COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC 2019 INTEGRATED RESOURCE PLANNING REPORT OF KENTUCKY POWER COMPANY	)))	CASE NO. 2019-00443

O R D E R

The Commission initiated this proceeding for its Staff to conduct a review of the 2019 Integrated Resource Plan (IRP) filed by Kentucky Power Company (Kentucky Power), pursuant to 807 KAR 5:058. Attached as an Appendix to this Order is the Staff Report summarizing Commission Staff's review of the IRP. This Staff Report is being entered into the record of this case pursuant to 807 KAR 5:058, Section 11(3).

Based on the evidence of record, the Commission finds that the Staff Report represents the final substantive action in this matter. The final administrative action will be an Order closing the case and removing it from the Commission's docket. That Order will be issued after the period for comments on the Staff Report has expired.

IT IS THEREOFRE ORDERED that:

1. The Staff Report on Kentucky Power's 2019 IRP represents the final substantive action in this matter.

2. Any party desiring to file comments regarding the Staff Report on Kentucky Power's 2019 IRP shall do so on or before February 25, 2021.

3. Kentucky Power shall file comments with respect to the Staff Report and in response to Intervenor comments on or before March 8, 2021.

4. An Order closing this case and removing it from the Commission docket shall be issued after the period for comments on the Staff Report has expired.

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By the Commission

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FEB 15 2021
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KENTUCKY PUBLIC
SERVICE COMMISSION

ATTEST:

Executive Director

APPENDIX

AN APPENDIX TO AN ORDER OF THE KENTUCKY PUBLIC SERVICE COMMISSION IN CASE NO. 2019-00443 DATED FEB 15 2021

THIRTY-TWO PAGES TO FOLLOW

Kentucky Public Service Commission

Staff Report on the

2019 Integrated Resource Plan

of Kentucky Power Company

Case No. 2019-00443

February 2021

SECTION 1

INTRODUCTION

807 KAR 5:058, promulgated in 1990 and amended in 1995 by the Kentucky Public Service Commission (Commission), established an integrated resource planning (IRP) process that provides for regular review by the Commission Staff (Staff) of the long-range resource plans of the Commonwealth's six major jurisdictional electric utilities. The Commission's goal in establishing the IRP process was to ensure that all reasonable options for the future supply of electricity were being examined in order to provide ratepayers a reliable supply of electricity that was cost-effective.

Kentucky Power Company (Kentucky Power) submitted its 2019 IRP to the Commission on December 20, 2019. The 2019 IRP reflects Kentucky Power's long-term plan for meeting their customers' electricity requirements for the period 2020-2034.

On February 14, 2020, an Order was issued establishing a procedural schedule for this proceeding. The procedural schedule established a deadline for requesting intervention, two rounds of data requests to Kentucky Power, an opportunity for intervenors to file written comments, and an opportunity for Kentucky Power to file a response to any intervenor comments. Additionally, a hearing was set in this matter, and was held on December 10, 2020.

The following parties filed for, and were granted, intervention in this matter: (1) the Attorney General of the Commonwealth of Kentucky, by and through the Office of Rate Intervention (Attorney General) and (2) Kentucky Industrial Utility Customers (KIUC). Intervenor comments are due after the issuance date of this Staff Report.

Southern Renewable Energy Association (SREA) filed a public comment on the IRP.

Kentucky Power is an investor-owned utility that generates, purchases, transmits, and distributes electricity to customers located primarily in Kentucky. Kentucky Power serves approximately 166,000 retail electric customers in 21 Kentucky counties.[1] Kentucky Power also provides wholesale power to two municipal electric systems in Kentucky.[2] Kentucky Power is a wholly owned subsidiary of American Electric Power Company (AEP).

Kentucky Power is an owner and operator of interconnected electric generation, transmission, and distribution facilities. They operate the interconnected and centrally

[1] 2019 IRP at 2.; *Annual Report of Kentucky Power Company to the Public Service Commission for the Calendar Year Ended December 31, 2019* (*2019 Annual Report*) at 4.

[2] *2019 Annual Report* at 90.

dispatched system through coordinated planning, construction, operation, and maintenance of their facilities.

With respect to supply-side resources, Kentucky Power's existing installed generation capacity is 1,452 megawatts (MW).[3] This consisted of 1,172 MW of coal-fired capacity, and 280 MW of natural gas combined cycle (NGCC) capacity.[4]

Kentucky Power's highest all-time system peak demand of 1,685 MW occurred in January of 2005, and its highest recorded summer peak was 1,358 MW, which occurred in July of 2005.[5] The highest annual energy requirements for Kentucky Power was 8.072 GWh in 2005.[6] Significant changes have occurred in Kentucky Power's territory with respect to industrial load that will make it unlikely it will ever reach such peak demands in the near and intermediate future. Kentucky Power projects that it will see customer counts decline at a rate of 0.4% per year, and that sales will show little growth per year, with its growth occurring mainly within its industrial class.[7]

The purpose of this report is to review and evaluate Kentucky Power's 2019 IRP in accordance with 807 KAR 5:058, Section 11(3), which requires Staff to issue a report summarizing its review of each IRP filing made with the Commission and make suggestions and recommendations to be considered by a utility in its next IRP filing. Staff recognizes that resource planning is a dynamic, ongoing process. Specifically, Staff's goals are to ensure, among other things, the following:

- All resource options are robust and are fully and fairly evaluated;
- Critical data, assumptions, and methodologies for all aspects of the resource plan are well documented, fully supported, and reasonable; and
- The report also includes an incremental component noting any significant changes from Kentucky Power's prior IRP, filed in 2016.

Kentucky Power states that the purpose of their 2019 IRP is to explain how Kentucky Power plans to meet the projected capacity and energy requirements of its

[3] 2019 IRP at 40.

[4] *Id.*

[5] *Id.* at ES-1.

[6] Kentucky Power's Response to Commission Staff's First Request for Information (Staff's First Request), Item 1.

[7] 2019 IRP at 6.

customers.[8] Kentucky Power states that they plan to monitor the action plan of this IRP and future IRPs to address changing circumstances, and that an IRP is a snapshot of the future at a given time and not a commitment to specific resource additions or other course of action.[9] Kentucky Power states that certain assumptions are made in their planning decisions and, as such, are subject to various degrees of risk and uncertainty. Kentucky Power examined the economics and practicality of supply-side and demand-side options in order to forecast the least-cost options available to meet forecasted customer needs.

The Kentucky Power resource planning process contains the following:

- Identification of current issues as they relate to resource planning;
- Establishment of reserve margin criteria;
- Project growth in demand and energy, which serves as the underpinning of the resource plan;
- Assessment of the adequacy of existing generation units and purchased power agreements;
- Screening of demand-side resource options;
- Screening of supply-side resource options;
- Development of the optimal economic plan from the available resource options;
- Tie underlying PJM reserve margin requirements to the resource plan.

While their 2019 IRP represents Kentucky Power's analysis of the best options to meet customer needs at a given point in time, the resource plan options are reviewed and re-evaluated prior to implementation. If new generation is needed or demand-side options are to be expanded, Kentucky Power must receive Commission approval prior to implementation and the information and data contained in Kentucky Power's 2019 IRP should serve, at a minimum, as a basis for determining the reasonableness of the needed new generation or implementation of demand-side management programs.

Kentucky Power's base forecast for its summer peak load is expected to increase from 1,012 MW, their weather-normalized 2020 peak, to 1,017 MW in 2034.[10] Kentucky

[8] *Id.* at ES-1.

[9] *Id.* at ES-8 and ES-9.

[10] *Id.,* Exhibit C-5.

Power's winter peak load is expected to decrease from 1,303 MW to 1,263 MW over the same period, a decrease of 3.1 percent.[11] Energy requirements for Kentucky Power are projected to increase 0.4 percent from 6,060 GWh in 2020 to 6,094 GWh in 2034.[12]

This report is organized as follows:

- Section 2, Load Forecasting – reviews Kentucky Power's projected load growth and load forecasting methodology;
- Section 3, Demand-Side Management (DSM) – summarizes Kentucky Power's evaluation of DSM opportunities;
- Section 4, Supply-Side Resource Assessment – focuses on supply resources available to meet Kentucky Power's load requirements and environmental compliance planning; and
- Section 5, Integration and Plan Optimization – discusses Kentucky Power's overall assessment of supply-side and demand-side options and their integration into an overall resource plan.

The report contains a number of recommendations for Kentucky Power's next IRP. Staff recommends the Commission require Kentucky Power to file their next IRP on or before December 20, 2022.

[11] *Id*.

[12] *Id.* at 5–25.

SECTION 2

LOAD FORECASTING

INTRODUCTION

Kentucky Power's load forecasts are based on a combination of econometric and statistically adjusted end use (SAE) models. Short term econometric time series models are used to obtain monthly forecasts extending two years and employ both the latest energy sales and weather data. In the short term, the stock of electric energy consuming equipment and appliances and other economic factors are assumed to be fixed.[13] Key variables include monthly and seasonal binaries, time trends, and monthly heating and cooling degree days.[14]

The long-term econometric models produce monthly forecasts extending out 30 years. These models are designed to capture structural shifts and trends in the underlying economy as well as changes in equipment stocks and energy efficiency. These long-term models incorporate SAE modeling techniques, which capture changes in energy efficiency that can drive changes in energy consumption.[15] Key economic and demographic variables include the gross regional product, employment, mortgage rates, population, real personal income, number of households, electricity and natural gas prices, heating and cooling degree days, and lagged and binary variables.[16]

The short-term and long-term forecasts are blended together for each revenue class to produce a seamless forecast. Energy class sales are summed and adjusted for energy losses to produce an internal[17] energy forecast.[18]

Kentucky Power's load forecasts incorporate economic data provided by Moody's Analytics, energy prices from the Federal Reserve, U.S. Department of Energy's Energy Information Administration (EIA and internal sources), weather data from the National Oceanographic and Atmospheric Administration and Itron.[19]

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[13] IRP at 8–9, and 11.

[14] *Id.* at 12.

[15] *Id.* at 8–9.

[16] *Id.* at 11–12.

[17] *Id. See also* footnote 3 at 6. Internal load is defined as "load that is directly connected to the utility's transmission and distribution system and that is provided with bundled generation and transmission service by the utility." And connected load is defined as including internal load and "directly connected load for which the utility serves only as a transmission provider."

[18] *Id.* at 9 and 18. *See also* Exhibit C-8 for an illustration of how the short-term and long-term forecasts are blended together.

[19] *Id.* at 7 and 15.

In addition to the customer class models, Kentucky Power employs other models to produce several independent variable forecasts. For example, forecasted natural gas prices are obtained from a consumed natural gas pricing model based upon Kentucky Power's residential, commercial and industrial sector prices and forecasted prices from the EIA's 2019 Annual Outlook.[20] Though diminished, coal mining still plays a role in Kentucky Power's service territory. A regional coal production model is used to forecast coal production in the mine power energy sales model. Key variables include EIA forecasts of Central Appalachian and U.S. coal exports.

RESIDENTIAL ENERGY SALES

The residential energy sales forecast is the product of two models: one that projects the number of customers and one that projects residential energy usage. The usage model is an SAE econometric model. Kentucky Power conducts a Residential Appliance Saturation Survey every three or four years to monitor appliance age, saturation levels and other demographics information.[21] When combined with Energy Information Administration saturation and efficiency projections, the data incorporates effects of Federal policies.

Energy usage is a function of Heating, Cooling and Other usage variables. The Heating variable is comprised of a heating index and a heating usage variable. The heating index is a function of heating equipment efficiency and saturation levels and trends and the thermal integrity as it relates to the size of homes. Heating usage is a function of the average number of number of billing days, heating degree days, household size, personal income, gas prices and electricity prices.[22] Similarly, the Cooling variable is comprised of a cooling index and a cooling usage variable. The cooling index is a function of cooling equipment efficiency and saturation levels and trends and the thermal integrity and size of homes. Cooling usage is a function of billing days, cooling degree days, household size, personal income, electricity prices, and gas prices.[23] The Other usage variable estimates nonweather sensitive residential sales. Like the Heating and Cooling variables, it is a function of billing days, household size, personal income, electricity prices, and gas prices.[24]

The residential energy sales are obtained as the product of the customer forecast and the energy usage forecast. Over the 2020–2034 forecast period, residential energy sales are projected to decrease at an average annual rate of 0.5 percent from 1,951 GWh to 1,820 GWh.[25] The forecast represents a gradual decline, which is in contrast with

[20] *Id.* at 28.

[21] *Id.* at 23.

[22] *Id.* at 15–16.

[23] *Id.* at 16.

[24] *Id.*

[25] *Id.* Exhibit C-1 and C-2.

recent history as from 2014-2019, residential energy sales declined from 2,350 GWh to 2,034 GWh, or 13.4 percent.[26]

COMMERCIAL ENERGY SALES

Similar to the residential revenue class, commercial energy sales are the product of the number of commercial customers and customer usage. Commercial customer energy usage is estimated using SAE modeling techniques and is a function of equipment efficiencies, square footage and equipment saturations in the East North Central Region, electric prices, economic factors, heating and cooling degree days, and billing cycle days. Heating usage, Cooling usage, and Other usage variables are derived in the modeling process.[27]

Similar to residential energy sales, Commercial energy sales are projected to decline 0.4 percent annual rate over the 2020-2034 forecast period from 2,156 GWh to 1,167 GWh. This is in contrast to the more recent 7.7 percent decline in sales from 1,361GWh in 2014 to 1,256 GWh in 2019.[28]

INDUSTRIAL ENERGY SALES

This revenue category includes both Industrial Manufacturing and Mine Power Energy Sales. Industrial manufacturing energy usage estimates are a function of gross regional product manufacturing, service territory electricity prices and binary variables.[29] Due to the mining industry's importance and relative impact on Kentucky Power's total sales, it is modeled separately from the rest of industrial manufacturing sales. The mining sector accounted for approximately 15.0 percent of Kentucky Power's industrial load in 2018.[30] Mine Power energy usage is a function of regional coal production and service territory electricity prices, as well as binary variable.[31]

Industrial energy sales increase slowly over the forecast period at an annual rate of 0.6 percent from 2,391 GWh to 2,607 GWh. The majority of that increase occurs in the 2021-2023 period, increasing from 2,393 GWh to 2,580 GWh.[32] This is in contrast to the

[26] *Id.*

[27] *Id.* at 17.

[28] *Id.,* Exhibit C-1 and C-2.

[29] *Id*. at 17.

[30] Kentucky Power's response to Staff's First Request, Item 19.

[31] 2019 IRP at 17.

[32] *Id.* Exhibit C-1 and C-2. *See also* Application at 33 and Kentucky Power's response to Staff's First Request, Item 1. Kentucky Power did not include Enerblu in its 2019 industrial forecast. However, Braidy Industries was included, though at a discounted value to reflect risk.

preceding five-year period where industrial sales declined 408 GWh, or 14.5 percent, from 2,810 GWh to 2,402 GWh.[33]

OTHER INTERNAL ENERGY SALES

This small category of energy sales includes both public street and highway lighting energy sales and wholesale sales to municipal utilities. Public street and highway lighting sales are a function of service territory employment and binary variables. It is essentially flat over the forecast period fluctuating between 94 GWh and 92 GWh. Wholesale energy sales are a function of service territory employment, population, energy prices and heating and cooling degree days and binary variables.[34] Sales to Municipals-For-Resale are also constant, increasing from 79 GWh to 83 GWh.[35]

TOTAL INTERNAL ENERGY REQUIREMENTS

Lost And Unaccounted-For Energy losses fluctuate with changes in the amount of flowing energy. Over the forecast period, total energy losses start at 397 GWh rising to 405 GWh in 2023 reflecting the increase in Industrial sales and then slowly decline back to 397 GWh. After summing across all the revenue classes and accounting for lost and unaccounted-for energy, Kentucky Power's Total Internal Energy Requirements are essentially flat over the forecast period.[36] Total requirements begin at 6,099 GWh in 2019 and climbing to 6,194 GWh in 2023 and then declining back to 6,084 GWh in 2034.[37]

SEASONAL PEAK INTERNAL DEMAND

The peak demand model allocates monthly energy sales to hourly demands. Model inputs include the forecast revenue class energy sales, energy losses, weather, 24-hour load profiles and calendar information.[38] The 24-hour load profiles are developed from the appropriate historical hourly seasonal load profiles of end user or revenue class and combined with day type and average temperature data.[39] Weather profile data is taken from service area related weather stations over a 30-year period to obtain heating and cooling degree days.[40] Finally, the 24-hour load profiles are benchmarked to the aggregate energy and seasonal peaks from the annual 8,760 hour load duration curves.

[33] *Id.*

[34] *Id.* at 18.

[35] *Id.,* Exhibit C-1 and C-2.

[36] *Id.* at 18–19.

[37] *Id.,* Exhibit C-1 and C-2.

[38] *Id.* at 19.

[39] *Id.*

[40] *Id.*

Summing the hourly values yields net internal energy needs and the maximum of the values represents peak demand.[41]

Kentucky Power has been and remains a winter peaking utility over the forecast period. Kentucky Power's winter peak begins at 1,303 MW climbing to 1,311 MW in 2023 reflecting the increase in Industrial sales, and then slowly declines to 1,263 MW. The summer peak is also essentially flat over the forecast period, beginning at 1,012 MW, climbing to 1,031 MW in 2022 and slowly declining to 1,017.[42]

LOAD FORECAST SCENARIOS – SENSITIVITY ANALYSIS

Kentucky Power conducted multiple sensitivity analyses using the Base case, since it is the expected load growth scenario, as a guiding benchmark. The various scenarios included a high and low economic growth, no new DSM, more rapid development of energy efficiency, existing energy efficiencies extended, and extreme weather.[43] The high and low economic growth scenario results proved to represent the upper and lower bounds of the various sensitivity scenario results.[44] Over the 2020-2034 forecast period the base case result for the summer peak demand, and the energy requirements exhibit virtually no growth. The winter peak demand declines at an average annual rate of 0.2 percent.[45] For the low economic growth scenario, the growth in summer peak demand and energy requirements decline by 0.5 percent and 0.6 percent respectively. The winter peak demand growth declines by average annual 0.8 percent rate. For the high economic growth scenario results, the summer peak demand and energy requirements grow at an average annual rate of 0.5 percent and 0.4 percent respectively. The winter peak demand grows at an average annual rate of 0.2 percent.[46] By 2034 the low economic growth scenario is approximately 9.1 percent below the base case estimate for summer peak demand and energy requirements and approximately 9.6 percent below the base case winter peak demand estimate. By 2034, the high growth economic scenario is approximately 7.4 percent above the base case estimate for summer peak demand and energy requirements. The winter peak demand is approximately 8.2 percent greater than the base case estimate.[47]

SIGNIFICANT CHANGES

Compared to Kentucky Power's last IRP filing in 2017, several significant changes were applied. First, the 2019 internal load forecast was adjusted downward and is

[41] *Id.*

[42] *Id.,* Exhibit C-2.

[43] *Id.* at 28 and Figure 10 at 29.

[44] *Id.* at 28.

[45] *Id.* Exhibit C-9.

[46] *Id.*

[47] *Id.*

approximately 1–4 percent less than the 2016 forecast. In addition, over the 2019 forecast period, industrial sales is the only sector with a forecast increase in sales, reflecting anticipated economic development whereas in the 2016 IRP, increased sales were anticipated in the three major classes. The 2019 peak demand forecasts are similarly less than the 2016 forecast. The 2019 winter peak forecast ranges from 1,311 MW to 1,272 MW over the forecast period, which is approximately 2.4 percent to 3.9 percent less than the 2016 forecast. The 2019 summer peak forecast ranges from 1,031 MW to 1,017 MW over the forecast period, which is approximately 1.3 percent to 3.1 percent less than the 2016 forecast.[48]

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

- Kentucky Power should continue to provide comparisons of forecasted winter and summer peak demand with actual results for the period following the 2016 IRP, along with a discussion of the reason(s) for the differences between forecasted and actual peak demands.

- Kentucky Power should continue to provide a comparison of the annual forecast of residential energy sales with actual results for the period following the 2016 IRP, along with a discussion of the reason for differences between forecasted and actual sales.

- Kentucky Power should examine more closely the reasonableness of the coal mining sector forecast and make necessary adjustments to reflect Kentucky Power's territorial circumstances.

- Kentucky Power should continue to provide an update on Kentucky Power's economic development efforts including the impact on its load and employment in its service territory.

Overall, Kentucky Power's 2019 IRP addressed these recommendations and Staff is satisfied with and accepts the manner and method in which Kentucky Power's load forecasting incorporated the recommendations set forth in Staff's 2016 IRP Staff Report.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

For the next IRP:

- Kentucky Power should provide a more detailed description and explanation of the county level historical, and forecast data obtained from Moody's Analytics (or any other source) and the process employed to tailor data to specific counties and to Kentucky Power's service territory. The explanation should also include a description of any alternative forecast scenarios provided by Moody's Analytics, such as optimistic and pessimistic growth scenarios reflecting different economic and

[48] *Id.*, Exhibit C-13.

demographic assumptions, which may influence the ultimate forecast data used by Kentucky Power.

- Kentucky Power should provide a more detailed description of the different load forecast scenarios including how the base case assumptions were changed, how they differ from the base case, and a table depicting the all the various results.

- Kentucky Power should continue to provide an update on Kentucky Power's economic development efforts including the impact on its load and employment in its service territory.

- Kentucky Power should provide a comparison of the annual and seasonal peak forecasts of the residential, commercial, and large commercial and industrial sales classes with actual results for the period following the 2019 IRP.

- Kentucky Power should include discussion and analysis of the potential for and any increases in distributed energy resources on the load forecasts. This should include behind the meter generation at residential, commercial and industrial customer locations. These should be evaluated separately and cumulatively including discussion of drivers encouraging and discouraging such development.

SECTION 3

DEMAND-SIDE MANAGEMENT/ENERGY EFFICIENCY

INTRODUCTION

This section discusses the DSM-EE aspects of the Kentucky Power IRP. DSM-EE programs are designed to make the production and delivery of energy more cost–effective with the goal of increasing the efficient use of electricity. Demand response programs reduce consumption at peak times while EE programs reduce energy usage on a day–to–day basis. Kentucky Power stated that the EE programs create zero energy or demand impacts on the load forecast.[49] All DSM effects, including EE and DR activity as well as other grid related projects such as Volt VAR Optimization (VVO), are modeled on the same economic, or least cost, basis as supply-side resources.[50]

Before the IRP filing, Kentucky Power's most recent DSM application, Case No. 2019–00410,[51] was filed on November 15, 2019, for approval to continue its Targeted Energy Efficiency (TEE) Program through December 31, 2020, and authority to recover through its DSM surcharge the full costs associated with its programs through December 31, 2019. The Commission issued a final Order on December 12, 2019, approximately one week prior to the filing date of Kentucky Power's IRP, approving the continuation of the TEE program and approving the proposed revisions to the DSM surcharges. This IRP did not included the DSM proposals from Case No. 2019–00410.

SUMMARY DISCUSSION OF DSM-EE

Kentucky Power currently offers only one DSM program as a result of the Commission–initiated investigation into the reasonableness of Kentucky Power's DSM programs in Case No. 2017-00097.[52] In that case, the Commission ordered the elimination of all offerings except for those programs that target income-eligible residential customers until Kentucky Power's capacity position indicates a need for additional generation to serve its load.[53] The Order also directed Kentucky Power to eliminate its commercial DSM programs and allowed for Kentucky Power to pay the incentives for

[49] 2019 IRP, Section 3.4 at 51.

[50] *Id.* at 52.

[51] Case No. 2019-00410, *Electronic Application of Kentucky Power Company for (1) Approval of Continuation of Its Targeted Energy Efficiency Program; (2) Authority to Recover Costs And Net Lost Revenues, and to Receive Incentives Associated with the Implementation of Its Demand-Side Management Programs; (3) Acceptance of Its Annual DSM Status Report; and (4) All Other Required Approvals and Relief,* (Ky. PSC Dec.12, 2019).

[52] Case No. 2017-00097, *Electronic Investigation of the Reasonableness of the Demand Side Management Programs and Rates Kentucky Power* Company, (Ky. PSC January 18, 2018).

[53] *Id*.

certain commercial projects that were in process or had been accepted before Kentucky Power's DSM programs were suspended.[54] Consistent with that Order, Kentucky Power's current DSM portfolio consists of only the residential TEE Program. Administered through community action agencies (CAA) in Kentucky Power's service area, the TEE program is designed to improve EE for low-income customers through energy audits coupled with the installation of various energy conservation measures. The TEE program is available to Kentucky Power customers whose primary heat source is electricity and who use an average of at least 700 kWh per month. In addition, limited efficiency measures are available to Kentucky Power customers whose primary heat source is not electricity, but who have an electric water heater and use an average of at least 700 kWh of electricity per month from November through March. For these reasons, Kentucky Power's load forecast did not include any demand or energy impacts of Kentucky Power's current DSM programs.

The load forecast included the impact of existing and future codes and standards for lighting and appliances that are forecasted for implementation through 2025.[55] Kentucky Power estimated that the impact of EE, including codes and standards, is expected to reduce retail load by a total of 5.0 percent through the forecast period.[56] Kentucky Power also will add new EE resources in 2022. Regarding DR, Kentucky Power currently has a total of 5.6 MW of peak reduction.[57]

For Distributed Generation, Kentucky Power explained that the economics of solar are projected to improve, however, based upon the expected wholesale rate, roof top solar would not be economically favorable.[58] As of December 2018, Kentucky Power had 24 net metering system installations for a total of 0.28 MW.

Kentucky Power also modeled VVO as a DSM resource. VVO represents a form of voltage control that allows for more efficient grid operation. VVO sensors and controllers monitor load flow and direct VVO controls on capacitors and voltage regulating equipment, resulting in reduced system losses. VVO also enables conservation voltage reduction, which allows a utility to systematically reduce voltages in the utility's distribution network, resulting in a reduction of load on the network. The result is less energy use without any customer behavior changes or changes in appliance efficiencies. Early

[54] *Id.*

[55] 2019 IRP, Section 3.4.1 at 52.

[56] *Id.* at 53.

[57] *Id.* at 54. Kentucky Power has 2 DR customers.

[58] In Kentucky Power's most recent rate case, Case No. 2020-00174, Kentucky Power proposed a new net metering tariff at a rate based upon their avoided cost. The Commission deferred a decision on the net metering tariff, which Kentucky Power placed into effect on January 14, 2021, subject to refund.

results indicate a reduction of 0.7 to 1.2 percent of energy demand for each 1.0 percent voltage reduction.[59]

Kentucky Power's 2019 IRP preferred plan would increase reliance on demand-side and renewable resources as it reduces Kentucky Power's reliance on coal-based generation. Energy from these renewable resources, combined with EE and VVO energy savings, reduces Kentucky Power's exposure to energy, fuel, and potential carbon prices with a 0.0 percent to 27.0 percent increase in wind and solar.[60] The 2019 IRP preferred plan reduces the amount of VVO and EE programs to 10 MW as compared to 89 MW in the 2016 plan. The 2019 IRP also excludes Battery Storage as a DSM component.[61]

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

In the 2016 IRP Staff Report, Staff made several recommendations:

- Staff encouraged Kentucky Power to continue to examine the results of the cost-effectiveness tests of its remaining DSM programs compared to the estimates projected by the AEG Study and to report on existing programs that do not meet or exceed their cost-effectiveness estimate.

- Staff advised Kentucky Power that the final order in Case No. 2016-00281, no longer required it to pursue further industrial programs.

- Staff recommended that Kentucky Power should continue participating with adjoining AEP operating companies in order to take advantage of economies of scale that allow for reduced advertising costs and enhanced marketing to the extent possible for income-eligible residential DSM programs.

As discussed above, since the 2016 Staff IRP Report was issued, the final Order in Case No. 2017-00097 ended all but one DSM program in Kentucky Power's portfolio. Therefore, some of the Staff Recommendations are no longer relevant.

DISCUSSION OF REASONABLENESS

Staff concludes that Kentucky Power took appropriate steps to reach its obligations concerning DSM spending. Staff agrees that Kentucky Power has historically modeled and evaluated its DSM-EE programs in a reasonable and proper manner.

[59] 2019 IRP, Section 3.4.5 at 60.

[60] 2019 IRP at ES-7.

[61] *Id.* at Section 1.5 at 5.

RECOMMENDATIONS

- As required by the IRP regulation, 807 KAR 5:058, Kentucky Power should continue to define and improve procedures to evaluate, measure, and verify both actual costs and benefits of energy savings based on the actual dollar savings and energy savings. With the expiration of the Rockport UPA, the potential impact of new DSM programs will be much greater in the next IRP.

- Kentucky Power should continue to scrutinize the results of each existing DSM program measure's cost-effectiveness test and provide those results in future DSM cases, along with detailed support for future DSM program expansions and additions after the Rockport UPA capacity is no longer available.

- Kentucky Power should evaluate the marginal benefits and costs, including opportunity costs of VVO and DR programs.

- Kentucky Power should examine additional low-income programs that allow for more participants and easier access to EE alternatives.

- Kentucky Power should continue to monitor the DG additions.

SECTION 4

SUPPLY-SIDE AND DEMAND-SIDE RESOURCE ASSESSMENT

In this Section, Staff reviews, summarizes, and comments on Kentucky Power's evaluation of existing and future supply- and demand-side resources. In addition, there is a discussion on Kentucky Power's environmental compliance plan.

INTRODUCTION

Kentucky Power's all-time peaks were 1,685 MW in January 2005 and summer peak of 1,358 MW in July 2005. The most recent winter and summer seasonal peaks were 1,297 MW in January 2019 and 993 MW in August 2019.[62] To meet peak load and energy requirements, Kentucky Power owns a 50.0 percent share of the two coal-fired units (385 MW each) at Mitchell Station and 280 MW of gas fired generation capacity at Big Sandy Unit 1.[63] In addition, Kentucky Power's Rockport Unit Power Agreement (Rockport UPA) provides 393 MW. In the supply-side analysis, Kentucky Power assumes that the Rockport UPA will not be renewed when it expires at the end of 2022.[64] After the expiration of the Rockport UPA, Kentucky Power plans to meet its capacity obligations through bilateral market purchases. In addition, Kentucky Power is negotiating for 20 MW of solar generation that is assumed to be on-line by the end of 2021.[65]

The modeling process begins with AEP's Fundamentals Forecast, which is made available to all AEP operating companies. It is a long-term weather normalized energy market forecast, which is used for fixed asset impairment accounting, capital improvement analysis, resource planning and strategic planning.[66] The primary model used for this analysis is the Aurora energy market simulation model which iteratively generates zonal long-term capacity expansion plans, annual energy dispatch, fuel burn and emission totals. Inputs to the model include monthly and annual regional power prices, coal prices, monthly and annual natural gas prices, uranium prices, SO_2, NO_x, and CO_2 prices, electric capacity values, renewable energy subsidies and inflation factors.[67]

The Fundamentals Forecast includes four commodity pricing scenarios; base case, upper band, lower band, and No Carbon. The upper and lower band consider changes in North American demand for electric generation and fuels, hence, higher and lower fuel prices. For these two cases, fuel prices vary one standard deviation above and

[62] 2019 IRP at ES-1 and ES-2.

[63] *Id.* at Table 3, 40.

[64] *Id.* at ES-2, ES-3, and 41.

[65] *Id.*

[66] *Id.* at 74 and 76. Weather normalization is based on 30 years of weather observations.

[67] *Id.*

below the base case values. Renewable energy credits (RECs) are assumed to be zero over the long-term forecast. The Fundamentals Forecast also includes a carbon price of $15 on all fossil fuel-fired generation, which escalates at a 3.5 percent annual rate. The No Carbon scenario assumes that there will be no carbon legislation over the forecast period.[68]

Kentucky Power utilizes the Plexos LP long-term optimization model (Plexos model)[69] for evaluation of the various assets and resources that are available to meet its capacity and energy needs. For this set of demand and supply resources and economic assumptions, Plexos yields an optimal set of supply-side resources that will satisfy the resource needs on a least cost Cumulative Net Worth basis.[70]

Various demand-side resources are treated as alternative supply-side resources in the Plexos model. Such demand-side resources include energy efficiency (EE), VVO, demand response, distributed generation, and combined heat and power (CHP). All potential EE programs are based on Kentucky Power's internal data and the 2019 update of the Electric Power Research Institute's "2014 U.S. Energy Efficiency Potential Through 2035" report.[71] The Plexos model includes EE measures that will be adopted via updated codes and standards and those that will be implemented through utility sponsored programs.[72] VVO is modeled in bundles or tranches of 10–15 circuits based on the potential peak and energy reduction potential.[73] DR consisted of two programs: a residential Wi-Fi enabled thermostat program and a commercial light program. For modeling purposes, residential program participants were grouped into bundles of 1,000 and commercial participants were grouped into bundles of 10.[74] DG is modeled as roof top solar resources.[75] CHP is modeled as a generic 15 MW facility utilizing a natural gas fired combustion turbine (CT) with a heat recovery steam generator and a SCR to control NO_x.[76]

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[68] *Id.* at 77–78.

[69] *Id.* at 110.

[70] *Id.* at 74. *See* 2019 IRP at 113–115 for specific resource modeling assumptions within the Plexos model. Also, on November 2, 2020, an Informal Conference was held where Kentucky Power provided further explanation of modeling assumptions and a demonstration of how the Plexos model worked.

[71] *Id.* at 83.

[72] *Id.* at 83–84. Note that the impacts of Kentucky Power's existing demand-side management and EE programs are accounted for in the long-term load forecast.

[73] *Id.* at 88. Based on the results of programs in Kentucky Power affiliates' service territories, a 1 percent reduction in circuit voltage resulted in an energy demand saving of 0.7-1.2 percent. IRP at 60.

[74] *Id.* at 89.

[75] *Id.* at 90.

[76] *Id.* at 92.

In addition to demand-side resource options, Kentucky Power modeled various supply-side resource options. For the IRP Kentucky Power followed assumptions of is parent company, AEP, in regards to the cost and performance characteristics of alternative supply-side capacity options. AEP relies on its own experience, association with industry organizations including EPRI and EEI, and contacts equipment manufacturers, to keep its data current.[77] The table below highlights examples of possible new generation technology characteristics maintained by AEP:

New Generation Technology Options[78]

Resource Type	Capability (MW)			Installed Cost($/kW)	Capacity Factor(%)	LCOE ($/MWh)
	Std. ISO	Summer	Winter			
Base Load						
Nuclear	1,610	1,560	1,690	8,500	80	174.3
Pulv. Coal with Carbon Capture (PRB)	540	520	570	9,500	75	216.6
Combined Cycle (1X1 "J" Class)	610	800	820	900	75	60.2
Combined Cycle (2X1 "J" Class)	1,230	1,600	1,640	700	75	56.1
Combined Cycle (2X1 "H" Class)	1,150	1,490	1,530	700	75	56.9
Peaking						
Combustion Turbine (2 - "E" Class)	180	190	190	1,200	25	148.9
Combustion Turbine (2 - "F" Class, w/evap coolers)	490	500	510	700	25	117.2
Aero-Derivative (2 - Small Machines)	120	120	120	1,100	25	135.7
Recip Engine Farm	220	220	230	1,300	25	126.6
Battery	10	10	10	1,900	25	157.1

For planning purposes, Kentucky Power modeled both base load and peaking generation technology options. For base load and intermediate resources, Kentucky Power modeled natural gas-fired combined cycle (NGCC) technology as this technology typically has relatively low capital costs and emissions levels, small footprints, high reliability and operating efficiency. Kentucky Power did not include nuclear or coal-fired generation technologies, as the construction of either technology was uneconomic.[79]

Multiple peaking technologies were considered for inclusion in the Plexos model including simple cycle natural gas combustion turbine (SCCT), aeroderivatives,

[77] *Id.* at 93.

[78] *Id. See* Table 13 at 93. *See also* Exhibit D for an expanded table with key assumptions.

[79] *Id.*

reciprocating engines, battery storage, and short-term market purchases (STMP). Additionally, renewable options such as utility scale solar, wind, hydroelectric and biomass were modeled. Advantages of a SCCT include low cost, operating ease, and fast start up[80]. Aeroderivatives are jet engines, are smaller than SCCTs, though the cost per kW is higher, have short start up times and are suitable for being run multiple times per day.[81] Reciprocating engine generators typically range from 8 MW to 18 MW, are highly efficient, illustrate flat heat rate curves, and possess rapid response times. In addition, this technology is less affected by elevation and ambient temperatures than gas-fired technology.[82] Kentucky Power modeled 10 MW lithium ion battery storage technology. Kentucky Power also modeled STMP, allowing the model to select capacity market purchases through 2024 as an alternative to constructing additional generation capacity.

Noting that renewable resources typically provide more energy than capacity due to their intermittent nature and both solar and wind technologies have been decreasing in installed and operating cost,[83] for the IRP Kentucky Power limited wind to 30 percent and solar to 15 percent of energy demand.[84] Solar resources were modeled in Plexos in two tiers or 152 MW each with an overall limit of 455 MW over the planning period and capacity factors of 24 percent.[85] For wind, Kentucky Power also modeled it in two tranches. The first tranche as a 100 MW block with a 37 percent capacity factor. The second tranche was modeled as a 100 MW block with a 35 percent capacity factor. Both tranches were made available to the model starting in 2023. Neither hydroelectric nor biomass generation resources were included in the modeling. Hydroelectric resources were excluded due to long environmental study and construction times and permitting issues.[86] Biomass was excluded from consideration due to its high cost and feed stock requirements.[87]

At the hearing, Kentucky Power explained that the Plexos model takes into account the fixed and variable resource costs as well as the forecasted hourly energy prices to arrive at a cumulative present worth of revenue requirements for different resource option

[80] *Id.* at 95–96.

[81] *Id.* at 96.

[82] *Id.* at 97.

[83] *Id.* at 100 and 102–102. *See* also 2019 IRP at 104. Federal tax credits were included in the pricing of both solar and wind resources.

[84] *Id.* at 100.

[85] *Id.* at 101.

[86] *Id.* at 105.

[87] *Id.* at 106.

plans.[88] It will not necessarily choose the absolute lowest cost resource mix. Kentucky Power noted that cost is a factor, but the timing and amount of capacity needed in a given period can also be an important factor.[89] Therefore, Kentucky Power may choose a resource plan with a slightly higher overall cost. In arriving at the preferred plan resource mix, Kentucky Power evaluated multiple commodity pricing and resource mix options.[90] The table below contains Cumulative PJM Capacity Additions (MW) for the modeled preferred plan.[91]

Commodity Pricing Scenario	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
New Nat. Gas											122	122
New Solar (Nameplate)			101	253	253	253	253	253	253	253	455	455
New Solar (Firm)			52	129	129	129	129	129	129	129	233	233
New Wind (Nameplate								100	100	200	200	200
New Wind (Firm)								12	12	25	25	25
New EE		2	4	6	5	5	4	4	3	3	3	3
New VVO				4	4	4	4	4	4	4	8	8
New DG			1	2	2	2	2	2	3	3	4	4
STMP		150	100									
Reserves (MW) without new additions	232	(141)	(141)	(138)	(136)	(133)	(132)	(131)	(131)	(130)	(392)	(392)
Reserves (MW) with new additions	232	11	15	2	5	7	8	21	21	34	2	1

Note that there are no further capacity additions in the preferred plan after 2030 - 2024

In the table above, the preferred plan shows that after the expiration of the Rockport UPA (391 MW) in December 2022, the summer reserves with new capacity additions are 11 MW and 15 MW in 2022 and 2023. Then, when the short term market purchases drop off, the bulk of the capacity deficit is made up of 253 MW nameplate and 129 MW firm solar capacity in 2024 and reserves fall from 15 MW in 2023 to 2 MW in 2024.[92]

Kentucky Power explained that it, along with its sister AEP East regulated FRR companies (Indiana Michigan Power, Kentucky Power, Appalachian Power, West Virginia

[88] *See* December 10, 2020 Hearing Transcript (Hearing Transcript) at 2:13:12–2:20:15.

[89] 2019 IRP at Section 5.3.2 at 129–131.

[90] See the discussion in the IRP Sections 5.2 and 5.3 at 115–133.

[91] See IRP Section 5.3 Table 17 at 128.

[92] Note that for planning purposes and at the time the IRP analysis was based upon, PJM assigned 51.1 percent of nameplate solar capacity (effective load carrying capability) as what can be counted toward a utility's capacity obligation currently. See Hearing Transcript at 10:50:15-10:51:19.

Power, Wheeling Power and Kingsport Power)[93] have a FERC approved pool arrangement known as the Power Coordination Agreement (PCA), and that through the PCA, it would make the STMP through May 2023. Within the PCA, companies that are long on capacity over their FRR capacity obligation will make a bilateral sale to companies that are short on capacity.[94] Multiple capacity long companies can make a sale jointly and will share the revenue proportionately.[95] In addition, Kentucky Power explained that the FRR plan filed with PJM includes the combined resources of the regulated AEP East FRR companies.[96] Within the context of satisfying its FRR obligation, Kentucky Power will make the STMPs in 2022 and 2023 from its regulated sister AEP FRR companies who are long on capacity through the PCA.[97] The clearing price for the sale is the PJM Base Residual Auction capacity-clearing price.[98]

Kentucky Power went on to explain that under the PJM FRR construct, it was satisfying its PJM FRR summer peak capacity obligations only and that during the winter, market energy purchases was all that was required to satisfy its demand requirements. In other words, KRS 278.030 did not require it to maintain any given level of capacity.[99] Kentucky Power explained that the Service Corporation manages sales and purchases for the companies participating in the PCA as a block within PJM's markets.[100]

Also noted during the hearing is that Kentucky Power models its IRP to satisfy the PJM summer peak capacity requirements as opposed to its own winter peak requirements.[101] As noted, Kentucky Power is a winter-peaking utility whose winter demand is far greater than its summer demand. Therefore, the IRP and the preferred plan presents an incomplete and misleading picture of Kentucky Power's true capacity needs overall as presented to the Commission and to its ratepayers.[102] Kentucky Power went on to explain that to the extent the winter load is higher than its summer PJM

[93] Hearing Transcript at 10:36:39-10:37:21.

[94] 2019 IRP, Section 3.2 at 41; and Hearing Transcript at 10:25:49–10:26:58.

[95] Hearing Transcript at 10:26:59–10:27:30.

[96] Hearing Transcript at 10:36:30–10:39:15.

[97] Hearing Transcript at 10:27:31–10:29:47.

[98] Hearing Transcript at 10:32:55–10:34:03.

[99] Hearing Transcript at 11:05:20–11:06:40. *See also* Kentucky Power's Response to Staff's Post-Hearing Data Request, Items 1-2.

[100] Hearing Transcript at 10:35:06–10:36:03.

[101] Hearing Transcript at 10:56:13–10:57:51.

[102] *See* 2019 IRP Section 5.3 Table 17 at 128. *See also* 2019 IRP at ES-2. Kentucky Power states that it's "IRP provides adequate supply and demand resources to meet its peak load and energy obligations for the next fifteen years."

obligation, that it would be a pure energy settlement and that the company could purchase that energy through the PJM energy market.[103]

Kentucky Power's argument, even though it is capacity short in the winter and its winter load may be satisfied with energy purchases through the PCA, does not appear to be very different from actions it would take as a PJM RPM company. Staff is concerned that Kentucky Power's reliance on the PCA, while advantageous for short-run purchases to satisfy winter demand and energy requirements, has allowed it to potentially circumvent state requirements for having sufficient capacity to serve its native load customers, in spirit, if not in fact.[104]

SIGNIFICANT CHANGES

Since the 2016 IRP, lower natural gas and coal price trends are driving continued declines in fundamental prices. In the 2019 IRP, annual delivered natural gas prices over the forecast period range from $3.07 to $4.12 per MMBtu and are approximately $2.00 less than 2016 IRP forecast. Similarly, annual Illinois Basin coal prices range from $42.94 to $34.06 per ton over the forecast period and are approximately $4 to $10 less than the 2016 IRP forecast.[105] PJM energy and capacity forecasts in the 2019 IRP are uniformly lower than in the 2016 IRP. Over the forecast period, annual on-peak energy prices range from $29.24 to $39.41 per MWh and are approximately $10 to $22 per MWh lower than in 2016. In addition, annual off-peak energy prices range from $24.15 to $33.21 per MWh and are approximately $5 to $20 per MWh lower than in 2016. Annual capacity price forecasts ranges are significantly higher in 2019 over 2016 prices until 2030 when the 2016 forecast prices overtakes the 2019 forecast. Other than two aberration years, 2019 annual forecast capacity prices fall from around $82.69 per MW to $50.75 per MW.[106] The 2019 IRP still contains a carbon pricing proxy; however, in the 2019 IRP, the CO_2 price is $15 per metric ton beginning in 2028 whereas the 2016 IRP had a CO_2 price of $3 per metric ton in 2024 climbing to $20 by 2030.[107] Finally, unlike the 2016 IRP, Kentucky Power did not include the renewal of the Rockport UPA, which expires on December 7, 2022.[108]

Regarding the 2019 IRP preferred plan, the most significant difference from the 2016 plan is the greater inclusion of renewable capacity over the forecast period totaling 455 MW of solar and 200 MW of wind by 2034 whereas the 2016 plan included the

[103] Hearing Transcript at 10:58:36–10:59:36.

[104] Kentucky Power's response to Staff's Post-Hearing Data Request, Items 1-2, appears to indicate that Kentucky Power does not believe that KRS 278.030 requires it to maintain capacity beyond what is required to fulfill its PJM capacity obligations.

[105] 2019 IRP, Tables 1 and 2 at 4–5.

[106] *Id.* at Table 1.

[107] *Id.* at 5.

[108] *Id.*

addition of 130 MW of solar and 300 MW of wind by 2031. The current plan also includes a 122 MW aeroderivative unit rather than combined heat and power installation and much less DSM savings from VVO and EE for a total of 10 MW as compared to 89 MW of DSM in the 2016 IRP.[109]

PUBLIC COMMENTS

The Southern Renewable Energy Association (SREA) filed multiple comments regarding Kentucky Power's IRP.[110]

- Kentucky Power's renewable energy price assumptions for solar and wind resources of approximately $50 per MWh in 2023 and $60 per MWh in 2024 are much higher than current and near term forecast market offerings.[111] SREA goes on to recommend that Kentucky Power benchmark its assumptions against the National Renewable Energy Laboratory's Annual Technology Baseline for appropriate renewable energy and energy storage cost assumptions or other publically available requests for proposals or power purchase agreement contracts.[112]

- Kentucky Power should expand evaluation of renewable generation resources beyond "in Kentucky only." Specifically, Kentucky Power should analyze:
  - In-state renewable energy resources,
  - Out-of-state renewable energy resources in PJM,
  - Fixed-tilt and single axis tracking solar resources,
  - Hybrid and energy storage resources, and
  - Self-build, build-own-transfer and power purchase agreement contractual configurations.[113]

- Kentucky Power should allow the model to co-optimize wind and solar energy resource to achieve the best mixture of renewable energy resources. SREA notes that Kentucky Power relied upon outdated studies as basis for its assumptions to cap renewable energy penetration at a possible 30 percent for wind and 15 percent for solar. In addition, several states have already installed capacity that surpasses those modeling limitations.[114]

- Kentucky Power unnecessarily restricted the amounts of wind and solar resources to 200 MW and 152 MW per year, respectively. In addition, the SERA claims

[109] *Id.*

[110] See Southern Renewable Energy Association comments filed October 16, 2020.

[111] *Id.* at 2.

[112] *Id.* at 3.

[113] *Id.* at 7.

[114] *Id.* at 7–8.

the model was restricted from selecting these resources as early as possible. SREA cited an AEP Partners RFP for wind and solar resources in PJM with contract execution in five months as evidence that it is possible from a modeling perspective that these types of resources can be obtained without the longer delays assumed by Kentucky Power.[115]

- Kentucky Power should improve its evaluation of energy storage. Even though accurate modeling is difficult and data is scarce regarding the value of energy storage, it is not clear whether Kentucky Power evaluated the "value stack" of energy storage potential appropriately.[116] SREA notes that it is unclear exactly what the costs used in this IRP represent and that they appear to be higher than current market offerings.[117] Finally, SREA notes that even though battery storage was excluded from the resources available to the model, AEP and Kentucky Power filed a request at FERC to approve its Middle Creek energy storage project in July 2020. The projects inferred cost is substantially higher than the Company's cost assumptions in this IRP and other publicly available sources.[118]

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

- Provide a status report of Kentucky Power's implementation and operation with respect to the CP requirements in PJM and any related impacts.

- Include a discussion of the status of and any changes or modifications that are under consideration for the PCA and the potential impacts to Kentucky Power.

- In the Modeling for supply side resources, provide models that include and exclude the Rockport units, including all environmental costs for the model that includes the UPA throughout the planning period, and a comparison of the results.

- Provide current specific discussion on pending renewable generation sought by Kentucky Power in its system, or by coordination with other utilities.

- Discuss the status of cogeneration and CHP opportunities in its service territory and the consideration given to cogeneration and CHP in the resource plan.

- Identify and describe currently installed net metering systems.

- Provide additional specific discussions of the improvements and more efficient utilization of generation, transmission and distribution facilities as required by 807 KAR 5:058, Section 8(2)(a).

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[115] *Id.* at 8.

[116] *Id.*

[117] *Id.* at 9.

[118] *Id.* at 10–11.

- Discuss system reliability and the criteria used to determine appropriate summer and winter reserve margins. Identify the capacity margin required by PJM and how it correlates to the reserve margin Kentucky Power used prior to its RTO membership.

- In addition to describing how Kentucky Power is addressing current and pending environmental regulations and anticipated new regulations and legislation, the next IRP should address the expected impact and changes on the costs and operations of Kentucky Power from these environmental regulations and or legislation.

DISCUSSION OF REASONABLENESS

Staff considers Kentucky Power's supply-side resource assessment to be thoughtful, but as expressed later in this report, is concerned that it is focused on meeting PJM requirements only and does not address the winter peak of the utility itself. Although Staff is not concerned with the focus on renewables, Staff has concerns regarding the uncertainty whether renewable resources will be located in Kentucky Power territory, in the AEP zone, or outside the AEP zone. Further, Staff is concerned that Kentucky Power arbitrarily capped certain resources, such as solar, and made self-imposed modeling assumptions regarding CT resources based only on locating resources within the AEP zone, excluding any sources outside the AEP zone. Staff is also concerned about the potential cost of mitigating transmission constraints, which are not included in the modeling process. Staff believes the modeling software of Plexos is a capable modeling program.

Staff concurs with SREA that the Kentucky Power should use the National Renewable Energy Laboratory's Annual Technology Baseline for appropriate renewable energy and energy storage cost assumptions in future resource planning.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

- Kentucky Power's response to the Staff's post-hearing information request[119] indicates that it does not believe that KRS 278.030 requires it to have sufficient capacity to fulfill its annual peak demand. Further, it believes that it is only required to fulfill its PJM required capacity obligations and that any winter demand in excess of summer PJM capacity requirements can be satisfied with energy purchases.[120] Kentucky Power should provide a detailed cost benefit study demonstrating why it should continue to participate in PJM as an FRR versus RPM, and discussing the advantages of remaining an FRR company.

- Kentucky Power should, if not already included in the prior study, conduct a separate FRR versus RPM cost benefit study similar to the first, except that the analyses

[119] Kentucky Power's Response to Staff's Post-Hearing Data Request, Item 1.

[120] *Id.* Item 2.

should explicitly assume the Mitchell station will continue generating beyond 2028 and then assume the Mitchell station will retire in 2028.

- Kentucky Power should explicitly discuss how and demonstrate that its winter capacity requirements are being satisfied over the forecast horizon. The discussion should include the role the PCA plays in the satisfaction of Kentucky Power's seasonal capacity and energy requirements.

- Kentucky Power should explicitly describe its evaluation of the inclusion of Kentucky base generation merchant plants and how those costs compare to other alternate supply-side resources.

- Kentucky Power should explain the costs and benefits of acquiring renewables through purchased power contracts or through the construction of the facility itself generally and specifically in support of any renewable capacity additions.

- Kentucky Power should explain the costs associated with upgrading the transmission system so to accommodate any renewable generation capacity.

- Kentucky Power should model the impact to the Mitchell Plant due to the publication of the final ELG rule along with any impacts to Kentucky Power's preferred supply side plan to meet its PJM reserve margin requirements and its anticipated winter capacity and demand requirements.

- Kentucky Power should model scenarios of differing renewable constraints and no constraints on the size or addition.

- If Kentucky Power has not pursued any of the preferred plan options or has pursued another option by the next IRP, provide a detailed explanation of why and a detailed explanation and modeling of any alternate course taken.

SECTION 5

INTEGRATION AND PLAN OPTIMIZATION

The final step in the IRP process is to integrate supply-side and demand-side options to achieve the optimal resource plan. This section will discuss the integration process and the resulting Kentucky Power plan.

For the resource evaluation, the capacity resource requirement evaluation must include current and anticipated capacity resources, environmental impacts, changes in efficiencies, current DR and EE resources, capacity and transmission constraints and limitations, changes that can result from decisions surrounding unit deposition evaluations, overall load and peak demand, and PJM requirements regarding reserve margins and reliability. PJM requirements are short term in nature in that after 2022, capacity requirements and margins are based upon Kentucky Power's own internal forecasted demand at the projected PJM annual peak.

Regarding environmental issues and implications, the IRP is modeled on those requirements in effect at the time and any options modeled are those that Kentucky Power considered to be most likely implemented. Concern regarding the August 31, 2020 Steam Electric Reconsideration Rule for effluent limitation guidelines and pretreatment standards (ELG) limits for existing facilities which established new compliance dates, among other things, and the Final Coal Combustion Residuals (CCR) Rule was noted during the course of discovery. Kentucky Power responded that estimated compliance costs were included in their analysis and that the final CCR and ELG rules were largely consistent with the inputted IRP assumptions.[121] Kentucky Power further noted that the estimated compliance costs for the Mitchell Plant have increased since the December 2019 IRP filing and any significant changes will be noted in the near future.[122] For the IRP, environmental requirements modeled include those that support the Clean Air Act, National Ambient air Quality Standards, Cross-State Air Pollution Rule, Mercury and Other Hazardous Air Pollutants, CO2 Regulation, the CCR Rule, Clean Water Act Regulations, and the New Source Consent Decree.[123]

Regarding transmission constraints, Kentucky Power is part of the AEP eastern transmission system. AEP's transmission system footprint consists of numerous interconnections and is designed and operated to conform to the North American Electric Reliability Corporation Reliability Standards. The recent uptick of merchant generation has yielded numerous studies to assess the impact of the connection and requires transmission system upgrades or modifications, or both. For Kentucky Power, the transmission network in the Hazard-Wooten area is prime example of a transmission

[121] Kentucky Power's Response to Staff's Third Request for Information, Item 1.

[122] *Id*.

[123] For a complete list of environmental inputs, see, IRP, Section 3.3, at 42–51.

enhancement so to meet current reliability standards.[124] On behalf of Kentucky Power, AEP coordinates its regional expansion plan with PJM as part of the regional Transmission Expansion Plan process so to ensure interregional reliability. For both near-term and long-term planning, the impact of both supply- and demand-side resources is evaluated to ensure adequate transmission reliability. Kentucky Power must not only ensure sufficient transmission capacity for its own demand, but as a member of PJM and in compliance with FERC Orders 888 and 889, the transmission system must support the wholesale electric energy market as well as support the power supply and transmission reliably needs of the PJM–MISO joint market.[125]

For the modeling, Kentucky Power states that its objective is to recommend a system resource expansion plan that is least cost driven, but also incorporates planning flexibility, asset mix considerations, adaptability to risk, be environmental complaint, and conforms to applicable NERC and RTO criteria.[126] Kentucky Power also allows for selected resources to not be locational specific.[127] Kentucky Power notes that the fulfilling the regulatory obligation to serve native load is only one cornerstone of the Kentucky Power's IRP process and hence the optimal plan may not be the absolute least cost as all inputs are difficult to monetize.

Utilizing the Plexos model, potential supply- and demand-side proxy resources as well as a scenario of economic conditions are inputted to create an optimal portfolio of resources. Four pricing scenarios and two load scenarios were analyzed: Base Case, High Commodity Price Case, Low Commodity Price Case, No Carbon, Low Load Case, and High Load Case. The optimized portfolios developed under the four pricing scenarios include similar resource additions and include a STMP of 150 MW in 2022 and 100 MW in 2023, an addition of 200 MW of nameplate wind resources in 2023, additional 150 MW of nameplate solar by 2024 and increasing to 455 MW in 2034, and 122 MW of Aeroderivative Natural Gas unit in 2031[128]. Also, all scenarios modeled EE initiatives and all but the high band price selected VVO. For the load scenarios, a similar portfolio resulted as STMP's were selected in 2022 and 2023, and 200 MW of wind was selected in 2023.[129] Not unexpectedly, the High Load scenario resulted in more capacity additions both sooner and overall.

Kentucky Power also developed a two additional "bookend" cases where specific resources were introduced during the planning period.[130] Case 7 introduced a

[124] 2019 IRP, Section 3.5.1, at 63.

[125] 2019 IRP, Section 3.5.5, at 66.

[126] 2019 IRP, Section 4.1 at 73.

[127] 2019 IRP, Section 4.1 at 73.

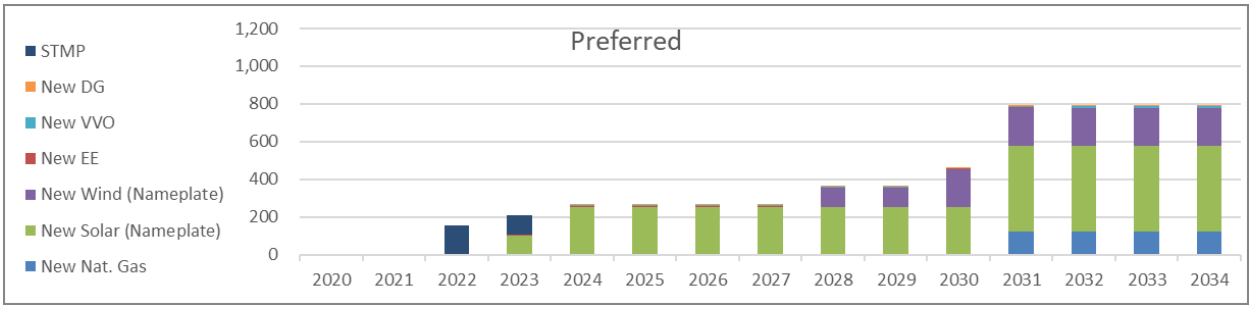
[128] 2019 IRP, Section 5.2.2.1 at 117–118.

[129] 2019 IRP, Section 5.2.2.2 at 120.

[130] 2019 IRP, Section 5.2.2.3, at 121.

combustion turbine (CT) in 2023 while Case 8 introduced a Combined Cycle (CC) in 2024. The results still included the addition of wind beginning in 2023 but a delay of solar additions into 2030.[131] Both of the additional cases were more costly than the Base Case. Finally, Kentucky Power analyzed four Stakeholder Scenarios where a single resource was utilized through 2030 to meet capacity needs. The results of all four cases were higher than all other IRP scenarios.[132]

All scenarios provided Kentucky Power insight into the future and potential resource mixes. The development of the preferred plan includes STMP, solar, wind, EE and VVO DSM, and an Aeroderivative unit. The preferred plan recognizes a declining customer base and flat retail sales growth through 2034, minimal growth of internal energy and a decline in peak demand through 2034, cost minimization to customers, a reliance on a diverse mix of resources, and the addition of renewable energy resources in a cost-effective manner. The Cumulative Present Worth (CPW) of the preferred plan is $4,693,977.[133] The preferred plans' CPW is slightly higher than the Base Case CPW. Kentucky Power noted this difference but also notes that through the first 10 years the preferred plan is less and is near parity over 15 years.[134] The following figure illustrate the cumulative capacity additions and the reserves relative to the PJM required reserve levels.[135]



Noting that the cost assumption is suggestive in nature as any investment decision and associated rate changes are subject to regulatory approval, the estimated bill impacts of the preferred plan increases from $0.122/kWh in 2020 to $0.135 in 2028 to $0.140 in 2040 in 2020 dollars.[136] This increase is based upon the assumption that Kentucky Power does not add any major new baseload generation, but consists of the investment and/or purchase obligations of renewable projects, new EE programs, and small-peaking unit additions.

[131] 2019 IRP, Section 5.2.2.3 at 122.

[132] 2019 IRP, Section 5.2.2.4 at 126.

[133] 2019 IRP, Section 5.3.2 at 130.

[134] 2019 IRP, Section 5.3.2 at 129.

[135] 2019 IRP, Section 5.3 at 128.

[136] 2019 IRP, Section 5.3.4 at 134.

In addition to comparing the preferred plan to optimized portfolios under varying pricing assumptions, Kentucky Power also evaluated the preferred plan and an alternative portfolio using a stochastic or Monte Carlo modeling technique. Kentucky Power states that doing so allows the company to "test" the preferred plan over a distribution of key variables and, in turn, the output is a distribution of possible outcomes which provides insight to the risk or probability of a higher cost or revenue requirement relative to the expected outcome.[137] Through evaluating the outcome, the Revenue Requirement at Risk between the portfolios is relatively small and favors the preferred plan; and therefore, Kentucky Power believes the inherent risk characteristics of the preferred plan are comprised of a reasonable combination of expected costs and risk.[138]

Overall, Kentucky Power believes the preferred plan allows Kentucky Power to meet its customers' requirements with existing resources, the use of STMP, and investments in renewable resources and EE while balancing cost and other factors.[139] Kentucky Power further supports this plan stating that it will reduce Kentucky Power's reliance on coal-based generation and increase reliance on demand-side and renewable resources, further diversifying their portfolio.[140] Kentucky Power also notes that the preferred plan is not a commitment to specific resource additions or other courses of action, and that the resource planning process is becoming increasingly complex due to regulatory restrictions, technology advancement, changing energy supply pricing fundamentals, uncertainty of demand and end-use efficiency improvements.[141] Kentucky Power notes that it intends to pursue a three-year action plan, which includes the following:[142]

- Pursue economic development opportunities. This includes looking at green power tariff alternatives.
- Explore opportunities to initiate a Request for Proposal to add cost-effective market capacity purchases and solar and wind resources.
- Examine opportunities to increase cost-effective levels of EE.
- Keep abreast and assist in formulating plans for Kentucky pertaining to the Affordable Clean Energy rule to replace the Clean Power Plan with new emission guidelines for regulating CO2 from existing resources.
- Address any changing circumstances.

[137] 2019 IRP, Section 5.4.5 at 134–135.

[138] 2019 IRP, Section 5.3.5.1 at 138.

[139] 2019 IRP, Section 6.0 at 139.

[140] 2019 IRP, Section 6.0 at 141–142.

[141] 2019 IRP, Section 6.1 at 144.

[142] 2019 IRP, Section 61, at 144–145.

DISCUSSION OF REASONABLENESS

Staff is generally satisfied with Kentucky Power's integration process as well as its risk analysis and plan optimization. However, the Commission expresses concern that the preferred plan is strategized so to meet PJM and AEP zonal peaks and not to meet the internal needs of Kentucky Power. Kentucky Power does not agree that is has an obligation under KRS Chapter 278 to maintain sufficient generating capacity to serve native load, but has an obligation to provide adequate, efficient, and reasonable service with fair, just and reasonable rates and as a result believes it satisfies both its statutory obligations through its participation as a load serving entity in PJM through the Fixed Resource Requirement alternative.[143] However, on page 1 of the IRP's executive summary, Kentucky Power Kentucky Power states that the purpose of their 2019 IRP is to explain how Kentucky Power plans to meet the projected capacity and energy requirements of ***its customers*** (emphasis added).[144] Staff expresses its concern that the preferred plan is not designed to meet winter peaking capacity needs of Kentucky Power, but the summer peaking needs of PJM and plans to rely on market energy purchases and on financial or contractional hedges.[145] Staff stresses to Kentucky Power that the utility needs to think of its native customers and its commitment to those customers when evaluating energy and capacity options and recommends that for the next IRP, Kentucky Power illustrate that the preferred plan meets internal peaks of the company.

[143] Kentucky Power's Response to Staff's Post-Hearing Data Request, Item 1.

[144] 2019 IRP at ES-1.

[145] Kentucky Power's Response to Staff's Post-Hearing Data Request, Items 2 and 3.

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