

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC 2016 INTEGRATED RESOURCE)	
PLANNING REPORT OF KENTUCKY POWER)	CASE NO.
COMPANY TO THE PUBLIC SERVICE)	2016-00413
COMMISSION OF KENTUCKY)	

ORDER

The Commission initiated this proceeding for its Staff to conduct a review of the 2016 Integrated Resource Plan (“IRP”) filed by Kentucky Power Company (“Kentucky Power”) pursuant to 80 KAR 5:058. Attached as an Appendix to this Order is the report summarizing Commission Staff’s review of the IRP (“Staff Report”). This 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 the 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 THEREFORE ORDERED that:

1. The Staff Report on Kentucky Power’s 2016 IRP represents the final substantive action in this matter.
2. Any comments with respect to the Staff Report shall be filed within ten days of the date of entry of this Order.
3. An Order closing this case and removing it from the Commission’s docket shall be issued after the period for comments on the Staff Report has expired.

By the Commission



ATTEST:


Executive Director

APPENDIX

APPENDIX TO AN ORDER OF THE KENTUCKY PUBLIC SERVICE
COMMISSION IN CASE NO. 2016-00413 DATED **APR 05 2018**

Kentucky Public Service Commission

Staff Report On the 2016 Integrated Resource Plan of Kentucky Power Company

Case No. 2016-00413

April 2018

SECTION 1

INTRODUCTION

In 1990, the Kentucky Public Service Commission (“Commission”) promulgated 807 KAR 5:058 to create an integrated resource planning process to provide for review of the long-range resource plans of Kentucky’s jurisdictional electric generating utilities by Commission Staff (“Staff”). The Commission’s goal 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 at the lowest possible cost.

Kentucky Power Company (“Kentucky Power”) filed its 2016 Integrated Resource Plan (“IRP”) with the Commission on December 20, 2016. The IRP includes, among other things, Kentucky Power’s plan for meeting its customers’ electricity requirements over a 15-year forecast period from 2017 through 2031.

By Order dated January 19, 2017, a procedural schedule was established that provided for two rounds of data requests, an opportunity for Intervenor to file written comments, and an opportunity for Kentucky Power to file a response to any Intervenor comments. Intervenor in this matter are the Attorney General of the Commonwealth of Kentucky, by and through the Office of Rate Intervention (“Attorney General”); Kentucky Attorney General Industrial Utility Customers, Inc., (“KIUC”); and Jim Webb and the Sierra Club (jointly “Sierra Club”).

Kentucky Power, a subsidiary of American Electric Power (“AEP”), supplies electricity to approximately 168,000 retail customers in eastern Kentucky. As part of its customer base, Kentucky Power serves the metal, chemical and allied products, petroleum refining, and coal mining industries. Kentucky Power also provides wholesale power to the Vanceburg and Olive Hill municipal electric systems.

This report provides a review and evaluation of Kentucky Power’s 2016 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, and make suggestions and recommendations to be considered in future IRPs. Staff recognizes resource planning to be a dynamic and ongoing process. Specifically, Staff’s goals are to ensure that:

- All resource options are adequately and fairly evaluated;
- Critical data, assumptions, and methodologies for all aspects of the plan are adequately documented and are reasonable; and
- The report also includes an incremental component, noting any significant changes from Kentucky Power’s most recent IRP, filed in 2013.¹

¹ Case No. 2013-00475, *Integrated Resource Planning Report of Kentucky Power Company to the Kentucky Public Service Commission*, (Ky. PSC Dec. 8, 2014) (“2013 IRP”).

Kentucky Power is one of the AEP operating companies that comprise the AEP eastern transmission system (“AEP-East”). For more than 75 years, the AEP-East utilities that owned generating facilities coordinated the planning and operation of their generation under the provisions of the AEP Interconnection Agreement (“Pool Agreement”). The AEP-East utilities terminated the Pool Agreement effective January 1, 2014, resulting in Kentucky Power being responsible for its own load requirements for capacity, including any required reserve margin. Kentucky Power is a party to a power coordination agreement (“PCA”).² The most recent change to the PCA was the addition of Wheeling Power Company (“WPCo”) effective June 1 2015. This addition was the result of WPCo acquiring a 50 percent undivided interest in the Mitchell Plant. This change had no impact on Kentucky Power’s obligation under the PCA. Kentucky Power states that no further changes to the PCA are under consideration at this time.³

Kentucky Power’s system peak demand historically has occurred in the winter season. Kentucky Power reported its record system peak of 1,685 megawatts (“MW”) in January 2005.⁴ Its record summer peak demand, 1,358 MW, occurred in July 2005.⁵ Kentucky Power’s most recent summer peak was 1,044 MW, on August 9, 2016, and its most recent winter peak was 1,342 MW, on January 19, 2016.⁶ In 2015 Residential, commercial, and industrial sales accounted for approximately 32, 20, and 40 percent of its load, respectively.⁷ The remaining 8 percent of its load was attributed to public-street and highway lighting, sales for resale, and all other categories.

On January 1, 2014, Kentucky Power added 780 MW of capacity when it acquired a 50 percent ownership interest in Units 1 and 2 of the Mitchell Plant

² The PCA currently provides for Appalachian Power Company (“APCo”), Indiana Michigan Power (“I&M”), Kentucky Power and WPCo to participate collectively (a) under a common Fixed Resource Requirement (“FRR”) capacity plan in PJM Interconnection, LLC (“PJM”), and (b) in specified collective off-system sales and purchase activities. Under the PCA, generation is not planned on a single-system basis as it was under the previous Pool Agreement. Rather, APCo, I&M, Kentucky Power and WPCo, individually, are required to own or contract for sufficient generation to meet their respective load and reserve obligations.

³ IRP at 30.

⁴ *Id.* at 28.

⁵ *Id.*

⁶ *Id.*

⁷ *Id.* at 170, Exhibit C-1.

generating facility located in Moundsville, West Virginia.⁸ This acquisition was based on Kentucky Power's decision to retire Big Sandy Unit 2 in 2015 rather than incur the cost to bring the unit into compliance with environmental emissions limits established by the U.S. Environmental Protection Agency ("EPA"). On December 6, 2013, Kentucky Power submitted an application for Commission approval to convert Big Sandy Unit 1 to natural gas, also in response to environmental emission limits.⁹ The Big Sandy Unit 1 conversion was completed in 2016 and has a PJM Installed Capacity rating of 285 MW.¹⁰ Kentucky Power has a unit power agreement under which it purchases 393 MW of capacity from the affiliate-owned Rockport Plant in southern Indiana ("Rockport UPA"). While the agreement, by its terms, will expire on December 7, 2022, for purposes of its IRP, Kentucky Power assumed the Rockport UPA would be in effect through the entire 15-year IRP planning period.¹¹ A dry sorbent injection system was installed on Rockport Units 1 and 2 in 2015, resulting in no change to unit capacities.¹²

In order to determine the appropriate level and mix of incremental supply-side and demand-side resources to include in its portfolio, Kentucky Power utilized the *Plexos Linear Program* ("*Plexos LP*") optimization model to develop least-cost resource portfolios under a variety of pricing and load scenarios.¹³ Kentucky Power used the results of the modeling to develop a Preferred Plan in the IRP during the 2017-2031 planning period.¹⁴ The major features of the Preferred Plan include: (1) investing \$6 million/year in demand-side management ("DSM") through 2024; (2) adding 75 MW (nameplate capacity)/year of wind resources beginning in 2018, for a total of 300 MW through 2021; (3) adding utility scale solar, beginning with 10 MW in 2019, for a total of 130 MW by 2031; (4) implementing customer and grid energy efficiency ("EE") programs, including Volt VAR Optimization ("VVO"), reducing energy requirements by

⁸ Case No. 2012-00578, *Application of Kentucky Power Company for (1) a Certificate of Public Convenience and Necessity Authorizing the Transfer to the Company of an Undivided Fifty Percent Interest in the Mitchell Generating Station and Associated Assets, (2) Approval of the Assumption by Kentucky Power Company of Certain Liabilities in Connection with the Transfer of the Mitchell Generating Station, (3) Declaratory Rulings, (4) Deferral of Costs Incurred in Connection with the Company's Efforts to Meet Federal Clean Air Act and Related Requirements, and (5) All Other Required Approvals and Relief* (Ky. PSC Oct. 7, 2013).

⁹ Case No. 2013-00430, *Application of Kentucky Power Company for a Certificate of Public Convenience and Necessity Authorizing the Company to Convert Big Sandy Unit 1 to a Natural Gas-Fired Unit and for All Other Required Approvals and Relief* (Ky. PSC Aug. 1, 2014).

¹⁰ IRP at 61.

¹¹ *Id.* at 14.

¹² *Id.* at 61.

¹³ *Id.* at 15. Kentucky Power modeled the results through 2035, instead of the 15-year planning period in the IRP, to properly consider the various cost-based "end-effects" for the resource alternatives being considered.

¹⁴ *Id.*

over 90 gWh and 70 MW of capacity by 2031; (5) assuming customers add Distributed Generation (“DG”) (i.e. rooftop solar) capacity totaling 1.1 MW (nameplate) by 2031; (6) adding 10 MW (nameplate) of battery storage resources in 2025; (7) assuming a host facility is identified such that a combined heat and power (“CHP”) project can be implemented by 2022; (8) continuing operation of its existing generation facilities, including Big Sandy 1, through 2030, and its share of the Mitchell Units; and (9) continuing the Rockport UPA.¹⁵

Since October 1, 2004, AEP-East, including Kentucky Power, has been under the functional control of PJM Interconnection, LLC (“PJM”), a regional transmission organization (“RTO”) approved and authorized by the Federal Energy Regulatory Commission (“FERC”). The Commission approved Kentucky Power’s integration into PJM in Case No. 2002-00475.¹⁶ PJM directs the dispatch of AEP-East generation and determines the reserves required to maintain resource adequacy within its footprint. AEP-East’s transmission system extends from Virginia to Michigan; contains 345 kV, 500 kV, and 765 kV lines; and interconnects with several neighboring power systems.¹⁷ The number of interconnections AEP-East has with other large control areas provides increased reliability to the region.

Kentucky Power describes its IRP process as a continuous activity in which its assumptions are reviewed as new information becomes available and modified when appropriate.¹⁸ The level of uncertainty facing electric utilities means the assumptions in resource expansion plans are subject to change. Faced with a highly uncertain future, Kentucky Power states that this IRP is not a commitment to a specific course of action. Pending regulatory restrictions, technology advancements, changing energy supply pricing fundamentals, the uncertainty of demand, and EE advancements all contribute to making resource planning increasingly complex. Such complexity, according to Kentucky Power, makes flexibility and adaptability a necessary part of resource planning. A final issue that must be factored into resource planning is the challenge of investing in capital-intensive generation infrastructure under current economic conditions.

Kentucky Power’s winter peak is expected to decrease from 1,362 MW in 2017 to 1,315 MW in 2031, a -0.3 percent average annual decrease once the impacts of its EE programs are acknowledged.¹⁹ Its summer peak is expected to decrease from 1,052

¹⁵ *Id.* at 16.

¹⁶ Case No. 2002-00475, *Application of Kentucky Power Company d/b/a American Electric Power for Approval, to the Extent Necessary, to Transfer Functional Control of Transmission Facilities Located in Kentucky to PJM Interconnection L.L.C. Pursuant to KRS 278.218* (Ky. PSC May 19, 2004).

¹⁷ IRP at 89-90.

¹⁸ *Id.* at 23.

¹⁹ *Id.* at 175, Exhibit C-5.

MW to 1,041 MW over the same period, reflecting a -0.1 percent annual decrease.²⁰ These rates are different from those reported in Kentucky Power's 2013 IRP, when its winter peak and summer peak annual growth rates were projected to be 0.1 percent and 0.3 percent, respectively.²¹

On February 23, 2017, the Commission initiated an investigation into the reasonableness of the DSM programs and rates of Kentucky Power.²² The Commission opened the investigation due to an approximately 2,000 percent increase in the DSM rates charged to Kentucky Power's customers in 2016, and in light of the worsening economic conditions in its service territory.²³ This investigation will be discussed further in Section 3 of this Report.

The remainder of this Report is organized as follows:

- Section 2, Load Forecasting, reviewing Kentucky Power's projected load growth and load forecasting methodology.
- Section 3, Demand-Side Management and Energy Efficiency, summarizing Kentucky Power's evaluation of DSM opportunities.
- Section 4, Supply-Side Resources and Environmental Compliance, focusing on supply resources available to meet Kentucky Power's load requirements and environmental compliance planning.
- Section 5, Integration and Plan Optimization, discussing Kentucky Power's overall assessment of supply-side and demand-side options and their integration into an overall resource plan.

The report contains Staff's recommendations for Kentucky Power's next IRP. Staff's recommendations are contained in Sections 2, 3, and 4.

Departures from the filing schedule established in 807 KAR 5:058 have caused overlapping IRP filings. To minimize future overlaps, in conjunction with changes in other utilities' filing schedules, Staff recommends to the Commission a filing date for Kentucky Power's next IRP of December 21, 2019.

²⁰ *Id.*

²¹ 2013 IRP Staff Report at 4.

²² Case No. 2017-00097, *Electronic Investigation of the Reasonableness of the Demand-Side Management Programs and Rates of Kentucky Power Company* (Ky. PSC Jan. 18, 2018).

²³ *Id.* at 1.

SECTION 2

LOAD FORECASTING

INTRODUCTION

Kentucky Power's load forecasts for the major customer classes were developed using econometric, statistically adjusted end-use ("SAE") models and analyses of time-series data.²⁴ Energy forecasts incorporate national and regional economic forecasts provided by Moody's Analytics.²⁵ Peak demand forecasts are based on revenue class sales, energy loss multipliers, weather, 24-hour load profiles, and calendar information.²⁶

For its load forecast, Kentucky Power applies a blend of short-term and long-term econometric models. The first full-forecast year is generated with short-term regression models that analyze the latest sales and weather data but do not incorporate ties to economic factors. The longer-term models account for changes in both the economy and customer consumption. These models incorporate regional economic forecast data for income, employment, household size, output, and population.

The shorter-term model inputs weather and recent load growth trends as the primary variables in forecasting monthly energy sales. Over time, however, energy consumption in all classes is influenced by demographic and economic factors and changes in the stock of electric-using equipment. Hence, the long-term models incorporate these long-term factors. Energy prices are important also but are more influential in the long term as consumers are able to adjust and change their levels of energy consumption over time while adjustments to energy consumption are constrained in the short term.

CUSTOMER FORECAST MODELS

The customer count forecast also utilizes a blend of both short-term and long-term models. For the short term, Kentucky Power employs time series models, with intervention on an as-needed basis, using Autoregressive Integrated Moving Average ("ARIMA") methods of estimation. The short-term time horizon is 24 months. The long-term customer count model is monthly for 30 years. This model employs economic and demographic variables as well as a lagged dependent variable to capture the adjustment of customer growth to changes in the economy.

²⁴ IRP at 36.

²⁵ *Id.* at 34.

²⁶ *Id.* at 37.

SHORT-TERM FORECASTING MODELS

The goal of the short-term forecasting models is to produce accurate forecasts for the first year into the future.²⁷ Short-term models use monthly and seasonal binary variables, time trends, and monthly heating and cooling degree-days, and rely on ARIMA modeling. The heating and cooling degree-days are calculated from weather data taken from weather stations throughout Kentucky Power's territory. Separate models for the residential, commercial, industrial, other, and wholesale classes are estimated.²⁸

LONG-TERM FORECASTING MODELS

The goal of the long-term forecasting models is to produce an accurate forecast for up to 30 years in the future.²⁹ Kentucky Power uses various structural models to produce load forecasts based upon the economic outlook of the U.S. economy, its service territory, and relative energy prices.

Supporting models of natural gas prices and regional coal production are used as inputs into the internal energy forecast. For natural gas prices, Kentucky Power uses a forecast of state natural gas prices for three primary sectors: residential, commercial, and industrial. It also uses a regional coal production model as an input in its mine power energy sales forecast. Both the natural gas price forecasts and the coal production forecasts were obtained from the U.S. Department of Energy's ("DOE") Energy Information Administration's ("EIA") 2015 Annual Energy Outlook.³⁰

RESIDENTIAL ENERGY SALES

The residential sales forecast is calculated as the product of the class customer count forecast and the usage per customer forecast. The final forecast is a blend of the short-term and long-term models.

Residential usage is estimated using an SAE model. There are three variables developed for the energy use forecast heating, and cooling, variables to estimate weather sensitive usage, and an "other" variable to estimate non-weather sensitive usage.³¹ The heating variable reflects heating equipment saturation, heating equipment efficiency standards, and the thermal integrity and size of homes. The cooling variable

²⁷ *Id.* at 39.

²⁸ *Id.* at 39. Unique forecasts for ten large industrial customers are modeled, with one model for the remainder of the industrial sector.

²⁹ *Id.* at 40.

³⁰ *Id.* at 41.

³¹ *Id.* at 42.

reflects cooling equipment saturation, cooling equipment efficiency standards, and the thermal integrity and size of homes. Both the heating use variable and the cooling use variable are based on billing days, degree-days, household size, personal income, natural gas prices, and electricity prices. The “other” variable is a function of appliance and equipment saturation levels, average monthly billings days, household size, real personal income, and natural gas and electricity prices.

Appliance saturations come from Kentucky Power’s residential customer survey. Saturation forecasts and efficiency trends are based on EIA forecasts and analysis by Itron.³² The thermal integrity and size of homes are for the East North Central Census Region and are based on DOE and Itron data. The number of billing days and the electric price forecast are developed from internal data. Economic and demographic forecasts are obtained from Moody’s Analytics. The residential SAE model incorporates the effects of the EPAct, EIA, American Recovery and Reinvestment Act of 2009, and Energy Improvement and Extension Act of 2008.³³

From 2011 to 2015, Kentucky Power’s residential energy sales declined from 2,342-gigawatt hours (“gWh”) to 2,192 gWh, which represents an average annual growth rate of -1.6 percent.³⁴ Over the 2017–2031 forecast period, Kentucky Power’s residential energy sales are projected to decline. In 2017, residential energy sales are projected to be 2,125 gWh, while by 2031 they are projected to be 1,983 gWh, which represents an average annual growth rate of -0.5 percent.³⁵

COMMERCIAL ENERGY SALES

Commercial energy sales are estimated in a manner similar to residential by employing an SAE model based upon heating, cooling, and an “other” variable. The model variables utilize efficiencies, square footage, and equipment saturations for the East North Central Regional. Additionally, electric prices, economic drivers, heating and cooling degree-days, and billing cycle days are used.

From 2011 to 2015, Kentucky Power’s commercial energy sales have declined from 1,381 gWh to 1,323 gWh, an average annual decline of -1.1 percent.³⁶ Over the 2017-2031 forecast period, Kentucky Power’s commercial sales are expected to decline

³² *Id.* at 43. Itron is a consulting firm with expertise in energy modeling who developed the SAE model.

³³ *Id.*

³⁴ *Id.* at 170, Exhibit C-1.

³⁵ *Id.*

³⁶ *Id.*

slightly from 1,319 gWh to 1,272 gWh, which represent an average annual growth rate of -0.2 percent.³⁷

INDUSTRIAL ENERGY SALES

Kentucky Power models mine power energy sales separately because of the size and importance of these customers to Kentucky Power's overall industrial sales base. For mine power energy sales, the forecast is based on regional coal production and service area mine power electricity prices. Additionally, local information regarding mine openings, closures, or load adjustments is incorporated into the model. For all other industrial sales, Kentucky Power used a combination of economic and pricing variables coupled with specific service territory information from customer service engineers.³⁸

From 2011 to 2015, Kentucky Power's industrial energy sales have declined from 3,250 gWh to 2,693 gWh, an average annual rate of -4.6 percent.³⁹ Over the 2017-2031 forecast period, Kentucky Power's energy sales forecast is expected to level off and remain relatively stable with expected sales of 2,499 gWh in 2017 and 2,527 gWh in 2031, a 0.1 percent annual growth rate.⁴⁰

ALL OTHER ENERGY SALES

This category is comprised of public street and highway lighting and wholesale energy sales. The public street and highway lighting energy sales forecast is a function of service area commercial employment and binary variables. The wholesale energy sales are a function of service area employment, energy prices, heating and cooling degree-days, and binary variables. Other Energy sales have declined at an average annual rate of -1.0 percent over 2011-2015 from 105 gWh to 100 gWh.⁴¹ Over the forecast period of 2017-2031, Other Energy sales will decrease slightly with projected sales declining from 101 gWh in 2017 and to 99 gWh in 2031, an average annual growth rate of -0.1 percent.⁴²

³⁷ *Id.*

³⁸ Kentucky Power's Response to Commission Staff's First Request for Information ("Staff's First Request"), Item 13. Kentucky Power notes that manual adjustments were made to the other industrial sales forecast to reflect known closure of two manufacturing facilities and expected additions of four facilities.

³⁹ IRP at 170, Exhibit C-1.

⁴⁰ *Id.*

⁴¹ *Id.*

⁴² *Id.*

ENERGY LOSSES

Energy losses are measured as the average ratio of revenue class energy sales measured at the customer meter to the net internal energy metered at the production source. Factoring in line losses over the 2017–2031 forecast period, Kentucky Power’s overall total internal energy requirements are projected to decrease from 6,399 gWh to 6,253 gWh.⁴³ This equates to an average annual growth rate of -0.2 percent.⁴⁴

SEASONAL PEAK INTERNAL DEMAND

The demand forecast model involves allocating monthly blended revenue class sales to hourly demand. The hourly demand forecast is based on blended revenue class sales, energy loss multipliers, weather, 24-hour load profiles, and calendar data.⁴⁵ Thirty-year historical weather data⁴⁶ from a representative weather station in Kentucky Power’s service area is modeled into twelve monthly profiles.⁴⁷ Next, 24-hour load profiles are developed from historical hourly load and end-use or revenue class hourly load profiles. Load profiles are derived by segregating, indexing, and averaging hourly load profiles by season, day type, and average daily temperature ranges. The profiles are benchmarked to the aggregate energy and seasonal peaks through adjustments to the hourly load duration curves of the annual 8,700 hourly values. Net internal energy requirements are the sum of these hourly values to Kentucky Power’s energy need basis. Peak demand is the maximum of the hourly values from a stated period (monthly, seasonally, or annually).

Historically, Kentucky Power’s higher seasonal peak demand has occurred in the winter and this is expected to continue over the forecast period. The winter peak is expected to decline from 1,362 MW in 2017 to 1,315 MW in 2031, for an average annual rate of -0.3 percent.⁴⁸ The summer peak is expected to decline slightly from 1,052 MW in 2017 to 1,041 MW in 2031, for an average annual rate of -0.1 percent.⁴⁹

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ *Id.* at 37.

⁴⁶ Kentucky Power’s Response to Staff’s First Request, Item 17. Kentucky Power states that it periodically tests 20-year degree-days and its analysis showed no statistically significant differences between the 30-year normal and the 20-year normal.

⁴⁷ Kentucky Power’s Response to Staff’s First Request, Item 15. Kentucky Power uses the weather station located in Huntington, West Virginia.

⁴⁸ *Id.* at 175, Exhibit C-5.

⁴⁹ *Id.*

LOAD FORECAST TRENDS AND ISSUES

Kentucky Power has witnessed significant changes in electricity usage. During the 1990s, residential usage per customer grew at an average annual rate of 1.6 percent while commercial usage grew by 0.5 percent per year. During the first decade of the 2000s, residential and commercial usage still grew, but at a slower annual rate, 0.8 percent for the residential class and 0.2 percent for the commercial class. In the current decade (2011-2020), both residential and commercial usage is projected to decline at an average annual rate of -1.1 percent.⁵⁰

Kentucky Power notes that the decline in energy usage includes some significant reduction in usages as a result of projected EE.⁵¹ The SAE model accounts for changes in saturation and efficiencies, which are modeled from Kentucky Power's Residential Appliance Saturation Survey, and EIA projections, which include impacts from various enacted federal policies.

Additionally, Kentucky Power's forecasting models account for the impact of the various DSM/EE programs offered by Kentucky Power. Through 2018, the models account for currently approved DSM programs.⁵² For years beyond 2018, the IRP model selected optimal levels of economic EE.⁵³ Additionally, the model accounted for the evolution of market and industry efficiency standards, applied a downward adjustment of the energy savings for specific Kentucky Power EE programs to account for the market and industry standards, and selected optimal economic EE programs. Over the forecast period, the impacts of Kentucky Power's DSM programs on energy usage increases from 33.3 gWh in 2017 to 39.6 gWh in 2031. The effect of DSM/EE on summer and winter peaks in 2017 is 5.9 MW and 12.2 MW, respectively, and in 2031, the impact is 5.9 MW in the summer and 13.1 MW in the winter.⁵⁴

Another item to note about the load forecast is that interruptible load impacts are not reflected in the load forecast, but are seen as a resource when Kentucky Power's

⁵⁰ *Id.* at 48.

⁵¹ *Id.* at 48.

⁵² For a list of current DSM/EE programs, costs and recovery, see Case No. 2016-00281, *Electronic Application of Kentucky Power Company for (1) Authority to Expand Its Appliance Recycling Program to Include Commercial Customers, (2) Authority to Recover Costs and Net Lost Revenues and to Receive Incentives Associated with the Implementation of the Programs, (3) Report in Compliance with the Commission's March 11, 2015 Order in Case No. 2015-00271 Regarding Industrial Customers, (4) Leave to Dispense with Filing Monthly DSM Reports, and (5) All Other Required Approvals and Relief* (Ky. PSC Dec. 29, 2016).

⁵³ Kentucky Power's Response to Staff's First Request, Item 18. Optimal levels of new EE either (1) meet capacity requirements and are a least cost solution or (2) result in a lower overall portfolio cost.

⁵⁴ IRP, 176, Exhibit C-6.

load is peaking. Therefore, estimates for such a demand response impact are reflected in Kentucky Power's projected capacity position.

LOAD FORECAST SCENARIOS

Kentucky Power models high and low economic growth forecast scenarios around the base load forecast. Kentucky Power states that these high and low economic growth scenarios are consistent with scenarios in EIA's 2017 Annual Outlook and contends that while other factors may affect load growth, the economy is seen as a crucial factor.⁵⁵ The low and high case energy and peak demand forecasts for 2031 are about 8.1 percent below and 8.8 percent above the base-case forecasts, respectively. The base case internal energy requirement is 6,253 gWh. The low and high case forecasts are 5,747 gWh and 6,804 gWh, respectively. The 2031 base-case summer peak demand is 1,041 MW while the low and high case forecasts are 957 MW and 1,133 MW, respectively. For the 2031 base-case winter peak, the forecast is 1,315 MW while the low and high case forecasts are 1,206 MW and 1,435 MW, respectively. The average annual growth rates over the forecast period for Kentucky Power's internal energy requirements are -0.2 percent in the base case with low and high case growth rates of -0.6 percent and 0.3 percent, respectively. Average annual summer-peak growth rates are -0.1 percent in the base case with low and high case growth rates of -0.5 percent and 0.7 percent, respectively. Winter peak annual average growth rates range from a low case of -0.7 percent to a high case of 0.2 percent with a base case of -0.3 percent.⁵⁶

ELASTICITY OF DEMAND

As in every load forecast, Kentucky Power accounts for the electric price and the responsiveness of a price change on consumption. Known as the price elasticity of demand, Kentucky Power explains the relationship between energy prices and energy consumption, and its importance in developing a forecast of electricity consumption.⁵⁷ Kentucky Power recognizes that there is a short-term and long-term price elasticity of demand. In the short term, the effect of an increase in the price of electricity on consumption is constrained by consumers' inability to substitute other fuels or to incorporate more EE technology.⁵⁸ Therefore, Kentucky Power's short-term energy consumption models do not include price as an explanatory variable reflecting the belief that this constraint is severe.⁵⁹

⁵⁵ *Id.* at 52.

⁵⁶ *Id.* at 179, Exhibit C-9.

⁵⁷ *Id.* at 53.

⁵⁸ *Id.* at 54.

⁵⁹ *Id.*

In the long term, the IRP states that constraints on fuel substitution and consumers' ability to acquire more energy efficient products are lessened. For example, durable equipment begins to reflect changes in relative energy prices by favoring equipment using the fuel that is expected to be cheaper. Also, increased consumer interest in saving electricity, coupled with consumer willingness to pay for more energy efficient products in the long-term, spurs development of conservation technology. In addition, existing technology, considered too expensive to implement commercially at previous levels of energy prices, becomes feasible at the new higher prices. Finally, normal turnover of electricity-using equipment contributes to a higher average level of energy efficiency.⁶⁰

Operating under the assumption that changes in energy price have a direct effect on long-term energy consumption levels, most of Kentucky Power's long-term forecasting models, including the residential, commercial manufacturing, and mine power energy sales models, incorporate the price of electricity as an explanatory variable. The residential SAE model uses electricity price in the development of explanatory variables. It also uses the price of natural gas and associated cross-price elasticities. Similarly, the commercial SAE model incorporates electricity price and an associated price elasticity to develop explanatory variables.⁶¹

SIGNIFICANT CHANGES

Kentucky Power confirmed that its forecasting methodology has not significantly changed since its last IRP filed in 2013.⁶² Kentucky Power notes that since the last filing with the Commission, both national and service area economies continue to be sluggish. Therefore, the current load forecast reflects a more modest outlook than in the past.⁶³

The prior forecast projected internal energy requirements for Kentucky Power in 2028 of 7,158 gWh and an average annual growth rate of 0.2 percent. The current forecast projects internal energy requirements in 2028 of 6,254 gWh and an average annual growth rate of -0.2 percent.⁶⁴ This difference is 12.6 percent less than the prior forecast for the same year.⁶⁵ Similarly, the prior winter peak demand forecast for 2028 was 1,459 MW as opposed to the current IRP forecast for that same year of 1,329 MW, which is 8.9 percent lower. Winter peak demand was forecasted to grow at an average

⁶⁰ *Id.*

⁶¹ *Id.*

⁶² Kentucky Power's Response to Staff's First Request, Item 23.

⁶³ IRP at 55.

⁶⁴ The year 2028 is used for comparison as it was the final year of the forecast for the 2013 IRP.

⁶⁵ IRP at 181, Exhibit C-11.

annual rate of 0.2 percent in the previous forecast as compared to an average annual growth rate of -0.2 percent in the 2016 forecast. Summer peak demand in 2028 was 1,179 MW in the previous IRP compared to 1,038 MW in the current IRP forecast. The average annual growth rate for summer peak demand in the prior forecast was 0.3 percent while in the current IPR it is -0.1 percent.⁶⁶

Insights into the forecast changes are provided when comparing the specific customer classes. The 2016 forecasts of residential and commercial class energy requirements are 11.1 percent and 11.2 percent lower, respectively than the previous IRP forecasts. Additionally, the industrial sale forecast is 14.89 percent lower and the other internal energy sales forecasts are 13.9 percent lower.⁶⁷

Kentucky Power states that factors contributing to the lower residential and commercial sales forecasts include a sluggish economy, deteriorating residential customer base, and a re-evaluation of expected long-term trends in residential and commercial consumption patterns compared to what was experienced historically. For the industrial class, the decrease reflects more recent trends that have evolved since the last forecast as well as the downward pressures faced by the coal industry that has negatively affected the forecast.⁶⁸ Kentucky Power also states that reduced growth in demand and energy sales can be attributed to the impact of more stringent efficiency standards being mandated by Congress.⁶⁹

INTERVENOR COMMENTS

The Sierra Club asserts that Kentucky Power's load forecasts likely overestimate future demand from the coal mining sector, as the energy demand is forecasted to remain essentially flat rather than a forecast of continual decline as has been experienced in recent years.⁷⁰ Kentucky Power's IRP forecasts that the decline in mine power energy sales levels off in 2017 and annual sales will decrease from 469 gWh in 2017 to 450 gWh in 2031 and the Sierra Club contends that this 4.05 percent decline is unreasonable.⁷¹ In support of its position, the Sierra Club cites actual sales and coal production in 2016 were 365.7 gWh and 16,689,541 tons, respectively.⁷² This difference represents 22 percent fewer energy sales, and 40 percent less coal

⁶⁶ *Id.* at 183, Exhibit C-13.

⁶⁷ *Id.* at 55.

⁶⁸ *Id.*

⁶⁹ *Id.* at 58.

⁷⁰ Jim Webb and Sierra Club's Comments on Kentucky Power Company's 2016 Integrated Resource Planning Report ("Sierra Club's Comments") at 13.

⁷¹ *Id.*

⁷² *Id.* at 14

production than forecasted in Kentucky Power's IRP in 2017.⁷³ The Sierra Club contends that given these statistics, even if Eastern Kentucky mine power energy sales and coal production have stabilized, it would not be at the 2017 forecasted levels but closer to the actual 2016 levels.

The Sierra Club also asserts that the load forecast is unreasonable because Kentucky Power relies on the EIA forecast that represents the entire Central Appalachian region, rather than Eastern Kentucky.⁷⁴ Additionally, the Sierra Club contends that the EIA forecast does not support Kentucky Power's forecast because Kentucky Power uses a coal supply forecast, not coal production forecast.

Finally, the Sierra Club disagrees with Kentucky Power's approach to forecasting mine power energy sales. The Sierra Club states that Kentucky Power took a similar approach in the 2013 IRP, which forecasted that annual sales would stabilize in 2014 and decrease by 17 gWh from 688 gWh to 671 gWh over the 2013 IRP forecasted period. Instead, sales declined to 367.5 gWh in 2016, not stabilizing as forecasted.⁷⁵ The Sierra Club believes that Kentucky Power's approach produces an inaccurate forecast and should be reevaluated.

KENTUCKY POWER'S REPLY TO THE SIERRA CLUB'S COMMENTS

In its reply to the Sierra Club's comments, Kentucky Power states that its IRP process and the assumptions used in its modeling are reasonable. Kentucky Power contends that its industrial forecast was developed using the best information available at the time it was developed and industrial load is forecast as a whole, which includes the coal mining and all other industrial sectors served by Kentucky Power. Kentucky Power agrees that 2016 mining sector results were weaker than projected, but first quarter 2017 results have been improving. Additionally, Kentucky Power states that if the coal-mining load fell 100 gWh below the forecasted load used in its IRP, the overall total load of Kentucky Power would still fall within the high/low scenarios.⁷⁶ Kentucky Power states that it will continue to monitor its forecasts for each sector and assess the need to adjust future forecasts.

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

The 2013 Staff Report made three recommendations regarding Kentucky Power's Load Forecast:

⁷³ *Id.*

⁷⁴ *Id.*

⁷⁵ *Id.* at 15.

⁷⁶ Kentucky Power's Response to the Comments of the Attorney General, Southern Wind Energy Association, and the Sierra Club to the 2016 Integrated Resource Planning Report ("Kentucky Power's Response to Intervenors") at 12.

- Provide a comparison of forecasted winter and summer peak demands with actual results for the period following Kentucky Power's 2013 IRP, along with a discussion of the reasons for the differences between forecasted and actual peak demands.
- Provide a comparison of the annual forecast of residential energy sales, using the current econometric models, with actual results for the period following the 2013 IRP. Include a discussion of the reasons for the differences between forecasted and actual results.
- Depending on the timing of its next IRP filing, Kentucky Power should, as needed, update the information relied upon in developing its forecast in order to reflect a greater amount of actual data for the year the forecast is prepared.

Kentucky Power addressed these recommendations in its current IRP load forecasting section. Staff is satisfied with and accepts Kentucky Power's responses to the forecasting-related recommendation on the 2013 IRP.

DISCUSSION OF REASONABLENESS

Staff is satisfied with Kentucky Power's overall load forecasting. Kentucky Power's methodology, which incorporates a significant number of factors and assumptions, is well documented and robust. The forecasting results, in their entirety, appear to reflect the economic and demographic circumstances and changes that are mainly responsible for the reduced demands and energy sales Kentucky Power has experienced and that are projected for the future. Staff is concerned that the mine energy sales forecast is flat throughout the forecast period and the point at which it flattens is at an energy level that is significantly higher than the most current actual mining energy sales level.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

The following are Staff's recommendations regarding Kentucky Power's load forecast for its next IRP filing:

- 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.
- 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.

- More closely examine the reasonableness of the coal mining sector forecast and make necessary adjustments to reflect Kentucky Power's territorial circumstances.
- Provide an update on Kentucky Power's economic development efforts including the impact on its load and employment in its service territory.

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SECTION 3

DEMAND-SIDE MANAGEMENT AND ENERGY EFFICIENCY

INTRODUCTION

This section addresses the DSM and EE portion of Kentucky Power's 2016 IRP. Since the filing of its 2013 IRP, Kentucky Power has markedly increased the size of its DSM program.⁷⁷ This increase is the result of the Stipulation and Settlement Agreement ("Agreement") approved by the Commission in Case No. 2012-00578.⁷⁸ Pursuant to the Agreement, Kentucky Power increased its annual spending on cost-effective DSM/EE programs by \$1 million annually from the 2013 level of \$3 million to \$6 million by 2016 and to maintain the \$6 million level of spending for subsequent years, unless otherwise approved by the Commission.

In 2016, Kentucky Power had 4.5 MW of DSM resources.⁷⁹ This DSM consisted of EE and Demand Response ("DR") programs and tariffs that encourage reduced energy consumption.⁸⁰ For the IRP, Kentucky Power included the current DSM effects associated with previously and currently approved DSM programs, the potential for additional or incremental effects, and other smart-grid related projects. All DSM effects are modeled on the same economic or least cost basis as supply-side resources.

DSM MEASURES

EE measures reduce the amount of energy consumed at the end use. Such measures have a trade-off in that up-front investments must be made to modify, upgrade, or install a new technology, but the customer realizes lower energy consumption and thus a lower bill. Customers choose EE measures when, over time, the savings found in the form of reduced bills pay for the cost of the EE measure. EE measures affect the amount of energy consumed in kWh, but have a limited effect at the time of peak demand.

Kentucky Power recognizes that even though EE measures are readily deployable, relatively low in cost, and a clean energy resource, market barriers exist for the potential participant.⁸¹ For example, access to financing is limited due to customer

⁷⁷ For a list of current DSM/EE programs, costs and recovery, see Case No. 2016-00281 (Ky. PSC Dec. 29, 2016), Final Order at p. 3.

⁷⁸ Case No. 2012-00578, (Ky. PSC Oct. 7, 2013).

⁷⁹ IRP at 73.

⁸⁰ EE programs reduce consumption constantly while DR programs reduce consumption at the peak.

⁸¹ IRP at 77.

credit-worthiness, some EE equipment and services are more costly than standard products, and consumers do not foresee the long run money savings. Therefore, Kentucky Power offers consumer education, technical training, energy audits, rebates, and discounts to encourage customer adoption of EE. In 2016 Kentucky Power's EE programs reduced energy use by 18 gWh and summer peak demand by 3 MW.⁸²

DR is associated with peak demand and is measured in MW. New capacity must be built in order to meet increases in peak demand that are the result of economic and population growth. DR measures help to temper this peak to avoid additional capacity that is typically only called upon during peak situations. Interruptible loads, direct load control, time-differentiated rates, EE measures, and voltage regulation all address peak conditions and can lower the amount of power consumed. Most DR measures only alter when energy is consumed, not the amount of energy consumed; a practice known as load shifting. Currently, Kentucky Power has 1.5 MW of active DR capability from interruptible load agreements.⁸³

EE savings are also realized through heightened lighting, appliance, and equipment codes and standards, which lower energy consumption. This impact is modeled by the SAE long-term load forecast, not by individual company sponsored DSM programs. Codes and standards implemented by the Energy Independence and Security Act of 2007 ("EISA") are expected to reduce retail load by 5 percent in 2031.⁸⁴

DG offers small-scale customer-sited generation. Since DG is behind the customer meter and reduces a customer's load, its effect is similar to that of a DSM or EE product. Examples of DG include CHP, solar, and wind. Currently, DG is a very small component of demand-side resources, but through the IRP forecast period, the economics of DG, in particular solar, improve. While the price of residential rooftop solar continues to decline, the economics of a residential rooftop solar system is highly dependent on its capacity factor. Assuming a capacity factor of 19.7 percent along with a discount factor of 10 percent, Kentucky Power projects that residential solar may become economic beginning in 2018.⁸⁵ However, assuming a discount rate of 10 percent and a capacity factor of 16 percent, Kentucky Power projects that residential rooftop solar systems not becoming become economical until 2025.⁸⁶ As of July 2016, Kentucky Power had less than 0.15 MW of installed rooftop solar and all are served under Kentucky Power's net-metering tariff.⁸⁷ In the Preferred Plan, the impact of DSM/EE results provide a decrease in residential and commercial energy usage of

⁸² *Id.* at 79

⁸³ *Id.* at 77.

⁸⁴ *Id.* at 75.

⁸⁵ *Id.* at 81.

⁸⁶ *Id.*

⁸⁷ *Id.* at 83.

nearly 7 percent. This savings consist of Non-DSM EE, Existing DSM Programs, and Incremental DSM program additions.⁸⁸

INTERVENOR COMMENTS

The Sierra Club lauded Kentucky Power's Preferred Plan for including the continuation of its current level of annual investment in EE through 2024, followed by further increases in EE efforts beginning in 2023. However, the Sierra Club suggests that there are more EE savings that are readily and economically achievable. The Sierra Club believes that Kentucky Power did not assess the full range of potential DSM programs that would minimize costs and risks for Kentucky Power customers.⁸⁹ In particular, the Sierra Club contends that the IRP falls short on evaluating the ability of DSM to reduce costs. The Sierra Club states that DSM programs are the least-cost, least risk resource with an average cost of 2-3 cents per kWh, no emission costs, no fuel costs, and the ability to reduce energy generation.

The Sierra Club notes that the Commission has long recognized the importance of DSM resources as cost-effective and has encouraged utilities, particularly Kentucky Power, to promote, educate, and increase participation levels in DSM programs.⁹⁰ Additionally, the Sierra Club points out that the IRP provides a forum for evaluating levels of greater and expanded DSM as 807 KAR 5:058(7) & (8) provides that utilities must include existing and potential DSM programs and their estimated load impacts in load forecasts and resource assessment plans.⁹¹ The Sierra Club contends that Kentucky Power failed to fully assess a range of potential levels of DSM and such failure should be addressed by the Commission to ensure future resource planning and decision making includes a full array of DSM opportunities.⁹²

Concerning the amount of energy savings, the Sierra Club believes that Kentucky Power underestimates these savings. Kentucky Power reports that the overall EE savings will reduce energy demand by nearly 7 percent by 2031. The Sierra Club estimates that half of these savings are the result of federal codes and standards, thus reducing the EE effect from Kentucky Power's effort to 3.5 percent. With the removal of the industrial load impact, since Kentucky Power has no industrial EE programs, the Sierra Club estimates the EE programs included in the Preferred Plan would impact load by 1.8 percent by 2031.⁹³ Averaging this over a 15-year planning

⁸⁸ *Id.* at 138.

⁸⁹ Sierra Club's Comments at 15.

⁹⁰ *Id.* at 16

⁹¹ *Id.*

⁹² *Id.* at 15.

⁹³ *Id.* at 17.

period, the annual incremental energy savings amounts to approximately 0.23 percent of residential and commercial demand per year or 0.12 percent of total demand. The Sierra Club believes these estimates are well below potential cost-effective savings.

The Sierra Club additionally contends that this IRP does not model or evaluate other DSM savings. The Sierra club supports this opinion using the results of the 2015 market potential study by the Applied Energy Group (“AEG Study”).⁹⁴ Commissioned by Kentucky Power, the AEG Study assessed the technical, economic and achievable levels of energy savings for Kentucky Power’s residential, commercial, and industrial loads. The AEG Study found that Kentucky Power has potential savings in the range of 4 to 9 percent in 2025 and 7 to 17 percent in 2035; levels significantly higher than the savings included in the Preferred Plan.

The Sierra Club states that other utilities have shown that higher potential DSM savings are achievable than those modeled by the Preferred Plan or identified in the AEG study.⁹⁵ The Sierra Club further states that Kentucky Power does not explain why savings levels similar to other utilities are not modeled, but claims that this may be in part due to Kentucky Power not evaluating whether it could achieve additional savings and asks the Commission to ensure that Kentucky Power remedy this in all future resource planning and decision making.⁹⁶

The argument that Kentucky Power is underestimating potential savings from DSM programs is further explored by the Sierra Club in terms of industrial EE programs. Currently, Kentucky Power does not offer any programs to its industrial customers; nor does Kentucky Power plan to offer any during the forecast period of the IRP. According to the Sierra Club, Kentucky Power’s lack of industrial EE and DSM programs is unreasonable and represents a significant missed opportunity because industrial DSM programs should play an important role in any resource planning process. The Sierra Club believes Kentucky Power is ignoring a class where EE resources can be half the cost of EE resources in residential and commercial sectors, thus offering higher benefit-to-cost ratios.⁹⁷

The Sierra Club notes that the AEG Study identified achievable savings, specifically with regard to variable speed drives to motor end uses, interior lighting

⁹⁴ Filed August 10, 2015, in the post case files folder for Case No. 2014-00271, *Application of Kentucky Power Company for (1) Re-Authorization of Certain of its Existing Programs; (2) Authority to Discontinue the Commercial and Residential HVAC Diagnostic and Tune-Up Programs; (3) Authority to Amend Its Demand-Side Management Program to Implement Residential Home Performance and Residential Appliance Recycling Programs; (4) Authority to Recover Costs and Net Lost Revenues and to Receive Incentives Associated with the Implementation of the Programs; and (5) All Other Required Approvals and Relief* (Ky. PSC Feb. 13, 2015).

⁹⁵ Sierra Club’s Comments at 17.

⁹⁶ *Id.* at 18.

⁹⁷ *Id.* at 19.

measures, process timers and controls, and space heating that can lead to additional savings. Since Kentucky Power does not offer industrial EE programs, it did not incorporate any of these identified savings in the IRP. In response to the Sierra Club, Kentucky Power stated that it does not offer any industrial EE programs because industrial customers are not interested in EE programs and such customers self-invest in EE measures.⁹⁸ The Sierra Club asserts that Kentucky Power's claim is based on an industrial audit and incentive program that is twenty years old and thus does not provide a reasonable basis to conclude a complete lack of interest among industrial customers for EE and DSM programs.⁹⁹ The Sierra Club agrees with the AEG Study that there are significant levels of untapped energy savings potential and industrial EE programs should be considered by Kentucky Power.

Finally, the Sierra Club recognizes that load growth within Kentucky Power's service territory is projected to decline but emphasizes that this should not be an excuse to stop further evaluations of increased levels of cost-effective DSM.¹⁰⁰ The Sierra Club states that it is cheaper to avoid the need for a kWh of electricity than to purchase that kWh and that savings will accrue to the customers regardless of whether total electricity needs are increasing or decreasing. The Sierra Club avers that, just as DSM programs help to stave off the need for additional generation capacity during rising demand, DSM can replace higher priced existing capacity during declining demand. The Sierra Club cites the existing lease for 15 percent share of the Rockport plant as an example. The Sierra Club contends that, by pursuing more DSM, Kentucky Power may be able to decline the renewal or extension of the lease thereby relieving its customers of the cost of that resource.

KENTUCKY POWER'S REPLY TO SIERRA CLUB'S COMMENTS

Kentucky Power maintains that, contrary to the Sierra Club's contention, it reasonably evaluated and properly modeled DSM/EE resources in the IRP. Kentucky Power agrees with the Sierra Club that DSM resources are integral to the development of the IRP, but asserts that they are appropriately evaluated alongside other demand-side and supply-side resources.¹⁰¹

Kentucky Power responds that it properly examined a broad menu of DSM and EE resources. Kentucky Power focused on resources that would benefit its customers and modeled six scenarios that resulted in a range of 57 - 75 MW cumulative benefit by 2031.¹⁰² Consistent with these results, the Preferred Plan models 70 MW of DSM/EE resources.

⁹⁸ Kentucky Power's Response to Sierra Club's First Request for Information, Item 14.

⁹⁹ Sierra Club's Comments at 19.

¹⁰⁰ *Id.* at 20.

¹⁰¹ Kentucky Power's Response to Intervenors at 12.

¹⁰² *Id.* at 13.

In response to the Sierra Club's argument that Kentucky Power should evaluate the addition of utility-sponsored industrial EE resources and model such effects, Kentucky Power reiterates that it terminated its industrial DSM programs because of a lack of customer participation. Kentucky Power states that it has not received any requests to reinstate the program. Kentucky Power emphasizes that experience supports the assumption that industrial customers will self-invest in EE measures based upon customer-specific economic evaluations, not on utility-sponsored EE programs.¹⁰³

Kentucky Power also contends that the Preferred Plan includes the cumulative addition of DSM/EE resources thus providing for customer savings as compared to Kentucky Power's continued reliance on its existing resources.

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

The 2013 Staff Report made six recommendations regarding Kentucky Power's DSM/EE efforts. Below are the recommendations and Kentucky Power's responses:

1. Include all environmental costs, as they become known, in future benefit/cost analyses.

The benefit-cost analyses for DSM programs include AEP's forecast of capacity and energy prices for PJM. These forecasted prices are embedded with the costs associated with evolving environmental regulations.

2. Research and report on best practices for DSM/EE program promotion, educational programs, and innovative marketing opportunities.

Kentucky Power states that, for the residential customer, radio and television advertisements promote customer participation and increase customer awareness. Additionally, Kentucky Power has found that newspaper advertisements are not as effective as they once were as subscriptions are decreasing and advertising costs are increasing. Short television or website advertisements, utilizing static or animated images instead of live actors, are effective and less expensive than advertisements involving live actors. Furthermore, website banner advertising is effective in promoting both residential and commercial EE programs. Kentucky Power promotes DSM with two-sided bill inserts, messages on monthly bill statements, and a shared common website with AEP operating companies, which provides a common experience for all AEP customers.

3. Research and report on possible partnering with adjoining AEP operating companies in order to enhance marketing and reduce advertising costs by using common program titles and offerings.

¹⁰³ *Id.* at 13.

Kentucky Power reports that it uses the same advertising consulting company used by APCo thus sharing costs and taking advantages of economies of scale. Further, sharing similar names with programs from other AEP companies supports customer recognition across multiple geographic service areas. Finally, regional support services and master service agreements allow for a sharing of costs amongst neighboring utilities.

4. Report on work that was undertaken to enhance evaluation, measurement, and verification procedures to ensure DSM/EE programs are achieving expected goals.

The AEG Study assessed EE and DR potential in the residential, commercial, and industrial sectors. The study provided savings targets and cost-effective measures that were incorporated into a ten-year program design. The results of this study were used to develop Kentucky Power's 2016 DSM portfolio as submitted with Case No. 2015-00271.¹⁰⁴ Kentucky Power will conduct a process and market evaluation following the first year of operation of its 2016 DSM Portfolio, followed by an impact evaluation in the third year. This evaluation will include a retrospective and prospective analysis of demand and energy savings and overall cost-effectiveness.

5. Report on the results of the market potential study and, specifically, on industrial sector potential for implementing DSM/EE measures.

For the industrial class, the AEG Study found there was untapped savings potential specifically in regard to variable-speed drives to motor end uses. For DR potential, the study revealed potential savings through Time of Use Rates for industrial customers; however, such savings would not be realized until 2020.¹⁰⁵

6. Monitor the PJM capacity markets for economic opportunities related to demand response and DSM/EE and include an update on the potential for bidding peak savings from DR and DSM/EE in the PJM capacity markets.

For capacity markets, Kentucky Power is a Fixed Resource Requirement participant and that assumption is carried out in this IRP. Kentucky Power is responsible for the capacity resources to supply its own load and reserve margins. Therefore, DSM effects modify Kentucky Power's own load responsibility.

¹⁰⁴ Case No. 2015-00271, *Application of Kentucky Power Company for (1) Authority to Modify Certain Existing Demand-Side Management programs; (2) Authority to Implement New Programs; (3) Authority to Discontinue Certain Existing Demand-Side Management programs; (4) Authority to Recover Costs and Net Lost Revenues, and to Receive Incentives Associated with the Implementation of the Programs; and (5) All Other Required Approvals and Relief* (Ky. PSC Mar. 11, 2016).

¹⁰⁵ *Id.* at 10.

DISCUSSION OF REASONABLENESS

Staff believes that Kentucky Power took appropriate steps to reach its obligations concerning DSM spending. Staff is in agreement that historically Kentucky Power has reasonably evaluated and properly modeled its DSM/EE programs. Staff supports Kentucky Power's assertion that industrial DSM programs are currently not a viable option due to a lack of participation and interest. Staff appreciates Kentucky Power's unique challenges and the difficult economic environment in its service territory as well as the problems with comparing its DSM/EE results with those of other utilities. Staff also recognizes the concern the Commission has with the increased burden DSM costs have on Kentucky Power's customers as evidenced by the Commission's recent termination of all of Kentucky Power's DSM programs in Case No. 2017-00097, except those that target income-eligible residential customers, due to Kentucky Power's excess generating capacity.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

The following are Staff's recommendations on DSM/EE for Kentucky Power's next IRP:

- Kentucky Power should continue to examine the results of the cost-effectiveness tests of its remaining DSM programs as compared to the estimates projected by the AEG Study. Kentucky Power should report on existing programs that do not meet or exceed their cost-effectiveness estimate and the proposed alterations, if any, that may allow those programs to be altered to meet the study targets.
- In further support of the Commission's final order in Case No. 2016-00281, Kentucky Power is no longer required to pursue further industrial programs.
- 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 and report such savings.

SECTION 4

SUPPLY-SIDE RESOURCES AND ENVIRONMENTAL COMPLIANCE

INTRODUCTION

This section addresses Kentucky Power's evaluation of supply-side resources and various aspects of Kentucky Power's environmental compliance planning. Kentucky Power's customers consist of both retail and wholesale customers with distinctive peak summer and winter demands. Through 2031, Kentucky Power expects to be able to meet its peak load, energy obligations and reserve margin with existing resources and a modest infusion of renewable energy, demand-side resources, and distributed generation. Kentucky Power expects a decline in population in its service territory, resulting in commensurate declines in customer count and retail sales.

Kentucky Power's evaluation of supply-side resource planning is a balanced combination of least-cost objectives and EPA-driven environmental compliance planning. The effect of environmental rules and guidelines are modeled as well as multiple scenarios with differing commodity pricing conditions and multiple internal load conditions. In determining the level and mix of incremental supply-side and demand-side resources, Kentucky Power utilized the *Plexos* LP optimization model.¹⁰⁶ The *Plexos* program produces least cost resource portfolios under a variety of pricing and load scenarios. Kentucky Power developed six *Plexos*-derived portfolios under four long-term commodity price forecasts and two load sensitivity forecasts.¹⁰⁷ Kentucky Power adopted the Preferred Plan because Kentucky Power is of the opinion that this option best-balanced cost and other factors while meeting Kentucky Power's peak load obligations and considered existing and future environmental requirements and the practical limitations of customer self-generation.¹⁰⁸

Kentucky Power's capacity resource requirements consider projections of existing capacity resources, changes in capacity due to efficiency and environmental considerations, changes resulting from decisions surrounding unit disposition evaluations, regional and sub-regional capacity and transmission constraints and limitations, load and peak demand, current demand response and energy efficiency, and PJM capacity reserve margin and reliability criteria.

¹⁰⁶ *Plexos* is a production cost-based resource optimization model.

¹⁰⁷ IRP at 15.

¹⁰⁸ *Id.*

EXISTING CAPACITY

Kentucky Power is a fixed resource requirement (“FRR”) participant in PJM’s capacity market construct. As such, Kentucky Power is required to have the capacity resources to serve its load and PJM’s FRR minimum reserve margin. As mentioned in the 2013 Staff Report, in the event that Kentucky Power fails to meet the FRR requirement, it has the option to rely on the capacity available through the PCA.¹⁰⁹ The creation of the PCA offers the opportunity for its members to collectively participate in the PJM FRR capacity operations while also providing members an off-system sales allocation methodology.¹¹⁰

Generation owned by Kentucky Power or to which it had contractual rights when it filed its 2016 IRP is shown in Table 4.1. The Big Sandy Unit 1 conversion to natural gas was timely completed and became operational on June 1, 2016. All units are currently compliant with Clean Air Act (“CAA”) requirements and associated federal Consent Decrees.

Table 3.1
Existing Generation¹¹¹

PLANT	UNIT	LOCATION	FUEL	IN-SERVICE YEAR	CAPACITY RATING (MW) ^A
Big Sandy	1	Louisa, KY	Natural Gas	1963 ^B	285
Mitchell	1	Moundsville, WV	Coal	1971	385 ^C
Mitchell	2	Moundsville, WV	Coal	1971	395 ^C
Rockport	1	Rockport, IN	Coal	1984	198 ^D
Rockport	2	Rockport, IN	Coal	1989	195 ^D
TOTAL					1,458

^A Installed Capacity.

^B Big Sandy Unit 1 was converted from coal to natural gas in 2016

^C Represents Kentucky Power’s 50 percent ownership stake in Mitchell Units 1 and 2.

^D Represents Kentucky Power’s 15 percent purchased share of the output of Rockport Units 1 and 2 under the UPA.

Since Kentucky Power’s 2013 IRP, several changes have occurred to its supply-side resources:¹¹²

- Big Sandy Unit 2, an 800 MW coal-fired Unit, retired in 2015.
- The conversion of Big Sandy Unit 1 from coal to natural gas was completed in 2016.
- Acquisition of a 50 percent share in Mitchell Units 1 and 2 in 2014

¹⁰⁹ 2013 IRP Staff Report at 36.

¹¹⁰ *Id.*

¹¹¹ IRP at 61.

¹¹² *Id.*

- Installation of a dry sorbent injection system in Rockport Units 1 and 2 in 2015.¹¹³

In another legal matter, on April 14, 2017, a three-judge panel for the Sixth Circuit U.S. Court of Appeals ruled that it was the duty of the plant operator, AEP Generating, not the plant owner's trustee, Wilmington Trust, to install selective catalytic reduction ("SCR") at Rockport Unit 1 by December 31, 2019, at a cost of \$1.4 billion, pursuant to the December 2007 Consent Decree. Rockport Unit 1 is scheduled to have an SCR in place by December 31, 2017, and Kentucky Power is seeking recovery of its fifteen percent share of the costs in the UPA in Case No. 2017-00179.¹¹⁴

For the planning period, Kentucky Power's summer and winter peak, energy requirements and load factor are shown below in Table 4.2.

Table 4.2¹¹⁵

PROJECTED PEAK DEMANDS, ENERGY AND LOAD FACTOR				
2017-2031				
	PEAK	DEMAND	ENERGY	LOAD
	(M W)		(GWH)	FACTOR %
YEAR	WIN	SUM		
2017	1,362	1,052	6,399	53.2
2018	1,358	1,043	6,349	53.2
2019	1,347	1,043	6,331	53.2
2020	1,350	1,038	6,304	53.4
2021	1,349	1,042	6,296	53.3
2022	1,344	1,044	6,280	53.1
2023	1,336	1,041	6,268	53.2
2024	1,338	1,038	6,262	53.5
2025	1,336	1,041	6,256	53.4
2026	1,334	1,040	6,253	53.4
2027	1,328	1,040	6,254	53.5
2028	1,329	1,038	6,254	53.8
2029	1,325	1,044	6,258	53.7
2030	1,321	1,043	6,254	53.9
2031	1,315	1,041	6,253	54.0

¹¹³ The DSI system had no impact on the unit capacities for Rockport Units 1 and 2.

¹¹⁴ Case No. 2017-00179, *Electronic Application of Kentucky Power Company for (1) A General Adjustment of its Rates for Electric Service, (2) An Order Approving its 2017 Environmental plan; (3) An Order Approving its Tariffs and Riders; (4) An Order Approving Accounting Practices to Establish Regulatory Assets and Liabilities, and (5) An Order Granting All Other Required Approvals and Relief* (Application filed July 20, 2017).

¹¹⁵ IRP, 170, Exhibit C-1.

CHANGES IN CURRENT GENERATION

Kentucky Power is anticipating turbine upgrades at Rockport Units 1 and 2 in 2018 and 2020, respectively. Based on Kentucky Power's 15 percent entitlement under the UPA, each update will provide Kentucky Power with an additional 5.4 MW of capacity. The additional 5.4 MW of capacity is modeled; however, the impact the upgrades will have on the ratepayers under the UPA has not been determined. Kentucky Power states that the additional capital investments will result in an increased demand charge, but will also result in efficiency improvements that may reduce fuel costs.¹¹⁶

Under its current terms, the Rockport UPA for 393 MW will expire in 2022. Kentucky Power is assuming that this agreement will be renewed and continued throughout the IRP planning period; however, Kentucky Power states there remains much uncertainty with regard to load growth, carbon regulations, commodity pricing, and the future UPA cost.¹¹⁷ If not renewed, Kentucky Power projects a capacity deficit of 120-140 MW during the period 2023-2030. Furthermore, not renewing would result in an energy reduction of 2,200 gWh/year for the same time period. Such a deficit would require Kentucky Power to acquire additional resources to meet its capacity and energy requirements.¹¹⁸

Kentucky Power references efforts to improve overall grid efficiency through an emerging technology known as VVO. VVO sensors and intelligent controllers monitor load flow characteristics and direct controls on capacitor and voltage regulating equipment, which in turn optimizes power factor and voltage levels. This optimization improves grid efficiency by reducing losses on the system. The voltage optimization function of VVO results in a decrease in demand and energy consumption at the customers' end and thus decreases the circuit loading which further contributes to loss reduction. Early tests indicate a range of 0.7 percent to 1.2 percent of energy demand reduction for each 1 percent voltage reduction.¹¹⁹ VVO has been modeled as a unique EE resource.

RELIABILITY CRITERIA

In 2004, Kentucky Power became a member of PJM and transferred functional control of its transmission facilities and generation dispatch to the RTO. As a member, Kentucky Power is required to adhere to the PJM Reliability Assurance Agreement, which sets reliability standards by which all members must abide. The obligations

¹¹⁶ Kentucky Power's Response to Staff's First Request, Item 4.

¹¹⁷ IRP at 14.

¹¹⁸ Kentucky Power's Response to Staff's First Request, Item 1.

¹¹⁹ IRP at 84.

ensure adequate capacity resources for all load-serving entities, including the requirement that members abide by the PJM defined Installed Reserve Margin (“IRM”).

The IRM is derived based on the number of resources needed to maintain a loss-of-load expectation of one day in ten years. The diversity of load within the Kentucky Power PJM zone and the coordination of individual utility peak load needs are factors that impact Kentucky Power’s required minimum reserve levels. This IRM is converted by PJM into Unforced Capacity requirements.

Kentucky Power’s underlying minimum reserve margin criterion utilized in the determination of its capacity needs is based on the current PJM IRM of 16.4 percent, increasing to 16.5 percent beginning in the 2017/2018 PJM planning year.¹²⁰ The ultimate reserve margin of 9.52 percent (8.81 percent in 2017/2018) is determined from the PJM Forecast Pool Requirement, which considers the IRM and PJM’s Pool-Wide Average Equivalent Demand Forced Outage Rate of 5.91 percent (6.6 percent in 2017/2018).¹²¹ As previously discussed, Kentucky Power participates in the PJM FRR market, basically a “self-planning” format, and is required to meet a PJM summer peak load, even though it is a winter peaking utility. Kentucky Power states that it has the capacity to meet both its winter peak and PJM’s summer peak load throughout this IRP’s planning horizon.¹²²

To meet the peak loads, Kentucky Power utilizes the *Plexos* optimization model to determine which economically based capacity resources are selected for deployment to meet the higher winter capacity requirements. *Plexos* selects economic resources, based on their energy contributions, to offset the higher avoided cost. For example, Kentucky Power’s customers use more energy in the winter season and without the addition of economic capacity to meet this internal demand, they are exposed to higher costs in the PJM Energy Market. Therefore, these economic resources reduce the long-term exposure of customers to PJM’s more expensive energy markets.¹²³

SUPPLY-SIDE EVALUATION

Kentucky Power used the *Plexos* Linear Program optimization model to develop a “least cost” plan or, as characterized by Kentucky Power, its Preferred Plan. *Plexos* finds the optimal portfolio utilizing base-case load forecasts and develops overall resource requirements. The DSM and supply-side options are screened, optimized, and integrated in *Plexos*. Model outputs are reviewed for the minimum cumulative present worth (“CPW”) revenue requirements of generation options for Kentucky Power to endorse as the optimal long-term resource plan.

¹²⁰ IRP at 60.

¹²¹ *Id.*

¹²² *Id.* at 13.

¹²³ *Id.* at 22.

Kentucky Power stated that considering its long capacity position throughout the planning period, the optimized portfolios serve as a guide for identifying the type and quantity of resources that would benefit customers if added to its portfolio.¹²⁴ Kentucky Power initially analyzed six scenarios consisting of four commodity price scenarios and two load scenarios. Kentucky Power stated the six different scenarios allow it to assess uncertainty in the future and assess the portfolio of resources that would be needed to meet various market and load conditions.¹²⁵

Specific supply alternatives modeled include peaking and intermediate capacity, wind resources up to 75 MW annually, large-scale solar resources in two tranches of 20 MW per year, distributed generation in the form of rooftop solar, CHP in 15 MW (nameplate) blocks, incremental EE resources, and VVO.¹²⁶ In addition, Kentucky Power intends to have battery storage in 2025, as it is currently not an economic resource but may provide benefits that complement the additional renewable resources.¹²⁷ Plexos took the individual specific inputs and modeled an optimized portfolio for each of the scenarios, and then produced the Preferred Plan of future resources. The Preferred Plan is discussed in detail in Section 5 of this Staff Report.

COGENERATION, DISTRIBUTED GENERATION, AND NET METERING

Kentucky Power's Preferred Plan includes an assumption for cogeneration as it plans on identifying a host facility and implementing a 15 MW CHP in its service territory by 2022.¹²⁸ Kentucky Power has cogeneration tariffs and currently does not have any CHP customers in its territory, but it is open to discussing the possibility of such resources with interested parties.¹²⁹

Kentucky Power points out that the economics of DG, particularly solar, continue to improve; however, these sources represent a small component of demand-side resources in its 2016 IRP, even with available federal tax credits and tariffs favorable to such applications.¹³⁰ Kentucky Power's Preferred Plan includes DG resources, primarily in the form of rooftop solar. The amount of DG in 2016 represents a significant decrease as compared to the amount modeled in the 2013 IRP. The 2013 plan included 41 MW of residential DG and 91 MW for commercial DG by 2028. The 2016

¹²⁴ *Id.* at 134.

¹²⁵ *Id.* at 134 and 135.

¹²⁶ *Id.* at 133-134.

¹²⁷ *Id.* at 135.

¹²⁸ *Id.* at 16 and 33.

¹²⁹ *Id.* at 83 and 84.

¹³⁰ *Id.* at 79.

plan includes only 1.1 MW of DG over the planning period.¹³¹ The 2016 amount of DG modeled was based on a forecast by IHS Inc. on behalf of PJM. The forecast resulted in a significant decrease in the amount of DG due in large part to the compound annual growth rate (“CAGR”) assumption used for modeling purposes. The CAGR utilized in the 2013 modeling was 40 percent but dropped to 15 percent in the 2016 IRP based upon the forecast.¹³²

In its Preferred Plan, Kentucky Power modeled distributed generation as a capacity resource at a cost equal to the retail net metering rate. As a result, beginning in 2018, residential rooftop solar systems may become economic assuming the system has been installed properly.¹³³ Kentucky Power currently has five residential and six commercial customers with total capacities of 53.8 and 91.1 kW, respectively.¹³⁴ Kentucky Power noted that rooftop solar currently does not represent the most economical means for adding renewable generation as the cost of rooftop solar remains considerably higher than the cost of large-scale solar.¹³⁵

As pointed out in the 2013 Staff Report, Kentucky Power’s capacity credits within the PJM market are different than its net metering tariff due the timing and capacity of the production of renewable energy in relation to PJM’s peak load requirement.¹³⁶ The nameplate capacities for solar and wind resources are discussed in the following section on renewables.

RENEWABLES

Renewable generation alternatives use energy sources that are either naturally occurring such as wind, solar, hydro or geothermal or are sourced from a by-product or waste-product of another process such as biomass or landfill gas. Since Kentucky Power’s last IRP, the cost of large- or utility-scale solar projects have declined in recent years and is expected to continue.¹³⁷ This scenario, combined with federal tax credits and evolving technology, makes these resources competitive with the cost of traditional generation. As result, Kentucky Power’s Preferred Plan is significantly increasing its reliance on these resources over the planning period.

¹³¹ *Id.* at 16 and 33.

¹³² *Id.* at 139.

¹³³ *Id.* at 81.

¹³⁴ *Id.* at 83.

¹³⁵ *Id.* at 115.

¹³⁶ 2013 IRP Staff Report at 44.

¹³⁷ IRP at 123.

Kentucky Power's Preferred Plan includes the addition of the 75 MW/year of wind resources beginning in 2018, with a total acquisition of 300 MW by 2021.¹³⁸ Further, beginning in 2019, with the addition of 10 MW of utility-scale solar, Kentucky Power would add a total nameplate capacity of 130 MW by 2031.¹³⁹ This represents an increase of 14.9 percent for renewable resources from the current level of 0 percent.¹⁴⁰ The increase in these renewables from the 2013 IRP is due to changes in load forecast, commodity price forecast, and resource pricing assumptions.

Kentucky Power, as discussed earlier in this Staff Report, currently has minimal amounts of solar in its net metering program but plans on adding 1.1 MW over the planning period.

PJM's Capacity Performance Rule could affect "intermittent" resources such as wind and solar. In response, Kentucky Power's solar resources are valued at 38 percent of nameplate capacity rating and wind resources at 5 percent nameplate capacity rating.¹⁴¹ Solar is consistent with PJM criterion for new solar; however, Kentucky Power's value for wind is below PJM's value of 13.5 percent.

ENVIRONMENTAL COMPLIANCE

Multiple environmental rules and issues have and will continue to impact Kentucky Power's existing supply-side resources. On April 16, 2012, the final Mercury and Air Toxics Standards ("MATS") became effective and required compliance by April 16, 2015. MATS regulates emissions of hazardous air pollutants from coal and oil-fired electric generating units. Mitchell Units 1 and 2 meet the MATS requirements. Big Sandy Unit 1 was refueled to a natural gas-fired unit and, therefore, is no longer regulated under MATS. For the Rockport Plant, recent upgrades have allowed it to all meet the MATS requirements.

To reduce interstate transport of sulfur dioxide ("SO₂") and nitrous oxides ("NO_x"), the Cross-State Air Pollution Rule ("CSAPR") addressed air quality standards for ozone and particulate matter. CSAPR established state-specific annual emission budgets of SO₂ and annual and seasonal budgets for NO_x. Based on the budgets, each emitting unit is allocated a specified number of NO_x and SO₂ allowances, which are traded within and between states. In 2016, the Environmental Protection Agency ("EPA") issued a final rule updating CSAPR to address the 2008 ozone National Ambient Air Quality Standards ("NAAQS"). This reduced seasonal NO_x allowance budgets, effective 2017. Kentucky Power states that it is well positioned to comply with CSAPR through a combination of installed emission control equipment, the use of allocated emission

¹³⁸ *Id.* at 16.

¹³⁹ *Id.*

¹⁴⁰ *Id.* at 19.

¹⁴¹ *Id.* at 107-108, PJM Capacity Performance Rule Impacts.

allowances, and the purchase of additional allowances as needed through the open market.¹⁴²

The CAA requires the EPA to establish and review NAAQS. Certain revisions for SO₂, fine particulate matter, and ozone occurring in 2010, 2012, and 2015, respectively, have not yet been fully implemented and may be updated further. Kentucky Power states that the scope and timing of any emission reduction requirements associated with these NAAQS revisions are uncertain. In response to discovery, Kentucky Power stated that modeling analyses performed show no exceedances based on the 2010 1-hour SO₂ Primary NAAQS.¹⁴³

On December 19, 2014, the EPA signed the final Coal Combustion Residual (“CCR”) Rule, regulating CCR as a non-hazardous waste, applicable to new and existing CCR landfills and surface impoundments. Full compliance with the CCR Rule is pending. Estimates of anticipated plant modifications and capital expenditures for complying with the CCR Rule have been factored into the IRP.¹⁴⁴ Kentucky Power’s ash impoundment at its Big Sandy plant is in the process of being closed based on the Commission granting a Certificate of Public Convenience and Necessity on January 27, 2016.¹⁴⁵ The Mitchell and Rockport Plants are already equipped with dry fly ash handling systems and dry ash landfills and meet current permit requirements.¹⁴⁶

The Effluent Limitation Guidelines and Standards (“ELG Rule”) was finalized on September 30, 2015. This rule requires compliance for wastewater discharges from power plants, prohibits the discharge of fly ash and bottom ash transport water, and requires the installation of physical/chemical/biological treatment for wastewater. To ensure compliance with the ELG Rule, Kentucky Power included the capital costs for compliance for the Mitchell and Rockport Plants.¹⁴⁷

The EPA issued a final rule with an effective date of October 14, 2015, under Section 316(b) of the Clean Water Act to decrease the impact on fish and other aquatic organisms from the operation of cooling water intake systems that withdraw more than 125 million gallons per day. All of Kentucky Power’s active units are equipped with

¹⁴² *Id.* at 65.

¹⁴³ Kentucky Power’s Response to Staff’s First Request, Item 66.

¹⁴⁴ IRP at 66. For the expected impact to Kentucky Power’s ratepayers see Kentucky Power’s Response to Staff’s First Request, Item 29.

¹⁴⁵ Case No. 2015-00152, *Application of Kentucky Power Company for: (1) A Certificate of Public Convenience and Necessity Authorizing the Company to Close the Big Sandy Plant Coal Ash Impoundment; and (2) For All Other Required Approvals and Relief* (Ky. PSC Jan. 27, 2016).

¹⁴⁶ IRP at 66.

¹⁴⁷ *Id.* at 67. For the expected impact to Kentucky Power’s ratepayers, see Kentucky Power’s Response to Staff’s First Request, Item 30.

natural draft (hyperbolic) cooling towers and withdraw less than 125 million gallons of water per day; therefore, the anticipated impact of the 316(b) rule is limited to the installation of flow monitoring equipment.¹⁴⁸

Kentucky Power and AEP entered into a consent decree with the Department of Justice (“DOJ”) in 2007 concerning the EPA’s New Source Review (“NSR”) requirement to settle all outstanding complaints against AEP and its operating companies. The NSR Consent Decree required Kentucky Power to operate low NO_x burners and burn low sulfur coal at Big Sandy 1 and install an SCR on Big Sandy 2. It also required Big Sandy 2 to be retired by year-end 2015, unless it was repowered or fitted with a scrubber.¹⁴⁹ The Consent Decree furthered required the Rockport Units to be fitted with scrubbers and SCRs prior to 2020.¹⁵⁰ In February 2013, the EPA, DOJ, and others filed agreed-to modifications to the Consent Decree allowing DSI to be installed at the Rockport units by April 2015 followed by high-efficiency scrubbers at Rockport 1 by year-end 2025 and at Rockport 2 by 2028.¹⁵¹ The Modified Consent Decree contains annual NO_x and SO₂ caps and establishes annual tonnage limits for SO₂ for the Rockport Plant.¹⁵²

On October 23, 2015, the EPA published the Clean Power Plan (“CPP”) regulating CO₂ emissions from fossil fuel-based electric generating units. Kentucky Power’s compliance analysis focused on the CPP as finalized with state-specific mass and rate-based emission goals based on EPA’s determination.¹⁵³ On February 9, 2016, the United States Supreme Court stayed the CPP and, to date, the U.S. Supreme Court has not issued an opinion on the case. Therefore, any conclusions as to the expected impact of the rule would be premature.

TRANSMISSION SYSTEM

The AEP-East transmission consists of six eastern zone AEP operating companies, including Kentucky Power, which is interconnected by a high-capacity transmission system that extends from Virginia to Michigan. AEP-East’s transmission system contains 345 kV, 500 kV, and 765 kV lines, interconnects with several neighboring power systems and is the most integrated transmission system in North

¹⁴⁸ *Id.* at 68.

¹⁴⁹ Big Sandy Unit 2 was retired on June 1, 2015.

¹⁵⁰ SCR is to be installed on Rockport Units 1 and 2 by December 31, 2017 and December 31, 2019, respectively. Kentucky Power’s pending rate case filed June 28, 2017, Case No. 2017-00179, addresses the New Source Review Consent Decree costs.

¹⁵¹ DSI was installed on both Rockport Units by April 16, 2015.

¹⁵² The annual caps are for AEP-East operating companies, which includes Kentucky Power. The caps for the Rockport Plant are for the total plant, not Kentucky Power’s 15 percent portion.

¹⁵³ Kentucky Power’s Response to Staff’s First Request, Item 31.

America.¹⁵⁴ The number of interconnections AEP has with other large control areas provides increased reliability to the region. The entire AEP-East transmission system is located within the Reliability First Corporation (“RFC”) geographic area and conforms to the Reliability Standards developed and administered by the North American Electric Reliability Corporation as well as applicable RFC standards and performance criteria.¹⁵⁵

Kentucky Power’s transmission system is composed of approximately 1,271 transmission line miles operating at or above 34.5 kV, and takes transmission service under the PJM open access transmission tariff.¹⁵⁶ The transmission line miles in Kentucky include approximately 258 miles of 765-kV, 8 miles of 345-kV, 48 miles of 161-kV, 359 miles of 138-kV lines, 429 miles of 69-kV lines, 166 miles of 46-kV lines, and 3 miles of 34.5-kV lines.¹⁵⁷

As previously mentioned, PJM has functional control of the AEP-East companies’ transmission facilities. In October 2010, FERC approved the AEP System Transmission Agreement, which provides for the sharing of costs incurred among the members of the AEP System-East Zone for its ownership operation and maintenance outlays in its respective portions of the high voltage transmission system.¹⁵⁸ AEP, in conjunction with Kentucky Power and PJM, coordinates the planning of the transmission facilities in the AEP System-East Zone. AEP continues to develop transmission plans to meet the reliability criteria in support of PJM’s transmission planning process. PJM incorporates these expansion plans with those of other PJM member utilities and collectively evaluate the expansion plans as part of its Regional Transmission Expansion Plan (“RTEP”) process.¹⁵⁹ The RTEP process ensures that transmission expansion is developed for the entire RTO footprint via a single regional planning process, ensuring a consistent view of need and expansion timing while minimizing expenditures.

AEP uses power flow analyses to simulate normal conditions, and credible single and double contingencies to determine the potential thermal and voltage impact on the transmission system in meeting the future requirements.¹⁶⁰ The planning process embraces two major sets of tests to ensure reliability. The first set, which applies to both bulk and local area transmission assessment and planning, includes all significant single contingencies. The second set, which is applicable only to the Bulk Electric

¹⁵⁴ IRP at 89-90.

¹⁵⁵ *Id.*

¹⁵⁶ *Id.* at 89.

¹⁵⁷ *Id.*

¹⁵⁸ 2013 IRP at 112.

¹⁵⁹ IRP at 91.

¹⁶⁰ *Id.* at 93.

System, includes multiple and more extreme contingencies.¹⁶¹ Thermal and voltage performance standards are usually the most constraining measures of performance and reliability for the AEP transmission system.¹⁶² AEP files Form 715, the Annual Transmission Planning and Evaluation Report, with FERC. Form 715 provides a discussion of AEP System reliability criteria for transmission planning, the assessment practice utilized, transmission maps, pertinent information on power flow studies and an evaluation and continued adequacy assessment of AEP's eastern transmission system.¹⁶³

As stated in the 2013 IRP Staff Report, the AEP-East transmission system is aging and some station equipment is becoming obsolete.¹⁶⁴ In order to ensure acceptable levels of reliability, significant investments in the transmission infrastructure will be needed through the planning horizon due to the integration of merchant generation connected in the eastern zone and the significant amount of retirements of coal-fired generation in the PJM footprint.

Kentucky Power identified enhancement projects planned in the near future that will allow the reliable operation of its transmission system. The transmission network in the Hazard-Wooton area serves approximately 300 MWs of load and is connected to the Tennessee Valley Authority's ("TVA") 161-kV system at TVA's Pineville Station and to LG&E's 161-kV system at Wooton Station. A comprehensive plan is being developed by Kentucky Power that will replace the thermally limited and aging Hazard 161/138-kV transformer. This portion of the project will be complemented by the rebuild of the physically deteriorated and thermally limited Hazard-Pineville (TVA) 161-kV transmission line.

There are seven transmission projects planned over the next three years: the Hazard area improvements, Big Sandy area improvements, Thelma and Busseyville Station upgrades, Dorton 138-kV circuit breakers, Cedar Creek Station upgrades, Johns Creek and Stone Station upgrades, and Hazard-Wooton-Pineville 161-kV project.

THE DISTRIBUTION SYSTEM

Kentucky Power did not identify specific increases or improvements planned for its distribution facilities. Kentucky Power stated that it had 168,000 retail customers in its service territory, a reduction of 5,000 since the 2013 IRP.¹⁶⁵ Since the last IRP filing four years ago, there has been a decrease in the number of residential customers and a

¹⁶¹ *Id.* at 93.

¹⁶² *Id.* at 94.

¹⁶³ *Id.* at 93-94.

¹⁶⁴ 2013 Staff Report at 50.

¹⁶⁵ IRP at 28.

decrease in mine power sector sales.¹⁶⁶ Consequently, distribution facilities will receive improvement and upgrade attention in order to lessen their internal energy losses and lower the distribution network load. Improvements include smart grid projects, which includes VVO to enable Conservation Voltage Reduction. These changes allow Kentucky Power to systematically reduce its system voltages and therefore its load.¹⁶⁷

The Commission approved Kentucky Power's request to significantly increase its vegetation management plan ("VMP") expenditures to improve system reliability in Case Nos. 2009-00459¹⁶⁸ and 2014-00396.¹⁶⁹ As part of a unanimous settlement agreement in Case No. 2009-00459, the Commission approved a \$10 million increase in VMP expenditures making the total annual expenditures \$17,237,965. The goal was for Kentucky Power to transition from a reactive performance-based plan to a four-year clearing cycle. As reflected in Exhibit 9 of the settlement agreement in Case No. 2014-00396, based on the 2015 VMP, Kentucky Power was to spend \$22.3 million in 2015, \$27.7 million beginning 2016-2018, and \$21.5 in 2019. Furthermore, the Order stated that beginning July 1, 2019, Kentucky Power projects implementing a five-year maintenance cycle, at which time it will reduce VMP expenditures to approximately \$16 million per year through 2023.¹⁷⁰ However, in Case No. 2017-00179, based upon Kentucky Power's 2017 VMP, Kentucky Power is requesting an annual revenue requirement of \$21,465,163 for O&M expense associated with the VMP due to cost revisions.¹⁷¹ Kentucky Power states that its VMP has improved its reliability metrics. The System Average Interruption Duration Index, the primary metric used by the Commission to assess the progress of Kentucky Power's reliability performance progress, improved from 505.3 in 2014 to 445.7 in 2016 as a result of its VMP.¹⁷²

¹⁶⁶ *Id.* at 28 and 41.

¹⁶⁷ *Id.* at 84.

¹⁶⁸ Case No. 2009-00459, *Application of Kentucky Power Company for a General Adjustment of Electric Rates* (Ky. PSC June 28, 2010).

¹⁶⁹ Case No. 2014-00396, *Application of Kentucky Power Company For: (1) A General Adjustment of its Rates for Electric Service; (2) An Order Approving its 2014 Environmental Plan; (3) An Order Approving its Tariffs and Riders; and (4) An Order Granting all Other Required Approvals and Relief* (Ky. PSC June 22, 2015).

¹⁷⁰ *Id.* at 76 (Final Order June 22, 2015).

¹⁷¹ See Kentucky Power's Response to the Attorney General's First Request, Item 3 and Case No. 2017-00179, Application, Direct Testimony of Everett G. Phillips ("Phillips Testimony") at 43.

¹⁷² Phillips Testimony at 13-14.

INTERVENOR COMMENTS AND KENTUCKY POWER'S RESPONSES

The Attorney General's Comments

For several reasons, the Attorney General believes Kentucky Power's analyses regarding the cost-effectiveness of its Rockport UPA have been inadequate and warrants the Commission's scrutiny.¹⁷³ First, the Attorney General maintains that the 12.6 percent return on equity ("ROE") in the UPA that was allowed by FERC in Docket ER13-286 is unreasonable. The Attorney General points out that at the time the current version UPA was executed in 2004, the average ROE awarded to electric utilities was 11 percent and is significantly higher than both the 9.6 percent average authorized ROE's for electric utilities in 2015-2016 and the 9.8 percent ROE Kentucky Power was allowed to earn in its most recent rate case.¹⁷⁴ The Attorney General also states that, "[a]lthough the IRP report in the current docket does reflect at least some analysis of the cost-effectiveness of the Rockport UPA, that analysis apparently does not assess the cost to Kentucky Power's ratepayers, to whom the financial burden of the Rockport UPA's 12.6 percent ROE is ultimately passed. Accordingly, the Attorney General contends that the IRP Report's cost analysis is inadequate."¹⁷⁵

The second reason the Attorney General lists for the inadequate cost analysis for the Rockport UPA is the cost of the turbine upgrades at both Rockport units, as well as the plant modifications and capital expenditures necessary to achieve compliance with the EPA's ELG Rule, do not appear to have been adequately taken into consideration.¹⁷⁶

In summary, the Attorney General states that the extraordinarily high cost that Kentucky Power and its ratepayers are required to pay under the Rockport UPA ROE, and the additional Rockport capital costs for which Kentucky Power will be partly responsible, must be taken into full consideration in order to adequately determine the true cost-effectiveness of the Rockport UPA.¹⁷⁷

The Attorney General states the Commission should require Kentucky Power to include a ratepayer cost impact measure as part of its evaluation of the cost-effectiveness of the supply-side resources.¹⁷⁸ The Attorney General states that, "Although Kentucky Power's IRP Report states that '[t]he goal of the IRP process is to

¹⁷³ Attorney General's Comments at 1 and 2.

¹⁷⁴ *Id.* at 2.

¹⁷⁵ *Id.*

¹⁷⁶ *Id.* at 2 and 3.

¹⁷⁷ *Id.* at 3.

¹⁷⁸ *Id.*

ensure a reliable supply of power and energy to customers at the least **reasonable cost**,' it appears that Kentucky Power interprets the word 'reasonable' from Kentucky Power's sole perspective. More importantly, Kentucky Power thus mistakes the actual legal standard to which it should be held: 'least **possible cost**."¹⁷⁹ Thus, the Attorney General maintains that Kentucky Power's analysis regarding costs is inadequate and fails to meet the least-cost standard, which, at a minimum, addresses the following cost items, on a per unit basis, year over year since the last IRP filing: (a) the dollar value of each resource placed in rate base; (b) fuel costs; (c) environmental costs; (d) return on equity paid for any purchased power agreement; (e) annual levels of fuel adjustment charges, environmental cost recovery mechanisms, and all other tracking mechanisms; and (f) capital expenditures.¹⁸⁰

The Attorney General states that the Commission should investigate whether continuation of the Rockport UPA under the current 12.6 percent ROE provides an undue subsidization to Kentucky Power's affiliates.¹⁸¹ The Attorney General believes an investigation is warranted in order to determine whether Kentucky Power is unjustly enriching Rockport's owners to the detriment of its own jurisdictional ratepayers. The Attorney General avers that the fact that Kentucky Power's management has failed to address the unusually high ROE, and its ratepayers are compelled to pay for power derived from the Rockport UPA, it appears to indicate that Kentucky Power's stance on continuing the UPA is conflicted between representing the best interests of its ratepayers and those of its affiliated parties.¹⁸² He also stated the Commission has authority, pursuant to KRS 278.2201, to investigate the non-regulated activities of Kentucky Power's affiliate, Indiana Michigan Power, and order that costs attached to any transactions with those affiliates be disallowed from Kentucky Power's rates.¹⁸³

The Attorney General stated that the addition of wind power as a supply side resource should also take into consideration the potential impact of PJM Capacity Performance ("CP") penalties. He pointed out that PJM currently ascribes a 13.5 percent nameplate capacity rating to wind resources and that Kentucky Power assigned a five percent nameplate capacity, due to the significant penalties that PJM can impose under its CP Rule, which takes full effect in 2020-2021.¹⁸⁴ The Attorney General believes that if Kentucky Power does pursue wind resources for its capacity value, it should take additional measures to insulate itself and its ratepayers from that additional

¹⁷⁹ *Id.* at 5. (Emphasis is original)

¹⁸⁰ *Id.*

¹⁸¹ *Id.*

¹⁸² *Id.* at 5 and 6.

¹⁸³ *Id.* at 6.

¹⁸⁴ *Id.* at 6 and 7.

risk by using measures including hedging or insurance products.¹⁸⁵ Additionally, the Attorney General believes it would be appropriate that Kentucky Power include in its next IRP the potential costs for any such hedging/insurance product in order to determine the overall cost-effectiveness of such an intermittent resource.¹⁸⁶

The Sierra Club's Comments

The Sierra Club applauded Kentucky Power for making several important steps toward diversifying its energy portfolio by increasing its investment in renewable energy and DSM and concurrently saving money for its customers through the planning period. However, the Sierra Club states that the IRP is flawed in its assumption of continued operation of all of Kentucky Power's existing generation resources and that the IRP never compares the economics of continued operation of existing resources versus the replacement of those resources. The Sierra Club believes that the IRP limits the role of renewables and DSM and fails to reflect the type of thorough and reasonable planning that can lead to a least-cost and least-risk energy future for customers. The Sierra Club contends that this flawed approach results in a resource portfolio in 2031 that looks similar to its current fleet. The Sierra Club further notes that under the Preferred Plan, Kentucky Power has excess capacity over its PJM obligation, which is an unnecessary expense. As a result, the Sierra Club requests that Staff find the IRP inadequate and require Kentucky Power to address each of these shortcomings in all future resource planning and decision making.¹⁸⁷

The Sierra Club criticizes Kentucky Power's resource portfolio modeling in that Kentucky Power relies on the same existing generation assets and capped utility renewable wind and solar resources. Further, no portfolios were modeled in which Rockport and/or Mitchell were retired. The Sierra Club points out that the point of an IRP process is to evaluate alternative portfolios and scenarios and assess different resource approaches. The Sierra Club states that because the IRP did not consider other resource portfolios, the results may not be least cost or least risk. The Sierra Club suggests addressing this shortcoming and requiring Kentucky Power to evaluate and model resource portfolios that assume a range of options rather than the continued operation of existing resources.¹⁸⁸

Kentucky Power's assumption that it will continue relying on all of its existing capacity is further called into question by the Sierra Club. The Sierra Club notes that lower forecasted energy, capacity, and gas, as well as lower PJM energy prices, should have led Kentucky Power to reevaluate this key initial assumption of continuing to

¹⁸⁵ *Id.* at 7.

¹⁸⁶ *Id.*

¹⁸⁷ Sierra Club's Comments at 2.

¹⁸⁸ *Id.* at 7.

operate its existing capacity. Additionally, the Sierra Club believes Kentucky Power failed to evaluate different generation sources by assuming that the Rockport UPA would be extended throughout the forecast period. The Sierra Club notes that assuming that the Rockport UPA will be renewed and continued past 2022 and not be evaluating and planning for other resource scenarios is one-sided. The Sierra Club believes Kentucky Power's uncertainty argument is unpersuasive and suggests planning tools to address the risk of uncertainty. The Sierra Club further questions whether the renewal of Rockport UPA is part of a least-cost portfolio because of the significant capital costs associated with the NSR consent decree, other pollution control requirements, and the return on equity that Kentucky Power pays under the Rockport UPA. The Sierra Club suggests that Kentucky Power begin evaluating now whether to renew the Rockport lease or pursue other lower-cost options.

As for renewable resources, the Sierra Club claims that Kentucky Power has been slow in its recognition of wind resources and unreasonably constrains the increase in utility-scale solar. In regards to wind capacity, the Sierra Club states that since Kentucky Power's own model selected 300 MW of wind capacity in every pricing scenario shows that it is a low cost-resource and Kentucky Power should pursue more wind resources more quickly or further scale up this resource. The Sierra Club contends that the 300 MW is capped by Kentucky Power, and this constraint is unreasonable and unsupported.¹⁸⁹ In regards to solar, the Sierra Club notes that although Kentucky power recognizes a decline in the cost, Kentucky Power's capping of solar resources to 40 MW per year is erroneous and suggests that, at a minimum, Kentucky Power should annually increase its solar cap limit over the planning period.

KENTUCKY POWER'S REPLY TO THE INTERVENOR COMMENTS

The Attorney General

In its comments to the intervenors, Kentucky Power maintains that its IRP provides for an adequate and reliable supply of electricity at the lowest possible cost given current regulations and reasonable expectations and assumptions of future costs and regulations. Kentucky Power states that, "[b]ecause there is no need to make decisions regarding the purchase or disposition of any Kentucky Power capacity resources prior to the next IRP cycle, many of the arguments the Attorney General and Sierra Club make in their comments, in addition to being factually incorrect and made without proper context, are premature."¹⁹⁰

Kentucky Power pointed out that while the Southern Wind Energy Association ("SWEA") did not intervene but tendered public comments on February 16, 2017, SWEA "congratulate[d]" Kentucky Power "for performing an outstanding IRP" and that its

¹⁸⁹ *Id.* at 21.

¹⁹⁰ Kentucky Power's Response to Intervenors at 5.

Preferred Plan “responsibly incorporates low-cost wind energy resources in the near term.”¹⁹¹

Kentucky Power maintains that the Attorney General’s comments regarding the Rockport UPA misapprehend both the nature and purpose of Staff’s review of its IRP as the pertinent regulations under 807 KAR 5:058 provide the authority for the duties and responsibilities of the parties in an IRP proceeding.¹⁹² Kentucky Power states that the IRP is a planning document and not an application of a certificate of public convenience and necessity to construct or acquire the identified resources, much less an application by the utility to recover the costs of the identified resource through rates.¹⁹³ Kentucky Power further states the current Rockport UPA was approved by the Commission in 2004 and at that time the Commission had expressed serious concern about what had been for some time Kentucky Power’s intent to meet its native load requirements by purchasing power at market-based rates rather than extending the Rockport unit power contract.¹⁹⁴ Kentucky Power also pointed out that in Administrative Case No. 387, the Commission found that:

Reliance on power purchases that reflect market price volatility is not in the best interests of Kentucky consumers. AEP-KY must plan to meet its load requirements by securing sufficient capacity that is not subject to market place volatility. Only by doing so will AEP-KY be able to maintain reasonable electric rates while mitigating to the extent possible market price and fuel price fluctuations.

The Commission found that the terms and conditions of the 18-year extension of the UPA, as set forth in the Stipulation in Case No. 2004-00420,¹⁹⁵ to be reasonable and granted its approval.

With respect to the ROE utilized in the UPA, Kentucky Power pointed out that the correct ROE was 12.16 percent as opposed to the 12.6 percent ROE stated in both the Attorney General and Sierra Club comments.¹⁹⁶ Kentucky Power also stated that more recently, the Commission rejected a similar effort by the Attorney General to involve the Commission in challenging and reviewing the terms of the Rockport UPA, including the ROE:

¹⁹¹ *Id.* at 2.

¹⁹² *Id.* at 6.

¹⁹³ *Id.* at 4.

¹⁹⁴ *Id.* at 7.

¹⁹⁵ Case No. 2004-00420, *Application of Kentucky Power Company for Approval of a Stipulation And Settlement Agreement Resolving State Regulatory Matters* (Ky. PSC Dec. 13, 2004).

¹⁹⁶ Kentucky Power’s Response to Intervenors at 8.

The Commission finds that the AG's [Attorney General's] recommendation to address at FERC the 12.16 ROE being used in the Sales Agreement and the establishment of an affiliate Charge-ROE-Reduction Rider should be denied. As with the Commission, FERC is mandated to set rates that are fair, just, and reasonable. While the Commission may not agree with the manner in which FERC establishes ROE, we take note that the terms of a FERC-approved contract have been found to legally constitute a fair, just, and reasonable rate. We also note that FERC's methods of setting an ROE have withstood prior challenges.¹⁹⁷

The UPA expires on December 7, 2022, and Kentucky Power stated that it anticipates making the determination during 2019 on whether to extend the UPA beyond 2022.¹⁹⁸ At that time, Kentucky Power will present the Commission with a request to either extend the UPA or seek acquisition of replacement capacity and energy as well as addressing the issue in its 2019 IRP.

With respect to the Attorney General's comment for the Commission to require Kentucky Power to examine of the cost-effectiveness of its supply-side resources to include a ratepayer cost impact measure, Kentucky Power stated that it had considered the cost-effectiveness of its Preferred Plan in the IRP.¹⁹⁹ In support thereof, Kentucky Power stated that inherent in any IRP is its consideration of the impact of various plans on the CPW of revenue requirements over the study period and that its capacity optimization model's objective is to determine the least cost portfolio solution over the study period under a variety of pricing scenarios.²⁰⁰ Kentucky Power also noted that Table 22 and Figure 30 in the IRP listed the appropriate rate impacts of the Preferred Plan when compared to the Do-Nothing Plan.²⁰¹

With respect to the Attorney General's comment that the addition of wind power as a supply-side resource should also take into consideration the potential impact of PJM CP penalties, Kentucky Power responded that its IRP considered the potential impact of the PJM CP rule penalties for all resources, including intermittent resources such as wind.²⁰² Kentucky Power stated that it reflected the potential effect of the PJM

¹⁹⁷ Case No. 2014-00396, Final Order at 81.

¹⁹⁸ Kentucky Power's Response to Intervenors at 8.

¹⁹⁹ *Id.*

²⁰⁰ *Id.* at 8-9.

²⁰¹ *Id.* at 9.

²⁰² *Id.*

CP rule penalties for wind generating resources by reducing the planning capacity to five percent of the wind resources' nameplate capacity.²⁰³ In addition, Kentucky Power anticipates coupling wind and solar resources as allowed under PJM's CP rule which provides the "hedging" the AG proposed as a means to protect against CP penalties. Kentucky Power states that coupling the different generation profiles of wind and solar resources yields a "combined resource" with an increased ability to produce adequate power throughout the entire year, which mitigates the risk of CP penalties.²⁰⁴

The Sierra Club

Kentucky Power responds that it operates in a dynamic and rapidly changing energy market and the IRP is based on evaluations of the best available information at the time it was prepared. Kentucky Power emphasizes that the IRP is not a commitment to acquire any resource or undertake a specific course of action. Advancements in technology and emerging regulations make resource planning critical but challenging and Kentucky Power states it monitors regulatory and technological developments, customer need, and uses the most current information to make resource decisions. Kentucky Power disagrees with the Sierra Club's suggestion that it failed to consider an appropriate range and mix of resource portfolio options.²⁰⁵

Kentucky Power states that it analyzed and considered a reasonable range of portfolio options, including gas-fired generation, wind, distributed and utility-scale solar, DR, and EE. Kentucky Power contends that it is not a large utility and, therefore, its portfolio of generating assets is relatively small. Given the most recent Commission approved long-term investment in its generating portfolio, opportunities for variation is limited.²⁰⁶ Kentucky Power stresses that the optimization model selected wind, solar, and EE resources in all forecast scenarios because the resources were at least cost and would translate into lower costs for customers.

As for the Sierra Club's claim that the IRP should have evaluated portfolios where the Rockport UPA was not extended after the December 7, 2022 expiration date, Kentucky Power responds that it anticipates addressing the extension of the Rockport UPA coincident with the filing of Kentucky Power's 2019 IRP. Kentucky Power further contends that the uncertainty surrounding load growth, carbon regulations, commodity pricing, capacity pricing, and future Rockport UPA costs make any other model more uncertain than the current model.²⁰⁷ Similarly, Kentucky Power states cost associated

²⁰³ *Id.*

²⁰⁴ *Id.* at 9-10.

²⁰⁵ *Id. Id.* at 10.

²⁰⁶ *Id.*

²⁰⁷ Kentucky Power's Response to the Sierra Club's First Request, Item 1.

with the NSR Consent Decree through 2022 will be incurred whether or not Kentucky Power renews the Rockport UPA and will be addressed in the 2019 IRP.

In response to the Sierra Club's position that Kentucky Power unreasonably limits the pursuit of wind resources, Kentucky Power states that the IRP report appropriately considered wind resources and its Preferred Plan recommends a reasonable level of wind resources. Kentucky Power states that there are practical limitations in planning, managing, and development of wind sources. Further, Kentucky Power's "going-in" capacity position limits wind resources over the planning period as the transmission grid is limited to the number of intermittent resources and costs associated with upgrades to the transmission systems to support large amounts of wind are not yet fully quantifiable.²⁰⁸

Finally, in response to the Sierra's Club comment that Kentucky Power continues to constrain utility-scale solar and assumes a very low level of DG, Kentucky Power believes the amount of solar and DG assumptions are reasonable. Kentucky Power recognizes that there is an annual limit on the number of solar resources that can be implemented, and as the pool of suitable sites dwindles, less desirable sites drive up the costs.²⁰⁹ As for DG, even with a forecasted decline in the cost, rooftop solar is forecasted to be economical only for a small subset of Kentucky Power's customers due to the overall economics of Kentucky Power's customer base.²¹⁰

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

In its report on Kentucky Power's 2013 IRP, Staff made the following recommendations on supply-side resources and environmental compliance:

- Include a discussion of the status of, and any changes or modifications that are under consideration for, the PCA, and potential impacts to Kentucky Power.
- Provide current specific discussions of 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 a detailed discussion of the ways in which net metering systems are encouraged and considered in the IRP, along with customer-specific statistics.

²⁰⁸ Kentucky Power's Response to Intervenors at 14-15.

²⁰⁹ *Id.* at 17.

²¹⁰ *Id.*

- Provide detailed discussions of the consideration, suitability, and evaluation given to distributed generation.
- 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). The discussion should cover all modifications since the filing of the 2013 IRP and should address Kentucky Power's plans for the three years immediately following the filing of its next IRP.
- 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.
- Discuss how Kentucky Power has addressed uncertainty in modeling future load and the resources to meet that load.

Staff is generally satisfied with Kentucky Power's responses to its previous recommendations and with the information provided. Staff believes Kentucky Power's responses adequately address those recommendations.

DISCUSSION OF REASONABLENESS

Staff considers Kentucky Power's supply-side resource assessment and environmental compliance plan to be reasonable. However, Staff has some comments with respect to the intervenors' and Kentucky Power's comments.

With respect to the AG's comment on the ROE in the Rockport UPA, as explained in Kentucky Power's comments, this issue has been previously addressed by the Commission. Furthermore, the AG has the authority to challenge the ROE at FERC on its own accord.

Staff does find some merit in the comments of the AG and the Sierra Club regarding Kentucky Power's supply-side modeling whereby the Rockport UPA was included as being in place throughout the planning period. Accordingly, Staff recommends that in its next IRP, Kentucky Power should have a model that includes the Rockport UPA through the planning period and a model that excludes the UPA following its expiration. In addition, in the model that includes the UPA, all environmental costs should be identified, explained, and included in the modeling assuming the UPA is renewed.

Staff believes that Kentucky Power's IRP properly considered the impact of the PJM CP rule. By coupling the wind and solar resources and utilizing a five percent nameplate capacity for wind, as opposed the 13.5 nameplate capacity utilized by PJM, Kentucky Power has mitigated the risk of CP penalties.

Staff recognizes the differences in the intervenors' and Kentucky Power's comments of what constitutes a satisfactory IRP filing. Nonetheless, Staff believes that Kentucky power has complied with the requirements of 807 KAR 5:058.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

Staff's recommendations for Kentucky Power's next IRP are as follows:

- Provide a status report of Kentucky Power's implementation and operation with respect to the CP requirements in PJM and any impacts related thereto.
- Include a discussion of the status of, and any changes or modifications that are under consideration for the PCA, and potential impacts to Kentucky Power.
- In Kentucky Power's 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 discussions 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).
- 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.

- Discuss how Kentucky Power has addressed uncertainty in modeling future load and the resources to meet that load.

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SECTION 5

INTEGRATION AND PLAN OPTIMIZATION

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

THE INTEGRATION PROCESS

An ultimate resource assessment and acquisition plan was developed based on minimizing expected costs over the 15-year planning horizon based on CPW revenue requirements. For modeling purposes, portfolios were created using *Plexos* through the year 2035. Differences were studied by changing assumptions and calculating total costs based on the changes with lower costs as the objective.

Kentucky Power developed *Plexos*-derived “optimum” portfolios under four long-term commodity various commodity price forecasts and two “load sensitivity” forecasts.²¹¹ Among these portfolios, Kentucky Power developed a “Preferred Plan” which includes:

- Investing \$6 million/year in DSM through 2024.
- Adding 75 MW (nameplate capacity)/year of wind resources beginning in 2018 for a total of 300 MW through 2021.
- Adding utility-scale solar, beginning with 10 MW in 2019, for a total of 130 MW by 2031.
- Implementing customer and grid EE programs, including VVO, reducing energy requirements by over 90 gWh and 70 MW of capacity by 2031.
- Assuming customers add DG (i.e. rooftop solar) capacity totaling 1.1 MW (nameplate) by 2031.
- Adding 10 MW (nameplate) of battery storage resources in 2025.
- Assuming a host facility is identified such that a CHP project can be implemented by 2022.
- Continuing operation of its existing generation facilities including Big Sandy 1 through 2030, and its share of the Mitchell Units.

²¹¹ IRP at 15

- Continuing the UPA for a 15 percent share from the Rockport Plant.²¹²

Under the Preferred Plan, Kentucky Power's coal-fired capacity would decline from 80 to 71 percent over the planning period.²¹³ Gas-fired assets would decrease from 19.5 to zero percent and renewable assets would increase from zero to 26 percent.

Plexos was used to study the long-term integration and optimization of resource alternatives that require projections of externally driven parameters. Input variables to these parameters include, but are not limited to, forecasts of fuels, load, emissions, emission retrofits, and construction costs for capital projects. The analysis was focused on emissions, renewables, commodity prices, and evolving economic conditions.

The *Plexos* long-term optimization model, also known as the "LT Plan" is used to find the optimal portfolio of future capacity and energy resources, including DSM/EE additions that will minimize the CPW of generated-related variable and fixed costs over a long-term planning horizon. *Plexos* accomplishes this while seeking to minimize the aggregate of the following costs of the portfolio of resources:

- Fixed costs of capacity additions, *i.e.*, carrying charges on incremental capacity additions (based on a Kentucky Power's weighted average cost of capital), and fixed O&M;
- Fixed costs of capacity purchases;
- Program costs of (incremental) DSM alternatives;
- Variable costs associated with Kentucky Power's generating units. This includes fuel, start-up, consumables, the market replacement cost of emission allowances or carbon tax, and variable O&M costs;
- Distributed, or customer-domiciled, resources at the equivalent cost of a full retail net-metering credit to those customers (*i.e.*, a utility perspective);
- A netting of production revenue made in the PJM power market from Kentucky Power's generation resource sales and the cost of energy, based on unique load shapes from PJM purchases necessary to meet Kentucky Power's load obligation.²¹⁴

²¹² *Id.* at 16.

²¹³ *Id.* at 17.

²¹⁴ *Id.* at 130.

Plexos performs this task while operating with a number of possible constraints, including:

- Minimum and maximum reserve margins;
- Resource additions (i.e., maximum units built);
- Age and lifetime of generation facilities;
- Retrofit dependencies (SCR and FGD combinations);
- Operation constraints such as ramp rates, minimum up/down times, capacity, heat rates, etc.;
- Fuel burn minimum and maximums;
- Emission limits on effluents such as SO₂ and NO_x; and
- Energy contract parameters such as energy and capacity.²¹⁵

The LT Plan also models the following major system limitations:

- Maintain a PJM-required minimum reserve margin;
- Factor in the potential impact of current and pending environmental regulations, including the incremental costs to comply with the proposed CPP using both a mass-based and rate-based compliance approach; and
- The installed cost of replacement capacity alternative options, as well as the attendant costs associated with those options.²¹⁶

Based upon the established comparative screenings, the following specific supply options were modeled in *Plexos* for each designated duty cycle:

- Peaking capacity was modeled, effective in 2019 due to the anticipated period required to approve, site, engineer, and construct
- CT units consisting of two “E” class turbines at 179 MW total at summer conditions.

²¹⁵ *Id.* at 131.

²¹⁶ *Id.* at 132.

- CT units consisting of a 50 percent share of two “F” class turbines with evaporative coolers and dual fuel capability, rated at 477 MW total at summer conditions.
- AD units consisting of two General Electric LM 6000 turbines at 90 MW total at summer conditions.
- Battery Storage units available in 10 MW blocks per year.
- Intermediate-Baseload capacity was modeled, effective in 2021 due to the anticipated period required to approve, site, engineer, and construct.
- 25 percent share of a Natural Gas Combined Cycle (“NGCC”) (2x1 “H” class turbines with duct firing and evaporative inlet air cooling) facility, rated at 948 MW at summer conditions. The 25 percent interest assumes Kentucky Power coordinated the addition of this resource with other parties.
- Wind resources were made available up to 75 MW annually, beginning in 2018. Wind resources had a levelized cost of energy of \$47 per MWh, in 2017, with the production tax credit. Wind resources were assumed to have a PJM capacity value equal to 5 percent of nameplate rating.
- Large-scale solar resources were made available in two tranches, with up to 20 MW of each tier available each year, for a total of up to 40 MW annually. Initial costs for Tier 1 were approximately \$1,556/kW in 2017 with the investment tax credit (“ITC”). Tier 2 had an initial cost of approximately \$1,763/kW in 2017 with the ITC. Solar resources were assumed to have a PJM capacity value equal to 38 percent of nameplate rating.
- DG, in the form of rooftop solar resources, was embedded in amounts equal to a compound annual growth rate of 15 percent applied to the current installed level of approximately 0.15 MW.
- CHP resources were made available in 15 MW (nameplate) blocks, with an overnight installed cost of \$1,800/kW and assuming full host compensation for thermal energy for an effective full load heat rate of approximately 4,800 Btu/kW.
- EE resources, incremental to those already incorporated into Kentucky Power’s long-term load and peak demand forecast, were made available in 10 unique “bundles” of Residential and Commercial measures considering cost and performance parameters for Achievable Potential programs. These resources were made available beginning in 2019.

- VVO was available in eight tranches of varying installed costs and a number of circuits ranging from 0.6 MW up to 3.9 MW of demand savings potential. These resources were made available beginning in 2018.²¹⁷

Given Kentucky Power's long capacity position throughout the planning period, the optimized portfolios serve as a guide for identifying the type and quantity of resources that would benefit customers if added to Kentucky Power's portfolio. Kentucky Power initially analyzed six scenarios in its IRP resulting in six unique portfolios. Kentucky Power states that these different scenarios allow Kentucky Power to assess uncertainty in the future and assess the portfolio of resources that would be needed to meet various market and load conditions.²¹⁸

Four commodity pricing scenarios were developed by AEP Fundamental Analysis for Kentucky Power to enable *Plexos* to construct resource plans under various long-term commodity pricing conditions. Long-term power commodity forecasts were derived using AEPSC Long-Term North American Energy Market Forecast information and *Aurora*, a proprietary long-term fundamental production-costing tool developed by EPIS, Inc. In the IRP, the four distinct long-term commodity pricing scenarios developed for base load conditions were as follows: 1) Mid; 2) Low Band; 3) High Band; and, 4) No Carbon.²¹⁹ In addition to the commodity pricing scenarios, Kentucky Power modeled two load scenarios, which assumed a Low Load Condition and a High Load Condition associated with a Mid Commodity Pricing scenario.²²⁰

The Mid scenario recognizes the decision by the U.S. Court of Appeals to vacate CSAPR and reflects certain emission pricing beginning in 2024. The assumptions include:

- MATS Rule implementation beginning in 2015;
- relatively lower gas price due to the emergence of shale gas plays; and
- CO₂ emission pricing beginning in 2024.²²¹

The Low Band scenario reflects a lower natural gas/solid-fuel/energy price profile compared to the Mid scenario. In the early years, lower natural gas prices tend to track the Base Case but in the long-term reflect lower natural gas prices as compared to the

²¹⁷ *Id.* at 133 and 134.

²¹⁸ *Id.* at 134 and 135.

²¹⁹ *Id.* at 135.

²²⁰ *Id.*

²²¹ *Id.* at 102.

Mid scenario.²²² As with the Mid scenario, CO₂ pricing is assumed to start in 2024.²²³

The High Band scenario reflects higher natural gas prices compared to the Mid scenario. This is based on impediments to shale gas development including stalled technological advances and as yet unseen environmental costs.²²⁴ The pace of the environmental regulation implementation is comparable to the Mid and Low Band scenarios.

The No Carbon scenario did not consider a price for CO₂ emissions.²²⁵ Kentucky Power states that while also including the necessary correlative fuel price adjustments, the No Carbon scenario serves as a baseline to understand the impact of a price of CO₂ emissions on unit dispatch.²²⁶

MODELING RESULTS

Over the 2017-2031 planning horizon, all six of the modeled scenarios include resource additions. The optimized cumulative capacity additions associated with the four commodity pricing scenarios all include the addition of EE programs and renewable energy resources.²²⁷ The Mid and Low Band portfolios call for the addition of VVO during the planning period. The Mid, Low Band, and High Band portfolios include solar resources while the No Carbon does not.²²⁸ Due to lower energy prices for the No Carbon scenario, solar resources are excluded throughout the planning period, as they are not economic. Kentucky Power stated that the only portfolio that calls for fossil-fuel generation is the High Band portfolio, which includes a 25 percent share in a baseload NGCC in 2031.²²⁹ Each of the commodity pricing scenario portfolios is projected to leave Kentucky Power with a surplus of energy beginning in 2018 and continuing throughout the forecast period.

²²² *Id.*

²²³ *Id.*

²²⁴ *Id.* at 103.

²²⁵ *Id.*

²²⁶ *Id.*

²²⁷ *Id.* at 135.

²²⁸ *Id.* The addition of solar resources in later years of the planning period is due to the anticipated declining cost of this resource.

²²⁹ *Id.*

In both the Low Load and High Load scenarios, the cumulative capacity additions include wind, solar, EE, and VVO resources.²³⁰ As could be expected, the High Load scenario includes more overall resources than the Low Load scenario. Kentucky Power stated that both portfolios put it in a position of having an energy surplus beginning in 2018, and throughout the planning period.²³¹

While Kentucky Power has sufficient capacity to satisfy its PJM summer reserve margin criterion, *Plexos* will consider the addition of resources that are economic based on their energy contribution. Over the long-term, adding these resources would serve to reduce the production-related revenue requirement. Since Kentucky Power's customers use significant amounts of energy, especially in the winter, not considering the addition of these resources would result in them having greater exposure to dependency on external energy and PJM energy market prices. In effect, *Plexos* may add resources because those resources may produce energy at a lower cost than that expected in the energy markets.

Kentucky Power analyzed each of the scenarios to gain insight on its preferred potential mix of resources for the future that resulted in the Preferred Plan. The cumulative capacity additions associated with the Preferred Plan incorporates the following changes from the optimized Mid portfolio:

- Earlier adoption of solar resources, beginning in 2019. This increases fleet diversification and takes advantage of the ITC;
- Increased levels of EE beginning in 2023. This maintains Kentucky Power's level of investment in EE programs for customers through 2024.
- Addition of a CHP facility in 2022. This acknowledges that certain customers may be interested in CHP initiatives and assumes a suitable host application is identified; and
- Addition of battery storage in 2025. While currently not an economic resource, battery storage may provide benefits that complement the additional renewable resources.²³²

In its Preferred Plan, Kentucky Power selected incremental EE resources beginning in 2019 and throughout the remainder of the planning period with most of the economic savings coming from Lighting and Thermal Shell programs. Kentucky Power states that by 2031, overall EE savings – consisting of Non-DSM Energy Efficiency (i.e. efficiency due to evolving codes and standards), existing DSM Programs, and

²³⁰ *Id.* at 136.

²³¹ *Id.*

²³² *Id.* at 137 and 138.

Incremental DSM programs – will provide a decrease in residential and commercial energy usage of nearly seven percent.²³³

Kentucky Power performed a comparison of its Preferred Plan, which primarily adds renewable resources and energy efficiency measures, to a plan that relies only on existing resources, making no incremental investments in new resources or energy efficiency (“Do Nothing Plan”).²³⁴ The comparison resulted in the Preferred Plan having a monthly bill that was \$13.30 less than the Do Nothing Plan over the planning period, illustrating that by diversifying its fleet and continuing energy efficiency programs, Kentucky Power could potentially provide service at a lower cost than by just maintaining the status quo.²³⁵

The average real rate per kWh, i.e, not adjusted for inflation, expected to be paid by Kentucky Power’s customers in the planning period under the Preferred Plan is \$0.116 per kWh in 2017 and increases to \$0.159 per kWh in 2031.²³⁶ The real rate is the result of direct costs and energy consumption impacts associated with the Preferred Plan exclusive of any increases in Kentucky Power’s transmission and distribution related costs and base-generation-related costs not uniquely incorporated into the planning/modeling process. The average nominal rate per kWh Kentucky Power’s customers will pay in the planning period under the Preferred Plan is \$0.116 in 2017 and increases to \$0.173 in 2031.²³⁷

Kentucky Power performed a comparison of the expected cost of complying with the CPP under both the mass-based and rate-based compliance approaches. Kentucky Power stated that modeling compliance with the CPP was challenging due to the many uncertainties that surround the plan. Among the uncertainties are at what level the CPP compliance plans will be implemented (e.g. state-specific, regional, national, etc.), the lack of guidance on preference for a type of plan or design elements from three states in which Kentucky Power owns (or purchases) fossil generation – Indiana, Kentucky and West Virginia, and the stay issued by the U.S. Supreme Court which will likely delay the development of compliance plans and strategies.²³⁸ Based upon the assumptions used and the scope of the study only covering Kentucky Power assets, for the planning period Kentucky Power determined the cost of the mass-based compliance to be

²³³ *Id.* at 138.

²³⁴ *Id.* at 139 through 141. Kentucky Power assumed a typical customer would use 1,000 kWh/month and that the non-energy portion of the bill, primarily transmission and distribution costs, would increase at the same rate under both plans.

²³⁵ *Id.* at 140 and 141.

²³⁶ *Id.* at 141 and 142.

²³⁷ *Id.* at 142.

²³⁸ *Id.* at 143.

approximately \$61 million and the cost of rate-based compliance to be approximately \$252.5 million.²³⁹

Under the Preferred Plan, resource additions during the 2017-2031 planning horizon are estimated at 520 MW of nameplate capacity in addition to the proposed CHP facility and the 10 MW (nameplate) of battery storage. Compared to the Do Nothing Plan, wind additions total 300 MW, solar additions total 131.1 MW, and EE measures account for 89 MW.²⁴⁰

RISK ANALYSIS

In addition to comparing the Preferred Plan to the Do Nothing Plan to determine differences in cost, Kentucky Power evaluated the two portfolios using a stochastic or Monte Carlo modeling technique. This is a technique in which input variables are randomly chosen from a universe of possible values given certain constraints and correlative relationships. This was done to isolate the impacts of the incremental assets added in the Preferred Plan. The outcome of these evaluations was presented as the Revenue Requirement at Risk (“RRaR”) which was measured as the difference between the portfolio’s median and 95th percentile.²⁴¹ The larger the RRaR, the greater the risk that customers would be exposed to adverse outcomes relative to the portfolio’s mean or expected cost CPW revenue requirements.

Although the difference in RRaR between the two portfolios was not significant at the 75th percentile, at the 95th percentile the additional revenue requirement associated with the Preferred Plan is over a \$100 million lower than the Do Nothing Plan.²⁴² The addition of economic renewable resources in the Preferred Plan reduces the risk of revenue requirement volatility. In summary, Kentucky Power stated that the Preferred Plan reduces the inherent risk characteristics when compared to a plan where no new resources are added and reduces the risk of rate volatility as well.²⁴³

DISCUSSION OF REASONABLENESS

Staff is generally satisfied with Kentucky Power’s integration process, as well as its risk analysis, and plan optimization. The Preferred Plan chosen by Kentucky Power contains a revenue requirement that is significantly less than the Do Nothing Plan’s revenue requirement. The Preferred Plan reduces the risk of revenue requirement

²³⁹ *Id.*

²⁴⁰ *Id.* at 21.

²⁴¹ Assuming a given plan is adopted, the 95th percentile represents a level of required revenue sufficiently high that it will be exceeded in only five of 100 simulations.

²⁴² IRP at 145 through 147

²⁴³ *Id.* at 147.

volatility and includes the addition of renewable resources and customer-based DSM and EE. All recommendations for Kentucky Power's next IRP filing, the timing of which will be determined by the Commission, are contained in Sections 2, 3, and 4 of this report.

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