Exhibit 1

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Report on Kentucky Power Company's 2022 Integrated Resource Plan

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Kentuckians for the Commonwealth, Kentucky Solar Energy Society, Appalachian Citizens' Law Center, and Mountain Association

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1 Summary and Introduction

1.1 Introduction

Energy Futures Group ("EFG") was asked by Kentuckians for the Commonwealth, Kentucky Solar Energy Society, Appalachian Citizens' Law Center, and Mountain Association ("Joint Intervenors") to perform a review of Kentucky Power Company's ("Kentucky Power") 2022 Integrated Resource Plan ("IRP"). The review was performed by Chelsea Hotaling, Consultant, and Stacy Sherwood, Managing Consultant. EFG is a clean energy consulting company that has two primary areas of practice. The first is in the design, implementation, and evaluation of programs and policies to promote investments in efficiency, renewable energy, other distributed resources, and strategic electrification. The second is in integrated resource planning and related analyses. EFG has performed IRP modeling and critically reviewed IRPs in over a dozen states, provinces, and territories.[1] Our work in these jurisdictions includes conducting our own simulations and/or reviewing modeling conducted using a wide variety of electric system modeling platforms including Aurora, which was used by Kentucky Power and its consultant for this IRP.

Our feedback and recommendations are intended to show how Kentucky Power can enhance future IRP processes and filings.

1.2 Kentucky Power's Preferred Plan

Kentucky Power's Preferred Plan is a combination of resource builds from the optimized portfolios along with the renewable resources from the CC Portfolio. As Kentucky Power describes its Preferred Plan:

> *The Preferred Plan pre-selects the 480 MW frame CT build identified in the optimized portfolios along with the renewable and intermittent resource selections from the CC portfolio represented by 700 MW of new wind and 800 MW of new solar, along with 50MW of storage by 2037. The Preferred Plan also includes the extension of the Big Sandy gas unit to 2041. Short-Term Market Purchases (STMP) are utilized with up to 78 MW annually through 2026 and 407 MW in 2028 to fully satisfy near-term adequacy*.[2]

In the IRP, Kentucky Power does note that an All-Source Request for Proposals ("RFP")[3] will be issued and "Depending on the results of the RFP, the Company may pursue different quantities or types of resources from those identified in the Preferred Plan.[4] As Kentucky Power outlined in its IRP,

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[1] The résumés of Ms. Hotaling and Ms. Sherwood are attached to this report as Attachments A and B.
[2] Kentucky Power 2022 Integrated Resource Plan, Volume A – Public Version, Case No. 2023-00092, at 173 (Mar. 20, 2023) ("KPCo 2022 IRP-Vol. A").
[3] Kentucky Power issued battery storage, wind, solar, and thermal RFPs on September 22, 2023. *See* Kentucky Power Co., *KPCO 2023 All Source RFP*, www.kentuckypower.com/rfp (last accessed Oct. 5, 2023).
[4] KPCo 2022 IRP-Vol. A at 175 n.48.

> *The cost of renewable generation alternatives is expected to continue to decline, providing an opportunity to increase affordable clean energy to address future electricity needs, consistent with Kentucky Power's aim of enabling a greener future. These technologies can provide a hedge against future uncertainties in fuel prices and carbon policies as they have zero carbon emissions and zero marginal costs. Renewables are likely to remain competitive against other technologies as fuel prices fluctuate*.[5]

As we will discuss in this report, there are several items that Kentucky Power should continue to evaluate before deciding whether to commit to the resources contained in the Preferred Plan.

1.3 Summary of Recommendations

Our recommendations are explained in detail in the body of the report. The following presents a high-level summary of our recommendations on the IRP:

Stakeholder Process

- Provide stakeholders with a schedule of when modeling and supporting data will be shared;
- Build time into the IRP development schedule to allow stakeholders to submit feedback on information shared;
- Schedule follow up meetings as necessary to discuss feedback that results in points of disagreement; and
- Assist with negotiating discounted, project-based licensing fees that permit interested intervenors the ability to perform their own modeling runs in the same software package(s).

Inputs and Modeling

- Update modeling to include runs in which the Ebon[6] load is removed from the load forecast;
- Include the evaluation of potential supply side DERs in future IRP filings and incorporate this as an item of discussion in the IRP stakeholder workshops;
- Evaluate multiple forecasts for DER resources that consider higher levels of DER adoption and incorporate this as an item of discussion in the IRP stakeholder workshops;
- Include modeling runs that relax annual build limits on renewable and battery storage resources;
- Apply cost increases to all resources, regardless of technology type in the modeled scenarios;

[5] *Id.* at 93–94.
[6] Case No. 2022-00387, *In the Matter of Electronic Tariff Filing of Kentucky Power Company For Approval Of A Special Contract with Ebon International, LLC*, Order (Ky. PSC Aug. 28, 2023). Kentucky Power appealed the Commission's order in this case to the Franklin County Circuit Court on September 26, 2023, Case No. 23-CI-00899, and that appeal remains pending.

- Model battery storage resources with at least a 15-year book life;
- Ensure that the full tax gross up is applied to the Production Tax Credit ("PTC") and the Investment Tax Credit ("ITC") is modeled for renewables and battery storage resources in Aurora;
- Include the potential for renewables and battery storage resources to qualify for the Energy Community bonus adder;
- Update information around the pipeline and firm gas transportation costs for any new natural gas combustion turbine ("NGCT") capacity;
- Model 8- or 10-hour lithium-ion battery storage and multiday storage resources as candidate resources;
- Evaluate higher levels for the Effective Load Carrying Capability ("ELCC") for four-hour battery storage resources to align with projections from PJM;
- Include modifications to the Portfolio Scorecard metrics;
- Evaluate the proposed greenhouse gas regulation from the Environmental Protection Agency ("EPA");
- Implement adjustments to modeling energy efficiency as a supply side resource; and
- Remove the application of the Supplemental Efficiency Adjustment ("SEA") to energy efficiency bundles modeled as a supply side resource.

Also included in the report below is a review of Kentucky Power's recent Market Potential Study ("MPS") and recommendations concerning demand side management ("DSM") programs. The DSM program recommendations particularly consider ways to serve customers who rely on electric resistance heating, live in manufactured housing, or run small businesses. We also offer observations and recommendations related to workforce development potential through energy efficiency and leveraging federal incentives created and expanded by the Inflation Reduction Act.

2 Stakeholder Process

While Kentucky's IRP rules do not contain a specific requirement for utilities to hold stakeholder meetings leading up to the filing of the IRP, we recognize that Kentucky Power has already taken steps to be ahead of their peer utilities in Kentucky by holding two stakeholder meetings for the 2022 IRP. Kentucky Power held the first stakeholder meeting on July 14, 2022, to discuss inputs and market scenarios, and the second meeting on January 25, 2023, where modeling results were presented to stakeholders.[7] We commend Kentucky Power for taking the initiative to hold these stakeholder meetings. The recommendations we offer in this section are reflective of the perspective EFG can offer on what we have learned from participating in stakeholder processes in many different jurisdictions across North America. These recommendations are made to help Kentucky Power *further* enhance the

[7] KPCo 2022 IRP-Vol. A at 17–18.

stakeholder process to foster collaboration and transparency, which will in turn, lead to a more robust IRP process.

IRPs are not a set of discrete tasks that one can repeat and perfect, but rather are a process that must evolve with changes in circumstances, technology improvements, consumer preferences, policy requirements, etc. It is crucial for IRPs to have a continuous stakeholder process where stakeholder feedback is solicited and considered for incorporation into the IRP process. Figure 1 below shows a graphic of what we believe are the three pillars – transparency, collaboration, and implementation – that are necessary components of a robust IRP stakeholder process.

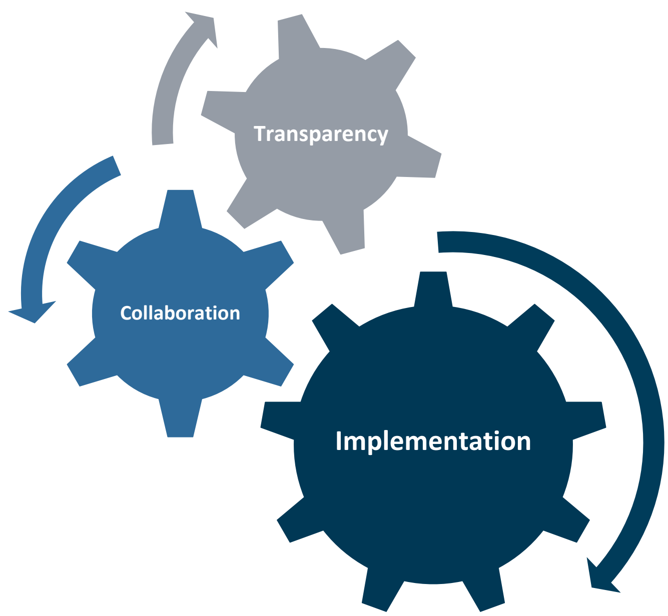

Figure 1. Three Pillars for IRP Stakeholder Process

For transparency and collaboration, we have found that the most transparent IRP processes include the following elements:

1. A process that allows for the sharing of modeling data[8] with stakeholders who sign a nondisclosure agreement ("NDA") to receive access to that information, while the IRP is still in development (and not merely after it is filed in the docket of a formal proceeding);
2. A schedule that outlines when modeling data will be released during the stakeholder process and by when feedback needs to be submitted;

[8] Modeling data such as load forecast inputs, demand side management inputs, costs and operational parameters for new and existing resources, commodity price forecasts, and the modeling input and output files.

3. A timeline that allows for stakeholders to review modeling data and provide feedback with enough time for that feedback to be incorporated into the IRP before it is finalized; and
4. Discussions between the utility and stakeholders on feedback and any potential points of disagreement.

One of the biggest barriers to a transparent and collaborative IRP process is when stakeholders do not have the opportunity to see modeling inputs or outputs prior to the filing of an IRP. When this occurs, stakeholders can only react to what information has been provided to them once an IRP has been filed and are limited in their ability to have feedback incorporated into the IRP while there still is enough time for changes to be implemented. Alternatively, when there is a process of stakeholder workshops, and provision of modeling files and supporting data with stakeholders, this means that stakeholders can be active and thorough participants. Furthermore, if time is built into the schedule for stakeholder feedback, this increases the opportunity for stakeholder feedback to be incorporated in the IRP modeling.

For example, AES Indiana implemented this approach of sharing modeling inputs and outputs with stakeholders and soliciting feedback for its last two IRPs and we found that it significantly improved the stakeholder process. Table 1 below provides an example of a timeline that a utility could share with stakeholders for the release of information.

Table 1. Example of Timeline to Release Information

Meeting	Topic
Meeting One	Load forecast Demand Side Management inputs
Meeting Two	New resource costs and operating characteristics
Meeting Three	Portfolio Scorecard Metrics Preliminary results
Meeting Four	Preferred Plan Selection

Incorporating time into the schedule for stakeholders to submit feedback also affords stakeholders with the opportunity to express their viewpoints throughout the stakeholder process. While we recognize that there will be items where there is still disagreement between the stakeholder and the utility, allowing for feedback and holding meetings where all parties involved can express their opinion helps to ensure a collaborative environment and narrow any disagreements. It also allows for a forum where there is open dialogue on feedback and each party can express their viewpoint on particular issues of concern.

An additional layer of transparency that can be incorporated into IRP processes is when utilities assist with obtaining project-based licenses which permit Commission Staff and stakeholders to conduct their own modeling runs in the same software package as the utility, at a lower price than if the stakeholders had to purchase a modeling license on their own (which many stakeholders could not afford). For example, KU and LG&E assisted the Joint Intervenors with obtaining a license to run the PLEXOS model in a pending CPCN proceeding (Case No. 2022-00402).

When all three pillars work together, this helps to ensure that an IRP can be shaped by stakeholders in important and meaningful ways, which is the objective of a stakeholder process. We acknowledge the steps that Kentucky Power has already taken to involve stakeholders in the IRP, and would offer the following recommendations to further enhance the IRP process to achieve higher levels of transparency and collaboration:

1. Provide stakeholders with a schedule of when modeling and supporting data will be shared;
2. Build time into the schedule to allow stakeholders to submit feedback on information shared;
3. Schedule follow up meetings as necessary to discuss feedback that results in points of disagreement; and
4. Assist with negotiating discounted, project-based licensing fee that permits interested intervenors the ability to perform their own modeling runs in the same software package(s).

3 Request for Proposals ("RFPs")

On September 22, 2023, Kentucky Power issued Requests for Proposals ("RFPs") for solar, wind, battery storage, and thermal resources. However, leading up to the issuance of the RFPs, Kentucky Power did not hold any stakeholder meetings to solicit feedback on the RFP. This contrasts with our experience in other jurisdictions where the utility will either share the draft RFP language with stakeholders to obtain feedback or solicit feedback through a more formal stakeholder meeting process[9] like Indiana Michigan Power's 2022 and 2023 RFPs. Although there was not a stakeholder process surrounding the RFP where stakeholders had the opportunity to provide feedback on the language of the RFP, we would offer the following items of concern regarding the RFPs:

1. Inability for stakeholders to provide feedback on the RFP process;
2. The term and duration of battery storage resources;
3. Opportunity for wind projects outside of PJM to participate;
4. Assumptions around resource accreditation;
5. The RFP language does not seem to allow for solar storage hybrid systems to be into the RFP;

[9] *See* Ind. Mich. Power, *RFP Documents and Stakeholder/Archive Documents*, https://imallsourcerfp.com/documents/ (last accessed Oct. 5, 2023).

6. The exclusion of distribution connected resources *unless* such a project has an already complete Distribution Impact Study;
7. Any AEP or KPCO affiliate proposals should be bid into the RFPs so that they are compared consistently against the same criteria when determining projects to pursue and implement; and
8. The RFPs should be overseen by an independent third-party administrator rather than AEPSC.

In the battery storage RFP, the language states that "[t]he maximum Term of the PPA shall be no more than ten (10) years. Bidder may offer Alternate Term proposals, provided the Term is no more than ten (10) years."[10] This language is concerning because it limits the bidders to one specific term for the project, which may limit the number of bidders that can submit bids in response to the RFP, as the projects may be for longer than 10 years. Furthermore, a 10-year term is also significantly shorter in duration than what EFG has seen in other RFPs conducted across North America. For example, Indiana Michigan Power's 2023 RFP included the following term for solar, wind, and battery storage resources:

> *New Wind, Solar, and Gas Projects must have a minimum design life of 30 years and Energy Storage Projects must have a minimum design life of 20 years. The design life for Supplemental Capacity Resources is technology dependent with a preference for 30 years and a minimum of 15 years*.[11]

In addition, a 10-year term for a battery storage project makes it more challenging for the battery storage project to compete financially with the other projects being bid into the RFP. The capital recovery for a 10-year battery storage project will look different than the recovery for a 15- or 20-year battery storage project. The language in the Kentucky Power RFP is concerning because it will preclude bidders with battery storage projects with lives longer than 10 years, and if they are able to modify the project, then the costs will most likely be higher if the costs are spread over 10 years instead of 15 or 20 years.[12]

It is also not clear if Kentucky Power is open to receiving bids on longer duration battery storage resources. In the Indiana Michigan Power RFP, there was specific language on duration:

> *For Bidders proposing Standalone Storage, the base proposal must include options for both a 4-hour and 6-hour storage duration. I&M recognizes that 4-hour duration is a*

[10] Am. Elec. Power Serv. Corp.as agent for Ky. Power Co., *Request for Proposals Power Purchase Agreements (PPAs) from Qualified Bidders for Battery Storage Resources*, at 5 (Sept. 22, 2023), https://www.kentuckypower.com/lib/docs/business/b2b/rfp/ky/KPCO_2023_Storage_PPA_RFP.pdf.
[11] Ind. Mich. Power Co., *2023 Indiana Michigan Power Company [All-Source] Requests for Proposals*, at 11. (Mar. 31, 2023), https://imallsourcerfp.com/wp-content/uploads/2023/04/2023-IM-All-Source-RFP-3-31-23.pdf ("2023 I&M All-Source RFP").
[12] *See infra* Sec. 4.4.2 (further discussing Battery Storage Book Life).

common standard, but also has a strong interest in 6-hour storage duration responses. I&M will also consider proposals with durations of 8 hours or longer.[13]

The RFP also appears to preclude wind projects that are located outside of the PJM footprint from bidding. The solar and wind RFP language states that "Projects must be 1) physically located in the PJM Interconnection, LLC Region[14] and interconnected to the PJM Transmission system."[15] We would recommend that Kentucky Power allow wind projects from locations that can provide firm transmission to participate in the RFP in order to ensure that no project is precluded from consideration. Ultimately, Kentucky Power may deem that projects outside of the PJM footprint are not viable, but at least they will have had the opportunity to be considered. With the RFP language written as it is, Kentucky Power will gain no knowledge of projects that may be available to submit a bid which are located outside of PJM.

The RFP also includes language around how accredited capacity of the resources will be considered:

> *Accredited Capacity shall be computed by adjusting a qualifying Proposal's applicable nameplate or contracted capacity by the expected adjustments that are used- or are expected to be used by the PJM RTO to determine the number of MW that the Company will be credited for use in meeting applicable capacity obligations. These adjustments will include, but are not limited to, summer and winter Effective Load Carrying Capability (ELCC) adjustments and forced outage rate adjustments*.[16]

It is not clear how the accreditation will be determined and what numbers might be used in the evaluation. For instance, will Kentucky Power assign the values from the IRP modeling? If there had been a stakeholder meeting, we could have had the opportunity to submit this question to Kentucky Power to receive more clarity on the accreditation assumption.

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[13] 2023 I&M All-Source RFP at 11.

[14] It is also worth noting that Kentucky Power's RFP for thermal (coal and gas) resources does *not* require that those resources be physically located in PJM to be eligible to bid into the RFP, as long as they are interconnected with PJM and have completed a PJM System Impact Study that is active in the queue. Am. Elec. Power Serv. Corp.as agent for Ky. Power Co., *Request for Proposals Power Purchase Agreements (PPAs) from Qualified Bidders for New and Existing Thermal Energy Resources*, at 4 (Sept. 22, 2023), https://www.kentuckypower.com/lib/docs/business/b2b/rfp/ky/KPCO_2023_Thermal_RFP.pdf ("RFP for Thermal Energy Resources").

[15] Am. Elec. Power Serv. Corp.as agent for Ky. Power Co., *Request for Proposals Power Purchase Agreements (PPAs) from Qualified Bidders for Solar and Wind Energy Resources*, at 5 (Sept. 22, 2023), https://www.kentuckypower.com/lib/docs/business/b2b/rfp/ky/KPCO_2023_Wind_Solar_PPA_RFP.pdf ("RFP for Solar and Wind Energy Resources").

[16] RFP for Solar and Wind Energy Resources at 12–13.

The language in the solar and battery storage RFPs also does not seem allow for respondents to bid in projects that would include solar paired with battery storage resources or the opportunity for standalone solar projects to have an option to include a battery storage resource. Such hybrid resources are a growing portion of projects in the interconnection queue and should not be excluded from the RFP process.

The RFP for wind and solar resources may have limited eligible projects by requiring distribution-connected resources to have applied for a Distribution Impact Study by no later than September 22, 2023—the same day the RFP was published:

> *3.10.2. Projects must be interconnected to KPCO's distribution electrical system and must have a completed Distribution Impact Study from the KPCO Distribution Planning Group prior to the Proposal Due Date. In addition, the application for the Distribution Impact Study shall have a utility* <u>*date and time-stamp no later than September 22, 2023*</u>.[17]

Requiring a bidder to have applied for a Distribution Impact Study by the same date the RFP was issued may unreasonably limit the potential pool of proposals, and may limit a bidders ability to develop a proposal based on Kentucky Power's stated need in the RFP. The reason for this limitation is not explained in the RFP. Considering that the RFP seeks projects to come online in January 2027 or January 2028, there should be ample time for distribution-level projects to be developed, even if their application for the Distribution Impact Study had not been received by the date the RFP was issued. This requirement risks biasing the RFP process against distribution-connected projects. In future RFPs the Company should provide respondents more time to submit this application, to enable a larger number of projects to respond to the RFP.

In the standalone storage RFP, it states that "AEPSC"[18] is administering this Request for Proposals (RFP) on behalf of KPCO Affiliates of AEP and KPCO (Affiliate) will not participate in this RFP."[19] Similar language is found in both the thermal and the solar and wind RFPs.[20] Instead of preventing bids from affiliates of AEP and KPCO, we recommend that the RFP language should have allowed for those bids to ensure that if there are any such projects that might be considered, they can be compared consistently against the same criteria when determining projects to pursue and implement. In addition, the RFPs should be overseen by a third-party administrator in order to help ensure that all resources are treated

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[17] *Id. at* 6.
[18] American Electric Power Service Corporation ("AEPSC").
[19] Am. Elec. Power Serv. Corp.as agent for Ky. Power Co., *Request for Proposals Power Purchase Agreements (PPAs) from Qualified Bidders for Battery Storage Resources*, at 3 (Sept. 22, 2023), https://www.kentuckypower.com/lib/docs/business/b2b/rfp/ky/KPCO_2023_Storage_PPA_RFP.pdf.
[20] RFP for Solar and Wind Energy Resources at 3; RFP for Thermal Energy Resources at 1.

equally and to provide potential bidders with increased assurance that the process will be fair and competitive.

4 Integrated Resource Plan Modeling

The following sections are organized around the inputs for the IRP modeling, including the load forecast, supply side resources, portfolio scorecard metrics, and how energy efficiency was modeled as a supply side resource.

4.1 Load Forecast

The load forecast is one of the major inputs into IRP modeling, as any forecasted increase in energy and capacity for Kentucky Power will drive the need to add more resources to the system. It is especially important for Kentucky Power as the Company projects that it will have a large capacity deficit in 2028 when it divests from the Mitchell coal plant.

For this IRP, Kentucky Power included the addition from Ebon, a proposed cryptocurrency customer with a load of up to 250 MW who sought to locate in the service territory to take advantage of a special contract that would approximate the Economic Development Rider ("EDR").[21] It is our understanding based on discovery responses from Kentucky Power that all modeling performed for this IRP included the Ebon load in the base load forecast. [22] Furthermore, it is possible that the load addition from Ebon included a higher level of capacity than what would have been expected as the Ebon load was modeled without including interruptible load. As Kentucky Power stated, "[a]t the time of the load forecast development, it was not known that the contract would contain interruptible provisions."[23]

As Kentucky Power discussed in its IRP, the addition from Ebon was the main driver for the growth in the commercial sales forecast:

> *Over the next 15-year period (2023-2037), Kentucky Power's service territory is expected to experience population decline at 0.6% per year and non-farm employment to decline 0.4% per year. Kentucky Power is projected to see customer count decline at a similar rate of 0.6% per year. Over the same forecast period, Kentucky Power's retail sales are projected at 0.2% growth per year with growth expected from the commercial class (+2.0% per year) while the residential and industrial classes experience decline of 0.7% and 0.2% per year, respectively, over the forecast*

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[21] *See generally* Case No. 2022-00387, *In the Matter of Electronic Tariff Filing of Kentucky Power Company for Approval Of A Special Contract with Ebon International, LLC*, Order (Ky. PSC Aug. 28, 2023).
[22] Response of Kentucky Power Company to Joint Intervenors' Supplemental Request for Information, Case No. 2023-00092, Question 11(f) (Sept. 8, 2023) ("KPCo Response to JI Q11(f)").
[23] Response of Kentucky Power Company to Commission Staff's First Request for Information, Case No. 2023-00092, Question 6(a) (June 23, 2023) ("KPCo Response to Staff Q6").

horizon. It should be noted that growth for the commercial class is fueled by a large customer addition. Finally, Kentucky Power's internal energy is projected to show little growth and peak demand is expected to decline at an average rate of 0.3% through 2037.[24]

Table 2 below shows the actual (2017 – 2021) and forecasted (2022 – 2030) commercial sales. As can be seen in the table, the forecasted growth in sales between 2023 and 2024 is 35.8%, which is driven by the inclusion of the Ebon load in the load forecast starting in 2024.

Table 2. Actual and Forecasted Commercial Sales[25]

	Year	Sales (GWh)	Growth (%)
Actual	2017	1,240	-
Actual	2018	1,276	2.9
Actual	2019	1,251	-2.0
Actual	2020	1,153	-7.8
Actual	2021	1,144	-0.7
Forecast	2022	1,213	6.0
Forecast	2023	1,220	0.6
Forecast	2024	1,657	35.8
Forecast	2025	1,654	-0.2
Forecast	2026	1,650	-0.3
Forecast	2027	1,644	-0.3
Forecast	2028	1,641	-0.2
Forecast	2029	1,637	-0.2
Forecast	2030	1,633	-0.3

By including the Ebon load in the base load forecast, and therefore in all the modeling performed for this IRP, the IRP analysis does not reflect the risk that the Ebon special contract would not be approved by the Commission and that the Ebon load would not materialize. That risk materialized when the Commission issued an Order on August 28, 2023, which denied the proposed special contract with Ebon.[26]

While Kentucky Power did include a low load forecast in its IRP modeling for the "Enhanced Carbon Regulation" scenario, the inclusion of the Ebon load would still be factored into that load forecast. In the IRP the Company stated that:

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[24] KPCo 2022 IRP-Vol. A at 16.
[25] *Id.* at 197, Ex. C-1.
[26] Case No. 2022-00387, *In the Matter of Electronic Tariff Filing of Kentucky Power Company For Approval Of A Special Contract with Ebon International, LLC*, Order (Ky. PSC Aug. 28, 2023) (on appeal to the Franklin County Circuit Court on September 26, 2023, Case No. 23-CI-00899).

When modeling, the Company always attempts to accurately account for the expected impact of customer loads. For purposes of the IRP, the Company's modeling methods would be unchanged as a result of any future load not materializing. The Company similarly does not model a scenario in which interruptible load fails to interrupt, consistent with the fact that only firm load is considered for load forecast purposes.[27]

We respectfully disagree with this position. The risk of the Ebon load not materializing should have at least been considered at a minimum as a sensitivity in the IRP modeling – particularly given the size of Ebon's load and the fact that the proposed special contract with Ebon was pending Commission approval at the time the IRP was developed – to evaluate how the resource mix might change in response to a lower load forecast.

4.2 Distributed Energy Resources ("DERs")

4.2.1 Modeling Supply Side DERs

In the IRP, Kentucky Power states that "[t]he Company evaluates Distributed Energy Resources including Energy Storage as alternatives when planning for capacity and reliability upgrades." [28] It is not clear how an evaluation of DERs to help avoid distribution system upgrades may have been incorporated into the IRP.

Other utilities are taking steps to evaluate DER as a supply side resource in their IRPs. For example, the Northern Indiana Public Service Company ("NIPSCO") evaluated Distributed Energy Resources ("DERs") in its 2021 IRP by factoring in customer sited DERs as adjustments to the load forecast and additional DERs that were modeled as supply-side options within AURORA. NIPSCO explained that this modeling change was due to market changes, including technology cost declines for solar and storage and regulation such as FERC Order 2222.[29] The excerpt below explains how NIPSCO evaluated DERs in its IRP modeling:

Specific to the potential to defer distribution system investments, NIPSCO's distribution planning team assessed near-term (within the next 5 years) system upgrade requirements across the distribution system, with an eye towards how strategically-sited generation alternatives could defer substation and other distribution system investment. As part of this process, the team identified 21 locations on the system that will require capacity improvement investments in the next five years and assessed the following for each location, ultimately identifying eight locations with generation addition opportunities:

[27] Response of Kentucky Power Company to Commission Staff's Supplemental Request for Information, Case No. 2023-00092, Question 2(a) (Sept. 8, 2023) ("KPCo Response to Staff Q").
[28] KPCo 2022 IRP-Vol. A at 81.
[29] N. Ind. Pub. Service Co. LLC, *2021 Integrated Resource Plan*, at 94 (Nov. 15, 2021) ("NIPSCO 2021 IRP").

- *Estimated distribution upgrade project cost at various locations on the system;*
- *Potential battery storage and paired solar plus storage additions that could defer the distribution upgrade, with consideration given for the availability of nearby land to site capacity;*[30] *and*
- *Estimated years of deferral of the distribution upgrade project that could be achieved with the generation addition.*

Based on each location's deferred upgrade cost, potential capacity additions, and estimated investment deferral, a NPV of deferred investment on a $/kW basis was developed for each location. NIPSCO and CRA then categorized the projects identified by the distribution planning team into High, Medium, and Low bundles of deferred distribution investment costs to allow for resource selection and economic portfolio analysis […].[31]

Table 3 below shows how the solar and battery storage DER bundles were modeled within Aurora. The NPV of the deferred distribution investment was subtracted from the capital cost of the resources to reflect the benefit of the DER bundles. When these bundles were incorporated into the modeling, about 10 MW of the DER supply side resources were selected in the model. [32]

Table 3. NIPSCO DER Bundle Characteristics[33]

Deferral Cost Bundle	Resource	Battery Storage MW	Solar MW	Range of Potential NPV of Deferred Investment ($/kW)
High	Solar + Battery	7.0	2.7	**700 – 900**
Mid	Solar + Battery	7.0	9.1	**200 – 300**
Low	Solar + Battery	2.0	2.7	**10 – 100**

We recommend that Kentucky Power include the evaluation of potential supply side DERs in future IRP filings and incorporate this as an item of discussion in the IRP stakeholder workshops.

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[30] Case No. 2023-00159, *Electronic Application of Kentucky Power Company For (1) A General Adjustment of Its Rates for Electric Service; (2) Approval of Tariffs and Riders; (3) Approval of Accounting Practices to Establish Regulatory Assets and Liabilities; (4) A Securitization Financing Order; and (5) All Other Required Approvals and Relief*, Testimony of Andy Mcdonald on Behalf of Joint Intervenors Mountain Association, Appalachian Citizens' Law Center, Kentuckians for the Commonwealth, and Kentucky Solar Energy Society, at 10–11 (Ky. PSC Oct. 2, 2023) ("McDonald Testimony").
[31] NIPSCO 2021 IRP at 95.
[32] NIPSCO 2021 IRP at 212 (Figures 9-2 & 9-3).
[33] NIPSCO 2021 IRP at 96 (Figure 4-16).

4.2.2 Modeling Customer Owned DERs

For customer owned DERs, Kentucky Power provided the forecast of DERs in Exhibit C-28[34] of the IRP, but stated that "As with electric vehicles, distributed energy resources are expected to grow but still do not have a significant impact on the load forecast."[35] When looking at the difference between the historical and forecasted DER capacity size, there seems to be a disconnect in the growth rates. On an average annual basis, the ten-year historical growth has been about 51% and the five-year average annual growth has been 63%. For the forecasted period of the IRP, Kentucky Power projects an average annual growth rate is 6%, but has not provided any explanation or basis for that projection.[36]

It is possible that the forecasted growth of DERs factored into the load forecast may be limited by the 1% net metering threshold.[37] It is important to note that the 1% threshold is not a cap that limits the utilities' ability to offer net metering as the statute says "If the cumulative generating capacity of net metering systems reaches one percent (1%) of a supplier's single hour peak load during a calendar year, the supplier shall have no further obligation to offer net metering to any new customer-generator at any subsequent time [emphasis added]."[38] In other words, utilities have the option to continue offering net metering beyond the 1% threshold. We recommend that the DER forecast included in the IRP should include scenarios in which net metering is permitted to expand beyond the 1% threshold. In addition, we recommend that Kentucky Power evaluate the impact of the policy recommendations that Witness McDonald provided in his direct testimony in the rate case.[39]

We recommend that the DER forecast be included as a discussion topic in IRP stakeholder workshops so that stakeholders can provide feedback on the forecast. In addition, Kentucky Power should evaluate multiple forecasts for DER resources that consider higher levels of DER adoption.[40]

4.3 Supply Side Resource Constraints

Table 4 below shows the annual and cumulative constraints that Kentucky Power applied to the Natural Gas Combustion Turbines ("NGCT"), battery storage, wind, solar, and solar hybrid resources offered as candidate resources for selection in the capacity expansion modeling.

[34] KPCo 2022 IRP-Vol. A, Ex. C-28, at 216.
[35] *Id.* at 53.
[36] McDonald Testimony at 12–13, 18–20.
[37] *Id.* at 12–13.
[38] KRS 278.466(1).
[39] McDonald Testimony at 17–18.
[40] *Id.* at 12–17.

Table 4. Annual and Cumulative Constraints on New Supply Side Resources

	First Year Selectable	Project Size (MW)	Annual Maximum (MW)	Cumulative Maximum (MW)
NGCT[41]	2029	240	480	720
Battery Storage, 4HRs[42]	2026	50	200	500
Onshore Wind[43]				
Tier One	End 2026	100	100	1200
Tier Two	End 2026	100	300	1200
Solar[44]				
Tier One	2026	50	150	1800
Tier Two	2026	50	300	1800
Solar plus Storage Hybrid[45]	2026	50 (3:1)	300	600

One of the recommendations that Staff made from the 2019 IRP was that "Kentucky Power should model scenarios of differing renewable constraints and no constraints on the size or addition."[46] In the narrative of the 2022 IRP, Kentucky Power responded to that recommendation and stated that:

> *Kentucky Power identified renewable build limits that were informed by resources in the PJM queue. For renewable resources such as wind and solar, annual limits were not generally demonstrated as binding in the model. The Company maintains the benefits of running a model without constraints would not provide any further insights.*[47]

We disagree with Kentucky Power's position on running the model to gain further insight. While we understand the incorporation of some build limits into the model, it is inaccurate to say that no insights can be gained from a fully optimized run where the model can optimize the selection of candidate resources without the build constraints.

For instance, in the ECR Portfolio, the model hits the annual limit of battery storage resources in 2032 when Big Sandy is not extended.[48] By not looking at a run without the 200 MW annual limit, one is

[41] KPCo 2022 IRP-Vol. A at 89.
[42] *Id.* at 92.
[43] *Id.* at 94.
[44] *Id.* at 96.
[45] *Id.* at 96.
[46] *Id.* at 113–14.
[47] *Id.*
[48] While the resource capacity addition chart for the ECR Portfolio shows Big Sandy being extended in 2031, *see* KPCo 2022 IRP-Vol. A, Exhibit E-1 at 221, we confirmed in the modeling files that Big Sandy was not actually extended in that portfolio.

unable to answer the question on what the resource build might be if the model could add a level higher than 200 MW of battery storage in 2032.

4.4 Supply Side Resource Costs

4.4.1 Asymmetry in Modeling

When modeling the costs of solar and wind resources across the different scenarios, Kentucky Power developed two tiers for solar and wind, which Kentucky Power stated was "to reflect the range of potential RFP responses that might be received."[49] An open and transparent all-source RFP would likely reveal price separation between bids, but it is unlikely that Kentucky Power would receive only 150 MW worth of bids for best in class solar resource and only 150 MW for the next best.

In addition to the price differentials modeled for solar and wind resources, the renewable and battery storage costs were subjected to different cost assumptions across the different scenarios, which are shown in Table 5 below.

Table 5. Kentucky Power Scenarios[50]

Scenario Concept	Load	Natural Gas	Carbon	New Resource Cost
Reference	Base	Base	Moderate	Base
Reference High-Cost (REF-HC)	Base	Base	Moderate	Slower Decline
Clean Energy Technology Advancement (CETA)	High	Base	Moderate	Faster Decline
Enhanced Carbon Regulation (ECR)	Low	High	High	Faster Decline
No Carbon Regulation (NCR)	Base	Low	No Price	Base

However, it does not appear that any of the modeling runs captured different capital cost assumptions for the NGCC and the NGCT. Upon review of the Aurora output provided in discovery, it appears that the 2029 NGCT and NGCC costs were [redacted] under the Reference High-Cost scenario.[51] We recommend that if capital costs are going to be evaluated across scenarios for renewables and battery storage resources, then capital cost sensitivities should also be modeled for thermal resources.

[49] *Id.* at 94, 96.
[50] *Id.* at 124, Fig. 45.
[51] *See* KPCo Response to Staff Q1.8, Confidential Attachment10 (Tab "PortfolioResourcesYear1").

The rationale for the price increases for the renewables and storage resources seem to be based on concerns of inflationary pressure and supply chain constraints. We recommend that this should also be considered for NGCC and NGCT resources. In EFG's work in other jurisdictions related to the construction of natural gas facilities, we are starting to see the impact of inflationary and supply chain pressures, along with increased demand, on the costs for thermal assets. In addition, many of the Producer Price Indices for certain inputs that would be needed for the conversion also suggest that inflation is a serious risk. As shown in Figure 2, indices for Cement and Concrete, Metal Products, Construction Machinery, Hot Rolled Steel, and General Freight Trucking have increase materially at rates higher than inflation for over a year now.

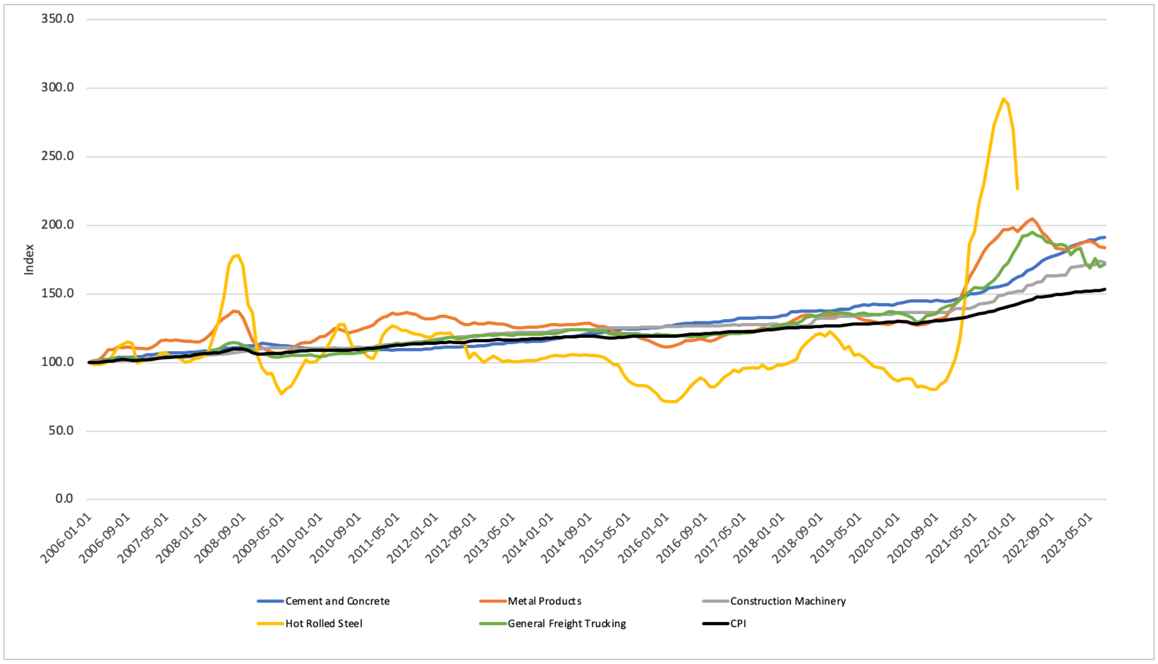

Figure 2. Producer Price Indices for Key Inputs Compared to CPI[52]

If the basis for modeling scenarios with higher capital costs for new resources is from risk of higher capital costs, then those risks should be reflected across all resource types, regardless of technology.

4.4.2 Battery Storage Book Life

Capital costs for new resources are modeled in Aurora on a \$/MW-week basis. In order to translate capital costs into a \$/MW-week input, the capital cost recovery factor ("CCR") is used to translate the capital expenditures. One of the inputs into the calculation of the CCR is the assumption for the book life of the resource. For battery storage resources, Kentucky Power modeled a 10-year-book life, which

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[52] Fed. Reserve Bank of St. Louis, Data taken from the Producer Price Indices of the U.S. Bureau of Labor Statistics (last visited Oct. 5, 2023), https://fred.stlouisfed.org/searchresults?st=producer+price+index.

meant that the real CCR was 14.94%.[53] The lower the book life for a resource, the higher the CCR, and therefore the higher the capital cost modeled in Aurora. If the book life for a battery storage resource is modified from 10 years to 15 years, that lowers the CCR from 14.94% down to 10.95%. For instance, if a 15-year book life was modeled for a new battery storage resource added in 2028, this means the capital cost in $/MW-week modeled in Aurora would go from $2,826/MW-week down to $2,149/MW-week.[54]

We recommend that Kentucky Power increase the operating life of battery storage resources to at least a 15-year life. EFG has reviewed the results from numerous all-source RFPs across North America and we typically see the operating life for battery storage resources in the range of 15–30 years. We would also note that the PJM CONE 2026/2027 report references a 15-year life for battery storage resources.[55]

4.4.3 Production Tax Credit ("PTC") and Investment Tax Credit ("ITC")

In order to apply the Production Tax Credit ("PTC") and the Investment Tax Credit ("ITC"), we typically see utilities apply a gross up for taxes. For Kentucky Power, we were provided with a supporting workbook in the discovery process[56] that appeared to show support for the PTC and ITC being grossed up for taxes. However, when we reviewed the Aurora output, which shows the PTC modeled as negative variable operations and maintenance ("O&M") it seemed like the PTC numbers did not align with that workbook. Table 6 below shows an example of the PTC values shown in the supporting workbook for a renewable resource coming online in 2027 compared to the output shown in Aurora (dividing the total variable O&M by the generation). It is not clear what might be driving the difference in the PTC value, but we would recommend that any modeling of the PTC and ITC for renewable and battery storage resources should reflect an application of the tax gross up. If the full value of the PTC is as reflected in the input workbook, then the modeling within Aurora seems to be understating the value of the PTC for solar and wind. If the PTC value is understated, then this means that portfolios with wind and solar would see further reductions in the PVRR and/or the model may have selected additional levels of wind or solar resources.

[53] KPCo Response to JI Q2.31(i), Attach. 1.
[54] Reported in 2022 dollars.
[55] KPCo Response to JI Q1.51(b), Attach. 1 at 71, tbl. 29.
[56] Response of Kentucky Power Company to Joint Intervenors' Supplemental Request for Information, Case No. 2023-00092, Question 29 (Sept. 8, 2023) ("KPCo Response to JI_2.29"); KPCo Response to JI Q1.62, Attach. 1. In KPCo Response to JI Q2.29, Kentucky Power confirmed that the ITC and PTC values modeled in Aurora are reported in workbook titled "KPCO_R_JI_1 62 Attachment1", worksheet titled "Tax Credits".

Table 6. PTC Tax Gross Up for 2027 Solar

Year	Input Workbook[57]	Aurora Output[58]
2027	[redacted]	[redacted]
2028	[redacted]	[redacted]
2029	[redacted]	[redacted]
2030	[redacted]	[redacted]
2031	[redacted]	[redacted]
2032	[redacted]	[redacted]
2033	[redacted]	[redacted]
2034	[redacted]	[redacted]
2035	[redacted]	[redacted]
2036	[redacted]	[redacted]

4.4.4 Energy Community Bonus

One of the provisions of the Inflation Reduction Act ("IRA") is that renewable and battery storage resources can qualify for an additional 10% bonus adder to the PTC and ITC if they are located in an Energy Community census tract. Qualifying census tracts include census tracts with a coal closure or those census tracts that adjoin a census tract with a coal closure.

When reviewing the DOE website with information about Energy Community census tracts in Kentucky, it appears that there are at least 13 different counties[59] with census tracts that would qualify for the Energy Community Bonus adder.[60] When Kentucky Power was asked about including the Energy Community bonus adder in the modeling of new renewable and battery storage resources, the response was that "The IRP does not include location-specific assumptions for generic generation resources. The requested analysis would be location-specific. The Company has not performed the requested analysis nor made determinations about specific resources or their location."[61]

While we understand that Kentucky Power may not know the location for the new resources, it is still important to evaluate the benefit of siting new projects within Energy Community census tracts and

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[57] KPCo Response to JI Q1.62, Workbook "KPCO_R_JI_1_62_Attachment1", worksheet "Tax Credits".
[58] KPCo Response to Staff Q1.8, Attach. 6.
[59] Census tracts located in Breathitt, Carter, Greenup, Johnson, Lawrence, Martin, Pike, Floyd, Magoffin, Letcher, Leslie, Knott, and Perry counties.
[60] U.S. Dept. of Energy, *Energy Community Tax Credit Bonus*, https://arcgis.netl.doe.gov/portal/apps/experiencebuilder/experience/?data_id=dataSource_3-1888dd08255-layer-4%3A1381&id=a2ce47d4721a477a8701bd0e08495e1d (last visited Sept. 29, 2023).
[61] KPCo Response to JI Q2.9(a).

how that might impact the capacity expansion plan. We would expect that Kentucky Power would want to incorporate this information into the language of RFPs or receive information from prospective bidders about what level of ITC or PTC the projects would qualify for and explicitly state whether the project would be located in an Energy Community.

4.4.5 Pipeline and Firm Gas Transportation Costs

Two important inputs when modeling new NGCTs or natural gas combined cycle ("NGCC") resources include the cost for any gas pipeline connections or capital expenditures to build pipeline capacity, in addition to any assumptions around firm gas transportation costs for the resources.

In discovery, Kentucky Power was asked what assumptions were included around gas pipeline interconnection, and Kentucky Power stated that:

> *For the purposes of the IRP, new gas resources were assumed to require gas pipeline interconnection. An interconnection cost was assumed as part of the NGCT costs as described in the associated EIA report "Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies" (February 2020), Table 6.1. Any costs associated with potential new gas pipeline infrastructure are expected to be resource specific*.[62]

Kentucky Power also confirmed that no firm gas transportation costs[63] were included in the costs of new NGCC or NGCT resources. In its 2021 IRP, KU/LG&E reported a firm gas transportation cost of $22/kW-year for the NGCC and NGCT resource options included in its modeling.[64]

It will be important for Kentucky Power to evaluate pipeline and firm gas transportation costs for any new natural gas resources explored. This will be a crucial cost to evaluate, as NGCTs are included in all the portfolios modeled by Kentucky Power and a new NGCC is modeled in the stakeholder requested CC portfolio.

4.4.6 Big Sandy Extension Costs

The ECR portfolio is the only portfolio modeled by Kentucky Power that does not include the extension of the Big Sandy unit for ten years. Since this resource decision is in almost all the resource plans, it will be important for Kentucky Power to keep stakeholders up to date with information around the costs of

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[62] KPCo Response to JI Q2.18.
[63] KPCo Response to JI Q2.19.
[64] Case No. 2021-00393, *In the Matter of: Electronic 2021 Joint Integrated Resource Plan Of Louisville Gas And Electric Company And Kentucky Utilities Company*, Kentucky Utilities Company and Louisville Gas and Electric Company 2021 Joint Integrated Resource Plan, Volume I, at 5-40 tbl. 5-15 (Ky. PSC Oct. 19, 2021) ("KU/LG&E 2021 IRP-Vol I").

the extension as more detailed cost estimates are obtained. When Kentucky Power was asked about the financial, environmental, and regulatory risks surrounding the extension, Kentucky Power stated that "The IRP does not make specific assumptions about those plans. As part of the Company's 3-year action plan discussed in section 8.2 of the IRP the Company will seek to refine cost estimates and develop plans for Big Sandy life extension."[65]

4.5 Battery Storage Effective Load Carrying Capability ("ELCC")

The accreditation assumption for new resources is an important input for capacity expansion modeling, as it determines how much contribution a resource has towards meeting the planning reserve margin. For the four-hour battery storage resources modeled in Aurora, the accreditation for "4-hour storage begins at 82% ELCC, but declines to 66% ELCC by 2037 as increments of new resources are expected to provide less additional capacity value as more of the resource is added to the system."[66]

One thing we noted about the ELCC for four-hour battery storage resources is that it does not seem to align with the projections that PJM has released for values between 2028 and 2032. Figure 3 below shows the projected ELCC for four-hour battery storage resources from PJM's 2021 ELCC report and Figure 4 shows the projected ELCC for four-hour battery storage resources from PJM's 2022 ELCC report. Both trajectories indicate an uptick in the ELCC between 2027–2028, which continues to increase each year through 2032. It appears that the uptick in the ELCC for four-hour battery storage resources could be the result of synergistic benefits with solar and wind resources.

[65] Response of Kentucky Power Company to LS Power Development, LLC's Initial Request for Information, Case No. 2023-00092, Question 7 (Sept. 8, 2023) ("KPCo Response to LS Power Q").
[66] KPCo Response to Staff Q1.31(b).

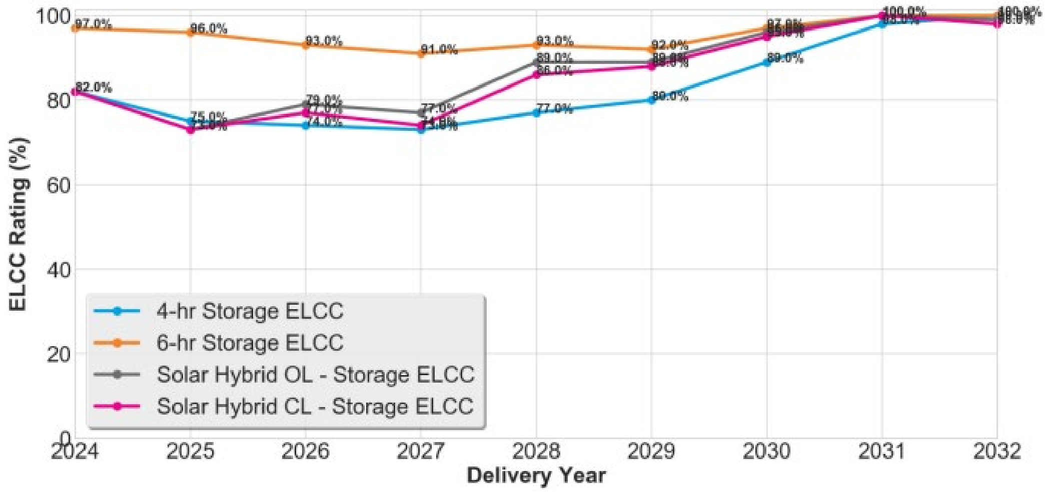

Figure 3. Four Hour Storage ELCC From PJM 2021 ELCC Report[67]

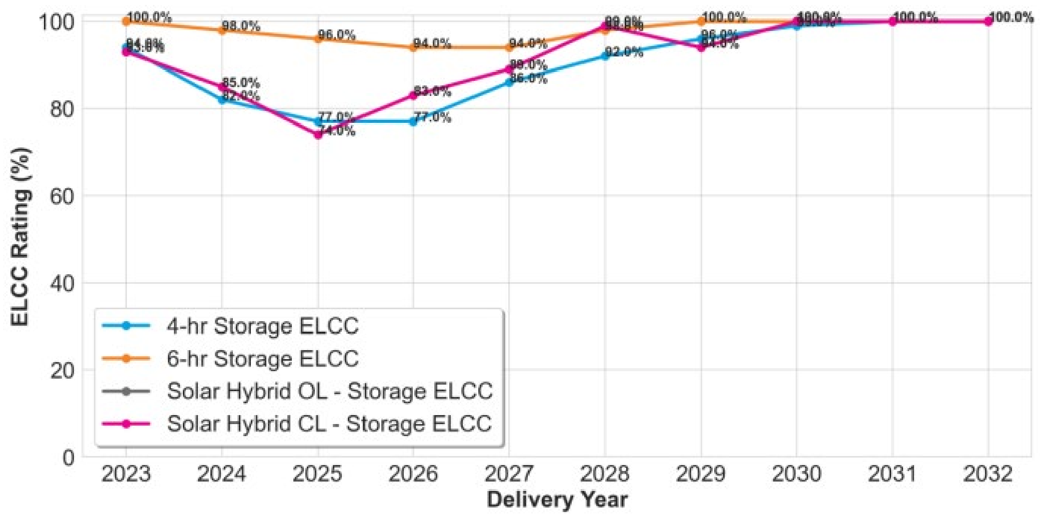

Figure 4. Four Hour Storage ELCC From PJM 2022 ELCC Report[68]

The trajectory from the PJM ELCC reports is different from what Kentucky Power used for the accreditation of four-hour battery storage resources. Table 7 shows a comparison of the ELCC that Kentucky Power modeled in the Reference Case with the values reported in the 2021 and 2022 PJM reports. Kentucky Power's projection starts at a similar level to the PJM reports, but does not show the

[67] *December 2022 Effective Load Carrying Capability (ELCC) Report*, PJM at 8 (Jan. 6, 2023), https://www.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2022.ashx.
[68] *Id.*

same projected increase in accreditation starting in 2027 or 2028 and running through at least 2032 as do the PJM reports.

Table 7. Four Hour Battery Storage ELCC Comparison

	Modeled by KP for Reference[69]	PJM 2022 Report[70]	PJM 2021 Report[71]
2024	82%	82%	82%
2025	82%	77%	75%
2026	82%	77%	74%
2027	82%	86%	73%
2028	82%	92%	77%
2029	82%	96%	80%
2030	79%	98%	89%
2031	77%	100%	98%
2032	74%	100%	98%
2033	71%		
2034	69%		
2035	69%		
2036	68%		
2037	66%		
2038	66%		
2039	65%		
2040	65%		

The ELCC for battery storage resources is an important input that should have been evaluated further through a sensitivity analysis to see what impact modeling a higher accreditation might have had on the capacity expansion plan.

4.6 Long Duration and Multiday Storage Resources

In addition to modeling four-hour battery storage resources, Kentucky Power modeled long-duration storage resources, which it refers to as resources that can provide 20 hours of energy.[72] The

[69] KPCo Response to JI Q1.54, Attach. 1.
[70] *December 2022 Effective Load Carrying Capability (ELCC) Report*, PJM at 8 (Jan. 6, 2023), https://www.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2022.ashx.
[71] *December 2021 Effective Load Carrying Capability (ELCC) Report*, PJM at 8 (Dec. 31, 2021), https://wired.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2021.ashx.
[72] KPCo 2022 IRP-Vol. A, at 105.

technologies modeled in Aurora include pumped thermal energy storage, vanadium flow battery storage, and compressed air energy storage.[73]

We recommend that Kentucky Power model either an eight or ten-hour lithium-ion battery storage resource in addition to a resource that would approximate Form Energy's[74] iron air battery storage resource.[75]

4.7 Portfolio Scorecard

4.7.1 Metrics

The different metrics included in the Portfolio Scorecard developed by Kentucky Power are outlined in Table 8 below.

Table 8. Scorecard Metrics[76]

Objective	Metric	Description
Customer Affordability	Short term	5-year Cost CAGR (2023–2028)
	Long Term	15-year CPW (2023–2037)
Rate Stability	Scenario Range	High minus low scenario range
	Cost Risk	95th percentile minus 50th percentile
	Market Exposure	Net sales as a percentage of portfolio load in 2037 (Average across all scenarios)
Maintaining Reliability	Planning Reserves	Reserve margin (Average across scenarios)
	Operational Flexibility	Dispatchable Capacity in 2027 and 2037
	Resource Diversity	Generation mix by technology in 2037
Local Impacts & Sustainability	Local Impacts	New nameplate MW and total CAPEX installed inside service territory
	CO_2 Emissions	Percent reduction from 2005 Baseline in 2027 and 2037

After reviewing the metrics, we offer several recommendations for Kentucky Power to consider:

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[73] *Id.* at 105–06.
[74] Form Energy has announced demonstration projects with electric utilities including Xcel Energy, Great River Energy, and Georgia Power. Form Energy has also received an award from New York State for a demonstration project. *See generally* https://formenergy.com/category/press-release/.
[75] Patricia Levi et al., *Modeling Multi-Day Energy Storage in New York Storage Portfolios that Can Enable a Reliable, Zero Carbon Grid*, Form Energy (Aug. 2023), https://formenergy.com/wp-content/uploads/2023/09/Form-Modeling-Multi-Day-Energy-Storage-in-NY-whitepaper-8.8.23.pdf.
[76] KPCo 2022 IRP-Vol. A at 172, Fig. 79.

1. Include a fuel price volatility metric as either a range of fuel costs or as a percentage of generation from fossil fuel generation (with fossil fuel generation being from coal and natural gas);
2. Modify the application of the stochastic analysis;
3. Include an equity metric;
4. Show the resource diversity metric with percentage values for each technology and include more than just the year 2037;
5. Include energy efficiency investments in the Local Impacts metric; and
6. Include cumulative CO_2 emissions or percentage of clean energy as metrics for sustainability.

We recommend that a metric be added to the scorecard to capture fuel price risks of portfolios. Since fuel costs are passed through to customers, fuel price risks are entirely borne by the customer and portfolios should be evaluated on how they compare on the amount of fuel price risk associated with the resources contained in each portfolio. For instance, this metric could be calculated as a proportion of annual energy generated by resources that rely on fuels that have volatile costs, including coal and natural gas. This metric could be shown as an average across the planning period or for certain points in the planning period. This will be an important metric to consider since the portfolios developed in the IRP contain different levels of fuel price risk depending on the mix of new fossil fuel resources compared to zero-fuel resources like wind, solar, battery storage, and energy efficiency in the portfolios. Capturing the risk that each portfolio poses to ratepayers should be considered in the decision to pursue portfolios that contain fossil-fuel resources.

Kentucky Power incorporated stochastic modeling where gas prices, power prices, and renewable output were modeled as stochastic variables across 250 iterations.[77] When we review stochastic modeling in other IRPs, we typically see the stochastic modeling for every year of the planning period. However, Kentucky Power's approach was to use 2037. In support of this approach, Kentucky Power stated that "while price paths are developed for the period 2022–2037, data from 2037 is singled out for the portfolio cost analysis as representative of the study period."[78] As we will discuss in the next section, there is variation in the production from the new NGCTs and the Big Sandy unit that would have implications for fuel costs, and this would not be captured if the stochastic analysis is only performed for the year 2037. We recommend that Kentucky Power either model the full planning period in the stochastic analysis or not include any stochastic modeling.

We also recommend that Kentucky Power include an equity metric in its Portfolio Scorecard to capture low-income cost burdens and emissions exposure. We recommend a metric that measures whether emitting units in each portfolio are located in low-income and/or communities of color and how those

[77] *Id.* at 137.
[78] *Id.* at 138.

overlap with other emitters in Kentucky. An example of this, as it relates to peaker plants in New Mexico, is given below.

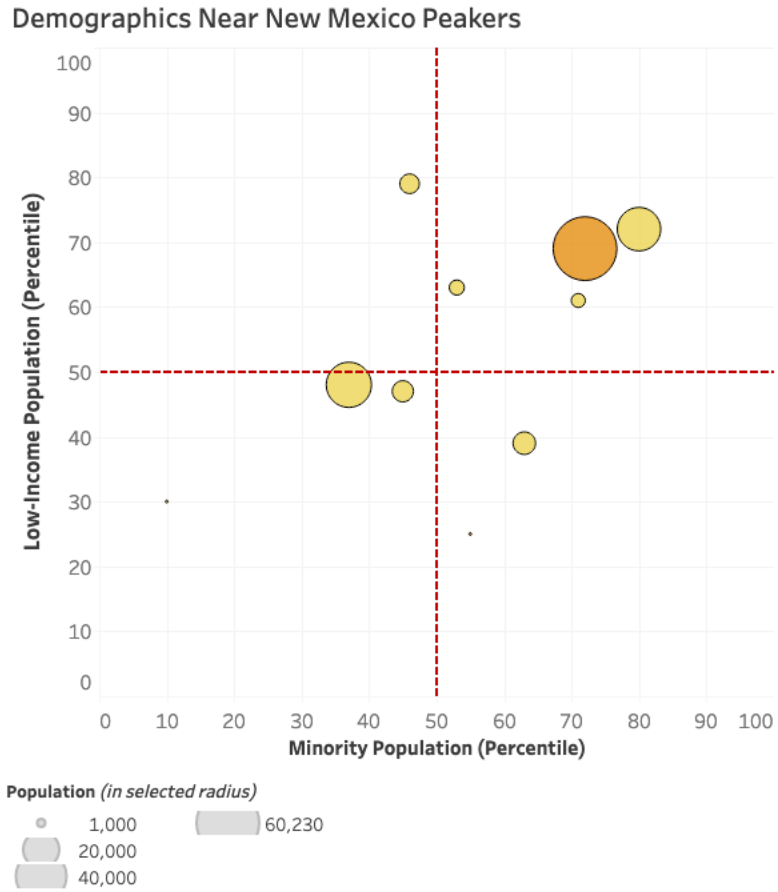

Figure 5. Demographics Near New Mexico Peaker Plants[79]

The circle size indicates the population within a given radius of the plant and the color. In this case, it distinguishes between peakers at their own site versus those co-located with a combined cycle plant. For Kentucky Power's purposes, we recommend keeping the low-income and community of color axes, but changing the color coding to reflect the fuel burned at emitting units. We would note that a similar graph, but for all fuel types, could be used to identify some of the positive and negative impacts as well as the equity of those impacts of replacement generation once those locations are identified.

[79] *Opportunities for Replacing Peaker Plants with Energy Storage in New Mexico*, Physicians, Scientists, and Engineers for Healthy Energy (PSE), Fig. 3 (May 2020), https://www.psehealthyenergy.org/wp-content/uploads/2020/05/New-Mexico.pdf.

Kentucky Power presents the Resource Diversity metric as pie charts with no quantitative information showing percentages for each resource technology. This leaves the reader to try to discern the differences across portfolios, which makes it challenging to compare portfolios. We recommend that instead of presenting this metric as a pie chart, that Kentucky Power calculate the percentages for each resource technology and present that across several years in the planning period.

For the Local Impacts metric, Kentucky Power evaluated the total new nameplate (MW) and total capital expenditures installed inside the service territory for new resources. It seems like this metric is focused on the supply side additions. We recommend that Kentucky Power also factor in the impact from energy efficiency resources added across the portfolios as energy efficiency will also have an impact on the local economy.

For the Sustainability metric, we recommend that Kentucky Power include the cumulative CO_2 emissions across the entire planning period rather than comparing one year of the planning period to the 2005 emissions. This will provide a better comparison on how the emissions change over the course of the planning period and how different resource portfolios may have different total climate impacts over the planning period. In addition, Kentucky Power could also include a metric that measures the clean energy progress for each portfolio that calculates the percentage of generation from renewable resources.

4.8 EPA Regulation

On May 11, 2023, the Environmental Protection Agency ("EPA") EPA proposed new GHG emission limits and guidelines for new and existing coal and gas-fired power plants.[80] Specifically, EPA proposed standards for GHG emissions from new and reconstructed fossil fuel-fired stationary combustion Electric Generating Units ("EGUs") based on hydrogen co-firing and carbon capture and sequestration ("CCS"), and is simultaneously proposing to establish new emission guidelines for existing fossil fuel-fired steam EGUs that reflect the application of CCS and the availability of natural gas co-firing, and guidelines for the largest, most frequently operated existing stationary combustion turbines based on hydrogen co-firing and CCS.[81] On May 23, 2023, the proposed new GHG rules were published in the Federal Register. EPA has announced the intention to finalize the proposed new GHG rules by April 2024 after considering the comments submitted this summer.[82]

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[80] *New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule*, 88 Fed. Reg. 33,240 (May 23, 2023).
[81] *Id.* at 33,243.
[82] White House Office of Mgmt. & Budget, Office of Info. & Reg. Affairs, Spring 2023 Unified Regulatory Agenda (2023), https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202304&RIN=2060-AV09.

For new or reconstructed natural gas simple cycle turbines with a low-load capacity factor of less than 20%, only the use of "lower emitting fuels," e.g. natural gas and distillate oil, with a standard of performance of 120 lbs. to 160 lbs. CO_2 per MMBtu, would be required; while such units that operate at more than a 20% capacity factor would need to meet emission limits that are based on the blending of 30% low-GHG hydrogen starting in 2032.[83] These rules, if finalized as proposed, would increase costs associated with operating gas turbines, though the specific increases depend on the compliance pathway elected. One of the compliance pathways will be operating units with a capacity factor limit of 20% starting in 2032.

While we understand that the EPA proposed rule was released after the filing of Kentucky Power's IRP, this represents a regulatory risk that should be evaluated for portfolios with new fossil fuel resources. Table 9 below provides the annual capacity factors for the extension of the Big Sandy unit starting in 2031 along with the new NGCT resources added to the resource mix in 2029. The operation of the new NGCTs indicates that the resources could operate higher than the 20% capacity factor level. Insufficient information regarding the work that would be needed to extend the life of Big Sandy has been provided for us to determine whether the extended unit would be subject to new or existing source standards under the 111 rule. In the event that it is not subject to the operational or fuel blending limitations in the proposed rule, this would still have implications for the costs of the portfolios including the extension, since the generation could shift from the new NGCTs to Big Sandy, if the NGCTs needed to operate at less than an annual capacity factor of 20%.

If Kentucky Power opted for a compliance pathway that did not place an annual capacity factor limit on the new NGCTs then there would need to be consideration of how those units would operate with a 30% blending of low-GHG hydrogen. Whether there is a limit on how often the new NGCTs could operate or whether there would be reliance on hydrogen fuel to operate the new NGCTs, both would have implications for the costs associated with the new NGCTs that should be fully and transparently vetted before any decision is made whether to proceed with such units.

[83] *See, e.g.*, EPA, Presentation: Clean Air Act Section 111 Regulation of Greenhouse Gas Emissions from Fossil Fuel-Fired Electric Generating Units, https://www.epa.gov/system/files/documents/2023-05/111%20Power%20Plants%20Stakeholder%20Presentation2_4.pdf (accessed Oct. 4, 2023) (Table on slide 8, summarizing the proposed new GHG NSPS for new natural gas EGUs and Table on slide 13, summarizing the proposed new GHG rule for existing EGUs).

Table 9. Big Sandy 1 and New CT Capacity Factors in the Preferred Plan[84]

	Big Sandy 1 - Gas	Area 1001 Gas CT 2029
2023	72%	
2024	79%	
2025	71%	
2026	63%	
2027	62%	
2028	31%	
2029	50%	58%
2030	34%	39%
2031	20%	36%
2032	18%	31%
2033	23%	28%
2034	18%	26%
2035	15%	26%
2036	23%	30%
2037	18%	28%

4.9 Modeling Energy Efficiency in IRPs

4.9.1 Modeling Energy Efficiency as a Supply Side Resource

In our experience, there are two ways to evaluate energy efficiency in IRPs. One way is to model energy efficiency as a reduction to the load forecast; and the second is to model energy efficiency as a supply-side resource and allow it to be selectable within the capacity expansion model. Both methods of modeling energy efficiency have pros and cons, and it is important to ensure that energy efficiency is appropriately modeled under either approach.

When modeling energy efficiency as a supply-side resource, these are the recommendations EFG puts forward to ensure that energy efficiency is placed on a level playing field with other supply-side resources:

1. Model energy efficiency savings in magnitude and with measure lives consistent with the Market Potential Study ("MPS");
2. Levelize energy efficiency costs over the MPS life to ensure costs are on equal footing with supply-side resources;
3. Use marginal, not average, line losses to convert the MPS savings at the meter to IRP savings at the generator;[85] and
4. Apply the avoided transmission and distribution ("T&D") cost as a reduction in energy efficiency program cost.

[84] KPCo Response to Staff Q2.31, Attach 1.
[85] Jim Lazar and Xavier Baldwin, *Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements*. (Aug. 2011), https://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-eeandlinelosses-2011-08-17.pdf

Kentucky Power modeled energy efficiency bundles as a supply side resource available for selection within the Aurora capacity expansion model.[86] Kentucky Power modeled three residential bundles, one income-qualified bundle, and two C&I bundles. The bundles were available for the model to select for the years 2023–2025, 2026–2030, and 2031–2042. Since the Market Potential Study ("MPS")[87] was not complete at the time of the IRP modeling, Kentucky power and GDS conducted a benchmarking study to develop the bundles of savings to model.[88] The residential and C&I bundles were modeled with a separation between a low/medium cost bundle and a high-cost bundle with a split between measures that cost less than $100/MWh and those that cost more. The behavioral bundle separated out measures with an effective useful life of one year to prevent those measures from impacting the effective useful lives of bundles that might have a mixture of behavioral and non-behavioral measures.

We recommend "levelizing" energy efficiency costs over the MPS life to ensure that there is not a bias against energy efficiency when modeling it as a supply side resource. Modeling energy efficiency without recognizing the benefit of savings outside of the planning period may bias against the selection of energy efficiency. For instance, if there are bundles available in 2026 that contain measures with a 20-year life, the model will see the full cost of that measure, but will not see the full lifetime of savings from that measure since the planning period ends in 2037. In the case of how Kentucky Power modeled energy efficiency costs, they were not modeled on a levelized basis, but instead were modeled with as spent dollars. For example, the residential low/medium bundle for 2023-2025 has costs only modeled in 2023, 2024, and 2025. This means that the model will see the upfront cost in those three years even though the savings continue past 2025. For the residential bundle in 2025, those savings would persist until 2034.[89] This could introduce a bias in the model since the new supply side resources are modeled on a levelized basis in Aurora.

Kentucky Power made three adjustments to model the energy efficiency bundles as a supply side resource, which included translating savings from the meter to the generator level by multiplying by the line loss factor, adjusting bundle costs to net out an avoided T&D benefit of $11.5/kW-year, and aligning projections of future gross energy efficiency potential accounted for in the load forecast. [90] We are in agreement with the translation of savings from the meter to the generator, with one suggested change

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[86] KPCo 2022 IRP, Vol. A at 83.
[87] The Kentucky Power specific MPS was filed in Case No. 2022-00392 on August 11, 2023. *See* Case No. 2022-00392, *In the Matter of The Electronic Application Of Kentucky Power Company For: (1) Approval Of Continuation Of Its Targeted Energy Efficiency Program; (2) Authority To Recover Costs And Net Lost Revenues, And To Receive Incentives Associated With The Implementation Of Its Demand-Side Management Programs; (3) Acceptance Of Its Annual DSM Status Report; And (4) All Other Required Approvals And Relief*, Not. of Filing of Market Potential Study (Ky. PSC Aug. 11, 2023) ("MPS").
[88] KPCo 2022 IRP, Vol. A at 82.
[89] KPCo Response to JI Q42, Attachment 1 (Tab "SEA," Column E, Rows 36–45).
[90] *Id.* at 84.

to the calculation, and agree with reducing the energy efficiency bundle costs by the avoided T&D benefit. However, we disagree with the alignment of energy efficiency potential and what is accounted for in the load forecast. We will discuss this item in more detail in the following section.

Most market potential studies define potential at the meter, *i.e.*, as a reduction in sales. However, IRP modeling is conducted at the generator. So, in order for EE to be correctly accounted for in an IRP, it must be grossed up to account for line losses between the generator and meter.

In order to translate the energy efficiency savings at the meter to the generator level, Kentucky Power applied average[91] line losses by multiplying the energy savings at the meter by (1 + Line Loss Factor) as shown below:

$$Energy\ Savings\ at\ Generator = Energy\ Savings\ at\ Meter\ \times\ (1 + Line\ Loss\ Factor)$$

This application of the line loss factor was incorrect since line losses are measured with respect to the generator, not the meter. Converting savings back to the generator, from the perspective of the meter, requires the following calculation:

$$Energy\ Savings\ at\ Generator = Energy\ Savings\ at\ Meter\ \div\ (1 - Line\ Loss\ Factor)$$

While we support the translation of energy savings from the meter to the generator, we would recommend the adjustment in the calculation shown above for the execution of that translation. With the formula that Kentucky Power used to convert the energy efficiency savings, the savings of each bundle were slightly understated.

We would also recommend that Kentucky Power apply marginal and not average line losses for this translation. Oftentimes, energy efficiency savings are grossed up based on an average line loss rate, *e.g.*, 7 percent. However, energy efficiency saves energy on the margin, not on average, and therefore the marginal line loss rate should be applied. As the Regulatory Assistance Project puts it:

> *There are two types of losses on the transmission and distribution system. The first are no-load losses, or the losses that are incurred just to energize the system – to create a voltage available to serve a load. Nearly all of these occur in step-up and step-down transformers. The second are resistive losses, which are caused by friction released as heat as electrons move on increasingly crowded lines and transformers . . . Losses increase significantly during peak periods. The mathematical formula for the resistive losses is I^2R, where "I" is the amperage (current) on any particular transformer or distribution line, and "R" is the resistance of the wires through which that current flows. While the "R" is generally*

[91] KPCo Response to JI Q2.23(e), (f).

> *constant through the year, since utilities use the same wires and transformers all year long, the "I" is directly a function of the demand that customers place on the utility. Thus, resistive losses increase with the square of the current, meaning losses increase as load increases.*[92]

Therefore, the loss reduction benefit of energy efficiency also increases as load increases. For example, a utility with average line losses of 7 percent could have peak line losses of 20 percent or more. This is a very important benefit of energy efficiency that should be captured in the IRP modeling.

One of the benefits of energy efficiency is that it avoids costs that supply-side generators cannot such as T&D costs. Most IRP models, including Aurora, do not have a way to explicitly include avoided T&D costs, but those avoided costs can be captured as a reduction in energy efficiency program cost. That is the approach taken by Kentucky Power in this IRP, using an avoided T&D benefit of $11.15/kW-yr provided by the GDS Team.[93] While we support this methodological approach, there is limited information offered in the IRP to explain how GDS derived that avoided T&D benefit value or what specific data was used. We recommend that, going forward, Kentucky Power share these details, which are critical to ensuring that the modeling reflects the full benefits of energy efficiency.

4.9.2 Supplemental Energy Efficiency Adjustment ("SEA")

One of the adjustments that Kentucky Power stated that it needed to make to the energy efficiency bundles modeled in Aurora included what AEP has called a "Supplemental Efficiency Adjustment" ("SEA"). When asked about the rationale for adjusting energy efficiency savings by the SAE, Kentucky Power stated that:

> *Supplemental Efficiency Adjustment (SEA)" is included to align the projections of future energy efficiency potential with the embedded efficiency trends already included in the KPCo forecast. The SEA functions to net out incremental efficiency already embedded in the IRP load forecast.*[94]
>
> *The Company's Statistically Adjusted End-Use (SAE) models capture energy efficiency trends that may also be reflected in potential Company sponsored DSM/EE programs. It is perceived that these DSM/EE programs will accelerate the adoption of naturally occurring energy efficiency gains. To avoid double counting these savings, the Company degrades the DSM/EE savings over the forecast horizon to properly account for the energy efficiency*

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[92] Jim Lazar and Xavier Baldwin, *Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements.* (Aug. 2011), https://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-eeandlinelosses-2011-08-17.pdf
[93] KPCo 2022 IRP, Vol. A at 84.
[94] KPCo Response to JI Q2.23(a).

gains that are included in the SAE model. The Company developed the percentages to reflect the decaying nature of net to gross DSM program savings over time. These percentages are based on measured historical relationships.[95]

In order to implement this adjustment, Kentucky Power developed trajectories of savings reductions for different measure lives (the SEA) and then applied those reductions to the energy efficiency savings for each bundle. Figure 6 below shows an example of the difference in the savings for the unadjusted and the SEA adjusted Low/Medium residential 2023-2025 bundle:

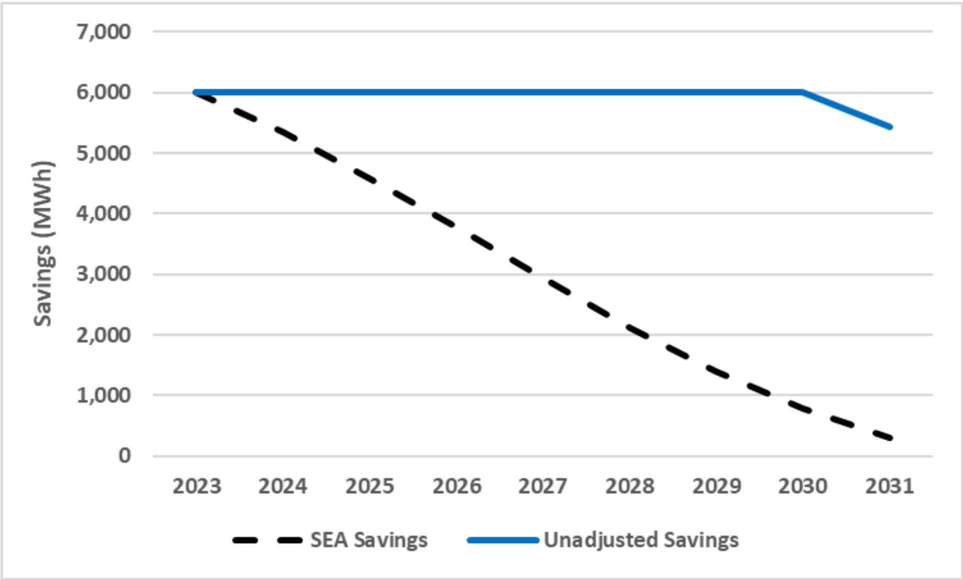

Figure 6. Application of the SEA to the Residential Low/Medium Bundle[96]

We have encountered this SEA approach in other jurisdictions where AEP operates. We have expressed concern that this approach is not evidence-based and does not align with the purpose for which it purports to be applied.[97]

Kentucky Power uses two rationales for the SEA, that "embedded energy efficiency trends" contained in its load forecast need to be netted out of the energy efficiency savings and that DSM/EE will accelerate the adoption of "naturally occurring" energy efficiency. The latter point is another way of describing free ridership, i.e., the phenomenon that some participants in an energy efficiency program would have adopted the measure even without an incentive to do so. To the extent that free riders are not

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[95] *Id.* at JI Q2.23(c).
[96] KPCo Response to JI Q1.42, Attach. 1.
[97] *E.g.*, Chelsea Hotaling et al., *Report on Indiana Michigan Power Company's 2021 Integrated Resource Plan*, at 26–28 (Ind. Util. Reg. Cmm'n Aug. 3, 2022), https://www.in.gov/iurc/files/IM-IN-2021-IRP-CAC-Earthjustice-VS-Comments-8-8-2022_Redacted.pdf.

accounted for in the MPS, it is appropriate to apply a reasonable net to gross ("NTG") factor to the MPS potential, but such a factor is very different than the SEA.

As part of the IURC Cause 45546 settlement, Indiana Michigan Power ("I&M") agreed to model portfolios that utilized a NTG factor in place of the SEA.[98] It is our understanding that I&M is going to discontinue the application of the SEA or any kind of factor that degrades energy efficiency savings for future IRP filings. Kentucky Power should follow suit.

For Kentucky Power's MPS, it reports that the NTG for "new program offerings are defaulted to 0.8,"[99] which indicates that there was an adjustment for free riders. The MPS clearly states that this factor was included:

> *All estimates of technical, economic, and achievable potential, as well as measure level cost-effectiveness screening were conducted in terms of gross savings to reflect the absence of program design considerations in these phases of the analysis. The impacts of free-riders (participants who would have installed the high efficiency option in the absence of the program) and spillover customers (participants who install efficiency measures due to program activities, but never receive a program incentive) were considered in the development of program potential (Chapter 5).*[100]

A net-to-gross adjustment would be applied in a flat line to all savings in the MPS and *not* in a linear manner declining to zero as it does in Figure 6.

On the first rationale that "embedded energy efficiency trends" contained in its load forecast need to be netted out of the energy efficiency savings, those trends are defined by stock efficiency data from the Energy Information Administration and consist largely of naturally occurring savings with a small amount accounting for utility-sponsored energy efficiency. As previously discussed, naturally occurring savings ought to be and are excluded from this MPS using the NTG factor. To the extent that the load forecast includes some amount of new DSM because the data upon which it is based also included DSM, that is an issue that is unique to the load forecast and has nothing to do with the MPS. It must be resolved

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[98] Case No. 45546, *Joint Petition of Indiana Michigan Power Company (I&M) and AEP Generating Company (AEG) for Certain Determinations with Respect to the Commission's Jurisdiction over the Return of Ownership of Rockport Unit 2 and for the Creation of a Subdocket to Address Associated Accounting and Ratemaking Matters, or in the Alternative Issuance of a Certificate of Public Convenience and Necessity*, Final Order at 23 (Ind. Util. Reg. Cmm'n Dec. 8, 2021) (approving and attaching settlement agreement including commitment to eliminate use of supplemental efficiency adjustment and instead model "DSM as an independent variable in the regression equation consistent with certain other Indiana Investor Owned Utilities.").
[99] MPS at 37 *supra* n.81.
[100] *Id.* at 24.

through adjustments to the load forecast, and Itron, the vendor of AEP's load forecast model, has offered several ways to do this including adding back the historical impact of energy efficiency, incorporating a DSM variable in the SAE model, and using trends.[101]

However, even if the bundles modeled in Aurora did not account for free riders, the SAE approach would still be problematic for the following reasons:

1. The SAE approach assumes that savings decline linearly to zero over the life of the measure. For instance, savings from a hot water heater would decline to 0 over the life of the heater. However, in this example, the customer must either be a free rider or not. The savings will persist for the entirety of the water heater life, or they are 0 for the entirety of the life of the water heater—there is no in between. And even averaging the free riders with non-free riders, i.e., averaging the zero and ones, cannot, mathematically, lead to a different average over the life of a measure.
2. Since the SAE factors decline to almost zero over the assumed life of the efficiency measure bundles, the impact on lifetime savings is much more than the NTG factor.
3. Free ridership is largely a function of program design and should vary from one program to another. It is likely 0% for low-income customers, relatively low for many HVAC and appliance rebates, and higher for residential lighting. Free ridership would likely change if the program offering a rebate of $50 on a $500 measure was increased to a $400 rebate on that $500 measure, yet the SAE does not take this variability into account.

We recommend that Kentucky Power discontinue the application of the SEA to energy efficiency bundles, as AEP's affiliate Indiana Michigan Power Company has committed to do so in the state of Indiana. Instead, we recommend that Kentucky Power make bundles available for selection within the model and only make adjustments to account for free riders through the application of the NTG to convert gross energy savings to net savings.

5 Demand Side Management

Kentucky Power's Preferred Plan includes demand side resources, with an additional 48 MW of such resource between years 2023 and 2037 to offset 52 MW of supply side resources during the same time frame. The projected demand side resources are based upon a benchmarking study,[102] as the IRP was filed prior to the completion of the market potential study ("MPS"), both of which were conducted by

[101] Stuart McMenamin, *Incorporating DSM into the Load Forecast*, Itron, https://www.itron.com/-/media/feature/products/documents/white-paper/incorporating-dsm-into-the-load-forecast.pdf
[102] The benchmarking study was based on recently completed MPS for utilities in Indiana and Kentucky, as well as a review of EIA information.

GDS Associates.[103] Currently, the Company's demand side management ("DSM") activity is limited to a weatherization program for income-qualified ratepayers, as the Commission directed Kentucky Power to suspend DSM activities until the service territory either experiences load growth or has a capacity deficiency. Kentucky Power is currently experiencing the latter, particularly with Kentucky Power planning to divest from the Mitchell units in 2028.[104]

5.1 Benefits of Demand Side Management

DSM, delivered through both EE and demand response ("DR") programs, provides a wide variety of benefits, for both participants and non-participants. These benefits include reduction in infrastructure and operational costs through cost-effective investments in efficiency, as well as reduced energy usage costs for homes and businesses. The latter is considered a direct customer benefit for participants, as it can reduce monthly energy bills through the reduction of energy or shifting energy usage form periods with high demand. Beyond these direct benefits, cost-effective DSM programs can increase economic development within the service territory, reduce capacity requirements, reduce exposure to fuel price volatility, and increase reliability and safety for ratepayers.

As noted by the American Council for an Energy-Efficiency Economy ("ACEEE"), "Energy efficiency today is an important utility system resource, typically, the lowest-cost system resource compared to supply side investments."[105] As identified in Figure 7, EE and DR efforts can be implemented cost-effectively and at a lower cost than meeting ratepayers' energy needs through investments in new generation and transmission and distribution assets, essentially deferring or eliminating some infrastructure investments. The reduction in infrastructure investments benefits both participants in DSM programs, as well as non-participants as these cost reductions are shared across all ratepayers.

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[103] The Kentucky Power specific MPS was filed in Case No. 2022-00392 on August 11, 2023.

[104] *See* KPCo 2022 IRP-Vol. A at 55 (Figure 12 showing Kentucky Power "Going-In" Capacity Position throughout the Planning Period). The Company has entered into bilateral contracts for the next two PJM delivery years to make up its capacity shortfall. *See* Response of Kentucky Power Company to Attorney General and Kentucky Industrial Utility Customers' Supplemental Request for Information, Case No. 2023-00092, Question 2.7 (Sept. 8, 2023) ("KPCo Response to AG-KIUC Q").

[105] ACEEE, *Energy Efficiency as a Resource,* https://www.aceee.org/topic/ee-as-a-utility-resource#:~:text=Energy%20efficiency%20today%20is%20an,compared%20to%20supply%2Dside%20investments (last visited Sept. 29, 2023).

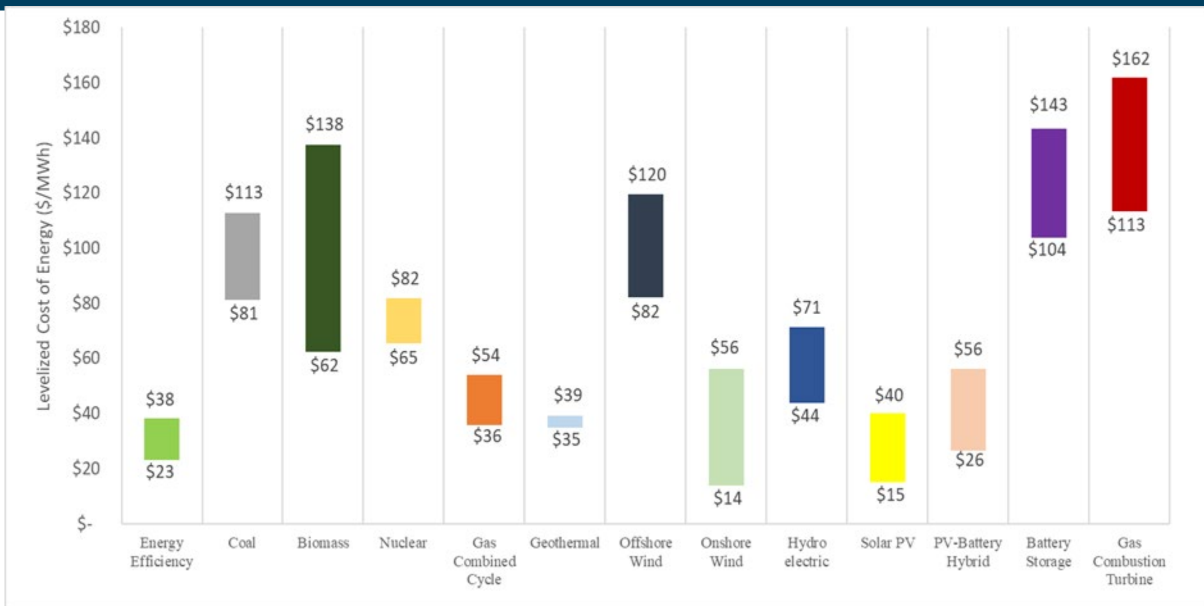

Figure 7. Levelized Cost of Energy Resources[106]

Direct participation in DSM programs, both EE and DR, may result in benefits such as reduced monthly bills, energy usage, increased comfort, health benefits, and increased reliability through improved building shell improvements.[107] EE programs consisting of building weatherization and more efficient measures such as appliances and heating, ventilation, and air conditioning ("HVAC") equipment, may lower energy and capacity needs. EE investment in income qualified homes is an important part of any DSM portfolio as it may not only achieve the benefits listed above, but also reduce energy burden.[108] In addition to capacity savings through EE programs, DR programs can lower capacity during periods of high demand in specific areas or throughout the service territory by shifting equipment operation times

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[106] Levelized cost of energy ("LCOE") for energy efficiency from ACEEE Policy Brief, *The Cost of Saving Electricity for the Largest U.S. Utilities: Ratepayer-Funded Efficiency Programs in 2018* (June 2021), https://www.aceee.org/sites/default/files/pdfs/cost_of_saving_electricity_final_6-22-21.pdf. LCOE for generation is from the U.S. Energy Information Administration Annual Energy Outlook 2023, https://www.eia.gov/outlooks/aeo/electricity_generation/ (Last accessed October 3, 2023). The LCOE for energy efficiency was in 2018 dollars while the LCOE for generation was provided in 2022 dollars. To allow for benchmarking, the 2018 dollars were inflated to 2022 dollars using the Core Consumer Price Index.

[107] While it is typical to experience reduced energy usage and cost with investments in EE, if a home is going through the process of electrification, then there is potential for increase electric usage; however, these costs can be offset by lower or eliminated delivered fuel bills and/or better bill management.

[108] Ariel Drehobl et al., *How High are Household Energy Burdens?: An Assessment of National and Metropolitan Energy Burden across the United States*, American Council for an Energy Efficient Economy, at iii (Sept. 2020), https://www.aceee.org/sites/default/files/pdfs/u2006.pdf ("Energy burden is the cost of household energy use compared to household income. Households with energy burden of 6% are considered high and those with energy burdens above 10% are considered severe.").

to periods of lower demand. Shifting demand can lower overall capacity requirements and be achieved either through devices which cycle water heaters and HVAC equipment or provide rates which discourage demand during specific hours.

Economic development is another benefit of DSM with an increase in direct jobs, such as those to implement efficiency programs and measures, and indirectly through increased spending from lower energy bills, which create economic benefits and, potentially, additional jobs. Based on recent filings by Kentucky Power, there is a strong desire in the region to incentivize investment in economic development and jobs. Implementing EE and DR programs within the service territory would also be supportive of Governor Andy Beshear's energy strategy, KYE3, which incorporates the environment and economic development.[109]

Energy efficiency savings avoid fuel costs, like solar and wind generation, and can be used as a tool to reduce exposure to fuel price volatility. For example, a 2018 study from the American Council for an Energy Efficient Economy explained that in addition to often being the lowest-cost resource available, energy efficiency:

> *provides utilities and retail electric providers an additional strategy to reduce exposure to price volatility. Efficiency can serve as a type of long-term supply contract that provides energy resources at a fixed price. . . . Resource planning should consider this value of reduced risk when making long-term decisions on how to meet anticipated electricity demand.*[110]

As noted here, there are significant and quantifiable benefits that result from investment in DSM, which is also the lowest-cost resource when compared to supply side resources. These benefits are not only recognized by direct program participants through increased resiliency of their homes and businesses, but also for non-participants through avoided costs, workforce development, and increased investment in the community. These benefits, particularly during a period of capacity shortage, are best recognized through comprehensive and cost-effective DSM efforts which include both EE and DR programs.

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[109] E^3 Foundation, *KYE^3: Designs for a Resilient Economy* (2021), https://eec.ky.gov/Energy/Documents/KYE3_Final_10.18.2021.pdf.
[110] Brendon Baatz et al., *Estimating the Value of Energy Efficiency to Reduce Wholesale Energy Price Volatility*, ACEEE, at iii (April 2018), https://www.aceee.org/research-report/u1803; *see also* David Hoppock and Dalia Patino Echeverri, *Using Energy Efficiency to Hedge Against Natural Gas Price Uncertainty* (Jan. 2013), https://nicholasinstitute.duke.edu/sites/default/files/publications/ni_wp_13-02.pdf.

5.2 Market Potential Study

The MPS, released late in the process of the IRP and therefore not available for discovery purposes, leaves several questions about how it may validate the level of efficiency that should be modeled in the IRP. These questions include what are the assumptions that the achievable potential savings is based upon, the direction provided by Kentucky Power for consideration in the study, such as the exclusion of DR programs, and whether stakeholder input could have resulted in more robust results for the achievable potential.

There are a total of five programs proposed by the MPS that will be implemented over the three-year portfolio period for less than $10 million. Below is a highlight of each of the proposed programs, as well as a high-level comment on the program and proposed recommendations for consideration by the Company as it develops it EE portfolio. The programs include:

- Targeted Energy Efficiency Program – This is a continuation of the current income eligible program currently funded by Kentucky Power that provide supplemental funding to the state's weatherization assistance program ("WAP") for HVAC and weatherization technologies.
    - Positive: The program intends to double its funding from current levels over the three-year plan period. Although the program is not cost-effective, most income eligible programs are not cost-effective unless non-energy benefits are included as part of the cost-effectiveness screening.
    - Concern: There is an influx of federal funding for WAP, which may make it difficult for the community action agencies to utilize the Kentucky Power funding. Kentucky Power should consider implementing its own complimentary income-eligible program to have control over the level of savings anticipated from the program, expand the effort of weatherization in the area, and can still cost share with WAP as a way to leverage the funding opportunities. If implemented by Kentucky Power instead of the WAP agencies, an income eligible program could also include specific funding allocations for manufactured homes and multifamily buildings.
- Home Energy Improvement Program ("HEIP") – this program will provide energy audits and rebates for weatherization and HVAC equipment.
    - Positive: The program will not only offer financial incentives but will also include funding for energy audits to help participants understand how to improve the efficiency and resiliency of their home.
    - Concern: The energy audits will not be implemented until year 2 or 3, which may delay measures such as attic insulation, duct insulation, and air sealing to make the home tighter prior to the sizing of new HVAC equipment. The audits should be available as the program is initially rolled out. It is also unclear if

renters will be able to take advantage of this program. That should be clarified and a process to receive approval from landlords should be established.

- Marketplace Program – this effort will be provided via an online platform that will allow customers to purchase items such as smart thermostats, air purifiers, clothes washers, and smart plugs.
  - Positive: This program offers products at various price points, which means that all residential customers that pay into the system will have the ability to participate. Kentucky Power plans to leverage operating this program along with other AEP subsidiaries to reduce the cost of the program.
  - Concern: Despite this program already operating in other AEP subsidiaries, the program will not begin operation until the second year of the portfolio. It's unclear why this program could not be rolled out in the first year of the three-year plan term.
- Commercial Prescriptive Program – The program will offer commercial and industrial customers incentives for measures such as lighting fixtures and controls, thermostats, HVAC equipment, and kitchen equipment.
  - Positive: The program will be able to deploy lighting fixtures and replacement prior to the phase out of lighting in commercial EE programs.
  - Concern: The program lacks any energy audit option which will require businesses to be aware of the program and what their businesses may need, even though they are likely not EE experts. There is no small business aspect to the program, which will likely serve as a financial barrier to those customers. Additionally, there are no manufacturing efficiency measures such as variable frequency drives and retro commissioning.
- Commercial Custom Program – existing and new facilities can receive incentives for measures not included in the Commercial Prescriptive Program and will require verified energy savings for each project.
  - Positive: Customers can receive incentives for measures such as HVAC, refrigeration, and compressed air.
  - Concern: the program also does not appear to include an energy audit, like the Commercial Prescriptive Program, and is not expected to launch until the third year of the program plan. There are plenty of program models available throughout the US to have this program begin sooner in the program plan year, which could be done with the assistance of a third-party implementor.

The expansion of DSM programs in the Kentucky Power service territory is a positive development for ratepayers and will deliver benefits to both participants and non-participants. However, the limitations of potential studies have been well-documented by organizations such as ACEEE, the Regulatory Assistance Project, Lawrence-Berkeley National Laboratory, and others who have studied the correlation between potential study estimates and actual savings achievements.[111] ACEEE, for example, reviewed "45 publicly available studies published since 2009" with the intent to "better understand the nuts and bolts of these studies and how their various methodological approaches and assumptions influence energy efficiency potential estimates."[112] The report concludes, among other things, that

> *given the inaccuracy of models and the generally conservative approach of these studies, there is likely a great deal of additional cost-effective potential available beyond what is identified. . . . Moreover, given the fact that most studies base their customer-participation models on economics, even short-term forecasts of market dynamics are murky. This is because studies tend to downplay the impact of program design elements such as marketing and education, as well as the non-energy justifications for investing in energy efficiency*.[113]

As discussed in the next section, Kentucky Power can likely implement EE programs which achieve energy and demand savings in excess of what was identified as achievable in the MPS. Kentucky Power should consider expansion of the program offerings to ensure an equitable delivery of the program and that those that pay into the DSM programs are able to participate. This can be achieved by target marketing to environmental justice and disadvantaged communities and offering programs such as small business programs and financing opportunities for both residential and commercial customers. Additionally, while Kentucky Power is in the planning phase of its DSM portfolio, it should consider the inclusion of DR programs and the benefits of a third-party implementer to shorten the roll out time outlined in the MPS.

5.3 Recommendations for Demand Side Management

The DSM offered by Kentucky Power should be cost-effective, at a portfolio level, and offer program and measure opportunities which will allow all those who pay into the program to be able to participate.

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[111] *See, e.g.*, David B. Goldstein, *Extreme Efficiency: How Far Can We Go If We Really Need to?,* ACEEE Summer Study on Energy Efficiency in Buildings, 10-44 –10-56 (2008), https://www.aceee.org/files/proceedings/2008/data/papers/10_435.pdf; Philip Mosenthal, *Do Potential Studies Accurately Forecast What is Possible in the Future? Are We Mislabeling and Misusing Them?: Presentation for ACEEE Energy Efficiency as a Resource Conference*, Optimal Energy, Inc. (Sept. 21, 2015), https://www.aceee.org/sites/default/files/pdf/conferences/eer/2015/Philip_Mosenthal_Session2D_EER15_9.21.15.pdf; Chris Kramer & Glenn Reed, *Ten Pitfalls of Potential Studies*, Regulatory Assistance Project (2012), https://www.raponline.org/wp-content/uploads/2016/05/energyfutures-kramerreed-tenpitfalls_esdraft2-2012-oct-24.pdf.
[112] Max Neubauer, *Cracking the TEAPOT: Technical, Economic, and Achievable Energy Efficiency Potential Studies*, Report U1407, Am. Council for an Energy Efficient Econ., at v (Aug. 2014) ("Neubauer Report").
[113] *Id*. at 39.

Kentucky Power should consider offering a suite of programs that has an equity lens to focus on environmental justice and disadvantaged communities, as well as provide measures for different housing and business types, such as manufactured homes and small businesses, respectively. The savings from DSM should be focused on comprehensive and long-lived savings, rather than short-lived savings, such as those achieved through behavioral reports.

There are certain program and measure offerings that should be considered as part of Kentucky Power's portfolio, such as housing type and heating type, to ensure that the programs address efficiency needs. On the residential side, Kentucky Power's EE programs should offer programs that address manufactured homes and provide incentives to replace inefficient electric resistance heating. With commercial programs, like the income-eligible program carve-out, there should be a carve-out for small businesses to ensure that they can access the programs despite potential financial barriers.

According the U.S. Census Bureau, manufactured housing makes up approximately 11 percent of housing in Kentucky, or 220,581 homes.[114] On an average per square foot basis, manufactured homes have the highest energy consumption compared to any other housing type, paying more than double the energy cost.[115] As noted in Table 10 below, the increased energy usage in a manufactured home in Kentucky Power's service territory is higher than single or multifamily properties. The energy burden is significant as residents of manufactured housing are more likely be on fixed-income or qualify as low-income. Furthermore, existing manufactured housing is likely to be less efficient than single- and multi-family homes, as nationwide standards for multifamily housing first went into effect in 1976, were updated in 1994, and then did not undergo any significant changes until 2016.[116] In 2022, the Department of Energy adopted the latest International Energy Conservation Code ("IECC") standards, IECC 2021, for manufactured homes which should lower energy bills compared to existing models due to increased insulation and air sealing requirements; however, this code adoption only impacts new units.[117] This energy burden is experienced by Kentucky Power's customers, as shown in the MPS, where manufactured homes account for 31 percent of the residential energy consumption. The MPS

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[114] *Comparative Housing Characteristics [for Kentucky]* (2022), U.S. Census Bureau, https://data.census.gov/table?q=housing+types+in+kentucky&t=Heating+and+Air+Conditioning+(HVAC):Physical+Characteristics&g=050XX00US21019&y=2022
[115] Forest Bradley-Wright, *Energy Efficiency in the Southeast Fifth Annual Report*, Southern Alliance for Clean Energy (Mar. 2023),https://cleanenergy.org/wp-content/uploads/Energy-Efficiency-in-the-Southeast-Fifth-Annual-Report.pdf; Lowell Ungar, Mobile Homes Move Toward Efficiency, ACEEE (Aug. 3, 2016), https://www.aceee.org/blog/2016/08/mobile-homes-move-toward-efficiency
[116] Forest Bradley-Wright, *New Traction on Efficiency Programs for Manufactured Homes*, Southern Alliance for Clean Energy (April 2023), https://www.cleanenergy.org/blog/new-traction-on-efficiency-programs-for-manufactured-homes/ (last visited October 3, 2023).
[117] *DOE Updates Mobile Home Efficiency Standards to lower Household Energy Bills*, Department of Energy, https://www.energy.gov/articles/doe-updates-mobile-home-efficiency-standards-lower-household-energy-bills.

identified that 15% of the achievable potential for Kentucky Power will come from manufactured homes.[118] Yet, the MPS did not include any specifics regarding measures to address this type of housing.

Table 10. Average Energy Use Per Square Foot in Kentucky by Housing Type[119]

PREMISE TYPE	AVG. ANNUAL ENERGY USE (KWH)	AVERAGE PREMISE SIZE (SQ. FT)	AVERAGE ENERGY USE PER SQUARE FOOT (KWH/SQ. FT)
SINGLE FAMILY	15,834	1,433	11.05
MANUFACTURED HOMES	14,821	1,001	14.81
MULTIFAMILY	8,582	1,957	4.39
AVERAGE	14,879	1,340	11.10

While there are some measures, such as insulation, air sealing, and heat pumps, that can be installed in manufactured housing, having a dedicated program promotes equitable EE programs and can address issues specific to manufactured housing, such as weatherization techniques for air sealing due to the design and insulated skirting. Development of a manufactured housing efficiency program would be supportive of the Manufactured Housing and Energy Efficiency Affordability Initiative, which the Kentucky Office of Energy Policy has committed to, that is designed to develop best practices for addressing various parts of manufactured housing, high heating and cooling costs and improving the availability of affordable and energy-efficiency housing options.[120] There are several examples of dedicated manufactured home efficiency programs that Kentucky Power can reference as it develops its own program design.[121]

For homes that are heated with resistant heating, it typically costs more to remove the inefficient heating system and replace it with either a central or mini-split heat pumps due to the costs, lack of duct

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[118] MPS at 31.

[119] MPS at 47. Average Annual Energy Use and Average Premise Size are recreated, in part, from Table 6-1 Summary Statistics by Residential Premise Type. The premise level square footage in the MPS was derived from individual residential accounts. Therefore, the assumption is that the multifamily premise square footage is the average per multifamily unit and not average per multifamily building.

[120] *Nat'l Ass'n Energy Officials, Manufactured Housing,* https://www.naseo.org/issues/buildings/manufactured (last visited Oct. 5, 2023).

[121] Examples of EE manufactured homes can be found here: Forest Bradley-Wright, *New Traction on Efficiency Programs for Manufactured Homes*, Southern Alliance for Clean Energy (Apr. 19, 2023), https://www.cleanenergy.org/blog/new-traction-on-efficiency-programs-for-manufactured-homes/; Jonathan Susser, *Keeping Manufactured Housing Affordable Through Energy Efficiency*, Advanced Energy (June 11, 2018), https://www.advancedenergy.org/2018/06/11/keeping-manufactured-housing-affordable-through-energy-efficiency/.

work, and/or upgrades for electrical panels. Therefore, transitioning to more efficient equipment, like a heat pump, will require a higher investment than a home that already has a central furnace. Therefore, Kentucky Power should consider offering a wide variety of incentive levels, based upon existing heating and cooling conditions, to allow for more inclusive programs related to HVAC.

On the commercial side, there should be a focus to ensure that small business customers, including mom and pop shops, are able to take advantage of EE opportunities related to weatherization and building resiliency. Small business customers typically require higher financial incentives and short-term, no cost financing to adopt EE measures, as well as more assistance to complete the process, such as an energy assessment. The only mention of small businesses in the MPS is related to the Marketplace program, where customers can purchase items such as thermostats, smart plug strips, and, potentially, small appliances.[122] Beyond limited program offerings specific for small-business, there are no financing options discussed throughout the MPS; however, it is common for small business efficiency programs to be complemented with financing options, designed to have the remaining project cost paid back over a short-term period during which the benefits/savings matches or exceeds the payback term. There are voluminous examples of small business EE programs throughout the United States.[123]

On both the residential and business side, there may be a concern about the rural nature of the Kentucky Power service territory which can provide geographic barriers, impact workforce availability, and result in higher upfront costs to provide services. However, there are offerings throughout the U.S., including in Maine, Alaska, and Vermont, that identify successful implementation of EE programs in rural areas.[124] AEP, the parent company of Kentucky Power, has successfully implemented EE programs in

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[122] MPS at 8.

[123] Some examples of programs include: AEP Energy Small Business, https://www.aepenergy.com/small-business/; Appalachian Power Small Business Direct Install Program, https://takechargeva.com/programs/for-your-business/small-business-direct-install-program; Baltimore Gas and Electric Small Business Energy Solutions, https://bgesmartenergy.com/business/business-programs/small-business-energy-solutions#:~:text=Eligible%20businesses%20located%20in%20BGE's,Learn%20more; Energize Connecticut Small Business Energy Advantage Program; Southwestern Electric Power Company Small Business Pathway, https://swepcosavings.com/#/small-business; Duke Energy Progress Small Business Energy Saver, https://www.duke-energy.com/business/products/small-business-energy-saver/learn-more?jur=NC02; Consumers Energy Small Business Energy Efficiency, https://www.consumersenergy.com/business/energy-efficiency/small-business-solutions.

[124] A Department of Energy-funded two-year project, known as Bridging the Rural Efficiency Gap Project, identified effective approaches to address residential EE in rural areas of Alaksa, Maine, New Hampshire, and Vermont. Kentucky Power should review how the options could be successfully adopted within its service territory. Brooks Winner et al., *Bridging the Rural Efficiency Gap: Expanding Access to Energy Efficiency Upgrades in Remote and High Energy Cost Communities*, Island Institute (2018), https://www.energy.gov/scep/slsc/articles/bridging-rural-efficiency-gap-expanding-access-energy-

nearby states, such as Southwestern Electric Power Company's programs in Arkansas, [125] Indiana Michigan Power's programs in Indiana and Michigan,[126] Appalachian Power's programs in West Virginia and Virginia.[127] To drive participation and workforce development in rural areas, like the Kentucky Power service territory, the Company should consider working with local partners and the community to design and implement the EE programs, as well as work with the state to develop workforce training, which could potentially leverage funds from other utilities in the area, as well as funding from the Inflation Reduction Act ("IRA").[128] In addition, when evaluating DSM implementation contractors, the Company should prioritize contractors with demonstrated experience implementing EE programs in rural areas and developing a workforce and trade allies in an area that has not previously had EE programs.

While there are specific attributes to the Kentucky Power service territory that may appear as barriers to implementing DSM programs, such as a rural service territory, none of those should be viewed as a limitation on the potential energy and capacity savings that can be achieved. While MPS's are performed for individual utilities, ACEEE found, through the analysis of 45 potential studies, that "the relationship between savings and study time period, savings and census region (to assess possible geographical differences), savings and participation rates, and savings and avoided costs . . . [that] [i]t does not appear that savings vary by geography: there was equal representation across the country for a given level of savings."[129] Figure 8 below shows that regardless of the potential study's region, with each region represented in a different color, the savings achieved by a region varies significantly instead of being clustered together. Therefore, the Company's geographic characteristics should not dictate the level of savings that can be achieved, rather it should influence the program design to ensure successful delivery.

efficiency-updates-remote#:~:text=The%20"rural%20efficiency%20gap"%20describes,areas%20with%20lower%20energy%20prices.

125 Sw. Elec. Power Co., *Money Saving Programs*, https://www.swepco.com/savings/home/money/incentives/ (last visited Sept. 29, 2023).

126 Indiana Michigan Power Co., *Electric Ideas: Rebates & Products*, https://electricideas.com/at-home/rebates-products/ (last visited Sept. 29, 2023).

127 Appalachian Power, *Appalachian Power Residential Programs*, https://www.appalachianpower.com/savings/home/ (last visited Sept. 29, 2023).

128 Mary Shoemaker et al., R*eaching Rural Communities with Energy Efficiency Programs*, ACEEE (Sept. 2018), https://www.aceee.org/sites/default/files/publications/researchreports/u1807.pdf.

129 Neubauer Report at v, *supra* n.73.

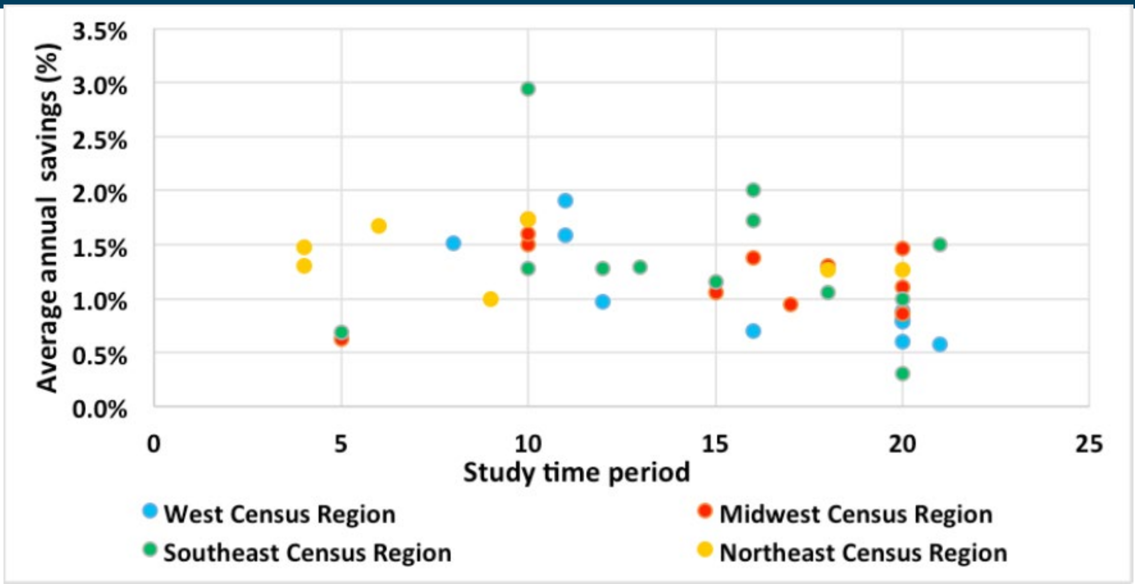

Figure 8. Average annual electricity savings (%), by census region, reproduced from ACEEE[130]

5.4 IRA Funding

Through the IRA the state of Kentucky will receive $67.3 million for the Home Energy Performance-based, Whole House rebates ("HOMES") and $66.9 million for the High Efficiency Electric Home Rebate ("HEERA"), which are programs that rebate efficiency electrification and weatherization, with increased rebates for low- and moderate-income households. While these funds are available through the year 2031, it is likely that the funds will be utilized before that time if successfully implemented. While $134 million seems like a lot of funding, 20 percent of these funds are allowed to be allocated for administration of the rebate programs, which lowers the amount of funds to approximately $107 million.[131] This funding will be available to qualified homes throughout the entire state of Kentucky and will likely be utilized in locations that have available workforce that can provide energy audits and perform weatherization and HVAC work. Therefore, having EE programs in place from the utility will help ensure that Kentuckians in the Kentucky Power service territory will be able to take advantage of the funds.

The IRA funding from HOMES and HEERA will likely be best utilized if leveraged with other efficiency rebates and incentives and in an area with an established weatherization and HVAC workforce. While it

[130] *Id.* at 30, Fig. 4: Average annual electricity savings (%), by census region.
[131] Without existing infrastructure in place, such as utility EE programs, the administration of the funds will likely require use of the full 20 percent of the funds, if not more from additional funding sources given the program requirements.

will likely take time for Kentucky Power to implement and ramp up programs, the Company could have its utility programs up and running well before the conclusion of the funding available. It will also provide opportunities for Kentucky Power to leverage program opportunities, such as direct load control switches on heat pumps, which can help to shift demand as homes electrify.

Rebates are not the only form of funding coming from IRA that will support EE. In addition to the rebates, there are IRA initiatives that will offset the costs for solar and EE upgrades for single and multifamily properties, such as those from the Greenhouse Gas Reduction Fund Solar for All initiative and the Green and Resilient Retrofit Program. Furthermore, complimentary efforts on financing are being offered through green bank efforts. Kentucky Power should explore how these initiatives, plus partnering with the Green Bank of Kentucky, can provide ratepayers with options to implement EE within their homes and businesses.

IRA funding should be seen as complementary to any DSM efforts implemented by Kentucky Power, rather than as a replacement for utility investment in energy savings. EE and DR programs take time to ramp up, likely at a faster pace than projected by Kentucky Power in its benchmarking and MPS report. The infrastructure used to implement Kentucky Power's DSM programs can be used to support the utilization of the IRA funds, which are likely not going to be widely available until 2025. The launch of DSM programs in the Kentucky Power Service territory can benefit from the buzz around the IRA funding and discussions of efficiency to help promote their programs outside of any direct marketing performed by the Company. Outside of IRA funding, Kentucky Power is facing a capacity shortage, which can be offset by investment in EE. Therefore, it is important that Kentucky Power begin its EE sooner rather than later.

6 Summary of Recommendations

Based on our review of the Companies' IRP and its responses to our discovery, we offer the following recommendations to Commission Staff and Kentucky Power:

Stakeholder Process

1. Provide stakeholders with a schedule of when modeling and supporting data will be shared;
2. Build time into the schedule to allow stakeholders to submit feedback on information shared;
3. Schedule follow up meetings as necessary to discuss feedback that results in points of disagreement; and
4. Assist with negotiating a discounted, project-based licensing fee that permits interested intervenors the ability to perform their own modeling runs in the same software package(s).

Inputs and Modeling

1. Update modeling to remove the Ebon load from the load forecast;
2. Include modeling runs that relax annual build limits on renewable and battery storage resources;
3. Apply cost increases to all resources, regardless of technology type in the modeled scenarios;
4. Model battery storage resources with at least a 15-year book life;
5. Ensure that the full tax gross up was applied to the Production Tax Credit ("PTC") and the Investment Tax Credit ("ITC") modeled for renewables and battery storage resources in Aurora;
6. Include the potential for renewables and battery storage resources to qualify for the Energy Community bonus adder;
7. Update information around the pipeline and firm gas transportation costs for any new natural gas combustion turbine ("NGCT") capacity;
8. Model 8 or 10-hour lithium-ion battery storage and multiday storage resources as candidate resources;
9. Evaluate higher levels for the Effective Load Carrying Capability ("ELCC") for four-hour battery storage resources to align with projections from PJM;
10. Include modifications to the Portfolio Scorecard metrics;
11. Evaluate the proposed greenhouse gas regulation from the Environmental Protection Agency ("EPA");
12. Implement adjustments to modeling energy efficiency as a supply side resource; and
13. Remove the application of the Supplemental Efficiency Adjustment ("SEA") to energy efficiency bundles modeled as a supply side resource.

With respect to Kentucky Power's DSM planning process, we recommend that programs specifically tailored to customers who rely on electric resistance heating, live in manufactured housing, or run small businesses—all segments with great need and opportunity for energy savings. We encourage Kentucky Power to consider the workforce development benefits of DSM program investments, and to develop a portfolio of programs that leverage and complement federal efficiency incentives.

Attachment - A

Chelsea Hotaling
Consultant

Professional Summary

Chelsea is a Consultant at Energy Futures Group specializing in integrated resource planning and load forecasting. Prior to joining EFG, Chelsea held a research position at Clarkson University while completing her Master's in Data Analytics and Environmental Policy & Governance. Chelsea's research focused on multi-stakeholder microgrids for resiliency. She also participated in the Reforming the Energy Vision (REV) proceedings for the Potsdam (NY) microgrid REV project. Chelsea's current work is focused on all aspects of Integrated Resource Planning including capacity expansion and production cost modeling and load forecasting. Chelsea runs the EnCompass model in support of long-term planning exercises such an IRP analyses and has critiqued IRP modeling performed using Aurora, PLEXOS, PowerSimm, and System Optimizer. Chelsea has also conducted capacity expansion, production cost, and reliability modeling using the Aurora, PLEXOS, and SERVM models. Chelsea has experience working with numerous software programs including Python, R, and Stata.

Education

M.S., Data Analytics, Clarkson University, 2020

M.S., Environmental Policy and Governance, Clarkson University, 2019

MBA, Concentration in Environmental Management, Clarkson University, 2012

B.S., Accounting and Economics, Elmira College, 2011

Experience

2021-present: Consultant, Energy Futures Group, Hinesburg, VT

2020-2021: Senior Analyst, Energy Futures Group, Hinesburg, VT

2019-2020: Analyst, Energy Futures Group, Hinesburg, VT

2018-2019: Intern, Sommer Energy, Canton, NY

2016-2019: Research Assistant, Clarkson University, Potsdam, NY

Selected Projects

- The South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. Performed SERVM modeling to evaluate a clean energy replacement portfolio for proposed coal plant retirements in the Dominion Energy South Carolina 2023 IRP. (2023)
- The Ecology Center, the Environmental Law & Policy Center, the Union of Concerned Scientists, and Vote Solar. Performed capacity expansion and production cost modeling

within EnCompass to put forward an alternate plan to DTE's preferred plan in its 2022 IRP. (2022 to 2023)

- GridLab. Performed capacity expansion and production cost modeling within EnCompass to identify resource mixes to achieve 100% emissions-free electricity by 2035 for the Public Service Company of New Mexico's electric system. (2022 to 2023)
- Sierra Club. Performed capacity expansion and production cost modeling within EnCompass to evaluate retirement and replacement of MidAmerican's coal plants. (2022 to 2023)
- Kentuckians for the Commonwealth, Kentucky Solar Energy Society, and Mountain Association. Reviewed and provided comments on East Kentucky Power Cooperative's 2022 Integrated Resource Plan. (2022)
- Kentuckians for the Commonwealth, Kentucky Solar Energy Society, Metropolitan Housing Coalition, and Mountain Association. Reviewed and provided comments on Louisville Gas & Electric and Kentucky Utilities' 2021 Integrated Resource Plan. (2022)
- The Department of Attorney General and Sierra Club. Reviewed and submitted testimony on the Aurora modeling Indiana Michigan Power Company performed for its 2021 Integrated Resource Plan. (2022)
- The Environmental Law and Policy Center, The Ecology Center, Union of Concerned Scientists, and Vote Solar. Performed Aurora modeling to evaluate higher levels of distributed solar for the Consumers Energy Company's 2021 Integrated Resource Plan. (2020 to 2021)
- Colorado Office of the Utility Consumer Advocate. Performed EnCompass modeling related to the Public Service Company of Colorado's 2021 Electric Resource Plan. (2021)
- Minnesota Center for Environmental Advocacy. Evaluation of Otter Tail Power's 2021 Integrated Resource Plan and EnCompass modeling in support of that evaluation. (2022 to present) Evaluated Minnesota Power's 2021 Integrated Resource Plan and performed EnCompass modeling in support of that evaluation. (2021 to 2022) Evaluated Xcel Energy's 2020 Integrated Resource Plan and performed EnCompass modeling in support of that evaluation. (2019 to 2021)
- Earthjustice. Evaluation of PREPA's request for proposals for temporary emergency generation. (May 2020) Evaluation of the Puerto Rico Electric Power Authority's 2019 Integrated Resource Plan. (2019 to 2020)
- The Council for the New Energy Economics. Participated in Evergy's integrated resource plan stakeholder workshops and performed EnCompass modeling to evaluate coal plant retirements (2020 to 2021).
- EfficiencyOne. Supported EfficiencyOne's participation in Nova Scotia Power's integrated resource planning process. (2019 to 2020)
- Southern Alliance for Clean Energy. Evaluation of Dominion Energy South Carolina's 2020 Integrated Resource Plan. (2020)
- Washington Electric Cooperative. Conducted the analysis for the 2020 Integrated Resource Plan. (2019 to 2020)

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- Coalition for Clean Affordable Energy. Evaluated the Public Service Company of New Mexico's abandonment and replacement of the San Juan generating station and performed EnCompass modeling to develop an alternative replacement portfolio. (2019 to 2020)
- Citizens Action Coalition of Indiana. Comments regarding Duke Energy Indiana's integrated resource plans to meet future energy and capacity needs (May 2022). Comments regarding Northern Indiana Public Service Company's integrated resource plans to meet future energy and capacity needs. (March 2022) Comments regarding Southern Indiana Gas and Electric's integrated resource plans to meet future energy and capacity needs (November 2020). Comments regarding Indianapolis Power and Light's integrated resource plans to meet future energy and capacity needs (April 2020). Comments regarding Indiana Michigan Power Company's integrated resource plans to meet future energy and capacity needs (December 2019).
- Institute for Energy Economics and Financial Analysis (IEEFA). Evaluation of National Grid's long-term natural gas capacity report. (March 2020) Evaluation of the Puerto Rico Energy Commission's proposed wheeling regulation. (March 2019) Co-author for the report Retail Choice Will Not Bring Down Puerto Rico's High Electricity Rates. (August 2018) Evaluation of the Puerto Rico Energy Commission's proposed microgrid rules. (February 2018)

Publications

Hotaling, C., Bird, S., & Heintzelman, M. D. (2021). Willingness to pay for microgrids to enhance community resilience. Energy Policy, 154, 112248.

Atems, B., & Hotaling, C. (2018). The effect of renewable and nonrenewable electricity generation on economic growth. Energy Policy, 112, 111-118.

Bird, S., & Hotaling, C. (2017). Multi-stakeholder microgrids for resilience and sustainability. Environmental Hazards, 16(2), 116-132.

Bird, S., Enayati, A., Hotaling, C., and Ortmeyer, T. (2017). Resilient Community Microgrids: Governance and Operational Challenges. In Energy Internet: An Open Energy Platform to Transform Legacy Power Systems into Open Innovation and Global Economic Engine, edited by Alex Q. Huang and Wencong Su. Elsevier.

Expert Testimony

Before the South Carolina Public Service Commission, Docket No. 2023-9-E. On behalf of the South Carolina Coastal Conservation League, Southern Alliance for Clean Energy, and Sierra Club.

Before the Michigan Public Service Commission, Case No. U-21193. *In the Matter of the Application of DTE Electric Company for Approval of its Integrated Resource Plan Pursuant to MCL 460.6t, and for other* *relief,* on behalf of the Ecology Center, the Environmental Law & Policy Center, the Union of Concerned Scientists, and Vote Solar.

Before the Kentucky Public Service Commission, Case Number 2022-00387. *In the Matter of Electronic Tariff Filing of Kentucky Power Company for Approval of a Special Contract with Ebon International, LLC,* on behalf of Mountain Association, Kentuckians for the Commonwealth, Appalachian Citizens' Law Center, Sierra Club, and Kentucky Resources Council.

Before the Kentucky Public Service Commission, Case Number 2022-00371. *In the Matter of Electronic Tariff Filing of Kentucky Utilities Company for Approval of an Economic Development Rider Special Contract with Bitiki-KY, LLC,* on behalf of Kentuckians for the Commonwealth, Kentucky Solar Energy Society, Mountain Association, and Kentucky Resources Council.

Before the Iowa Utilities Board, Docket No. RPU-2022-0001. *Application for a Determination of Ratemaking Principle*, on behalf of Environmental Intervenors.

Before the Michigan Public Service Commission, Case No. U-21189. *In the Matter of the Application of Indiana Michigan Power Company for Approval of its Integrated Resource Plan Pursuant to MCL 460.6t, Avoided Costs and for Other Relief,* on behalf of Attorney General Dana Nessel and Sierra Club.

Before the Michigan Public Service Commission, Case No. U-21090. *In the Matter of the Application of Consumers Energy Company for Approval of its Integrated Resource Plan Pursuant to MCL 460.6t and for Other Relief*, on behalf of the Environmental Law and Policy Center, the Ecology Center, Union of Concerned Scientists, and Vote Solar.

Before the Public Utilities Commission of Colorado, Proceeding No. 21A-0141E. *In the Matter of the Application of Public Service Company of Colorado for Approval of its 2021 Electric Resource Plan and Clean Energy Plan*, on behalf of the Colorado Office of the Utility Consumer Advocate.

Attachment - B

Stacy Sherwood
Managing Consultant

ENERGY FUTURES GROUP

Professional Summary

Stacy Sherwood brings over a decade of experience in the energy industry, specializing in energy efficiency (EE), demand response (DR), automated metering infrastructure (AMI), cost recovery, and renewable energy. Stacy has testified or provided comments before the public service commissions of Louisiana and Maryland and the public utilities commissions of Pennsylvania and Rhode Island on AMI, EE, and reasonableness of revenue increases. Throughout her career, Stacy has evaluated various electric and natural gas EE and DR plans; potential studies; evaluation, measurement, and verification reports; and riders for cost recovery. In particular, she has specialized in the design of low-income EE programs in Arkansas, Maryland, and Pennsylvania. Ms. Sherwood has also testified in 14 cases related to the reasonableness of revenuer requirements in Pennsylvania and Rhode Island.

Experience

2021-present: Managing Consultant, Energy Futures Group, Hinesburg, VT

2015-2021: Senior Analyst, Exeter Associates, Inc., Columbia, MD

2013-2015: Assistant Director of Energy, Analysis, and Planning Division, Maryland Public Service Commission, Baltimore, MD

2011-2013: Regulatory Economist II, Maryland Public Service Commission, Baltimore, MD

2009-2011: Regulatory Economist I, Maryland Public Service Commission, Baltimore, MD

Education

B.A., Business Administration, Economics, Accounting/Economics, McDaniel College, 2009

Select Projects

- Connecticut Energy Efficiency Board. Senior Technical Lead of the oversight of the state's electric and gas residential energy efficiency programs. Work closely with the state's utilities to develop, implement, and evaluate cost-effective program designs and goals for the Three-Year Conservation and Load Management Plan.
- Louisiana Public Service Commission. Filed testimonies evaluating the reasonableness of automated metering infrastructure implementation plans by Concordia Electric Cooperative, Inc., Southwest Louisiana Electric Membership Corporation, and Point Coupee Electric Membership Corporation. (2020-2021)
- Pennsylvania Office of Consumer Advocate. Reviewed and commented on potential studies utilized to develop energy efficiency and demand response targets for Phase III and IV of the Act 129 Energy Efficiency and Conservation (EE&C) Program. Provided written testimony on utility EE&C five-year plans. (2015-2021)

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- Arkansas Attorney General's Consumer Utility Rate Advocacy Division. Drafted a dedicated limited income EE program strawman implemented on a pilot basis by the electric and natural gas utilities. (2018-2020)
- Arkansas Attorney General's Consumer Utility Rate Advocacy Division. Participated in Parties Working Collaboratively (PWC) group regarding the electric and natural gas EE programs. Provided comments on three-year plans, annual progress reports, and evaluation, measurement, and verification reports. (2017-2021)
- U.S. Air Force Civil Engineer Center. Evaluated the feasibility of geothermal energy production at Edwards Air Force Base. (2015-2016)
- Maryland Public Service Commission Staff. Developed templates and directed work groups related to the implementation of the electric and natural gas EmPOWER Maryland EE and DR programs. Evaluated the semi-annual reports and three-year plans filed by the utilities and submitted comments regarding plan recommendations before the Maryland Public Service Commission. (2009-2015)

Select Publications

- Author on Chapter 2.5 Environmental Justice, Final Report Concerning the Maryland Renewable Portfolio Standard as Required by Chapter 393 of the Acts of The Maryland General Assembly of 2017, https://dnr.maryland.gov/pprp/Documents/FinalRPSReportDecember2019.pdf.
- Lead Author, Power Plant Research Program, Maryland Department of Natural Resources
  - Electricity in Maryland – Fact Book, 2019
  - Electricity in Maryland – Fact Book, 2016

Expert Testimony

Before the Kentucky Public Service Commission, Case No. 2022-00424, *Kentucky Power Company's Special Contract Under its Economic Development Rider And Demand Response Service Tariffs with Cyber Innovation Group LLC*, March 2023, on behalf of Joint Intervenors Kentuckians For the Commonwealth, Appalachian Citizens' Law Center, Sierra Club, Mountain Association, and Kentucky Resources Council, Inc. Testified on compliance of the Special Contract with the Economic Development Tariffs and Orders.

Before the Kentucky Public Service Commission, Case No. 2022-00529, *Kentucky Power Company's Special Contract for Electric Service and Rider D.R.S. Addendums with Ebon International, LLC*, February 2023, on behalf of Joint Intervenors Kentuckians For the Commonwealth, Kentucky Solar Energy Society, Mountain Association, and Kentucky Resources Council, Inc. Testified on compliance of the Special Contract with the Economic Development Tariffs and Orders.

Before the Kentucky Public Service Commission, Case No. 2022-00371, *Electronic Tariff Filing of Kentucky Utilities Company for Approval of An Economic Development Rider Special*

PO Box 587, Hinesburg, VT 05461 – USA | 410-371-0623 | ssherwood@energyfuturesgroup.com

Contract with Bitiki-KY, LLC., January 2022, on behalf of Joint Intervenors Kentuckians For the Commonwealth, Kentucky Solar Energy Society, Mountain Association, and Kentucky Resources Council, Inc. Testified on compliance of the Special Contract with the Economic Development Tariffs and Orders.

Before the Maine Public Utilities Commission, Docket No. 2022-00255, *In the Matter of Versant Power Request for Approval of a Rate Change Pursuant* to 35-A M.R.S. *§ 307 and Chapter 120*, December 2022, for Maine Office of Public Advocate. Testified regarding reasonableness of the overall revenue increase.

Before the Kansas Corporation Commission, Docket No. 22-EKME-254-TAR *In the Matter of the Application of Evergy Kansas Metro, Inc., Evergy Kanasas South, Inc. and Evergy Kansas Central, Inc. for Approval of its Demand-Side Management Portfolio Pursuant to the Kansas Energy Efficiency Investment Act ("KEEIA"), K.S.A. 66-1283*, for Natural Resources Defense Council. Testified regarding reasonableness of the proposed Plan and its compliance with the KEEIA Act.

Before the Louisiana Public Service Commission, Docket No. U-35877 *Pointe Coupee Electric Membership Corporation Application to Acquire and Install an Automated Metering System and Request for Cost Recovery and Related Relief*, February 2021, for the Louisiana Public Service Commission Staff. Testified regarding the implementation of automated metering infrastructure to replace current meters. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. M-2020-3020818, *Petition of Duquesne Light Company for Approval of its Energy Efficiency and Conservation Phase IV Plan*, January 2021, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the proposed Plan and its compliance with Pennsylvania Act 129. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. M-2020-3020830, *Petition of PECO Energy Company for Approval of its Energy Efficiency and Conservation Phase IV Plan*, January 2021, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the proposed Plan and its compliance with Pennsylvania Act 129. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. M-2020-3020824, *Petition of PPL Electric Utilities for Approval of its Energy Efficiency and Conservation Phase IV Plan*, January 2021, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the proposed Plan and its compliance with Pennsylvania Act 129. (Case settled prior to cross-examination.)

Before the Louisiana Public Service Commission, Docket No. U-35707 Southwest Louisiana Electric Membership Corporation *Application for Approval to Acquire and Install an*

Automated Metering System and Request for Cost Recovery and Related Relief, December 2020, for the Louisiana Public Service Commission Staff. Testified regarding the implementation of automated metering infrastructure to replace current meters. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. R-2020-3020919 *Pennsylvania Public Utility Commission v. Audubon Water Company*, November 2020, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. R-2020-3020256 *Pennsylvania Public Utility Commission v. City of Bethlehem – Water Department*, November 2020, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase. (Case settled prior to cross-examination.)

Before the Louisiana Public Service Commission, Docket No. U-35456 Concordia Electric Cooperative Inc. *Application for Certification of a Replacement Advanced Metering System and Approval of Related Financing*, November 2020, for the Louisiana Public Service Commission Staff. Testified regarding the implementation of automated metering infrastructure to replace current meters. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. R-2020-3019612 *Pennsylvania Public Utility Commission v. Reynolds Disposal Company*, October 2020, for the Pennsylvania Office of Consumer Advocate. Participated in mediation regarding reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3010955 *Pennsylvania Public Utility Commission v. City of Lancaster – Sewer Fund*, October 2019, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3008208 *Pennsylvania Public Utility Commission v. Wellsboro Electric Company*, October 2019, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3008209 *Pennsylvania Public Utility Commission v. Valley Energy, Inc*, October 2019, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3008212, *Pennsylvania Public Utility Commission v. Citizens' Electric Company of Lewisburg, PA*, October 2019, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3009559, *Pennsylvania Public Utility Commission v. Eaton Sewer & Water Company, Inc. – Wastewater Division*, August 2019, for the Pennsylvania Office of Consumer Advocate. Participate in mediation regarding reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3009567, *Pennsylvania Public Utility Commission v. Eaton Sewer & Water Company, Inc. – Water Division*, August 2019, for the Pennsylvania Office of Consumer Advocate. Participate in mediation regarding reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3008947, *Pennsylvania Public Utility Commission v. Community Utilities of Pennsylvania Inc. Water Division*, July 2019, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3008948, *Pennsylvania Public Utility Commission v. Community Utilities of Pennsylvania Inc. Wastewater Division*, July 2019, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. R-2019-3006904, *Pennsylvania Public Utility Commission v. The Newtown Artesian Water Company (Supplement No. 136 to Tariff Water – Pa. P.U.C. No. 9)*, March 2019, for the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the overall revenue increase. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. R-2018-3006814, *Pennsylvania Public Utility Commission v. UGI Utilities, Inc – Gas Division (Utility Code 123100, Filed Tariff Gas- Pa. P.U.C. Nos. 7 and 7S)*, January 2019, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of its proposed consolidated natural gas energy efficiency plan. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. M-2018-3004144, *Petition of UGI Utilities, Inc. – Electric Division for Approval of Phase III of its Energy Efficiency and Conservation Plan*, August 2018, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of proposed Plan. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. R-2018-3001307, *Pennsylvania Public Utility Commission v. Hidden Valley Utility Services, L.P. – Wastewater (General Rate Increase Filed Pursuant to 66 PS. CS 1308, Including Answers to 52 PA. Code 53.52)*, April 2018, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding the reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. R-2018-3001306, *Pennsylvania Public Utility Commission v. Hidden Valley Utility Services, L.P. – Water (General Rate Increase Filed Pursuant to 66 PS. CS 1308, Including Answers to 52 PA. Code 53.52)*, April 2018, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding the reasonableness of the overall revenue increase.

Before the Pennsylvania Public Utilities Commission, Docket No. P-2015-2497267, *Petition of Duquesne Light Company for Approval of its Smart Meter Procurement and Installation Plan*, February 2016, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding the inclusion of additional costs related to the Plan's implementation.

Before the Pennsylvania Public Utilities Commission, Docket No. M-2015-2477174, *Petition of UGI Utilities, Inc. – Electric Division for Approval of Phase II of its Energy Efficiency and Conservation Plan*, February 2016, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of proposed Plan. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. M-2015-2515642, *Petition of PPL Electric Utilities for Approval of its Energy Efficiency and Conservation Phase II Plan*, January 2016, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the proposed Plan and its compliance with Pennsylvania Act 129. (Case settled prior to cross-examination.)

Before the Pennsylvania Public Utilities Commission, Docket No. M-2015-2515375, *Petition of Duquesne Light Company for Approval of its Energy Efficiency and Conservation Phase II Plan*, January 2016, on behalf of the Pennsylvania Office of Consumer Advocate. Testified regarding reasonableness of the proposed Plan and its compliance with Pennsylvania Act 129. (Case settled prior to cross-examination.)

Before the Public Utilities Commission of Rhode Island, Docket No. 4595, *Newport Water Division – Rate Application to Collect Additional Revenues of $1,304,595 for a Total Cost of Service of $20,151,440*, December 2015, on behalf of the Division of Public Utilities and Carriers. Testified regarding reasonableness of the overall rate revenue increase.

Before the Maryland Public Service Commission, Case No. 9311, *In the Matter of the Application of Potomac Electric Power Company for an Increase in its Retail Rates For the Distribution of Electric Energy*, April 2013, on behalf of the Maryland Public Service Commission Staff. Testified regarding the inclusion of advanced metering infrastructure meters and energy advisor and engineer positions in rates.

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