Kentucky Public Service Commission

Staff Report On the

2013 Integrated Resource Plan

of Kentucky Power Company

Case No. 2013-00475

November 2014

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" or "the Company") filed its 2013 Integrated Resource Plan ("IRP") with the Commission on December 20, 2013. The IRP includes Kentucky Power's plan for meeting its customers' electricity requirements for the period 2014-2028.

On January 17, 2014, an Order was issued establishing a procedural schedule for this proceeding. The schedule allowed two rounds of data requests to Kentucky Power, an informal conference, written comments by intervenors and reply comments by the Company. Intervening in this matter were Kentucky Industrial Utility Customers, Inc., ("KIUC") and Beverly May, Alexander DeSha, and the Sierra Club ("Sierra Club"). KIUC did not issue data requests or submit written comments.

Kentucky Power is a subsidiary of American Electric Power ("AEP"). It supplies electricity to approximately 173,000 customers in its eastern Kentucky service area. Industries served by Kentucky Power include metals, chemicals and allied products, petroleum refining, and coal mining. The Company is also a wholesale power provider to the Vanceburg and Olive Hill municipal electric systems, other electric utilities and cooperatives, and non-utility entities participating in the wholesale energy market.

The purpose of this report is to review and evaluate Kentucky Power's 2013 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, 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 includes an incremental component, noting any significant changes from the Company's most recent IRP, filed in 2009.

Kentucky Power is one of the AEP operating companies that make up the AEP-East zone. 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, leaving Kentucky Power responsible for its own generating resources. This will require that Kentucky Power individually maintain an adequate amount of power supply resources to meet its load requirements for energy and capacity, including an adequate reserve margin.

Kentucky Power's system peak demand has historically occurred in the winter. Its IRP reported its record system peak as 1,678 megawatts ("MW") in January 2008. Its record summer peak demand, 1,358 MW, occurred in August 2007. Residential, commercial, and industrial sales accounted for approximately 31, 19, and 43 percent of its load, respectively, in 2012. The remaining 7 percent of its load was attributed to public street and highway lighting, sales for resale, and all other categories.

Kentucky Power owns the Big Sandy Plant in Louisa, Kentucky, a 1,078-MW coal-fired plant, made up of two units: Big Sandy 1 (278 MW), and Big Sandy 2 (800 MW). Kentucky Power has a contract under which it purchases 393 MW of capacity and the associate energy from the affiliate-owned Rockport Plant in southern Indiana. While it expires December 7, 2022, for purposes of its IRP, Kentucky Power assumed the Rockport contract would be in effect through the entire planning period.

Subsequent to filing its IRP, on January 1 2014, the Company added 780 MW of capacity when it acquired a 50 percent ownership interest in Units 1 and 2 of the Mitchell Plant generating facility located in Captina, West Virginia, from an AEP affiliate.[1] 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"). Shortly before filing its IRP, Kentucky Power submitted an application for Commission

[1] This acquisition was approved by the Commission's acceptance, with modifications, of the non-unanimous Stipulation and Settlement Agreement of July 2, 2013, in 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 Nov. 22, 2013).

approval to convert Big Sandy Unit 1 to natural gas, also in response to environmental emission limits.[2] Other features of the IRP during the 2014-2028 period include adding: (1) a potential 100 MW (nameplate rating) wind resource in 2015; (2) a 58.5 MW biomass resource in 2017; (3) relatively small amounts of solar-powered resources; and (4) incorporating incremental levels of demand-side management ("DSM") and energy efficiency ("EE") resources.

Since 2004, the AEP transmission system 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 this transfer of functional control in Case No. 2002-00475.[3] 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, which extends from Virginia to Michigan, contains 345 kilovolt ("kV"), 500 kV, and 765 kV lines, and interconnects with several neighboring power systems. The number of interconnections AEP 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. The level of uncertainty facing electric utilities means the assumptions in its resource expansion plan 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, uncertainty of demand, and EE advancements all contribute to making resource planning increasingly complex. Such complexity, according to the Company, makes flexibility and adaptability a necessary part of resource planning. A final issue which 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 increase from 1,431 MW in 2014 to 1,459 MW in 2028, for a growth rate of 0.1 percent, once the impacts of its EE programs are acknowledged. Its summer peak is expected to increase from 1,132 MW to 1,179

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[2] 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).

[3] 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).

are lower than those reported in the Company's 2009 IRP, when its winter peak annual growth rate was 0.7 percent and its summer peak growth rate was 0.9 percent.

The remainder of this report is organized as follows:

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

In issuing this report, Commission Staff is recommending to the Commission that Kentucky Power's next IRP be filed three years from the filing date of this IRP. This will result in a December 20, 2016 filing date for Kentucky Power's next IRP.

SECTION 2

LOAD FORECASTING

INTRODUCTION

Kentucky Power's forecasts of energy consumption for the major customer classes were developed using both short-term and long-term econometric models, and supplemented by statistically adjusted end-use ("SAE") models.[4] Energy forecasts are based on forecasts of the regional economy which, in turn, are based on forecasts of U.S. economic growth provided by Moody's Analytics.[5] Peak demand forecasts are based on revenue class sales, energy loss multipliers, weather, 24-hour load profiles, and calendar information.

In the short term, Kentucky Power assumes that electricity consumption changes in response to changes in electricity prices are minimal, due to the limits on customers' ability to significantly alter their consumption levels. Substituting other fuels or switching to more energy efficient technology, such as energy efficient appliances and buildings, is limited in the short run. Energy prices are not included in the short-term models used by Kentucky Power. However, energy prices are included in the long-term models.

In the long term, consumers' ability to replace energy inefficient equipment is much less constrained than in the short term. Over time, consumers are able to purchase more energy efficient appliances, heating and cooling equipment, and other devices. Consumers can change their electricity consumption levels over time, so the long-term forecasting models include energy price variables.

SHORT-TERM FORECASTING MODELS

The goal of the short-term forecasting models is to produce accurate forecasts for the first year into the future.[6] Short-term models use monthly and seasonal binary variables, time trends, and monthly heating and cooling degree days. The heating and cooling degree days are calculated from weather data taken from weather stations throughout Kentucky Power's territory.

For the residential and commercial classes, energy sales are developed based on forecasts of usage per customer and the number of customers. Variables included

[4] IRP at 31.

[5] *Id.* at 30.

[6] *Id.* at 34.

in the models are lagged energy usage, lagged number of customers, heating and cooling degree days, lagged error terms, and binary variables. The residential and commercial energy sales forecasts are derived from the usage and customer forecasts.

For short-term industrial energy sales, separate forecasts are produced for the ten largest industrial customers. The remaining industrial customers are segregated into manufacturing and mining load categories. These 12 models forecast industrial energy sales using lagged energy sales, lagged error terms, and binary variables. The 12 forecasts are summed to produce the industrial energy sales forecast.

All Other Energy Sales includes public street lighting and highway lighting sales, and sales-for-resale to municipal customers. The short-term model for the street and highway category uses binary variables and lagged energy sales. The municipal sales-for-resale model variables include binaries, heating and cooling degree days, lagged error terms, and lagged energy sales and error terms.

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.[7] 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.

Kentucky Power forecasts natural gas prices for use in its energy models based on a forecast of state natural gas prices in four primary sectors: residential, commercial, industrial, and electric utilities. It also uses a regional coal production model 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/Energy Information Administration's ("DOE/EIA") "2013 Annual Energy Outlook."[8]

Residential Energy Sales

Residential sales are forecast using two models: one that projects the number of customers and one that projects usage per customer. The long-term residential customer model variables are population, employment, and lagged customers. This forecast is blended with the short-term customer forecast to produce a final forecast.

[7] *Id.* at 35.

[8] *Id.* at 36.

The residential energy usage model is estimated using a 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. The heating variable is derived by multiplying a heating index variable by a heating use variable. A heating index reflects heating equipment saturation, heating equipment efficiency standards, and the thermal integrity and size of homes. The cooling variable is derived by multiplying a cooling index by a cooling use variable. The cooling index 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.

As stated earlier, the "other" variable estimates non-weather-sensitive sales. It is a function of appliance and equipment saturation levels, average monthly billing days, household size, real personal income, natural gas prices, and electricity prices.

Appliance saturations come from Kentucky Power's residential customer survey. Saturation forecasts and efficiency trends are based on DOE forecasts and analyses by Itron. Thermal integrity and the size of homes are for the East North Central Census Region and are based on DOE and Itron data.[9] The number of billing days and the electricity price forecast are developed from internal data. Economic and demographic forecasts are obtained from Moody's Analytics. The SAE model incorporates the effects of the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, the Energy Improvement and Extension Act of 2008, and the American Recovery and Reinvestment Act of 2009 on residential energy use.[10] The long-term residential energy sales forecast is derived by multiplying the blended customer forecast by the usage forecast from the SAE model.

From 2008 to 2012, Kentucky Power's residential energy sales declined from 2,481 gigawatt-hours ("GWH") to 2,241 GWH, which represents an average annual growth rate of -2.5 percent.[11] Over the 2014–2028 forecast period, Kentucky Power's residential energy sales are projected to decline slightly. In 2014, residential energy sales are projected to be 2,267 GWH, while by 2028, they are projected to be 2,234 GWH, which represents an average annual growth rate of -0.1 percent.[12]

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[9] *Id.* at 38.

[10] *Id.* at 38-39.

[11] *Id.* at 56, Exhibit 2-2.

[12] *Id.*

Commercial Energy Sales

The commercial energy sales forecast employs an SAE model and is also based on variables for (1) heating, (2) cooling, and (3) other. Like the residential model, the heating variable is obtained by multiplying a heating index variable by a heating use variable. It is ultimately a function of heating degree days, heating equipment saturation levels, heating equipment operating efficiencies and trends, building size, average monthly billing days, commercial output, and electricity prices. The cooling variable uses measures similar to the heating variable, except that it uses information on cooling degree days and cooling equipment rather than those items related to heating load.

The "other" variable estimates non-weather-sensitive commercial sales. It uses non-weather-sensitive equipment saturations and efficiencies, billing days, commercial output, and electricity prices. Itron supplied the building size, and equipment saturation and efficiency data based on DOE's 2012 Annual Energy Outlook. Billing data and electricity prices are developed internally. The commercial output is measured by real commercial gross regional product from Moody's Analytics. The equipment stock and building size information are for the East North Central Census Region.[13]

From 2008 to 2012, Kentucky Power's commercial energy sales declined from 1,429 GWH to 1,350 GWH, an average annual rate of -1.4 percent. Over the 2014–2028 forecast period Kentucky Power's commercial sales are expected to grow from 1,346 GWH to 1,436 GWH, which represents an average annual growth rate of 0.5 percent.[14]

Industrial Energy Sales

The manufacturing energy forecast is based on real electricity prices, production indexes for primary metals, gross regional product for manufacturing, and binary variables. The mine power forecast is based on coal production and real electricity prices. From 2008 to 2012, industrial energy sales declined from 3,322 GWH to 3.060 GWH, an average annual rate of -2.0 percent. Over the 2014–2028 forecast period, Kentucky Power's industrial energy sales are projected to grow from 2,828 GWH to 2,957 GWH, an average annual rate of 0.3 percent.[15] Manufacturing accounts for about two-thirds of industrial sales, and mine power energy sales represent about one-third.

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[13] *Id.* at 39.

[14] *Id.* at 56, Exhibit 2-2.

[15] *Id.*

All Other Energy Sales

This category is made up of public street and highway lighting and sales-for-resale to municipalities. The public street and highway lighting energy sales forecast is a function of service area commercial employment and binary variables. The municipal energy sales are a function of service area gross regional product, heating and cooling degree days, electricity prices, and binary variables. This category represents a small portion of Kentucky Power's overall energy sales. Over the forecast period, sales are projected to grow from 106 GWH to 115 GWH, an annual average rate of 0.6 percent.[16]

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 2014–2028 forecast period, Kentucky Power's overall total internal energy requirements are projected to grow from 6,958 GWH to 7,158 GWH. This equates to an average annual growth rate of 0.2 percent.[17]

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. Weather data is developed from representative weather stations in Kentucky Power's service area. Twelve monthly profiles of average daily temperature that best represent cooling and heating degree days of specific locations are based on historical data from the National Oceanographic and Atmospheric Administration of the last 30 years.[18]

The 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 8,760 hourly values. Net internal energy requirements are the sum of these hourly values to the Company's energy need basis. Peak demand is the maximum of the hourly values from a stated period (monthly, seasonally, or annually).

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[16] *Id.*

[17] *Id.*

[18] In response to Staff Data Request 1-15, Kentucky Power stated that it periodically tests periods other than 30 years and has not found any statistical differences using alternative periods.

Historically, Kentucky Power's higher seasonal peak demand has occurred in the winter, and that is expected to continue over the forecast period. The winter peak is expected to grow from 1,431 MW in 2009 to 1,459 MW in 2028, for an average annual rate of 0.1 percent. The summer peak is expected to grow from 1,132 MW in 2009 to 1,179 MW in 2028, for an average annual rate of 0.3 percent.[19]

CONSERVATION AND DEMAND SIDE MANAGEMENT

Kentucky Power offers DSM programs to its residential and commercial customer classes. Historically, the impact of these programs on energy requirements and peak demands has been fairly insignificant, primarily due to the small size of the programs. However, in the Stipulation and Settlement Agreement ("Agreement") approved by the Commission in Case No. 2012-00578, Kentucky Power agreed to increase its annual spending on cost-effective DSM to $4 million in 2014, $5 million in 2015, and $6 million in 2016, 2017, and 2018, with a pledge to maintain the $6 million level of annual spending in years after 2018.[20] For 2013, the Company estimates its internal energy requirements without these DSM programs to be 7,100 GWH and 7,093 GWH with these programs, a difference of 7 GWH. For 2028, energy requirements are forecast to be 7,255 GWH without DSM programs and 7,158 GWH with them, a difference of 97 GWH.[21] Over the forecast period, the effect of the Company's DSM programs on summer peak demand is projected to increase from 5 to 14 MW.[22] Kentucky Power's winter peak demand in 2014 is forecast at 1,440 MW without them and 1,432 MW with them. In 2028, winter peak demand is forecast to be 1,480 MW without DSM programs and 1,459 MW with them.[23]

ELASTICITY OF DEMAND

Kentucky Power's IRP describes the economic theory of the effect a change in the price of an item will have on the consumption of that item. It explains that there are actually two effects: the "income" effect and the "substitution" effect. The income effect refers to the change in consumption of an item relative to a change in real income. The substitution effect refers to the change in consumption of an item associated with the

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[19] IRP at 57, Exhibit 2-3.

[20] *See* footnote 1.

[21] IRP at 62, Exhibit 2-8, and 56, Exhibit 2-2.

[22] Reflecting DSM program impacts, summer peak demand in 2028 is projected to be 1,179 MW.

[23] IRP at 63, Exhibit 2-9, and 57, Exhibit 2-3.

change in the price of that item relative to the prices of all other items.[24] Accordingly, if the price of electricity increases, the consumption of electricity would decline, all other things being equal. Part of that would be due to the income effect, as consumers make decisions on how to allocate their budgets to purchase electricity and other goods after the price of electricity increases. Conversely, part of the consumption decline would be due to the substitution effect, as consumers substitute relatively cheaper fuels for electricity after the electricity price has risen.[25]

The IRP states that 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 electricity-efficient technology.[26] Kentucky Power's short-term energy consumption models do not include price as an explanatory variable, reflecting its belief that this constraint is severe.[27]

In the long term, the IRP states that constraints on substitution are lessened for several reasons. Among them: (1) durable equipment stocks begin to reflect changes in relative energy prices by favoring equipment using the fuel that was expected to be cheaper; (2) increased consumer interest in saving electricity, coupled with willingness to pay for more efficiency, spurs development of conservation technology; (3) existing technology considered too expensive to implement commercially at pervious levels of energy prices becomes feasible at the new higher prices; and (4) normal turnover of electricity-using equipment contributes to a higher average level of energy efficiency.[28]

With its expectation that energy price changes have an 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, directly incorporate the price of electricity as an explanatory variable. The residential SAE model uses 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 associate price elasticity to develop explanatory variables.[29]

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[24] *Id.* at 45.

[25] *Id.*

[26] *Id.*

[27] *Id.* at 45-46.

[28] *Id.* at 46.

[29] *Id.*

FORECAST UNCERTAINTY ANALYSIS

The IRP states that forecast uncertainty is of primary interest at the total system level rather than the operating company level.[30] As a result, the analysis of forecast uncertainty begins with AEP-East Zone load. An aggregated "mini model" of AEP-East Zone internal energy requirements is developed which is intended to represent the full forecasting structure employed in producing a base case forecast for the AEP-East Zone, of which Kentucky Power is a part. Independent variables in the mini model are gross regional product, average real price of electricity to all AEP-East Zone customer classes, average real price of natural gas in the seven states served by AEP-East Zone companies, and AEP-East Zone service are heating and cooling degree days.

After a base case energy forecast is developed with the mini model, high and low values for the independent variables are determined based upon professional judgment. The base case growth rate for real service area gross regional product is 1.8 percent annually, while the low and high case growth rates are 1.1 and 2.3 percent, respectively. The base case real electricity price growth rate is 0.4 percent annually, while the low and high average annual growth rates are 0.3 percent and 0.5 percent.[31]

The low case and high case internal energy requirement forecasts for 2028 are about 8 percent below and 6 percent above the base case forecast. The base case internal energy requirement is 7,158 GWH. The low and high case forecasts are 6,574 and 7,579 GWH, respectively.[32] The 2028 base case summer peak demand is 1,179 MW, while the low and high case forecasts are 1,083 MW and 1,249 MW. For the 2028 base case winter peak, the forecast is 1,459 MW, while the low and high case forecasts are 1,336 MW and 1,548 MW.[33] The average annual growth rates over the forecast period for the Company's internal energy requirements are 0.2 percent in the base case with low and high case growth rates of -0.4 and 0.5 percent.[34] Average annual summer peak growth rates are 0.3 percent in the base case with low and high case growth rates of -0.3 percent and 0.7 percent. Winter peak annual average growth rates range from a low case of -0.4 percent to a high case of 0.5 percent with a base case of 0.1 percent.[35]

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[30] *Id.* at 47.

[31] *Id.* at 48.

[32] *Id.* at 67, Exhibit 2-13.

[33] *Id.*

[34] *Id.*

[35] *Id.*

SIGNIFICANT CHANGES

Kentucky Power confirmed in response to a data request that its forecasting models have not changed since its last IRP, filed in 2009.[36] However, for a number of reasons, the latest forecast results are quite different from its prior forecast results.

The prior forecast projected internal energy requirements for Kentucky Power in 2023 of 9,007 GWH and an average annual growth rate of 0.9 percent. The current forecast projects internal energy requirements in 2023 of 7,056 GWH and an average annual growth rate of 0.2 percent. The year 2023 is used for comparison, as it was the final year of the forecast in the prior IRP. The 2013 IRP internal energy requirements for 2023 are 21.7 percent below the prior forecast for the same year.[37] Similarly, the prior winter peak demand forecast for 2023 was 1,799 MW, as opposed to the 2013 forecast for that same year of 1,438 MW, which is lower by 20.1 percent.[38] Winter peak demand was forecast to grow at an average annual rate of 0.7 percent in the previous forecast, as compared to a 2013 growth rate forecast of 0.1 percent. Summer peak demand in 2023 was 1,483 MW in the previous IRP, compared to 1,157 MW in the current IRP forecast. The average annual growth rate for summer peak demand in the prior forecast was 0.9 percent, while in the current IRP it is 0.3 percent.

Comparing the specific customer class changes provides some insights into the forecast changes. The 2013 forecasts of residential and commercial class energy requirements for 2023 are 9.7 percent and 19.2 percent lower, respectively, than in the previous IRP forecasts.[39] The 2023 industrial class energy sales are 25.7 percent lower in the current IRP forecast, compared to the prior IRP forecast.[40]

Kentucky Power states that factors contributing to the residential and commercial sales forecasts being lower than previously include a sluggish economy, a deteriorating residential customer base, and 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 2008-2009 recession as well as the downward pressures faced by the coal

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[36] Response to Staff Data Request 1-12.

[37] IRP at 49

[38] *Id.* at 50.

[39] *Id.* at 49.

[40] *Id.*

industry that have negatively affected the forecast.[41] Kentucky Power also states that reduced growth in demand and energy sales, as reflected in its 2013 forecasts, is a result of federal legislation mandating more stringent efficiency standards.[42]

INTERVENOR COMMENTS AND KENTUCKY POWER'S REPLY

The Sierra Club states that Kentucky Power's load forecast likely overestimates future demand from the coal mining sector.[43] It notes that the Company clarified at the April 16, 2014 informal conference that its coal mining sector forecast was based on EIA regional data, rather than data specific to Eastern Kentucky, and that the forecast was generated using information through the first quarter of 2013.[44] Citing various reports which indicate that Eastern Kentucky coal production is decreasing more quickly than production in other areas, the Sierra Club asserts that Kentucky Power's use of regional data is likely why the forecast is skewed, thereby predicting a higher demand from the coal mining sector than the Company should reasonably expect.

In its reply to Sierra Club's Comments, Kentucky Power states that its forecast projected a steep decline in the coal mining sector in 2013 and additional decline in 2014. Kentucky Power states that given when it was prepared, the 2013 forecast was based on two months of actual data and ten months of forecast data. It acknowledges that, due to there being no readily available forecast for Eastern Kentucky, it developed its own forecast using EIA's historical data and forecast of Eastern regional coal production.[45] Kentucky Power notes that mine power sales have been an increasingly smaller portion of its total energy requirements in recent years and are projected to decline from 11 percent of its total requirements in 2012 to about 9 percent in 2028. At this level, Kentucky Power points out, if the mine power forecast is 25 percent too high in 2028, the result will be that its peak demand is over-forecasted by 40 MW, which amounts to a 2.8 percent forecast error 15 years into the future.[46]

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[41] *Id.*

[42] *Id.* at 51-52.

[43] Sierra Club's Comments on Kentucky Power Company's Integrated Resource Planning Report ("Sierra Club's Comments") at 37.

[44] *Id.* at 38.

[45] Kentucky Power Company's Response to Comments from Sierra Club on the Company's Integrated Resource Planning Report ("Kentucky Power's Response") at 22.

[46] *Id.* at 23.

Kentucky Power states that it will continue to monitor how quickly coal production declines in the future. It avers that it will use the best information available at the time a forecast is developed in order to get a forecast that is as accurate and reasonable as possible.[47]

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

In its report on the Company's 2009 IRP, Staff offered the following forecasting recommendations:

- Kentucky Power should consider disaggregating its residential customer class in its SAE models to gain further insight into usage patterns and future energy needs. Disaggregating the commercial class may also provide additional insights.

- Provide a comparison of forecasted winter and summer peak demands with actual results for the period following the 2009 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 current models, with actual results for the period following the 2009 IRP. Include a discussion of the reasons for differences between forecasted and actual sales.

- Given that Kentucky Power's service area economy is not expected to perform as well as the rest of the region, the possibility of either federal emissions-limiting legislation or targeted EPA actions limiting various emissions may have significant impacts on the Company's service territory. In its next IRP, Kentucky Power should explicitly account for potential federal legislation imposing stricter emissions limits on its generation in its forecasts and risk analysis. Potential EPA actions limiting emissions should also be explicitly accounted for in the forecasts and risk analysis.

The Company addressed these recommendations in various sections of its load forecasting chapter. Staff is satisfied with and accepts Kentucky Power's responses to its forecasting-related recommendations on the Company's 2009 IRP.

DISCUSSION OF REASONABLENESS

Staff is satisfied with Kentucky Power's overall load forecasting. The Company'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 in recent

[47] *Id.*

years and that are projected for the future. Staff is somewhat concerned that the mine power forecast could not be updated to reflect more actual data for calendar year 2013 in the development of the forecast.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

Staff has the following recommendations regarding the Company's load forecast for Kentucky Power's next IRP filing.

- Provide a comparison of forecasted winter and summer peak demands with actual results for the period following the 2013 IRP, along with a discussion of the reasons for the differences between forecasted and actual peak demands (update of one of the recommendations in the previous IRP Staff Report).

- Provide a comparison of the annual forecast of residential energy sales, using current models, with actual results for the period following the 2013 IRP. Include a discussion of the reasons for differences between forecasted and actual sales (update of one of the recommendations in the previous IRP Staff Report).

- 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 in which the forecast is prepared.

SECTION 3

DEMAND-SIDE MANAGEMENT AND ENERGY EFFICIENCY

INTRODUCTION

This section addresses the DSM/EE portion of Kentucky Power's 2013 IRP. Since filing its 2009 IRP, Kentucky Power has markedly increased the size of its DSM programs and established several new programs.[48] The new and expanded DSM/EE portfolio is due to many factors, including the Stipulation and Settlement Agreement ("Agreement") approved by the Commission in Case No. 2012-00578,[49] Staff's DSM recommendations in its report on the Company's 2009 IRP, and the efforts of Kentucky Power's DSM Collaborative.[50] In the Agreement, Kentucky Power agreed to increase its annual spending on cost-effective DSM/EE programs from the 2013 level of $3 million to $4 million in 2014, $5 million in 2015, and $6 million in all subsequent years.

In its application in Case No. 2013-00487,[51] Kentucky Power proposed a plan for allocating the increased funding resulting from the Agreement among its residential and commercial DSM/EE programs. It also stated that it would complete a DSM/EE market potential study in 2014 and would work with the Kentucky School Board Association to develop a School Energy Management Program application.[52] Industrial customers are

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[48] IRP, page 81. Case No. 2010-00095, *Joint Application Pursuant to 1994 House Bill No. 501 for the Approval of Kentucky Power Collaborative Demand-Side Management Programs, and for Authority to Recover Costs, Net Lost Revenues and Receive Incentives Associated with Implementing One New Residential, One Combined Residential/Commercial, and One Commercial Demand-Side Management Program Beginning January 1, 2010* (Ky. PSC Aug. 10, 2010); and Case No. 2010-00198, *Joint Application Pursuant to 1994 House Bill No. 501 for the Approval of Kentucky Power Collaborative Demand-Side Management Programs and for Authority to Recover Costs, Net Lost Revenues and Receive Incentives Associated with Implementing One New Combined Residential/Commercial and One Commercial Demand-Side Management Program Beginning August 2, 2010* (Ky. PSC Oct. 15, 2010).

[49] *See* footnote 1.

[50] The DSM Collaborative includes Kentucky Power, the Kentucky Attorney General's Office of Rate Intervention ("AG"), Kentuckians for the Commonwealth, Big Sandy Area Development District, Northeast Kentucky Area Development Council, Kentucky Tech Northeast Region, Christian Appalachian Project, Kentucky Division of Energy, Coleman Oil, Cedar Knoll Galleria, Big Sandy Area Community Action Program, LKLP – Community Action Council, Middle Kentucky River Area Development Council, Appalachian Regional Defense Fund, KIUC, and Appalachian Service Project.

[51] Case No. 2013-00487, *Application of Kentucky Power Company to Amend Its Demand-Side Management Program and for Authority to Implement a Tariff to Recover Costs and Net Lost Revenues, and to Receive Incentives Associated with the Implementation of the Programs* (Ky. PSC June 30, 2014). Application Cover Letter at 1.

[52] *Id.* at 3.

not included in Kentucky Power's current DSM/EE programs,[53] but this sector will be included as part of the market potential study.[54] Some industrial customers currently have internal DSM/EE programs, as identified at the March 13, 2014 Kentucky Industrial Utility Customers' Conference.[55]

The Kentucky Power DSM Collaborative was established in November 1994 to develop the Company's DSM plans, including program design, budgets, and cost-recovery mechanisms. In addition, the DSM Collaborative has been responsible for performing DSM program screening and evaluation. Through continuous monitoring of program performance, program participation levels, and DSM market potential, the Collaborative has recommended the addition, deletion and modification of DSM programs.[56] As a result of the Collaborative's efforts, Kentucky Power's implementation of customer and grid DSM/EE programs is expected to reduce energy requirements by 260 GWH (or 4 percent of projected energy needs) by 2028.[57]

DSM/EE PROGRAM SCREENING & EVALUATION PROCESS

The DSM/EE screening process used by Kentucky Power involves a cost-benefit analysis for each of the DSM programs, with recommendation for extension of operation based on prospective cost performance. This includes application of the Total Resource Cost and Ratepayer Impact Measure tests, as well as the Utility Cost Test and the Participant Cost Test, as defined in the California Standard practice Manual.[58]

Kentucky Power states that DSM/EE programs are included in its IRP in one of two ways: current, approved programs expected to continue through the forecast period as their impacts are included in the load forecast; and incremental programs that are reflected as incremental savings estimated through modeling.

The major supply-side benefits used in the cost-benefit analysis are avoided energy (production) costs and avoided demand/capacity costs (generation, transmission

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[53] Response to Staff Data Request 2-8.

[54] Company Responses to Items 11 and 3, respectively, of Sierra Club's Initial and Supplemental Requests for Information in Case No. 2013-00487.

[55] *See*, for example, the paper titled *"Energy Efficiency at Marathon Petroleum"* by Wayne Kinnel, Catlettsburg Energy Coordinator, Marathon Petroleum Company LP.

[56] IRP at 11.

[57] *Id*. at ES-4.

[58] *Id*. at 86.

and distribution).[59] The analysis also considered benefits from SO_2 emission credits, NO_x market price, estimates for CO_2 costs based on expected legislation, and expected additional system sales, thus improving the cost-effectiveness of each DSM measure.[60]

Kentucky Power states that in assessing DSM/EE programs, the amount of DSM/EE and Demand Response are typically described in three groups: technical potential, economic potential, and achievable potential, adding that the third set of efficiency assets, and the one of greatest practical value, is that which is achievable.[61] It states that of the total potential, only a fraction is achievable, and then only over time.

In selecting which DSM/EE programs to expand as a result of the Agreement, a determination was made as to the cost of incremental programs as well as the ability to expand current programs. In addition, Kentucky Power analyzed Efficiency Vermont, which provided comprehensive public information on end-uses that are impacted by a utility program as well as measure and programs costs, and adapted those measures to fit Kentucky's climate.[62] Kentucky Power states that it is already targeting residential heating, cooling, and lighting measures and believes incremental opportunity may lie in residential appliances, commercial refrigeration and expansion of commercial heating ventilation and air conditioning ("HVAC") and other miscellaneous programs.[63] Details of Kentucky Power's expanded DSM/EE portfolio are included in Case No. 2013-00487.

Kentucky Power states that the DSM/EE landscape is increasingly challenging due to federal legislation and economic conditions. The complete phase-in of increased lighting standards has limited the prospective savings possible with utility lighting programs, which have provided the bulk of energy savings to date. Thus, the Company states that it is unrealistic to expect energy savings associated with lighting programs of the past to translate to prospective programs with substantially non-lighting measures. Kentucky Power anticipates that its DSM/EE programs are not expected to achieve as much "bang-for-the-buck" absent any new market transforming technologies.

Kentucky Power has provided the Commission semiannual DSM Status Reports since the Company began program implementation in 1996, furnishing information on program participation levels, costs and estimated load impacts. Additionally, DSM

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[59] *Id.*

[60] *Id.* at 87.

[61] *Id.*

[62] *Id.* at 95

[63] *Id.* at 96.

Evaluation Reports were submitted to the Commission in 1997, 1999, 2002, 2005, 2008, 2011, and 2012, which provided extensive results of the screening and evaluation of each of the DSM programs implemented.[64]

EXISTING DSM/EE PROGRAM DESCRIPTIONS

Kentucky Power expanded its program portfolio from seven residential programs to 12 residential and commercial programs[65] since the Staff Report was issued on the 2009 IRP. These existing programs, as described by the Company, are as follows:

1. Targeted Energy Efficiency Program - The Kentucky Power Targeted Energy Efficiency Program provides weatherization and EE services to qualifying residential customers who need help reducing their energy bills. The Company provides funding for this program through the Kentucky Community Action network of not-for-profit community action agencies. The program funding and service is supplemental to the Weatherization Assistance Programs offered by local community action agencies. This program provides energy saving improvements to existing homes. Program services can include these items, as applicable and per program guidelines:

- Energy audit
- Air infiltration diagnostic test to find air leaks
- Air leakage sealing
- Attic, floor, side-wall insulation
- Duct sealing and insulation
- High-efficiency compact fluorescent light bulbs ("CFLs")
- Domestic hot water heating insulation (electric)
- Customer education on home energy efficiency

[64] Per the Final Order in Case No. 2012-00367, *Application of Kentucky Power Company to Amend its Demand-Side Management Program and for Authority to Implement a Tariff to Recover Costs and Net Lost Revenues, and to Receive Incentives Associated with the Implementation of the Programs* (Ky. PSC Feb. 22, 2013), the Company was to evaluate its entire DSM portfolio by August 15, 2014.

[65] The Residential and Small Commercial Heating, Ventilation, Air Conditioning ("HVAC") Diagnostic and Tune-up services have been combined into one program description, and this is the reason for only 11 program descriptions.

- Partial funding high efficiency heat pump (restrictions apply).

2. Mobile Home High Efficiency Heat Pump Program – This program offers an incentive to residential customers living in mobile homes who upgrade their central electric resistance heating system with a new, high-efficiency heat pump. To qualify, the new heat pump unit must have a minimum rating of 13 SEER (Seasonal Energy Efficiency Ratio) and 7.7 HSPF (Heating Seasonal Performance Factor).

3. Mobile Home New Construction Program - The Kentucky Power Mobile Home New Construction Program offers an incentive to residential customers who purchase a new mobile home having an insulation upgrade and a high-efficiency heat pump unit. To qualify, the new heat pump unit must have a minimum rating of 13 SEER and 7.7 HSPF.

4. Modified Energy Fitness Program - The Kentucky Power Modified Energy Fitness Program provides weatherization and EE services to qualifying residential customers who need help reducing their energy bills. This program provides energy saving improvements to existing homes. Program services can include these items, as applicable and per program guidelines:

- Complete energy audit with customized report
- Air infiltration diagnostic test to find air leaks
- Energy savings booklet
- Energy conservation measures installed (per program guidelines).

5. High Efficiency Heat Pump Program - The Company's High Efficiency Heat Pump Program offers an incentive to residential customers who upgrade their central electric resistance heating system or existing less efficient heat pump system to a new, high-efficiency heat pump unit. To qualify, the new heat pump unit must have a minimum rating of 13 SEER and 7.7 HSPF for resistance heat upgrade, or 14 SEER and 8.2 HSPF for upgrading from a less efficient existing heat pump to a high-efficiency heat pump unit.

6. Energy Education for Students Program - The Kentucky Power Student Energy Education Program targets seventh grade students at participating schools within the Company's service territory. The program introduces them to various aspects of responsible energy use and conservation. With this program, students use math and

science skills to learn how energy is produced and used, and methods to conserve energy that can easily be applied in their own homes.

The Company partners with the National Energy Education Development Project ("NEED") to implement this program. NEED is an established and respected energy education organization that has been presenting programs for teachers and students in Eastern Kentucky for many years. The program, provided at no cost to participating school systems, includes:

- Professional development in which teachers receive classroom curriculum and educational materials on energy, electricity, economics, and the environment.

- Each student receives CFLs to help apply their classroom learning at home.

- An opportunity for participating students and their families to make the ENERGY STAR® pledge.

7. Community Outreach Compact Fluorescent Lighting Program – Through this program, Kentucky Power distributes CFLs to customers at company-sponsored community events. The program aims to educate and encourage customers to save money by using energy efficient lights. The Company sponsors community distribution events throughout the year at which a package of CFLs is distributed to each qualifying residential customer. Customer energy education is also provided at these events.

8. Residential and Small Commercial HVAC Diagnostic and Tune-up - The residential and commercial customer will be offered an incentive when receiving this Diagnostic and Tune-up service from a participating, state-licensed contractor. It will help extend the life of the system, reduce energy costs, and improve the interior comfort of a customer's residence or business. The diagnostic and tune-up service includes testing for inefficiencies in air conditioning and heat pump systems due to air-restricted indoor or outdoor coils and over or under refrigerant charge.

9. Residential Efficient Products - The Kentucky Power Residential Efficient Products Program offers residential customers instant rebates on ENERGY STAR® lighting products at participating retail stores across our service territory. The program targets the purchase of lighting products through in-store promotion as well as special sales events. Customer incentives facilitate the increased purchase of high-efficiency products while in-store signage, sales associate training, and support makes provider participation easier. A convenient online store where you can shop for energy efficient lighting and get immediate discounts is also available, including specialty and hard-to-find lighting and ENERGY STAR® ceiling fans.

10. Small Commercial High Efficiency Heat Pump/Air Conditioner - The commercial customer will receive financial incentives for upgrading to a new qualifying central air conditioning or heat pump system (up to a five-ton unit with a Consortium for Energy Efficiency Tier 1 rating). The incentive helps offset the cost of the investment, and the improved efficiency can give long-term savings.

11. Commercial Incentive – Kentucky Power's Commercial Incentive Program offers a convenient way to receive funding for common EE projects. The Commercial Incentive Program provides financial incentives to business customers who implement qualified energy-efficient improvements and technologies.

Incentives are available for energy-saving measures in existing buildings and new construction projects. Customers may select from a menu of prescriptive measures with standardized incentives. The menu includes, but is not limited to, incentives for:

- Lighting
- HVAC
- Food Service and Refrigeration.

OTHER POTENTIAL EE PROGRAMS

The Company acknowledges that EE saves customers money. Efficiency measures will always reduce the amount of energy consumed, but some measures may have limited effectiveness at the time of peak demand. EE is viewed as a readily deployable, relatively low-cost, clean-energy resource that provides many benefits.

Unlike supply-side resources, demand-side resources, particularly EE resources, require that consumers achieve reduced consumption. While an analysis may indicate that an "investment" in a particular measure is cost-effective, it does not guarantee that conservation will be universally achieved or adopted, as technology adoption can depend upon many other factors, including ease of adoption, market delivery methods, market barriers, and customer economics.[66]

Market barriers to efficiency exist which limit the rate and ultimate level at which efficiency measures are adopted by consumers. These barriers typically include: high initial cost, uncertainty about performance, and "agency" problems, in which the person

[66] IRP at 88-89.

buying an appliance may not benefit from the improved efficiency.[67] To overcome many such barriers, a portfolio of programs may often include many of the following elements:

- Consumer education
- Technical training
- Energy audits
- Rebates and discounts for efficient appliances, equipment, and buildings
- Industrial process improvements.[68]

Kentucky Power states that in order to defer construction of new power plants, the amount of power consumed at the time of its system peak must be reduced. It further states that in addition to passive or non-dispatchable resources like EE and Volt VAR Optimization ("VVO"), active or dispatchable resources, which have impacts primarily only at times of peak demand, should include:[69]

- Interruptible loads. This refers to a contractual agreement between the utility and a large consumer, typically an industrial customer. In return for reduced energy costs, the customer agrees to "interrupt" or reduce power consumption during peak periods, freeing capacity for use by other consumers.[70]

- Direct load control. Very much like an (industrial) interruptible load, but accomplished with many more, smaller, individual loads. Commercial and residential customers, in exchange for monthly credits or payments, allow the energy provider to deactivate or cycle discrete appliances, typically air conditioners, hot water heaters, lighting banks, or pool pumps during periods of peak demand. These power interruptions can be accomplished through various media such as FM-radio signals that activate switches, or through digital "smart" meters that allow activation of thermostats and other control devices. Often, these smaller loads can be aggregated by curtailment service providers so that they meet RTO minimum requirements.[71]

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[67] *Id.* at 89.

[68] *Id.*

[69] *Id.* at 90.

[70] *Id.* at 90-91.

[71] *Id.* at 91.

- Time-differentiated rates. This program offers customers different rates for power at different times. During periods of peak demand, power would be relatively more expensive, encouraging conservation. Rates can be split into as few as two rates (peak and off-peak) and to as often as 15-minute increments known as "real-time pricing." Accomplishing real-time pricing would typically require digital (smart) metering to "download" pricing signals from a utility host system.[72]

The Company states, "On a broad scale, direct load control-type programs are typically more expensive as similar infrastructure is needed to achieve smaller load reductions. Moreover, these programs can also introduce consumer dissatisfaction since the 'economic choice' is removed from the customer."[73] Given Kentucky Power's current and expected capacity position within PJM, it is not necessary to aggressively pursue all available demand response ("DR") at this time.[74]

VVO is a smart grid technology that falls under the AEP gridSMART® umbrella of programs. It provides all of the benefits of power factor correction, voltage optimization, and condition-based maintenance in a single, optimized package. In addition, VVO enables conservation voltage reduction ("CVR") on a utility's system. CVR is a process by which the utility systematically reduces voltages in its distribution network, resulting in a proportional reduction of load on the network. A 1 percent reduction in voltage typically results in a 1 percent reduction in load.[75]

Distributed Generation ("DG") can take multiple forms, from rooftop (or pole-mounted) solar photovoltaic panels to combined heat and power ("CHP"), fuel cells, micro-turbines, diesel internal combustion engines, and small wind turbines. From the utility perspective, these different "behind-the-meter" technologies are the same in that they result in a reduction to load and incremental costs to the utility, but are owned by the customer with a cost at a prescribed amount: either the retail net metering or Public Utility Regulatory Policies Act ("PURPA") rates. Operating characteristics are different and so corresponding the "resource value" to the utility will vary.[76]

The Company discussed technologies considered but not evaluated. Some DG alternatives (micro-turbines, fuel cells, CHP, and residential and small commercial wind) were not evaluated. However, DG was modeled as a resource that cost either the retail

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[72] *Id.*

[73] *Id.*

[74] *Id.* at 92.

[75] *Id.*

[76] *Id.*

net metering rate or the PURPA rate, as appropriate. Currently, these technologies cost more than other utility-scale options and were not considered for wide-scale utility implementation. Their costs will continue to be monitored.[77]

INTERVENOR COMMENTS

The Sierra Club lauded Kentucky Power's progress toward making a more diverse energy portfolio in the future, which it believes would enable the Company to start seizing the opportunities presented by the growing availability of low-cost DSM/EE programs and renewable energy resources. However, the Sierra Club suggests that Kentucky Power's progress is limited to the short term, since the Company failed to accurately assess low-cost and low-risk DSM/EE and renewable energy opportunities. The Sierra Club states that the IRP does not incorporate the type of thorough and reasonable planning necessary to achieve a least-cost and least-risk energy future.[78] In addition, the Sierra Club points out that Kentucky Power's projected savings remain low, in large part due to its assumptions that federal lighting standards eliminate much of the future cost-effective savings opportunities and to its failure to account for the substantial savings opportunity in the energy-intensive industrial sector.[79] As such, the Sierra Club opines that the IRP fails to meet the IRP standard with respect to DSM/EE and renewable energy resource evaluation.[80]

Regarding the amount of incremental DSM/EE in the IRP, the Sierra Club asserts that Kentucky Power did not adequately support the amount of realistically achievable savings each year. It states that while the IRP contained a brief discussion of the assessment of achievable potential, how the Company arrived at the ceiling placed on new efficiency was unclear.[81] It also states that the Company admitted in discovery that "[n]o assessment of EE potential was performed by or for the Company."[82]

The Sierra Club believes that energy efficiency is the least-cost, least-risk system resource, with an average levelized cost of roughly 2-3 cents per Kwh, no emissions,

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[77] *Id.* at 93-94.

[78] Sierra Club's Comments at 2.

[79] *Id.* at 19.

[80] *Id.*

[81] *Id.* at 21.

[82] *Id.*

and the ability to defer or avoid new generation and related infrastructure.[83] It claims that Kentucky Power's incremental energy efficiency resources based on measure and cost assumptions which were adapted from Efficiency Vermont data appear to be out of step with the cost of efficiency across the country. The Sierra Club states that Kentucky Power's metric of incremental costs captures only the first-year savings and does not reflect the full value of investments in energy efficiency; thus, misrepresenting the full benefits of efficiency.[84] The Sierra Club further states that a metric that only uses the cost for the first-year savings is not comparable to the cost of generating electricity ($/MWh) and should not be used to compare demand- and supply-side resources.[85] Instead, the Sierra Club suggests Kentucky Power use the levelized cost of energy efficiency (or electricity saved) over the measure life of savings.[86]

The Sierra Club maintains that Kentucky Power's energy savings projections are below the levels being achieved by other utilities across the country due to its failure to model different levels of DSM/EE and its questionable incremental cost assumptions.[87] The Sierra Club identified one of Kentucky Power's affiliates, AEP Ohio, as an example of substantial increases in cost EE, citing its having achieved energy savings of 2.4 percent in 2009-2011.[88] In addition, the Sierra Club pointed out that 14 states achieved annual energy savings of 1 percent of retail sales in 2011.

The Sierra Club recognized that Kentucky is not among the 26 states with long-term binding EE savings targets; however, it claims that DSM/EE is a priority resource in Kentucky, given the fact that KRS 278.285(2) provides for three components for cost recovery to facilitate the successful implementation of utility-administered energy efficiency. The Sierra Club states that the Commission has affirmed its support for greater EE.[89] It identifies the EE goals outlined in the Governor's 2008 Energy Strategy and the Stimulating Energy Efficiency in Kentucky Action Plan ("SEE KY") and states that Kentucky Power is far from achieving the levels contained in the Governor's plan.

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[83] *Id.* at 18.

[84] *Id.* at 22.

[85] *Id.*

[86] *Id.*

[87] *Id.* at 24.

[88] *Id.*

[89] *Id.* at 19.

The Sierra Club stated that it supports properly designed cost recovery for EE and DR investments and incentive mechanisms with proper consumer protections tied to strong performance. Sierra Club further stated that ensuring these mechanisms are beneficial to both Kentucky Power and its customers will likely result in lower bills for customers by capturing higher levels of available energy and demand savings.[90]

The Sierra Club urges Kentucky Power to continue pursuing cost-effective EE programs. Despite the Company's statement that a substantial amount of utility efficiency from lighting programs has already been achieved due to federal efficiency standards, the Sierra Club believes that a significant amount of cost-effective savings potential remains for lighting technology, even after accounting for the federal standards. The Sierra Club also recommends that Kentucky Power continue to explore emerging technologies and different marketing approaches for existing measures to expand its program measures in the residential and commercial sectors.

The Sierra Club maintains that Kentucky Power should explore opportunities in industrial EE programs. It states that the Company has not discussed EE programs with its industrial customers since 1998, even though that sector represents 43 percent of all energy consumption in its service territory and though stakeholder feedback during the SEE KY process indicated that the industrial community is underserved with respect to EE programs and services.[91] Moreover, it states that KRS 278.285 permits individual industrial customers with energy intensive processes to implement cost-effective energy efficiency measures in lieu of measures approved as part of a utility's DSM programs.[92] The Sierra Club recommends that Kentucky Power's proposed market potential study include all customer sectors and that it work with stakeholders to develop programs to capture the potential available in the industrial sector.[93]

The Sierra Club claims that Kentucky Power failed to sufficiently assess DR as a resource. As such, the IRP is in contravention of Kentucky's regulatory requirements.[94] The Sierra Club also states that the Company improperly discounted potential DR savings[95] and maintains that DR can provide important, quantifiable and substantial benefits to both the utility and its customers. Instead of a properly conducted IRP that

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[90] *Id.* at 24-25.

[91] *Id.* at 27.

[92] *Id.*

[93] *Id.* at 28.

[94] *Id.*

[95] *Id.* at 2.

evaluates cost-effective DR from all three major sectors, the Sierra Club claims that Kentucky Power conducted only a limited, back-of-the-envelope calculation of industrial DR, and no analysis of its residential and commercial sectors.[96] The Sierra Club recommends, due to what it considers the Company's failure to adequately and fairly assess DR it its service territory, that Kentucky Power be required to complete a comprehensive DR potential study that examines a variety of demand program structures for all customer classes, and that analyzes market and policy barriers to increased investment in this potentially cost-savings resource.[97]

The Sierra Club notes Kentucky Power's additional investments in its current and future DSM/EE programs, and recommends that Kentucky Power bid energy efficiency and demand response resources in the PJM Base Residual Auctions ("BRA").[98] This, the Sierra Club states, would maximize the potential for reduced energy bills and avoid risk. Failure to do so, according to the Sierra Club, will result in adverse financial consequences to Kentucky Power's customers.[99] The Sierra Club states that Kentucky Power's status as a Fixed Resource Requirement ("FRR") participant in PJM should not hinder its ability to bid such savings into the PJM auction.[100] In conclusion, the Sierra Club recommends the Commission implement a process to ensure that Kentucky Power bids 75 percent of its efficiency savings into the PJM auction.[101]

The Sierra Club maintains that Kentucky Power failed to adequately consider the value of solar resources. The Sierra Club states that the failure to realize the potential of solar in Kentucky and in Kentucky Power's service territory more specifically stems from the absence of a robust analysis of solar resource value.[102] Also, the Sierra Club states that Kentucky Power's IRP fails to provide for continuing investments in wind power. It further states that the declining price of wind power is already leading utilities throughout the country to ramp up the acquisition of wind resources.[103]

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[96] *Id.* at 29.

[97] *Id.* at 30.

[98] *Id.* at 31.

[99] *Id.*

[100] *Id.* at 33.

[101] *Id.* at 34.

[102] *Id.* pp. 34-36.

[103] *Id.* at 36.

KENTUCKY POWER'S REPLY TO SIERRA CLUB'S COMMENTS

Contrary to the Sierra Club's contention that Kentucky Power incorrectly modeled DSM/EE resources in the IRP, the Company maintains that it reasonably evaluated and properly modeled such resources. It also states that the Sierra Club's argument that vast amounts of energy efficiency exist to use as a resource and that it costs almost nothing to implement is without merit.[104]

In response to the Sierra Club's conclusion that DSM/EE must be modeled on a levelized cost basis, Kentucky Power argues that its method of modeling resources based on their initial cost to implement ("acquisition cost") and their useful life is the most practical way to model the costs within the *Plexos*® LP long-term optimization model.[105] The Company also states that because the costs of non-lighting measures are significantly higher than those of lighting measures, it is not surprising that the cost of a portfolio excluding or limiting lighting is higher than the costs of portfolios that are composed primarily of lighting measures, such as Vermont's or virtually all other programs.[106] Kentucky Power also states that the acquisition costs used by the Sierra Club were incorrect and provided a schedule to show the cost of the incremental EE resources to the Preferred Portfolio. Thus, the Company maintains it properly modeled the costs associated with implementing and maintaining EE programs.

Kentucky Power states that the Sierra Club's reliance on other utility programs regarding the apparent abundance of cost of energy efficiency resources is mistaken. Kentucky Power claims the Sierra Club is also mistaken due to its misguided reliance on reported face-value accomplishments of utilities that are not directly comparable and the extrapolation of those utilities' results onto the Company and into the future.[107]

Kentucky Power identifies what it considers a number of problems with the Sierra Club's approach including the high level of manufactured homes in its service territory and the statutory ability of industrial customers to opt out of programs.[108] Kentucky Power points out that it has unique challenges and references its May 8, 2014 Response to the Comments of the Sierra Club in Case No. 2013-00487 for a greater

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[104] Kentucky Power's Response at 10.

[105] *Id.* at 10.

[106] *Id.*

[107] *Id.* at 12.

[108] *Id.*

description of the problems with the Sierra Club's reliance on other utilities' energy efficiency programs as a comparable measure for the savings it should be achieving.

Kentucky Power maintains that it is adequately pursuing cost-effective energy saving opportunities contrary to the Sierra Club's contention that it is failing to do so. Kentucky Power maintains that in the short term, there are some energy efficiency savings to be garnered from lighting even in view of federal efficiency standards, but that in the longer term such savings are limited and its load forecast reflects this eventuality.[109] Any amount of lighting savings on top of that already embedded in its load forecast is double counting.[110] Kentucky Power also states there is mounting evidence that CFL programs' effectiveness is less than touted, and that savings from other states can neither be taken at face value nor automatically applied to Kentucky. Finally, Kentucky Power states that it is committed to a considerable expansion of its DSM/EE programs and will be preparing a market potential study to ensure that the expansion of its programs occurs in the most cost-effective manner possible.

Kentucky Power states that it has reasonably considered and evaluated demand response as a resource. The Company currently has time-of-day/demand response available to its residential, commercial, and industrial customers, and it contends that adding additional capacity from demand response will further increase its long-term capacity position. Further, Kentucky Power states that if it were to offer any additional capacity from demand response in the PJM auctions, that capacity could not be used to satisfy its own requirements resulting in speculation in the capacity market and exposing its customers to unnecessary risk.[111]

In response to the Sierra Club's recommendation that it offer EE resources into PJM's BRA, Kentucky Power states that it cannot reasonably do so. It states that the Sierra Club's argument that the Commission implement a process to ensure that Kentucky Power effectively bid 75 percent of all planned energy efficiency into the annual BRA is contrary to the Commission's own regulation. It states that the IRP process is limited to Commission review of the IRP and issuing a report summarizing its review and offering its suggestions and recommendations to the utility for subsequent filings.[112] Kentucky Power maintains that unlike large utilities operating in large states that have been unbundled and must sell their capacity in the PJM auction under the reliability pricing model ("RPM"), it is a vertically integrated utility that participates in PJM

[109] *Id.* at 13.

[110] *Id.*

[111] *Id.* at 20.

[112] *Id.* at 18-19.

under the fixed resource requirement ("FRR") construct. Kentucky Power states that energy efficiency assets can be used to meet part of its capacity obligations and may serve as a valuable hedge in the event of an unforeseen outage.[113] If such assets were sold at auction, Kentucky Power would lose that capability.

Kentucky Power concludes that it has reasonably considered the value of solar resources. Kentucky Power stated that it is a winter-peaking utility in a summer-peaking utility RTO in a region of the country where the costs of energy are low and the sun does not shine as much as in other parts of the country where solar is better suited.[114] The Company states that it did consider wind, citing its inclusion of 100 MW of production tax credit eligible wind in its preferred resource plan.[115]

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

The 2009 Staff Report made two recommendations regarding Kentucky Power's DSM/EE efforts. These recommendations were made in recognition of the fact that historically, Kentucky Power had not significantly targeted reducing its peak demand.

The recommendations were as follows:

- Kentucky Power should work to increase its portfolio of DSM programs to assist in achieving demand reductions targeted by AEP.

- Kentucky Power should evaluate whether the size of existing DSM programs can be increased.

As stated earlier, the Company has met and exceeded these recommendations. It has expanded its DSM/EE program portfolio from seven residential programs to 12 residential and commercial programs and will be increasing the size and scope of these programs as a result of the Agreement, which will increase spending on cost-effective programs to $6 million annually by 2016. Further, it will perform a market potential study during 2014 to determine the most cost-effective way to administer the increased spending on existing programs, as well as identifying possible new DSM/EE programs and technologies. In addition, it has implemented or is in the process of implementing several programs that increase energy efficiency, including interruptible loads, direct load control, time-differentiated rates, VVO and distributed generation.

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[113] *Id.* at 19.

[114] *Id.* at 14-18.

[115] *Id.* at 20.

DISCUSSION OF REASONABLENESS

Staff commends Kentucky Power for the steps it has taken in increasing both the number and scope of its DSM/EE programs since its 2009 IRP. Staff agrees with Kentucky Power that it has reasonably evaluated and properly modeled its DSM/EE programs. Staff believes Kentucky Power has taking the right steps to ensure implementation and expansion of cost-effective DSDM/EE programs by continually monitoring its programs and performing a market potential study to ensure in the future that resources are wisely utilized, as well as identifying potential new or expanded DSM/EE program offerings and new technologies. In addition, Staff is encouraged by Kentucky Power's inclusion of renewable resources in its Preferred Portfolio and advises the Company to continue researching for such opportunities.

Staff appreciates Kentucky Power's unique challenges and the difficult economic environment in the Company's service territory, as well as the problems comparing its DSM/EE results with those of other utilities and other states. Staff realizes that much of the energy savings from lighting programs has been achieved and that programs other than lighting will be more costly. However, in view of increasing capacity and energy costs, more programs will become cost-effective in the future, and Kentucky Power must continue to evaluate programs to ensure implementation of cost-effective programs as well as accurate evaluation, measurement, and verification of the results of its programs. In addition, Kentucky Power should research the opportunity for bidding DR and DSM into the PJM capacity markets due to its long position on capacity.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

Following are Staff's recommendations on DSM/EE for the Company's next IRP:

- Include all environmental costs, as they become known, in future benefit/cost analyses;

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

- 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;

- Report on work undertaken to enhance evaluation, measurement, and verification procedures to ensure DSM/EE programs are achieving expected goals;

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

- 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 demand response and DSM/EE in the PJM capacity markets.

SECTION 4

SUPPLY-SIDE RESOURCES AND ENVIRONMENTAL COMPLIANCE

This section addresses Kentucky Power's evaluation of supply-side resources and various aspects of Kentucky Power's environmental compliance planning.

EXISTING CAPACITY

Generation owned by Kentucky or to which it had contractual rights when it filed its IRP is shown in Table 4.1. While none of this capacity is equipped with scrubbers, Big Sandy 2 has been retrofitted with a Selective Catalytic Reduction device ("SCR"). The Rockport generating facilities from which Kentucky Power purchases power will be compliant with the federal Mercury and Air Toxics Standards ("MATS") in 2015.

Table 4.1

Existing Generation[116]

PLANT	LOCATION	UNIT	IN-SERVICE	SCR	FGD[117]	CAPACITY
Big Sandy	Louisa, KY	1	1963	-	-	278 MW
Big Sandy	Louisa, KY	2	1969	2004	-	800 MW
Rockport	Rockport, IN	1	1984	-	-	198 MW
Rockport	Rockport, IN	2	1989	-	-	195 MW
TOTAL						1,471 MW

Kentucky Power is one of seven operating companies of the AEP East Zone, which, historically, was planned, constructed and operated as an integrated system. Effective January 1, 2014, AEP terminated the East Zone power pooling arrangement and Kentucky Power transformed into a stand-alone operating company.

The Company's planning posed in this section is its best attempt to ensure that it will have adequate resources to provide a sufficient and diverse supply to achieve its customers' energy needs through 2028. Further, the plan ensures that the Company will have adequate capacity to meet its PJM FRR minimum capacity reserve margin.

[116] IRP at 175, Exhibit 4-2.

[117] FGD is the initialism for Flue Gas Desulfurization unit, commonly referred to as a scrubber.

In the event that Kentucky Power fails to meet the FRR requirement, it has the option to rely on capacity available through the Power Coordination Agreement ("PCA"). The creation of the PCA among three AEP operating companies[118] and AEP Service Corporation offers the opportunity for its members to participate collectively in the PJM FRR capacity operations while also providing members an off-system sales allocation methodology.[119]

In its efforts to meet the EPA air quality requirements, and more specifically, the MATS requirements, Kentucky Power filed two applications involving changes to its supply-side resources with the Commission within the past two years dealing with its native load generation.

In December 2012 Kentucky Power petitioned the Commission for a Certificate of Public Convenience and Necessity ("CPCN") to retire Big Sandy 2 and purchase a 50 percent interest in the scrubbed Mitchell plant, which is owned by an AEP affiliate and located in West Virginia.[120] A majority of the intervenors agreed with Kentucky Power that purchasing a 50 percent interest in the Mitchell plant was the best solution for the Company to continue to meet its native load obligations. Kentucky Power and those intervenors entered into the Agreement referenced earlier in this report.[121] In the non-unanimous Agreement, Kentucky Power agreed to investigate future wind[122] and biomass power,[123] while the signatory intervenors agreed not to oppose the subsequent filing by Kentucky Power to convert Big Sandy 1 from coal-fired to natural gas-fired generation. The Commission approved the Agreement, with modifications, and granted Kentucky Power a CPCN to purchase a 50 percent interest in the Mitchell plant on October 7, 2013.

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[118] Kentucky Power, Appalachian Power Company and Indiana Michigan Power.

[119] IRP at 2.

[120] *See* footnote 1.

[121] The Sierra Club and KIUC agreed to the terms of the Agreement. The AG did not join the Agreement.

[122] Pursuant to this commitment, Kentucky Power issued a Request for Information for a 100 MW Purchase Power Agreement for Wind Power. Twenty five proposals are pending review for a decision.

[123] Case No. 2013-00144, *Application of Kentucky Power Company for Approval of the Terms and Conditions of the Renewable Energy Purchase Agreement for Biomass Energy Resources Between the Company and ecoPower Generation-Hazard LLC; Authorization to Enter Into the Agreement; Grant of Certain Declaratory Relief; and Grant of All Other Approvals and Relief* (Ky. PSC Oct. 10, 2013).

In December 2013, Kentucky Power filed an application for a CPCN to refuel Big Sandy 1. After conversion of the Unit 1 boiler fuel type from coal to natural gas is completed in 2016, all Company-owned generation will meet EPA MATS standards.[124] Its owned generation resources at that time will consist of 268 MW from Big Sandy 1 and 780 MW from its 50 percent interest in the Mitchell Facility.[125] As reflected in Table 4.1, Kentucky Power also has a unit power agreement with an affiliate, AEP Generating Company ("AEG"), for 15 percent, 393 MW, of the installed capacity of Units 1 and 2 at the Rockport Plant located in southern Indiana. The unit power agreement remains in force through December 7, 2022, and for planning purposes the Company has assumed that the agreement will be extended for the 15-year planning horizon.[126] Table 4.2 shows Kentucky Power's planned generating resources in 2016, as approved by the Commission.[127]

Table 4.2

2016 Generation

PLANT	LOCATION	UNIT	IN-SERVICE	SCR	FGD	FUEL	CAPACITY
Big Sandy	Louisa, KY	1	1963	-	-	NG	268 MW
Mitchell	Moundsville, WV	50 % of 1 & 2	1971	Y	Y	COAL	780 MW
Rockport	Rockport, IN	1	1984	N	N	COAL	198 MW
Rockport	Rockport, IN	2	1989	N	N	COAL	195 MW
TOTAL							1,441 MW

Kentucky Power's projected capacity needs in MW for each year of the 2014-2028 planning horizon are shown below in Table 4.3, along with its projected reserve margins at the times of its winter and summer peak demands, exclusive of additional biomass, new wind and solar generation, or incremental DSM/EE.

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[124] In July of 2014, the Commission approved the conversion of Big Sandy 1. *See* footnote 2.

[125] Big Sandy Unit 2 is planned to be retired in mid-2015. The conversion of Big Sandy Unit 1 from coal to natural gas will result in reducing its capacity by 10 MW.

[126] The Rockport units have future Consent Decree requirements in 2015, 2025, and 2028.

[127] Big Sandy Unit 1 will operate as a coal-fired unit through early 2016. Converting to natural gas is planned to take place in the second quarter of 2016.

Table 4.3

PROJECTED PEAK DEMANDS, CAPABILITIES AND MARGINS AT TIME OF WINTER AND SUMMER PEAK UNFORCED CAPACITY (UCAP) FOR 2014-2028[128]								
Year	Peak Demand (MW)		Capability (MW)		Reserve (MW)		Margin (%)	
	Win	Sum	Win	Sum	Win	Sum	Win	Sum
2014	1,431	1,259	2,251	1,783	820	524	57.3	64.1
2015	1,432	1,278	1,433	1,316	1	38	0.1	18.7
2016	1,431	1,304	1,433	1,326	2	22	0.1	17.6
2017	1,431	1,159	1,438	1,326	7	167	0.5	32.3
2018	1,432	1,160	1,438	1,331	6	171	0.4	32.6
2019	1,430	1,161	1,444	1,331	14	170	1.0	32.5
2020	1,436	1,162	1,444	1,336	8	174	0.6	32.9
2021	1,439	1,167	1,444	1,336	5	169	0.3	32.3
2022	1,438	1,172	1,444	1,336	6	164	0.4	31.8
2023	1,438	1,174	1,444	1,336	6	162	0.4	31.6
2024	1,444	1,175	1,444	1,336	0	161	0.0	31.4
2025	1,448	1,182	1,441	1,333	(7)	151	-0.5	30.4
2026	1,452	1,186	1.441	1,333	(11)	147	-0.8	29.9
2027	1,454	1,192	1,441	1,333	(13)	141	-0.9	29.3
2028	1,459	1,195	1,448	1,331	(21)	136	-1.4	28.8

To optimize its supply-side offerings, Kentucky Power modeled options to come up with a preferred capacity portfolio. Its "Preferred Portfolio" assumes the addition of 100 MW of wind energy from the Federal Production Tax Credit incentive in the 2015 planning year. It recognizes the probability of several MW of customer/distributed solar coming online in the 2017 timeframe, followed by the probability of 4 to 8 MW of utility scale solar as it becomes more economic in the 2020-2021 planning years. Kentucky Power presumes solar affordability will drive the distributed solar component of its generating portfolio to 41 MW and the utility scale solar to 90 MW by the year 2028.

Kentucky Power plans to have access to 58.5 MW of capacity from ecoPower, Hazard, LLC ("ecoPower") starting in 2017. This biomass renewable source of energy will burn waste wood from the proximate lumber industry. The wood-fired boiler fuel source will produce steam which rotates a turbine generator to provide energy.

[128] IRP at 14-15.

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

The IRM is based on the amount 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 which impact the Company's required minimum reserve levels. This IRM is converted by PJM into Unforced Capacity requirements.

Kentucky Power's capacity proposal contains an amount of uncertainty over the 15-year planning horizon. With this uncertainty, the Company opted to keep its anticipated IRM steady throughout the period at the current 15.6 percent threshold. As previously discussed, it 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.[129]

To meet the peak loads, Kentucky Power utilizes the *Plexos*® optimization model to determine which economically based capacity sources are selected for deployment to meet the higher winter capacity requirements.[130] *Plexos*® selects economic resources, based on their energy contributions, to offset 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. In sum, these economic resources provide a hedge to customers from PJM's more expensive energy markets.[131]

SUPPLY-SIDE EVALUATION

The Company used the *Plexos*® Linear Program optimization model to develop a "least cost" or optimal resource plan. *Plexos*® finds the optimal portfolio utilizing base

[129] Response to Staff DR 1-29.

[130] *Id.* 1-43.

[131] IRP at 159.

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 the Company to endorse as the optimal long-term resource plan.

Specific supply alternatives modeled include peaking and intermediate capacity, wind resources up to 100 MW, utility-scale distributed generation, solar resources up to 10 MW, and realistically achievable EE resources. *Plexos*® took the individual specific inputs and modeled an optimized portfolio for each of the scenarios, and then produced the Preferred Portfolio of future resources, as summarized below in Table 4.4.

Table 4.4

Future Resources[132]

MW	WIND	SOLAR	EFFICIENCY	TOTAL
BASE	100	90	25	215
LOW	-	80	25	105
HIGH	100	90	25	215
NO CARBON	-	80	25	105
HIGH CARBON	100	90	25	215
PREFERRED	100	132	31	263

To summarize the overall Preferred Portfolio composition, Kentucky Power:

- Acquires 50 percent of the Mitchell plant in 2014;
- Retires Big Sandy Unit 2 in 2015;
- Converts Big Sandy Unit 1 to natural gas in 2016;
- Assumes the addition of 100 MW of wind energy;[133]
- Implements customer and grid energy efficiency programs;
- Purchases the output of the 58.5 MW ecoPower beginning in 2017;
- Adds 90 MW of utility scale solar by 2028; and

[132] *Id.* at 165.

[133] Assumes a federal production tax credit eligible for wind projects beginning in 2015.

- Recognizes additional customer base distributed solar capacity.[134]

Kentucky Power states that its recommended Preferred Portfolio provides the lowest practical cost solution through traditional supply-side, renewable, and demand-side investments while exhibiting flexibility and adaptability to risk. It further states that the greatest risk exposures lie in probable greenhouse gas regulation which could be finalized in the early 2020's. Nevertheless, it anticipates having sufficient resources to serve customer internal peak load, as a stand-alone utility, throughout the 2028 planning period. Table 4.5 displays the Preferred Portfolio capacity position.

Table 4.5

Preferred Portfolio Capacity[135]

Year	Peak Demand (MW)		Capability (MW)		Reserve (MW)	
	Win	Sum	Win	Sum	Win	Sum
2014	1,431	1,259	2258	1788	529	529
2015	1,432	1,278	1456	1337	24	59
2016	1,431	1,304	1458	1350	27	46
2017	1,431	1,159	1523	1406	92	247
2018	1,432	1,160	1524	1413	92	253
2019	1,430	1,161	1533	1416	103	255
2020	1,436	1,162	1539	1429	103	267
2021	1,439	1,167	1546	1440	107	273
2022	1,438	1,172	1547	1444	109	272
2023	1,438	1,174	1549	1450	111	276
2024	1,444	1,175	1554	1459	110	284
2025	1,448	1,182	1554	1463	106	281
2026	1,452	1,186	1557	1471	105	285
2027	1,454	1,192	1561	1479	107	287
2028	1,459	1,195	1554	1480	95	285

[134] Begins at 3 MW in 2016 and escalating to 41 MW by 2028.

[135] IRP at 188–189, Exhibits 4-12 and 4-13.

COGENERATION, DISTRIBUTED GENERATION, AND NET METERING

Cogeneration, the simultaneous production of electricity and heat from a single fuel source, like natural gas, is often referred to as CHP. CHP increases the net thermal efficiency of the plant and is ideally suited for large industrial or commercial applications requiring ample amounts of electricity and heat.

Kentucky Power has cogeneration tariffs, yet has no customers receiving service under them. Kentucky Power states that industry leaders have approached it several times for help in analyzing cogeneration opportunities, yet have not proceeded further in the process due to the relatively low projected benefit compared to the assumed cost and risk. The Company further opines that cogeneration has not proven economical to customers due to the historically high cost of natural gas combined with its relatively low energy cost.

Distributed generation resources reduce Kentucky Power's load, as the utility's customer owns its facility and provides power to itself and possibly others by way of net metering. These behind-the-meter technologies can take on many forms, from solar to CHP, fuel cells, micro-turbines, diesel internal combustion engines, or small wind turbines.

In its Preferred Portfolio model, Kentucky Power modeled distributed generation as a capacity resource at a cost equal to the retail net metering rate. At this full cost of service, distributed generation did not clear the preferred portfolio from a utility-based revenue requirement perspective due to the fact that from the *Plexos*® perspective, it would be cheaper for Kentucky Power to pay the PJM avoided market cost for capacity and energy than the net metering tariffed price.[136]

Kentucky Power recognizes the adoption of customer-installed generation and notes the presence of three such commercial customers currently on its network.[137] All three accounts are school photovoltaic accounts, which account for 38 kW of capacity. These accounts are located at the Ashland Independent, Leslie County, and Magoffin County Boards of Education.[138]

Under its net metering tariff, Kentucky Power credits the same retail tariffed amount for each kWh produced independent of the generating technology. This is

[136] IRP at 161.

[137] *Id.* at 163.

[138] Response to Staff DR 1-48.

different from the capacity credits recognized within the PJM market. For example, within PJM, capacity credits are higher for solar than for wind, as higher levels of photovoltaic energy are produced during the heat of the summer day that more aptly align with PJM's peak load requirement. The peak output for solar panels occurs in the 12 to 1 p.m. range and the grid peak falls later, about 5 p.m. As such, and like wind resources which are credited in PJM at 13 percent of nameplate rating,[139] solar resources' useful capacity is 38 percent of the nameplate rating, as credited in the PJM market.[140] These justifiable factors seem to support the advancement of photovoltaic development in the future over other types of net metered supply.[141]

RENEWABLES

Renewable generation comes from naturally occurring sources such as solar, geothermal, hydro, or wind. Other forms of renewable energy come as a byproduct of another process, such as landfill gas or biomass. In the earliest renewable timeframe it was not unusual to subsidize evolving technologies by way of federal initiatives or individual state renewable portfolio standards.[142] However, with the development of new technologies and expected mass adoption, renewables are predicted to compete economically with traditional supply-side options in the near future.[143]

Kentucky Power, as discussed earlier in this section, currently has minimal amounts of solar in its net metering program. It does, however, expect both commercial and residential solar to expand in the near future, with the potential for 90 MW of contributing commercial and 41 MW of residential solar power prior to the end of this IRP planning period. The convictions for this confidence are many, and include the ease of installation for solar panels in the grid and declining solar panel cost, which is expected to continue over the next decade.

Kentucky Power plans to purchase biomass generated power from ecoPower. The biomass facility will use waste wood material from the lumber industry to fire a steam boiler that will drive a steam turbine generator producing power. EcoPower is expected to be online by 2017 with a projected 58.5 MW of output power.

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[139] IRP at 134.

[140] *Id.* at 132.

[141] Responses to Staff DR 1-36 and 1-37.

[142] Such as the federal tax credit for wind resources.

[143] Kentucky Power projects utility-scale solar to compete by 2020. Response to Staff DR 1-34.

As part of the Agreement in the Mitchell case, Kentucky Power also agreed to explore the possibility of adding 100 MW of wind power to its supply-side portfolio by 2015. Kentucky Power presently has no wind generation in its portfolio, and wind power is recognized by PJM at only 13-14 percent of its nameplate capacity, due to its low availability during system peak.[144]

Other than what has been previously outlined in this report, Kentucky Power has no other renewables within its portfolio. It did not model hydro power in its preferred portfolio, as it assumed that hydro is either already developed and in use or it is more costly to develop than competing technologies.[145]

OTHER NON-UTILITY SOURCES

Kentucky Power does not discuss power from non-utility sources other than what is considered in the renewable section and modeled in its optimized generation preferred portfolio model.[146] Projecting minimal load growth while reflecting increases in renewable energy and EE, Kentucky Power anticipates no need within this planning period to add internal or non-utility supply-side generation.

COMPLIANCE PLANNING

Kentucky Power has made many recent decisions to bring its current generating fleet in compliance with MATS, which goes into effect in 2015.[147] Its goal is to develop a broad plan allows it to meet future resource needs in a consistent manner, as well as ever-more-stringent environmental requirements, in a cost-effective manner. The decisions include, but are not limited to, the retirement of Big Sandy 2, the purchase of a 50 percent interest in the Mitchell Plant and the refueling of Big Sandy 1 from coal-fired to natural gas-fired generation. Kentucky Power is also investigating renewables to add to its portfolio, in addition to the ecoPower agreement.

Kentucky Power plans to meet current and future regulations, which could ultimately include CO_2/Greenhouse Gas ("GHG") emissions. Complying with future regulations affects the Company's consideration of new supply-side resources due to

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[144] IRP at 130.

[145] *Id.* at 136.

[146] *Id.* at 159 and 191.

[147] Kentucky Power may request an extra year to meet MATS compliance deadlines.

the effects on capital and operational costs. Regulations, both current and proposed, also impact its decisions concerning the viability of plants currently in operation.

Air emissions are presently regulated by Title V operating permits that integrate requirements from the State Implementation Plan ("SIP") and the Clean Air Act ("CAA"). Other applicable requirements include those linked to MATS, the Clean Air Interstate Rule ("CAIR"), and the New Source Review Consent Decree ("NSR Consent Decree"). Regulations under development which will affect the Mitchell and Rockport plants include those connected to the National Ambient Air Quality Standards ("NAAQS") for NO_x, SO_x, ozone and fine particulate matter, and GHG emissions.

Kentucky Power, as part of AEP, was party to the Interim Allowance Agreement ("IAA"), which allowed it to trade allowances within AEP to meet SO_2 requirements. Changes occurred within the program that devalued the trading procedure, such as not covering NO_x allowance trading and developing regulations which are administered on a system-wide basis. As a result, the IAA was dissolved in January 2014.

Kentucky Power met the 1990 Title IV Acid Rain Program rules through fuel strategies, the purchase of SO_2 allowances, and adopting post-combustion retrofit technologies. It met the NO_x requirements through the installation of low-NO_x burners on its Phase II NO_x units and using a fleet-wide averaging plan for its remaining units.

To augment the Title IV NO_x reduction plan, the NO_x SIP Call was implemented to reduce the effects of cross-state ozone concentrations. After examining the regulations and reviewing solutions, Kentucky Power was able to comply with the 2004 SIP Call by retrofitting Big Sandy Unit 1 with new burners and a water injection system and boiler tube overlay, and retro-fitting Big Sandy 2 with an electrostatic precipitator and selective catalytic reduction system. With the commencement of CAIR in 2009, the NO_x Budget SIP Call Program and progressive control was terminated.

CAIR, published in March 2005 by the EPA, called for the substantial reduction of SO_x and NO_x from Electric Generating Units ("EGUs"). It incorporated three cap-and-trade programs; an annual and seasonal NO_x reduction program, along with an annual SO_2 reduction program. To remain compliant, Kentucky Power planned to purchase a significant number of allowances. In July 2008, the DC Circuit Court of Appeals vacated CAIR and remanded it to the EPA for revision. In December 2008, the court clarified the earlier ruling and indicated that CAIR was being remanded to EPA for revision, but it was not vacated. Kentucky Power anticipated more rigorous and restrictive emission policies would be the outcome of the revisions and planned appropriately.

In 2011, the EPA released the Cross State Air Pollution Rule ("CSAPR") to replace CAIR. In August 2012, the DC Circuit Court vacated CSAPR based on the approach EPA outlined to reduce air pollution and the belief that the rule did not allow individual states the opportunity to establish their own compliance plans. In June 2013, the U.S. Supreme Court granted EPA's appeal of the Circuit Court's decision to vacate CSAPR. The EPA subsequently published new rules on June 2, 2014, after Kentucky Power's instant IRP was submitted to the Commission.

The final MATS rule was published in April 2012. MATS regulates emissions of Hazardous Air Pollutants ("HAPs") from coal or oil-fired EGUs. It becomes operational three years from the date of publication. Specifically, it targets mercury, arsenic, lead, cadmium, selenium, acid gases, and a number of organic HAPs. AEP and Kentucky Power installed an active carbon injection system to mitigate mercury at the Rockport Plant and have also received approval to install a dry sorbent injection system ("DIS").

Kentucky Power and AEP entered into a consent decree with the Department of Justice ("DOJ") in 2007 concerning EPA's new source review requirement to settle all outstanding complaints against AEP and its operating companies. The NSR Consent Decree required the Company to operate low NO_x burners and burn low sulfur coal at Big Sandy 1 and install a SCR on Big Sandy 2. It required Big Sandy 2 to be retired by year end 2015, unless it was repowered or fitted with a scrubber. The Consent Decree also required the Rockport Units to be fitted with scrubbers and SCRs prior to 2020. In February 2013, EPA, DOJ, and others filed agreed-to modifications to the Consent Decree with the U.S. District Court for the Southern District of Ohio, Eastern Division. The modifications will allow DSI technology to be installed at the Rockport units by April 2015, followed by high-efficiency scrubbers at Rockport 1 by year-end 2025 and at Unit 2 by 2028. It also tightened SO_x and NO_x caps for Kentucky Power's generating units.

Kentucky Power is actively planning for possible future environmental rules. Coal Combustion Residual proposed rules were issued by EPA in 2010. The proposed regulations affect the storage of coal ash and FGD waste product. Kentucky Power projects that wet storage ponds will need to close and convert to dry storage and that there will be a requirement for new wastewater treatment facilities by January 2018.

Effluent Limitation Guidelines and Standards for EGUs were proposed by the EPA in June 2013. These guidelines place controls on waste water discharge focusing on waste from FGDs, fly ash sluice water, bottom ash sluice water, and landfill leachate. Kentucky Power expects the rules to affect the Rockport and Mitchell units.

GHG regulations, which include CO_2, were proposed in April 2012. The new source proposal was published in September 2013, with the caveat that it be finalized in

a "timely fashion." The regulations for existing EGUs were released on June 2, 2014, with an expected finalization date of June 1, 2015. It is expected that the states would then have one year within which to finalize their respective plans.

In Kentucky Power's planning process, it modeled a proposed rate for impending carbon costs in its preferred portfolio package. Carbon was included at a base price of $15 per ton or high price of $25 per ton during the model runs, and the impending 2014–2040 present value base rate cost turned out to be $525 million, or approximately $1.10/kWh, beginning in 2022. In the high price scenario, the cost escalates to $834 million or $1.80/kWh.[148]

Rule 316(b), the Clean Water Act Rule, was issued by the EPA in March 2011. It sets standards for cooling water intake structures such that existing aquatic creatures are not harmed. This set of regulations will have minimal impact on Kentucky Power and at most require new water intake screening at the Rockford and Mitchell Plants.

The CAA requires the EPA to establish and periodically review NAAQS designed to protect public health and welfare. Several NAAQS components are under review which could lead to changes in NO_x and SO_2 emission level requirements; however, the scope and timing of final changes are uncertain.

EFFICIENCY IMPROVEMENTS IN GENERATION

Kentucky Power states that implicit in its power system planning is "maximizing the efficiency of operation of the power supply system" in order to provide a reliable, adequate, and economical electric power supply to consumers.[149] Kentucky Power's generation is maintained on a unit-specific basis in order to remain economically efficient for the unit's maximum lifetime. The function of component replacement or refurbishment is carried out with the goal of minimizing cost and outage service time. This approach allows Kentucky Power the ability to evaluate and review specific generation for continued inclusion within the fleet or retirement.[150]

Kentucky Power references efforts that contribute to overall generation efficiency. As an example of a non-generation endeavor which affects power generation efficiency, "Kentucky Power is installing Volt VAR Optimization (VVO) on 26 circuits. The VVO function of this system will improve circuit power factors closer to unity and thus reduce

[148] IRP at 169.

[149] *Id.* at 110.

[150] *Id.* at 123.

losses on circuits. The Voltage optimization function VVO results in a decrease in demand and energy consumption at the customers' end and thus decrease the circuit loading which further contributes to loss reduction."[151]

THE TRANSMISSION SYSTEM

The AEP-East transmission system consists of six eastern zone AEP operating companies, including Kentucky Power, which are interconnected by a high-capacity transmission system that extends from Virginia to Michigan. "This portion of the Transmission System is composed of approximately 15,000 miles of circuitry operating at or above 100 kV. The eastern zone includes over 2,100 miles of 765 kV overlaying 3,800 miles of 345 kV and over 8,900 miles of 138 kV circuitry."[152] Also included in the system are numerous interconnections with 19 neighboring power systems.

"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."[153] The planning process embraces two major sets of tests to ensure reliability: the first includes all significant single contingencies; the second includes multiple and more extreme contingencies. Thermal and voltage performance standards are usually the most constraining measures of performance and reliability for the AEP transmission system.

As stated earlier, 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.[154]

Transmission costs for new natural gas-fueled generation technology typically add around $60 per kW.[155] To maximize wind speed and sustainability factors making new wind generation practical, wind turbines are typically found at very remote sites, thereby forcing the power to be transmitted long distances over Extra High Voltage

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[151] Response to Staff DR 1-27.

[152] IRP at 139.

[153] *Id.* at 145.

[154] *Id.* at 112.

[155] *Id.* at 126.

lines. Grouping multiple wind turbine units and farms facilitates fewer connections and allows for a reduction in transmission build costs.[156] "The AEP-East Transmission System is designed and operated to perform adequately even with the outage of its most critical transmission elements or the unavailability of generation. The eastern zone conforms to the NERC Reliability Standards and applicable RFC standards and performance criteria."[157] Despite the robust nature of the AEP-East transmission system, the system is aging and some station equipment is becoming obsolete.

In order to maintain acceptable levels of reliability, significant investments are needed over the next ten years. In addition, the integration of merchant generation connected in the eastern zone will require some minor transmission upgrades, and with the announcement of approximately 13,000 MW of generation being retired in the PJM footprint, the need for power to be transmitted over a greater distance in Kentucky will have to be accommodated.

Kentucky Power identified two enhancement projects planned for its transmission system over the next couple of years. First, to improve reliability, alleviate thermal overloading, and correct low voltage conditions in the Hazard area, it will establish a new 138 KV circuit from the Beaver Creek Station via the Soft Shell Station. In addition, it will install a 20-mile line that will tie the Soft Shell Station to the Bonnyman Station, establishing a second 138 kV source into Hazard. This project is currently projected to be in service by December 2014.

PJM's Summer Regional Transmission Expansion Plan revealed overloads on 345 kV and 138 kV facilities in the Kentucky-Ohio-West Virginia tri-state area during single contingency outage conditions. System studies indicate that a second 765/345 kV transformer installation at the Baker Station in Kentucky, as well as two 765 kV and three 345 kV circuit breakers are needed to alleviate the problem. This upgrade project is expected to be in service in 2015.

Finally, six transmission projects are planned over the next three years: the Hazard-area improvements; Big-Sandy area improvements; Thelma and Busseyville Station upgrades; Johns Creek and Stone Station upgrades; Dorton 138 kV Circuit breakers; and the Cedar Creek Station upgrades.[158]

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[156] *Id.* at 133-134.

[157] *Id.* at 140. NERC is the acronym for the North American Electric Reliability Corporation. RFC is the initialism for Reliability First Corporation.

[158] *Id.* at 147-148.

THE DISTRIBUTION SYSTEM

Kentucky Power did not identify specific increases or improvements planned for its distribution facilities. Kentucky Power stated that it had 173,000 retail customers in its 3,762 square-mile territory and served a population of 429,000.[159]

Since the last IRP filing four years ago, there has been a decrease in the number of residential customers and a decrease in mine power sector sales.[160] 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 falling under AEP's gridSMART technology umbrella, which includes VVO to enable CVR. These changes allow Kentucky Power to systematically reduce its system voltages, and therefore, its load.[161]

INTERVENOR COMMENTS

The Sierra Club states that after decades of being almost entirely reliant on coal-fired power generation, Kentucky Power's IRP reflects important and laudatory progress towards having a more diverse energy portfolio. For example:

- Kentucky Power is scheduled to retire the Big Sandy Unit 2 coal-fired plant in 2015. This retirement allows it to avoid the more than 30 percent rate increase that would have been needed to keep the unit operating.

- As a result of retiring Big Sandy Unit 2 and converting Big Sandy Unit 1 to natural gas, Kentucky Power's nearly 99 percent reliance on coal-fired generation for its capacity and energy is diversified.

- Kentucky Power further agreed in the Mitchell Settlement to pursue 100 MW of wind resources in 2015.

Each of these steps is positive and could reduce costs and risks for Kentucky Power ratepayers, help the Company adjust to changes in today's energy markets, and enable the Company to take advantage of opportunities presented by the growing availability of DSM and renewable energy resources.

The Sierra Club opines that overall, however, the IRP indicates that Kentucky Power's progress is short-term. It points out that under the preferred resource plan, 85

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[159] *Id.* at 4.

[160] *Id.* at 15 and 51.

[161] *Id.* at 41 and 92.

percent of Kentucky Power's energy will still be produced from fossil fuels 15 years from now, while 71 percent of its capacity would remain coal-fired generation. The Sierra Club also points out that, while 100 MW of wind capacity is assumed to be added in 2015, no additional wind resources are planned to be added through 2028.

The Sierra Club states that, after positive developments over the next few years, Kentucky Power's IRP implies a return to business as usual, with the Company planning long-term overreliance on coal-fired generation and failing to accurately assess, much less pursue, low-cost and low-risk renewable resource opportunities.

The discouraging results, according to the Sierra Club, stem from a fundamental shortcoming in the IRP — namely, that the Company failed to meaningfully evaluate a range of potential resource plans. "As a result, the IRP does not incorporate the type of thorough and reasonable planning needed for Kentucky Power to achieve a least cost and least risk energy future."[162] The Sierra Club claims the IRP is a flawed document that fails to satisfy the standards of Kentucky law because, among other things:

- The portfolios modeled by Kentucky Power all involved virtually identical generation resources, rather than evaluating meaningfully different levels of DSM, solar, wind, and coal generation;

- The IRP ignores or understates the significant environmental compliance costs that the Company faces;

- The IRP failed to evaluate scenarios in which Kentucky Power declines to renew its contract with the Rockport Generation Station in Indiana, or terminate that contract in advance of its current 2022 expiration date;

- The IRP failed to evaluate a reasonable range of likely future carbon prices;

- Kentucky Power failed to consider bidding its energy efficiency and demand response savings into the PJM Base Residual Auction;

- The IRP's analysis of solar generation ignores ways in which solar resources provide significant value, and it relies on an unreasonable 10 MW cap on the level of solar generation that can be added each year; and

- Kentucky Power's preferred resource plan fails to add any wind capacity after 2015.

[162] Sierra Club's Comments at 3.

The Sierra Club states that until these serious shortcomings in Kentucky Power's IRP are remedied, the reasonableness of future actions based on this resource planning is suspect. Based on that assessment, the Sierra Club asserts that the Commission Staff should find that the IRP is inadequate and require that Kentucky Power address each of these shortcomings in all future resource planning and decision making.[163]

KENTUCKY POWER'S RESPONSE TO SIERRA CLUB'S COMMENTS

Kentucky Power claims its "resource plan is based on the Company's evaluation of the best available information at the time it was prepared, and it is not a commitment to acquire any resource or undertake any course of action. Dramatic shifts in the power generating sector due to advancements in technology and emerging regulations make resource planning on this scale critical but also challenging. Kentucky Power constantly monitors regulatory and technology developments as well as customer need and will use the most current information to make any resource acquisition decisions. The Company appreciates Sierra Club's interest and participation in the IRP process. Nevertheless, a number of its comments miss the mark, are without legal basis, or otherwise should not guide the Commission Staff's review of the IRP Report."[164]

Kentucky Power analyzed and considered a reasonable range of portfolio options, including; gas-fired generation, wind, distributed and utility-scale solar, DR and EE.[165] Information was provided by the Sierra Club "on behalf of the solar industry in other parts of the country, with different solar potentials, regarding the value of solar generation installed in the service territory of Kentucky Power."[166] "There simply is no significant (or otherwise) avoided transmission and distribution investment as a result of installing solar panels when a utility is winter-peaking."[167]

Staff recognizes the differences in the Sierra Club and Kentucky Powers view of a satisfactory IRP filing. However, Staff believes that Kentucky Power has complied with the requirements of 807 KAR 5:058.

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[163] *Id.*

[164] Kentucky Power Response at 2.

[165] *Id.* at 8.

[166] *Id.* at 14.

[167] *Id.* at 18.

RESPONSES TO PREVIOUS STAFF RECOMMENDATIONS

In its report on the Company's 2009 IRP, the Staff made the following recommendations on supply-side resources and environmental compliance:

- Provide a specific discussion of the consideration given to renewable generation by both AEP-East and Kentucky Power.

- Specifically discuss the existence of any cogeneration within its service territory and the consideration given to cogeneration in the resource plan.

- Specifically identify and describe the net metering equipment and systems installed. A detailed discussion of the manner in which such resources are considered in its IRP should also be provided.

- Provide a detailed discussion of the consideration given to distributed generation.

- Provide a specific discussion of the improvements and more efficient utilization of transmission and distribution facilities as required by 807 KAR, Section 8(2)(a). This information should be provided for the past three years and should address Kentucky Power's plans for the next three years.

- In addition to describing how AEP-East has addressed currently pending environmental regulations and perhaps new legislation, describe how Kentucky Power has specifically addressed such legislation. The next IRP should also address the expected impact on AEP-East and Kentucky Power of any then-potential environmental regulation or legislation.

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.

RECOMMENDATIONS FOR KENTUCKY POWER'S NEXT IRP

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

- 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.

- 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(2a). 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 the Company 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.

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 2040.[168] Differences were studied by changing assumptions and calculating total costs based on the changes with lower costs as the objective.

Recognizing the impact of the Mitchell Agreement, Kentucky Power developed *Plexos*-derived "optimum" portfolios under a number of commodity price forecasts. Among these portfolios, Kentucky Power developed *a* "Preferred Portfolio" which includes:

- Receiving 50 percent of the Mitchell plant in 2014.
- Retiring Big Sandy Unit 2 in 2015.
- Converting Big Sandy Unit 1 to natural gas operation in 2016.
- The assumed addition of 100 MW of wind energy from a federal production tax credit eligible wind project starting in 2015.
- Implementing customer and grid EE projects so as to reduce energy requirements by 260 GWH (four percent) by 2028.
- Purchasing the output of the ecoPower biomass plant starting in 2017.
- Add utility-scale solar starting in 2020; solar capacity is 90 MW by 2028.

[168] IRP at 151-152.

- Recognize distributed solar capacity will be added by customers starting in 2016, which will reach 41 MW by 2028.[169]

Under the Preferred Portfolio, Kentucky Power's coal-fired capacity would decline from 99 to 71 percent over the planning period. Gas-fired assets and renewable assets increase from 0 to 16 percent, and 1 percent to 13 percent, respectively.

Plexos® was used to study the long-term integration and optimization of resource alternatives, which requires 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 and fixed O&M costs;
- Fixed costs of capacity purchases;
- Program costs of incremental DSM alternatives;
- Variable costs associated with the Company's generating units;
- Distributed (customer-based) resources are "cost out" at the equivalent of a full retail "net metering" credit to customers;
- The net of production revenue made into the PJM power market from the Company'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.[170]

Plexos® performs this task while operating with a number of possible constraints, including 1) reserve margin constraints, 2) resource addition and retirement candidates, 3) generator ages, 4) retrofit dependencies (SCR and FGD combinations), 5) operations

[169] *Id.* at 171.

[170] *Id.* at 150.

constraints such as ramp rates and heat rates, 6) fuel burn minimums and maximums, 7) emission limits, and 8) energy and capacity contract parameters.[171]

The LT Plan also models the following major system limitations:

- Maintain a PJM-required minimum reserve margin of roughly 15.6 percent.

- Meet the agreed-to limits for AEP-East's generation fleet for SO_2 and NO_x.

- Consideration of generation additions was assumed to not precede PJM's 2017-1018 planning year, given the typical five-year timeframe to approve, permit, design, engineer, and construct new fossil-fuel generation.[172]

The supply-side alternatives modeled in *Plexos*® were as follows:

1) Peaking capacity – as blocks of seven combustion turbines ("CT") with a summer rating of 550 MW, available beginning in 2017;

2) Intermediate capacity – a single combined-cycle combustion turbine ("CCCT") with a summer rating of 562 MW;

3) Wind resources – 100 MW annually of incremental nameplate capacity;

4) DG/solar resources – approximately 2.5 percent of energy consumption in 2028;

5) EE resources incremental to those included in the load forecast – were limited to realistically achievable levels in each year.[173]

Five commodity pricing scenarios were developed to enable *Plexos*® to construct resource plans under various long-term pricing conditions. Long-term power commodity forecasts were derived using *Aurora*®, a proprietary long-term fundamental production-costing tool developed by EPIS, Inc. In the IRP, the three distinct long-term commodity pricing scenarios developed were as follows: 1) Fleet Transition 1H2013 Base; 2) Fleet Transition 1H2013 Lower Band; and 3) Fleet Transition 1H2013 Upper Band.[174]

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[171] *Id.* at 151.

[172] *Id.* at 152.

[173] *Id.* at 153.

[174] *Id.* at 154.

Fleet Transition 1H2013 Base, the Base Case, recognizes the decision by the U.S. Court of Appeals to vacate CSAPR, and reflects certain emission allowance values prior to 2015 reverting back to levels in line the CAIR. The assumptions include:

- MATS rule effective as proposed with compliance starting in 2015;
- Initially lower gas prices due to the emergence of shale gas plays; and
- CO_2 emission pricing at $15 per ton begins in 2022.[175]

The Fleet Transition 1H2013 Lower Band case reflects lower natural gas prices compared to the Base Case. In the early years, lower natural gas prices tend to track the Base Case but, in the long-term natural gas prices reflect a more significant infusion of shale gas. Other assumptions in the Lower Band mirror the Base Case.

The Fleet Transition 1H2013 Upper Band case reflects higher natural gas prices compared to the Base Case. This is based on impediments to shale gas development including stalled technological advances and as yet unseen environmental costs. The remaining assumptions in the Upper Band mirror the Base Case.

The two additional scenarios are a High CO_2 scenario and a No CO_2 scenario.[176] In the High CO_2 scenario, a $25 per ton mitigation price is assumed beginning in 2022. This produces price changes to natural gas and coal due to changes in consumption resulting in retirement of some coal-fired generation around the implementation period with natural gas, and to a lesser degree, renewable generation being built to replace the retired generation.

The No CO_2 scenario is also referred to as a "business as usual" scenario which includes relative changes to fuel prices and best serves as a baseline to understand the market impact of the Base Case and the High CO_2 scenario. All five scenarios assume the same input parameters except for fuels and CO_2 mitigation pricing.

MODELING RESULTS

Over the 2014-2028 planning horizon, all five of the modeled scenarios include resource additions. The Base Case, Upper Band, and High CO_2 scenarios all call for total additions of 215 MW consisting of 100 MW of wind, 90 MW of solar, and 25 MW of

[175] *Id.*

[176] *Id.* at 156.

efficiency measures. The Lower Band and No CO_2 scenarios each call for additions of 105 MW consisting of 80 MW of solar and 25 MW of efficiency measures.[177]

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 their having greater exposure to 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.[178]

The optimum portfolios do not add DSM/EE in quantities necessary to comply with the Mitchell Agreement. Eventually, the cost and impact of incremental programs will become known and approval thereof will take place through Kentucky Power's collaborative process, and ultimately the Commission. So, while not complying explicitly with the Mitchell Agreement, the Preferred Portfolio does include DSM/EE resources in amounts approximate to those in the Agreement.[179]

The Company's Preferred Portfolio largely reflects the *Plexos*® model-optimized portfolio established under the Base Case commodity pricing forecast, while recognizing the following practical considerations:

1) Deferral of a currently-developed wind investment to take advantage of the wind production tax credit in 2015, which provides time for more analysis and regulatory approval.

2) A minimal amount of net-metered distributed solar is included. While not an optimal resource from a utility perspective, current net metering economics for the customer make it reasonable to expect some level of adoption by the Company's customers.

3) Additional customer-based DSM and EE programs were added to meet the terms of the Mitchell Agreement.[180]

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[177] *Id.* at 159.

[178] *Id.*

[179] *Id.* at 164.

[180] *Id.* at 164-165.

Under the Preferred Portfolio, resource additions during the 2014-2028 planning horizon are estimated at 263 MW. Compared to the Base Case allocation of resources, solar additions are 132 MW instead of 90 MW, while EE measures account for 31 MW as opposed to 25 MW. Through 2028, the Preferred Portfolio results in approximately $29 million in incremental costs compared to the Base Case portfolio. The $29 million results in a rate difference of approximately $0.0005 per kWh, largely due to assuming non-economic distributed resource additions, which may or may not materialize.[181]

RISK ANALYSIS

Kentucky Power evaluated the Preferred Portfolio and a portfolio consisting of just its fossil-fueled assets and the ecoPower facility. This was done to isolate the impacts of the incremental assets added in the Preferred Portfolio. The two portfolios were evaluated using a Monte Carlo technique in which input variables were randomly chosen from a universe of possible values given certain constraints and relationships. 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.[182] The larger the RRaR, the greater the risk that customers would be exposed to adverse outcomes relative to the Base Case CPW revenue requirements.

Although the difference in RRaR between the two portfolios was not significant, the addition of EE and solar power in the Preferred Portfolio worked to reduce the risk of revenue requirement volatility. In summary, Kentucky Power stated that the Preferred Portfolio represented a reasonable combination of expected costs and risks relative to the cost and risk profiles of a portfolio with greater energy market exposure.[183]

Kentucky Power also evaluated the portfolios for the Base Case, No CO_2 and High CO_2 scenarios. The Base Case scenario reflects an expected cost of $525 million in present value for the period 2014-2040, or approximately 1.1 cents per kWh starting in 2022, relative to the No CO_2 scenario. The High CO_2 scenario reflects an expected cost of $834 million in present value for the same period, or approximately 1.8 cents per kWh starting in 2022, relative to the No CO_2 scenario.[184] Kentucky Power stated that its optimization analyses and risk modeling show that, as a stand-alone entity in the PJM

[181] *Id.* at 165.

[182] 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.

[183] *Id.* at 169.

[184] *Id.* at 169-170.

RTO, adding wind, solar, and customer and grid energy efficiency resources results in lower overall costs.[185]

DISCUSSION OF REASONABLENESS

Staff is generally satisfied with Kentucky Power's integration process, as well as with its risk analysis, and plan optimization. The Preferred Portfolio chosen by the Company contains a revenue requirement that is minimally greater than the Base Case revenue requirement. However, it reduces the risk of revenue requirement volatility and includes the addition of the customer-based DSM and EE required to comply with the terms of the Mitchell Agreement. 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.

[185] *Id*. at 170.