utility zones: ATSI (First Energy); AEP; DAY (Dayton Power & Light); and DOEK (Duke).

[13] This is a very conservative analysis. The effect of demand reduction on the market price is not linear or average. The effect is much greater at the margin, where the effect of demand reduction will occur in market pricing. In other words, a relatively small change in demand can have very disproportionate effects on market price and customer costs, particularly when all vendors are given the market clearing price.

[14] Market adjustments means that, in response to reductions in load and price, utilities will change the operating schedules of their plants or capacity deployment. For example, some marginal generation resources (i.e., non-baseload resources) may no longer be available, or new generation might not be added as soon.

Table 4. Energy Price Impact Calculations for Changes in Ohio Load

Year	Total Annual Energy Savings (GWh)	Market Price Reduction %	Market Price Reduction (2012$/MWh)	Ohio Load After EERS Savings (GWh)	Ohio Annual Cost Mitigation (M2012$)
2010	1,885	0.31%	0.124	154,100	$19
2011	3,800	0.61%	0.245	158,300	$39
2012	4,881	0.77%	0.246	161,173	$40
2013	6,125	0.97%	0.301	161,274	$49
2014	7,515	1.18%	0.373	163,058	$61
2015	8,905	1.38%	0.441	164,599	$73
2016	10,304	1.59%	0.513	165,920	$85
2017	11,715	1.81%	0.601	165,434	$99
2018	13,131	2.03%	0.678	165,384	$112
2019	15,964	2.49%	0.843	163,729	$138
2020	18,781	2.95%	1.006	163,124	$164
Total					**$878**

Source: Synapse Energy Economics

Wholesale Capacity Price Mitigation

Our analysis of wholesale capacity price mitigation impacts presents estimates for two of PJM's Base Residual Auctions. The first analysis estimates the economic savings that would have been realized had all potential energy efficiency resources been bid into the 2015/2016 BRA. The second analysis estimates the economic savings that can be realized if all potential energy efficiency resources are bid into the 2020/2021 PJM BRA. Available time and resources limited our analysis to these two years. We consider it reasonable to assume that the potential price mitigation savings from bidding all potential energy efficiency resources into the 2017/2018 through 2019/2020 BRAs would be the same order of magnitude as for the 2020/2021 BRA. Our methodology and assumptions are presented in Appendix A.3.

SAVINGS FROM ENERGY EFFICIENCY IN THE 2015/2016 PJM AUCTION

In the spring of 2012, PJM held the capacity auction for the 2015/2016 delivery year. In that auction most of the zones in Ohio cleared as part of the larger regional transmission organization (RTO). However, in 2012 FirstEnergy decided to retire several coal-fired plants in its territory rather than incur compliance costs with Environmental Protection Agency regulations. PJM realized import capacity in FirstEnergy's service territory — the Northern Ohio region, ATSI — would be constrained[15] and carved out an independent zone for the 2015/2016 auction (Reuters 2012). The clearing price for the ATSI zone in that auction was three times higher than the price that cleared for the rest of the RTO.

Our analysis finds that, had greater energy efficiency resources been bid into that market, equivalent to the mandated savings by Ohio's EERS, the auction clearing prices would have been suppressed, particularly in the ATSI zone by 35%. In Table 5, we show that the

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[15] A constraint arises when PJM is unable to transmit the demanded electricity due to congestion on the grid. In these cases PJM will carve out the constrained zone and set a separate clearing price for the zone during the BRA (PJM 2012a).

wholesale capacity cost savings to customers across Ohio would have been almost $500 million had this been the case, 90% of which would have been realized by resources bid from the ATSI zone. Utilities bidding in these resources also lose out on the potential revenues from selling them on the market, which is an additional benefit but one that we did not attempt to quantify.

Table 5. Potential Wholesale Capacity Cost Savings Had Maximum Available Energy Efficiency Resources Been Bid into the 2015/2016 BRA

Zone	Actual Auction Capacity Costs (M$)	Capacity Costs with Additional EE (M$)	Capacity Cost Savings (M$)	Capacity Cost Savings (M2012$)
ATSI	$1,368	$883	$484	$452
All Others	$717	$666	$51	$47
Ohio Total	**$2,084**	**$1,549**	**$535**	**$499**

Source: Synapse Energy Economics

POTENTIAL CAPACITY COST SAVINGS FROM ENERGY EFFICIENCY IN THE 2020/2021 PJM AUCTION

In our price and load forecast (see Appendix B), we estimate the wholesale capacity price in Ohio for calendar year 2020 to be $124/MW-day ($45/kW-yr) in 2012 dollars, if the energy savings program in Ohio was truncated in 2015. In this analysis we instead estimate the impact on the wholesale capacity price in Ohio for calendar year 2020 if the EERS continued and a portion of the resulting incremental reduction in peak load reduction were bid into the 2020/2021 BRA.

Our estimate of capacity price mitigation in Ohio in 2020 assumes a statewide cumulative differential peak load reduction of 811 MW. This again is the difference between continuing Ohio's EERS to 2020 and truncating it in 2015. We estimate that efficiency program administrators would bid 75% of that reduction, or 608 MW, into the PJM Base Residual Auction for 2020/2021.[16]

Table 6 provides our calculations of the price mitigation based upon this set of data and assumptions. This table illustrates both a possible gross effect based on a statewide reduction in peak load of 811 MW in 2020 and an illustrative net effect based on an incremental peak load reduction of 200 MW in 2020. Again, this assumes that program administrators bid in a maximum of 75% of these peak load reductions—equivalent to 608 MW and 150 MW, respectively.

Using PJM BRA auction data for 2015/2016, we estimate that incremental reduction would reduce capacity prices for annual resources by $27.02 per MW-day in $2012, or 21%, producing a potential gross annual savings to Ohio customers of $82 – $334 million in capacity costs in 2020 from the continuation of the EERS.

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[16] See Appendix B for more information on the PJM Base Residual Auction and the Reliability Pricing Model (RPM).

Table 6. Supply-Side Capacity Price Mitigation for Ohio in 2020

Applicable VRR Curve	Year	**2015-2016**
Applicable VRR Curve	LDA	**RTO**

		BRA result	Result with additional demand response	Change / Mitigation	Result with additional demand response	Change / Mitigation
		Q 1	Q 2	Q 2 - Q 1	Q 2	Q 2 - Q 1
Maximum Incremental DR	MW		811	811	200	200
Percent of Maximum Incremental DR bid in Base Residual Auction (BRA)	%		75%		75%	
Quantity of Incremental DR bid in BRA	MW		608	608	150	150
Results, Nominal $						
System Marginal Price	$/MWd	$ 118.54	$ 89.86	$ (28.68)	$ 111.47	$ (7.07)
Extended Summer price adder	$/MWd	$ 17.46	$ 17.46	$ -	$ 17.46	**$ -**
Price for Annual Resources	$/MWd	**$ 136.00**	**$ 107.32**	**-21%**	**$ 128.93**	**-5%**
UCAP Requirement, MW in	OHIO	33,853	33,853	-	33,853	0
Price Mitigation, $ million	OHIO	$ 1,680	$ 1,326	$ (354)	$ 1,593	$ (87)
				-21%		**-5%**
Deflator ($nom in 2015 to $2012)		0.9423				
Results, 2012$						
Price for Annual Resources	$/MWd	$ 128.16	$ 101.13	**$ 27.02**	$ 121.49	**$ 6.66**
Price Mitigation, $ million	OHIO	$ 1,584	$ 1,250	$ (334)	$ 1,501	$ (82)

Source: Synapse Energy Economics

Overall Results from Analyses of Energy Efficiency's Financial Impact on Electricity Expenditures and Wholesale Prices

Our analysis of the potential impacts on wholesale energy expenditures and wholesale energy and capacity prices show that there is an inextricable link between the state's energy policy and its economic health. The results below show that energy efficiency directly and indirectly generates benefits in, essentially, four primary ways: (1) it helps reduce customer demand for electricity, thereby directly reducing monthly electricity bills for participants; (2) it reduces customer demand, or load, which lowers wholesale energy prices, particularly in the short and medium term; (3) in a competitive wholesale market, bidding in energy efficiency resources lowers wholesale capacity prices for all customers throughout the system, and 4) they provide revenue for utilities that bid energy efficiency resources into the PJM wholesale capacity auctions, which helps to offset energy efficiency program costs.

Our analysis on annual wholesale energy cost savings above estimates these direct economic savings, which are the product of the energy savings achieved by utility energy efficiency programs and wholesale electric energy prices (see Table B-1, Appendix B). In addition to direct savings on energy bills, customers also benefit from energy efficiency investments through reductions in wholesale energy and capacity prices. In a competitive wholesale electricity market, Ohio's utilities will be able to bid these energy efficiency resources into the PJM BRA, as discussed in this analysis. The reduced demand for generation capacity helps to lower wholesale energy prices and the clearing price for generation capacity. Wholesale electricity prices fall because, for a given demand for capacity, bidding in additional demand savings from energy efficiency lowers the price of that capacity, as seen in Figure A-3 in Appendix A.3.3.

The volume of savings bid into the auction predicates the magnitude of the electricity price impacts, showing a direct correlation between the level of energy efficiency resources bid into the market and the rates paid by customers. Given the assumption that utilities continue to meet the energy efficiency savings targets as set by SB 221, in Table 7 we show that Ohio customers could save a total of almost $5.6 billion by 2020: $3.37 billion from reduced customer expenditures on electricity; $880 million from wholesale energy price mitigation impacts, and; $1.3 billion from wholesale capacity price mitigation impacts from the 2017/2018 through 2020/2021 PJM capacity auctions. Table 7 also presents utility energy efficiency program administration costs, which we estimate at $2.8 billion. These program expenditures would be partially offset by revenues awarded to utilities through selling energy efficiency resources into the PJM auctions, however, which we estimate could total around $100 million in revenues from the same four PJM auctions, for a net effect of $2.7 billion.

Table 7. Summary of Wholesale Energy Cost Savings, and Wholesale Energy and Capacity Price Mitigation Impacts Through 2020

	Economic Savings (Million $2012)
Wholesale Energy Cost Savings	**$3,370**
Wholesale Energy Price Mitigation Savings	**$880**
Wholesale Capacity Price Mitigation Savings (Estimated, 2017-2020)	**$1,320***
Total Savings	**$5,570**
Wholesale Capacity Price Mitigation Savings (Forgone, 2015/2016)	**$500**
Utility Program Administration Costs**	$2,800

* Assumes that savings from the 2017/2018 through 2019/2020 auctions are equal to the estimates of savings from 2020/2021 auction. Does not include savings from 2016/2017 auction, which transpires in May 2013 and, hence, the potential savings have already been lost.

** Utility program investments will accrue savings over the life of the measures installed in each program year and, therefore, they will deliver savings beyond 2020. However, we only count program savings through 2020.

It is important to note that our estimates of the wholesale capacity price mitigation savings are conservative: they only include the potential effects of energy efficiency from four capacity auctions for the years 2017/2018 through 2020/2021. The 2015/2016 and 2016/2017 auctions have effectively already transpired, so Ohioans have already missed out on the savings that could have accrued had utilities bid all available energy efficiency resources into those auctions. Table 5 above shows the savings from the 2015/2016 auction that could have accrued had utilities bid all available energy efficiency resources into that auction, which we estimate to be almost $500 million. Ninety percent of these savings would have come from energy efficiency resources bid from the ATSI zone in northern Ohio.

Our estimates for the potential price mitigation savings during the 2020/2021 auction are approximately $330 million, although this assumes that utilities only save as much energy as required by the mandated targets and no more. Ultimately, this means savings to non-participants of energy efficiency programs of at least $2.2 billion dollars, which, again, does not include savings already lost from the 2015/2016 and 2016/2017 auctions.

In sum, along with direct economic savings from reductions in customer energy bills, bidding in energy efficiency resources into the wholesale electric market also means lower rates for customers. Through these analyses we can visualize the link between Ohio's EERS policy and wholesale prices: the introduction of energy efficiency savings targets, by reducing the demand for energy across all sectors of the economy, helps to lower electricity prices for all customers while also reducing their demand. Whether the energy savings derive from the residential, commercial, or industrial sectors, investments in energy efficiency have the potential to benefit the entire system, both within the state and regionally, and regardless of whether or not customers participate in utility-funded energy efficiency programs. Of course, participants in energy efficiency programs realize additional benefits through reductions in their energy purchases, as opposed to only reductions in their electricity prices.

Benchmarking Program Cost-Effectiveness

The implementation of Ohio's EERS has had a clear impact on the volume of energy savings achieved by Ohio's investor-owned utilities (IOUs) and the programs they administer. By the end of the first EERS program year, in 2009, savings from energy efficiency had increased 25-fold since 2007 (ACEEE 2009, 2012). Furthermore, in every year since the EERS was established, each utility, except FirstEnergy, successfully met their EERS goal and did so cost-effectively, through the offering of robust energy efficiency programs for residential, commercial, and industrial customers (see Table 8).

Ohio's four IOUs are successfully incorporating customer energy efficiency as a utility system resource, just as SB 221 envisioned. As shown in Table 8 below, collectively, the utilities have exceeded the incremental annual energy savings goals for each of the first three years of the enactment of SB 221 (0.3% of sales in 2009; 0.5% in 2010; and 0.7% in 2011). American Electric Power (AEP), Dayton Power & Light, and Duke Energy far exceeded their energy efficiency goals in all three years, while FirstEnergy achieved its goals in all but the first year.[17]

In Table 8 we show that AEP, Duke, and DP&L achieved their goals in all three years at a levelized cost of saved energy of around 1 ¢/kWh across their entire portfolios. Although FirstEnergy did not report program costs[18] in its annual demand-side management (DSM) reports, in these reports each utility is required to report cost-effectiveness using at least the Total Resource Cost (TRC) test, at both the portfolio and program levels.[19] Only one of FirstEnergy's five programs passed the TRC test during the 2009 program year and cost-

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[17] A large portion of FirstEnergy's savings were from mercantile "opt-out" programs that had been conducted prior to the start of the EERS.

[18] We use portfolio budgets from FirstEnergy's 2009 plan to fill this gap.

[19] There are four cost-effectiveness tests commonly used for energy efficiency program evaluation: the Utility Cost test, the Total Resource Cost (TRC) test, the Rate-Impact Measure (RIM) test, and the Participant Cost test.

effectiveness results were not included for the 2010 program year (FirstEnergy 2010, 2011). FirstEnergy offered more robust energy efficiency programs during its 2011 program year, almost half of which passed the TRC test (FirstEnergy 2012a).

Table 8. Utility Energy Efficiency Savings Achievements and Portfolio Cost-Effectiveness

2009

	Baseline Sales (MWh)	Reported Savings (MWh)	Program Costs (Ths. $)	Savings as % of Sales	EERS Target	% of Target Achieved	Cost of Saved Energy ($/kWh)
AEP	45,751,000	250,600	$ 14,837	0.5%	0.3%	183%	$ 0.008
Duke	22,553,819	86,353	$ 9,205	0.4%	0.3%	128%	$ 0.014
DP&L	14,639,828	114,288	$ 7,648	0.8%	0.3%	260%	$ 0.009
First Energy	55,429,628	22,614	$ 31,174	0.0%	0.3%	14%	$ 0.179
Total	**138,374,275**	**473,855**	**$ 62,865**	**0.3%**	**0.3%**	**114%**	**$ 0.017**

2010

	Baseline Sales (MWh)	Reported Savings (MWh)	Program Costs (Ths. $)	Savings as % of Sales	EERS Target	% of Target Achieved	Cost of Saved Energy ($/kWh)
AEP	45,458,000	364,000	$ 34,781	0.8%	0.5%	160%	$ 0.012
Duke	21,907,173	310,553	$ 19,797	1.4%	0.5%	284%	$ 0.008
DP&L	14,343,484	179,206	$ 12,157	1.2%	0.5%	250%	$ 0.009
First Energy	53,362,400	534,486	$ 25,257	1.0%	0.5%	200%	$ 0.006
Total	**135,071,057**	**1,388,245**	**$ 91,992**	**1.0%**	**0.5%**	**206%**	**$ 0.009**

2011

	Baseline Sales (MWh)	Reported Savings (MWh)	Program Costs (Ths. $)	Savings as % of Sales	EERS Target	% of Target Achieved	Cost of Saved Energy ($/kWh)
AEP	43,881,000	502,000	$ 51,456	1.1%	0.7%	163%	$ 0.013
Duke	21,633,024	215,699	$ 21,412	1.0%	0.7%	142%	$ 0.013
DP&L	14,099,979	179,586	$ 13,980	1.3%	0.7%	182%	$ 0.010
First Energy	51,278,143	461,158	$ 23,283	0.9%	0.7%	128%	$ 0.007
Total	**130,892,146**	**1,358,443**	**$110,131**	**1.0%**	**0.7%**	**148%**	**$ 0.010**

Note: Program costs for FirstEnergy are budgets, taken from their 2009 DSM Plan (FirstEnergy 2009)
Sources: AEP 2010, 2011b, 2012; Duke 2010, 2011, 2012; DP&L 2010, 2011, 2012; FirstEnergy 2009, 2010, 2011, 2012

Discussion

We have shown that energy efficiency generates utility system benefits in four primary ways: (1) it helps reduce customer demand for electricity, thereby directly reducing monthly electricity bills for participants; (2) reductions in customer demand, or load, lowers wholesale energy price impacts, particularly in the short and medium term; (3) in a competitive wholesale market, bidding in energy efficiency resources lowers wholesale capacity prices for all customers throughout the system, and 4) they provide revenue for utilities that bid energy efficiency resources into the PJM wholesale capacity auctions, which helps to offset energy efficiency program costs.

Clearly Ohio's EERS policy is having the effects legislators intended it to have, and utilities are achieving the mandated targets cost-effectively, generating system-wide benefits regardless of whether or not customers participate in programs. Ultimately, continuing this policy could result in billions of dollars of savings for all customers while allowing the wholesale electricity market to operate more efficiently.

CAPACITY CONSTRAINTS IN NORTHEAST OHIO

Due to capacity constraints in FirstEnergy's service territory, which is part of the American Transmission Systems, Inc. zone, the BRA price for delivery in the 2015/2016 auction cleared at an unprecedented price, three times higher than the rest of the PJM market: $357 MW/day in the ATSI zone versus $136 MW/day in PJM (PJM 2012d). The capacity constraints are a result of pending retirements of aging coal plants, catalyzed by air quality regulations set by the U.S. Environmental Protection Agency. The PUCO noted in January 2012 that FirstEnergy announced that its generation subsidiaries would be retiring several power plants by September 2012, most of them coal-fired.

The retirement of these plants in the ATSI region means a reduction in the ability to meet demand in that area, with specific concern of demand during peak periods (PJM 2012d). The increased costs of delivering capacity throughout the region will be passed on to customers in the form of higher electricity prices, and FirstEnergy's generation affiliate will experience a windfall as a result.

Adding generation capacity is an expensive, medium- to long-term solution for meeting capacity requirements. In contrast, energy efficiency can be deployed quickly and is much more cost-effective.

INNOVATIVE POLICY/PROGRAM OPTIONS

There are number of options that could be considered to address customer concerns about the cost and quality of energy efficiency programs.

Industrial Self-Direct

In some states, large customers frequently seek to "opt out" of utility energy efficiency programs for an array of reasons, some moot and some legitimate. Primary among the moot reasons is the claim that large customers have already done all the energy efficiency that is cost effective, which is not always the case (Chittum 2011). This situation arises from a capital allocation decision by many companies (e.g., very short-term "payback" requirements) that leaves many energy efficiency opportunities on the table. Significant cost-effective energy efficiency opportunities exist if the funds are available. There are, however, two legitimate concerns about utility energy efficiency programs: (1) the program offerings available to large customers are not responsive to their energy efficiency needs; and (2) the rider paid by one customer subsidizing competitors' operations.

In response to these legitimate concerns, a new form of program structure has emerged — the self-direct program. In a self-direct program, all or a portion of the energy efficiency charge a large customer pays is reserved for internal energy efficiency investments by that company. ACEEE has studied 23 of these programs and found a wide variation in structure and requirements. Among the more interesting of these programs is Puget Sound Energy's *Large Power User* self-direct program.

Puget Sound Energy's (PSE) self-direct program is unique in that it is a long-term program (spanning four or five years) that combines a dedicated incentive funding structure based on customer contributions with a competitive bidding process for unclaimed funds. Companies that are serviced by PSE under several rate schedules are eligible for the self-direct program, but most become eligible due to their taking of 3-phase service at greater than 50,000 volts.

Self-direct customers continue to pay their energy efficiency charge, but PSE tracks individual customer contributions for their own individual use. Customers have access to 82.5% of their contributed change. PSE retains 7.5% for administration of the program, and 10% to fund certain broad energy efficiency efforts jointly funded by all customers (e.g., market transformation activities of the Northwest Energy Efficiency Alliance). While participants in other PSE commercial and industrial programs are limited to maximum incentives of 70% of measure cost, self-direct customers may fund up to 100% of measure cost.

After an initial non-competitive phase (e.g., 24 months) of a program cycle, all unused funds are escrowed into a public pool of funds, and PSE issues a request-for-proposal for program-eligible customers to compete for the remaining pooled funds. The projects funded as a result of this competitive bid process are generally more cost-effective than those funded during the first two years, as customers compete against each other to make an economic case for their projects.

All projects must meet PSE's avoided cost requirements. Though the customer submits its own proposal and measurement and verification plan, PSE reviews the proposal and plan. Upon approval, PSE enters into a funding allocation agreement with the company and conducts a post-installation inspection after the measure is implemented.

LARGE CUSTOMER SELF-DIRECT PROPOSAL

ACEEE feels that a similar approach should be considered in Ohio. We suggest the following structure:

- Large customers who elect to participate in the self-direct option would continue to pay the energy efficiency rider, but the utility would track these payments.

- The majority of the payments — we suggest 90% — would be reserved for the customer to make investments in energy efficiency in their own facilities. Once a project is proposed, the customer could request release of the funds to pay for the project.

- The customer would have three years to spend the escrowed portion of the funds for energy efficiency investments. If after three years a firm has not used all the funds in its escrow account, the utilities would pool all remaining funds from self-direct customers and make these funds able to other customers on a competitive basis, using cost of energy savings as the determining factor.

- A small portion of the payments — we suggest 10% — would be used by the utility for administration of the program, including educational programs, that benefit large customers and evaluation of the savings, thus ensuring that this program is working successfully and the investments meet cost-effectiveness requirements specified by the Commission.

Once a firm elects to self-direct their energy efficiency payments, the company's load would no longer be included in the utility's EERS target calculation, effectively transferring the obligation to the customer.

DISCUSSION

Implementing such a self-direct option for large customers should address the primary concerns we have heard from large customers:

1. **Deriving value from the energy efficiency rider assessed by utility.** The funds paid by the large customers would be available to fund energy efficiency projects in their own facilities and could be prioritized to meet the strategic needs of the company. The creation of a dedicated energy efficiency fund is a strategy that a number of large companies such as BASF and the Dow Chemical Company have used to ensure that funds are available for these strategically important investments to the company. This pool of funds also allows customers to receive internal approval for energy efficiency projects that may have previously been ignored or not prioritized.

2. **The funds would be reserved for the customer**, so concerns about subsidization of competitors or other customer classes would be addressed.

3. **The firm would be responsible for choosing the most important projects for themselves**, addressing the concern about the responsiveness and cost-effectiveness of the utility's energy efficiency programs for large customers. Funds are not limited to specific technologies and could be used, for instance, for the updating of operations and maintenance practices or the support of an internal energy management system.

From the general consumer's perspective this approach would ensure that the low-cost energy efficiency savings available from large customers would be available to reduce market demand and help contain future electricity price increases. By having the utility responsible for evaluation, other customers are assured that the investments result in cost-effective savings. This approach would also assure customers that savings are realized in the most cost-effective manner and that energy costs are kept lower for everyone, including large customers.

In addition to the direct savings that the large customer would realize from the energy efficiency investments, they could also bid these energy efficiency savings into the wholesale market. They could choose to bid these in themselves, aggregate through a third-party, or choose to have the utility bid these into the market on their behalf acting as an aggregator.

Cap on Energy Efficiency Rider

Right now utilities recover the cost of providing energy efficiency and peak demand reduction programs through a series of riders imposed on customers in different ways by each of the utilities. Rationalizing these charges and ensuring they do not reach onerous levels for larger customers is important, though this has not been addressed by the Commission in the series of utility energy efficiency planning cases.

Utility riders that pay for energy efficiency and peak demand programs are sometimes divided into separate riders; other utilities lump the programs and payments together. Sometimes, these charges are not well designed. Specifically, at least one utility formula for collecting energy efficiency rider costs has been volatile and at times high. Additionally this utility has issued some inaccurate charges, resulting in a refund to large customers that will continue through much of this year.

A statutory cap on the amount a utility can charge for these riders would create business certainty and eliminate volatility. Accordingly, Section 4928.66 of the Ohio Revised Code could be amended simply to ensure that no customer pays more than $25,000 a month in any given month for energy efficiency programs as part of utility service.

Third-Party Administration of Energy Efficiency Programs

One concern that has been expressed by large customers is the disparity of energy efficiency program costs among Ohio's IOUs. While it appears that all the utilities' programs are "cost-effective," a variation in cost across utilities does elicit concern. One option may be to consider a third-party administrator for some or all of the state's utility service territories. This could take several forms: The PUCO could solicit proposals from various entities to administer programs in utility service territories. The incumbent utility could bid in, and would be assumed to have a competitive advantage since they have an existing relationship with their customers. The performance of the administrator would be reviewed and could be rebid if the performance was out of line with other programs in the state.

Purchase of Energy Efficiency from Customers

The PUCO could establish a "standard-offer" program in which individual customers above a certain size (or an entity, such as an energy service contractor or aggregator), could bid in energy efficiency savings at a level below that of the utility's program and the utility would be required to purchase those savings to reduce its portfolio cost.

Either of these options would be subject to the same PUCO oversight and evaluation requirements to which utility programs are subjected.

ENERGY EFFICIENCY RIDERS

The costs associated with the energy savings targets under SB 221 are collected by the utilities through a charge ("rider") on customers' electric bills. Customers either contribute energy efficiency projects to their utility, or they pay the energy efficiency rider. Options are available to certain larger customers for receiving rebates for their energy efficiency investments and possibly even avoiding the rider altogether. While these surcharges can be significant, especially for customers with high-demand for electricity, energy efficiency investments are a lower-cost option than the cost of future investment in new gas-fired base load generation, and so energy efficiency's impacts on rates is relatively lower.

When comparing utility portfolios to determine their relative effectiveness, understanding the levels of savings achieved in relation to the amount of the rider helps to understand which utilities are more effective at delivering energy efficiency services to their customers. In theory, a more robust, well-designed program portfolio will deliver high levels of energy savings at a modest "price" to customers.

To that end, comparing contemporaneous riders for Ohio's four investor-owned utilities reveals much about their program designs and efforts. Referencing tariff filings for energy efficiency riders for the fall of 2012 shows that AEP and FirstEnergy charged their customers the highest for energy efficiency services (Docket Nos. 89-6001-EL-TRF and 89-6004-EL-TRF for FirstEnergy and AEP, respectively). However, AEP offers robust, traditional energy efficiency programs to its customers and has been achieving high levels of savings since the inception of Ohio's EERS, both in absolute terms and as a percent of sales (see Table 5 above).

On the other hand, FirstEnergy has been almost entirely dependent upon savings achieved through its mercantile opt-out program to meet its annual targets, savings that were achieved by industrial customers between 2006 and 2008. Although comparisons across utility riders are not necessarily apples-to-apples, FirstEnergy does charge the highest rates for its general service riders compared to the rest of Ohio's IOUs. Furthermore, in its most recent tariff filing for its energy efficiency rider, FirstEnergy has had to issue credits to its residential customers and its "general service — transmission" customers due to over-collecting from the previous period (Docket No. 89-6001-EL-TRF, December 3, 2012). The over-collection was significant, as the rider for residential customers went from $0.3506 /

kWh in the fall of 2012 to a credit of ($0.0225)/kWh for the beginning of 2013.[20] Other general service riders fell by 30–50% between the fall of 2012 and the beginning of 2013.

Conclusion

Our analyses of the performance of Ohio's energy efficiency resource standard to date and the potential economic benefits created by this policy show that Ohio customers stand to benefit considerably from growing investments in energy efficiency. In Table 9 we show that Ohio customers could save a total of almost $5.6 billion by 2020: $3.37 billion from reduced customer expenditures on electricity; $880 million from wholesale energy price mitigation impacts, and; $1.3 billion from wholesale capacity price mitigation impacts from the 2017/2018 through 2020/2021 PJM capacity auctions. Table 9 also presents utility energy efficiency program administration costs, which we estimate at $2.8 billion. These program expenditures would be partially offset by revenues awarded to utilities through selling energy efficiency resources into the PJM auctions, however, which we estimate could total around $100 million in revenues from the same four PJM auctions, for a net effect of $2.7 billion.

Table 9. Summary of Wholesale Energy Cost Savings, and Wholesale Energy and Capacity Price Mitigation Impacts Through 2020

	Economic Savings (Million $2012)
Wholesale Energy Cost Savings	**$3,370**
Wholesale Energy Price Mitigation Savings	**$880**
Wholesale Capacity Price Mitigation Savings (Estimated, 2017-2020)	**$1,320***
Total Savings	**$5,570**
Wholesale Capacity Price Mitigation Savings (Forgone, 2015/2016)	**$500**
Utility Program Administration Costs**	$2,800

*** Assumes that savings from the 2017/2018 through 2019/2020 auctions are equal to the estimates of savings from 2020/2021 auction. Does not include savings from 2016/2017 auction, which transpires in May 2013 and, hence, the potential savings have already been lost.**

**** Utility program investments will accrue savings over the life of the measures installed in each program year and, therefore, they will deliver savings beyond 2020. However, we only count program savings through 2020.**

It is important to note that our estimates of the wholesale capacity price mitigation savings are conservative: they only include the potential effects of energy efficiency from four capacity auctions for years 2017/2018 through 2020/2021. The 2015/2016 and 2016/2017 auctions have effectively already transpired, so Ohioans have already missed out on the savings that could have accrued had utilities bid all available energy efficiency resources into those auctions, for which we estimate to be almost $500 million for the 2015/2016 auction alone. Ultimately, this means savings to non-participants of energy efficiency programs of at least $2.2 billion dollars, which, again, does not include savings already lost from the 2015/2016 and 2016/2017 auctions.

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[20] Duke Energy also is providing its non-residential and transmission service customers credits during the first part of 2013; however, these credits are on the order of 1/1000 of a cent for riders that charged customers about the same during the fall of 2012, so the over-collection was not as egregious.

While natural gas prices have reached historically low levels and an abundance of shale gas has been discovered in the Marcellus and Utica Formations, neither of these phenomena preclude the need for investments in energy efficiency. Energy efficiency is still the lowest-cost energy resource to meet burgeoning demand and can deployed much more quickly than new capacity can be constructed. Energy efficiency helps reduce customer demand for electricity, thereby reducing monthly electricity bills for participants; it reduces customer demand, or load, which has direct wholesale energy price impacts, particularly in the short and medium term; and, in a competitive wholesale market, bidding in energy efficiency resources lowers wholesale capacity prices for all customers throughout the system. The value proposition to businesses and manufacturers, participants and non-participants alike, is unequivocal: reduced energy expenditures reduce risks associated with volatile energy markets and, ultimately, enhance competitiveness.

ACEEE strongly urges that Ohio continue its dedication to energy efficiency generally and to the SB 221 energy efficiency resource standard policy specifically. ACEEE calls upon Ohioans to ensure that these energy policies remain in place.

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Appendix A. Methodology for the Analysis of Energy Price and Capacity Mitigation Effects

A.1. BACKGROUND OF PRICE MITIGATION DYNAMICS IN ENERGY MARKETS

Price mitigation in energy markets is a measure of the reduction in prices, caused by a reduction in the amount of electricity ("load") to be supplied, relative to the prices that would otherwise have prevailed. Price mitigation reflects the value of efficiency to all retail customers because reductions in wholesale prices are eventually reflected in retail prices.

Price mitigation effects are usually small when expressed as a percentage impact on the prices of energy and capacity in the wholesale market. However, these effects are often significant when expressed in absolute dollar terms. In other words, small percentage impacts on market prices, when applied to all energy and capacity being purchased in the market, translate to large absolute dollar savings. Our estimates are limited to the absolute impacts within Ohio, but there would be impacts throughout the entire PJM West market.

A.1.1. Caveats Regarding Suppliers' Response to Price Mitigation Effects

Suppliers participating in these wholesale markets will likely respond to reductions in market prices by taking actions that will, over time, offset the reduction and eventually cause the market price to move toward the level it would have been in the reference case. Market adjustments mean that, for example, utilities will change the operating schedules of their plants or capacity deployment. Or some marginal generation resources (i.e., non-baseload resources) may no longer be available, or new generation might not be added as quickly. So, due to these adjustments, the actual economic savings will likely be lower, though that is dependent upon how rapidly the market responds to changes.

Our estimates of wholesale energy price mitigation effects assume some market adjustments on the part of suppliers, and hence reflect some degree of "net price mitigation." We assume some adjustments on the part of suppliers in the short to medium term (1-5 years) because of the inherent flexibility of energy markets to react to changes in supply and demand through changes such as those described above. We estimated a range of price effects due to load changes: if the market fully adjusts to these load changes then there would be no savings; if not, then the full savings potential will be realized. We think a price effect somewhere in between is most likely, so we use the midpoint value as the assumption for our savings calculations.

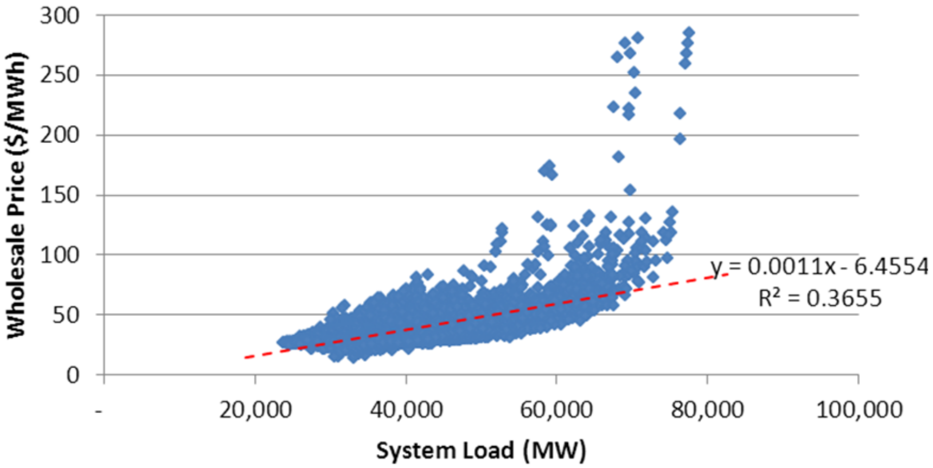
Our estimates of wholesale capacity price mitigation effects assume that there are no subsequent, offsetting changes by market participants. In other words, these prices reflect "gross price mitigation," and therefore establish an upper limit for the economic savings. We assume that there are no adjustments on the part of suppliers because the demand for energy in Ohio is forecasted to grow slowly over time and possibly even decline. Thus, the change in capacity will be small over the period of our analysis. While some plants are likely to be retired, more efficient natural gas plants will likely be built to replace them. But the vast majority of the existing generation will still be operating under similar conditions as they are today. See Figure A-10 for a heuristic example of how the wholesale capacity price mitigation effects would change if market participants were to take offsetting actions.

A.2. WHOLESALE ENERGY PRICE MITIGATION, ANALYSIS METHODOLOGY

In the short to medium term the demand for electricity ("load") has an effect on energy prices: all else being equal, higher loads are associated with higher energy prices. Figure A-1 shows the relationship between electric load and price in the Western PJM for 2011. For most hours the loads and prices fall into the central cloud where prices uniformly increase with increases in load. There are, however, a few outlying hours of very high prices, many of which are associated with very high loads, but some of which are not.

The slope coefficient ("R^2" or "r-squared") on the fitted line represents the average relationship between load and the wholesale price of electricity, including the effects of the highest-priced hours. For this data set the coefficient is 0.0011,[21] which means that on average a load increase of 1 MW would increase the wholesale price by $0.0011/MWh; by the same token, a load increase of 1000 MW would increase the average price by $1.1/MWh. For this data set the average load was 41,211 MW and the average price was $38.7/MWh (see Figure A-1).

Figure A-1. Historical Load and Price Relationships in Western PJM



Source: Synapse Energy Economics

This kind of general relationship tends to hold from year to year, although electric energy prices may change depending on fuel prices and load generally increases over time. To represent the general relationship between load and price, we often calculate and use a dimensionless energy price elasticity coefficient. This coefficient tends to be fairly stable from year to year even when prices and load levels change. This coefficient is represented as the percentage change in average price for a percentage change in average load. For 2011,

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[21] The units for the regression coefficient are $/MWh price change per MW load change. The removal of outliers from the data set would improve the regression coefficient and better represent the typical relationship between load and price. Nevertheless, while the coefficient as given is not particularly large, the relationship between load and price in this dataset is highly statistically significant ($p<<.001$), meaning that it is extremely unlikely to be the result of chance alone.

using the data above, this price elasticity coefficient is 1.17. This means that a 1% change in average annual load changes the average wholesale energy price by 1.17%.

Looking forward to 2020 we expect a similar relationship to hold. While some older coal plants (with a lower capacity factor) are likely to retire, and newer, more efficient natural gas plants and renewable generation will be added, the vast majority of existing generation will still be operating under conditions similar to those today.

There are, however, a number of things to consider in estimating energy cost savings for the period 2010 through 2020:

1. **Ohio is only a small portion of the relevant wholesale market territory.** We think PJM West better represents the market region for Ohio than all of PJM. Since Ohio represents only about 44% of the sales in that territory, any percentage reduction in Ohio sales is, proportionally, much less in terms of the total market. If we were to consider all of PJM's territory, which covers thirteen states and the District of Columbia, and/or parts of MISO, the impacts would be even more diluted.

2. **The price elasticity represents an annual period.** Over the longer term, load changes could affect future resource additions and retirements, and thus counteract some of the price response. For example, if load reductions result in less new capacity being built, then that would shift the supply curve to the left and increase prices at a given load level. This all depends on how and when the supply system responds.

3. **The slope of the supply curve would change if there are substantial changes in fuel prices or generation costs.** For example, if natural gas prices were to increase to the high levels last seen in 2008, the cost of natural gas generation would increase and raise the right portion of the energy supply curve (see Figure A-2), thereby increasing the slope. If some form of CO_2 regulation were implemented, that would flatten the curve somewhat by increasing the cost of coal generation on the left more than natural gas generation on the right.

A.3. WHOLESALE CAPACITY PRICE MITIGATION, ANALYSIS METHODOLOGY

In this section we provide our assumptions and methodologies for estimating the potential impacts of energy efficiency in two different PJM base residual auctions (BRA).[22] First, we review the capacity cost savings that could have resulted had the maximum available energy efficiency resources been bid into the 2015/2016 PJM BRA auction in May 2012. Second, we take a forward look at the potential capacity cost savings that could arise in 2020 should the annual savings targets mandated by the EERS continue and the maximum available energy efficiency resources are bid into the 2020/2021 PJM BRA auction.

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[22] See Appendix B.2 for a detailed overview of the dynamics of the PJM wholesale capacity market.

A.3.1. Determining the Market Clearing Price for Capacity

PJM sets the market clearing price for capacity in any given auction at the intersection of a demand curve that it establishes prior to the auction and the supply curve of resources bid into the auction. The PJM demand curve — referred to as the Variable Resource Requirement ("VRR") curve — plots price, on the y axis, versus quantity, on the x axis. The market clears at the price at which the supply curve intersects the demand curve.

Figure A-2 shows the demand and supply curves and results for the PJM for the 2015/2016 auction. This graph shows the Limited Market Clearing Price (MCP) of \$118.54/MW-day as well as the Extended Summer MCP of \$136.00/MW-day.[23]

Figure A-2. PJM 2015/2016 Base Residual Auction, RTO Supply Curve

Source: PJM 2012c

A.3.2. Capacity Cost Savings from Energy Efficiency in the 2015/2016 PJM Auction

In the spring of 2012 PJM held the auction for the 2015/2016 delivery year (6/1/15 – 5/31/16). In that auction most of the zones in Ohio cleared as part of the larger RTO region. However, in 2012 FirstEnergy decided to retire several coal-fired plants in its territory rather than incur compliance costs with Environmental Protection Agency regulations. PJM realized import capacity in FirstEnergy's service territory — the Northern Ohio region, ATSI

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[23] Effective with its 2014/2015 Base Residual Auction, PJM began establishing prices for three different categories of capacity resources: limited resources, extended summer resources and annual resources. The latter two categories receive higher prices.

— would be constrained and carved out an independent zone for the 2015/2016 auction (Reuters 2012).

Although Ohio is completely within the PJM region, there is no single PJM zone for Ohio, but, rather, four zones that overlap different parts of the state (see Table B-2). In the previous auction held in 2011 for the 2014/2015 delivery year, all of Ohio's zones cleared as part of the RTO at a price of $130/MW-day. However, in the most recent capacity auction for 2015/2016, the ATSI cleared separately at a price of $357/MW-day. All the other Ohio zones cleared at the RTO price of $136/MW-day (PJM 2012d).

A.3.2.1. PJM CAPACITY MARKET OUTCOMES

Table A-1 below shows the various PJM zones and their capacity obligations for the 2015/2016 delivery year and how much of the obligations represents Ohio load. For example, even though most of the ATSI zone is in Ohio, a small portion is located in western Pennsylvania. The overall AEP zone also represents part of Michigan, Indiana, Pennsylvania, Kentucky, Tennessee, West Virginia, and Virginia.

Table A-1. Zonal Unforced Capacity (UCAP) Obligations for the 2015/2016 Delivery Year

Zone	Base Zonal UCAP Obligation (MW)	Ohio Portion of UCAP Obligation	Ohio UCAP Obligation (MW)
AE	3,077		-
AEP	13,079	45%	5,916
APS	9,847		-
ATSI	14,940	98%	14,699
BGE	8,210		-
COMED	26,507		-
DAY	3,935	100%	3,935
DEOK	5,358	86%	4,587
DLCO	3,340		-
DOM	22,883		-
DPL	4,697		-
JCPL	7,142		-
METED	3,443		-
PECO	10,099		-
PENLC	3,407		-
PEPCO	7,709		-
PL	8,532		-
PS	11,951		-
RECO	475		-
	168,631		**29,138**

Source: PJM 2012d

Table A-2 shows the actual auction results and the impacts on Ohio customers. The expected capacity costs for the 2015/2016 delivery year come to almost $2 billion, with customers in the ATSI zone paying over 65% of that total.

Table A-2. Capacity Market Results for the 2015/2016 Delivery Year

Zone	Capacity Requirement in Ohio (MW)	Capacity Cleared in Auction (MW)	Auction Capacity Price ($/MWd)	Annual Capacity Cost (M$)	Annual Capacity Cost (M2012$)
ATSI	14,699	10,496	$357	$1,368	$1,276
All Others [24]	14,439	14,439	$136	$717	$669
Ohio Total	**29,138**	**24,934**		**$2,084**	**$1,945**

Source: PJM 2012d

A.3.2.2. ENERGY EFFICIENCY IN THE PJM CAPACITY MARKET

Both energy efficiency and demand response resources can and have been bid in the PJM capacity market. Table A-3 below shows these resources relative to the 2015/2016 auction. The magnitudes of the demand resources are about twenty times that of energy efficiency. Nevertheless, 940 MW of energy efficiency resources were bid into this auction and nearly all, 923 MW, cleared.

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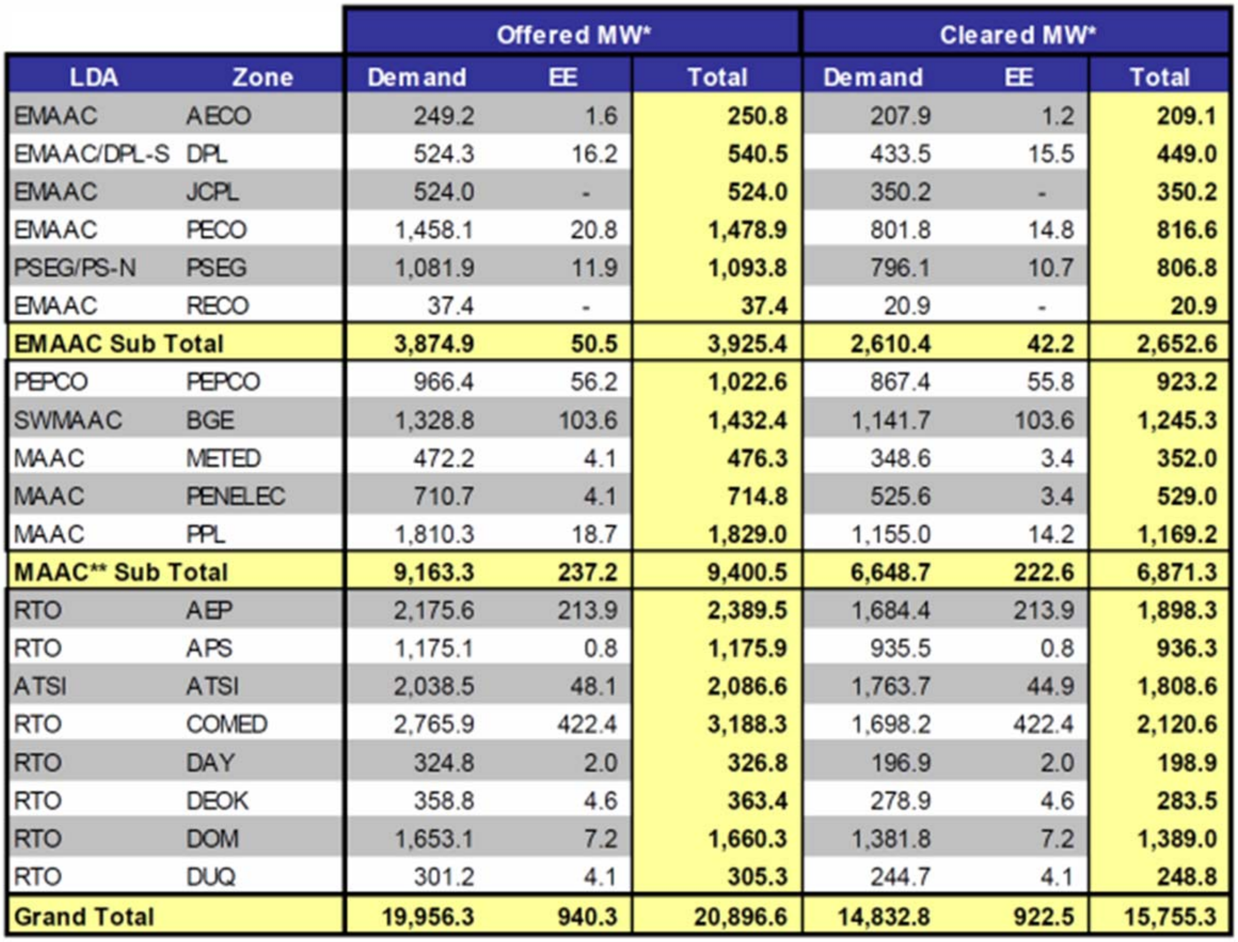
[24] Ohio portions of AEP, DAY and DEOK.

Table A-3. Demand Response and Energy Efficiency Resources in the PJM 2015/2016 Auction



		Offered MW*			Cleared MW*		
LDA	**Zone**	**Demand**	**EE**	**Total**	**Demand**	**EE**	**Total**
EMAAC	AECO	249.2	1.6	**250.8**	207.9	1.2	**209.1**
EMAAC/DPL-S	DPL	524.3	16.2	**540.5**	433.5	15.5	**449.0**
EMAAC	JCPL	524.0	-	**524.0**	350.2	-	**350.2**
EMAAC	PECO	1,458.1	20.8	**1,478.9**	801.8	14.8	**816.6**
PSEG/PS-N	PSEG	1,081.9	11.9	**1,093.8**	796.1	10.7	**806.8**
EMAAC	RECO	37.4	-	**37.4**	20.9	-	**20.9**
EMAAC Sub Total		**3,874.9**	**50.5**	**3,925.4**	**2,610.4**	**42.2**	**2,652.6**
PEPCO	PEPCO	966.4	56.2	**1,022.6**	867.4	55.8	**923.2**
SWMAAC	BGE	1,328.8	103.6	**1,432.4**	1,141.7	103.6	**1,245.3**
MAAC	METED	472.2	4.1	**476.3**	348.6	3.4	**352.0**
MAAC	PENELEC	710.7	4.1	**714.8**	525.6	3.4	**529.0**
MAAC	PPL	1,810.3	18.7	**1,829.0**	1,155.0	14.2	**1,169.2**
MAAC Sub Total**		**9,163.3**	**237.2**	**9,400.5**	**6,648.7**	**222.6**	**6,871.3**
RTO	AEP	2,175.6	213.9	**2,389.5**	1,684.4	213.9	**1,898.3**
RTO	APS	1,175.1	0.8	**1,175.9**	935.5	0.8	**936.3**
ATSI	ATSI	2,038.5	48.1	**2,086.6**	1,763.7	44.9	**1,808.6**
RTO	COMED	2,765.9	422.4	**3,188.3**	1,698.2	422.4	**2,120.6**
RTO	DAY	324.8	2.0	**326.8**	196.9	2.0	**198.9**
RTO	DEOK	358.8	4.6	**363.4**	278.9	4.6	**283.5**
RTO	DOM	1,653.1	7.2	**1,660.3**	1,381.8	7.2	**1,389.0**
RTO	DUQ	301.2	4.1	**305.3**	244.7	4.1	**248.8**
Grand Total		**19,956.3**	**940.3**	**20,896.6**	**14,832.8**	**922.5**	**15,755.3**

Source: PJM 2012d

Table A-4 summaries the Ohio-specific resources that were bid into the capacity market for Ohio in the 2015/2016 auction. Note that 48.1 MW were bid in the ATSI zone and 44.9 MW cleared. For the other zones, all of the energy resources that were bid cleared. Also note that the zones represent resources bid from all PJM states and not just the Ohio fractions.

Table A-4. Ohio Energy Efficiency Resources in the PJM Capacity Market

LDA	Zone	Base Zonal UCAP Obligation (MW)	2015/2016 BRA (MW) Offered	2015/2016 BRA (MW) Cleared
ATSI	ATSI	14,940	48.1	44.9
RTO	AEP	13,079	213.9	213.9
RTO	DAY	3,935	2.0	2.0
RTO	DEOK	5,358	4.6	4.6
			268.6	265.4
	ATSI	14,940	48	45
	Other	22,372	221	221

Source: PJM 2012d

Ohio's EERS sets goals for peak demand reductions. Table A-5 summarizes those requirements by calendar year. The resources eligible for bidding into the 2015/2016 capacity auction need to be installed between 6/1/11 and 5/30/15. That means, based on the EERS requirements, that 805 MW of peak demand resources would have been eligible for that auction, which represents a floor as utilities in Ohio have been exceeding their mandated targets.

Table A-5. Ohio EERS Peak Demand Reduction Requirements

	Year	EERS Increm. Target	Target Reduction (MW))	Eligible Fraction	Eligible for Auction (MW)
Historic	2009	1.00%	260		
	2010	0.75%	202		
	2011	0.75%	204	54%	110
Forecast	2012	0.75%	204	100%	204
	2013	0.75%	205	100%	205
	2014	0.75%	202	100%	202
	2015	0.75%	200	42%	84
	2016	0.75%	202		805
	2017	0.75%	204		
	2018	0.75%	206		

Source: Synapse Energy Economics

Table A-6 breaks out those requirements by PJM zone and indicates how much more peak demand resources could have been bid into the 2015/2016 auction, based on the Ohio EERS requirements. To be conservative, we reduced the potential eligible resources by 10% to determine the auction bids. We have also conservatively counted all of the bid resources to count against the EERS requirements, although that is likely not to be the case, particularly for AEP.

Table A-6. Ohio EERS Requirements by PJM Zone and Bid Shortfall

LDA	Zone	Base Zonal UCAP Obligation (MW)	2015/2016 BRA (MW) Offered	2015/2016 BRA (MW) Cleared	2015/2016 BRA (MW) Eligible (Ohio Req.)	Offer Fraction	Offer Expectation (MW)	Offer Shortfall (MW)
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h) = (g) x (f)	(i) = (h) - (d)
ATSI	ATSI	14,940	48.1	44.9	330	90%	297	249
RTO	AEP	13,079	213.9	213.9	271	90%	244	30
RTO	DAY	3,935	2.0	2.0	84	90%	76	74
RTO	DEOK	5,358	4.6	4.6	121	90%	109	104
			268.6	**265.4**	**805**		**725**	**456**
	ATSI	**14,940**	**48**	**45**	**330**		**297**	**249**
	Other	**22,372**	**221**	**221**	**476**		**428**	**208**

Source: Synapse Energy Economics

A.3.2.3. PJM Capacity Market Outcomes with Additional Energy Efficiency Resources

Next we looked at how the capacity market prices might have differed if energy efficiency resources equivalent to the EERS targets were actually bid into the 2015/2016 auction. Table A-7 updates the results of Table A-2, summarizing the auction outcomes if the additional available energy efficiency resources had been bid into that auction. For the ATSI, we see a significant price mitigation effect, from $357/MW-day to $225/MW-day, with a cost savings for Ohio's ATSI customers of $452 Million. Savings also accrue to other zones, although they are considerably lower.[25]

Table A-7. Alternative 2015/2016 Auction Results with Additional Energy Efficiency Resources

Zone	Additional Available EE Resources (MW)	Capacity Price with Additional Resources ($/MWd)	Annual Capacity Cost (M$)	Cost Mitigation with Additional EE (M$)	Cost Mitigation with Additional EE (M2012$)
ATSI	277	$225	$ 883	$ 484	$ 452
All Others	231	$126	$ 666	$ 51	$ 47
Ohio Total	**508**		**$ 1,549**	**$ 535**	**$ 499**

Source: Synapse Energy Economics

While this is a reasonable estimate of the capacity market outcomes for the 2015/2016 auction, there are some caveats that should be noted. First, a countervailing factor might be that some resources that cleared the auction may not have done so at a lower price. This would then offset some of the savings from additional energy efficiency resources. The ISO with access to the 2015/2016 auction bid data would be better able to calculate that effect.

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[25] Even though the additional capacity in the other zones is small compared to the total requirements, there are still significant price effects because of the very steep slope of the VRR demand curve.

Second, if no Ohio energy efficiency resources had been bid in the 2015/2016 capacity auction, the clearing prices would have been higher. A very rough calculation of this effect estimates an additional $100 million of capacity costs to customers in the ATSI zone and an additional $50 million of capacity costs to customers in the rest of Ohio.[26]

Lastly, we have made a conservative assumption in focusing on the capacity price mitigation of resources within each PJM zone. Realistically, ATSI in particular could import up to 5,418 MW of capacity in addition to the local capacity requirements. This imported capacity would be priced at the RTO price and also benefit from the energy efficiency savings discussed above.

Tables A-8 and A-9 on the following pages summarize our calculations for the two relevant Ohio areas of the PJM zones.

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[26] For ATSI the EE resources that cleared in the market were 45 MW. The additional resources that could have bid were 277 MW which would have produced savings of $452 million. Assuming a simple linear relationship (-45/277) x 452 gives a savings in the actual auction of $73 million. For the rest of Ohio the amount that cleared was 221 MW and the additional amount that could have been offered was 231 MW for a savings of $47 million. The equivalent calculation (-221/231) x 47 gives actual auction savings of $45 million.

Table A-8. Supply-Side Capacity Price Mitigation in 2015/2016 Delivery Year

Applicable VRR Curve	Year	2015-2016		
Applicable VRR Curve	Zone	ATSI		
		BRA result	Result with additional EE Resources	Change / Mitigation
		Q 1	Q 2	Q 2 - Q 1
Potential Incremental EE resources	MW		277	277
Percent of incremental resources bid in Base Residual Auction (BRA)	%		90%	
Quantity of Incremental resources bid in BRA	MW		249.3	249.3
VRR Curve Segment in which Supply Cleared		*b-c*	*b-c*	
VRR Parameters				
UCAP Price	$/MWd			
Point b		$358.2	$358.2	
Point c		$71.6	$71.6	
UCAP quantity	MW			
Point b		15,981	15,981	
Point c		16,542	16,542	
VRR Curve Segment slope	$/MWd per MW	-0.51	-0.51	
Base Zonal UCAP Requirement	MW	14,940	14,940	
Cleared ICAP	MW		249.3	249.3
Forecast Pool Requirement			1.0859	
Demand Resource Factor			0.955	
Cleared UCAP	MW	10,668	10,926	258.5
Auction Clearing Price	$/MWd	**$357.0**	**$225.1**	**-$131.9**
				-37%
Ohio Fraction of Cleared UCAP		98.4%	98.4%	
ATSI Ohio Cleared Capacity	MW	10,496	10,750	254.4
Capacity Costs and Mitigation	**Million $**	**$1,368**	**$883**	**-$484**

Source: Synapse Energy Economics

Table A-9. Supply-Side Capacity Price Mitigation in 2015/2016 Delivery Year

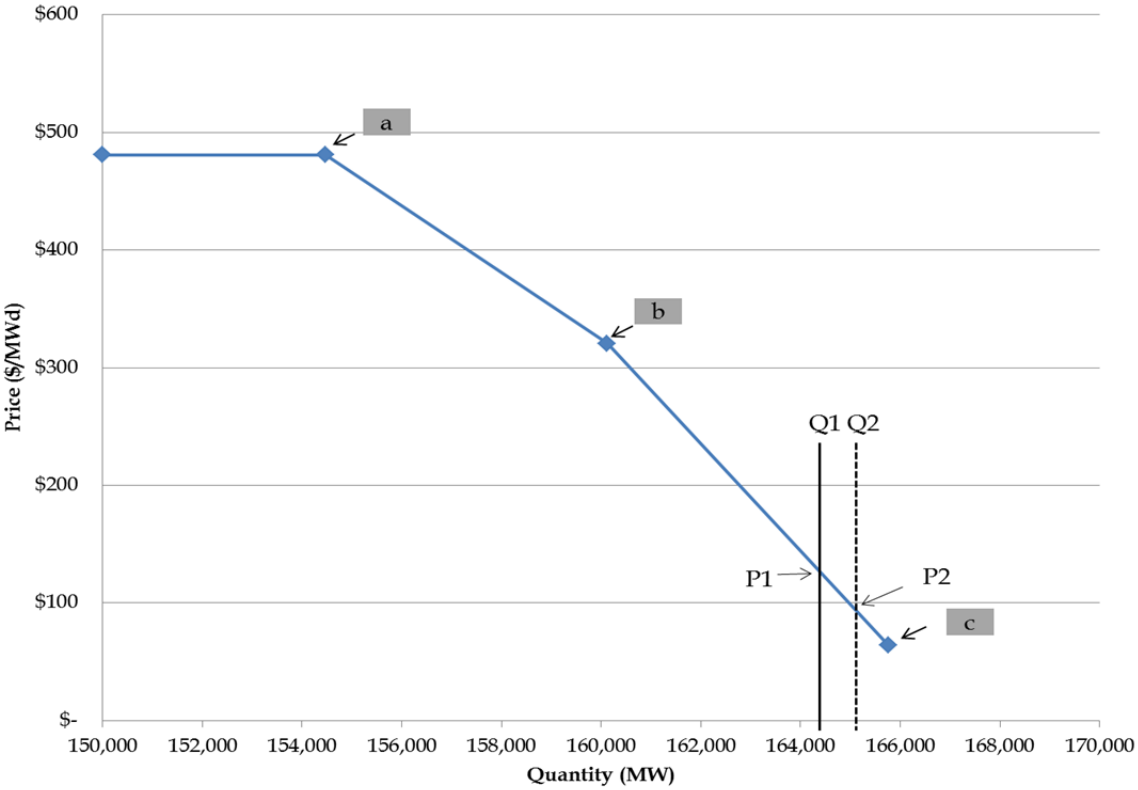
Applicable VRR Curve	Year	2015-2016		
Applicable VRR Curve	LDA	RTO		
		BRA result	Result with additional EE Resources	Change / Mitigation
		Q 1	Q 2	Q 2 - Q 1
Potential Incremental EE	MW		231	231
Percent of incremental resources bid in Base Residual	%		90%	
Quantity of Incremental DR bid in BRA	MW		207.9	207.9
VRR Curve Segment in which Supply Cleared		*b-c*	*b-c*	
VRR Parameters				
UCAP Price	$/MWd			
Point b		$320.6	$320.6	
Point c		$64.1	$64.1	
UCAP quantity	MW			
Point b		$160,119	$160,119	
Point c		$165,761	$165,761	
VRR Curve Segment slope	$/MWd per MW	-0.05	-0.05	
UCAP Requirement, MW in	DAY	3,935	3,935	
UCAP Requirement, MW in	DEOK	5,358	5,358	
UCAP Requirement, MW in	AEP	13,079	13,079	
	Other zones	131,319	131,319	
UCAP Requirement, MW in	RTO	153,690	153,690	
Cleared ICAP	MW		207.9	207.9
Forecast Pool Requirement			1.0859	
Demand Resource Factor			0.955	
Cleared UCAP	MW	153,894	154,109	215.6
Auction Clearing Price	$/MWd	**$136.0**	$126.2	-$9.8
				-7.2%
Ohio Fraction of Cleared UCAP		9.4%	9.4%	
Ohio (RTO) Cleared Capacity	MW	14,439	14,459	20
Capacity Costs and Mitigation	**Million $**	**$716.7**	**$666.0**	**-$50.7**

Source: Synapse Energy Economics

A.3.3. Potential Savings from Energy Efficiency in the 2020/2021 PJM Auction

Figure A-3 illustrates the concept underlying our calculation of capacity price mitigation in 2020 using PJM data for the 2015/2016 auction for western PJM. The rightmost portion of the PJM VRR curve from Figure A-2 is represented here in blue. In that BRA, the market cleared at $118.54 per MW-day (nominal), which represents the point (P1) where the cleared bid quantity (Q1) intersects the VRR curve. Our analysis calculates the price at which the market would clear if an additional 608 MW were bid into the auction, i.e. Q2 = Q1 + 608 MW. Given that the VRR (demand) curve slopes downward, bidding in additional capacity results in a lower price of $90/MW-day, a difference of about $28 per MW-day (nominal). This represents the intersection (P2) of the VRR curve and this larger capacity (Q2).

Figure A-3. PJM VRR Curve Detail



Source: Synapse Energy Economics

A.3.2.2. ASSUMPTIONS AND RESULTS OF BIDDING ENERGY EFFICIENCY INTO THE 2020/2021 PJM BRA AUCTION

In our price and load forecast (see Appendix B), we estimated the wholesale capacity price in Ohio for calendar year 2020 to be $124/MW-day ($45/kW-yr) in 2012 dollars, if the energy savings program in Ohio was truncated in 2015. In this analysis we instead estimate the impact on the wholesale capacity price in Ohio for calendar year 2020 if the EERS continued and a portion of the resulting incremental reduction in peak load reduction were bid into the 2020/2021 BRA.

Our estimate of capacity price mitigation in Ohio in 2020 assumes a state-wide cumulative differential peak load reduction of 811 MW. This again is the difference between continuing

Ohio's EERS to 2020 and truncating it in 2015. We estimate that efficiency program administrators would bid 75% of that reduction, or 608 MW, into the PJM Base Residual Auction for 2020/2021.

Table A-10 provides our calculations of the price mitigation based upon this set of data and assumptions. This table illustrates both a possible gross effect based on a statewide reduction in peak load of 811 MW in 2020, and an illustrative net effect based on an incremental peak load reduction of 200 MW in 2020. Again, this assumes that program administrators bid in a maximum of 75% of these peak load reductions—equivalent to 608 MW and 150 MW, respectively.

Using PJM BRA auction data for 2015/2016, we estimate that incremental reduction would reduce capacity prices for annual resources by $27.02 per MW-day in $2012, or 21%, producing a potential gross annual savings to Ohio customers of $82 - $334 million in capacity costs in 2020 from the continuation of the EERS. We note, however, that there are a number of reasons the net savings could be lower, which we discuss in section A.3.4 below.

Table A-10. Supply-Side Capacity Price Mitigation for Ohio in 2020

Applicable VRR Curve	Year	**2015-2016**
Applicable VRR Curve	LDA	**RTO**

		BRA result	Result with additional demand response	Change / Mitigation	Result with additional demand response	Change / Mitigation
		Q 1	Q 2	Q 2 - Q 1	Q 2	Q 2 - Q 1
Maximum Incremental DR	MW		811	811	200	200
Percent of Maximum Incremental DR bid in Base Residual Auction (BRA)	%		75%		75%	
Quantity of Incremental DR bid in BRA	MW		608	608	150	150
Results, Nominal $						
System Marginal Price	$/MWd	$ 118.54	$ 89.86	$ (28.68)	$ 111.47	$ (7.07)
Extended Summer price adder	$/MWd	$ 17.46	$ 17.46	$ -	$ 17.46	**$ -**
Price for Annual Resources	$/MWd	**$ 136.00**	**$ 107.32**	**-21%**	**$ 128.93**	**-5%**
UCAP Requirement, MW in	OHIO	33,853	33,853	-	33,853	0
Price Mitigation, $ million	OHIO	$ 1,680	$ 1,326	$ (354)	$ 1,593	$ (87)
				-21%		**-5%**
Deflator ($nom in 2015 to $2012)		0.9423				
Results, 2012$						
Price for Annual Resources	$/MWd	$ 128.16	$ 101.13	**$ 27.02**	$ 121.49	**$ 6.66**
Price Mitigation, $ million	OHIO	$ 1,584	$ 1,250	$ (334)	$ 1,501	$ (82)

Source: Synapse Energy Economics

A.3.2.3. SOME CAUTIONS

As mentioned in the introduction these calculations represent the gross savings potential. For a variety of reasons the actual net savings in 2020 and subsequent years may be lower.

1. The change in the capacity price is very large compared to the relative change in the quantity of capacity because of the steep slope in the b-c segment of the PJM VRR curve where the BRA cleared. If the BRA cleared in the a-b segment of the VRR curve, with a reduced slope, the price impact would be less (see Figure A-3).

2. Our analysis assumes that an incremental reduction of 608 MW (75% of 811 MW) is bid into the 2020/21 BRA. However, the 811 MW differential peak load savings is available as early as 2018. If some portion of that 811 MW is bid into one or more of the preceding BRAs—e.g., the BRAs for power years 2016 through 2019—the increment remaining to be bid in 2020 would be less and the resulting price mitigation in that year would be less. Table A-10 illustrates this lower impact assuming a 200 MW increment rather than an 811 increment.

3. The capacity market price is set in annual auctions conducted three years in advance. Some resources bid into that market are very responsive to prices. Thus if those resources receive a low price in one BRA, e.g. 2020/2021, they may not bid into the next BRA, e.g. 2021/2022, resulting in a countervailing higher results in the subsequent BRA.

Appendix B. Ohio Energy and Capacity Price Forecasts

In this section we describe the reference case projections of wholesale energy and capacity prices in the Ohio region of PJM, which are utilized to determine the economic savings potential from price mitigation effects arising from investments in energy efficiency.

B.1. ENERGY PRICE FORECAST

Ohio is part of the PJM market region and represents portions of four load zones: ATSI, AEP, DAY and DOEK. Electric energy futures for the Dayton zone are traded in the NYMEX futures market. However, since there is a much longer history and much greater trading volumes for the PJM Western Hub, our analysis focuses on that market and makes appropriate adjustments to arrive at an Ohio price.

Table B-1 gives our Ohio wholesale electric energy price for both the reference case and energy efficiency cases, and subsequent material describes the process that was used to create it. For 2020 our forecast of the all-hours wholesale electric energy price in Ohio is $34.2/MWh (2012$).

Table B-1. Ohio Wholesale Electric Energy Price Forecast, Reference and Energy Efficiency Cases ($2012/MWh)

	Year	Peak	Off-Peak	All-Hours (Ref Case)	All-Hours With Mitigation Effects (EE Case)
Actual	2010	45.88	33.75	39.53	39.41
	2011	46.29	34.12	39.90	39.65
	2012	36.61	27.19	31.69	31.44
Forecast	2013	36.58	25.95	31.01	30.71
	2014	37.43	26.29	31.59	31.22
	2015	37.55	26.62	31.82	31.38
	2016	37.96	27.14	32.30	31.78
	2017	38.88	28.00	33.18	32.58
	2018	39.11	28.20	33.39	32.71
	2019	39.50	28.60	33.79	32.95
	2020	39.87	28.97	34.16	33.15

Source: Synapse Energy Economics

As mentioned above there is no single PJM zone for Ohio but rather a collection of four territories as described in Table B-2. The ATSI area just joined PJM in late 2011. The percentages of state loads are based on Table 3.2 of the "Ohio Long Term Forecast of Energy Requirements 2011-2030" produced by the Ohio Public Utilities Commission in March 2012.

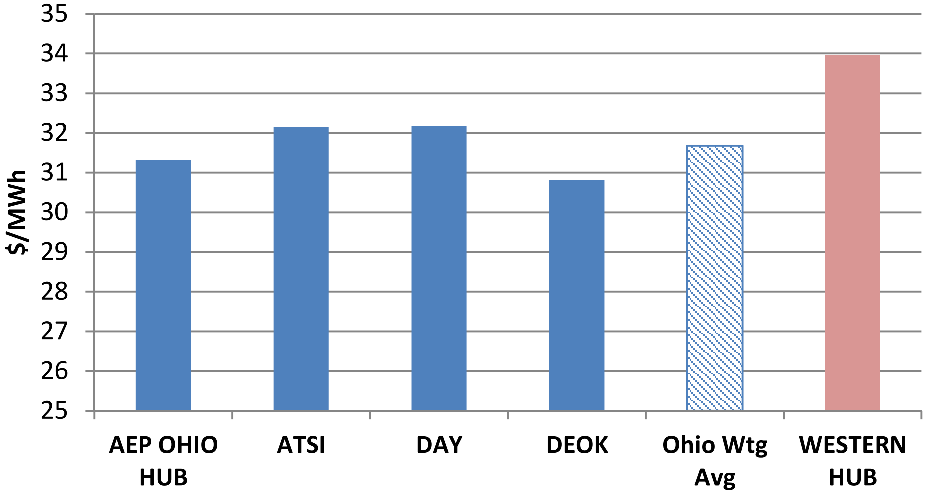
Table B-2. PJM Zones in Ohio

PJM Zone Name	Description	% of Ohio Load
ATSI[27]	First Energy in northern Ohio (CEI, OEP, TOL).	40.9%
DAY	Dayton P&L in western Ohio.	10.5%
DEOK	Duke Energy Ohio in the southwest.	15.0%
OHIO HUB	AEP areas in southern and western Ohio.	33.6%
Entire State	All of the above.	**100.0%**

Source: Synapse Energy Economics

Using prices for the PJM zones in 2012 we established a load-weighted price for Ohio as indicated in Figure B-1. The wholesale price differences between the various regions of Ohio is quite small, on the order of $1/MWh, with average prices lowest in DEOK, highest in ATSI and DAY and close to the state average in the (AEP) Ohio Hub. The PJM Western Hub price is presented here for comparison and was $2.3/MWh above the Ohio average in 2012.

Figure B-1. Wholesale All-Hours Electricity Prices in 2012



Source: Synapse Energy Economics

Since the PJM Western Hub electric price provides the primary basis for the Ohio price forecast we examine that relationship both in the past and as currently represented in the futures price. Figure B-2 indicates that Ohio prices have been, and are expected to be, about $5/MWh below the PJM West prices from 2013-2015. Note that 2012 was a very unusual year because of extremely low natural gas prices. Natural gas prices have increased since then and are expected to continue to do so. Thus, future conditions are expected to resemble 2011 more than 2012.

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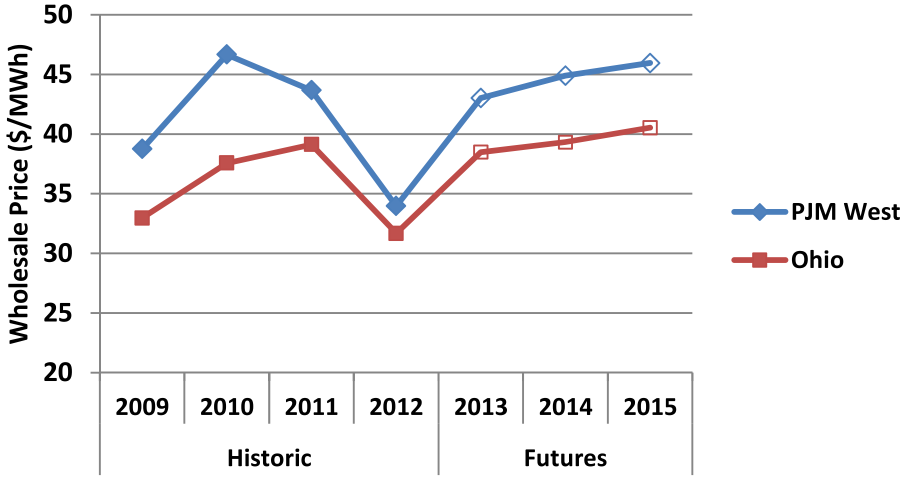
[27] American Transmission Systems, Inc.

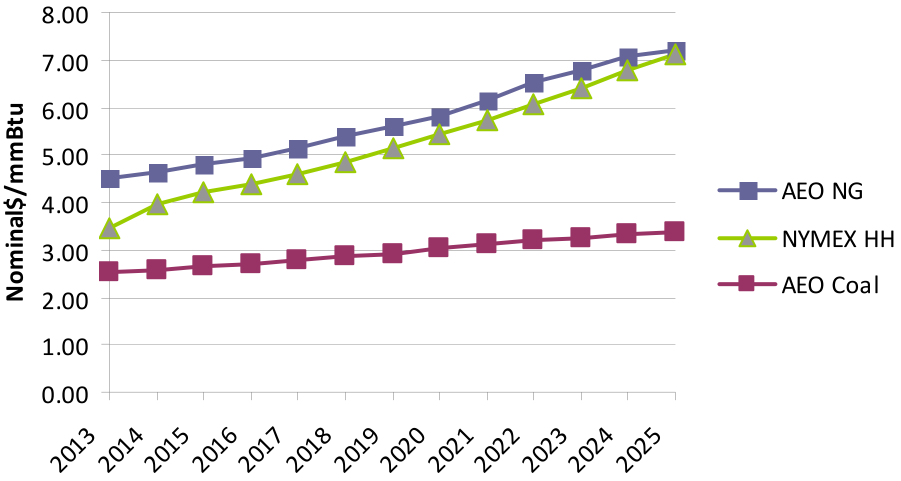
Figure B-2. Wholesale All-Hours Price Comparisons



Source: PJM 2012b

To predict future wholesale electricity prices we look at fuel costs. In PJM and Ohio the primary fossil fuel used for generating electricity is coal. In Ohio (in 2010) 82% of the electricity generation was from coal and 5% from natural gas. The fraction of natural gas generation is likely to increase in the future. For PJM as a whole in 2011, coal units were operating on the margin 69% of the time and natural gas units 26% (PJM 2012). However in western PJM, which includes Ohio, there is much less natural gas capacity than in the east. Thus we would expect the increase in future wholesale electricity prices in Ohio to reflect more the increases in coal prices than those of natural gas. Figure B-3 shows coal and natural gas price forecasts from AEO 2012 as well as recent January 2013 NYMEX futures prices for natural gas at Henry Hub (AEO 2012). The two natural gas forecasts are roughly similar, but only very modest increases are expected in coal prices.

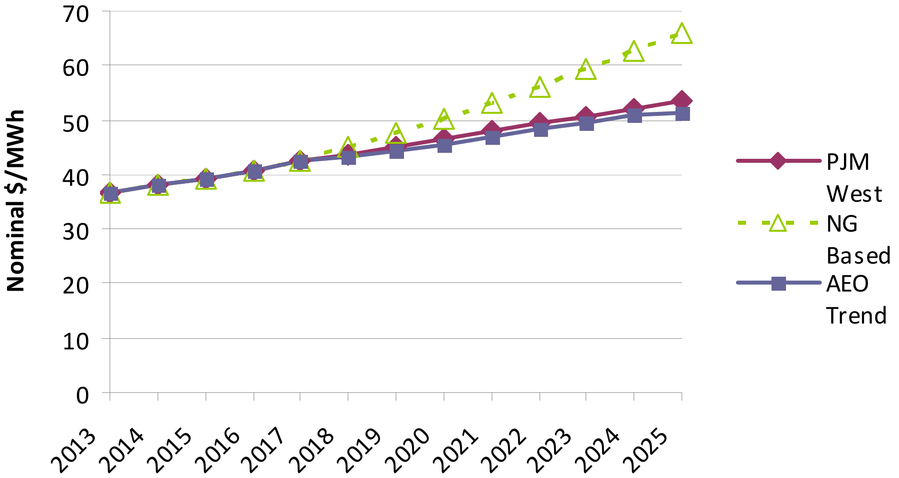
Figure B-3. Fuel Price Forecasts



Source: AEO 2012

Figure B-4 shows PJM West price forecasts based on current futures (which extend through 2017) and one based on the AEO trend in generation costs. These two are nearly identical with an average annual price increase of 3.0%. This is a little more than the expected coal price escalation rate of 2.5%, but below the AEO natural gas price rate of 4.0%. Thus this is a reasonable, and conservative, wholesale electricity price forecast. Higher natural gas prices and coal price closures might produce higher wholesale electricity prices, but that is quite uncertain.

Figure B-4. PJM West Wholesale Electricity Price Forecasts



Source: PJM 2012b

This PJM Western Hub price provides the basis then for our Ohio price forecast. We then apply the ratio of Ohio to PJM West prices based on historical and futures data to arrive at the numbers shown for the Ohio wholesale electricity prices in Table B-1.

B.1.1. CO_2 Cost Effects

We have not included future regulation of greenhouse gases in our energy price forecast because there is great uncertainty about when and how that would be implemented. However, Synapse is on the record with a mid-case forecast of $20/short ton for CO_2 in 2020 (in 2012$). Based on a 50/50 mix of coal and natural gas generation on the margin this would translate into an additional cost of about $15/MWh.

B.1.2. Generation Mix Changes

We expect that the overall generation mix in 2020 will not be significantly different than that at present. Some older, less efficient coal plants may retire because of environmental regulations, which would result in more marginal natural gas generation. A countervailing effect would be the addition of new renewable generation. This could push out the generation supply curve and push more coal generation into marginal hours. Since a more extensive analysis is beyond the scope of this study, we assume overall negligible effects on wholesale electricity prices from changes in the generation mix.

B.2. WHOLESALE CAPACITY PRICE FORECAST

The prices for capacity in the wholesale market operated by PJM, referred to as the Reliability Pricing Model ("RPM"), set the value for wholesale generating capacity as well as for reductions in peak load. This section summarizes the major market fundamentals that affect wholesale capacity prices and provides a high-level projection of that price for Ohio in 2020.

B.2.1. Overview of PJM Wholesale Capacity Market (RPM)

The PJM Interconnection, one of nine Regional Transmission Organizations (RTOs)/ISOs in the United States, operates a competitive wholesale market for electricity, scheduling electricity generation and coordinating the transmission of electricity in some portion of 13 states, including Ohio. It is also responsible for the reliability of its transmission grid, which it accomplishes by conducting long-term planning of generation capacity through the operation of its RPM. The RPM functions to ensure that adequate capacity—including energy efficiency and demand response—is available to maintain the reliability of the regional power grid (FERC 2012).

In operating the RPM, PJM begins by setting the capacity obligation of load serving entities (LSEs). This is the quantity of capacity, either supply-side or demand-side resources, that each LSE must control in a given year in order to ensure adequate service in that year. (The PJM planning or power year runs from June through May.) Because of the lead time required to bring new conventional capacity into service, PJM sets the capacity obligation three years in advance of the actual delivery or power year.

PJM acquires the resources for each power year through a series of auctions. The primary auction is the Base Residual Auction (BRA) which is held three years in advance of the delivery year. As noted above, the BRA for the 2015/2016 planning year was held in May 2012. PJM holds several subsequent, interim auctions between the BRA and the start of the delivery year. One of the major purposes of the RPM is to provide suppliers of existing capacity and demand response sufficient compensation to assure their continued participation and, if new capacity is required, to provide prospective providers sufficient compensation to invest in that new capacity (PJM 2009). The price for capacity established by the RPM auction for any given delivery year is the market value of capacity in that delivery year.

PJM sets the market clearing price for capacity in a given auction at the intersection of a demand curve that it establishes prior to the auction and the supply curve of resources bid into the auction. The supply curve reflects the quantity and price bids submitted by generators and demand resources in the BRA. Energy efficiency can be bid into the auction just like any other supply resource.

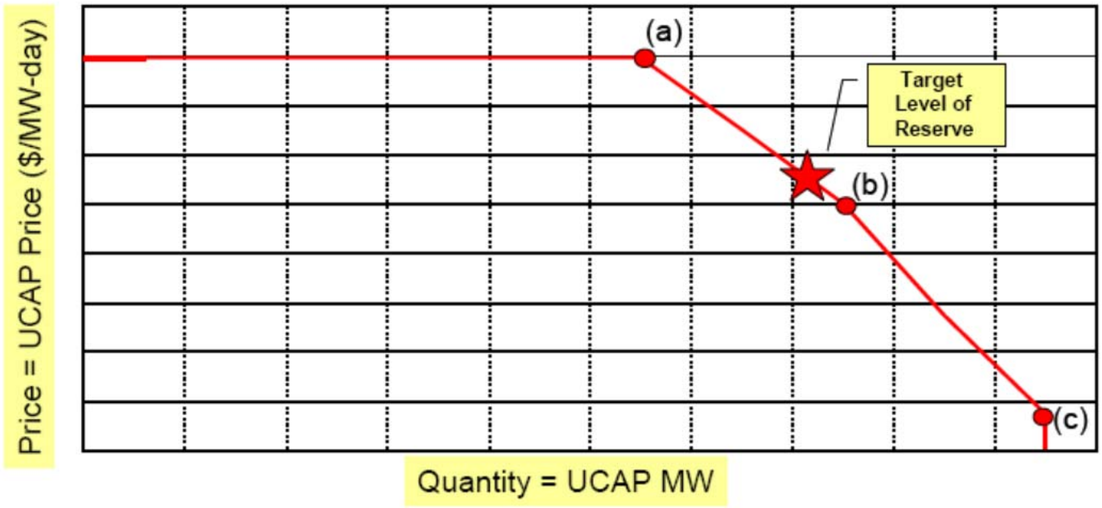
The PJM demand curve, referred to as the Variable Resource Requirement ("VRR") curve, plots price, on the y axis, versus quantity, on the x axis for three key points:

- Point A is equal to a y axis value of 1.5 times the Net Cost of New Entry ('CONE') and an x axis quantity equal to 3% less than the Installed Reserve Margin;

- Point B is net CONE at the Installed Reserve Margin plus 1%; and
- Point C is 20% of net CONE at a supply 5% greater than the Installed Reserve Margin.

Figure B-5 is an illustrative example of PJM's VRR curve.

Figure B-5. PJM's Variable Resource Requirement Curve



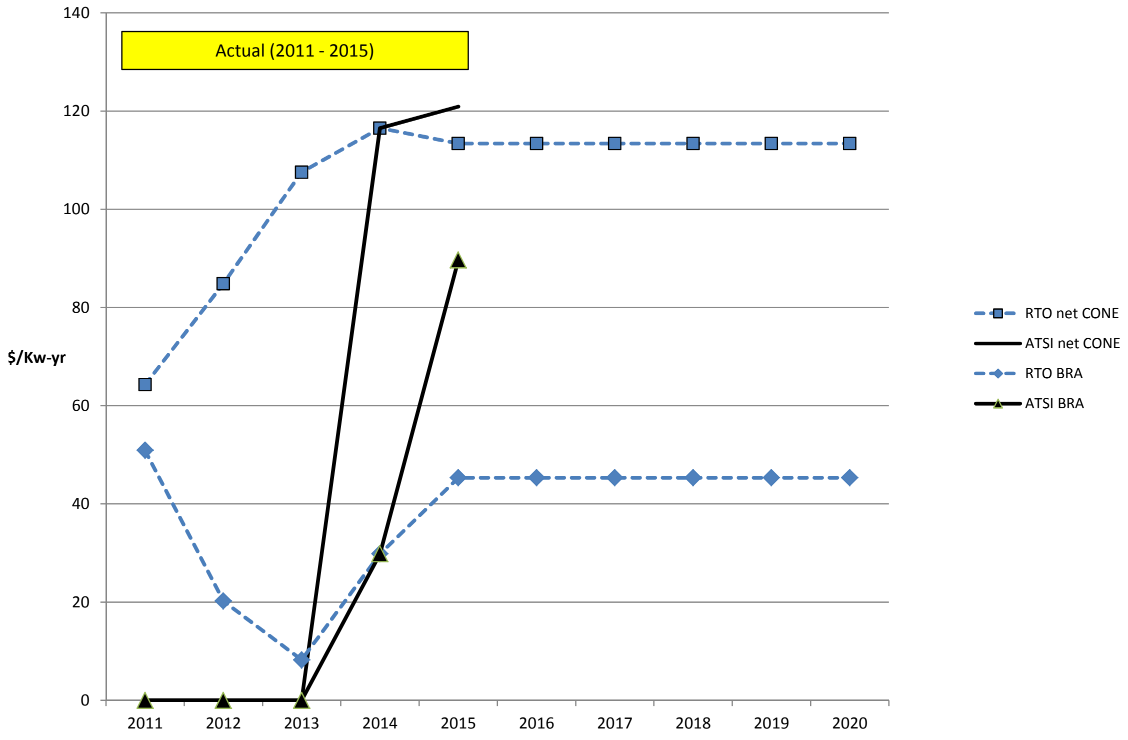
Source: PJM 2012a

CONE is PJM's estimate of the cost an entity would incur to build a new gas-fired unit and bringing it into service, net of the revenues. The unit may be either a combustion turbine (CT) or a combined-cycle (CC) unit. Net CONE is the difference between CONE and the energy and ancillary service revenues PJM estimates the entity would receive from the new unit under average market conditions. In other words net CONE is an estimate of the compensation, in excess of energy and ancillary service revenues, that a developer of a gas-fired unit would require from the capacity market in order to bring it online. Thus the RPM is currently explicitly designed to provide a capacity price that would support the development of new gas-fired capacity, if and when new capacity is required.

B.2.2. Estimate of Wholesale Price for Capacity in Ohio in 2020

Our conservative estimate of the wholesale capacity price in Ohio for calendar year 2020 in $2012 is $124/MW-day, which is equivalent to $45/kW-yr. This estimate assumes that capacity prices over the five years from 2016 to 2020 will, on average, equal the capacity price for calendar year 2015 in western PJM, excluding the ATSI zone. The estimate implies that capacity prices over the five years from 2016 to 2020 in western PJM in general, and Ohio in particular will, on average, be 40 percent higher than the average of actual capacity prices from 2011 to 2015 as illustrated in Figure B-6. This estimate assumes that these higher prices will be driven by increases in the cost of new capacity, retirement of some existing capacity and growth in peak demand. It also assumes that prices in the ATSI zone will clear at these levels by 2020 due to capacity additions in response to that zone's high prices in 2015 as well as investment in transmission to increase its integration with western PJM.

Figure B-6. RTO and ATSI PJM Capacity Price Forecasts, per kW, Calendar Year ($2012)



Source: Synapse Energy Economics

Our analysis focuses on the five most recent PJM auctions, for planning years 2011 through 2015 respectively. The PJM planning year is June through May.

When reviewing those auctions we focus on the key input assumptions, and results, relevant to the establishment of capacity prices for LSEs serving Ohio. Those input assumptions and results are for the zones PJM refers to as "Rest of Transmission Organization" or RTO and ATSI. RTO represents the bulk of the PJM territory (which may change from auction to auction) where most of the capacity clears. ATSI stands for American Transmission System Inc., confined mostly in northern Ohio and representing First Energy's service territory. FirstEnergy only joined PJM in 2011, therefore it has participated in only the most recent three BRAs.

Table B-3 provides the net CONE values that PJM set for each of the five most recent BRAs for the RTO and ATSI zones and the resulting market prices for annual resources[28] in each BRA in absolute terms. These values are in nominal dollars as reported by PJM. Table 8 also expresses the market prices as a percentage of net CONE in each year. Table B-3 indicates that except for the 2015 auction for ATSI, all of the other BRAs cleared at market prices below net CONE. On average between 2011 and 2015, PJM set net Cone for RTO at

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[28] Effective with its 2014/2015 BRA PJM began establishing prices for 3 different categories of capacity resources - limited resources, extended summer resources and annual resources. The latter two categories receive higher prices.

$286/MW-day ($104/kW-yr) and the market cleared at $83/MW-day ($30 / kW-yr) or 32% of net CONE.

Table B-3. PJM BRA Auctions

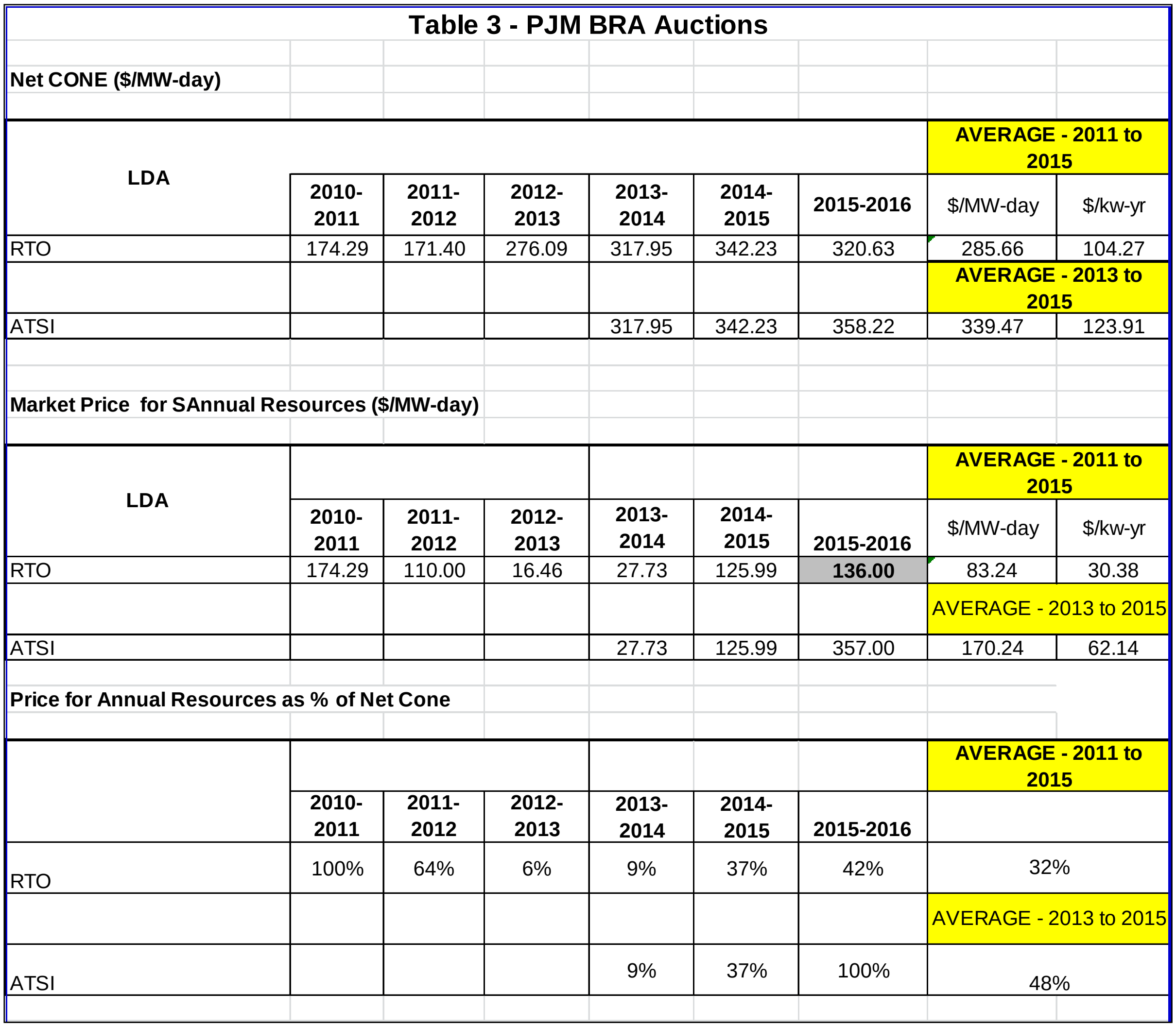

Table 3 - PJM BRA Auctions

Net CONE ($/MW-day)

LDA	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**AVERAGE - 2011 to 2015**	
							$/MW-day	$/kw-yr
RTO	174.29	171.40	276.09	317.95	342.23	320.63	285.66	104.27
							AVERAGE - 2013 to 2015	
ATSI				317.95	342.23	358.22	339.47	123.91

Market Price for SAnnual Resources ($/MW-day)

LDA	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**AVERAGE - 2011 to 2015**	
							$/MW-day	$/kw-yr
RTO	174.29	110.00	16.46	27.73	125.99	**136.00**	83.24	30.38
							AVERAGE - 2013 to 2015	
ATSI				27.73	125.99	357.00	170.24	62.14

Price for Annual Resources as % of Net Cone

	2010-2011	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**AVERAGE - 2011 to 2015**
RTO	100%	64%	6%	9%	37%	42%	32%
							AVERAGE - 2013 to 2015
ATSI				9%	37%	100%	48%

Our analysis indicates that the RPM results for the RTO for calendar 2015 represent a reasonable, conservative estimate of the cost of capacity in Ohio for calendar year 2020. The RPM results for the RTO for calendar 2015 are a composite of two different power years, i.e. the last 5 months of the 2014/2015 power year and the first 7 months of the 2015/2016 power year. Thus the nominal dollar RPM result for calendar year 2015 is $131.83 per MW-day or $48.12 per KW-yr. Expressed in $2012 that result is $124.23 per MW-day or $45.34 per KW-yr.

The RPM results for the RTO for calendar 2015 represent a conservative estimate of the cost of capacity in Ohio for calendar year 2020 for several reasons. First, it assumes that capacity prices over the five years from 2016 to 2020 in western PJM in general, and Ohio in particular will, on average, be 40 percent higher than the average of actual capacity prices from 2011 to 2015 due to increases in the cost of new capacity, retirement of some existing capacity and growth in peak demand. Second, it assumes that by 2020 prices in the ATSI zone will clear at this western PJM level due to the addition of new capacity in that zone in response to that zone's high prices in 2015. This second assumption is consistent with the experience of other LDAs in PJM. Specifically, the market prices in other LDAs have varied from BRA to BRA, with some BRAs clearing at or near net Cone. However, the subsequent BRAs in those LDAs have consistently cleared at much lower prices as new capacity resources and transmission investments are made in response to the high BRA price.

It is important to note that the 2015/2016 BRA was the first BRA where the ATSI zone experienced a price higher than the RTO price. The ATSI zone cleared at the RTO price in both the 2013 and 2014 BRA. Table B-4 indicates that over half of the 2015/2016 BRA price for ATSI is a "locational price adder" of $186.08 per MW-day.

Table B-4. 2015/2016 RPM BRA Results for RTO and ATSI ($/MWd) (nominal)

Auction Results	Units	**RTO**	**ATSI**
System Marginal Price	**$/MWd**	**$ 118.54**	**$ 118.54**
Locational Price adder	$/MWd	$ -	$ 186.08
Extended Summer price adder	$/MWd	$ 17.46	$ 17.46
Annual Price adder	$/MWd	$ -	$ 34.92
Price for Annual Resources	**$/MWd**	**$ 136.00**	**$ 357.00**

Source: PJM 2012d

One major reason why the ATSI zone received that price adder is the fact that FirstEnergy is retiring approximately 2.2 GW of older coal units effective 2015 (First Energy 2012b). That retirement obviously reduced the capacity available in that zone for the 2015/2016 year. However, it is reasonable to expect that additional demand reduction resources will bid into subsequent BRAs and that FirstEnergy and merchant plant developers will bring new capacity on-line in the ATSI zone between 2015 and 2020. In addition, there may be investment to eliminate transmission constraints and thereby increase the ability to import capacity into ATSI from other zones and thereby increase its integration with western PJM. Readers should take note that the PJM RPM prices have shown great volatility in the past and could do so in the future as well.