BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of Ohio Power Company to Initiate its gridSMART® Phase 3 Project	**)** **)** **)**	**Case No. 19-1475-EL-RDR**

COMMENTS OF THE ENVIRONMENTAL LAW & POLICY CENTER and THE OHIO ENVIRONMENTAL COUNCIL

I. INTRODUCTION

The Environmental Law & Policy Center (ELPC) and the Ohio Environmental Council (OEC) respectfully submit these comments regarding Ohio Power Company's (AEP Ohio or the Company) Application to Initiate its gridSMART Phase 3 Project. While the Company's application consists of nine components, these comments focus on the Company's proposed Phase 3 AMI and VVO deployments. Based on our review of the Company's application, including its testimony and exhibits, ELPC and OEC recommend that the Company:

1. Implement robust time-of-use tariffs in parallel with AMI deployment, including modifications to existing TOU programs that ELPC and OEC recommend in Case No. 17-1234-EL-ATA;
2. Implement a robust smart thermostat program in parallel with AMI deployment in order to ensure that customers benefit from AMI;
3. Explain how it will incorporate AMI data in its distribution planning processes—including in load forecasting, hosting capacity analysis and voltage monitoring;
4. Withdraw the proposed continuation of the "It's Your Power" app *unless* the Company proposes a robust complementary smart thermostat program such that customers actually realize energy and demand savings benefits;
5. Provide more detail regarding the protocols it will implement to monitor, track and report the performance of its VVO deployment, and;
6. Consider the use of customer-owned smart inverters as a part of its VVO strategy.

ELPC and OEC do not support approval of the Company's application until the issues above are satisfactorily resolved. ELPC and OEC's silence on other components in AEP Ohio's application does not constitute an endorsement of those components, and we reserve the right to address any issues relevant to the Company's application in reply comments or subsequent testimony submitted in this proceeding.

II. BACKGROUND ON COMMENTERS

ELPC is a non-profit public interest environmental organization that works to achieve cleaner air, advance clean renewable energy and energy efficiency resources, improve environmental quality, protect clean water, and preserve natural resources in Ohio and throughout the Midwest. ELPC's members, several of whom live and work in Ohio and in AEP Ohio's service territory, have an interest in thoughtful grid modernization investments that provide consumer and environmental benefits, including opportunities for all customers to manage their energy use and demand. ELPC regularly intervenes and actively participates in cases before the Commission, including Duke Energy Ohio, Inc.'s (Case No. 19-1750-EL-UNC), Dayton Power & Light Company's (Case Nos. 18-1875-EL-GRD *et al*.) and First Energy Solutions' (Case Nos. 16-481-EL-UNC et al.) recent grid modernization cases.

The OEC is a non-profit, non-partisan environmental advocacy organization comprised of a network of over 100 affiliated member groups and thousands of individual members, with the mission to secure healthy air, land, and water for all who call Ohio home. Throughout its 50-year history, the OEC has been a leading advocate for fresh air, clean water, and sustainable energy use in Ohio. OEC was an active participant in the effort that led to the passage of S.B. 221, and has intervened in scores of cases before this Commission to secure proper implementation of Ohio's clean energy laws. The OEC's Clean Energy Program works to secure the strong state carbon reduction strategies for Ohio, and accelerate Ohio's transition away from fossil fuels through deployment of, and increased innovation in, clean, efficient, and competitive energy choices. As evidenced in our active participation in the Company's previous ESP cases and gridSMART Collaborative, the OEC sees a modern and more efficient grid as a key to Ohio's clean energy future.

III. GRID MODERNIZATION PRINCIPLES AND OBJECTIVES

The Company proposes an approximately $1.1 billion revenue requirement over 15 years on gridSMART Phase 3. Those expenditures would significantly scale up the Company's existing grid modernization efforts, including both expansions to existing technology deployments (for example, VVO and AMI) as well as entirely new technology deployments (for example, intelligent distribution line sensors and dynamic VAR compensators). ELPC and OEC submit that before the Commission approves spending of this magnitude, it should scrutinize the Company's proposed grid modernization investments—both individually and as a portfolio—to determine whether the Company's application satisfies the following principles[1], many of which the PUCO outlines in its PowerForward Roadmap:

Does the Company's proposal:

[1] Attach 1 to these Comments, Sara Baldwin, Ric O'Connell and Curt Volkmann. "A Playbook for Modernizing the Distribution Grid; Volume 1: Grid Modernization Goals, Principles and Plan Evaluation Checklist." IREC and Gridlab, May 2020. https://irecusa.org/publications/.

1. Provide net value to customers; create an environment that fosters innovation; enhance the experience for all?
2. Result in a strong grid; the grid as a platform; a robust marketplace; and an enhanced customer experience?
3. Result in decarbonization of the electricity system and the beneficial electrification of the transportation and building sectors?
4. Result in adoption and optimization of distributed energy resources (DER)?
5. Empower people, communities and businesses to adopt affordable clean energy technologies and clean energy solutions?
6. Provide transparent information sharing and data access?
7. Enable innovation in technology and business models?

IV. AMI DEPLOYMENT PROPOSAL

A. Overview of Proposal

In this proceeding, AEP Ohio proposes installing approximately 475,000 AMI meters, mostly in rural areas that have not been covered by deployments in prior gridSMART phases. Company witness Osterholt explains that AMI meters use internal communication systems to convey near real-time energy use and load information to both the Company and the customer. Osterholt Direct Testimony at 22. He also explains that AMI meters provide the capability to monitor equipment and quickly convey information about malfunctions and operating conditions. *Id*. The Company cites a host of specific benefits that AMI meters enable, including:

- Empowering customers to control (reduce or shift) their energy use by providing near real-time consumption and load data (and ultimately helping customers reduce bills);
- Achieving deeper energy savings from VVO deployment;
- Facilitating participation in time-of-use or "incentivized" rate programs, and;
- Achieving more reliable and cost-effective integration of DER.

Id. at 23. ELPC and OEC agree that AMI can, *in theory*, provide significant benefits to the Company's grid and its customers, and can represent a core component of a comprehensive grid modernization strategy. In order for those benefits to materialize, the Company must:

- Strengthen its time-variant rate and smart thermostat programs, and;
- Explain how it will use AMI data to advance its distribution planning processes.

Below we explain these necessary steps in turn.

B. Time-Variant Rates and Smart Thermostats

By metering energy consumption and demand on a granular, hourly or sub-hourly basis, AMI unlocks the potential for time-of-use (TOU) rates. When properly designed, TOU rates can

help customers shift their use away from periods of high energy demand. This shift helps customers save money on their energy bills by reducing the typically expensive power that the Company must purchase during peak demand periods. Shifting energy use also reduces carbon emissions by curbing the utility's need to rely on fossil fuel-fired coal and natural gas peaker plants, which often emit more carbon than baseload plants.

The Commission recognized the importance of TOU rate development in parallel with AMI deployment in the Company's Phase 2 gridSMART proceeding, and the Company has accordingly proposed a two-tier TOU rate for AMI customers in Case No. 17-1234-EL-ATA. In that docket, ELPC and OEC have recommended the following modifications to the Company's TOU proposal:

- A three-tiered rather than two-tiered tariff design that includes different prices for off peak hours (7pm – 7am), mid peak hours (7am – 2pm), and peak hours (2pm – 7pm).
- Monthly on-bill comparisons for TOU customers that show how customers' actual bills compare to what they would have paid under non-time-of-use rates.

See Comments of the Ohio Environmental Council and Environmental Law & Policy Center (July 24, 2020). ELPC and OEC emphasize here, again, their support of the Company's proposed TOU rate (with the modifications it recommends in Case No. 17-1234-EL-ATA)—and note that without a robust TOU rate offering, the benefits AEP claims customer benefits will receive from the Company's proposed AMI deployment will likely not materialize.

While a well-designed TOU rate is a critical complement to AMI deployment, good design does not ensure that customers benefit from AMI. AEP Ohio needs to combine TOU rates with smart thermostats. Smart thermostats benefit customers by automating energy savings. In terms of residential usage, the electricity customers consume cooling their homes dwarfs all the other appliances. Hence, a properly designed TOU program provides a significant opportunity for customers to reduce their demand at peak time and lower their bills. Moreover, combining TOU rates with smart thermostats will give the Company critical load flexibility, allowing it to shift home cooling during critical periods without the need for direct customer intervention. This benefits participants and non-participants alike by reducing peak demand on the system.

The Company currently offers a modest smart thermostat program, including rebates than range between $50 to $80 when customers purchase those thermostats through the AEP Ohio Marketplace. The Company must vastly expand its smart thermostat program to match the scale of its proposed AMI deployment in this proceeding, not only to ensure that customers receive the purported benefits of AMI, but also to establish the foundational infrastructure necessary to make the Company's grid more flexible.

C. Use of AMI in Distribution Planning

Company witness Osterholt correctly notes that AMI will generate data that "can be utilized by increasingly sophisticated software to drive a multitude of other benefits to

customers." Osterholt Direct Testimony at 23. Indeed, AMI not only delivers customer energy consumption data on a frequent, sub-hourly interval, but can also deliver data on customer voltage, current, power factor, and excess generation (if the customer has installed an on-premise distributed generation system). That data can enhance and modernize utilities' existing distribution planning processes, including load forecasting, hosting capacity analysis, and voltage monitoring. By incorporating AMI data into its distribution planning processes, utilities can help customers integrate increasing levels of DER and electric vehicles while ensuring that their distribution grid is prepared for those increased penetration levels. In contrast, if the Company deploys AMI without using the data those meters generate to enhance its distribution planning processes, it will leave significant value "on the table." Failing to maximize the benefits from the data weakens AEP's case for expanding its AMI deployment. In its application, the Company alludes to using AMI data to advance distribution planning in general terms but provides no detail to explain how or when it plans to do so. ELPC and OEC request that before approving this additional spending, the Commission order the Company to provide a detailed plan for how and when it will leverage AMI data to enhance its distribution planning processes, with specific emphasis on how it will use AMI data to advance load forecasting, hosting capacity analysis and voltage monitoring.

D. "It's Your Power" App Proposal

The Company has an application (app) called "It's Your Power" which, according to witness Osterholt, "serves as a platform to give customers the ability to access and utilize real-time AMI data." Osterholt Direct Testimony at 44. In this filing, the Company proposes to continue the "It's Your Power" app for 5 years at an average cost of $1.275 million per year (or a total of approximately $6.4 million). The Company claims that customers experience 2% energy savings using the app, however, it does not provide any evidence or evaluation demonstrating those savings. In fact, the Company's 2018 Portfolio Status Report of its Energy Efficiency and Peak Demand Response Programs shows that neither the "It's Your Power App" nor the Company's smart hub ("Energy Bridge") result in **any** energy consumption (kWh) or demand (kW) reductions unless customers *also received a smart thermostat*.[2] While the Company "anticipates that customers will achieve additional energy savings as they become more familiar with the [It's Your Power app], and as additional app features are added over time", without a robust parallel smart thermostat program (as ELPC and OEC describe above), there is no reason to believe that those savings will materialize. The Company's proposed continuation of its "It's Your Power" app is therefore not reasonable, and the Commission should reject it *unless* the Company proposes a complementary, expanded smart thermostat program consistent with ELPC and OEC's recommendations in these comments.

[2] *See* Attach 2 to these Comments at 18, 2018 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs, Ohio Power Company (May 14, 2019).

V. VVO DEPLOYMENT PROPOSAL

A. Overview of Proposal

VVO technology delivers energy savings by allowing utilities to reduce voltage on specific localized portions of the distribution grid while maintaining adequate voltage levels to maintain reliability. Lower voltage levels reduce line losses and customer energy usage, decrease local and system-wide demand and consequently lower retail power costs.

In this proceeding, AEP Ohio proposes deployment of VVO on 190 substation buses. The Company projects that deployment on the 190 substation buses will result in a 3 percent average improvement in energy efficiency—plus an additional 1 percent improvement using meter interval data from AMI. The Company projects that its Phase 3 VVO deployment will cost $323 million over 15 years, while providing approximately $414 million in customer power cost savings. The Company states it would conduct additional benefit-cost analyses on an unspecified periodic basis to identify additional circuit candidates that might have positive net present values from VVO deployment. Additionally, the Company stated it would implement unspecified "Measurement & Verification (M&V) protocols … to continually measure the energy savings and voltage reductions provided by the VVO."

B. Importance of VVO Monitoring to Ensure Efficacy

Company witness Osterholt states that AEP Ohio's DDC and Grid Modernization teams will monitor its Phase 3 VVO deployment. Osterholt Direct Testimony at 21. Mr. Osterholt also states that the Company will implement Measurement & Verification (M&V) protocols throughout the deployment period to evaluate the energy savings, demand reductions and voltage reductions provided by VVO. ELPC and OEC support rigorous and transparent monitoring of VVO investments by measuring the effect of those investments on peak demand, energy usage and line losses. ELPC and OEC also support rigorous and transparent monitoring to determine how the demand, energy use and line loss reductions from VVO investments might vary when deployed adjacent to or upstream from other grid technologies, such as AMI, customer-owned distributed energy resources (DER), or smart inverters. In order for customers and advocates to accurately assess the efficacy of this VVO deployment, it is important that the Company make its VVO M&V reports public as it deploys VVO. Furthermore, while ELPC and OEC support the Company's intention to implement M&V protocols, the Company should provide additional detail regarding its proposed monitoring, measurement and verification protocols such that the Commission and parties can determine whether those protocols are sufficiently robust.

C. Smart Inverters as a VVO Alternative

As customers and third-parties increasingly deploy DER (such as solar photovoltaic system and batteries) to self-produce and store energy, the technologies also present new opportunities to provide distribution grid services in innovative and cost-effective manners, such as voltage regulation. DER connected to the grid via "smart inverters" have the ability to regulate voltage on circuits both by injecting real power and controlling reactive power. In response to these technological advances, some utilities have considered DER equipped with smart inverters to provide VVO services in lieu of making infrastructure investments in utility-owned VVO technology. ELPC and OEC recommend that the Company evaluate whether customer- and third-party-owned DER equipped with smart inverters can provide voltage services that would complement the Company's investments in VVO.

VI. CONCLUSION

The Company's application does not sufficiently demonstrate that its proposed Phase 3 deployments of AMI and VVO will optimize customer and grid benefits. ELPC and OEC recommend that the Company:

1. Implement robust time-of-use tariffs in parallel with AMI deployment, including modifications to existing TOU programs that ELPC and OEC recommended in Case No. 17-1234-EL-ATA;
2. Implement a robust smart thermostat program in parallel with AMI deployment in order to ensure that customers benefit from AMI;
3. Explain how it will incorporate AMI data in its distribution planning processes—including in load forecasting, hosting capacity analysis and voltage monitoring;
4. Withdraw the proposed continuation of the "It's Your Power" app *unless* the Company proposes a robust complementary smart thermostat program;
5. Provide more detail regarding the protocols it will implement to monitor, track and report the performance of its VVO deployment, and;
6. Consider the use of customer-owned smart inverters as a part of its VVO strategy.

ELPC and OEC do not support approval of AEP Ohio's Phase 3 application unless the Company satisfactorily addresses these recommendations.

Respectfully submitted,

September 9, 2020

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Certificate of Service

In accordance with Rule 4901-1-05, Ohio Administrative Code, the PUCO's e-filing system will electronically serve notice of the filing of this document upon the following parties. In addition, I hereby certify that a service copy of the foregoing Comments of Environmental Law & Policy Center and the Ohio Environmental Council was sent by, or on behalf of, the undersigned counsel for the Environmental Law & Policy Center to the following parties of record this 9th day of September 2020, via electronic transmission.

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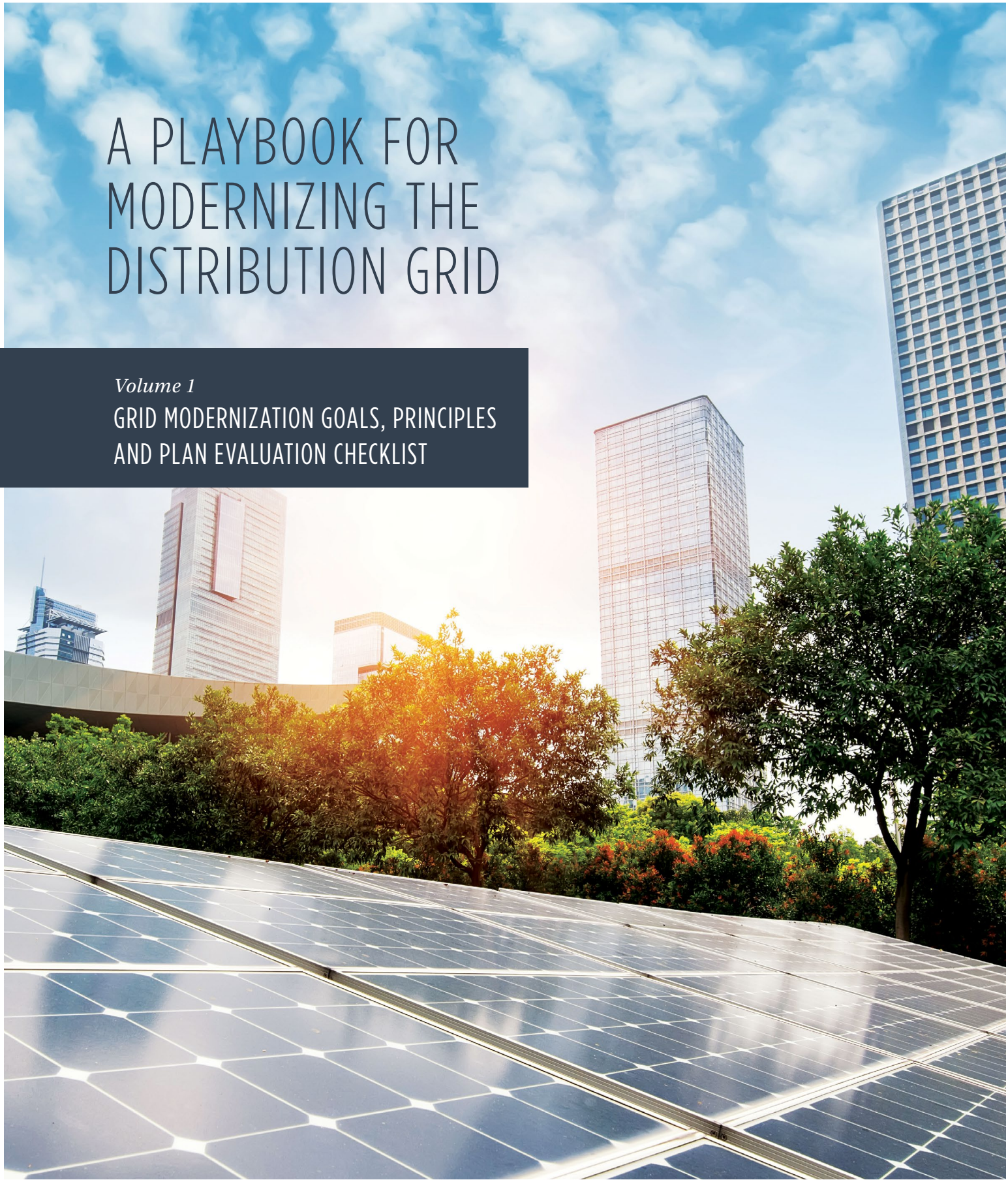
Attachment 1 to ELPC OEC Comments

A PLAYBOOK FOR MODERNIZING THE DISTRIBUTION GRID

Volume 1

GRID MODERNIZATION GOALS, PRINCIPLES AND PLAN EVALUATION CHECKLIST



IREC GridLAB

ABOUT THE PLAYBOOK

Developed by the Interstate Renewable Energy Council (IREC) and GridLab, A Playbook for Modernizing the Distribution Grid (hereinafter, the GridMod Playbook) is an evaluation toolkit to help regulatory stakeholders navigate, analyze and make more informed decisions about grid modernization proposals, distribution plans and grid investments. The GridMod Playbook aims to ensure more efficient and impactful grid modernization efforts in support of state public policy goals, such as clean energy adoption, across the United States and U.S. territories.

The first volume, *Grid Modernization Goals, Principles and Plan Evaluation Checklist*, consists of goals and principles for grid modernization, and an evaluation checklist – combined, they provide an initial framework to help utility regulators and regulatory stakeholders assess the merits of proposed grid modernization plans, investments and initiatives. The GridMod Playbook concept was developed at Rocky Mountain Institute (RMI)'s 2019 eLab Accelerator. This volume was developed by IREC and GridLab with peer review and input from the following individuals. No part of this document should be attributed to these individuals or their affiliated organizations.

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IREC

About IREC

IREC builds the foundation for rapid adoption of clean energy and energy efficiency to benefit people, the economy and our planet. IREC develops, informs and advances the regulatory reforms, technical standards, and workforce solutions needed to enable the streamlined, efficient and cost-effective installation of clean, distributed energy resources. www.irecusa.org

GridLAB

About GridLab

GridLab is an innovative non-profit that provides technical grid expertise to enhance policy decision-making and to ensure a rapid transition to a reliable, cost effective, and low carbon future. www.gridlab.org

GOALS OF GRID MODERNIZATION

Over 150 states, local governments and prominent businesses have adopted ambitious renewable and clean energy goals to rapidly reduce carbon emissions in an effort to address climate change and improve the resilience of the electric grid. Concurrently, states and utilities are undertaking "grid modernization" efforts that could enable strategic investments in new technologies for the distribution grid and allow for increased grid integration of distributed energy resources (DERs) and accompanying technologies — e.g., solar, energy storage, advanced meters, smart inverters, smart devices, demand response and electric vehicle (EV) charging infrastructure. These grid modernization efforts have the potential to leverage the deployment of DER technologies to meet policy and customer goals, while also creating more transparency and minimizing the risks associated with future grid investments.

Utilities across the country are proposing investments that add up to billions of ratepayer dollars over the next several years. Although considerable investments in the distribution grid will be needed in the coming decades to address aging infrastructure and changing demands on the electricity grid, not all grid modernization investments may be warranted or beneficial, either economically or for carbon emission reductions.

Although state policymakers, regulators and utilities may articulate discrete goals for their respective grid modernization efforts, we believe the overarching goals of grid modernization plans and ensuing investments should be to enable the swift evolution of the grid to integrate modern technologies that meet public policy and clean energy objectives, such as reducing carbon emissions and achieving 100% clean energy goals. In particular, grid modernization plans and investments should cost-effectively enable, not hinder, the electrification and decarbonization of the vehicle and building sectors, support increased energy efficiency, facilitate the deployment of DERs and improve grid reliability and resilience. The latter is especially critical given the increased frequency and intensity of natural disasters, which will only be further exacerbated by climate change. In addition, grid modernization should avoid costly and unnecessary investments in legacy grid infrastructure that may crowd out or impede the adoption of proven, cost-effective clean energy technologies and the transition to a clean energy future.

PRINCIPLES OF GRID MODERNIZATION

The following principles support and reflect the above goals of grid modernization and should be present in some form in any proposal. These principles can be used as an initial filter and framework to assess the merits of proposed grid modernization plans, investments and initiatives.

Grid Modernization should…

1. **Support and enable policy goals, including the decarbonization of the electricity system and the beneficial electrification[1] of the transportation and building sectors.** Grid modernization proposals should support relevant policy and regulatory objectives for reducing carbon emissions and enabling the electrification of the transportation and building sectors. Grid modernization investments should take into account other incentives or programs that spur increased consumer and community adoption of DERs, such as EVs and EV fast charging, electric appliances, solar, wind, energy storage, demand response and/or energy efficiency measures. Rather than duplicate utility investments, consumer investments in DERs should be leveraged and properly accounted for in grid modernization plans, particularly as optimal alternatives to more costly grid investments.
2. **Enable the adoption and optimization of distributed energy resources (DERs).** Grid modernization investments should enable, not hinder, the adoption of DERs, which can offer economic, reliability, resilience and environmental benefits to consumers, communities and utilities.[2] Grid modernization efforts should aim to increase the transparency of the grid and improve grid modeling procedures such that consumers, local governments, developers and technology providers can support the accelerated customer adoption of DERs. In addition, concurrent with grid modernization investments and plans, efforts should be made to streamline and automate interconnection processes and reduce the overall cost of DER adoption and integration for the benefit of all ratepayers.
3. **Empower people, communities and businesses to adopt affordable clean energy technologies and clean energy solutions.** Grid modernization plans and investments should help, not hinder, consumers' ability to adopt technologies and solutions that reduce the impact of their energy usage, enable easier ways to manage energy costs, and support their carbon reduction, energy consumption and/or financial goals. In addition, all interested and vested stakeholders should have easy access to information about the grid. Grid modernization investments should help support the adoption of more streamlined processes for installing, interconnecting and integrating these technologies (without impacting grid safety and reliability).
4. **Support secure and transparent information sharing and data access.** Grid modernization plans should facilitate the increased understanding of grid needs and operations among all stakeholders, including regulators. In addition, investments should enable enhanced interoperability, improved visibility and coordinated control of the grid. Improvements in transparency should allow all parties — utilities, developers, customers, local governments, regulators and other decision-makers — to access information about the grid such that DERs and other low-carbon clean energy technologies are deployed strategically, swiftly and affordably in preferred locations on the grid.

5. **Enable innovation in technology and business models.** Grid modernization plans and investments should encourage the participation of third-party stakeholders in providing information, technologies, services, and technical and financial support to consumers. To the extent applicable and appropriate, economic development and job creation goals could also be taken into account when evaluating the merits of grid modernization plans. Non-wires alternatives (NWA) should be identified and supported as viable solutions to serve identified grid needs, ahead of traditional, more capital-intensive investments (which may lead to stranded assets or more costly infrastructure). Grid modernization plans should also address whether financial incentives, penalties and/or pilot programs are needed to address the limitation of existing utility business models to encourage consumer-based technology innovation, and particularly the underlying regulatory incentive for utilities to prioritize capital expenditures to increase their profits based on the prevalent return on investment-based business model.

In addition to the above principles, we suggest that regulators and stakeholders evaluating Grid Modernization (GridMod) plans consider the following questions in their assessments (please refer to endnotes for additional explanation).

1) Does the GridMod plan include specific, measurable goals and objectives?

- **a)** Does the plan align with and support existing state policy goals and/or commission orders?
- **b)** Is it clear what specifically the utility is trying to achieve with its plan?
- **c)** Is it clear how the utility will measure the success of the plan?

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2) Does the GridMod plan include a credible Benefit/Cost Analysis (BCA) to demonstrate the plan's cost effectiveness or cost reasonableness?

- **a)** Has the utility applied an appropriate BCA methodology (e.g., least-cost/best-fit, benefit/cost ratio, Utility or Societal Cost test, etc.) for each category of GridMod expenditures?[3]
- **b)** Does the plan include disclosure of all planned GridMod expenditures including those beyond the initial period of the request?
- **c)** Do the costs reflect the full revenue requirements and customer bill impacts over the life of the assets?[4]
- **d)** Has the utility explicitly included cost contingencies and provided a corresponding range of potential BCA results?[5]
- **e)** If the BCA includes benefits from improved reliability, are the identified benefits reasonable and credible?[6]
- **f)** Does the plan include a qualitative assessment of how it will improve resilience?[7]
- **g)** Has the utility applied an appropriate discount rate in its BCA calculations?[8]
- **h)** Has the utility provided support for its key BCA assumptions and provided a sensitivity analysis of those assumptions?[9]

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3) Does the GridMod plan include detailed metrics to track progress?

- a) Are the metrics tied to the stated goals/objectives of the plan, the BCA, and the underlying BCA assumptions?
- b) Has the utility provided baselines and targets for each metric?
- c) Has the utility defined a process for ongoing tracking and reporting of metrics including costs and benefits?

4) Will the GridMod plan enable beneficial electrification?

- **a)** Has the utility quantified and planned for the potential impact on load and demand from on-road, non-road[10] and building electrification?
- **b)** Are the utility's assumptions about electrification consistent with state policy goals?
- **c)** Does the plan reflect input from other relevant transportation and building sector programs/ agencies (e.g., public transportation office, large fleet vehicle users, state transportation agency, building codes and standards, etc.)?
- **d)** Has the utility identified barriers to EV adoption in its service territory, and does the plan adequately address the barriers?
- **e)** Does the plan include investments in the grid to accelerate EV adoption and deployment of EV charging infrastructure?
- **f)** Does the plan include an appropriate balance between utility ownership and private ownership of EV charging infrastructure?
- **g)** Will the utility offer rate structures to encourage off-peak EV charging and, if so, by when?
- **h)** Does the plan include programs and incentives for the electrification of space and water heating?

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5) Is the GridMod plan a requirement and/or outcome of a credible Integrated Distribution Planning (IDP) process?[11]

- **a)** Will the plan help accelerate the adoption and integration of DERs?
- **b)** Does the plan enable or enhance identified IDP objectives, capabilities or tools (i.e., improved load and DER forecasting, hosting capacity analyses, identification/ publication of grid needs and locational value, explicit consideration of non-utility owned DERs as non-wires alternatives (NWA) and NWA acquisition)?
- **c)** Will the plan result in increased transparency and understanding of distribution system data (e.g., historical loads and load forecasts, hosting capacity, grid needs, beneficial locations for non-wires alternatives, etc.)?

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6) Are the GridMod plan's proposed investments based on a demonstrated need?[12]

- **a)** Has the utility defined all of the capabilities[13] the plan will enable or enhance?
- **b)** Has the utility adequately explained how these capabilities relate to the overall goals and objectives of the plan?
- **c)** Has the utility provided benchmarking or other credible analysis supporting the need for the new or enhanced capabilities?

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7) Is the GridMod plan synergistic with other existing or planned investments (e.g., Advanced Metering Infrastructure (AMI) supporting metering as well as distribution planning/operations, etc.)?

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8) Does the GridMod plan meaningfully reflect input from stakeholders, including consumer advocates, clean energy advocates, customers, large energy users, technology vendors, transportation interests and local governments?

- **a)** Will the utility meaningfully incorporate Commission and stakeholders' input throughout the plan's design and implementation?

In addition to the above questions, the following table lists the categories of investments that may be included in a GridMod plan, along with specific examples or components in each category. The questions are intended to help evaluate the merits of the GridMod plan and may highlight the need for additional analysis and/or evidence to support proposed investments. Please refer to the Glossary for definitions of terms and acronyms, and please refer to endnotes for additional context and perspective.

Within the GridMod plan:

IF YOU SEE INVESTMENTS FOR
ADVANCED METERING

EXAMPLES OR COMPONENTS INCLUDE...	THEN ASK...

• Advanced Metering Infrastructure (AMI)[14]
• Smart Meters
• Meter Data Management System (MDMS)
• AMI Head-end System
• Mesh Network
• Backhaul Network
• Field Area Network (FAN)
	• Do the benefits exceed the costs (as measured by present value of revenue requirements or bill impacts)?
	  - *If not, is there a credible rationale for why the AMI investment is needed?*
	• How will AMI support distribution planning/operations (e.g., load forecasting, voltage monitoring, communications with intelligent grid devices, etc.)?
	• Will customers be able to download and share their usage data using a standardized format, such as Green Button data? If so, by when?
	• What time-varying rates will the utility offer and by when?
	  - *What are the projected energy/demand savings from the proposed rates?*
	  - *Are the projections credible and based on actual results from other utilities?*
	• What new AMI-enabled energy efficiency and/or demand response programs will the utility offer and by when?
	  - *What are the projected energy/demand savings from these programs?*
	  - *Are the projections credible and based on actual results from other utilities?*
	• What other tools will the utility deploy to help customers manage energy usage, and by when?
	• What plans does the utility have for customer education, and are the plans sufficient?
	• Are there well-defined metrics with targets to track implementation progress and benefit realization?

IF YOU SEE INVESTMENTS FOR

GRID AUTOMATION AND SENSING

EXAMPLES OR COMPONENTS INCLUDE...

- Distribution Automation (DA)
- Substation Automation
- Supervisory Control and Data Acquisition (SCADA)
- Fault Location, Isolation and Service Restoration (FLISR)
- Self-Healing Grid
- Remote Fault Indicators
- Line Sensors
- Intelligent Grid Devices
- Telemetry
- Installation of Reclosers

THEN ASK...

- Is there credible proof of cost reasonableness or cost effectiveness?
- Is the utility claiming that the automation will improve reliability? If so:
  - *Is there a demonstrated need for the reliability improvement (e.g., benchmarking results, legislative mandates, poor customer satisfaction, etc.)?*
  - *Are the projected improvements in SAIDI (System Average Interruption Duration Index), SAIFI (System Average Interruption Frequency Index) and CAIDI (Customer Average Interruption Duration Index) credible?*[15]
  - *Is the utility using the Interruption Cost Estimate (ICE) Calculator to quantify the benefits from improved reliability? If so:*
    - » *Are the inputs to and outputs from the ICE Calculator credible?*
    - » *Has the utility accounted for the impact of momentary interruptions?*
- What steps has the utility taken to minimize the risk of technology obsolescence?[16]
- Are there well-defined metrics with targets to track implementation progress and benefit realization?

IF YOU SEE INVESTMENTS FOR

OTHER RELIABILITY IMPROVEMENTS

EXAMPLES OR COMPONENTS INCLUDE...

- Grid Hardening
- Undergrounding[17]
- Voltage Conversions
- Line Rebuilds
- Battery Energy Storage Systems (BESS)
- Microgrids
- Asset Replacements
- Installation of Reclosers

THEN ASK...

- Is there credible proof of cost reasonableness or cost effectiveness?
- Is there a demonstrated need for reliability improvement (e.g., benchmarking results, legislative mandates, poor customer satisfaction, etc.)?
- Is the utility using the ICE Calculator to quantify the benefits from improved reliability? If so:
  - *Are the inputs to and outputs from the ICE Calculator credible?*
  - *Has the utility accounted for the impact of momentary interruptions?*
- Has the utility sufficiently considered customer- and third party-owned DERs as NWA?[18]
- What steps has the utility taken to minimize the risk of technology obsolescence?[19]
- Are there well-defined metrics with targets to track implementation progress and benefit realization?

IF YOU SEE INVESTMENTS FOR

FOUNDATIONAL TOOLS AND SOFTWARE

EXAMPLES OR COMPONENTS INCLUDE...

- Load Forecasting
- DER Forecasting
- Power Flow Modeling
- Load Flow Modeling
- Fault Analysis
- Geographic Information System (GIS)
- Distribution Management System (DMS)
- Outage Management System (OMS)
- Advanced Distribution Management System (ADMS)
- Customer Information System (CIS)
- Customer Information Platform (CIP)
- Enterprise Asset Management System (EAMS)

THEN ASK...

- Has the utility sufficiently demonstrated the need for the requested tools/software (i.e., in the context of stated goals/objectives)?
- Is the utility claiming that the tools/software will improve reliability? If so, are the projected improvements measurable and credible?
- Is the utility claiming that the tools/software are needed to integrate DERs? If so, has the utility sufficiently demonstrated this need and explained how the tools/software will address this need?
- If the utility plans to use commercial-off-the-shelf (COTS) software, do the selected technologies and associated cost estimates reflect a rigorous Request for Proposals (RFP) process?[20]
- If custom software, what is the basis for the estimated costs and how do these costs compare to COTS?
- Does the utility currently have the staff and expertise to take full advantage of the software tools? If not, does the utility have an appropriate training or hiring plan?
- If COTS software is used, what steps has the utility taken to minimize the risk of technology obsolescence?[21]
- Has the utility explained how the technologies will enable or enhance IDP capabilities?
- Will the utility provide the inputs, assumptions and outputs of the tools and software in a transparent, easily understandable manner?

IF YOU SEE INVESTMENTS FOR

ADVANCED TOOLS AND SOFTWARE

EXAMPLES OR COMPONENTS INCLUDE...

- Distributed Energy Resources Management System (DERMS)
- Demand Response Management System (DRMS)
- Locational Net Benefit Analysis (LNBA)
- Locational Value Analysis
- Advanced Analytics
- Optimization Analytics

THEN ASK...

- Has the utility sufficiently demonstrated the need for the requested tools/software?
- Do existing and forecasted DER penetration levels warrant the need for the investment?[22]
- Are the requested tools/software commonly used by other utilities?
- If COTS software is used, are the selected technologies and associated cost estimates reflective of a rigorous RFP process?
- If custom software is used, what is the basis for the estimated costs and how do these compare to COTS?
- Will the requested tools/software enable communications with smart inverters?
- What steps has the utility taken to minimize the risk of technology obsolescence?[23]

IF YOU SEE INVESTMENTS FOR

TELECOMMUNICATIONS

- Broadband Fiber
- Broadband Microwave
- Wide Area Network (WAN)
- Field Area Network (FAN)

THEN ASK...

- Is there credible proof of cost reasonableness or cost effectiveness?
- Has the utility appropriately considered and incorporated public solutions (e.g., leasing lines from existing telecommunications infrastructure providers)?
- Will the proposed field area network (FAN) enable and/or support communications with advanced inverters?
- If the utility is also deploying AMI, can the AMI communications network also function as the FAN? If not, why?
- What steps has the utility taken to minimize the risk of technology obsolescence?[24]

IF YOU SEE INVESTMENTS FOR

VOLTAGE AND REACTIVE POWER MANAGEMENT

EXAMPLES OR COMPONENTS INCLUDE...

- Voltage Optimization (VO)
- Integrated Volt/VAR Control (IVVC)
- Integrated Volt/VAR Optimization (IVVO)
- Conservation Voltage Reduction (CVR)

THEN ASK...

- Has the utility appropriately considered and utilized the capabilities of advanced inverters and secondary VAR controllers?
- What are the expected peak demand and energy usage reductions, and how will the utility measure and verify the savings?
- What are the expected line loss reductions, and how will the utility measure and verify the savings?
- If the utility is also deploying AMI, how will AMI support or enhance the proposed voltage management solution?
- What steps has the utility taken to minimize the risk of technology obsolescence?[25]

IF YOU SEE INVESTMENTS FOR

DER INTEGRATION OR INTERCONNECTION

EXAMPLES OR COMPONENTS INCLUDE...

- Hosting Capacity Analysis (HCA)
- DER Interconnection Tools
- Information Sharing Portals
- Reconductoring
- Voltage Conversion
- Relay and protection upgrades or replacements
- Voltage regulator installation or replacement
- Recloser installation or replacement
- Transformer replacement
- Capacitor installation or replacement
- Upgrades to address reverse power flow

THEN ASK...

- Has the utility sufficiently demonstrated the need for the investment?
- Do existing and forecasted DER penetration levels support the need?
- Are the issues allegedly caused by DERs supported with evidence?
- Has the utility appropriately considered the capabilities of advanced inverters and secondary VAR controllers to defer or eliminate the need for the investment?
- Are state level discussions underway to adopt the The Institute of Electrical and Electronics Engineers (IEEE) *Standard 1547-2018 for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (IEEE Std 1547-2018)* for smart inverters? If so, do the assumptions in the GridMod plan reflect the impact of this new standard?
- If the utility is proposing investments in interconnection tools, how will the utility incorporate customer and developer feedback into creation/refinement of the tools?
- If the utility is proposing an HCA:
  - *Has the utility clearly defined the HCA use cases?*
  - *What HCA methodology is the utility proposing, and is it appropriate for the use cases?*
  - *Are the utility's plans for publishing HCA results sufficient?*[26]
  - *How frequently will the utility update the HCA, and is this sufficient?*
  - *How will the utility incorporate customer and developer feedback into the creation/refinement of its HCA?*
- To what extent will the investments enable sharing of distribution system information (e.g., historical loads and load forecasts, hosting capacity, grid needs, beneficial locations for non-wires alternatives, etc.)?

IF YOU SEE INVESTMENTS FOR

PILOT PROJECTS

EXAMPLES OR COMPONENTS INCLUDE...

- Battery Energy Storage Solutions (BESS)
- Non-Wires Alternatives
- Microgrids
- Time-of-use rates
- Managed EV Charging
- Demand Response programs

THEN ASK...

- Has the utility established clear goals and objectives for each proposed pilot? Are these aligned with the overall GridMod goals and objectives?
- Has the utility demonstrated that each pilot is designed based on lessons learned and best practices from other utilities?
- Does the plan call for cross-functional collaboration and stakeholder engagement during pilot design and implementation?
- For each pilot, is there a plan for replicating or scaling to support full deployment if successful?

ENDNOTES

[1] Beneficial electrification is a term for replacing direct fossil fuel use (e.g., propane, heating oil, gasoline, natural gas) with electricity in a way that reduces overall emissions and energy costs.

[2] See e.g., "Whereas many States recognize that DER, if interconnected and operated in a safe and reliable manner with uniform standards across multiple jurisdictions, can offer economic, reliability, resilience, and environmental benefits to consumers, communities and utilities." *EL-1/ERE-1 Resolution Recommending State Commissions Act to Adopt and Implement Distributed Energy Resource Standard IEEE 1547-2018*, Resolution Passed by National Association of Regulatory Utility Commissioners (NARUC) Board of Directors 2020 Winter Policy Summit, 12 February 2020, page 1, available at: https://pubs.naruc.org/pub/4C436369-155D-0A36-314F-8B6C4DE0F7C7

[3] See a forthcoming Berkeley Lab report, *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges, and Considerations*, by Woolf, T., B. Havumaki, D. Bhandari, M. Whited (Synapse Energy Economics) and L. Schwartz, Berkeley Lab.

[4] In addition to capital and O&M costs, the BCA should include full financing costs and taxes over the life of the assets, as measured by revenue requirements. It is also informative to understand how much typical customer bills are likely to increase or decrease as a result of the proposed GridMod investments.

[5] Cost contingencies are amounts added to base costs in a spending plan to account for risks and uncertainty. Good project management practices call for the use of cost contingencies, particularly for large, complex projects deploying new technologies over a long time period. Risks and uncertainties that could impact GridMod plan costs include, but are not limited to, unknowns related to the integration of new and legacy IT systems; equipment deployment delays due to weather or other factors; emergence of new viable technologies; new security threats or vulnerabilities; and changing legislation or regulations. Cost contingencies effectively provide a range of expected costs and best- and worst-case benefit/cost ratios. As with all BCA assumptions and calculations, it is important that the utility's inclusion of cost contingencies be explicit and transparent.

[6] Although the determination of reasonable and credible benefits is subjective, the GridMod plan should include clear, understandable, and verifiable data/analysis in support of claimed benefits. The ranges of benefits should be consistent with what the utility has demonstrated in pilots or with what other utilities have realized deploying similar technologies.

[7] A 2019 report written for NARUC concluded that, although DERs and other GridMod investments can offer resilience benefits, it is unclear how to determine their value. See Rickerson, Wilson, J. Gillis, M. Bulkeley, *The Value of Resilience for Distributed Energy Resources: An Overview of Current Analytical Practices*, Prepared by Converge Strategies for the National Association of Regulatory Utility Commissioners, April 2019, available at: https://pubs.naruc.org/pub/531AD059-9CC0-BAF6-127B-99BCB5F02198

[8] A utility often uses its own weighted average cost of capital (WACC) as the discount rate in its BCA. However, according to the Synapse/LBNL report referenced in endnote 3, the appropriate BCA discount rate should reflect the time preference chosen by regulators on behalf of all customers (i.e., the regulatory perspective). The regulatory perspective should account for many factors, including low-cost, safe, reliable service; intergenerational equity; and other regulatory policy goals. The regulatory perspective suggests a greater emphasis on long-term impacts than what is reflected in the WACC, and that a discount rate lower than the WACC may be appropriate for the BCA. GridMod plans can use sensitivities to consider the impact of different discount rates (e.g., use the utility WACC as a high case, use a low-risk or societal discount rate as a low case)

[9] A typical GridMod plan BCA includes multiple assumptions such as future reliability improvements, equipment failure rates, customer participation in DSM programs, EV adoption rates, etc. Most, if not all, of these assumptions are uncertain. A sensitivity analysis determines how much the overall costs or benefits change from a change in one or more key assumptions. A sensitivity analysis also identifies the assumptions that have the most impact on the overall costs and benefits of the GridMod plan, thus highlighting the key assumptions that the utility should further validate, monitor, and report on throughout the GridMod plan implementation.

[10] Non-road electrification converts commercial and industrial equipment (such as forklifts, airport baggage handling equipment, cranes, conveyors, onshore generation for dock shipping, welding equipment, tugboats and ferries) from propane or diesel fuel to electricity.

[11] A credible IDP process includes the consideration of Commission, staff and other stakeholder input when developing the IDP framework and IDP priorities.

[12] A demonstrated need should include evidence that a proposed investment is actually necessary. Such evidence may include benchmarking results showing relatively poor performance, customer complaints, fines and/or penalties for poor performance, or other documented proof of poor or inadequate system conditions.

[13] In this context, the authors define a capability to be the combination of skills, processes and technologies required to achieve a specific outcome or objective. The U.S. Department of Energy (DOE) has defined 26 grid modernization capabilities. See pp. 43-49 of Modern Distribution Grid Volume I: Customer and State Policy Driven Functionality, available at https://gridarchitecture.pnnl.gov/media/Modern-Distribution-Grid_Volume-I_v1_1.pdf.

[14] The authors are generally supportive of AMI but emphasize the importance of a utility taking full advantage of AMI capabilities for the benefit of its customers. For recommendations to ensure that utilities and customers realize the full value from AMI, see e.g., Gold, Rachel, C. Waters, and D. York, *Leveraging Advanced Metering Infrastructure to Save Energy*, American Council for an Energy-Efficient Economy, Report U2001, 3 January 2020, pp. 42-43, available at: https://www.aceee.org/sites/default/files/pdfs/u2001.pdf.

[15] According to the 2016 DOE report on results from the Smart Grid Investment Grant (SGIG) program, distribution automation (DA) can reduce the frequency and duration of sustained customer interruptions by 15-55%. However, p. 24 of the report cautions, "The best way to evaluate the impact of DA technologies on system reliability is to compare reliability indices before and after deployment using a well-established pre-deployment baseline. Unfortunately, many SGIG utilities had trouble establishing accurate, reliable pre-deployment baselines from which to measure performance improvements. It is recognized that the process of developing a baseline is complex and time consuming for utilities. Simply comparing reliability indices from year to year—rather than against a baseline—cannot effectively measure the full impact of DA investments." Additionally, utilities must take into account the increase in momentary interruptions for some customers when quantifying DA benefits.

[16] It is important that the utility emphasize "future proofing" the GridMod technologies and capabilities to minimize the risk of obsolescence. Selected GridMod technologies should include characteristics such as over-the-air firmware and configuration upgrades without the need for field visits or equipment replacement; use of open standards, protocols, and standard service components that are not vendor-specific; enhanced memory size to support potential future use cases; architecture for ease of integration with existing and future systems; and re(use) of standard interfaces to reduce design and development costs.

[17] Converting overhead facilities to underground is costly and almost never justified by reliability improvements alone. A 2012 Edison Electric Institute report, *Out of Sight, Out of Mind 2012 — an Updated Study of the Undergrounding of Overhead Power Lines* (available at https://www.eei.org/issuesandpolicy/electricreliability/undergrounding/Documents/UndergroundReport.pdf), shows an industry range of distribution overhead to underground conversion costs of $1-5 million per mile for urban construction, and $0.15-2 million per mile for rural construction. The report states, "Currently, no state has recommended wholesale undergrounding of their utility infrastructure. The cost of conversion has always been the insurmountable obstacle in each of these studies … Since 1999, an increasing number of state utility commissions have studied the possibility of mandating utilities to place all or part of their electrical facilities underground … The conclusion in every study, has determined that the cost to achieve the desired underground system is considerably too expensive for either the utility or the electrical customers."

[18] For example, in the recent Green Mountain Power (GMP) Bring Your Own Device (BYOD) pilot, the utility offers bill credits to customers in exchange for control of customer-owned home battery backup systems, EV chargers, and water heaters during peak periods. Participating customers in the GMP BYOD pilot with backup batteries experience improved reliability while also providing peak demand reductions to benefit all customers. See https://www.greentechmedia.com/articles/read/green-mountain-power-kept-1100-homes-lit-up-during-storm-outage.

[19] *See endnote 16.*

[20] The authors strongly recommend COTS only as utilities should not be in the business of developing custom software.

[21] *See endnote 16.*

[22] The authors believe DERMS technologies are nascent and unnecessary even with high penetrations of DERs. For example, at the end of 2018, Pacific Gas & Electric (PG&E) had 370,000 customers with rooftop solar and a total of 4,000 MW of rooftop solar distributed generation (DG), or 20% of the private rooftop DG capacity in the U.S. PG&E also was adding 5,000 new DG customers and 55 MW of new rooftop DG to its grid each month. In its 2018 general rate case application, PG&E did not request approval of a DERMS, stating that no vendor currently provides the comprehensive set of DERMS capabilities it requires. As DERMS functionality matures, PG&E determined that it should first "invest in foundational technology including improved data quality, modeling, forecasting, communications, cybersecurity, and a DER-aware ADMS to address the near-term impacts of DERs and grid complexity while providing the groundwork for a future DERMS system."

[23] *See endnote 16.*

[24] *See endnote 16.*

[25] *See endnote 16.*

[26] HCA results should be published via online maps illustrating the hosting capacity of each circuit line section. The maps should include quick-display boxes, allowing the viewer to easily see summary information for a given node, line section or feeder. All HCA results and underlying data should also be available for download.

GLOSSARY

ADMS (Advanced Distribution Management System) - software that integrates several operational systems to optimize distribution grid performance. ADMS components can include a distribution management system (DMS); DER management system (DERMS); outage management system (OMS); demand response management system (DRMS); fault location, isolation, and service restoration (FLISR); conservation voltage reduction (CVR) and integrated Volt-VAR control (IVVC).

Advanced Inverter - a power electronics device that transforms DER direct current to alternating current. It also provides functions such as reactive power control and voltage/frequency ride-through responses to improve the stability, reliability and efficiency of the distribution system. Also known as a "smart inverter."

AMI (Advanced Metering Infrastructure) – a system that includes meters, communication networks between the meters and utility, and data collection and management systems that make the information available to the utility. AMI communications networks may also provide connectivity to other types of devices such as grid sensors, switches, and DERs.

AMI Head-end System - software that transmits and receives data, sends operational commands to smart meters, and stores interval load data from the smart meters to support customer billing.

Backhaul Network - a comunications system for transmitting large volumes of data between the AMI/field device mesh networks and the utility.

Broadband Fiber - communication systems using optical fiber that are capable of very high bandwidths.

Broadband Microwave - high frequency radio communication systems that are widely used by utilities for substation and SCADA communications.

Bring Your Own Device (BYOD) - a type of energy efficiency or demand response program involving the use of customer-owned DER devices (e.g., batteries, thermostats, etc.), and may include aggregated dispatch to provide grid services.

CAIDI (Customer Average Interruption Duration Index) – the average duration of sustained outages in a year, measured in minutes per interruption. CAIDI = SAIDI / SAIFI.

CIP (Customer Information Platform) – software for billing and revenue collection, may also include incorporation of new capabilities enabled by AMI and an MDMS.

CIS (Customer Information System) - software for billing and revenue collection.

Cost Effectiveness - determination if a proposed investment's benefits exceed the costs.

Cost Reasonableness - determination if a proposed investment represents the least-cost/ best-fit solution to address a need, regardless if the benefits exceed the costs.

COTS (Commercial-Off-The-Shelf) - software products that are ready-made and available for purchase in the commercial market.

CVR (Conservation Voltage Reduction) - intentional reduction of voltage within established limits to achieve demand reduction and energy savings for customers.

DA (Distribution Automation) - technologies including sensors, communication networks, and switches, through which a utility can improve the operational efficiency of its distribution system.

DERs (Distributed Energy Resources) - energy resources connected to the distribution system that include distributed wind and solar generation, combined heat and power, energy storage, electric vehicles, energy efficiency, demand response and microgrids.

DERMS (Distributed Energy Resources Management System) - software that provides distribution operators near real-time visibility into and control of individual DERs or DER aggregations.

DMS (Distribution Management System) - software capable of collecting, displaying and analyzing near real-time electric distribution system information. A DMS can interface with other operations applications, such as a GIS, OMS, and CIS to create an integrated view of distribution operations.

DR (Demand Response) - voluntary (and compensated) load reduction used by utilities as a system reliability or local distribution capacity resource. Demand response allows utilities to cycle certain customer loads on and off in exchange for financial incentives.

DRMS (Demand Response Management System) - software to administer and operationalize DR aggregations and other DR programs.

EAMS (Enterprise Asset Management System) - software for collecting attributes and analysis of distribution grid assets.

FAN (Field Area Network) - the communications network between distribution substations and grid devices (such as switches, sensors and AMI meters) on the distribution system.

FLISR (Fault Location, Isolation and Service Restoration) - a combination of hardware and software technologies that identify the location on a circuit where a fault has occurred, isolate the faulted line segment and restore service to all customers not connected to the faulted line segment. FLISR is also called a Self-Healing Grid.

GIS (Geographic Information System) - as defined in the context of the electric distribution system, software containing attributes of distribution grid assets and their geographic locations to enable presentation on a map. GIS may also serve as the system of record for electrical connectivity of the assets.

Green Button – an industry standard for making detailed customer energy-usage information available for download in a simple, common format.

Grid Hardening - grid improvements such as rebuilding portions of distribution circuits or proactively replacing assets to improve reliability and resilience.

Hosting Capacity - the amount of DERs that can be accommodated on the distribution system under existing grid conditions and operations without adversely impacting safety, power quality, reliability or other operational criteria, and without requiring significant infrastructure upgrades.

HCA (Hosting Capacity Analysis) - the calculation and publication of the distribution system's hosting capacity.

ICE (Interruption Cost Estimate) Calculator – an online tool for quantifying the economic impact to customers from improved reliability. See https://icecalculator.com/home.

IDP (Integrated Distribution Planning) - proactive planning for DERs growth consisting of four principal components: (1) mapping circuits' hosting capacity; (2) forecasting the expected growth of DERs on each circuit; (3) prioritizing grid upgrades to integrate DERs and (4) proactively pursuing grid upgrades (including traditional capital upgrades as well as DERs themselves) to meet anticipated grid needs.

Intelligent Grid Devices – devices such as switches and sensors that provide situational awareness, grid control capability and enable two-way communications.

IVVC (Integrated Volt/VAR Control) - a process of controlling voltage and reactive power flow on the distribution system to improve overall system performance, allowing a utility to reduce electrical losses, eliminate voltage profile problems and reduce electrical demand.

Line Loss - A natural occurrence of power delivery systems, consisting mainly of power dissipation in system components. The largest component of losses is caused by the electrical resistance of equipment and is proportional to the square of the current. As system load or current increases, system components lose more energy in the form of heat, and losses increase exponentially. Losses are therefore greatest during peak loading periods.

MAIFI (Momentary Average Interruption Frequency Index) – the average number of momentary interruptions experienced by customers in a year.

MDMS (Meter Data Management System) – a software platform that processes and stores AMI interval data used for billing.

Mesh Network - a wireless method of communication in which information is transmitted through a network of transmitters/ receivers en route to its final destination.

Microgrid - a group of interconnected loads and DERs able to operate when connected to the larger distribution grid and also able to operate as an "island" when there is an outage or other grid disturbance.

Momentary Interruptions – according to IEEE, momentary interruptions are outages lasting less than 5 minutes. Momentary interruptions are not included in the standard reliability indices of SAIDI, SAIFI, and CAIDI.

NWA (Non-Wires Alternative) – the deployment of DERs or combinations of DERs — owned by the utility, customers or other third parties — to defer or avoid the need for investment in conventional, more costly grid infrastructure. Also referred to as a Non-Wires Solution.

OMS (Outage Management System) - software to enable the efficient and safe restoration of outages, as well as communications with customers regarding restoration status. An OMS can serve as the system of record for the as-operated distribution connectivity model, as can the DMS or ADMS.

Reclosers - devices that, when sensing a fault, temporarily interrupt power downstream from their location and then automatically reclose and restore power if the fault has cleared.

Reconductoring - replacing existing conductor with larger conductor to address a thermal or voltage issue.

SAIDI (System Average Interruption Duration Index) - the average duration of sustained outages experienced per customer in a year, measured in minutes per customer. SAIDI = CAIDI x SAIFI.

SAIFI (System Average Interruption Frequency Index) - the average number of sustained outages experienced per customer in a year, measured in interruptions per customer. SAIFI = SAIDI / CAIDI.

SCADA (Supervisory Control and Data Acquisition) - a system of remote controls and telemetry to monitor and control the transmission and distribution system.

Secondary VAR Controllers - devices installed on the low-voltage side of distribution transformers to assist in controlling reactive power and voltage.

Self-Healing Grid - *see FLISR*

Smart Meter - a device capable of two-way communications used for measuring electricity consumption and other end-use information and transmitting this information on demand to a central location. Smart meters provide near real-time customer usage data, as well as interface with other 'smart' devices in the home or business.

Sustained Interruptions - according to IEEE, sustained interruptions are outages lasting more than five minutes.

Telemetry - the automatic measurement and wireless transmission of data from remote sources.

Undergrounding - conversion of existing overhead distribution facilities to underground for improved aesthetics or to address reliability issues.

Voltage Conversion - increasing the voltage of a distribution circuit (e.g., from 4kV to 12kV) to increase its capacity to serve load or to accommodate DERs.

VAR (Volt Ampere Reactive) – a measure of reactive power. Reactive power energizes the magnetic field of alternating current power system components but does no actual work, and represents the component of the current that is out of sync with the voltage.

VO (Voltage Optimization) - a combination of CVR and IVVC, resulting in optimal flow of reactive power, reduced line losses, and reduced customer demand and energy consumption.

VVO (Volt-Var Optimization) - *see VO*.

WAN (Wide Area Network) - the communications network connecting distribution substations with operations/control centers and other utility facilities.

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Attachment 2 to ELPC OEC Comments

Legal Department

May 14, 2019

Barcy F. McNeal
Docketing Division Chief
Public Utilities Commission of Ohio
180 East Broad Street
Columbus Ohio 43215-3793

Re: *In the Matter of the Annual Portfolio Status Report Under Rule 4901:1-39-05(C), Ohio Administrative Code, by Ohio Power Company,* Case No. 19-1099-EL-EEC.

Steven T. Nourse
VP Legal –
Regulatory Services
(614) 716-1608 (P)
(614) 716-2950 (F)
stnourse@aep.com

Dear Ms. McNeal:

Ohio Power Company ("OPCo," "the Company" or "AEP Ohio") submits the enclosed 2017 Portfolio Status Report, pursuant to Rule 4901:1-39-05(C), Ohio Administrative Code (OAC).

In Case Nos. 11-5568-EL-POR, et al., the Commission approved the Stipulation and Recommendation on March 21, 2012, and granted the requested waiver of Rule 4901:1-39-05(C), OAC, such that AEP Ohio may file its annual portfolio status report by May 15 instead of March 15 during each year of the EE/PDR Action Plan in order to provide sufficient time for adequate evaluation, measurement and verification of plan results.

Thank you for your attention to this matter.

Respectfully Submitted,

/s/ Steven T. Nourse

2018 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs

Volume I: Main Report, Affidavit of Jon Williams, and Appendices A through S

Ohio Power Company
Gahanna, Ohio
May 14, 2019

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R. C&I Comprehensive Process Evaluation Report
S. Joint Utility Standardized Reporting

INTRODUCTION

In Docket No. 08-888-EL-UNC, the Public Utilities Commission of Ohio ("the Commission") approved Rules for Energy Efficiency and Peak Demand Reduction Programs of electric utilities ("the Green Rules"). These Green Rules first became effective December 10, 2009. In accordance with Amended Substitute Senate Bill 221 (S.B. 221), the Rules require that each electric utility in the Commission's jurisdiction implement energy efficiency and peak demand reduction programs and file an annual Portfolio Status Report, originally due March 15 of each year but extended to May 15 in the January 18, 2017 order in Docket No. 16-0574-EL-POR for AEP Ohio.

In 2012, the General Assembly enacted Senate Bill 315 (S.B. 315) which, among other items, classified combined heat and power projects as energy efficiency projects. In 2014, the General Assembly then enacted Senate Bill 310 (S.B. 310) which froze energy efficiency targets at the 2014 levels for two years. After the freeze expired, the targets have resumed and AEP Ohio is operating under an approved 2017-2020 four-year plan.

Per Ohio Administrative Code (OAC) 4901:1-39-05(C), these Status Reports are required to address all approved energy efficiency and peak demand reduction (EE/PDR) programs' performance over the prior calendar year. The Ohio Power Company ("the Company" or "AEP Ohio") filed a Program Portfolio Plan for 2017-2020 under Docket No. 16-0574-EL-POR, which the Commission approved January 18th, 2017.

AEP Ohio submits this 2018 Portfolio Status Report in compliance with the above-cited Rules. In accordance with OAC 4901:1-39-05(C)(2)(b), AEP Ohio has contracted with Navigant Consulting, Inc. ("Navigant") to review the Company's programs; perform the impact and process evaluations; and provide evaluation, measurement, and verification reports.

This report is divided into three major sections: The first section covers how the Company has met all the requirements in the Green Rules in 2018 and achieved its S.B. 310 benchmark requirements. The second section reviews each of AEP Ohio's EE/PDR programs and how they have performed this past year. The third and final section contains Ohio Power Company's recommendations going forward for each of the programs.

Attached with this report are 19 appendices: Appendix A lists individual units incented and measures installed, at a detailed level, under each of Ohio Power Company's EE/PDR programs. Appendices B through P contain the Evaluation Reports of each program from Navigant. Appendix Q covers transmission and distribution projects related to EE/PDR. Appendix R contains the comprehensive process evaluation for the C&I sector. Finally, Appendix S contains the joint utility standardized reporting template that contains performance information at a program level.

DEMONSTRATION OF COMPLIANCE

BENCHMARK UPDATES

AEP Ohio filed its Initial Benchmark Report on February 8, 2010[1] and has made regular updates in its intervening Portfolio Status Reports for both energy usage and peak demand. The Company has adjusted both its gross energy sales and peak demand to include the impacts of mercantile[2] customers' energy efficiency resource commitments and economic development. These adjusted figures are shown in Figures 1 and 2 below.

The annual benchmark target is calculated as the average of the prior three years' adjusted load, multiplied by the yearly statutory benchmark requirements from S.B. 310. The amounts for 2018 are 1.0 percent incremental energy reduction and 7.75 percent cumulative demand reduction.

For purposes of this compliance filing, the 2018 benchmark adjustments include the following: Economic growth exclusions, the associated opt outs legislated under S.B. 310[3], and the load generated by the Combined Heat and Power projects that existed during the period used to establish the baseline[4].Figure 1 shows the calculation of the adjusted 2018 benchmark for energy usage savings: 377.5 gigawatt-hours (GWh). Figure 2 shows the calculation for the adjusted 2018 benchmark for peak demand savings: 603.5 megawatts (MW).

FIGURE 1: ADJUSTED ENERGY USAGE BASELINES

Year	Actual Retail Sales	Econ. Devel. Adj.*	S.B. 310 Opt Out*	Combined Heat and Power*	2012-17 Merc. Savings	2018 Merc. Savings	Adjusted Retail Sales
2015	43,418.1	0.0	-5,422.5	44.7	55.1	0.1	38,095.4
2016	43,393.4	0.0	-5,263.3	95.7	55.8	1.3	38,282.7
2017	42,715.2	0.0	-6,008.4	95.7	55.8	3.7	36,861.8
						Three-Year Average:	**37,746.7**
						Benchmark Rate:	**1.00%**
						2018 Benchmark Target:	**377.5**

All figures are in GWh - Docket 19-501-EL-FOR.

[1] *In the Matter of the Initial Benchmark Report of Columbus Southern Power Company and Ohio Power Company*, Case No. 10-153-EL-EEC, February 8, 2010.

[2] "Mercantile customer" means a commercial or industrial customer if the electricity consumed is for nonresidential use and the customer consumes more than seven hundred thousand kilowatt hours per year or is part of a national account involving multiple facilities in one or more states. See Ohio Revised Code § 4928.01(A)(19).

[3] http://codes.ohio.gov/orc/4928.6611v1

[4] http://codes.ohio.gov/orc/4928.66v1 - See Ohio Revised Code §4928.66(A)(2)(c)

*This baseline differs from the AEPS baseline filed in 19-0933-EL-ACP to reflect the above adjustments.

FIGURE 2: ADJUSTED PEAK DEMAND BASELINES

Year	Coincident Peak Demand	Econ. Devel. Adj.*	S.B. 310 Opt Out*	Combined Heat and Power*	2012-17 Merc. Savings	2018 Merc. Savings	Adjusted Peak Demand
2015	8,423.0	0.0	-642.2	5.5	7.6	0.0	7,793.9
2016	8,616.0	0.0	-635.9	9.2	7.7	0.2	7,997.3
2017	8,241.0	0.0	-688.0	9.2	7.7	0.6	7,570.5
						Three-Year Average:	**7,787.2**
						Benchmark Rate:	**7.75%**
						2018 Benchmark Target:	**603.5**

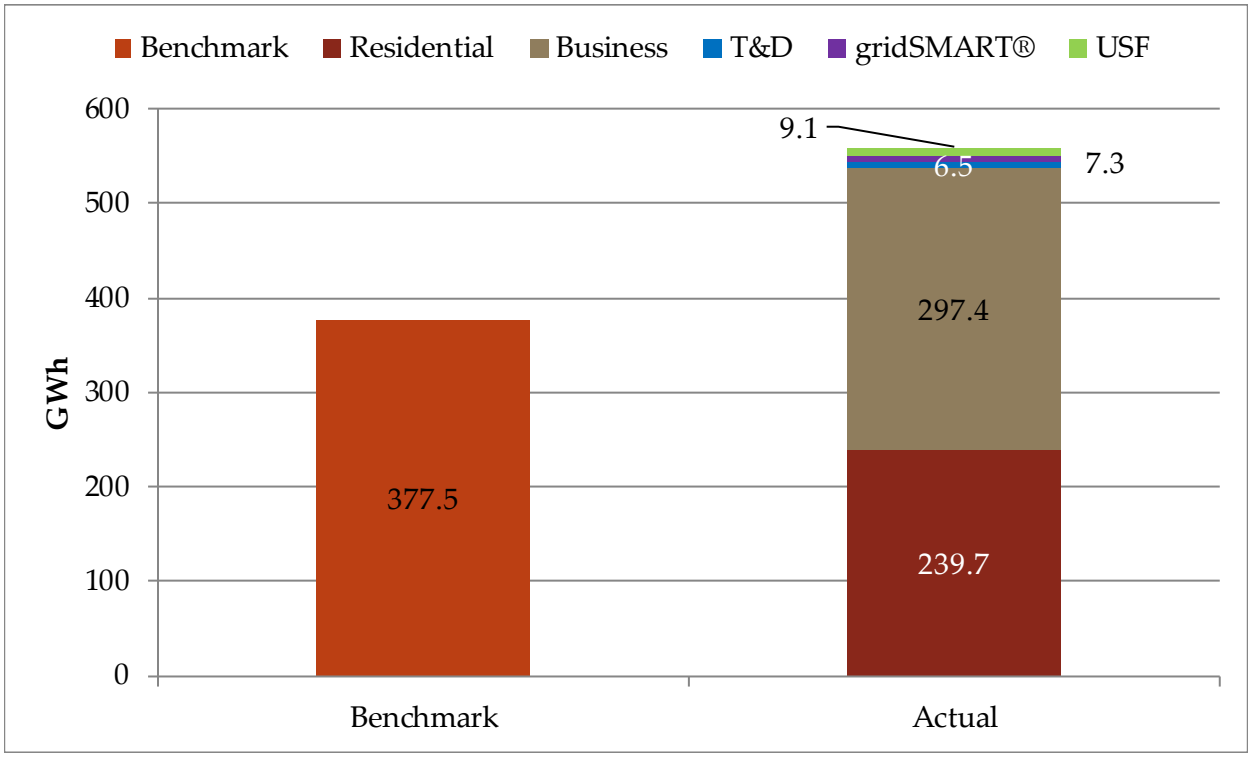
All figures are in MW - Docket 19-501-EL-FOR.

ACHIEVED SAVINGS

The Company has met all its EE/PDR benchmarks for both energy and demand savings for 2018, with all of Ohio Power's EE/PDR programs saving a combined 537.1 GWh of energy.

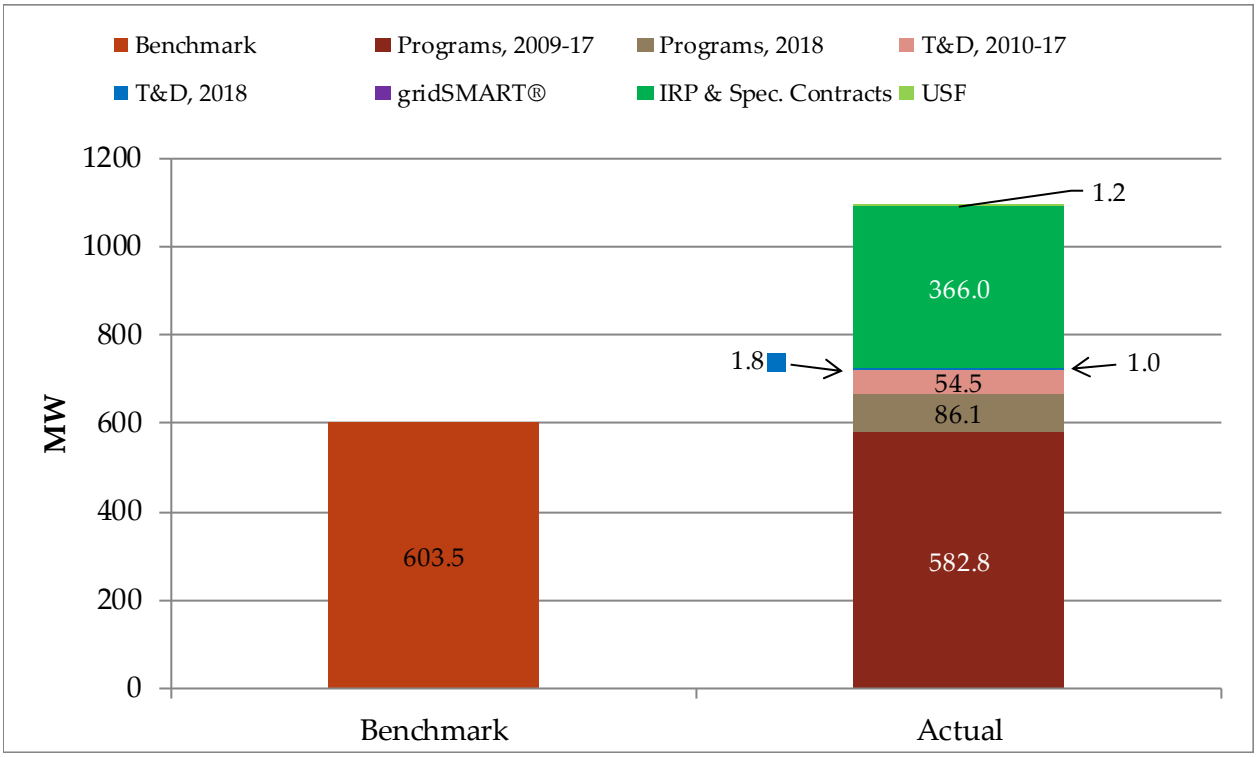
AEP Ohio is also permitted to add savings resulting from transmission and distribution (T&D) projects that reduce losses (see pages 35-36). In 2018, the Company saved 6.5 GWh of energy from T&D projects. AEP Ohio is also allowed to claim savings from the Universal Service Fund established by section 4928.51 of the Revised Code that benefits low-income customers, these savings are 9.1 GWh. Additionally, 2018 savings from Home Energy Reports for gridSMART® Phase I/II customers totaled 7.3 GWh. Together this yielded a grand total of 560.0 GWh, well above the benchmark target. Figure 3 illustrates the breakout of these savings between residential programs, business programs, T&D improvements, the Universal Service Fund, and gridSMART®. The majority of energy savings in 2018 came from business programs (53.1 percent). Residential programs, T&D projects, gridSMART®, and Universal Service Fund accounted for 42.8 percent, 1.2 percent, 1.3 percent, and 1.6 percent of the total, respectively.

FIGURE 3: ACHIEVED ANNUAL ENERGY SAVINGS, BY SEGMENT, 2018



The Company's portfolio yielded 86.1 MW in permanent peak demand reductions in 2018, shown in Figure 4. The cumulative permanent peak demand reduction impact of programs from 2009 through 2017 was 582.8 MW. Combined with other sources of demand reduction, including past year T&D projects (54.5 MW), current year T&D projects (1.8 MW), special contracts and interruptible tariffs (366.0 MW), the Universal Service Fund (1.2 MW), and gridSMART® Phase I/II (1.0 MW) AEP Ohio reduced peak demand by 1093.2 MW in total.

FIGURE 4: ACHIEVED PEAK DEMAND SAVINGS, BY SOURCE, 2018



COST EFFECTIVENESS

The Company's portfolio of EE/PDR programs has been cost-effective. There are four common tests to determine cost effectiveness, differing in which costs and benefits are included and for whom:

- **Participant Test (PCT):** Participation is cost effective from this perspective if the reduced electric costs to the participating customer from the measure exceed the after-incentive cost of the measure to the customer.
- **Utility Cost Test (UCT):** Programs are cost effective from this perspective if the costs avoided by the program's energy and demand savings are greater than the utility's EE/PDR program costs to promote the program, including customer incentives.
- **Ratepayer Impact Measure (RIM) Test:** Programs are cost effective from this perspective if their avoided costs are greater than the sum of the EE/PDR program costs and the "lost revenues" caused by the program.
- **Total Resource Cost (TRC) Test:** Programs are cost effective from this perspective if their avoided costs are greater than the sum of the measures cost and the EE/PDR program administrative costs.

Figure 5 shows benefit-cost ratios for each of the cost effectiveness tests listed above. These ratios are based on *ex ante* savings. A ratio higher than one indicates that net benefits are greater

than net costs, and the portfolio is beneficial by the test's standards. Also included is the TRC levelized cost of energy.

FIGURE 5: PORTFOLIO EX ANTE BENEFIT-COST RATIOS AND TRC LEVELIZED COST, 2018

Test	Ratio or Cost
Total Resource Cost	2.3
Participant Cost	3.4
Ratepayer Impact	0.7
Utility Cost	5.6
TRC Levelized Cost per kWh (¢)	3.2

Total resource cost ratios and levelized energy costs for each individual program are shown in Figure 6. Again, a ratio greater than one indicates that the program's benefits exceed its costs. Note that the ratios presented in this table are based on *ex ante* savings and may differ from the *ex post* figures contained in Appendices B through P.

FIGURE 6: TOTAL RESOURCE COST RATIOS AND LEVELIZED COSTS, 2018

Program	Benefit-Cost Ratio	Levelized Cost per kWh (¢)
Efficient Products	5.6	1.4
Appliance Recycling	3.3	2.0
e^3 *smart*^{SM}	2.4	3.0
Community Assistance	0.6	13.4
EfficiencyCrafted^{SM} New Homes	1.9	6.8
Manu. New Homes	0.8	13.1
Home Energy Reports	2.8	1.5
It's Your Power	0.0	297.0
Efficient Products for Bus.	1.6	4.7
Process Efficiency	1.3	5.6
Self Direct	1.5	4.3
Business New Construction	1.7	4.3
Express	1.8	4.0
Data Center	1.5	4.7
Continuous Energy Improvement	1.5	3.1
Combined Heat and Power	2.5	2.9

Banking of Energy Efficiency Achievements

In accordance with Senate Bill 310 Section 4928.662(G)[5], AEP Ohio presents its banking methodology. The Company reserves the right to bank all achievements exceeding the benchmark. At a minimum for 2018, Ohio Power is banking all achievement in excess of 115 percent of benchmark, shown in Figure 7.

FIGURE 7: BANKING OF ENERGY EFFICIENCY ACHIEVEMENTS

Year	GWh
2009	141.9
2010	103.3
2011	148.7
2012	252.6
2013	186.5
2014	182.2
2015	72.7
2016	152.2
2017	125.7
2018	125.9
Total	**1,491.8**

Summary

In 2018, Ohio Power Company met its benchmark targets for both energy usage and peak demand. The Company's EE/PDR portfolio as a whole was cost-effective.

[5] http://codes.ohio.gov/orc/4928.662

PROGRAM ACTIVITY DESCRIPTIONS

This section of the report discusses program activity from January 1 through December 31, 2018. AEP Ohio operated sixteen programs this year, not counting T&D improvements:

Residential Programs:

- Efficient Products
- Appliance Recycling
- *e³smart*SM
- Intelligent Home & DR
- Community Assistance
- EfficiencyCrafted℠ New Homes
- New Energy Efficient Manufactured Home
- Home Energy Reports

Business Programs:

- Efficient Products for Business
- Process Efficiency
- Self Direct
- Business New Construction
- Express
- Continuous Energy Improvement
- Data Center
- Combined Heat & Power

Figure 8 summarizes each program's direct and allocated department costs to AEP Ohio; the number of participants or units sold; and ex ante energy and demand savings. Descriptions of each program follow Figure 8. Not all figures seen below may sum due to rounding.

FIGURE 8: SUMMARY OF DIRECT PROGRAM COSTS AND BENEFITS, 2018

Program	Customer Incentives	Third Party Costs	Utility Admin. Costs*	Total Costs	Number of Participants / Units	Coincident Peak MW Saved	Annual GWh Saved
Efficient Products	$7,171.4	$3,422.4	$1,114.3	$11,708.1	3,052,732	20.3	110.4
Appliance Recycling	1,581.3	1,239.0	328.0	3,148.3	18,810	4.1	25.5
$e^3 smart$ SM	532.9	287.7	81.8	902.4	25,094	0.5	3.3
Intelligent Home & DR	122.4	1,319.0	841.5	2,282.8	35,440	1.4	0.8
Community Assistance	4,399.4	876.2	479.9	5,755.6	4,927	0.7	4.6
Residential New Homes	1,231.7	977.9	253.2	2,462.8	2,011	3.0	6.3
Manu. New Homes	73.4	200.7	60.0	334.0	58	0.2	0.4
Home Energy Reports	0.0	1,236.3	133.9	1,370.2	531,283	11.5	88.6
Efficient Products for Bus.	8,918.7	3,073.0	2,303.1	14,294.9	2,070	24.7	143.1
Process Efficiency	428.9	558.3	322.0	1,309.2	37	1.2	8.2
Self Direct	99.6	160.8	97.4	357.8	23	0.6	3.7
Bus. New Construction	2,481.8	924.3	782.5	4,188.6	174	5.3	31.5
Express	3,521.4	0.0	561.1	4,082.5	861	2.4	17.2
Retro-Commissioning	0.0	7.5	0.0	7.5	0	0.0	0.0
Data Center	1,550.9	609.3	333.2	2,493.4	15	4.2	36.1
Demand Response	0.0	0.0	0.0	0.0	0	0.0	0.0
CEI	362.0	1,225.4	264.3	1,851.7	57	1.3	17.0
Combined Heat & Power	2,244.0	0.0	153.3	2,397.3	2	4.6	40.7
Total	**$34,719.6**	**$16,117.9**	**$8,109.7**	**$58,947.2**	**3,673,594**	**86.1**	**537.1**

Education and Media	3,529.5
Pilot Programs, Research & Development	2,670.7
Grand Total	**$65,147.4**

*Programs' utility administrative costs include allocated departmental, evaluation, and capital carrying charge costs.
All cost figures are in thousands of dollars. Columns may not sum due to rounding.

RESIDENTIAL PROGRAMS

EFFICIENT PRODUCTS

This program provides incentives and marketing support through retailers to encourage purchases of ENERGY STAR®-approved lighting and appliances. The Efficient Products program contains multiple savings paths: The first is customer rebates at the point of sale. Over 200 participating retailers in the Company's service territory are equipped to offer instant rebates on certain ENERGY STAR®-approved lighting devices. Other retailers without the capability to offer electronic markdowns may also offer retailer-reimbursed rebates on these same approved lighting products. These products include various Light Emitting Diode (LED)

bulbs. In addition, the program offers customers the opportunity to mail-in rebate applications for refrigerators, smart thermostats, pool pumps, clothes washers, dehumidifiers, HVAC replacements, and heat pump water heaters. These applications are available from the retailer, on the AEP Ohio website, or the AEP Ohio Marketplace. These rebates and incentives range from approximately one dollar each for 7-watt LEDs to $500 for heat pump water heaters.

As available technologies and ENERGY STAR® standards continue to evolve over time, AEP Ohio maintains and regularly updates the list of qualifying devices.

In addition, AEP Ohio offers marketing support to retailers. These services include in-store signage to promote efficient devices and training for sales associates to help them understand the benefits of energy-efficient lights and appliances.

In the 2017-2020 plan approved stipulation, AEP Ohio has combined the In Home program with the Efficient Products program. AEP Ohio offers the *Online Energy Checkups*, a free online tool available on AEP Ohio's website that customers may use to quickly identify their home energy costs, receive recommendations on how to save energy, and learn how to qualify for a kit of free energy-saving items. AEP Ohio provided 6,891 kits to Energy Checkup participants in 2018. Another option that is cost shared with Columbia Gas is the *In-Home Energy Assessments* for customers with dual fuel. This offering includes an in-home visit, visual inspection, prioritized suggestions for efficiency improvements, and installation of several energy-saving devices such as LEDs, programmable thermostats, or low-flow showerheads, at a subsidized price. In 2018, 1,712 customers had In-Home Assessments.

Additionally, program implementers work with property managers in multi-family housing complexes to schedule home assessments and installations with residents, as well as to identify potential savings in common areas. All individually metered residential multi-family housing in AEP Ohio's service territory is eligible to participate. This part of the program receives some marketing assistance from property manager associations around the state. In 2018, 50 properties had assessments.

Figure 9 below shows the number of products for which AEP Ohio provided incentives or distributed at no cost in 2018. Please see Appendix A for a detailed measure listing.

FIGURE 9: EFFICIENT PRODUCTS INCENTED OR PROVIDED, 2018

Product	Number	kWh	kW
Lighting	3,015,464	103,440,436	18,380.7
Appliances	6,675	1,142,206	204.8
HVAC	2,528	1,004,224	566.7
Hot Water	18,795	1,679,214	217.6
Smart Strips	4,303	443,497	39.7
Thermostats	4,615	2,250,523	314.4
Pool Pumps	352	411,840	609.0
Total	**3,052,732**	**110,371,941**	**20,332.8**

Energy and demand savings were calculated using the Draft Ohio Technical Resource Manual (TRM)[8] when calculations were presented. The Draft Ohio TRM does not provide energy savings for smart thermostats. The calculations for smart thermostats are taken from the Illinois TRM, page 152[9].

The Company's Action Plan goals for 2018 were 69.4 GWh of savings in energy consumption and 7.6 MW of savings from peak demand. Figure 10 below shows the Efficient Products program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 10: EFFICIENT PRODUCTS PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	110.4	69.4	159.0%
Demand Savings (MW)	20.3	7.6	267.5%
Program Costs ($M)	11.7	13.5	86.7%
First Year Cost per kWh Saved (¢)	10.6	19.5	54.5%

The Efficient Products program exceeded its goals for both energy and demand savings in 2018. The program saved 110.4 GWh of energy, 59.0 percent more than what was planned. The program also reduced peak demand by 20.3 MW, 167.5 percent more than planned. The

[8] In the Matter of the Protocols for the Measurement and Verification of Energy Efficiency and Peak Demand Reduction Measures, Case No. 09-512-GE-UNC, August 6, 2010.

[9] http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final/IL-TRM_Effective_060116_v5.0_Vol_3_Res_021116_Final.pdf

program came in below budget at $11.7 million, yielding an average first year cost of 10.6 cents per kWh saved.

Appliance Recycling

This program seeks to remove functioning but inefficient refrigerators and freezers from the power grid. Often, older appliances, especially refrigerators, remain in use as second or "backup" appliances—still plugged in and using an inordinate amount of energy. By removing these high-usage appliances from the grid, the Company reduces unnecessary load and usage. This program's primary focus is on these second refrigerators, but recycling for stand-alone freezers is also available. In return for recycling appliances, AEP Ohio paid the customer an incentive of $50 in 2018. In the second quarter of 2018, appliance replacement for the Community Assistance Program has been included into the Appliance Recycling Program. With this economy of scale, AEP Ohio was able to procure a low cost source with all products from a large Ohio manufacturer. This scale also gave AEP the ability to extend the warranty provided for the measures to three years.

Customers enroll in the program either through the Company's website or over the phone, and schedule an at-home pickup. Figure 11 shows the number of appliances that were recycled through this program in 2018. Energy and demand savings were calculated using the Draft Ohio TRM. Please see Appendix A for a detailed measure listing.

FIGURE 11: APPLIANCES RECYCLED, 2018

Appliances	Number	kWh	kW
Freezers	3,266	4,064,210	653.2
Refrigerators	15,544	21,390,876	3,419.7
Total	**18,810**	**25,455,086**	**4,072.9**

The Company's Action Plan goals for 2018 were 11.9 GWh of savings in energy consumption and 1.8 MW of savings from peak demand. Figure 12 shows the Appliance Recycling program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 12: APPLIANCE RECYCLING PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	25.5	11.9	213.9%
Demand Savings (MW)	4.1	1.8	226.3%
Program Costs ($M)	3.1	2.7	116.6%
First Year Cost per kWh Saved (¢)	12.4	22.7	54.5%

The Appliance Recycling program exceeded its goals for energy and demand savings for 2018. The program saved 25.5 GWh of energy, 113.9 percent above target. The program also reduced peak demand by 4.1 MW, 126.3 percent above goal. The program spent more than budgeted at $3.1 million, yielding an average first year cost of 12.4 cents per kWh saved.

*e³smart*SM

AEP Ohio offers an educational program covering energy efficiency for students in grades 4 through 12, which are in schools throughout the Company's service territory. It includes a curriculum designed to meet state and national science standards for these grades, teacher training, and supplies for classroom instruction. Students served by the program will learn about different forms of energy, their sources, and how electric power reaches their homes. Students are then given a box of energy-efficient devices—Light Emitting Diode (LED) bulbs, LED night lights, low-flow showerheads, faucet aerators, and weather-stripping—to install at home with their parents' or guardians' supervision. Kits also include tools students can use to measure energy use and efficiency losses.

In the 2017-2018 school year, there were 25,094 kits distributed to students in *e³smart*SM. (Of these, 20,624 students returned surveys.) Figure 13 shows how many of which items were included in their kits. Please see Appendix A for a detailed measure listing.

FIGURE 13: ITEMS INCLUDED IN *e³smart*SM KITS, 2018

Item	Number	kWh	kW
Faucet Aerators	6,382	479,848	59.9
Hot Water Temp. Setback	602	49,123	5.4
Lighting	40,810	1,247,658	198.0
Low-Flow Showerheads	3,946	1,105,906	141.5
Weather-Stripping	8,319	92,341	6.6
Allocated Kits*	4,470	303,889	42.2
Total	**64,529**	**3,278,765**	**453.6**

*These are kits for participants who had not returned surveys; AEP Ohio reduced the installation rates of these cases.

Energy and demand savings were calculated using the Draft Ohio TRM when calculations were available. The Draft Ohio TRM does not include calculations for LED nightlights or weather-stripping.

The calculation for LED nightlights is taken from the 2012 Portfolio Status Report, Navigant Program Evaluation ("2012 Navigant Evaluation").[10]

The formula for weather-stripping is shown below, where ΔE is energy savings in kWh; x_1 is maximum energy savings potential from weatherization measures; y_1 is average annual energy usage in all-electric residences; y_2 is average annual energy usage in non-all-electric residences; e is the percentage of homes that are all-electric; L_{shell} is the fraction of air leaks through windows, doors, ceilings, walls, and floors; L_{HT} is the fraction of total heat transfer due to air leaks; Q is total inches of weather-stripping applied; L_{wid} is the average width of the leakage area in inches; and L_{area} is the average leakage area per house in inches.

$$\Delta E = x_1 \times \Big((y_1 \times e) + \big(y_2 \times (1 - e)\big)\Big) \times L_{\text{shell}} \times L_{\text{HT}} \times \frac{Q \times L_{\text{wid}}}{L_{\text{area}}}$$

AEP Ohio's Action Plan goals for 2018 were 6.8 GWh of savings in energy consumption and 0.5 MW of savings from peak demand. Figure 14 below shows the *e³smart*SM program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 14: *e³smart*SM PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	3.3	6.8	48.2%
Demand Savings (MW)	0.5	0.5	90.7%
Program Costs ($M)	0.9	1.2	75.2%
First Year Cost per kWh Saved (¢)	27.5	17.6	156.0%

The *e³smart*SM program did not meet either its energy or demand goals for 2018. The program saved 3.3 GWh of energy, 51.8 percent below goal. The program also reduced peak demand by 0.5 MW, 9.3 percent below goal. The program came in slightly under budget at $0.9 million, yielding an average first year cost of 27.5 cents per kWh saved.

INTELLIGENT HOME & DR

AEP Ohio launched its Intelligent Home and DR program titled "It's Your Power" in 2018. This program offers a mobile smartphone app that customers may download for information to illustrate electricity consumption patterns, how their decisions and actions influence their usage, how that usage affects their energy bill, and actions they may take to manage and reduce their usage. Specifically targeting AMI customers, this app features includes a weather overlay,

[10] *In the Matter of the Annual Portfolio Status Report Under Rule 4901:1-39-05(C), Ohio Administrative Code, by Ohio Power Company*, Case No. 13-1182-EL-EEC, May 15, 2013, Appendix E, page 22.

estimated billing based on usage, energy project and tip tracking. In addition, AEP Ohio offers a smart hub (Energy Bridge) that can communicate with the AMI meter and with the app to give customers near real-time, highly granular usage information, and through which customers may control various smart devices.

Coupled with the AEP Ohio "It's Your Power" app this offers customers control of electric space cooling and heating load using a thermostat with two-way communication capabilities. Load control is achieved through temperature set point adjustments on individual thermostats for both cooling and heating loads and/or through cycling of compressors. The app will enable customers to change heating and cooling settings remotely. AEP Ohio had an adoption of 23,471 AMI customers download the mobile app. From this participant segment, 9,816 customers have bound an energy bridge. In 2018, it was negatively affecting customer experience when choosing to receive an energy bridge, but could not due to being selected for the control group. For this reason, AEP Ohio has moved off the randomized encouraged design (RED) as its control group. Due to the timing of the change, savings were analyzed using the RED group. AEP Ohio's analysis could only show statistically valid savings for Thermostats. Figure 15 shows the number of measures utilized for the program. Please see Appendix A for a detailed measure listing.

FIGURE 15: MEASURES INSTALLED THROUGH THE INTELLIGENT HOME, 2018

Item	Number	kWh	kW
Energy Bridge	9,816	0.0	0.0
AMI Mobile App	23,471	0.0	0.0
Connected Thermostat	2,153	768,688	1,419.6
Total	**35,440**	**768,688**	**1,419.6**

With a paired energy bridge, a customer is then eligible for a communicating thermostat, this allows for additional control and functionality for the It's Your Power program. This engagement resulted in 2,153 customers installed a communicating thermostat. The

FIGURE 16: INTELLIGENT HOME PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	0.8	24.1	3.2%
Demand Savings (MW)	1.4	50.0	2.8%
Program Costs ($M)	2.3	6.9	33.1%
First Year Cost per kWh Saved (¢)	297.0	28.6	1037.3%

The It's Your Power program did not meet its energy or demand savings goals, in 2018. The program saved 0.8 GWh of energy and reduced peak demand by 1.4 MW. The program came in under budget at $2.3 million, yielding an average first year cost of 297.0 cents per kWh saved. Unlike other residential programs, this program only has a one-year measure life.

Community Assistance

This program offers energy efficiency services to those AEP Ohio customers with limited income to assist them in reducing their electric energy use and making their utility bills more manageable. Residential customers with incomes up to 200 percent of the federal poverty level are eligible to participate.[11] The program offers services such as home assessments, efficient lighting, appliance replacement, HVAC replacement, water heating upgrades, health and safety repairs, and weatherization; at no cost to the customer. For 2018, the appliance replacement portion of the CAP program is running through one single implementer. With this economy of scale, AEP is able to provide: Lower pricing, a better quality product sourced from an Ohio manufacturer, and a 3 year warranty. The appliance recycling implementer does the recycling portion; this gives certainty that the appliance was recycled in an environmentally friendly manner.

In 2018, there were 4,927 jobs completed in the Community Assistance program. Figure 17 below shows which measures were installed. Please see Appendix A for a detailed measure listing.

FIGURE 17: MEASURES INSTALLED THROUGH COMMUNITY ASSISTANCE PROGRAM, 2018

Item	Number	kWh	kW
Appliance Retirement	1	1,244	0.2
Fridges & Freezers	3,889	1,776,109	286.6
Audits	5,333	0	0.0
HVAC	2,069	26,587	3.9
Hot Water	2,176	174,618	19.2
Lighting	52,165	1,988,082	341.9
Other	67	3,145	0.7
Smart Strips	3,668	300,448	0.0
Air Sealing & Insulation	225,260	290,250	8.1
Total	**294,628**	**4,560,483**	**660.7**

[11] In 2018, this came to roughly $50,200 per year for a family of four. See U.S. Department of Health and Human Services, "2018 Poverty Guidelines," https://aspe.hhs.gov/2018-poverty-guidelines.

Energy and demand savings were calculated using the Draft Ohio TRM when calculations were available. The savings for replaced fridges and freezers is the assumed savings for the new unit when compared to baseline. This differs slightly from the TRM, and occurred when the program design change for appliance replacement was integrated with the Appliance Recycling program.

Ohio Power's Action Plan goals for 2018 were 8.5 GWh of savings in energy consumption and 0.8 MW of savings from peak demand. Figure 18 below shows the Community Assistance program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 18: COMMUNITY ASSISTANCE PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	4.6	8.5	53.7%
Demand Savings (MW)	0.7	0.8	82.6%
Program Costs ($M)	5.8	5.1	112.9%
First Year Cost per kWh Saved (¢)	126.2	60.0	210.3%

The Community Assistance program did not meet its energy or demand savings goals. The program saved 4.6 GWh of energy and reduced peak demand by 0.7 MW. The program came in over budget at $5.8 million, yielding an average first year cost of 126.2 cents per kWh saved.

EFFICIENCYCRAFTED℠ NEW HOMES

EfficiencyCrafted℠ New Homes (formerly known as ENERGY STAR® New Homes) seeks to effect the construction of single-family residences that meet specific ENERGY STAR® or EnergyPath℠ standards. Such structures can use up to 50 percent less energy than residences built to the minimum code requirements. AEP Ohio will pay various incentives to participating builders of single-family residences to help offset incremental construction costs. In addition, builders receive training, marketing, and financial support, including site signage, consumer brochures, model home displays, advertising, and other consumer education tools. All new single-family residential construction that meets standards is eligible. In 2018, this program incented the construction of 2,011 efficient single-family homes. Energy and demand savings were calculated as the difference between a baseline residence constructed at the applicable code and the as-built *REM/Rate* model. *REM/Rate* is software that analyzes energy usage in residential buildings.

The Company's Action Plan goals for 2018 were 4.8 GWh of savings in energy consumption and 1.0 MW of savings from peak demand. Figure 19 below shows the program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 19: EFFICIENCYCRAFTED℠ NEW HOMES PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	6.3	4.8	130.9%
Demand Savings (MW)	3.0	1.0	301.1%
Program Costs ($M)	2.5	2.3	107.1%
First Year Cost per kWh Saved (¢)	39.2	47.9	81.8%

The EfficiencyCrafted℠ New Homes program exceeded both its energy and demand savings goals in 2018. The program saved 6.3 GWh of energy. The program also reduced peak demand by 3.0 MW, over triple the annual goal. The program came in over budget at $2.5 million, yielding an average first year cost of 39.2 cents per kWh saved.

NEW ENERGY EFFICIENT MANUFACTURED HOME

The New Energy Efficient Manufactured Home Program will improve the energy performance of manufactured homes. AEP Ohio initially offered incentives to manufacturers to outfit new manufactured homes at the plant with high efficiency equipment, appliances, lighting and electronics for homes to be sited in AEP Ohio service territory. AEP Ohio utilizes the retail channel of manufactured homes by giving an incentive for the more efficient manufactured homes. In addition, since the HVAC unit is installed after the manufactured home has been delivered, HVAC dealers/contractors were incentivized to supply the home with an efficient heat pump instead of an electric furnace.

This program incented the construction of 58 efficient manufactured homes in 2018. Energy and demand savings were calculated as the difference between a baseline residence constructed at the applicable code and the as-built *REM/Rate* model. *REM/Rate* is software that analyzes energy usage in residential buildings.

AEP Ohio's Action Plan goals for 2018 were 2.5 GWh of savings in energy consumption and 0.01 MW of savings from peak demand. Figure 20 below shows the New Energy Efficient Manufactured Home program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 20: NEW ENERGY EFFICIENT MANUFACTURED HOME, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	0.4	2.5	15.9%
Demand Savings (MW)	0.2	0.1	153.1%
Program Costs ($M)	0.3	0.8	41.8%
First Year Cost per kWh Saved (¢)	83.8	32.0	261.9%

The New Energy Efficient Manufactured Home program did not meet energy savings goals, but exceeded the demand savings goals. With the program beginning to see traction with distributors and HVAC contractors, the program saved 0.4 GWh of energy, 84.1 percent below target. The program also reduced peak demand by 0.2 MW, this amount was 53.1 percent above the goal. The program came in below budget at $.3 million, yielding an average first year cost of 83.8 cents per kWh saved.

HOME ENERGY REPORTS

This program targets high-usage and/or low-income customers in the Company's service territory to receive a comparison mailing of how occupied homes of similar size and heating source use electricity. This is designed to spur these selected customers to save energy and use electricity more efficiently. Customers who wish to opt out of receiving these reports may call a toll-free number to do so. In 2018 there were 531,283 customers receiving reports.

Savings calculations for this program begin with the vendor using a proprietary model. Each year, AEP Ohio analysts compare participation in other residential EE/PDR programs between these two groups to determine whether savings in these other programs are being double-counted. This year, a significant difference was found, indicating report recipients participated in other programs at higher levels than the control group. Savings in both energy and demand were therefore adjusted downward by 504,103 kWh and 65.5 kW, respectively. AEP Ohio will continue to run cross participation tests to validate and remove double counted savings.

AEP Ohio's Action Plan goals for 2018 were 75.0 GWh of savings in energy consumption and 3.8 MW of savings from peak demand. Figure 21 below shows the Home Energy Report program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 21: HOME ENERGY REPORTS PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	88.6	75.0	118.1%
Demand Savings (MW)	11.5	3.8	303.0%
Program Costs ($M)	1.4	1.5	91.3%
First Year Cost per kWh Saved (¢)	1.5	2.0	77.3%

The Home Energy Report program exceeded both its energy and demand savings goals for 2018. The program saved 88.6 GWh of energy, 18.1 percent above goal. The program also reduced peak demand by 11.5 MW, 203.0 percent above goal. The program came in under budget at $1.4 million, yielding an average first year cost of 1.5 cents per kWh saved; however, unlike other residential programs, this program only has a one-year measure life.

BUSINESS PROGRAMS

EFFICIENT PRODUCTS FOR BUSINESS

This program offers fixed incentives for the installation and implementation of certain pre-approved types of energy efficient lighting; heating, ventilation, and air conditioning (HVAC) systems; variable frequency drives (VFDs); motors; controls; refrigeration equipment; and compressed air systems, among other commercial- and industrial-grade equipment. Incentive amounts offered to customers typically range between 10 and 50 percent of the incremental cost to purchase energy-efficient equipment. All non-residential customers in AEP Ohio's service territory are eligible to participate.

In 2018, there were 2,070 projects completed in the Efficient Products for Business program. Figure 22 shows which measures were installed through these projects. A single project may involve multiple measures. Please see Appendix A for a detailed measure listing.

FIGURE 22: MEASURES INSTALLED THROUGH THE EFFICIENT PRODUCTS FOR BUSINESS, 2018

Type	Number	kWh	kW
Agriculture	89	186,186	45.6
Compressed Air	7,347	2,269,048	311.4
Comm. Kitchen	28	99,808	9.0
HVAC	1,885,397	6,081,777	1,364.0
Controls	1,536,929	1,630,768	356.5
Advanced Lighting	1,204,805	7,659,063	837.7
Lighting	439,345	119,396,253	20,890.8
Other	60,667	173,809	74.9
Process/Motors	104	2,270,161	290.9
Refrigeration	7,672	3,339,281	503.2
Total	**5,142,382**	**143,106,154**	**24,683.8**

Energy and demand savings for prescriptive measures were calculated using the vendor-internal TRM that is filed with the Commission annually.

The Company's Action Plan goals for 2018 were 105.3 GWh of savings in energy consumption and 27.9 MW of savings from peak demand. Figure 23 shows the Efficient Products for Business program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 23: EFFICIENT PRODUCTS FOR BUSINESS PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	143.1	105.3	135.8%
Demand Savings (MW)	24.7	27.9	88.5%
Program Costs ($M)	14.3	14.2	101.0%
First Year Cost per kWh Saved (¢)	10.0	13.4	74.4%

The Efficient Products for Business program met its energy goals, but did not meet its demand goals for 2018. The program saved 143.1 GWh of energy, 35.8 percent above goal. The program also reduced peak demand by 24.7 MW, 11.5 percent below goal. The program came in above budget at $14.3 million, yielding an average first year cost of 10.0 cents per kWh saved.

PROCESS EFFICIENCY

This program is for cost-effective energy efficiency improvements in existing buildings that reduce energy consumption or peak demand and have more complicated measures that are not

included in the Efficient Products for Business program. All non-residential customers in the Company's service territory are eligible to participate. Customers work closely with their Ohio Power account managers and other employees to determine measure eligibility and verify energy savings. Customers receive an incentive customized to the specific results of the energy savings technologies implemented. Program management will assist commercial and industrial customers with the analysis and selection of high-efficiency equipment or processes.

There were 37 Process Efficiency projects completed in 2018. Figure 24 summarizes the measures installed in these projects. A single project may involve multiple measures. Please see Appendix A for a detailed measure listing.

FIGURE 24: MEASURES INSTALLED THROUGH THE PROCESS EFFICIENCY PROGRAM, 2018

Type	Number	kWh	kW
Compressed Air	894	3,596,248	536.1
HVAC	6	1,219,424	237.7
Lighting	1	24,895	2.4
Misc. Motors	1	389,269	27.4
Process	5	2,359,613	255.9
Refrigeration	518	607,741	97.9
Total	**1,425**	**8,197,190**	**1,157.5**

Energy and demand savings in the Process Efficiency program were individually computed for each measure in each project using methodologies consistent with the Draft Ohio TRM.

The Company's Action Plan goals for 2018 were 41.9 GWh of savings in energy consumption and 6.8 MW of savings from peak demand. Figure 25 below shows the Process Efficiency program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 25: PROCESS EFFICIENCY PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	8.2	41.9	19.6%
Demand Savings (MW)	1.2	6.8	17.0%
Program Costs ($M)	1.3	3.0	43.1%
First Year Cost per kWh Saved (¢)	16.0	7.3	220.1%

The Process Efficiency program missed both its energy and demand savings goals for 2018. The program saved 8.2 GWh of energy, 80.4 percent below goal. The program also reduced peak

demand by 1.2 MW, 83 percent below goal. The program came in below budget in 2018 at $1.3 million, yielding an average first year cost of 16 cents per kWh saved.

Self Direct

This program is designed for large customers able to internally administer their own energy management initiatives. Participants design their own energy efficiency programs and submit an application documenting their energy savings. Customers may apply for inclusion in the Self Direct program up to three years after implementing their energy efficiency measures. All applications are subject to approval by both Ohio Power and the Commission. If approved, participants may either receive a one-time payment, up to 75 percent of an equivalent incentive under the Efficient Products for Business or Process Efficiency programs, or an equivalent EE/PDR rider exemption. (The accounts may not participate in any other EE/PDR programs while under such an exemption.)

Participation in this program is limited to mercantile customers. In 2018, Ohio Power submitted 23 Self Direct applications to the Commission. Figure 26 below shows which measures were installed under these projects. A single project may involve multiple measures. For a detailed measure listing, see Appendix A.

FIGURE 26: MEASURES INCENTED THROUGH SELF DIRECT PROGRAM, 2018

Type	Number	kWh	kW
Comm. Kitchen	2	23,004	2.1
HVAC	12	78,768	22.1
Controls	1,408	1,215	0.0
Lighting	224,197	3,268,242	547.3
Misc. Motors & Process	1	285,947	47.7
Total	**225,620**	**3,657,175**	**619.2**

Energy and demand savings in the Self-Direct program are calculated using the same methods employed in the Efficient Products for Business and Process Efficiency programs.

AEP Ohio's Action Plan goals for 2018 were 13.3 GWh of savings in energy consumption and 1.9 MW of savings from peak demand. Figure 27 below shows the Self Direct program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 27: SELF DIRECT PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	3.7	13.3	27.5%
Demand Savings (MW)	0.6	1.9	32.6%
Program Costs ($M)	0.4	0.9	41.1%
First Year Cost per kWh Saved (¢)	9.8	6.5	149.6%

The Self Direct program did not meet either its energy or demand savings goals in 2018. The program saved 3.7 GWh of energy, 72.5 percent below goal. The program also reduced peak demand by 0.6 MW, which is 67.4 percent below the target level. The program came in at budget at $0.4 million, yielding an average first year cost of 9.8 cents per kWh saved.

BUSINESS NEW CONSTRUCTION

This program targets non-residential customers who are either building new facilities or making major renovations to existing sites, encouraging building owners, designers, and architects to exceed requirements in current construction practices and codes—specifically, measures that exceed the ASHRAE 90.1-2010 minimum requirements. Because of the lag time associated with new construction, any project certified before the ASHRAE 90.1 2010 code adoption is required to exceed the former ASHRAE 90.1 2007 requirements. The program includes incentives for the installation of high-efficiency lighting, HVAC systems, building envelopes, industrial refrigeration equipment, and other equipment and controls. The New Construction program offers four tracks: prescriptive and custom, similar to what is offered in those respective programs, a "whole building" approach based on building simulation modeling, and a "My Solutions" track that is based on a prescriptive model for smaller new construction customers. All non-residential customers building new facilities are eligible to participate.

There were 174 New Construction projects completed in 2018. Figure 28 below shows which measures were installed under these construction projects. A single project may involve multiple measures. A detailed measure list is available in Appendix A.

FIGURE 28: MEASURES INSTALLED THROUGH BUSINESS NEW CONSTRUCTION PROGRAM, 2018

Type	Number	kWh	kW
Agriculture	149	292,243	71.9
Compressed Air	5	17,406	2.1
Comm. Kitchen	35	52,399	6.1
HVAC	1,041	1,996,253	672.7
Controls	159,167	331,031	79.1
Lighting	3,278,864	16,185,794	2,383.2
Other	60,830	2,339,155	247.4
Whole Building Models	17	9,221,649	1,734.0
Prescriptive Model	99,729	268,613	45.0
Refrigeration	507	695,542	88.4
Shell Upgrades	158,181	75,360	5.7
Total	**3,758,524**	**31,475,445**	**5,335.6**

Energy and demand savings were calculated using the same methods as employed in the Efficient Products for Business and Process Efficiency programs, the ENERGY STAR® website, or with simulation calculations in projects using whole building models.

The Company's Action Plan goals for 2018 were 28.2 GWh of savings in energy consumption and 6.3 MW of savings from peak demand. Figure 29 below shows the New Construction program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 29: BUSINESS NEW CONSTRUCTION PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	31.5	28.2	111.6%
Demand Savings (MW)	5.3	6.3	84.7%
Program Costs ($M)	4.2	4.3	97.9%
First Year Cost per kWh Saved (¢)	13.3	15.2	87.7%

The Business New Construction program exceeded its energy goal but did not meet its demand goal for 2018. The program saved 31.5 GWh of energy, 11.6 percent over goal. The program reduced peak demand by 5.3 MW, which equates to 15.3 percent below goal. The program was under budget this year at $4.2 million, yielding an average first year cost of 13.3 cents per kWh saved.

EXPRESS

This program provides a streamlined, one-stop, turn-key energy efficiency service for small businesses. The program implementer first conducts a free on-site assessment to identify potential energy-saving opportunities. Based on recommendations from this assessment the implementer provides the participant with a proposal for installing energy efficiency measures. If the customer approves, the implementer then hires local contractors to perform the installation work. Once the work is completed, and after the customer has signed off on the work performed, the implementer bills the participant directly, after applying incentives from AEP Ohio. Incentive levels are generally higher in this program than in the Efficient Products for Business or Process Efficiency programs, up to 80 percent of project cost. This program is designed for small business customers with annual energy consumption levels no greater than 200 MWh or peak billing demands no higher than 100 kW.

Figure 30 below shows the number of measures installed through the Express program. Again, a single project may involve multiple measures. In total, there were 861 projects completed. See Appendix A for a complete listing of installed measures.

FIGURE 30: MEASURES INSTALLED THROUGH EXPRESS PROGRAM, 2018

Type	Number	kWh	kW
Delamping	150	103,969	21.6
LEDs	38,434	14,028,008	2,158.4
T5/T8	48	8,863	0.8
Exit Signs	820	233,213	22.6
Controls	257	50,194	0.0
Refrigeration	1,289	2,753,712	216.0
Total	**40,998**	**17,177,959**	**2,419.3**

Due to the granularity with respect to small business types, energy and demand savings are calculated using the New York TRM[12] and the Pennsylvania TRM[13].

The Company's Action Plan goals for 2018 were 14.8 GWh of savings in energy consumption and 3.9 MW of savings from peak demand. Figure 31 below shows the Express program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

[12] New York State Department of Public Service, *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs: Residential, Multi-Family, and Commercial/Industrial Programs*, version 2, December 10, 2014.

[13] State of Pennsylvania, *Technical Reference Manual, Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards*, June 2016.

FIGURE 31: EXPRESS PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	17.2	14.8	116.1%
Demand Savings (MW)	2.4	3.9	62.0%
Program Costs ($M)	4.1	4.0	101.8%
First Year Cost per kWh Saved (¢)	23.8	27.1	87.7%

The Express program exceeded its energy savings goals, but did not meet the demand savings goals for 2018. The program saved 17.2 GWh of energy, 16.1 percent above goal. The program also reduced peak demand by 2.4 MW, 38 percent below its goal. The program came in slightly over budget at $4.1 million, yielding an average first year cost of 23.8 cents per kWh saved.

CONTINUOUS ENERGY IMPROVEMENT

The Continuous Energy Improvement Program (CEI) is designed to target industrial customers and institutional facilities served by AEP Ohio. Like Retro-Commissioning, CEI focuses on low-cost or no-cost measures to reduce usage, primarily through system efficiency and process optimization. Participants join a targeted cohort of 10 to 20 companies, with care taken to avoid placing competitors in the same cohort, to protect participants' trade secrets. Each participant designates an internal team to act as *energy champions* and coordinate efforts within their companies to implement changes. Over a period of one year, energy champions attend workshops and work closely with program implementers to understand how their facilities' loads change and identify opportunities for reducing energy usage. Program implementers, using information on electric consumption, weather, and participants' internal metrics (such as production levels), develop a predictive model of energy usage for each participant. Subsequent usage levels below model predictions are counted as savings. First-year energy savings pay an incentive of 2 cents per kWh.

At the close of 2018, there were 37 participating customers with a combined 57 accounts in four cohorts in the CEI program. Savings were estimated based on individual regression models for each participant and, in some cases, multiple premises.

The Company's Action Plan goals for 2018 were 23.2 GWh of savings in energy consumption and 0.5 MW of savings from peak demand. Figure 32 shows the CEI program's energy savings, demand savings, program costs, and average cost per first-year energy savings during calendar year 2018.

Figure 32: Continuous Energy Improvement Program Summary, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	17.0	23.2	73.3%
Demand Savings (MW)	1.3	0.5	267.4%
Program Costs ($M)	1.9	2.5	74.7%
First Year Cost per kWh Saved (¢)	10.9	10.7	101.9%

The CEI program did not meet its energy savings goal for 2018, but exceeded demand goals. The program saved 17.0 GWh of energy, 26.7 percent below the target level. The program saved 1.3 MW in energy demand, 167.4 percent above goal. The program came in below its budget at $1.9 million, yielding a first year cost of 10.9 cents per incremental kWh saved.

Data Center

The Data Center program is a capital improvement program specially geared toward the unique needs of business IT operations and space. Such equipment can be highly energy-intensive, incorporate heavy HVAC loads, and have strict uptime requirements. Measures covered under this program may include ENERGY STAR® servers and telecommunications equipment; high-efficiency uninterruptable power supplies; high-efficiency power rectifiers; server virtualization; high-efficiency computer room air conditioner units; variable-speed drives on chilled water pumps; and airflow management and controls to optimize data center cooling. An additional track covers IT load growth when measured against an industry standard baseline.

Figure 33 below shows which measures were implemented through the Data Center program. A single project may involve multiple measures. In total, there were 15 projects completed. Please see Appendix A for a complete list of installed measures.

FIGURE 33: MEASURES INSTALLED THROUGH DATA CENTER PROGRAM, 2018

Type	Number	kWh	kW
HVAC	22	2,336,346	287.8
IT Equipment	6	226,165	16.7
Whole Building Model	3	31,670,983	3,731.3
Energy Mgt. System	1	1,864,564	212.8
Total	**32**	**36,098,058**	**4,248.6**

Energy and demand savings were modeled individually for each project by the program implementer.

The Company's Action Plan goals for 2018 were 17.1 GWh of savings in energy consumption and 1.5 MW of savings from peak demand. Figure 34 below shows the Data Center program's

energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 34: DATA CENTER PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	36.1	17.1	211.1%
Demand Savings (MW)	4.2	1.5	283.2%
Program Costs ($M)	2.5	2.8	88.7%
First Year Cost per kWh Saved (¢)	6.9	16.4	42.0%

The Data Center Program exceeded both its energy and demand savings goals for 2018. The program saved 36.1 GWh of energy, 111.1 percent above goal. The program also reduced peak demand by 4.2 MW, 183.2 percent above the goal. The program came in slightly under budget at $2.5 million, yielding an average first year cost of 6.9 cents per kWh saved.

COMBINED HEAT AND POWER

The Combined Heat and Power program is a cogeneration strategy that involves the generation of both electricity and useful heating (and/or cooling). CHP is a thermodynamically efficient method of generating electricity because it utilizes waste heat for local heating and/or cooling. The CHP Program is focused on incentivizing and enabling development of efficient CHP systems for large customers typically in the industrial, institutional, and healthcare sectors. All incentive payments are subject to AEP Ohio approval and are based on measured production kWh generated by the CHP/WER project. The minimum total CHP system efficiency is 60 percent with a minimum 20 percent useful thermal energy.

For 2018, there were two projects completed for the Combined Heat and Power program. The Company's Action Plan goals for 2018 were 106.0 GWh of savings in energy consumption and 15.1 MW of savings from peak demand. Figure 35 below shows the Combined Heat and Power program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2018.

FIGURE 35: COMBINED HEAT AND POWER PROGRAM SUMMARY, 2018

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	40.7	106.0	38.4%
Demand Savings (MW)	4.6	15.1	30.7%
Program Costs ($M)	2.4	3.4	70.9%
First Year Cost per kWh Saved (¢)	5.9	3.2	184.8%

The Combined Heat and Power program did not meet its energy and demand savings goals for 2018. The program saved 40.7 GWh of energy, 61.6 percent below goal. The program also reduced peak demand by 4.6 MW, 69.3 percent below the goal. The program came in slightly under budget at $2.4 million, yielding an average first year cost of 5.9 cents per kWh saved.

Customer Outreach Channels

Energy Efficiency Auction

The Energy Efficiency Auction is a unique reverse auction in which pre-qualified non-residential customers and solution providers can submit bids to deliver energy savings at a price per annual kilowatt-hour saved or watts reduced, either at a single site or spread out among multiple sites. The Energy Efficiency Auction is ideal for larger projects. Bidding processes are conducted online, with competing bids placed in real time and the winning bid being that with the lowest cost per kilowatt-hour. The participant or participants with the winning bid or bids are then eligible to receive incentive payments for their projects' completion at the winning price. Auctions are typically conducted in the fall of the year for projects to be submitted through the Efficient Products for Business or Process Efficiency program during the following calendar year.

Because the projects are submitted to the Efficient Products for Business or Process Efficiency program using auction incentive pricing, the energy and demand savings from these projects were evaluated in those programs. The auction simply serves as a pricing vehicle for these larger projects. The energy efficiency auction follows the standard Efficient Products for Business and Process Efficiency policies and procedures. Therefore, AEP Ohio is not submitting a separate evaluation report for this pricing alternative.

Figure 36 below shows which measures utilized the Energy Efficiency Auction. A single project may involve multiple measures. In total, there were 48 projects completed. These savings are captured in the Efficient Products for Business and Process Efficiency programs. This figure is for informative purposes only.

FIGURE 36: MEASURES INSTALLED THROUGH ENERGY EFFICIENCY AUCTION, 2018

Type	Number	kWh	kW
Compressed Air	3	2,110,933	307.3
Comm. Kitchen	3	4,839	0.0
HVAC	7	841,957	241.9
Lighting Controls	340,173	334,224	28.8
Lighting	39,181	10,544,370	2,144.6
Process	17	3,072,648	368.8
Total	**379,384**	**16,908,971**	**3,091.2**

Energy and demand savings in the Energy Efficiency Auction are calculated using the same methods employed in the Efficient Products for Business and Process Efficiency programs.

AGRICULTURE

The main focus of the Agriculture Outreach is targeted outreach to the agricultural customers in AEP Ohio's service territory. The agricultural community is hard to reach, particularly residential farms, which may not be identified as such in AEP Ohio customer information. The agricultural market sector has not had strong historical participation with the EE/DR program, and will be approached through an outreach strategy that demonstrates understanding of the agricultural business and concerns.

Because the projects are submitted to the Efficient Products for Business, Process Efficiency, or New Construction program through the standardized application process, the energy and demand savings from these projects were evaluated in those programs. The Agriculture outreach follows the standard policies and procedures of the business programs, thus AEP Ohio is not submitting a separate evaluation report.

Figure 37 below shows which measures were utilized through the Agriculture outreach. A single project may involve multiple measures. In total, there were 38 projects completed. The savings for these measures are captured in the Efficient Products for Business, Process Efficiency, and Business New Construction programs. This figure is for informative purposes only.

FIGURE 37: MEASURES INSTALLED THROUGH AGRICULTURE OUTREACH, 2018

Type	Number	kWh	kW
Agriculture	238	478,429	117.6
HVAC	42,965	200,980	38.1
Lighting Controls	8,342	11,418	0.8
Lighting	116,121	1,042,976	135.1
VFD	2	12,518	1.7
Process	1	46,980	6.9
Total	**167,668**	**1,793,300**	**300.2**

Energy and demand savings in the Agriculture outreach are calculated using the same methods employed in the Efficient Products for Business, Process Efficiency, and Business New Construction programs.

TRANSMISSION AND DISTRIBUTION PROJECTS

Inherent in the operation of any electric power system is the electrical resistance of its various elements, such as conductors, transformers, or regulators. The greater the distance the power must travel from generation to end use, the greater the amount of power lost in this transfer. The Ohio Revised Code allows a utility to include transmission and distribution infrastructure improvements to reduce line losses to meet benchmarks[14], and T&D projects are a major part of Ohio Power's plan for compliance. These projects include reconductoring, substation improvements, capacitor bank installation, and voltage regulator replacement.

- **Reconductoring** projects involve the replacement of existing wires with improved wires designed for lower losses at transmission or distribution voltages, lowering the system's resistance and the power lost over transmission to the end-user.
- **Substation improvements** typically include connecting previously unconnected T&D lines and the addition or upgrade of transformers and circuits, balancing loads between circuits, changing lines to multi-phase current, or the construction of altogether new substations. Such projects improve efficiency and reduce load losses by adding new transformation points closer to customers' loads. A greater portion of energy is carried in higher-voltage transmission lines than lower-voltage distribution lines.
- **Capacitor banks** reduce losses by improving system power factors closer to 100 percent.
- **Voltage regulators** assist in maintaining delivery voltage within the Commission's guidelines.

[14] Ohio Revised Code § 4928.66(A)(2)(d).

AEP Ohio had 8 distribution projects and 17 transmission projects completed in 2018 related to energy efficiency and peak demand reduction. These improvements prevented the loss of 6.5 GWh of energy and lowered peak demand by 1.8 MW. The report in Appendix Q contains a complete list of the Company's 2018 T&D projects and their estimated impacts.

Recommendations to the Commission

Residential Programs

Efficient Products

In 2018, AEP Ohio rebated various LED light bulbs via retailers and the online marketplace with strong energy savings results and high customer satisfaction. AEP Ohio will continue aggressive promotional tactics centered on LED and specialty LED awareness and education. ENERGY STAR® certified appliances such as refrigerators, dehumidifiers, smart thermostats, VSD Pool Pumps, Electric Heat Pump Water Heaters, Air Source Heat Pumps, Mini-split Ductless Heat Pumps, and Geothermal Heat Pumps will also be rebated. In addition, the free online energy profile (home assessment) and direct install for multi-family units will continue. AEP Ohio recommends that the program continue as described in the Plan.

Appliance Recycling

AEP Ohio gave $50 incentive to the Appliance Recycling program participants. In addition, AEP Ohio negotiated a program with OPAE and Recleim called Community Assistance Appliance Recycling (CAAR). This program removes and recycles old inefficient refrigerators and customers receive an energy efficient refrigerator and/or freezer with an extended warranty. AEP Ohio recommends the program continue as described in the Plan.

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This program continues to receive high satisfaction from teachers and students with over 350 teachers involved. AEP Ohio receives numerous letters from students thanking us for the program and educating them on energy efficiency. AEP Ohio recommends the program continue as described in the Plan.

Intelligent Home & DR

The program marketed as It's Your Power offers real time energy measurement of AMI metered customers through an innovative mobile phone app and energy bridge in the customer's home. The app also disaggregates the various types of usage in the home and provides customers the opportunity to control usage through smart thermostats, switches, plugs and sensors for energy savings and convenience. In 2018, AEP Ohio called 19 demand response events with an average of over 67% opt-in rate. The startup, roll out and complexity of this program has required AEP Ohio to move the program back to an R&D effort for a portion of 2018. AEP Ohio is exploring the feasibility of combining the behavioral program with Intelligent Home since both are behavioral based. AEP Ohio recommends the program continue as described in the Plan.

Community Assistance

This program, like previous years, provides low income customers energy efficiency measures to reduce energy costs and provide more comfort. Any customers who are enrolled in the Percentage of Income Payment Plan (PIPP), Home Weatherization Assistance Plan (HWAP) or Home Energy Assistance Program (HEAP) are eligible to participate in AEP Ohio's Community Assistance Program. AEP Ohio recommends continuing this program as described in the Plan, except for the modification with CAAR, which is mentioned above.

EfficiencyCrafted[SM] New Homes

The AEP Ohio EfficiencyCrafted[SM] Homes Program had a very successful year with more builders joining the program and more homes built under this program. AEP Ohio and Columbia Gas of Ohio no longer share the same vendor to manage the program; however both utilities work together to promote the program. Builders continue to have high satisfaction with the program and AEP Ohio won another year of Energy Star Partner of the Year award. AEP Ohio recommends the program continue as described in the Plan.

New Energy Efficient Manufactured Home

This program did not meet year-end energy targets. The program was redesigned in 2018 to address the HVAC dealer market to drive energy savings and incentivize them along with the retailers. Once this program gets established results will follow. AEP Ohio recommends that the program continue, with the modifications detailed in the Residential section.

Home Energy Reports

AEP Ohio provided home energy reports to over 500,000 customers. This program provides an opportunity to educate our customers on all of the residential energy efficiency programs they can participate in and change behavior to use energy wisely. AEP Ohio recommends the program continue as described in the Plan.

Business Programs

Efficient Products For Business

The Efficient Products for Business program began June 1, 2009, focused in the first year on prescriptive lighting only. In addition and according to the Plan, AEP Ohio expanded the list of prescriptive measures in 2010 under this program beyond lighting, to include HVAC, motors, drives and other cost effective measures to simplify and market this program effectively. Over 200 prescriptive measures are currently offered. After a successful pilot, "Advanced Lighting Controls" were added to the program. In the 2017-2020 approved Plan, the Prescriptive Program was renamed the Efficient Products for Business Program to better characterize the nature of the program to AEP Ohio customers. AEP Ohio recommends that the program continue as described in the Plan.

Process Efficiency

The Process Efficiency program is designed to be a "kitchen sink" program to handle customer energy efficiency projects not addressed through other business programs. Target segments may also be explored to engage more non-participants in AEP Ohio programs. Each targeted marketing effort will be monitored and listed as a subset of the Process Efficiency Program to track performance and participation. Since 2011, measures which show increased usage as technology develops, such as LED lighting, are moved to the Efficient Products for Business Program to remove barriers to participation. In the 2017-2020 approved Plan, the Custom Program was renamed to Process Efficiency to better characterize the nature of the program to AEP Ohio customers. In 2018, program savings were impacted by participant opt-outs. AEP Ohio recommends that the program continue as described in the Plan.

Demand Response

The demand response program is used to supplement the peak demand reductions achieved from EE/PDR programs. AEP Ohio recommends that the program continue as described in the Plan.

Self Direct

This program has achieved significant impacts and participation since 2009. The Self Direct program has also helped drive participation in other programs through its unique allowance of previously completed projects and the option of either the payment of an energy efficiency credit or an exemption from the EE/PDR Rider. AEP Ohio recommends that the program continue as described in the Plan.

Business New Construction

The Business New Construction program started in 2011 with strong participation. In 2013 through 2018, participation continued to increase as customer recognition of the program increased. New construction continues to increase as the economy stabilizes and energy savings from new construction is a good opportunity for long-lived savings. AEP Ohio recommends that the program continue as described in the Plan.

Express

The Express program changed in 2012 from a program marketed by local contractors, to a program with dedicated program marketing staff that would present signed contracts and materials to local contractors for installation. Results from 2018 continue to be positive as customer knowledge of the program increases. AEP Ohio recommends that the program continue as described in the Plan.

Continuous Energy Improvement

The Continuous Energy Improvement program was a new program launched in early 2013. This program seeks to facilitate a comprehensive and enduring strategic approach to energy reduction at key customer facilities. Strong enlistment throughout 2013 indicated high acceptance of the program. In 2014, the first groups (cohorts) participated with exceptional no cost/low cost operational savings and very high satisfaction with the program. In 2015 through 2018, new groups of participants were enrolled yielding similar high satisfaction as the initial participants have experienced. Savings for this group of participants was strong when counted in 2016. AEP Ohio recommends that the program continue as described in the Plan.

Data Center

The Data Center program was a new program launched in early 2013. This program is designed to assist customers in addressing energy efficiency opportunities in both new and existing data centers (facilities used to house computer systems and associated components). Activity with data centers in 2013 indicated good acceptance of the program. In 2014, activity was expanded for medium size data rooms and smaller data closets. New enterprise size data centers expansion in 2015 through 2018 accounted for strong participation. AEP Ohio recommends that the program continue as described in the Plan.

Combined Heat and Power

A new program launched in 2017 after two successful CHP projects were filed in 2015 under the Custom Program following passage of SB 315. In 2017, several applications for CHP were received and projects started, however no projects operated beyond start-up to be able to

quantify participation, savings, and incentives. In 2018, two CHP projects were completed and several applications received for future projects.

AFFIDAVIT OF JON F. WILLIAMS

State of Ohio :
: ss
County of Franklin :

Jon F. Williams, being first duly cautioned and sworn, states as follows:

1. I am the Managing Director – Customer Experience and Distribution Technology for AEP Ohio.

2. I am responsible for the design, development and implementation of customer programs relating to Energy Efficiency (EE) and Peak Demand Reduction (PDR) for AEP Ohio, including overseeing compliance with the EE/PDR mandates of Senate Bill 310 (S.B. 310) and the rules adopted by the Public Utilities Commission of Ohio (Commission) for inclusion in Ohio Administrative Code Chapter 4901:1-39 (Green Rules).

3. Based on my understanding of S.B. 310 and the Commission's Green Rules, AEP Ohio's energy baseline to be used for the 2018 reporting year is 37,745.1 GWh.

4. Based on my understanding of S.B. 310 and the Commission's Green Rules, AEP Ohio's 1.00% EE benchmark for the 2018 reporting year is 377.5 GWh.

5. Based on my understanding of S.B. 310 and the Commission's Green Rules, AEP Ohio complied with the EE benchmark for the 2018 reporting year.

6. Based on my understanding of S.B. 310 and the Commission's Green Rules, AEP Ohio's demand baseline to be used for the 2018 reporting year is 7,867.2 MW.

7. Based on my understanding of S.B. 310 and the Commission's Green Rules, AEP Ohio's 7.75% PDR benchmark for the 2018 reporting year is 603.5 MW. On that basis, AEP Ohio could achieve compliance for 2018 by either implementing

programs (including programs offered through a tariff) designed to achieve a cumulative peak demand reduction of 603.5 MW in 2018 or if peak demand is less than 7,273.7 MW (*i.e.*, 7,867.2 MW less 603.5 MW).

8. Based on my understanding of S.B. 310 and the Commission's Green Rules, AEP Ohio complied with the PDR benchmark for the 2018 reporting year.

FURTHER AFFIANT SAYETH NAUGHT.

Jon F. Williams

Sworn to before me and subscribed in my presence this 13th day of May, 2019.

Amy M. Cribbs
Notary Public

NOTARIAL SEAL STATE OF OHIO

AMY M. CRIBBS
NOTARY PUBLIC
STATE OF OHIO
Recorded in
Stark County
My Comm. Exp. 5/20/2023

Summary: Report - Annual Portfolio Status Report submitted by Ohio Power Company (Part 1 of 4) electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company

Summary: Comments and Attachments 1 and 2 electronically filed by Mr. Nikhil Vijaykar on behalf of Environmental Law & Policy Center and Ohio Environmental Council