COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

2014 INTEGRATED RESOURCE PLAN OF DUKE ENERGY KENTUCKY, INC.	))	CASE NO. 2014-00273

ORDER

The Commission initiated this proceeding for its Staff to conduct a review of the 2014 Integrated Resource Plan ("IRP") filed by Duke Energy Kentucky, Inc. pursuant to 807 KAR 5:058. Attached in the Appendix to this Order is the Staff Report summarizing Commission Staff's review of the IRP. This Report is being entered into the record of this case pursuant to 807 KAR 5:058, Section 11(3).

Based on the evidence of record, the Commission finds that the Staff Report represents the final substantive action in this matter.[1] The final administrative action will be an Order closing the case and removing it from the Commission's docket. That Order will be issued after the period for comments on the Staff Report has expired.

IT IS THEREFORE ORDERED that:

1. The Staff Report on Duke Kentucky's 2014 IRP represents the final substantive action in this matter.

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

[1] The Staff Report can be accessed via the Commission's website at psc.ky.gov under "Utility Information—Industry Specific Info—Electric."

By the Commission

ENTERED

AUG 19 2015

KENTUCKY PUBLIC
SERVICE COMMISSION

ATTEST:

Executive Director

Case No. 2014-00273

APPENDIX

APPENDIX TO AN ORDER OF THE KENTUCKY PUBLIC SERVICE COMMISSION IN CASE NO. 2014-00273 DATED AUG 1 9 2015

Kentucky Public Service Commission

Staff Report on the

2014 Integrated Resource Plan

of Duke Energy Kentucky, Inc.

Case No. 2014-00273

August 2015

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.

Duke Energy Kentucky, Inc. ("Duke Kentucky" or "the Company") filed its 2014 Integrated Resource Plan ("IRP") on July 31, 2014. The IRP includes Duke Kentucky's plan for meeting its customers' electricity requirements for the period 2014-2034.

A procedural schedule was established for this proceeding which allowed two rounds of data requests to Duke Kentucky, written comments by intervenors and reply comments by the Company. The only intervenor is the Attorney General of the Commonwealth of Kentucky by and through his Office of Rate Intervention, ("AG") who did not issue data requests or file written comments on Duke Kentucky's IRP.

Duke Kentucky, an investor-owned utility supplying electricity and natural gas in northern Kentucky, is a subsidiary of Duke Electric Ohio, Inc., a subsidiary of Duke Energy, Inc. Duke Kentucky is a member of PJM Interconnection LLC ("PJM"), a regional transmission organization that is also Duke Kentucky's reliability coordinator. Duke Kentucky provides electricity to approximately 138,000 customers and natural gas to approximately 96,000 customers. Its net summer generation capacity in 2014 was 1,069 megawatts ("MW"), consisting of 577 MW of coal-fired base load capacity and 492 MW of gas-fired combustion turbine ("CT") peaking capacity. Its highest all-time system peak demand of 930 MW occurred in the summer of 2010.

The purpose of this report is to review and evaluate Duke Kentucky's 2014 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 IRP filings. Staff recognizes resource planning is a dynamic, ongoing process. Specifically, the 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 Duke Kentucky's most recent IRP filed in 2011.

Duke Kentucky's objective in its IRP is to define a robust strategy to provide electric energy services in a reliable, efficient, and economic manner while considering the uncertainty of the current environment. Its long-term objective is to employ a flexible planning process and pursue a resource strategy that considers the costs and benefits to all stakeholders (customers, shareholders, employees, suppliers and community). Duke Kentucky states that the plan in its IRP represents the most robust and economic outcome based on various assumptions and sensitivities which reflect the current uncertainty in regulatory, economic, environmental and operating conditions.

The major objectives of Duke Kentucky's 2014 IRP are to:

- Provide adequate, efficient, reasonable service that is economic in an uncertain environment;
- Maintain the flexibility and ability to alter the plan in the future as circumstances change;
- Choose a near-term plan that is robust over a wide variety of possible futures; and
- Minimize risks (such as wholesale market risks, reliability risks, etc.).

Duke Kentucky's summer peak is expected to increase from 864 MW in 2014 to 1,004 MW in 2034, reflecting an annual growth rate of 0.6 percent. Its winter peak load is expected to increase from 716 MW to 822 MW over the same period, for a growth rate of 0.7 percent. Energy requirements are projected to increase from 4,488,021 megawatt hours ("MWh") in 2014 to 5,087,276 MWh in 2034, for an annual growth rate of 0.6 percent.

The IRP was developed based on a minimum reserve margin of 13.7 percent. With its planned Demand-Side Management ("DSM") programs and demand response, Duke Kentucky expects to have a 93-MW reduction in summer peak demand by 2029.

The remainder of this report is organized as follows:

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

It must be noted that departures from the filing schedule in 807 KAR 5:058 have caused overlaps of IRP filings. To help minimize future overlaps, Staff recommends to the Commission a filing date for Duke Kentucky's next IRP of June 21, 2018.

SECTION 2

LOAD FORECASTING

This section reviews Duke Kentucky's projected load growth and load forecasting methodology. Its energy and demand forecasts are prepared yearly by a staff it shares with other Duke Energy utilities, using the same methodology. Duke Kentucky does not perform joint load forecasts with affiliates and its forecast is developed independently of the forecasts of affiliates. Its service area is located in northern Kentucky just south of the Duke Energy Ohio service area. Being within the Cincinnati Primary Metropolitan Statistical Area, this area is an important component of the regional economy.

FORECASTING METHODOLOGY ASSUMPTIONS

Duke Kentucky's forecast of energy requirements is part of the overall forecast of energy requirements for the Greater Cincinnati area, which includes its service territory and that of Duke Energy Ohio, Inc. The process of developing the northern Kentucky service area data involves allocating the Kentucky portion of the Greater Cincinnati Metropolitan area using historically based percentages of Kentucky load relative to the load for the entire region. Duke Kentucky uses econometric models to relate national and service area economic activity to electricity use and to obtain forecasts of its future energy and demand needs. It changed its approach for this IRP by relying more on information from Itron, Inc. ("Itron") for estimates of historical appliance efficiency. As of 2013, Duke Kentucky also uses Itron's Statistically Adjusted End-Use ("SAE") modeling process. Gathering national, state, and local demographic and economic historical and forecast data to develop models that describe customers' usage characteristics is the first step in the forecasting process.

Moody's Analytics provides historical and long-term forecasts of the national and service area economic variables, including employment, income, production, inflation, electricity and energy prices, and demographics. Duke Kentucky's service-area economy is assumed to behave much as the national economy over the forecast period. The national and local economies experienced a decline in economic activity from late 2007 through early 2009, with weak-to-moderate growth since then. In the near term, according to the IRP, the ultimate outcome depends on the success of the economy in continuing its recent trend of moderate growth and the reduction of federal policy uncertainty. The Cincinnati area economy, including northern Kentucky, is diverse. Major manufacturing industries include food products, paper, printing, chemicals, steel, fabricated metals, machinery, and automotive and aircraft transportation equipment. Major non-manufacturing industries include insurance and finance, with emerging growth sectors in health, education, hospitality, and data centers.[2]

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[2] IRP, Appendix B – Electric Load Forecast ("Appendix B") at 86.

The Energy Independence and Security Act ("EISA"), passed in 2007, included new higher efficiency standards for lighting beginning in 2012. The Duke Kentucky load forecast incorporates the impacts associated with EISA.

ENERGY FORECASTS

Service-area employment, population growth, industrial production, and inflation are drivers for the service-area economy. The majority of employment growth in the forecast period is in the non-manufacturing sector. However, since 2013, manufacturing has reversed its negative trend locally and is expected to maintain moderate growth until 2016. Local employment is expected to grow 1.1 percent, versus 0.8 percent nationally, over the forecast period. While reflecting national aging trends, the Cincinnati metropolitan area is projected to grow at a faster rate than the U.S. on average due to its diverse economy and ability to attract and retain young adult workers. The local population is expected to grow at an average annual rate of 1.0 percent, versus 0.6 percent nationally. The number of residential customers is expected to grow from 122,727 in 2014 to 150,314 in 2034, which represents an average annual growth rate of approximately 1.1 percent. Within the Company's service territory, many commercial customers serve local markets, creating a close relationship between the growth in the number of residential customers and growth in the number of commercial customers. The number of commercial customers in Duke Kentucky's service territory is also expected to grow approximately 1.1 percent annually, from 13,850 in 2014 to 17,072 in 2034. The number of industrial customers, however, is expected to decrease by approximately 10.0 percent, cumulatively, over the same 20-year period, from 375 to 337.[3]

Duke Kentucky prepares forecasts for the residential, commercial, industrial, governmental or other public authority, and street lighting energy sectors, plus three minor categories: interdepartmental use (gas department), company use and losses. The company also prepared forecasts on a before-and-after basis to illustrate the anticipated effects of energy-efficiency programs on each of the rate class projections.

Residential sales of electricity are the product of two components: the number of customers and kWh energy use per customer. The number of residential customers is a function of the projected number of households in Duke Kentucky's service territory. Energy use per customer is a function of per capita income, real electricity prices, and the saturation of air conditioners, electric space heating, other appliances, the efficiency of those appliances and weather.[4] Local weather data is obtained from the National Oceanic and Atmospheric Administration ("NOAA"). Duke Kentucky relies on the most recent ten-year derivation of normal weather available from NOAA and updates the data

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[3] *Id.* at 109.

[4] *Id.* at 83.

on an annual basis.[5] This weather data forms the basis for the Heating Degree Days ("HDD") and Cooling Degree Days ("CDD") used by Duke Kentucky in its forecasts.

To account for the impact of appliance saturations and federal efficiency standards, Duke Kentucky creates an appliance stock variable. This variable consists of appliance efficiencies, saturations, and energy consumption values. Generally, information on historical appliance saturations for all appliances is obtained from the Company's appliance saturation surveys. Data on historical forecast appliance efficiency is obtained from Itron, which has developed regional statistically adjusted SAE models used to provide forecasts of appliance saturations and efficiencies.[6]

Over the forecast period, residential energy sales are projected to grow from 1,500,327 MWh in 2014 to 1,872,209 MWh in 2034. Accounting for energy-efficiency impacts, residential energy use is projected to grow from 1,497,963 MWh in 2014 to 1,771,527 MWh in 2034, which reflects an average annual growth rate of 0.8 percent.[7]

The commercial-sector energy-sales forecast is a function of gross output, real electricity price, weather, and the combined impact of the commercial saturation of air conditioners, commercial heating, other appliances, the efficiency of those appliances, and commercial square footage.[8] Over the forecast period, commercial-sector energy sales are projected to grow from 1,481,419 MWh in 2014 to 1,758,377 MWh in 2034. Accounting for energy-efficiency impacts, commercial-class energy use is projected to grow from 1,478,002 MWh in 2014 to 1,560,985 MWh in 2034, which reflects an average annual growth rate of 0.3 percent.[9]

Industrial sales are primarily dependent on real gross manufacturing product, real electricity prices, electric prices relative to alternative fuel prices, and weather.[10] Over the forecast period, industrial sales are projected to grow from 814,340 MWh in 2014 to 973,250 MWh in 2034, which reflects an average annual growth rate of 0.9 percent.[11]

The other public authorities ("OPA") sector energy sales (including federal, state and local government) are the sum of sales to schools, government facilities, airports, and water pumping stations. OPA sales are a function of government employment, the

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[5] Duke Kentucky's Response to Staff's First Request for Information ("Staff's First Request"), Item 14.

[6] Appendix B at 91.

[7] *Id.*, Figure B-2 at 100, and Table 3-B at 15.

[8] *Id.* at 83.

[9] *Id.*, Figure B-2 at 100, and Table 3-B at 15.

[10] There are no energy efficiency impacts associated with industrial sales.

[11] *Id.*, Figure B-1 at 99, and Table 3-A at 15.

real price of electricity, and heating degree days. Over the forecast period, OPA energy sales are expected to grow from 308,207 MWh in 2014 to 337,225 MWh in 2034. Accounting for energy-efficiency impacts, energy use for this sector is projected to decrease from 307,450 MWh in 2014 to 293,415 MWh in 2034.[12]

For street lighting, electricity usage varies in relation to the number of street lights and the efficiency of the lighting fixtures used. The number of street lights is associated with the population of the service area. The efficiency of street lights is related to the saturation of mercury and sodium vapor lights, compact fluorescent lights, and light emitting diode lamps.[13] Over the forecast period, street lighting energy sales are expected to grow from 15,720 MWh in 2014 to 15,909 MWh in 2034. Energy-efficiency programs are not expected to have an effect on this rate class's projected energy use.

Combining the results of the individual class energy sales forecasts to derive the total energy sales forecast and then adding interdepartmental sales and system losses, Duke Kentucky obtains the total net energy needed to serve service area load. Over the forecast period, total net service area energy is projected to grow from 4,495,494 MWh in 2014 to 5,411,130 MWh in 2034. Accounting for energy-efficiency programs, energy use is projected to grow from 4,488,421 MWh in 2014 to 5,087,276 MWh in 2031, which represents an average annual growth rate of 0.6 percent.[14]

PEAK LOAD FORECASTS

Duke Kentucky produces peak-demand forecasts for both summer and winter using SAE peak demand models. The peak forecasting model is intended to closely reflect the relationship of weather to peak loads. The peak model estimates historical peak loads against heating end-use energy sales, cooling end-use energy sales, and non-weather-sensitive energy sales.

Both peak summer load and peak winter load are influenced by economic activity and weather conditions. For summer peak, primary weather factors are temperature and humidity at the time of the peak. However, the morning low temperature and the high temperature from the previous day are variables important in capturing the effect of thermal buildup.

For winter peaks occurring in the morning, the morning low temperature, associated wind speed, and the previous night's low temperature are the primary weather factors. If the peak occurs at night, the primary factors include the evening low temperature, associated wind speed, and the morning low temperature.

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[12] Appendix B, Figure B-2, at 100.

[13] *Id.* at 83.

[14] IRP at 8.

The level of peak demand is related to economic activity. To determine the impact of economic variables on peak demand, aberrations caused by non-normal weather must be eliminated in order to develop the level of base load. The first step in the process is to weather normalize the Company's historical monthly sendout. Since the energy model produces forecasts under the assumption of normal weather, the forecast of sendout is weather normalized by design. Hence, the sendout forecast drives the forecasts of the peak demands.

In order to develop weather-normalized sendout, each individual rate class (residential, commercial, industrial, and governmental) is adjusted for the difference between actual and normal weather.[15] Weather-normalized sales are computed by scaling actual sales for each class by a factor from the forecast equation that accounts for the deviation from normal weather. Weather-normalized sendout is then computed by summing weather-normalized sales and non-weather sensitive sector sales. Duke Kentucky's summer peak typically occurs in August in the afternoon, while its winter peak typically occurs in January in the morning. In the forecast, the weather variables are set to values determined to be normal peak-producing conditions. These values are derived using historical data on the worst weather conditions in each year for both summer and winter.[16]

Over the forecast period, summer internal peak demand, after accounting for energy efficiency and demand response (controllable load), is projected to grow from 884 MW in 2014 to 1,004 MW in 2034, which represents an annual growth rate of 0.6 percent.[17] After accounting for energy efficiency and demand response, winter internal peak demand is projected to grow from 716 MW in 2014 to 822 MW in 2034, which represents an annual growth rate of 0.7 percent.[18] Net energy is projected to grow from 4,488 GWh in 2014 to 5,087 GWh in 2034.[19]

RANGE OF FORECASTS

Assuming normal weather, the most likely forecast for energy demand and peak load demand is determined from forecasts of economic variables. The most likely energy and peak load forecasts are developed using the base econometric forecast provided by Moody's Analytics. To generate high and low forecasts, Duke Kentucky used the standard errors of the regression from the econometric model used to produce the base energy forecast. The bands are based on a 95 percent confidence interval around the forecast, which equates to 1.96 standard deviations.

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[15] Street lighting sales are not considered weather sensitive.

[16] Appendix B at 85.

[17] *Id.*, Figure B-3 at 101, and Table 3-B at 15.

[18] *Id.*

[19] *Id.*, Figure B-2 at 100.

After taking account of energy efficiency and demand-response programs, the low energy forecast ranges from 4,274 GWh in 2014 to 4,873 GWh in 2034. The high energy forecast ranges from 4,702 GWh in 2014 to 5,301 GWh in 2034. The low peak-load (summer peak) forecast ranges from 836 MW in 2014 to 956 MW in 2034. The optimistic peak-load forecast ranges from 932 MW in 2014 to 1,052 MW in 2034.[20]

CHANGES IN METHODOLOGY

Duke Kentucky continues to use the same econometric forecast methodology it has used in prior IRPs. However, as stated previously, it has changed its approach regarding development of its appliance stock variable to rely more completely on information from Itron for estimates of historical appliance efficiency.[21]

DISCUSSION OF REASONABLENESS—RESPONSE TO 2011 RECOMMENDATIONS

Staff is satisfied with Duke Kentucky's forecasting. Econometric modeling is a well-accepted industry standard and has been used in Duke Kentucky's previous IRP filings. SAE modeling has been used by other utilities in their IRPs and is being more widely used within the industry.

In its report on Duke Kentucky's 2011 IRP, Staff made one recommendation relative to forecasting:

- Implementing existing and future environmental regulations could have significant effects on fuel prices, electricity prices, income, employment, and other economic variables. Service area economic activity adjusting to the effects of potentially stringent environmental regulations could significantly impact service area energy use and peak demand. Therefore, the effects of existing and/or pending environmental regulations of electricity prices and other economic variables should be explicitly examined as part of the load forecast, including the sensitivity analysis.

- Future increases in electricity prices due to stricter environmental regulations could be large enough to affect consumer behavior and energy consumption. A discussion of how price increases impact the elasticity of customer demand should be included in the next IRP.

In response to this recommendation, Duke Kentucky stated, "Existing and future environmental regulations will alter the expected generation mix, significantly reducing the role of coal-fired generation, while increasing the role of nuclear, natural gas, and

[20] *Id.*, Figure B-7 at 104.

[21] *Id.* at 94–95.

non-hydropower renewable technologies." The Company provided a comparison of two scenarios for its residential customer class: a "carbon scenario" and a "no carbon scenario" to illustrate the impact of future environmental regulations. In the "carbon scenario" future electricity prices increase significantly as investment in combined cycle generation, renewables, and nuclear capacity becomes important in being able to comply with future regulations. The higher prices significantly reduce load growth starting in 2019. While load growth begins to rebound shortly thereafter, it does not reach the same level of load growth as in the "no carbon scenario" until the year 2033.

Staff appreciates Duke Kentucky's response to our 2011 recommendation. We believe that this comparison of scenarios provides an appropriate analysis of how price increases can impact load growth over time.

RECOMMENDATIONS

Staff has no specific criticisms of Duke Kentucky's forecasting methodologies or the results of its forecasts of energy use and peak demands. Staff notes that as it has refined its forecasting approach beginning with the 2011 forecast included in its prior IRP, the Company's forecast results have been more accurate relative to actual energy use and peak demand.[22] For its next IRP, Staff makes the following recommendations concerning Duke Kentucky's energy and demand forecasts:

- The impact of existing and future environmental regulations on the price of electricity and other economic variables continues to be a subject of great interest in the electric utility industry. Accordingly, the effects of such regulations should continue to be examined as a part of Duke Kentucky's load forecast and sensitivity analysis.

- The potential for future increases in electricity prices due to stricter environmental regulations to be large enough to affect consumer behavior and energy consumption continues to exist. An updated analysis/discussion of how such price increases may impact the elasticity of customer demand should be included in the next IRP.

- Weather continues to have an impact of Duke Kentucky's forecasting. In its forecasting discussion, Duke Kentucky should identify the period it uses for weather normalization in its forecasting models and explain how Duke Kentucky determined that this period is reasonable.

[22] Duke Kentucky provided a comparison of forecasted levels and actual results for the years 2009-2013 on page 18 of its IRP. 2009-2010 results showed average variances of 3.5 percent between forecasted and actual energy use and 10.3 percent between forecasted and actual peak demand. The 2011-2013 results included average variances of 3.3 percent between forecasted and actual energy use and 2.7 percent between forecasted and actual peak demand. The smaller difference in peak demand in the later years reflects Duke Kentucky's refinement of its 2008 change in setting the base temperature for HDD calculations and use of a ten-year period in developing normal HDD and CDD levels.

SECTION 3

DEMAND-SIDE MANAGEMENT AND ENERGY EFFICIENCY

This section addresses the DSM/Energy Efficiency ("DSM/EE") portion of Duke Kentucky's 2014 IRP. Duke Kentucky states that it continuously evaluates and considers opportunities for DSM/EE to meet its resource needs, and specifically as part of this IRP.[23] Through applications by Duke Kentucky and in conjunction with its DSM/EE Collaborative,[24] the Commission has approved expansions of Duke Kentucky's DSM/EE efforts over time.

On April 11, 2013, the Commission issued an Order in Case No. 2012-00495[25] that, among other things, ordered that Duke Kentucky file an application by August 15, annually, requesting program expansion(s) to include: (1) an Appendix A, setting forth the Cost Effectiveness Test Results of all DSM programs, (2) an Appendix B, setting forth the recovery of program costs, lost revenues, and shared savings that it uses in determining the true-up of proposed DSM factors; and (3) a signed and dated proposed Rider DSMR, Demand Side Management Rate, for both its electric and natural gas customers.

Duke Kentucky's existing portfolio of DSM/EE programs was approved by the Commission in Case No. 2014-00280.[26] The portfolio includes traditional conservation EE programs and demand response ("DR") programs. Duke Kentucky's conservation DSM/EE portfolio contained in the IRP is projected to reduce energy consumption and peak demand by approximately 378,000 MWh and 55 MW, respectively, by 2029. The Residential Direct Load Control Program ("Power Manager") is projected to reduce peak demand by 12 MW and the PowerShare® program is projected to reduce peak demand by 26 MW, resulting in a total peak reduction across all programs of approximately 93 MW by 2029.[27]

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[23] IRP at 19.

[24] The Residential and Commercial & Industrial Collaborative includes the Attorney General, People Working Cooperatively, Kentucky Need Project, Northern Kentucky University Small Business Development, Northern Kentucky Chamber of Commerce, Department of Energy Development and Independence, Kenton County Schools, Wiseway Supply, Monohan Development Company, Kentucky Energy Smart Schools, Northern Kentucky Community Action Commission, Campbell County Fiscal Court, Brighton Center, Boone County Fiscal Court, Northern Kentucky Legal Aid, Boone County Fiscal Court, Kenton County Fiscal Court, Greater Cincinnati Energy Alliance, and Duke Energy Kentucky.

[25] Case No. 2012-00495, *Application of Duke Energy Kentucky, Inc. for the Annual Cost Recovery Filing for Demand Side Management* (Ky. PSC Apr. 11, 2013).

[26] Case No. 2014-00280, *Application of Duke Energy Kentucky, Inc. to Amend Its Demand-Side Management Programs* (Ky. PSC Jan. 28, 2015).

[27] IRP at 19.

DSM/EE PORTFOLIO OF PROGRAMS

Duke Kentucky's DSM/EE/DR portfolio of programs for its residential, commercial and industrial customers at the time the IRP was filed includes the following:

1. Residential Smart Saver Program – This program is offered under two separate tariffs, Residential Smart Saver Energy Efficient Residences and Residential Smart Saver Energy Efficient Products.

The Residential Smart Saver Energy Efficient Residences program offers customers a variety of energy conservation measures designed to increase EE in their homes. The program utilizes a network of contractors to encourage the installation of high-efficiency equipment and implementation of energy-efficient home improvements. There are equipment and services incentives for:

- Installing high-efficiency air conditioning ("AC") and heat pump ("HP") systems;
- Performance of AC and HP tune-up maintenance services;
- Implementation of attic insulation and air sealing services; and
- Implementation of duct sealing services.

Duke Kentucky currently contracts with Good Cents to administer the Residential Smart Saver Program. The services under this program are jointly implemented with Duke Energy Indiana, Duke Energy Ohio, and Duke Energy Carolinas in order to reduce administrative costs and leverage promotion.[28]

The Residential Smart Saver Energy Efficient Products program provides high efficiency lighting through various channels. In April 2013, Duke Kentucky launched online Saving Store enabling eligible customers to purchase specialty bulbs and have them shipped directly to their homes. The Property Manager Program is also an extension of the lighting program which allows Duke Kentucky to use an alternative channel which targets multi-family complexes.

2. Residential Energy Assessment Program – This energy audit program is known as the Home Energy House Call. It is administered by contractor Wisconsin Energy Conservation Corporation, Inc. The program provides a comprehensive walk-through and an in-house analysis by a Building Performance Institute Building Analyst certified home energy specialist. The home audit analyzes total home energy usage, checks the home for air infiltration, examines insulation levels in different areas of the home, and checks appliances and heating/cooling systems.

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[28] *See* Case No. 2012-00085, *Application of Duke Energy Kentucky, Inc. for an Energy Efficiency Cost Recovery Mechanism and for Approval of Additional Programs for Inclusion in Its Existing Portfolio* (Ky. PSC June 29, 2012), in which Duke Kentucky was granted permission to synchronize its DSM/EE/DR programs with those offered by Duke Energy Ohio, Inc.

3. Energy Efficiency Education Program for Schools – This program offers an in-depth classroom curriculum through the National Energy Education Development ("NEED") project and a live theatrical production by the National Theatre for Children. Energy education coordinators work with schools, teachers, and students on energy education programs. The live theatrical performance is intended to educate and reinforce energy efficiency lessons learned in the classroom. Home Energy Efficiency Kits are delivered to the classroom to teach students and their families how to install EE measures and record energy savings.

4. Low Income Services Program–Weatherization – This program helps Duke Kentucky's income-qualified customers reduce their energy consumption and lower their energy cost. It specifically focuses on Low Income Home Energy Assistance Program customers that meet the income qualification level of 130 percent of the federal poverty level. This program provides direct installation of weatherization and energy-efficiency measures and educates customers about their energy usage and other opportunities to reduce energy consumption and lower their energy costs. The program is structured in tiers so that the homes needing the most work and having the highest energy use per square foot receive the most funding. Regardless of placement in a specific tier, Duke Kentucky provides energy education to all customers in the program.

Included in the Low Income Services Program is the refrigerator replacement program. This program encourages residential customers to responsibly dispose of older, functioning but inefficient refrigerators. To determine replacement eligibility, the program weatherization provider performs a two-hour meter test of the existing refrigerator unit. If it is a high-energy consuming refrigerator as determined by the test results, it is replaced with an Energy Star qualified unit. Disposal of the existing refrigerator is handled in an environmentally appropriate manner to ensure the unit is not used as a second refrigerator in the home or does not end up in the secondary appliance market.

Also included as part of the Low Income Services Program is the Payment Plus Program. This program is designed to impact participants' behavior (e.g., encourages utility bill payment and reducing arrearages) and results in energy conservation. The program has three parts: (1) Energy & Budget Counseling; (2) Weatherization; and (3) Bill Assistance. This program is offered over six winter months per year.

5. Residential Direct Load Control–Power Manager – The purpose of this load control program is to reduce demand by controlling residential air conditioning usage during peak demand, high wholesale price conditions, and/or generation emergency conditions during the summer months.

6. Smart Saver Prescriptive Program ("Prescriptive") – This program provides incentives to commercial and industrial customers for installation of high-efficiency equipment in applications involving new construction, retrofit, and replacement of failed equipment. The program also uses incentives to encourage maintenance of existing equipment in order to reduce energy usage. The program offers incentives for:

- Lighting;
- HVAC;
- Motors/Pumps/Drives;
- Energy Star Food Service Equipment; and
- Information Technology Process Equipment and Water Conservation.

Incentives are designed to offset a portion of the capital cost of higher-efficiency equipment. Incentive amounts are known to customers before they undertake a project, so they can proceed with the project and submit documentation after installation.

7. Smart Saver Custom ("Custom") – This program encourages the installation of high-efficiency equipment in both new and existing nonresidential establishments with incentive payments to offset a portion of the higher cost of energy efficient equipment. It is intended to capture quantifiable energy savings from projects that do not fit into the Prescriptive program. A key difference between the Prescriptive program and the Custom program is that the Custom program requires customers to submit applications before they begin their projects.

The types of equipment eligible for incentives are: high-efficiency lighting; high-efficiency HVAC; high-efficiency motors, pumps, and variable frequency drives; high-efficiency food service installations; high-efficiency process equipment installations, including compressed air systems; and other high-efficiency installations as determined by Duke Kentucky on a case-by-case basis. The potential incentive amounts are based on the avoided energy and capacity produced by the installed measure(s).

8. Peak Load Manager (Rider PLM)–PowerShare Program – This is the brand name of Duke Kentucky's voluntary Peak Load Management Program, which offers non-residential customers the opportunity to reduce their electric costs by managing their electric usage during peak load periods.

9. Appliance Recycling Program – This program encourages residential customers to responsibly dispose of older functioning-but-inefficient refrigerators and freezers. Residential customers who choose to participate are paid a cash incentive of up to $30 per unit, with a maximum of two units per year for participating. The disposal of the refrigerators and freezers is handled in an environmentally friendly manner, with approximately 95 percent of the material recycled and 5 percent going to a landfill.

10. Low Income Neighborhood – This program is available to both homeowners and renters occupying single-family and multi-family dwellings in target neighborhoods that have electric service provided by Duke Kentucky. Targeted low-income neighborhoods qualify for the program if at least 50 percent of the households are at or below 200 percent of the federal poverty guidelines. A neighborhood is defined as an area of approximately 100 to 500 homes, where a significant number of households are at or below 200 percent of poverty level.

Participating customers will receive an energy assessment to identify energy-efficiency opportunities in the customer's home; one-on-one education on energy-efficiency techniques and measures; and a comprehensive package of energy-conservation measures installed or provided to the extent the measure is identified as an energy-efficiency opportunity based on the results of the energy assessment. Energy conservation measures may include low-cost energy-efficiency starter items, such as air infiltration reduction measures, energy-efficient lighting, water conservation measures, HVAC filters, or other energy-saving devices.

11. My Home Energy Report – This program provides an energy usage report that compares household use to similarly situated neighboring homes, and recommends ways to lower energy usage. The report also promotes Duke Kentucky's other EE programs when applicable. The comparisons provided by the program are intended to change consumption behavior. The reports are distributed up to 12 times a year; delivery may be interrupted during off-peak energy usage months in the fall and spring.

12. Non-Residential Small Business Energy Saver Program ("SBES") – This is a new program which is designed to target the hard-to-reach small business sector by introducing approved prescriptive measures. The program consists of a free energy assessment for qualifying customers resulting in a customized proposal with improvement recommendations and eligible incentives provided upfront to offset the cost of measure installation, with the process managed by a program administrator.

In addition to these programs, the Commission approved a general DSM portfolio enhancement in Case No. 2014-00280 allowing Duke Kentucky to implement cost-effective measures costing less than $75,000 for programs without prior Commission approval. Duke Kentucky was also granted approval to remove measures as needed.

<u>DSM SCREENING AND COST-EFFECTIVENESS</u>

The 2014 IRP analysis includes the level of DSM/EE and DR products and services that were requested and approved in Case No. 2014-00280. All EE programs were screened for cost-effectiveness using DSMore, a financial analysis tool designed to evaluate the costs, benefits, and risks of energy efficiency and programs and measures, utilizing the traditional California Standard tests.[29] DSMore provides the test results for any type of EE program (demand response and/or energy conservation). DSMore estimates the value of an EE measure at an hourly level across distributions of weather and/or energy costs and prices, providing Duke Kentucky with a better measure of the risks and benefits of employing EE measures. CO_2 costs were not included in avoided production costs for purposes of determining cost-effectiveness of current programs, but Duke Kentucky will include an estimate of the production costs that will include an estimate of avoided CO_2 in its next IRP filing.[30]

[29] California Public Utilities Commission and California Energy Commission, "Standard Practice Manual for Economic Analysis of Demand-Side Management Programs," Document Number P400-87-006, December 1987. The standard tests are the Utility Test, the Participant Test, the Ratepayer Impact Measure, and the Total Resource Cost test.

[30] *See* Duke Kentucky's Response to Staff's First Request, Item 20.

SUMMARY DISCUSSION OF DSM

Staff recognizes Duke Kentucky's efforts since the last IRP to research, develop, and implement the programs approved in Case Nos. 2011-00471,[31] 2012-00085,[32] 2013-00313,[33] and 2014-00280.[34] In particular, Staff commends the proposal that was approved in Case No. 2012-00085 to align the Company's DSM/EE offerings with those provided by its parent company, Duke Energy Ohio, to reduce promotion and marketing costs and to alleviate customer confusion that can arise when customers share a common media market but have different programs available to them.

Duke Kentucky's screening for cost-effectiveness of DSM/EE programs with DSMore is an enhancement to this process which will aid in measuring the risks and benefits of employing DSM/EE measures in the same way traditional generation capacity additions are analyzed. Furthermore, this process ensures that demand-side resources are compared to supply side resources on a comparable basis. These changes, as well as budgetary increases approved in Case No. 2014-00280, will aid in the evaluation, verification, and measurement of Duke Kentucky's DSM programs.

Commission Staff is very encouraged by Duke Kentucky efforts to promote and educate customers on its DSM programs and the benefits of such programs.

DISCUSSION OF REASONABLENESS

The DSM section in the prior IRP made no specific recommendations regarding the existing programs due to the proximity to Duke Kentucky's filing of Case No. 2009-00444.[35] Staff noted that the relatively broad, comprehensive scope of Duke Kentucky's programs appeared to be meeting a need, both for customers and for Duke Kentucky, in developing its least-cost supply plan. The current IRP shows this trend continuing as DSM becomes a more important planning tool for electric utilities as well as combination electric and gas utilities such as Duke Kentucky. Staff recognizes Duke Kentucky's

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[31] Case No. 2011-00471, *Application of Duke Energy Kentucky, Inc. to Implement a Pilot Nonresidential Smart Saver Custom Energy Efficiency Program* (Ky. PSC Apr. 12, 2012).

[32] Case No. 2012-00085, *Application of Duke Energy Kentucky, Inc. for an Energy Efficiency Cost Recovery Mechanism and for Approval of Additional Programs for Inclusion in Its Existing Portfolio* (Ky. PSC June 29, 2012),

[33] Case No. 2013-00313, *Application of Duke Energy Kentucky, Inc. to Amend Its Demand Side Management Programs* (Ky. PSC Dec. 19, 2013).

[34] Case No. 2014-00280, *Application of Duke Energy Kentucky, Inc. to Amend Its Demand-Side Management Programs* (Ky. PSC Jan. 28, 2015).

[35] Case No. 2009-00444, *Annual Cost Recovery Filing for Demand-Side Management by Duke Energy Kentucky, Inc.* (Ky. PSC Mar. 22, 2010).

efforts to provide DSM opportunities to residential, commercial, and industrial customers and its ongoing efforts to promote its programs by educating customers on the benefits of DSM. Staff encourages Duke Kentucky to pursue potential cost-effective industrial programs, even though the opt-out provision exists in KRS 278.285(3).[36] In addition, Duke Kentucky is commended for continuing to identify and evaluate new or expanded DSM programs for Commission approval and implementation.

RECOMMENDATIONS

While the Commission Staff is generally pleased with the DSM efforts of Duke Kentucky, the following recommendations should be addressed in its next IRP:

- Duke Kentucky should include all environmental costs, including, but not limited to, costs of carbon, as they become known, in future benefit/cost analysis.
- Duke Kentucky should monitor its DSM charges in order to prevent large over/(under) collections of DSM charges.
- Duke Kentucky should continue to aggressively review other cost-effective DSM/EE programs and measures for all customer classes (residential, commercial, and industrial) to include in its DSM portfolio.

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[36] The Commission has directed Kentucky Utilities Company and Louisville Gas and Electric Company to conduct an industrial DSM study, develop a definition of the term "industrial" as that term is used in KRS 278.285(3), and develop criteria which will be used to determine whether an industrial customer qualifies for the DSM exemption under KRS 278.285(3). *See* Final Orders in Case No. 2014-00371, *Application of Kentucky Utilities Company for an Adjustment of Its Electric Rates* (Ky. PSC June 30, 2014); and Case No. 2014-00372, *Application of Louisville Gas and Electric Company for an Adjustment of Its Electric and Gas Rates* (Ky. PSC June 30, 2014).

SECTION 4

SUPPLY-SIDE RESOURCES AND ENVIRONMENTAL COMPLIANCE

This section summarizes, reviews, and comments on Duke Kentucky's evaluation of existing and future supply-side resources. It also includes discussion on various aspects of Duke Kentucky's environmental compliance planning.

EXISTING CAPACITY

Duke Kentucky provides electric service in Boone, Campbell, Grant, Kenton, and Pendleton counties in northern Kentucky.[37] Its power source options include existing generating units, cogeneration, independent power producers, power purchases, and new utility generating units (conventional, advanced technologies, and renewables).[38]

At the time of its filing, Duke Kentucky owned 1,069 MW of net summer rated generating capacity (see Table 1) consisting of 577 MW of coal-fired steam capacity and 492 MW of gas-fired peaking capacity. The coal units are located at the East Bend and Miami Fort Stations. The gas-fired peaking units are located at the Woodsdale Station. To enhance reliability, propane is available on site as a back-up fuel.[39]

TABLE 1 -- MID 2014 GENERATION[40]

Station name	Installation	Retirement	Capability Summer (MW)	Capability Winter (MW)	Fuel
East Bend Boone County, Ky	1981	Unknown	414	414	Coal
Miami Fort North Bend, Oh	1960	2015	163	163	Coal
Woodsdale Trenton, Oh	1992	Unknown	492	564	Gas

On December 8, 2014, Duke Kentucky purchased the minority interest in the East Bend Power plant from Dayton Power & Light Company ("DP&L"). The transaction was completed to offset the loss of generating capacity due to the expected retirement of the Miami Fort unit by mid-2015.[41] Duke Kentucky acknowledged that the Miami Fort

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[37] IRP at 6.

[38] *Id.* at 21.

[39] *Id.*

[40] *Id.* at 75, Table A-3.

[41] Case No. 2014-00201, *Application of Duke Energy Kentucky, Inc. for (1) A Certificate of Public Convenience and Necessity Authorizing the Acquisition of the Dayton Power & Light Company's 31% Interest in the East Bend Generating Station; (2) Approval of Duke Energy Kentucky, Inc.'s Assumption of Certain Liabilities in Connection With the Acquisition; and (3) Deferral of Costs Incurred as Part of the Acquisition; and (4) All Other Necessary Waivers, Approvals, and Relief* (Ky. PSC Dec. 4, 2014).

In its report on Duke Kentucky's 2011 IRP, Staff recommended that a reserve margin study be performed for this IRP or that the IRP explain why such a study was not necessary. Duke Kentucky did not perform a study but explained that determination of an appropriate reserve margin is specified by PJM. It stated that its customers have greater energy security with the reserve margins of all PJM generating entities that can be called upon when any PJM-connected generation incurs a forced outage.[44]

Duke Kentucky works with this PJM planning reserve margin in its generating modeling process, yet notes numerous current and possible future uncertainties on the horizon.[45] It believes the most sensible planning approach is a robust approach which remains flexible to economic, environmental, regulatory and operating fluctuations. For the short term, the analysis supports replacing the Miami Fort 6 unit with an additional 195 MW of capacity. This addition, along with renewables and DSM, will meet Duke Energy's customers' need for power over the long-term planning horizon.

Among the electric generating utilities under the Commission's jurisdiction, Duke Kentucky serves one of the smallest system peaks. Although reserve margins above 25 percent are not optimal, Staff recognizes that Duke Kentucky's size tends to limit its choices when selecting reliable generation capacity portfolio options.

Table 3 denotes the summer projection of load, capacity, and reserves for Duke Kentucky at different years included in its planning horizon.

TABLE 3[46]

	2014	2015	2019	2024	2029	2034
System Peak (MW)	886	900	934	949	976	1,024
Adjusted Peak (MW)	852	869	878	877	897	934
Generating Capacity (MW)[47]	1,067	1,099	1,104	1,130	1,148	1,152
Generating Reserve (MW)	215	229	226	254	251	217
Percent Reserve Margin	25.3	26.4	25.7	28.9	28.0	23.3

[44] *Id.* at 180.

[45] These uncertainties include but are not limited to fuel prices, possible renewable portfolio standard, load forecast uncertainties, the proposed GHG rule, changing carbon constraints, and coal-fired plant retirements due to MATs.

[46] IRP at 63.

[47] Table 3 includes the East Bend generation addition while recognizing the Miami Fort generation retirement.

unit is 56 years old and without the SOx and NOx controls needed to comply with the Mercury and Air Toxic Standards ("MATS"), it was targeted for retirement. The purchase from DP&L increases the summer rated generation capacity at East Bend from 414 to 600 MW, effectively offsetting the impact of the probable retirement of the Miami Fort unit. Table 2 reflects Duke Kentucky's generation post-Miami Fort 6, with 1,092 MW of net summer rated capacity.

TABLE 2

Station name	Installation	Retirement	Generating Summer (MW)	Capability Winter (MW)	Fuel
East Bend Boone County, KY	1981	Unknown	600	600	Coal
Woodsdale Trenton, OH	1992	Unknown	492	564	Gas

RELIABILITY CRITERIA

Duke Kentucky assembles a generation resource portfolio to reduce reliability risks. At the same time, the selection of resources must consider the impact on rates. To safeguard portfolio reliability, Duke Kentucky also includes a rigorous maintenance schedule to ensure generation performance at above average levels.

Baseload coal units receive regularly scheduled major maintenance on a six- to ten-year interval. The gas–fired peaking units, on the other hand, are utilized more during peak load demand and as such, are maintained on an as-needed support schedule. When minor maintenance procedures are required, the units are taken out of service at appropriate times when it is economic to do so.[42]

To provide reliable service, utilities keep a margin of power above projected peak demand. This is called a reserve margin and is needed to provide operational reserves plus security for uncertainties in projected loads and unpredictable weather fluctuations.

Duke Kentucky is a member in PJM, which coordinates movement of wholesale electricity and operates a capacity and energy market. PJM also sets the planning reserve margin requirements for its member generating entities. Duke Kentucky's customers benefit from greater energy reliability due to the availability of numerous existing generating sources at any given time. While Duke Kentucky's planning reserve margin for 2014 calculates to 13.7 percent,[43] its calculated reserve margins for 2014 as well as most of the planning period covered in its IRP are in excess of 25.0 percent.

[42] IRP at 22.

[43] *Id.* at 12.

SUPPLY-SIDE EVALUATION

Duke Kentucky evaluated a range of fuels and technology choices in preparing its IRP. Alternatives included pulverized coal units with carbon capture sequestration ("CCS"), Integrated Gasification Combined Cycle ("IGCC") with carbon sequestration, combustion turbines ("CTs"), and combined-cycle units ("CCs"). It also reviewed solar, wind, and municipal waste landfill gas technologies.[47]

Duke Kentucky assessed diverse technology types to deliver the most suitable supply per generation type. The cost and performance data used by Duke Kentucky in its modeling is derived primarily from a Burns & McDonnell's ("B&M") study of new generation. B&M is an architectural/engineering firm with long-term experience in the electric industry whose data was cross-referenced with industry subject matter experts, EPRI, and studies performed by external sources. The data is not site specific, yet is accepted as useable for utilities seeking Midwest costs and operating input parameters.

Lastly, Duke Kentucky made efforts to ensure that the cost and other constraints are timely, as keeping budget estimates consistent throughout a variety of technology types essential.[48]

To construct a strong portfolio, Duke Kentucky screened and eliminated technologies which are not practicable in its service territory. It eliminated geothermal as not generally available for significant power generation projects, advanced energy storage as too expensive compared to comparable conventional generation sources, and compressed air energy storage due to a constrained supply of available geological formations meeting the necessary conditions for a compressed air storage reservoir.[49]

Fuel cells, it was judged, tend to be more suitable for smaller-scale integration in the range of a few kW to possibly tens of MW in the long-term. They effectively limit themselves to smaller distributed-generation power plants and not commercially available central power plants. Poultry and swine waste digesters are generally expensive and hard to permit, while woody biomass-fired plants tend to become more favorable in boiler conversion applications. The construction of a biomass plant needs to be evaluated on a site-specific basis, as the proximity of the biomass source must be geographically available for a positive economic outcome.

Duke Kentucky re-evaluated clean-air emission renewables to include landfill gas, solar photovoltaic and wind technologies in its supply-side evaluation blend.[50]

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[47] *Id.* at 30.

[48] *Id.* at 31.

[49] *Id.* at 32.

[50] *Id.* at 33.

When comparing fuel sources, the technologies were screened using relative dollar per kW-year versus the capacity factor for the generator. The analysis, which used a confidential spreadsheet-based model developed by Duke Energy, calculates the fixed costs associated with a technology in a dollar-per-kW-year value. The variable costs of operation over a lifetime are calculated and the present worth is computed back to the start year. These points are used to arrive at a total owning-and-operating value for each supply technology to be screened. The results of the screening process are evaluated per category, both with and without a projected cost of CO_2 emissions.[51]

At the end of the process, the most cost-effective baseload/intermediate technology generated by the model was a natural gas-fired combined-cycle plant with duct-firing and inlet chilling. This least-cost technology won out over super critical pulverized coal with carbon capture and storage and integrated gasification combined cycle with carbon capture and storage. The capital and operating costs of carbon capture technology are still being developed, including overall feasibility.[52]

As to peaking technologies, the least-cost technology chose a simple-cycle, heavy-frame combustion turbine unit with evaporative coolers and dual fuel capabilities for both the CO_2 and non-CO_2 cases.[53]

In evaluating renewable technology, a multitude of input allowances alter the modeling process. For example, wind and solar do not contribute their full installed capacity at the system peak. Wind is assumed to contribute 13 percent of installed capacity at peak while solar adds 38 percent at peak. The models tend to give more weight to these renewables as the evaluation compares costs on an installed kW basis as opposed to a delivered power at the peak hour. As these technologies have no CO_2 emissions or are considered carbon neutral, CO_2 does not impact their operating cost.

Solar appears to be the least-cost alternative through its maximum practical capacity factor range, followed closely by wind. Landfill gas, on the other hand, is the most costly renewable within the group, yet operates with the largest capacity factor.[54]

Other factors tend to play into generation selection, such as the size of a unit, its availability and lead time for construction, and its performance. It is also critical to evaluate new and emerging technology when considering long-term investments.

Duke Kentucky has determined a need for additional resources in 2015 with the probable retirement of Miami Fort. As noted earlier in this section, Duke Kentucky has offset the approximately 15 percent Miami Fort generation loss with the purchase of the remaining portion of the East Bend power plant from DP&L.

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[51] *Id. at* 34.

[52] *Id.* at 35.

[53] *Id.*

[54] *Id.* at 36.

With the additional base load coal plant, a portfolio was established to meet the long-term needs of Duke Kentucky. Table 4 below illustrates the resulting blend, which depends upon the assumptions made regarding CO_2 regulations. This portfolio results in the least-cost resource plan for Duke Kentucky.

TABLE 4[55]

YEAR	EE&DR (DSM) MW	Additions/Retirements	Renewables MW	Net additions MW
2015	-3	Retire 163 MW MF6 Add 196 Coal DP&L		29
2016	6			34
2017	7			42
2018	6			48
2019	6		5	59
2020	3		5	68
2021	3		5	77
2022	3		5	85
2023	3		7	95
2024	3		3	102
2025	3		5	11
2026	3		2	116
2027	3		5	125
2028	-7		5	124
2029	3			126
2030	3			129
2031	15			144
2032	-10			124
2033	3			137
2034	0		3	140

COGENERATION, NET METERING, AND DISTRIBUTED GENERATION

Duke Kentucky has two cogeneration tariffs on file with the Commission that allow qualifying facilities to sell excess power back on the grid at published rates. It is willing to work with and supply customers interested in cogeneration with a copy of the tariff, yet it currently has no sellers.

[55] *Id.* at 10. The renewables in the table represent contribution to peak.

Duke Kentucky supposes that a multitude of dynamics contribute to this. Chief among the factors discouraging cogeneration is economics. Customers understand their costs, profits, goals, and competitive positions. As they review the utility's buyback rates, it becomes apparent that obtaining cheaper electric rates through cogeneration is difficult due to Duke Kentucky's competitive electric rates and all the uncertainties surrounding customer cogeneration.

Duke Kentucky does not forecast specific MW projections for cogeneration.[56] Using similar reasoning, Duke Kentucky has no distributed generation within its territory.

Duke Kentucky has 29 net metering customers on its system with a cumulative connected capacity of 0.6 MW. The largest contributor is a photovoltaic solar system located at a school, producing 0.39 MW. The rest of the installations consist of four commercial businesses, two schools, two multi-unit residences, and 20 single family residences. All of the net-metering facilities, with the exception of one other school and one commercial entity, have generating capacities of less than 10 kW.[57]

<u>RENEWABLES</u>

Duke Kentucky modeled numerous capital cost sensitivities, which in general found renewables non-economic in its portfolio. The factors cited include the low capital cost of coal-fired generation versus renewable energy and the lack of need for further resources in the Duke Kentucky system.[58]

However, since Duke Kentucky believes that it is sensible to recognize the value of renewable energy, it included biomass, wind, and solar renewables in its supply side resource modeling and planning options in this IRP, due to their low CO_2 impact and maximum practical capacity factor range.[59] For modeling purposes, Duke Kentucky assumes that 5 percent of retail sales will be met with renewable energy sources beginning in 2019, increasing 0.5 percent per year through 2028.[60] Although there are currently no Kentucky or federal renewable portfolio standards in place, there is a potential for future carbon emission constraints, hence Duke Kentucky modeled 12.5 MW's of wind, 8 MW's of Solar and 2 MW's of landfill gas.[61] Refer to Table 4 for the renewable energy contribution to meeting peak load needs.

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[56] *Id.* at 29.

[57] *Id.* at 176.

[58] *Id.* at 61.

[59] *Id.* at 36.

[60] *Id.* at 9.

[61] *Id.* at 50–51

OTHER NON-UTILITY SOURCES

Duke Kentucky has no contracts with, nor does it acquire energy from, non-utility sources in its service territory. As discussed earlier, Duke Kentucky opines that entities will make energy decisions based mainly on economics, and until the economic results support a clear profit margin to potential energy suppliers, non-utility sources will not materialize within its service area.

COMPLIANCE PLANNING

Duke Kentucky is required to remain in compliance with numerous state and federal regulations. It is an ever-changing landscape with regulations in the discovery phase, some in comment stages and others being finalized at any given time. All of the published regulations will have an impact on operations and rates.

The Clean Air Interstate Rule ("CAIR") was finalized by the EPA in May of 2005. CAIR limits total annual and ozone season NO_X emissions and annual SO_2 emissions. The D.C. Circuit remanded CAIR back to the EPA in December 2008.

In August 2010, the EPA proposed to replace CAIR, with the Cross State Air Pollution Rule ("CSAPR"), which remained in effect until it also was remanded by the D.C. Circuit back to the EPA in 2012. The Supreme Court overturned and remanded CSAPR back to the D.C. Circuit in April 2014 for further consideration. At the time of this IRP submittal, Duke Kentucky was unable to predict the outcome of these court proceedings.[62]

In May 2005, the EPA issued the Clean Air Mercury Rule ("CAMR"). The rule established mercury emission limits for new coal-fired steam generating units. CAMR was vacated by the D.C. Circuit in February 2008. In May 2011, EPA published the MATS, which regulates hazardous air pollutant emissions from existing and new coal or oil-fired steam generating units. Duke Kentucky is in compliance with MATS, which was the regulatory driver for the potential closing of Miami Fort Unit 6 when this IRP was submitted; it has since been closed.[63]

The EPA's Eight Hour Ozone Standard, one of two National Ambient Air Quality Standards ("NAAQS"), lowered the ozone levels from 84 to 75 parts per billion ("ppb") in March 2008. In September 2009, the EPA decided to revisit the standard in response to a court challenge. In September 2011, it was determined that the EPA would not finalize the standards prior to a five-year review cycle. The EPA is currently considering a standard in the 60-70 ppb range, with possible compliance by the 2020-2023 timeframe. It anticipates finalizing the revised ozone standard in the fall of 2015. Meanwhile, the EPA is enforcing the 75 ppb standard finalized in 2008. Under this

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[62] *Id.* at 38,and Table 6-A at 45.

[63] *Id.* at 39, and Table 6-A at 45.

guideline, parts of three counties (Boone, Campbell, and Kenton) in Kentucky near Cincinnati are designated as marginal non-attainment areas.[64]

The second portion of the NAAQS deals with SO_2 emissions. In June 2010, the EPA finalized a 75 ppb, 1-hour SO_2 standard. Consequently, it designated two non-attainment areas in parts of two Kentucky counties, neither of which should have an impact on Duke Kentucky.

The first zone is a multi-state non-attainment area that includes portions of Campbell County. In the EPA's technical document detailing the issues, it concluded that the W.C. Beckjord Station is the likely major contributor to the violation. Duke Energy Corp. has announced the closing of the station, and the East Bend Station was not mentioned as a possible contributor.[65]

The second non-attainment area is in Jefferson County. The EPA identified a number of likely sources in the vicinity which could possibly be contributors to the high SO_2 level, none of which included East Bend. Also, due to its geographical distance from Jefferson County, it is unlikely that the station would contribute to non-attainment.[66]

The EPA addressed Green House Gas emissions ("GHG") in May 2010, finalizing what is commonly referred to as the Tailoring Rule. For Duke Kentucky to be regulated under the Tailoring Rule, its generating unit must be determined to be "potentially subject to prevention of significant deterioration." Since it is not known when or if a Duke Kentucky generating unit will be in this category, the possible implications of the regulatory requirement are unknown.[67]

In January 2014, EPA published its New Source Performance Standards for CO_2 emissions for new pulverized coal, integrated gasification combined cycle, and stationary natural gas-fired CTs. The EPA could finalize the rules in 2015, yet they will have no effect on Duke Kentucky.[68]

Similarly, the EPA proposed GHG emission rules for existing electric-generating units in June 2014. These were early in the rulemaking process and it was not possible for Duke Kentucky to know what the outcome might be at the time it submitted its 2014 IRP.[69]

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[64] *Id.* at 39.

[65] Duke Kentucky's Response to Staff's First Request, Item 9.

[66] *Id.*

[67] IRP at 40.

[68] *Id.* at 41.

[69] *Id.*

As to air emission allowances, CAIR is currently in effect. Under CAIR, SO_2 allowances utilize the 1990 Clean Air Amendments Title IV allowance allocations. NOx emissions fall under two guidelines, one during the ozone season and the second on an annual basis. East Bend has an SCR for NO_X control and an FGD for SO_2, positioning it well for compliance.[70]

As Duke Kentucky's generation is in compliance with Air Quality regulations it is also in compliance with Water Quality regulations. Sections 316(a) and 316(b) of the Clean Water Act ("CWA") provide protection for fish and other aquatic species from heated cooling water discharges and entrainment and impingement on screens and structures of cooling water intake systems. Duke Kentucky has minimal exposure to these water regulations, since East Bend 2 uses cooling towers, which are closed loop systems, and Miami Fort 6 has been retired.[71]

In April 2013, EPA proposed revisions to the Steam Electric Effluent Limitations Guidelines ("ELGs") with a final rule to be issued by September 30, 2015. These guidelines will place effluent limitations on waste streams from power plants, including pollution-control equipment wastewater and ash transport water. The proposed effluent requirements will be implemented during the permit renewal of each station's National Pollutant Discharge Elimination System ("NPDES") wastewater discharge permit after July 2017.[72] The effect on Duke Kentucky will be known after issuance of the final rule and compliance will depend on each station's permit renewal schedule.

The final rule on Coal Combustion Residuals ("CCRs") was issued in December 2014 by EPA, with the required implementation from six to 30 months later. Typically the CCRs addressed in the rule are residual products from power plant production which include FGD byproducts, fly ash, and bottom ash. The rule addresses concerns about preventing surface impoundment structural failures and groundwater contamination. It provides criteria for operating CCR units and record keeping, as well as requirements for inactive units and impoundment closure.[73] Duke Kentucky did not address CCR rule compliance, since there was no rule in effect at the time of its IRP submittal.

EFFICIENCY IMPROVEMENTS - GENERATION

Duke Kentucky routinely evaluates its generation facilities for cost-effective improvements which affect both efficiency and reliability. If during the evaluation phase it becomes apparent that a generation improvement can improve efficiency, Duke

[70] *Id.* at 44.

[71] *Id.* at 41.

[72] *Id.* at 42–43.

[73] www2.epa.gov/coalash/coal-ash-rule

Kentucky takes note and makes plans to complete the task during a future scheduled maintenance outage.[74]

Duke Kentucky has a formal process for deciding when to award capital to fund proposed efficiency projects. First, the project must demonstrate a solid cost/benefit ratio. For example, Duke Kentucky used this process to evaluate and determine that high pressure/intermediate pressure dense pack turbine technology did not have a solid cost/benefit ratio and would therefore not be funded for East Bend. Using this process, Duke Kentucky concluded the same for generator air preheater technology.

A project which cleared this process and was implemented to impprove efficiency at East Bend was a high-pressure turbine foam wash system. The spring 2013 task increased efficiency from 78.6 to 82.0 percent. During the subsequent spring scheduled outage, Duke Kentucky improved the heat transfer properties of its boiler through a chemical cleansing.[75]

TRANSMISSION SYSTEM

Duke Energy Kentucky, Duke Energy Ohio and Duke Energy Indiana in the Midwest are interconnected with East Kentucky Power Cooperative, Kentucky Utilities, Louisville Gas and Electric, American Electric Power, Dayton Power and Light, Ohio Valley Electric, Hoosier Energy, Ameren, Indianapolis Power and Light, Southern Indiana Gas and Electric, Northern Indiana Public Service, and the Tennessee Valley Authority.[76] Duke Energy Kentucky's transmission system utilizes four transmission substations to transmit 69-kV electric power from its generation and feeder sources to 36 substations placed across its 300 square miles of service territory. The distribution substations are located such that the voltage is reduced to energize an appropriate number of circuits at each substation in order to serve that area's portion of Duke Kentucky's total 136,000 retail customers.[77]

Duke Energy Kentucky transferred its transmission assets from MISO to PJM for dispatching and will continue to operate within PJM consistent with its operation prior to that transfer on January 1, 2012.[78] No additional utility interconnections or other transmission projects have occurred since 2011, or are planned by Duke Kentucky through 2014; however, there is a 69-kV interconnection planned for completion in 2015

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[74] IRP at 26.

[75] *Id.* at 177.

[76] *Id.* at 29.

[77] Duke Kentucky's 2011 IRP at 234–235. Case No. 2011-00235, *2011 Integrated Resource Plan of Duke Energy Kentucky, Inc.* (Ky. PSC Feb. 21, 2013).

[78] IRP at 28.

with East Kentucky Power Cooperative.[79] Therefore, the existing facilities apparently must meet system performance requirements and customers' needs, since "[c]hanges to the Duke Energy Kentucky transmission and distribution systems are based on meeting planning criteria, which are intended to provide reliable system performance in a cost-effective manner."[80]

Current transmission facilities are designed to provide adequate capacity and supply the reliable transport of current generating resources. Typically, any changes to Duke Kentucky's transmission system are based on planning criteria intended to provide reliable performance to the system in the most cost-effective manner. However, projects intended solely to reduce losses have been shown not to be cost effective.[81]

DISTRIBUTION SYSTEM

Since the 2011 IRP, a major distribution system improvement was completed in 2012, establishing a new 12 kV feeder, Grant 43. This project was done to increase needed capacity and reliability.[82] Several distribution system improvements are scheduled for 2015; including the installation of new 138 12-kV, 22.4 MVA transformers at two substations, one at Silver Grove and one at Crescent. Five new 12-kV distribution feeders are also to be established in 2015; Silver Grove 41, 42 and 43, and Crescent 45 and 46.[83] As with changes to the transmission system, distribution projects are based on appropriate criteria needed for an increase in the number of customers to be served and to provide more reliable, cost-effective performance in the system. Typically loss reduction is a secondary aim, as projects solely implemented to reduce losses tend to not be cost-effective.[84]

DISCUSSION OF REASONABLENESS

Duke Kentucky used planning and analysis in order to meet its commitment and obligation to meet customers' future energy needs in a reasonable, adequate, and efficient manner. The resource planning entailed quantitative and qualitative analysis to determine the best and most economical options. "Quantitative analysis provides insights into future risks and uncertainties associated with the load forecast, fuel and energy costs, and renewables. Qualitative considerations, such as fuel diversity, the Company's environmental profile, emerging environmental rules, and the progress of

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[79] *Id.* at 183–184.

[80] *Id.* at 183.

[81] *Id.*

[82] *Id.* at 184.

[83] *Id.*

[84] *Id.* at 183.

emerging technologies, are also important factors."[85] The result of the process enables development of an IRP that hopefully will be a reliable strategic tool for meeting energy needs of customers in today's dynamic environment and uncertain future landscape.

Duke Kentucky's long-term objective is to use a flexible planning process and pursue a resource strategy that considers the costs and benefits to its customers, shareholders, employees, suppliers, and service area. It involves balancing several competing objectives, such as: providing adequate, efficient, economical service in an uncertain environment; maintaining flexibility to alter the plan as future circumstances change and be able to meet a variety of possible futures while minimizing the risks.[86]

Renewables were employed in the quantitative analysis process of resource options to provide insights of future risks and uncertainties. Though neither Kentucky nor the federal government has a renewable energy portfolio standard, Duke Kentucky believed it prudent to plan for such a standard beginning in 2019, with 5 percent of retail power sales provided by renewables and that level increasing by 0.5 percent each year through 2028.[87] The renewable technologies considered include solar photovoltaic, wind, and landfill gas. Solar tends to be the least in cost, but has the lowest practical capacity factor, with wind following closely for the generation levels modeled. The most expensive is landfill gas but it provides a larger generation capacity factor.[88] The variety of renewable technologies was limited in order to facilitate modeling of potential supply-side resource options.[89] Nuclear units known as small modular reactors, which are in a conceptual phase, are being monitored by Duke Kentucky for potential consideration for future resource planning, even though the current nuclear moratorium in Kentucky on such power plants would prevent their use.[90]

To identify the most theoretically attractive resource alternatives for expected loads and risks, Duke Kentucky used modeling software to provide the most appropriate results, minimize their future revenue requirements and meet a determined 13.7 percent marginal planning reserve.[91]

RESPONSE TO 2011 RECOMMENDATIONS

In its report on the prior IRP, Staff recommended that Duke Kentucky discuss and provide information on several issues. The information and a discussion of those

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[85] *Id.* at 6.

[86] *Id.* at 11.

[87] *Id.* at 9 and 52.

[88] *Id.* at 36.

[89] *Id.* at 50.

[90] *Id.* at 32 and 51.

[91] *Id.* at 12 and 52.

issues were incorporated into this IRP, and most of the items have been referenced and summarized in other portions of this section.[92] Staff is reasonably satisfied with the information provided and the responses of Duke Kentucky. Discussion of the Staff's recommendations and Duke Kentucky's responses thereto is included below.

Renewables and Distributed Generation

Staff recommended that more discussion of Duke Kentucky's consideration of, and efforts in promoting, various forms of distributed generation be included in its next IRP. It also recommended that Duke Kentucky continue to provide information related to the net metering statistics and activities of its customers.

Duke Kentucky responded that some customers' production facilities are used for self-generation, emergency back-up, or peak shaving, and that peak shaving equipment is typically oil and/or gas fired and generally is used to reduce a customer's peak billing demand.[93] It stated that if customers think they can lower their overall costs by self-generating, they will investigate the possibility. However, with its relatively low electric rates and avoided-cost buyback rates, Duke Kentucky asserts that cogeneration and small power production are generally uneconomical for most customers.[94]

Duke Kentucky also stated that its unregulated affiliate, Duke Energy Generation Services, constructs, owns, and operates cogeneration and trigeneration facilities for industrial plants, office buildings, shopping centers, hospitals, universities, and other major energy users that can benefit from combined heating/cooling or power production economies. It stated that a diverse range of technologies utilizing a variety of fuels was considered, including pulverized coal with CCS, IGCC with CCS, CTs, CC, and nuclear. In addition, renewable technologies such as wind, municipal waste landfill gas, and solar were considered in this year's screening analysis.[95]

Generation Efficiency

The Staff reminded Duke Kentucky in the 2011 IRP recommendations to include discussions of the requirements in 807 KAR 5:058, Section 8(2), requiring improvements to, and more efficient utilization of, existing power generation; requirements which were specified in Administrative Case No. 2007-00300,[96] as well as

[92] *Id.* at 172–180.

[93] *Id.* at 28.

[94] *Id.* at 29.

[95] *Id.* at 30.

[96] Administrative Case No. 2007-00300, *Consideration of the Requirements of the Federal Energy Policy Act of 2005 Regarding Fuel Sources and Fossil Fuel Generation Efficiency* (Ky. PSC Aug. 25, 2009).

the Federal Energy Policy Act of 2005 Regarding Fuel Sources and Fossil Fuel Generation Efficiency.

Duke Kentucky responded by indicating that outage activities are important to its efficiency plan, noting a 3.4 percent increase in efficiency at the East Bend station by implementing a high-pressure turbine foam wash during the spring 2013 outage. As noted earlier, in the spring 2014 outage, the East Bend boiler was chemically cleaned to gain increased heat transfer.[97] These scheduled outages remove a generating unit from production, typically during periods of lowest demand in the spring and fall, in order to perform work on pre-determined specific components. Such planned maintenance of coal-fired units is vital and helps to avoid forced outages requiring a unit to be removed from service suddenly and unexpectedly, potentially during periods of higher demand.

Compliance Planning

In its recommendations on the previous IRP, Staff reminded Duke Kentucky to include discussions of the requirements in Regulation 807 KAR 5:058, Section 8(5)(f), concerning actions to be taken in meeting the Clean Air Act Amendments of 1990. Staff noted that the Commission expects utilities' environmental planning to be performed on a comprehensive basis, giving consideration to existing and pending regulations, and to those reasonably anticipated. Comprehensive planning is essential to ensure that the compliance measures proposed be implemented and allow the Commission adequate time to perform its statutory duties in determining that new facilities and modifications are necessary in order to provide safe and adequate service to customers at the lowest reasonable cost.

In addressing this recommendation, Duke Kentucky described the numerous environmental issues and regulation schedules needing to be addressed, and included discussions of various actions to be undertaken during the 20-year period covered by the plan, and the impacts of how these actions affect its resource assessment. Duke Kentucky listed some of the history of the EPA air rules and their limitations of various pollutants, such as, NO_X and SO_2 which are awaiting court proceedings addressing CSAPR.[98] Additional hazardous air-pollutant emission impacts are discussed in the IRP regarding compliance with the MATS rule. Its standards and effects on East Bend are noted (Miami Fort 6 was shuttered before compliance dates were in effect).[99] Further air-quality discussions concerned future GHG limit requirements and their implications.[100]

Water-quality issues addressing cooling water discharges and the entrainment through, and the impingement on, water intake systems and the impact these rules

[97] IRP at 177.

[98] *Id.* at 38 and 44.

[99] *Id.* at 39, 44, and 46.

[100] *Id.* at 40–41.

have on Duke Kentucky's generating facilities were discussed and noted. Water-issue impacts were also addressed regarding the pending Steam Electric ELGs which provide effluent limitations for seven wastewater streams.[101]

Certain coal combustion wastes regulated under the Resource Conservation and Recovery Act, including fly ash, bottom ash, and FGD byproducts, were addressed and the compliance issues of their handling, disposal and possible reuse were noted.[102] A fairly complete discussion of compliance issues, actions, and plans related to current and pending environmental regulations is included in Chapters 6 and 8 of the IRP.[103]

<u>2014 IRP RECOMMENDATIONS</u>

The Staff considers the supply-side resource assessment of this IRP reasonable, considering that, for the planning period of this IRP, Duke Kentucky maintains a 13.7 percent reserve margin. Miami Fort 6 is retired and therefore is not a component in the power supply resources. The supply-side resources encompass a variety of options considered to meet customers' energy needs. These options include conventional, advanced technology, and renewable generating units.

Staff believes, however, that several issues should be addressed in greater detail in the next IRP. Staff's discussion and recommendations are included below:

<u>Renewables and Distributed Generation</u>

- Duke Kentucky should continue to provide a discussion of its efforts to promote cogeneration, and its consideration of various forms of renewable and distributed generation.
- In addition, Duke Kentucky should continue to provide information related to customers' net metering statistics and activities.

<u>Generation Efficiency</u>

- Continue providing discussion of options considered in the IRP, especially improvements to and more efficient utilization of existing facilities.

<u>Compliance Planning</u>

- Compliance issues, actions, and plans relating to current and pending environmental regulations should be included in the next IRP, as these are of utmost importance in deciding future utility actions.

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[101] *Id.* at 41–43 and 46.

[102] *Id.* at 43–44 and 46

[103] *Id.* at 38–46 and 48–62.

Other Issues

o Duke Kentucky should provide an update on the Miami Fort 6 retirement, its facilities' status, any razing and/or property restoration involved in its shuttering situation, and any issues affecting environmental compliance.

o Concerning recent reports on Duke Energy's coal ash ponds in North Carolina, and the fact that substantial fines have been paid for spills, etc., Duke Kentucky should provide a discussion of the status, inspections and any other pertinent information about the condition of similar ponds at the East Bend Station, unless a circumstance of a critical nature requires expedited notification to the Commission prior to its next IRP filing.

SECTION 5

INTEGRATION AND PLAN OPTIMIZATION

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

THE INTEGRATION PROCESS

Duke Kentucky used the Ventyx System Optimizer model and Ventyx Planning and Risk ("PAR") model to develop an optimal expansion plan. The System Optimizer model uses a linear programming procedure to choose the most economical expansion plan of the lowest PVRR. The PAR is a production costing model which simulates the operation of the electric production facilities of an electric utility.[104]

Duke Kentucky also used its in-house Engineering Environmental Compliance Planning and Screening Model ("ESM") to organize modeling information and provide modeling data for emission control alternatives to the System Optimizer and PAR models. With East Bend already well controlled, and because capital-intensive controls were not economic for Miami Fort 6, specific screening activity was not performed.[105]

The technologies in Duke Kentucky's quantitative analysis were modeled in small increments (35 MW or less), due to the small amount of capacity needed over the study period. Smaller units are used to level the playing field, so choices will be based on economics rather than size. The following technologies were considered: (1) nuclear; (2) pulverized coal with carbon capture and sequestration; (3) CT capacity; (4) CC capacity; (5) wind; (6) solar; and (7) biomass landfill gas. A 195-MW composite coal unit was also modeled, based on the cost and operating characteristics of favorable coal-based proposals received in response to a recent request for proposals ("RFP").[106]

Duke Kentucky's integration analysis using the System Optimizer model was performed over a 27-year period (2014-2040), while its final production costing modeling was performed using the PAR model over a 21-year period (2014-2034).[107] Analyses were performed under varied sets of inputs to test Duke Kentucky's system under different future conditions reflecting changes in variables such as fuel prices, load levels, and environmental requirements. These analyses produced numerous sets of

[104] *Id.* at 48.

[105] *Id.* at 49.

[106] *Id.* at 50–51.

[107] *Id.* at 51.

resources required to meet a planning reserve margin of 13.7 percent and minimize long-run revenue requirements to customers.[108]

A variety of portfolios was developed to assess the impact of various risk factors on the costs to serve Duke Kentucky's customers. For the 2014 IRP, the analyzed portfolios focused in the short term on the replacement option in 2015 for Miami Fort 6 and on the impacts of different carbon policies in the longer term.[109]

SYSTEM OPTIMIZER SCENARIO AND PORTFOLIO ANALYSIS

Two potential scenarios were modeled using System Optimizer to evaluate the impacts of key risks and decisions. Those were:

1. Reference Case with CO_2 regulation beginning in 2020; and
2. No CO_2 Case.

The Reference Case scenario considered potential CO_2 prices starting at $17/ton in 2020 and increasing to $53/ton by 2034. In the No CO_2 Case, CO_2 emissions have no cost. The difference between the total cost in this case compared to the Reference Case can be considered an approximation of the cost of carbon regulation.[110]

Portfolios

Portfolio options were tested in order to evaluate long-term costs to customers under various potential outcomes. The five portfolios analyzed were:

1. Miami Fort 6 retires in 2015 and is replaced with composite coal in 2015;
2. Miami Fort 6 retires in 2020 and is replaced with composite coal in 2015;
3. Miami Fort 6 retires in 2020 and is replaced with CC capacity in 2020;
4. Miami Fort 6 retires and is replaced with composite coal in 2015; all coal retires in 2027 and is replaced with CC capacity; and
5. Miami Fort 6 retires and is replaced with composite coal in 2015; all coal retires in 2027 and is replaced with CT capacity.

In each of the portfolios, additional generation, either the 195-MW composite coal, or 170-MW of CC capacity, would be added to replace Miami Fort 6 when, or before, it retires. In Portfolios 4 and 5, when all coal retires in 2027, roughly 500 MW of gas-fired capacity, either CT or CC, is added in that year. In all five scenarios, approximately 50 MW of wind and solar is added in small increments over the forecast period.[111]

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[108] *Id.* at 52.

[109] *Id.*

[110] *Id.* at 53.

[111] *Id.* at 54, Table 8-B.

QUANTITATIVE ANALYSIS – MIAMI FORT 6

This analysis evaluated whether it was cost-effective to retire Miami Fort 6 or retrofit it with necessary environmental controls. Per the System Optimizer evaluation, the optimal resource replacement for Miami Fort 6 was 195 MW of composite coal generation in 2015 in all scenario analyses.[112]

Three portfolios were used in each scenario to evaluate the cost-effectiveness of installing controls at Miami Fort 6 versus retirement and replacement of the unit using the PAR model. Those three portfolios, which were evaluated on a Present Value Revenue Requirements ("PVRR") basis for both a 21-year period and a 10-year period, are as follows:

1. Retire Miami Fort 6 in 2015 and replace with a composite coal unit in 2015;[113]

2. Retire Miami Fort 6 in 2020 and replace with a composite coal unit in 2015; and

3. Retire Miami Fort 6 in 2020 and replace with CC capacity in 2020.

Under both the Reference Case and the No CO_2 Case, Portfolio 1 above, *Retire Miami Fort 6 in 2015 and replace the unit with a composite coal unit in 2015*, was the lower-cost option on a PVRR basis, compared to installing controls on the unit in both the 21-year and 10-year analyses.[114] Based on its analyses, Duke Kentucky determined that its optimal plan includes retiring Miami Fort 6 in 2015 and replacing its capacity with the addition of a 195-MW composite coal unit in 2015.

SENSITIVITY ANALYSIS

Sensitivities representing highest future risks were evaluated in both scenarios:

- 15 percent higher coal prices.
- 15 percent lower coal prices.
- 15 percent higher natural gas prices.
- 15 percent lower natural gas prices.
- Higher capital costs for traditional, wind, and solar generation.
- Lower capital costs for traditional, wind, and solar generation.

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[112] *Id.* at 56.

[113] As noted in Section Four of this report, subsequent to filing its IRP, Duke Kentucky acquired the minority interest in the East Bend Station and retired Miami Fort 6.

[114] IRP at 57.

- A 'No Renewable Energy Portfolio Standard' sensitivity was run to determine how much renewable energy would be chosen as a least-cost resource.

- Purchases and Sales – the base assumption was to allow purchases and sales to develop the base portfolios. As a member of PJM, the opportunity to make purchases and sales provides value to Duke Kentucky. Models runs were also conducted of: (1) no purchases or sales; (2) purchases only; and (3) sales only, to quantify the benefit of participating in the energy markets.

For these sensitivity analyses, Duke Kentucky used its five original portfolios, except for Portfolio 2, *Miami Fort 6 retires in 2020 and is replaced with composite coal in 2015*, which was eliminated based on economics and risk profile. Portfolio 1, *Miami Fort 6 retires in 2015 and is replaced with composite coal in 2015*, had the lowest cost in the majority of sensitivities. However, in both the High Coal Price and Low Gas Price sensitivities, Portfolio 4, *Miami Fort 6 retires and is replaced with composite coal in 2015; all coal retires in 2027 and is replaced with CC capacity*, had the lower PVRR in the Reference Case. In the No CO_2 Case, with no cost on carbon, Portfolio 1 remained the lowest cost under both the High Coal Price and Low Gas Price sensitivities.

DISCUSSION OF REASONABLENESS

The integration process employed by Duke Kentucky addresses a number of issues that are largely driven by recent and emerging environmental compliance rules. In addressing how to comply with these rules in a reasonable, cost-effective manner, Duke Kentucky has analyzed the generating units that should be, or may be, retired and the type of capacity additions that will be the most cost-effective.

Given the concentration of its supply since it acquired its exiting generating fleet, Duke Kentucky has operated with back-up power supply plans for a number of years. As stated earlier in this report, Duke Kentucky acquired the minority interest in East Bend Unit 2 from DP&L in December 2014. Since then, recognizing its even greater concentration of supply, Duke Kentucky sought and received Commission approval of a new back-up power supply plan which could include business-interruption insurance.[115]

The Staff is satisfied with how Duke Kentucky has approached the changes that are being faced by electric utilities. The Staff concludes that Duke Kentucky's overall integration and optimization approach is thorough, well-documented, and reasonable.

RECOMMENDATION

Staff has one additional recommendation for the Company's next IRP beyond those contained in Sections 2, 3, and 4 of this report:

[115] Case No. 2015-00075, *Back-Up Power Supply Plan of Duke Energy Kentucky, Inc.* (Ky. PSC June 15, 2015).

- Unless otherwise addressed before filing its next IRP, Duke Kentucky should report on the effectiveness of its recently approved back-up power supply plan and discuss whether it intends for its future plans to include insurance products or other means to address its concentration of supply.

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