Kentucky Public Service Commission

Staff Report on the

2011 Integrated Resource Plan

of Duke Energy Kentucky, Inc.

Case No. 2011-00235

February 2013

SECTION 1

INTRODUCTION

In 1990, the Kentucky Public Service Commission ("Commission") promulgated 807 KAR 5:058 to establish an integrated resource planning process to provide for review of the long-range resource plans of Kentucky's six major jurisdictional electric utilities by the Commission Staff ("Staff"). The Commission's goal was to ensure that all reasonable options for the future supply of electricity were being examined and pursued, and that ratepayers were being provided a reliable supply of electricity at the lowest possible cost.

Duke Energy Kentucky, Inc. ("Duke Kentucky" or "the Company") filed its 2011 Integrated Resource Plan ("IRP") on July 1, 2011. The IRP includes Duke Kentucky's plan for meeting its customers' electricity requirements for the period 2011-2031.

On August 8, 2011, an Order was issued establishing a procedural schedule for this proceeding. The schedule allowed two rounds of data requests to Duke Kentucky, written comments by intervenors and reply comments by the Company. There were no intervenors in this matter.

Duke Kentucky is an investor-owned utility that supplies electricity and natural gas to customers in northern Kentucky. A subsidiary of Duke Electric Ohio, Inc., which is a subsidiary of Duke Energy, Inc., Duke Kentucky serves five Kentucky counties in the greater Cincinnati, Ohio, metropolitan area. It provides electricity to approximately 136,000 customers and provides natural gas to approximately 95,000 customers.

The Company's net summer generation capacity in 2011 was 1,077 megawatts ("MW"), consisting of 577 MW of coal-fired base load capacity and 500 MW of gas-fired combustion turbine ("CT") peaking capacity. Its highest system peak demand of 912 MW occurred in the summer of 2007.

The purpose of this report is to review and evaluate Duke Kentucky's 2011 IRP in accordance with 807 KAR 5:058, Section 12(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 that resource planning is a dynamic, ongoing process. Thus, this review is designed to offer suggestions and recommendations to Duke Kentucky on how to improve its resource plan in the future. Specifically, Staff's goals are to ensure that:

- All resource options are adequately and fairly evaluated;
- Critical data, assumptions and methodologies for all aspects of the plan are adequately documented and are reasonable; and
- The report also includes an incremental component, noting any significant changes from the Company's most recent IRP, filed in 2008.

Duke Kentucky states that the objective of its IRP is to outline a robust strategy to furnish electric energy services to its customers in a reliable, efficient, and economic manner while factoring in the uncertainty of the current environment. Its long-term planning objective is to employ a flexible 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 reflected 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.

Duke Kentucky's resource planning process comprises the following objectives:

- Develop planning objectives and assumptions;
- Consider the impacts of anticipated or pending regulations or events;
- Prepare the electric load forecast;
- Identify energy efficiency and demand-side management ("DSM") options;
- Identify supply-side resource options and perform economic screening for cost-effectiveness;
- Integrate energy efficiency, renewable, and supply-side options with the existing system and electric load forecast to develop potential resource portfolios to meet the desired reserve margin criteria;
- Perform detailed modeling of potential resource portfolios to determine the portfolio that exhibits the lowest cost to customers over a wide range of alternative futures; and
- Evaluate the ability of the selected resource portfolio to minimize price and reliability risks to customers.

Duke Kentucky's summer peak is expected to increase from 855 MW in 2011 to 981 MW in 2031, reflecting an annual growth rate of 0.7 percent. Its winter peak load is expected to increase from 717 MW to 811 MW over the same period, for a growth rate of 0.6 percent. Energy requirements are projected to increase from 4,219,302 MWh in 2011 to 4,749,702 MWh in 2031, for an annual growth rate of 0.63 percent.

The IRP was developed based on a minimum reserve margin of 14.5 percent. With its planned DSM programs and demand response, Duke Kentucky expects to have a 80 MW reduction in summer peak demand by 2031.

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, summarizes Duke Kentucky's evaluation of DSM opportunities.
- Section 4, Supply-Side Resource Assessment, 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.

SECTION 2

LOAD FORECASTING

This section reviews Duke Kentucky's projected load growth and load forecasting methodology. Duke Kentucky's energy and peak demand forecasts are prepared yearly as part of its planning process by a staff it shares with other Duke Energy utilities, using a common methodology. 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

Energy use, and especially electricity use, are key components of economic activity. As such, as the level of economic activity changes, the amount of energy and electricity used will vary. 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. Ordinary least squares is the principle regression analysis technique used to estimate behavior, or economic, relationships among relevant variables. Gathering national, state, and local economic and demographic historical and forecast data to specify 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. Even though there are no major economic shocks, the continued growth of the economy is a major risk factor behind the load forecast. In the near term, continued growth coming out of a slow economy and managing increases in energy prices are major risk factors. The Cincinnati area economy, including northern Kentucky, is diverse. Major manufacturing sector industries include food products, paper, printing, chemicals, steel, fabricated metals, machinery, and automotive and transportation equipment. Major non-manufacturing industries include insurance and finance.[2]

[2] Appendix B of Duke Kentucky's 2011 IRP – Electric Load Forecast (Appendix B) at 89-90, 98, 100-103 and Response to Item 31 of Commission Staff's First Information Request ("Staff's First Request)".

The Energy Independence and Security Act ("EISA"), passed in 2007, included new higher efficiency standards for lighting. The 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 non-manufacturing industrial sector is the main source of employment growth and reflects a continuing trend toward the service sector and a fundamental change in manufacturing and other basic industries. Local employment is expected to grow 1.3 percent versus 0.7 percent nationally over the forecast period. While mirroring the general aging trends, the local population is expected to grow at an average annual rate of 0.6 percent versus 1.0 percent nationally. The number of residential customers (year-end) is expected to grow from 120,774 in 2011 to 139,586 in 2031 which represents an average annual rate of 0.78 percent. Within the Company's service territory, many commercial customers serve local markets. Since the residential sector is the largest in terms of total existing customers and total new customers, there is a strong tie between growth in the residential and growth in the commercial sector. Industrial production is expected to grow at a 2.0 percent annual rate locally, versus 1.4 percent nationally. [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 the kWh energy usage per customer. The number of customers forecast is modeled as a function of real per capita income and lag variables. Real per capita income is defined as personal income, divided by population, divided by the consumer price index ("CPI"). The lag variables capture the changes in the number of customers as real per capita income changes over time. Residential use per customer is modeled as a function of real per capital income, real marginal electricity prices, the saturation/stock of efficient appliances, and saturation variables of electric heating customers, central air conditioning customers, window air cooling customers, space conditioning appliances, Heating Degree days ("HDD"), and Cooling Degree days ("CDD"). Local weather data are obtained from the National Oceanic and Atmospheric Administration ("NOAA") for the Cincinnati/Covington airport weather station.[4]

The appliance stock variable is a function of the fixed energy consumption values for each-end use appliance, the saturation of each appliance type and the efficiency of

[3] Appendix B at 99-101.

[4] Regression equations at 111, Appendix B at 92, 104 and Response to Item 28.a. of Staff's First Request.

each appliance type. Historical appliance-saturation level information is obtained using the company's appliance-saturation survey. The appliances tracked in the survey include electric range, frost-free refrigerator, manual-defrost refrigerator, food freezer, dishwasher, clothes dryer, clothes washer, water heater, microwave oven, television, room air conditioner, central air conditioner, electric resistance heat and electric heat pump, and miscellaneous uses, including lighting. Itron Inc. is used to provide historical and appliance efficiency data and forecasts of appliance-saturation levels and appliance efficiency levels. Itron Inc. has developed regional statistically adjusted end use ("SAE") models are used to obtain the forecasts.[5]

Over the forecast period, residential class energy sales are projected to grow from 1,470,777 MWh in 2011 to 1,815,677 MWh in 2031. Accounting for energy efficiency impacts, rural and residential rate class energy use is projected to grow from 1,468,766 MWh in 2011 to 1,653,911 MWh in 2031, which represents an average annual growth rate of 0.63 percent.[6]

The commercial sector energy sales forecast is modeled as a function of commercial employment, real marginal electricity price, HDD, and CDD.[7] Over the forecast period, commercial sector energy sales are projected to grow from 1,445.145 MWh in 2011 to 1,741,816 MWh in 2031. Accounting for energy efficiency impacts, commercial class energy use is projected to grow from 1,443,695 MWh in 2011 to 1,631,755 MWh in 2031, which represents an average annual growth rate of 0.65 percent.[8]

The industrial sales forecast is the summation of forecasts for specific industrial sectors by the North American Industry Classification System ("NAICS"). Generally, industrial energy sales are modeled as a function of industrial production (by NAICS sector), the marginal price of electricity relative to other fuel prices, HDD, and CDD. Industrial production is derived as the product of sector productivity (production per employee and sector employment).[9] Over the forecast period, industrial energy sales are projected to grow from 794,032 MWh in 2011 to 1,023,054 MWh in 2031. Accounting for energy efficiency impacts, industrial sector energy use is projected to increase from 813,959 MWh in 2011 to 947,917 MWh in 2031, which represents an average annual growth rate of 0.98 percent.[10]

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[5] Appendix B at 104-105. Also, see the response to Item 7.a. of Staff's First Request. Trends in lighting efficiencies are now incorporated into the appliance forecast.

[6] Regression equations at 111-112 and Figure B-2 Part 1, Appendix B at 135, 137.

[7] Appendix B at 93.

[8] Regression equations at 113 and Figure B-2 Part 1, Appendix B at 135, 137 and Response to Item 28.a. of Staff's First Request.

[9] Appendix B at 90 and 93 and Response to Item 28.a. of Staff's First Request

[10] Regression equations at 114-125 and Figure B-2 Part 1, Appendix B at 135, 137.

The other public authorities (government) sector energy sales (including federal, state and local government) are the summation of two categories: water pumping customers and non-water pumping customers. The water pumping energy sales forecast is modeled as a function of the number of residential electricity customers, the real electricity demand price, precipitation, and CDD. Non-water pumping energy sales are modeled as a function of government employment levels, the marginal price of electricity relative to natural gas prices, HDD, and CDD.[11] Over the forecast period, government sector energy sales are expected to decrease slightly from 292,847 MWh in 2011 to 285,117 MWh in 2031. Accounting for energy efficiency impacts, energy use for this sector is projected to decrease from 292,544 MWh to 265,264 MWh in 2031. Energy use is projected to increase slowly to 305,266 MWh by 2017 and then decrease throughout the rest of the forecast period.[12]

For street lighting, electricity usage varies in relation to the number of street lights and the efficiency of the sodium vapor and mercury vapor lighting fixture stock. The number of street lights is dependent on the population of the service area. Street light energy sales are modeled as a function of mercury vapor light saturation and sodium vapor light saturation.[13] Over the forecast period, street lighting energy sales are expected to grow from 15,127 MWh to 17,459 MWh in 2031, which represents a 0.77 percent average annual growth rate. Energy efficiency programs are not expected to have a measurable effect on this rate class's projected energy use.[14]

Summing the results of the individual class energy sales forecasts to derive the total energy sales forecast and then adding in company use 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 needed for load is projected to grow from 4,224,513 MWh in 2011 to 5,135,783 MWh in 2031. Accounting for energy efficiency programs, energy use is projected to grow from 4,219,302 MWh in 2011 to 4,749,702 MWh in 2031, which represents an average annual growth rate of 0.63 percent.[15]

PEAK LOAD FORECASTS

Duke Kentucky produces two peak load forecasts: one for summer peak demand and one for winter peak demand. The peak forecasting is intended to closely reflect the relationship of weather to peak loads. Only days with a temperature of 90 degrees or more are included in the summer model, and only days with a temperature of 10 degrees or below are included in the winter peak model.

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[11] Appendix B at 94.

[12] Regression equations at 126-127 and Figure B-2 Part 1, Appendix B at 135, 137.

[13] Appendix B at 94.

[14] Regression equations at 128 and Figure B-2 Part 1, Appendix B at 135, 137.

[15] Figure B-2 Part 1, Appendix B at 136, 138.

Both peak summer load and peak winter load are influenced by economic activity, temperature and humidity. For the summer peak, 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. Both summer and winter peak load are modeled as a function of weather normalized sendout and specific weather factors. Weather conditions associated with the monthly peak load are obtained from hourly and daily data provided by NOAA. An average of extreme weather conditions is the basis for the weather variables in the peak load forecast. The average is computed from historical data for the single worst summer weather occurrence and the single worst winter occurrence in each year.[16]

Weather normalized sendout is developed through a two-step process. Each of the individual rate classes (residential, commercial, industrial, and governmental) is adjusted for the difference between actual and normal weather. Street lighting sales are not considered weather sensitive. Weather normalized sales are derived by multiplying actual sales by a weather normalization factor that accounts for the deviation from normal weather. Weather normalized sendout is then computed by summing the weather normalized sales with the 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. The sendout forecast drives the peak forecasts. Values used in the forecasts, which are determined to be normal peak-producing conditions, are based on historical data on the worst weather conditions in each year for both summer and winter.[17]

Over the forecast period, summer internal peak demand, before energy efficiency and demand response (controllable load) is projected to grow from 886 MW in 2011 to 1,061 MW in 2031, reflecting an annual growth rate of 0.7 percent. Similarly, internal winter peak demand is projected to grow from 736 MW in 2011 to 868 MW in 2031, reflecting an annual growth rate of 0.6 percent. After accounting for energy efficiency and demand response (controllable load), summer native peak demand is projected to grow from 855 MW in 2011 to 981 MW in 2031. After accounting for energy efficiency and demand response (controllable load), winter peak demand is projected to grow from 717 MW in 2011 to 811 MW in 2031.[18]

RANGE OF FORECASTS

Assuming normal weather, the base case (most likely) forecast for energy demand and peak load demand is obtained using the econometric models and

[16] Appendix B at 95-96, 105.

[17] Appendix B at 96-97.

[18] Appendix B Figures B-4 and B-5 at 140-141.

forecasts of the economic variables from Moody's Analytics for each rate class. In order to generate the high/low (optimistic/pessimistic) forecast ranges, the Company used the standard errors of the regression from the econometric model rate class runs. The bands are based on a 95 percent confidence interval around the forecast, which equates to 1.96 standard deviations. The Company did not specifically model the price effects of existing and future environmental regulations. However, once the expected costs of complying with new regulations are developed, they will be reflected in the projected price of electricity, which will then have effects on the load forecast. Also, the Company believes that its pessimistic forecast provides some insight into the effects of more stringent regulations.[19]

Prior to taking account of energy efficiency and demand response programs, the pessimistic energy forecast ranges from 3,942 GWh in 2011 to 4,609 GWh in 2031. The optimistic energy forecast ranges from 4,508 GWh in 2011 to 5,663 GWh in 2031. The pessimistic peak load (summer system peak) forecast ranges from 827 MW in 2011 to 948 MW in 2031. The optimistic peak load forecast ranges from 944 MW in 2011 to 1,173 MW in 2031.[20]

After taking into account energy efficiency, Duke Kentucky's pessimistic energy forecast ranges from 3,936 GWh in 2011 to 4,224 GWh in 2031, while its optimistic energy forecast ranges from 4,502 GWh in 2011 to 5,227 GWh in 2031. Duke Kentucky's pessimistic peak load forecast ranges from 827 MW in 2011 to 908 MW in 2031, while the Company's optimistic peak load forecast ranges from 944 MW in 2011 to 1,133 MW in 2031.[21]

CHANGES IN METHODOLOGY

Duke Kentucky continues to make use of well-accepted econometric modeling, as it has done in previous IRPs. However, the Company has made a change regarding the appliance stock variable. It now relies on Itron, Inc. to provide forecast information obtained from its SAE model for appliance efficiencies and saturation levels. Specifically, trends in lighting efficiency, which were not present previously, are now incorporated into the data.[22]

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[19] See the response to Items 4 and 32 of Staff's First Request. The Company reported that it did not specifically model the potential impacts of carbon constraints as compared to scenarios without carbon constraints. Neither did it specifically include the effects of energy pricing on employment or other economic variables. However, if real electric prices were assumed to be flat, electric energy consumption would be five percent higher by 2020.

[20] Appendix B Figure B-7 at 143.

[21] Appendix B Figure B-8 at 144.

[22] Appendix B at 105, 109.

DISCUSSION OF REASONABLENESS---RESPONSE TO 2008 RECOMMENDATIONS

Staff is satisfied with Duke Kentucky's forecasting. The econometric modeling methodology is well-accepted industry practice and has been used in Duke Kentucky's previous IRP filings.

In its report on Duke Kentucky's 2008 IRP, Staff made the following recommendations relative to forecasting:

- Report on how the change in base temperature for HDD calculations and use of a 10-year period in developing HDD and CDD "normal" have impacted how actual energy and demand levels compare to forecasted levels.

- Examine and report on the impact of future environmental regulations (specifically carbon capture and sequestration and other greenhouse gas mitigation requirements) and how these issues are incorporated into future forecasts and/or will be incorporated into future forecasts.

- Report on the need, if any, to incorporate impacts occurring due to the expanding role of the Midwest Independent System Operator ("Midwest ISO") into future forecasts.

The Company provided a comparison of its actual results to two forecasts using different base temperatures and different historical periods to develop normal HDD and CDD. The actual results were more in line with the forecast which used the alternate base temperature and the 10-year historical period.

Duke Kentucky reported that it was not currently incorporating carbon capture and sequestration or other greenhouse gas mitigation requirements in its load forecasts. It did reflect projected costs of CO_2 allowances and their impact on electric prices, which is one of the variables used in its forecasts.

The Company stated that it did not believe the expanding role of Midwest ISO would have a material impact on its future load forecasts. It stated that, consistent with its intent to transfer control of its transmission assets from Midwest ISO to PJM Interconnection, LLC ("PJM"), effective January 1, 2012, it will operate within PJM. Accordingly, it developed its 2008 IRP with such expectations.

RECOMMENDATIONS

For its next IRP, Staff makes the following recommendation concerning Duke Kentucky's energy and demand forecasts:

- 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 a 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.

SECTION 3

DEMAND-SIDE MANAGEMENT—ENERGY EFFICIENCY

INTRODUCTION

This section addresses the DSM portion of Duke Kentucky's 2011 IRP. Through applications by the Company and in conjunction with its DSM Collaboratives,[23] the Commission has approved expansions of the Company's DSM efforts over time. At the time of the IRP filing, the Company's DSM programs were set to expire at the end of December 2012;[24] however, shortly before the filing, the Commission approved Duke's request for approval of the proposed adjustments to its DSM rider, continuation of the existing programs and the addition of a new energy efficiency program called Residential Smart Saver into its DSM portfolio.[25] Subsequent to filing the IRP, the Commission issued orders in the following DSM related cases: 2011-00471,[26] 2011-00448,[27] and 2012-00085.[28] Also, the Commission ordered the Company to extend its expired Real Time Pricing Tariff to continue till otherwise ordered by the Commission.[29] Together, Duke Kentucky's DSM programs are expected to achieve a 73 MW reduction in peak demand with energy savings of 120,000 MWh by 2016.[30]

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[23] The Residential and Commercial & Industrial Collaboratives include the following: 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, Campbell County Fiscal Court, Northern Kentucky Legal Aid, Boone County Fiscal Court, Kenton County Fiscal Court, Greater Cincinnati Energy Alliance, and Duke Energy Kentucky.

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

[25] Case No. 2010-00445, Annual Cost Recovery filing for Demand-Side Management by Duke Energy Kentucky, Inc. (Ky. PSC, Jun 7, 2011).

[26] 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).

[27] Case No. 2011-00448, Application of Duke Energy Kentucky, Inc. for the Annual Cost Recovery Filing for Demand-Side Management (Ky. PSC Apr. 13, 2012).

[28] 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).

[29] Case No. 2011-00428, Application of Duke Energy Kentucky, Inc. to Modify and Extend the Availability of its Rate RTP, Real Time Pricing Program (Ky. PSC, Dec. 28, 2011).

[30] Id. at Duke Kentucky's Response to Item 2 of Staff's First Request.

DSM PORTFOLIO OF PROGRAMS

On June 29, 2012, the Commission issued an order in Duke Kentucky's application approving the cost recovery mechanism and program approval.[31] The application sought additional measures of existing programs and three additional programs. The three new programs are the Appliance Recycling Program, the Low Income Neighborhood Program, and the My Home Energy Report Program. One of the goals of this application is that the Duke Kentucky DSM portfolio be similar to DSM programs of Duke Energy Ohio. The impacts of these programs were not included in the 2011 IRP. Case No. 2012-00085 states that the cumulative MWh reductions of the current DSM portfolio is approximately 99,000 MWh for 2012-2016, but the proposed DSM portfolio for 2012-2016 will increase 20 percent to 120,000 MWh, an increase of 20,000 MWh.[32]

Duke Kentucky's portfolio of DSM programs include 10 existing and three new programs. They are the following:

1. Residential Smart Saver Energy Efficient Residences. This program is divided into two tariffs: Energy Efficient Residences and Energy Efficient Products. They provide incentives to customers, builders, heating, ventilation and air conditioning ("HVAC") dealers and weatherization contractors to promote and install high-efficiency air conditioners and heat pumps with electronically commutated fan motors, as well as attic insulation and air sealing, duct sealing, HVAC tune-ups, and efficient lighting.

New measures include duct insulation and property manager lighting. The property manager lighting provides for multifamily property managers to install compact fluorescent bulbs ("CFL") in permanent, landlord-owned light fixtures. Duke Kentucky will pay for the CFLs and the property manager will pay for the shipping costs.

2. Residential Smart Saver Energy Efficient Residences. This program was formerly the Home Energy House Call, an energy audit program. It is administered by contractor Wisconsin Energy Conservation Corporation, Inc. The program provides a comprehensive walk-through, in-house analysis. The home audit reviews total home energy usage, and checks appliances and heating/cooling systems.

3. Energy Efficiency Education Program for Schools. This program, formerly the Residential Comprehensive Energy Education Program, is operated under contract by the National Energy Education Development Project ("NEED"). Energy education coordinators work with schools, teachers, and students on energy education programs. Duke Kentucky is adding a live, theatrical production category to this program. The performances are intended to educate students and reinforce energy efficiency lessons learned in the classroom. Students and their families will continue to be encouraged to order and employ the Home Energy Starter Kit.

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[31] Case No. 2012-00085, Duke Energy Kentucky, Inc. (Ky. PSC June 29, 2012).

[32] Id. at Duke Kentucky Response to Item 2 of Staff's First Request.

4. Low Income Services. This program includes the former Residential Conservation and Energy Education and the Payment Plus programs. The former Residential Conservation and Energy Education program focuses on Low Income Home Energy Assistance Program customers who meet the income qualification level of less than 130 percent of the federal poverty level. The former Payment Plus 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 costs. The program has three parts: (1) Energy & Budget Counseling; (2) Weatherization; and (3) Bill Assistance. This program is offered on a yearly basis from October through March.

5. Residential Direct Load Control – Power Manager. Formerly known as Power Manager, the purpose of this load-control program is to reduce demand by controlling residential air conditioning usage during peak demand conditions in the summer months.

6. Smart Saver Prescriptive ("Prescriptive"). This program is currently part of the Commercial and Industrial High-efficiency Incentive (for Business and Schools). Duke Kentucky expanded the program to include over 220 measures covering five broad technology categories of: Lighting, HVAC, Motors/Pumps/Drives, Energy Star Food Service Equipment, and Process Equipment.

The following types of equipment are eligible for incentives: high-efficiency lighting; high-efficiency HVAC installations; high-efficiency motors, pumps, and variable frequency drives; high-efficiency food service installations; high-efficiency process equipment installations, including compressed air systems; other high-efficiency installations as determined by Duke Kentucky on a case-by-case basis; and maintenance to increase the efficiency of existing equipment.

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

7. Smart Saver Custom ("Custom"). This program was most recently approved as the pilot Nonresidential Smart Saver Custom Incentive program in Case No. 2011-00471.[33] This program 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 an application before they begin their project.

The following types of equipment are eligible for incentives: high-efficiency lighting; high-efficiency HVAC installations; high-efficiency motors, pumps, and variable frequency drives; high-efficiency food service installations; high-efficiency process

[33] Case No. 2011-00471, Duke Energy Kentucky, Inc. (Ky. PSC Apr. 12, 2012).

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 avoided capacity produced by the installed measure(s). Duke Kentucky expanded this program to all eligible commercial and industrial customers.

8. Smart Saver Energy Assessments. This program offers several different types of assessments to help nonresidential customers identify energy efficiency opportunities. The assessments are the online analysis, telephone interview analysis, and the on-site audit and analysis.

The online assessment is free and available for all nonresidential customers through Duke Kentucky's website.

The telephone interview analysis is for customers with a peak demand over 500 kW, and is free. Duke Kentucky reserves the right to decline a telephone-based assessment if its resulting analysis is not expected to yield actionable recommendations for implementation or specific areas for further investigation.

The cost of the on-site audit and analysis is shared by Duke Kentucky and the customer. The cost of the on-site assessment can vary, depending on the length of the time an assessor spends at a customer's facility. The customer pays 50 percent of the cost, and Duke Kentucky pays 50 percent, but the customer's cost can be further reduced through incentives paid by Duke Kentucky for equipment installed based on the audit's recommendations made under the Prescriptive or Custom programs.

9. Peak Load Manager, also known as PowerShare. This was formerly the PowerShare program, the brand name of Duke Kentucky's voluntary Peak Load Management Program. It offers non-residential customers the opportunity to reduce their electric costs by managing their electric usage during peak load periods.

The following are three new DSM programs:

1. Appliance Recycling. This program encourages residential customers to responsibly dispose of older, functioning, but inefficient refrigerators and freezers. Residential customers who chose to participate will be paid a cash incentive of up to $30 per unit, with a maximum of two units per year. The disposal of the refrigerators and freezers will be handled in an environmentally friendly manner, with approximately 95 percent of the material recycled and five percent going to a landfill. JACO Environmental, Inc. is vendor chosen to recycle, reclaim, and dispose of materials.

The program's marketing will consist of direct mail, social media, and community presentations and publications such as newsletters. Point-of-sale messaging will also be pursued with prominent appliance retailers.

2. Low-Income Neighborhood. This program will be available to both homeowners and renters occupying single-family and multi-family dwellings in target

neighborhoods where electric service is provided by Duke Kentucky. Targeted low-income neighborhoods qualify for the program if at least 50 percent of the households' incomes are at or below 200 percent of the federal poverty guidelines. A neighborhood is defined as an area of approximately 100–500 homes in which a significant number of households have incomes at or below 200 percent of poverty level.

Participating customers will receive the following: 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, up to $210 worth, 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.

3. My Home Energy Report. This program provides an energy usage report that compares household usage to similarly situated neighboring homes, and provides recommendations to lower energy usage. The report also promotes Duke Kentucky's other energy efficiency programs when applicable. The goal is to prompt customers to change the way they use energy. The printed reports are distributed up to 12 times a year; however delivery may be interrupted during off-peak energy usage months in the fall and spring.

In addition to Duke Kentucky's DSM portfolio of programs, the Commission approved a limited automatic approval process for pilot programs to encourage future development of DSM programs and innovation. The parameters of the limited automatic approval process are:

a. The total pilot program cost, including Evaluation, Measurement & Verification, is projected at less than $75,000.

b. The pilot program is found to be cost-effective under the Total Resource Cost Test and Utility Cost Test.

c. The pilot program has been vetted and approved by the Collaborative.

By allowing these small scale tests and avoiding the traditional approval process for new programs, Duke Kentucky will be able to test new and innovative products and services quickly, adapting to and capitalizing on market conditions to bring energy savings opportunities to customers. If the pilot proves successful and Duke Kentucky decides that a program should be commercialized and offered on a large scale as part of its broader suite of programs, it will request approval by the Commission and will have data from the pilot sampling to support such a filing.

DSM SCREENING AND COST-EFFECTIVENESS

The 2011 IRP analysis includes the level of energy efficiency and demand response products and services that were requested and approved in Case No. 2010-00445. All energy efficiency programs were screened for cost-effectiveness using DSMore, a financial analysis tool designed to evaluate the costs, benefits, and risks of energy efficiency programs and measures, utilizing the traditional California Standard tests.[34] DSMore provides the results of these tests for any type of energy efficiency program (demand response and/or energy conservation). DSMore estimates the value of an energy efficiency measure at an hourly level across distributions of weather and/or energy costs and prices providing the Company with a better measure of the risks and benefits of employing energy efficiency 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.[35]

SUMMARY DISCUSSION OF DSM

Staff recognizes Duke Kentucky's efforts since the last IRP to implement the programs approved in Case No. 2009-00444 and in researching and developing the new program approved in Case No. 2010-00445, as well as in its new and expanded programs in Case Nos. 2011-00471 and 2012-00085. Additionally, Duke Kentucky's enhanced screening for cost-effectiveness of DSM programs with DSMore is an enhancement to this process which will aid in measuring the risks and benefits of employing energy efficiency 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. In addition, these changes, as well as budgetary increases approved in Case No. 2010-00445, will aid in the evaluation, verification, and measurement of Duke Kentucky's DSM programs.

The Commission 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

Staff's report in the prior Duke Kentucky IRP had no specific recommendations regarding the existing programs, due to the IRP's proximity to Duke Kentucky's DSM filing in Case No. 2009-00444. Staff noted that the relatively broad, comprehensive scope of Duke Kentucky's programs appeared to be meeting a need for its customers, and for Duke Kentucky, in developing its least-cost supply plan. The current IRP, as well as subsequent DSM case filings, appears to continue this trend as DSM becomes a more important tool in planning by utilities. Staff commends Duke Kentucky for its

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[34] 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 Cost Test, the Participant Test, the Ratepayer Impact Measure, and the Total Resource Cost Test.

[35] See the Response to Item 33 of Commission Staff's First Request.

efforts to increase DSM for residential and commercial customers and for its continuing efforts to promote its programs by educating customers on the benefits of DSM. In addition, the Company is commended for continually working to identify and evaluate new and/or expanded DSM programs for Commission approval and implementation.

RECOMMENDATIONS

While the Staff is generally pleased with the DSM efforts of Duke Kentucky, the following recommendations are being made to be addressed in its next IRP:

- The Company should include all environmental costs, as they become known, in future benefit/cost analysis.
- The Company should more closely monitor its DSM charges in order to prevent large over-collection of DSM charges.
- The Company should more closely monitor its tariffs in order to ensure that all are current and in accordance with Commission requirements.
- The Company should identify and explain all impacts to DSM resulting from changing its independent transmission operator from Midwest ISO to PJM.
- The Company should continue to review other cost-effective DSM or energy efficiency programs to include in its DSM portfolio.

SECTION 4

SUPPLY-SIDE RESOURCE ASSESSMENT

INTRODUCTION

This section summarizes Duke Kentucky's resources and options needed to meet the energy requirements of its consumers. The IRP assesses option feasibility, fuels, contracts, resource longevity, construction, timing, capital costs, operation and maintenance ("O&M") costs, reliability, and environmental compliance planning activities. Duke Kentucky utilizes a flexible planning approach in pursuit of a resource strategy and considers the costs and the benefits for all stakeholders involved.[36]

EXISTING CAPACITY

Duke Kentucky's net summer generating capability is 1,077 MW, consisting of 577 MW of coal-fired generation and 500 MW of natural gas-fired generation.[37] The coal-fired generation consists of 414 MW at East Bend Unit 2, Boone County, Kentucky, and 163 net MW at Miami Fort Unit 6, North Bend, Ohio. East Bend Unit 2 was installed in 1981, while Miami Fort Unit 6 was installed in 1960.[38] The gas generation consists of six 86 MW nominally rated CTs at the Woodsdale Station in Trenton, Ohio.

Table 1 -- Summary of Existing Electric Generating Facilities[39]

STATION NAME	UNIT NUMBER	APPLICABLE FOOT NOTE	UNIT TYPE	YEAR INSTALLED	TENTATIVE RETIREMENT YEAR	NOMINAL CAPABILITY IN NET MW	ENVIRONMENTAL CONTROLS
EAST BEND	2	A	CF-S	1981	UNKNOWN	414	EP, LNB, TRO, FGD, SCR, CT
MIAMI FORT	6		CF-S	1960	JAN. 1, 2015	163	EP, LNB, OFA
WOODSDALE	1	B	G-CT	1993	UNKNOWN	86	WI
	2	B	G-CT	1992	UNKNOWN	86	WI
	3	B	G-CT	1992	UNKNOWN	86	WI
	4	B	G-CT	1992	UNKNOWN	86	WI
	5	B	G-CT	1992	UNKNOWN	86	WI
	6	B	G-CT	1992	UNKNOWN	86	WI
					TOTAL	1093	

LEGEND
CF-S= COAL-FIRED STEAM
CT= COOLING TOWERS
FGD= SCRUBBER FOR SO_2
G-CT= GAS FIRED SIMPLE CYCLE CT
WI= WATER INJECTION FOR NO_X
LNB= LOW NO_X BURNERS
OFA= OVERFIRE AIR
TRO=TRONA INJECTION SYSTEM
SCR= SELECTIVE CATALYTIC REDUCTION
EP= ELECTROSTATIC PRECIPITATOR

FOOTNOTES (A) co-owned by Duke Kentucky (69% & Operator) and Dayton Power and Light Company (31%)

(B) Unit ratings at 90 deg F (Summer) slightly lower and at 20 deg F (Winter) slightly higher with inlet misting

Miami Fort Unit 6 is to be retired to coincide with the implementation of the U.S. Environmental Protection Agency's ("EPA") Utility Maximum Achievable Control Technology ("MACT") rule on January 1, 2015, and also to avoid the capital investment

36 2011 IRP at 11.

37 Id. at 24.

38 Id., Table A-3 at 83.

39 Id. at 83.

needed to possibly meet other pending and expected environmental regulations. Replacing Miami Fort 6, which currently provides approximately 15 percent of Duke Kentucky's generation, is addressed later in this section.

The Woodsdale CTs use propane for a backup should there be a disruption in the natural gas supply.[40] The most likely near-term replacement option for the Miami Fort 6 retirement is to obtain a 140 MW combined cycle generation ("CC") unit, which along with anticipated energy efficiency and demand response programs providing a 47 MW reduction in peak generation needed, will adequately cover the loss of generation.[41]

RELIABILITY CRITERIA

The North American Electric Reliability Corporation ("NERC") guidelines and its Reliability Indicators (specifically the Planning Reserve Margin from 2011 through 2021 in the Long-Term Reliability Assessment) assign a 15 percent reserve margin for a predominately thermal system.[42] Reserve margin is the available generating capacity, minus peak demand, required in order to maintain reliable operation of the bulk power system, and to determine whether demand growth is adequately being served by planned generation and transmission additions. PJM now controls the dispatch of the Duke Kentucky generating units and has a published Installed Reserve Margin ("IRM") of 15.3 percent. Midwest ISO, the prior dispatcher of Duke Kentucky's units, calculated, but did not require maintaining, a reserve margin; Midwest ISO's IRM calculation for the Duke Kentucky system was 18.7 percent.[43] Both dispatchers differ slightly in their system planning, analysis and calculations, but the traditional minimum reserve margin of 15 percent used by Duke Kentucky for its planning purposes has apparently met the requirements needed to maintain a reliable power system.

The purpose of having a reserve margin is to reduce the risks that are presented by forced outages, transmission constraints, load forecast deviations, or other events that prevent a utility from meeting its load requirements. Duke Kentucky does not anticipate any system reliability issues as it faces the implemented and anticipated EPA regulations and expects to see little change after its complete integration into PJM. However, any change in how the units might be dispatched could affect its generation efficiency. Increasing the required reserve margin beyond that anticipated by Duke Kentucky would have the obvious result of increased costs. One typical planning objective is to meet the guidelines of the reliability authority, NERC, since the

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[40] Id. at 28, and Response to Item 12 of Staff's First Request.

[41] 2011 IRP at 9, Response to Item 5 of Staff's First Request, and Response to Item 3 of Commission Staff's *Second Information Request*.

[42] The North American Electric Reliability Corporation, Reliability Indicators: Planning Reserve Margin, under Assessments & Trends at www.nerc.com.

[43] PJM and Midwest ISO Reserve Studies as published on their respective websites (www.pjm.com and www.midwestiso.org), and Response to Items 15 and 44 of Staff's First Request.

Commission itself does not require a specific reserve margin. Following the NERC guidelines and using its traditional operational planning reserve margin of 15 percent, Duke Kentucky has met or exceeded that reserve margin level in its results for 19 of the 20 years in the period considered for this IRP; in 2026 the reserve margin is forecasted to be 14.5 percent, which is the annual minimum reserve margin the Company used for its planning purposes.[44] Based on data available from the U.S. Energy Information Administration ("EIA"), which monitors and publishes reserve margins, and the Federal Energy Regulatory Commission ("FERC"), which also monitors and assesses reserve margins and their attainment seasonally, the use of 15 percent as a planning reserve margin appears representative.[45] The PJM Forecast Pool Requirement results in a forced outage calculation of 8.27 percent. Since its zone peak coincident rate with PJM is 95.3 percent, Duke Kentucky's forced outage rate in 2010 was 9.83 percent. Also, while Duke Kentucky has an installed coincident capacity reserve margin of 20.1 percent, the planning reserve margin translates to 14.5 percent.[46]

SUPPLY-SIDE RESOURCES

Duke Kentucky's baseload generation is coal-fired and the Duke Regulated Fuels group provides the necessary and reliable supply of quality fuel in sufficient quantities to meet its electric generating requirements. According to Duke Kentucky, it purchases the appropriate coal mixtures as needed to meet environmental regulations, and obtains supplies prudently from a dispersed variety of suppliers. The Regulated Fuels group pursues the lowest reasonable cost while meeting the necessary delivery schedules.[47] To track and forecast fuel prices Duke Kentucky uses data obtained from the New York Mercantile Exchange, a public exchange service, and consultants such as Wood Mackenzie.[48] In addition to coal as the primary fuel, Duke Kentucky utilizes oil to cold start the coal-fired boilers and for flame stabilization at times of reduced dispatching of those units. Duke Kentucky's CT peaking units are fueled by natural gas, and for back-up it maintains an adequate propane supply on site. It also holds a contractual supply agreement for additional amounts of fuel if the need arises.[49]

Although Duke Kentucky is not a participant in any formal agreement of power pooling, it is interconnected through Duke Energy Midwest with approximately a dozen other electricity suppliers: These include Louisville Gas and Electric, Kentucky Utilities,

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[44] 2011 IRP at 71.

[45] The United States Energy Information Administration at www.eia.gov/todayinenergy/detail, and the Federal Energy Regulatory Commission 2012 Summer Market and Reliability Assessment at www.ferc.gov/market-oversight.

[46] 2011 IRP at 13.

[47] Id. at 27.

[48] Id. at 29.

[49] Id. at 28.

Dayton Power and Light, American Electric Power, East Kentucky Power Cooperative, Ohio Valley Electric Corporation, Indianapolis Power and Light, Southern Indiana Gas and Electric, Hoosier Energy, Ameren, and Northern Indiana Public Service, and indirectly with the Tennessee Valley Authority.[50] Duke Kentucky recently transferred its affiliation from Midwest ISO to PJM for dispatching of its assets and will operate within PJM consistent with its operation in Midwest ISO prior to the January 1, 2012 transfer.[51] Duke Kentucky has investigated and continues to review a variety of generation technologies using an assortment of different fuels. Renewable technologies which have been considered as supply-side sources include wind, biomass and solar. Technologies such as Integrated Gasification Combined Cycle ("IGCC") generating units have been screened as supply-side resources, with consideration of carbon capture and sequestration technology to moderate CO_2 emissions.[52] Each variety of technology is categorized according to its cost and performance data available from external sources such as the Electric Power Research Institute, as well as Duke Kentucky's internal experts. Several technologies were eliminated due to technical limitations, feasibility issues and commercial availability. These discarded technologies included geothermal, compressed air energy storage, advanced battery storage, fuel cells, small and medium nuclear, farm animal waste digesters, G-class CC, and off-shore wind. Supply-side resources are assessed and evaluated with regard to technical feasibility, equipment life, capital cost, construction and implementation timing, fuel availability and cost, environmental issues, O&M costs, and reliability.[53]

Duke Kentucky evaluated the cost-effectiveness of either adding environmental controls to, or retiring Miami Fort Unit 6. In the evaluation of environmental regulatory requirements, many components had to be considered individually and combined in order to provide for an effective system. These control items include cooling-water intake screens and modifications, Trona injection,[54] selective non-catalytic reduction, activated carbon injection, fabric filter, continuous emission monitors, dry fly ash and bottom ash conversion, a lined landfill, and wastewater treatment. Future additions could include flue gas desulfurization and selective catalytic reduction. The evaluation of Present Value Revenue Requirements ("PVRR"), at an after-tax discount rate of 7.5 percent over a 34-year period for the long-term effect of control or replacement technologies indicated that resource replacement was achieved by 140 MW of CC generation installed in 2015 at Miami Fort Unit 6.[55] After that, if DSM and Renewable

[50] Id. at 33.

[51] Id. at 34 and Response to Item 15 of Staff's First Request.

[52] 2011 IRP at 35.

[53] Id. at 24.

[54] Trona is a mineral which is injected into the flue gas stream as a less expensive alternative for full wet flue gas desulfurization.

[55] 2011 IRP at 211.

Energy Portfolio Standards ("REPS") are implemented, the next capacity shortage would not occur until 2027, or with no renewable requirements instituted, until 2022.

> In summary, combined cycle generation was the optimal resource selection to replace Miami Fort 6 in 2015. Though CC generation was selected as the optimal replacement, new coal generation was competitive as a replacement option under a Cap and Trade regulatory construct. However, combined cycle generation has an advantage over coal in a Clean Energy Standard construct because half of its generation would count toward the compliance. Duke Kentucky is evaluating options to satisfy the 2015 capacity need.[56]

Modeling and evaluating future generation resource options is difficult, since the amount of additional capacity needed at various times throughout a study period are, for a limited system like Duke Kentucky's, in amounts smaller than commercially available units of a particular technology or in economically justified unit sizes. The typical investigation of technology normally illustrates that, for any given technology, the largest available unit sizes are the most cost-effective and efficient. Any convenient unit sizes can be incorporated in a modeling exercise, but those units at those output capacities, even if available, would be much higher in cost and not economical. However, the economies of purchasing commercially available larger units might be achieved by jointly buying and owning a larger unit with another utility, or by the use of a Purchased Power Agreement for the amount of capacity required.[57]

Table 2 -- Technologies and Sizes Considered for This IRP[58]

Technology	Unit Size Cost Basis (MW)	Unit Size Modeled (MW)	Percentage of Peak Contributed
Nuclear	1,117 (2 units)	35	100%
Supercritical Coal	800	35	100%
Supercritical Coal with 90% Carbon Capture	800	35	100%
IGCC	630	35	100%
Simple Cycle CT	204 (4 units)	35	100%
Combined Cycle CC	500 Unfired 150 Duct Fired	28 Unfired 7 Fired	100%
Wind	150	25	13%
Solar	25	2	38%
Biomass	100	2	100%

[56] Id. at 70.

[57] Id. at 59.

[58] Id. at 60, and Response to Item 17 of Staff's First Request.

ASSESSMENT OF NON-TRADITIONAL UTILITY GENERATION SOURCES

1. COGENERATION

There are some facilities for self-generation, peak shaving, or emergency back-up owned by customers of Duke Kentucky. The non-emergency self-generation units are typically of a base load meeting type, which are generally sized for the demands of specific industrial processes or heating and not for electric demand. Peak shaving equipment reduces the customer's peak billing demand, and can reduce the load otherwise required to be served. Cogeneration decisions are made by customers due to their individual situations; therefore, Duke Kentucky makes no effort to forecast the level of that activity or its supply capability. If contracts are presented and entered into, then the resulting energy capacity and supply will be shown in a future planning process.[59] Duke Kentucky has comparatively low energy and avoided cost rates; thus, cogeneration and small power production are typically uneconomical for the majority of customers.[60] Therefore, it does not have any contracts for cogeneration currently and indicates that its plan incorporates no other renewable resources, cogeneration or non-utility sources. Duke Kentucky did assess the Combined Heat and Power ("CHP") potential of suitable customers in its service territory and indicated an estimate of 9.15 MW for CHP energy production.[61] However, if the appropriate situation is presented, Duke Kentucky does have two cogeneration tariffs available for its customers.[62]

2. RENEWABLES

Renewable generation technologies typically contribute with lower capacity factors than current thermal generation with wind at 15 percent and solar at 70 percent of installed capacity at the time of peak loading.[63] And the cost of renewable generation technologies is generally greater for a given capacity factor than current thermal generation, with solar photovoltaic being the most expensive and wind being the least expensive. In addition, there would most probably be additional site-specific transmission costs involved in these technologies, as well as project lead times of two to four years minimum.[64] Since residential and small commercial customers having their own generation capabilities will typically utilize a type of renewable fuel technology, that record of generation appropriately is placed at this location. This is especially true of information relating to the installation of net metering equipment and systems, since in order to meet the definition set forth in the net metering statute, KRS 278.465, the

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[59] 2011 IRP at 33.

[60] Id. at 34.

[61] Id. at 224.

[62] Id. at 34.

[63] Response to Item 18 of Staff's First Request.

[64] 2011 IRP at 42, and Response to Item 19 of Staff's First Request.

generation must be fueled by renewable energy. Seventeen Duke Kentucky customers are net metered, and all generate electricity by inverter-based photovoltaic equipment. Of these 17, two are multi-unit residential customers, two are businesses, two are schools, and 11 are single-family residences. The schools have the largest generating capability, with one able to produce 0.39 MW; each of the remaining customers have 10 kW or less of generating capacity. The total connected capacity of all the net metering customers is 0.47 MW. Duke Kentucky more than doubled its number of net metering customers in 2010, from its total of eight since 2006.[65]

3. OTHER NON-UTILITY SOURCES

Duke Energy Generation Services is an unregulated affiliate of Duke Kentucky which builds, owns, and operates cogeneration and tri-generation facilities for industrial plants, office buildings, shopping centers, hospitals, universities, and other major energy users that can benefit from combined heating/cooling and power production economies."[66] Distributed generation is included in Duke Kentucky's System Optimizer Portfolio Analysis software, a model that incorporates operating characteristics in its analysis, such as: generation, heat rates, emission rates and allowances and disposal, control equipment, availabilities, variable O&M expenses, fuel prices, operating margin, market information and cash flow.[67] In order to properly simulate the potential of increased distributive generation in the long-term resource planning, solar was aggressively increased from 0.25 percent to 1 percent of retail sales. This is somewhat parallel to the planning of those areas that have implemented REPS, and in Duke Kentucky's case delayed the capacity shortfall from 2027 to 2028, and illustrated a CT generation advantage over CC generation during that time.[68] Typically, several requests for cogeneration buyback rates are received by Duke Kentucky each year from independent small power producers. As a result of its low electricity rates and avoided costs (previously mentioned under cogeneration) Duke Kentucky has no cogeneration contracts, even though it has two cogeneration tariffs available. Of course, there are concerns about cogeneration projects being safe and reliable, as well as, the possibility that other customers might end up subsidizing these power producers through the use of avoided cost buyback rates that are too high.[69]

TRANSMISSION SYSTEM

Duke Kentucky's transmission system utilizes four transmission substations to transmit 69kV electric power from its generation and feeder sources to 36 substations

[65] 2011 IRP at 225.

[66] Id. at 35.

[67] Id. at 58.

[68] Id.at 226.

[69] Id. at 34.

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.[70] Duke Kentucky has transferred its transmission assets from Midwest ISO to PJM for dispatching and will continue to operate within PJM consistent with its operation prior to, and in anticipation of, the transfer which was effective on January 1, 2012.[71] No additional utility interconnections or other transmission projects have occurred since 2008, or are planned by Duke Kentucky through 2013, nor are there any projects in process of construction. 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."[72] The current transmission facilities are designed to provide adequate capacity, and supply the reliable transport of the current generating resources. Typically, changes to Duke's transmission system are based on planning criteria intended to provide more reliable performance to the system and in the most cost-effective manner.[73]

DISTRIBUTION SYSTEM

Several major distribution system and component improvements have been completed, ten are noted, since 2008 and at least one is scheduled for 2012. These projects were accomplished in order to increase needed capacity and reliability. The majority of these projects have been to install new transformers or new distribution feeders.[74] As with changes to a transmission system, distribution projects are based on appropriate criteria to increase the number of customers served and to provide more reliable performance to the system in a cost-effective manner.[75]

COMPLIANCE PLANNING

EPA has proposed and implemented multiple environmental regulations in recent years that affect fossil-fueled electric generation, especially coal-fired generation and force unit retirements in developing compliance plans. The regulations include the MACT rule. This rule is also known as the Mercury and Air Toxics Standards and requires compliance, typically by the installation of control technologies by April 1, 2015. In addition, the emerging environmental regulations include new water quality

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[70] Id. at 234 and 235.

[71] Id. at 33, and Response to Item 15 of Staff's First Request.

[72] 2011 IRP at 231.

[73] Id.

[74] Id. at 232 - 233.

[75] Id. at 231.

standards, fish impingement and entrainment standards, a Coal Combustion Residuals ("CCR") rule and new Sulfur Dioxide (SO_2), and Particulate Matter and Ozone requirements in the National Ambient Air Quality Standards. A replacement for the Clean Air Interstate Rule called the Cross-State Air Pollution Rule was in place, but it was struck down in court.[76] Generation moderation and constraints are a consequence of adding the necessary controls, requiring additional acquired power resources in order to provide for the reduction in generator capability that results from meeting environmental regulations.[77]

Another area of concern for Duke Kentucky as an integrated electricity provider is reducing CO_2 emissions from carbon-based fuel thermal electricity generation. The Company is focusing on developing and deploying new low-emitting and even zero-emitting generation technologies, such as IGCC and Nuclear Power Production facilities, in a strategy Duke Energy is using to help mitigate the risk of potential climate change actions.[78] In addition, Duke Energy has explored with success the practicality of deep carbon capture and storage technology in the Mt. Simon saline reservoir.[79] Although currently there is no federal or Kentucky REPS, Duke Kentucky considered it prudent for the IRP to consider that an RPS might be a possibility, starting at 5 percent of retail sales in 2016 and increasing 0.5 percent each year until 2025.[80]

Since its last IRP, in 2008, Duke Kentucky has stayed abreast of environmental regulations and its plants have remained in compliance. At the time when this IRP was filed, EPA had proposed but not finalized new regulations which when implemented will have an enormous impact on generation facilities and fuel sources, particularly coal. Duke Kentucky did not specifically address all the proposed regulations for this IRP as most were not finalized, but it will continue to evaluate EPA's implemented regulations before making many of the decisions which will impact its generation. Such decisions may involve multimillion dollar plant retrofits, the possible purchase of allotments, changing fuel types and supplies, or retiring coal-fired generators. There is concern that if all companies retiring plants buy power on the open market, the cost of purchased power will likely increase. If a great many coal-fired plants are modified to burn natural gas, then that fuel's costs will most likely increase.

Water-handling systems face modification under the Clean Water Act 316(b), which requires minimization of aquatic organisms' impingement and entrainment by cooling water handling components.[81] Other areas affected are water-based CCR

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[76] The U.S. Court of Appeals for the District of Columbia Circuit: In the decision in EME Homer City Generation v. EPA (No. 11-1302), the Court stated that the EPA exceeded its authority.

[77] 2011 IRP at 7 and 30, and Response to Item 20 of Staff's First Request.

[78] 2011 IRP at 48.

[79] Id. at 50.

[80] Id. at 9 and 62, and Response to Items 24 and 27 of Staff's First Request.

[81] 2011 IRP at 50.

effluent systems, such as ash handling facilities and Flue Gas Desulfurization wastewater treatment arrangements, which may require anhydrous processing of gypsum, fly ash and bottom ash.[82]

GENERATOR EFFICIENCY

Projections of generation availability for this IRP assume that all units will continue at present levels of operation and efficiency.[83] Typically, generating station performance is measured by its availability and then qualified by the unit's operating cost versus the market price of electricity. Starting in 1999, a program was instituted by the name of "availability outages" which allowed units to be removed from service when electric demand is lowest in the spring and fall, for periods of less than nine days as is required for needed urgent maintenance. These situations were in addition to regularly scheduled maintenance programs.[84] Major maintenance on baseload units upwards of 400 MW, such as East Bend 2, is performed at intervals of six to ten years, while intermediate duty units between 140 MW and 400 MW, such as Miami Fort 6, have major maintenance done at six- to 12-year intervals.[85] Other major generating unit maintenance, such as that on CT peaking units, is determined by judgment and the results of predictive maintenance.

Generating units are continually inspected, components are monitored and calibrated, and all elements are examined to predict their condition and avoid failure. Maintenance and modification options are evaluated for their impact on efficiency and cost-effectiveness. Improvements in fossil-fuel generation efficiency must also consider the EPA's new source review regulatory requirements. Since the 1950s there have been some incremental improvements, but there have been few technological innovations and/or noteworthy improvements in the efficiency of coal-fueled electric generation in the decades since that time.[86]

DISCUSSION OF REASONABLENESS

Duke Kentucky used its Engineering Environmental Compliance Planning and Screening Model ("Engineering Screening Model") program to determine which environmental compliance technologies are most economical to be used in further consideration in the System Optimizer model. The Engineering Screening Model uses the operating parameters of the generation units and market information to calculate the dispatch costs of these units. The model also incorporates the operating characteristics

[82] Id. at 52.

[83] Id. at 25.

[84] Id. at 26 and Response to Item 11 of Staff's First Request

[85] 2011 IRP at 25.

[86] Id. at 30–32.

and costs of various combinations of emission control equipment, along with various fuel-switching options and the related capital costs.[87]

In screening resource options for any future consideration, Duke Kentucky found that for any specific type of technology, the largest available sizes were the most cost-effective, even though small units were modeled as necessary to fit the projected need. However, due to its limited size, Duke Kentucky would most likely need to jointly acquire and own commercially available larger units in order to justify and benefit from the price and economies of the larger scale, while securing only the generation portion needed.[88]

Several renewables were also employed in the modeling process of resource options; those modeled were biomass, wind and solar, as these are the most prevalent renewables. Nuclear units were also modeled as alternatives due to the potential of future mandated carbon constraints. However, the nuclear alternative was only included to give another resource option under the possibility of future federal environmental restrictions, even though there is currently a moratorium in Kentucky on nuclear power plants.[89]

To identify the most theoretically attractive resource alternatives for expected loads and risks, Duke Kentucky used the System Optimizer Model software to provide the most appropriate results, minimize their future revenue requirements and meet a determined 14.5 percent marginal planning reserve.[90]

RESPONSE TO 2008 RECOMMENDATIONS

In the last resource plan reviewed in Case No. 2008-00248, Staff recommended that Duke Kentucky discuss and provide relevant information regarding several issues and concerns. The requested information and an adequate discussion of the topics mentioned were incorporated in this resource plan, and most of the items have been referenced and summarized in prior portions of this chapter.[91]

Duke Kentucky provided specific information relating to cogeneration, net metering equipment and distributed generation, which Staff had recommended in 2008 for inclusion in future plans. The information Duke Kentucky provided on each of these is summarized in the "Assessment of Non-Traditional Utility Generation Sources" section of this chapter. Staff is reasonably satisfied with the information provided and the response of Duke Kentucky, specific recommendations are included below.

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[87] Id. at 58.

[88] Id. at 59, and Response to Item 5 of Staff's First Request.

[89] 2011 IRP at 60.

[90] Id. at 61.

[91] Id. at 217-227.

It was also recommended that Duke Kentucky provide a specific discussion of the improvements to, and the more efficient utilization of, transmission and distribution facilities as required by 807 KAR 5:058, Section 8 (2)(a). The information provided by Duke Kentucky is included in this chapter in the Transmission System and Distribution System sections. Staff is satisfied with the information provided but has included some specific related recommendations below.

RECOMMENDATIONS

The Staff considers the supply-side resource assessment of this IRP reasonable, considering that during the 20-year planning period covering 2011-2031, Duke Kentucky maintains around a reasonable 15-percent reserve margin. There are, however, several issues that the Staff finds should be addressed in greater detail in the next IRP. The Staff discussion and recommendations are noted in the items below:

1. RENEWABLES AND DISTRIBUTED GENERATION

Duke Kentucky included consideration of renewable generation in its modeling and provide some discussion of various types of that generation in its consideration of possible renewable power. Although, Duke Kentucky provided some reasonably in-depth discussion of renewable generation, it should also consider more discussion of its consideration of, and efforts in promoting, various forms of distributed generation in the next IRP filing. In addition, Duke Kentucky should continue to provide information related to the net metering statistics and activities of its customers in future IRPs.

2. GENERATION EFFICIENCY

Duke Kentucky provided discussion under the requirements of Section 8(2) in 807 KAR 5:058 requiring utilities to describe and discuss all options considered for inclusion in their plan, including improvements to and more efficient utilization of existing power generation, transmission and distribution facilities. In addition, the Commission in Administrative Case No. 2007-00300,[92] in the August 25, 2009 Order, specifically noted this requirement and directed jurisdictional generators to focus greater research on cost-effective generation efficiency initiatives and to include a full, detailed discussion of such efforts. Duke Kentucky also gave consideration of the requirements of the Federal Energy Policy Act of 2005 Regarding Fuel Sources and Fossil Fuel Generation Efficiency, which was also in the Commission's directive in Admin. Case No. 2007-00300. Duke Kentucky knows and has stated accurately that generation outage planning is important to its reliability plan. These planned outages remove a generating unit from production typically during periods of lowest demand – usually occurring in the

[92] Kentucky Public Service Commission 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.

spring and fall[93] – in order to perform work on pre-determined specific components. Such planned maintenance of coal-fired generating units is vital to the power production process and helps avoid forced outage maintenance, requiring a unit to be removed from service unexpectedly and immediately.

3. COMPLIANCE PLANNING

Section 8(5)(f) of 807 KAR 5:058 requires jurisdictional utilities to include a description and discussion of actions to be undertaken during the period covered by the plan, typically 15 years, but in this case 20 years, to meet the requirements of the Clean Air Act amendments of 1990, and an examination of how these actions affect the utility's resource assessment. Staff at this point mentions the Commission's expectation that environmental planning be performed comprehensively, considering not only existing and pending regulations, but also those reasonably anticipated including, but not limited to, regulation of CO_2. Comprehensive planning is essential in ensuring that compliance measures proposed be implemented. It also gives 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, and that the rates charged are fair, just, and reasonable. A complete discussion of compliance actions and plans relating to current and pending environmental regulations should always be included in any IRP filing.

OTHER RECOMMENDATIONS

Duke Kentucky should provide updates on its retirement of Miami Fort Unit 6 process and its planned replacement alternatives progress. In regard to the retirement of Miami Fort 6: the response to Item 5 of Staff's First Request states: "Duke Energy Kentucky believes a decision must be made by mid-year 2012 to determine how to proceed with replacing Miami Fort 6 with combine cycle generation capacity in 2015. The generic CC selected by the model is viewed as an indicator of the type of capacity needed at that time. The generic combine cycle that is commercially available is much larger than 140 MW selected by the model. The approximate length of time from contract to completion of construction is four years for a 650 MW CC unit that is commercially available." Provide an update to this response.

Also, provide an update to the response to Item 14 of Staff's First Request, which states:

> There is no expectation for existing coal-fired generation to be retired in the next two years. In the short term, power will be purchased according to guidelines specified as a participant in the Midwest ISO and then by PJM when the transfer occurs in 2012. The need for capacity on a longer term basis will be determined by mid-year 2012.

[93] Response to Item 11 of Staff's First Request.

It appears that Duke did not perform a reserve margin study. If such a study has been, or will be done, Duke should provide it in the next IRP, or clearly explain why it is not necessary to perform such a study. If Duke is required to meet PJM requirements and those suffice, provide a discussion of the reasonableness of those requirements.

SECTION 5

INTEGRATION AND PLAN OPTIMIZATION

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

THE INTEGRATION PROCESS

Duke Kentucky uses the Ventyx System Optimizer and Ventyx Planning and Risk models in developing 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 Planning and Risk model is a production costing model which simulates the operation of the electric production facilities of an electric utility.[94]

Duke Kentucky also uses the Engineering Screening Model to screen environmental compliance technology alternatives to determine the most economical, which will be reviewed for further consideration within the System Optimizer model. The screening operation of the model involves testing the economics of many various combinations of emission control equipment of each generating unit by calculating the net present value of adding emissions control technology or fuel switching.[95]

The technologies included in Duke Kentucky's quantitative analysis were listed in Table 2 in Section 4 of this report, Supply-Side Resource Assessment. Both demand response and energy efficiency programs were modeled as "bundles" that could be selected based on economics.

Duke Kentucky's integration analysis was performed over a 20-year period using the System Optimizer model. Final production costing modeling was performed using the Planning and Risk model over the same period with an additional 14 years of fixed costs and escalated production costs incorporated to better reflect end effects.[96]

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 resources required to meet a planning reserve margin of 14.5 percent and minimize long-run revenue requirements to customers.[97]

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[94] 2011 IRP at 57–58.

[95] Id. at 58–59.

[96] Id. at 61.

[97] Id.

A variety of portfolios were developed to assess the impact of various risk factors on the costs to serve Duke Kentucky's customers. For the 2011 IRP, the analyzed portfolios focused in the short term on the retirement in 2015 of Miami Fort 6 and in the longer term on the impacts of different carbon policies.[98]

SYSTEM OPTIMIZER PORTFOLIO ANALYSIS

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

1. Reference Case with Combined Cycle (RC – CC)
2. Reference Case with Combustion Turbine (RC – CT)
3. Clean Energy Standard with Combined Cycle (CES – CC)
4. Clean Energy Standard with Nuclear and Combined Cycle (CES – NUC)

The two reference case scenarios considered potential climate change legislation with CO_2 costs starting in 2016. Duke Kentucky used CO_2 prices in the lower range of prices estimated to result from climate change legislation proposed in Congress in recent years. The CES scenarios assumed that 10 percent of sales must come from clean energy resources in 2015, with a one percent annual increase, to 30 percent by 2030.[99]

SENSITIVITY ANALYSES

Within the development of the plan, sensitivity analyses performed represented the highest risks going forward. In the RC cases, the sensitivities were:

1. High and low load forecasts
2. High and low fuel prices
3. Higher CO_2 prices and no CO_2 costs
4. Increased energy efficiency and no energy efficiency
5. No renewables and high solar generation
6. Sale power into the market[100]

In each of the four scenarios, additional gas-fired generation, either a 140 MW CT or 140 MW of CC capacity, would be added in 2015 to replace Miami Fort 6. Under the CES scenarios, an additional capacity increment of 35 MW would be added in 2016.

[98] Id. at 62.

[99] Id. at 63.

[100] Id. at 63–64.

In all four scenarios, another 35 MW increment would be added in either 2027 or 2028. In the reference case scenarios, a final 35 MW increment was called for in 2031. The total increase in capacity in each scenario over the period 2012 – 2031, is 210 MW.[101]

The System Optimizer sensitivity analyses showed that:

- The high load forecast sensitivity causes the later capacity additions to be CT generation rather than CC generation.
- Only the low fuel cost sensitivity causes the 2016 capacity addition to be CT generation rather than CC generation.
- The high CO_2 sensitivity does not impact the generation selected while the no CO_2 sensitivity changes the selection of capacity from CC to coal-fired.
- Base and high EE sensitivities result in lower PVRRs than the no EE case.
- No renewables accelerates the long-term capacity addition from 2027 to 2022. The renewable PVRR was $87 million above the no renewable PVRR. High solar sensitivity delays the new capacity from 2027 to 2028.
- In the sensitivity with market sales plus high fuel costs a 35 MW block of nuclear capacity is selected in 2030.

QUANTITATIVE ANALYSIS – MIAMI FORT 6

This analysis evaluated whether it was cost-effective to retire Miami Fort 6 rather than retrofit it with the necessary environmental controls. During the System Optimizer evaluation, in all but one sensitivity the optimal resource replacement for Miami Fort 6 was 140 MW of CC generation in 2015.[102]

Based on the results of the Engineering Screening Model, Duke Kentucky anticipated additional controls would be required for the unit as discussed under "Supply-Side Resources" on page 21 in Section 4 of this report. Three scenarios were developed to evaluate the cost-effectiveness of installation of environmental controls as opposed to retiring Miami Fort 6 and replacing it with 140 MW of CC capacity. Retiring the unit was considered the base case, while two cases in which controls were added, one with the unit continuing to operate to 2025 and another with it operating until 2035, were the sensitivity cases. The PVRR results show that the base case was less costly than either of the control cases, in both instances by approximately $116 million. Duke Energy stated that there was significant risk that additional environmental controls, beyond those modeled in its analysis, could be required in the future.[103]

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[101] Id. at 65, Table 8-B.

[102] Id. at 67.

[103] Id. at 68.

OVERALL ANALYSIS

Based on its analyses, Duke Kentucky determined that its optimal expansion plan includes meeting the need for additional capacity with CC generation rather than simple cycle CT generation. The first capacity addition after 2015 will not be until 2027 if anticipated demand-side and renewable energy programs are implemented. With the longer-term capacity addition not needed for another 15 years, there will be time to optimize the plan as future regulations develop. Continuation of DSM programs is shown to be cost-effective compared to conventional generation resources.

DISCUSSION OF REASONABLENESS

Duke Kentucky's integration process addresses an increasing number of issues being driven by changing environmental compliance rules. In addressing how to comply with these rules in a reasonable, cost-effective manner, Duke Kentucky has determined which generating units should be retired and the type of generation that will be the most cost-effective additions of capacity.

The Staff is satisfied with the way in which Duke Kentucky has approached the changes that electric utilities are facing. The Staff concludes that the overall integration and optimization approach used by Duke Kentucky is thorough, well-documented and reasonable and has no further recommendations for the Company's next IRP beyond those contained in Sections 2, 3 and 4 of this report.

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