COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC 2021 JOINT INTEGRATED RESOURCE PLAN OF LOUISVILLE GAS AND ELECTRIC COMPANY AND KENTUCKY UTILITIES COMPANY	**)** **)** **)** **)**	**CASE NO. 2021-00393**

RESPONSE OF
LOUISVILLE GAS AND ELECRIC COMPANY AND
KENTUCKY UTILITIES COMPANY TO
THE LOUISVILLE/JEFERSON COUNTY METRO GOVERNMENT'S
REQUEST FOR INFORMATION
DATED JANUARY 21, 2022

FILED: FEBRUARY 11, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **John Bevington**, being duly sworn, deposes and says that he is Director – Business and Economic Development for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

John E. Bevington
John Bevington

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 10th day of February 2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 11, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Philip A. Imber**, being duly sworn, deposes and says that he is Director – Environmental and Federal Regulatory Compliance for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

Philip A. Imber

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 9th day of February 2022.

Notary Public

Notary Public ID No. KY03967

My Commission Expires:

July 11, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Charles R. Schram**, being duly sworn, deposes and says that he is Director – Power Supply for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

Charles R. Schram

Subscribed and sworn to before me, a Notary Public in and before said County and State this 8th day of February 2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 14, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **David S. Sinclair**, being duly sworn, deposes and says that he is Vice President, Energy Supply and Analysis for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

David S. Sinclair

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 10th day of February 2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 11, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Stuart A. Wilson**, being duly sworn, deposes and says that he is Director, Energy Planning, Analysis & Forecasting for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

Stuart A. Wilson

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 10th day of February 2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 11, 2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **John K. Wolfe**, being duly sworn, deposes and says that he is Vice President, Electric Distribution for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge, and belief.

John K. Wolfe

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 9th day of February 2022.

Notary Public

Notary Public ID No. 603967

My Commission Expires:

July 14 2022

LOUISVILLE GAS AND ELECTRIC COMPANY
KENTUCKY UTILITIES COMPANY

Response to Louisville/Jefferson County Metro Government's
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Question No. 1

Responding Witness: Charles R. Schram

Q-1. Refer to the IRP, Volume I, page 5-4, regarding the maximum 4-second demand. Provide the definition of a "maximum 4-second demand" and explain why maximum 4-second demand on January 6, 2014 from 6pm to 7pm was more than 150 MW higher than the average demand during this time frame.

A-1. See the response to PSC 1-2a. The maximum 4-second demand is the maximum of 4-second demands in an hour. While it is not possible to precisely identify the causes for moment-to-moment changes in customers' energy demands, it is likely that a primary driver behind the 150 MW increase on January 6, 2014 was the extremely cold weather during the ongoing polar vortex and the resulting increase in load associated with customers' electric space heating.

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Question No. 2

Responding Witness: John Bevington / Stuart A. Wilson

Q-2. Refer to the IRP, Volume I, page 5-11, which indicates that LG&E/KU did not directly evaluate new demand-side management (DSM) programs in the IRP. Provide an explanation as to why no new DSM programs were directly considered in the IRP.

a. Also, refer to the IRP, Volume I, pages 5-40 through 5-41, in which LG&E/KU states that DSM programs were not directly evaluated but that the IRP identifies potential opportunities for new DSM programs based on data and DSM pilot programs associated with the implementation of the Advanced Metering Infrastructure project. Provide a listing of those potential new DSM programs and the types of data and pilot programs that LG&E/KU will be relying upon.

A-2. See the response to PSC 1-4a.

a. See the response to PSC 1-4b. AMI will provide hourly usage data for assessing the efficacy of potential DSM programs.

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Question No. 3

Responding Witness: Stuart A. Wilson

Q-3. Refer to the IRP, Volume I, page 5-33, regarding the increased use of electric space heating in both KU and LG&E's territories. Explain whether the companies have identified the reason(s) for the increase use of electric space heating for new customers added since 2010 and, if so, provide the reason(s).

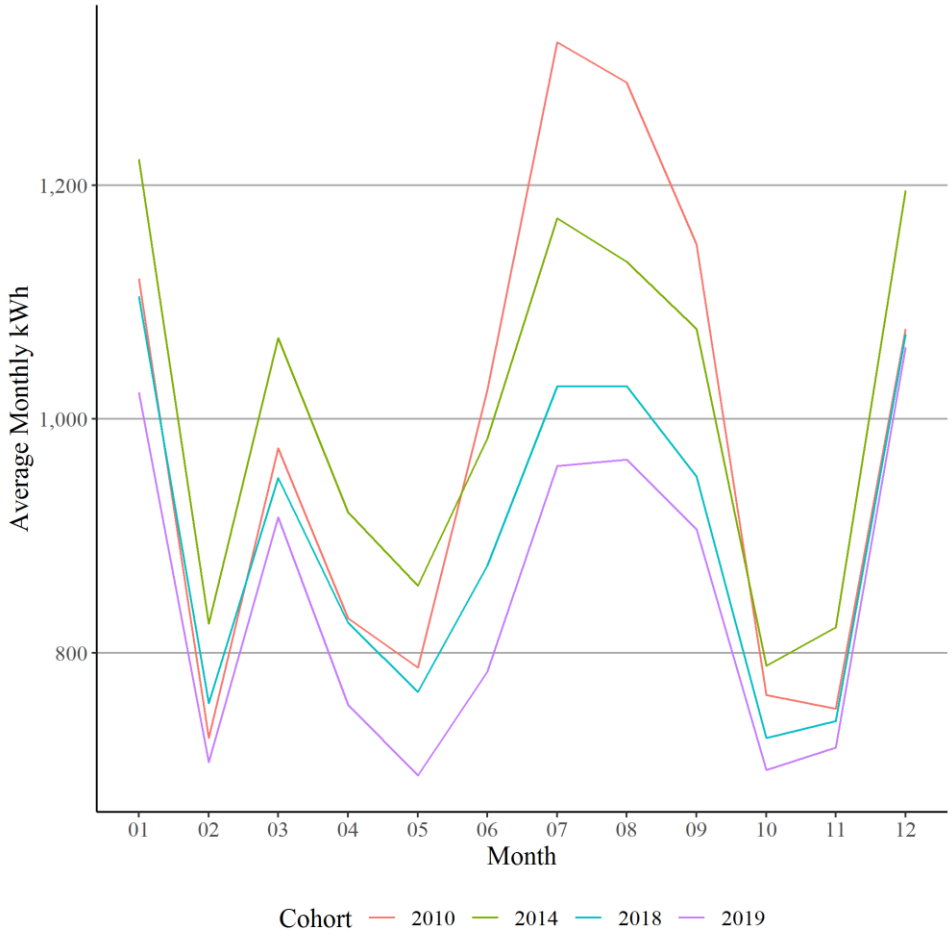
a. Also, refer to the IRP, Volume I, page 5-3, which states that the proliferation of electric space heating in conjunction with the potential for cold winter temperatures have caused the companies to experience annual peak demands to occur in the winter rather than in the summer. State whether the increase use of electric space heating has contributed significantly to LG&E/KU having an annual peak demand during the winter and, if so, explain how the increase use of electric space heating has caused the system demand to shift in light of the statement on page 5-33 that the average residential customer consumption in 2020 for customers added in 2019 is actually lower than that for customers added through 2010 (for KU 11,608 kWh vs. 13,583 kWh and for LG&E 10,108 kWh vs. 11,138 kWh).

A-3. The increased use of electric space heating for new customers is thought to be driven primarily by improvements in electric heat pump technologies which increase the efficiency of electric heating even in colder climates.

a. The increased use of electric space heating has increased the likelihood of the Companies' annual peak occurring in the winter. See the response to Question No. 1. In the Companies' high load forecast, the assumed higher levels of electric space heating account for the largest increases in winter peak demand (see Figure 5-22 on page 5-39). In this case, the annual peak occurs in the winter under normal weather conditions beginning in 2027 (see Table 5-14 on page 5-37).

The figure below compares monthly usage in 2020 for customers added through 2010 and for customers added in 2014, 2018, and 2019.[1] Compared to customers added through 2010, annual usage in 2020 for customers added in 2019 is lower primarily due to lower consumption in the summer. Because new customers have more efficient homes and appliances on average, their usage in the summer is significantly lower than customers added through 2010. However, because newer customers have a higher incidence of electric heating versus gas heating, their usage in the winter is more similar to that of customers added through 2010. In 2020, newer customers used more electricity in the winter, whereas customers added through 2010 used more electricity in the summer.

Average 2020 Use-Per-Customer by Housing Cohort



[1] Figure 5-19 on page 5-34 contains a similar comparison of 2019 usage data.

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Question No. 4

Responding Witness: Stuart A. Wilson

Q-4. Refer to the IRP, Volume I, page 5-41, which states that fixed operating and maintenance (O&M) costs have increased significantly from the 2018 IRP for all evaluated technologies with the exception of wind resources. Identify the various items that makeup the fixed O&M costs and explain reason(s) for fixed O&M costs increasing significantly for all evaluated technologies, except for wind resources, since the 2018 IRP.

A-4. The Companies utilized NREL's 2018 ATB for the 2018 IRP and the 2021 ATB for the 2021 IRP. In general, as NREL includes in its online documentation of its ATBs, fixed O&M costs represent the annual fixed expenditures required to operate and maintain a resource over its lifetime, and include components such as labor (operations, maintenance, supervision, and administrative labor) as well as annual property taxes and insurance costs. For battery storage, fixed O&M costs also include augmentation costs needed to keep the battery system operating at rated capacity for its lifetime.[2] See the response to PSC 1-42, part (b) for a table showing fixed O&M assumptions from NREL's 2018-2021 ATBs in 2022 nominal dollars. NREL does not provide an explanation of changes from one ATB to the next.

[2] https://atb.nrel.gov/

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Question No. 5

Responding Witness: John Bevington

Q-5. Refer to the IRP, Volume I, Tables 6-4 and 6-5. For the 2018 IRP, DSM was projected to reduce summer peak demand between 236 MW and 247 MW. For the 2021 IRP, DSM was projected to reduce summer peak demand between 294 MW and 311 MW. Explain the increase in the projected peak demand savings associated with DSM programs in the 2021 IRP as compared to the 2018 IRP.

A-5. The reason for the increase between IRP Plans is the result of greater than expected demand reductions due to higher customer participation for the Nonresidential Rebates Program between 2018 and 2021 coupled with fewer than expected requested removals of devices in the Residential and Small Nonresidential Demand Conservation Program. The 2019-2025 Filed DSM Plan assumed an annual reduction of approximately 5% of devices per year because of reduced customer incentives and limited communications about the program.

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Question No. 6

Responding Witness: Philip A. Imber

Q-6. Refer to the IRP, Volume I, page 6-9, regarding the Revised Cross State Air Pollution Rule, which significantly reduced the nitrogen oxide allowances issued to electric generating units in Kentucky. Provide in more detail what is meant by the statement that "[t]he reduced allocation of allowances may result in the replacement of the Companies' non-SCR-equipped units" and identify the cost impact of this compliance measure.

A-6. The Companies received a set number of "Group 3" NOx allowance allocations under the 2021 Revised Cross State Air Pollution Rule Update, a compliance mechanism for the 2008 Ozone NAAQS. At the time of this response, an analysis of those Group 3 allocations and future expected operation of affected Company units indicates the allocations are sufficient to meet operational needs under normal weather and system conditions. The Companies are planning no reduction/replacement of the Companies' existing units beyond those retirements/additions mentioned elsewhere in the IRP.

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Question No. 7

Responding Witness: Philip A. Imber

Q-7. Refer to the IRP, Volume I, pages 6-9 through 6-10, regarding the National Ambient Air Quality Standards (NAAQS) for ozone and PM2.5. State whether the status for the 2015 Ozone NAAQS for Jefferson County was reclassified from marginal non-attainment to moderate non-attainment, as stated in the IRP.

A-7. As of the date of this response, EPA has not published a redesignation/reclassification of the Louisville KY-IN marginal nonattainment area for the 2015 ozone NAAQS to a moderate nonattainment area.

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Question No. 8

Responding Witness: Philip A. Imber

Q-8. Refer to the IRP, Volume I, page 6-12, regarding environmental justice issues. The IRP states that "[a]lthough not actively utilizing the EPA's EJ Screen, the Companies consider environmental and economic factors in assessing and planning development activity." Identify the factors that are considered by the U.S. EPA's environmental justice screening tool and state whether LG&E/KU's consideration of environmental and economic factors are reflective with those factors that are evaluated by the U.S. EPA's environmental justice screening tool. In addition, provide some recent examples of a development activity carried out by LG&E/KU that would be consistent of the U.S. EPA's environmental justice screening tool.

A-8. The EJScreen tool includes 11 environmental indicators (e.g., National-Scale Air Toxics Assessment (NATA) air toxics cancer risk, NATA respiratory hazard index, NATA diesel PM, ozone, traffic proximity and volume) and six demographic indicators (e.g., percent low-income, percent people of color, linguistic isolation).[3] Referring to the IRP, Volume I, page 6-12, there is no prescribed guidance on data interpretation nor any defined or suggested actions to be taken based on the data provided by use of EJ Screen. Regarding the Companies' processes, first, the Companies seek to provide safe and reliable service at the lowest reasonable cost, which benefits all customers. Second, the Companies follow the LG&E and KU Energy LLC Capital and Investment Review Policy when authorizing capital projects. In support of this policy, the Companies use a Capital Evaluation Model to help evaluate and prioritize programs and projects. Further, the policy requires an Investment Proposal that addresses environmental compliance. When locating facilities, the Companies follow least-cost and reliability principles, while also considering the impact of the facilities on all communities.

Federal, state, and local laws regarding permitting, licensing, and oversight of proposed/planned projects provide all customers the meaningful opportunity to

[3] *See* https://www.epa.gov/ejscreen/what-ejscreen

provide input in the Companies' business and construction processes that affect them. Regulatory agencies provide numerous opportunities for public comment, participation in proceedings, and/or offering testimony at public hearings. For instance, when seeking a Certificate of Public Convenience and Necessity ("CPCN") in Kentucky, the CPCN proceedings provide for meaningful involvement by those affected by the project.

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Question No. 9

Responding Witness: Stuart A. Wilson

Q-9. Refer to the IRP, Volume I, page 7-13, regarding the data collected from the Brown Solar facility. Explain what risks are associated with solar facilities that are without significant geographic diversity.

A-9. The resource expansion plan for the base load, base fuel price case includes 2,100 MW of new solar. If this generation was located in one area and not distributed throughout the state, a greater portion of the generation would be susceptible to a single weather pattern (e.g., storm front), its total output would be more variable, and more dispatchable resources would be required to integrate it reliably. The IRP assumes this solar generation will be located throughout the state.

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Question No. 10

Responding Witness: Stuart A. Wilson

Q-10. Refer to the IRP, Volume I, Table 8-1 on page 8-1, which shows that the reserve margin based on summer peak demand to be 44.9 percent to 47.8 percent during the 2034-2036 time frame. State whether LG&E/KU consider this level of reserve margin to be reasonable.

A-10. Yes. With 2,100 MW of new solar generation, the Companies' need for generating capacity is shifted primarily to the winter where reserve margins are at the minimum of the target range (26 to 35 percent). See the response to AG 1-8(b). Also, refer to associated discussion with both IRP, Volume I, Figure 5-8 IRP and IRP, Volume III, Reserve Margin Analysis Figure 6. "Based on the array's average generation over the hour, between 60 and 88 percent of Brown Solar is available during peak hours. However, based on minimum generation during the hour, between 19 and 56 percent is available. Because the Companies plan generation to serve load in every moment, the distribution of minimum generation is an important consideration and reflects the intermittent nature of solar generation."

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Question No. 11

Responding Witness: Stuart A. Wilson

Q-11. Refer to the IRP, Volume I, Table 8-2 on page 8-2, which shows that the reserve margin based on winter peak demand to be 25.9 percent to 29.8 percent during the 2034-2036 time frame. State whether LG&E/KU consider this level of reserve margin to be reasonable.

A-11. Yes. See the response to Question No. 10.

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Question No. 12

Responding Witness: John K. Wolfe

Q-12. Refer to the IRP, Volume I, page 8-10, regarding the implementation of an online DER interconnection application portal. State when the companies anticipate fully implementing this online customer portal.

A-12. The Companies are planning the implementation of the online DER interconnection portal for 2023-2024.

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Question No. 13

Responding Witness: Stuart A. Wilson

Q-13. Refer to the IRP, Volume I, Table 8-4 on page 8-13, regarding the projected capacity factors of the companies' generation resources. With respect to Cane Run 7, state why its projected capacity factor in 2035 is at 72 percent.

A-13. The forecasted capacity factor for Cane Run 7 in 2035 is 72 percent because the analysis assumes an 8-week planned maintenance outage to perform a turbine overhaul, which is in addition to an unplanned and forced outage rate of 6.6%. The exact timing of this turbine overhaul may change as a function of unit starts and run hours.

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Question No. 14

Responding Witness: David S. Sinclair

Q-14. Refer to the IRP, Volume I, page 8-33, regarding the use of sheep as a vegetation management technique at the Brown Solar Station. Explain whether the companies were able to quantify any efficiencies or cost savings associated with the use of sheep as a form of vegetation management as compared to conventional vegetation management practices at the solar and also explain whether this technique could be scaled to apply to larger solar sites.

A-14. Mowing costs for E.W. Brown Solar in 2017 and 2018, when standard mowing practices were used to prevent vegetation from shading the solar panels, averaged $1,520 per acre per year. In contrast, the Companies' vegetation management research project has concluded that the on-going cost of using sheep to graze this solar site will be between $800 and $1,200 per acre per year. However, most of the cost for the grazing project is the shepherd's labor, which could vary significantly by person and with the proximity of a suitable shepherd to the solar site. In the case of this research project of E.W. Brown Solar, the Companies benefited from partnership with our neighbors at Shaker Village of Pleasant Hill, a non-profit farm within 3 miles of the solar farm. Longer distances between the solar site and the shepherd would increase mileage, labor time, and costs. Larger solar sites may reduce costs on per acre basis by allowing for lower mobilization costs and other economies of scale. The cost of the sheep, veterinary care, and fencing are relatively insignificant drivers of overall costs. While grazing drastically reduces the need for human labor, and thus costs, even with grazing, some vegetation management will still be required, either by the shepherd or facility owner, to maintain parts of the property that sheep cannot access, such as trimming the perimeter fence line, or manually removing certain plants with sharp prickles that sheep do not eat, such as thistle. In our case at E.W. Brown, our shepherd performed these tasks for us in addition to caring for the sheep. For the use of 125 to 200 sheep, the shepherd's labor, mileage, veterinary care, and other services, the Companies will pay be paying Shaker Village $30,000 per year in 2022 and 2023, to maintain 25 to 35 acres, at an average cost of $857 to $1,200 per acre. While grazing costs in 2022 and 2023 will be held constant at $30,000, the Companies have provided a range of costs per acre because the exact acreage

the sheep will be able to maintain will naturally vary with weather, the rate that grass grows, and the numbers of available sheep. For example, in a dryer summer, when grass grows slower, the sheep will be able to—and will need to—graze a larger area of land. If grass grows faster, for example in a year with more rainfall, then the volume of vegetation per acre will be increased and the acres of land the same number of sheep can maintain will be reduced. Since this is an ongoing research project, the Companies will continue to make adjustments until the optimal stocking density has been established. The Companies also are actively considering the use of sheep at other sites, including our Solar Share facility in Shelby County.

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Question No. 15

Responding Witness: David S. Sinclair

Q-15. Refer to the IRP, Volume I, page 8-34, under the Data Analytics heading. Explain in more detail the companies' study with respect to methods that can be used to increase "intermittent renewable capacity."

A-15. The Companies have conducted significant research into the limitations of intermittent renewable energy as well as the methods that can be used to increase that limit.[4] In March 2019, the Companies partnered with the University of Kentucky (UK) Power and Energy Institute of Kentucky to analyze the impact of large PV penetration on the generation and transmission system.[5] Using historical one-minute load and solar irradiance data from multiple sites distributed across the service territory, the project team developed a one-minute generation and transmission model to estimate the maximum amount of intermittent renewable energy sources the service area can sustain without the need for significant upgrades to the existing infrastructure. Methods to increase intermittent renewable capacity include retiring coal capacity and adding more agile natural gas units, which have faster ramp rates and more turndown capabilities relative to coal. In addition, diversifying renewable generation resources, i.e., including both wind and solar, also increases renewable hosting capacity. Solar and wind resources balance and complement each other since solar power works best in the summer and during the daytime, while wind power works best in the winter and at night, allowing for more renewable penetration than either resource alone. At higher costs, additional renewable penetration can be achieved by adding lithium-ion energy storage to capture excess generation, or through demand-side management to synchronize customer loads to coincide with the availability of renewable energy. Our intermittent renewable research methodology was peer reviewed and published in the journal *Energies*.[6]

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[4] "Using solar and storage to meet 100% of the electricity requirements of a distribution circuit. A case study for the LG&E Highland 1103 Circuit." December, 2019. https://lge-ku.com/sites/default/files/Using-Solar-And-Storage-Case-Study-LGE-Highland-1103-Circuit.pdf

[5] PEIK, LG&E and KU Expand Research Collaboration on Renewable Energy. July, 2020. https://www.engr.uky.edu/news/2020/07/peik-lge-and-ku-expand-research-collaboration-renewable-energy-and-smart-grid

[6] Akeyo, Oluwaseun M., Aron Patrick, and Dan M. Ionel. "Study of Renewable Energy Penetration on a Benchmark Generation and Transmission System." Energies 14, no. 1 (2021): 169.