2023 Integrated Resource Plan Annual Update Report

File No. EO-2023-0294

The Empire District Electric Company
d/b/a Liberty

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2023 Integrated Resource Plan Annual Update Report

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Liberty – The Empire District Electric Company
("Liberty-Empire" or the "Company")
2023 Integrated Resource Plan Annual ("IRP") Update Report

1. Introduction

The purpose of the IRP Annual Update is to ensure that members of the Missouri stakeholder group have the opportunity to provide input and to stay informed regarding the changing conditions since the last triennial IRP ("2022 IRP") filed April 2022 in File No. EO-2021-0331. Consistent with 20 CSR 4240 (the "Rule"), this annual update filing includes updates regarding the:

1) Utility's current preferred resource plan;
2) Status of the identified critical uncertain factors;
3) Utility's progress in implementing the resource acquisition strategy;
4) Analyses and conclusions regarding any special contemporary issues that may have been identified pursuant to 20 CSR 4240;
5) Resolution of any deficiencies or concerns pursuant to 20 CSR 4240; and
6) Changing conditions generally.

In developing this report, Liberty-Empire reviewed and updated the critical uncertain factors identified in the 2022 IRP. Some of these updates were based on Liberty-Empire's 2023-2028 Budget Cycle forecast, which was developed and used for internal short-term budgeting purposes.

This report also provides updates regarding Liberty-Empire's progress on implementing various aspects of the 2022 IRP Short-Term Action Plan, including the retirement of Riverton Units 10 and 11 and the progress being made on the new dual fuel (natural gas and fuel oil) units that will replace them in the 2025 timeframe.

Additionally, since resource planning is a dynamic process, there have been some notable industry changes since the Company filed the IRP in April 2022. This includes recent changes to the Southwest Power Pool ("SPP") planning reserve margin (increasing from 12% to 15%); the introduction of performance-based accreditation in 2024 for conventional generating resources; updated estimates to Effective Load Carrying Capability ("ELCC") ratings for wind and solar resources, and the uncertainty surrounding implementation of the ELCC in the SPP; and the passage of the Inflation Reduction Act ("IRA"). Each of these issues will be addressed within this report.

Finally, the 2023 IRP Annual Update report analyzes and responds to nine special contemporary issues. As the Rule states, special contemporary issues involve a "written list of issues contained in a Commission order with input from staff, public counsel, and intervenors that are evolving new issues, which may not otherwise have been addressed by the utility or are continuations of unresolved issues from the preceding triennial compliance filing or annual update filing." The Order establishing the special contemporary issues to be addressed in this annual update was issued on October 26, 2022, in File No. EO-2023-0102, with an effective date of November 5, 2022. These issues are addressed in Section 7 of this report.

A separate report filed in this docket addresses the 2022 IRP concerns of the Missouri Office of the Public Counsel ("OPC"). This report is an analysis of unserved hours as described within the report and as outlined in the Joint Agreement from the 2022 IRP.

Following section (1) introduction, this report contains sections addressing (2) the status of the critical uncertain factors, (3) a resource acquisition strategy update, (4) a transmission and distribution analysis update, (5) other general updates, (6) a preferred plan update, and (7) responses to the special contemporary issues.

Liberty-Empire's IRP workshop is scheduled for Tuesday, April 18, 2023. The Company's

next triennial IRP compliance filing is scheduled for 2025, with another IRP Annual Update in 2024.

2. Status of the Identified Critical Uncertain Factors

In the 2022 IRP, Liberty-Empire identified the following critical uncertain factors: (1) load; (2) the cost of new builds; (3) natural gas prices; and (4) emission prices and the pressure to reduce carbon.

This section will address the changes to these planning factors since the filing of the 2022 IRP. Most of the critical uncertain factor updates in this section are based on Liberty-Empire's most recent rolling six-year business plan, which is internally developed on an annual basis as a part of Liberty-Empire's ongoing internal planning and budgeting process. The 2023 internal budget covers the period 2023-2028.

Load Forecast Update

A summary of the 2022 IRP load forecast can be found in the 2022 IRP Executive Summary. Additional information can be found in the 2022 IRP Volume 3, which is dedicated to load analysis and load forecasting.

As a part of its ongoing internal planning process, Liberty-Empire developed a new six-year load forecast for the Company's six-year Budget Cycle covering the period 2023-2028.

Liberty-Empire used the 2023-2028 Budget Cycle load forecast update for purposes of this report ("2023 Update"). The following tables compare the demand and energy forecasts from the 2022 IRP, and the 2023 Update for the period 2023-2028.

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As shown in the tables above, the Company's 2023-2028 Budget Cycle forecast (2023 Update) is similar to the load forecast presented in the 2022 IRP. In other words, if the IRP would be prepared at the time that this report was developed, the base load forecast from the 2022 IRP would still be a reasonable forecast. The 2022 IRP was developed in late-2021, while the most recent budget forecast was developed in mid-2022. Some minor differences in forecasts are common and expected, based on timing and methodology. Given that the 2022 IRP is a long-term 20 plus year forecast utilizing the statistically adjusted end-use ("SAE") methodology, and the budget forecast was a shorter-term six-year non-SAE forecast, the two forecast are closely aligned. During the six years presented in the tables, in some years the 2023 Update is slightly higher than the 2022 IRP forecast, and in other years it is slightly lower for both peaks and energy. If you consider the absolute value difference between the 2022 IRP forecast and the 2023 Update forecast, the five-year average differences between the two forecasts would be 0.29% for summer peaks, 1.09% for winter peaks and 0.92% for the native load energy requirement. The following tables present the deltas between the two forecasts.

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Extreme Weather Peak in December 2022

In December 2022, the Company set a new all-time record peak demand of 1,249 MW on the evening of December 22nd during hour ending 7:00 PM with a temperature of minus 6° Fahrenheit. This occurred during Winter Storm Elliott that transpired from roughly December 21 through December 26, 2022. Winter Storm Elliott was a cross-country storm that brought blizzard like conditions to several states, and strong winds and brutally cold temperatures to the eastern two-thirds of the nation. In general, this weather event impacted the Liberty-Empire service territory by delivering extreme cold temperatures that greatly impacted the demand for electricity.

This record peak demand eclipsed the previous record of 1,220 MW which occurred on February 16, 2021, at hour ending 7:00 AM with a temperature of minus 14° Fahrenheit during Winter Storm Uri. However, it should be noted that the Storm Uri peak could have been even higher except for curtailments. During Storm Uri, SPP declared an Energy Emergency Alert ("EEA") Level 3 due to extremely low temperatures and inadequate supplies of generation. As a result, SPP directed member utilities to implement controlled, temporary interruptions of service. Based on SPP's direction, the Company shed about 60 MW of load during the peak hour of Storm Uri. Additionally, the Company requested conservation efforts from all customers during Storm Uri. The Company also called on its interruptible customers to curtail load during this period and attained about 9.25 MW of industrial load reductions during the peak hour of Storm Uri.

Cost of New Builds Update

The cost of 2022 IRP supply-side resource candidates can be found in 2022 IRP Volume 4, Supply-Side Resource Analysis. This section will address updates to the cost of new resource options since the 2022 IRP was prepared.

Technology Capital Cost Update

The original planning-level capital cost assumptions for generic resources in the 2022 IRP

were developed by Charles River Associates ("CRA") with review and input by experts from a third-party engineering firm, Black & Veatch. CRA reviewed key publicly available resources to identify any material trends in cost evolution that have occurred since the original study.

The Energy Information Administration ("EIA") Annual Energy Outlook ("AEO") 2023 released in March 2023 indicates that the capital costs for natural gas fueled combustion turbine ("CT"), combined cycle ("CC"), and reciprocating internal combustion engine ("RICE") generators have increased by 9-10% in real terms (22-24% nominal terms) relative to the EIA AEO 2021 which served as a key input for the 2022 IRP study. For storage, the AEO 2023 shows a 9% increase in nominal terms (small decrease in real terms). Although the data behind the AEO 2023 will have an inherent lag relative to current levels, this dynamic reflects the magnitude and direction of increasing inflationary pressures observed across the industrial sector and broader economy since the 2022 IRP.

Renewable technologies have similarly experienced cost increases. In their Q4 2022 Power Purchase Agreement ("PPA") Price Index, LevelTen Energy observes that PPA prices increased by 40-50% for both wind and solar from Q4 2021 to Q4 2022.

Liberty-Empire will monitor and again reevaluate the capital costs and all other planning assumptions during the development of the 2024 Annual IRP update and the 2025 triennial IRP.

Inflation Reduction Act and the Cost of Resource Options

The Inflation Reduction Act of 2022 passed the Senate and House of Representatives and was signed by President Biden on August 16, 2022. The bill includes the following energy related features which have implications for power markets:

- Overall, $369 billion in estimated energy and climate related spending over the next decade.
- Extension of the investment tax credit ("ITC") and production tax credit ("PTC") by 10 years, which become technology neutral starting in 2025. An extension of the ITC for stand-alone storage was also included.
- Bonus tax credit levels available based on prevailing wage and apprenticeship requirements, domestic content conditions, and location of projects.
- New or expanded subsidies for emerging technologies such as carbon capture, hydrogen, and existing nuclear generators.
- Subsidies for energy efficiency and electric vehicles.

The IRA has a material impact on the economics of new low emissions resources. Prior to the IRA, previous policy provided federal tax incentives for wind via the PTC at a rate of $15/MWh (60% of $25/MWh real $2021 level) with eligibility through 2021 for start of service, and for solar via the ITC at a rate of 10% of upfront capital cost for start of service after 2025 (phasing down from 30%, 26%, and 22% ITC for projects commencing construction through 2019, 2022, and 2023, respectively, and in service through 2025). IRA extends eligibility for the PTC until start of service in 2032 at a rate of $25/MWh (real $2021), expands this PTC to include solar, makes storage eligible for the ITC until start of service in 2032 at a rate of 30% of upfront capital cost, offers certain bonus opportunities for even greater tax credits, and provides provisions for other low emissions technologies including nuclear, hydrogen, and carbon capture and storage ("CCS").[1]

Liberty-Empire will continue to monitor technology costs and federal tax incentives for clean energy going forward.

[1] Federal tax incentive figures in this paragraph are prior to tax gross up.

Natural Gas Price Update

This section discusses updates to natural gas prices since the filing of the 2022 IRP. A summary of the natural gas price forecast used in the 2022 IRP can be found in more detail in 2022 IRP Volume 4, Supply-Side Resource Analysis.

For the long-range 2022 IRP study, Liberty-Empire used the natural gas price forecasts from the CRA Natural Gas Fundamentals Model ("NGF") (considered confidential). CRA developed three separate price forecasts for use in modeling base, low, and high gas price scenarios.

For the development of a six-year budget for the 2023-2028 Budget Cycle, Liberty-Empire used gas prices from the Horizons Energy 2022 market forecast. Overall, the gas price forecasts used for the 2023-2028 Budget Cycle were higher than the gas price forecasts modeled in the 2022 IRP Base Case and more closely aligned with the IRP High Case forecast, especially in the latter years. However, the updated gas prices are still within the range of uncertainty analyzed in the 2022 IRP and closely aligned with the EIA AEO 2022 forecast. Furthermore, although near-term natural gas prices spiked through much of the second half of 2022, they have fallen materially below the levels used in the 2023 Budget Cycle. The Natural gas price forecasts from the 2022 IRP, the recent budget cycle and EIA AEO 2022 are shown below for comparison.

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Emission Price / Carbon Pressure Update

Carbon prices from the 2022 IRP can be found in 2022 IRP Volume 4, Supply-Side Resource Analysis, Section 5.4.1. This section will provide an update on the emission price/carbon pressure critical uncertain factor.

Affordable Clean Energy Rule

In December 2017, the U.S. Environmental Protection Agency ("EPA") issued an advance notice of proposed rulemaking ("ANPRM") in which the EPA proposed emission guidelines to limit greenhouse gas ("GHG") emissions from existing Electrical Generating Units ("EGUs") and solicited information on the proper respective roles of the state and federal governments in that process, as well as information on systems of emission reduction that are applicable at or to an existing EGU, information on compliance measures, and information on state planning requirements under the Clean Air Act ("CAA"). This ANPRM did not propose any regulatory requirements.

In June 2019, the EPA issued the final Affordable Clean Energy ("ACE") rule and repealed the Clean Power Plan. The ACE rule established emission guidelines for states to develop plans to address GHG emissions from existing coal-fired power plants. The ACE rule has several components: a determination of the best system of emission reduction for GHG emissions from coal-fired power plants, a list of "candidate technologies" states can use when developing their plans, a new preliminary applicability test for determining whether a physical or operational change made to a power plant may be a "major modification" triggering New Source Review, and new implementing regulations for emission guidelines under CAA 111(d). During 2020, Missouri utilities conducted regular meetings with the Missouri Department of Natural Resources to determine the standard of compliance for this rule. Plum Point Energy Associates has also been working through the standard of compliance with the Arkansas Division of Environmental Quality. However, on January 19, 2021, the United States Court of Appeals for the District of Columbia Circuit struck down the ACE Rule.

It is likely that the Biden Administration will propose a replacement for the ACE rule. However, the prospect for more stringent carbon emissions controls through EPA regulation is uncertain, particularly given the June 30, 2022, Supreme Court decision in West Virginia v. EPA, which specifically limited the EPA's ability to regulate carbon dioxide emissions from power plants, on the basis that the original CPP had overstepped authority granted under the Clean Air Act. This precedent could create challenges to other regulations looking to address climate change at the federal level. It is now more likely that the Biden EPA replacement for the ACE rule will involve setting a new definition for the "best available control technology" for carbon emissions from power plants as opposed to larger-scale system limits. The definition could include biomass co-blending, efficiency improvements, or carbon capture for fossil fuel power plants as potential solutions.

Carbon Price Timing

In the 2022 IRP, Liberty-Empire evaluated the probable environmental costs of new supply side resource options associated with potential CO2 emissions. Although several legislative and executive actions related to carbon emissions have been attempted over the last decade, there is currently no price on carbon and no binding emission limits at the federal level.

Given previous federal proposals to regulate carbon emissions, Liberty-Empire's Base Case incorporates a modest price on carbon emissions of $9-10/short ton starting in 2026, which can be seen as a proxy for several different potential pathways for legislative action or executive regulation (not explicitly a carbon tax). However, with the passage of the Inflation Reduction Act (previously discussed and further described in special contemporary issue D) and associated additional near to medium term renewable development, any Congressional action on power sector carbon emissions pricing is now unlikely until 2030 or later.

Liberty-Empire will continue tracking federal action related to GHG emissions going forward.

Long-Term Net Zero Target Considerations

In 2021, Algonquin Power & Utilities Corp. established a goal of net-zero by 2050 for scope 1 and scope 2 emissions across its business operations. [2] A significant portion of Liberty-Empire's generation comes from its two existing natural gas CC units, Riverton Unit 12 and State Line CC. In addition to "baseline" retirement assumptions which assume that both

[2] Scope 1 emissions refer to direct greenhouse gas emissions from sources that are controlled or owned by Liberty-Empire. Scope 2 emissions refer to indirect greenhouse gas emissions associated with the purchase of electricity. Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization. For Liberty-Empire, all emissions except those associated with the owned portion of Plum Point and Iatan 1 and 2 are scope 1 and 2 emissions and are counted against Liberty-Empire's net zero goals. Scope 3 emissions are subject to environmental costs but do not count against Liberty-Empire's emissions accounting.

CCs operate beyond 2050, Liberty-Empire also evaluated earlier retirement years for these units in this 2022 IRP to assess the economic feasibility and cost impact of achieving long-term net zero carbon emissions by 2035 or by 2050.[3] Environmental sustainability (carbon reduction) was a key consideration in the Company's scorecard approach used to help determine the preferred resource plan. Although 2050 was beyond the planning horizon of the 2022 twenty-year IRP, the preferred plan resulting from the 2022 IRP is considered a pathway to the corporate net-zero target.

3. Resource Acquisition Strategy Update

This section provides a status update on the supply-side and demand-side implementation plan and describes progress made since the filing of the 2022 IRP. For the 2023 IRP Annual Update, the following will be discussed: the status of Asbury decommissioning; the status of the Community Solar Pilot Program; the Riverton replacement project and retirements of Riverton Units 10 and 11 in the 2025 timeframe; the utility-scale 2:1 solar + storage project envisioned in the IRP for 2027; and the status of the demand-side management implementation plan.

Asbury Decommissioning Status

The Asbury Power Plant ("Asbury") was an approximately 200 MW mine-mouth coal-fired electric power plant located in Jasper County, Missouri, first operational in 1970. The unit was wholly owned and operated by the Company until being officially de-designated from SPP as of March 1, 2020. The electric generating unit is no longer in service.

[3] To achieve net zero carbon emissions by *2050*, Liberty-Empire would likely need to retire Riverton 12 in 2045 and State Line CC in 2050 and replace them with carbon-free resources. To achieve net zero carbon emissions by *2035*, Liberty-Empire would likely plan to either retire both Riverton 12 and State Line CC in 2035 or retrofit these CCs to be able to run entirely on a clean fuel like green hydrogen. While it is currently uncertain whether the existing CCs could feasibly operate on 100% hydrogen, Liberty-Empire assumed the technical capability would arise in the long term solely for IRP analysis and testing purposes. The costs associated with performing this hydrogen retrofit on the existing CCs in 2035 are documented in Sections 2 and 4.

In compliance with the EPA-published final rule to regulate the disposal of coal combustion residuals ("CCRs") as a non-hazardous solid waste under subtitle D of the Resource Conservation and Recovery Act, Liberty-Empire completed final closure of the existing ash impoundment in 2023.

The Asbury campus includes facilities and buildings necessary to support the operations of the original plant. Some of these facilities are now repurposed to support the Asbury Renewable Operations Center ("AROC") used to maintain the new North Fork Ridge Wind Farm, Neosho Ridge Wind Farm, and Kings Point Wind Farm, as well as the Prosperity Solar Facility. The AROC could also potentially be used to support other renewable facilities in the future. The Asbury 161kV substation is also the point of interconnection for the North Fork Ridge Wind Farm, which provides 150 MW of wind energy to the SPP grid.

The remaining portion of the former Asbury power plant is in the demolition process. The contract for demolition was awarded to GSD Trading USA, Inc. Temporary fencing, barricades, and signs were installed to establish safe access-controlled work zones at the site. The environmental sampling (polychlorinated biphenyls ("PCBs"), lead-based paint ("LBP"), background air quality) is now complete. A major milestone was recently achieved with the completion of the asbestos abatement project. A demolition notification has been provided to the Missouri Department of Natural Resources ("MDNR"). This project has proceeded without any challenges to the budget or schedule.

Community Solar Pilot Program Implementation Status

The existing Prosperity Community Solar facility, located on approximately 15 acres of land near Prosperity, Missouri with a capacity of approximately 2.25 MWs (with more than 5,500 bifacial photovoltaic panels) went into service in 2021. Additional community solar capacity is expected to be installed during the next five years. The exact amount to be built will depend upon customer demand. Community solar is unique, in that it is sold as a

voluntary option to interested customers as dedicated renewable supply to offset their individual consumption. These customers participate through a simple and convenient billing mechanism, so they gain the benefits of solar energy supply without needing to install a dedicated system on their own roof or facility. However, at this time, details about the build out are unknown. The tariff requires a full subscription before additional certificates of convenience and necessity ("CCNs") may be effective. The Company has a substantial waitlist for customers expressing an interest in community solar. Liberty-Empire has filed revised tariff sheets that would allow for expansion of the program as supported by customer demand, in conjunction with an additional CCN.

Riverton Replacement Project & Retirements of Riverton Units 10 and 11 (2025 timeframe)

The 2022 IRP preferred resource plan included the replacement of the aging Riverton Units 10 and 11 to enhance the resiliency of Liberty-Empire's electric supply. The original preferred plan identified the addition of approximately 30 MW of RICE generation using existing interconnection at the Riverton site with the retirements of Riverton Units 10 and 11. At the time of the IRP filing, RICE units were selected due to their high efficiency and output capacities similar to the units to be retired. Following the IRP filing, Liberty-Empire worked with Black & Veatch ("B&V") on a technology review examining three models of RICE, six simple-cycle CT models, and batteries. Using the operating data and capital cost information gathered by B&V and fuel and market pricing models available to the Company, Liberty-Empire calculated the 30-year net present value of the revenue requirement ("NPVRR") for the generators studied (see a description of these analyses on page 35). This analysis demonstrated that new CTs had the lower NPVRR as compared to the RICE units originally included in the IRP preferred plan. Liberty-Empire's preferred resource plan was updated to reflect the change to CTs for its 2025 Riverton replacement project. The analysis demonstrated that the substitution of CTs for RICE units reduced the NPVRR by roughly $7.0 million. Additionally, the CTs may provide a benefit for the potential of utilizing H2 as a blend fuel in the future. The updated Riverton CT Replacement project

proposes the installation of two CT generators in the 2025 timeframe. Each new unit will have a nominal net output of 13.3 MW. The turbines are fast-starting and are dual fuel capable, providing resiliency for periods of natural gas scarcity and the capability to start when no off-site power is available. The two new turbines will have no post-combustion pollution controls but will employ dry low NOx combustion to limit NOx formation. The new units have a nominal heat rate of 10,906 Btu/kWh, meaning they will consume approximately 37% less fuel per kWh generated than the units they will replace.

Internally the Company is referring to this as the "Riverton Fast Start Project." The CCN application for this project was filed on February 14, 2023, in Case No. EA-2023-0131. The Missouri Public Service Commission ("Commission") issued an order on February 16, 2023, regarding notice, intervention and response deadlines, and Staff recommendation. At this time, the project expects to receive an air permit around March 2024, with construction commencing in early 2024 for commercial operation in early 2025.

Utility-Scale 2:1 Solar + Storage (2027 timeframe)

In the timeframe considered by this IRP annual update, the preferred plan included a 105 MW utility-scale 2:1 solar + storage resource in 2027. The ratio 2:1 refers to the amount of solar compared to the amount of storage in MW. In the 2022 IRP, solar + storage resources assumed single axis tracking solar and four-hour lithium-ion batteries. A 2:1 ratio of solar to storage helps manage the Company's winter peaking situation. The 2022 IRP envisions that Liberty-Empire would construct this project as part of its core energy supply fleet. The exact timing and location of this facility is currently under evaluation. Changes to this project may result from the Inflation Reduction Act of 2022, specifically provisions of that law extending the solar investment tax credit.

Demand-Side Management ("DSM") Implementation Plan Update

The 2022 IRP preferred plan included the low, mid, and high-cost bundle of the Realistically

Achievable Potential ("RAP") DSM Plan. At this time, Liberty-Empire is offering energy efficiency programs under the Missouri Energy Efficiency Investment Act ("MEEIA") approved by the stipulation and agreement in File No. EO-2022-0078. The portfolio has a total budget of $3,992,313 and consists of Residential Program offerings that include Efficient Products; Low Income Multifamily; the Heating, Ventilation, and Air-Conditioning Program; and Whole Home Energy. Commercial Program offerings include Small Business Direct Install; and a Commercial and Industrial ("C&I") program. These programs were developed with the results of the 2019 IRP analysis. Liberty-Empire is operating this portfolio of programs through 2023 and intends to file MEEIA Cycle 2 to cover 2024-2026 with the results of the 2022 IRP analysis.

4. Transmission and Distribution (T&D) Analysis

This section of the report will update stakeholders about Liberty-Empire's T&D system reliability efforts, including recent SPP interconnection studies conducted for the recent State Line CC upgrade; the Riverton-Neosho transmission line project; a waiver request at the Federal Energy Regulatory Committee ("FERC") regarding the Riverton Unit 10 generation interconnection rights; and time of use rates.

State Line Combined Cycle Interconnection & Transmission Studies

The existing State Line Combined Cycle ("SLCC") generator was placed into service in 1997 and converted to a combined cycle in 2001. Liberty-Empire identified potential facility upgrades that would increase the capacity (about 64 MW of additional capacity being studied) and generator efficiency. These upgrades were included in the GI Queue (GEN-2020-064) and subsequently placed in the Definitive Interconnection System Impact Study (DISIS-2020-001) in June of 2020. Phase one of the established three-phase Generator Interconnection process for SPP showed no required upgrade costs for the additional capacity to be interconnected at the State Line plant. According to SPP, the entire set of study results for DISIS-2020-001 should be expected by 2025.

Riverton-Neosho Transmission Line Project

The Riverton to Neosho 161kV/69Kv transmission line project has recently been placed into service. This project upgraded an aged section of about 25.4 miles of transmission line in Cherokee County, Kansas. This transmission line extends from near Riverton, Kansas to near the Neosho River area southeast of Parsons, Kansas. The permitting and planning for this project began in May 2020 and mobilization began in August 2021. The 161Kv portion was placed in service in January 2023, and the 69kV portion was placed in service in February 2023.

Liberty-Empire customers are expected to see benefits from the Neosho to Riverton line upgrade. The primary benefits are system resiliency, in the forms of reliability and outage contingencies, as well as allowing customers improved access to low-priced generation. Overall, since the upgrade has been in-service, the Company's Energy Supply Services group has noticed eased congestion on the west side of the Liberty-Empire transmission system, where in the past, it was often considered frequently constrained.

Riverton 10 Waiver Request at FERC

This FERC request (ER23-928-000) is related to the Riverton replacement project previously described. The preferred plan from the 2022 IRP calls for the retirement of the aging Riverton Units 10 and 11 and their replacement with newer, more reliable, and more efficient dual fuel units, utilizing the existing generation interconnection rights at the site. However, the SPP Open Access Transmission Tariff ("OATT") contains a requirement that a generating facility replacement request ("GFRR") must be filed "at least one (1) year prior to the date that the Existing Generating Facility will cease operation or up to one year after a unit is determined to be in forced outage." Riverton Unit 10 has been on outage since early 2021, causing the Company to request a waiver at FERC.

On February 8, 2021, Riverton Unit 10 went offline due to a fire in the insulation around the turbine exhaust bearing. To minimize the fire damage, the lube oil system was shut

down prior to the rotor coming to a stop, further damaging the unit. Because of the age of Riverton Unit 10, it is likely certain replacement parts would be unavailable and would have to be manufactured.[4] Given the cost that the Company's customers would incur associated with the fabrication of 1966 vintage custom parts for a relatively small, used and refurbished generating facility, Liberty-Empire's 2022 IRP concluded that Empire's customers would be better served by replacing Riverton Unit 10 with a new, more reliable RICE or other similar technology unit at the same location. However, by the time the IRP process was completed, the SPP OATT requirement that a GFRR be filed "at least one (1) year prior to the date that the Existing Generating Facility will cease operation or up to one year after a unit is determined to be in forced outage" had lapsed."[5]

On January 1, 2023, Liberty-Empire petitioned FERC requesting that the Commission grant it a waiver of SPP's OATT to allow the Company to timely replace the existing generating facility. Good cause exists to grant the waiver of this requirement as the timeline for Liberty-Empire's required IRP process prevented the Company from submitting its GFRR within the one-year period. Following the Company's filing (FERC case number ER23-928-000), both SPP and the Kansas Corporation Commission filed comments in Liberty-Empire's petition. If approved, the waiver and GFRR process will allow Liberty-Empire to replace both Riverton Unit 10 and Riverton Unit 11 by no later than 2025 and thus quickly bring online approximately 30 MWs of capacity to help the Company efficiently and reliably serve its customers and meet its resource adequacy obligations.[6]

[4] Although Empire placed Riverton in service in December of 1988—rendering it over 30 years old—the Westinghouse W191 unit was purchased used and refurbished at that time. The actual date of manufacture for this turbine was 1966 which puts its total age at approximately 57 years.
[5] SPP OATT, Att. V, § 3.9.1(ii).
6 In addition to providing 30 MWs of reliable capacity, the RICE or similar technology facility that Empire intends to replace Riverton Units 10 and 11 is expected to have excellent black-start capabilities with only minimal auxiliary power required and thus will further enhance Empire's ability to respond to extreme weather events.

Time-of-Use Rates

Time-of-use ("TOU") rates present different power prices associated with the corresponding costs to provide electricity during pre-determined times of the day. This type of rate structure usually includes on-peak and off-peak pricing. The on-peak period is broadly defined by the periods of the day in which system loads are highest and off-peak times are associated with the remaining periods in which loads are typically lower. The cost of providing electricity varies within these pre-defined time periods. A goal of a TOU rate is to provide a tool for customers to have more control of their electricity bill. When a customer shifts load from the on-peak period to the off-peak period with the intent of reducing their bill, the customer uses system resources more efficiently and reduces the overall cost of providing service to all customers. While there is no direct bill impact to non-participants, as TOU participants shift load away from the on-peak period, overall costs are reduced for the utility and all customers benefit.

The Company's approved TOU rate schedules are an integral part of the Company's strategy to modernize its pricing portfolio. Advanced metering infrastructure ("AMI") or smart meters enabled the introduction of TOU rates since time-based energy consumption data is available to support the introduction of more advanced pricing structures. In its most recent Missouri rate case the Commission approved, limited differential ("Time Choice") and a high differential ("Time Choice Plus") Time-of-Use schedules for its residential and small commercial customers. Additionally, in its next Missouri general rate case, Liberty will be proposing Time-of-Use rate schedules applicable for large commercial and industrial customers.

5. Other Updates

This section of the report will provide updates to other IRP related issues, or what the IRP Rule refers to as "changing conditions generally."

Demand-Side Management Update for Arkansas

As of December 31, 2022, Liberty-Empire serves about 5,426 customers in northwest Arkansas. Besides Missouri, Arkansas is the only other jurisdiction where Liberty-Empire offers electric demand-side programs. Liberty-Empire has been granted a variance from statewide energy efficiency savings targets for 2020-2023 due to the small customer count, the rural nature of Liberty-Empire's Arkansas service territory, and other factors. However, Liberty-Empire continues to make improvements and offers a portfolio of programs with a proven record of success. In 2020, Liberty-Empire introduced a new portfolio, which offers a residential products program and features lighting and other direct install measures, a school-based energy education program for residential customers, and prescriptive and custom rebates for Commercial and Industrial customers. Liberty-Empire also contributes its share to the statewide energy education program, Energy Efficiency Arkansas. Liberty-Empire has offered customer programs in Arkansas since October 2007. Liberty will file a new energy efficiency plan for Arkansas in 2023 for program years 2024-2026.

Transportation Electrification

Decarbonizing transportation through electrification contributes to safer and healthier communities. Liberty-Empire is supporting this objective through a diverse portfolio of projects and programs that enable transportation electrification equitably across its service territory in Missouri through education, charging infrastructure, financial incentives, and hands-on support with customers as they transition their fleets and specific equipment to electric. In January 2022, a Liberty-Empire Transportation Electrification ("TE") pilot comprised of utility-administered electric vehicle ("EV") charging programs for different types of electric customers was approved by the Missouri Commission (File No. ET-2020-0390).

Aside from supporting the development of EV infrastructure in Liberty-Empire's Missouri service territory, the TE pilot program continues to enable the company to gather insights in multiple areas that will enhance its long-term planning capabilities, including:

- The extent (if any) of accelerated strain to adjacent assets brought about by EV charging (and especially Direct Current chargers).
- Technical and operating parameters of potential Vehicle-to-Grid and EV- specific Demand Response (DR) schemes.
- The demand elasticity of EV charging in response to the Time-of-Use rate schedules approved by the program.
- The customer journey insights, including the real and perceived barriers of customer EV adoption in Liberty-Empire's service territory.
- The suitability of charger equipped consumption measurement devices for utility customer billing.

In addition to these Transportation Electrification programs for Missouri customers, Liberty-Empire continues to decarbonize emissions from its own fleet.

Other Environmental Updates

Liberty-Empire is subject to various federal, state, and local laws and regulations with respect to air and water quality; hazardous and toxic materials; hazardous and other wastes including their identification, transportation, disposal, and record-keeping; reporting; and remediation of contaminated sites and other environmental matters. Liberty-Empire's jointly-owned coal-fired generating facilities, jointly-owned combined cycle facility, and all other wholly-owned resources must be operated in compliance with environmental laws and regulations.

Environmental laws or regulations that may be imposed at some point within the planning period may impact air emissions, water discharges, or waste material disposal. A brief discussion of the probable compliance costs that could result from expected and existing environmental standards was provided in the 2022 IRP Volume 4 Section 2.5. An additional update to the standards since the filing of the 2022 IRP is described below.

National Ambient Air Quality Standards

The Clean Air Act ("CAA") requires the EPA to set National Ambient Air Quality Standards ("NAAQS") for four air pollutants associated with fossil-fuel generation, including particulate matter, ground-level ozone, sulfur dioxide ("SO_2"), and nitrogen dioxides ("NO_X"). These air pollutants are regulated by setting human health-based or environmental-based criteria for permissible levels.

Particulate Matter

In 2013, the EPA strengthened the PM standard. The Jasper County (Missouri) area is currently in attainment of the 2013 PM NAAQS. No additional emission control equipment is currently needed to comply with this standard. It is not known whether the Jasper County area will remain in attainment of a future revision of the standard. Future non-attainment of revised standards could require additional reduction technologies, emission limits, or both on fossil-fueled units.

Ozone

In 2015, the EPA strengthened the NAAQS for ground-level ozone. The Jasper County area is currently in attainment of the 2015 Ozone NAAQS. No additional emission control equipment is currently needed to comply with this standard. Future non-attainment of revised standards could result in regulations requiring additional NO_X reduction technologies, emission limits, or both on fossil-fueled units.

Sulfur Dioxide

In 2010, the EPA strengthened the NAAQS for SO_2. The Jasper County area is currently in attainment of the 2010 SO_2 NAAQS. No additional emission control equipment is currently needed to comply with this standard. Future non-attainment of revised standards could result in regulations requiring additional SO_2 reduction technologies, emission limits or both on fossil-fueled units.

Nitrogen Dioxides

In 2010, the EPA strengthened the NAAQS for NO_X. The Jasper County area is currently in attainment of the 2010 NO_X NAAQS. No additional emission control equipment is currently needed to comply with this standard. Future non-attainment of revised standards could result in regulations requiring additional NO_X reduction technologies, emission limits or both on fossil-fueled units.

Cross-State Air Pollution Rule

In 2011, the EPA finalized the Cross-State Air Pollution Rule ("CSAPR"), requiring eastern and central states to significantly reduce power plant emissions that cross state lines and contribute to ground-level ozone and fine particle pollution in other states. The CSAPR Update Rule took effect in 2017 with more stringent ozone-season NO_X emission budgets for electric generating units ("EGUs") in many states to address significant contribution and maintenance issues with respect to the ozone NAAQS established in 2008. In 2021, the EPA issued new amended budgets for 12 states, although Missouri and Kansas were not impacted.

In 2022 the Missouri Department of Natural Resources ("MDNR") proposed revisions to the Missouri State Implementation Plan ("SIP"). This revision is a supplement to the SIP-Interstate Transport Provisions for the 2015 Ozone Standard. The EPA's response to the

MDNR SIP revision was proposed denial. In addition, the EPA also proposed implementing the Good Neighbor Federal Implementation Plan ("FIP") to assure that the 26 states identified in the proposal (including Missouri) do not significantly contribute to problems attaining and maintaining the 2015 Ozone NAAQS in downwind states. The Good Neighbor FIP would impose more stringent NOx ozone season compliance requirements for Missouri EGUs. Should the Good Neighbor FIP become applicable, additional emission control equipment could be needed to comply with this rule. In lieu of adding control equipment to comply with the Good Neighbor FIP, the Company could also comply through a combination of trading allowances within or outside its system in addition to changes in operations, as necessary. The proposed Good Neighbor FIP has the potential to move Missouri sources from the Group 2 NOx ozone season trading program to Group 3 NOx ozone season trading program. Pricing per ton emitted is much higher in the Group 3 trading program (fall of 2022 Group 3 NOx ozone season allowances have cost as much as $35,000 each). Future strengthened ozone, NO_X, or SO_2 standards could result in additional cross-state rule updates requiring additional trading of allowances, emission reduction technologies or reduced generation on fossil-fueled units.

Regional Haze

In June 2005, the EPA finalized amendments to the July 1999 Regional Haze Rule. These amendments apply to the provisions of the Regional Haze Rule that require emission controls known as best available retrofit technology ("BART") for industrial facilities emitting air pollutants that reduce visibility by causing or contributing to regional haze.

The pollutants that reduce visibility include $PM_{2.5}$ and compounds which contribute to $PM_{2.5}$ formation, such as NO_X, SO_2, and under certain conditions, volatile organic compounds, and ammonia. Under the 1999 Regional Haze Rule, states are required to set periodic goals for improving visibility in natural areas. As states work to reach these goals, they must develop regional haze implementation plans that contain enforceable measures and strategies for reducing visibility-impairing pollution.

The Regional Haze Rule directs state air quality agencies to identify whether visibility-reducing emissions from sources subject to BART are below limits set by the state or whether retrofit measures are needed to reduce emissions. It also directs these agencies to file Regional Haze plans with the EPA for approval.

Future visibility progress goals could result in additional SO_2, NO_x, and PM controls or reduction technologies on fossil-fired units.

Inflation Reduction Act

The Inflation Reduction Act of 2022 ("IRA") was signed into law on August 16, 2022. This United States federal law invests in domestic energy production while promoting clean energy and energy justice. Utilities can leverage the climate law's clean energy tax credits to bolster investments in renewable energy and battery storage. Although the law supports an increase in investments, clean energy projects can be constrained by permitting delays, transmission constraints, operational curtailments, and lack of energy storage to satisfy demand during renewable generation's off-peak hours. Intended outcomes of the law include reducing greenhouse gas, impacting climate change, and providing energy justice to underserved communities. Additional information on the IRA can be found in Section 2 of this report and within a response to special contemporary issue D.

Mercury and Air Toxics Standards (MATS)

In 2011, the EPA finalized a rule to reduce emissions of toxic air pollutants from power plants. These MATS for power plants reduced emissions from new and existing coal and oil-fired electric EGUs. Control equipment was installed at Liberty-Empire facilities to comply with this rule. No additional emission control equipment is currently needed to comply with this standard. It is not known whether the rule will be strengthened in the future. Future strengthening of the rule could require additional reduction technologies, emission limits, or both on coal and oil-fired units.

Water Related Impacts

Liberty-Empire operates under the Kansas and Missouri National Pollutant Discharge Elimination System ("NPDES") plans that were implemented in response to the Federal Clean Water Act ("CWA"). Liberty-Empire operates its generation facilities in compliance with applicable regulations, and all facilities have received necessary discharge permits.

Clean Water Act Section 316(b)

On September 17, 2018, the Kansas Department of Health and Environment ("KDHE") issued a Certificate of Determination stating that the Riverton Generating Station cooling water intake structure ("CWIS") is in compliance with Section 316(b) of the CWA. The location, design, construction, and capacity of the CWIS reflects the best technology available ("BTA") for minimizing adverse environmental impacts. Additionally, Iatan Unit 2 and Plum Point Unit 1 also meet the BTA standard. Future modifications at the Iatan Unit 1 facility could range from flow velocity reductions, traveling screen modifications, or the installation of a closed cycle cooling tower retrofit.

Surface Impoundments

Liberty-Empire owns and maintains a coal ash impoundment at the former Asbury Power Plant site. Additionally, Liberty-Empire owns a 12 percent interest in a coal ash impoundment at the Iatan Generating Station and a 7.52 percent interest in a coal ash impoundment at Plum Point. Future closure of all surface impoundments is anticipated.

Effluent Limitation Guidelines ("ELGs") for Steam Electrical Power Generating Point Sources are currently incorporated into all facilities' wastewater discharge permits. The EPA rule defines bottom ash transport water, fly ash transport water, and scrubber wastes as wastewaters which cannot be discharged after December 31, 2023.

Coal Combustion Residuals

Liberty-Empire has posted a ** [redacted] ** asset retirement obligation ("ARO") for the Asbury pond closure costs. Liberty-Empire expects resulting costs to be recoverable in rates. Final closure of the other existing ash impoundment at the Iatan Generating Station has been accounted for in Liberty-Empire's ARO. In December 2016, The Missouri Department of Natural Resources ("MDNR") granted Liberty-Empire a Utility Waste Disposal Area Construction Permit that could be used for CCR waste disposal. Construction of the landfill is not expected as Liberty-Empire closed the Asbury impoundment by leaving all accumulated CCR in place.

In 2014, the former Riverton Plant impoundment was closed as a monofil landfill in accordance with Kansas Department of Health and Environment regulations.

Elk River Windfarm PPA Contract Expiration in 2025

The 150 MW Elk River Windfarm PPA is a 20-year contract that began in mid-December 2005. This resource is located in Butler County, Kansas near the town of Beaumont. During the duration of this contract, the Company receives 100% of the output from this facility at a net energy price established by contract. This contract will expire in mid-December 2025.

Meridian Way Windfarm PPA Contract Expiration in 2028

The 105 MW Meridian Way Windfarm PPA is a 20-year contract signed in mid-June 2007, with the windfarm entering service in late December 2008. This resource is located in Cloud County, Kansas near the town of Concordia. During the duration of this contract, the Company receives 100% of the output from this facility at a net energy price established by contract. This contract will expire in December 2028.

Missouri Renewable Energy Standard Requirement

The Missouri Renewable Energy Standard ("RES") requires Liberty-Empire and other investor-owned utilities in Missouri to generate or purchase electricity from renewable energy sources or purchase Renewable Energy Credits ("RECs") to meet a specified percentage of the Missouri retail energy requirement. The RES portfolio requirement is currently 15% of Missouri retail electric sales. The Company currently complies with the RES by utilizing the Elk River Windfarm PPA, the Ozark Beach hydroelectric facility, and a solar component supplied by the Customer Solar Rebate program (the Meridian Way Windfarm PPA, which expires in late 2028, could be used if needed).

The addition of the Neosho Ridge Wind Project, North Fork Ridge Wind Farm, and Kings Point Wind Farm will provide RECs that can be used for compliance in addition to RECs attributable to Elk River and Meridian Way Windfarm PPAs. Additionally, the Company has REC volumes available to Missouri retail non-residential customers based upon customer usage and a current market rate. In the future, if new renewable energy requirements are implemented, the Company is in a favorable position to meet additional requirements.

6. Preferred Plan Update

During the period covered by this IRP Annual Update (2023-2028), the preferred plan from the 2022 IRP consisted of supply-side and demand-side resource additions, the retirement of Riverton Units 10 and 11, and the expiration of existing wind farm PPA contracts. The supply-side resources from the 2022 IRP are included in the load and capability balance tables presented in the next section and can be summarized as follows:

- Retirement of Riverton Units 10 and 11 in 2025
- Approximately 30 MW combustion turbines at the Riverton, Kansas site in 2025
- 150 MW Elk River Windfarm PPA contract expiration in December 2025
- 105 MW utility scale solar + storage in 2027
- 105 MW Meridian Way Windfarm PPA contract expiration in December 2028

Analyses of Reciprocating Internal Combustion Technology Versus Simple Cycle Combustion Turbine Technology for the 2025 Riverton Replacement Project

The 2022 IRP analysis originally found that replacement of the retiring Riverton Units 10 and 11 combustion turbine units would be most economic with a block of RICE units (3 x 10 MW). Liberty-Empire has since identified an alternate solution with dual Siemens SGT-400 CT's (2 x 13.3 MW) to be considered for this application. The SGT-400 offers similar levels of output and operating characteristics required to fulfill performance requirements at the Riverton site.

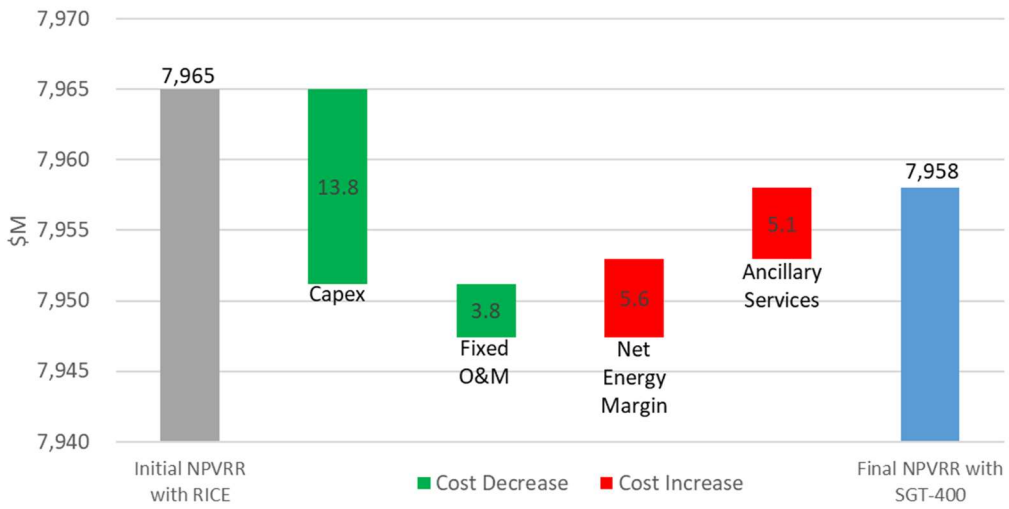
CRA assessed the SGT-400 option as a direct substitute for the RICE units under Base conditions in the Preferred Plan (Plan 8). The total portfolio 20-year NPV was evaluated for the SGT-400 against the RICE units, all else held equal.

Table 6.1- Key Modeling Parameters and Inputs

	Units	RICE	SGT-400	SGT-400 Source
Initial Capex	2020 $/kW	1562	1192	Empire (deflated from $2022)
Capacity	MW	30.0	26.6	Empire
Fixed O&M	2020 $/kW-yr	25	17	B&V/CRA
Ongoing Capex	2020 $/kW-yr	4.1	4.1	B&V/CRA
Heat Rate	MMBtu/MWh	8.3	10.9	Empire
Variable O&M (non fuel, non emissons)	2020 $/MWh	7.0	7.5	B&V/CRA
Incremental Ancillary Service Revenue	2020 $/kW-yr	59	38	CRA

As depicted in the chart below, the 20-year NPVRR of the SGT-400 case is $7.0M lower than for the RICE case due mostly to the lower capex as well as lower fixed operation and maintenance ("FOM") ($5.5M lower NPVRR on 30-year basis). However, the lower capex is offset to a large extent by less energy value for the SGT-400 versus the RICE. The SGT-400 has a materially higher heat rate, resulting in less economic dispatch and lower energy market margins, with a capacity factor close to 10% versus 30% for the RICE. Given that these are both mature technology applications, there is likely more risk around the unit dispatch and energy margin than the capital costs, although both elements have uncertainty.

Table 6.2- 20 Year NPVRR Comparison: 2025 SGT-400 vs RICE



Overall, the option of substituting the SGT-400 CT for the RICE units as a replacement for Riverton 10 and 11 is economic and should be considered as a viable option by Liberty-Empire.

SPP Accreditation Changes

Changes to the SPP Planning Reserve Margin

Based on the results of the 2021 Loss of Load Expectation ("LOLE") Study along with additional considerations, the SPP Board of Directors and Regional State Committee approved to increase the Planning Reserve Margin ("PRM") requirement from 12% to 15% beginning in the 2023 Summer Season. The 15% PRM requirement resulted in a LOLE of less than 1-day-in-10 years for both generation reduction scenarios studied and reflected a reduced level of risk compared to lower PRM levels studied. According to SPP, "The increased PRM requirement increases confidence that the SPP Balancing Authority ("BA") will have access to generating resources needed to continuously supply demand."

SPP Performance Based Accreditation

SPP's current accreditation methodology utilizes a resource's net generating capability. This methodology acknowledges the resource's maximum output but does not consider the resource's performance or contribution to reliability in comparison to other resources in the SPP footprint. According to SPP, it was determined that a change to the existing accreditation practices that considers performance or availability would more accurately quantify each resource's contribution to reliability in the SPP BA and incentivize increased resource performance during the peak seasons.

The recently approved Performance Based Accreditation ("PBA") methodologies can be found in the SPP "PERFORMANCE BASED ACCREDITATION RECOMMENDATIONS FOR CONVENTIONAL RESOURCES" document. In short, the PBA calculation is a "deterministic method that utilizes an equation and historical outages to calculate an individual resource's accredited capacity" known as the "Demand Equivalent Forced Outage Rate" ("EFORd"). According to SPP, this is "the most common equation used in the industry and takes into consideration forced outages and derates when the resource is needed most to serve load." Additionally, resources with less than 100 service hours per season will be accredited with a modified EFORd equation known as "Equivalent Forced Outage Rate Demand Prime" ("EFORd'"). The newly approved methodologies will be performed for the summer and winter seasons separately while excluding "shoulder" seasons from the calculation. Additionally, it was decided that "out of the most recent five years, four years will be included in the calculation where each year and season are calculated separately." The value from each year, by season, will be averaged together with equal weighting. The data gathering period for this new policy began in 2022, with a transition period beginning in 2024 and full implementation in 2027.

Updated ELCC Estimates for Existing Resources

Beginning with the 2023 summer season, the accreditation for wind and solar resources in SPP will be determined using the Effective Load Carrying Capability ("ELCC") methodology. ELCC is defined as the amount of incremental load a resource, in this case wind and solar, can dependably and reliably serve, while considering the probabilistic nature of generation shortfalls and random forced outages as driving factors to load not being served. According to SPP, ELCC is an industry-wide accepted methodology used for determining the capacity value of resources.

In February 2021, SPP completed its first ***informational-only*** study for both wind and solar resources using the approved ELCC methodology for future use. As of October 2022, SPP completed the first formal ELCC study which was effective for the summer 2023 and winter 2023-2024 seasons. The comparison between the 2021 ***informational-only*** study and the final 2022 ELCC results for Liberty-Empire's existing renewable resources can be seen in the table below, and the final 2022 results are reflected in the included Load and Capability table for this IRP Annual Update.

Table 6.3- ELCC 2021 vs 2022 Comparison

Resource	2021 ELCC Summer Accredited Value (MW)	2022 ELCC Summer Accredited Value (MW)	2021 ELCC Winter Accredited Value (MW)	2022 ELCC Winter Accredited Value (MW)
Elk River Wind Farm PPA (150 MW)	25.7	20.5	21.9	18.3
Meridian Way Windfarm PPA (105 MW)	13.1	11.2	14.6	13.7
Neosho Ridge Wind (301 MW)	66.9	51.3	57.8	94.2
North Fork Ridge Wind (149 MW)	37.3	28.2	38.1	57.6
King's Point Wind (149 MW)	37.6	27.5	38.4	58.8

Uncertainty Surrounding the Implementation of ELCC in SPP

On March 2, 2023 in Docket ER22-379, in response to Clean Energy Advocates seeking a rehearing of FERC's August 5th, 2022 order accepting, subject to condition, SPP's proposed revisions to Attachment AA of the SPP OATT, FERC set aside their August 2022 Order's acceptance of SPP's proposal and rejected SPP's proposed OATT revisions to include the ELCC methodology and encouraged SPP to "expeditiously submit any future filings it may choose to make" due to the relationship between ELCC and reliability.

This is a developing issue that the Company is monitoring closely. Load and Capability forecasts with and without ELCC assumptions are provided in the Preferred Plan Update section below.

Load and Capability Balance Report

The 2022 IRP preferred plan was described in the 2022 IRP Executive Summary. Additional information can be found in Volume 7 of the IRP.

The Load and Capability Balance Report for the 2023 IRP Annual Update is presented on the following pages and is consistent with the requirements of SPP Resource Adequacy and consistent with the Company's recent 2023 SPP Resource Adequacy submission.

Due to the nature of the evolving requirements of SPP Resource Adequacy, there are notable differences in certain assumptions between the 2022 IRP Load and Capability Balance Report and the 2023 IRP Annual Update Load and Capability Balance Report. For example, the new DSM that is included in the 2022 IRP is not included below because it is still a "prospective" resource addition that is still lacking certain planning details that are required by SPP, such as a tariff rate.

Another assumption that differs between the 2022 IRP and 2023 IRP Annual Update Load and Capability Balance Reports is the capacity credit assumed for wind resources. With

SPP's transition to ELCC methodology accreditation for wind and solar resources beginning in the summer 2023 season, SPP released the final ELCC study in October 2022 to be used for the 2023 Resource Adequacy submission. The seasonal accredited capacity values from the 2022 ELCC study are assumed for the period covered in this IRP Annual Update. As previously mentioned, there exists some uncertainty as to the implementation of the ELCC in SPP.

Additionally, Performance Based Accreditation ("PBA") for conventional resources has been approved by the SPP stakeholder process and has begun its data gathering stage with a phased in implementation beginning in 2024. The estimated impacts from PBA are included in the assumptions for this IRP Annual Update.

Moreover, Liberty-Empire included small community solar, distributed solar, and solar + storage resources as behind-the-meter resources, as a reduction to the load and peak forecasts rather than separate resources in the following table, as it is assumed that these resources will not be registered in the SPP Integrated Marketplace based upon SPP Business Practices Section 2.0. Normally, the Company would present six years of data for the load and capability table for an IRP annual update. However, given the amount of change in this area, and the requirements of special contemporary issues related to this topic, the Company is presenting 20 years of data.

Finally, the following Load and Capability tables are updated to reflect SPP's change in the planning reserve margin from 12% to 15%.

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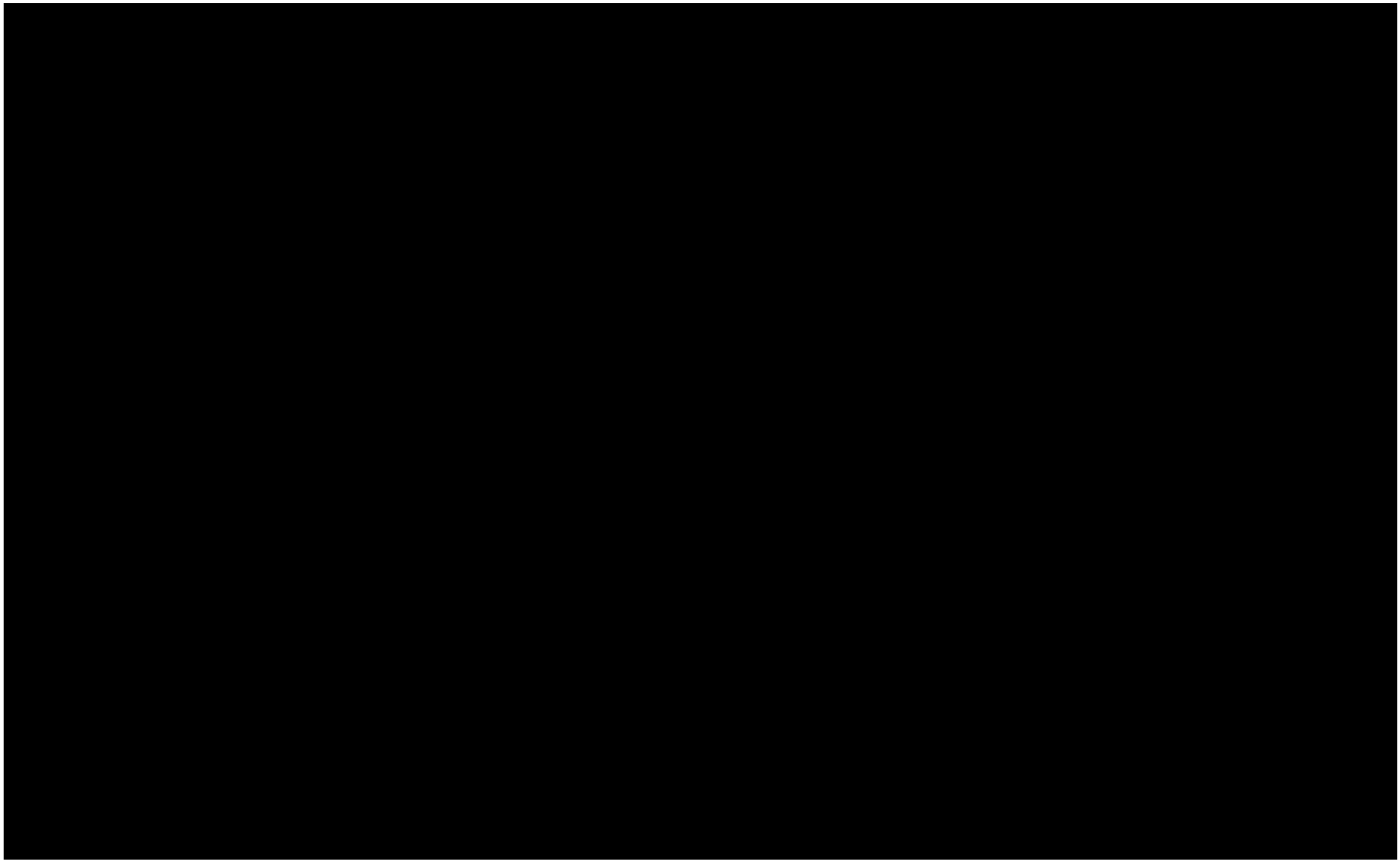

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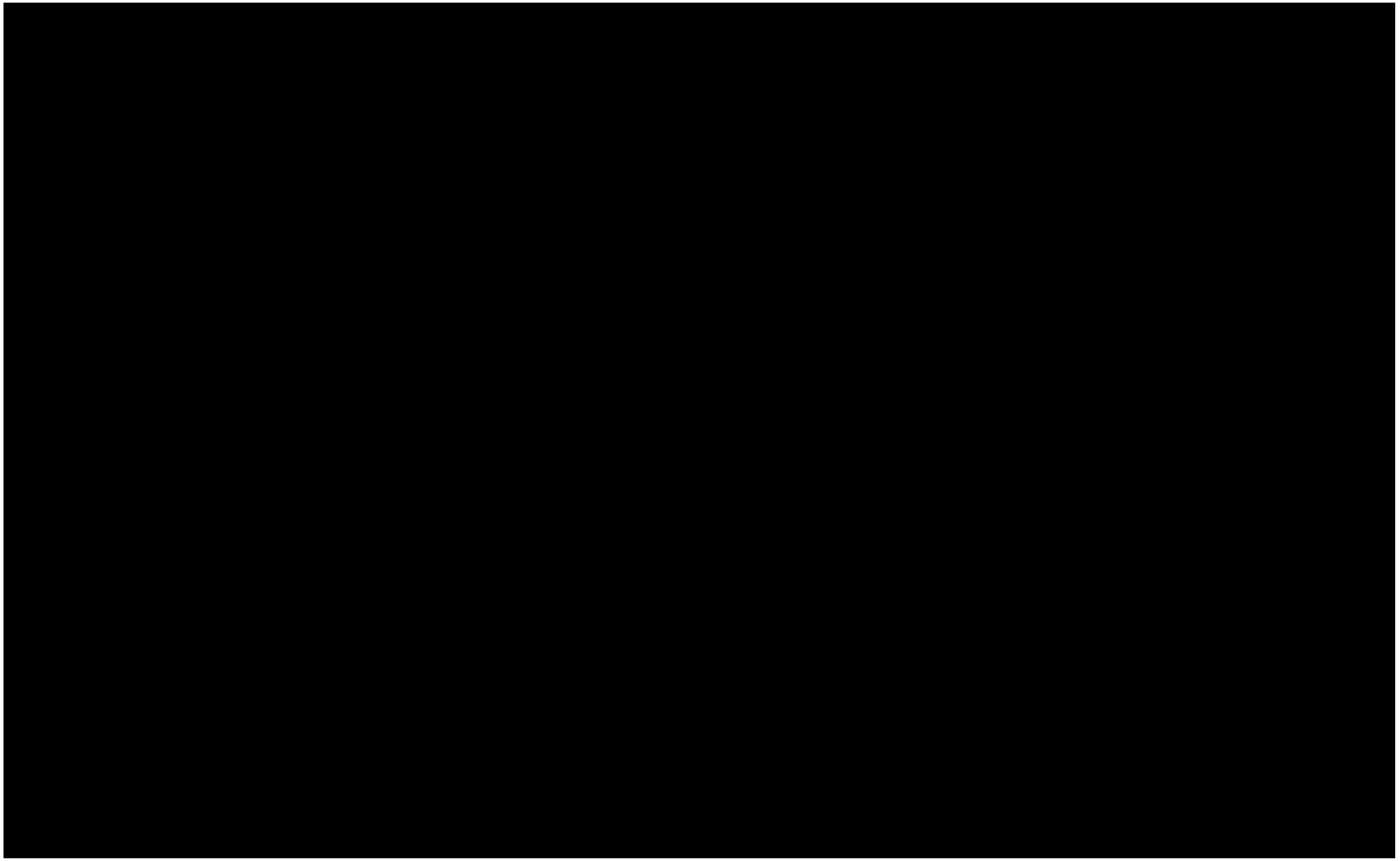

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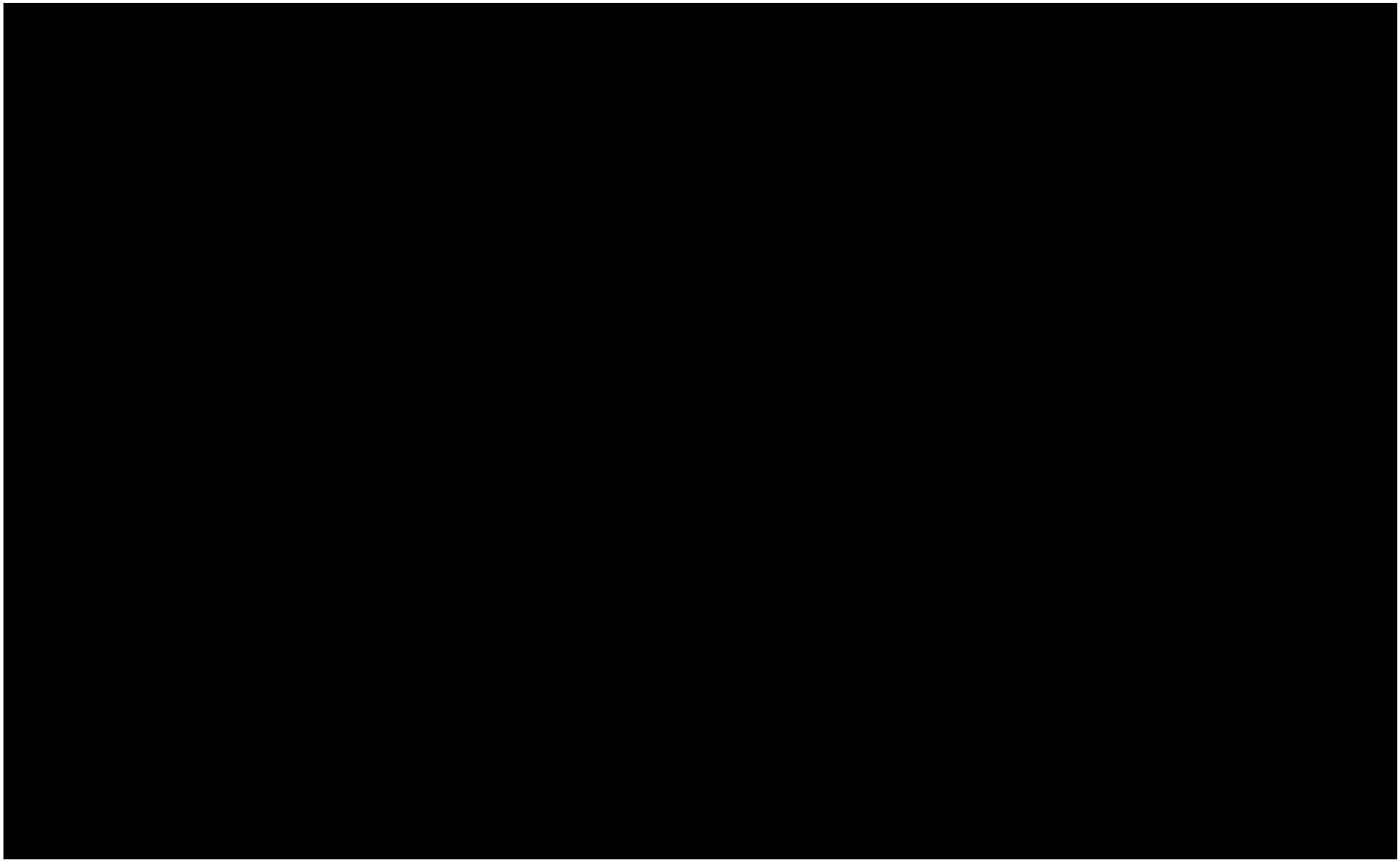

7. Liberty-Empire Special Contemporary Issues

According to the Rule, special contemporary issues ("SCI") means "a written list of issues contained in a Commission order with input from staff, public counsel, and interveners that are evolving new issues, which may not otherwise have been addressed by the utility or are continuations of unresolved issues from the preceding triennial compliance filing or annual update filing."

In this section of the report, Liberty-Empire will address the nine SCIs (issues A through I) that were established by Commission Order in File No. EO-2023-0102. It should be noted that some SCIs for this IRP Annual Update reference sections of the IRP Rule that are specific to the triennial compliance requirements. In those cases, the Company has attempted to address the SCI as completely as possible within the scope of the IRP Annual Update process.

(A). Address modeling for low, medium, and high-performance base accreditation of existing and planned generation units by updating its annual IRP filing with what Liberty (or Southwest Power Pool (SPP)) believes is the likely (or known) performance accreditation amount for each of its existing generating units and including the rationale for calculating that amount for each of its new supply side resources modeled in its IRP.

Southwest Power Pool's ("SPP") approved Performance Based Accreditation ("PBA") methodologies can be found in the SPP "PERFORMANCE BASED ACCREDITATION RECOMMENDATIONS FOR CONVENTIONAL RESOURCES" document. In short, the PBA calculation is a "deterministic method that utilizes an equation and historical outages to calculate an individual resource's accredited capacity" known as the "Demand Equivalent Forced Outage Rate" ("EFORd"). According to SPP, this is "the most common equation used in the industry and takes into consideration forced outages and derates when the resource is needed most to serve load." Additionally, resources with less than 100 service hours per

season will be accredited with a modified EFORd equation known as "Equivalent Forced Outage Rate Demand Prime" ("EFORd'"). The newly approved methodologies will be performed for the summer and winter seasons separately while excluding "shoulder" seasons from the calculation. Additionally, it was decided that "out of the most recent five years, four years will be included in the calculation where each year and season are calculated separately." The value from each year, by season, will be averaged together with equal weighting. The data gathering period for this new policy began in 2022, with a transition period beginning in 2024 and full implementation in 2027.

As such, the "Load and Capability Balance" tables included in Section 6 of this IRP annual update report reflects updates to the Company's 2022 IRP Preferred Plan based on these methodologies and the newly approved increase in the SPP Planning Reserve Margin ("PRM") from 12% to 15%.

(B). Model for low, medium, and high participation scenarios of commercial and industrial customers electing to participate in demand response activities based on the introduction of third-party ARCs within its footprint and provide an analysis of that impact ARCs would have on its IRP.

At the onset of Liberty-Empire's evaluation of various demand response technologies, FERC order 2222 had not existed or materialized at various public engagements with FERC. However, Liberty-Empire pre-emptively considered the impacts of aggregation of Distributed Energy Resources ("DERs") on its transmission and distribution networks as supplemental to FERC order 2222.

Demand response through aggregation of DERs in an area with historically high congestion or delivery costs could yield benefits to Liberty-Empire's system and customers by reducing the need for transmission of energy across various delivery systems. To assess the value of distributed solar and/or storage, Liberty-Empire evaluated the value of these

representative distribution upgrade projects as offsets to the capital and fixed costs of distributed solar and storage resources.

To assess the value of distribution cost deferral for distributed energy resources, Liberty-Empire identified a set of planned and/or representative distribution upgrade projects that could be deferred if transformer current were reduced.

In anticipation of FERC order 2222, Liberty-Empire also considered establishing fiber-optic networks which could also be used in the real-time system awareness and aggregation efforts for DERs. In doing so, Liberty-Empire would be poised for implementation to comply with plans set forth by the Regional Transmission Organization ("RTO"). Integration of DERs along with new innovative technologies should yield a more robust electrical network to serve Liberty-Empire's customers and a more fluid implementation of near-term regulatory requirements.

Liberty-Empire has evaluated demand response measures and included several as candidate demand-side resources for residential and commercial applications and for Realistic Achievable Potential ("RAP") and Maximum Achievable Potential ("MAP") cases (described in the 2022 IRP technical Volume 5 – Demand-Side Resource Analysis). These resources require time-variant pricing. Accordingly, they require the availability of detailed participant billing determinants at the hourly or sub-hourly level of granularity, which can be addressed with two-way Advanced Metering Infrastructure ("AMI"). Liberty-Empire has been implementing two-way AMI across its service territory through 2021.

(C). Adjust its IRP modeling to account for the new fifteen percent reserve planning margin recently set by SPP.

The included "Load and Capability Balance" table in Section 6 of the IRP Annual Update Report reflects updates to the Company's 2022 IRP Preferred Plan based on the new

Performance Based Accreditation ("PBA") methodologies and the newly approved increase in the SPP Planning Reserve Margin ("PRM") from 12% to 15%. This section also describes the process in more detail.

(D). Account for and explicitly identify cost reductions, tax credits (including all available tax credits for renewable and storage assets), additional funding sources, and other potential benefits from the Inflation Reduction Act and incorporate those changes into its IRP modeling as appropriate.

Resource planning is an ever-changing process. Since the Company filed its most recent triennial IRP in April 2022, conditions in the electric industry have continued to evolve. A prime example is the passage of the Inflation Reduction Act of 2022 ("IRA"), that was signed into law on August 16, 2022, and has been briefly described in earlier sections of this report. This is a complex piece of legislation that includes, among other features, provisions to address clean energy and climate change. In fact, it is said to be the largest piece of U.S. federal legislation ever to address climate change to date. It will provide at least $391 billion for energy and the climate; it is projected to reduce CO2 emissions by 40% in 2030 from 2005 levels; it provides incentives for investment intended to lower CO2 emissions and grants the EPA broader authority to regulate CO2 and promote renewable energy.

As stated in the SCI, the Company is asked to address the IRA "as appropriate." Since this is an IRP annual update, this topic will be addressed within the scope of the annual update process. Further, since the preferred plan from the Company's 2022 IRP included renewable energy resources and the preferred plan selection process included an objective of environmental sustainability (carbon reduction), the 2022 IRP preferred plan is well positioned to benefit from the IRA. In the near term, changes to solar projects may result from the IRA, specifically provisions of the law extending the solar investment tax credit.

The IRA amends or repeals portions of the Internal Revenue Code of 1986. It makes use of loans, grants, and tax credits to incentivize clean energy and promote a significant reduction in carbon emissions. Corporate tax credits make up nearly 55% of the approximately $394 billion dollars in energy and climate funding. These direct pay incentives are intended to grow private investment of clean energy, manufacturing, and transportation.[7] The IRA includes Production Tax Credits ("PTC") for production of clean hydrogen, use of US manufacturing in components of batteries and renewables, as well as an extension of existing Renewable Energy PTC and the creation of Clean Energy PTC to begin in 2024. Investment Tax Credits ("ITC") include an extension of current ITC for qualifying energy projects, emissions-based ITC incentives for new clean energy to begin in 2024, and a continuation of the Advanced Energy Project Credit incentivizing domestic production and recycling of clean energy products. Additional credits for fuel and clean vehicles are also included.[8] Focused on the reduction of greenhouse emissions by 1 gigaton by 2030,[9] the IRA improves the Carbon Capture and Sequestration Tax Credit through deadline extension and lowering of the plant size eligibility threshold.

Nearly $30 billion of available Title 17 loans and substantial investment in the Department of Energy ("DOE") National Laboratories will drive the advancement of technology and energy science. Lease funding for offshore wind, oil, gas, and the establishment of the Methane Emissions Reduction Program provide additional incentive for energy planning. Community driven programs such as the Low Emissions Electricity Program and Energy Credit for Solar and Wind in Low-Income Communities further drive the incentive for new renewables and the lowering of greenhouse emissions.[10] Also included in the IRA are protections and incentives for labor. Make it in America provisions encourage the use of

[7] https://www.mckinsey.com/industries/public-and-social-sector/our-insights/the-inflation-reduction-act-heres-whats-in-it
[8] https://bipartisanpolicy.org/blog/inflation-reduction-act-summary-energy-climate-provisions/
[9] https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/15/by-the-numbers-the-inflation-reduction-act/
[10] https://bipartisanpolicy.org/blog/inflation-reduction-act-summary-energy-climate-provisions/

American-made clean energy components and offer bonus tax credits for prevailing wage pay and registered apprenticeship programs.[11]

It should be noted that the IRA does have some possible impediments. Currently, supply-chain issues still exist, with the cost and availability of raw materials remaining a concern. While the IRA might incentivize the build-out of clean energy resources, it does not solve permitting and generation interconnection issues, not to mention public opinion and the not in my back yard ("NIMBY") problems that some projects can face. Finally, while it was signed into law, it could face future challenges with a change in administration.

The Company's preferred resource plan was selected to provide energy services that are safe, reliable, and efficient, at just and reasonable rates, consistent with state energy and environmental policies, in compliance with all legal mandates, and in a manner that serves the public interest. It also allows for the significant reduction of carbon emissions over the long term. The preferred plan, as described in IRP Volume 6, section 3.3.13, includes a mix of renewables both at the distribution-level and at the utility-scale level. The selected plan consists of 175 MW of utility-scale solar and storage at existing interconnection sites by the end of 2030. By 2041, this preferred plan adds an additional 200 MW utility-scale solar, 600 MW utility-scale 2:1 solar + storage, 50 MW flow battery, and 132 MW of distributed solar and/or storage.

It remains to be seen, but various provisions of the IRA may be able to be utilized. For example, the IRA's New Clean Hydrogen Production Tax Credit creates an incentive for the installation of hydrogen production. Future projects may take advantage of the New Clean Energy Production Tax Credit, the New Advanced Manufacturing Production Tax Credit, the New Clean Electricity Investment Tax Credit, and the Advanced Energy Project Tax Credit.

[11] https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/19/fact-sheet-the-inflation-reduction-act-supports-workers-and-families/

Solar and storage projects included in the 2022 IRP's preferred plan, both utility-scale and those placed throughout the distribution system, could meet requirements for the New Clean Energy Production Tax Credit, the New Advanced Manufacturing Production Tax Credit, the New Clean Electricity Investment Tax Credit, and the Advanced Energy Project Tax Credit. Community based programs, such as the Low Emissions Electricity Program and Energy Credit for Solar and Wind in Low-Income Communities, could be further investigated for additional incentives.

As previously mentioned, Liberty-Empire's 2022 preferred IRP plan, without modification, readily takes advantage of incentives offered in the IRA. Additional incentives can further benefit Liberty-Empire and, in turn, its customers.

(E). Update its analysis and planning activities regarding actions necessary for system-wide voltage optimization analysis of its distribution system.

System-wide voltage optimization seeks to achieve efficient grid operation through the management of voltage levels and reactive power. Techniques for voltage optimization can reduce brief periods of peak demand, system loss, and energy consumption with conservative voltage reduction ("CVR") programs focused on the distribution system.

The Company filed its most recent triennial IRP in Missouri File No. EO-2021-0331 on April 1, 2022. This IRP was reviewed by stakeholders and a joint filing was made on November 3, 2022. As prescribed by the IRP Rule, the Company prepared and filed a volume dedicated to Transmission and Distribution Analysis in IRP Volume 4.5. Within these analyses, the report describes the adequacy of the transmission and distribution networks, including a distribution system overview, distribution contingency evaluation and review of distribution advanced grid technologies. This response is provided within the scope of the IRP Annual Update and relies primarily on the recent 2022 IRP analysis.

As an update, the Company recently converted portions of the Joplin, Missouri distribution from 4kV to 12kV. This project reconfigured the downtown Joplin, Missouri distribution system to operate at the Company standard voltage of 12.47kV while rebuilding three substations. This project was completed in November 2022. Also, within the past year Liberty-Empire continued investments in grid resiliency for the Company's distribution and transmission systems through system voltage conversions, substation improvements, transmission and distribution line rebuilds, new distribution lines to remove radial feeds and various other types of projects.

As reported in the Company's most recent Plant in Service Accounting ("PISA") Annual Report, new standards for design and construction of Liberty-Empire's electric distribution system will be applied through a series of projects and through the recurring process of constructing new or replacing old facilities to accomplish a stronger and more resilient infrastructure. Liberty-Empire has evaluated and approved numerous projects to improve the resiliency of its electrical infrastructure and accounted for in its Clean Transition Plan ("CTP"). Notable projects include:

- Replace and upgrade distribution circuit breakers.
- Replace and upgrade critical aged assets and equipment prone to failure.
- Build new substations to accommodate redundancy and load growth.
- Install and upgrade animal guards on distribution and substation equipment.
- Increase capacity and resiliency of lines serving remote communities.
- Systematically inspect, treat, and replace old underground cable as needed.
- Upgrades to service center facilities and equipment inventories.

These projects, among others, will increase the resiliency of distribution infrastructure to withstand threats from vegetation and extreme weather, increase load-carrying capacity to accommodate evolving customer loads and two-way power flows, and reduce the average age of distribution assets reducing risk and frequency of failure. As emerging

technologies present opportunities to approach existing problems in new ways, Liberty seeks to add them to its planning toolbox.

As described in the 2022 IRP, Volume 4.5, 1.1.1, Liberty-Empire's distribution system parallels that of a rural area co-op, with long distribution feeders and a distributed load profile. The average total distribution feeder exposure length within the Missouri portion of the Liberty-Empire footprint is approximately 17.83 miles. With such widespread infrastructure components, much of the service area is susceptible to large voltage disturbances due to minute load manipulation can cause large disturbances to customers' voltage. To optimize voltage throughout the distribution system, Liberty-Empire prepares multiple studies of its infrastructure to determine weaknesses or risks and to assess the overall adequacy. These studies, completed throughout the year, focus primarily on increasing reliability and prioritizing work based upon cost, scope, impact, and effectiveness. This work encompasses four specific areas, including voltage. As a result of these studies, Liberty-Empire is committed to several proactive projects described in the 2022 IRP, Volume 4.5, 1.1.2.2-1.1.2.2.6, including underground cabling, pole replacement, and updating aging infrastructure. Liberty-Empire has committed to the remediation or replacement of underground cabling intended to yield a more robust system and improve reliability to customers. Liberty-Empire plans on the replacement of Bad Order poles and to address aging infrastructure, including distribution sectionalization.

The 2022 IRP, Volume 4, 2.4.4.1, exhibits Liberty-Empire quantitative assessment of the value of distributed energy resources, such as distributed solar and distributed storage (paired or unpaired) on the grid. Energy storage resources provide a way to store excess energy produced in low load hours for use during high usage periods when demand exceeds renewable output. Combined with distributed renewable generation such as solar, energy storage can further smooth energy usage trends across peak and off-peak times, deliver emergency backup power for customers during outage events, provide local distribution system support to correct for under- and over-voltage problems, and shift load

requirements to less expensive periods for wholesale market purchases. It was determined positioning a distributed energy resource in an area with historically high congestion or delivery costs could yield benefits to Liberty-Empire's system and customers by way of injection at the load site as opposed to the transmission of energy across various delivery systems.

Liberty-Empire continues to analyze and evaluate distribution grid benefits of its newly completed Community Solar Pilot Program. The Prosperity Solar Facility, located in Joplin, Missouri, is a 2.25 MW distributed solar farm consisting of more than 5,500 bifacial photovoltaic panels. The facility is the first phase of these types of facilities and others are planned to be added based on customer demand. As new facilities are built, they are planned for installation directly on the distribution grid in specific areas that have historically experienced congestion or have neared their peak capacity. By placing these solar facilities around the grid, Liberty-Empire can alleviate some pockets of system demand while potentially avoiding the need for larger construction projects, such as expanding power lines or building new central generators. Additionally, the 2022 IRP preferred plan contains about 175 MW of solar and storage by 2029, that is planned to be installed at existing interconnection sites to help ensure robust and reliable delivery of electricity to customers without performing expensive upgrades to the grid infrastructure. The exact locations and scale of facilities remains under evaluation.

By 2022, Liberty-Empire successfully completed deployment of AMI across its service territory. Volume 4.5, 1.4 of the 2022 IRP describes AMI as a comprehensive metering solution intended to create two-way communications between customer meters and the utility. Often referred to as "smart meters," these digital meters possess advanced features and capabilities beyond traditional electricity meters. The AMI system will effectively enable Liberty-Empire to access more granular data about its customers and allow more advanced integrated distribution planning with an informed application of storage and distributed energy resources. Increased communication platforms and capabilities will

create opportunity for future implementation of real-time system awareness and auto-healing networks and will encourage focused investment efforts for needed infrastructure improvements or postponements.

Additional grid self-healing has been enhanced through distribution automation. Liberty-Empire's distribution automation investments are designed to improve system reliability through coordinated deployment of smart protective devices like reclosers and smart fuses across the distribution grid. These devices, and others like smart capacitor banks and smart voltage regulators that can record and communicate with other devices and the Advanced Distribution Management System ("ADMS"), will augment energy efficiencies and power quality on the distribution system. Liberty-Empire continues to pursue several opportunities to expand distribution automation across the grid, including installation of viper reclosers and introducing automation onto interconnected circuits. In addition, Liberty-Empire continues to work with third-party engineering firm, Burns and McDonnell, to conduct a study on the impacts of automated systems. This information, combined with recent efforts, will help Liberty-Empire to set a foundation that can be built on with emerging technology like a Distributed Energy Resource Management System ("DERMS") or advanced analytics in the future to achieve a more modern and advanced grid.

As distribution technologies continue to advance, Liberty-Empire will continue to analyze prospects to optimize its distribution system with minimal rate impact to better serve its customers. The Company will continue to implement advanced technologies on its distribution system to benefit customers and support an increasingly smarter, reliable, and efficient grid. Over time, Liberty-Empire will better understand the extent of implementation of these programs, determining Liberty-Empire's specific requirements in relation to load and customer needs, and when said advanced technologies may become cost-effective.

(F). Analyze the impact resulting from satisfaction of the clean energy goals of large customers.

Liberty-Empire filed its most recent triennial IRP in April 2022 ("2022 IRP"). Environmental sustainability (carbon reduction) was included as a key objective in the preferred plan selection process. As stated in the IRP reports, the preferred plan from the 2022 IRP is considered a pathway to the corporate net-zero target by year 2050 for scope 1 and scope 2 emissions across its business operations. The commitment to clean energy is evident in the 2022 IRP results. In addition to demand-side resources, the 2022 IRP preferred plan has additions of solar and storage resources in the medium and long term to take advantage of federal tax incentives and interconnection rights at existing sites, with flexibility and optionality around long-term resource decisions to achieve significant carbon emissions reductions as policy and technology evolve.

The Company is concerned with the clean energy goals of all customers. Outreach to key commercial customers and communities served by Liberty shows that many have adopted sustainability goals including reduction in greenhouse gas ("GHG"). Support from their utility partners is needed for customers to meet these goals. Additionally, many companies seeking a new business location often list access to clean energy and the ease of meeting their sustainability and GHG goals among their selection criteria during the decision-making process.

In addition to the forward-looking 2022 IRP, in 2020, Liberty-Empire retired its wholly-owned Asbury coal-fired plant, after nearly fifty years of service. This was followed by the Company's addition of approximately 600 MW of new wind resources to the generation portfolio in 2021 at three new wind farm sites, two of which are in Missouri (approximately 300 MW combined) and one in Kansas (approximately 300 MW). To further meet customer needs, the Prosperity Community Solar facility, located on approximately 15 acres of land near Prosperity, Missouri with a capacity of approximately 2.25 MW (with more than 5,500 bifacial photovoltaic panels) went into service in 2021. Community solar is sold as a

voluntary option to interested customers as a dedicated renewable supply to offset their individual consumption. These customers participate through a simple and convenient billing mechanism, to gain the benefits of solar energy supply without needing to install a dedicated system on their own roof or facility. Additional community solar capacity is expected to be installed during the next five years, with the amount determined by customer demand. At this time, the Company has a substantial waitlist for customers expressing interest in community solar.

(G). Study and/or model various technologies and programs designed to reduce demand on the customer side of the meter, including but not limited to:

1. Residential demand response programs, pairing increased rebates for web-enabled or "smart" thermostats with demand response program participation;

2. Increased rebates for residential electric vehicle charging units paired with customer agreements to participate in a program allowing the Company's use of electricity from a customer's connected electric vehicle at times of high demand;

3. New rebates for residential battery storage units paired with customer agreements to participate in a program allowing the Company's use of batteries at times of high demand;

4. A program offering free installation of utility-owned battery storage units in exchange for customer agreements to allow the Company to use batteries at times of high demand.

Liberty-Empire filed its most recent Missouri IRP on April 1, 2022, in File No. EO-2021-0331. As required by the IRP Rule, part of the IRP study is a demand-side resource analysis, which is essentially a study and modelling of various technologies and programs designed to reduce demand on the customer side of the meter. IRP Volume 5, which was filed in the 2022 IRP docket, is dedicated to this Demand-Side Resource Analysis. This response, commensurate with the scope of the IRP Annual Update, will describe this recently completed demand-side study at a high level. Implementation of the IRP demand-side resources are generally handled within a follow-on Missouri Energy Efficiency Investment

Act ("MEEIA") filing in Missouri and potentially in other demand-side filings for other jurisdictions as applicable.

Liberty-Empire analyzed demand-side resources and supply-side resources on an equivalent basis as options for meeting load requirements in the IRP. For the 2022 IRP, Liberty-Empire engaged Applied Energy Group ("AEG") to conduct a demand-side management ("DSM") Potential Study in the Company's service territory and develop DSM program inputs for the IRP analysis. AEG analyzed potential demand-side resources for all major end-uses and all major classes as identified by the Residential Customer Energy Survey and secondary sources. The major end-uses considered included:

- Residential sector: cooling, space heating, water heating, interior lighting, exterior lighting, appliances, electronics, and miscellaneous.
- Non-Residential sector: space heat, space cooling, ventilation, water heating, refrigeration, interior and exterior lighting, office equipment, food preparation, motors, process, and miscellaneous.

Volume 5 from the 2022 IRP also outlines in more detail, all the measures that were evaluated in this study. Demand response and demand side rate resources that were identified as cost effective were included in the modeling. Time of use rates ("TOU"), which includes a higher rate for the peak block of hours that occurs every day and requires either on/off peak meters or AMI technology was considered for all major customer classes. Critical Peak Pricing ("CPP"), which has a much higher rate for the peak block of hours that occurs only on critical event days and requires AMI technology, was also considered for all major customer classes. Real-time Pricing ("RTP"), or dynamic rates that fluctuates throughout the day based on hourly energy market prices and requires AMI technology, was considered for the Commercial and Industrial customer classes.

The integrated portfolio analysis evaluated two levels of achievable potential for energy

savings associated with DSM programs: realistic achievable potential ("RAP") and maximum achievable potential ("MAP"). Achievable potential embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase, the maintenance activities they undertake, the controls they use for energy-consuming equipment, and the elements of building construction. MAP is defined as the maximum amount of savings that can be realized under ideal market, implementation, and customer preference conditions, and has higher incentives than RAP due to higher program participation. RAP reflects expected program participation given barriers to customer acceptance, non-ideal implementation conditions, and limited program budgets.

Within the RAP and MAP scenarios, AEG bundled DSM programs together based on the $/kWh cost of the programs (low, mid, and high-cost energy efficiency bundles plus a demand side rates bundle) for use in the integrated portfolio analysis. These DSM bundles were incorporated into the IRP as eligible resources in the portfolio optimization analysis along with supply-side resources in the alternative plan development stage. A summary of the demand-side program bundles that passed cost-effectiveness screening and was used in the integrated analysis is presented below.

Table 7.1- Description of DSM 2022 IRP Bundles		
DSM	**Program Bundle**	**Description**
RAP	Low Cost	Programs with a three-year average $/kWh saved below $0.18 per kWh. Includes: - Retail Lighting - Residential Behavioral - Commercial Custom - SEM - Retro-Commissioning
	Mid Cost	Programs with a three-year average $/kWh saved between $0.18 to $0.25 per kWh. Includes: - Residential Prescriptive - Appliance Recycling - Commercial Prescriptive - Midstream Food Service
	High Cost	Programs with a three-year average $/kWh saved above $0.25 per kWh. Includes: - Whole Home Efficiency - SBDI
	Demand Side Rates ("DSR")	DR and DSR programs. Includes: - Time of Use Rate (Res & Non-Res) - Critical Peak Pricing (Res & Non-Res) - DLC Smart Thermostat - Real Time Pricing
MAP	Low Cost	Programs with a three-year average $/kWh saved below $0.18 per kWh. Includes: - Retail Lighting - Residential Behavioral - Commercial Custom - SEM - Retro-Commissioning
	Mid Cost	Programs with a three-year average $/kWh saved between $0.18 to $0.25 per kWh. Includes: - Residential Prescriptive - Appliance Recycling - Commercial Prescriptive - Midstream Food Service
	High Cost	Programs with a three-year average $/kWh saved above $0.25 per kWh. Includes: - Whole Home Efficiency - SBDI
	Demand Side Rates ("DSR")	DR and DSR programs. Includes: - Time of Use Rate (Res & Non-Res) - Critical Peak Pricing (Res & Non-Res) - DLC Smart Thermostat - Real Time Pricing

(H). Study and/or model the potential for utility-scale battery storage to meet current and future demand, including:

1. **Consideration of the range of potential price reductions in these technologies over the coming two decades;**
2. **Consideration of pumped hydro, stacked blocks, liquid air, above-ground and underground compressed air, and flow battery technologies in addition to lithium-ion battery technologies;**
3. **Pairing mid-scale deployments of battery storage technologies with current and future utility-scale solar generation sites; and**
4. **Offering free installation of utility-owned battery storage systems to large commercial and industrial customers in exchange for the Company's use of systems at times of high peak demand.**

1. Consideration of the range of potential price reductions in these technologies over the coming two decades;

In the recently filed 2022 IRP, Liberty-Empire considered capital cost reductions in various storage technologies assuming an engineering, procurement, and construction ("EPC") contracting strategy. The estimated capital costs included engineering design, construction, testing, start-up, and certification of new facilities or major upgrades, refurbishment, or rehabilitation of existing facilities, as applicable. Further, a high and low range of cost estimates were also developed as part of the larger process of developing cost and operational parameters.

For lithium-ion battery storage technologies, the table below summarizes costs for base, low and high cases over the next two decades. As discussed in Section 2.4.3, Liberty-Empire also considered vanadium redox flow batteries with availability for 2035 and beyond for all portfolios and gravity concrete block storage only for longer-term net-zero portfolios. Further, all cost estimates are provided prior to consideration of federal tax credits.

The capital cost (2020$/kW) for Li-Ion storage (utility scale) declines from 1,333 in 2023 to 899 in 2033. Similarly, the capital cost (2020$/kW) for Li-Ion storage (distributed) falls from 1,807 in 2023 to 1,219 in 2033.

Table 7.2- 2020 $/kW

Case	Year	Li-Ion Storage - Utility-Scale	Li-Ion Storage - Distributed
Base	2023	1,333	1,807
Base	2028	1,016	1,377
Base	2033	899	1,219
Low	2023	870	1,179
Low	2028	561	761
Low	2033	444	601
High	2023	1,618	2,194
High	2028	1,373	1,861
High	2033	1,276	1,730

Table 7.3- Nominal

Case	Year	Li-Ion Storage - Utility-Scale	Li-Ion Storage - Distributed
Base	2023	1,540	2,088
Base	2028	1,315	1,783
Base	2033	1,291	1,751
Low	2023	1,005	1,362
Low	2028	726	985
Low	2033	638	863
High	2023	1,870	2,535
High	2028	1,777	2,409
High	2033	1,833	2,485

2. Consideration of pumped hydro, stacked blocks, liquid air, above-ground and underground compressed air, and flow battery technologies in addition to lithium-ion battery technologies;

In the 2022 IRP, Liberty-Empire considered a wide range of potential supply-side resource options for inclusion in its future portfolio resource mix, then narrowed the range down to a subset of feasible and commercially viable options to be evaluated in the fuller integrated portfolio analysis in conjunction with demand-side resources. The following energy storage resources that were evaluated:

- Lithium-ion battery
- Vanadium redox flow battery
- Molten salt
- Energy Vault concrete block gravity storage
- Compressed air

Molten salt energy storage and compressed air energy storage were eliminated for further analysis based on initial feasibility screen given the engineering complexity of development and operation. Lack of natural geology for compressed air storage, and scarcity of operating examples of molten salt energy storage to draw upon were further reasons screening out of these technologies. Pumped hydro and liquid air were not included in the screening process for these same reasons, lack of geology and operating examples, respectively.

3. Pairing mid-scale deployments of battery storage technologies with current and future utility-scale solar generation sites

Assumptions for paired solar and battery storage systems were developed for the candidate resource list. These paired systems use the costs and parameters associated with the single axis tracking solar PV options in Table 4-17 and the costs and parameters associated with the lithium-ion battery options in Table 4-20 of the IRP report. Liberty-

Empire has assumed configurations based on both a 4:1 ratio and a 2:1 ratio of solar to storage at the utility scale, and a 2:1 ratio of solar to storage at the distributed scale.

Liberty-Empire considered the ability to co-locate new resources at the following existing sites: Energy Center 1 and 2, North Fork Ridge Wind Farm, Kings Point Wind Farm, Neosho Ridge Wind Farm, and the Asbury site. Based on land and siting availability at these sites, Liberty-Empire assumed that solar and/or lithium-ion battery storage resources could be co-located at the sites prior to unit retirement up to the amount of the interconnection availability, with 2025 being the first feasible in-service year.

4. Offering free installation of utility-owned battery storage systems to large commercial and industrial customers in exchange for the Company's use of systems at times of high peak demand.

While Liberty-Empire did not explicitly consider free installation of utility-owned battery storage systems to large commercial and industrial customers in exchange for the Company's use of systems at times of high peak demand, the company did identify the lithium-ion battery option as the best benchmark for potential distributed storage resource additions in the short to medium term. The analysis also considered paired solar + storage as a candidate resource at the distributed scale due to the need to manage Liberty-Empire's winter peak. Utility control of resources at the customer site would also require appropriate technology and communication capabilities. Planned upgrade programs will enable these opportunities in the future.

(I). Model stand-alone or hybrid battery storage resources.

In the 2022 IRP CRA modeled stand-alone and hybrid battery storage resources, both at the utility and distributed scale. Please see 2022 IRP Report Volume 4, Supply-Side Resource Analysis, Section 4.1.8.

In the 2022 IRP evaluation, Liberty-Empire evaluated several storage technologies, including lithium-ion and vanadium flow batteries, as well as concrete block gravity storage. Although various technologies will continue to be evaluated, Liberty-Empire ultimately identified a lithium-ion battery option as the best benchmark for potential storage resource additions in the short to medium term. Lithium-ion batteries currently represent the industry standard option for utility-scale storage technology. These resources involve the transfer of lithium ions between electrodes during charging and discharging. There are variations in the exact chemistry of a lithium-ion battery. Generally, the cathode is made of lithiated metal oxides or phosphates, and the anode is made of carbon or lithium titanate. The resulting electrodes are lightweight. Lithium is a highly reactive element, which means it can store a significant amount of energy in its atomic bonds and has high energy efficiency.

In the past few years, there has been a rapid build-out of lithium-ion manufacturing factories, including Tesla's Gigafactories, to meet the demand for batteries in EV applications, which are typically lithium-ion due to their light weight and high energy efficiency. Production costs have fallen significantly as a result of this increase in scale, although recent supply chain pressures, high demand, and economy-wide inflation have pushed costs up in recent years. Lithium-ion batteries have a higher up-front cost than other alternatives like lead-acid batteries, they generally have important advantages over lead-acid batteries, such as their superior volumetric energy density and gravimetric energy density, meaning that they are smaller and lighter. Lithium-ion batteries are also more resilient, and thus have longer life cycles and are less likely to be harmed if discharged too quickly or if extreme weather occurs.

Assumptions for paired solar and battery storage systems were also developed for the candidate list. These paired systems use the costs and parameters associated with the single axis tracking solar PV options and the costs and parameters associated with the lithium-ion battery options. For solar + storage resources, Liberty-Empire has assumed

single axis tracking solar and lithium-ion batteries with a combined capital cost based on both a 4:1 ratio and a 2:1 ratio of solar to storage at the utility scale and a 2:1 ratio of solar to storage at the distributed scale due to the need to manage Liberty-Empire's winter peak.

Liberty-Empire's preferred plan incorporates new storage additions, including the following:

Table 7.4 – Liberty-Empire Storage Additions in Preferred Plan

Year	Technology	Scale	MW
2023			
2024			
2025			
2026			
2027	Hybrid Solar + Lithium-ion 4-hour Battery (2:1)	Utility	105
2028			
2029			
2030			
2031	Hybrid Solar + Lithium-ion 4-hour Battery (2:1)	Distributed	3
2032	Hybrid Solar + Lithium-ion 4-hour Battery (2:1)	Distributed	6
2033			
2034			
2035			
2036			
2037			
2038			
2039	Hybrid Solar + Lithium-ion 4-hour Battery (2:1)	Utility	480
2040	Dist. Storage (4 MW)	Distributed	4
2041	Hybrid Solar + Lithium-ion 4-hour Battery (2:1)	Utility	120
	Lithium-ion 4-hour Battery	Distributed	1
	Hybrid Solar + Lithium-ion 4-hour Battery (2:1)	Distributed	3
	Flow Battery 8-hour Battery	Utility	50