

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC 2018 JOINT INTEGRATED)	
RESOURCE PLAN OF LOUISVILLE GAS AND)	
ELECTRIC COMPANY AND KENTUCKY)	CASE NO. 2018-00348
UTILITIES COMPANY)	

RESPONSE OF
LOUISVILLE GAS AND ELECTRIC COMPANY
AND
KENTUCKY UTILITIES COMPANY
TO COMMISSION STAFF'S SECOND REQUEST FOR INFORMATION
DATED NOVEMBER 25, 2019

FILED: DECEMBER 17, 2019

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's Second Request for Information
Dated November 25, 2019

Case No. 2018-00348

Question No. 1

Witness: David E. Huff / Stuart A. Wilson / Thomas A. Jessee / John K. Wolfe

- Q-1. Refer to the IRP, Volume 1, Section 5, page 5-2, in which LG&E/KU state, "An understanding of the way customers use electricity is critical for planning a generation, transmission, and distribution system that can reliably serve customers in every moment."
- a. Explain how the Advanced Metering Systems (AMS) in place for residential and commercial customers have impacted the ability of LG&E/KU to understand the way customers use electricity.
 - b. State whether the existing AMS data provided any insights into further segmenting customer load profiles.
 - c. State whether the existing AMS is utilized for load profile information to aid in customer load forecasting.
 - d. State whether the AMS system is part of transmission and distribution system planning. If so, explain how the AMS is utilized in transmission and distribution system planning.
- A-1.
- a. Access to interval data from the AMS Opt-In program augments the data available for general load research and sales analysis endeavors. Specific examples of analysis completed utilizing AMS opt-in data include:
 - Analysis of the economics of private solar based on forecasted private solar generation and 15-minute consumption data for AMS Opt-in customers. This analysis supports the Companies' forecast of distributed generation.
 - Analysis of different netting period options for the Solar Share program.
 - Creation of tool to determine whether a residential customer would likely benefit from switching to a residential TOD rate. Advance Meter Program participants (RS and GS customers) have access to this tool through their MyMeter portal.
 - Analysis to estimate the percentage of new and existing customers with all-electric heating. This analysis was the basis for Table 6-3 on page 6-9 in IRP Vol I.

- Snow day behavioral impact analysis. The analysis assessed the differences in use-per-customer and load profiles on snow days compared to non-snow days while controlling for weather.
 - Analysis of the number of residential customers required to approximate a smooth load shape. The analysis studied the number of customers required to create a smooth aggregate load shape as a result of load shape variability netting out. Several metrics for smoothness were studied.
 - Analysis of the degree to which customers' monthly peaks are coincident to the system and class-level peak. Additionally, the potential impact on system load was quantified in the extremely unlikely event that all customers' monthly peak occurred simultaneously.
- b. Yes. See the response to part a.
- c. See the response to part a. The analysis of the economics of private solar and the analysis to estimate the percentage of new customers with all-electric heating were used to develop the Companies' distributed generation and residential energy forecasts. To date, AMS data has not been used for load research. The Companies' load research program uses stratified random samples of residential and general service customers to ensure estimated load profiles are representative of the entire residential and general service classes. With increased AMS program participation in 2019, there may be opportunities moving forward to leverage AMS data for load research.
- d. AMS data is used as part of distribution system planning only for load allocation in models for the LG&E downtown networks. AMS is not part of transmission system planning.

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Question No. 2

Witness: Stuart A. Wilson

Q-2. Refer to the IRP, Volume 1, Section 5, page 5-4, in which LG&E/KU state, “Renewable resources have little to no fuel or emissions costs, but their availability is uncertain during peak load conditions.”

- a. Provide a list of renewable generating assets and the respective capacity value in which capacity value refers to the contributions of the power plant to reliability meet demand, expressed as a percent of nameplate capacity.
- b. Provide data that illustrates the hourly generating profile of each solar and hydroelectric generating asset in LG&E/KU’s existing resource portfolio compared to LG&E/KU’s hourly load profile. Explain how much capacity from each solar and hydroelectric facility is counted towards offsetting LG&E/KU’s peak demand requirements.

A-2. a.

Unit Name	Generator Nameplate Ratings (MW AC)	Net Capacity Rating (MW AC)		Capacity % of Nameplate	
		Winter	Summer	Winter	Summer
Brown Solar	10	0	8	0%	80%
Business Solar - Archdiocese of Louisville	0.03	0.00	0.02	0%	80%
Community Solar - Simpsonville Solar 1	0.4	0.0	0.3	0%	80%
Dix Dam 1	11.2	10.5	10.5	94%	94%
Dix Dam 2	11.2	10.5	10.5	94%	94%
Dix Dam 3	11.2	10.5	10.5	94%	94%
Ohio Falls 1	12.6	5	8	40%	64%
Ohio Falls 2	12.6	5	8	40%	64%
Ohio Falls 3	12.6	5	8	40%	64%
Ohio Falls 4	12.6	5	8	40%	64%
Ohio Falls 5	12.6	5	8	40%	64%
Ohio Falls 6	12.6	5	8	40%	64%
Ohio Falls 7	12.6	5	8	40%	64%
Ohio Falls 8	12.6	5	8	40%	64%

- b. For the capacity that is expected, on average, to be generated at the time of the Companies’ winter and summer peak loads, see the net capacity ratings shown in part (a).

- Brown Solar’s ratings are based on its historical output during high-load winter and summer hours since its in-service date in 2016.
- The Business Solar and Community Solar ratings are set equal to Brown Solar’s ratings on a percentage basis.
- Dix Dam is dispatchable but is also typically operated to maintain the water level in Herrington Lake within a target range. Its ratings are set as a function of its expected maximum net output potential at average temperature.
- Ohio Falls’ winter and summer ratings are based on historical average output in January and July, respectively, adjusted for the recently completed overhauls.

The following table shows the capacity factors of Brown Solar, Dix Dam, and Ohio Falls during the peak hour on each of the peak winter and summer days in 2018 and 2019. The subsequent charts show the Companies’ actual hourly load and the actual hourly capacity factors (“CF”) for these stations on each of these peak days. Ohio Falls’ output can be curtailed when the Ohio River’s water levels above and below the Ohio Falls dam, which are controlled by the US Army Corps of Engineers, are too high or too low. Chart 2 shows that a shutdown of Ohio Falls occurred on January 31, 2019, which was due to high water. Dix Dam is typically operated to maintain a target water level range. Chart 4 shows that a shutdown of Dix Dam occurred on August 19, 2019, which was due to low water.

Season	Peak Day	Peak Hour (Hr. Beginning)	Peak Hourly Load (MW)	Hourly Capacity Factor		
				Brown Solar	Dix Dam	Ohio Falls
Winter	1/2/2018	8	6,699	11%	89%	60%
Winter	1/31/2019	8	6,234	7%	89%	0%
Summer	7/5/2018	14	6,490	95%	92%	55%
Summer	8/19/2019	15	6,278	61%	0%	24%

Chart 1: 2018 Winter Peak Load Day - 1/2/2018
Actual Hourly Load and Renewables' Capacity Factors

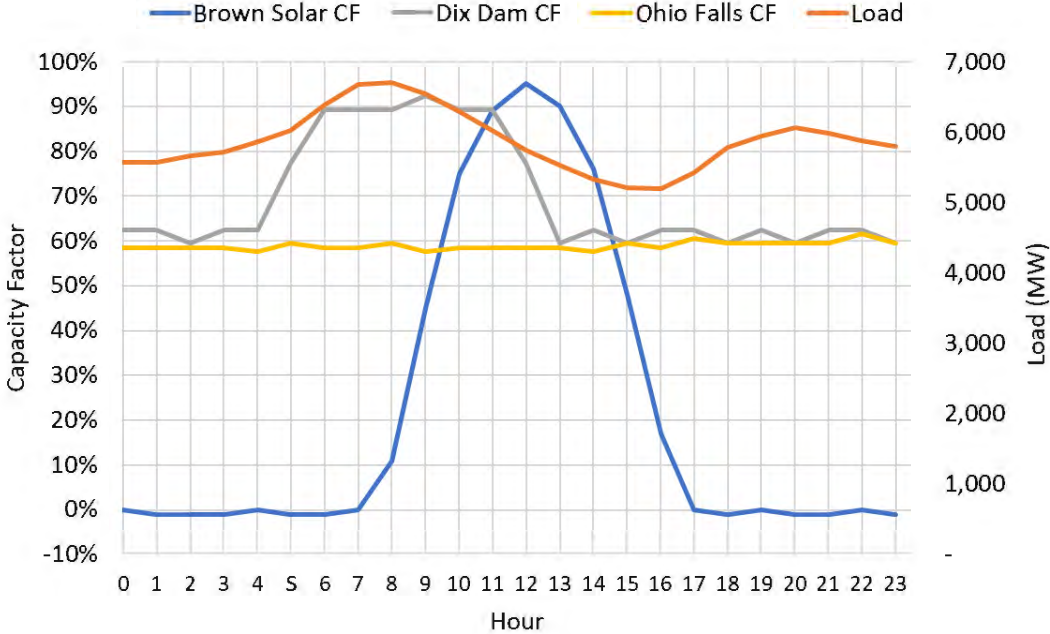


Chart 2: 2019 Winter Peak Load Day - 1/31/2019
 Actual Hourly Load and Renewables' Capacity Factors

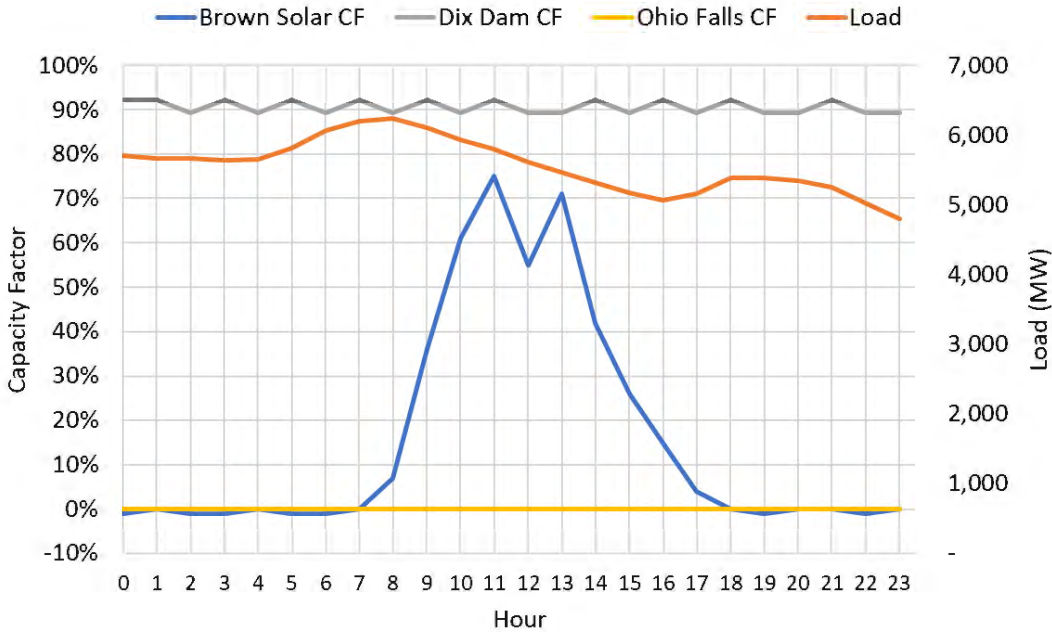


Chart 3: 2018 Summer Peak Load Day - 7/5/2018
 Actual Hourly Load and Renewables' Capacity Factors

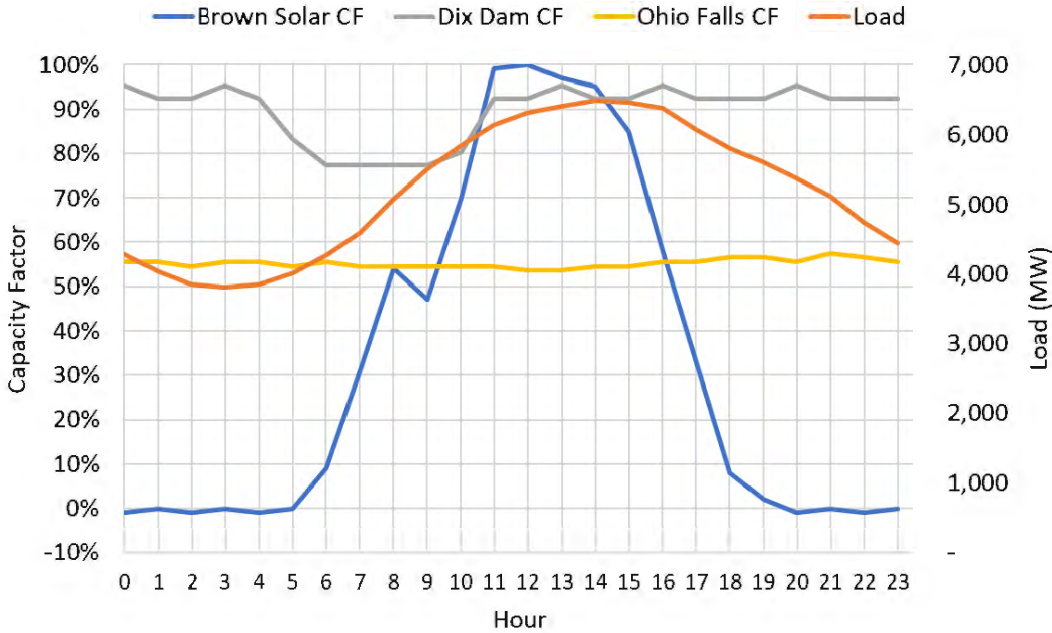
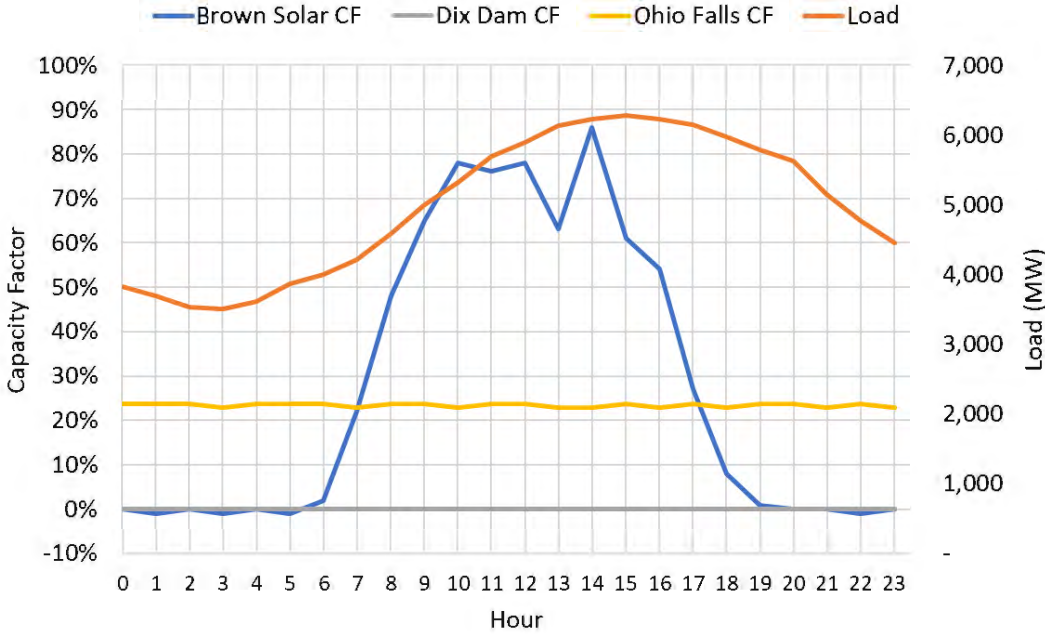


Chart 4: 2019 Summer Peak Load Day - 8/19/2019
Actual Hourly Load and Renewables' Capacity Factors



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Question No. 3

Witness: Stuart A. Wilson / Thomas A. Jessee / John K. Wolfe

- Q-3. Refer to the IRP, Volume 1, Section 5, page 5-19, in which LG&E/KU state, "A key category of risk in resource planning stems from uncertainty related to the way customers use electricity." Confirm if the Companies have strategies or plans in place to reduce this uncertainty.
- a. Confirm whether the deployment of an AMS system reduces uncertainty.
 - b. Confirm whether forecasting of Distributed Energy Resource adoption can reduce the risk in resource planning.
 - c. Confirm whether substation Supervisory Control and Data Acquisition (SCADA) systems increase visibility of the customer base to LG&E/KU.
 - d. What percentage of substations by LG&E/KU is visible to the LG&E/KU via SCADA technology?
- A-3. This statement refers to uncertainties in customer usage caused primarily by factors that are outside of the Companies' control and highlights the importance of planning a generation portfolio that can serve load over a wide range of scenarios. The Companies have already taken actions to reduce this uncertainty. For example, the Companies evaluate generation reliability based on weather in each of the past 40+ years to properly assess the likelihood of severe weather events as well as a full range of weather scenarios. In addition, the Companies contract with IHS Markit to provide economic and demographic inputs to their sales forecasts. Finally, the Companies are closely monitoring the adoption of electric vehicles and the installation of distributed generation. As discussed in the response to Question No. 1, the Companies have used AMS Opt-in data to analyze the economics of private solar and inform their forecast of distributed generation.
- a. The full deployment of AMS may improve the Companies' ability to predict customers' behavior and consumption for a particular scenario, but it will not impact the need to plan a generation portfolio that can serve load over a wide range of scenarios.
 - b. See the response to Question No. 1a and Question No. 27. The Companies already forecast Distributed Energy Resource adoption. Forecast scenarios for both electric

vehicle contributions to load as well as reductions in load from distributed generation aid in planning the generation portfolio. While current volumes are negligible, the magnitudes are likely to increase in the future. As a result, these projections have potential implications later in the forecast period.

- c. Yes, substation SCADA technologies provide increased visibility into the customer base, but at limited granularity. Substation SCADA systems enable remote and automated operation and control of substation devices and provide for collection and monitoring of real-time data on those components. Data collected by substation SCADA systems represent a real-time aggregative view of customer loads and usage characteristics; detailed customer visibility is limited or dependent on the number of customers behind each substation SCADA device. Archived substation SCADA data can be used in the planning horizon to understand system load trends and to identify and prioritize system capacity improvement investments.
- d. Currently, LG&E/KU has approximately 35% of distribution substations visible via SCADA technology. (~208 of 565). 100% of transmission substations necessitating SCADA are visible via SCADA technology.

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Question No. 4

Witness: Stuart A. Wilson

Q-4. Refer to the IRP, Volume 1, Section 5(6), page 5-40, Key Issues that Could Affect Plan Implementation:

- a. Explain how LG&E/KU's parent company, PPL Corporation, addresses climate change, including any greenhouse gas reduction goals.
- b. Explain how any strategy by PPL Corporation to reduce greenhouse gas emissions could affect LG&E/KU's IRP implementation.

A-4.

- a. On its public website, PPL makes the following statement.¹

“PPL’s voluntary corporate goal is to reduce CO₂ emissions 70 percent from 2010 levels by 2050. The company expects to achieve the reductions through a variety of actions. These include replacing Kentucky coal-fired generation over time with a mix of renewables and natural gas while meeting regulatory requirements to provide least-cost and reliable service to customers. Actions also include taking steps across PPL’s U.S. and U.K. operations to improve energy efficiency, reduce greenhouse gas emissions from substations and reduce vehicle fleet emissions.”

- b. PPL’s climate goal is entirely consistent with the scenarios presented in the Companies’ 2018 IRP as well the PPL Corporation Climate Assessment (“Climate Assessment”).² As stated in the Climate Assessment PPL’s goal is driven by least-cost planning, with retiring coal units to likely be replaced by a mix of natural gas-fired and renewable generation, which is demonstrated in the Companies’ IRP. The following excerpts from the Climate Assessment highlight this approach.

- “Under Kentucky statute (KRS 278), the KPSC is responsible for ensuring that utility rates are “fair, just and reasonable.” Historically, the KPSC has applied a “lowest reasonable cost” analysis to meet this requirement as rates are set and applications for certificates of public convenience and necessity

¹ See <https://www.pplweb.com/sustainability/climate-action/>.

² See <https://www.pplweb.com/wp-content/uploads/2017/12/Climate-Assessment-Report.pdf>.

for major construction are reviewed. To recover their costs, LG&E and KU are required to demonstrate to the KPSC that their investments are prudent and represent the lowest reasonable cost option.”³

- “Scenario 1 reflects the current regulatory regime in which carbon emissions from existing power plants may need to be addressed only if the plant undergoes a major modification resulting in a significant increase in emissions of certain other air pollutants. As LG&E and KU have no current plans to make any such major modifications, CO₂ reductions under Scenario 1 are driven not by law or environmental regulation, but by economics and technology consistent with existing Kentucky policies and regulation governing electric utility service. These policies and regulations require regulated utility generation investments to be prudent and meet the KPSC’s lowest reasonable cost standard.”⁴

³ See page 4 of the Climate Assessment.

⁴ See page 11 of the Climate Assessment.

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Question No. 5

Witness: Elizabeth J. McFarland / Stuart A. Wilson

- Q-5. Refer to the IRP, Volume 1, Section 6, and the National Renewable Energy Laboratory's published study on Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges.
- a. Identify the number of customers that have adopted behind the meter energy storage, including thermal storage.
 - b. Demonstrate where in the IRP filing LG&E/KU evaluated the demand charges for commercial and industrial customers in order to assess the potential for behind the meter storage and impacts on demand and energy requirements.
- A-5.
- a. Customers self-report on Net Metering Service, Level 1, per each company's respective Tariff Original Sheet No. 57.6. As of November 30, 2019, there are 6 net metering customers with battery storage.
 - b. The Companies have developed tools to assess the economics of behind-the-meter battery storage for peak shaving, but the impact of behind-the-meter battery storage is not explicitly included in the IRP load forecast.

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Question No. 6

Witness: Elizabeth J. McFarland / John K. Wolfe

Q-6. Refer to the IRP, Volume 1, Section 6, relating to significant changes since October 2014.

- a. Confirm whether LG&E/KU have surveyed large customers relating to the willingness to adopt energy-related technologies, sustainability plans, and long-range energy planning.
- b. Confirm whether LG&E/KU maintain a list of critical facilities for power restoration priority during an emergency event.
- c. Confirm whether LG&E/KU have evaluated the potential for emergency microgrids or other resilience projects at critical facilities.

A-6.

- a. Yes, LG&E/KU routinely survey large customers relating to their plans to adopt energy-related technologies, sustainability plans, and long-range energy planning. LG&E/KU's DSM Non-Residential Rebate Program is also experiencing an increase in the number of customers adopting energy-related technologies and participating in the program.
- b. Yes, LG&E/KU maintain a list of critical facilities for power restoration priority based on the Priority Levels defined in the Tariffs under Energy Curtailment and Service Restoration Procedures.
- c. LG&E/KU have neither evaluated the potential for, nor have been in any recent discussions with customers regarding setting up emergency microgrids or similar arrangements for critical facilities. LG&E/KU supports customer discussion and dialogue with respect to potential customer microgrid installations and resiliency projects. Additionally, LG&E/KU has created an internal working group to position the company to assist and address customer requests for information with respect to distributed energy resources (DER), including microgrids.

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Question No. 7

Witness: Stuart A. Wilson

- Q-7. Refer to the IRP Volume 1, Section 7, page 7-13, which states, "The Companies utilize survey data and direct feedback from large customers to understand usage. To further their knowledge and understanding, the Companies plan to conduct commercial surveys and continue residential surveys, ad hoc studies, and the online panel."
- a. Explain how the survey questions are devised and any stakeholder involvement in the survey creation.
 - b. Explain the survey methodology utilized for industrial and residential customers.
 - c. Provide a copy of the last survey for industrial and residential customers, including the date issued.
 - d. Summarize the survey response rate and the response results by questions for the latest industrial and residential survey completed.
- A-7.
- a. The industrial survey questions were developed by the Companies' sales forecasting group with input from Key Account Managers who support the Companies' largest customers. The survey was developed to gather information regarding significant forecasted load changes so that these changes can be appropriately reflected in the load forecast. The survey is administered to a subset of the Companies' largest customers during conversations with these customers.

The residential survey questions were originally developed by an external vendor in 2003 and have been updated as needed by the Companies' sales forecasting group. The survey now includes, for example, questions regarding LED lighting, electric vehicles, energy efficiency. The survey is administered using the LG&E and KU proprietary online panel.
 - b. See the response to part a.
 - c. See attached.

- d. In 2017, nearly 100% of the large customers who received the industrial survey agreed to provide responses. The response rate for the residential survey was 71.8%. See the attachment being provided in Excel format for the results of the 2017 survey.



PPL companies

Date:	
Major Account Manager:	
Major Account:	
Customer Contact and Title:	
Meeting Type:	In-Person <input type="checkbox"/> Phone <input type="checkbox"/>
Service Type:	Electric <input type="checkbox"/> Gas <input type="checkbox"/>

Contact Individual

Contact Title

General

Have there been any changes to expectations since we last spoke?
Have energy/demand over the past 12 months been consistent with expectations?
If not, what were the causes, timing, and impact of any deviations?
Are there any newly scheduled events/changes to build into future expectations?

Expansions / Reductions

Are there any in-progress or planned expansions?
If so, what is the expected timing, impact (energy & demand), and likelihood?



PPL companies

Are there any in-progress or planned reductions?
If so, what is the expected timing, impact (energy & demand), and likelihood?

Other

Are there any efficiency, process changes, or equipment change plans that will impact energy or demand?
If so, can you quantify the impact?
Is there anything else that will affect the forecast?
Notes:

TITLE: LG&E and KU Appliance Saturation
SAMPLE: ENTIRE LG&E AND KU COMMUNITY – filter new recruits

LAUNCH DATE: February 13, 2017
FIELD DATE: February 13-27, 2017

INVITE

[SUBJECT]

LG&E AND KU'S Customer Panel: Appliance Saturation

[BODY]

Hi [%First Name%],

Welcome back to the LG&E and KU's Online Customer Panel. We value the opinions of our customers and we're glad that you have agreed to engage with us and provide important feedback. Your input is valuable as we continue to improve the customer experience.

The topic for today's survey is home energy usage. Your feedback will help LG&E and KU better understand the current usage of our customers in order to help meet future energy needs.

This survey should take about 15 minutes of your time, and you will receive 30 points when you complete this survey.

Please click [%LinkHref("style='color:red;'", "here")%] to start the survey.

As a reminder, the points you are accumulating can be redeemed for an Amazon.com gift coupon. For every 50 points you earn you can redeem for a \$5 Amazon.com gift coupon.

We look forward to hearing from you.

Sincerely,
Wendy Wagoner

Having problems? Contact support@lge-ku-panel.com

[INCLUDE PREVIOUS BUTTON AT THE END OF EACH PAGE]

[PAGE Q1 – Q3]

Q1. How is your home primarily heated?

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, RANDOMIZE, VERTICALLY 10 ROWS, FORCE RESPONDENT TO ANSWER]

- Natural gas furnace
- Heat pump (electric) with gas furnace backup
- Heat pump (electric)
- Heat pump (geothermal)
- Electric furnace only
- Baseboard
- LP/Bottled Gas/Propane
- Other _____ **[ANCHOR, EXCLUSIVE, PLEASE SPECIFY]**

Q2. Approximately what year was your primary heating system installed? _____

[NUMERIC VERBATIM, ALLOW 4 DIGITS ie. 1998, FORCE RESPONDENT TO ANSWER]

Q3. Do you have other heating equipment that is used on a regular basis?

[MULTI-CHOICE QUESTION, RANDOMIZE, VERTICALLY 11 ROWS, FORCE RESPONDENT TO ANSWER, DO NOT SHOW RESPONDENT Q1 ANSWER IN LIST UNLESS OTHER WAS SELECTED]

- Natural gas furnace
- Heat pump (electric) with gas furnace backup
- Heat pump (electric)
- Heat pump (geothermal)
- Heat pump (mini split)
- Electric furnace only
- Baseboard
- LP/Bottled Gas/Propane
- Wood stove
- Electric space heaters
- Other _____ **[ANCHOR, PLEASE SPECIFY]**
- No other heating equipment **[ANCHOR, EXCLUSIVE]**

[END PAGE]

Q4. Do you have an air conditioner in your home?

- Yes
- No →**SKIP TO Q7**

[IF Q4=YES ASK Q5; IF Q4=NO ASK Q7]

[END PAGE]

Q5. What type of air conditioner and how many units do you have?

[MULTI-CHOICE QUESTION, NUMERIC ALLOW 1-6, 2 COLUMNS, VERTICALLY 3 ROWS, FORCE RESPONDENT TO ANSWER HOW MANY FOR EACH TYPE SELECTED]

- Central air How many _____
- Heat pump..... How many _____
- Window or wall mounted air conditioner How many _____
- Heat pump mini split How many rooms _____

[END PAGE]

Q6. [IF Q5 = CENTRAL AIR] Approximately what year was your air conditioner installed? If you have multiple units, list the approximate year of each unit. **[NUMERIC VERBATIM, ALLOW 4 DIGITS ie. 1998]**

- Year Installed Unit 1 _____
 - Year Installed Unit 2 _____ **[SHOW IF "HOW MANY" = 2]**
 - Year Installed Unit 3 _____ **[SHOW IF "HOW MANY" = 3]**
- [Etc.... LIST TO EQUAL CENTRAL AIR "HOW MANY" ANSWERED IN Q5 UP TO 6 UNITS]**

[END PAGE]

[PAGE Q7-Q9]

Q7. How is water heated in your home?

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, RANDOMIZE, VERTICALLY 5 ROWS, FORCE RESPONDENT TO ANSWER]

- Natural Gas
- Electricity
- Heat pump
- Solar
- LP/Bottled Gas/Propane
- Other _____ **[ANCHOR, EXCLUSIVE, PLEASE SPECIFY]**

Q8. What is the approximate size of your water heater?

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, VERTICALLY 6 ROWS]

- Less than 30 gallons
- 30 – 39 gallons
- 40 – 49 gallons
- 50 – 59 gallons
- 60 or more
- Don't know

Q9. Approximately how old is your water heater?

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, VERTICALLY 5 ROWS]

- Less than 3 years old
- 3 to 5 years old

- 6 to 10 years old
- 11 to 15 years old
- Over 15 years old

[END PAGE]

Q10. Please indicate how many of the following items you have in your home.
 [NUMERIC QUESTION ALLOW 0-99, 4 COLUMNS, VERTICALLY 10 ROWS]

Ceiling fans	Laptop or tablet computers
Televisions (tube)	Pool pumps (summer use)
Televisions (flat screen)	Hot tubs
Televisions (LCD)	Refrigerators
Televisions (LED)	Freezers (separate unit)
Televisions (Plasma)	Microwaves
Outdoor lighting (i.e: porch non-solar yard lights)	Dishwashers
Space heaters (winter use)	Clothes washers
Dehumidifiers (summer use)	Game consoles (PS3, Xbox, etc)
Desktop computers	Programmable thermostat
DVR	DVD

[END PAGE]

Q11. [IF Q10 = REFRIGERATORS >0] Approximately what year was your refrigerator installed? If you have more than one, list approximate year for each refrigerator [NUMERIC VERBATIM, ALLOW 4 DIGITS ie. 1998]

Year Installed Refrigerator 1 _____
 Year Installed Refrigerator 2 _____ [SHOW IF "HOW MANY" = 2]
 Year Installed Refrigerator 3 _____ [SHOW IF "HOW MANY" = 3]
 [Etc.... LIST TO EQUAL REFRIGERATOR "HOW MANY" ANSWERED IN Q10 UP TO 6]

[END PAGE]

[PAGE Q12-Q13]

Q12. What type of range/cooktop/oven do you cook with?
 [SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, VERTICALLY 5 ROWS, FORCE RESPONDENT TO ANSWER]

- Electric
- Natural gas
- LP/Bottled Gas/Propane
- No Range
- Other _____ [ANCHOR, PLEASE SPECIFY]

Q13. What type of clothes dryer do you use in your home?

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, VERTICALLY 5 ROWS, FORCE RESPONDENT TO ANSWER]

- Electric
- Natural gas
- LP/Bottled Gas/Propane
- No Dryer
- Other _____ **[ANCHOR, PLEASE SPECIFY]**

[END PAGE]

[PAGE Q14-Q17]

Q14. Which of the following best describes your home?

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, VERTICALLY 5 ROWS, FORCE RESPONDENT TO ANSWER]

- Single family home
- Apartment/townhouse
- Condominium
- Duplex/Fourplex
- Mobile home

Q15. Approximately how old is your home? _____ Years

[NUMERIC QUESTION, ALLOW 1-500]

Q16. What is your estimate of the total living space in your home?

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, VERTICALLY 6 ROWS]

- Under 800 square feet
- 800 to 1500 square feet
- 1501 to 2500 square feet
- 2501 to 3500 square feet
- Over 3500 square feet
- Don't know

Q17. During the past year how many people, including yourself, regularly lived in your home? _____

[NUMERIC QUESTION, ALLOW 1-99]

[END PAGE]

Q18. Please indicate which of the following you've done in the **past 12 months** to reduce energy usage.

[MULTI-CHOICE QUESTION, RANDOMIZE, VERTICALLY 9, FORCE RESPONDENT TO ANSWER]

- Adjust thermostat (lower in winter/higher in summer)
- Install programmable thermostat
- Install compact fluorescent bulbs

How many?

- Install LED bulbs How many?
- Replace an appliance for the specific purpose of increasing efficiency
- Turn off computer/lights/TV's when not being utilized
- Purchase space heaters
- Add insulation
- Have a home energy audit
- Purchased a maintenance or service plan for your heating and cooling system

[IF SELECT "INSTALL PROGRAMMABLE THERMOSTAT" ASK Q18a What type of thermostat did you purchase? [multi-select buttons]

- **Programmable**
- **Wi-Fi enabled**
- **Self-learning**
- **Don't know**
- **Other, please specify [ANCHOR]**

[IF SELECT "INSTALL COMPACT FLUORESCENT BULBS" ASK HOW MANY, NUMERIC VALUE > 1]

[IF SELECT "INSTALL LED BULBS" ASK HOW MANY, NUMERIC VALUE > 1]

[END PAGE]

Q19. Please indicate which of the following you plan to do in the **next 12 months** to reduce energy usage.

[MULTI-CHOICE QUESTION, RANDOMIZE, VERTICALLY 9, FORCE RESPONDENT TO ANSWER]

- Adjust thermostat (lower in winter/higher in summer)
- Install programmable thermostat
- Install compact fluorescent bulbs How many?
- Install LED bulbs How many?
- Replace an appliance for the specific purpose of increasing efficiency
- Turn off computer/lights/TV's when not being utilized
- Purchase space heaters
- Add insulation
- Have a home energy audit
- Purchased a maintenance or service plan for your heating and cooling system

[IF SELECT "INSTALL COMPACT FLUORESCENT BULBS" ASK HOW MANY, NUMERIC VALUE > 1]

[IF SELECT "INSTALL LED BULBS" ASK HOW MANY, NUMERIC VALUE > 1]

[END PAGE]

[PAGE Q20-Q21]

Q20. When you are home during winter months, at what temperature do you keep your home?

During the day _____degrees
 During the night _____degrees

[NUMERIC QUESTION, FORCE RESPONDENT TO ANSWER, VALUE BETWEEN 0-100 DEGREES]

Q21. When you are home during the summer months, at what temperature do you keep your home?

During the day _____degrees
 During the night _____degrees

[NUMERIC QUESTION, FORCE RESPONDENT TO ANSWER, VALUE BETWEEN 0-100 DEGREES]

[END PAGE]

Q22. When people purchase major equipment/appliances for their home, certain elements are more important to some people.

For each of the following items, please rate the importance of Energy Efficiency, Price, Appearance and Brand Name. [ALLOW ONLY ONE ANSWER PER EQUIPMENT/ATTRIBUTE QUESTION, FORCE RESPONDENT TO ANSWER ALL 16 QUESTIONS, VERTICALLY 4 ROWS]

	Energy Efficiency		
	Very Important	Somewhat Important	Not Important
Heating & cooling equipment			
Kitchen appliances (refrigerator and dishwasher)			
Laundry appliances (washer and dryer)			
Home entertainment equipment (TV, stereo, computer)			

	Price		
	Very Important	Somewhat Important	Not Important
Heating & cooling equipment			
Kitchen appliances (refrigerator and dishwasher)			
Laundry appliances (washer and dryer)			
Home entertainment equipment (TV, stereo, computer)			

	Appearance		
	Very Important	Somewhat Important	Not Important
Heating & cooling equipment			
Kitchen appliances (refrigerator and dishwasher)			
Laundry appliances (washer and dryer)			
Home entertainment equipment (TV, stereo, computer)			

	Brand name		
	Very Important	Somewhat Important	Not Important
Heating & cooling equipment			
Kitchen appliances (refrigerator and dishwasher)			
Laundry appliances (washer and dryer)			
Home entertainment equipment (TV, stereo, computer)			

[END PAGE]

Q23. Please indicate which of the following you currently own. **[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER , VERTICALLY 3 ROWS, FORCE RESPONDENT TO ANSWER]**

- Hybrid plug-in electric vehicle
- All-electric plug-in vehicle
- None of the above

Q24. Are you planning to purchase a hybrid plug-in electric vehicle or all-electric vehicle in the next 12 months, assuming similar pricing and technology as today? **[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, VERTICALLY 3 ROWS, FORCE RESPONDENT TO ANSWER]**

- Yes
- No

[TEXT]

[END]

That concludes this month's survey. Thank you for your participation. You earned 30 points for completing this survey.

Be sure to look for your next survey invitation in March. As a reminder, you can check your points and redeem them by logging into www.lge-ku-panel.com

Thank you.

[INCLUDE FINISH BUTTON THAT AUTOMATICALLY REDIRECTS TO www.lge-ku.com]

TERMINATE

Online Panel Survey: Heating and Cooling Source Appliance Survey

Internal Client: Patrick Kennedy

Tester Name: _____

Testing Completed: _____

Test Instructions: *Ensure all wording matches exactly matches the text as written below. Go through survey multiple times testing with different responses to each question. Print a copy of the questionnaire and check all of the combinations you test.*

If you find an error, take a screen shot and place it into a MS-Word document and document the exact scenario you tested that produced the error.

[TEXT TO BE INCORPORATED ON INVITES] Welcome to the first survey in *Energizing Conversations* forum! Thank you again for agreeing to be a member. We value the opinions of our customers and we're glad that you have agreed to engage with us and provide important feedback. Your input is valuable as we continue to improve the customer experience.

In this survey we would like to learn a little more about the types of different heating and cooling sources and appliances our customers use. Your feedback will help LG&E, KU and ODP better understand the current usage of our customers in order to help meet future energy needs.

This survey should take about 10 minutes of your time. As a reminder, each time you complete a survey, your name will be entered into the monthly sweepstakes drawing to win one (1) of ten (10) Amazon gifts cards worth \$50.

We look forward to hearing from you.

Sincerely,
Elizabeth Siebert
Manager, Marketing

Having technical problems? Contact support@energizingconversations.com

All other questions contact marketing@lge-ku.com

[TEXT FOR LANDING PAGE] In this survey we would like to learn a little more about the types of different heating and cooling sources and appliances our customers use. Your feedback will help LG&E, KU and ODP better understand the current usage of our customers in order to help meet future energy needs.

Please click the "Continue" button to get started.

Q1. About how many square feet of living space does your residence contain (excluding garages, attics and basements not used for living quarters)?

Please select one.

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, FORCE RESPONDENT TO ANSWER]

Tester Instructions: *Ensure you can only select one response and you cannot move to the next question unless you select an answer.*

1. Under 1,000 sq. ft.
2. 1,000 – 1,499 sq. ft.
3. 1,500 – 1,999 sq. ft.
4. 2,000 – 2,499 sq. ft.
5. 2,500 – 2,999 sq. ft.
6. 3,000 or more sq. ft.
7. Don't know

Q2. How is your home primarily heated?

Please select one.

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, RANDOMIZE, FORCE RESPONDENT TO ANSWER]

Tester Instructions:

- *Ensure you can only select one response and you cannot move to the next question unless you select an answer.*
- *Test multiple times to ensure response list is not in the same order each time and the 'Other' response is ALWAYS the last response in the list.*
- *Ensure if "heat pump" is selected question #3 appears next*
- *Ensure if "heat pump" is not selected question #4 appears next*

1. Natural gas furnace
2. Electric furnace
3. Heat pump
4. Baseboard
5. Wood stove
6. Electric space heaters
7. LP/Bottled Gas/Propane
8. Other **[ANCHOR, DISPLAY TEXT BOX]**

[IF Q2=Heat Pump, ASK Q3. ALL OTHERS SKIP TO Q4]

Q3. Please specify the type of heat pump used to primarily heat your home.

Please select one.

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, RANDOMIZE, FORCE RESPONDENT TO ANSWER]

Tester Instructions:

- *Ensure you can only select one response and you cannot move to the next question unless you select an answer.*
 - *Test multiple times to ensure response list is not in the same order each time and the ‘Don’t know’ response is ALWAYS the last response in the list.*
1. Heat pump with gas furnace backup
 2. Heat pump with electric furnace backup
 3. Heat pump with no furnace backup
 4. Don’t know **[ANCHOR]**

Q4. Approximately what year was your primary heating system installed?

Please enter a 4-digit year in the box below (e.g. 2018)

[NUMERIC; 4 DIGITS; RANGE: 1900-2018; FORCE RESPONDENT TO ANSWER]

Tester Instructions:

- *Ensure you can only input a 4 digit number into the text box between 1900 and 2018.*
- *Ensure you are not allowed to enter in a 4 digit number and select don’t know.*
- *Ensure you do not move to the next question unless you select answer.*

Don’t know **[EXCLUSIVE]**

Q5. Do you have other heating equipment that is used on a regular basis?

Please select all that apply.

[MULTI-CHOICE QUESTION, FORCE RESPONDENT TO ANSWER]

Tester Instructions:

- *Ensure you can select multiple responses, you cannot move to the next question unless you select an answer.*
- *Ensure if you select don't know or none of the above you cannot select anything else.*
- *Ensure if "heat pump" is selected question #6 appears next*
- *Ensure if "heat pump" is not selected question #7 appears next*

1. Natural gas furnace
2. Electric furnace
3. Heat pump
4. Baseboard
5. Wood stove
6. Electric space heaters
7. LP/Bottled Gas/Propane
8. Other **[DISPLAY TEXT BOX]**
9. Don't know **[EXCLUSIVE]**
10. None of the above **[EXCLUSIVE]**

[IF Q5=3 (Heat Pump), ASK Q6. ALL OTHERS SKIP TO Q7]

Q6. Please specify the type of heat pump used on a regular basis.

Please select one.

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, RANDOMIZE, FORCE RESPONDENT TO ANSWER]

Tester Instructions:

- *Ensure you can only select one response and you cannot move to the next question unless you select an answer.*
- *Test multiple times to ensure response list is not in the same order each time and the 'Don't know' response is ALWAYS the last response in the list.*

1. Heat pump with gas furnace backup
2. Heat pump with electric furnace backup
3. Heat pump with no furnace backup
4. Don't know **[ANCHOR]**

Q7. Do you have an air conditioner in your home?

Please select one.

[SINGLE-CHOICE QUESTION ALLOW ONLY ONE ANSWER, FORCE RESPONDENT TO ANSWER]

Tester Instructions:

- *Ensure you can only select one response and you cannot move to the next question unless you select an answer.*
- *Ensure if “yes” is selected question #8 appears next*
- *Ensure if “no” is selected question #10 appears next*

1. Yes
2. No

[IF Q7=YES ASK Q8; ALL OTHERS GO TO Q10]

Q8. Which of the following types of air conditioners and how many units do you have?

Please select one response for each type of unit.

Central air

Number of Units **[NUMERIC TEXT BOX; RANGE 1-6]**

Do not have this type of unit **[EXCLUSIVE]**

Heat pump

Number of Units **[NUMERIC TEXT BOX; RANGE 1-6]**

Do not have this type of unit **[EXCLUSIVE]**

Window or wall mounted air conditioner

Number of Units **[NUMERIC TEXT BOX; RANGE 1-6]**

Do not have this type of unit **[EXCLUSIVE]**

Heat pump mini split

Number of Units **[NUMERIC TEXT BOX; RANGE 1-6]**

Do not have this type of unit **[EXCLUSIVE]**

IF ‘DO NOT HAVE THIS TYPE OF UNIT’ SELECTED FOR ALL TYPES SKIP TO Q10; FORCE AN ANSWER FOR EACH TYPE]

Tester Instructions:

- Ensure you enter in a numeric response ranging only from 1-6 for each type.
- If you select 'do not have this type of unit' then you should not be able to enter in a numeric value
- Ensure that you must select the number of units or do not have this type of unit before you can proceed to the next question.
- Ensure if you enter a number of air conditioning units question #9 appears next.
- Ensure the number of air conditioning units entered match the number of unit install lines in question #9.
- Ensure if you select "do not have this type of unit" for any air conditioning unit that question #10 appears next.

Q9. Approximately what year was your air conditioner installed? If you have multiple units, list the approximate year of each unit.

Please select one response for each unit shown.

[DISPLAY EACH TYPE OF UNIT SELECTED IN Q8; FORCE AN ANSWER FOR EACH TYPE]

Central air

[LIST TO EQUAL 'NUMBER OF UNITS' ANSWERED IN Q8; UP TO 6 UNITS]

Unit #1

Year Installed: **[NUMERIC TEXT BOX; RANGE 1900-2018]**

Don't know **[EXCLUSIVE]**

Heat pump

[LIST TO EQUAL 'NUMBER OF UNITS' ANSWERED IN Q8; UP TO 6 UNITS]

Unit #1

Year Installed: **[NUMERIC TEXT BOX; RANGE 1900-2018]**

Don't know **[EXCLUSIVE]**

Window or wall mounted air conditioner

[LIST TO EQUAL 'NUMBER OF UNITS' ANSWERED IN Q8; UP TO 6 UNITS]

Unit #1

Year Installed: **[NUMERIC TEXT BOX; 4-DIGIT; RANGE 1900-2018]**

Don't know **[EXCLUSIVE]**

Heat pump mini split

[LIST TO EQUAL 'NUMBER OF UNITS' ANSWERED IN Q8; UP TO 6 UNITS]

Unit #1

__ Year Installed: **[NUMERIC TEXT BOX; 4-DIGIT; RANGE 1900-2018]**

__ Don't know **[EXCLUSIVE]**

Tester Instructions:

- *Ensure the number of units that appear equals the number of air conditioning units entered in question #8*
- *Ensure the type of units that appear equals the types of air conditioning units selected in question #8*
- *Ensure you can only input a 4-digit number into the Year Installed box between 1900 and 2018 and you are not able to enter a Year Installed and Don't Know.*
- *If you select 'do not have this type of unit' then you should not be able to enter in a numeric value*
- *Ensure that you must enter the "year installed" or "don't know" before you can proceed to the next question.*

Q10. Does your household own any of the following appliances? And which, if any, of the following appliances are high efficiency?

[ALLOW ONLY ONE ANSWER PER APPLIANCE QUESTION, FORCE RESPONDENT TO ANSWER ALL 6 QUESTIONS]

Tester Instructions:

- *Ensure you can only select one response in each row and you cannot move to the next question unless there is a response for ALL appliances in the row.*

[COLUMNS:]

Yes, not high efficiency

Yes, high efficiency

No

Don't know

[ROWS:]

Clothes dryer

Clothes washer

Dishwasher

Refrigerator

Water heater

[TEXT END PAGE] Thank you for your invaluable feedback in this important survey. Your name will be entered into the monthly sweepstakes drawing for a chance to win one (1) of ten (10) \$50 Amazon gift cards. The drawing for the monthly sweepstakes will be approximately a week after the close of the survey. The winners will be posted on energizingconversations.com.

Be sure to look for your next survey invitation in October.

Thank you!

[INCLUDE FINISH BUTTON THAT AUTOMATICALLY REDIRECTS TO www.lge-ku.com/energy-efficiency-tips]

Tester Instructions:

- *Ensure you are redirected to the LG&E and KU corporate website to the EE tips landing page.*

The attachment 7(d) is
being provided in a
separate file in Excel
format.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 8

Witness: John K. Wolfe

- Q-8. Refer to the IRP, Volume 1, Section 8, page 8-5, in which LG&E/KU state, "The distribution system has been enhanced over the years through the construction and enhancement of substation and distribution lines, as well as the integration of modern technology to meet growing customer loads and to improve service reliability and quality."
- a. Explain in detail LG&E/KU's distribution system.
 - b. Confirm that "to meet growing customer loads" is one driver for distribution system enhancements and, if applicable, explain which customer load growth is driving distribution system enhancements.
 - c. Detail the number of Circuits Identified for Improvement segmented by company and how many circuits, segmented by company, have been completed since the 2014 IRP.
 - d. Detail the number of Customers with Multiple Interruptions and planned improvements for those customers.
 - e. Explain what "modern technology" has been integrated into the distribution system and how this is contributing to improved service reliability and quality.
- A-8.
- a. The LG&E/KU electric distribution system serves a total of approximately 941,400 customers in 79 Kentucky counties. Electric distribution facilities in Kentucky include a total of 521 substations (87 of which are shared with transmission), 16,789 miles of overhead electric lines and 5,089 miles of underground electric lines.
 - b. Yes, customer load growth is one driver for distribution system enhancements. Load growth for all customer types continues to occur in developing and revitalized communities, primarily stimulated by customer movement from rural to more urban service areas and new customer load.
 - c. From 2014 through 2018, 61 and 70 CIFI circuits have been identified and completed by LG&E and KU, respectively.

- d. Within the Companies' CEMI program, investments are generally made to improve system coordination, sectionalization, and harden circuits in order to reduce the frequency and duration of potential outages for customers experiencing six or more outages annually. The Companies also routinely monitor recurring outages on devices to prevent potential future repeating interruptions.

At the beginning of the program in 2010, nearly 18,000 customers experienced six or more interruptions. In 2018, 11,500 customers experienced six or more interruptions—a 36% decrease in total CEMI customers.

- e. See the response to Question No. 12 a and c.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 9

Witness: John K. Wolfe

- Q-9. Refer to the IRP, Volume 1, Section 8, page 8-5, in which LG&E/KU state, "Loading data and other system information is used to develop a joint ten-year plan for major capacity enhancements necessary to address load growth and improve system performance."
- a. Provide a copy of the most recent joint ten-year plan.
 - b. Confirm whether the deployment of AMS is a component of the joint ten-year plan.
 - c. Explain how LG&E/KU measure distribution system performance.
 - d. Explain how the distribution system is performing according to the performance metrics identified.
 - e. Explain the expected improvement in distribution system performance in relation to the most recent ten-year plan.
- A-9.
- a. See attached.
 - b. AMS data is used as part of distribution system planning only for load allocation in models for the LG&E downtown networks.
 - c. The Companies measure distribution system performance through monitoring and reporting on reliability performance metrics such as distribution SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index). Distribution SAIDI measures the average electric service interruption duration in minutes per customer for the specified period and distribution system. Distribution SAIFI measures the average electric service interruption frequency per customer for the specified period and distribution system.
 - d. In 2018, the Companies' combined distribution system SAIDI was 88.8 total minutes per customer. Combined distribution system SAIFI was 0.820 total interruptions per customer. These results continued to rank the Companies in the first or second quartile for reliability performance when compared with peer utilities.

- e. Distribution Automation is expected to result in fewer outages and faster restoration times for customers. The estimated benefits upon program completion are a 12% improvement in distribution system SAIDI and an 18% improvement in distribution system SAIFI. Proactive replacement of aging infrastructure will maintain reliable service and advance distribution system operations. See the response to Question No. 10 b.

LG&E Summer Load Forecast

KU Summer Load Forecast

LG&E Winter Load Forecast

KU Winter Load Forecast

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 10

Witness: John K. Wolfe

Q-10. Refer to the IRP, Volume 1, Section 8, page 8-5, in which LG&E/KU state, "The Companies have completed projects to install, upgrade, or replace distribution substation transformer in the Companies service territories to serve new customers and improve service reliability."

- a. Explain what projects have been completed and are planned relating to distribution substation transformers.
- b. Explain SCADA functionality and benefits, including SCADA status of LG&E/KU's distribution substations.
- c. Explain what capital investments have been made are forecasted for LG&E/KU's substations.

A-10.

- a. In years 2018 and 2019, LG&E-KU will have invested \$40M in distribution substation transformer installations and purchases. Per the LG&E-KU business planning process (years 2020 through 2023), the Companies will further invest \$85M for distribution substation transformer installations and purchases. This six-year period will provide for a combined installation of 33 distribution substation transformers.
- b. Supervisory Control and Data Acquisition (SCADA) enables LG&E/KU system operators ability to centrally monitor and operate substation and distribution/transmission line equipment remotely. It is considered "good utility practice" for electrical system grid operators to deploy SCADA technology to manage the electrical system infrastructure, protect the public, and minimize customer exposure to outages. Substation SCADA benefits include more efficient operations providing system operators with instant status of circuit breaker operations, faults, and alarms, enabling remote and rapid response to reroute power and to direct responding crews. Another key safety benefit of SCADA is supporting first responders (911 calls) in securing power during times of emergencies and weather extremes.

LG&E/KU has 565 distributions substations; 208 have SCADA capability.

- c. In years 2018 and 2019, LG&E-KU will have invested \$85.4M in distribution substation assets to replace aging infrastructure, improve service reliability and to meet customer needs. The current LG&E-KU business plan (years 2020 through 2023) identifies another \$185M in distribution substation capital investments in support of continued asset management strategies.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff’s Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 11

Witness: John K. Wolfe / Stuart A. Wilson

Q-11. Refer to the IRP, Volume 1, Section 8, and Case No. 2018-00295, Exhibit LEB-5, the Distribution Reliability & Resiliency Improvement Program.

- a. Explain how the Distribution Reliability & Resiliency Improvement Program is incorporated into the Integrated Resource Planning process.
- b. Detail the forecasted capital investment by year in the distribution system and total distribution system expenses by year, specifically comparing distribution system investments and expenses to other capital investment and expenses within LG&E/KU.
- c. Explain the changes to the Distribution Reliability & Resiliency Improvement Program since the 2014 IRP.

A-11.

- a. The Distribution Reliability and Resiliency Improvement Program (“DRRIP”) outlines the Companies’ historical and planned investments in its Distribution systems to improve service for its customers. The DRRIP does not directly tie to the IRP process, however, these investments as part of the DRRIP provide for increased availability of service and flexibility to integrate new technologies such as Distributed Energy Resources and Electric Vehicles. This aligns with the IRP process which does not assume any distribution system barriers to these technologies and assumes they are available during the assessment period.
- b. The table below includes forecasted capital investments and expenses in total for electric distribution (including but not limited to items in the DRRIP) and total LG&E/KU.

Capital Investment (\$m)	2019	2020	2021	2022	2023
Electric Distribution	284.6	266.1	270.5	227.6	237.1
LG&E/KU	1,159.4	926.1	1,013.8	744.8	732.9

Expense (\$m)	2019	2020	2021	2022	2023
Electric Distribution	77.0	78.0	80.3	81.8	83.8
LG&E/KU	759.8	774.5	804.3	830.8	834.6

- c. The primary changes to the Companies' distribution reliability and resiliency-oriented investment programs since 2014 are the addition of:
 - i. Distribution Automation – CPCN approval obtained during June 2017.
 - ii. Expansion of KU Substation SCADA – 2018.
 - iii. Accelerated Replacement of Aging Infrastructure – 2019.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 12

Witness: John K. Wolfe

- Q-12. Refer to the IRP, Volume 1, Section 8, in which LG&E/KU requested and were granted a CPCN for Distribution Automation project in 2016.
- a. Explain what distribution automation projects have been completed.
 - b. Explain how much LG&E/KU have invested to date in the project and how much is forecasted to be invested.
 - c. Explain any system reliability and performance improvements that have resulted from the project.
- A-12.
- a. Since obtaining CPCN approval in June 2017, the Companies have completed the following phases of its approved Distribution Automation (DA) program:
 - Deployment of a Distribution Supervisory Control and Data Acquisition (DSCADA) system - January 2019;
 - Deployment of a Data Acquisition Node (DAN) system - October 2019; and
 - Installation of 994 electronic reclosers on distribution lines – through October 2019.
 - b. Through October 2019, the Companies had invested \$67.6 million in the DA program with a forecasted \$112 million total investment upon project completion.
 - c. The Companies estimate DA investments enabled avoidance of 107,000 service interruptions and 24.3 million customer outage minutes through October 2019.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 13

Witness: John K. Wolfe

Q-13. Refer to the IRP, Volume 1, Section 8, relating to the Distribution System.

- a. Confirm whether LG&E/KU utilize Advanced Distribution Management System and, if applicable, the current status.
- b. Explain how ADMS aid in efficiency gains of the distribution system and improves system performance.
- c. Confirm whether ADMS has contributed to improvement in SAIDI and SAIFI of LG&E/KU's distribution system.
- d. Explain how distribution line reclosers work with ADMS and any estimated customer benefits.
- e. Illustrate any customer satisfaction improvements or savings that have resulted from distribution system enhancements.

A-13.

- a. An advanced distribution management system (ADMS) is a software platform that supports a full suite of distribution system management and optimization modules. These modules provide functionality which enables fault location analysis, fault isolation, automated service restoration, power flow, suggested switching, and feeder load management. Through October 2019, the Companies had installed the power flow, fault location, and feeder load management modules. These modules continue to be tested and are not yet being fully operationalized. Fault isolation and restoration and suggested switching modules are scheduled to be deployed during 2020.

Full operationalization and utilization of ADMS functionality is not planned to occur until after the DA program is completed.

- b. See the response to part a, above. The described functionality in ADMS enables reduced outage frequencies and durations, automatic and intelligent switch/device operations, decreased truck roles and associated costs, and improved customer communications and satisfaction.

- c. LG&E/KU's SAIDI and SAIFI performance have benefited from the avoided customer outage minutes and interruptions as discussed in response to Question No. 12 c.
- d. Distribution line reclosers improve service reliability by providing greater segmentation of distribution circuits to minimize customer exposure to permanent or transient fault conditions on the electric system. The Companies had more than 3,600-line reclosers on its electric distribution grid prior to commencing its DA program in 2017. The Companies' DA program is providing for installation of approximately 1,400 electronic, SCADA capable, reclosers. These reclosers can be remotely monitored and controlled via the Companies' DSCADA system, and ultimately will be integrated into the ADMS system. Consistent with the response part b, customers will experience fewer outages and faster restoration times.

The Companies continue to experience outstanding customer satisfaction ratings, as demonstrated in results from J.D. Power's 2019 electric residential and business customers satisfaction surveys. For the year, KU and LG&E achieved 1st and 5th rankings respectively for residential customer satisfaction, and 1st and 3rd rankings respectively for electric business customer satisfaction, for mid-sized utilities in the Midwest. Furthermore, over the past three years, residential customer satisfaction indexes for KU and LG&E improved by 51 and 43 points respectively, led primarily by gains in power quality and reliability. (Customers consistently rate power quality and reliability as the most important component of their satisfaction.) When considering these results, it's important to note that the Companies are not scheduled to complete the Distribution Automation program until 2021. ADMS functionality is expected to be deployed during 2020 but will not be fully operationalized until completion of the DA program. Moving forward, it is unlikely customers will be able to differentiate between reliability improvements resulting from DA/ADMS and reliability performance associated with the Companies' other investment and maintenance programs.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 14

Witness: John K. Wolfe

Q-14. Refer to the IRP, Volume 1, Section 8, relating to Distribution.

- a. Confirm whether LG&E/KU are aware of the Interruption Cost Estimate Calculator developed by Lawrence Berkeley National Laboratory and Nexant, Inc.
- b. Confirm whether LG&E/KU have utilized the Interruption Cost Estimate Calculator
- c. Explain how LG&E/KU ensure physical and cybersecurity of the distribution system and compliance with NERC standards.

A-14.

- a. Yes, LG&E/KU is aware of the Interruption Cost Estimate Calculator developed by Lawrence Berkeley National Laboratory and Nexant, Inc.
- b. LG&E/KU does not typically utilize this calculator. For interruption cost estimates, LG&E/KU utilize a company specific Cost of Unserved Energy value that was derived internally and is more applicable to the LG&E/KU customer base.
- c. For physical protection, LG&E/KU utilize a variety of technologies such as fencing, locks, cameras and intrusion detection systems to protect the distribution system. For cybersecurity protection, LG&E/KU utilize methods such as multi-factor authentication, firewalls, secure communication protocols, and access controls to protect the distribution system. With regard to cyber and physical security, LG&E/KU has evaluated distribution assets per NERC Reliability Standard CIP-002-5.1a and have concluded no assets apply. Distribution ensures compliance with other applicable NERC standards thru activities such as, but not limited to, annually maintaining and reviewing applicable program documents, internal training for those individuals impacted by the requirements, and internal audits of activities against compliance program documentation.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff’s Second Request for Information
Dated November 25, 2019**

Case No. 2018-00348

Question No. 15

Witness: Elizabeth J. McFarland / Stuart A. Wilson

Q15. Refer to LG&E/KU’s response to Staff’s Initial Request for Information (Response to Staff’s Initial Request), Item 7.

- a. Provide the number of Qualifying Facility (QF) interconnections by company and tariff type. Provide the total installed QF Capacity by company and tariff type.
- b. State whether LG&E/KU consider the Business Solar Program a distributed generation program. Explain how LG&E/KU identify potential customers for their Business Solar Program.
- c. Explain whether LG&E/KU have evaluated the potential of aggregated distributed generation as a reasonable resource option to address LG&E/KU’s future capacity needs.

A-15.

- a. Provided below are the number of Qualifying Facility (QF) interconnections and total installed QF Capacity by company and tariff type, as of November 1, 2019.

<u>Company</u>	<u>Tariff - Standard Rate Rider</u>	<u>Interconnections</u>	<u>Capacity - kW</u>
KU	Small Capacity Cogeneration and Small Power Production Qualifying Facilities (SQF)	9	610
KU	Large Capacity Cogeneration and Small Power Production Qualifying Facilities (LQF)	4	2,162
	Total QF Facilities at KU	13	2,772
LG&E	SQF	1	73
LG&E	LQF	3	1,191
	Total QF Facilities at LG&E	4	1,265

- b. The goal of the Business Solar Program is to provide customers that desire access to solar generation an option to meet their needs through the Companies’ offerings. The

goal of the Business Solar Program is not to create distributed generation but to provide customer options. Through the Business Service Center and Key Accounts the Companies identify customers who have renewable goals, inquire about access to renewables, or respond to our business solar educational pieces.

- c. Given the Companies' lack of a need for capacity and the relatively small amount of distributed generation, the Companies have not evaluated aggregated distributed generation's potential to be a capacity resource.

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Question No. 16

Witness: Michael P. Drake

Q-16. Refer to the Response to Staff's Initial Request, Item 24. The answers contained an inadequate level of detail to be responsive to the questions.

- a. Explain what changes have occurred in coal supply that have negatively impacted boiler slagging and precipitator performance.
- b. Explain what changes have occurred in NO_x burner modifications that have negatively impacted boiler slagging and precipitator performance.

A-16.

- a. As the coal industry consolidates and coal supply has developed in the Illinois Basin, some of the lowest cost fuels available are from the Illinois #6 seam. This high-chlorine coal is more challenging to burn as it has an increased propensity for slagging in the boiler. The high chlorine content also accelerates corrosion in the gas path, which includes the furnace and precipitator.
- b. Low NO_x burners are designed to control fuel and air mixing at each burner in order to prevent the formation of NO_x. This is accomplished through gradual, 'staged' admission of air to the flame. As the burner assembly wears over time, the control of the air and fuel mixture becomes more challenging to maintain and can lead to increased slagging. Unburned fuel from incomplete combustion negatively impacts precipitator performance. Thus, new or modified burners are installed to improve combustion control as stated in the IRP.

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Question No. 17

Witness: Stuart A. Wilson

Q-17. Refer to the Response to Staff's Initial Request, Item 35.

- a. Table 1: Resource Screening Analysis Results omits an entry under Battery Storage Variable O&M using 2019 data, but the original Table 1 lists Battery Storage Variable O&M at \$2.72/MWh using 2018 data. Explain why there is an omission using 2019 data and provide the 2019 Variable O&M data, if available.
- b. Comparing the approximate \$/kW for each generation technology in Figure 1: Generation Technology Cost Forecast to the Capital Cost \$/kW in Table 1, it appears that the capital cost for battery storage is overstated in the table. Provide a reconciliation of the apparent differences.

A-17.

- a. NREL's 2018 ATB included variable O&M at \$2.72/MWh and fixed O&M at \$9/kW-yr. for battery storage. In NREL's 2019 ATB, all battery storage operating costs were represented in fixed O&M at \$38/kW-yr.
- b. Table 1 values are in 2018 dollars, while Figure 1 is shown in 2017 dollars. The value for year 2018 in Figure 1 is \$1,484/kW in 2017 dollars. Inflating this value by 2% annually results in the value in Table 1 of \$1,514/kW in 2018 dollars.

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Question No. 18

Witness: Elizabeth J. McFarland

- Q-18. Refer to LG&E/KU's amended response to the Attorney General's Initial Request for Information (Attorney General's Initial Request), Item 3(e). Provide the total installed capacity of QF facilities for LG&E/KU compared to the total installed capacity of net metering facilities.
- A-18. As of November 30, 2019, the QF installed capacity was 4 MW and the net metering installed capacity was 6.4 MW.

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Question No. 19

Witness: Elizabeth J. McFarland

Q-19. Provide the historical growth rates in terms of installed capacity and number of interconnections within the LG&E/KU service territory for both QF facilities and net metering facilities.

A-19.

Year	<u>Net Metering</u>				<u>QF</u>			
	<u>Interconnections</u>		<u>Capacity - kW</u>		<u>Interconnections</u>		<u>Capacity - kW</u>	
	<u>Cumulative</u>	<u>Growth</u>	<u>Cumulative</u>	<u>Growth</u>	<u>Cumulative</u>	<u>Growth</u>	<u>Cumulative</u>	<u>Growth</u>
2005	1		2		0		0	
2007	5	400%	13	745%	0		0	
2008	9	80%	23	79%	0		0	
2009	27	200%	83	266%	0		0	
2010	67	148%	208	151%	0		0	
2011	127	90%	355	70%	0		0	
2012	157	24%	542	53%	4		1,171	
2013	197	25%	826	52%	4	0%	1,171	0%
2014	244	24%	1,265	53%	4	0%	1,171	0%
2015	329	35%	2,014	59%	5	25%	1,222	4%
2016	403	22%	2,548	27%	7	40%	1,545	26%
2017	481	19%	3,346	31%	9	29%	2,422	57%
2018	607	26%	4,754	42%	17	89%	4,036	67%
2019	769	27%	6,449	36%	17	0%	4,036	0%

Note: Cumulative Capacity (kW) is rounded for the table. However, for the percentage Capacity Growth, non-rounded cumulative capacity by year was used.

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Question No. 20

Witness: Stuart A. Wilson / Gary H. Revlett

- Q-20. Refer to LG&E/KU's amended response to the Attorney General's Initial Request, Item 22. If generation is reduced in Jefferson County, where will it be increased, and would that create other environmental issues?
- A-20. Any generation displaced from assets in Jefferson County will be replaced by generation from the next least cost operating unit(s) available per the Companies' dispatch process. Depending on system conditions, the replacement generation would be a mix of coal and natural gas generation. The transfer of generation to other units will not create other environmental compliance issues. As identified in response to PSC 1-28, besides the ozone marginal-non-attainment in Jefferson and surrounding counties, the Companies' operating territories are currently in attainment for all other National Ambient Air Quality Standards. If any of these standards are revised, the Companies will assess compliance strategies and communicate as appropriate. Further, the transfer of generation to other unit(s) does not qualify as a *change-in-operation* for New Source Review.

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Question No. 21

Witness: Stuart A. Wilson

- Q-21. Refer to LG&E/KU's amended response to the Attorney General's Initial Request, Item 47. Explain the large decrease in forecasted and actual off-system sales from 2018 to 2019.
- A-21. The forecasted off-system sales volumes from 2018 were developed mid-year in 2018 and consist of six months of actual data and six months of forecasted data based on what was available at that time. Off-system sales in 2018 were significantly higher than in typical years due to market opportunities for off-system sales during the extremely cold temperatures experienced in January 2018. The large decrease in both forecasted and actual off-system sales from 2018 to 2019 reflects a return to more typical winter weather conditions in 2019.

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Question No. 22

Witness: Robert M. Conroy

- Q-22. Refer to LG&E/KU's amended response to the Attorney General's Initial Request, Item 48. When will the electric bus study be completed?
- A-22. There are no plans by the collaborative members to finalize the referenced study beyond its current draft format.

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Question No. 23

Witness: Daniel K. Arbough

- Q-23. Refer to LG&E/KU's amended response to the Attorney General's Initial Request, Item 50. What impact has the change in underwriting for coal-based energy production has on the Companies' insurance rates?
- A-23. The changes have not had an impact on the Companies' insurance rates to date, and current indications are that they will not have a significant impact in the future as there are several insurers that have not indicated they will cease underwriting coal-based energy production.

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Question No. 24

Witness: Thomas A. Jessee

- Q-24. Refer to LG&E/KU's response to the Attorney General's Initial Request, Item 53. Provide updates to this case throughout this proceeding.
- A-24. On November 8, 2019, the Kentucky Municipals filed a "Protective Petition for Review" of the March 21, 2019 and September 10, 2019 FERC Orders in the D.C. Circuit Court of Appeals. On November 12, 2019 the Companies also filed a similar appeal at the D.C. Circuit, which has now been consolidated with the Kentucky Municipals' appeal. Because the October 10, 2019 requests for rehearing are still pending, and thus the issues in the FERC decisions being appealed are not yet finally determined, the Companies have requested the D.C. Circuit to hold the appeals in abeyance. The Companies will provide further updates to this case throughout this proceeding.

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Question No. 25

Witness: Christopher M. Garrett

- Q-25. Refer to LG&E/KU's amended response to the Attorney General's Initial Request, Item 58. Explain the large decrease in fixed operations and maintenance expense (O&M), variable O&M, fuel cost and capital costs from 2018 to 2019.
- A-25. The 2019 figures represent September YTD amounts (nine months) whereas the 2018 figures represent December YTD amounts (twelve months).

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Question No. 26

Witness: Stuart A. Wilson

- Q-26. Refer to LG&E/KU's amended response to the Attorney General's Initial Request, Item 76. Explain why there were no power purchases from MISO for the years 2015 through 2018.
- A-26. MISO is generally less attractive as a source for economy power purchases due to its relatively higher transmission rates. Currently, MISO transmission rates for power purchases are \$11.00/MWh on-peak and \$5.40/MWh off-peak versus PJM's rate of \$1.29/MWh around-the-clock.

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Question No. 27

Witness: Stuart A. Wilson

- Q-27. Demonstrate where in the IRP filing LG&E/KU illustrate the combined effects of all distributed energy resource currently deployed and forecasted on LG&E/KU's demand (MW) and energy (MWh) requirements where DER includes distributed generation from net metering and non-net metering sources, demand response, and transportation electrification.
- A-27. The combined effects of these items are not presented in a single location in the IRP. The table below contains the combined effects of distributed generation and electric vehicle load.
- Distributed generation ("DG"), which includes generation from net metering customers and qualifying facilities, is discussed as a key load forecast uncertainty beginning on page 5-28 of Volume I. Figure 5-15 on page 5-29 contains base, low, and high forecasts of installed distributed solar capacity.
 - The adoption of electric vehicles ("EVs") is discussed as a key load forecasting uncertainty beginning on page 5-30 of Volume I. Figure 5-18 on page 5-32 contains base, low, and high forecasts of the number of electric vehicles in operation.
 - Demand response capabilities are provided by the Companies' Curtailable Service Rider ("CSR") and Demand Conservation Programs ("DCP"). The forecasted level of demand reductions for these programs is included in Table 5-13 on page 5-36. These programs do not have a material impact on energy requirements because they are utilized infrequently.

Year	+EV Demand (MW)	-DG Demand (MW)	Net Demand (MW)	+EV Energy (GWh)	-DG Energy (GWh)	Net Energy (GWh)
2019	1	-2	-1	7	-9	-2
2020	1	-3	-2	9	-10	-1
2021	1	-6	-5	12	-12	-1
2022	2	-6	-4	15	-15	0
2023	2	-5	-2	18	-18	0
2024	4	-7	-3	22	-21	1
2025	3	-11	-8	26	-26	0
2026	4	-11	-7	32	-35	-3
2027	4	-25	-21	39	-47	-8
2028	6	-16	-9	47	-64	-17
2029	8	-40	-32	58	-93	-35
2030	13	-33	-20	73	-122	-50
2031	9	-59	-50	92	-142	-50
2032	15	-76	-61	116	-170	-54
2033	19	-87	-68	147	-204	-58