APPENDIX N: ENGAGEMENT REPORT AND SOCIETAL COST BENEFIT ANALYSIS

This Appendix N to Minnesota Power's (or the "Company's") 2025-2039 Integrated Resource Plan ("2025 IRP") provides information on the stakeholder engagement process that informed the 2025 IRP and provides a societal cost benefit analyses (or "SCBA") for Boswell Energy Center ("BEC") Unit 4 ("BEC4") and the Hibbard Renewable Energy Center ("HREC"). Information is presented in the following sections:

- Part A – Introduction
- Part B – Engagement Process and Report
- Part C – Societal Cost Benefit Analysis

A. Introduction

Minnesota Power has served central and northern Minnesota for over a century and has a long history of thoughtful and intentional stakeholder and Tribal engagement. Minnesota Power was the first utility in the state to develop formal Community Advisory Panels ("CAPs") in host communities nearly a decade ago. These CAPs remain active today and their members participated in this 2025 IRP engagement process. When developing the 2025 IRP, it was critically important to the Company to engage customers, communities, advocates, local governments, Tribal governments, and other stakeholders who would be directly affected by any energy system changes.

As part of its approval of Minnesota Power's 2021 Integrated Resource Plan ("2021 IRP"), the Minnesota Public Utilities Commission ("Commission") required the following:

6. *In developing its next resource plan, Minnesota Power must consult with stakeholders, including but not limited to parties to the current proceeding, to develop an analysis that will inform its next IRP on the following topics:*
    a. *Implications of the Inflation Reduction Act on renewable energy projects.*
    b. *Efforts to access applicable federal Infrastructure Investment and Jobs Act funding.*
    c. *MISO's Long Range Transmission Planning process.*
    d. *MISO's Seasonal Adequacy Construct changes.*
    e. *An update on regional economic development activities in support of host communities.*[1]
7. *In developing the modeling analysis to be used in its next resource plan, Minnesota Power must consult with stakeholders, including but not limited to the Department of Commerce, Office of the Attorney General, Large Power Intervenors and the Clean Energy Organizations, regarding the Company's modeling inputs and parameters.*[2]

[1] *In the Matter of Minnesota Power's 2021-2035 Integrated Resource Plan,* Docket No. E-015/RP-21-33, Order Approving Plan and Setting Additional Requirements ("2021 IRP Order") at Order Point 6 (Jan. 9, 2023).
[2] 2021 IRP Order at Order Point 7.

8. *In its next resource plan, Minnesota Power must include a summary of the modeling stakeholder group discussions, including potential modeling constraints and how Minnesota Power could consider modeling solar-powered generators connected to the Company's distribution grid as a resource.*[3]

11. *In its next resource plan, Minnesota Power must work with stakeholders, including but not limited to parties to the current proceeding, to include a stakeholder report, consistent with the following:*

    a. *Minnesota Power will work to intentionally include stakeholders from groups historically not present in these regulatory processes, like low-income customers and customers from BIPOC (black, indigenous, and communities of color) communities.*

    b. *Stakeholders will provide input on a societal cost benefit analysis of Boswell Unit 4 and Hibbard Renewable Energy Center, considering impacts on host communities, workforce, economics, health, system reliability, the environment, and customer costs.*

    c. *An analysis of the near-term steps needed to ensure Minnesota Power meets clean energy goals set in Minnesota state statute.*[4]

The engagement process, summarized in the attached reports, informed the development of the 2025 IRP and meets these specific Commission requirements.

B. Engagement Process and Report

In 2019, Minnesota Power established a first-of-its-kind stakeholder engagement process to help inform the development of its 2021 IRP. For its 2025 IRP, Minnesota Power enhanced this engagement process to create opportunities for stakeholders from groups historically not represented in these types of regulatory proceedings and expanded engagement opportunities for engagement participants to interact outside of formal meetings and tour Minnesota Power generation facilities. Stakeholders participated in a series of in-person, virtual, and hybrid meetings to inform the Company's modeling inputs and help create a societal cost benefit analysis framework used to assess the impacts of Minnesota Power's preferred resource plan ("2025 Plan") as well as the costs and benefits of associated with BEC4 and HREC.

The 2025 Plan was directly informed by and reflects the insights from the over 65 participants in its year-long engagement process. Together, participants in the engagement process evaluated the positive and negative impacts of these generation facilities on host communities, local economies and workforce, customer costs, public health, the environment, and system reliability. It was clear that stakeholders were concerned about reliability as Minnesota Power advances its cease-coal plan, and about ensuring customer impacts of the Company's clean energy transition be transparent, incremental, and reasonable. Commitment to maintaining jobs in host communities, particularly at BEC, was also noted as a priority among stakeholders, as was the importance of additional economic opportunities for transitioning communities such as those associated with large power load growth.

The engagement process brought together a diverse group of participants representing various customer groups, environmental organizations, economic development entities, local government, industry, host communities, and others. Multiple engagement meetings allowed

[3] 2021 IRP Order at Order Point 8.
[4] 2021 IRP Order at Order Point 11.

participants the opportunity to provide their perspectives regarding Minnesota Power's future energy mix and the impacts of transitioning the current power system. In response to the Order Point 11(b) of the Commission's Order in the 2021 IRP referenced above, participants also provided input on a societal cost benefit analysis of BEC4 and HREC, considering impacts on host communities, workforce, economics, public health, system reliability, the environment, and customers. The Center for Energy and the Environment and the Great Plains Institute ("Facilitators") were hired as independent facilitators of the stakeholder process.

The engagement process included three overlapping groups of interested parties:

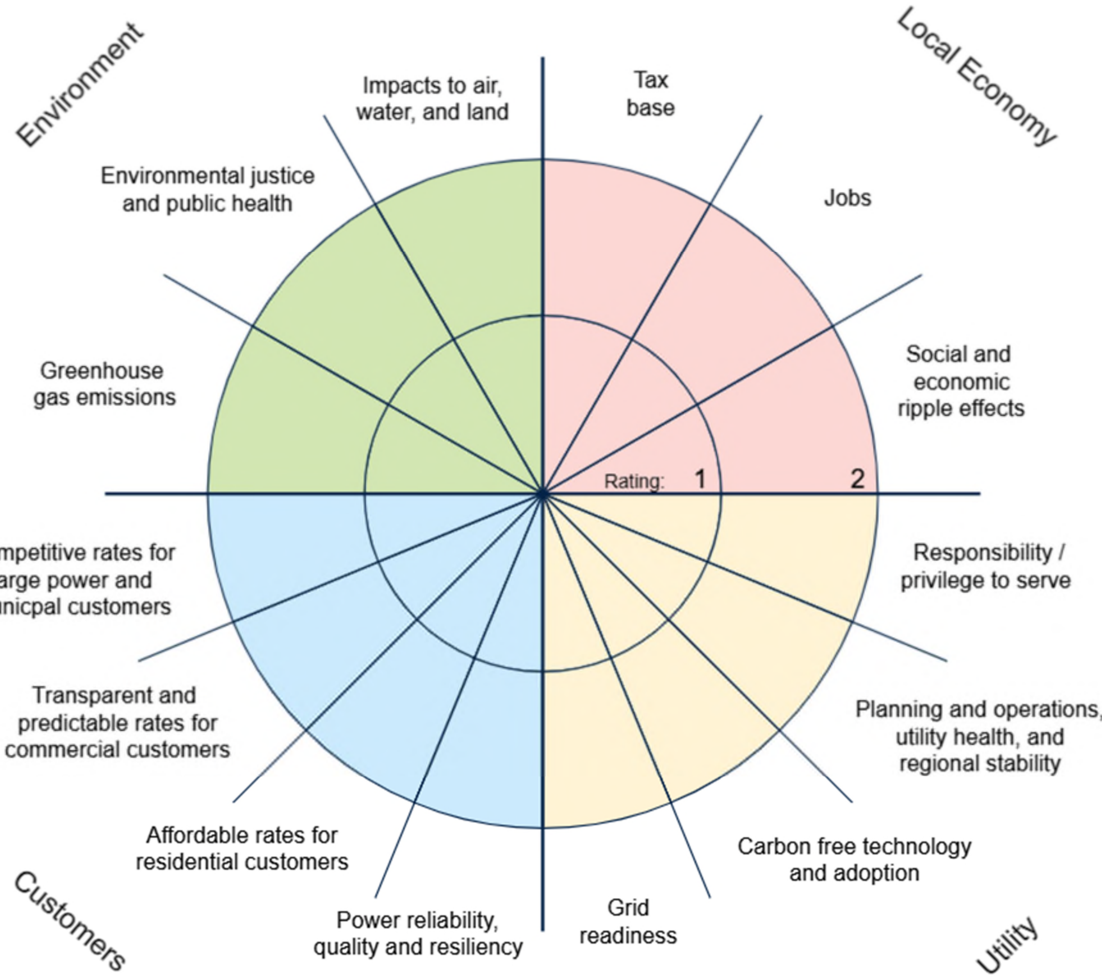
1. *The Engagement Group:* a broad set of participants that convened four times to build a shared understanding of the policy, technology, and socio-economic landscape for the 2025 IRP.
2. *The Societal Advisory Group ("SAG")*: a subgroup of participants from the Engagement Group that convened three times to inform the development of an SCBA for any Minnesota Power generation facility, including but not limited to HREC and BEC4.[5]
3. *The Technical Advisory Group ("TAG")*: a subgroup of participants from the Engagement Group that convened regularly over several months to discuss critical modeling assumptions and methodologies for the 2025 IRP, as well as technical topics such as the Midcontinent Independent System Operator ("MISO") transmission planning process, Minnesota Power Reliability Criteria, customer demand, modeling environmental futures and MISO resource adequacy construct reform.

The work of these three subgroups were intended to be complementary to one another. At the onset of this IRP's engagement process that began in February 2024, Minnesota Power heard from participants – many of whom participated in the Company's last IRP engagement process – that they did not want to reinvent a process but rather preferred to refine and build from the first-of-its-kind engagement process developed for the 2021 IRP. Minnesota Power heard from participants that it was challenging for them to find time to fully engage in a year-long process. The Company values the time that participants and facilitators dedicated to this process and has incorporated their feedback to evaluate the social, economic, and environmental impacts of the 2025 Plan in addition to the societal costs and benefits of HREC and BEC4.

While the full engagement report and materials are included as an attachment in this appendix, in order to organize stakeholder feedback in a way that could be used to inform the development of the 2025 Plan, participants developed a framework for what an "acceptable," "unacceptable," and "best case" future situation might look like for a refined set of impact areas from the customer, environmental, local economy, and utility perspective as shown in Figure 1 below.

[5] While this subgroup was focused on the SCBA framework, the impact map framework and feedback provided by participants through the SAG engagement meetings was in many cases applicable to Minnesota Power's planning more broadly and less focused on the outcomes related to a specific generation facility.

Figure 1. Minnesota Power's IRP Impact Map[13]



Minnesota Power used this forward-looking impact map to develop a plan that is responsive to what engagement participants shared was most important. The Company heard clearly from participants that stakeholders were concerned about the costs of compliance with Minnesota's Carbon-Free Standard ("CFS")[6] as well as reliability as Minnesota Power advances its cease-coal plan. Uncertainty about the readiness of emerging carbon-free technologies that could replace the capacity and energy currently provided by BEC Unit 3 ("BEC3") and BEC4 was a common theme throughout the engagement meetings, as were the customer impacts of resources required

[6] Minn. Stat. § 216B.1691 Subd. 2g requires "each electric utility must generate or procure sufficient electricity generated from a carbon-free energy technology to provide the electric utility's retail customers in Minnesota, or the retail customers of a distribution utility to which the electric utility provides wholesale electric service, so that the electric utility generates or procures an amount of electricity from carbon-free energy technologies that is equivalent to at least" 80 percent by the end of 2030 for public utilities, 90 percent by the end of 2035 for all electric utilities, and 100 percent by the end of 2040 for all electric utilities.

to comply with the CFS as emerging technologies are not commercially available, reliable, or cost effective prior to 2040.

As was identified in the 2021 IRP engagement process, commitment to maintaining jobs in host communities, particularly at BEC, continues to be a priority among participants along with the importance of additional economic opportunities for transitioning communities such as those associated with large power load growth. Also identified as a high priority among participants in northern Minnesota were impacts to the local tax base, higher property taxes, and school district funding in Cohasset if BEC3 and BEC4 were retired. Finally, while participants recognized the importance of transitioning the electric power system amidst concerns about climate change, participants are concerned about the costs associated with the infrastructure buildout necessary to make that transition in the timeframe outlined in the CFS. Minnesota Power heard that transparent and incremental cost increases were important to participants to avoid rate shocks and ensure that households, businesses, and communities can effectively plan for their economic futures.

Minnesota Power Customer Survey

Finally, in addition to the formal facilitated stakeholder process, Minnesota Power gave all customers an opportunity to share their preferences related to their future energy supply via an electronic survey. The survey included questions regarding system reliability, affordability, carbon-free energy and renewable goals, and local economic impacts. Despite a limited response rate, the survey results clearly indicated that reliability and affordability were the top concern for the majority of respondents, with over 80 percent indicating one of these two concerns were most important to them, and approximately 20 percent of customers indicating the environmental impacts of electricity generation was their top concern. Survey respondents ultimately signaled a preference for a balanced approach to resource planning to ensure reliability and affordability while managing environmental impacts. Minnesota Power values all input from customers, community members, and regional advocates, and will continue to engage them through bill messages, social media, the Minnesota Power website, and additional engagement meetings after the submission of this 2025 IRP. As stated above, the Company values input from all interested parties and has created a 2025 Plan that is responsive to customers, communities, and the climate.

C. Societal Cost Benefit Analysis

As noted above in Section A, the Commission's 2021 IRP Order directed Minnesota Power to work with interested parties to develop a societal cost benefits analysis of BEC4 and HREC. During the engagement meetings, participants shared that they did not want to reinvent the robust engagement process employed prior to filing the 2021 IRP. However, the impact map framework, and the feedback provided by participants through the SAG engagement meetings, was in many cases applicable to Minnesota Power's planning more broadly and less focused on the outcomes related to a specific generation facility. The engagement Facilitators therefore proposed using a modified version of a cost-benefit framework approved by the Commission in a previous proceeding. The Facilitators worked with Minnesota Power and participants to modify the SCBA framework to incorporate the four perspectives participants identified as most important, including local economy, environment, customers, and utility. The four perspectives were further broken down into fourteen impact areas shown in Figure 1 above.

After the SCBA framework was finalized with the Facilitators and participants, Minnesota Power worked to incorporate the feedback provided during engagement meetings, summarized in Attachment 1, in addition to working with its internal subject matter experts to evaluate HREC and BEC4 operations for each perspective's impact areas in terms of continued operations or retirement. Tables 1 and 2 below include the finalized SCBA for HREC and BEC4, which incorporates input from participants in the engagement process.

Tables 1 and 2 are each divided into two scenarios:

- Business as Usual ("BAU") Scenario: HREC and BEC4 continue to operate as they do today.
- Change Scenario: HREC and BEC4 operations are changed by retiring the power plant.

Notably, the SCBA and impact areas do not imply a specific time horizon of when the action is taken. The change scenario and preferred plan may consider action at a specific point in time. Some of the impact areas discussed may have longer timeframes than others.

Table 1. HREC Societal Cost Benefit Analysis

HREC Perspective: Customers		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Competitive rates for large power and municipal customers	HREC is an existing generation resource and there are no material rate increases associated with anticipated significant capital investments at the facility. Customer rates are primarily impacted by costs associated with fuel purchasing, operations and maintenance. Environmental compliance requirements can also impact rates. Abundant and affordable supply of regional fuel sourcing. HREC fuel produced in Minnesota reduces costs associated with importing fuel from outside the state.	HREC retirement involves replacement of energy, capacity, and renewable energy credits. The associated costs include permitting and construction of new energy generation facilities, power purchase agreements (“PPAs”) for new energy sources, or market energy, capacity, and renewable energy credit purchases. HREC retirement reduces costs associated with continued operations and maintenance of the facility, fuel purchases, and ongoing environmental compliance.
Competitive and affordable rates for commercial customers	HREC is an existing generation resource and there are no material rate increases associated with new permitting or construction of replacement energy generation resources. Customer rates are primarily impacted by costs associated with fuel purchasing, operations and maintenance. Environmental compliance requirements can also impact rates. Abundant and affordable supply of regional fuel sourcing. HREC fuel produced in Minnesota reduces cost associated with importing fuel from outside the state.	HREC retirement involves replacement energy costs associated with permitting and construction of new energy generation facilities, PPAs for new energy sources, or market energy purchases. HREC retirement reduces costs associated with continued operations and maintenance of the facility, fuel purchases, and ongoing environmental compliance.

HREC Perspective: Customers		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Affordable rates for residential customers	HREC is an existing generation resource and there are no material rate increases associated with new permitting or construction of replacement energy generation resources. Customer rates are primarily impacted by costs associated with fuel purchasing, operations and maintenance. Environmental compliance requirements can also impact rates. Abundant and affordable supply of regional fuel sourcing. HREC fuel produced in Minnesota reduces cost associated with importing fuel from outside the state.	HREC retirement involves replacement energy costs associated with permitting and construction of new energy generation facilities, PPAs for new energy sources, or market energy purchases. HREC retirement reduces costs associated with continued operations and maintenance of the facility, fuel purchases, and ongoing environmental compliance.
Power reliability, quality, and resiliency	HREC is a dispatchable generation resource that can provide baseload power during times of peak demand, such as during extreme (cold or warm) weather events, natural disasters, and power supply emergencies. Fewer outages for customers during times of high electricity demand.	HREC retirement involves the loss of a reliable dispatchable energy generation resource that would need to be replaced with another dispatchable resource that has similar operational characteristics to maintain a similar level of reliability such as, new natural gas-fired generation or advanced nuclear generation.

HREC Perspective: Environment		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Impacts to air, water, land, and public health	HREC produces pollutants such as sulfur dioxide, volatile organic compounds, and particulate matter (or soot) and electrostatic precipitators are used to capture most particulates. HREC operates within its allowable emissions permit ranges that have been determined to be protective of human health and the environment by state and federal permitting agencies, ensuring a safely operated biomass facility in the region. HREC also provides several valuable environmental services, such as being a critical resource for energy recovery from diseased, infested, or waste biomass, including hazardous wildfire fuels. HREC also generates fly ash which is used as a valuable soil amendment. Other ash byproducts are landfilled in approved landfills.	Retirement of HREC would reduce pollutants such as sulfur dioxide, volatile organic compounds, and particulate matter. The level of reduction would depend on the nature of the replacement energy. HREC retirement would also result in the loss of environmental services such as energy recovery from diseased, infested, or waste biomass, including hazardous wildfire fuels, and reduced production of beneficial fly ash. The biomass currently utilized at HREC for energy production would be expected to be either landfilled locally, transported longer distances to other suitable energy conversion facilities, or potentially open-burned, which would generate greenhouse gas ("GHG") emissions and other pollutants.
Environmental justice	HREC is located in a Minnesota Pollution Control Agency ("MPCA") designated Environmental Justice Area due to at least 35 percent of households having income at or below the federal poverty level (36 percent of residents reported an income less than 200 percent of the federal poverty level).[7] Those living near HREC have access to direct and indirect economic benefits associated with the facility's operations as well.	As the primary designation of the Environmental Justice Area that contains HREC is economic, the retirement of HREC would have a negative economic impact on the immediate Environmental Justice Area as well as St. Louis County more broadly. HREC retirement would eliminate the workers at the facility who currently earn approximately $2.5 million in wages and benefits. HREC retirement would reduce emissions of environmental pollutants and increase exposure to negative economic impacts.

[7] Minnesota Pollution Control Agency, Environmental Justice Areas, Census Tract #27137015800, https://experience.arcgis.com/experience/bff19459422443d0816b632be0c25228/page/Page/?views=EJ-areas#data_s=id%3AdataSource_11-190f070e1af-layer-3-3%3A811

HREC Perspective: Environment		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Greenhouse gas emissions	HREC directly emits GHGs including biogenic carbon dioxide and methane. Biomass utilized at the facility has the potential to be considered a carbon-neutral fuel when emissions are calculated net of the carbon dioxide sequestered by new vegetation growth or emissions avoided due to HREC's contributions to sustainable forest management in northern Minnesota.	The Company's position is that biomass can be a net carbon free resource when considering the life-cycle analysis of the fuel supply. The Commission has initiated proceedings to address compliance with the CFS based on a life cycle analysis. While direct GHG emissions from HREC may decrease if retired, there could be a net increase in GHG emissions if HREC is retired, depending on the replacement generation type selected to provide the same energy, capacity, and dispatchable capabilities as HREC provides today.
HREC Perspective: Host Community		
Tax base	HREC's Duluth, Minnesota operations generate approximately $2.9 million in annual tax revenue, which supports county, state, and federal governments.	Approximately $2.9 million in annual tax revenue will be lost in the event of HREC retirement.
Jobs	HREC directly employs 21 union workers and 3 non-union workers who earn approximately $2.5 million in wages and benefits annually. In total, HREC operations support 62 jobs in St. Louis County, contributing $5 million in labor income annually.	HREC retirement would result in the loss of 24 direct jobs, 21 union and 3 non-union, and $2.5 million annually in direct wages and benefits. HREC retirement would also result in an estimated loss of $5 million annually in labor income that is generated by the facility's operations.

HREC Perspective: Host Community		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Economic ripple effects	HREC spends approximately $9.2 million annually on intermediate goods and services such as energy, materials, and professional services which contribute to economic ripple effects across the local economy. The facility adds $7.8 million annually in value added Gross Domestic Product to the economy in St. Louis County and produces an economic output of $26.1 million annually.	HREC retirement would result in approximately $9.2 million lost in annual spending on intermediate goods and services in the local economy. Approximately $7.8 million in annual value added Gross Domestic Product would be lost in the St. Louis County economy. Approximately $26.1 million in annual economic output would be forfeited with HREC retirement.
HREC Perspective: Utility		
Responsibility/privilege to serve	HREC serves as a regional dispatchable power generation facility, operated by members of its surrounding community, helping to reduce customer vulnerability to market prices during times of extreme weather events and other times of peak electricity demand. HREC serves as a local connection to Minnesota Power customers located in Duluth, where the Company's highest concentration of residential and small business customers are located, and helps to keep cost of service affordable for all customers.	HREC retirement would result in the loss of a local power generation facility, operated by members of its surrounding community. In the event of HREC retirement, Minnesota Power would need to find affordable and reliable replacement power generation sources, which may or may not be sited in the local Duluth community.

HREC Perspective: Utility		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Planning and operations, utility health, and regional stability	HREC delivers approximately 100,000 MWh of electricity annually to the electric power system, where it is used to power homes and businesses in and around Duluth. As a provider of dispatchable power generation, HREC serves as a dispatchable power generation resource that can be ramped up or down based on grid conditions and needs, reducing the potential for blackouts.	HREC retirement would require either new permitting and construction of new energy generation resources or PPAs with similar operational characteristics that could provide at least 100,000 MWh of electricity annually and 60 MW of capacity to the electric power system.
Grid readiness	HREC supplies dispatchable energy generation during a time of increasing electricity demand and can respond quickly to demand fluctuations due to load increases and/or extreme weather events, minimizing system interruption risk and supporting increased integration of other renewable energy generation resources onto the grid.	HREC retirement would require new dispatchable energy resources to be permitted and constructed or new PPAs that have similar operational characteristics as HREC. HREC retirement could increase the risk of system outages during times of high energy demand, low periods of wind and solar production, or extreme weather events if not replaced by adequate sources of energy that support 24/7 electricity demand.

HREC Perspective: Utility		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Carbon-free technology and adoption	Biomass is defined as an Eligible Energy Technology for compliance with Minnesota's Renewable Energy Standard ("RES").[8] The Commission has initiated proceedings to address compliance with the CFS and its impact on the RES, including a proceeding to address a life-cycle analysis ("LCA") framework.[9] The Company's position in this pending docket is that biomass-derived energy to generate electricity at HREC can be carbon neutral when measured with a carbon life-cycle analysis, meeting the CFS requirements.	HREC retirement would require replacement with another resource that qualifies for the CFS to maintain similar level of compliance. Also, retirement would require alternative disposition of regional northeastern Minnesota excess biomass sources currently used for energy recovery at the facility, resulting in carbon impacts from the additional transport, decomposition, and/or wildfire risks.

[8] Minn. Stat. § 216B.1691, Subd. 1(c).
[9] *In the Matter of a Commission Investigation into a Fuel Life-Cycle Analysis Framework for Utility Compliance with Minnesota's Carbon-Free Standard*, Docket No. E-999/CI-24-352.

Table 2. BEC4 Societal Cost Benefit Analysis

BEC4 Perspective: Customers		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Competitive rates for large power and municipal customers	BEC4 incurs operational costs including maintenance, labor, and fuel expenses. BEC provides a stable and reliable source of energy, which is crucial for large power and municipal customers who require consistent power supply.	BEC4 retirement involves significant decommissioning and site remediation costs. The IRP analysis affirms that replacing BEC4 coal energy with lower carbon energy sources would increase rates for customers over the IRP study period.
Competitive and affordable rates for commercial customers	Operating a coal fired plant is an economic baseload and dispatchable type resource for customers. At this time, there are no new environmental controls required for BEC4 to be in compliance with environmental regulations which, if required, can increase operational costs and affect customer rates. To comply with pending Environmental Protection Agency ("EPA") section 111(d) regulations, the facility will need to refuel with 40 percent natural gas by 2030.[10] This is a modest capital investment and operating cost increase to keep BEC4 operating during a period where Minnesota Power would have higher capacity needs and unserved energy risk if the unit was retired. BEC supports local jobs and contributes to the local economy, which can help maintain competitive rates due to maintaining and/or increasing the number of commercial customers.	BEC4 retirement would have considerable costs associated with permitting and construction of new energy generation facilities, PPAs for new energy sources, or increase exposure and risk market energy purchases. BEC4 retirement reduces costs associated with continued operations and maintenance of the facility, fuel purchases, and ongoing environmental compliance. The IRP analysis affirms that replacing BEC4 coal energy and capacity to lower carbon energy sources would increase rates for customers over the IRP study period.

[10] *See* Appendix E: Environmental Policy and Compliance Assessment, EPA Regulation of GHG Emission: EPA Section 111 Rules section. On April 25, 2024, the EPA issued a set of final GHG regulations to establish emissions standards and guidelines for existing and new fossil fuel-fired electric generating units under Section 111 of the Clean Air Act.

BEC4 Perspective: Customers		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Affordable rates for residential customers	Significant investments have been made to reduce emissions at BEC. These costs are passed on to customers through rate case proceedings. Compliance with environmental regulations can increase operational costs, which are reflected in customer rates. Unit 4 provides a stable and reliable source of energy, which is crucial for residential customers who require consistent power supply.	BEC4 retirement would have considerable costs associated with permitting and construction of new energy generation facilities, PPAs for new energy sources, or market energy purchases. BEC4 retirement reduces costs associated with continued operations and maintenance of the facility, fuel purchases, and ongoing environmental compliance.
Power reliability, quality, and resiliency	BEC4 ensures a stable and reliable power supply, which is essential for both residential, commercial, and industrial customers. This reliability is particularly important during peak demand periods or when renewable energy sources are not producing at full capability. The consistent operation of BEC4 helps maintain power stability in the region Minnesota Power serves by providing a steady and reliable energy output. A reliable coal-fired unit like BEC4 adds resiliency to the power grid.	Retiring BEC4 involves significant decommissioning and site remediation costs. Transitioning to alternative energy sources, such as wind, solar, and natural gas, requires substantial investment. New transmission is needed to strengthen the grid with the absence of baseload generation in the region. Investing in a diverse mix of dispatchable gas generation, renewable energy sources, and storage solutions can enhance grid resiliency. Transitioning to modern, cleaner energy sources can maintain or improve power quality and other issues associated with older coal-fired plants.

BEC4 Perspective: Environment		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Impacts to air, water, land, and public health	BEC4 emits air pollutants such as nitrogen oxides (“NOx”), sulfur dioxide (“SO_2”), and particulates at or under levels allowed through its Title V air permit limits. These limits have been determined to be protective of human health and the environment by state and federal permitting agencies. Similarly, disposal of treated wastewater and storage of coal ash are allowed under state and federal regulations and permits, all of which have been designed to be protective of human health and the environment. Investments in emissions control technologies have significantly reduced mercury and sulfur dioxide air emissions. Reductions in emissions have contributed to better air quality. Continued operation with stringent environmental controls will contribute to a healthy environment.	Retiring BEC4 involves significant costs for decommissioning and site remediation to ensure the area is safe and environmentally sound. Substantial investments are required to replace the energy generated by BEC4 with wind, solar, and natural gas, and new transmission to strengthen the grid. Retiring BEC4 would reduce or eliminate emissions of pollutants such as NOx, SO_2, and particulates. The level of reduction would depend on the nature of the replacement energy. Ceasing coal combustion would reduce the volume of coal ash and other byproducts that are required to be safely stored or reused to minimize environmental impacts.
Environmental justice	BEC4 is not located in an MPCA designated Environmental Justice Area.	Retiring BEC4 could reduce emissions and contribute to a reduction of environmental burdens on nearby communities. A transition plan for retirement of BEC4 could include measures to support affected communities, such as job retraining programs and economic development initiatives. This can help mitigate the economic impact of the plant's closure and promote environmental justice.

BEC4 Perspective: Environment		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Greenhouse gas emissions	BEC4 emits a substantial amount of GHGs, including carbon dioxide (“CO_2”). These emissions contribute to climate change which can have long-term environmental impacts. Investments in emissions control technologies have significantly reduced mercury and sulfur dioxide emissions by more than 90%. This has helped improve air quality compared to historical levels.	Retiring BEC4 would result in a substantial decrease in GHG emissions, contributing to climate change mitigation efforts. The plan to replace BEC4's capacity with natural gas generation and renewable energy sources like wind and solar would further reduce GHG emissions, supporting a cleaner energy future.

BEC4 Perspective: Host Community		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Tax base	BEC[11] is a significant contributor to the local tax base. Property taxes from BEC3 and BEC4 account for 43 percent of the City of Cohasset's property tax revenue, 8 percent of Grand Rapids School District's property tax revenue, and 6 percent of Itasca County's property tax revenue.[12] When Units 1 and 2 were operational, the percentage of the property tax revenue supplied by BEC was even higher. This revenue supports local public services, infrastructure, and community programs.	BEC is a significant contributor to the local tax base. Property taxes from Boswell account s for 43 percent of the City of Cohasset's property tax revenue, 8 percent of Grand Rapids School District's property tax revenue, and 6 percent of Itasca County's property tax revenue. When Units 1 and 2 were operational, the percentage of the property tax revenue supplied by BEC was even higher. Retiring BEC4 would reduce this tax revenue, impacting funding for local public services, infrastructure, and community programs. The community may need to explore economic diversification strategies or increase local property taxes to offset the loss of tax revenue and jobs. This could include attracting new industries or investing in renewable energy projects.

[11] Boswell Energy Center Units 3 and 4.
[12] 2023 Data Reported in Itasca Economic Development Corporation, Sparking Change: Diversifying Our Regional Economy Report, available at https://www.itascadv.org/sparking-change.

BEC4 Perspective: Host Community		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Jobs	BEC4 supports local jobs and contributes to the local economy, which can help maintain competitive rates. BEC provides direct, full-time, highly skilled jobs to approximately 170 Minnesotans. The presence of the plant also stimulates economic activity in the region, benefiting local businesses and services. Keeping BEC4 operational ensures the retention of jobs at the plant, which is crucial for the local economy. This includes both direct employment at the plant and indirect jobs supported by the plant's operations.	The retirement of BEC4 could lead to job losses and reduced local economic activity, affecting the community around Cohasset. This can have a ripple effect on local businesses and services that rely on the plant's operations and have negative impacts on those whose jobs are affected.
Economic ripple effects	Currently, the area around BEC4 and Blackwater Lake support numerous recreational and other uses, including fishing, boating, and swimming. It also supports wild rice gathering due to extensive wild rice beds near the BEC facility. Retirement of BEC4 could increase usage of Blackwater Lake for one or more of these uses.	The retirement of BEC4 could lead to job losses and reduced local economic activity, affecting the community around Cohasset. This can have a ripple effect on local businesses and services that rely on the plant's operations and could have negative effects on those whose jobs are affected. Retirement helps meet regulatory requirements and avoids future costs associated with environmental compliance. The development of renewable energy projects to replace the capacity of BEC4 could create new job opportunities in construction, operations, and maintenance. This can help mitigate some of the negative economic impacts and create positive ripple effects in the local economy.

BEC4 Perspective: Utility		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Responsibility/privilege to serve	Keeping BEC4 operational ensures that Minnesota Power can continue to provide reliable and stable energy to its customers. This is a key aspect of the utility's responsibility to serve its customers effectively. By investing in emissions control and other environmental improvements, Minnesota Power demonstrates its commitment to regulatory compliance and environmental stewardship. This helps maintain Minnesota Power's privilege to operate and serve the community. Providing reliable and affordable energy helps build and maintain customer trust and satisfaction, which is essential for Minnesota Power's long-term success and its privilege to serve.	By retiring BEC4, Minnesota Power can demonstrate a strong commitment to environmental stewardship and sustainability, aligning with regulatory and public expectations. Transitioning to cleaner energy sources can improve the Minnesota Power's public image and strengthen its relationship with customers and stakeholders. Investing in renewable energy and modernizing the grid can enhance the long-term reliability and stability of the energy supply, fulfilling the Minnesota Power's responsibility to provide consistent and reliable service.
Planning and operations, utility health, and regional stability	Keeping BEC4 operational allows Minnesota Power to plan for a gradual transition to cleaner energy sources while maintaining reliability and affordability for customers. This includes integrating renewable energy and modernizing the grid. BEC4 provides economic stability for the region by supporting local jobs and businesses.	Retiring BEC4 allows Minnesota Power to strategically transition to a more sustainable energy mix, incorporating more renewable energy sources and lower carbon emitting natural gas generation. This aligns with long-term planning goals and regulatory requirements. The initial transition to renewable energy sources may be costly, however, the long-term financial benefits of lower costs for compliance with environmental regulations can contribute to the utility's financial stability.

BEC4 Perspective: Utility		
Impact Area	**BAU Scenario** Costs and Benefits of Continued Operation	**Change Scenario** Costs and Benefits of Retirement
Grid readiness	Keeping BEC4 operational ensures a stable and reliable power supply, which is essential for grid stability. This is particularly important during peak demand periods or when renewable energy sources are not producing at full capacity. BEC4 provides a reliable baseload and it allows for the gradual integration of renewable energy sources. This balanced approach helps maintain grid readiness while transitioning to cleaner energy while keeping rates affordable.	Retiring BEC4 requires investments in modern grid technologies, such as smart grids and advanced energy storage, which can improve overall grid readiness and efficiency, but could be a challenge to keeping rates affordable and the grid reliable. The transition plan recommended in the 2025 IRP includes adding up to 400 MW of wind , 100 MW of energy storage, and dispatchable natural gas generation required for reliability and stable rates, which supports compliance with Minnesota CFS.
Carbon-free technology and adoption	Keeping BEC4 operational allows Minnesota Power to balance the immediate need for reliable energy with the long-term goal of transitioning to carbon-free technologies and keeping rates affordable. This ensures that Minnesota Power can maintain grid stability while gradually integrating more renewable energy sources. By maintaining emissions control measures, Minnesota Power can comply with environmental regulations while working towards its carbon-free energy vision. This dual approach helps meet regulatory requirements and public expectations.	Retiring BEC4 allows Minnesota Power to accelerate its transition to less carbon intensive technologies. This aligns with the requirement to meet Minnesota's CFS. Retiring BEC4 would significantly reduce emissions, contributing to lower greenhouse gas emissions. Moving towards a carbon-free energy mix can enhance public perception and regulatory support for Minnesota Power. This positive relationship is essential for the successful adoption of new technologies and long-term sustainability.

Minnesota Power 2025 Integrated Resource Plan

Engagement Process Final Report

Docket No. E-015/RP-21-33

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Convened by the Great Plains Institute and the Center for Energy and Environment

About this Report

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USAGE OF THIS REPORT

This document provides a summary of the engagement process for Minnesota Power's 2025 integrated resource plan (IRP). It is intended to support important discussions within the formal regulatory process. Any comments captured should not be attributed to any individual or organization. No commentary in this document is intended to limit the ability of any party to take positions within regulatory proceedings.

ACKNOWLEDGMENTS

The Great Plains Institute and Center for Energy and Environment would like to thank the participants for their significant time commitment and thoughtful engagement throughout this process. In addition, we would like to thank Minnesota Power and those participants for the opportunity to serve as third-party facilitators for these important discussions.

ABOUT THE FACILITATORS

Great Plains Institute: A nonpartisan, nonprofit organization, the Great Plains Institute (GPI) accelerates the transition to net-zero carbon emissions for the benefit of people, the economy, and the environment. Working across the US, we combine a unique consensus-building approach, expert knowledge, research and analysis, and local action to find and implement lasting solutions. Our work strengthens communities and provides greater economic opportunity through the creation of higher-paying jobs, expansion of the nation's industrial base, and greater domestic energy independence while eliminating carbon emissions. Learn more at http://www.betterenergy.org/.

Center for Energy and Environment: Center for Energy and Environment is a clean energy nonprofit with special expertise in energy efficiency that stretches back nearly 40 years. Center for Energy and Environment provides a range of practical and cost-effective energy solutions for homes, businesses, and communities to strengthen the economy while improving the environment. More information is available at www.mncee.org.

QUESTIONS ABOUT THIS REPORT

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I. Executive Summary

Minnesota's regulatory review process requires investor-owned utilities (IOUs) to file an integrated resource plan (IRP). The IRP is a series of documents where the utility lays out what it thinks are the appropriate energy resources necessary to meet customers' energy needs over the next 15 years. These plans involve many discussions of potential outcomes, including changes in electricity rates, system reliability and resilience outcomes, changes to communities that host energy facilities, and environmental concerns.

Minnesota Power's 2025 IRP, to be filed in spring 2025, will be notable, as it will be the first plan submitted by any electric IOU to demonstrate how it will comply with Minnesota's new statutory milestones toward achieving 100 percent carbon-free electricity by 2040, referred to in this report as the "Carbon Free Standard." The 2025 IRP demonstrates Minnesota Power's path toward achieving the 2040 target,10 years earlier than Minnesota Power voluntarily established in its 2021 IRP, by achieving 90 percent renewable energy by 2035 in compliance with the Carbon Free Standard (CFS). The period of this IRP ends in 2039 when the CFS requires 90% carbon-free electricity. Minnesota Power's path to compliance is primarily through renewable energy such as wind, solar, hydro and potentially biomass resources as the Company does not currently own or operate nuclear resources.

To inform the development of its 2025 IRP, Minnesota Power sought to better understand the needs and desires of its customers, communities, and other interested parties. Minnesota Power hired the Great Plains Institute (GPI) and the Center for Energy and Environment (CEE) as neutral third-party conveners and facilitators to guide a year-long engagement process with participants. GPI and CEE convened these participants to broadly inform Minnesota Power's planning process and to consult with interested parties on a series of key topics, including those set forth by the Minnesota Public Utilities Commission (referenced going forward in this report as "Commission") in its order to approve Minnesota Power's 2021 IRP. Those key topics for consultation included the following:

- Implications of the Inflation Reduction Act on renewable energy projects
- Regional economic development activities in support of host communities
- IRP modeling inputs and parameters
- A societal cost-benefit analysis of Boswell Unit 4 and Hibbard Renewable Energy Center[1]

This report documents the engagement process, which included three overlapping groups of interested parties: the Engagement Group, the Societal Advisory Group, and the Technical Advisory Group. These groups, their makeup, and their contributions to Minnesota Power's IRP development are each explained thoroughly in their respective sections of this report.

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[1] Minnesota Public Utilities Commission, *In the Matter of Minnesota Power's 2021-2035 Integrated Resource Plan* (Docket No. E-015/RP-21-33), Order Approving Plan and Setting Additional Requirements issued (January 9, 2023) https://www.edockets.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={10CE9785-0000-CC15-93BC-CC94BB4400D6}&documentTitle=20231-191970-01.

The overall results of the engagement process are also reflected in this report. Notable results of this facilitated process included the following:

Development of the first-ever societal cost-benefit analysis for evaluating electric utility infrastructure changes. The infrastructure decisions that utilities and regulators make in response to integrated resource plans can have wide-ranging impacts on customers, communities, the environment, the local economy, and the electric grid. For example, shutting down a coal plant may be beneficial in reducing greenhouse gas emissions but detrimental to the local economy. While these impacts are typically considered in an integrated resource plan, there is not an established framework for analyzing and understanding them in an organized way. The Societal Cost Benefit Analysis (SCBA) Framework that is described in this report seeks to change that by providing a holistic way of assessing the costs of benefits of infrastructure decisions. Moreover, the proposed SCBA Framework is built upon the input that Minnesota Power received in its 2021 IRP engagement process and was thoroughly reviewed and refined by the Societal Advisory Group as part of this process.

Well-informed technical assumptions for the plan's modeling and analysis. Through the Technical Advisory Group, Minnesota Power had the opportunity to share and refine the technical assumptions and inputs that the company used to conduct scenario modeling for its 2025 IRP. The value of this is two-fold. First, Minnesota Power has better analysis and modeling because it engaged multiple participants with different perspectives to inform its inputs and assumptions. Second, there is a higher likelihood of minimizing unnecessary disputes in the formal regulatory process about the company's modeling for the 2025 IRP, allowing regulators and interested parties to focus on substantive areas of disagreement.

This report seeks to summarize and reflect on the meaningful discussions between Minnesota Power and participants in this process of considering IRP decisions. It also seeks to provide valuable insight to Minnesota Power as the company develops its 2025 IRP. Meaningful engagement with interested parties is critical to IRP discussions for Minnesota's utilities as they seek to achieve the goals of state policy, serve customers, and plan for strong electricity delivery systems.

Improved understanding of the trends and needs pertinent to the customers, communities, and region that Minnesota Power serves. Throughout the entire engagement process, participants had the opportunity to learn about and share their perspectives on what Minnesota Power should consider to meet the needs of its service territory and to remain adaptive to the changing economic, policy, and technology landscape. This is important for ensuring that the resulting IRP is responsive to the needs of the customers and communities Minnesota Power serves while meeting all federal, regional, state, and local requirements.

II. Background

Integrated Resource Planning in Minnesota

Resource planning is a process that energy utilities undertake to select the appropriate energy resources necessary to meet customers' energy needs over a given period of time. Resource planning is often described as the process by which utilities select the size, type, and timing of the resources that will make up their future energy supply. Utilities typically begin the process by forecasting energy needs over the planning period. They then use modeling software(s) to determine the mix of energy resources, the appropriate size of the resources, and the time at which each resource will be needed to meet customers' energy demand. For electric utilities, energy resources can include both supply-side resources and demand-side resources. Supply-side resources could include generation-scale resources like power plants and utility-scale wind and solar, as well as distributed resources like customer-sited rooftop solar. Demand-side resources include options like energy efficiency and demand response programs.

Utility investments in energy resources are large, long-term, and impactful. Energy resources affect the energy supply and can have direct and indirect impacts on the environment, the economy, the workforce, and communities. Utilities often use a combination of modeling tools and qualitative methods to consider the variety of implications of energy resource investments throughout the resource planning process.

In Minnesota, the Commission oversees electric utility resource planning through a public-facing docketed process. Electric utilities are required to file an IRP with the Commission once every two years, though the two-year rule can be varied at the Commission's discretion. An IRP is a forward-looking document that lays out the mix of energy resources that a utility intends to use to meet customer energy demand over a 15-year period.[2]

The requirements and rules for IRPs are described in Minnesota Statute 216B.2422[3] and in Minnesota Administrative Rule Chapter 7843.[4] The Commission evaluates electric utility IRPs on their ability to do the following:

- Maintain or improve the adequacy and reliability of utility service;
- Keep customers' bills and utility rates as low as practicable, given regulatory and other constraints;
- Minimize adverse socioeconomic effects and adverse effects upon the environment;
- Enhance the utility's ability to respond to changes in the financial, social, and technological factors affecting its operations; and
- Limit the risk of adverse effects on the utility and its customers from financial, social, and technological factors that the utility cannot control.[5]

The Minnesota IRP process allows interested parties to review a utility's resource plan and provide input to the Commission and the utility through written and oral comments. This process begins when a utility files an IRP to a docket. Once filed, interested parties may review the IRP and provide written comments to the docket through at least one written comment period and

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[2] "Electric Integrated Resource Planning (IRP)," Minnesota Public Utilities Commission (website) accessed January 30, 2025, https://mn.gov/puc/activities/economic-analysis/planning/irp/.

[3] Minn. Stat. § 216B.2422

[4] Minn. Rules. Chapter 7843

[5] Minn. Rules Part 7843.0500

one written reply comment period. Once the written record is complete, the Commission schedules a public hearing, at which the utility and parties to the docket may appear to provide further oral comments and answer Commission questions. Ultimately, the Commission makes a decision about the IRP at the public hearing and follows that oral decision with a written order in the docket. For IOUs like Minnesota Power, the Commission may reject, approve, or modify the IRP.[6]

Context for Minnesota Power's 2025 IRP

An important component of any integrated resource plan is a clear understanding of the planning environment—what has happened, what is happening, and what may happen that could impact the utility and its customers. Minnesota, like many states across the nation, is in the midst of a major transition in how its energy is supplied. The age of Minnesota's electric generation fleet, paired with recent advancements in technology, changes in the economics of different energy resources, changes in public policy, and environmental goals of utilities and their customers, are all increasing the pace of that transition.

Minnesota Power has made significant changes to its electric generation fleet in recent years, including retiring or refueling seven of its nine coal-fired generation units. Today, it generates between 50 and 60 percent of its electric supply with renewable energy and has only one large fossil fuel power plant remaining on its system providing baseload power generation, the Clay Boswell Energy Center (Boswell), which has two generating units in operation.

Minnesota Power's 2025 IRP development process was heavily influenced by the company's 2021 IRP, in which it committed to achieving 100 percent carbon-free energy by 2050 while maintaining safe, reliable, and affordable electric service. Accordingly, the company stated that it would cease coal operations at Boswell Unit 3 by 2030 and Unit 4 by 2035[7]—a decision that was felt heavily by communities and workers in Minnesota Power's service territory, given the important role that Boswell plays in the regional economy. Minnesota Power made that decision following an extensive engagement process that brought together the customers and communities that the company serves, as well as consumer, business, and environmental advocacy organizations that are active in Minnesota Power's proceedings at the Commission.

After the 2021 IRP was approved by the Commission, the Minnesota State Legislature passed a new law requiring all of the state's electric utilities to achieve the Carbon Free Standard. This is important for Minnesota Power's 2025 IRP because it moves up the company's previous carbon-free target by 10 years. In addition, the law provided some definition of what constitutes

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[6] "Electric Integrated Resource Planning (IRP)," Minnesota Public Utilities Commission (website), accessed January 30, 2025, https://mn.gov/puc/activities/economic-analysis/planning/irp/.

[7] "Minnesota Power ready to move next phase of EnergyForward following MPUC approval of resource plan," Minnesota Power, November 10, 2022, https://minnesotapower.blob.core.windows.net/content/Content/Documents/Company/PressReleases/2022/PressRelease11102022.pdf.

carbon-free energy technologies and established milestones for the amount of carbon-free electricity each utility must generate as a percentage of retail electric sales.[8]

All of these changes to Minnesota Power's system and its planning environment are important because they have had and will continue to have wide-ranging and important implications for Minnesota Power's customers, communities, and workforce, as well as the regional economy and the electric grid.

2025 IRP Engagement Process

To inform its 2025 IRP, Minnesota Power sought to engage a broad range of individuals who represent the interests of the customers and communities it serves. It also sought to use the time of participants wisely by building upon the extensive work that many of the same organizations had completed for the 2021 IRP only a few years prior.

In addition, when the Commission approved the company's 2021 IRP, it ordered the company to consult with interested parties on a series of key topics, including the following:

- Implications of the Inflation Reduction Act on renewable energy projects
- Regional economic development activities in support of host communities
- IRP modeling inputs and parameters
- A societal cost-benefit analysis of Boswell Unit 4 and Hibbard Renewable Energy Center

In response, the company hired GPI and CEE as third-party neutral facilitators to design and facilitate an engagement process consistent with the Commission's order and that built upon the 2021 IRP engagement process. The resulting process had three components:

- **Engagement Group:** a broad set of participants that convened four times to build a shared understanding of the policy, technology, and socio-economic landscape for the 2025 IRP.
- **Societal Advisory Group (SAG):** a subgroup of participants from the Engagement Group who met three times to inform the development of an SCBA analysis for any Minnesota Power generation facility, including but not limited to the Hibbard Renewable Energy Center and Boswell Unit 4.
- **Technical Advisory Group (TAG):** a subgroup of participants from the Engagement Group who met regularly over several months to discuss modeling assumptions and methodologies for the IRP, as well as technical topics such as MISO's transmission planning process and seasonal adequacy construct.

These three components were designed to be complementary to one another. The process included multiple in-person meetings in Minnesota Power's service territory and provided the opportunity to tour three of Minnesota Power's generating facilities: the Boswell Energy Center in Cohasset, Thompson Hydro in Esko, and the Hibbard Renewable Energy Center in Duluth.

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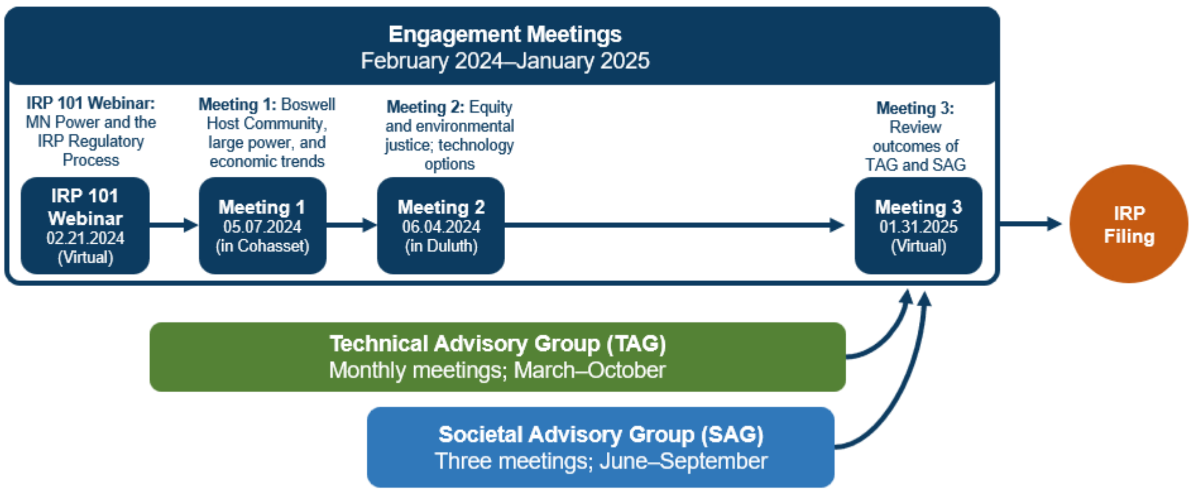
[8] Minn. Stat. § 216B.1691 – Electric utilities must generate an amount of carbon free electricity equal to 80% of retail electric sales in 2030, 90% in 2035, and 100% in 2040.

This report documents who participated, what was discussed, and what came out of each of these groups.

Figure 1: 2025 IRP Engagement Process



III. Engagement Group

The Engagement Group convened a broad set of interested parties to build a shared understanding of the policy, technology, and socio-economic landscape for the 2025 IRP. The group met four times, both virtually and in person, between February 2024 and January 2025. Two of those in-person meetings were held in Minnesota Power's service territory and included a tour of one of the utility's generating facilities.

- **IRP 101 Webinar:** This virtual webinar introduced Minnesota Power and the IRP regulatory process.
- **Meeting 1:** This full-day meeting took place in Cohasset, Minnesota, and focused on issues and trends pertinent to the Boswell host community, large industrial customers (also referred to as "large power" in this report), and the regional economy. The agenda included a panel of local experts who discussed the economic and energy needs of a variety of industries and customers in Northern Minnesota. Facilitators guided table discussions about what has changed since the 2021 IRP and what participants saw as the biggest questions to be considered and addressed through the 2025 IRP. After the meeting, participants received a tour of the Boswell Energy Center.
- **Meeting 2**: This full-day meeting took place in Duluth, Minnesota, and focused on building an understanding of two topics: (1) technology options for achieving requirements of the Carbon Free Standard while maintaining reliability and (2) equity and environmental justice impacts and considerations for Minnesota Power's service territory. Facilitators guided table discussions about equity, community engagement, and what participants wanted Minnesota Power to prioritize in its planning process.

Participants were also invited to a tour of the Thompson Hydro facility the day before the meeting.

- **Meeting 3:** This 90-minute virtual meeting focused on reviewing the outcomes of SAG and TAG, soliciting final input for the 2025 IRP, and clarifying the next steps for the regulatory process.

Participants

Sixty-five individuals attended at least one of the three Engagement Group meetings. These individuals represented a broad range of perspectives, including residents, small businesses, large commercial and industrial consumers, economic development organizations, labor unions, clean energy and environmental advocates, consumer advocates, local governments, tribes, schools and colleges, and state government agencies. All organizations that participated are listed below:

- APEX
- Barr Engineering
- BlueGreen Alliance
- CenterPoint Energy
- Citizens Utility Board
- City of Cohasset
- City of Duluth
- City of Grand Rapids
- Clean Grid Alliance
- Coalition of Utility Cities
- Conservative Energy Network
- DEED Energy Transition Office
- Duluth Seaway Port Authority
- Ecolibrium3
- Fresh Energy
- Grand Rapids Area Chamber of Commerce
- Grand Rapids Public Utilities
- IBEW Local 31
- International Union of Operating Engineers–Local 49
- Itasca Clean Energy Team
- Itasca County
- Itasca Economic Development Corporation
- Laborers' International Union of North America–Minnesota & North Dakota
- Large Power Intervenors
- Leech Lake Band of Ojibwe
- MiningMinnesota
- Minnesota Attorney General's Office
- Minnesota Center for Environmental Advocacy
- Minnesota Chamber of Commerce
- Minnesota Department of Commerce
- Minnesota Forest Industries
- Minnesota North College
- Minnesota Public Utilities Commission*
- Minnesota Timber Producers Association
- MnSEIA
- Range Association Municipalities & Schools
- Sierra Club
- St. Louis County
- University of Minnesota Duluth Office of Sustainability
- Western Lake Superior Sanitary District
- Xcel Energy

**Commission staff participated as observers only.*

Discussion Themes

Several high-level themes, considerations, questions, and takeaways emerged from the four Engagement Group meetings. The summaries below provide a high-level overview and are not intended to serve as a comprehensive list of every topic raised in the discussions.

Economic and Industrial Considerations

The May 7, 2024, engagement meeting in Grand Rapids, Minnesota, included presentations, a panel discussion, and small group discussions focused on understanding the current economic state and trends in Northern Minnesota.

During the meeting, panelists representing Northern Minnesota's mining and forest products industries shared perspectives regarding regional industrial trends. Panelists identified that, as a whole, the region's economy is expected to remain largely the same moving forward as it is today. Panelists stated that despite this, growth would be desirable, and there are some potential opportunities for economic growth in both the mining and forest products industries, depending on future trends. Additionally, panelists noted that conditions for industries are changing, including through the electrification of some industrial processes.

In addition to these economic trends, panelists identified that reliability remains critical for Northern Minnesota industries, regardless of the region's economic trends. Some industries are also interested in ways to offer lower-carbon products, but they can only do so if their power supply is reliable. Panelists also identified that competitive rates are important for ensuring the Northern Minnesota region remains globally competitive.

Managed Transition

A key theme for the Engagement Group was the importance of a well-managed transition, including consideration of impacts on workers, communities, and the regional economy. The May engagement meeting in Grand Rapids included a presentation about the concurrent community process that was being led by the Itasca Economic Development Corporation, which focused on economic opportunities for the region in response to Minnesota Power's plans to cease coal operations at Boswell. GPI and CEE also facilitated small group discussions at that meeting, in which participants expressed concerns regarding the remaining "unknowns" related to Boswell and the potential impacts on the local tax base. Along with sharing their concerns, participants said they appreciated the extensive opportunities to learn and provide feedback.

Minnesota Power shared its approach and considerations related to environmental justice during the June engagement meeting in Duluth. Participants then had another opportunity for small group discussion, during which some expressed that infrastructure needs must be balanced with costs to ensure rates remain affordable, especially for low-income customers. Some participants also expressed that part of an equitable energy transition includes rapid decarbonization to ensure that certain demographics do not disproportionately bear adverse impacts from climate change.

Engagement and Feedback Considerations

During the small group discussion portion of the Grand Rapids meeting, several participants expressed that it was difficult to make discrete decisions and suggestions with so many unknowns regarding what different Boswell futures might look like. The Duluth meeting included a detailed presentation covering different resource options, including potential deployment timelines for market-ready and more early-stage technologies. Some participants felt that having some high-level resource portfolios to review and react to could help them provide feedback by narrowing the scope of potential resources under consideration from that larger list. During both the Grand Rapids and Duluth meetings, participants expressed that while they did not yet know exactly what the solutions were, they appreciated that the resource planning process served as an opportunity for mutual learning among all participants and Minnesota Power.

IV. Societal Advisory Group

Introduction

In the Commission's order approving Minnesota Power's 2021 IRP, Minnesota Power was required to solicit input from interested and affected parties on "a societal cost-benefit analysis [SCBA] of Boswell Unit 4 and Hibbard Renewable Energy Center, considering impacts on host communities, workforce, economics, health, system reliability, the environment, and customer costs."[9] Minnesota Power will file the SCBA with its 2025 IRP.

In addition to the engagement meetings, GPI and CEE convened a smaller group of participants to help develop a framework that could be used to complete the required SCBA. This group was referred to as the Societal Advisory Group (SAG). SAG participants included a wide range of interest groups, local governments, and sovereign nations.

Minnesota Power sought to address the Commission's order with the following additional considerations in mind:

- **Applicability to any major change in energy infrastructure.** While the Commission requested an analysis of Boswell Unit 4 and Hibbard Renewable Energy Center for this IRP, Minnesota Power sought to develop a tool that could be used to evaluate broader changes to infrastructure. Further, the nature of the SAG participant engagement created feedback that had broader implications beyond the two facilities identified in the Commission's order. The SCBA framework developed through the SAG engagement served to meet the requirements of the Commission's order while also allowing Minnesota Power to incorporate feedback from participants to assess the impacts of the company's overall preferred IRP.

[9] Minnesota Public Utilities Commission, *In the Matter of Minnesota Power's 2021-2035 Integrated Resource Plan* (Docket No. E-015/RP-21-33), Order Approving Plan and Setting Additional Requirements issued (January 9, 2023) https://www.edockets.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={10CE9785-0000-CC15-93BC-CC94BB4400D6}&documentTitle=20231-191970-01.

- **Consistency with participant-developed issues from prior IRP engagements.** The 2025 SAG discussions and the resulting SCBA framework built on the extensive engagement process for Minnesota Power's 2021 IRP by using the issues identified in the 2021 process as the starting point.
- **Consistency with other Commission-approved societal cost-benefit frameworks.** The Commission recently approved a similar societal cost-benefit analysis framework for evaluating natural gas utility innovation plans. The SCBA framework being proposed by Minnesota Power is consistent with the gas utility framework in that it broadly considers costs and benefits, both quantitative and qualitative. The proposed Minnesota Power SCBA framework also utilizes the general structure and principles of the gas utility framework, which summarize and simplify outcomes from potential utility planning decisions. In addition, GPI researched trends in SCBA frameworks across US jurisdictions to ensure Minnesota Power's approach was consistent with industry best practices.
- **Development and refinement through participant input.** GPI and CEE solicited participant input on the SCBA framework at multiple stages of its development and made numerous changes to the framework in direct response to participant feedback. As a result, most participants said they generally supported the final SCBA approach.
- **Accommodation of quantitative and qualitative information.** Participants noted that the lack of easy quantification of outcomes posed challenges in SCBA considerations, such that certain costs and benefits are more easily quantified than others. Therefore, this framework is explicitly designed to accommodate both quantitative and qualitative information.

SCBA Engagement Process

SAG was designed to bring together individuals and organizations who collectively could speak to a broad array of costs and benefits. The following individuals participated in at least one of the SAG meetings and/or provided direct feedback on materials developed by SAG:

- Amber Lee, Stoel Rives LLP
- Amber Smith, Blandin Foundation
- Andrew Moratzka, Stoel Rives LLP
- Ari Zwick, Minnesota Department of Commerce
- Barb Freese, Minnesota Center for Environmental Advocacy
- Bart Johnson, Minnesota North College
- Brandon Kohlts, Western Lake Superior Sanitary District
- Brandy Toft, Leech Lake Band of Ojibwe
- Bree Halverson, BlueGreen Alliance
- Brett Crecelius, City of Duluth
- Brett Skyles, Itasca County
- Brian Cook, Minnesota Chamber of Commerce
- Brian Lebens, Minnesota Attorney General's Office
- Cameron Kadlubowski, Ecolibrium3
- Carla Vita, DEED Energy Transition Office
- Elena Foshay, City of Duluth
- Eric Berube, IBEW Local 31
- Erik Boleman, Barr Engineering
- Evan Mulholland, Minnesota Center for Environmental Advocacy
- Jamie MacAlister, Minnesota Department of Commerce

SAG participants cont.

- Jenna Yeakle, Sierra Club
- Jonna Korpi, University of Minnesota Duluth Office of Sustainability
- Julie Lucas, MiningMinnesota
- Karola Dalen, St. Louis County
- Kayla Christensen, Conservative Energy Network
- Kevin Pranis, Laborers' International Union of North America–Minnesota & North Dakota
- Lora Wedge, Ecolibrium3
- Malissa Bahr, Grand Rapids Area Chamber of Commerce
- Mateus Santos, Minnesota Department of Commerce
- Matt Shermoen, Itasca Economic Development Corporation
- Max Peters, City of Cohasset
- Molly MacGregor, City of Grand Rapids
- Paul Peltier, Range Association Municipalities & Schools
- Peter Teigland, Minnesota Department of Commerce
- Quintin Legler, Minnesota Forest Industries
- Rachel Johnson, APEX
- Ray Higgins, Minnesota Timber Producers Association
- Shane Zahrt, Coalition of Utility Cities
- Shayla Drake, DEED Energy Transition Office
- Tamara Lowney, Itasca Economic Development Corporation
- Tony Mendoza, Sierra Club

GPI and CEE convened SAG for the following three meetings, with representatives from Minnesota Power in attendance:

- **Meeting 1**: GPI and CEE asked SAG participants to discuss the process of Minnesota Power's 2021 IRP engagement and its potential applicability to the SCBA framework. Most participants agreed that the 2021 IRP engagement documents provided an effective foundation for the SCBA framework. Following this, GPI and CEE collected feedback from participants seeking which specific elements identified within the 2021 IRP engagement process should be kept, revised, or removed.
- **Meeting 2**: GPI and CEE presented an updated proposal for the framework, informed by research conducted on trends in SCBAs across other regulatory jurisdictions. Participants were introduced to a significant addition to the framework—the SCBA Table, which is described in Section III below. Participants provided feedback on the Customers and Environment perspectives of the SCBA framework.
- **Meeting 3:** SAG participants reviewed and provided feedback on the Local Economy and Utility perspective areas of the SCBA framework.

In advance of each meeting, participants received the most recent version of the draft SCBA framework for review. After meetings 2 and 3, participants were invited to provide feedback on a written summary of the SCBA framework as it was developed. After the final meeting, GPI and CEE shared this full SAG section of the final report with SAG participants. Those participants were invited to provide additional feedback via email. GPI and CEE also conducted outreach to solicit feedback from additional individuals and organizations who were unable to participate in the meetings. GPI and CEE made direct and material changes to the SCBA framework based on participant feedback. Minnesota Power also reviewed and approved the revised framework.

Proposed SCBA Framework

The proposed framework includes four major components:

1. **Perspective:** There are four high-level perspectives through which costs and benefits are assessed: customers, environment, local economy, and utility.
2. **Impact Area:** Each perspective contains a unique set of three to four impact areas for which costs and benefits should be considered.
3. **Rating**: Each impact area has a unique rating scale (included in this document) that is used to give a general rating between 0 and 2:

    0—Unacceptable. Most affected parties would not consider Minnesota Power to be meeting minimum standards and expectations in this impact area.

    1—Acceptable. Most affected parties would consider Minnesota Power to be meeting minimum standards and expectations in this impact area.

    2—Best Case. Most affected parties would consider Minnesota Power to be performing above and beyond minimum standards and expectations in this impact area.

4. **Costs and Benefits:** Each impact area provides an opportunity to list quantitative and qualitative cost and benefit information.

The SCBA Table

The framework's four perspectives and fourteen impact areas are structured in a table. Minnesota Power will complete one iteration of the table for each specific plant or energy infrastructure site under consideration (e.g., if two different sites are under consideration, Minnesota Power will complete two tables). The intent is to simplify the qualitative and quantitative impacts of Minnesota Power's decisions related to specific sites or facilities. Per the Commission's order, Minnesota Power is required to assess changes associated with two facilities as part of its 2025 IRP—Hibbard Renewable Energy Center and Boswell Unit 4.

The table communicates impacts, including costs and benefits, for two scenarios:

- **Business as Usual (BAU) Scenario**: The site under consideration would continue to operate as it does today. This scenario may also be used as the reference case for a site with no energy infrastructure, where new infrastructure may be built.
- **Change Scenario**: The site under consideration will change, such as recommissioning or retiring a power plant. This scenario may also be used to consider the impacts of building new energy infrastructure at the site.

The quantity and descriptions of the scenarios may be adjusted as needed to better represent the options being evaluated.

The framework of the SCBA helps provide Minnesota Power with a means of discussion for evaluating potential plans within its filing. Notably, the SCBA and the impact areas within it do not imply a specific time horizon. The change scenario and preferred plan may consider action at a specific point in time. Some of the impact areas may have longer timeframes than others.

Below is a sample SCBA table.

[Site Name] Societal Cost-Benefit Analysis Table		
Perspective: Customers		
Impact Area	**BAU Scenario** Costs and benefits of continued operation without change	**Change Scenario** Costs and benefits of the change being evaluated (e.g., recommission or retire)
Competitive rates for large power and municipal customers	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Transparent and predictable rates for commercial customers	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Affordable rates for residential customers	*Insert rating & qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Power reliability, quality, and resiliency	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Perspective: Environment		
Impact Area	**BAU Scenario** Costs and benefits of continued operation without change.	**Change Scenario** Costs and benefits of the change being evaluated (e.g., recommission or retire)
Impacts to air, water, and land	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Environmental justice and public health	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*

Greenhouse gas emissions	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Perspective: Local Economy		
Impact Area	**BAU Scenario** Costs and benefits of continued operation without change.	**Change Scenario** Costs and benefits of the change being evaluated (e.g., recommission or retire)
Tax base	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Jobs	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Social and economic ripple effects	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Perspective: Utility		
Impact Area	**BAU Scenario** Costs and benefits of continued operation without change.	**Change Scenario** Costs and benefits of the change being evaluated (e.g., recommission or retire)
Responsibility/ privilege to serve	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Planning and operations, utility health, and regional stability	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Grid readiness	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*

Carbon-free technology and adoption	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*

Perspectives and Impact Areas

In the sections below, we describe each of the four perspectives and fourteen impact areas that make up the SCBA framework. First, we describe the importance of equity as a cross-cutting theme throughout the framework. Then, we walk through each of the four perspectives, beginning with a general description based on SAG discussions, followed by a description of each impact area that falls within that perspective. Each impact area description includes a scale for evaluating potential impacts. The scales were developed through SAG engagement and include both qualitative and quantitative outcomes that may be considered.

Consideration of Equity

Equity is a fundamental underlying motivating principle embedded throughout the SCBA framework. Each of the four perspectives and their corresponding impact areas attempts to identify and consider challenges and opportunities borne by communities, including historical and potential future disparities across affected areas within Minnesota Power's service territory.

SAG reviewed potential definitions of equity. As a guide, facilitators suggested starting with a definition from the United States Department of Energy (DOE) from 2024, which applied to DOE efforts and offered a broad and applicable perspective for consideration within the SAG discussions:

> "Ensuring all customers benefit from the shift to clean energy, regardless of background or location, and broadening of engagement with historically underserved or underinvested communities through targeted policies and programs."[10]

To Minnesota Power, a commitment to equity in resource planning meant an inclusive decision-making process, a fair distribution of burdens and benefits, finding solutions that meet community needs, and considerations of how decisions impact communities challenged by environmental injustices or other systemic disinvestment.

While no singular definition of equity was applied to the SCBA, these topics influenced the development of significant portions of the framework. In this sense, equity is embedded across the SCBA and is not identified as a stand-alone topic within the framework.

Customer Perspective

Minnesota Power serves a unique mix of customers in comparison to other utilities, in Minnesota and nationally, due to the large portion of its annual retail sales that come from large power customers. The company serves approximately 150,000 retail customers in total. Minnesota Power's industrial customers account for approximately 73 percent of its annual retail sales, while approximately 13 percent of annual retail sales are attributed to residential

[10] Authors' Note: This definition of equity was provided from U.S. Department of Energy (DOE), including on DOE websites, and was federal policy during the time in which SCBA framework was under development. We preserve this definition as a means of providing context for the concepts of equity used within development of the SCBA. As of January 2025, this definition is removed from official DOE websites.

customers and approximately 14 percent to commercial customers. The company also provides service to fourteen non-affiliated municipal customers in Minnesota. As a point of comparison, Minnesota's largest IOU serves approximately 1.3 million electric customers in Minnesota, with industrial customers making up only 26 percent of its annual electricity sales. Minnesota Power also serves a larger electric load for the number of customers it has, selling nearly three times the power per retail customer, on average, compared to the state's largest electric utility. In addition, the large power customers tend to demand a consistent amount of electricity throughout the day, forming a unique load profile. This load profile means Minnesota Power does not experience significant changes in system demands in electricity usage throughout the day.

The large power customers Minnesota Power serves include most of Minnesota's forest products industry and taconite mines, which produce 85 percent of all US domestically produced iron ore. The large power customers compete in global markets and are sensitive to price fluctuations. This is particularly true with respect to energy costs, as some non-domestic competitors are in countries that socialize or reduce the cost of power to make those companies more competitive.

Minnesota Power is permitted by statute to propose electric rates for energy-intensive companies operating in these highly competitive markets. The Commission has the authority to approve Energy-Intensive, Trade-Exposed rates, which are intended to promote a healthy and stable regional economy.[11] When Minnesota Power pursues system planning, the rate impacts on these industries are an important consideration. This is consistent with state policy for these industries, which provide unique benefits to the state.

The small proportion of residential and commercial sales on Minnesota Power's system poses challenges to allocating energy system costs across the system and to specific customer classes. As with past IRPs, this unique mix of retail customers requires careful monitoring of costs and sensitivities across customer classes while assuring that all customers are receiving quality service that adequately meets their needs. These unique concerns informed the development of the SCBA.

CUSTOMER IMPACT AREAS

The four impact areas associated with the customer perspective are listed below in table 1 and described in greater detail throughout this section. The table below provides examples of theoretical adverse and beneficial impacts related to each impact area.

[11] Minn. Stat. § 216B.1696

Table 1. Impact Areas and Example Impacts from the Customer Perspective

Impact Area	Examples
Competitive rates for large power and municipal customers	**Adverse impact example:** High electricity rates interfere with large power customers' ability to compete globally. High rates may cause them to relocate to remain cost-competitive. Relocations or slowed operations contribute to regional job losses and economic decline. **Beneficial impact example:** Electricity rates for large power customers are globally competitive and enable regional economic stability and growth.
Predictable and transparent rates for commercial customers	**Adverse impact example:** Unpredictable electricity rates for commercial businesses make it difficult to accurately forecast financials, leading to unsustainable business operations. **Beneficial impact example:** Predictable and reasonable electricity rates enable commercial customers to manage operational costs effectively and accurately forecast financials, encouraging commercial business growth and economic development within the region.
Affordable rates for residential customers	**Adverse impact example:** High electricity rates will increase energy burden. Residential customers are financially challenged, and households may be forced to choose between paying their electricity bill and paying for other necessary expenses. **Beneficial impact example:** Reasonable electricity rates will allow customers to maintain a low energy burden. Residential rates are more likely to support financial stability.
Power reliability, quality, and resiliency	**Adverse impact example:** Power outage frequency and duration increase due to reduced system reliability. Because of these increased outages, residential customers are at greater risk of experiencing health and safety incidents; commercial and industrial customers may see equipment malfunction and face significant economic losses. **Beneficial impact example:** Power outage frequency and duration decrease, even with increasing extreme weather events. Because of this improvement in system reliability, residential customers can avoid the health and safety risks associated with outages and other power reliability events;

	commercial and industrial customers are able to operate without disruption.

Competitive Rates and Program Options for Large Power and Municipal Customers

Description: Large power and municipal utility customer representatives are seeking program options and rates that support economic investment and growth, as well as access to renewable electricity that they can market to their customers. For large power customers, in particular, electricity rates impact their ability to compete in international markets.

Table 2. Competitive Offerings for Large Power and Municipal Customers—Rating Scale

Competitive Offerings and Program Options for Large Power and Municipal Customers		
0 Unacceptable	1 Acceptable	2 Best Case
Rates are higher than the national average. Uncompetitive rates and limited rate and program options to meet their needs and desires. Large power (LP) facilities could or would close, and investments could be made elsewhere. High rates for municipalities are passed on to local customers.	Rates are competitive with the national averages. LP and municipal customer rates are at least in this range, so customers have a reasonable opportunity to sustain current operations and jobs. Customers have enough rate and program options to meet their corporate plan directives and growth expectations. Rates, programs, and energy affordability are consistent with state policy objectives for energy-intensive industries.	Rates are at least 5% below the national average. Competitive rates and multiple rates and program options are available. Job growth in existing and/or new businesses. Greater ability to attract new LP and municipal customers. Access to a cleaner energy portfolio enhances large power competitiveness in the market, and programs available create opportunities for those who desire increased portfolios. Customers have access to growing options for rates, programs, and investments that control costs and exceed state policy goals.

Predictable and Transparent Rates for Commercial Customers

Description: Commercial customers are primarily concerned about having incremental, predictable, and transparent rates and costs as Minnesota Power works toward compliance with Minnesota's 2040 Carbon Free Electricity Standard. Commercial customers understand rates may increase amid local, national, and global impacts but would benefit from incremental rate increases rather than one large rate increase at any given time. Predictable and transparent rate increases help commercial customers conduct more accurate financial forecasting, which is necessary for many commercial customers to stay in business.

Table 3. Predictable and Transparent Rates for Commercial Customers—Rating Scale

Predictable and Transparent Rates for Commercial Customers		
0 Unacceptable	1 Acceptable	2 Best Case
Rates are higher than the national average. Unpredictable rate increases and/or a large rate increase with little warning or transparency prevent commercial customers from accurately estimating electricity costs in financial forecasting. Commercial customers are struggling to sustain current operations due to electricity costs and may be forced to close.	Rates are equal to the national average and increasing incrementally. Rate increases are transparent and predictable, allowing commercial customers to accurately estimate electricity costs in financial forecasting. Commercial customers are able to sustain current operations. Overall cost objectives are met through adequate rate and program options.	Rates are at least 5% below the national average. Rate increases are incremental, transparent, and predictable, allowing commercial customers to accurately estimate electricity costs in financial forecasting. Commercial customers are able to sustain or grow current operations, and communities served are able to attract new commercial customers. Rates and programs are expanded to assist all customer types in optimizing use and costs.

Affordable Rates and Program Options for Residential Customers

Description: Residential customers are concerned with affordability and equity, particularly those who are highly vulnerable to changes in utility service costs. This rating scale evaluates affordability by considering the percentage of customers in arrears and the ability of residential customers to find clean energy and rate design options that meet their needs and desires.

Table 4. Affordable Rates and Program Options for Residential Customers—Rating Scale

Affordable Rates and Program Options for Residential Customers		
0 Unacceptable	1 Acceptable	2 Best Case
10+% of customers are in arrears, as a measure of energy burden.	5–10% of customers are in arrears, and the percentage is not increasing.	Consistently, 1% or fewer customers are in arrears.

Assistance programs are falling short of meeting the needs of customers. Utility is not identifying inequities. Customers are unable to meet their needs and desires due to limited rates and program options.	Assistance programs are insufficient to help everybody yet still helpful to some. The utility is identifying inequities and making plans to address them. Customers have enough rates and program options that can meet their needs and desires.	Assistance programs can help most customers. Utility is continually identifying and addressing inequities. All customers have multiple rate and program options (including conservation) that are appropriately segmented and targeted by usage patterns, communicated well, and focused on the things customers value.

Power Reliability, Quality, and Resiliency

Description: Significant participant input and feedback in SAG focused on the importance of quality of power and resiliency needs in Minnesota Power's territory. The participants noted the specific needs of large industrial customers, medical institutions, and education facilities, as well as for residential personal safety. Also unique to Minnesota Power's service territory were unique resilience risks, such as wildfire mitigation. Power quality and resilience are also an integral part of energy and economic competitiveness within the region.

Table 5. Power Reliability, Quality, and Resiliency—Rating Scale

Power Reliability, Quality, and Resiliency		
0 Unacceptable	1 Acceptable	2 Best Case
Long-term power outages or sustained intermittent outages are occurring even without significant events. Customers are experiencing poor service quality (voltage drops). Significant impacts on operations of industrial and commercial customers.	Outages and service quality issues only in significant events or exceedingly rare circumstances. Customers do not need to consider self-generation to ensure reliability. Impacts on business operations for industrial and commercial customers are minimal.	Few outages and excellent service quality (e.g., no voltage drops). Emergency demand response resources are infrequently used, other than due to natural disasters. Micro-grid or segmentation capabilities limit the geographic range of event impacts and enhance resiliency in response to

Adverse impacts on vulnerable and low-income residents, affecting personal safety, especially in winter.	Minimal resiliency issues for vulnerable residents, including medical and emergency services.	outages due to natural disasters. Businesses and residents avoid operational, health, and safety risks associated with outages and other power reliability events.

Environment Perspective

Environmental stewardship is a core value of Minnesota Power. In the SAG process, Minnesota Power noted that the company balances the environmental impacts of its activities with its obligations to employees, customers, communities, investors, and future generations. All electric resources can have environmental impacts on air, water, and land, as well as environmental justice and public health impacts, and contribute to greenhouse gas (GHG) emissions. Resource planning considerations must account for these impacts and comply with applicable environmental performance standards from state and federal governments and sovereign nations.

Minnesota Power noted within SAG meetings that the company had taken several steps in recent years to address the environmental impacts of its power plants. Air emissions of sulfur dioxide, nitrogen oxides, and mercury from the company's plants have all decreased substantially in recent years, primarily due to two factors.[12] First, the refueling, idling, and retirement of multiple power plants. Those plants include the following:

- Refueling of the Laskin Energy Center from coal to natural gas in 2015.
- Idling and retirement of the coal-fired Taconite Harbor Energy Center.
- The Hibbard Renewable Energy Center began consuming 90 percent or greater biomass on an annual average (or 85 percent on a three-year average). Compared to coal, biomass has generally lower emissions of sulfur dioxide, mercury, and various other pollutants.
- Retirement of Boswell Units 1 and 2.

[12] "Reducing Emissions," Minnesota Power (website), accessed February 11, 2025, https://www.mnpower.com/Environment/ReducingEmissions.

Second, multiple environmental upgrades were completed at the Boswell Energy Center, totaling roughly $670 million invested, including the following:

- Emissions controls at Boswell Units 1, 2, and 4 in 2008.
- Emissions controls at Boswell Unit 3 in 2009.
- Additional emissions controls at Boswell Unit 4 in 2015.
- Boswell turbine upgrades that improved efficiency, resulting in a lower rate of emissions.
- Boswell dry ash conversion and water reuse projects to reduce water emissions at the facility.

The combined effect of the factors lowered emissions, altering the environmental impact considerations related to key facilities. Those impacts influence Minnesota Power's potential resource decisions.

ENVIRONMENT IMPACT AREAS

The three impact areas associated with environmental perspectives are listed below in table 6 and described in greater detail throughout this section. Electricity system plans imply a variety of environmental outcomes. SAG discussed a range of impacts, including direct facility impacts on local environments, impacts on peoples—particularly vulnerable and/or marginalized communities—and greenhouse gas pollution from Minnesota Power facilities.

The table below provides examples of theoretical adverse and beneficial impacts related to each impact area.

Table 6. Impact Areas and Example Impacts for the Environmental Perspective Area

Impact Area	Examples
Impacts to air, water, and land	**Adverse impact example:** Facility discharge wastewater contains hazards (e.g., heavy metal levels) that exceed applicable standards. Connected bodies of water degrade, harming wildlife. Unmitigated air, water, and/or land pollutants that result from energy systems operations threaten ecosystems, as well as the cultural and economic resources of local communities dependent on those ecological assets. **Beneficial impact example:** Facility and energy resource decisions result in improved local or regional ecosystems. Impacts are mitigated or adapted through multiple approaches, such as habitat restoration, pollinator-friendly solar installations, or other science-based ecosystem improvement methodologies.
Environmental justice and public health	**Adverse impact example:** Public health issues result from facility operations, such as respiratory disease rates, increase in vulnerable and environmental justice communities.

	Beneficial impact example: Rates of negative public health issues resulting from energy facility operations in nearby communities—including environmental justice communities—are identified, acted upon, and reduced over time.
Greenhouse gas emissions	**Adverse impact example:** GHG emissions from resource decisions contribute to climate change. A slower pace of reducing GHG emissions increases the impacts of climate change. **Beneficial impact example:** Faster reductions in GHG emissions will reduce the impacts of climate change.

Impacts to Air, Water, and Land

Description: All electric system resources must comply with applicable environmental, health, and safety standards from the federal government, state government, and sovereign nations. Beyond those standards, there are national and international frameworks for benchmarking the environmental impacts of power generators.

This impact area rating scale is focused on (1) how Minnesota Power's electric system resources comply with or exceed federal, state, and local environmental (non-GHG), health, and safety standards; and (2) the impacts that Minnesota Power's resource and waste management decisions have on habitat, water, and air quality.

This rating scale states that Minnesota Power's new resources and existing infrastructure should bring about as many broad benefits as possible and comply with or exceed standards.

For this impact area, co-benefits are defined as solutions that incorporate beneficial environmental, economic, and social aspects. An example of capturing co-benefits would be building a solar array that incorporates pollinator habitat and water resource management to maximize the positive impacts of the array. In this way, one solution provides multiple benefits.

NOTE: GHG emissions, including carbon dioxide, are not included in this impact area. For GHG-related impacts, please refer to the impact area related to Greenhouse Gas Emissions.

Table 7. Impacts on Air, Water, and Land—Rating Scale

Impacts on Air, Water, and Land		
0 Unacceptable	1 Acceptable	2 Best Case
Non-compliance with all applicable standards. Specific resources or permits that cover more than one	Operations routinely meet all applicable environmental standards and follow established best practices	On average, Minnesota Power's resources are meeting limits and routinely working to further minimize

resource are out of compliance with minimum standards for air, water, or waste. Adverse environmental impacts are not prevented, resulting in environmental and ecosystem degradation in the surrounding community.	for water and waste (exceeding minimum regulatory standards). Adverse environmental impacts are addressed, but environmental co-benefits are not routinely implemented in operations.	negative environmental impacts. Adverse environmental impacts are minimized, and environmental co-benefits are realized and/or increased. Proactive actions are taken to prevent negative environmental impacts.

Environmental Justice and Public Health

Description: While environmental impacts and GHG emissions already address aspects of environmental justice, this impact area was designed to evaluate Minnesota Power's broader efforts. The economic, social, and health impacts of electric system resource choices affect different populations (specifically low-income communities, Indigenous communities, and communities of color) disproportionately. This disproportionate impact on communities creates issues of environmental injustice. For example, mercury pollution in a lake is an environmental issue, whereas mercury accumulating in the fetuses of women from a specific community is an environmental justice issue. This rating scale focused on how effectively Minnesota Power addresses environmental justice and public health in its resource planning. For this impact area, the following definition of environmental justice is adopted from the Minnesota Pollution Control Agency's Environmental Justice Framework:

> "The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This will be achieved when everyone benefits from the same degree of environmental protection and has equal access to the decision-making processes that contribute to a healthy environment."[13]

Environmental justice is embedded throughout the full SCBA framework.

Table 8. Environmental Justice and Public Health—Rating Scale

Environmental Justice and Public Health

[13] Minnesota Pollution Control Agency, *Environmental Justice Framework* (May 2022), https://www.pca.state.mn.us/sites/default/files/p-gen5-05.pdf.

0 Unacceptable	1 Acceptable	2 Best Case
Minnesota Power does not recognize that inequities exist and does not recognize MP's role in a larger system that has created inequities. No policy and/or strategy is in place to address environmental injustices. Communities or impacted parties are unable to participate meaningfully in decisions that impact environmental injustices and public health.	Minnesota Power has a policy and/or strategy to prevent and/or address negative environmental justice and public health impacts. MP addresses such considerations in its resource planning. Minnesota Power identifies environmental justice communities using a reputable screening tool and engages with those communities. Communities and impacted parties are given space to participate meaningfully in decisions that impact environmental injustices and public health.	Minnesota Power's efforts excel in preventing negative environmental justice and public health impacts, offer redress, and integrate such considerations into its resource planning. Minnesota Power proactively engages communities. Communities and impacted parties are given increased opportunities to participate meaningfully in decisions that impact environmental injustices and public health.

Greenhouse Gas Emissions

Description: For this rating scale, GHG emissions are intended to be measured across Minnesota Power's resource portfolio. This rating scale focused on how Minnesota Power's system is being planned with consideration for Minnesota's 2040 Carbon Free Electricity Standard. Electric system resource options imply different GHG emissions potential(s) and accordingly have variable potential to contribute to climate change.

Importantly, this scale is targeted at total emissions, not emissions on a per kilowatt-hour or per capita basis, so the measurement is absolute regardless of load growth or load loss.

Table 9. Greenhouse Gas Emissions—Rating Scale

Greenhouse Gas Emissions		
0 Unacceptable	1 Acceptable	2 Best Case
Minnesota Power's system is on a path to maintain or increase total GHG emissions by 2040.	Minnesota Power's system is on a path to fully decarbonize by 2040 and to achieve interim carbon-free	Minnesota Power's system is on a path to fully decarbonize well in advance of the 2040 state

	electricity goals within the Carbon Free Standard.	goal to exceed interim goals. Upstream supply chain GHG emissions are considered and minimized where possible.

Local Economy Perspective

Minnesota Power's power plants play a vital role in their communities and the local economy, both directly and indirectly. Minnesota Power and SAG noted that these plants are important employers in their communities and provide additional, substantial economic benefits to the region in the form of tax revenue and commerce with other regional businesses. SAG discussions also noted that community members employed by the plants contribute to the region economically through real estate investments, taxes, and commerce, philanthropically through charitable giving, and as volunteers by donating time to local schools and community organizations.

SAG members discussed regional challenges that could be impacted by plant closures. The Minnesota Chamber of Commerce released an analysis finding that in the first four years of the decade, Northeast Minnesota has trailed other regions of the state in jobs, labor force, wages, and GDP.[14] With this in mind, participants noted that Minnesota Power's power plants play a vital role in providing these economic benefits of jobs, wages, and GDP in plant communities and the greater region.

Previous analysis shows that for host communities facing plant retirement, there is broad uncertainty about the impacts retirement(s) will have on the local economy and the community at large. Socioeconomic impacts on host communities could be severe and lasting without a thoughtfully managed transition.[15]

LOCAL ECONOMY IMPACT AREAS

The three impact areas associated with the local economy perspective, as well as examples of theoretical adverse and beneficial impacts that could occur related to each impact area, are listed below in table 10.

[14] "Trends in Minnesota's Regional Economies," Minnesota Chamber of Commerce (website), accessed February 11, 2025, https://www.mnchamber.com/blog/trends-minnesotas-regional-economies.

[15] Audrey Partridge and Brady Steigauf (February 2020) Minnesota's Power Plan Communities: An Uncertain Future. Center for Energy and the Environment. Host-Communities-Study-Report-FINAL_2-24-20_updated (1).pdf

Table 10. Impact Areas and Example Impacts for the Local Economy Perspective

Impact Area	Examples
Tax base	**Adverse impact example:** Tax funding for public services in the host community is insufficient, and services are scaled back or cut entirely (e.g., for schools and infrastructure maintenance). **Beneficial impact example:** State and local government tax policies improve, allowing for expanded public services and leading to better funding for schools, enhanced emergency services, improved road maintenance, and more.
Jobs	**Adverse impact example:** The local economy declines due to reduced spending at local businesses, and population decline is caused by migration out of the community. **Beneficial impact example:** Job opportunities increase in new or related sectors such as construction and maintenance.
Social and economic ripple effects	**Adverse impact example:** Utility rates increase, and the local economy declines in response. Large customers' price sensitivities result in decreased economic activity or the retirement of facilities. **Beneficial impact example:** Existing large customers expand and/or new industry enters the region, leading to greater job opportunities and a more resilient and diversified local economy.

Tax Base

Description: This rating scale focuses on the future state of the tax base for the city, county, school district, and region.

Minnesota Power's power plants contribute a significant amount of property and employment tax revenues to their cities, counties, school districts, and the greater region. These tax revenues support cities, counties, school districts, and regional services and infrastructure while also stabilizing taxes for residents and other businesses. A plant retirement could result in the loss of tax revenues from the plant and businesses providing goods and services used in the plant's operation. Such a loss would have major implications for the area's tax base, as well as how much and from whom tax revenues are collected.

Plant workers and people employed by businesses that serve Minnesota Power's plants contribute substantially to the tax bases.[16]

Table 11. Tax Base—Rating Scale

Tax Base		
0 Unacceptable	1 Acceptable	2 Best Case
Immediate retirement of a plant and losing all tax base and associated tax revenues without mitigation or replacement of tax funds.	In the case of plant retirement, providing retirement date with a realistically achievable plan to replace lost tax revenues at a sufficient level to ensure sufficient services and infrastructure.	Maintaining and growing tax revenues needed to support a healthy, vibrant economy for the communities most impacted by any closures or losses due to significant changes in the scale of operations.

Jobs

Description: This rating scale focuses on the quality and quantity of jobs available in the region of a Minnesota Power plant.

Minnesota Power's power plants directly employ full-time, highly skilled, highly engaged workers and highly skilled, short-term, or contract workers for regular plant maintenance. Plants are understood to provide stable, long-term positions, pay above the median income for Minnesota more broadly, and provide medical, retirement, and other important benefits. SAG participants noted plants have a strong focus on workplace safety and protections, offer career advancement opportunities, and provide a high quality of life. Additionally, the plant supports indirect jobs for entities that provide services and materials for the plant and plant workers and their families, as well as local public sector jobs, like teachers, which serve plant workers and their families. As such, plant jobs, both direct and indirect, contribute significantly to the economy and stability of the region.

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[16] University of Colorado Boulder, Leeds School of Business (Business Research Division), *Minnesota Power Economic Impact Study* (March 2020), https://www.edockets.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={10B75F77-0000-C932-920B-5ECAAE3ED46F}&documentTitle=20212-170607-02.

Table 12. Jobs—Rating Scale

Jobs		
0 Unacceptable	1 Acceptable	2 Best Case
Plant retirement(s) with no replacement and insufficient time to build out the economy and grow employment opportunities. All direct plant jobs are lost, which leads to job losses in related industries. Additional loss of indirect jobs due to necessary migration out of the region (spouse jobs, jobs in school, etc.).	Plant retirement(s) with a sustained, advanced injection of workforce transition funding and economic development to diversify the local and regional economy and grow jobs to facilitate the transition.	High-quality, local, and long-term jobs are preserved and grown, creating opportunities for new industry and supporting new high-quality jobs in the region. Minnesota Power proactively invests in the future workforce pipeline through career exploration and job training programs. Resource decisions help bolster, further develop, and support local industries that may have ties to the energy sector (e.g., forestry, mining, etc.).

Social and Economic Ripple Effects

Description: Minnesota Power's resource decisions have far-reaching implications for the local economy and overall community well-being. The IRP decisions can create ripple effects (positive or negative) that extend far beyond the immediate impacts.

Reliable and competitively priced electricity is essential for various sectors, as a stable power supply fosters business growth, attracts new investments, promotes job creation across the region, and supports vital local services. Conversely, disruptions in power supply or rising costs can create operational challenges not only for businesses but also for community organizations, leading to job losses, reduced consumer spending, and diminished funding for public services.

A thriving local economy is integral to a healthy, vibrant community. A "healthy, vibrant community" is defined by the Blandin Foundation Community Leadership Program as one with dimensions of inclusion, economic opportunity, access to infrastructure and services, safety and security, community leadership, environmental stewardship, spirituality and wellness, life-long learning, and recreational and artistic opportunity.[17]

Table 13. Social and Economic Ripple Effects—Rating Scale

Social and Economic Ripple Effects		
0 Unacceptable	1 Acceptable	2 Best Case
Plant retirement(s) fail to support affordable, reliable, available energy resource alternative(s). Large industries cease operations, resulting in significant job losses in the region. Electric rates increase for remaining Minnesota Power customers. Wide-reaching negative ripple effects on the local economy and community. Population declines, taxes increase beyond capacity, school and other community amenities close, job loss in other sectors, and poverty increases.	Plant(s) maintain affordable, reliable, and available electricity. Large industry and other sectors maintain current job opportunities. The population remains stagnant, and access to community amenities and jobs does not grow but does not decrease.	Plant(s) succeed in providing affordable, reliable, and available electricity. Large industries continue operations and attract new opportunities for economic growth and jobs in the region. Wide-reaching positive ripple effects on the local economy and community. The population is growing, the social fabric is strong, the community is healthy and vibrant, poverty decreases, and the local economic benefits grow.

[17] Blandin Foundation, "*9 Common Dimensions of Healthy Community*," https://blandinfoundation.org/content/uploads/9-Common-Dimensions-of-Healthy-Community-Workbook.pdf .

Utility Perspective

The utility perspective was created for two primary reasons. First, the utility perspective acknowledges that Minnesota Power itself is a party in its resource planning efforts. Second, this perspective creates space for discussion of issues that may be important to Minnesota Power and interested parties but that may not have been captured in the other issue areas.

This area includes a variety of issues the utility faces in planning future systems. Minnesota Power wanted to ensure these unique issues were discussed in the SAG process. First, Minnesota Power wanted to discuss considerations related to how well it serves all its customers, with a focus on consultation/collaboration with parties in making decisions, customer satisfaction, cost of service, affordability, and equity. Second, Minnesota Power discussed how the IRP factors into planning and operating its electric system, meeting regulatory requirements, and managing impacts on regional economic stability. Third, Minnesota Power discussed preparing the grid to handle various challenges, including those related to grid modernization, security, resilience, load growth, and climate change. Lastly, Minnesota Power discussed monitoring and responding to technological developments.

UTILITY IMPACT AREAS

The four impact areas associated with the utility perspective, as well as examples of theoretical adverse and beneficial impacts that could occur related to each impact area, are listed below in table 14 and are described in greater detail throughout this section.[18]

Table 14. Impact Areas and Example Impacts for the Utility Perspective

Impact Area	Examples
Responsibility/privilege to serve	**Adverse impact example:** Utilities are insufficiently connected to customers. Customers face increased energy costs due to a new rate structure introduced without consulting key impacted groups. **Beneficial impact example:** Increased customer feedback and consultation programs guide decision-making processes, leading to high customer satisfaction and trust and lower energy costs.
Planning and operations, utility health, and regional stability	**Adverse impact example:** Public safety compromised due to increased and regular blackouts. **Beneficial impact example:** Economic growth in the region due to an efficient energy system that adapts to change and plans for a future grid.

[18] Author's Note: The rating scales do not represent an official communication or set of positions on behalf of Minnesota Power, nor its parent company ALLETE.

Grid readiness	**Adverse impact example:** Disruptions to power supply and critical services due to frequent security incidents impacting the grid. **Beneficial impact example:** Improved quality of life and consumer confidence due to uninterrupted access to electricity.
Carbon-free technology and adoption	**Adverse impact example:** Increased rates for customers due to the adoption of new carbon-free technology before it is ready or cost-effective. **Beneficial impact example:** Stable grid and cost savings due to the adoption of carbon-free technologies with little operational and cost risks.

Responsibility/Privilege to Serve

Description: As a regulated electric utility, Minnesota Power has a responsibility to provide service to its customers but also views the ability to provide service as a privilege. This rating scale speaks to how well Minnesota Power is serving all its customers, with a focus on four components: consultation/collaboration with interest groups, local governments, and sovereign nations in making decisions, customer satisfaction, cost of service/affordability, and equity.

For this rating scale, "customers" includes all customers including those from residential, commercial, industrial, and municipal sectors.

Importantly, customer satisfaction and equity are among several areas of electric utility performance where expectations of utilities are changing, and adequate measurement tools may not yet be readily available. During the previous IRP engagement work, Minnesota Power staff listed considerations related to satisfaction, including reliability, power quality, customer service, and products and service offerings.

Table 15: Responsibility/Privilege to Serve—Rating Scale

Responsibility/Privilege to Serve		
0 Unacceptable	1 Acceptable	2 Best Case
Relevant parties, interest groups, local governments, and sovereign nations were not consulted in utility decision-making. Any customer group is unsatisfied with the service.	Meaningful and balanced consultation with relevant parties, interest groups, local governments, and sovereign nations.	Meaningful and balanced consultation with relevant parties, interest groups, local governments, and sovereign nations impacts decision-making, facilitates collaboration,

Gross inequities exist in service offerings, rate structure, and impact on customers.	All customer groups are satisfied and view Minnesota Power as a trusted partner. Inequities in service are known, and Minnesota Power is working to address them.	and reaches all affected/interested parties. All customer groups are very satisfied and view Minnesota Power as a trusted partner. Customers are served equitably and as they want to be served.

Planning and Operations, Utility Health, and Regional Stability

Description: This rating scale considers the extent to which Minnesota Power is planning and operating its electric system and meeting regulatory requirements, as well as the impact those operations and plans have on regional economic stability. From the Minnesota Power perspective, the "best case" state is one where Minnesota Power is operating its system very efficiently, actively adapting to change, and planning with an eye to the future, all of which leads to greater economic stability for its service territory.

Table 16: Planning and Operations, Utility Health, and Regional Stability—Rating Scale

Planning and Operations, Utility Health, and Regional Stability		
0 Unacceptable	1 Acceptable	2 Best Case
Brownouts or blackouts are common. Frequent punitive action by regulators. Broad economic instability (system, customers, utility). Reactional planning to changes that occur.	Compliance with regulatory requirements for operations and planning. Interaction with regional entities and forward planning to help ensure utility health and regional stability.	Operating efficiently and ensuring safety and reliability. Exceeding regulatory requirements for operations and planning with a defined process for managing change. Utility engages in supporting broad economic stability for the region. Constructive relationships with regulators and relevant interested parties and productive outcomes.

Grid Readiness

Description: This rating scale speaks to how well Minnesota Power is preparing the grid to address various challenges, including those related to grid modernization, security, resilience, load growth, and climate change. The "best possible" state is one where Minnesota Power is ensuring the physical infrastructure (e.g., power lines, substations, transformers) is robust and can handle fluctuations in demand, renewable integration, extreme weather events, and potential cyber or physical security threats, and investments in the grid make it more efficient and adaptable.

Table 17: Grid Readiness—Rating Scale

Grid Readiness		
0 Unacceptable	1 Acceptable	2 Best Case
Physical infrastructure is aging well past its designed use life, leading to increasing failures. The grid cannot adequately respond to fluctuations in demand. Extended outages during extreme weather events are common. Renewable integration is challenging or impossible. Frequent grid security incidents impact grid stability.	Grid response to demand fluctuations is unpredictable but manageable. Renewable integration is slow. Customers and the utility fail to sufficiently benefit from the deployment of technologies. Grid security incidents are uncommon and have a minor impact on grid stability.	Physical infrastructure operates reliably and within its designed use life. Investments are made to modernize physical infrastructure and prepare for future demand expectations, including load growth (e.g., electrification of transportation and building sectors), technology, and customer expectations. The grid responds quickly to demand fluctuations. Extended outages during extreme weather events are rare. The grid is rarely impacted by security threats. Successful integration of renewables onto the grid.

Carbon-Free Technology Development and Adoption

Description: This rating scale speaks to how well Minnesota Power monitors and responds to technological developments. The "best possible" state is one where Minnesota Power can access, adopt, and deploy commercially available clean energy technologies that meet safety, reliability, and climate needs while keeping costs affordable for customers.

Table 18: Carbon-Free Technology Development and Adoption—Rating Scale

Carbon-Free Technology Development and Adoption		
0 Unacceptable	1 Acceptable	2 Best Case
Few carbon-free technologies have been proven through successful demonstrations. Carbon-free technology has not been adopted or deployed at scale. Low industry knowledge is available on operational and cost risks associated with carbon-free technologies.	Carbon-free technologies have been proven through successful demonstrations but have not been adopted or have been adopted before they were cost-effective. Moderate understanding of operational and cost risks associated with carbon-free technologies.	Operational experience enhances commercially available carbon-free technologies. The operational and cost uncertainty associated with technology performance risk is well understood and presents a negligible risk to customers and the grid.

V. Technical Advisory Group

Introduction

In addition to the engagement meetings and SAG, GPI and CEE convened a smaller group of interested parties, the Technical Advisory Group (TAG), focused on understanding and providing feedback on technical modeling assumptions to inform Minnesota Power's 2025 IRP.

TAG worked with Minnesota Power staff to understand and refine modeling assumptions and requirements, including those established by the Commission in its order approving Minnesota Power's 2021 IRP.[19] This order specifically directed that Minnesota Power engage parties in developing its modeling analysis and directed Minnesota Power to evaluate several technical topics via the modeling engagement process. For exact order language, please refer to pages 13–17 of the Commission's January 9, 2023, order.

Overall, TAG served as a collaborative venue through which interested parties built a shared understanding of the key themes and strategic questions being addressed through Minnesota Power's 2025 IRP process. TAG also enabled parties to explore perspectives and key modeling assumptions to inform the IRP in accordance with Commission requirements.

TAG met six times between March and October 2024 to discuss, inform, and refine 2025 IRP modeling assumptions in accordance with the Commission's requirements.[20] All meetings were held virtually. Minnesota Power provided slides in advance of each meeting to encourage and guide discussion among interested parties. Parties also communicated with Minnesota Power modeling staff and GPI and CEE facilitators between meetings. Parties were not asked to reach a consensus on modeling assumptions but were asked to provide thoughts, reactions, feedback, and suggestions for additional consideration.

A summary of all TAG meetings and a high-level list of topics discussed at each meeting is included under the *List of TAG Meetings and Topics Discussed* later in this report.

TAG Participants

The following individuals and organizations attended at least one TAG meeting. GPI and CEE facilitators and representatives from Minnesota Power were also in attendance.

- Amber Lee, Stoel Rives LLP, Large Power Intervenors

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[19] Minnesota Public Utilities Commission, *In the Matter of Minnesota Power's 2021-2035 Integrated Resource Plan* (Docket No. E-015/RP-21-33), Order Approving Plan and Setting Additional Requirements issued (January 9, 2023) https://www.edockets.state.mn.us/edockets/searchDocuments.do?method=showPoup&documentId={10CE9785-0000-CC15-93BC-CC94BB4400D6}&documentTitle=20231-191970-01.

[20] For its 2025 IRP, Minnesota Power used a modeling software tool called EnCompass. This is the same tool that Minnesota Power used for its 2021 IRP. TAG participants ranged from being generally familiar with EnCompass to being expert EnCompass practitioners and modelers themselves. Throughout the TAG process, Minnesota Power was available to answer participants' questions about how EnCompass works and its different capabilities.

- Amber Smith, Blandin Foundation
- Ari Zwick, Minnesota Department of Commerce
- Barbara Freese, Minnesota Center for Environmental Advocacy
- Bart Johnson, Minnesota North College
- Brian Lebens, Minnesota Attorney General's Office
- Chelsea Hotaling, Energy Futures Group
- Drew Moratzka, Stoel Rives LLP, Large Power Intervenors
- Erik Boleman, Barr Engineering
- Isabel Ricker, Fresh Energy
- Jamie MacAlister, Minnesota Department of Commerce
- Jenna Yeakle, Sierra Club
- Kayla Christensen, Conservative Energy Network
- Kristin Renskers, IBEW Local 31
- Loren Carlisle, 1898 & Co.
- Mateus Santos, Minnesota Department of Commerce
- Max Peters, City of Cohasset
- Patrick Woolsey, Sierra Club
- Sean Stalpes, Minnesota Public Utilities Commission
- Sherry Kemmetmueller, CenterPoint Energy
- Steven Douglas, Fond du Lac Band of Lake Superior Chippewa
- Tony Mendoza, Sierra Club
- Will Kenworthy, Vote Solar
- Will Keyes, IBEW Local 31

Major Assumptions Discussed

Below, we have provided high-level summaries of the modeling assumptions discussed throughout the six TAG meetings. For additional details on these assumptions, please refer to the meeting slides, which are included in Attachment C.

In general, these assumptions were discussed within a broader context of the shift from more traditional forms of resource planning to the type of resource planning required today under more variable conditions (including both weather and resource variability), Minnesota's 2040 Carbon Free Electricity Standard, and updated state carbon regulatory and environmental costs. This included discussion regarding what resource planning considerations are important as Minnesota Power works to decarbonize, such as changes in dispatchable capacity, generation portfolio, energy availability and resource mix in the broader MISO market, and additional reliability considerations (e.g., MISO's Long-Range Transmission Planning process and changes to MISO's seasonal resource adequacy construct).

Inflation Reduction Act[21]

The Inflation Reduction Act (IRA) offers several funding opportunities that Minnesota Power could take advantage of, including the Production Tax Credit (45Y), Investment Tax Credit (48E), Carbon Capture & Storage Credit (45Q), and the Clean Hydrogen Production Credit (45V). Of these IRA opportunities, Minnesota Power expressed they would focus on evaluating the Production Tax Credit, Investment Tax Credit, and Carbon Capture & Storage Credit, depending on technology and associated factors of capital cost and capacity. Minnesota Power will incorporate considerations related to these opportunities into its resource planning models.

Participants discussed how these opportunities offer different benefits and could have variable cost impacts based on factors including resource siting (e.g., Would the resource be sited in an energy community or on a brownfield site?), prevailing wage stipulations, and different domestic content considerations. Minnesota Power expressed it viewed meeting labor requirements as very important to maximizing credits and noted that meeting the domestic content bonus would be difficult. However, Minnesota Power would discuss the Energy Community bonus as part of the evaluation.

Participants discussed approaches they and other utilities have taken to model the Production Tax Credit and Investment Tax Credit in resource plans. This included an examination of ways utilities have modeled the energy community adder based on interconnection conditions and ways other utilities have applied percentages to model the likelihood of receiving the credit.

At the time of the filing of this report, federal policy makers are considering changes to IRA policies. As such, there are uncertainties regarding the future availability of IRA incentives.

Technology Characteristics and Associated System Characteristics

TAG extensively discussed the characteristics of various energy technologies, including how those characteristics contribute to broader grid conditions and reliability considerations. As part of this discussion, Minnesota Power provided a hypothetical example of what an entirely wind- and solar-based portfolio would look like compared to system needs across a one-year period. This helped demonstrate that in an entirely solar- and wind-based portfolio, there would be many hours when available wind and solar resources would be insufficient to meet Minnesota Power's load and many hours when there would be more electricity than needed to serve load. This hypothetical exercise demonstrates the need to balance energy resources with load to maximize energy adequacy, which participants discussed.

[21] The TAG presentations and discussions summarized in this section reflect Minnesota Power's and participants' understanding of the Inflation Reduction Act from March–October 2024 (the TAG process timeframe). Since that time, the Executive Branch of the US government has pursued several actions that may impact Inflation Reduction Act implementation. At the time this report is being written, those impacts are yet to be determined. This section of the report is intended to summarize TAG discussions related to the Inflation Reduction Act prior to these federal changes.

As part of this discussion, participants discussed different resource characteristics, including resource flexibility (e.g., ramping ability). Based on the hypothetical example described above, Minnesota Power shared how their ramping needs will likely increase with an additional 700 megawatts (MW) of planned renewables on the utility's system.

Participants had questions about resource needs and overall grid characteristics within Minnesota Power's system versus the broader MISO grid. Overall, there is less variability with the whole MISO grid incorporated, but some resource needs remain. Additionally, participants asked questions about Minnesota Power's solar procurement plans and about the role that storage would play in meeting grid needs. Charging timeframes for energy storage is an important modeling consideration for Minnesota Power with the large industrial customers the company serves. Notably, Minnesota Power expressed a need for controllable resources, including dispatchable generation and both short (i.e., 4- or 8-hour lithium-ion) and long-duration (i.e., 12+ hour), high-energy output storage resources.

Technology Deployment Considerations

In addition to technology characteristics, TAG discussed deployment considerations for various technologies. This included considering what types of resources may be market-ready for deployment across different timelines and how to incorporate those considerations into IRP models. In general, technology readiness and deployment timelines were considered especially important for storage because the various storage types offer different capabilities to serve the system and address critical needs, but not all storage types are as market-ready as others.

Deployment considerations included a discussion of technologies that could potentially operate on smaller pilot-level scales. Minnesota Power views pilots as an important way to explore and implement new technologies as the utility works to decarbonize, but it is cautious about managing costs. As part of this discussion, participants expressed interest in incorporating pilot-scale technologies, including 100-hour iron-air battery storage, local biomass (as a near-term local baseload option), fuel cells, virtual power plants, grid-enhancing technologies, and geothermal electricity generation into the 2025 IRP modeling.

In addition to discussions on more novel technologies that may be worth exploring (at pilot or non-pilot scales), Minnesota Power presented modeling considerations related to distributed solar generation, including projected distributed residential and commercial solar adoption within the IRP timeframe. Minnesota Power sought feedback on their distributed solar growth projections (26 percent average increase per year for residential distributed solar and 45 percent average increase per year for commercial distributed solar). Participants noted that these adoption rates appeared to be slower than recent trends based on the shape of the distributed solar adoption curve. The adoption rates are based on EIA data, and Minnesota Power is open to exploring adoption rate data from other sources.

Load Growth, Sales Outlook, and Customer Programs

Minnesota Power presented factors that contribute to its future load growth and sales projections and explained how the resource plan is tested against base-, high-, and low-load forecast scenarios to identify potential outcomes across potential futures.

Major sources of expected load growth across Minnesota Power's service territory include data centers, green steel, and overall electrification (building electrification, electric vehicles, industrial electrification, etc.). Minnesota sought participant feedback on what possible futures related to those areas of potential load growth might look like. Participants were interested in whether Minnesota Power would evaluate load declines (in addition to base-, high-, and low-load growth scenarios) in the models and sought clarification on factors contributing to past increases and reductions in load.

Participants and Minnesota Power both noted that customer programs were important factors in load growth and system peak because program participation can impact electrification trends, overall efficiency, and demand via demand response programs. Participants were interested in better understanding Minnesota Power's electric vehicle growth rates and whether growth rates might differ across the utility's urban and rural service territory. Participants also discussed trends related to residential customer participation in the time-of-use rate, the timeline at which all customers would be on that rate, and what those trends would look like in the 2025 IRP model.

Changing Conditions (System Peak, Weather, Fuel, etc.)

TAG discussed the challenge of resource planning when faced with more variability than ever before and the need to incorporate scenarios and sensitivities into the evaluation to reflect impacts from potential futures. This included discussions regarding major historical weather events that would be important to incorporate into models, including severe winter storms that can drive high winter peaks and drought conditions that can impact hydroelectric resource availability. The shift from a summer peak to a potential winter peak (or many similar peaks throughout the year) for residential customers was widely discussed.

As a whole, both Minnesota Power and participants viewed storage (including but not necessarily limited to long-duration energy storage) as an important technology for ensuring reliability under increasingly variable weather conditions and shifting system peaks.

In addition to changes in system and weather-related conditions, TAG also discussed how changes in the economic and policy/regulatory landscape may be important modeling considerations. Minnesota Power discussed the importance of considering different fuel availability and cost scenarios in plan development, in part exemplified by the 2022 natural gas price spike and other commodity-specific unknowns and risks. Participants also asked what sources Minnesota Power would use to inform solar, wind, and storage costs. Additionally, participants were interested in understanding how Minnesota Power might incorporate considerations related to the EPA's new GHG emissions standards rule into 2025 IRP models and discussed their views on eligible technologies under Minnesota's 2040 Carbon Free Electricity Standard.[22]

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[22] During the time the TAG met to discuss modeling considerations for Minnesota Power's 2025 IRP, the Commission had an open docket to investigate what constitutes compliance with the State's new carbon-free electricity standard under Minn. Stat. § 216B.1691. Throughout the TAG process, it was not yet known exactly which resource types

List of TAG Meetings and Topics Discussed

Below is a list of all six TAG meetings and a high-level overview of topics discussed at each meeting. All meetings were held virtually.

TAG Meeting 1 (March 11, 2024): TAG Process Kickoff

- Introduction of the purpose of TAG:
  - Ground rules for participation
  - Minnesota Public Utilities Commission directives
  - Group's role in informing modeling
  - Key areas of focus for Minnesota Power's 2025 IRP
- Overview of Minnesota Power's service territory, customer mix, generation supply, and power needs
- Overview of the evolution of integrated resource planning, including today's best practices in integrated strategic system planning
- Modeling considerations:
  - Assumptions from Minnesota Power's 2021 IRP process
  - Minnesota Power's initial list of modeling inputs and parameters
  - Additional modeling input and parameter suggestions from TAG participants

TAG Meeting 2 (April 15, 2024): Reliability, Resource Adequacy, and the Inflation Reduction Act

- Overview of current best practice in reliability planning, including a discussion of how resource planning has changed over time and why
  - Discussion of planning for 2025 forward, with decarbonization in mind
  - MISO's Reliability Imperative and the industry's response
  - How Minnesota Power is incorporating operational flexibility and energy adequacy considerations into its resource planning approach
- Resource adequacy drivers and requirements under MISO
  - Increased uncertainty within tight margins
  - Shift from a summer peak to a peak at any season, especially winter (shift from an annual to a seasonal construct)
  - MISO's Direct Loss of Load resource adequacy methodology to account for changing and growing reliability risks and increases in uncertainty on resource accreditation
- Overview of the IRA, including key opportunities for the electric sector (45Y Production Tax Credit, 48E Investment Tax Credit, 45Q Carbon Capture and Storage Credit, 45V Clean Hydrogen Tax Credit)

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would or would not be considered "carbon-free" under the statute. The Commission held a hearing on this matter on September 26, 2024, shortly before the final TAG meeting, and issued an order on the matter on November 7, 2024. The November 7, 2024 order is available here: https://www.edockets.state.mn.us/documents/%7B80E20793-0000-CD11-8C78-C3B3C0606CE1%7D/download?contentSequence=0&rowIndex=10

- Discussion of Minnesota Power's approach to pursuing IRA benefits, including base-case assumptions related to certain available credits

TAG Meeting 3 (May 20, 2024): Technologies to Consider Evaluating in Minnesota Power's 2025 IRP

- Continued discussion on defining reliability criteria based on current best practices in resource planning and meeting utility and MISO needs
    - Minnesota Power's reliability criteria
    - Minnesota Power's resource need
    - Industry resource Maturity
    - MISO's reliability system attributes road map
- Overview of the operational characteristics of a changing power supply with respect to reliability, general system capabilities, and technologies
- Discussion of different technology options
    - What different technologies offer (strengths, challenges, and expectations associated with different technologies)
    - Need for multi-dimensional operational flexibility to meet energy adequacy needs under changing weather conditions
    - Operational flexibility needs under Minnesota Power's system today and with 700 MW of renewables (to be deployed)
    - Balancing demand for certain technologies with uncertainties associated with those technologies when developing a resource portfolio
    - Discussion of data source options to inform values, estimates, and technology curves to be incorporated into modeling

TAG Meeting 4 (June 17, 2024): Technology (continued) and Customer Considerations

- Continued discussion of different technology options
    - Data sources for technology costs and escalation rates
    - Approach to incorporating technology curves into modeling
    - Detailed discussion of factors to consider when exploring emerging technologies to evaluate in the IRP, including:
        - Technology maturity (market readiness and feasible deployment timeline)
        - Technology reliability characteristics
        - Regulatory and legislative considerations
- Overview of Minnesota Power's electricity sales and projected growth, including changes to peak demand
    - How projected customer demand over time (low/medium/high) is considered in the IRP, and how resource pathways will be tested against those projections
    - Customer growth considerations, including data centers, green steel, and increased load from electrification
    - Impact of Minnesota Power's customer programs, program trends/projections, and program-specific considerations for the IRP, including how the IRP will test against low/medium/high program scenarios

TAG Meeting 5 (July 22, 2024): EnCompass Modeling Approach

- Overview of MISO's reliability and resource adequacy context
- Past and current approaches and considerations related to long-duration energy storage
- Cost considerations
    - Market interactions in 2025 and previous IRP, including market volatility for different energy resources
    - IRP approaches to applying state environmental costs and externality values for criteria pollutants and environmental and regulatory costs of carbon dioxide
    - Commission directive to incorporate environmental costs/externalities, as described in the Commission's order approving Minnesota Power's 2021 IRP
    - Overview of sensitivity analysis purpose and sensitivities under consideration (e.g., market interactions and volatility, renewable resource interconnections, weather conditions and how they impact different resources)

TAG Meeting 6 (October 3, 2024): Incorporating Transmission and Distribution System Planning into the IRP

- Overview of recent considerations related to Minnesota Power's Distribution System Planning approach
- Transmission planning considerations:
    - Regionally relevant Tranche 1 and Tranche 2 projects under MISO's Long-Range Transmission Plan
    - How different cease coal and retirement scenarios at the Boswell units[23] could impact the transmission system, including:
        - Power quality (e.g., voltage)
        - Power delivery (local and regional)
    - Retiring Hibbard Renewable Energy Center
    - Transmission interconnection cost projections
    - Overview of EnCompass modeling process and technical/software considerations

VI. Conclusion

The engagement process for Minnesota Power's 2025 IRP enabled Minnesota Power to learn directly from interested parties about their areas of interest and concern. The process also enabled all participants to build a shared understanding of the planning environment for the company's 2025 IRP, including considerations specific to Minnesota Power's service territory, regulatory directives, and compliance with the 2040 Carbon Free Electricity Standard milestones in 2030 and 2035.

Through this process, Minnesota Power was able to expand and further iterate upon its 2021 IRP engagement process. Informed by SAG participant feedback and developed in

[23] The Commission's January 9, 2023, order directed Minnesota Power to evaluate "capacity and energy replacement options including transmission solutions for both [Boswell] units" in the 2025 IRP, including MISO long-range transmission planning and other associated processes.

collaboration with those participants, Minnesota Power was able to develop an SCBA framework reflective of the group's discussions, with consideration for impacts related to customers, the environment, the local economy, and the utility. Similarly, through TAG, participants were able to share their perspectives regarding important modeling considerations and inputs for the IRP. Additionally, the broader Engagement Group enabled all process participants—including those who may not have elected to participate within SAG or TAG—to stay informed about the process and share additional perspectives.

In conclusion, the 2025 IRP Engagement Process established collaborative learning opportunities between Minnesota Power and participating parties. These discussions enabled Minnesota Power to consider participants' thoughtful feedback in their IRP while balancing additional regulatory requirements.

The facilitators would like to thank all participants for their time, thoughtfulness, and patience throughout this process, as well as Minnesota Power for the opportunity to convene these important conversations.

VII. Attachments

Attachment A: Engagement Meeting Materials

ATTACHMENT A: ENGAGEMENT MEETING MATERIALS

Minnesota Power and IRP 101 Webinar

WEDNESDAY, FEBRUARY 21, 2024, 8:30AM-10:00AM

Virtual Meeting: Click here to join

Pre-Reads

- Stakeholder process document

Meeting Goals

1. Provide stakeholders with background information to enable a more successful engagement process:
   a. Build a shared understanding of Minnesota Power's IRP.
   b. Build a shared understanding of the regulatory process for an IRP.

Agenda

8:30AM **Welcome and introductions**

- GPI to welcome the group and introduce GPI, CEE, and MN Power staff
- Ask participants to introduce themselves in the chat (to save time)
- Trevor to go over the meeting ground rules and engagement process
  - Pause for questions

8:45AM **Presentation on Minnesota Power**

9:15AM **Presentation on the IRP Regulatory Process**

9:55AM **Wrap-up and Next Steps**

10:00AM **ADJOURN**

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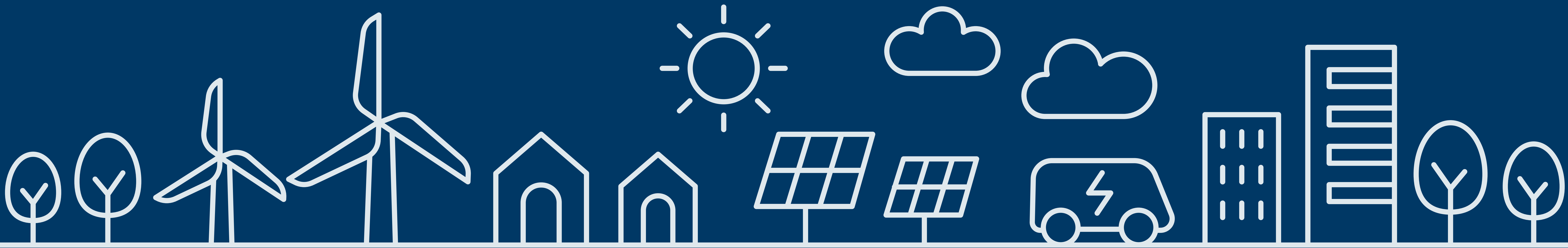
Center for Energy and Environment

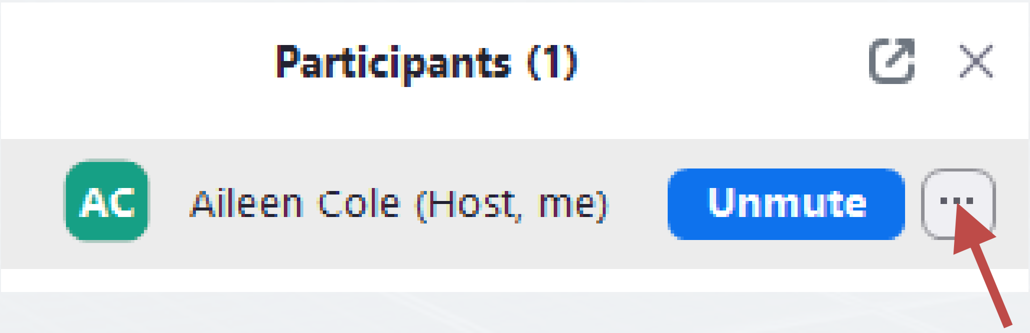
Minnesota Power & IRP 101

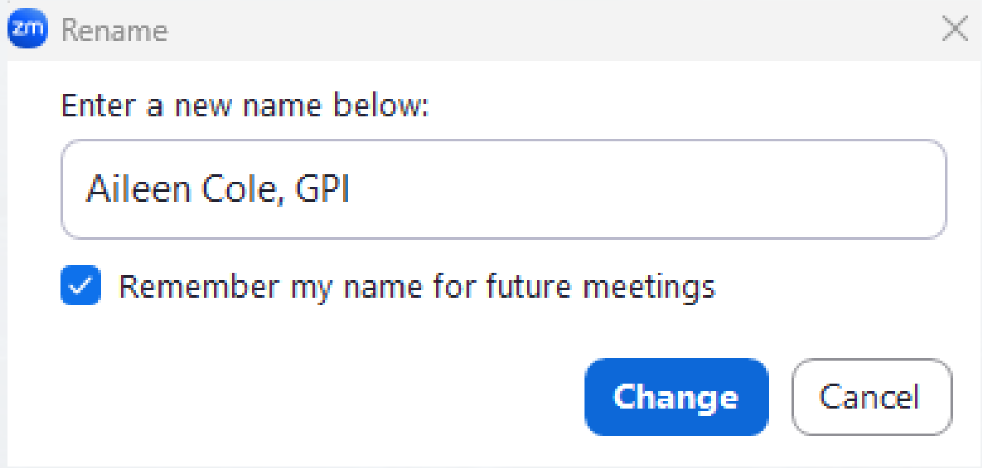
February 21, 2024 | Webinar

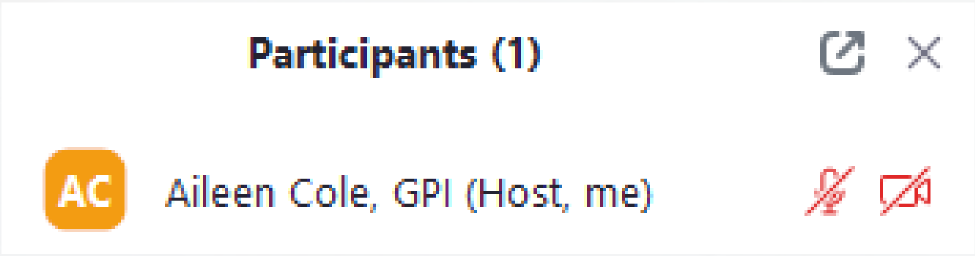


Welcome and Introductions

Please add your organization to your name in the participants list.





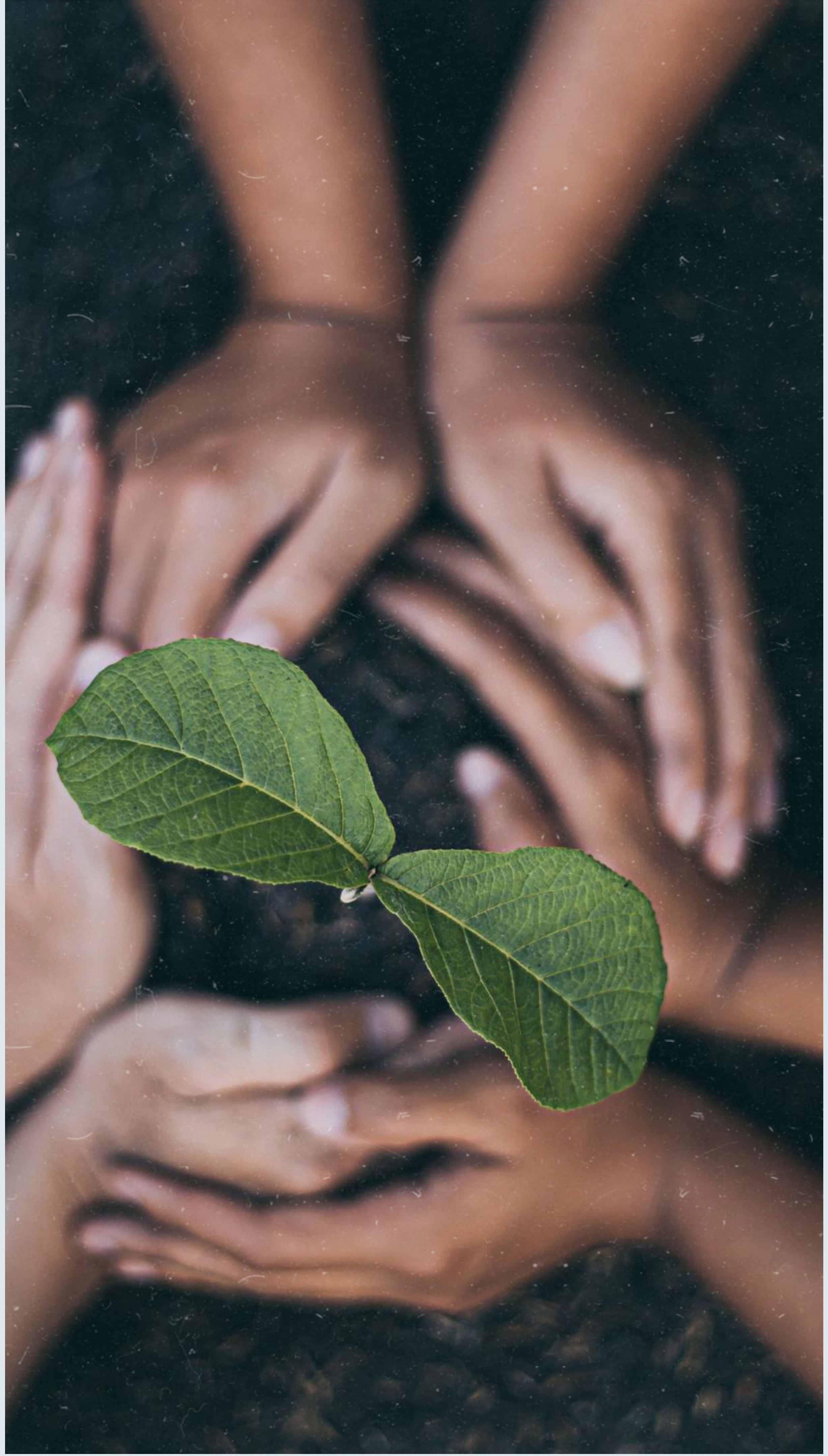


Goals for today

Provide an overview of Minnesota Power’s business, customer mix, power supply, and service territory

Build a shared understanding of what an integrated resource plan (IRP) is

Build a shared understanding of Minnesota Power and their IRP



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Proposed Process Objectives

- Build a shared understanding among all interested parties of the policy, technology, and socio-economic landscape for the 2025 IRP.
- Review and update the Issue Map developed during the 2021 IRP process as needed to make it relevant for the 2025 IRP.
- Inform the technical and modeling inputs and parameters that Minnesota Power will use for its 2025 IRP.
- Inform the development of retirement scenarios for the Boswell Energy Center and a societal cost benefit analysis of Boswell Unit 4.
- Inform the development of a societal cost benefit analysis of the Hibbard Renewable Energy Center.

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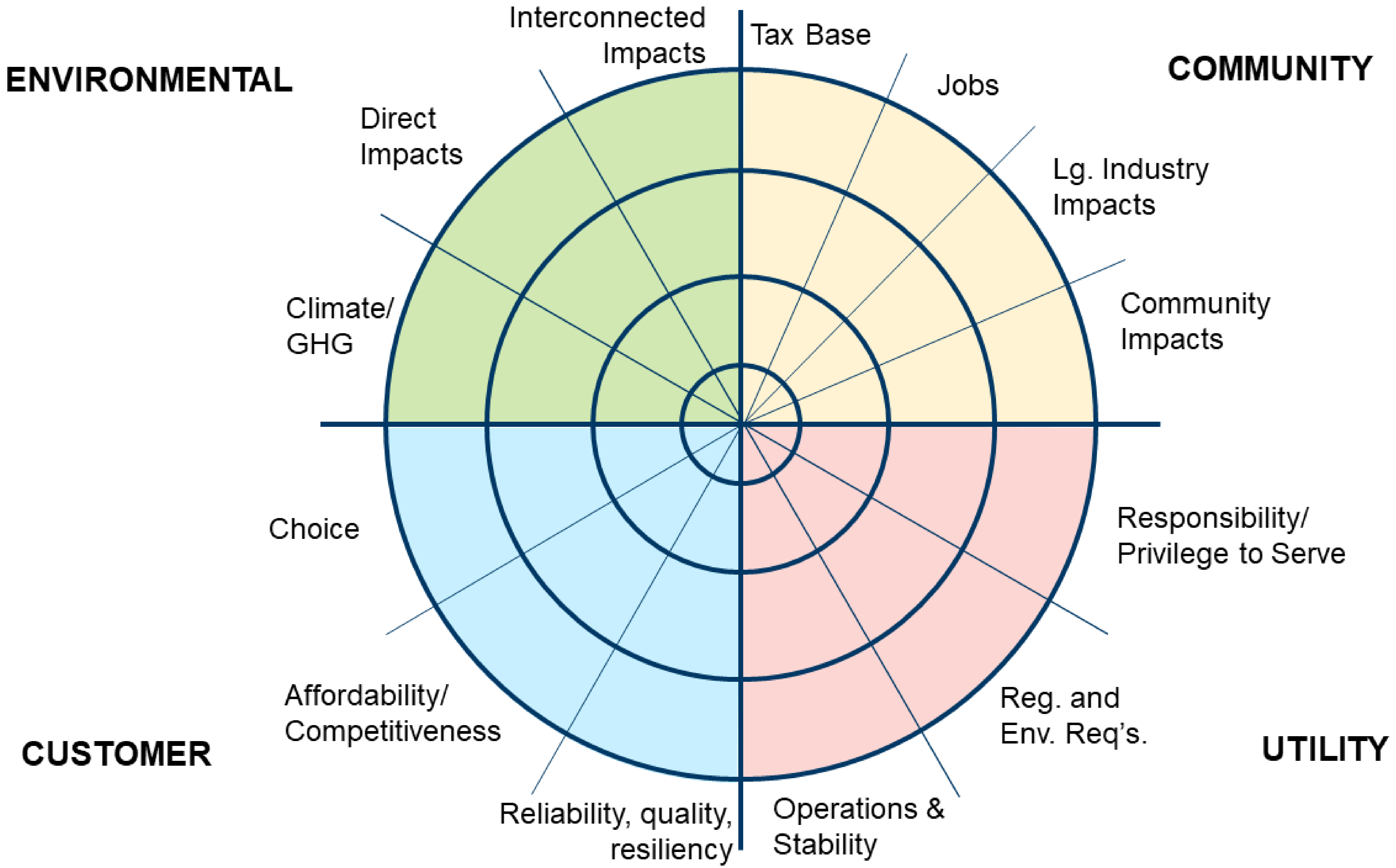
Issue Map (from 2021 IRP process)



Advisory Groups

Technical Advisory Group

- Will inform the IRP modeling assumptions and discuss other IRP technical issues as needed.
- Geared towards participants with technical expertise (i.e., familiar with modeling assumptions).

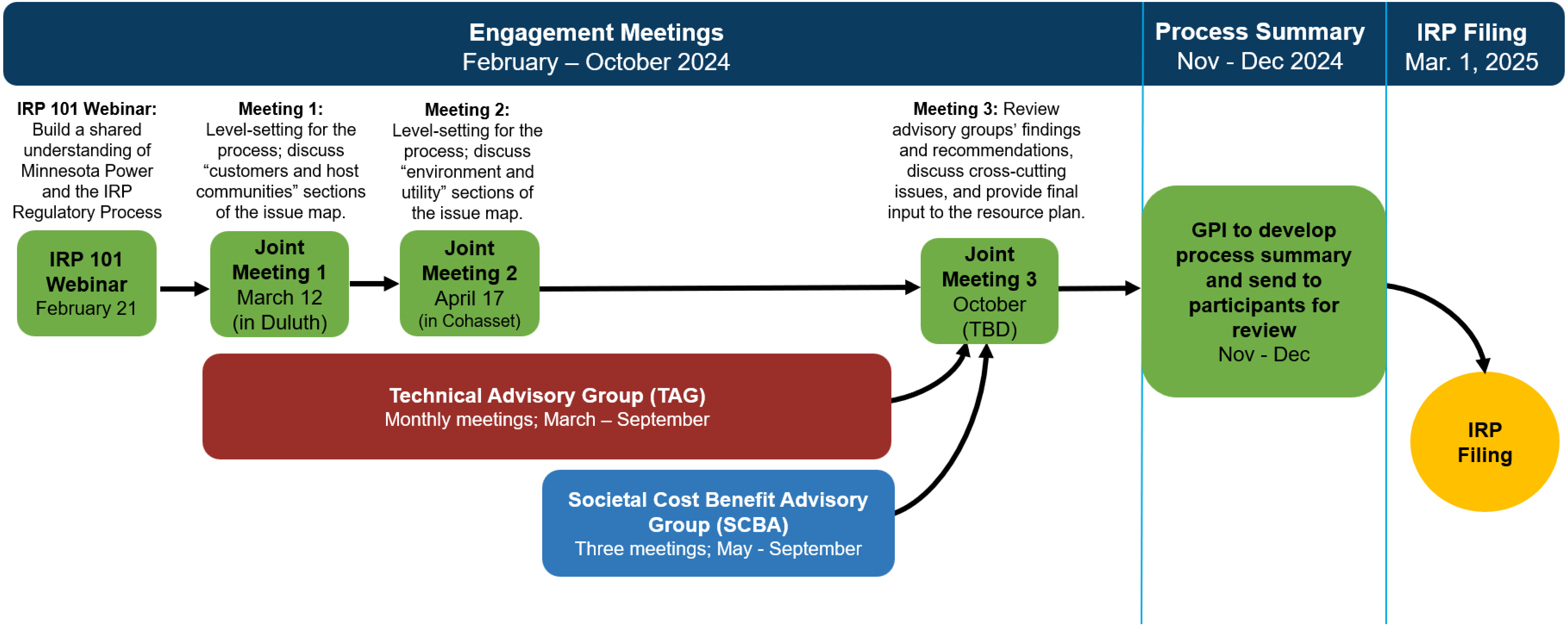
Societal Cost Benefit Advisory Group

- Will inform development of a societal cost benefit analysis for any Minnesota Power generation facility, including but not limited to the Hibbard Renewable Energy Center and Boswell Unit 4.

Process Timeline

MINNESOTA POWER 2025 IRP—ENGAGEMENT MEETING TIMELINE

NOTE: Dates and topics are subject to change to meet the group's needs.



Ground Rules for Participation

- Respect the time. Your time together is limited and valuable, so please be mindful of the time and of others’ opportunity to participate.
- Respect each other. Help us all to uphold respect for each other’s experiences and opinions, even in difficult conversations. We need everyone’s wisdom for the greatest results.
- Have fun! This is a unique opportunity to develop relationships with and see the humanity in people who may not share your same worldview. While discussing serious and contentious issues, let’s all remember to have some fun and humor while maintaining respect.

Questions?

Introduction to Minnesota Power

Jennifer Cady

Vice President of Regulatory and Legislative Affairs

ALLETE clean energy

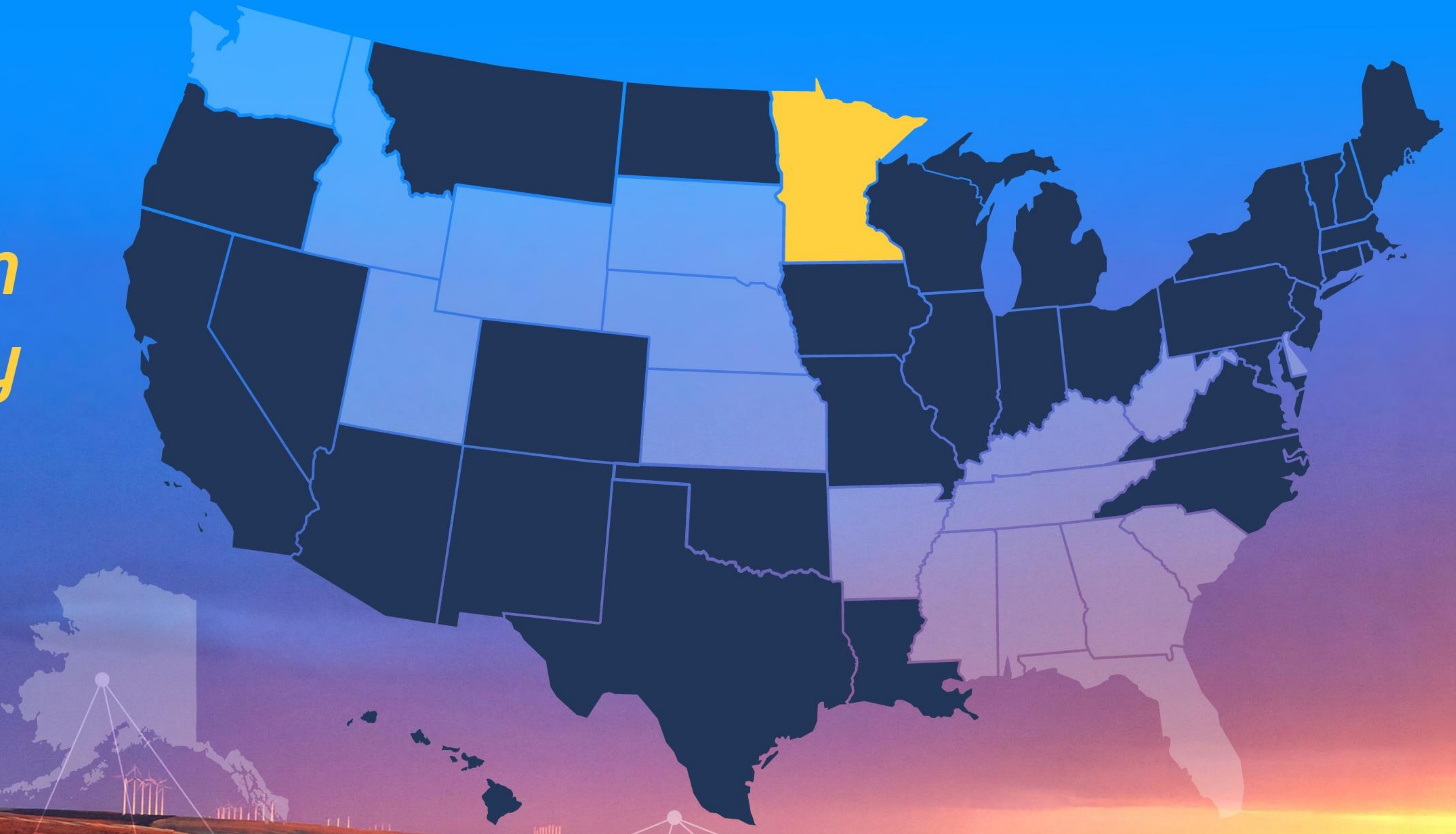
BNI energy

minnesota power

NEW ENERGY EQUITY

SWL&P

Relative to size, ***ALLETE is the largest investor in renewable energy*** of all IOUs in the country.



Recognized as an **Honor Roll Company with Special Distinction** by the Minnesota Census of Women in Corporate Leadership since 2018.

Currently

50%

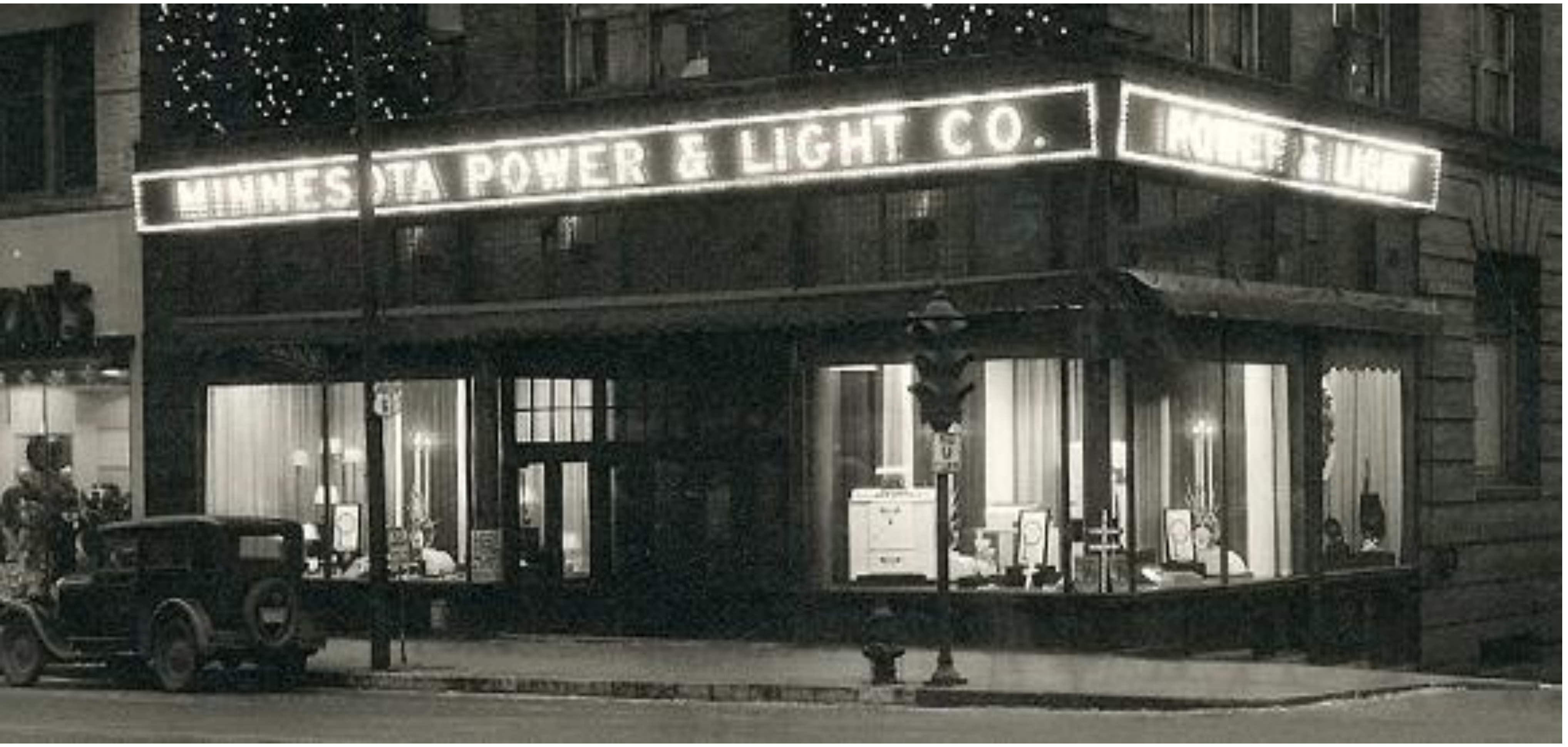
ALLETE board of directors and

50%

executive officers are women

MP's First Generation: Thomson Hydro in Carlton County Operational in 1906

Serving our Region for Over 118 Years



Headquartered on Superior Street in Duluth Since 1923

Linemen Respond to the Winter Storm of December 2022

WE ARE UNIQUE

Duluth, MN Headquarters

26,000 Square-miles

150,000 Customers

12% Residential sales

66% Mining and Forestry

14 Minnesota Municipalities

14 years Met or exceeded the MN energy savings goal

1st To Deliver 50% Renewable Energy to Customers

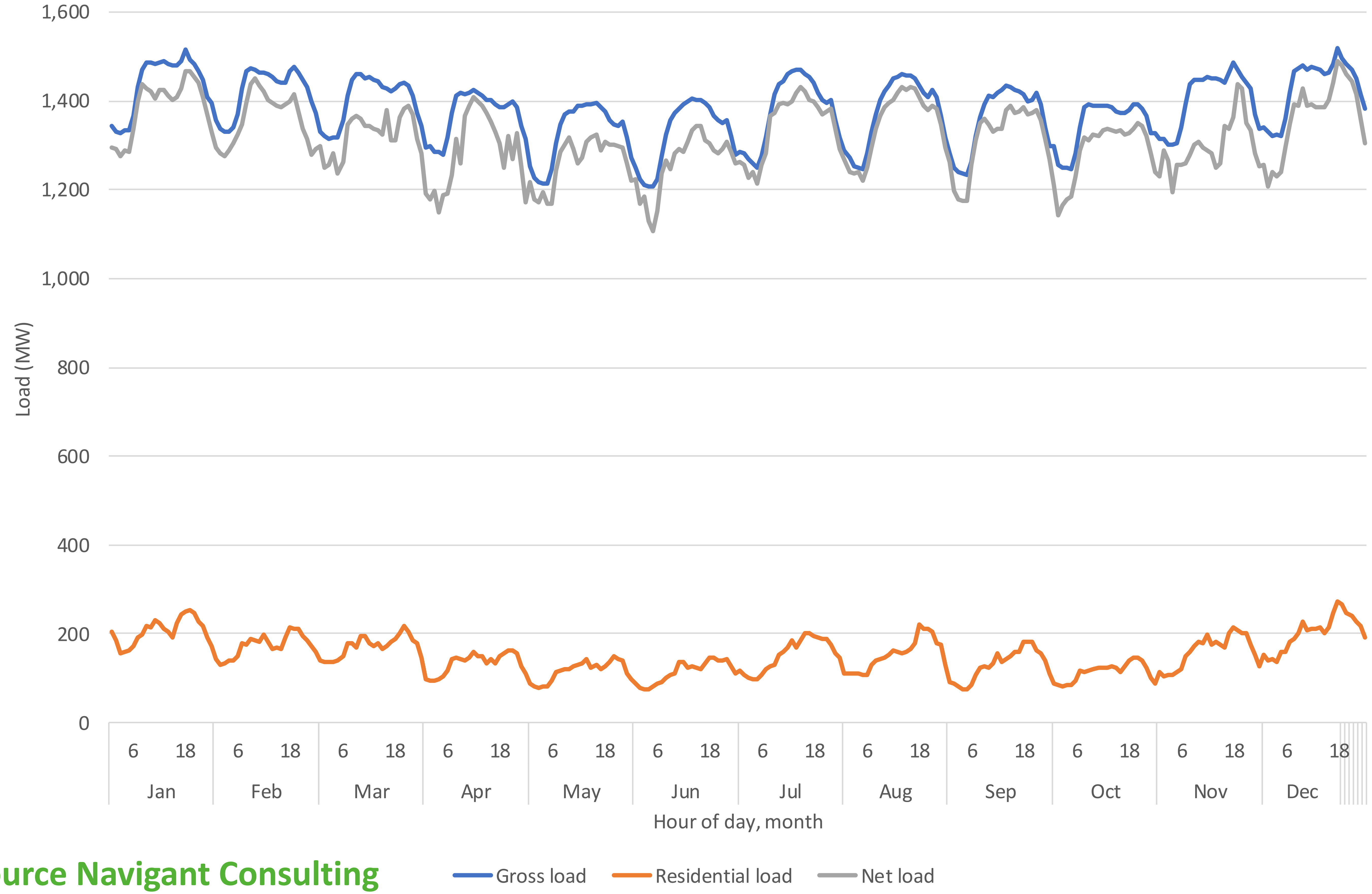
MP's Unique Customer Mix

- MP's taconite customers produce 75% of all domestic iron – only one other iron mine in the nation (Michigan)
  - MN taconite is the cleanest and our miners are the safest in the world
- Taconite is largest industry in northern MN
  - Generates $150 million in taconite revenue each year
  - There are 3,770 direct jobs in Minnesota
- Forest products industry has $494 million total state & local tax impact in Minnesota
  - There are 30,005 direct jobs and 69,010 indirect jobs in Minnesota

MP Serves Large Industrial Customers

Blandin Paper Company
Boise Paper Company
Hibbing Taconite (HibTac)
Keewatin Taconite (Keetac)
Minntac
Minorca Mine
North Shore Mining
Sappi – Cloquet Paper Mill
Sofidel – Duluth Paper Mill
United Taconite (UTAC)

MP Peak Load by Time of Day and Month



*Source Navigant Consulting

Residential load makes up less than 10% of gross load, a small share when compared with other utilities

MP has one of the highest load factors in the country

Large Industrial Customers operating at near 90% load factor

WE ARE COMMITTED TO MAKING A SUSTAINABLE TRANSITION

to a **reliable**, **affordable** and **carbon-free** energy mix for our customers.

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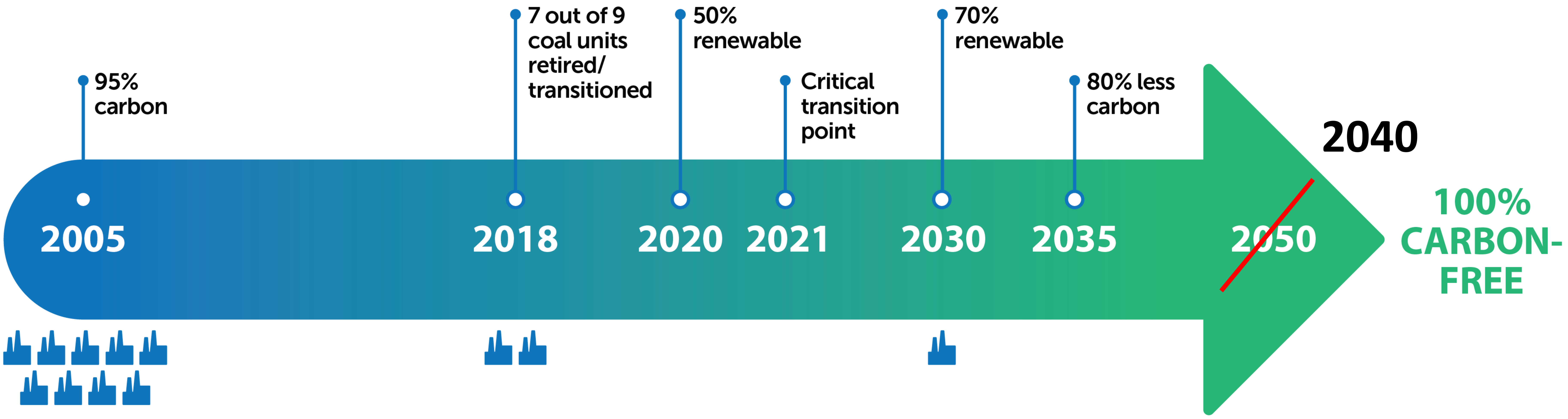


Reducing Emissions

REDUCED MERCURY
90%
SINCE 2016

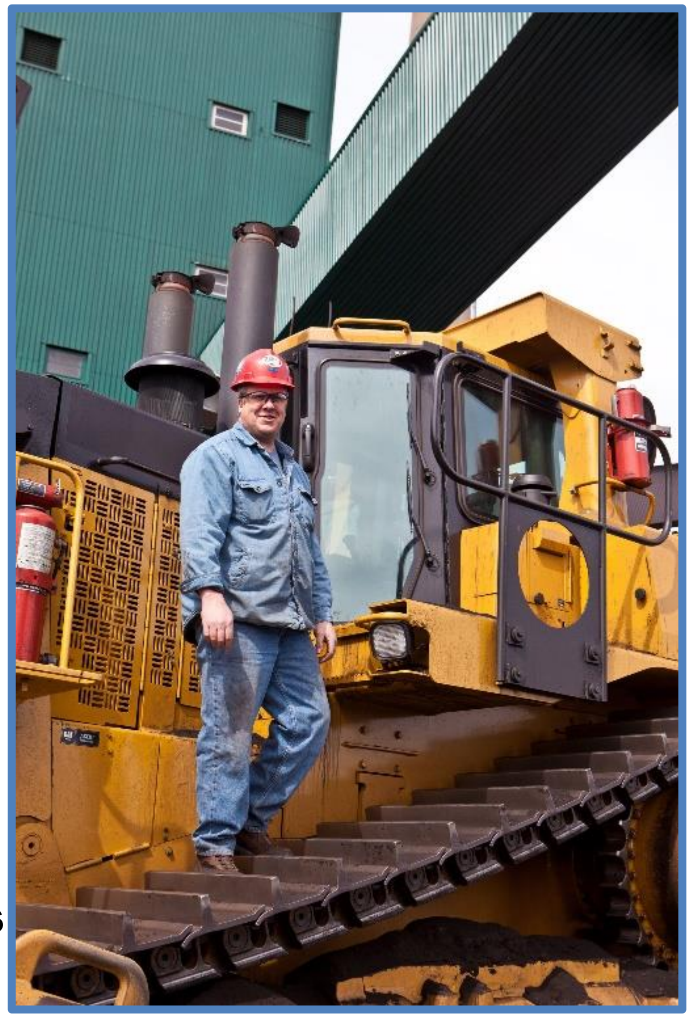
REDUCING CARBON
50%
BY 2021

REDUCING EMISSIONS
70%
TOTAL

MP's Clean Energy Transition

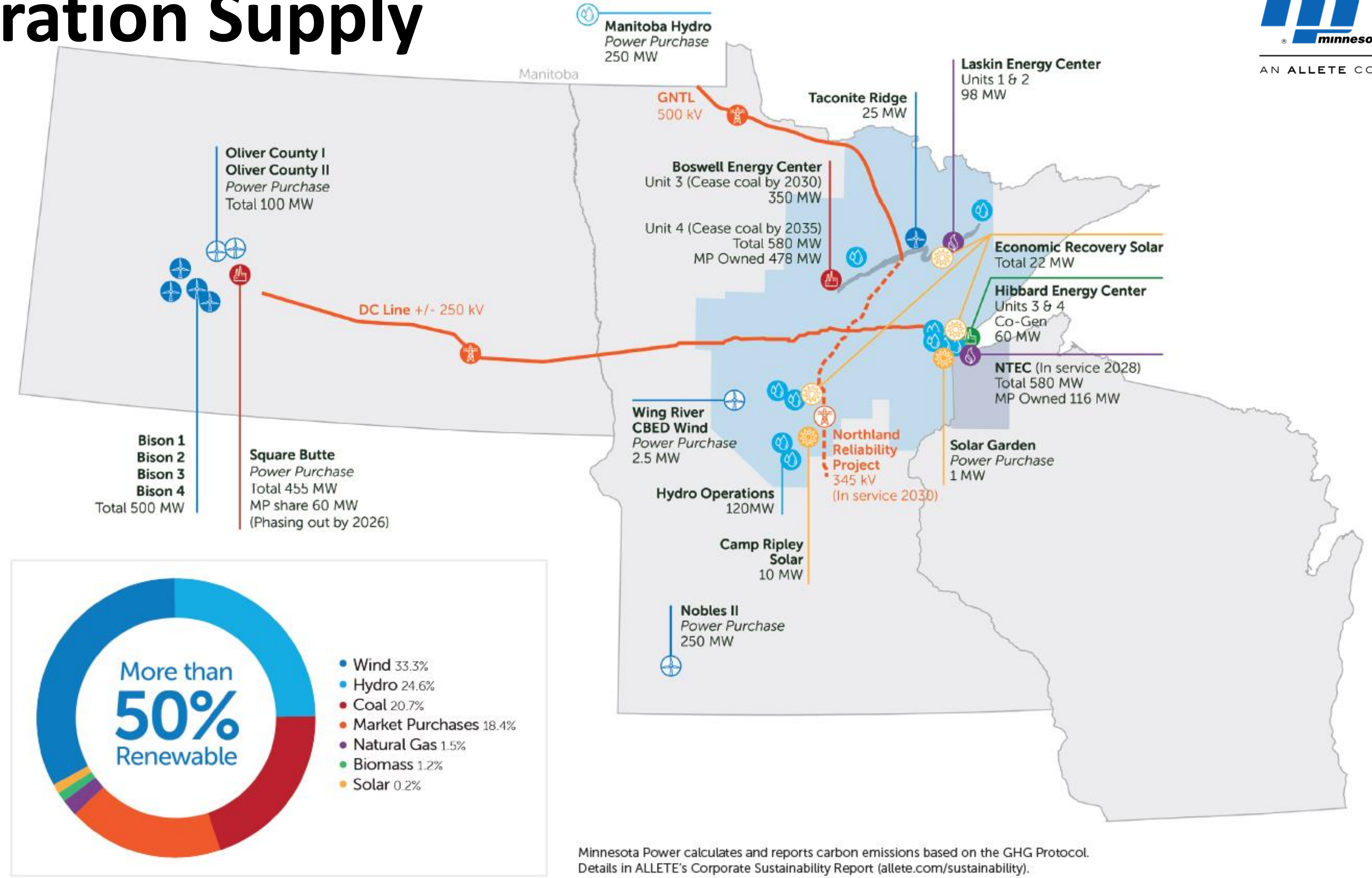
- Since the 2015 IRP, MP Generation has eliminated 180 positions
  - 443 employees in Generation in 2015 to 263 employees today
- Job eliminations are the result of:
  - Early closure of Boswell 1 & 2
  - Rapids Energy Center refueling
  - Laskin Energy Center refueling
  - Idling of Taconite Harbor Energy Center
  - Mission change for the Hibbard Renewable Energy Center
  - Rescaling of professional and technical services group
- With time and thoughtful transition, MP managed this downsizing through hiring freezes, relocations and planned retirements
  - Of 180 positions eliminated in 4 years, only 5 employees were laid off
  - Laid off employees have preference for rehire
- 161 employees currently operated Boswell Energy Center Units 3 and 4

Jane Orazem
Ash Handling
Technician



Troy Brutlag
Fuels Operations

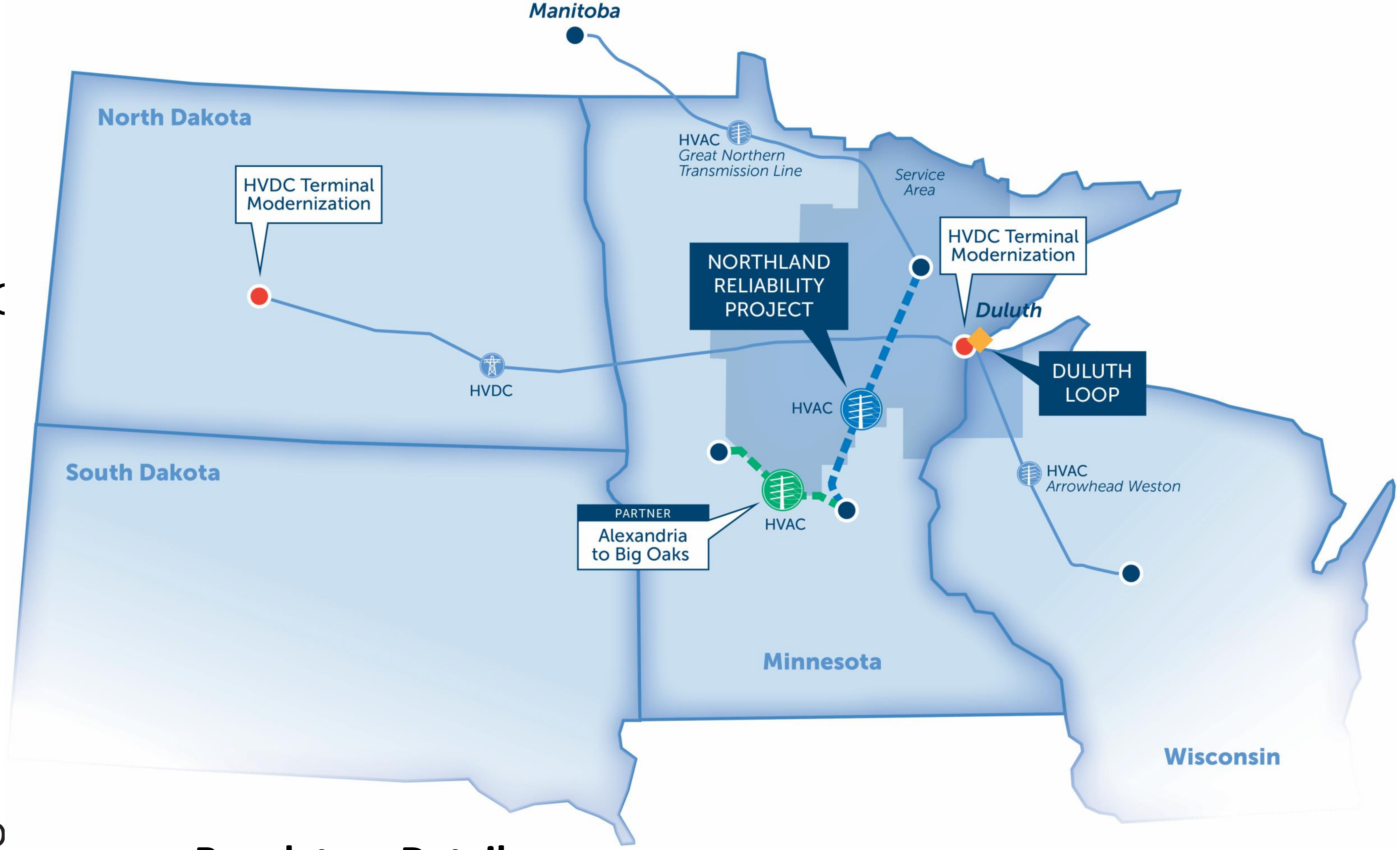
Generation Supply



Minnesota Power calculates and reports carbon emissions based on the GHG Protocol.
Details in ALLETE's Corporate Sustainability Report (allete.com/sustainability).

Transmission to Support the Transition

- **HVDC Modernization Project**
  - Upgrade project to replace aging infrastructure in ND & MN
  - When complete, the 465-mile HVDC Line will be capable of transferring 900 MW (from 550 MW)
  - MP has been selected for $75M in state & federal grant funding
- **Northland Reliability Project**
  - Partner project with GRE to build ~180-mile new transmission line from MP's Iron Range Substation to GRE's Benton County Substation
  - Supports grid reliability & resiliency as we continue to transition to more renewables



Regulatory Details:

- CON & Route Permits filed for HVDC Modernization Project, Northland Reliability Project, & Alexandria-Big Oaks Project
- CON & Route Permit granted for Duluth Loop

MP's Customer Programs and Services

Innovative, state-leading customer program offerings

Cross promotion of customer program offerings to help customers maximize benefits

Engagement within the communities we serve to increase customer awareness of customer programs and support workforce development

Energy Conservation and Optimization (ECO)	Renewable Programs
Electric Vehicles	Demand Response
Time of Day Rates	Affordability Offerings

Questions?

IRP 101
2025 IRP Requirements

Jennifer Cady
Vice President of Regulatory and Legislative Affairs

What is the Integrated Resource Plan (IRP)?

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- One of the most important planning tools and road maps for each electric utility in Minnesota
- Reasonable plan to ensure utilities can meet customers’ needs in a reliable and low cost manner
- Plans include forecasts, evaluation of current assets and long range power system planning
- Filed periodically with the Minnesota Public Utilities Commission
- Broad public process with opportunities for stakeholder input

First-Of-Its-Kind Integrated Resource Plan Stakeholder Process (2019-2022)

A vision informed by a robust process, capturing insights from diverse perspectives across Minnesota

* BlueGreen Alliance
* Citizen's Climate Lobby Two Harbors
* Citizens Utility Board
* City of Cohasset
* City of Duluth
* City of Grand Rapids
* City of Mountain Iron
* Clean Energy Economy Minnesota
* Cleveland-Cliffs Inc.
* Coalition of Utility Cities
* Dovetail Partners
* Duluth Seaway Port Authority
* East Range Joint Powers Board
* Ecolibrium3
* Fresh Energy
* Fond du Lac Band of Lake Superior Chippewa
* Grand Rapids Area Chamber of Commerce
* Grand Rapids City Council
* Hedstrom Lumber Company
* IBEW Local 31
* Iron Mining Association of Minnesota
* Itasca Community College
* Itasca County
* Itasca Economic Development Corporation
* Laborers' International Union of North America
* Large Power Intervenors
* Minnesota Public Interest Research Group
* Minnesota Center for Environmental Advocacy
* Minnesota Chamber of Commerce
* Minnesota Department of Commerce*
* Minnesota Department of Military Affairs
* Minnesota Public Utilities Commission*
* Northspan Group, Inc.
* Range Association of Municipalities and Schools
* Sierra Club – Minnesota Chapter
* UPM/Blandin Paper Company
* Vote Solar
* Western Lake Superior Sanitary District
* Zabinski Consulting Services LLC

***MPUC and DOC Staff Participated as Observers Only*

The Stakeholder Group Consensus: A Just Transition is Needed for Northern Minnesota

Our commitment to climate, customers and communities

A sustainable carbon reduction plan must:

1. Ensure reliability
2. Manage costs for all customers
3. Time for just transition for employees and host communities
4. Allows time for technology to develop and advance

We have **exceeded state clean energy goals** without risking safety, reliability and affordability—and we will continue to do so.

MINNESOTA POWER'S 2021 INTEGRATED RESOURCE PLAN

Joint Settlement Agreement

Who?

- Minnesota Power
- City of Cohasset
- Itasca County
- Itasca Economic Development Corporation
- IBEW Local 31
- Laborers Union (LiUNA)
- Carpenters Union
- Operating Engineers/49ers
- Fresh Energy
- Sierra Club
- MN Center for Environmental Advocacy
- Large Power Intervenors

What?

- **Plan for Ceasing All Coal-Fired Generation**
  - *Cease coal* at Boswell Unit 3 by 2030
  - *Cease coal* at Boswell Unit 4 by 2035
  - Study early plant retirement scenarios including impacts to electric rates, reliability, local workforce, tax base & other socioeconomic impacts
- **Significant Amounts of New Wind (400 MW) and Solar (300 MW) Energy Additions**
- **Energy Storage Demonstration Projects**
- **Prioritize Reinvestments in Northern Minnesota, Leverage Partnerships with Communities and Organized Labor**

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MINNESOTA POWER'S 2025 INTEGRATED RESOURCE PLAN

2025 IRP Process

1) 2024 Stakeholder Engagement
   - Regional economic development considerations
   - Societal cost-benefit analysis of generating units
   - Clean energy funding and goals
   - Technical advisement and modeling input

2) Modeling

3) Plan Development

4) File the IRP March 1, 2025
   - Public Hearings and Comments
   - Initial and Reply Comments
   - Commission Hearing

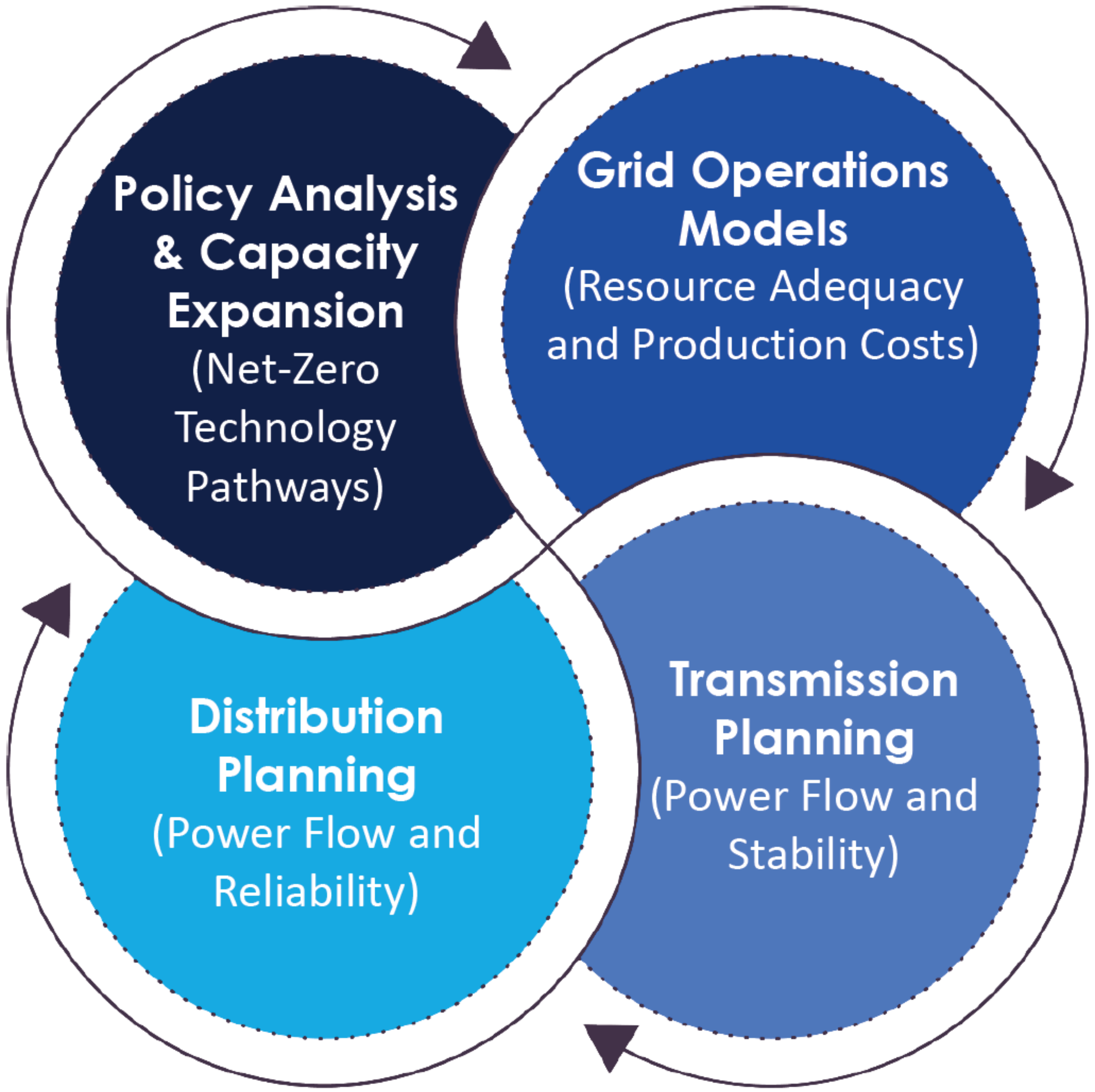
Questions?

Resource Planning 101

Eric Palmer

Manager – Utility Planning

Transitioned to Integrated Strategic System Planning



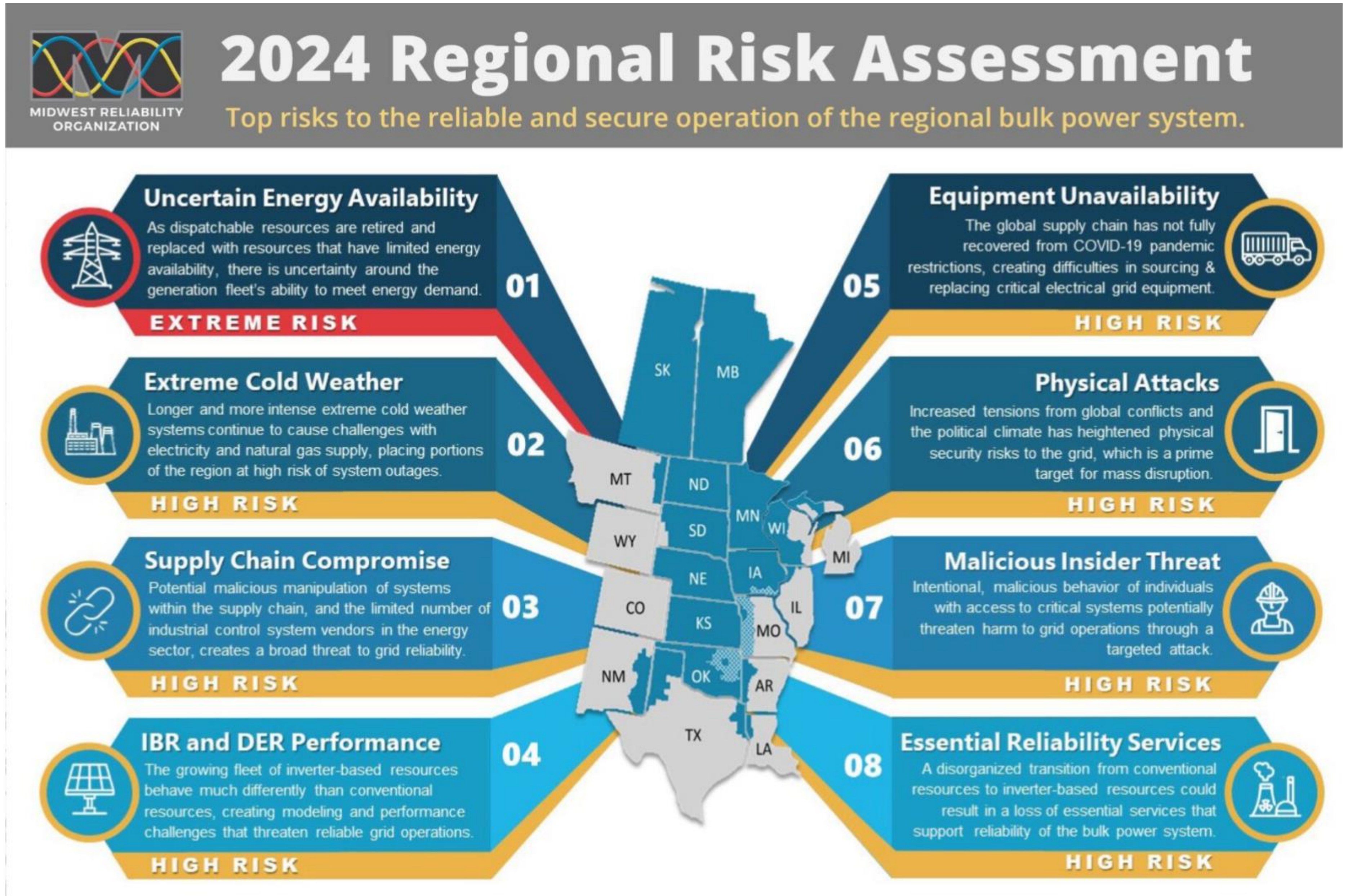
Develops a generalizable analytical framework to assess future expansion plans across supply (G) and delivery (T&D) & ensures reliability

FIGURE SOURCE: EPRI

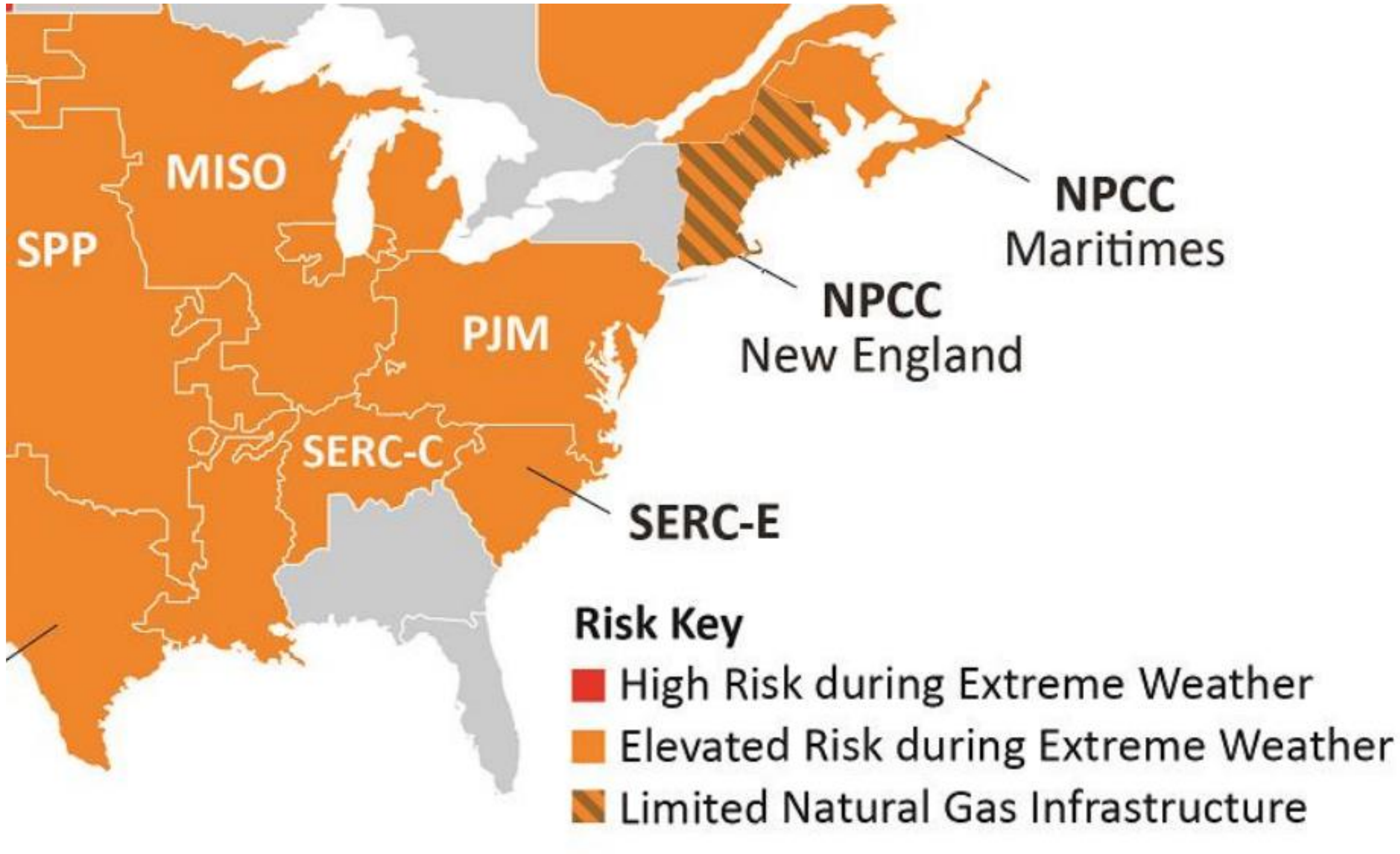
Strategic Questions for Planning

- Affordable pathways to decarbonize electric sector?
- Sufficient energy and flexibility required to balance intermittent renewables with changing demand profiles?
- T&D investments for reliability, decarbonization, and higher levels of renewables and inverter-based supply mix?
- Timing of emerging carbon-free technology availability and at what cost?
- Future customer demand levels and controllability?
- Role of distributed resources in resiliency and reliability?

Concrete ISSP Required Over for Next 15 Years



NERC Winter Reliability Assessment:



MISO 2023 OMS Survey:

Committed Capacity shows declines over survey window with potential resource deficits starting in PY 2025/26

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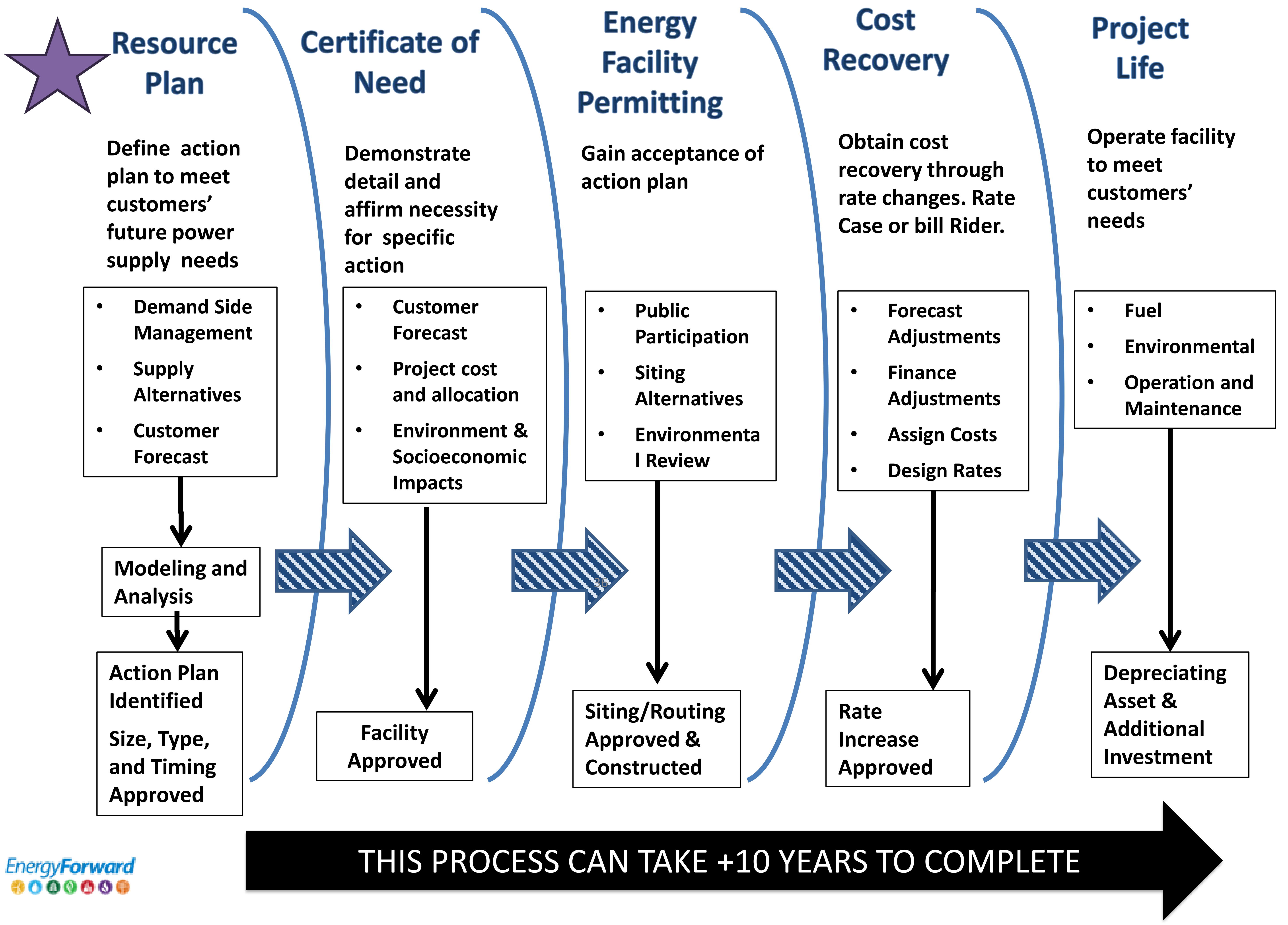
EnergyForward

Resource Acquisition Timeline



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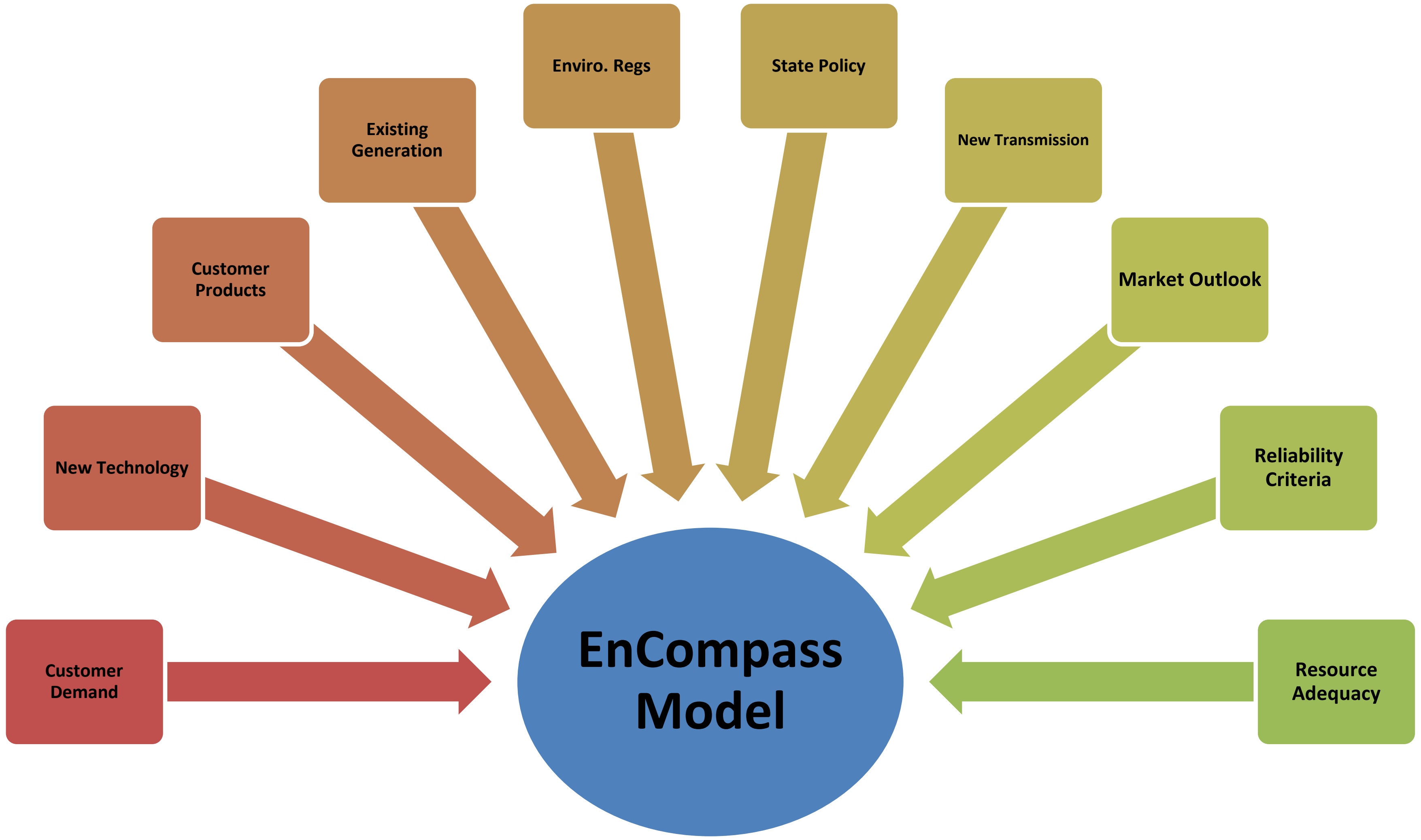
Considerations in Developing a Preferred Plan

- Reliability and System Operations
- Customer Cost
- Sustainability
- State & Federal Policy
- Technology Readiness
- Community/Social Economic Impacts
- Time for Just Transition for Communities Impacted by Energy
- Stakeholder Feedback

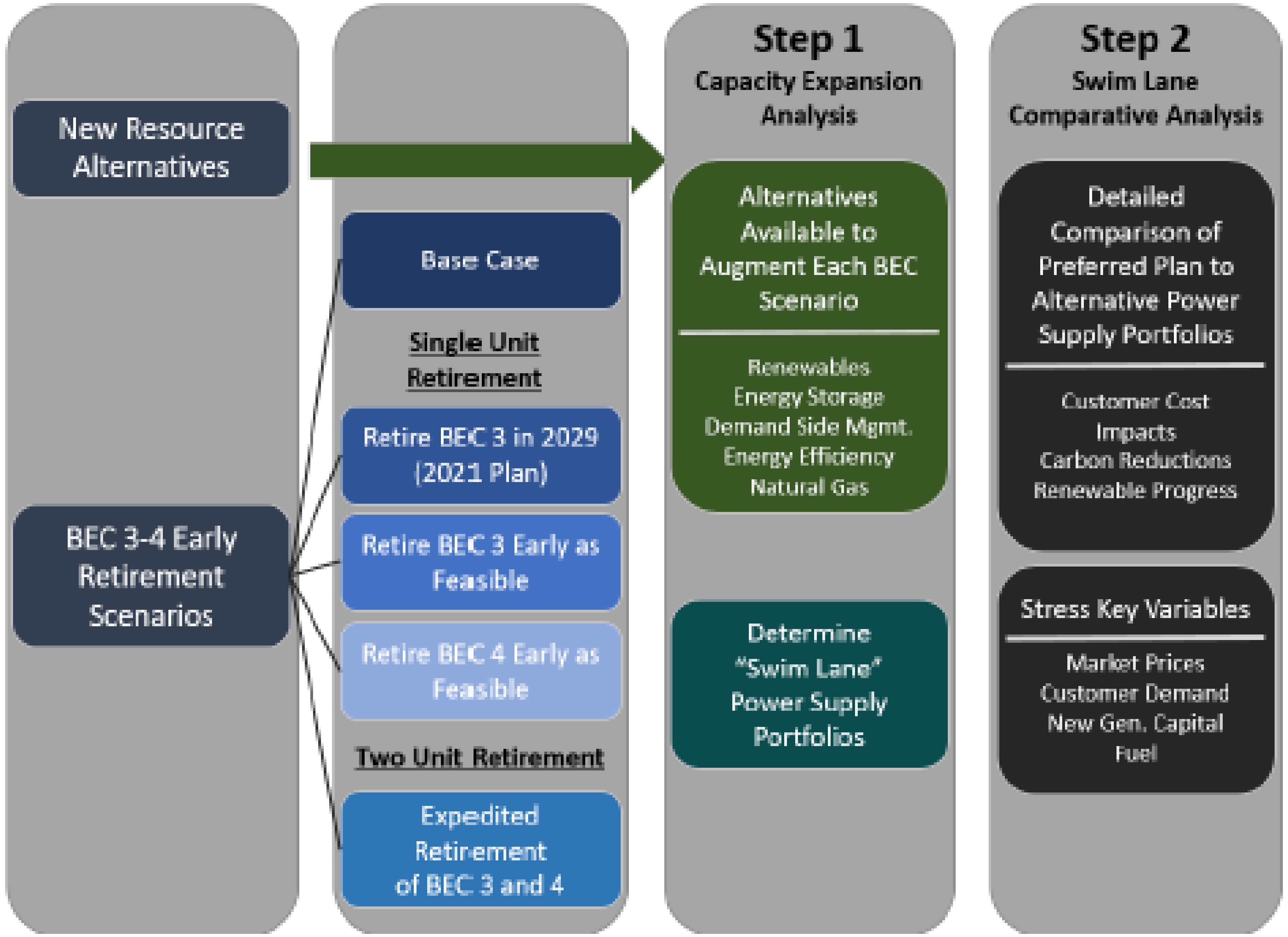
What Goes into Developing an IRP Analysis Plan

1. Develop the Modeling Assumption



2. Develop the Modeling Plan

Figure 8: Plan Development Process



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State & Federal Policy Guides Planning Decisions

- **Solar Energy Standard**
  - 1.5% solar by 2020, 10% of the 1.5% met with systems <40kW
  - 10% goal by 2030
- **Renewable Energy Standard – MP at 50% Renewable Today**
  - 25% by 2025
  - 55% by 2035
- **Carbon Free Standard – MP at 50% Carbon Free Today**
  - 80% by 2030
  - 90% by 2035
  - 100% by 2040
- **Distributed Solar Energy Standard**
  - 3% by 2030
- **CO_2 Environmental Cost Updated to Federal Social Cost of CO_2 (Range: ~$145 to ~$400 short ton)**
- **Carbon Regulation Cost Updated (Range: ~$5 to ~$75 short ton)**
- **Pending EPA regulation for carbon (111b/d) and Ozone Season (Good Neighbor Rule)**
- **Environmental Cost for SO_2, NOX, PM2.5, CO, and PB.**

Minnesota House passes bill requiring carbon-free electricity by 2040

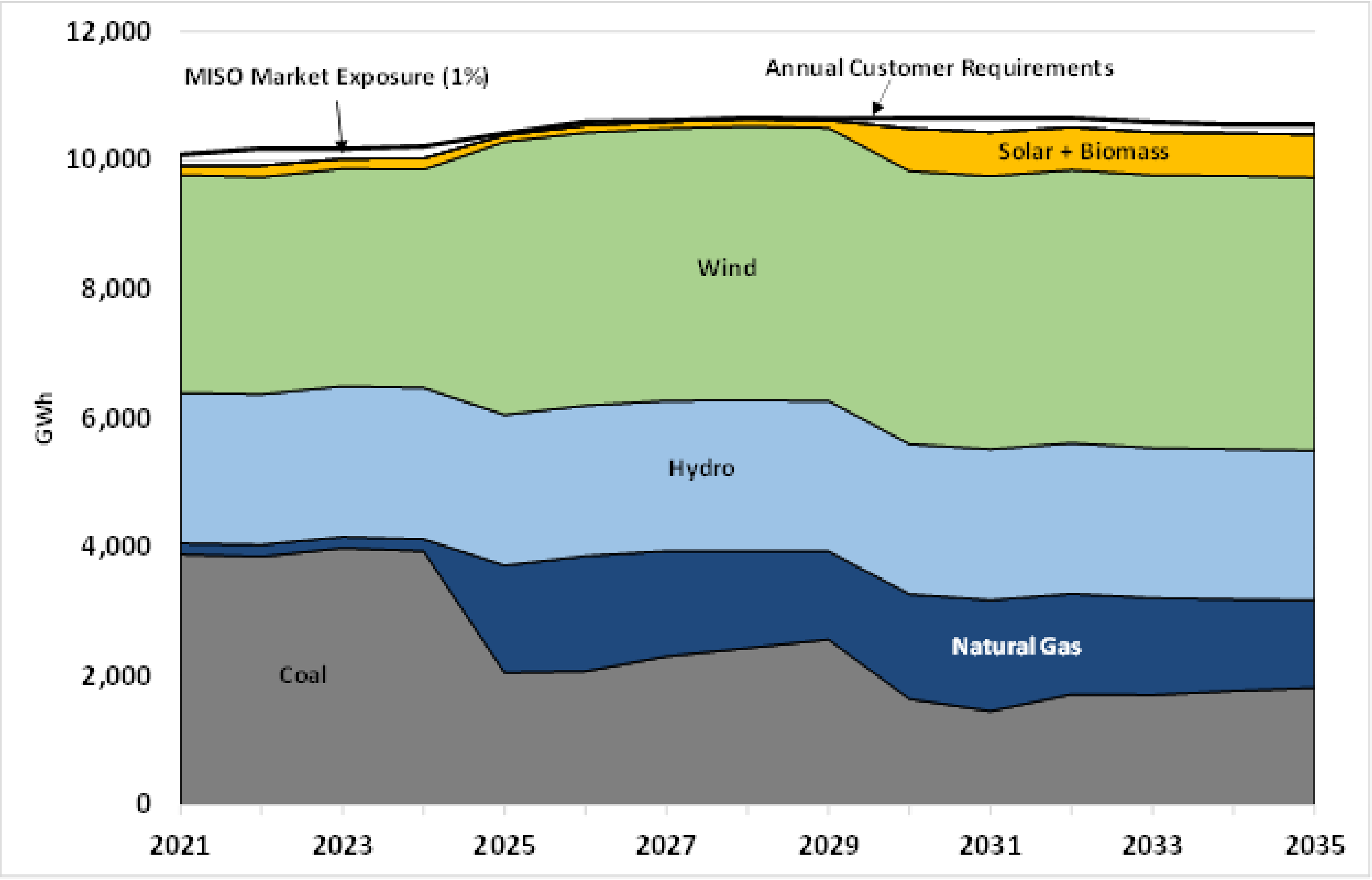
Kirsti Marohn January 27, 2023 5:51 AM

New or Updated State Policy Requirements for 2025 IRP

Planning for Serving Customer Demand

Energy Adequacy: Planning for adequate portfolio of resources that can serve customer needs 7x24 through various operational conditions.

Figure 18: 2021 Plan Energy Position Outlook



Resources Adequacy: Planning for an adequate portfolio of resources to serve expected peak demand reliably.

NEW: MISO Seasonal Resource Adequacy

Planning for seasonal planning reserve requirements and accreditation

Summer: 9% PRM

Fall: 14.2% PRM

Winter: 27.7% PRM

Spring: 26.7% PRM

NEW: Customer Demand Impacts

- Beneficial electrification
- Data Centers
- Greener Industrial Operations
- EV growth
- Distributed Generation

Emerging: Planning For System Characteristics

RELIABILITY CRITERIA CONSIDERATIONS

Traditional Planning
- Reliability: Capacity & Energy
- Sustainability: Carbon & Renewables

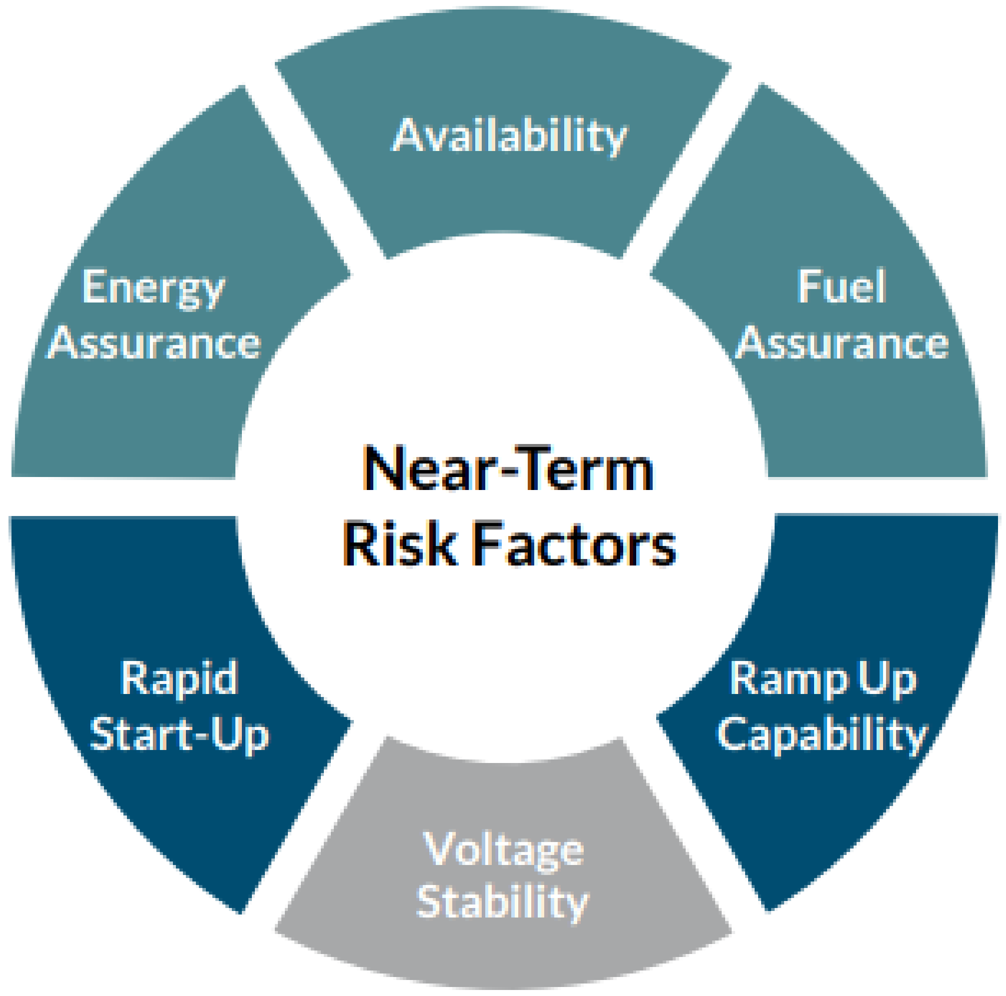
Energy Adequacy
- Fuel Assurance
- Long Duration Energy at High Output

Operational Flexibility
- Ramping
- Rapid Start-up/ Must-Run

Essential Services
- Voltage Stability /Reactive Power
- Inertia/Frequency Response/ Short Circuit Strength

<u>NEW</u> Layers as We Get Deeper in Decarbonization

MISO working on a "Reliability System Attributes" roadmap whitepaper to be published by end of 2023



ALSO….FERC, NERC, EPRI, and other proceedings addressing

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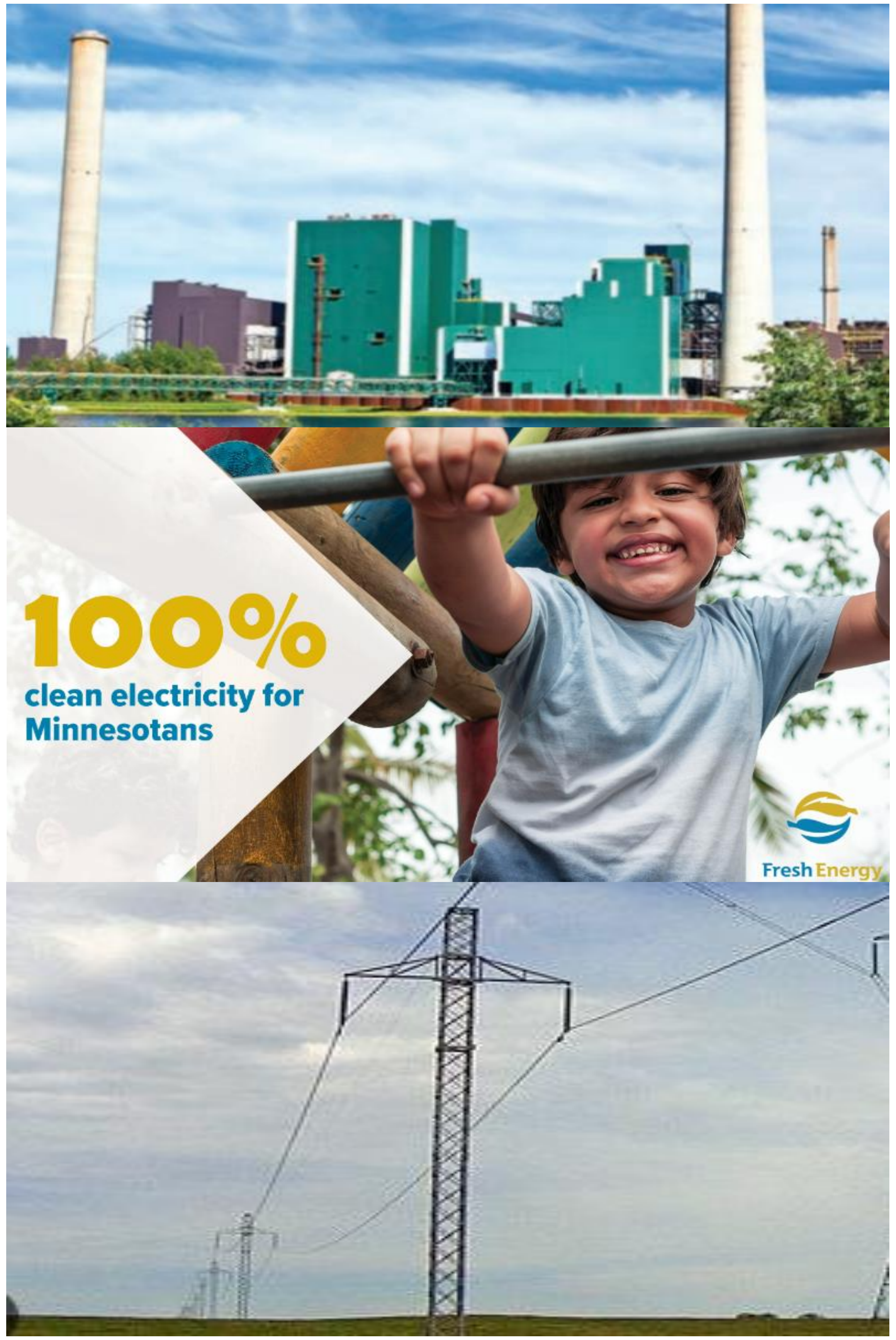
Key Areas of Focus for 2025 IRP

- **Pathways to achieve 100% Carbon Free energy by 2040 while maintaining reliability and keeping rates affordable.**
  - Post BEC 3&4 Coal Operations – Identify replacement for energy, capacity, fuel assurance, operating characteristics, and grid essential services.
  - Baseload retirement study for Hibbard.
  - What carbon-free technologies will be viable, commercially available, and at what cost.

- **Establish and incorporate new reliability criteria into evaluate each alternative to ensure compliance**
  - MISO Reliability Imperative initiative and other reliability research

- **Work with host communities and stakeholders on a just transition and leverage and reinvest in existing MP infrastructure.**

- **Continue ISSP between distribution, transmission, and generation.**



Interested in Informing the Modeling Assumptions for 2025 IRP?

Technical Advisory Group “TAG”

First Meeting – In Person

(Virtual Option Available)

Monday, April 11th
1 pm (CST)
Duluth, MN

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Questions?

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Wrap-up and Next Steps

- Calendar holds were already sent out for the March and April in-person meetings. Please contact GPI if you didn't receive them.
- If you would like to participate in either of the advisory groups (and didn't already indicate on the sign-up form) please contact GPI.
- Slides and notes from today's meeting will be shared on an online database after we've had a change to clean up the notes.
- If there are other organizations that you think should be in the room for these discussions, please let GPI know.

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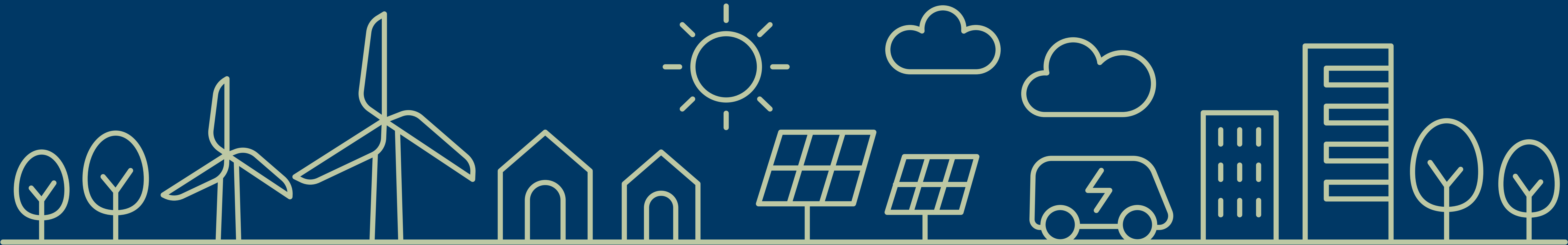
THANK YOU

Please contact Alissa Bemis, abemis@gpisd.net if you have any questions about this engagement process.

Betterenergy.org



Minnesota Power 2025 IRP
Engagement Meeting 1

TUESDAY, MAY 7TH, 2024, 8:30AM–3:30PM

In-person: Hickory Room -Timberlake Lodge – 144 SE 17th Street, Grand Rapids, MN

Purpose Statement

This stakeholder engagement process will play a pivotal role in informing the development of Minnesota Power's 2025 integrated resource plan (IRP). Key issues to discuss include the following:

- **Meeting the ambitious requirement of 100% carbon free energy** by identifying the right resources, understanding their impact on the system, and continuing to offer reliable and affordable energy throughout the clean energy transition.
- **Shaping the energy future in the communities Minnesota Power serves**, including direct impacts on key facilities such as the Boswell Energy Center and the Hibbard Renewable Energy Center.

Minnesota Power is committed to amplifying underrepresented voices and is striving for an inclusive and comprehensive process that reflects the diverse perspectives of our communities.

Meeting Goals

1. Build a shared understanding of the following topics:
   a. The plan and timeline for this engagement process. and how it will inform the 2025 IRP.
   b. What has happened since the 2021 IRP was approved by the PUC.
   c. The regulatory requirements that Minnesota Power must meet when it files the 2025 IRP.
   d. The biggest challenges Minnesota Power foresees in developing this IRP.
   e. Trends and considerations for the Boswell host community, large power, and the regional economy.
2. Through discussion, identify the following:
   a. What has changed since the last IRP
   b. What are the biggest questions that need to be considered and addressed through the 2025 IRP

Agenda

8:30AM	**Welcome, introductions, process overview**
9:00AM	**Presentation: Level-setting for the 2025 IRP**
10:00AM	**Break**
10:30AM	**Presentation and Discussion (continued): Level-setting for the 2025 IRP**
11:15AM	**IEDC Update: What is IEDC doing to support broader economic development in the community?**
11:45AM	**Lunch**
12:30PM	**Panel Discussion: Large Power and Economic Trends**
2:00PM	**Break**
2:15PM	**Small Group Discussions** • What has changed since the last IRP? • What are the biggest challenges/opportunities for this IRP? • (If time allows) what are potential solutions to those challenges?
3:00 PM	**Large Group Discussion** • What is something you learned from a participant at your table? • What questions need to be considered and addressed through the 2025 IRP?
3:20PM	**Wrap-up and next steps**
3:30PM	**ADJOURN**

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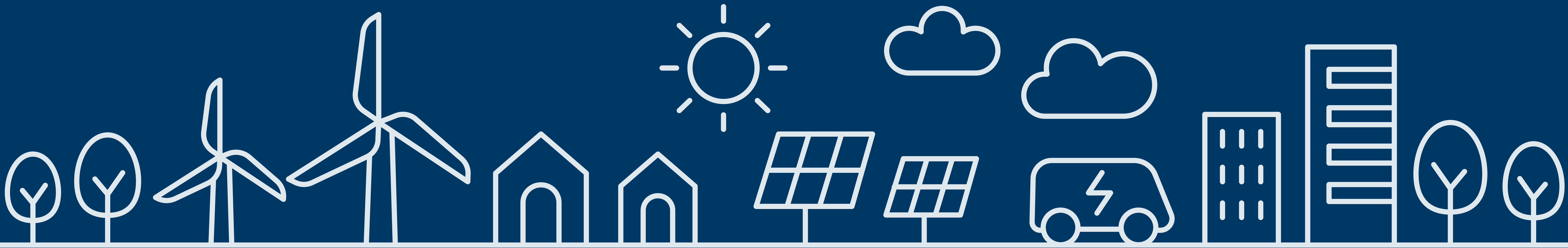
Minnesota Power 2025 Integrated Resource Plan

Engagement Meeting #1

May 7, 2024

Grand Rapids, MN



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2:15pm:	Small Group Discussions
3:00pm:	Large Group Discussion
3:20pm:	Wrap-up and Next Steps
3:30pm:	Adjourn

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TAG and SAG

Technical Advisory Group (TAG):

This group will inform the IRP modeling assumptions and discuss other IRP technical issues.

Societal Advisory Group (SAG):

This group will review and revise the Issue Map from the 2021 IRP process so that it can be used as a societal cost benefit analysis for any MP generation facility.

Engagement Meetings:

Today! Participants from both advisory groups, as well as participants not involved in either group. These meetings will help inform the 2025 IRP.

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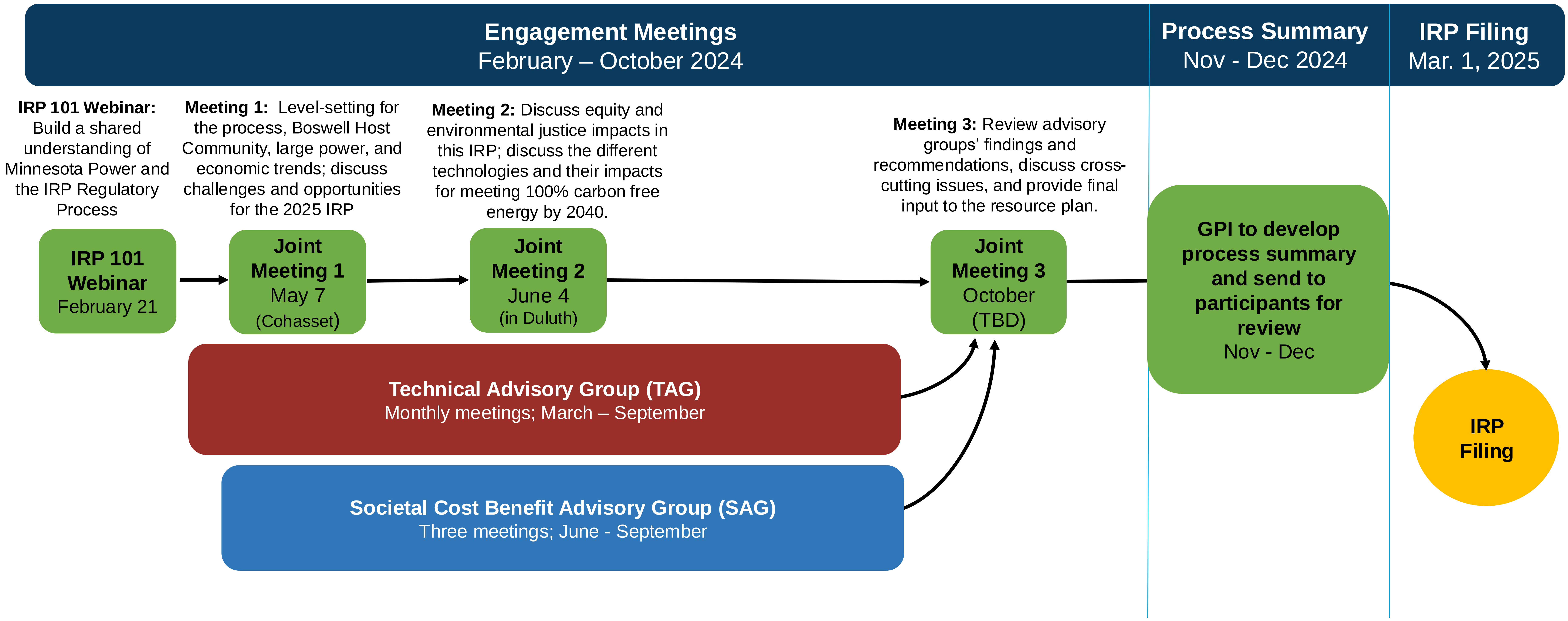
MINNESOTA POWER 2025 IRP—ENGAGEMENT MEETING TIMELINE

NOTE: Dates and topics are subject to change to meet the group's needs.



Ground Rules for Participation

- Respect the time. Your time together is limited and valuable, so please be mindful of the time and of others' opportunity to participate.
- Respect each other. Help us all to uphold respect for each other's experiences and opinions, even in difficult conversations. We need everyone's wisdom for the greatest results.
- Have fun! This is a unique opportunity to develop relationships with and see the humanity in people who may not share your same worldview. While discussing serious and contentious issues, let's all remember to have some fun and humor while maintaining respect.

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Questions?

GREAT PLAINS INSTITUTE

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Welcome to the Stakeholder Engagement Process for MP's 2025 IRP!

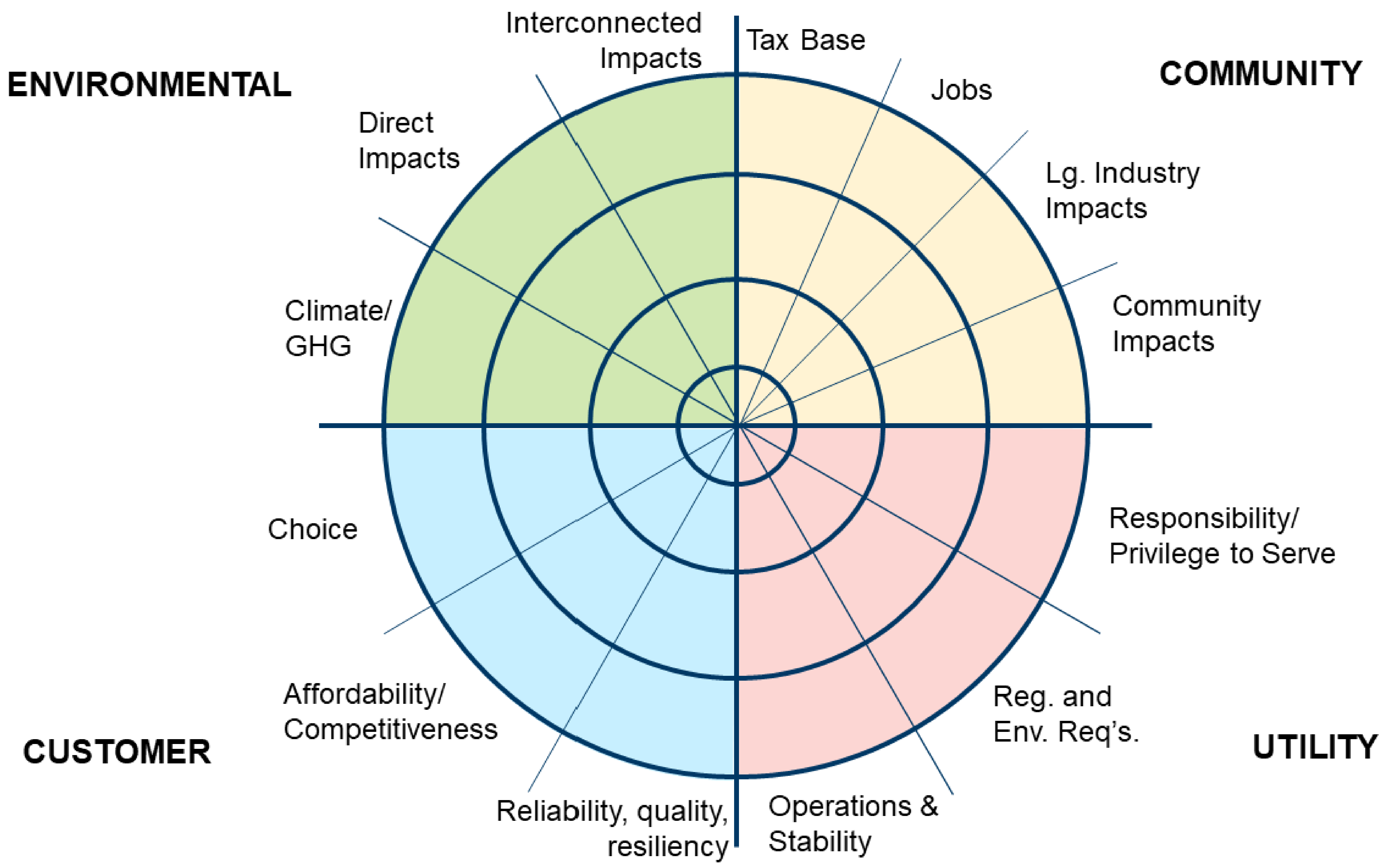
Jennifer Cady – Vice President of Regulatory and Legislative Affairs
Julie Pierce – Vice President of Strategy and Planning
Eric Palmer – Manager of Utility Planning


THANKS
FOR BEING
HERE

We are Committed To:

- Listening.
- Sharing information and our perspectives on things like technology options, aspects of different power supply scenarios (carbon reduction, reliability, cost), impact emerging rules and regulations and more.
- Being open to new or different perspectives and insights.
- Working collaboratively to try and solve complex problems together.
- Doing our best to support our customers, communities and the climate.

Issue Map (from 2021 IRP process)



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Joint Agreement

MINNESOTA POWER'S 2021 INTEGRATED RESOURCE PLAN

Who?

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- **Energy Storage Demonstration Projects**
- **Prioritize Reinvestments in Northern Minnesota, Leverage Partnerships with Communities and Organized Labor**

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MP Actions Since Last IRP Order Issued in Jan 2023

- **2023 Legislative Session & MPUC Implementation Proceedings**
  - 100% by 2040 Carbon Free Standard & Distributed Solar Energy Standard
- **New Resource Additions Underway**
  - RFP Issued for 300 MW of New Solar Energy
    - Oct 2023 RFP Noticed to MPUC; RFP Issued; Jan 2024 Bids Due; Currently Under Evaluation
  - RFP Issued for 400 MW of New Wind Energy
    - Dec 2023 RFP Noticed to MPUC; Feb 2024 RFP Issued; April 2024 Bids Due; Under Evaluation
  - New Energy Storage Proposals in Integrated Distribution Plan (Docket # 23-258)
    - 1 MW (3MWH) Kerrick Area Battery Energy Storage System (BESS) Reliability Backup Pilot Project (Distribution Level Non-Wires Alternative Project)
    - MP is in the Investigatory Phase of a Grid Scale BESS Pilot at Boswell Energy Center
- **New Transmission Projects Underway**
  - August 2023 Northland Reliability Project Route Permit/CON Submitted
  - June 2023 HVDC Modernization Project Route Permit/CON Submitted
- **Continued Energy Conservation Success**
  - In 2023, MP Exceeded MN's Energy Savings Goal for the 14^{th} Year
  - MP Achieved Energy Savings of 2.8% (State Goal is 1.5%)

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WHAT'S
NEXT ?

WE ARE UNIQUE

Duluth, MN	Headquarters
26,000	Square-miles
150,000	Customers
12%	Residential sales
66%	Mining and Forestry
14	Minnesota Municipalities
14 years	Met or exceeded the MN energy savings goal
1st	To Deliver 50% Renewable Energy to Customers

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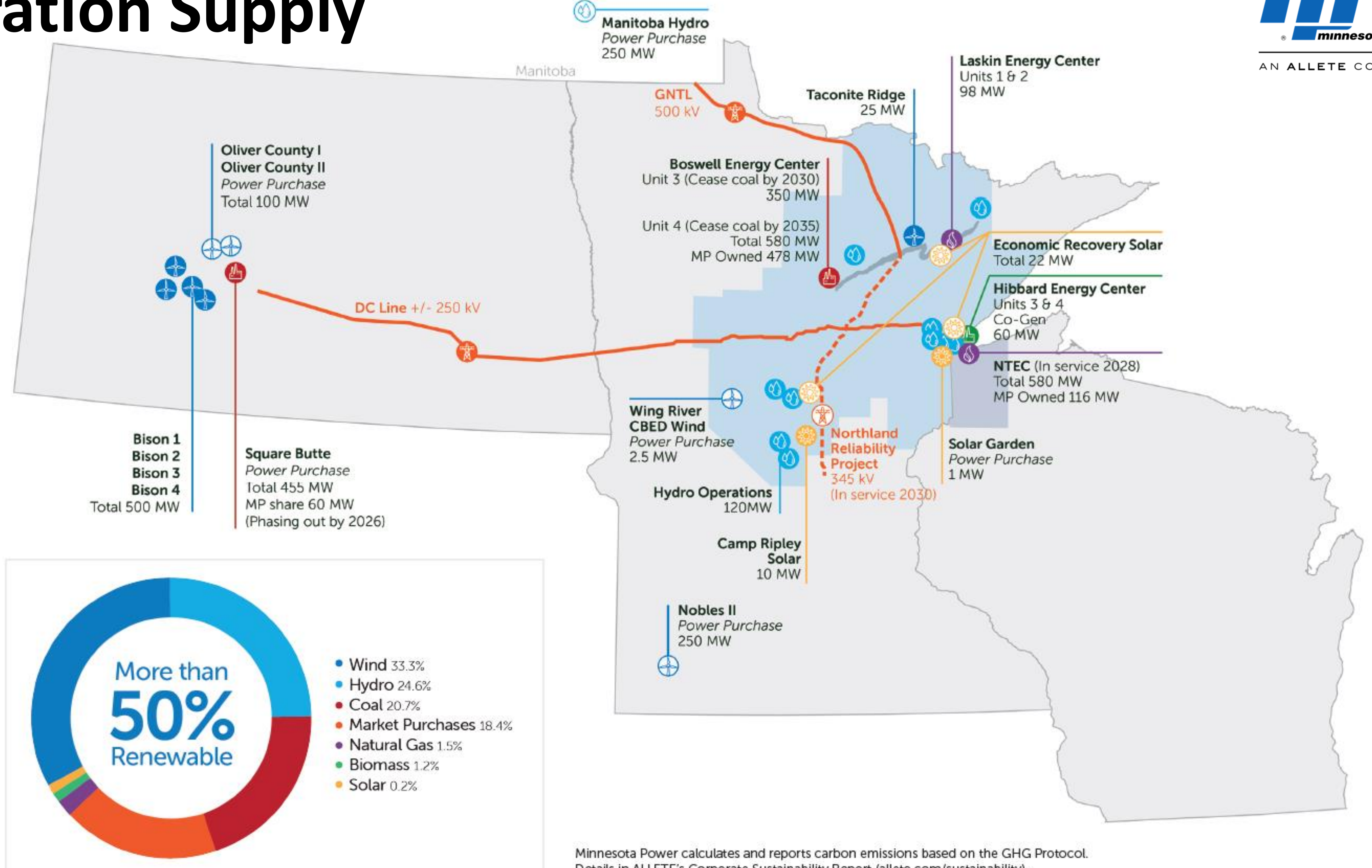
Generation Supply



Minnesota Power calculates and reports carbon emissions based on the GHG Protocol.
Details in ALLETE's Corporate Sustainability Report (allete.com/sustainability).

State of Minnesota Power's System

RENEWABLES

Preparing to integrate 700 MW of renewable generation

Strategically manage the hydro system and key Manitoba Hydro contracts

DISPATCHABLE

In transformation of 1000 MW and 3.5 million MWh of dispatchable generation as we evaluate ceasing coal operations and end-of-life considerations

TRANSMISSION / DISTRIBUTION

Modernizing and building +650 miles of high-voltage transmission to strengthen system and deliver renewable energy

Distribution asset renewal and Strategic Undergrounding

CUSTOMERS

Changes to load growth and electrification outlooks

Need expansion of demand response products for additional energy access

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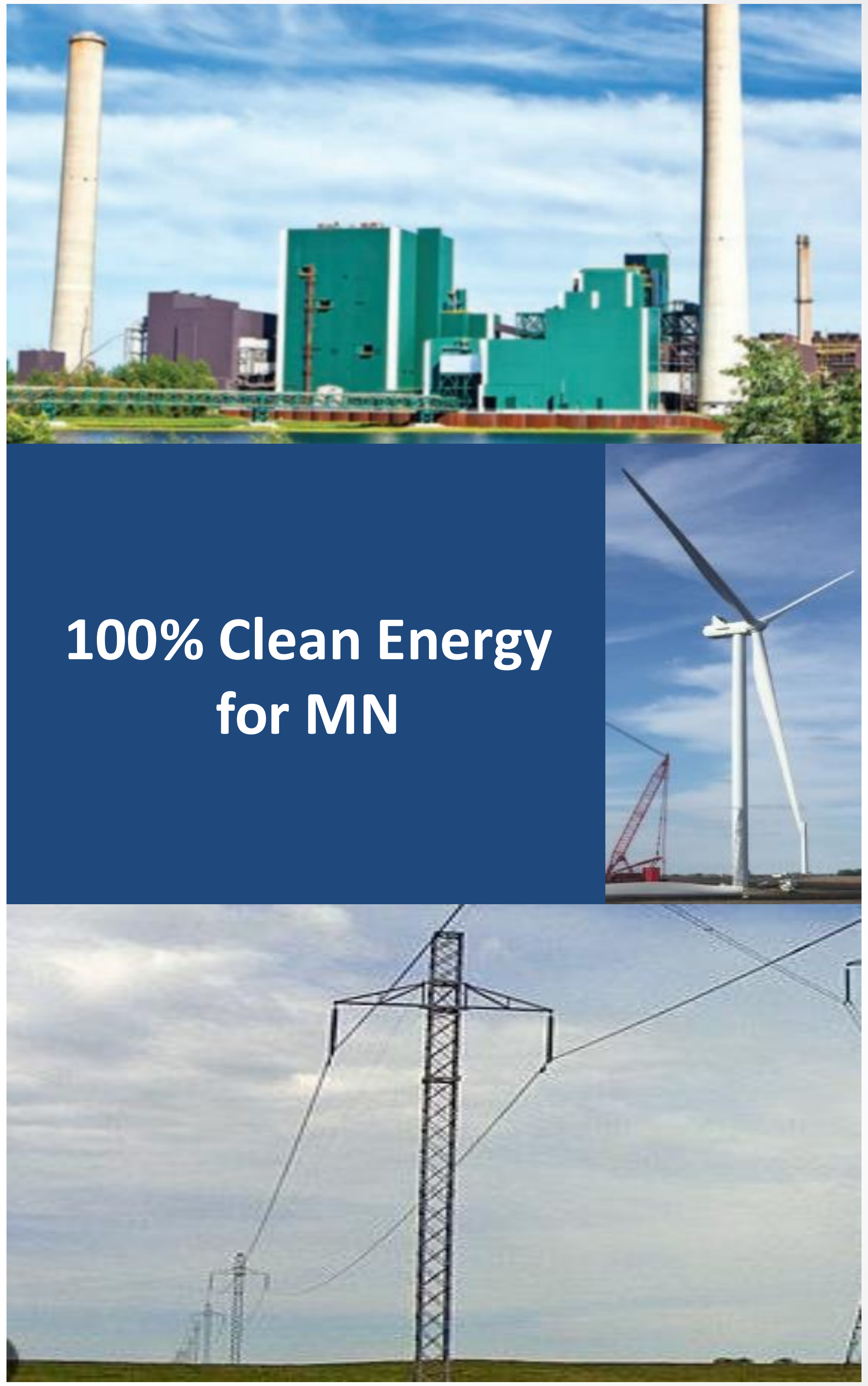
Focus Areas for 2025 IRP

- **Pathways to achieve 100% Carbon Free energy by 2040 while maintaining reliability and keeping rates affordable.**
  - Ceasing BEC 3&4 Coal Operations – Identify refuel alternatives available.
  - Identify needed replacement for energy, capacity, fuel assurance, operating characteristics, and grid essential services.
  - What carbon-free technologies will be viable, commercially available, and at what cost.
  - Baseload retirement study for Hibbard.

- **Establish and incorporate new reliability criteria into evaluate each alternative to ensure compliance.**

- **Work with host communities and stakeholders on a just transition and leverage and reinvest in existing MP infrastructure.**

- **Continue integrated planning between distribution, transmission, and generation.**



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State & Federal Policy – What's New?

- **Solar Energy Standard**
  - 1.5% solar by 2020, 10% of the 1.5% met with systems <40kW
  - 10% goal by 2030
- **Renewable Energy Standard – MP at 50% Renewable Today**
  - 25% by 2025
  - 55% by 2035
- **Carbon Free Standard – MP at 50% Carbon Free Today**
  - 80% by 2030
  - 90% by 2035
  - 100% by 2040
- **Distributed Solar Energy Standard**
  - 3% by 2030
- **CO_2 Environmental Cost Updated to Federal Social Cost of CO_2 (Range: ~$145 to ~$400 short ton)**
- **Carbon Regulation Cost Updated (Range: ~$5 to ~$75 short ton)**
- **EPA regulation for carbon (111b/d) and Ozone Season (Good Neighbor Rule)**
- **Environmental Cost for SO_2, NOX, PM2.5, CO, and PB.**

Minnesota House passes bill requiring carbon-free electricity by 2040

Kirsti Marohn January 27, 2023 5:51 AM

New or Updated State Policy Requirements for 2025 IRP

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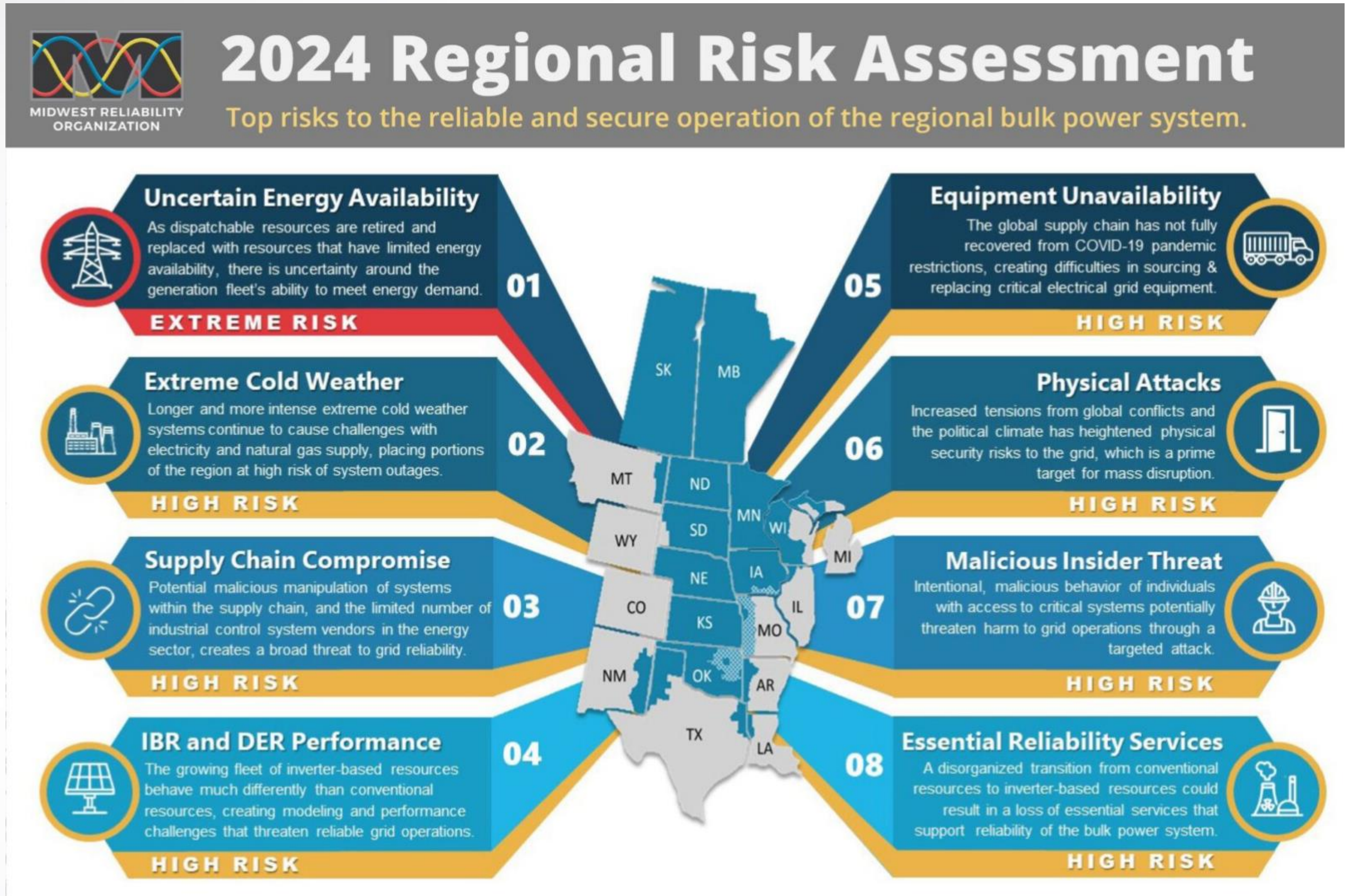
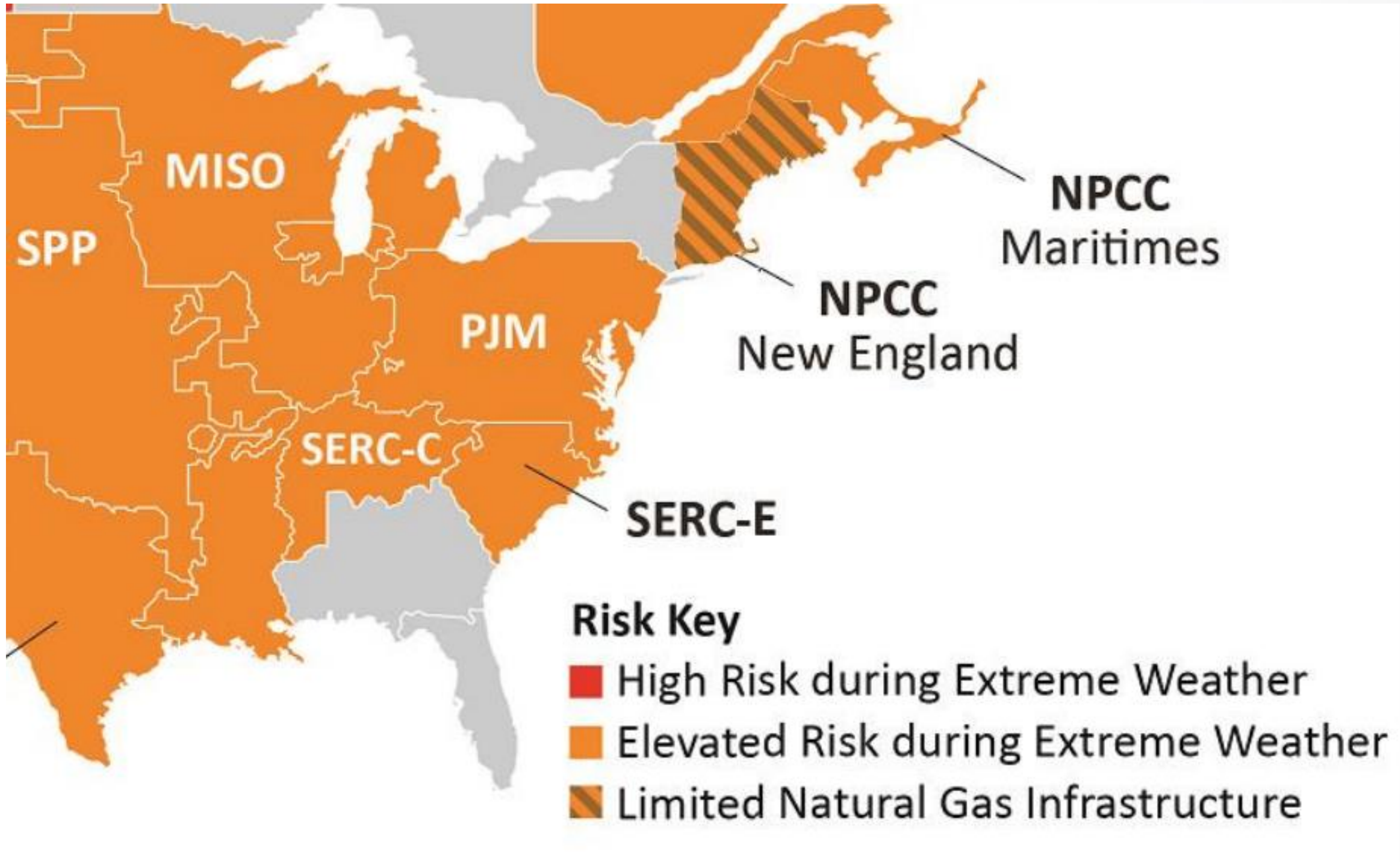
Reliability: A Core Issue Facing Today's System



NERC Winter Reliability Assessment:



MISO 2023 OMS Survey:

Committed Capacity shows declines over survey window with potential resource deficits starting in PY 2025/26

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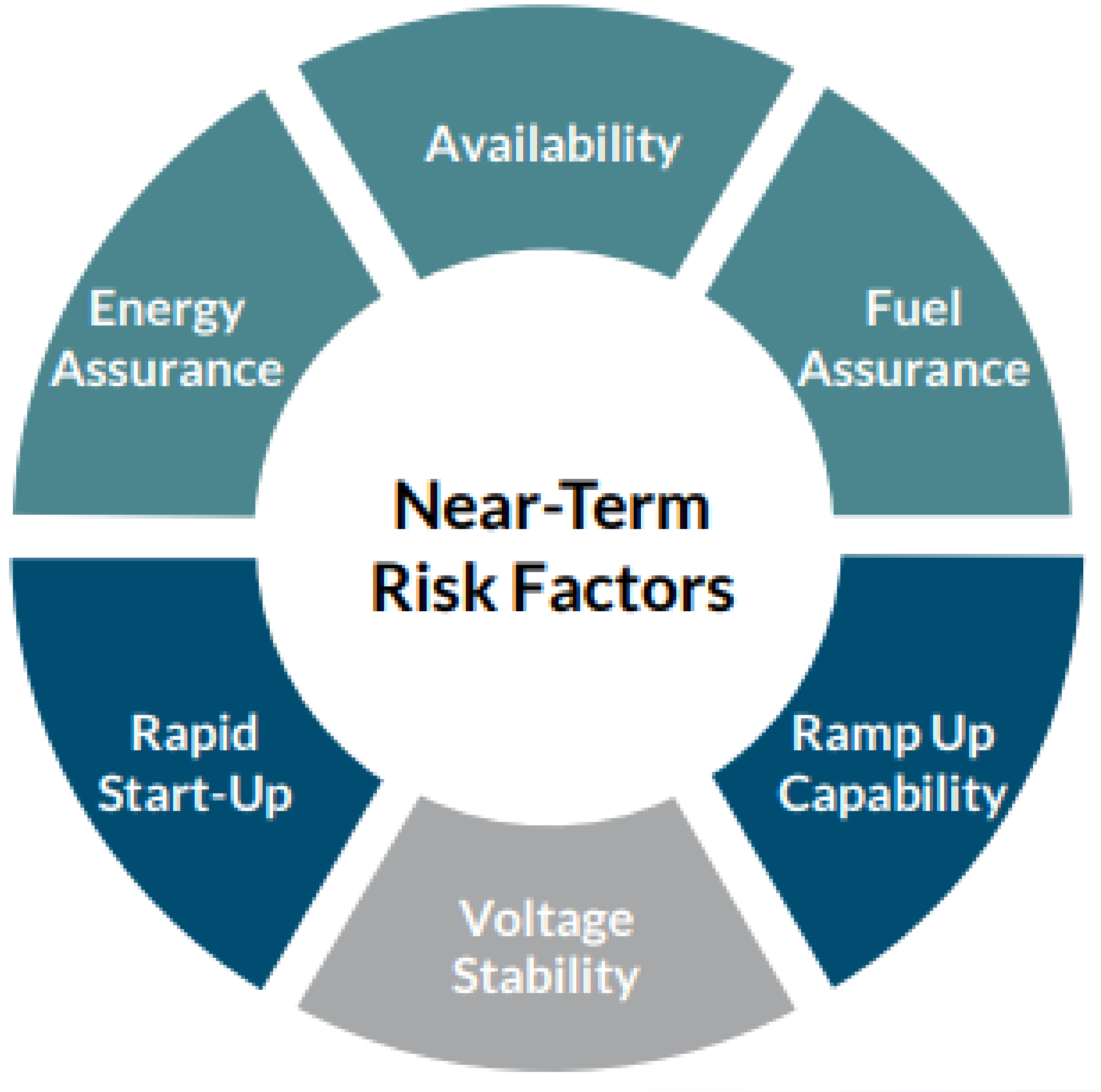
Expanded Planning Criteria Needed for Grid of the Future

RELIABILITY CRITERIA

- Traditional Planning
- Energy Adequacy
- Operational Flexibility
- Essential Grid Services

National and Regional entities working on a "Reliability System Attributes"



Source: MISO Reliability Imperative

2025 Integrated Resource Plan is Due March 1, 2025

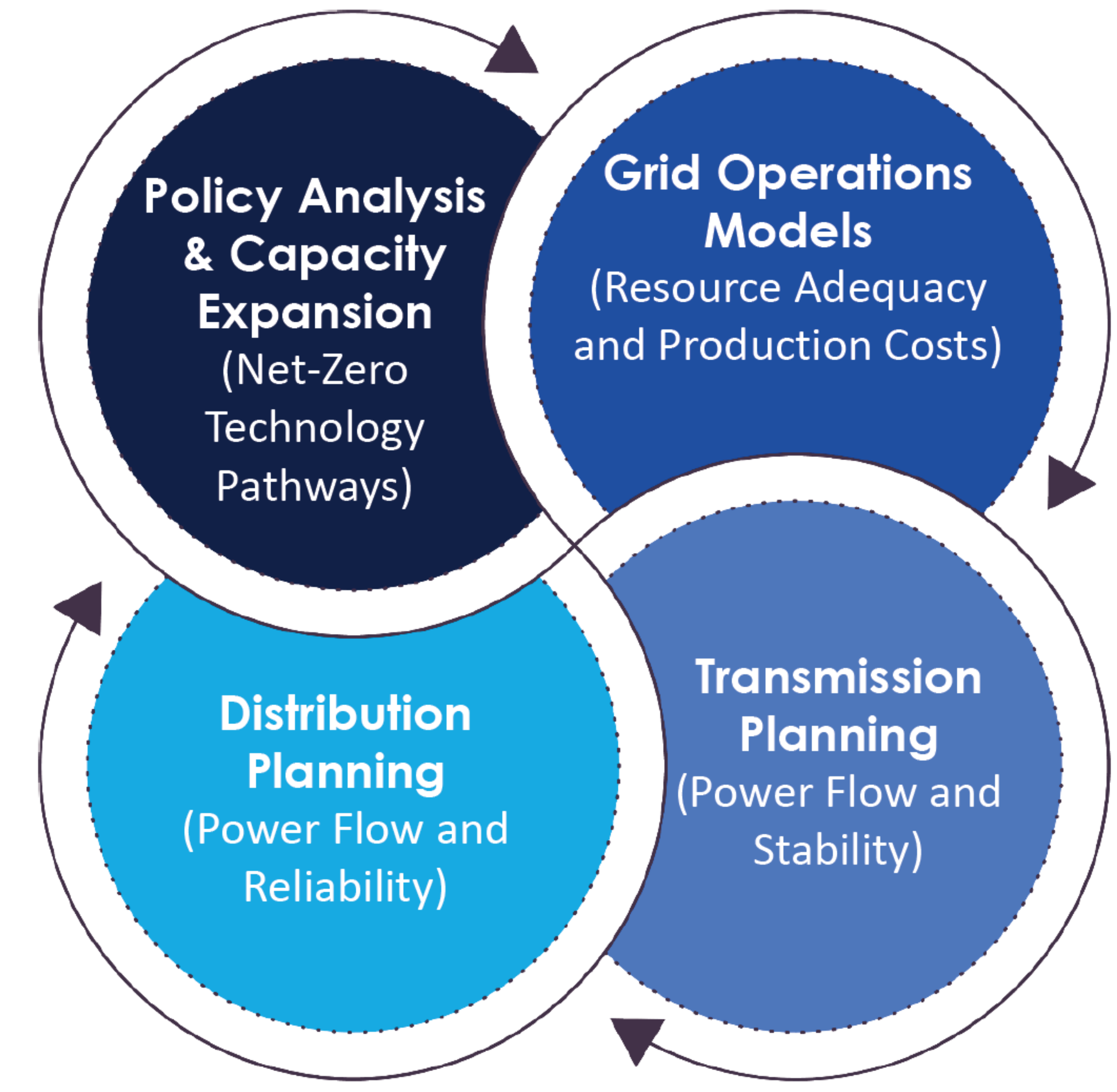
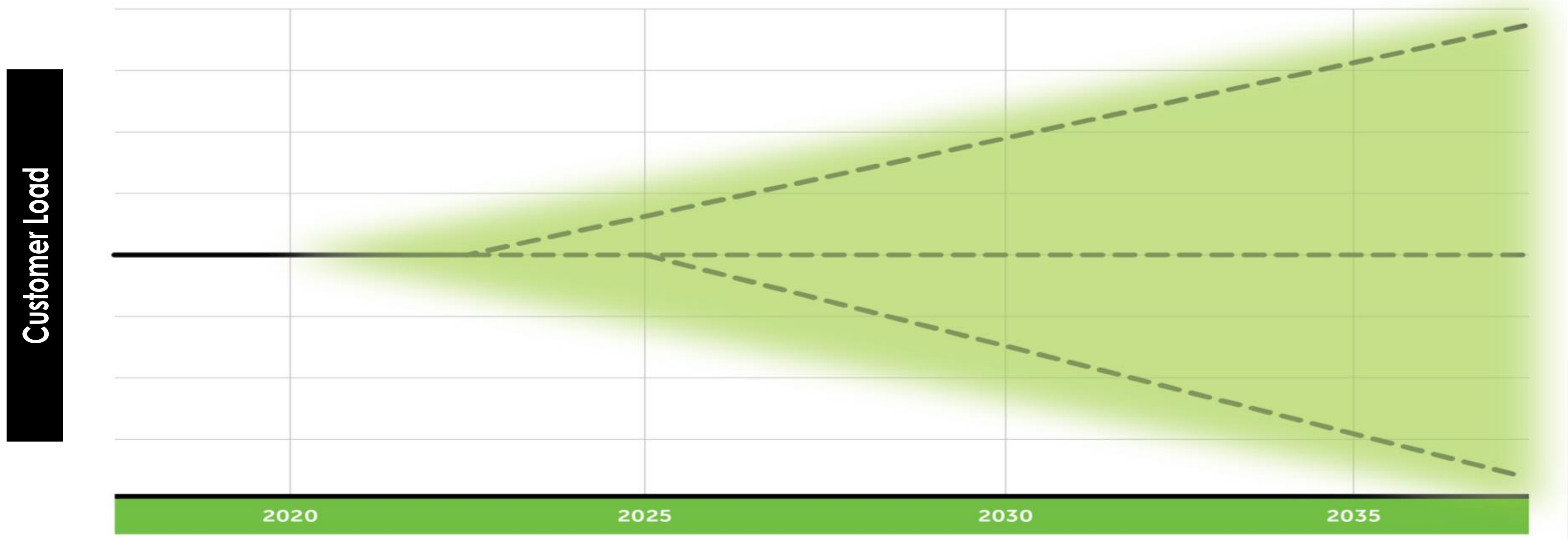


FIGURE SOURCE: EPRI



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Thank
you

Break

Please return at 10:35am

What brought you here?

What did you find most surprising?

What's your biggest question?

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A Just Transition

Community Investment

for the

Future Sustainable Energy Shift

Overview

Just Transition Fund Grant

Just Transition Facilitation, Steering Committee, and Taskforce

Just Transition Outreach & Engagement

Just Transition Timeline

Questions

Just Transition Fund Grant

$150,000 Awarded

Convene a year-long just transition process for Itasca County, and for the greater northern Minnesota region.

Develop an action plan to ensure a thriving economy, supported by an informed community, as we work through our energy transition.

The action plan will include a community-driven just transition vision and series of recommended pathways or actions that will allow the region to collaboratively identify and pursue federal funding and other resources in alignment with its vision.

Just Transition: Facilitation, Steering Committee, and Taskforce

FACILITATION

- IEDC, applicant and administrator
- Northspan, facilitation and organization
- Great Plains Institute (GPI), facilitator and industry expert
- Century on Energy and Environment (CEE), facilitator and industry expert

STEERING COMMITTEE

- Itasca County
- City of Cohasset
- MN Power, ALLETE
- Leech Lake Band of Ojibwe
- Iron Range Resources & Rehabilitation
- Itasca Economic Development Corp.

TASKFORCE

- Steering Committee
- 20-25 Individuals
- Diverse cross section of participants

Task Force


Education
Industry
Private Sector
State & Local Government
Tribal Nations
Childcare
Economic Dev.
Community Dev.
Utilities
Entrepreneur
Forest Products
Expert Consultants
Labor
Community Members
Non-Profit
Student

Steering Committee

What innovative, substantial actions, could we take to move us toward a just transition?

COMMUNITY INVESTMENT FOR THE FUTURE SUSTAINABLE ENERGY SHIFT

JUST TRANSITION ACTION PRIORITIES

Steering Committee | 08.23.23

What innovative, substantial actions could we take to move us toward a just transition?

RATIONAL AIM
Enable the group to create clearly focused yet innovative and empowering strategies that set the course.

EXPERIENTIAL AIM
Generate excitement about collaboration within the group and new commitment to practical possibilities.

Storytelling	Welcoming	Growing	Innovating	Facilitating
• Communication and messaging • Collective lobbying • Innovative outreach and community strategy • Develop collective partnership across communities • Communicate to your audiences, they may look different • Better framing of issue of the problem in context or rural versus urban, example: losing X jobs = this % of kids in school in rural versus urban • Better frame and context the rural impact story compared to urban • More shared community updates • Collaborative economic development • Shared understanding of the global issue • Build political will across city and county lines • Trust = Consistency & Transparency	• Engage and welcome growing populations and businesses • Engage in more welcoming efforts • Invest to become a cultural hot spot and vibrant community • Invest in destination type entrepreneurship, "marketplace" • Tioga 2, 3, 4, and 5!	• Site readiness for businesses and homes • Amplify and help to move forward Cohasset's top 3 tax impact priorities • Targeted industry recruiting • Cohasset (coal host) has site(s) ready now! Shovel ready! • Investment across the board, housing, spec buildings, industrial park • Cannibas center point of MN	• Add 4th T, technology • Innovator hubs • Broadband	• Grant writing and reporting support • Communicate to funders they should increase priority to coal impacted host communities

"Success is 20% skills and 80% strategy. You might know how to succeed, but more importantly, what's your plan to succeed?"

Jim Rohn

Outreach & Engagement

STEERING COMMITTEE

- 5 Steering Committee Meetings
- 5 Taskforce Meetings
- Oct 2023 – Dec 2024
- Attend Town Halls
- Attend Summit in November

TASKFORCE

- 5 in person meetings
- 3 hours each
- Feb – Nov
- Attend Summit in November

COMMUNITY TOWNHALL

- May Series – 6 Townhalls
- Oct Series – 6 Townhalls
- Community Surveys

Timeline 2024

Jan – Apr
Learn about Energy Transition, Challenges and Opportunities

May – Aug
Creating our action plan through facilitated workshop sessions.
1st Community Townhall Series

Sept – Oct
Draft Action Plan/Report
2nd Community Townhall Series

Nov.
Work on finalizing plan and present draft at Summit.

Dec 2024 – 2025+
Develop Project Plans, Committees, Grant Writing, etc.

Learning | Creating | Drafting | Feedback & Finalize | Action Plan

Task Force completed two meetings learning about the impacts to the community, other communities going through transition, and local, state and federal opportunities.

Energy Transition Town Halls

“What does Energy Transition mean to you?”

- Task Force & Steering Committee Members
- Community Helpful Host
- Resources in person and online
- Door Prizes
- Food Served
- Childcare Provided (evening events only)
- 6 Community Meetings in the Spring/Summer & 6 in the Fall
- Surveys

Summit 2024

- November 20 & 21, 2024
- Energy Transition Track
- Strategic Business & Community Development

Always Ready

Questions?

Tamara Lowney, IEDC, tlowney@itascadv.org, 218-242-0572

Elissa Hansen, Northspan, ehansen@northspan.org, 218-481-7737

Lunch Break

Please return at 12:45pm

Panel Discussion: Large Power and Economic Trends

- Julie Lucas, Mining Minnesota
- Rachel Johnson, APEX
- Rick Horton, Minnesota Forest Industries
- Chrissy Bartovich, U.S. Steel

Break

Please return at 2:15pm

Small Group Discussions

Small Group Discussion

2:15–3:00pm

- Please move to the table number that matches the number on your nametag
- Focusing on the **customer** and **community** portions of the Issue Map, consider and discuss the following questions:
  - What has changed since the last IRP?
  - What are the biggest challenges and opportunities?
  - What are some solutions to specific challenges?

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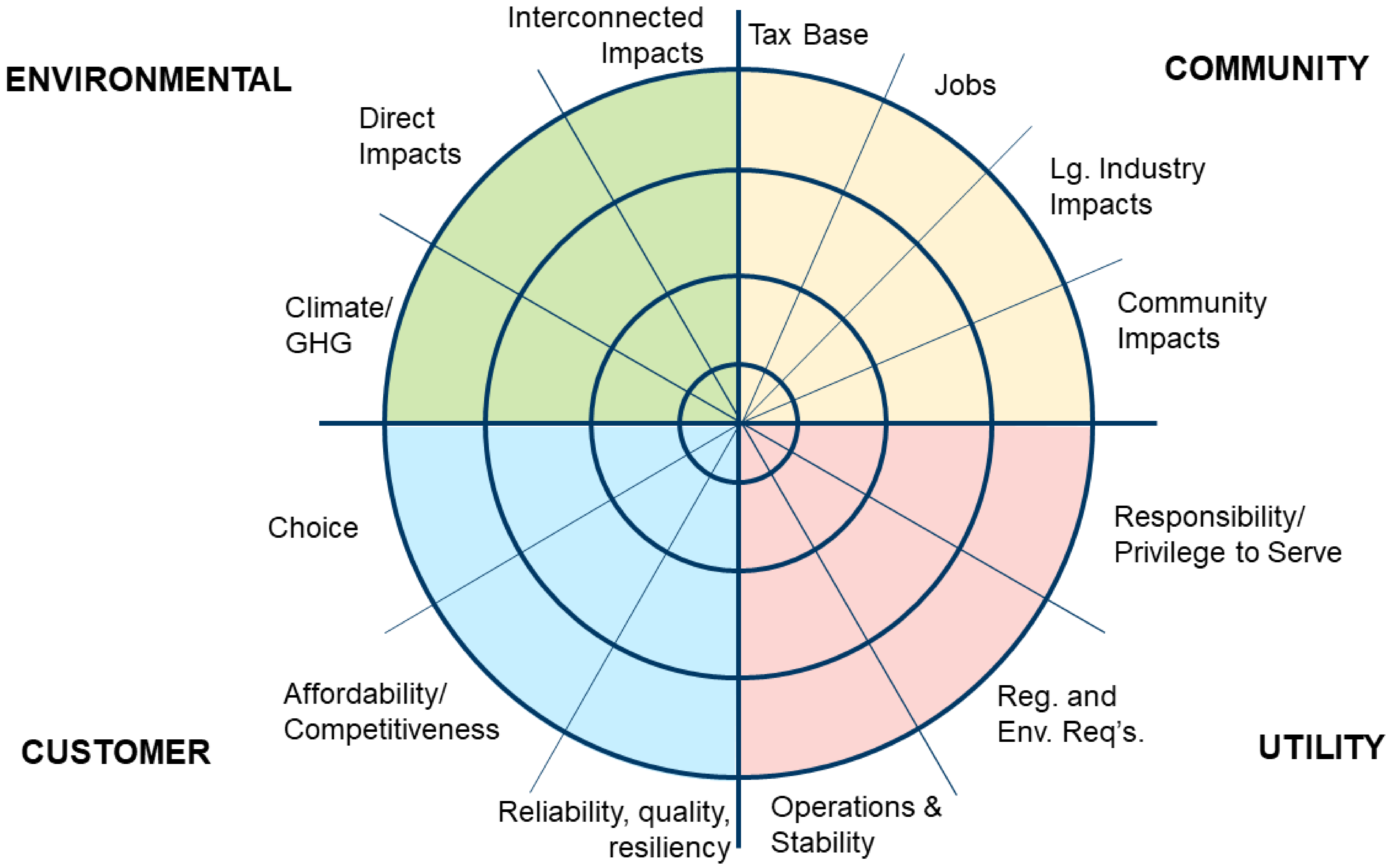
Issue Map (from 2021 IRP process)



Large Group Discussion

- What is something you learned from a participant at your table?
- What questions need to be considered and addressed through the 2025 IRP process?

Wrap-Up and Next Steps

- Materials from today's meeting will be shared.
- Upcoming meetings:
  - TAG (virtual): Monday, May 20, 1:00pm-4:00pm
  - SAG (in-person in Duluth, with virtual option): Monday, June 3, 11:30am-2:00pm
  - Engagement Meeting #2 (in-person in Duluth): Tuesday, June 4, 8:30am – 3:30pm
    - Optional activities on June 3:
      - 2:30pm Tour of Thompson Hydro Station
      - 4:30pm Happy Hour
- Questions and additional feedback can be sent to Alissa (abemis@gpisd.net).

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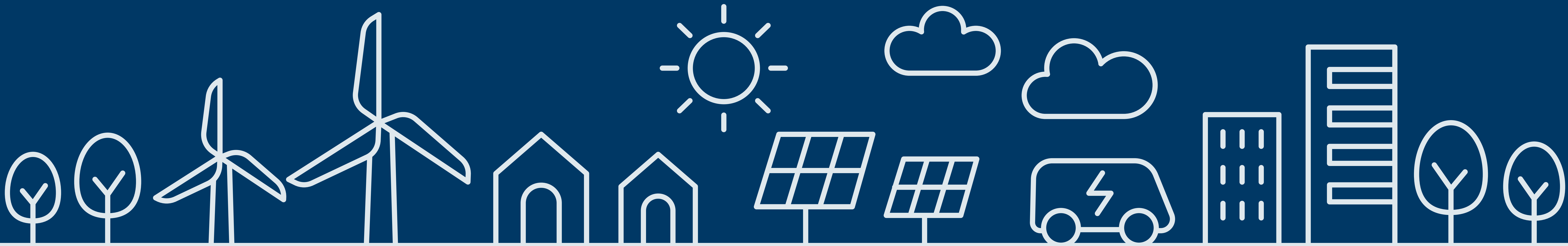
Thank you!



Minnesota Power 2025 IRP:

Engagement Meeting 2

TUESDAY, JUNE 4TH, 2024, 8:30AM-3:30PM

In-person: Allete – 30 W Superior St, Duluth, MN

Purpose Statement

This stakeholder engagement process will play a pivotal role in informing the development of Minnesota Power's 2025 integrated resource plan (IRP). Key issues to discuss include the following:

- **Meeting the ambitious requirement of 100% carbon free energy** by identifying the right resources, understanding their impact on the system, and continuing to offer reliable and affordable energy throughout the clean energy transition.
- **Shaping the energy future in the communities Minnesota Power serves**, including direct impacts on key facilities such as the Boswell Energy Center and the Hibbard Renewable Energy Center.

Minnesota Power is committed to amplifying underrepresented voices and is striving for an inclusive and comprehensive process that reflects the diverse perspectives of our communities.

Pre-Reads

1. MP IRP 101 Video

Meeting Goals

1. Build a shared understanding of different technologies and their impacts on reliability and meeting 100% carbon free energy by 2040.
2. Build a shared understanding of equity and environmental justice implications/impacts in this IRP.
3. Build a shared understanding of the perspectives of Tribal Nations in Minnesota Power's service territory.
4. Based on the key takeaways from today's presentations, discuss with participants what implications they have for the IRP.

Agenda

8:30AM	**Coffee, network, & find assigned seats**
9:00AM	**Welcome and introductions**
9:15AM	**Todd Gorgian (EPRI) Presentation: Report on Emerging Technology**

10:15AM	**Break**
10:30AM	**MP Presentation: Level Setting on Technologies, Reliability, Meeting 100% Carbon Free Energy by 2040**
11:15AM	**Small Group Discussions: Technology**
12:00PM	**Lunch**
12:45PM	**MP Presentation: Equity and Environmental Justice**
1:15PM	**Angie McKinley & Charley Bruce (Minnesota Public Utilities Commission) Presentation: The Commission's Engagement with Tribal Nations**
2:30PM	**Break**
2:45PM	**Small Group Discussions: Equity & Environmental Justice**
3:15PM	**Large Group Discussion: Final Thoughts**
3:25PM	**Wrap-up and Next Steps**
3:30PM	**ADJOURN**

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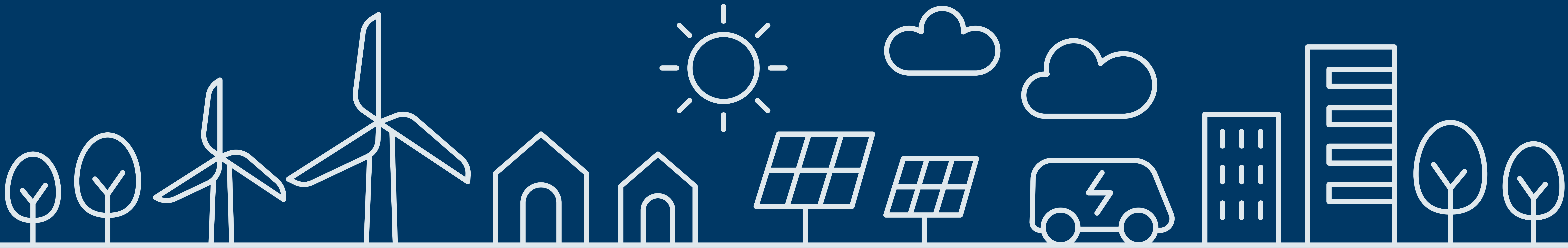
Minnesota Power 2025 Integrated Resource Plan

Engagement Meeting #2

June 4, 2024

Duluth, MN



Agenda

9:00am	Welcome & Introductions
9:15am	Presentation: Emerging Technology (Todd Gorgian, EPRI)
10:15am	Break
10:30am	Presentation: Level Setting on Technologies (Minnesota Power)
11:15am	Small Group Discussions: Technology
12:00pm	Lunch
12:45pm	Presentation: Equity and Environmental Justice (Minnesota Power)
1:15pm	Presentation: PUC Engagement with Tribal Nations (Angie McKinley & Charley Bruce, PUC)
2:30pm	Break
2:45pm	Small Group Discussions: Equity & Environmental Justice
3:15pm	Large Group Discussion: Final Thoughts
3:25pm	Wrap-up & Next Steps
3:30pm:	Adjourn

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Goals for today

1. Build a shared understanding of different technologies and their impacts on reliability and meeting 100% carbon free energy by 2040.
2. Build a shared understanding of equity and environmental justice implications/impacts in this IRP.
3. Build a shared understanding of how MPUC engages with Tribal Nations and the role that Tribal Nations play in IRP processes.
4. Based on the key takeaways from today's presentations, discuss with participants what implications they have for the IRP.

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TAG and SAG

Technical Advisory Group (TAG):

This group will inform the IRP modeling assumptions and discuss other IRP technical issues.

Societal Advisory Group (SAG):

This group will review and revise the Issue Map from the 2021 IRP process so it can be used as a societal cost benefit analysis for any MP generation facility.

Engagement Meetings:

Today! Participants from both advisory groups, as well as participants not involved in either group. These meetings will help inform the 2025 IRP.

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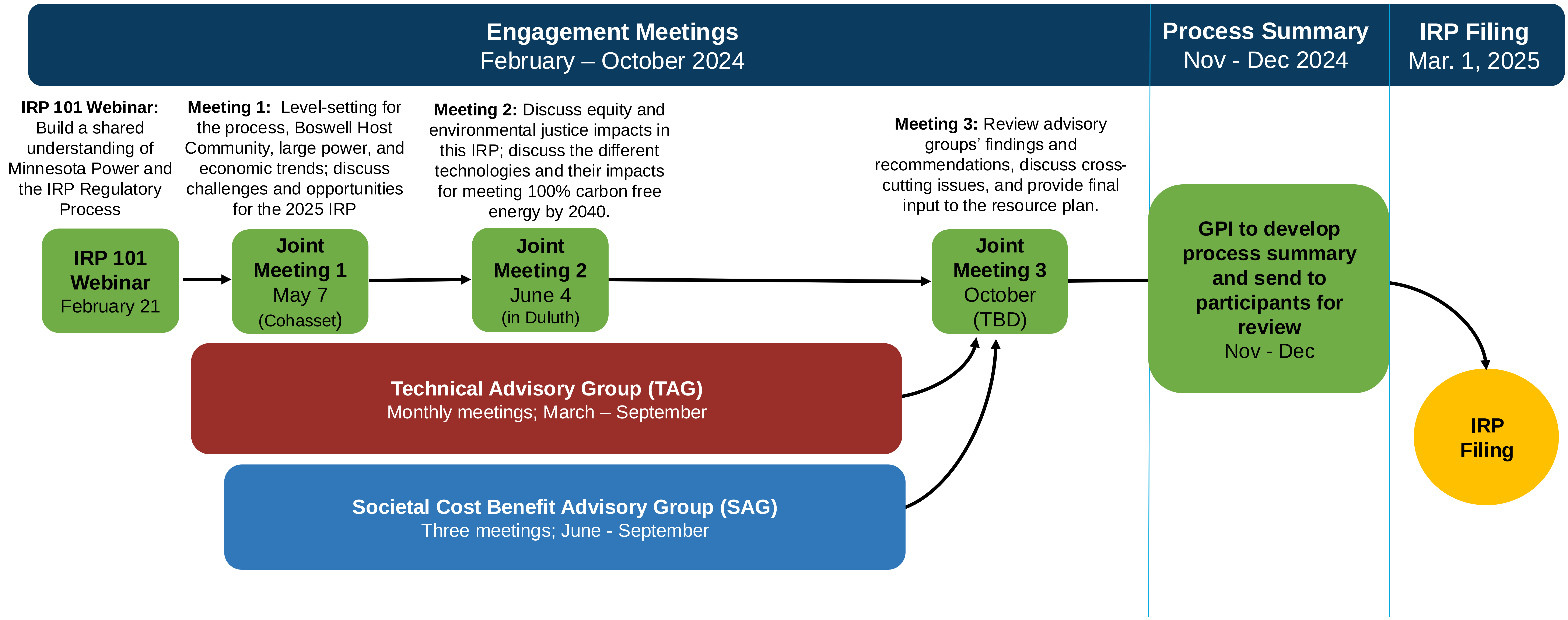
MINNESOTA POWER 2025 IRP—ENGAGEMENT MEETING TIMELINE

NOTE: Dates and topics are subject to change to meet the group's needs.



Engagement vs. Public Processes

- **Engagement process (today!):** Opportunity to provide input to Minnesota Power as they are developing their 2025 IRP
- **Public process through the Minnesota Public Utilities Commission (MPUC):** Process through which interested parties can provide feedback and comments on the filed IRP
- Minnesota Power's IRP is due on **March 1, 2025**. Following this, interested parties will have several opportunities to provide further feedback:
    - Initial comments
    - Reply comments
    - Public meetings
    - MPUC hearing
- Additional information about MPUC's public IRP process is available on the MPUC website.

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Questions?

Welcome to the Technology Discussion for MP's 2025 IRP!

June 4, 2024

Eric Palmer – MN Power – Manager of Utility Planning

Tom Butz – MN Power – Utility Planner Senior

Todd Gorgian – EPRI – Technical Leader

Today's Agenda - Technology

1. MP's Need for the 2025 IRP

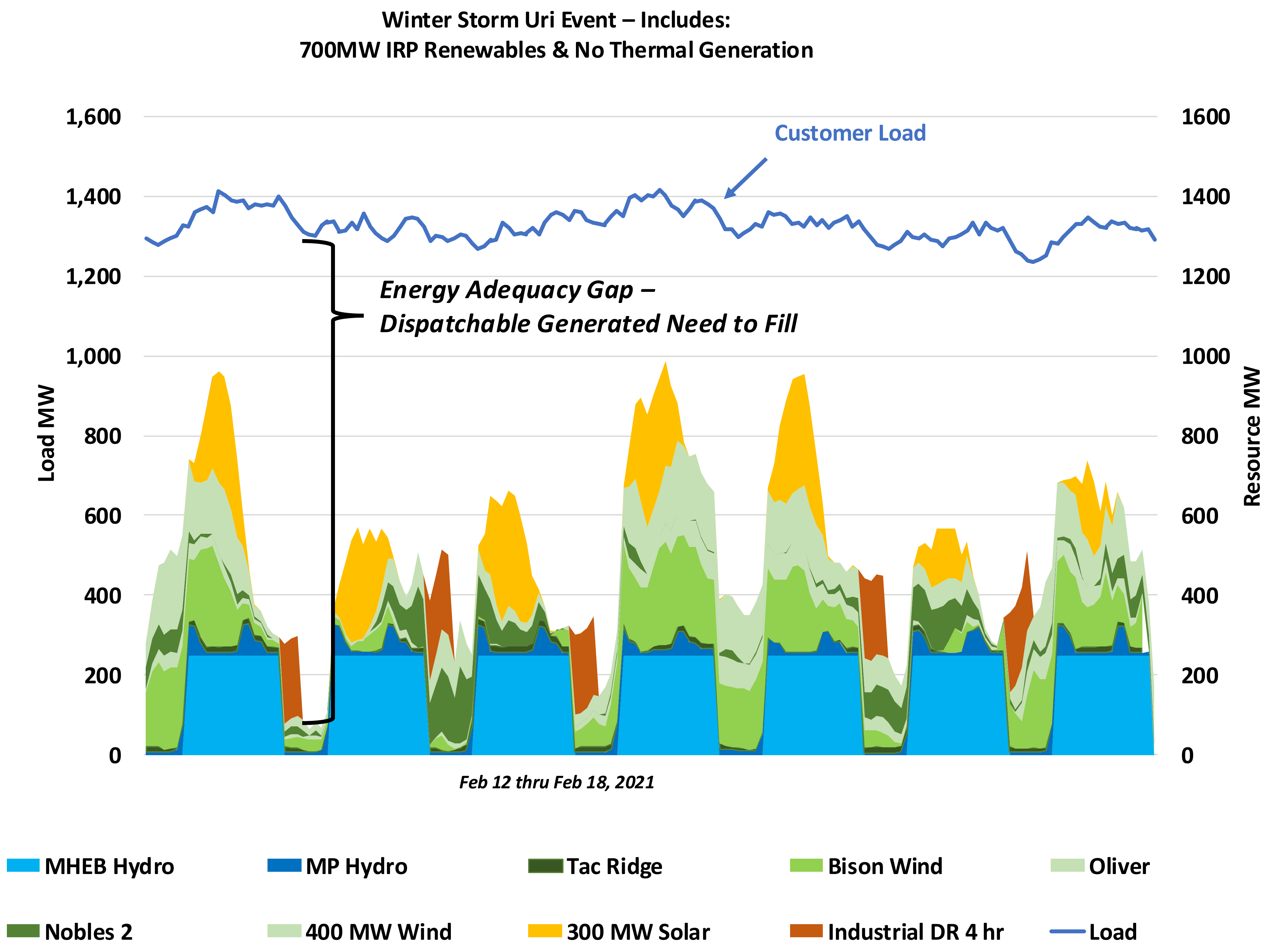
2. EPRI – Technology Deployment Timeline

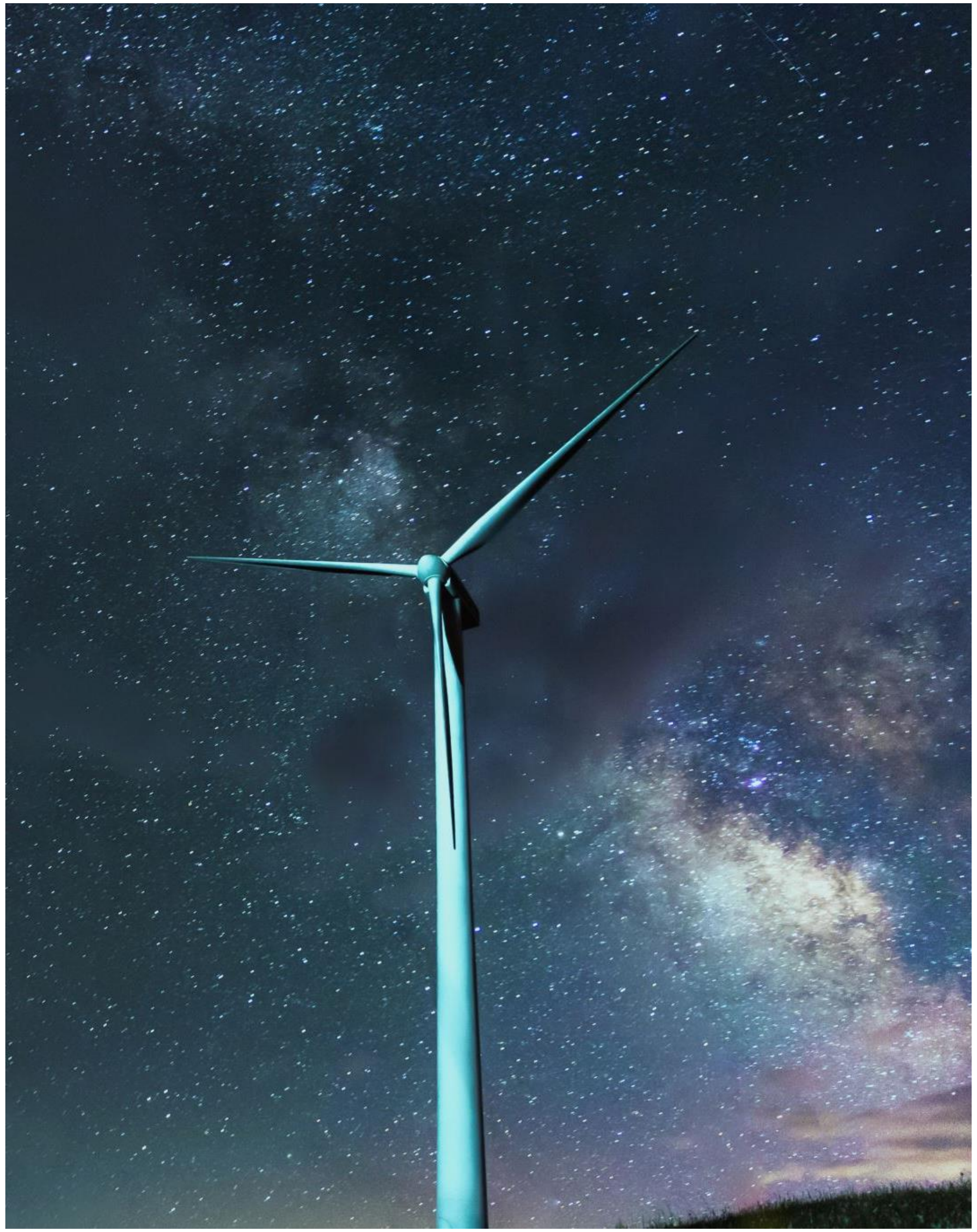
3. Technology Considerations for 2025 IRP

MN Power Needs for Post Coal Operations

- Determine pathway for 1000MW and 3.5million MWh of dispatchable coal and biomass energy and capacity.
- Add new carbon free energy to meet the 80% carbon free by 2030 target – approximately 1 million MWh.
- Generation portfolio capable to meet reliability criteria.

Resources Needed to Fill the Renewable Gap

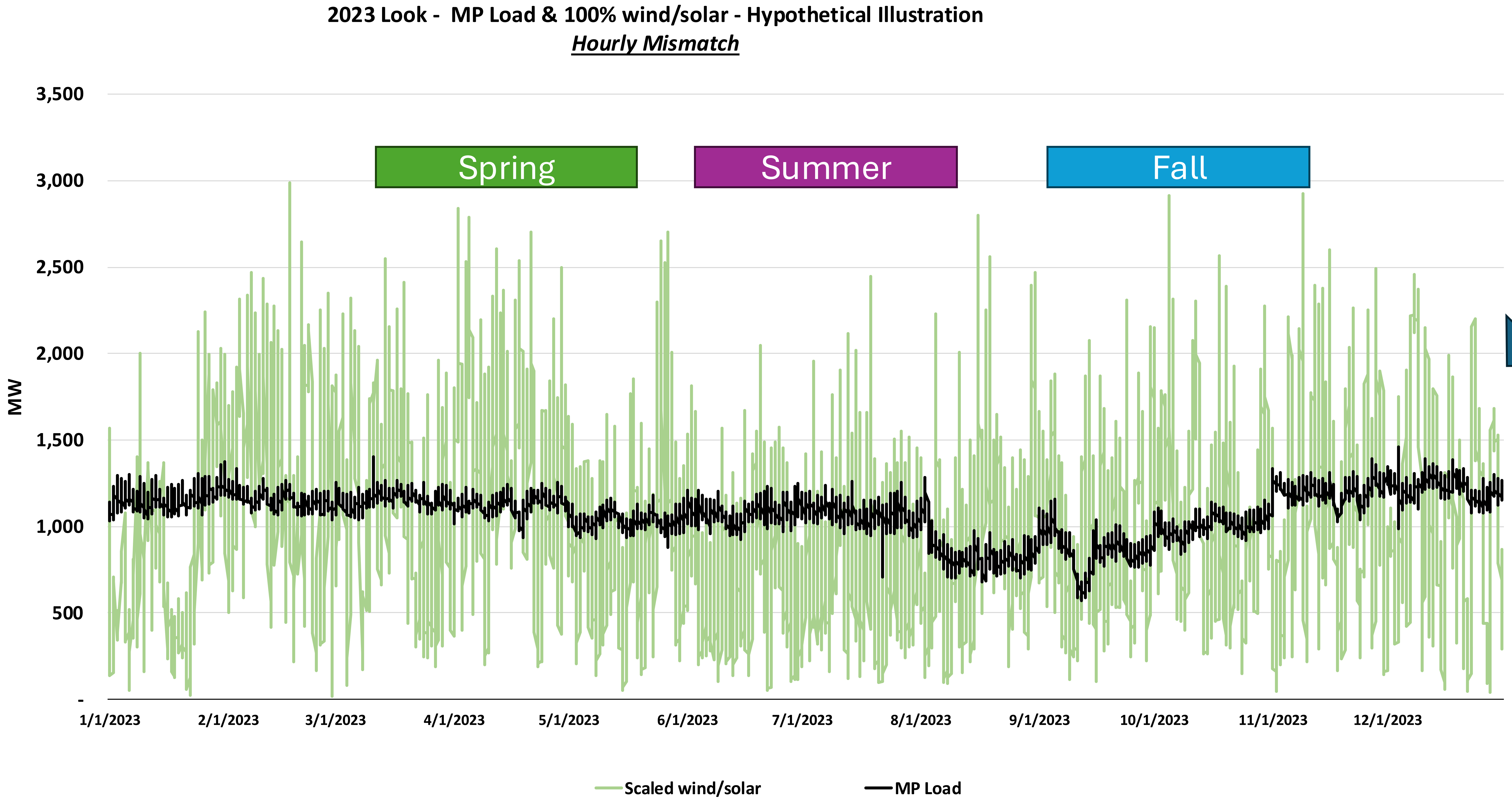




Identifying the Complexity – 2023 Illustrative Snapshot

- Matching Annual Load Energy to Wind + Solar Energy
- Wind Data
  - Scaled 2023 Actual MP Wind Data
- Solar Data
  - MISO North Total Solar
    - 400 MW
    - No Scaling
- This Example Ignored Reliability Criteria and Resource Adequacy Needs

Identifying the Mismatch – Additional Tech Needed to Balance System



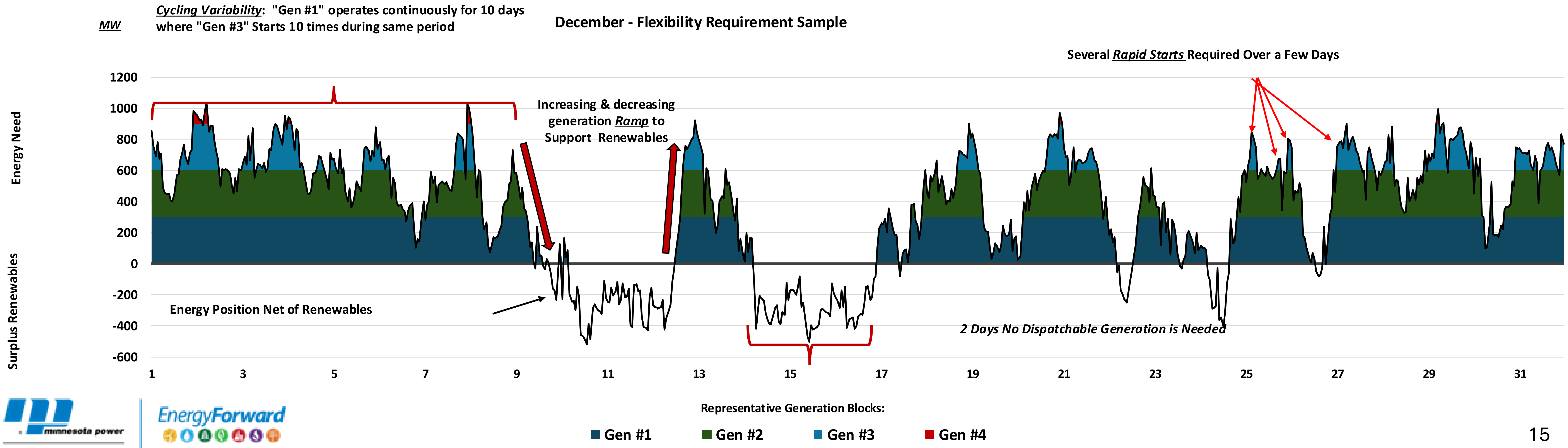
Excess Wind/Solar Gen

Resource Need Hours

Expanded Planning Criteria Needed for Grid of the Future

RELIABILITY CRITERIA

- **Traditional Planning**
- **Energy Adequacy**
  - **Fuel Assurance**
  - **Long Duration Energy**
- **Operational Flexibility**
  - **Ramping**
  - **Cycling**
- **Essential Services**



Key Intersection of Technology & Need

- **Minnesota Power Reliability Criteria**
  - Evaluating Full Range of Critical Attributes and Metrics
- **Minnesota Power Resource Need**
  - Accounting for Customer Demand, Climate Goals/Policy, and Reliability Criteria
- **Industry Resource Maturity**
  - What Resources are Grid Ready for Deployment – When – and at What Cost?

Welcome EPRI

Energy Technology Deployment Timelines

Research Overview & Selected Findings

Todd Gorgian
Technical Leader
EPRI – Energy Systems & Climate Analysis Group

Minnesota Power IRP Stakeholder Meeting
June 4th, 2024

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe.

Together, we are shaping the future of energy.

Nonprofit
Chartered to serve the public benefit, with guidance from an independent advisory council.

Thought Leadership
Systematically and imaginatively looking ahead to identify issues, technology gaps, and broader needs that can be addressed by the electricity sector.

Independent
Objective, scientific research leading to progress in reliability, efficiency, affordability, health, safety, and the environment.

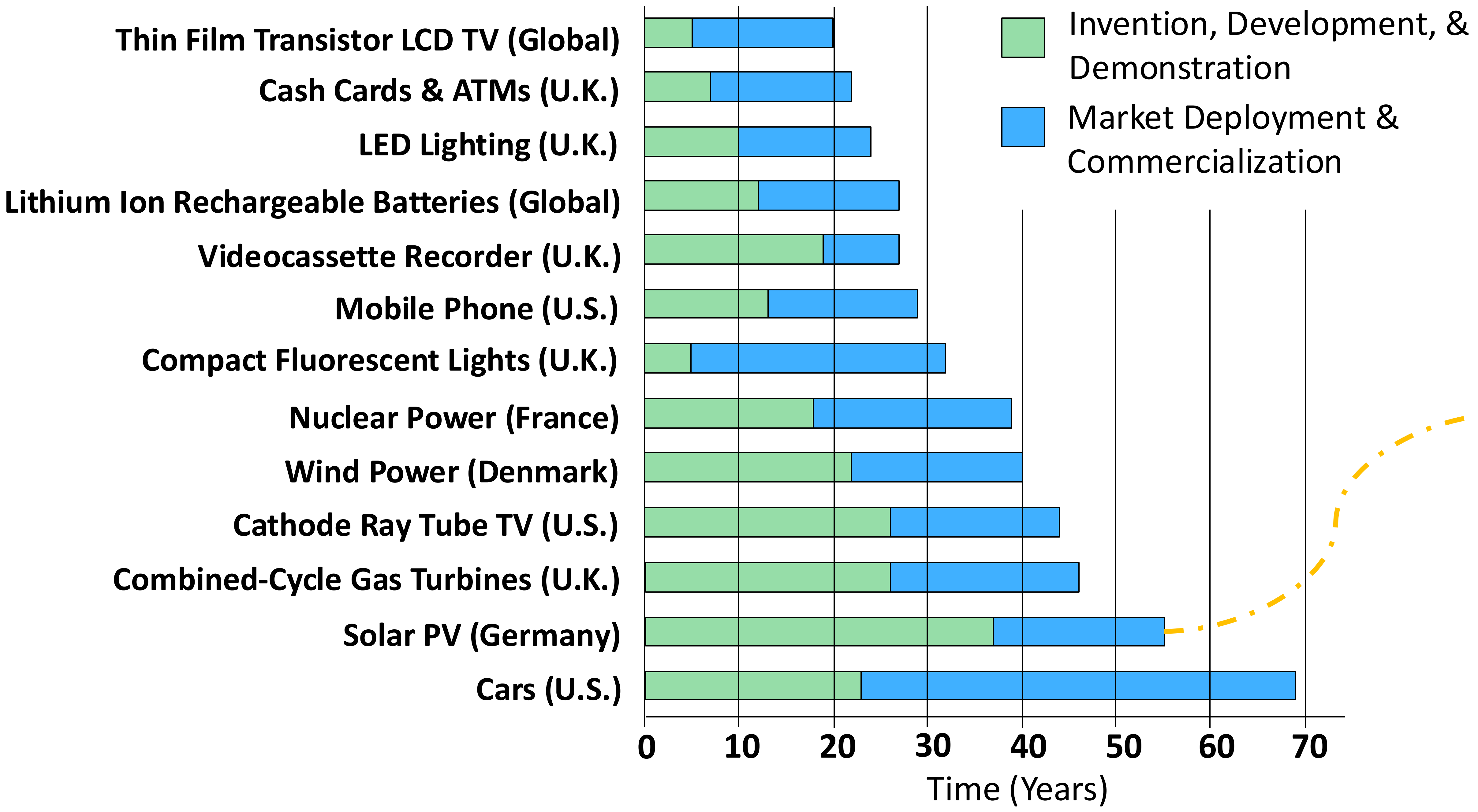
Scientific and Industry Expertise
Provide expertise in technical disciplines that bring answers and solutions to electricity generation, transmission, distribution, and end use.

Collaborative Value
Bring together our members and diverse scientific and technical sectors to shape and drive research and development in the electricity sector.

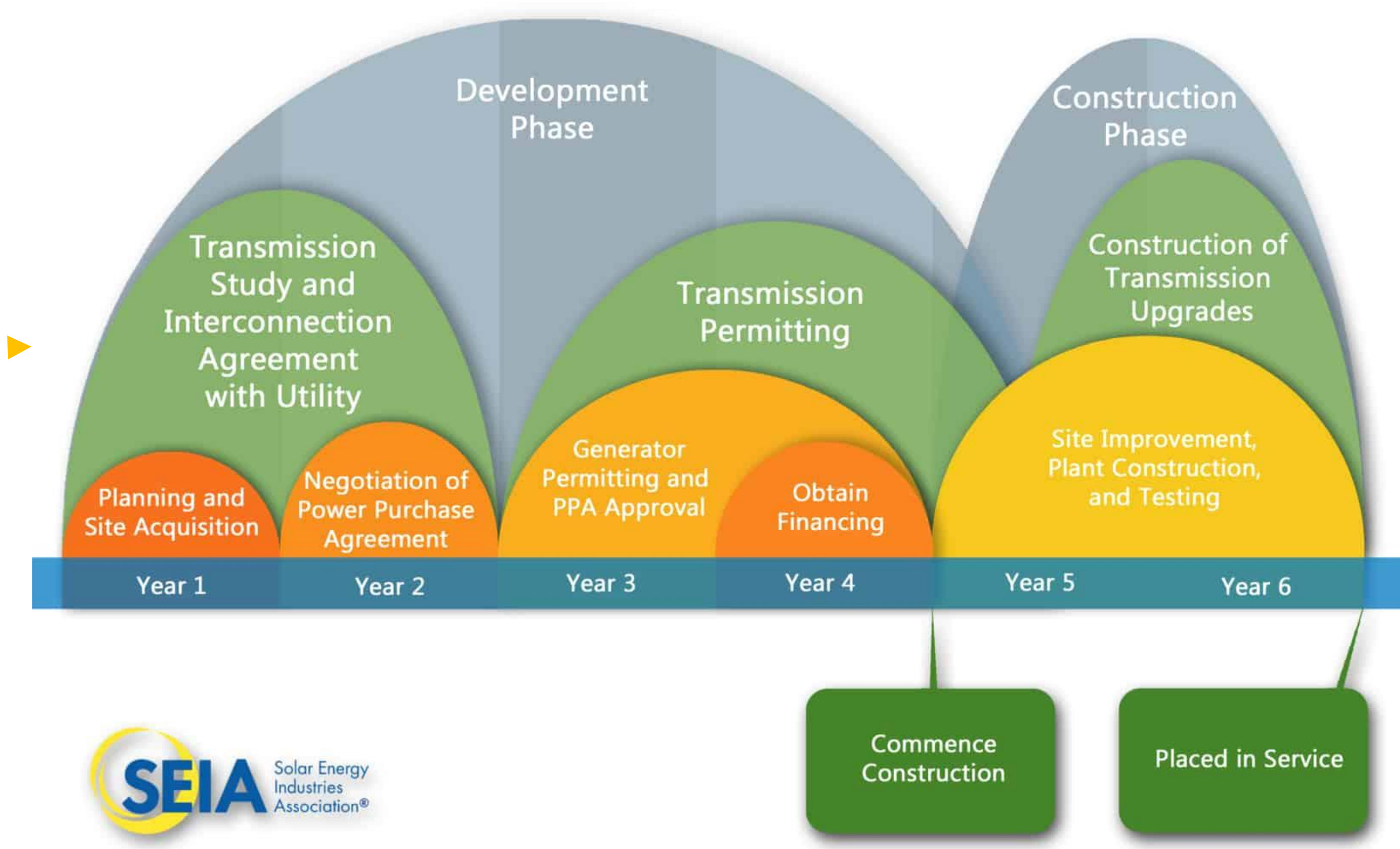
Research Overview

Research Motivation

Time to Technology Commercialization



Ideal Development Timeline for a Utility-Scale Solar Power Plant (250 MW)



Source: SEIA, "Development Timeline for Utility-Scale Solar Power Plant"
For illustrative purposes only.

Adapted from R. Gross et al., "How long does innovation and commercialisation in the energy sectors take?"
"Market Deployment & Commercialization" starts with market introduction & ends when technology has reached "widespread commercialization."
"Widespread commercialization" for power generation techs. defined as when their installed capacity reaches 20% of the potential maximuminstalled capacity of the technology group in question.

To Reliably Deploy a Portfolio of Low Carbon Technologies, Electric Companies Must Consider:
Time to Commercial Availability (if Applicable) + Time to Develop Project

Research Methodology & Technologies Included

Fossil Power Generation	Nuclear Power Generation	Renewable Power Generation	Battery Energy Storage	Mechanical Energy Storage	Thermal Energy Storage	Electrical Energy Storage, Electric Network Tech	Hydrogen	Enabling Infrastructure
Conventional Coal (PC)	Conventional Nuclear	Geothermal	Lithium Ion (Li Ion)	Pumped Storage Hydro (PSH)	Concrete Thermal	Low Temperature Superconducting Magnetic Energy Storage (LT SMES)	Electrolyzer	Electric Power Transmission
Combustion Turbine (CT)	“Advanced” Nuclear	Hydropower Generation	Sodium-Sulfur	Compressed Air (CAES)	Sand Thermal	Ultracapacitor	Fuel Cells	H_2 Transport & Storage
Combustion Turbine Combined-Cycle (CTCC)		Concentrating Solar Thermal (CSP)	Sodium Ion	Flywheels	Molten Salt Thermal	Synchronous Condenser (Sync Cond)	Hydrogen (H_2) Combustion	Carbon Dioxide (CO_2) Transport & Storage
Reciprocating Internal Combustion Engine (RICE)		Solar Photovoltaic (PV)	Vanadium Redox Flow	Gravity		Static Synchronous Compensator (STATCOM)		
Fossil + CO_2 Capture		Onshore Wind	Other Flow	Liquid Air		Static VAR Compensator (SVC)		
		Offshore Wind	Liquid Metal					
			Solid-State Li					

>30 Technologies Assessed | Literature Review + Perspectives of >20 Experts

Insights from the Research

Pathway to Commercialization: Technology Readiness Levels (TRLs)

Technology Readiness Level								
1	2	3	4	5	6	7	8	9
Basic Principles Observed & Reported	Formulation of Application	Proof of Concept	Component Validation in Laboratory Environment	Component Validation in Relevant Environment	Process Development Unit	Pilot Plant	Commercial Pilot Plant	Normal Commercial Service

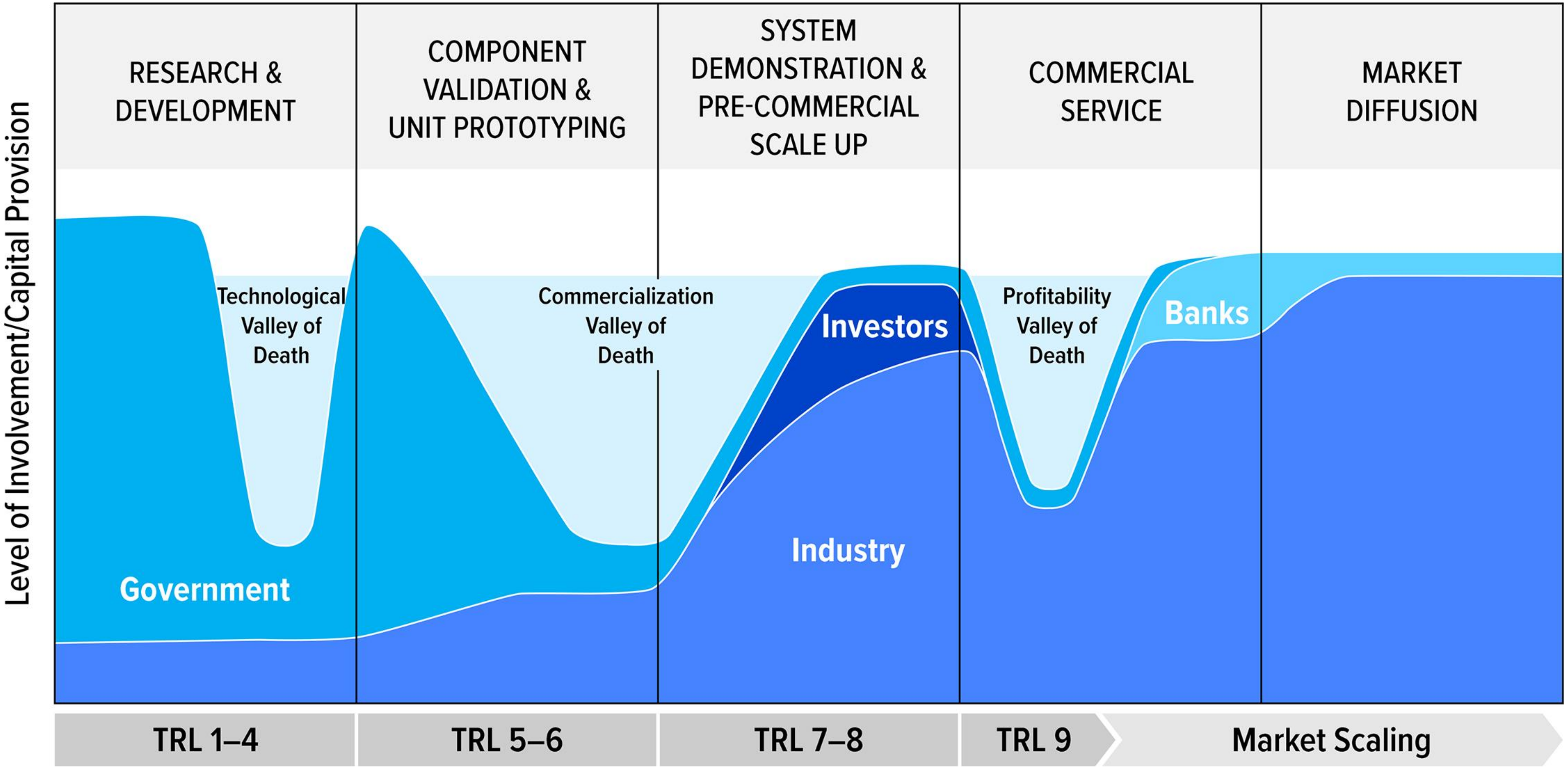
Research & Development (R&D)

Prototype

System Demonstration and Commercial Scale Up

Rating and descriptions adapted from Energy Storage Technology Database Report: 2022—Annual Year-End Snapshot Report (EPRI Report #3002024003)

TRLs, Technology Risk and Investment: Sidebar 1



Readiness & TRLs: A Few Words of Caution

"**Readiness**" **is inherently subjective** – even within the TRL framework. Opinions/ratings can vary.

TRLs may **vary by technology component/supply chain segment**.

A technology may be technically ready yet unviable in the marketplace until its **costs decrease and/or it gains confidence from market actors and stakeholders**. High TRL ≠ Economical

TRLs Useful for Quickly Communicating Technology Status. However, Technology Progress is Complex and Readiness Spans Many Dimensions Beyond What's Captured by a Discrete TRL.

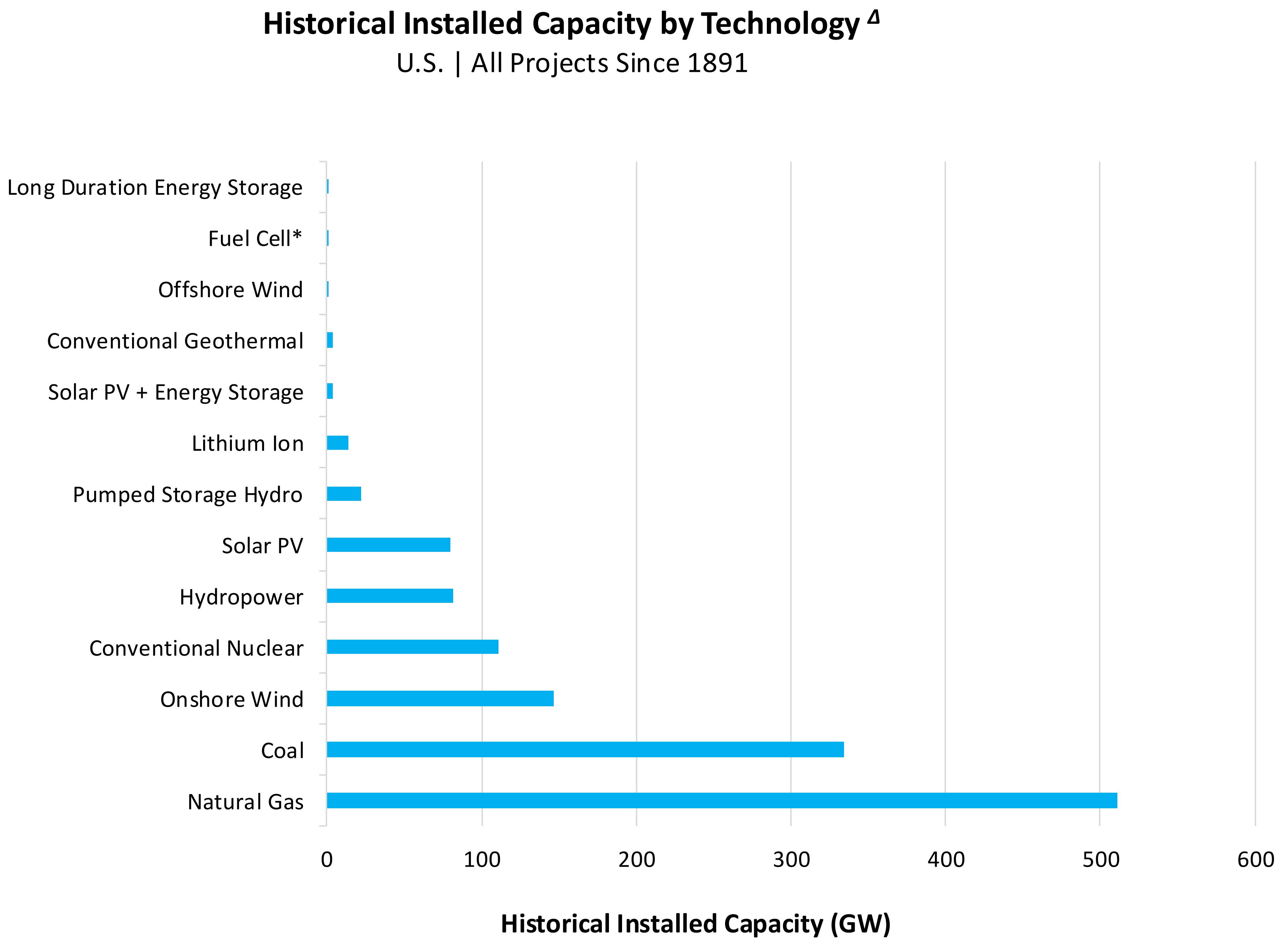
TRL Summary by Technology Category

R&D | Prototype | System Demonstration | Commercial

Timelines reflect plausible technology progression – not "forecasts."

	Present - 2025	2026-2035	2036-2045
Fossil			
Fossil + CO_2 Capture			
Conventional Nuclear			
Advanced Nuclear			
Demonstration Stage Technology			
Pre-Demonstration Stage Technology			
Utility-Scale Renewables			
Battery Energy Storage			
Commercially Available Technology			
Emerging Technology			
Mechanical Energy Storage			
Commercially Available Technology			
Emerging Technology			
Thermal Energy Storage			
Commercially Available Technology			
Emerging Technology			
H_2 Technologies			
Commercially Available Technology			
Emerging Technology			
Enabling Infrastructure			

Deployment of Selected TRL 9 Technologies: Sidebar 2



Enabling Infrastructure

	Current Installations U.S.; All Projects
Electric Transmission	>100,000 miles
CO_2 Pipeline	5,000 miles (South & Midwest Only)
H_2 Pipeline	1,600 miles (Gulf Coast Only)
CO_2 Storage: Deep Saline Formation	6 Metric Tons (Two Projects)

Compare to 305,000 miles of natural gas transmission

Δ Data exclude capacity retirements.

** Most fuel cells deployed to date use natural gas fuel, not H_2.*

TRL 9 ≠ Easy to Scale Up | Consider Historical Experience vs Rapid, Widescale Scale Up

Technology Deployment Timelines

Generalized Phases of Energy Project Development (New-Build)

Pre-Development

Site Identification
- Land area & topography
- Water availability
- Transmission access
- Environmental issues

Viability Assessment
- Fuel resource
- Market conditions
- Government incentives
- Stakeholder outreach

Conceptual Design
- Technology review
- Cost/risk assessment
- Preliminary design
- Business case

Development

Comprehensive Design

Land & Water Rights

Power Agreements

Grid Interconnection Process Initiation

Permitting

Financing

Contracting

Procurement

Financial Close

Construction

Construction Plans

Site Preparation

Project Build

Commissioning

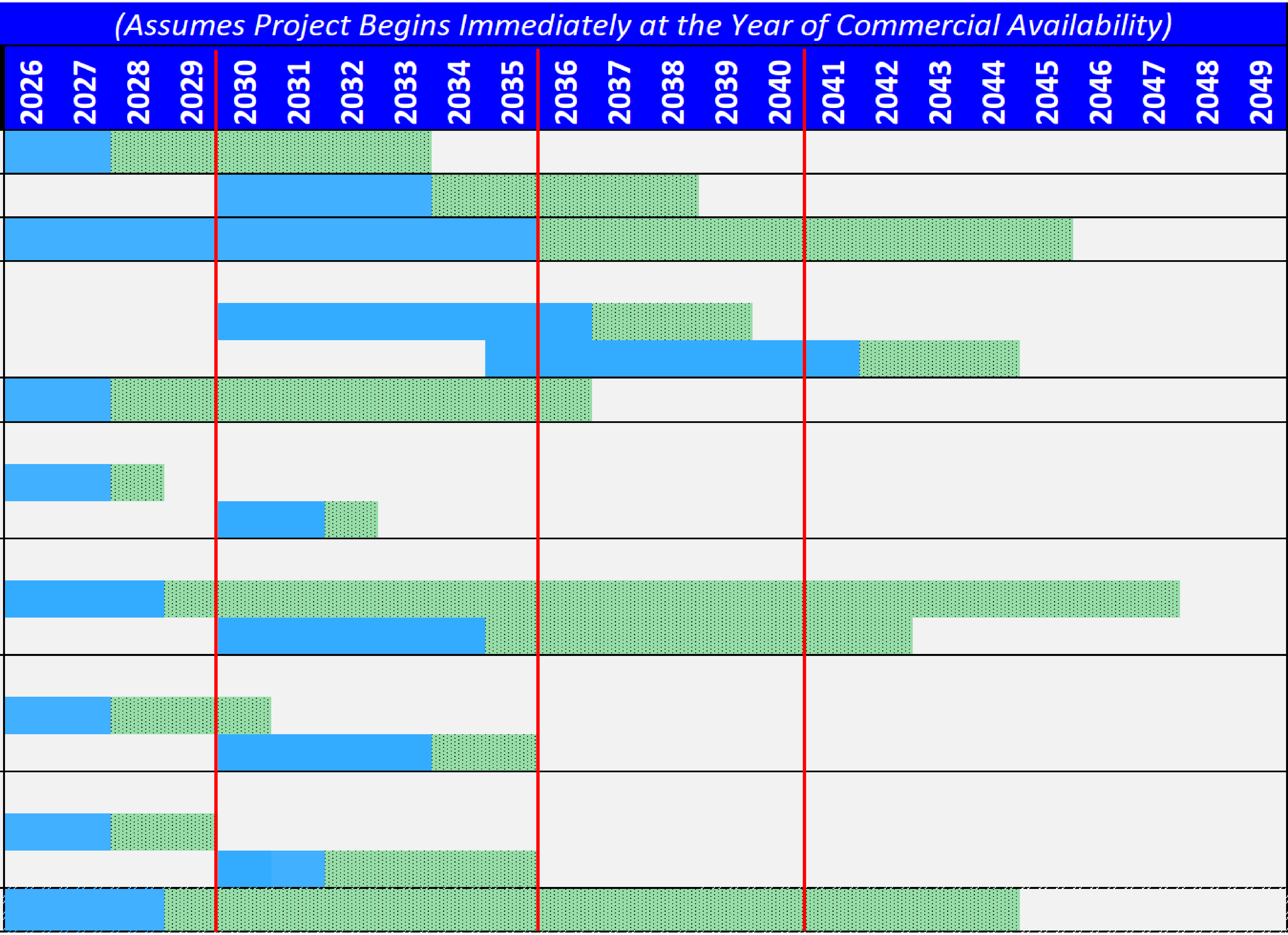
Balance of Activities Before Startup

Plant in Service

Project Development Timelines are Highly Variable and May Evolve

Deployment Timelines: Summary of All Technologies

Technology	Years to Complete Total
Fossil	2-8
Fossil + CO_2 Capture*	4-9
Conventional Nuclear	10-20
Advanced Nuclear	7-10
Demonstration Stage Technology	
Pre-Demonstration Stage Technology	
Utility-scale RenewablesΔ	2-12
Battery Energy Storage	2-3
Commercially Available Technology	
Emerging Technology	
Mechanical Energy Storage	
Commercially Available Technology	3-22
Emerging Technology	5-13
Thermal Energy Storage	
Commercially Available Technology	2-5
Emerging Technology	4-6
H_2 Technologies*	
Commercially Available Technology	2-4
Emerging Technology	2-6
Enabling Infrastructure	3-18

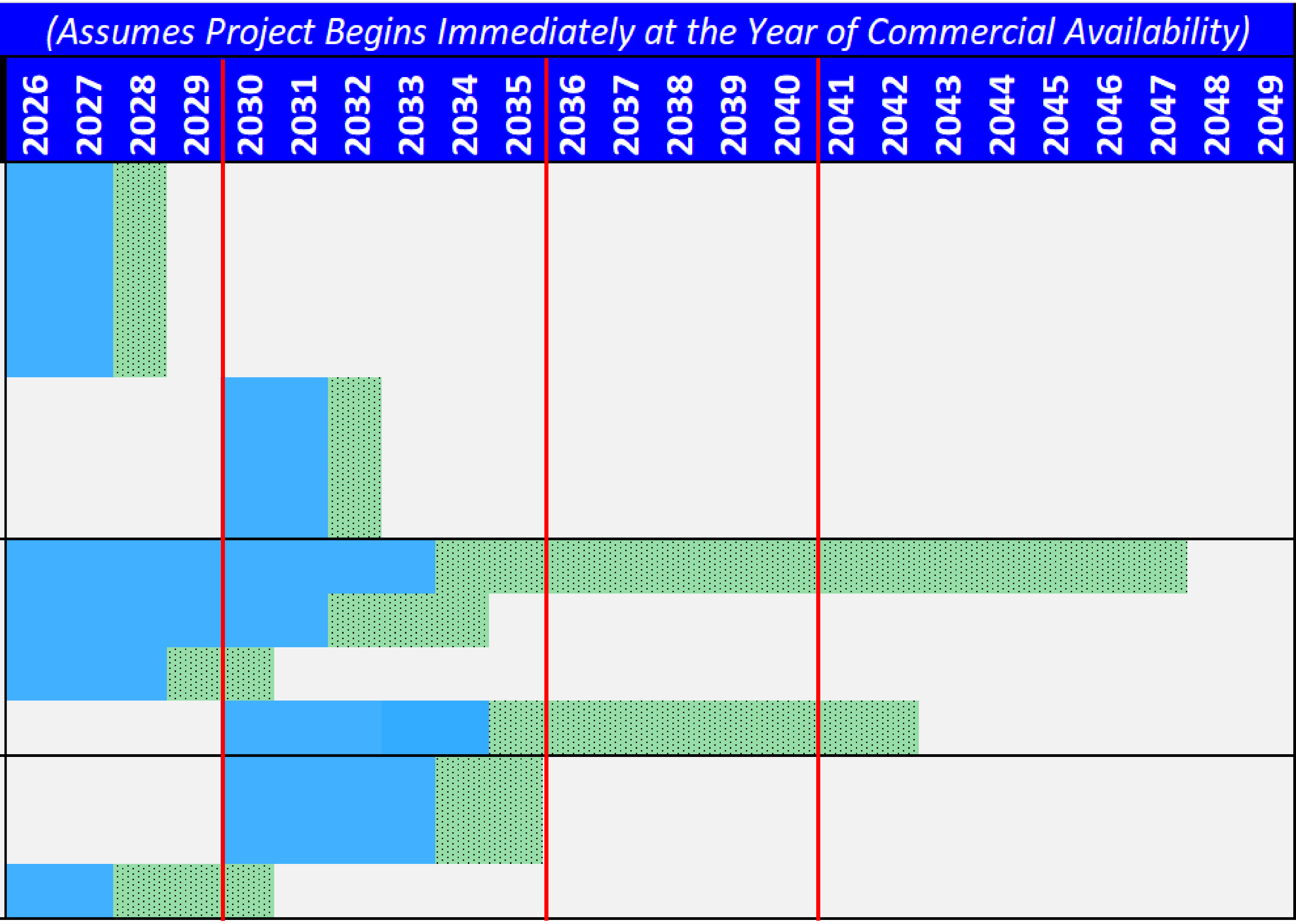


** Technologies in category require enabling infrastructure that does not yet exist.*
Δ Hydropower is excluded from the category of utility-scale renewables.
Electrical energy storage & grid strengthening technologies omitted from figure.

Total # of Blue Cells = minimum # of years
# of Green Cells = possible # of additional years

Deployment Timelines: Energy Storage

Technology		Years to Complete: Total
Battery Energy Storage	Lithium Ion	2-3
	Sodium-Sulfur	
	Sodium Ion	
	Vanadium Redox Flow	
	Other Flow	
	Liquid Metal	
	Solid-State Lithium	
Mechanical Energy Storage	PSH	8-22
	Diabatic CAES	6-9
	Flywheel	3-5
	Gravity	5-13
Thermal Energy Storage	Concrete Thermal	4-6
	Sand Thermal	4-6
	Molten Salt	2-5



Total # of Blue Cells = minimum # of years
# of Green Cells = possible # of additional years

Electrical energy storage & grid strengthening technologies omitted from figure.
PSH = pumped storage hydropower

Deployment Timelines: Fossil + CO_2 Capture & H_2 Technologies

Technology			Years to Complete Total	(Assumes Project Begins Immediately at the Year of Commercial Availability)														
			Total	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Fossil + CO_2 Capture	Δ	PC or CTCC + CO_2 Capture	4-9															
H_2 Technologies	§	* Electrolyzer	2-4															
	Δ	H_2 Fuel Cell	2-3															
	Δ	H_2 CT/CTCC (100%)	2-6															

Δ Non-Nuclear, Carbon-free Dispatchable Generation Technology
§ H_2 Fuel Production Technology

Total # of Blue Cells = minimum # of years
# of Green Cells = possible # of additional years

** Project uses an alkaline or polymer electrolyte membrane electrolyzer (currently commercial) powered by grid electricity*

Deployment Timelines: Fossil + CO_2 Capture & Storage – Take 2

Power plants with CO_2 capture need CO_2 transport and storage infrastructure.

Technology		Years to Complete: Total	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Fossil + CO_2 Capture + Enabling Infrastructure	PC or CTCC + CO_2 Capture	4-9																		
	CO_2 Transport: Pipeline	4-18																		
	CO_2 Storage: DSF	6-10+																		

<u>Fossil + CO_2 Capture & Storage Scenario:</u>
Need to construct a (1) CO_2 pipeline and (2) deep saline formation (DSF).

Deployment Timelines: Fossil + CO_2 Capture & Storage – Take 2

Power plants with CO_2 capture need CO_2 transport and storage infrastructure.
Consider timelines for enabling infrastructure.

Technology		Years to Complete: Total	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Fossil + CO_2 Capture + Enabling Infrastructure	PC or CTCC + CO_2 Capture	4-9																		
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<u>Fossil + CO_2 Capture & Storage Scenario:</u>
Need to construct a (1) CO_2 pipeline and (2) deep saline formation (DSF).

National and regional industrial strategy may be required to build CO_2 "hubs" where CO_2 captured from point source emitters is transported and stored using common infrastructure.

The probability and timing of such developments is uncertain.

Deployment Timelines: H_2 Technologies – Take 2

H_2 technologies need a fuel supply and a delivery network.

Technology		Years to Complete: Total	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
H_2 Technologies + Enabling Infrastructure	Electrolyzer	2-4																		
	H_2 Fuel Cell	2-3																		
	H_2 CT/CTCC (100%)	2-6																		
	H_2 Transport: Onshore Pipeline	3-13																		

<u>H_2 Scenarios:</u>

a) Fuel cell or turbine has existing off-site supply of H_2 fuel but an H_2 pipeline must be built to deliver the fuel.

b) An electrolyzer (using electricity from the grid) is constructed so that the fuel cell facility can use on-site H_2 fuel.

Deployment Timelines: H_2 Technologies – Take 2

H_2 technologies need a fuel supply and a delivery network.

Consider timelines for technology combinations and enabling infrastructure.

Technology		Years to Complete: Total	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
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a) Fuel cell or turbine has existing off-site supply of H_2 fuel but an H_2 pipeline must be built to deliver the fuel.

b) An electrolyzer (using electricity from the grid) is constructed so that the fuel cell facility can use on-site H_2 fuel.

a) Markets need to be created and enabling infrastructure built.

b) Co-located electrolyzers can provide on-site fuel supply (but you still need some storage).

Recap of Key Observations

Selected Takeaways: From the Lab to the Field

TRLs are not perfect, but they are helpful.

All technologies evaluated are projected to achieve commercial status by 2040, but an initial set of committed customers is needed to facilitate the uptake of a “new” technology.

Widespread technology deployment requires robust supply chains and favorable project- and system-level economics.

Project development is highly variable, as it is influenced by myriad factors. Conventional nuclear, conventional hydropower, and PSH have the longest minimum project development durations. PSH has the largest range.

In some situations, it is important to consider the project development duration for a technology/power plant facility AND that of the enabling infrastructure.

CCS and H_2 could play a key role in the future, but they require markets and/or enabling infrastructure that do not exist yet. National and regional level coordination across industries is needed to address “chicken and egg” problem.

Total project development duration for a power plant facility and its enabling infrastructure may be “less than the sum of its parts” since development can often occur concurrently.

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Break

Please return at 10:30am

Balance Challenges and Expectations of Emerging Technologies

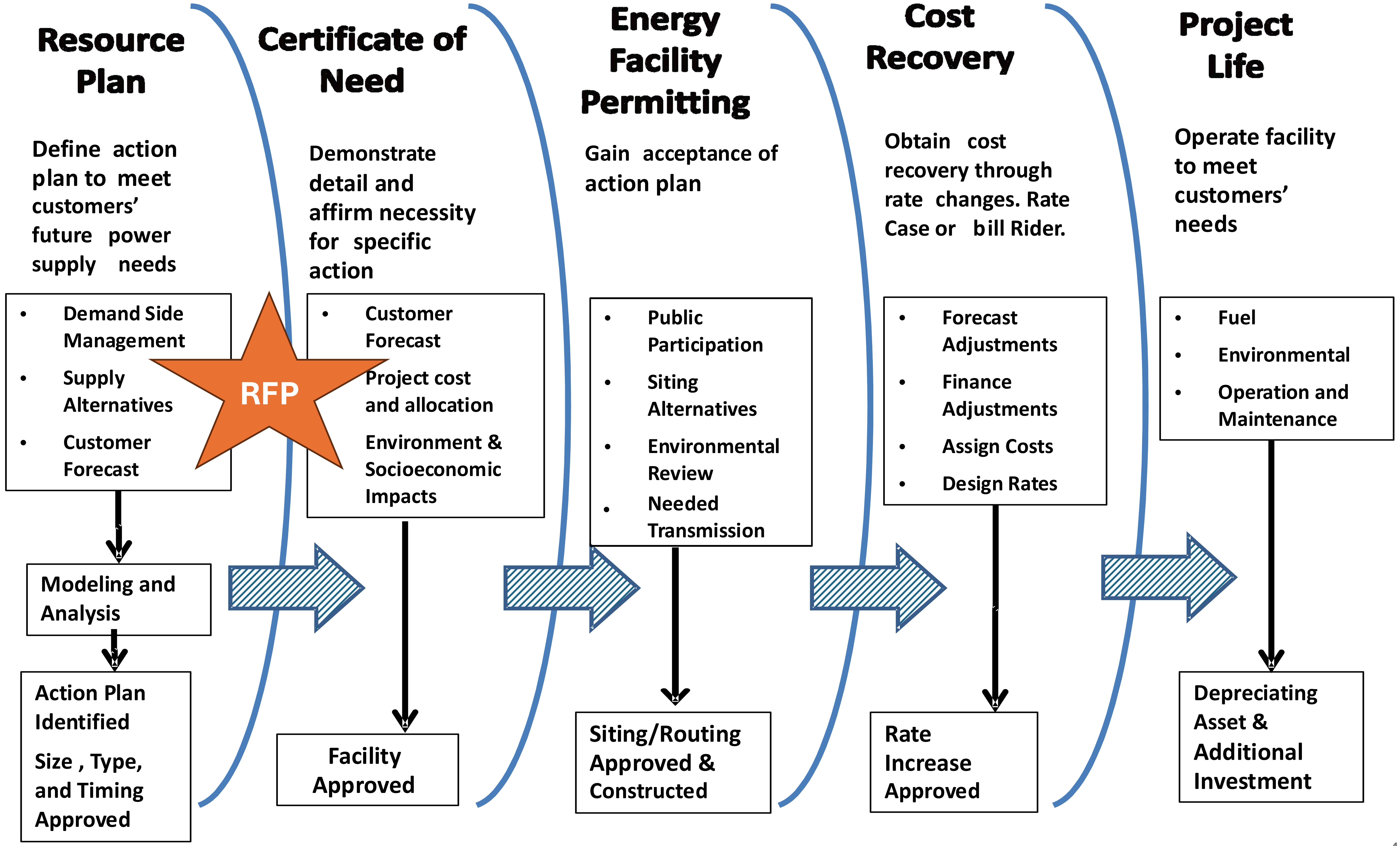
Societal Demand

TENSION

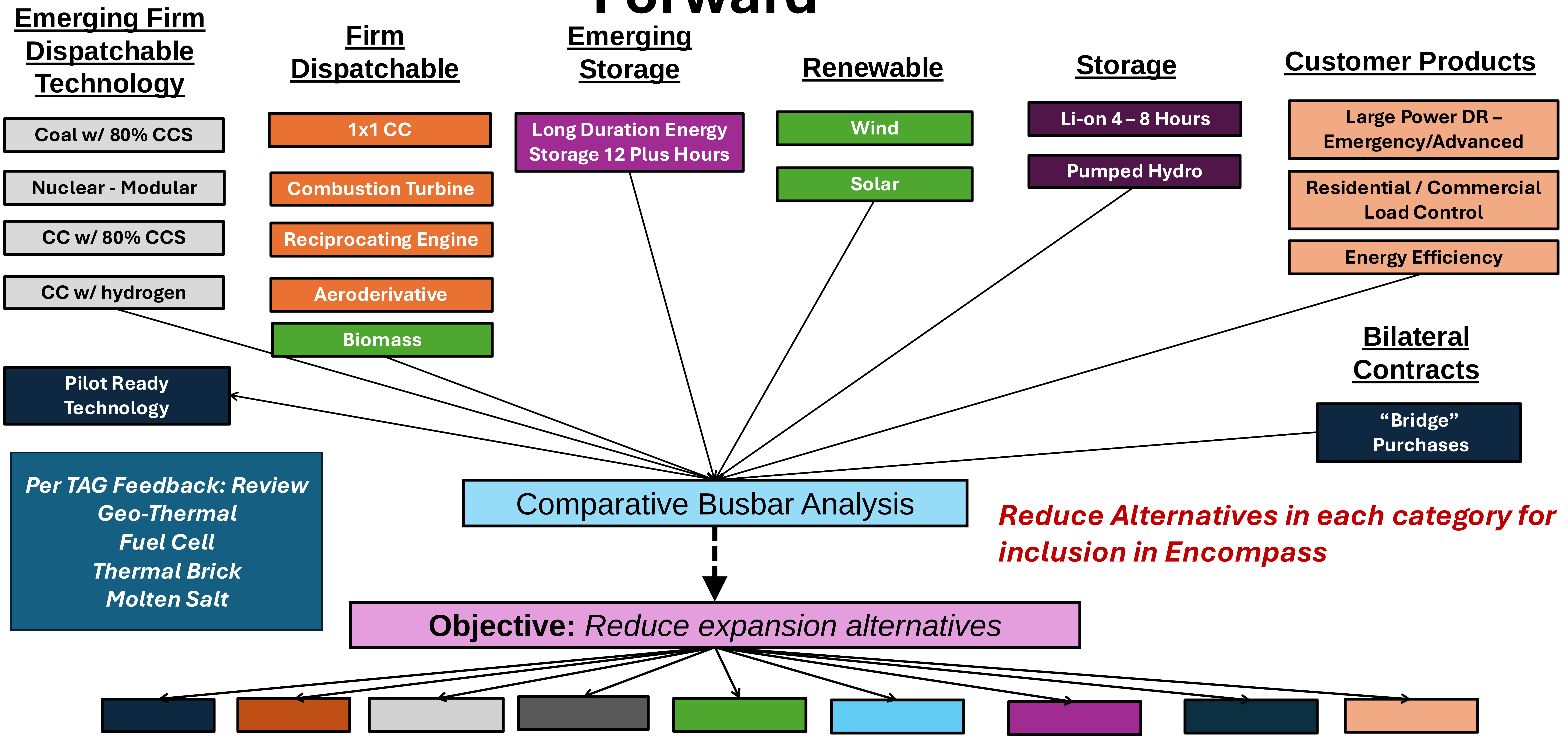
Uncertainty/ Readiness

- Need for Technology Maturity
- Earlier Carbon Goals

- Serial Number One Project Risk
- Future Years Cost Uncertainty


Resource Plan
Define action plan to meet customers' future power supply needs
Demand Side Management
Supply Alternatives
Customer Forecast
Modeling and Analysis
Action Plan Identified
Size , Type, and Timing Approved
RFP
Certificate of Need
Demonstrate detail and affirm necessity for specific action
Customer Forecast
Project cost and allocation
Environment & Socioeconomic Impacts
Facility Approved
Energy Facility Permitting
Gain acceptance of action plan
Public Participation
Siting Alternatives
Environmental Review
Needed Transmission
Siting/Routing Approved & Constructed
Cost Recovery
Obtain cost recovery through rate changes. Rate Case or bill Rider.
Forecast Adjustments
Finance Adjustments
Assign Costs
Design Rates
Rate Increase Approved
Project Life
Operate facility to meet customers' needs
Fuel
Environmental
Operation and Maintenance
Depreciating Asset & Additional Investment

Supply & Demand Side Alternatives – Looking Forward



IRA Helps Get Cost Down for Carbon Free Technology

Major tax credits available for carbon free technologies

45 Y: Production Tax Credit

- Up to ~$30/MWh for 10 years, with complicated bonus rules
- Replaces existing PTC for in 2025 for all carbon free technologies
- IRA §13701

48 E: Investment Tax Credit

- 30% with labor requirements plus 10% point bonuses for Domestic Content and Energy Communities
- Stand alone storage is eligible
- Replaces existing ITC in 2025 for all carbon free technologies
- IRA §13702

45 Q: CO_2 Capture & Storage Credit

- Up to \$85/tCO_2 captured with labor bonus
- Eligible for 12 years
- Must start construction by 2032
- Projects cannot stack 45Q and other credits
- IRA §13104

45 V: Clean H_2 Production Credit

- Qualification depends on GHG lifecycle of H_2 production
- Up to $3/kg with for 10 years
- Must start construction by 2032
- Allowed to be stacked with 45Y or 48E for electrolytic H_2
- IRA §13204

All credit estimates are in 2022 Dollars. Note model will escalate

MN Power Technology Capability Matrix

**Tech specs in development for providing Grid Strengthening services*

	CCS	SMR	H2	Gas	Biomass	Wind	Solar	Li-Ion	PHES	LDES
Mature Technology				✓	✓	✓	✓	✓	✓	
Deployable by 2030				✓		✓	✓	✓		
Deployable by 2035				✓	✓	✓	✓	✓		✓
Deployable by 2040			✓	✓	✓	✓	✓	✓		✓
Established Capital /O&M Experience				✓	✓	✓	✓	✓		
Capacity Provided	✓	✓	✓	✓	✓			✓	✓	✓
Fuel Assurance (On-site Storage)	✓	✓	✓	✓	✓			✓	✓	✓
Long Duration Energy (multi-day)	✓	✓	✓	✓	✓					✓
Ramping/Flexibility		✓	✓	✓				✓	✓	✓
Cycle/Rapid Start			✓	✓				✓	✓	✓
Grid Strengthening	✓	✓	✓	✓	✓	*	*	*	✓	✓
No Environmental Life Cycle Impact										
MN Carbon Free Eligible	✓	✓	✓		✓	✓	✓	✓	✓	✓

Adoption of Emerging Technology at Scale

When is the Right Technology for MN Customers Ready?

Move Too Early – Delay Using Future Technology?

Move Too Late – Slower Progress on Climate Objectives?

What is the Most Reasonable Pathway for Customers?

- Utilities are typically not early adopters -- cost and reliability risk evaluation
- Small pilots are needed
  - Helpful for positioning new tech for achieving 100% carbon free
  - But…typically higher cost and require creative funding options
- Want to see proven technology demonstrated at scale

Small Group Discussions

Small Group Discussion

11:15am–12:00pm

- There are tradeoffs between early vs. late adoption of technologies—a balance between moving quickly with unknowns or waiting for the technology to mature. How should MP balance these tradeoffs (affordability, reliability, climate goals), and how do unproven or pilot-scale technologies fit into the equation?
- What technologies do you think present the biggest opportunities to meet MP's load projects and reliably deliver affordable, carbon-free energy by 2040?
- What do you think are the biggest challenges?

GREAT PLAINS INSTITUTE

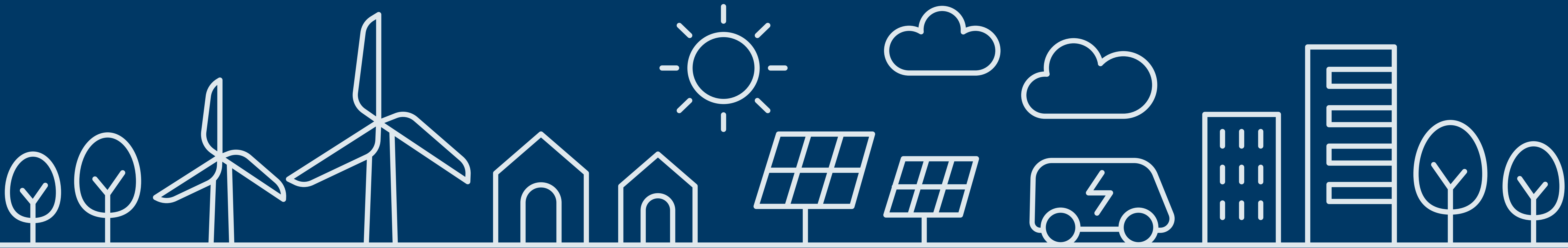
cee Center for Energy and Environment

Lunch Break

Please return at 12:45pm

Equity & Environmental Justice IRP Considerations

Jennifer Kuklenski, Senior Public Policy Advisor



Many different definitions, but broadly understood as…

Energy Equity

- Ensuring all customers benefit from the shift to clean energy, regardless of background or location, and broadening of engagement with historically underserved or underinvested communities through targeted policies and programs.

DOE

Environmental Justice (EJ)

- The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

EPA

Environmental Justice

- Environmental Justice "will be achieved when everyone benefits from the same degree of environmental protection and has equal access to the decision-making processes that contribute to a healthy environment." (EPA EJ Framework)
- Minn. Stat. § 216B.1691, Subdivision 1 defines an environmental justice area as "an area in Minnesota that, based on the most recent data published by the United States Census Bureau, meets one or more of the following criteria:

(1) 40 percent or more of the area's total population is nonwhite;

(2) 35 percent or more of households in the area have an income that is at or below 200 percent of the federal poverty level;

(3) 40 percent or more of the area's residents over the age of five have limited English proficiency; or

(4) the area is located within Indian country, as defined in United States Code, title 18, section 1151."

Energy Equity in Resource Planning

IRPs for Electric Utilities in Minnesota Have Typically Focused on Size, Type and Timing of Resources Required to Meet Energy Needs.

How should equity be incorporated into resource plans and the planning process?

- Consider the utility's ability to impact equity in terms of:
  - → Distribution of burdens and benefits (for example, where new infrastructure is built)
  - → Participation in decision-making (for example, when, where, and how public meetings, listening sessions, etc. are held)
  - → Solutions that match how people want to live their lives (for example, matching utility programs and services to individual community needs and wants, rather than one-size-fits-all solutions)
  - → Redress for previous harms (for example, considering how to locate utility jobs and affordability programs in communities that have been impacted by environmental injustices or another systemic disinvestment).

Source: PUC Gas IRP docket (23-117)

Combined, we can understand these concepts as:

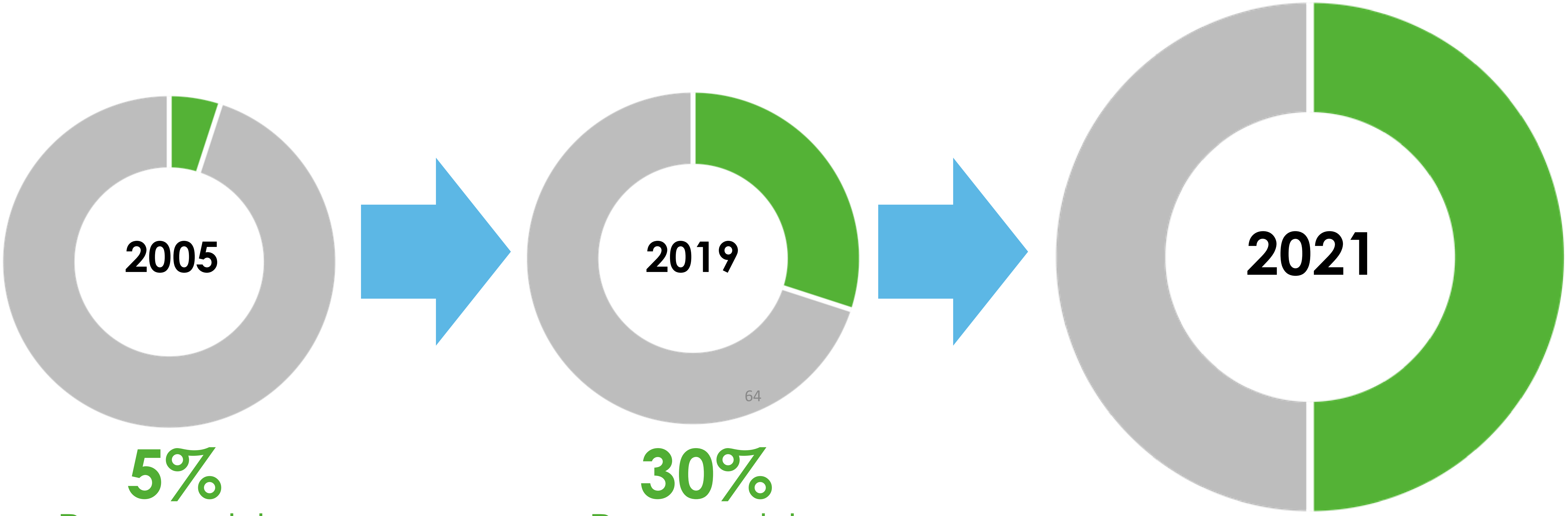
Energy Justice

The goal of achieving equity in both the social and economic participation in the energy system, while also working to remediate social, economic, and environmental burdens on those historically underserved or harmed by the energy system and ensure that all customers benefit from future investments as the energy system transitions to carbon-free electricity.

What is Minnesota Power Doing to Advance Energy Justice?

Relative to size, ***ALLETE is the largest investor in renewable energy*** of all IOUs in the country.

Leading Minnesota in Renewables



5% Renewable

30% Renewable

No. 1 in Minnesota
No. 2 in the Midwest*

50% Renewable

*Source: Navigant Consulting

Reducing Emissions

minnesota power
AN ALLETE COMPANY

REDUCED MERCURY
90%
SINCE 2016

REDUCING CARBON
50%
BY 2021

REDUCING EMISSIONS
70%
TOTAL

MP's Customer Programs and Services

minnesota power
AN ALLETE COMPANY

Innovative, state-leading customer program offerings

Cross promotion of customer program offerings to help customers maximize benefits

Engagement within the communities we serve to increase customer awareness of customer programs and support workforce development

Energy Conservation and Optimization (ECO)	Renewable Programs
Electric Vehicles	Demand Response
Time of Day Rates	Affordability Offerings

minnesota power
AN ALLETE COMPANY

Culture & Engagement

Diversity, Equity, and Inclusion

- Our DE&I steering committee focuses on strengthening our DE&I efforts in our five focus areas:
  - Workforce, supply chain, corporate citizenship, communications, and customers.
- Recognized as an Honor Roll Company with Special Distinction by the Minnesota Census of Women in Corporate Leadership since 2018.
  - Currently 50% of ALLETE board of directors and 50% of executive officers are women.
- Minnesota Power is designated as a Yellow Ribbon Company for its long-term commitment to service members, military families and veterans.

Culture & Engagement

Investing in our Communities

- The Minnesota Power Foundation contributed $200,000 annually to United Way organizations across our service territory.
- The Minnesota Power Foundation contributed $475,000 in grants to programs and nonprofits focused in the areas of education, community enrichment, health and human services, and arts and culture in 2022.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AN ALLETE COMPANY

DOE Grants Applications

To date, Minnesota Power has pursued DOE funding under the IIJA for 9 projects that will support increased clean energy integration into its system.

- Transmission upgrades
- Grid Modernization
- Long Duration Energy Storage
- Biomass Advanced Carbon Capture
- Hydroelectric system maintenance

The Minnesota Power HVDC Terminal Expansion Capability (HTEC) Project

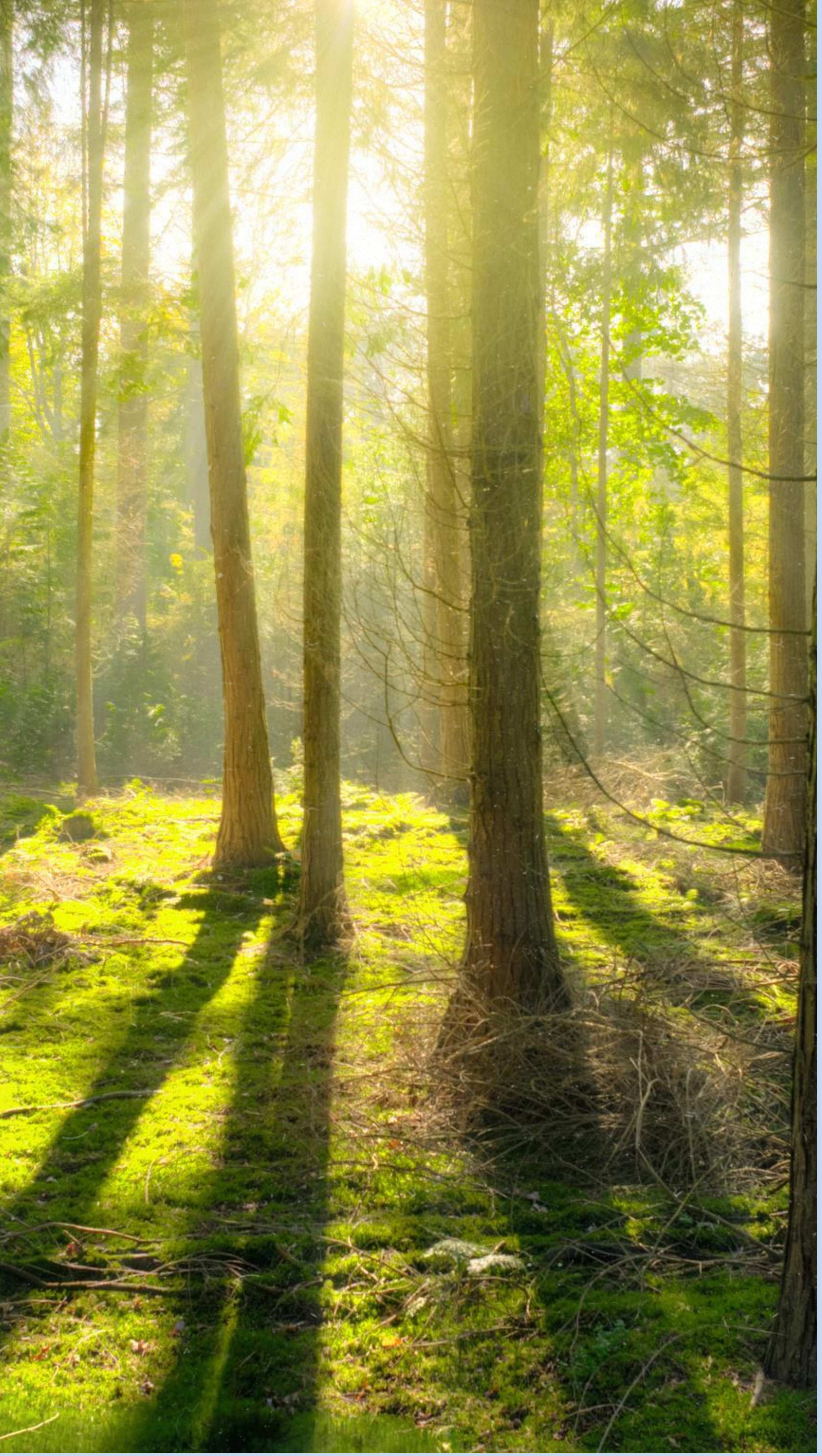
Awarded $50 million from DOE

The Project will facilitate the increased capacity along MP's HVDC Line to prepare the system for future expansion and the integration of clean energy resources.

The application received strong support from the Department of Commerce, labor organizations, clean energy groups and State and Federal legislators.

MP's application was 1 of 326 that submitted concept papers and 1 of 157 applicants that were encouraged to submit a full application for the GRIP funding.

Ultimately, 34 projects were selected for negotiation.



Questions to Consider

How can we work to address energy justice considerations into the current IRP process?

How do we best engage and serve all customers and communities in resource planning?

How can we balance the investment costs associated with technology needed to reach Carbon-Free by 2040 with affordability and equity?

Questions?

MINNESOTA
PUBLIC UTILITIES COMMISSION

Equity and Environmental Justice in Utility Regulation at the PUC

Angie McKinley | DEI Coordinator

Minnesota Statutes related to Equity

- **Minn. Stat. § 216B.03 (Utility Rates)**
  "Every rate made, demanded, or received by any public utility … shall be just and reasonable. Rates shall not be unreasonably preferential, unreasonably prejudicial, or discriminatory, but shall be sufficient, **equitable**, and consistent in application to a class of customers…."

- **Minn. Stat. § 216C.05 (Importance of energy planning)**
  "The legislature finds and declares that **continued growth in demand for energy will cause severe social and economic dislocations**, and … that the **protection of life, safety, and financial security for citizens** during an energy crisis is of paramount importance."

Minnesota Statutes related to Environmental Justice

- **Minn. Stat. § 216B.1691**

  Subd. 1 defines "environmental justice area" as "an area in Minnesota that, based on the most recent data published by the United State Census Bureau, meets one or more of the following criteria:

  (1) 40 percent or more of the area's total population is nonwhite;

  (2) 35 percent or more of households in the area have an income that is at or below 200 percent of the federal poverty level;

  (3) 40 percent or more of the area's residents over the age of five have limited English proficiency; or

  (4) the area is located with Indian country

Renewable Energy Objectives
Minn. Stat. § 216B.1691

Requires the Commission to consider equity and environmental justice in:

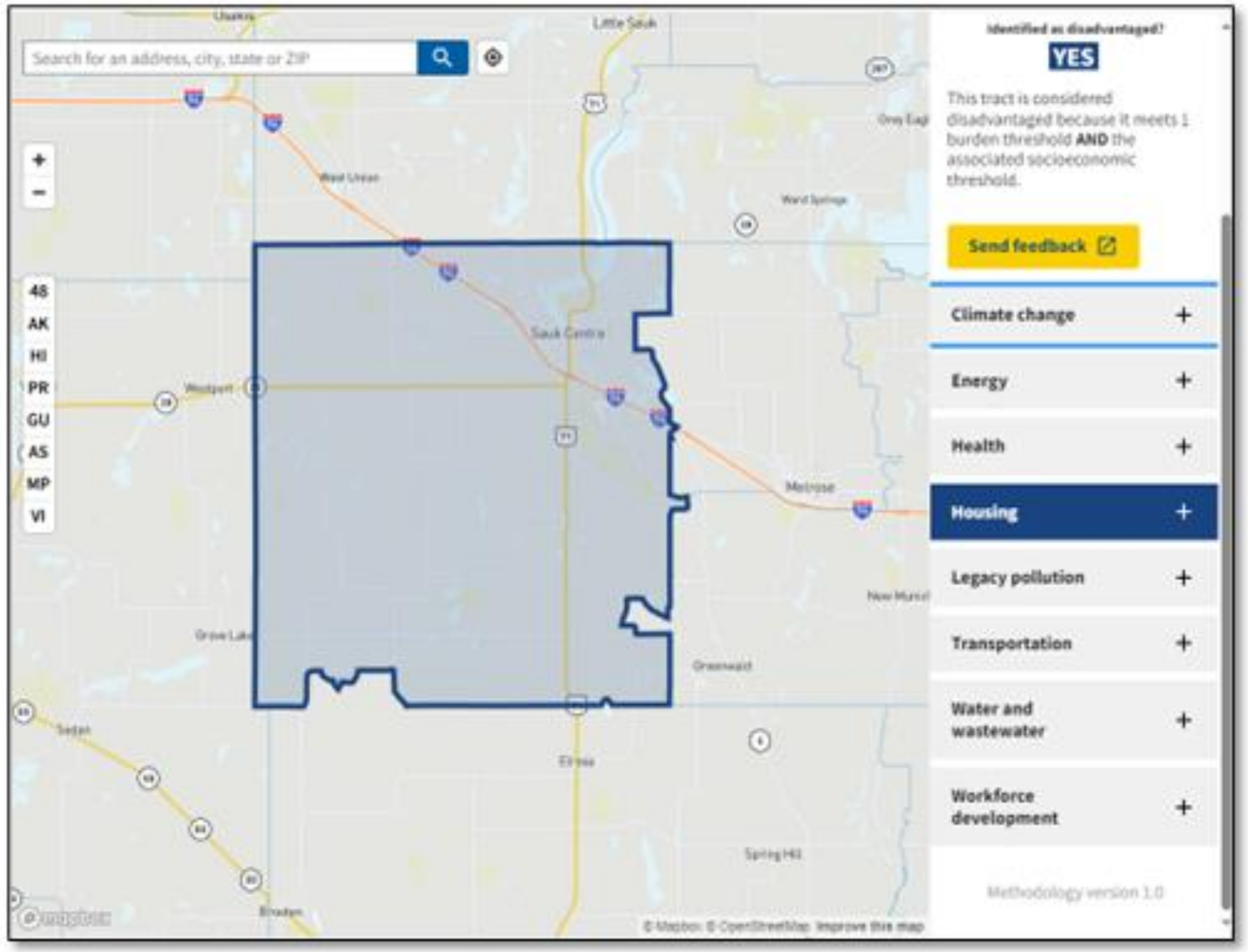
- How the renewable energy technology is implemented
- How quickly the renewable energy technology is implemented
- Ensuring that the benefits of renewable energy are maximized and the negative impacts are reduced, especially for EJ communities
- How many local jobs the project or technology creates
- Ensuring the renewable energy technology saves ratepayers money in the long-term

Equity Tools

1. Use of an Equity Analysis Framework Tool to evaluate projects and programs proposed by utilities

2. Use of EJ Mapping tools

3. Asking equity-focused questions in Notices of Comment and Information Requests

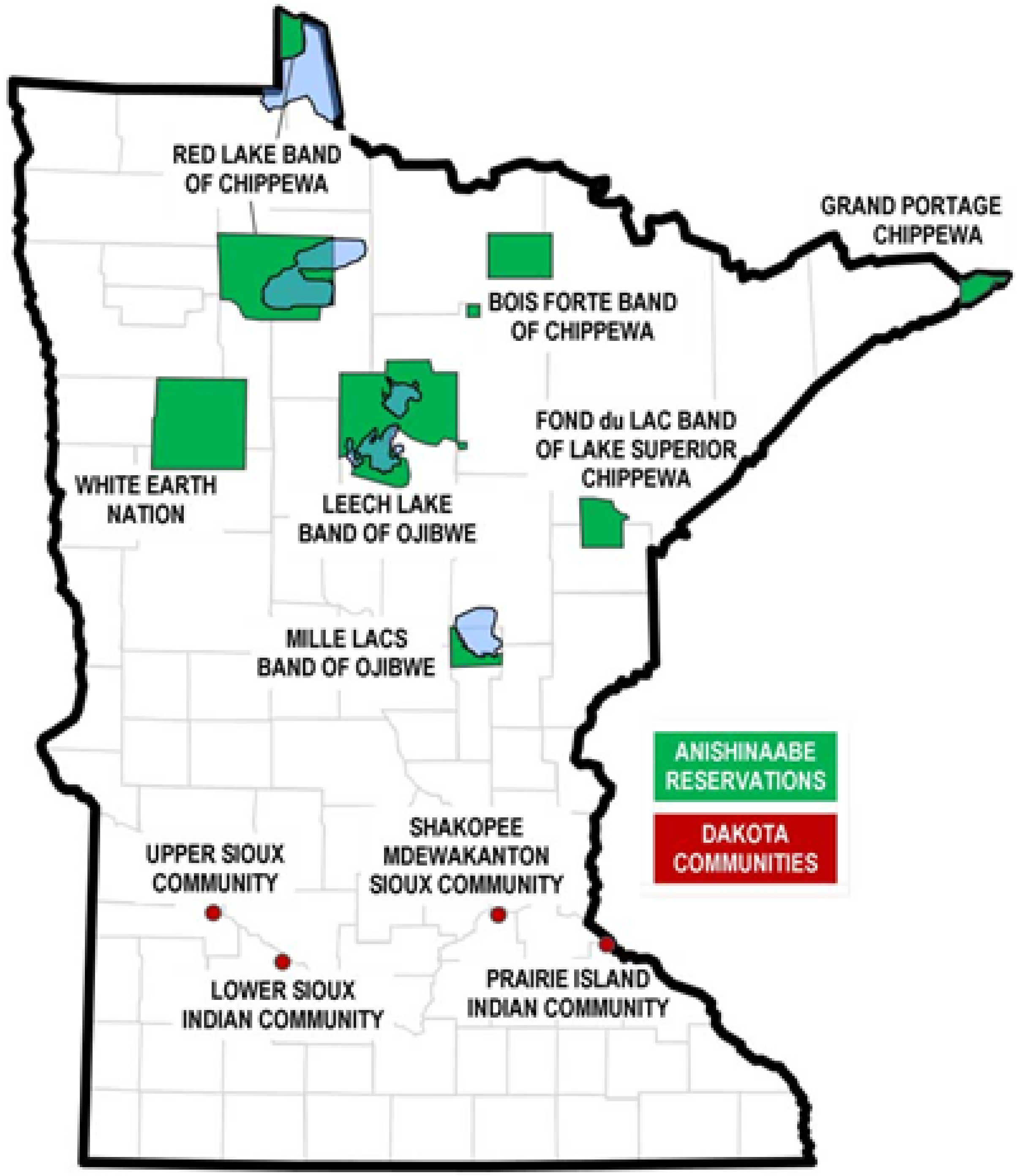


MINNESOTA
PUBLIC UTILITIES COMMISSION

Tribal Engagement

Charley Bruce | Public Engagement and Tribal Affairs

Tribal Nations in Minnesota



Graphic from
MnDOT

11 federally recognized Tribal Nations in Minnesota

- 7 Ojibwe and 4 Dakota

There are different government structures

- A chair and a three-to-five-member council,
- An executive branch and legislative branch,
- A council and district representatives

Minnesota is made up of Treaty Lands – 1837, 1847, 1851, 1854, 1858, 1863, 1866, 1889

- Each treaty had different impacts in different areas of the state, but many dealt with land concessions, creation of reservations, and the rights of Tribal Nations

Tribal Nations are served by many utilities

- Most reservations are served by electric cooperatives, and usually multiple utilities
- Most reservations do not have natural gas service

Tribal consultation policy background and update

The Commission adopted a Tribal Consultation Policy in 2019. It was most recently revised in 2023.

In 2019, Chair Sieben notified Gov. Walz and Lt. Gov. Flanagan of the Commission's intent in implementing the spirit of MN Stat 10.65 and designated a Tribal Liaison.

In 2024, the PUC successfully pursued legislation to add the Commission to MN Stat. 10.65. The permitting reform legislation will also impact how the PUC interacts with Tribal Nations.

The Consultation Policy can be viewed on our website

Tribal consultation policy

Recognizes the Unique Government-to-Government relationship Between Tribal Nations and the State of Minnesota

Annual Consultations

Issue Consultations

Commissioner & Staff Responsibilities

Limitations

Enhanced Notification

The Commission's consultation plan outlines two types of consultations

Annual Consultations

- Annual consultations occur once a year and are a chance for Tribal leadership and PUC Commissioners to meet and speak about issues important to both entities.
- Consultations often occur in person at a Tribal Nation's facility.
- The Commission brings one or two commissioners, sometimes senior leadership, and the Tribal Liaison.

Issue Consultations

- These are staff level meetings where we work on specific issues that come up. These are still important, but do not necessitate getting Tribal or PUC leadership involved.
- These meetings have generally occurred via telephone or Teams/Webex.

Limitations

The Commission is a quasi-judicial organization and operates under communication and operation restrictions

- Ex Parte communications restriction, ethics rules, open meeting law

How this works out in practice

- During a consultation, we only bring one or two commissioners.
- If there is a docket open, the PUC will provide information updates, but avoid talking about the merits of the issues in the docket.
- When it's an issue consultation with staff, we file a permissible ex parte communications report.

Enhanced notification

The Commission commits to notifying Tribal Nations in Minnesota about issues that may impact their government or citizens

- Maintaining contact lists for Tribal Councils (and key staff), Tribal Historic Preservation Officers
- Creating contact lists for Tribal Nations with treaty rights that are outside of Minnesota
- Issue-specific outreach to key staff
- Participation in Tribally led organizations

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Thank You!

Break

Please return at 2:45pm

Small Group Discussions

Small Group Discussion

2:45pm–3:15pm

- How should MP balance different factors when developing their IRP (cost, affordability, technology readiness, equity and environmental justice, reliability, etc.)?
- How can MP balance the need to serve communities that have not benefitted from being a host community with the need for a just transition for current host communities?
- How should MP best engage communities to understand their needs and experiences? How can we work equity considerations into the process itself?

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Large Group Discussion

Wrap-Up and Next Steps

- Materials from today's meeting will be shared.
- Upcoming meetings:
  - TAG Meeting #4: Monday, June 17, 1:00-4:00pm
  - Next SAG Meeting: TBD (summer)
  - Engagement Meeting #3: October
- Questions and additional feedback can be sent to Alissa (abemis@gpisd.net).

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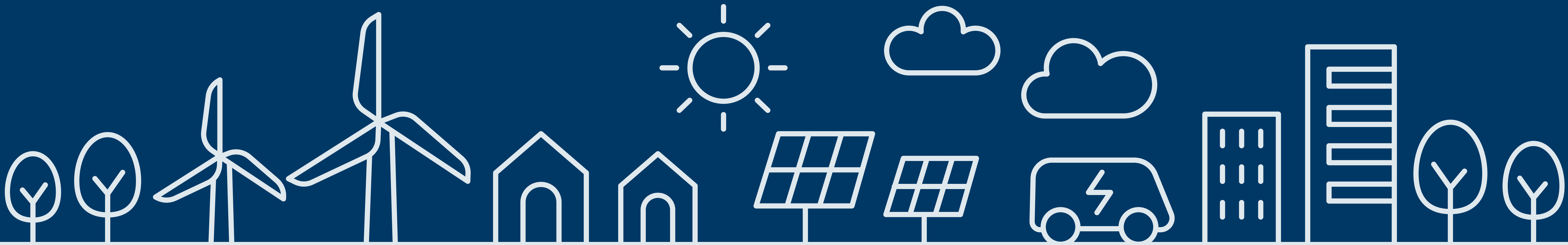
Thank you!



Minnesota Power 2025 IRP: Engagement Meeting 3

FRIDAY, JANUARY 31, 2025, 9:00AM-11:00AM

Virtual Meeting: Click here to join the call

Purpose Statement

This stakeholder engagement process will play a pivotal role in informing the development of Minnesota Power's 2025 integrated resource plan (IRP). Key issues to discuss include the following:

- **Meeting the ambitious requirement of 100% carbon free energy** by identifying the right resources, understanding their impact on the system, and continuing to offer reliable and affordable energy throughout the clean energy transition.
- **Shaping the energy future in the communities Minnesota Power serves**, including direct impacts on key facilities such as the Boswell Energy Center and the Hibbard Renewable Energy Center.

Minnesota Power is committed to amplifying underrepresented voices and is striving for an inclusive and comprehensive process that reflects the diverse perspectives of our communities.

Meeting Goals

1. Build a shared understanding of the SAG process and the resulting Societal Cost Benefit Analysis Framework; solicit any final feedback on the framework.
2. Build a shared understanding of the TAG process and allow time for Q&A on the modeling assumptions.
3. Clarify next steps for the IRP process.

Agenda

9:00AM	**Welcome & Review of Agenda**
9:10AM	**Presentation: Recap of the SAG Process and Key Takeaways**
9:30AM	**How the SCBA Framework will inform the IRP; Discussion**
10:10AM	**Presentation: Recap of the TAG Process**
10:25AM	**Questions & Discussion**
10:55AM	**Wrap-up and Next Steps**
11:00AM	**ADJOURN**

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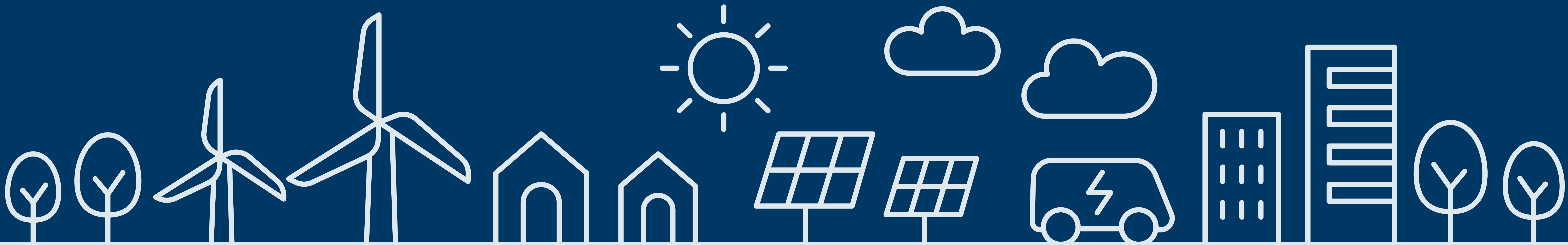
Minnesota Power
2025 Integrated Resource Plan

Engagement Meeting #3

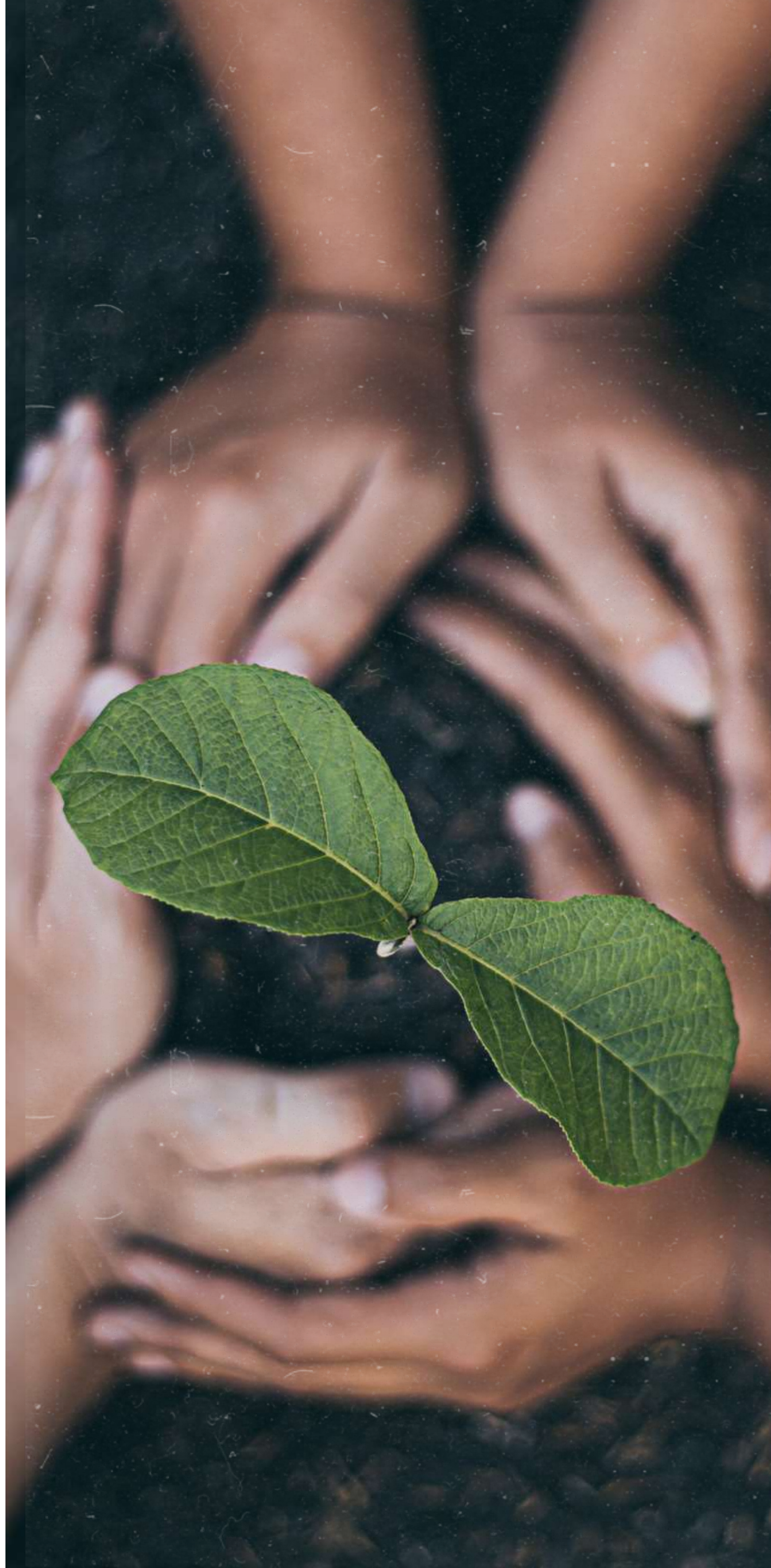
January 31, 2025

Virtual Meeting



Goals for today

1. Build a shared understanding of the Societal Advisory Group (SAG) process and the resulting Societal Cost Benefit Analysis Framework; solicit any final feedback on the framework.
2. Build a shared understanding of the Technical Advisory Group (TAG) process and allow time for Q&A on the modeling assumptions.
3. Clarify next steps for the IRP process.



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Agenda

9:00am	Welcome & Review of the Agenda
9:10am	Presentation: Recap of the SAG Process and Key Takeaways
9:30am	How the SCBA Framework will inform the IRP; Discussion
10:10am	Presentation: Recap of the TAG Process
10:25am	Questions & Discussion
10:45am	Wrap-up and Next steps
11:00am	Adjourn

Recap of the SAG Process and Key Takeaways

Order Points:

In approving Minnesota Power's 2021 IRP, the Commission ordered the following for the company's next IRP:

- 2d. All retirement scenarios at Boswell must also include a comprehensive analysis of reliability, customer rate implications, any proposal or Commission decision with respect to NTEC capacity, worker transition, and socioeconomic impacts, including projected impacts on the local tax base for the City of Cohasset and Itasca County.
- 11. In its next resource plan, Minnesota Power must work with stakeholders, including but not limited to parties to the current proceeding, to include a stakeholder report, consistent with the following:
    - Minnesota Power will work to intentionally include stakeholders from groups historically not present in these regulatory processes, like low-income customers and customers from BIPOC (black, indigenous, and communities of color) communities.
    - Stakeholders will provide input on a societal cost benefit analysis of Boswell Unit 4 and Hibbard Renewable Energy Center, considering impacts on host communities, workforce, economics, health, system reliability, the environment, and customer costs.
    - An analysis of the near-term steps needed to ensure Minnesota Power meets clean energy goals set in Minnesota state statute.

Impact Areas for Societal BCA evaluation

Minnesota Power hoped create understanding around the following key questions:

1. What is most important to stakeholders?
2. What do stakeholders want Minnesota Power to optimize its system for?
3. What are the benefits stakeholders want to create and the drawbacks stakeholders want to avoid?
4. Where are there potential trade-offs, real or perceived, in trying to balance the full set of issues that stakeholders care about?

Customer Perspective Area

Impact Area 1: Competitive rates for large power and municipal customers
Impact Area 2: Transparent and predictable rates for commercial customers
Impact Area 3: Affordable rates for residential customers
Impact Area 4: Power reliability, quality, and resiliency

Environmental Perspective Area

impact Area 5: Impacts to air, water, and land
Impact Area 6: Environmental justice and public health
Impact Area 7: Greenhouse gas emissions

Local Economy Perspective Area

Impact Area 8: Tax base
Impact Area 9: Jobs
Impact Area 10: Social and economic ripple effects

Utility Perspective Area

Impact Area 11: Responsibility/ privilege to serve
Impact Area 12: Planning and operations, utility health, and regional stability
Impact Area 13: Grid readiness
Impact Area 14: Carbon free technology and adoption

SAG Process

Meeting 1:

- GPI & CEE asked participants if the Issue Map from MP's 2021 IRP could be used as a basic structure for the SCBA. Most participants agreed.
- Participants provided feedback on which elements should be kept, revised, or removed.

Meeting 2:

- GPI & CEE presented an updated proposal for the framework informed by research conducted, including the SCBA Table.
- Participants provided feedback on the Customers and Environment perspectives.

Meeting 3:

- Participants provided feedback on the Local Economy and Utility perspectives.
- Between and after the meetings, GPI, CEE, and MP updated the framework based on feedback. Additional opportunities to provide written feedback were given.

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Rating Scale

Impact Area 7: Greenhouse Gas Emissions		
0 Unacceptable	1 Acceptable	2 Best Case
Minnesota Power's system is on a path to maintain or increase total GHG emissions by 2040.	Minnesota Power's system is on a path to fully decarbonize by 2040 and to achieve interim carbon-free electricity goals.	Minnesota Power's system is on a path to fully decarbonize well in advance of the 2040 state goal to exceed interim goals. Upstream supply chain emissions are considered and minimized where possible.

[Site Name] Societal Cost Benefit Analysis -- EXAMPLE FOR ILLUSTRATION

Perspective: Customers

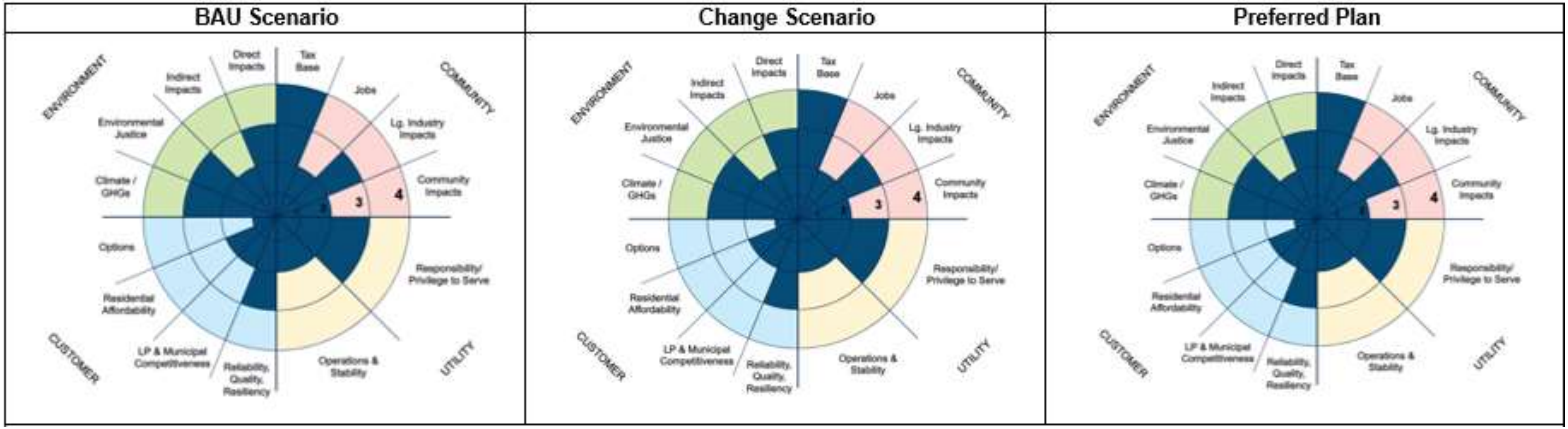
Impact Area	Business-as-Usual Scenario Costs and benefits of continued operation without change.	Change Scenario Costs and benefits of the change being evaluated (e.g., recommission or retire)
Competitive rates for large power and municipal customers	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Transparent and predictable rates for commercial customers	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Affordable rates for residential customers	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Power reliability, quality, and resiliency	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*

Perspective: Environment

Impact Area	Business-as-Usual Scenario	Change Scenario
Impacts to air, land, and water	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Environmental justice and public health	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*
Greenhouse gas emissions	*Insert qualitative/ quantitative information*	*Insert qualitative/ quantitative information*

Impact Map

For illustration purposes only



*Please note, the impact map is being updated to be a three-point scale.

- Does the SCBA make sense to you?
- Is there anything you find confusing or unclear?
- Do you feel like anything major is missing from the SCBA (if so, what is it)?
- Are there parts of the SCBA that you really like (if so, what)?
- Any other final feedback you'd like to share?

Recap of the Technical Advisory Group (TAG) Process and Key Takeaways

TAG Process Timeline

March 11, 2024:
- Process overview
- Overview of MN Power's service territory, customer mix, generation supply, and power needs
- IRP overview
- Modeling considerations

April 15, 2024:
- Best practice in reliability planning
- Resource adequacy drivers and requirements under MISO
- Overview of the IRA, including key opportunities for the electric sector

May 20, 2024:
- Continued discussion on defining MP reliability criteria
- Operational characteristics of a changing power supply
- Discussion of different technology options
- Data source options

June 17, 2024:
- Continued discussion of different technology options
- Overview of MN Power's electricity sales and projected growth (including peak demand)
- Impact of MN Power's customer programs, program trends/projections, and program-specific considerations for the IRP.

July 22, 2024
- MISO's reliability and resource adequacy context
- Approaches and considerations related to long-duration energy storage
- Cost Considerations
- Overview of sensitivity analysis purpose and sensitivities under consideration

October 6, 2024:
- Considerations related to MN Power's distribution system planning approach
- Transmission planning considerations
- Encompass modeling process and technical considerations

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Technology Characteristics and Associated System Considerations

- Characteristics of different energy technologies:
  - How those characteristics contribute to broader grid conditions
  - Technology-specific reliability considerations
- Participants had questions about resource needs and overall grid characteristics within MN Power's system versus the broader MISO grid.
- Solar and storage modeling considerations:
  - MN Power's solar procurement plans
  - Role of storage in meeting grid needs, including charging timeframes
  - MN Power expressed a need for long duration, high energy output storage capabilities

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Technology Deployment Considerations

- Technology readiness and deployment timelines:
  - Market readiness of different technologies
  - Deployment timelines especially important for storage—different types of storage offer different capabilities to serve the system and address critical needs, but not all storage types are as market-ready as others.
- Reflected on the challenge of technology readiness and timeline for the Minnesota Carbon Free Standard requirements, resource eligibility
- Discussion of technologies that could potentially operate on smaller pilot-level scales—participants expressed interest in incorporating pilot-scale technologies into 2025 IRP modeling, including:

100-hour iron-air battery storage	Virtual power plants
Local biomass (as a near-term local baseload option)	Grid-enhancing technologies
Geothermal energy generation	Fuel cells

Load Growth, Sales Outlook, and Customer Programs

- Major sources of expected load growth across MN Power's service territory include:
  - data centers
  - green steel
  - overall electrification (building electrification, electric vehicles, industrial electrification, etc.)
- Participants were interested in alternative load growth scenarios that MN Power might explore in the IRP
  - Base-, high-, low-, and load growth scenarios are typical
  - Some participants were curious what a negative load growth scenario would look like, informed by factors that contributed to past increases and reductions in load.
- Customer programs are important factors in load growth and system peak
  - Program participation can impact electrification trends, overall efficiency, and demand via demand response programs.
  - Participants interested in better understanding Minnesota Power's electric vehicle growth rates—whether EV adoption might differ across the utility's urban and rural service territory.

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Changing Conditions

- The TAG discussed the challenge of resource planning when faced with more variability than ever before and the need to incorporate different scenarios and sensitivities into models to reflect different potential futures.
  - Potential shift from a summer peak to a winter peak (residential)
  - Storage is an important technology for ensuring reliability under increasingly variable weather conditions and shifting system peaks.
- Changes in the economic and policy/regulatory landscape
- Resource costs
  - Fuel costs
  - Sources for informing solar, wind, and storage cost estimates

For EnCompass Modelers:

Seeking Feedback if there is Interest in a Model Overview Meeting Post IRP Filing?

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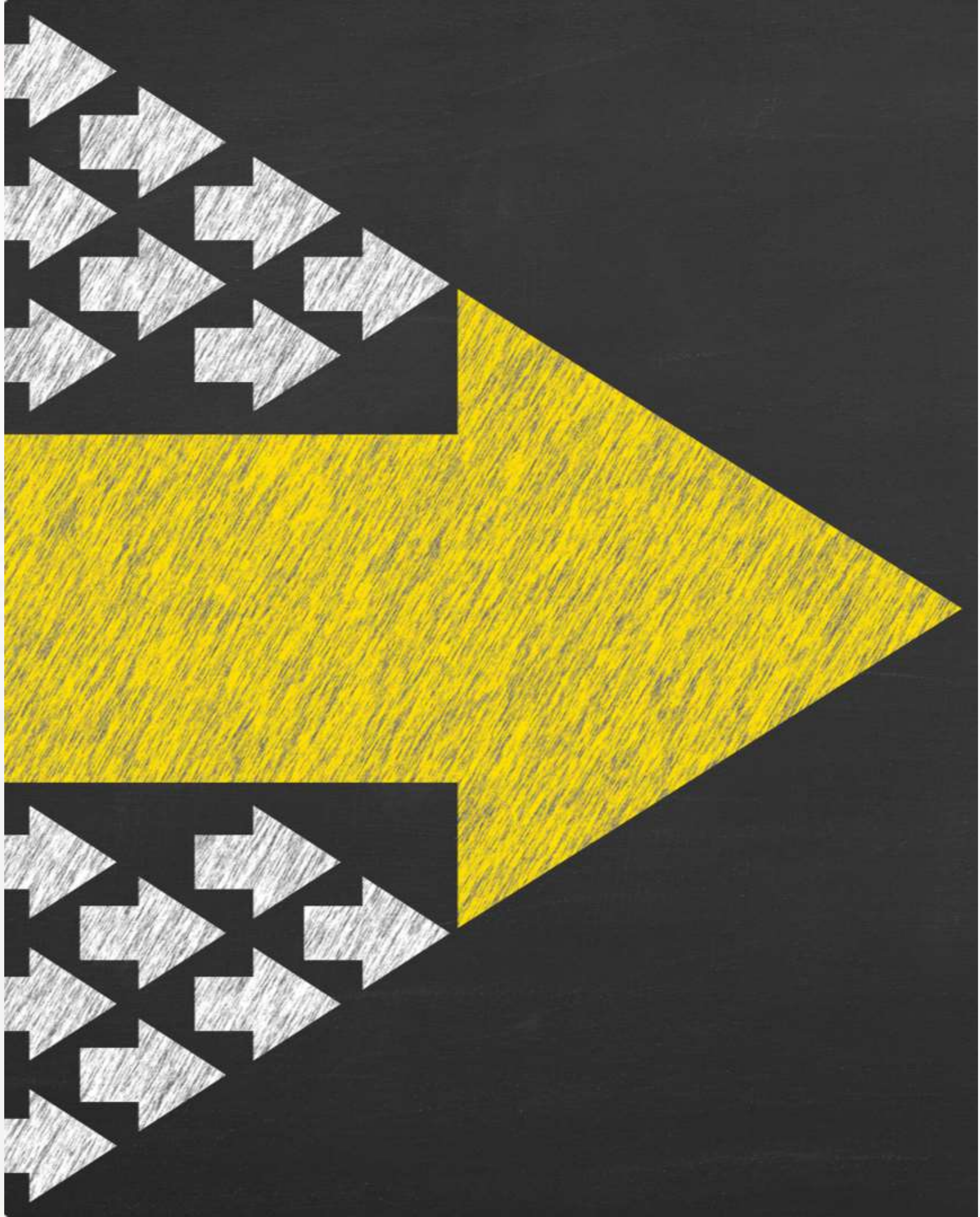
Discussion and Questions?

Next Steps

- Minnesota Power will be finalizing the engagement report in the next week
- Minnesota Power will submit the final engagement report with their IRP filing on March 3
- Thank you!



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Thank you!

ATTACHMENT B: SOCIETAL ADVISORY GROUP MEETING MATERIALS

Minnesota Power 2025 IRP: SAG Meeting 1

MONDAY, JUNE 3, 2024

Hybrid Meeting

In-person: Holiday Inn & Suites; 200 West First Street, Duluth, MN 55802; Lake Superior Room

Virtual (Zoom): Please join here

Purpose Statement

The Societal Advisory Group (SAG) will help inform and refine the framework that Minnesota Power will use to understand potential impacts associated with Minnesota Power plants, including but not limited to the Hibbard Renewable Energy and Boswell Unit 4. The framework will consider positive and negative impacts on host community members and stakeholders, workforce, economics, health, system reliability, the environment, and customer costs.

Pre-Reads

1. Issue Map summary document.

Meeting Goals

1. Build a shared understanding of the goals of and process for this working group.
2. Build a shared understanding of how this framework will be used to inform Minnesota Power's IRP.
3. Review and discuss the issue map, seeking to answer the following questions:
    a. Does the issue map provide an effective foundation for a framework used to understand impacts associated with Minnesota Power's power plants?
    b. Which parts of the issue map are suitable for evaluating individual power plants and should be kept as-is?
    c. Are there parts of the issue map that should be revised? If so, what are they?
    d. Are there gaps in the issue map that should be added? If so, what are they?
    e. Are there parts of the issue map that should be removed? If so, what are they?
4. Identify topics to discuss in future meetings.

Agenda

This is a working lunch; please arrive between 11–11:30 to grab your meal before the meeting.

11:30am	**Welcome, introductions & process overview**
11:45pm	**Why Minnesota Power is developing this framework**
12:00pm	**Review and discuss issue map**
1:30pm	**Identify topics to discuss at future meetings**
1:45pm	**Adjourn and board bus for tour of Thomson Hydro (if attending)**
2:30pm	**Tour of Thomson Hydro (if attending)**

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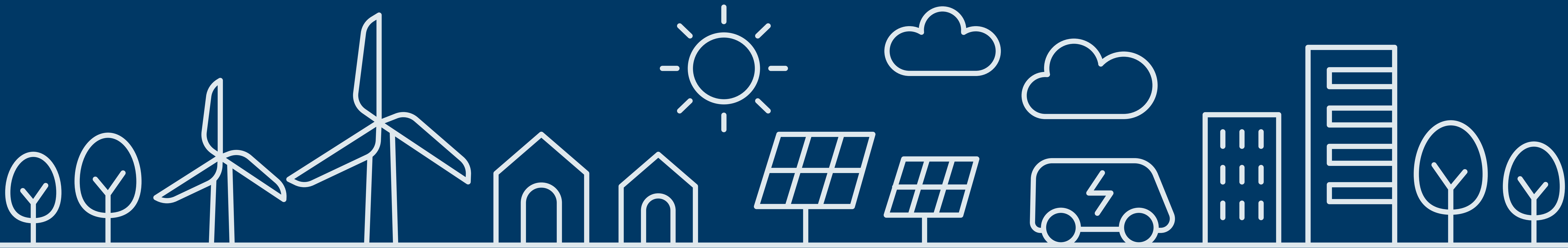
Minnesota Power 2025 Integrated Resource Plan

Societal Advisory Group Meeting #1

June 3rd, 2024

Duluth, MN



Agenda

11:30am	**Welcome, Introductions & Process Overview**
11:45am	**Why Minnesota Power is Developing this Framework**
12:00pm	**Review & Discuss Issue Map**
1:30pm	**Identify Topics for Future Meetings**
1:45pm	**Adjourn & Board Bus for Tour of Thompson Hydro**

Purpose of the Societal Advisory Group

The Societal Advisory Group (SAG) will help inform and refine the framework that Minnesota Power will use to understand potential impacts associated with Minnesota Power Plant, including but not limited to the Hibbard Renewable Energy and Boswell Unit 4. The framework will consider positive and negative impacts on host community members and stakeholders, workforce, economics, health, system reliability, the environment, and customer costs.

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Goals for today

1. Build a shared understanding of the goals and process for this working group.
2. Build a shared understanding of how this framework will be used to inform Minnesota Power's IRP.
3. Review and discuss the issue map, seeking to answer the following questions:
    - Does the issue map provide an effective foundation for a framework used to understand impacts associated with Minnesota Power's power plants?
    - Which parts of the issue map are suitable for evaluating individual power plants and should be kept as-is?
    - Are there parts of the issue map that should be revised? If so, what are they?
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    - Are there parts of the issue map that should be removed? If so, what are they?
4. Identify topics to discuss in future meetings.

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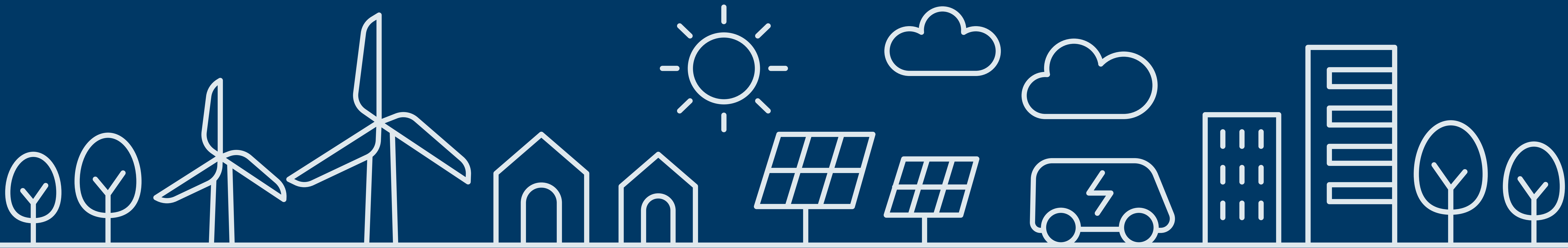
Process Overview



TAG and SAG

Technical Advisory Group (TAG):

This group will inform the IRP modeling assumptions and discuss other IRP technical issues.

Societal Advisory Group (SAG):

Today! This group will review and revise the Issue Map from the 2021 IRP process so it can be used as a societal cost benefit analysis for any MP generation facility.

Engagement Meetings:

Tomorrow! Participants from both advisory groups, as well as participants not involved in either group. These meetings will help inform the 2025 IRP.

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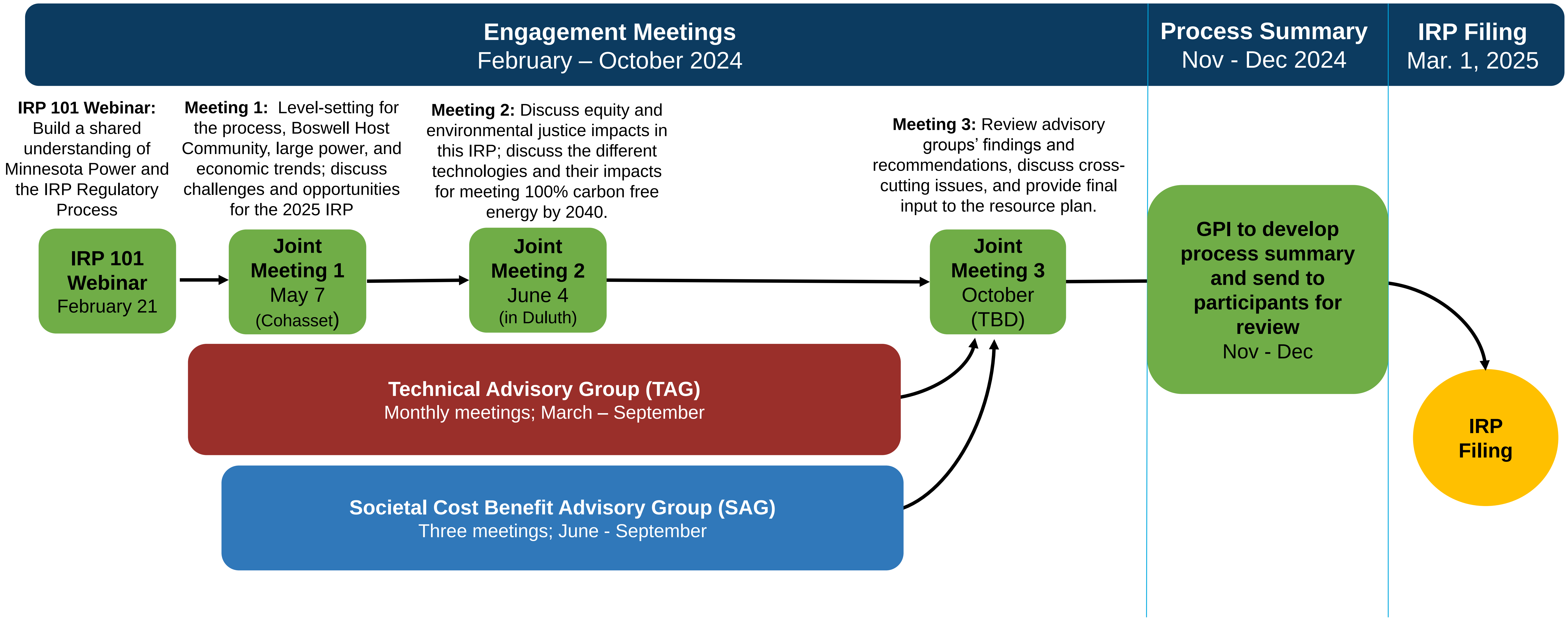
MINNESOTA POWER 2025 IRP—ENGAGEMENT MEETING TIMELINE

NOTE: Dates and topics are subject to change to meet the group's needs.



Ground Rules for Participation

- **Respect the time.** Your time together is limited and valuable, so please be mindful of the time and of others' opportunity to participate.
- **Respect each other.** Help us all to uphold respect for each other's experiences and opinions, even in difficult conversations. We need everyone's wisdom for the greatest results.
- **Have fun!** This is a unique opportunity to develop relationships with and see the humanity in people who may not share your same worldview. While discussing serious and contentious issues, let's all remember to have some fun and humor while maintaining respect.

Questions?

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Issue Map

Order Points

In approving Minnesota Power's 2021 IRP, the Commission ordered the following for the company's next IRP:

- 2d. All retirement scenarios at Boswell must also include a comprehensive analysis of reliability, customer rate implications, any proposal or Commission decision with respect to NTEC capacity, worker transition, and socioeconomic impacts, including projected impacts on the local tax base for the City of Cohasset and Itasca County.
- 11. In its next resource plan, Minnesota Power must work with stakeholders, including but not limited to parties to the current proceeding, to include a stakeholder report, consistent with the following:
  a. Minnesota Power will work to intentionally include stakeholders from groups historically not present in these regulatory processes, like low-income customers and customers from BIPOC (black, indigenous, and communities of color) communities.
  b. Stakeholders will provide input on a societal cost benefit analysis of Boswell Unit 4 and Hibbard Renewable Energy Center, considering impacts on host communities, workforce, economics, health, system reliability, the environment, and customer costs.
  c. An analysis of the near-term steps needed to ensure Minnesota Power meets clean energy goals set in Minnesota state statute.

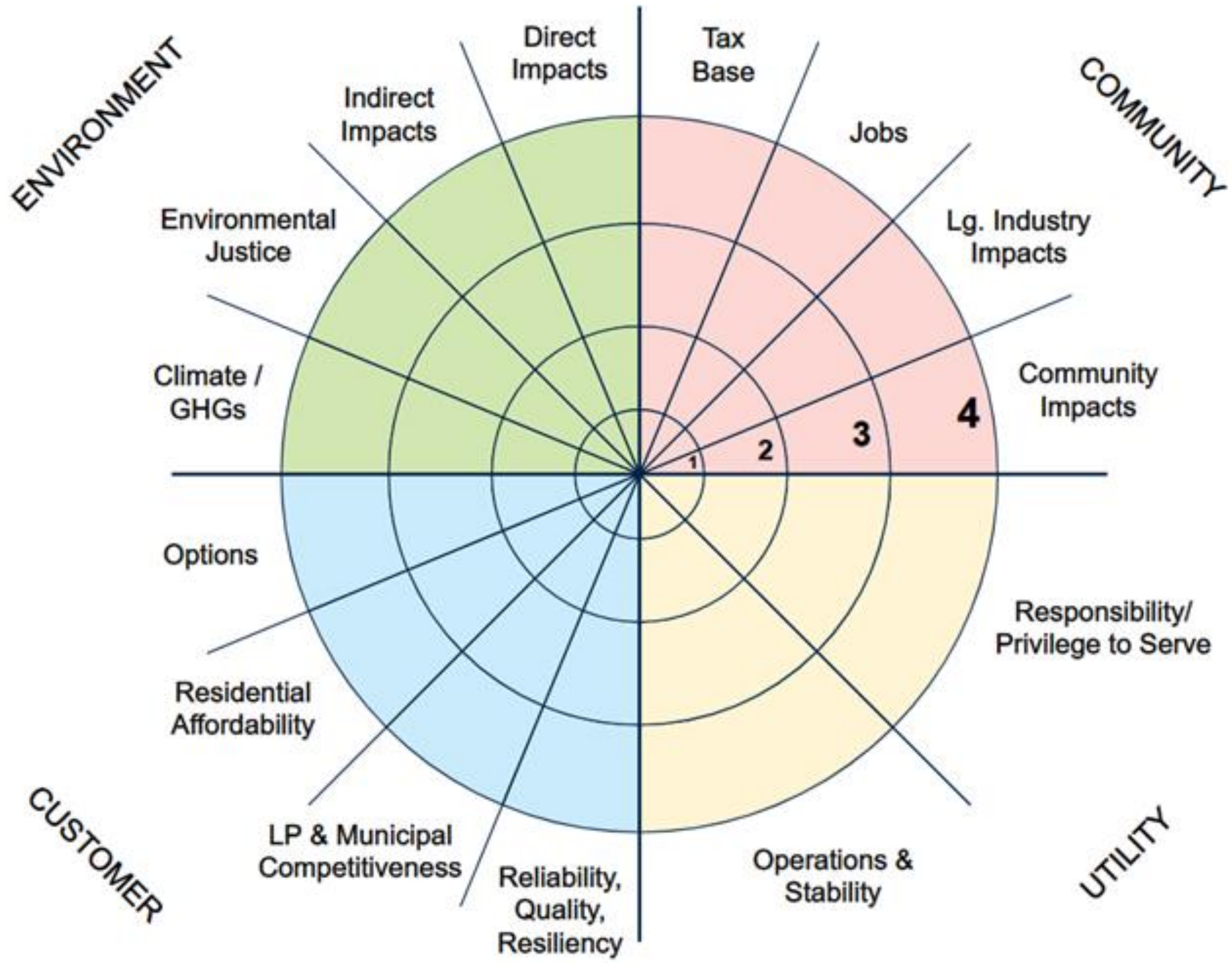
Why the Issue Map?

The Issue Map was developed during the 2021 IRP stakeholder engagement process as a tool to foster dialogue and understanding about how different future planning scenarios might impact the things that MP's customers, communities, and stakeholders care about most.

The facilitators hoped to create understanding around the following key questions:

1. What is most important to stakeholders?
2. What do stakeholders want MP to optimize its system for?
3. What are the benefits stakeholders want to create and the drawbacks stakeholders want to avoid?
4. Where are there potential trade-offs, real or perceived, in trying to balance the full set of issues that stakeholders care about?

Issue Map (from 2021 IRP process)

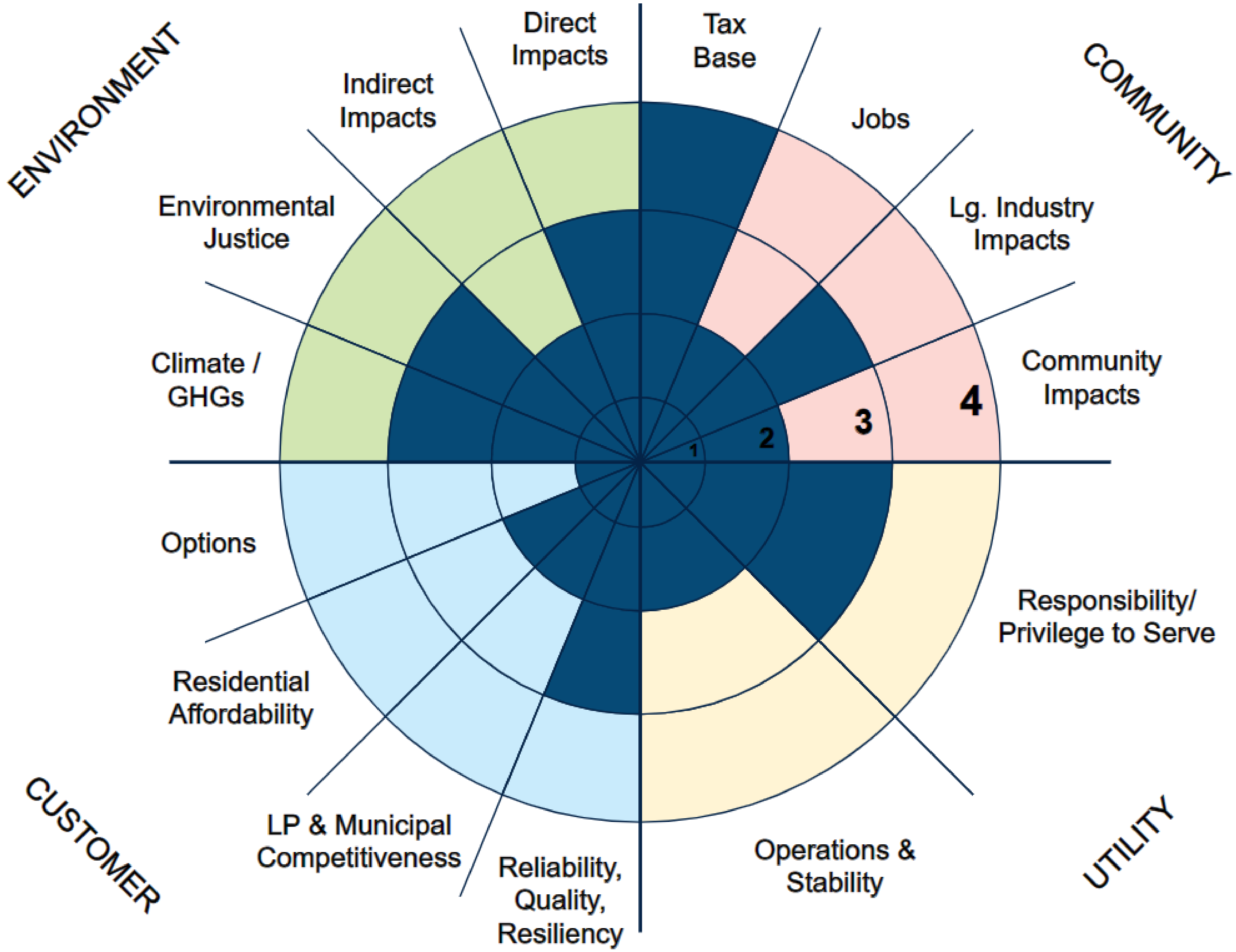


Rating Scale

Issue 1: Customer Options				
0 Worst Case	1 Poor	2 Barely Acceptable	3 Good	4 Best Case
Customers referenced as "load" without rate and program options offered (viewed as a burden on the system).	Demand response offered on limited occasions, with limited rate and program options for all customers.	Some rate and program options are available, but with limited choices (offer 1 major option, 1–2 limited options).	All customers have rate and program options that are communicated well and are focused on the things consumers value (including price and other things).	"Good" and all customers have multiple rate and program options, appropriately segmented and targeted by usage patterns.

Complete Issue Map

For illustration purposes only



Questions?

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Discussion Questions

- Does the issue map provide an effective foundation for a framework used to understand impacts associated with Minnesota Power's power plants?
- Which parts of the issue map are suitable for evaluating individual power plants and should be kept as-is?
- Are there parts of the issue map that should be revised? If so, what are they?
- Are there gaps in the issue map that should be added? If so, what are they?
- Are there parts of the issue map that should be removed? If so, what are they?

Topics for Future Meetings?

Wrap-Up and Next Steps

- Materials from today's meeting will be shared.
- Upcoming meetings:
  - Tomorrow! Engagement Meeting #2 (in-person in Duluth): Tuesday, June 4, 8:30am – 3:30pm
  - TAG Meeting #4: Monday, June 17, 1:00-4:00pm
  - Next SAG Meeting: TBD (Summer)
  - Engagement Meeting #3: October
- Questions and additional feedback can be sent to Alissa (abemis@gpisd.net).

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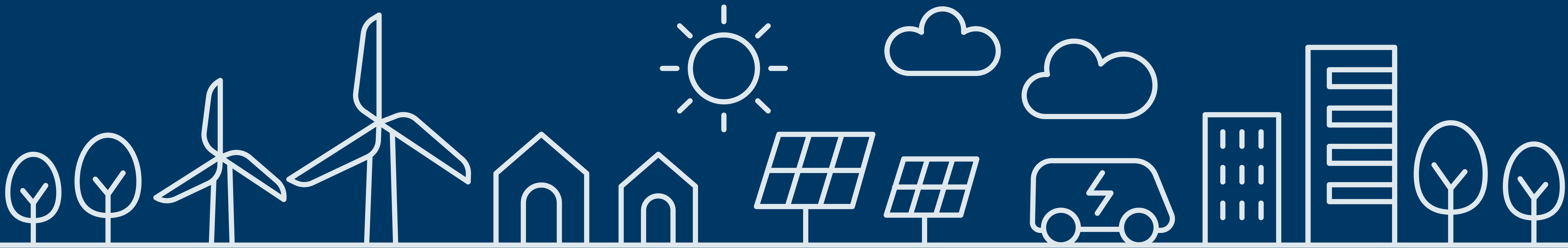
Thank you!



Minnesota Power 2025 IRP: SAG Meeting 2

MONDAY, JULY 29, 2024, 2:00PM-5:00PM

Virtual Meeting - Click here to join

Purpose Statement

The Societal Advisory Group (SAG) will help inform and refine the framework that Minnesota Power will use to understand potential impacts associated with Minnesota Power plants, including but not limited to the Hibbard Renewable Energy and Boswell Unit 4. The framework will consider positive and negative impacts on host community members and stakeholders, workforce, economics, health, system reliability, the environment, and customer costs.

Pre-Meeting

1. Read updated Societal Cost Benefit Framework summary document.
2. Provide feedback to GPI via email.
    a. Do you have any clarifying questions?
    b. Which parts of the updated framework should be kept as is?
    c. Are there parts of the updated framework that should be revised to make it more effective? If so, what are they?
    d. Are there parts of the updated framework that should be added to make it more effective? If so, what are they?
    e. Are there parts of the updated framework that should be removed to make it more effective? If so, what are they?

Meeting Goals

1. Build a shared understanding of how this framework will be used to inform Minnesota Power's IRP.
2. Review and discuss the updated framework, seeking to answer the above questions.

Agenda

2:00PM	**Welcome, introductions & process overview**
2:15PM	**Update from MP**
2:30PM	**Examples of other Societal Cost Benefit Analyses?**
2:45PM	**How will the Framework inform Minnesota Power's IRP?**
3:00PM	**Review and discuss framework**
3:30PM	**Break**
3:45PM	**Continue review and discuss framework**
5:55PM	**Next steps**
5:00PM	**Adjourn**

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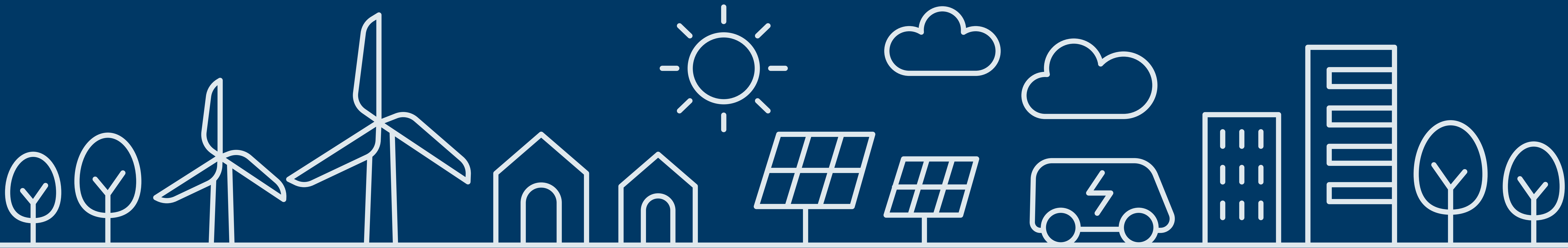
Minnesota Power 2025 Integrated Resource Plan

Societal Advisory Group

Meeting #2

July 29th, 2024

Virtual



Agenda

2:00PM	Welcome, Introductions & Process Overview
2:15PM	Update from MP
2:30PM	Background: Societal Cost Benefit Analyses
2:45PM	How will the Framework inform Minnesota Power's IRP?
3:00PM	Review and Discuss Framework
3:30PM	Break
3:45PM	Review and Discuss Framework
4:55PM	Next Steps and Adjourn

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Purpose of the Societal Advisory Group

The Societal Advisory Group (SAG) will help inform and refine the framework that Minnesota Power will use to understand potential impacts associated with Minnesota Power Plants, including but not limited to the Hibbard Renewable Energy and Boswell Unit 4. The framework will consider positive and negative impacts on host community members and stakeholders, workforce, economics, health, system reliability, the environment, and customer costs.

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Goals for today

1. Build a shared understanding of how this framework will be used to inform Minnesota Power's IRP.
2. Review and discuss the updated framework, seeking to answer the following questions:
   - Do you have any clarifying questions?
   - Which parts of the updated framework should be kept as is?
   - Are there parts of the updated framework that should be revised to make it more effective? If so, what are they?
   - Are there parts of the updated framework that should be added to make it more effective? If so, what are they?
   - Are there parts of the updated framework that should be removed to make it more effective? If so, what are they? Identify topics to discuss in future meetings.

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Ground Rules for Participation

- **Respect the time.** Your time together is limited and valuable, so please be mindful of the time and of others’ opportunity to participate.
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- **Have fun!** This is a unique opportunity to develop relationships with and see the humanity in people who may not share your same worldview. While discussing serious and contentious issues, let’s all remember to have some fun and humor while maintaining respect.

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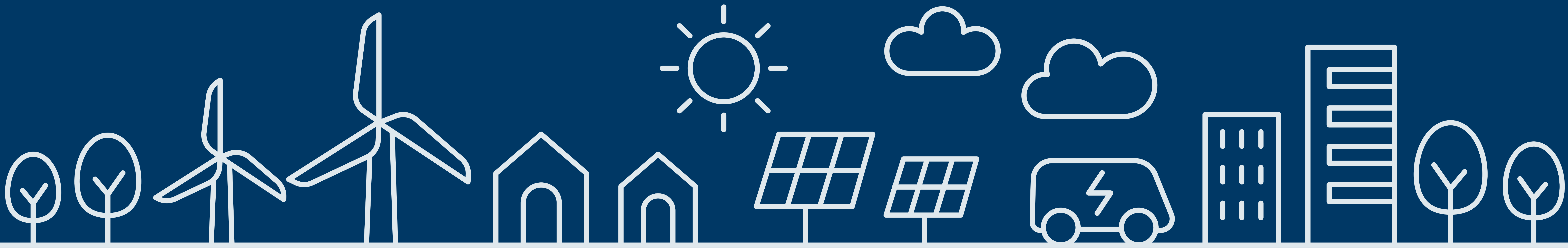
Process Overview



TAG and SAG

Technical Advisory Group (TAG):

This group will inform the IRP modeling assumptions and discuss other IRP technical issues.

Societal Advisory Group (SAG):

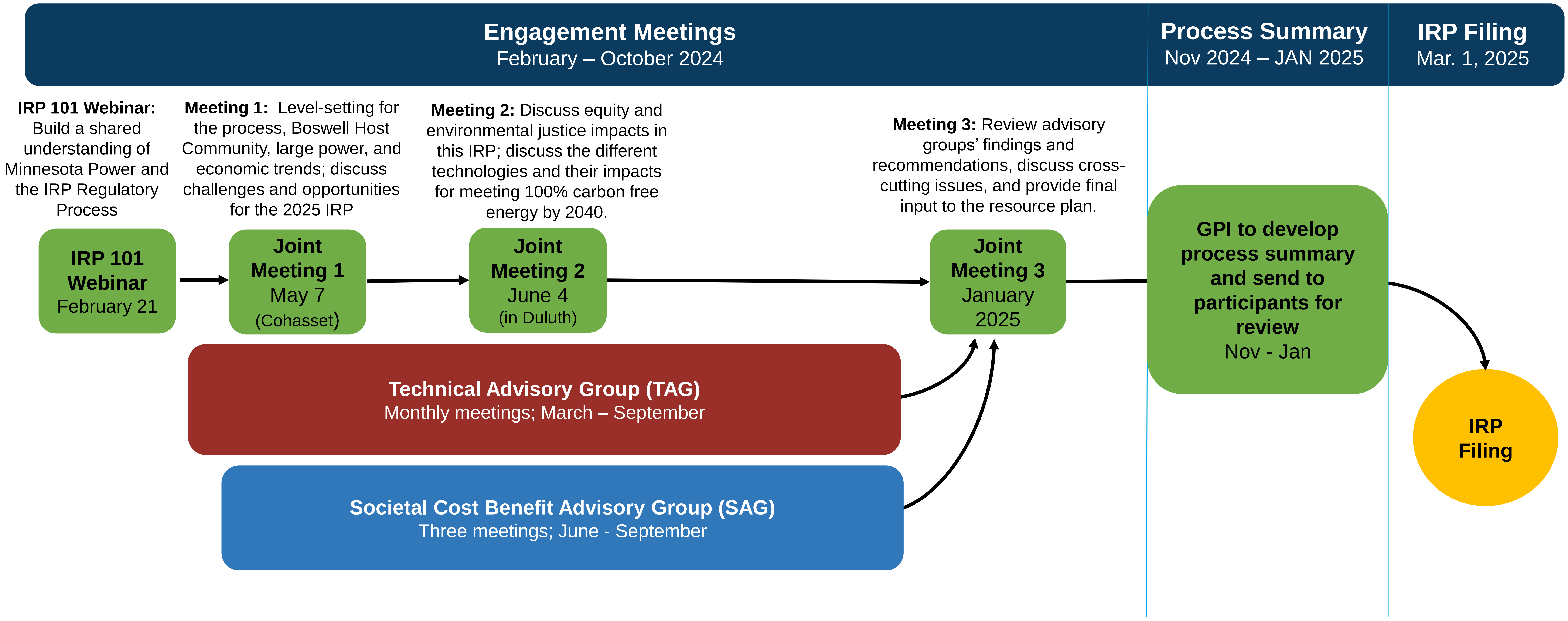
Today! This group will review and revise the Issue Map from the 2021 IRP process so it can be used as a societal cost benefit analysis for any MP generation facility.

Engagement Meetings:

Participants from both advisory groups, as well as participants not involved in either group. These meetings will help inform the 2025 IRP.

MINNESOTA POWER 2025 IRP—ENGAGEMENT MEETING TIMELINE

NOTE: Dates and topics are subject to change to meet the group's needs.



Questions?

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Background: Societal Cost Benefit Analyses

Minnesota PUC Orders Societal Cost Benefit Analysis

In approving Minnesota Power's 2021 IRP, the Commission ordered the following for the company's next IRP:

- 2d. All retirement scenarios at Boswell must also include a comprehensive analysis of reliability, customer rate implications, any proposal or Commission decision with respect to NTEC capacity, worker transition, and socioeconomic impacts, including projected impacts on the local tax base for the City of Cohasset and Itasca County.
- 11. In its next resource plan, Minnesota Power must work with stakeholders, including but not limited to parties to the current proceeding, to include a stakeholder report, consistent with the following:
    a. Minnesota Power will work to intentionally include stakeholders from groups historically not present in these regulatory processes, like low-income customers and customers from BIPOC (black, indigenous, and communities of color) communities.
    b. Stakeholders will provide input on a **societal cost benefit analysis** of Boswell Unit 4 and Hibbard Renewable Energy Center, considering impacts on host communities, workforce, economics, health, system reliability, the environment, and customer costs.
    c. An analysis of the near-term steps needed to ensure Minnesota Power meets clean energy goals set in Minnesota state statute.

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Trends in Societal Benefit-Cost Analysis

Industry trends in application of societal benefit-cost analysis (BCA)…

Cross-jurisdictional guidance, such as the National Standards Practice Manual (NSPM), help align BCA principles and consider common ways to measure benefits, understand practices, implement policy, etc. These tools are often applied in utility planning proceedings with adjustments to capture locally-relevant concerns.

Societal costs often intend to capture "indirect" costs of electricity service borne by all of society, including future generations, rather than directly borne by ratepayers. These may include public health, emissions, air quality, and unique climate change risks.

Some state utility regulators convene working groups to explore costs and benefits.

U.S. Department of Energy - Distributional Equity Analysis framework seeks to allow utilities, regulators, communities, and stakeholders to evaluate implications, particularly on equity and environment within a service territory, alongside traditional BCA.

Locally relevant application of Societal BCA for Minnesota Power's IRP filing….

In complying with this Commission Order, Minnesota Power aims to organize information within the regulatory proceeding to invite thorough stakeholder feedback - clearly outlining impacts and offering insight into thought processes. The Societal BCA is then useful as an evaluation tool alongside/complementary to system modeling.

In Minnesota Power's last IRP and through stakeholder engagement, the Company sought to capture important societal costs that (a) are most impactful to the service territory and (b) are in line with both qualitative and quantitative evaluation.

Similar discussions are becoming more common in Minnesota. For example, Minnesota's gas utility regulatory are gaining experience in considering stakeholder conversations on societal cost topics (e.g. Natural Gas Innovation Act).

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How will the Framework inform Minnesota Power’s IRP?

Impact Areas for Societal BCA evaluation

Minnesota Power hoped create understanding around the following key questions:

1. What is most important to stakeholders?
2. What do stakeholders want Minnesota Power to optimize its system for?
3. What are the benefits stakeholders want to create and the drawbacks stakeholders want to avoid?
4. Where are there potential trade-offs, real or perceived, in trying to balance the full set of issues that stakeholders care about?

Customer Perspective Area
Impact Area 1: Rate and program options for all customers
Impact Area 2: Competitive rates for large power and municipal customers
Impact Area 3: Affordable rates for residential customers
Impact Area 4: Power reliability, quality, and resiliency

Environmental Perspective Area
impact Area 5: Impacts to air, water, and land
Impact Area 6: Environmental justice
Impact Area 7: Climate / Greenhouse Gas emissions

Note: This is a working document. The Societal Cost Benefit Analysis Framework will continue to be updated as Minnesota Power receives feedback from SAG participants.

Rating Scale

Impact Area 1: Rate and program options for all customers				
0 Worst Case	1 Poor	2 Barely Acceptable	3 Good	4 Best Case
Customers referenced as “load” without rate and program options offered (viewed as a burden on the system).	Demand response offered on limited occasions, with limited rate and program options for all customers.	Some rate and program options are available, but with limited choices (offer 1 major option, 1–2 limited options).	All customers have rate and program options that are communicated well and are focused on the things consumers value (including price and other things). Customers understand the rationale behind options (e.g., lower nighttime EV rates help reduce system peak).	“Good” and all customers have multiple rate and program options, appropriately segmented and targeted by usage patterns. These could be utility or market driven.

[Plant Name] Societal Cost Benefit Analysis -- EXAMPLE FOR ILLUSTRATION			
Perspective: Customers			
Impact Area	**Portfolio A – Continued Business-as-Usual Operations**	**Portfolio B – Repurpose or Retire**	**Portfolio C – Preferred Plan**
1. Rate and program options	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*
2. Competitive rates for large power and municipal customers	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*
3. Affordable rates for residential customers	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*
4. Power reliability, quality, and resiliency	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*
Perspective: Environment			
Impact Area	**Portfolio A – Continued Business-as-Usual Operations**	**Portfolio B – Repurpose or Retire**	**Portfolio C – Preferred Plan**
5. Impacts to air, land, and water	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*
6. Environmental justice	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*
7. Greenhouse gas emissions	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*	*Insert rating & qualitative/ quantitative information*

Discussion Questions

- Which parts of the updated framework should be kept as is?
- Are there parts of the updated framework that should be revised to make it more effective? If so, what are they?
- Are there parts of the updated framework that should be added to make it more effective? If so, what are they?
- Are there parts of the updated framework that should be removed to make it more effective? If so, what are they? Identify topics to discuss in future meetings.

-Break-

Please return at 3:50PM.

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Wrap-Up and Next Steps

- **Next SAG Meeting:** September 23rd, in-person in Duluth (virtual option available) with an optional tour of the M.L. Hibbard Renewable Energy Center following the meeting.
- Materials from today's meeting will be shared on the online database *(link to the database was included on the bottom of the meeting agenda.)*
- Questions and additional feedback can be sent to Deirdre (dkennedy@gpisd.net).

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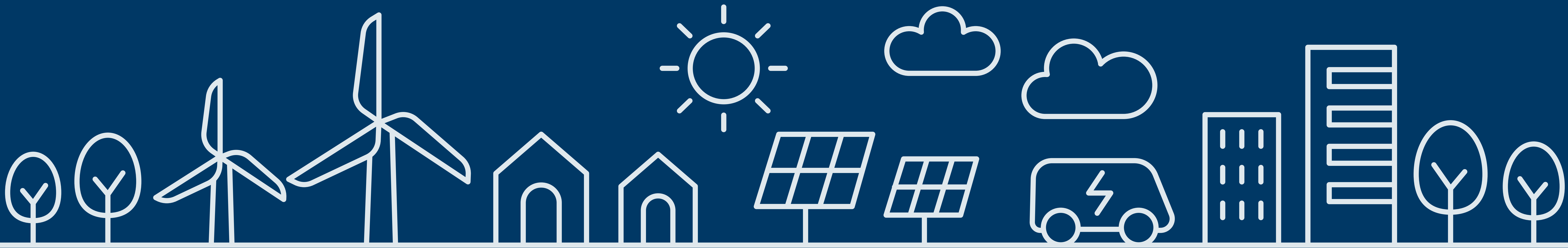
Thank you!



Minnesota Power 2025 IRP: SAG Meeting 3

MONDAY, SEPTEMBER 23, 2024, 9:00AM-12:00PM

Hybrid Meeting:

In-Person: Holiday Inn & Suites – Lake Superior Ballroom (200 West First Street, Duluth)

Virtual Link - Click here to join

TOPICS: Local Economy & Utility portions of the Issue Map

Purpose Statement

The Societal Advisory Group (SAG) will help inform and refine the framework that Minnesota Power will use to understand potential impacts associated with Minnesota Power plants, including but not limited to the Hibbard Renewable Energy Center and Boswell Unit 4. The framework will consider positive and negative impacts on host community members and stakeholders, workforce, economics, health, system reliability, the environment, and customer costs.

Pre-Meeting

1. Read updated Societal Cost Benefit Framework summary document.
2. Provide feedback to GPI via email.
    a. Do you have any clarifying questions?
    b. Which parts of the updated framework should be kept as is?
    c. Are there parts of the updated framework that should be revised to make it more effective? If so, what are they?
    d. Are there parts of the updated framework that should be added to make it more effective? If so, what are they?
    e. Are there parts of the updated framework that should be removed to make it more effective? If so, what are they?

Meeting Goals

1. Review and discuss the updated framework, focusing on the Local Economy & Utility perspectives, seeking to answer the above questions.

Agenda

9:00AM	**Welcome, introductions & process overview**
	Pastries, fruit, and beverages provided.
9:15AM	**Review & Discuss Framework**
10:30AM	**Break**
10:45AM	**Continue Review & Discuss Framework**
11:55AM	**Next steps**

12:00PM **Adjourn**

Lunch for those attending in-person

12:30PM **Meet in lobby at the Holiday Inn & Suites Duluth-Downtown**

12:35PM **Board bus to depart Holiday Inn**

*****There is limited parking at the Hibbard plant. We encourage attendees to take the shuttle being provided, rather than driving on their own. Should you need to drive on your own, please contact Alissa (abemis@gpisd.net) for instructions on how to get there.

TOUR ATTIRE: Long pants, closed toe shoes, no heels. Hard hats, safety glasses and ear plugs will be provided.

CONSIDERATIONS:

- There is a possibility the generator(s) may be running so **anyone with a pacemaker or sensitive to electrical fields would NOT want to walk through the generator floor**.
- There are also quite a few stairs with open grating to **anyone sensitive to heights or challenges climbing stairs should NOT participate** in that portion.

1:00PM **Hibbard Tour**

3:00PM **Depart Hibbard**

3:30PM **Approximate time attendees arrive back to Holiday Inn**

**Materials from past meetings, as well as helpful resources, can be found here on the online database.*

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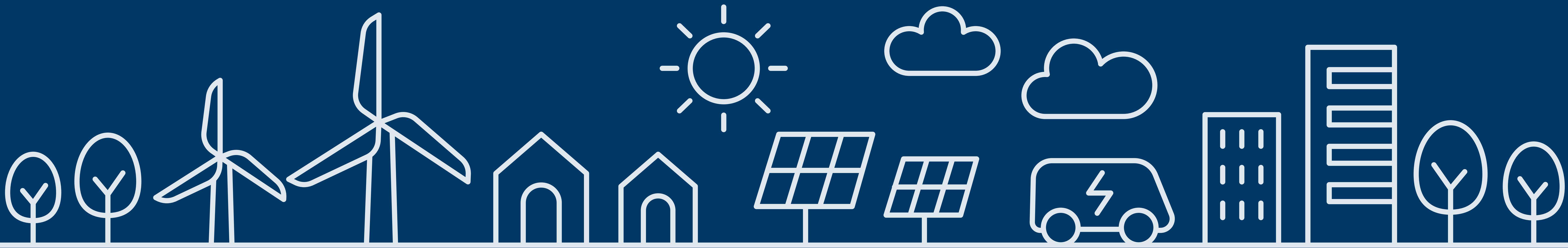
Minnesota Power 2025 Integrated Resource Plan

Societal Advisory Group

Meeting #3

September 23rd, 2024

Hybrid: In-Person & Virtual



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10:30AM	**Break**
10:45AM	**Continue Review & Discuss Framework**
12:00PM	**Next Steps and Adjourn**

Purpose of the Societal Advisory Group

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Goals for today

1. Review and discuss the updated framework, focusing on the Local Economy & Utility perspectives, seeking to answer the following questions:

- Do you have any clarifying questions?
- Which parts of the updated framework should be kept as is?
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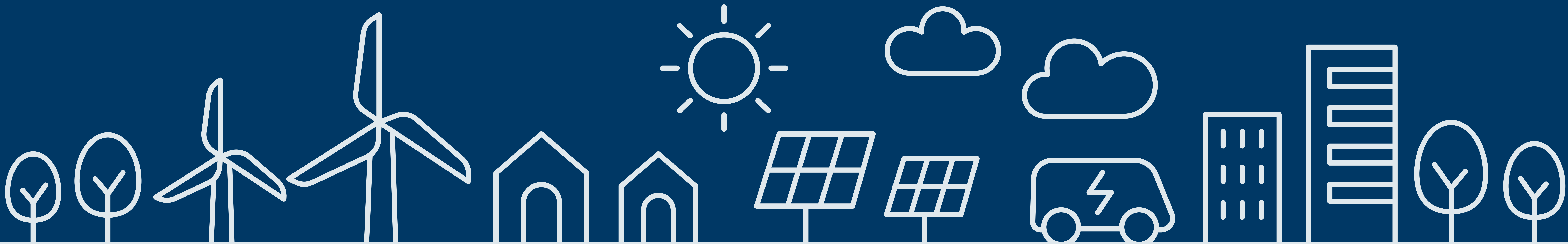
Ground Rules for Participation

- **Respect the time.** Your time together is limited and valuable, so please be mindful of the time and of others' opportunity to participate.
- **Respect each other.** Help us all to uphold respect for each other's experiences and opinions, even in difficult conversations. We need everyone's wisdom for the greatest results.
- **Have fun!** This is a unique opportunity to develop relationships with and see the humanity in people who may not share your same worldview. While discussing serious and contentious issues, let's all remember to have some fun and humor while maintaining respect.

Process Overview



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MINNESOTA POWER 2025 IRP—ENGAGEMENT MEETING TIMELINE

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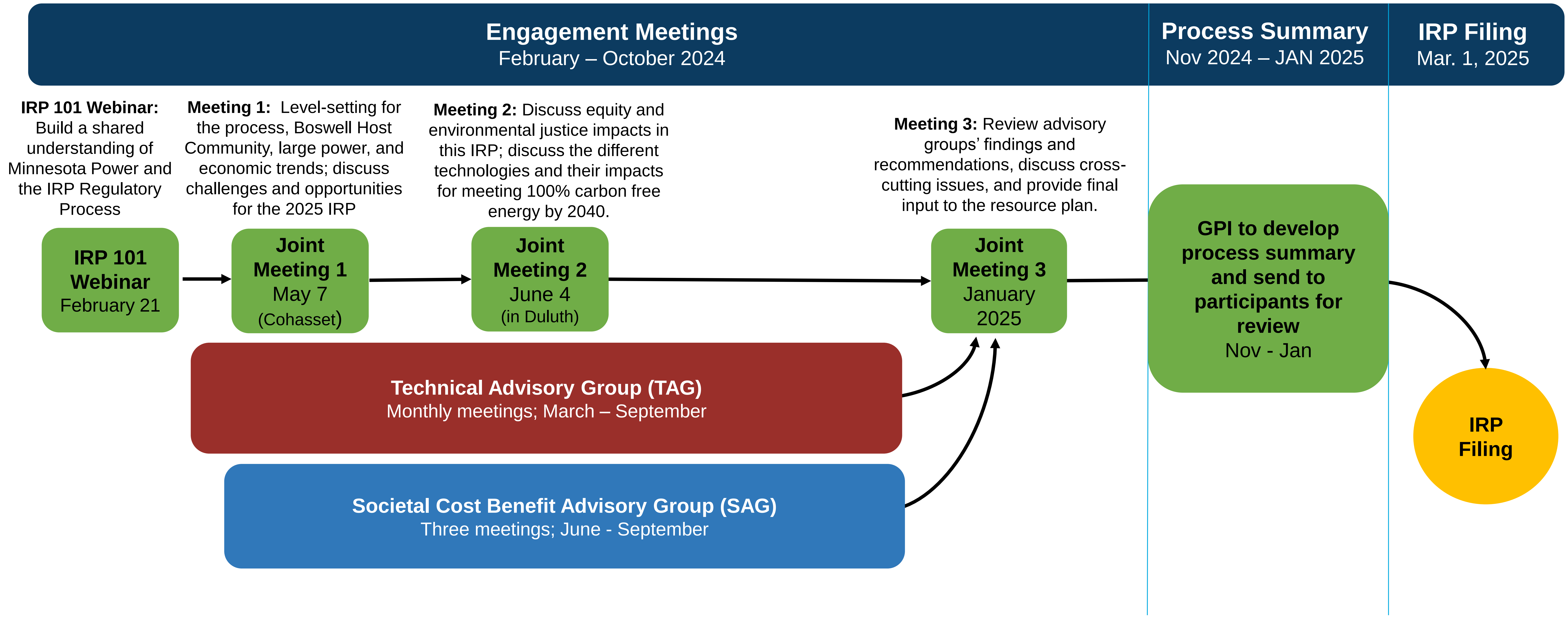

Questions?

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-Break-

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Wrap-Up and Next Steps

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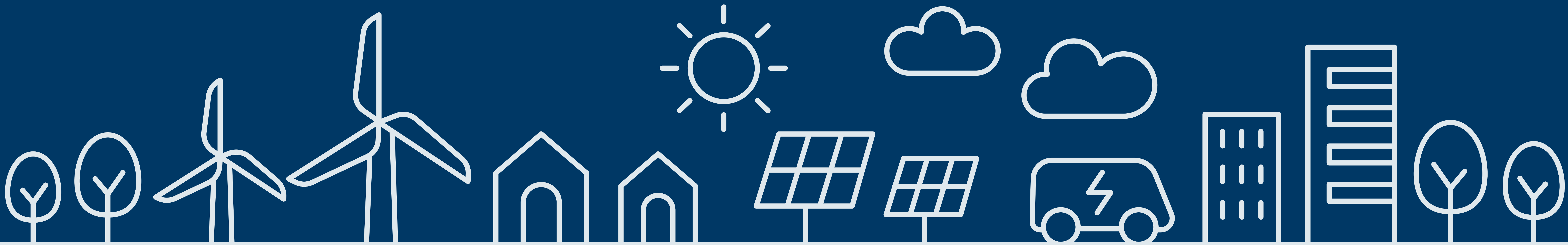

ATTACHMENT C: TECHNICAL ADVISORY GROUP MEETING MATERIALS

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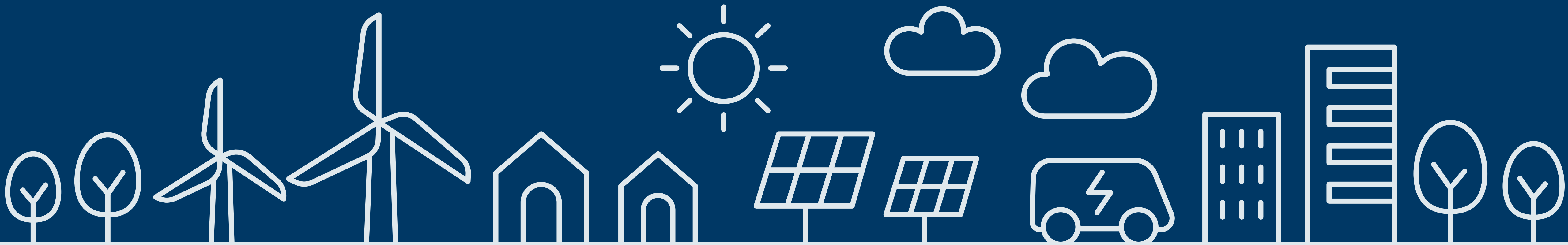
Minnesota Power 2025 IRP Technical Advisory Group

March 11, 2024 | Webinar



Meeting Objective…Collaboration

1. Develop collective objectives and ground rules for this group.

2. Build a shared understanding of the key themes and strategic questions being addressed in the IRP.

3. Explore perspectives and key modeling assumptions to discuss at future meetings.

Introductions

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- Respect the time. Your time together is limited and valuable, so please be mindful of the time and of others' opportunity to participate.
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- Have fun! This is a unique opportunity to develop relationships with and see the humanity in people who may not share your same worldview. While discussing serious and contentious issues, let's all remember to have some fun and humor while maintaining respect.
- Any comments or suggestions made by stakeholders or the Company during these meetings is not intended to bind parties later in the IRP proceeding and associated modeling analysis.
- Notes will be taken and submitted in the IRP, although comments or suggestions will not be tied to a specific party or individual.
- Will have a parking lot for questions that will be answered at future TAG meetings.

2021 IRP Orders – Seek Modeling Input

6. In developing its next resource plan, Minnesota Power must ***consult with stakeholders***, including but not limited to parties to the current proceeding, to develop an analysis that will inform its next IRP on the following topics:

   a. Implications of the ***Inflation Reduction Act on renewable energy projects***.
   b. Efforts to ***access applicable federal Infrastructure Investment and Jobs Act funding***.
   c. MISO's ***Long Range Transmission Planning*** process.
   d. MISO's ***Seasonal Adequacy Construct*** changes.

7. ***In developing the modeling analysis to be used in its next resource plan, Minnesota Power must consult with stakeholders***, including but not limited to the Department of Commerce, Office of the Attorney General, Large Power Intervenors and the Clean Energy Organizations, regarding the Company's modeling inputs and parameters.

8. In its next resource plan, Minnesota Power must include a summary of the modeling stakeholder group discussions, including potential modeling constraints and how ***Minnesota Power could consider modeling solar-powered generators connected to the Company's distribution*** grid as a resource.

Docket No. E015/RP-21-33

WE ARE UNIQUE

Duluth, MN Headquarters

26,000 Square-miles

150,000 Customers

12% Residential sales

66% Mining and Forestry

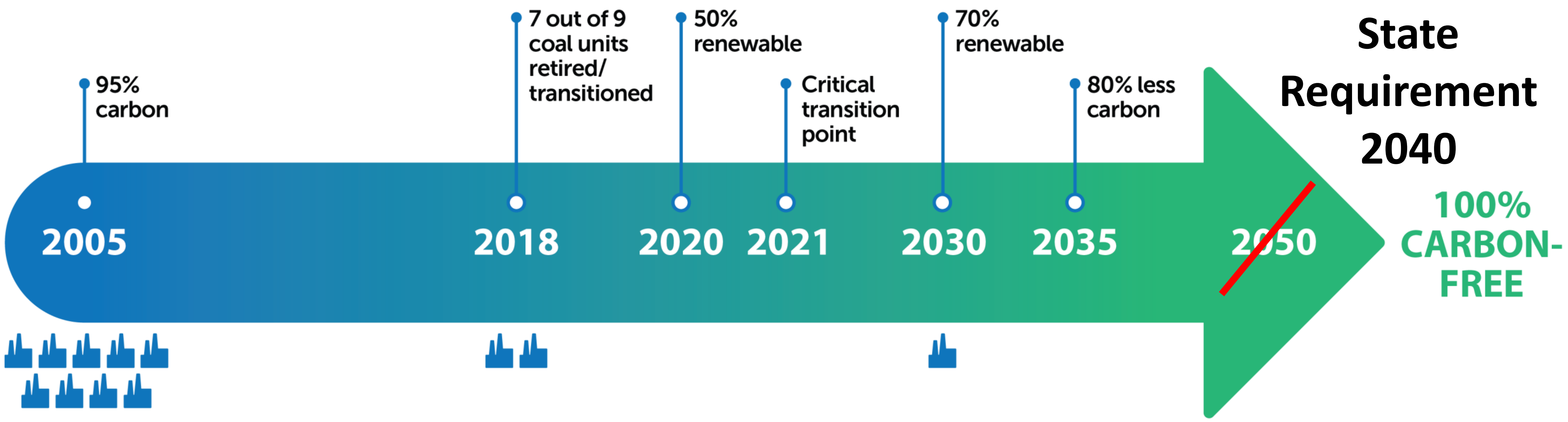
14 Minnesota Municipalities

14 years Met or exceeded the MN energy savings goal

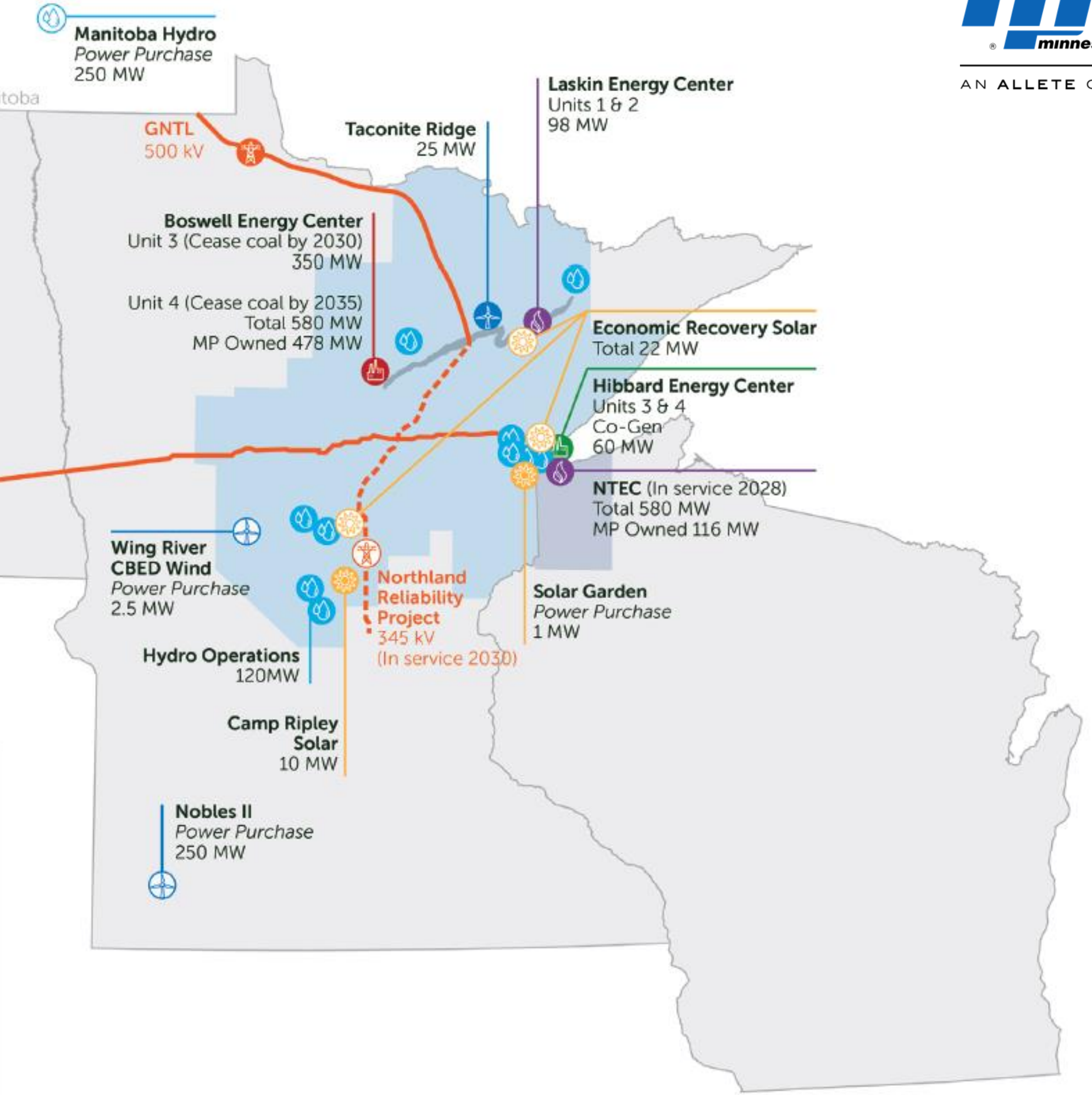
1st To Deliver 50% Renewable Energy to Customers

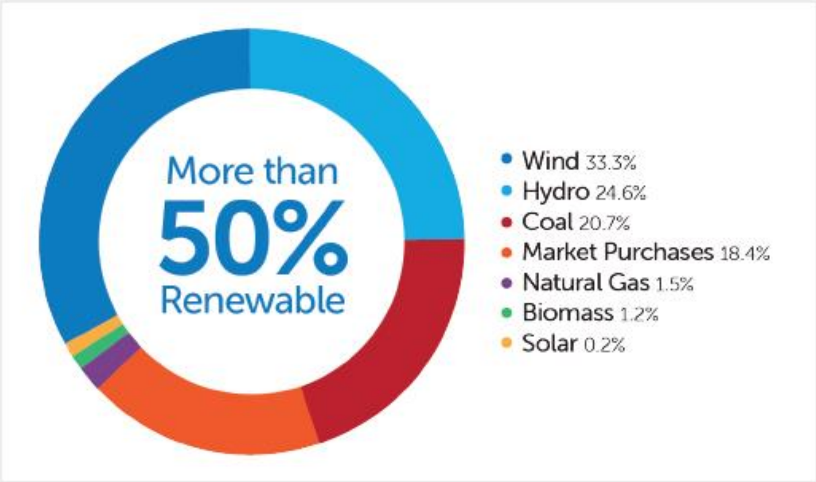
WE ARE COMMITTED TO MAKING A SUSTAINABLE TRANSITION

to a **reliable**, **affordable** and **carbon-free** energy mix for our customers.



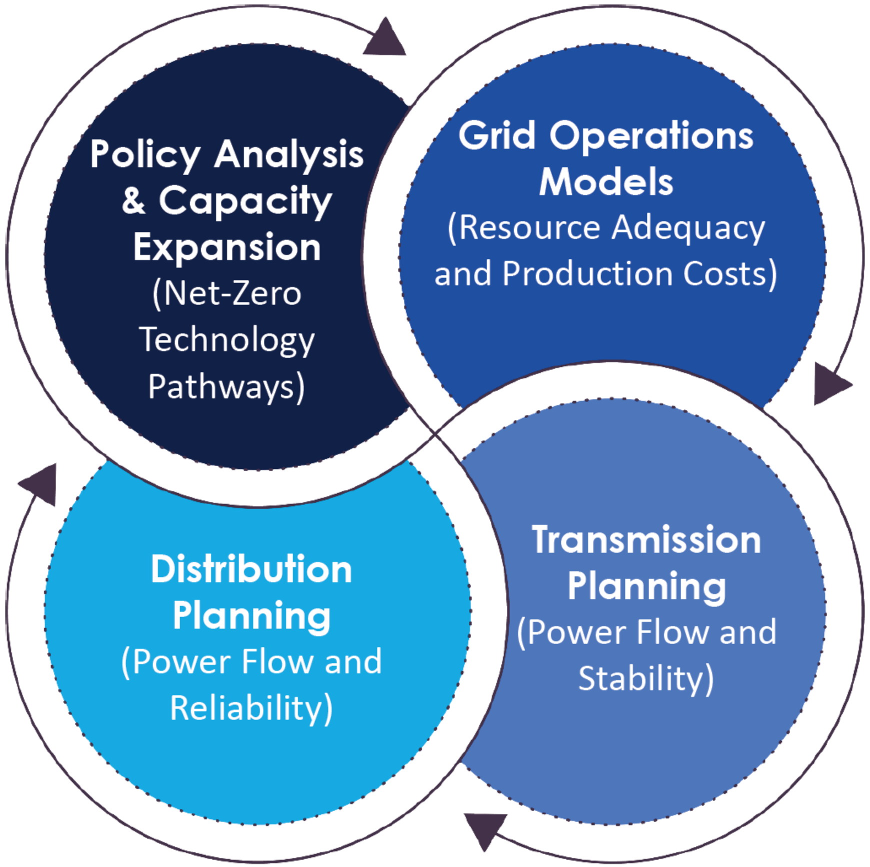
Generation Supply





Minnesota Power calculates and reports carbon emissions based on the GHG Protocol.
Details in ALLETE's Corporate Sustainability Report (allete.com/sustainability).

Integrated Strategic System Planning



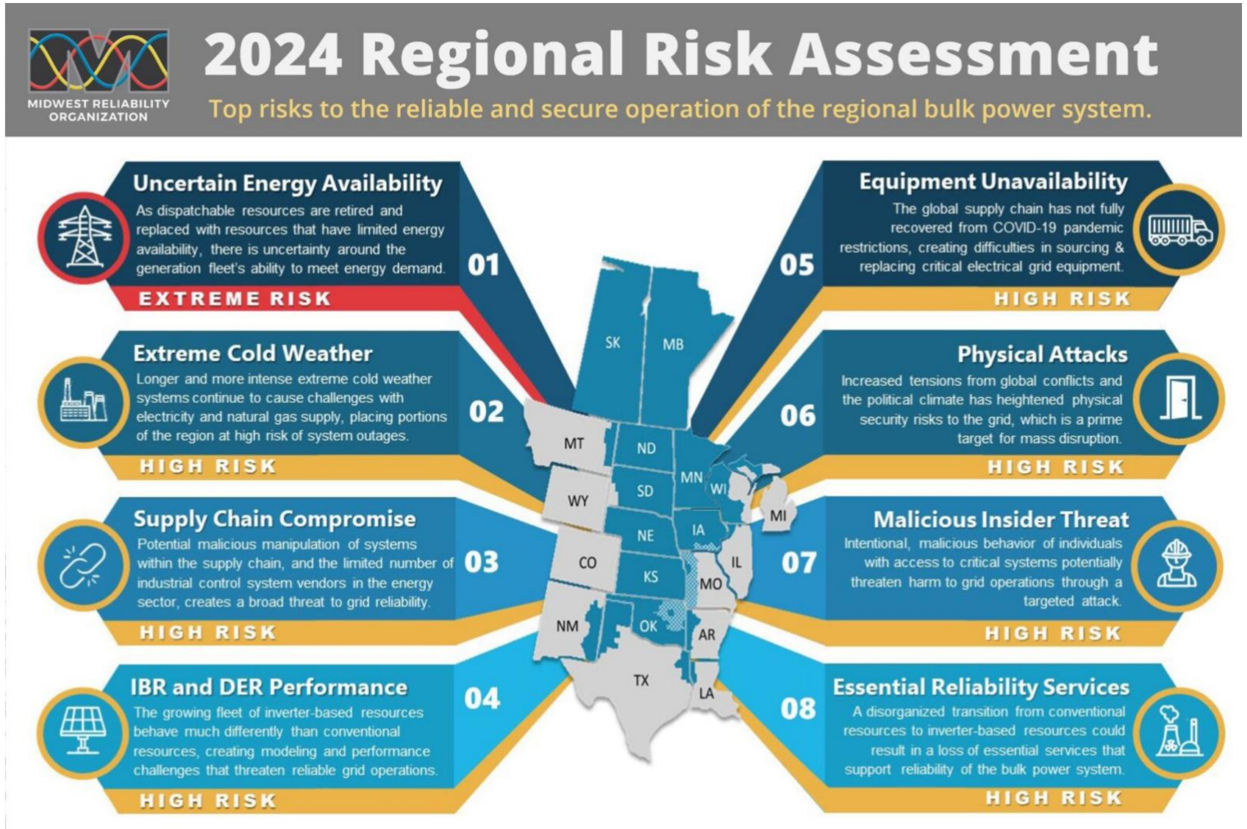
Develops a generalizable analytical framework to assess future expansion plans across supply (G) and delivery (T&D) & ensures reliability

FIGURE SOURCE: EPRI

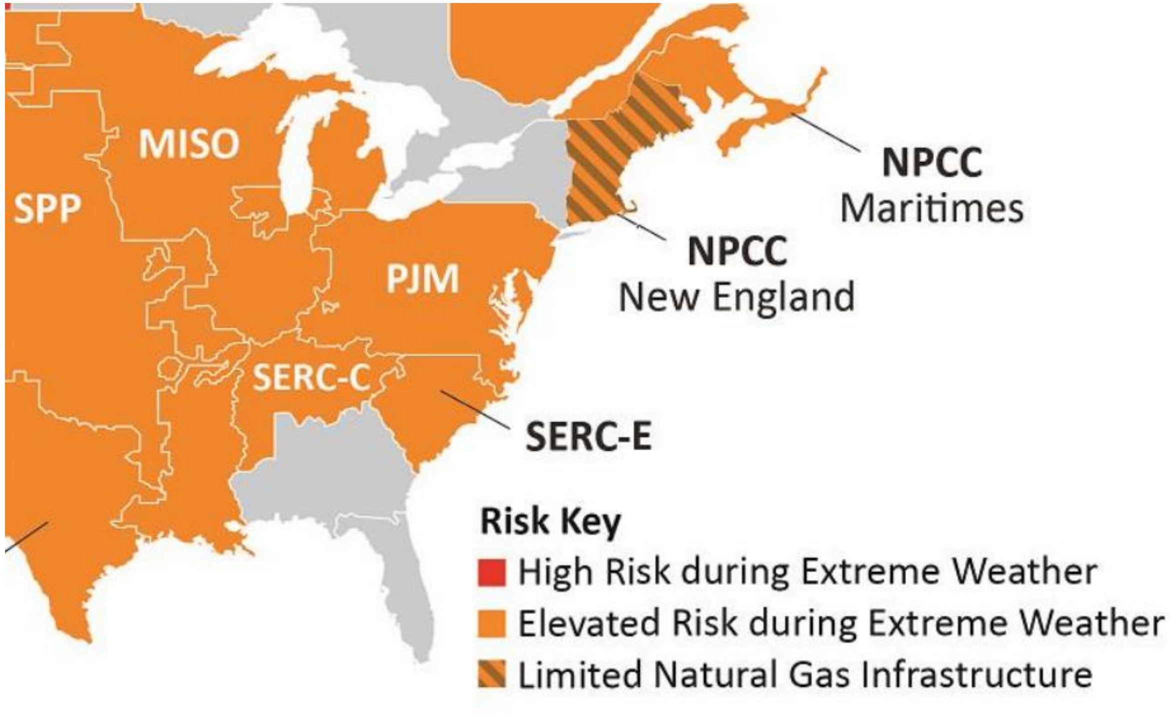
Strategic Questions for Planning

- Affordable pathways to decarbonize electric sector?
- Sufficient energy and flexibility required to balance intermittent renewables with changing demand profiles?
- T&D investments for reliability, decarbonization, and higher levels of renewables and inverter-based supply mix?
- Timing of emerging carbon-free technology availability and at what cost?
- Future customer demand levels and controllability?
- Role of distributed resources in resiliency and reliability?

Dynamic ISSP Required Over for Next 15 Years



NERC Winter Reliability Assessment:



MISO 2023 OMS Survey:

Committed Capacity shows declines over survey window with potential resource deficits starting in PY 2025/26

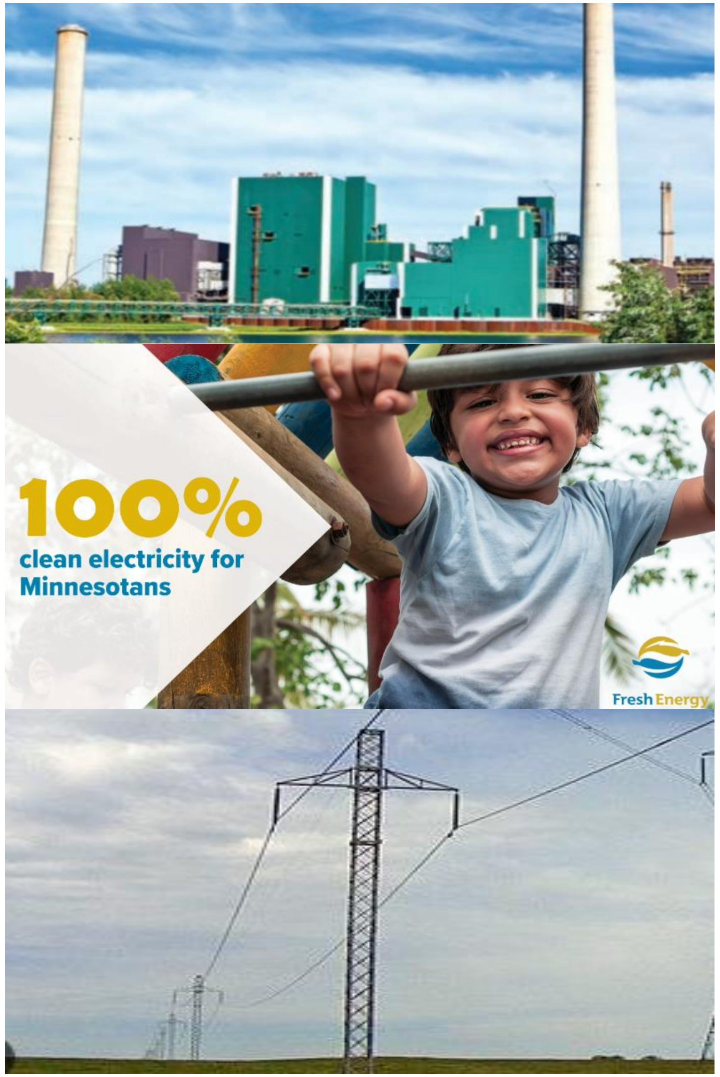
Key Areas of Focus for 2025 IRP

- **Pathways to achieve 100% Carbon Free energy by 2040 while maintaining reliability and keeping rates affordable.**
  - Post BEC 3&4 Coal Operations – Identify replacement for energy, capacity, fuel assurance, operating characteristics, and grid essential services.
  - Baseload retirement study for Hibbard.
  - What carbon-free technologies will be viable, commercially available, and at what cost.

- **Establish and incorporate new reliability criteria into evaluating each alternative to ensure compliance**
  - MISO Reliability Imperative initiative and other reliability research

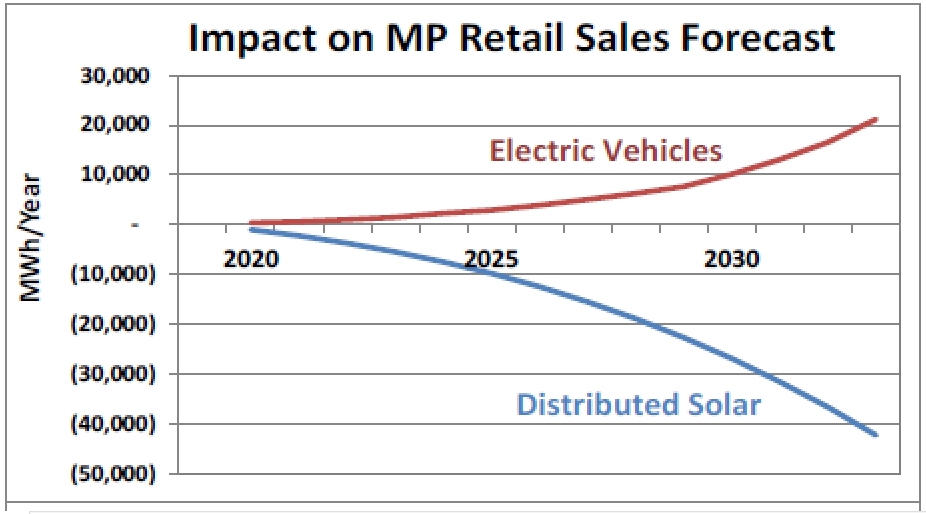
- **Work with host communities and stakeholders on a just transition and leverage and reinvest in existing MP infrastructure.**

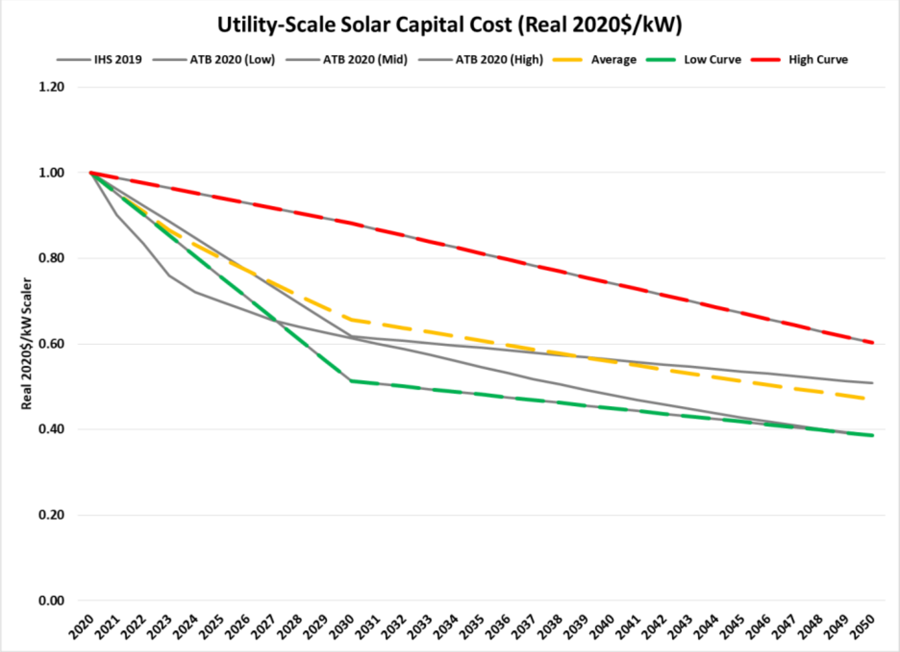
- **Continue ISSP between distribution, transmission, and generation.**



Assumptions Discussed at Modeling Group in Last IRP

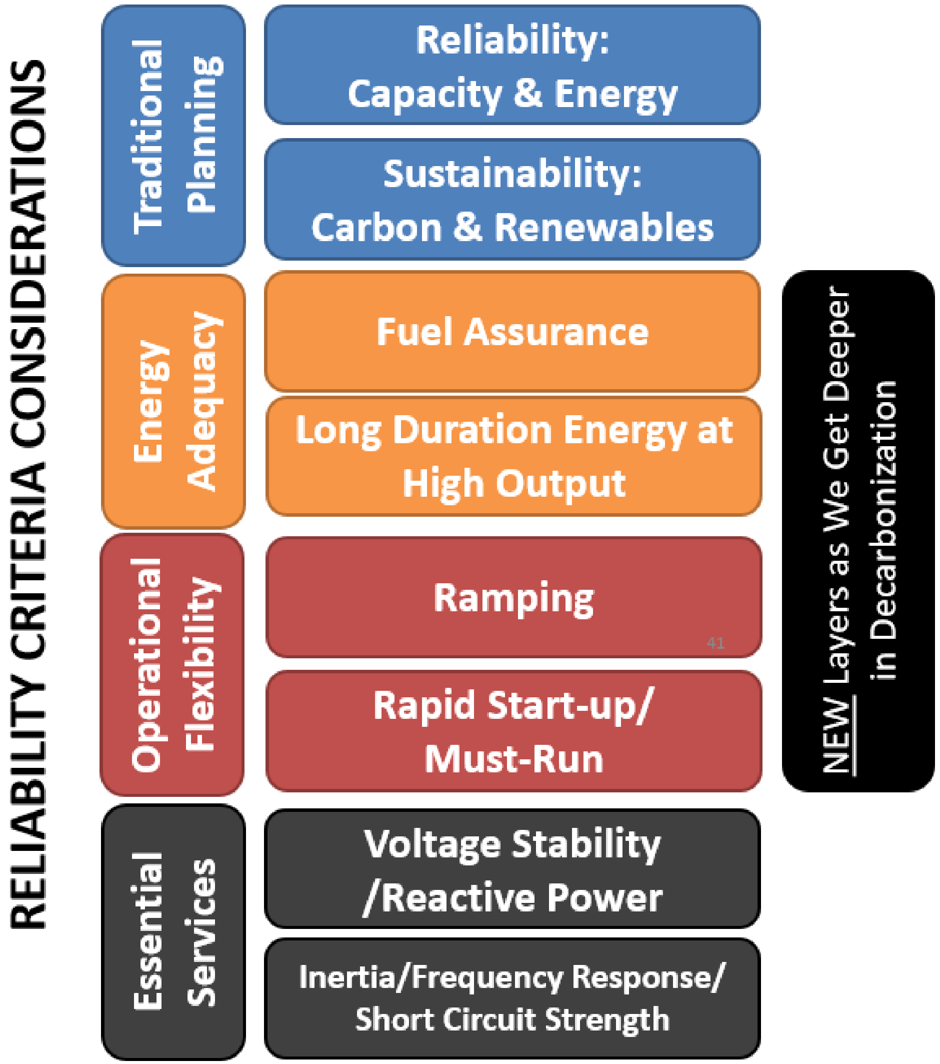
- New technology
  - Cost curves for wind, solar, and storage
- Customer demand forecast
  - EV / DG solar / electrification
  - Time of use
  - Variability
- Resource adequacy uncertainty & ELCC for wind and solar
- Conservation
- State required environmental futures and costs
- Sensitivities
  - Fuel, markets, capital for new tech, renewable uncertainty
- PTC/ITC Modeling for wind, solar, and storage
- Energy and capacity market design
- Transmission interconnection cost for new generation
- Approach to modeling wind, solar generation, and storage
- EnCompass modeling updates





MP List – Modeling Inputs and Parameters

- Reliability criteria / reliability analysis
- Technology readiness
- Capital cost forecast for new generation additions
- Inflation Reduction Act modeling
- MISO seasonal resource adequacy & upcoming DLOL
- MISO LRTP / interconnection cost
- MN Carbon Regulation Cost and Environmental Cost
- Distributed solar generation modeling
- Customer demand outlooks and sensitivities
- Demand response



What modeling inputs and constraints do stakeholders want to discuss at future TAG meetings?

Next TAG Meeting

Second Meeting

Monday, April 15th
1 pm (CST)

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Minnesota Power 2025 IRP Technical Advisory Group

April 15, 2024 | Webinar

Meeting Objective…Collaboration

1. Develop collective objectives and ground rules for this group.

2. Build a shared understanding of the key themes and strategic questions being addressed in the IRP.

3. Explore perspectives and key modeling assumptions to discuss at future meetings.

TAG Tentative Schedule – General Themes

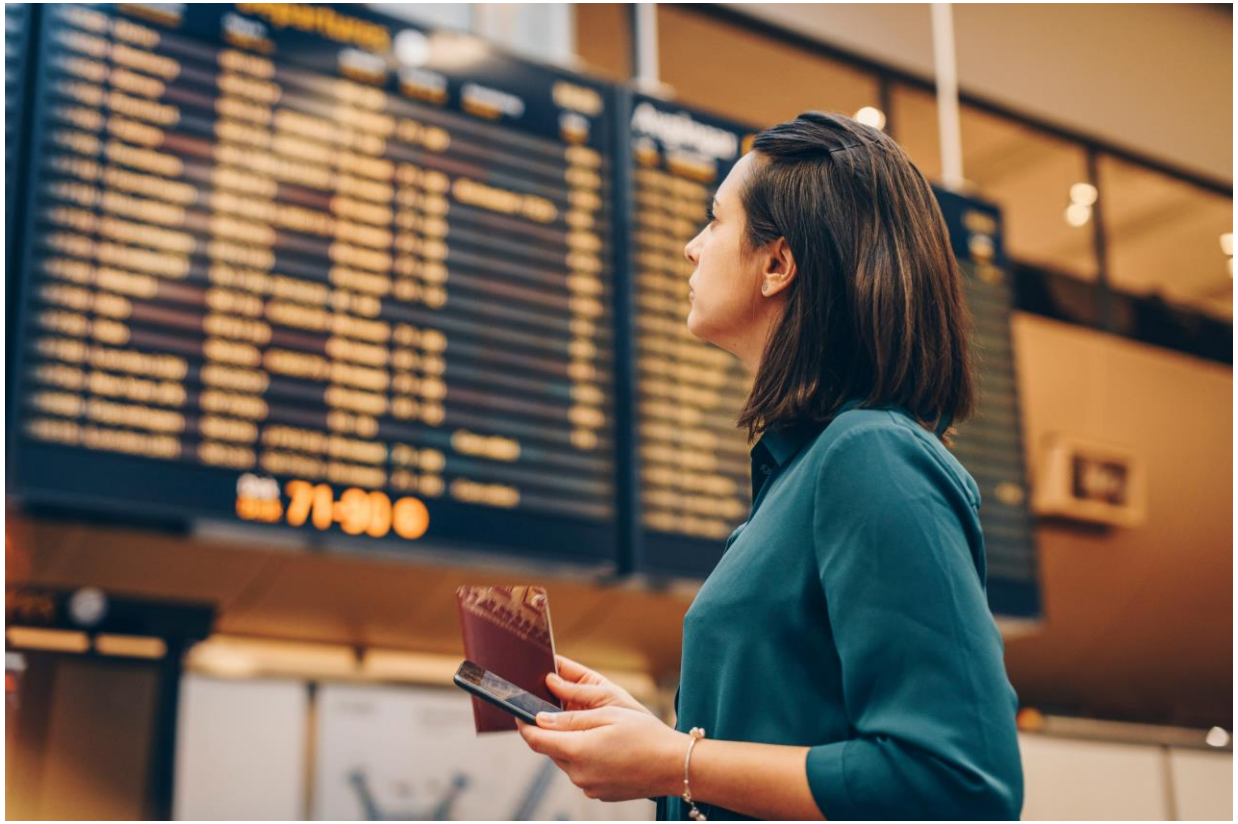
April – Reliability and Inflation Reduction Act (“IRA”)

May – Technology

June – Customer

July – EnCompass Modeling

August – Transmission / Distribution



Note: Some of the more complex topics, such as reliability & resource adequacy, will be discussed at several TAG meetings.

Today’s Agenda

1. Reliability and Resource Adequacy

2. Implications of the Inflation Reduction Act

Reliability Landscaping

"State of Union" for Reliability in Planning

- Why can't we keep doing what we have been doing?
  - No form of "Business As Usual" in the future
  - Need to meet carbon goals while maintaining reliability and minimizing rate impacts
  - Changing MISO market resource portfolio/backstop
- Why now?
  - Significant decisions in this IRP timeframe
  - Increased resource development risks
  - More interest in large load additions
  - Expectation from customers that reliability will be maintained as we transition

minnesota power
AN ALLETE COMPANY
EnergyForward

Evolution of Integrated Resource Planning

Up to Mid-2000s (Arrival of MISO)	Planning in the MISO Era through ~2025	Planning in the Decarbonization Era 2025 Forward
• Local system (LBA) focused planning and operations • Reserve sharing over smaller footprints – larger reserve margins • Less transparency on value of energy and capacity • Ancillary services met by own system • LBA performed loss of load studies	• Regional planning and operation • Reserve sharing over larger geographic region – lower reserve margin • Focus was planning for capacity needs - assumed energy is available at reasonable prices in MISO • Ancillary/flexibility needs met by market • MISO performed LOLE studies	• Declining dispatchable capacity • Increasing reliability events • Confidence declining in energy availability in MISO • Increasing recognition reliability attributes are declining • Challenge -- quantifying replacement resources for lost attributes • Utilities are returning to focus on LBA energy needs and less reliance on ISO

Pre-MISO Era Planning Themes are Remerging

Landscaping – ESIG Report

Recommendation – Making the switch to multi-metric criteria – no one metric is the solution – framework is needed to consider size, frequency, and duration.

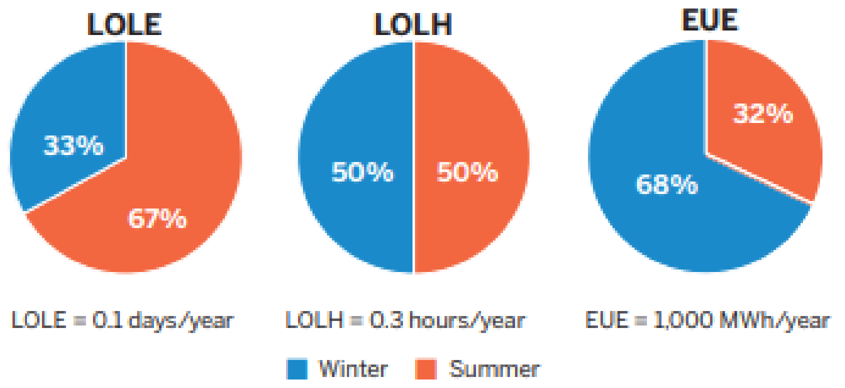
1. Number of Days - **LOLE** – frequency of days for reliability events
   MISO Does this today
2. Number of Events - **LOLEv**
3. Number of Hours – **LOLH**
4. MWh of Unserved Energy – **EUE**
5. **Maximum Shortfall** in MW
6. In Addition – Considering the economics loss of load events – what are customers willing to pay for reliability?
7. Identifies Challenges with Energy Storage Discharge – shifts LOLH
   - What is the strategy for dispatching storage/limited resources during event
     - First Come First Serve
     - Minimize Duration
     - Minimize Shortfall

Comparison of Resource Adequacy Metrics in California (2020), Texas (2021), and the Southeast (2022)

Event Characteristic	Metric Affected	California August 2020	Texas February 2021	Southeast December 2022
Number of days	LOLE	2 days	4 days	2 days
Number of events	LOLEv	2 events	1 event	2 events
Number of hours	LOLH	6 hours	71 hours	7 hours
Unserved energy	EUE	2,700 MWh	990,000 MWh	40,000 MWh
Maximum shortfall		1,072 MW	20,000+ MW	5,400 MW

The table shows the measures of unserved energy in three recent loss-of-load events in the United States between 2020 and 2022 and how they would influence resource adequacy metrics.

A Comparison of Resource Adequacy Metrics by Season, PJM

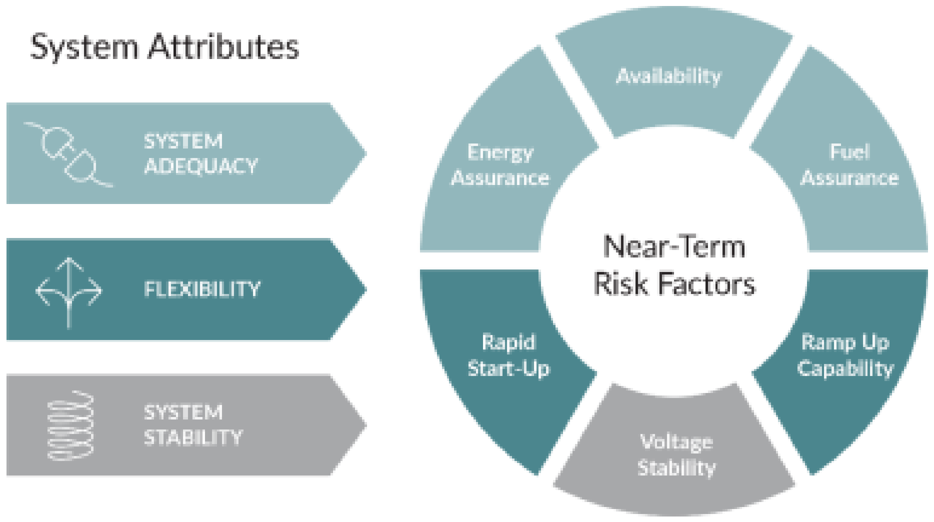


https://www.esig.energy/wp-content/uploads/2024/03/ESIG-New-Criteria-Resource-Adequacy-report-2024.pdf

MISO Reliability Imperative

"Shared responsibility that MISO, its members and states must address urgent and complex challenges to electric system reliability in the MISO region"

RELIABILITY IMPERATIVE PILLAR	KEY INITIATIVES *(partial list)*
MARKET REDEFINITION Enhance and optimize MISO's markets to ensure continued reliability and efficiency while enabling the changing resource mix, responding to more frequent extreme weather events, and preparing for increasing electrification	• Ensure resources are accurately accredited • Identify critical system reliability attributes • Ensure accurate pricing of energy & reserves
OPERATIONS OF THE FUTURE Focus on the skills, processes and technologies needed to ensure MISO can effectively manage the grid of the future under increased complexity	• Manage uncertainty associated with increasing reliance on variable wind and solar generation • Prepare control room operators to rapidly assess and respond to changing system conditions • Use artificial intelligence & machine learning to enhance situational awareness & communications • Evaluate interdependency of neighboring systems
TRANSMISSION EVOLUTION Assess the region's future transmission needs and associated cost allocation holistically, including transmission to support utility and state plans for existing and future generation resources	• Develop "Futures" planning scenarios using ranges of economic, policy, and regulatory inputs • Develop distinct "tranches" (portfolios) of Long Range Transmission Plan (LRTP) projects • Enhance joint transmission planning with seams partners • Improve processes for new generator interconnections and retirements
SYSTEM ENHANCEMENTS Create flexible, upgradeable and secure systems that integrate advanced technologies to process increasingly complex information and evolve with the industry	• Modernize critical tools such as the Day-Ahead and Real-Time Market Clearing Engines • Fortify cybersecurity and proactively address the rapidly evolving cyber threat landscape • Develop cutting-edge data and analytics strategies



How Has Industry Responded So Far

Response to Date

- MISO Resource Adequacy Construct
  - Seasonal Resource Adequacy Construct - Schedule 53 – focus on availability when needed by system
  - Reliability-Based Demand Curve – filed at FERC
- MISO Market Enhancements
- LRTP/Transmission expansion / MTEC Future Refresh
- Retirement studies impact on the transmission
- Awareness for the need of integrated planning between distribution, transmission, generation, and customer products

What still needs to be addressed – NEW LAYERS TO PLANNING

- Enhanced definition of the risk on your own system – extreme events
- Define dispatchable and flexibility needs of your system
- Define fuel certainty/energy duration needs of system
- Further enhancements to MISO market – multi-day dispatch
- Enhance retirement studies that consider lost generation attributes

MP's Plans to Address Some of the Needs in the Upcoming IRP

How MP is Thinking About Planning for System Reliability?

Traditional Planning
- Reliability: Capacity & Energy
- Sustainability: Carbon & Renewables

Energy Adequacy
- Fuel Assurance
- Long Duration Energy at High Output

Operational Flexibility
- Ramping
- Rapid Start-up/ Must-Run

NEW Layers as We Get Deeper in Decarbonization

Essential Services
- Voltage Stability /Reactive Power
- Inertia/Frequency Response/ Short Circuit Strength

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MISO Resource Adequacy

MISO Seasonal Accredited Capacity (SAC) Construct

Miso Resource Adequacy Drivers

More Uncertainty When Hours of Tight Margin Occur

Need Could Be Any Season – Not Summer Only

Desire to Provide Incentives for High Resource Availability

Compare Annual Approach vs. Seasonal Approach

ANNUAL - OLD

- Summer Season
- Annual Maximum MISO Peak
- Resource Accreditation
  - Thermal/Dispatchable Hydro – Annual UCAP
  - Wind – Annual ELCC
  - Solar/ROR Hydro – Availability on Four Hour Timeframe

SEASONAL - NEW

- All Four Seasons
- Seasonal Maximum Peak
- Resource Accreditation
  - Thermal Seasonal Accreditation
  - Wind – Seasonal ELCC
  - Solar -
  - Hydro

MISO Seasonal Accredited Capacity (SAC) Construct

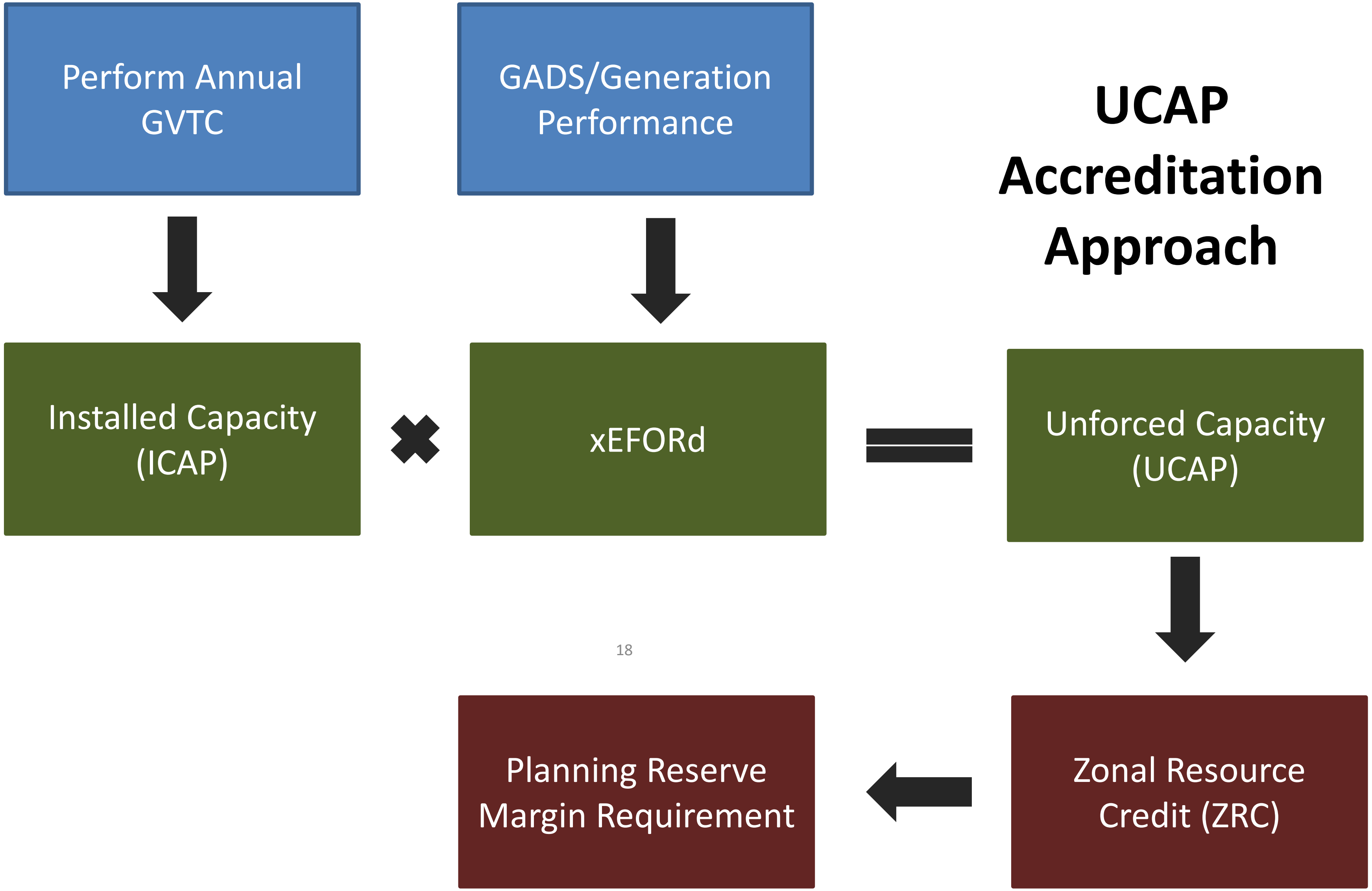
Addressing the changing energy portfolio

- Increasing Concerns
  - Changing Resource Mix
  - More Hours of Tight Margins that were not studied in annual construct – Not Just Peak Load Times
  - Better accreditation of resources that have attributes needed by the system – react quickly to system needs
- MISO Resource Adequacy Subcommittee
  - RAN 1 → 2018 and 18 Months – SAC Discussions
  - Submitted November 30, 2021 and Approved 8/31/2022
  - Implemented 9/1/2022 for MISO PY 23-24→ HUGE RUSH!

MISO PY 22-23 And Earlier UCAP Accreditation

	Annual	
	Class Level	Unit Level
Thermal & Hydro	UCAP	UCAP
Wind	Average ELCC	Peak Periods
Solar and Storage	Peak Periods	Peak Periods

UCAP Accreditation Approach



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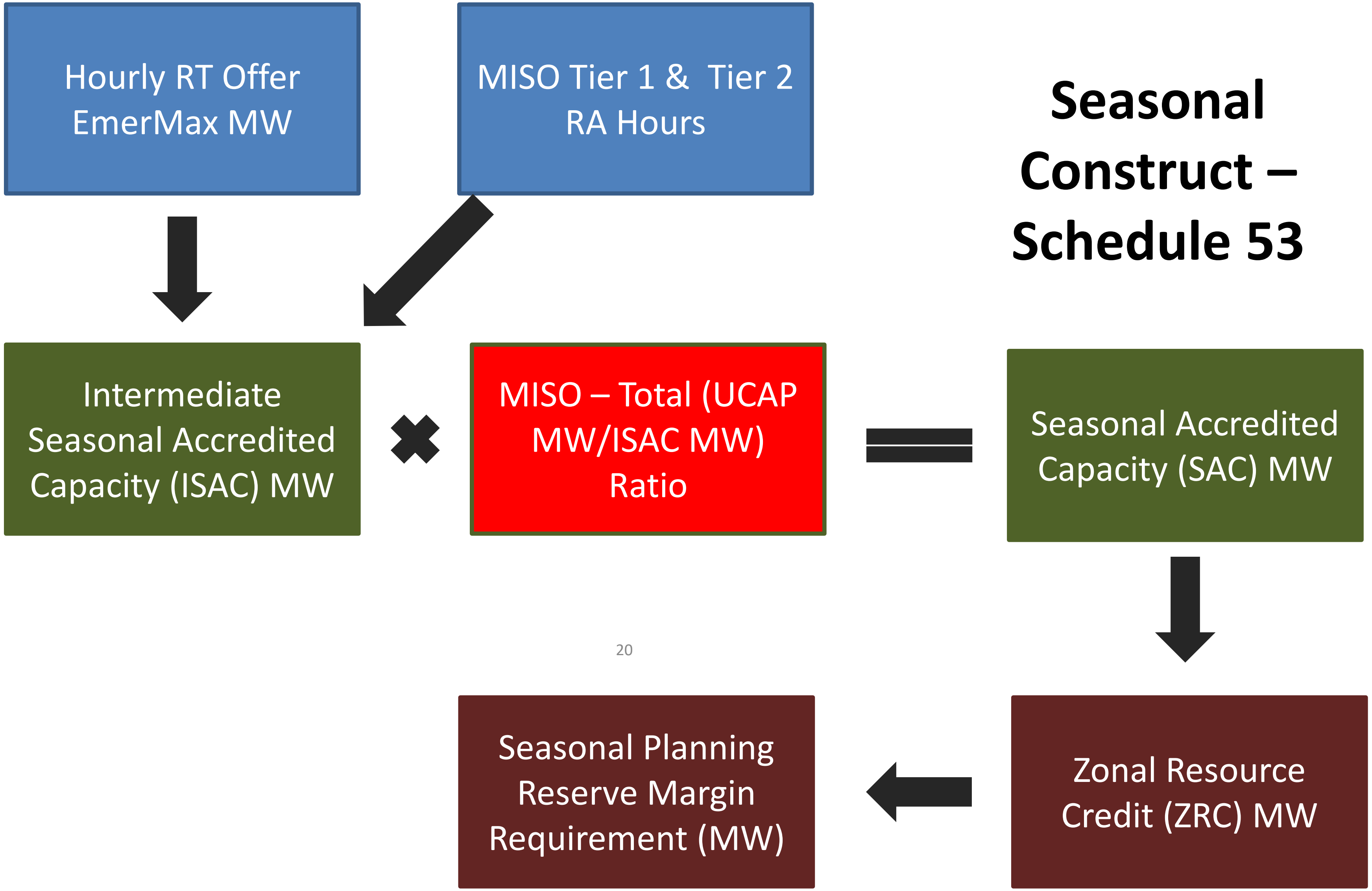
MISO PY 23-24 and Current Accreditation Approach

	Seasonal	
	Class Level	Unit Level
Thermal & Hydro	UCAP	Tier 1 and Tier 2 Hours
Wind	Average ELCC	Peak Periods
Solar and Storage	Peak Periods	Peak Periods

Seasonal Construct – Schedule 53



Summary: Annual Construct vs SAC

Design Elements		Annual Construct	Seasonal Accreditation Capacity
Accreditation Calculation	**Seasons**	Annual	4 Seasons (Jun-Aug Sep-Nov Dec-Feb Mar-May)
	Weighting of Outage Impact to Forced Outage Rate (i.e. XEFORd)	None – All eligible Hours Treated the Same	**3 Year transition of Tier 1/Tier 2 Weighting** **Year 1 Tier 1 40% Tier 2 60%** **Year 2-> 30%/70% Year 3-> 20%/80%**
	Lead Time for Offline Units*	None	24 Hours
	Real-Time Offer Considered	Emergency Max	Tier 1 and Tier 2 Emergency Max
	Replacement Capacity Rules	Unavailable first 90 Days of Planning Year	Impacts for Outages > 31 Days of Season
	UCAP/SAC Ratio	N/A	MISO UCAP/SAC Ratio Applied to Individual Gen Unit SAC
Hours Selection	**Top X% of Tightest Margin Hours**	N/A	Tier 1: all hours excluding tight hours in Tier 2 Tier 2: MaxGen hours supplemented with top 3% of tight margin hours per season. *With supplement deficient number of hours with annual average offered capacity over top 3% of tightest margin hours per year*
	Lead Time for Offline Units (tight margin calc)	N/A	12 Hours
Planned Outage Exemption	**RAN Phase I Enhancement**	Yes, with two-level structure	Yes, with three-level structure

**Generation modeled in the MISO market. LMR has it's own set of requirements that aligns with seasonal construct*

MISO Direct Loss Off Load (DLOL) Resource Adequacy Methodology

Why is MISO Proposing DLOL

- Increasing reliability risk driven by multiple factors that include increasing demand and shrinking reserve margins due to retirements and delays in new energy and capacity.
- Developed through a two-year stakeholder process, as part of MISO Resource Availability and Need initiative.
- DLOL's goal is to address growing reliability risks by better accounting for the capacity value different energy resources provide during periods when system reliability is stressed on the grid.
- MISO Quote: ""The DLOL-based methodology balances a range of reliability risks in the planning and operations horizons by incorporating forward-looking probabilistic analysis and measuring a resource's performance during recent periods of high system risk,"^
- Filed at FERC on March 28th.

^Source: https://www.utilitydive.com/news/miso-midcontinent-ferc-capacity-accreditation-dlol/711716/

Example: Illustrative DLOL accreditation calculation for solar

1

LOLE Study Model

(used to set the PRMR)

Outputs
(LOL, EUE, Gen eration)

System Unserved Energy

Hour of Year	Weather Year 1			Weather Year 2		
	Sample 1	Sample 2	Sample N	Sample 1	Sample 2	Sample N
1	0	0	0	10	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	20	0	0	0	0	0
5	40	0	0	0	30	0
6	10	0	0	0	10	0
7	0	0	0	0	5	0
8	0	0	0	0	2	0
9	0	0	0	0	1	0
10	0	0	0	0	0	0
...	0	0	6	0	0	0
8758	0	0	10	0	0	0
8759	0	0	2	0	0	0
8760	0	0	0	0	0	0

Two weather years, 6 outage samples
LOLE = 0.67 days/year
LOLH = 2 hours/year
EUE = 24.3 MWh/year

Generator Availability*

(installed capacity = 10 MW)

Hour of Year	Weather Year 1			Weather Year 2		
	Sample 1	Sample 2	Sample N	Sample 1	Sample 2	Sample N
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	1	1	1	0	0	0
4	4	4	4	2	2	2
5	8	8	8	3	3	3
6	3	3	3	1	1	1
7	1	1	1	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	1	1	1	2	2	2
...	5	5	5	6	6	6
8758	10	10	10	0	0	0
8759	6	6	6	6	6	6
8760	3	3	3	1	1	1

Average output during events = 3.33 MW
Nameplate Capacity = 10 MW
Capacity Accreditation = 33%

Adapted from: https://www.esig.energy/download/session-5-redefining-capacity-accreditation-derek-stenclik/

LOLH = Loss of Load Hour EUE = Expected Unserved Energy LOLE = Loss of Load Expectation PRMR = Planning Reserve Ma rgin Requirement

MISO recommends separately accrediting wind and solar resources based on performance during RA Hours and adjusting unit accreditation to a class capacity value that is derived from the Direct-LOL method

Existing Approach for Wind

Class Level	Unit Level
Individual ELCC - average	Based on performance in peak hours

Existing Approach for Solar

Class Level	Unit Level
N/A	Based on performance in peak hours

Recommended Approach for Wind

Class Level	Unit Level
Direct-LOL Based	ISAC (RA Hours Based)

Recommended Approach for Solar

Class Level	Unit Level
Direct-LOL Based	ISAC (RA Hours Based)

ISAC = Intermediate Seasonal Accredited Capacity LOL = Loss of Load ELCC = Effective Load Carrying Capability

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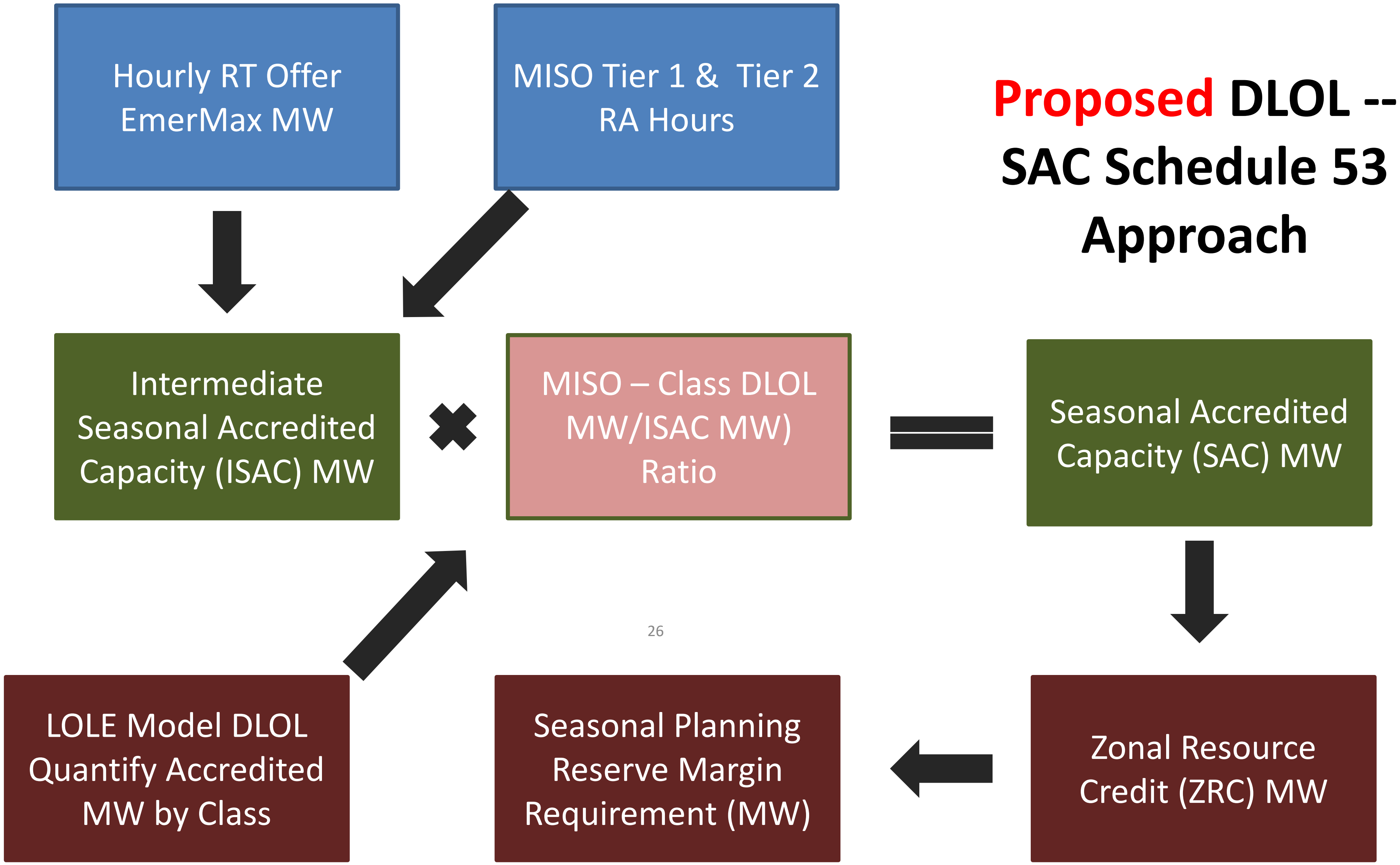
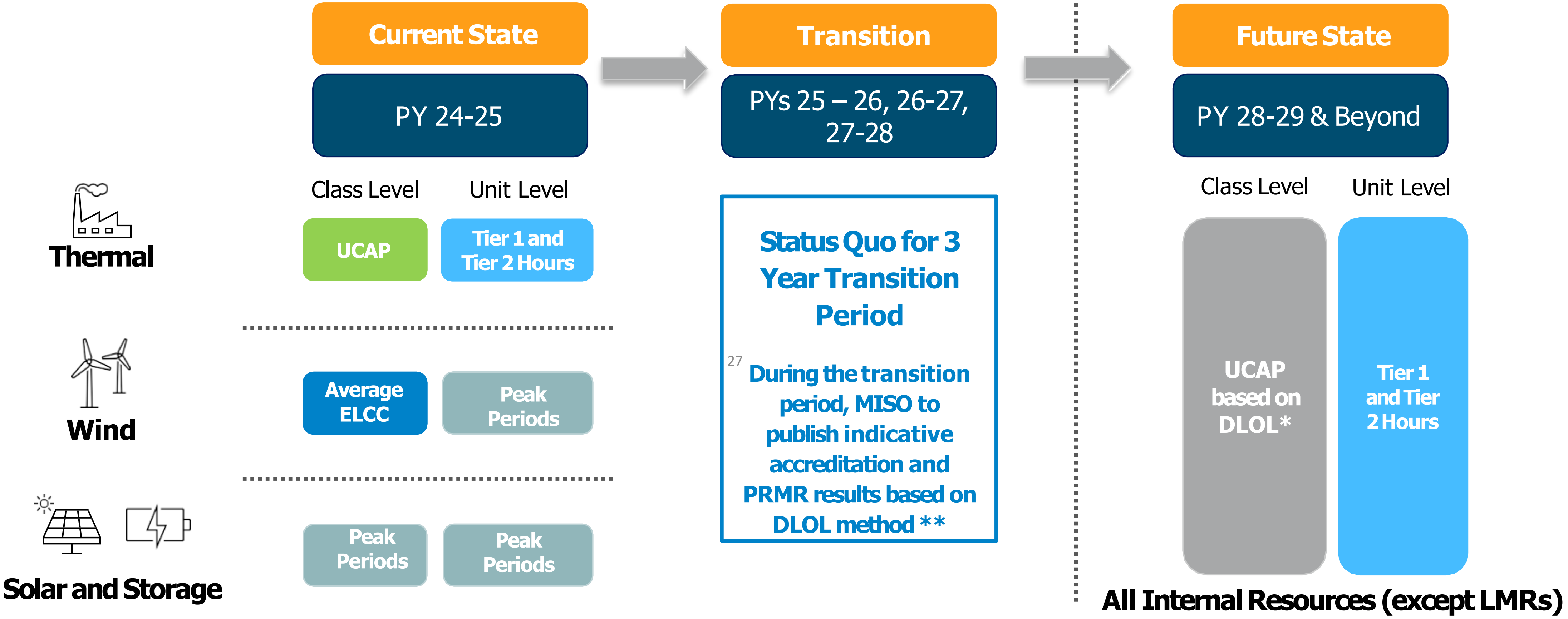
Proposed DLOL -- SAC Schedule 53 Approach



A three-year transition allows time for stakeholders to better understand and plan for the accreditation and reserve margin calculations based on DLOL approach



*Definition of Unforced Capacity (UCAP) is changing with the Accreditation Filing and will account for resource's availability in the LOLE analysis that will be computed based on DLOL method.

**MISO also plans to use the Regional Resource Assessment (RRA) to publish forward looking accreditation and planning reserve margin requirement estimates starting with the 2024 RRA

Seasonal Direct-LOL Results by Resource Class

PY23-24	Summer - 2,695 hrs		Fall - 269 hrs		Winter - 215 hrs		Spring - 206 hrs	
Resource Class	UCAP	DLOL	UCAP	DLOL	UCAP	DLOL	UCAP	DLOL
Gas	91%	89%	89%	89%	84%	70%	88%	74%
Coal	92%	91%	91%	88%	90%	72%	89%	75%
Hydro	97%	97%	97%	99%	42%	68%	62%	70%
Nuclear	95%	91%	96%	86%	95%	87%	92%	80%
Pumped Storage	99%	98%	91%	97%	94%	57%	89%	75%
Solar	45%	37%	25%	27%	6%	1%	15%	17%
Wind	18%	12%	23%	15%	40%	14%	23%	18%
Storage	95%	94%	95%	94%	95%	94%	95%	95%
Run-of-River	100%	100%	100%	100%	100%	100%	100%	100%

Resource class results expected to change as LOLE modeling enhancements are made to better reflect reliability risks across the year and the changing fleet, e.g., storage results expected to decrease

UCAP = current accreditation methodology by resource type

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Future 2A DLOL breakdown by fuel class (10 year out) [Action Items from November 7-8, 2023, RASC meeting]

Future 2A 2032	Summer		Fall		Winter		Spring	
	UCAP*	DLOL (Base)	UCAP*	DLOL (Base)	UCAP*	DLOL (Base)	UCAP*	DLOL (Base)
Gas**	88%	84%	87%	75%	86%	82%	87%	78%
Combined Cycle	91%	85%	90%	83%	87%	77%	90%	84%
Coal	95%	83%	94%	81%	94%	79%	95%	69%
Hydro	94%	90%	95%	90%	94%	75%	96%	79%
Nuclear	92%	91%	94%	93%	96%	90%	90%	87%
Flex Units***	89%	70%	84%	73%	80%	77%	83%	74%
Pumped Storage	97%	78%	94%	95%	85%	35%	92%	68%
Storage	100%	89%	100%	96%	100%	56%	100%	72%
Solar		4%		11%		2%		1%
Wind		7%		14%		14%		9%

*UCAP | **Includes Steam, Combustion Turbine | ***Modeled as a CT Gas unit
Wind, Solar and Storage DLOL breakdowns were previously published in the Technical Appendix of the Attributes Roadmap
https://cdn.misoenergy.org/2023%20Attributes%20Technical%20Appendix631176.pdf .

PRMR will be based on resource accredited values that are calculated using proposed method for expanded hours

PY 23/24 - PRMR Resource Class	Summer		Fall		Winter		Spring		Formula Key
	Base	Proposed	Base	Proposed	Base	Proposed	Base	Proposed	
Gas	29,557	29,541	29,746	29,745	23,628	23,605	23,725	23,657	[A]
Combined Cycle	27,327	27,326	26,698	27,015	23,563	23,650	22,805	22,997	[B]
Coal	39,956	39,955	38,274	38,812	31,732	32,539	32,751	32,641	[C]
Hydro (includes diversity contracts)	2,122	2,122	2,121	2,118	918	916	1,286	1,287	[D]
Nuclear	10,870	10,850	10,044	10,304	10,262	10,493	9,331	9,640	[E]
Pumped Storage	2,521	2,523	2,508	2,504	1,158	1,216	1,853	1,763	[F]
Storage	28	28	27	28	52	52	56	55	[G]
Solar	1,728	1,700	1,777	1,937	27	188	1,784	2,221	[H]
Wind	2,769	2,731	3,819	3,859	3,645	4,477	4,511	4,601	[I]
Run-of-River	966	966	966	966	966	966	966	966	[J]
BTMG	4,196	4,196	4,218	4,218	4,163	4,163	4,240	4,240	[K]
Demand Response	7,397	7,397	7,041	7,041	5,388	5,388	6,280	6,280	[L]
Firm External Support	1,707	1,707	1,714	1,714	1,857	1,857	1,778	1,778	[M]
Adj. {1d in 10yr}	(4,000)	(4,000)	(10,000)	(10,000)	(6,200)	(6,200)	(12,750)	(12,750)	[N]
PRMR	**127,144**	**127,042**	**118,952**	**120,261**	**101,159**	**103,310**	**98,616**	**99,376**	**[O]= sum of [A] through [N]**

Note:
1) Base: LOL-only hours (our previous proposal)
2) Proposed (Expanded): LOL + low margin hours with weights and a cap (as applicable)
3) Results based on the PY23-24 model

DLOL Filing Status

- Knowns
  - Accreditation approach on Class Level
  - Filed March 2024 – Asking for Implementation by 9/1/2024
- Unknowns
  - Accreditation – Storage Approach
  - LOLE Refinement Details
  - DLOL Load Requirements Approach
    - Allocation of PRMR to LSEs
- Timing and Interim Reporting
  - Three years of Evaluation
    - PY 25-26, PY 26-27, PY 27-28
  - First DLOL year PY 28-29

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Multiple Drivers to Minnesota Power Reliability Evaluation in IRP

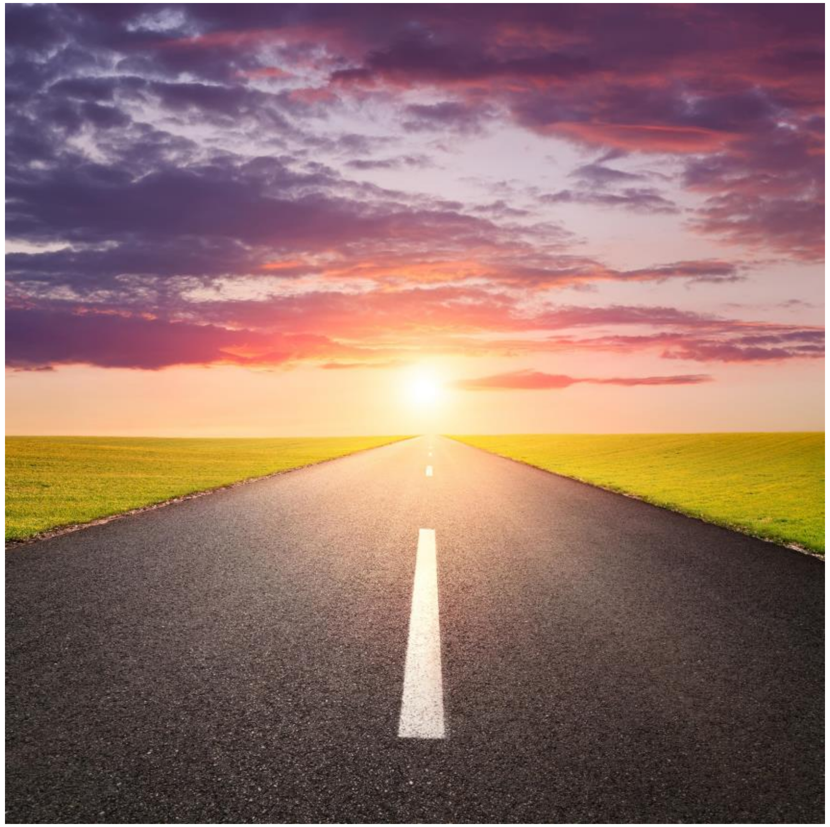
Three Years of SAC

Expected Transition to DLOL

Resource Transformation

Needing MISO Level Reliability Metrics

Need for Minnesota Power Reliability Criteria



Moving Forward Considerations

- New approach of defining and applying a Minnesota Power specific reliability criteria
- Use stakeholder process as opportunity for refining reliability criteria
- Evaluate Limited Number of Viable Plans with reliability criteria

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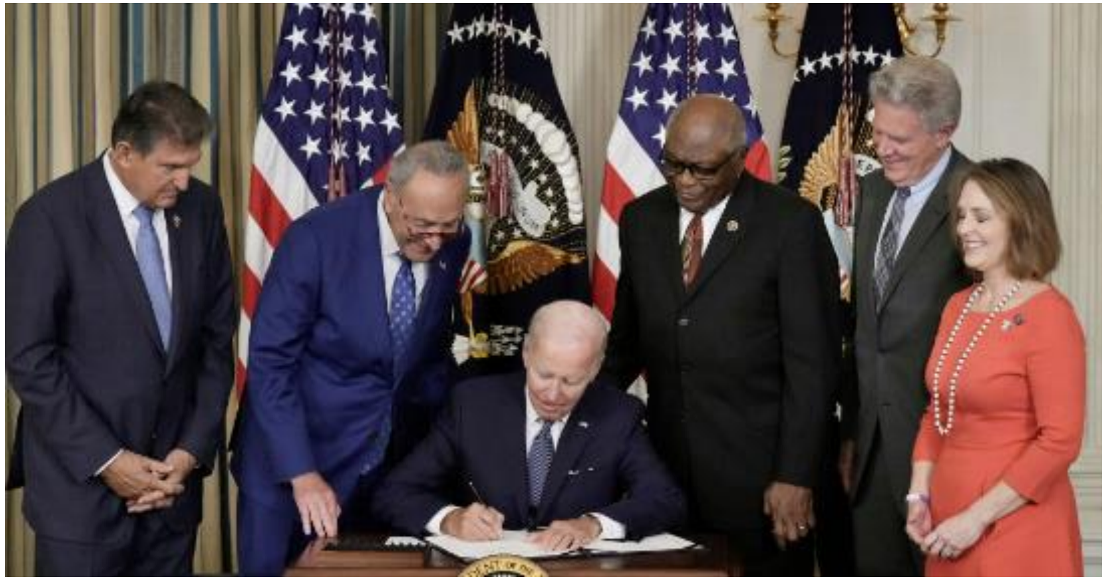
Inflation Reduction Act

Inflation Reduction Act

- **Invests $369 billion** and designed to reduce us carbon emissions up to 41% by 2030
- Provide at least a **10-year extension and expansion of** the production and investment **tax credits**
- **Tax credits become transferrable**



Electric Sector IRA Key Opportunities

Major tax credits available for carbon free technologies

45 Y: Production Tax Credit

- Up to ~$30/MWh for 10 years, with complicated bonus rules
- Replaces existing PTC for in 2025 for all carbon free technologies
- IRA §13701

48 E: Investment Tax Credit

- 30% with labor requirements plus 10% point bonuses for Domestic Content and Energy Communities
- Stand alone storage is eligible
- Replaces existing ITC in 2025 for all carbon free technologies
- IRA §13702

45 Q: CO_2 Capture & Storage Credit

- Up to $85/t$CO_2$ captured with labor bonus
- Eligible for 12 years
- Must start construction by 2032
- Projects cannot stack 45Q and other credits
- IRA §13104

45 V: Clean H_2 Production Credit

- Qualification depends on GHG lifecycle of H_2 production
- Up to $3/kg with for 10 years
- Must start construction by 2032
- Allowed to be stacked with 45Y or 48E for electrolytic H_2
- IRA §13204

All credit estimates are in 2022 Dollars. Note model will escalate

Technology Specific vs Carbon Net Zero

January 1, 2025

IRP APPROACH

PTC/ITC Technology Specific

PTC or ITC for Net Zero Carbon

Start of Construction

IRA Table – Production Tax Credit (PTC)

Category	Description	PTC Rates		Begins…	Ends…	Extended by Technology Neutral Credit…
		Labor Not Met	Labor Met			
Labor Stipulations	Pay prevailing wage rates and satisfy apprenticeship labor hours	$26/MWh		BOC** <60 days after Dept. of Treasure issues guidance OR PIS in 2022		2025 through the later of either: 2032 or year when year after electric sector CO2 emissions drop 75% below 2022 levels
		$5/MWh (base)	$26/MWh	BOC >60 days after Dept. of Treasure issues guidance	N/A	
Domestic Content	+10% maximum if steel and iron produced in US and 40% of manufactured products are made in the US	+2%	+10%	PIS** after 12/31/2022	BOC by 12/31/2024	
Energy Communities	Build at a brownfield site or in a coal, oil, or NG community	+2%	+10%	PIS after 12/31/2022	BOC by 12/31/2024	
Transferability	100% PTC claimed for tax-exempt entities	90% PTC claimed if BOC 2024	N/A	PIS after 12/31/2022	BOC by 12/31/2024	Phasedown applied if labor is not met

*For projects above 5 MWac
**PIS = placed in service, BOC = beginning of construction

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All credit estimates are in 2022 Dollars

IRA Table – Investment Tax Credit (ITC)

Category	Description	ITC Rates		Begins…	Ends…	Extended by Technology Neutral Credit…
		Labor Not Met	Labor Met			
Labor Stipulations	Pay prevailing wage rates and satisfy apprenticeship labor hours	30%		BOC** <60 days after Dept. of Treasury issues guidance OR PIS in 2022		2025 through the later of either: 2032 or year when year after electric sector CO2 emissions drop 75% below 2022 levels
		6% (base)	30%	BOC >60 days after Dept. of Treasure issues guidance	N/A	
Domestic Content	+10% maximum if steel and iron produced in US and 40% of manufactured products are made in the US	+2%	+10%	PIS** after 12/31/2022	BOC by 12/31/2024	
Energy Communities	Build at a brownfield site or in a coal, oil, or NG community	+2%	+10%	PIS after 12/31/2022	BOC by 12/31/2024	
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*For projects above 5 MWac
**PIS = placed in service, BOC = beginning of construction

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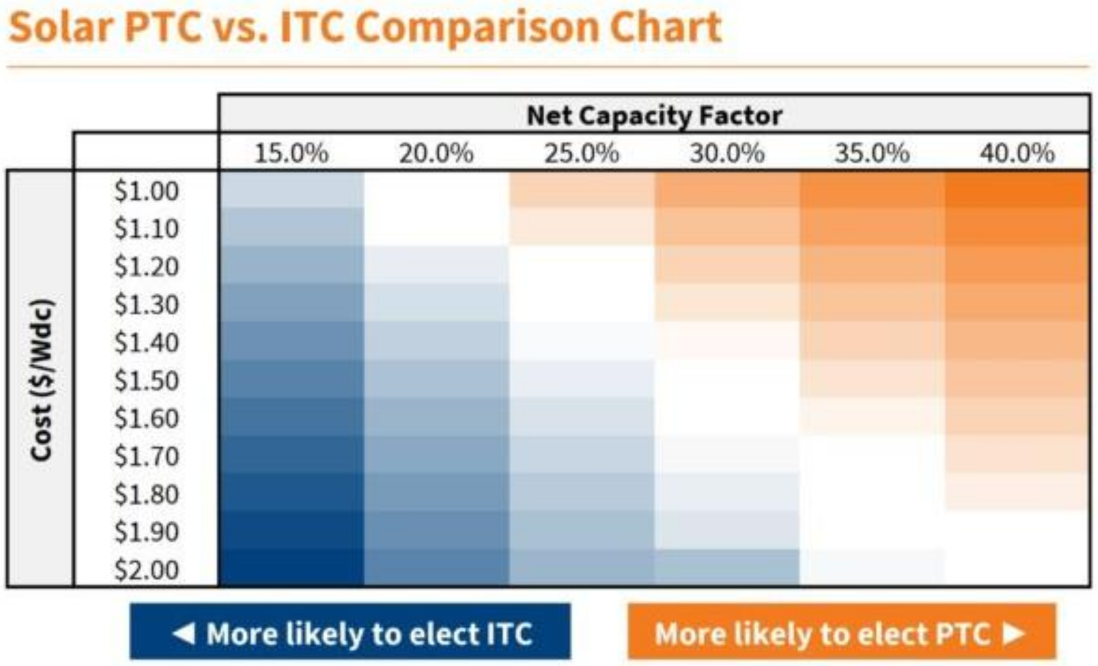
Recommended Approach for IRP Analysis

Base Case Assumptions:

Wind	PTC – Full Credit with Labor Requirements Met – No Bonus
Solar	ITC – Full credit with Labor Requirements Met – No Bonus (30%)
Storage	ITC – Full credit with Labor Requirements Met – No Bonus (30%)
Biomass	PTC – Full Credit with Labor Requirements Met – Include Energy Community
Carbon Capture	CCS Credit – Full credit with Labor Requirements Met ($85/tCO$_2$)
Hydrogen	Modeling delivered fuel price – assume the IRA benefits our reflected in the fuel price
Nuclear/SMR	ITC – Full credit with Labor Requirements Met – No Bonus (30%)



SOURCE: *PV Magazine, Aug. 2022*

Sensitivity Analysis: Include scenarios where the energy community is included for wind, solar, and storage.

Next TAG Meeting

Third Meeting

Monday, May 20th
1 pm (CST)

GREAT PLAINS INSTITUTE

cee

Center for Energy and Environment

Minnesota Power 2025 IRP Technical Advisory Group

May 20, 2024 | Webinar

Meeting Objective…Collaboration

1. Develop collective objectives and ground rules for this group.

2. Build a shared understanding of the key themes and strategic questions being addressed in the IRP.

3. Explore perspectives and key modeling assumptions to discuss at future meetings.

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TAG Tentative Schedule – General Themes

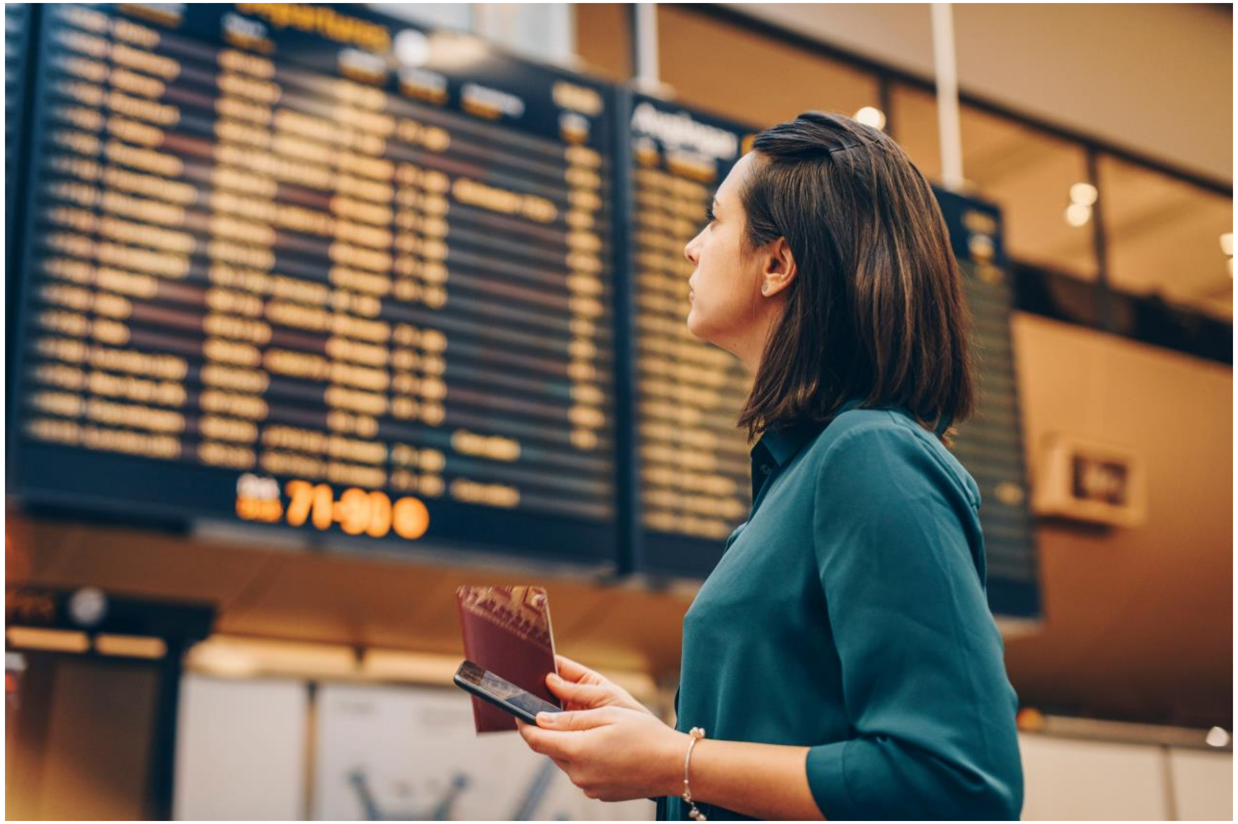
~~**April** – Reliability and Inflation Reduction Act ("IRA")~~

May – Technology

June – Customer

July – EnCompass Modeling

August – Transmission / Distribution



Note: Some of the more complex topics, such as reliability & resource adequacy, will be discussed at several TAG meetings.

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Today's Agenda

1. Reliability Criteria Defined

2. Technology to Consider in the 2025 IRP Evaluation

“State of Union” for Reliability in Planning

- Why can’t we keep doing what we have been doing?
  - No form of “Business As Usual” in the future
  - Need to meet carbon goals while maintaining reliability and minimizing rate impacts
  - Changing MISO market resource portfolio/backstop
- Why now?
  - Significant decisions in this IRP timeframe
  - Increased resource development risks
  - More interest in large load additions
  - Expectation from customers that reliability will be maintained as we transition

Key Intersection of Technology & Need

- **Minnesota Power Reliability Criteria**
  - Full Range of Critical Attributes and Metrics
- **Minnesota Power Resource Need**
  - System Needs Accounting for Customer Demand, Climate Goals/Policy, Fitting the Reliability Criteria
- **Industry Resource Maturity**
  - What Resources are Grid Ready for Deployment – When – and at What Cost?

Planning System Characteristics

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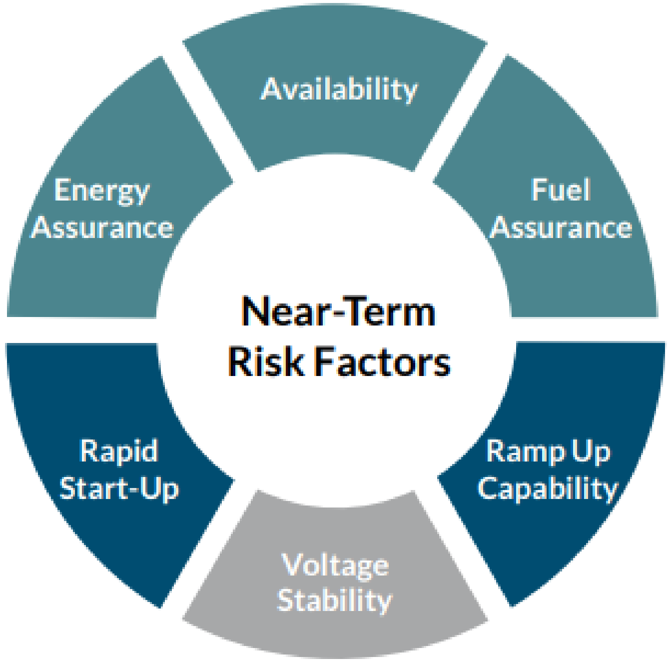
- **Traditional Planning**
  - Reliability: Capacity & Energy
  - Sustainability: Carbon & Renewables
- **Energy Adequacy**
  - Fuel Assurance
  - Long Duration Energy at High Output
- **Operational Flexibility**
  - Ramping
  - Rapid Start-up/ Must-Run
- **Essential Services**
  - Voltage Stability /Reactive Power
  - Inertia/Frequency Response/ Short Circuit Strength

NEW Layers as We Get Deeper in Decarbonization

MISO working on a "Reliability System Attributes" roadmap whitepaper to be published by end of 2023



ALSO….FERC, NERC, EPRI, and other proceedings addressing

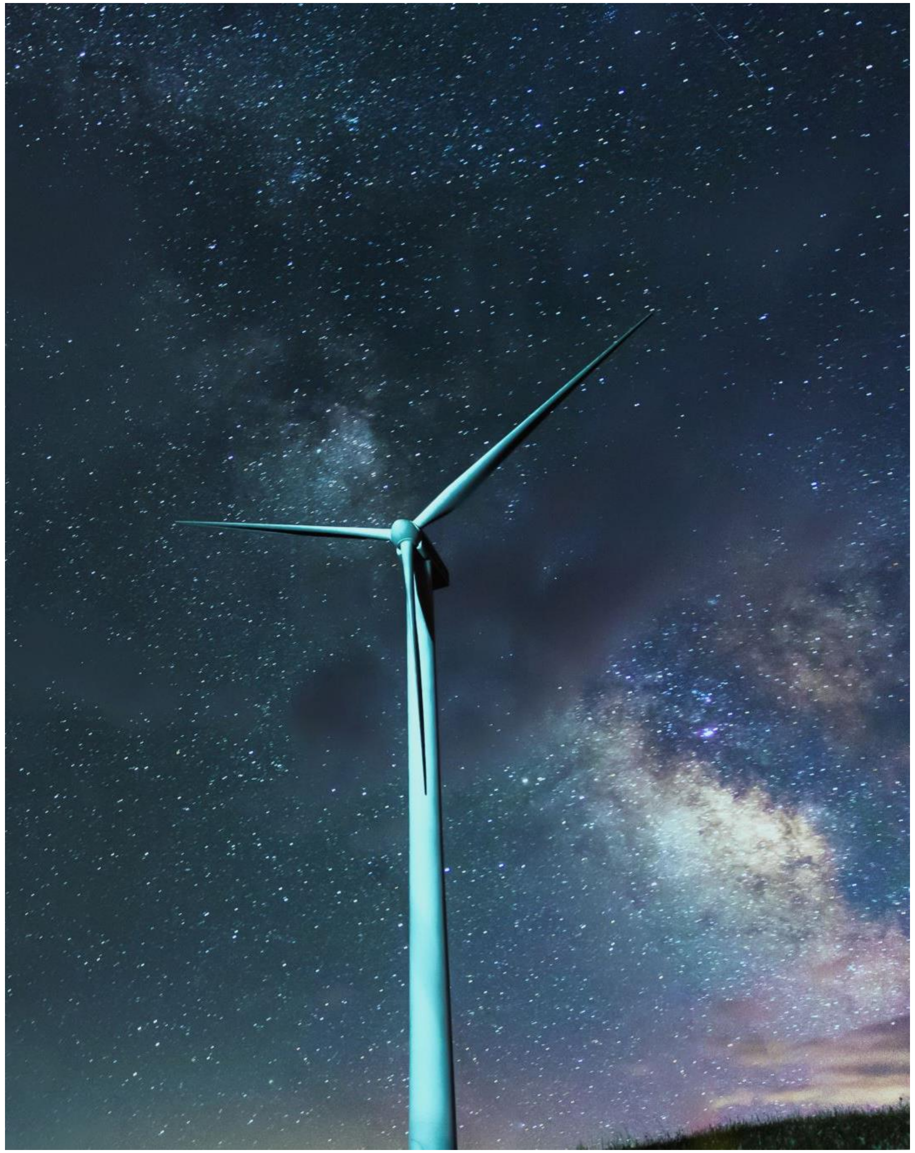
Changing Power Supply Operational Characteristics

System Wide Look:

Dispatchable Portfolio	↘
Fuel Assurance	↘
Market Availability	↘
Ramp Duration/Capability	↗
Cycling (on/off)	↗
Intermittent Generation	↗

Status of MP's System Today:

Dispatchable Portfolio *Up to 1060 MW*
Fuel Assurance *815 MW with 45 days of fuel supply*
Ramp Rates *Up to 350 MW/hr*
Ramp Duration *Up to 700 MW over 8 hours*
Cycling (on/off) *Limited capability*
Intermittent Generation *950 MW on system today*



Identifying the Complexity – 2023 Illustrative Snapshot

- Matching Annual Load Energy to Wind + Solar Energy
- Wind Data
  - Scaled 2023 Actual MP Wind Data
- Solar Data
  - MISO North Total Solar
    - 400 MW
    - No Scaling
- This Example Ignored Reliability Criteria and Resource Adequacy Needs

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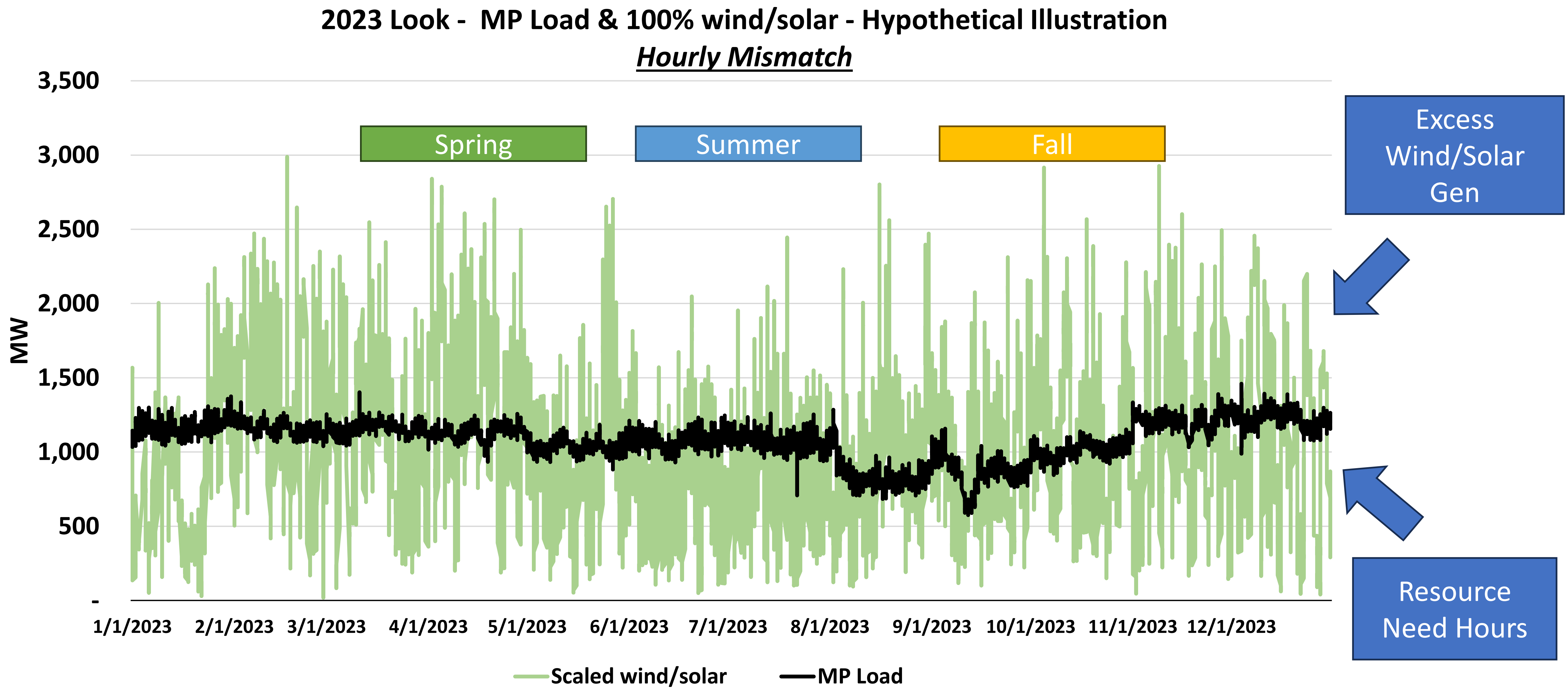
Identifying the Mismatch – Additional Tech Needed



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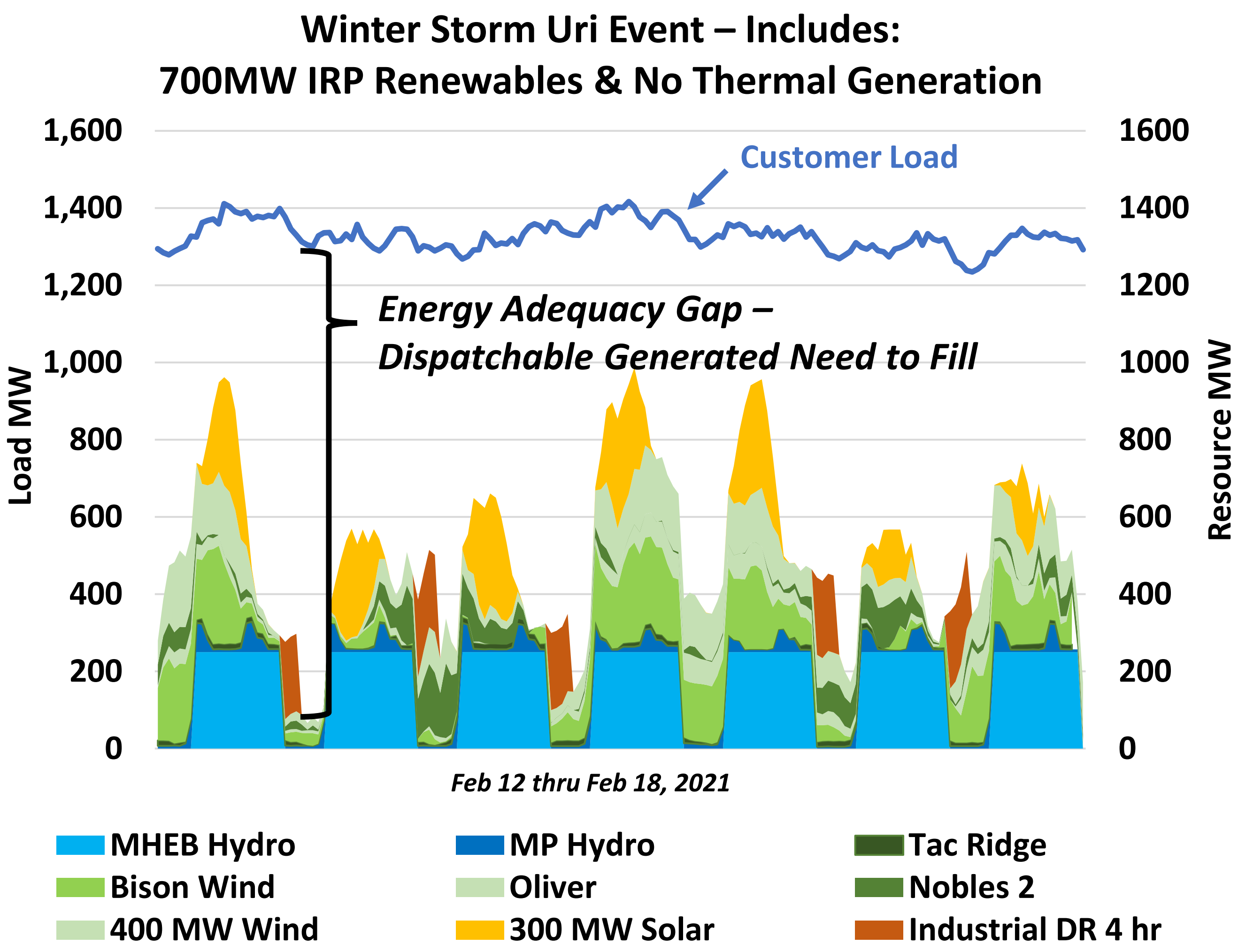
Energy Adequacy – "Long Duration Energy at High Output"

- Increasing weather impacts to broader geographical areas limits the ability to share resources across the eastern interconnection because multiple ISO/RTOs are experiencing weather impacts simultaneously.
- The energy need characteristics of the MP's system must be considered when determining the resource type for meeting dispatchable needs.
- *Considering these events to be included:*
  - *Winter Storm Uri February 12-18, 2021*
  - *Summer Wind Draught July 27, 2018 – July 31, 2018*
  - *Winter Wind Draught January 27, 2020 – January 31, 2020*



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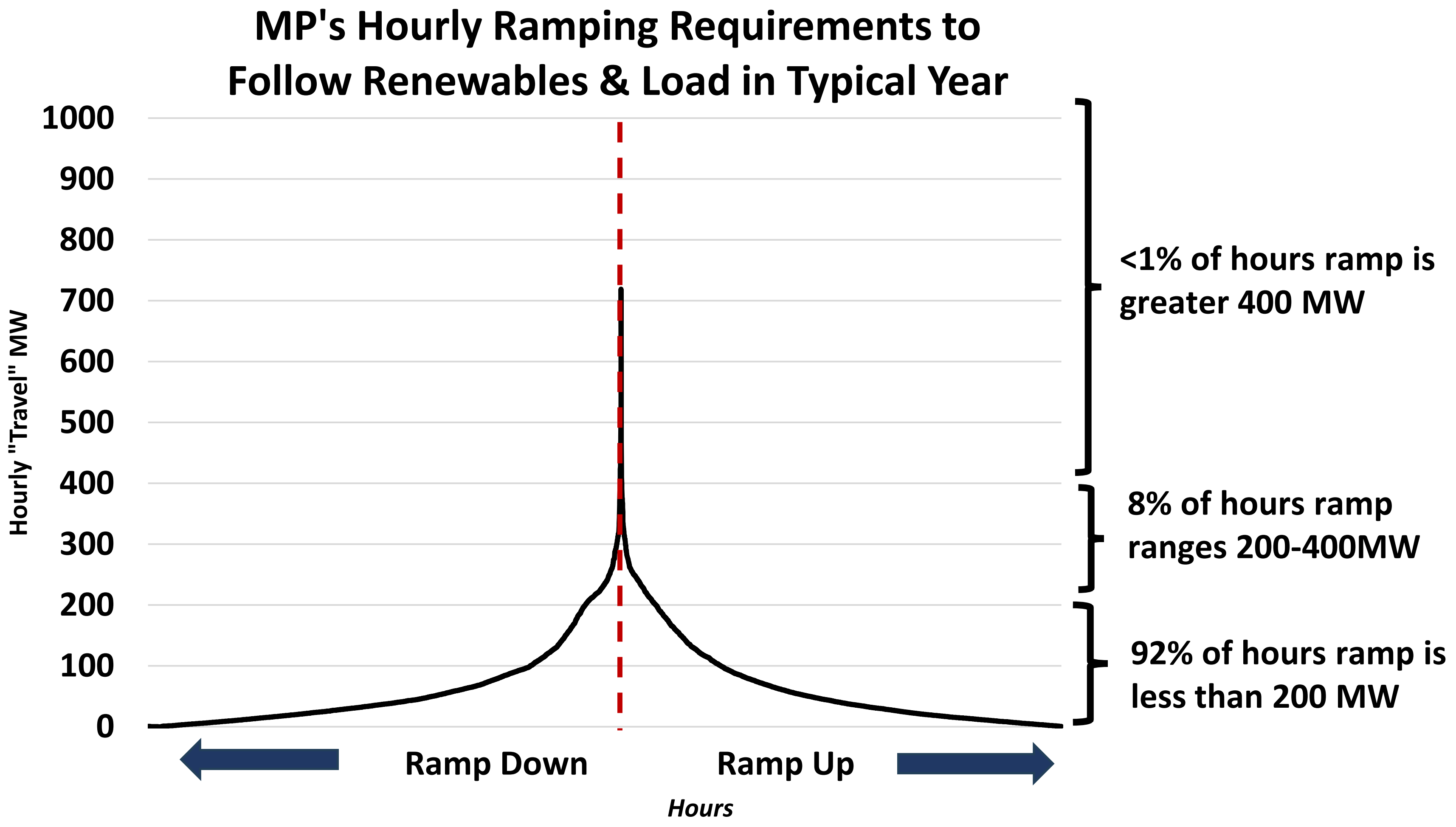
Operational Flexibility – Multi Dimension Look

- Having resources with ramping, cycling, and rapid start-up in the power supply is vital for integrating higher percentages of intermittent renewable resources and serving customers reliably all hours of the year.

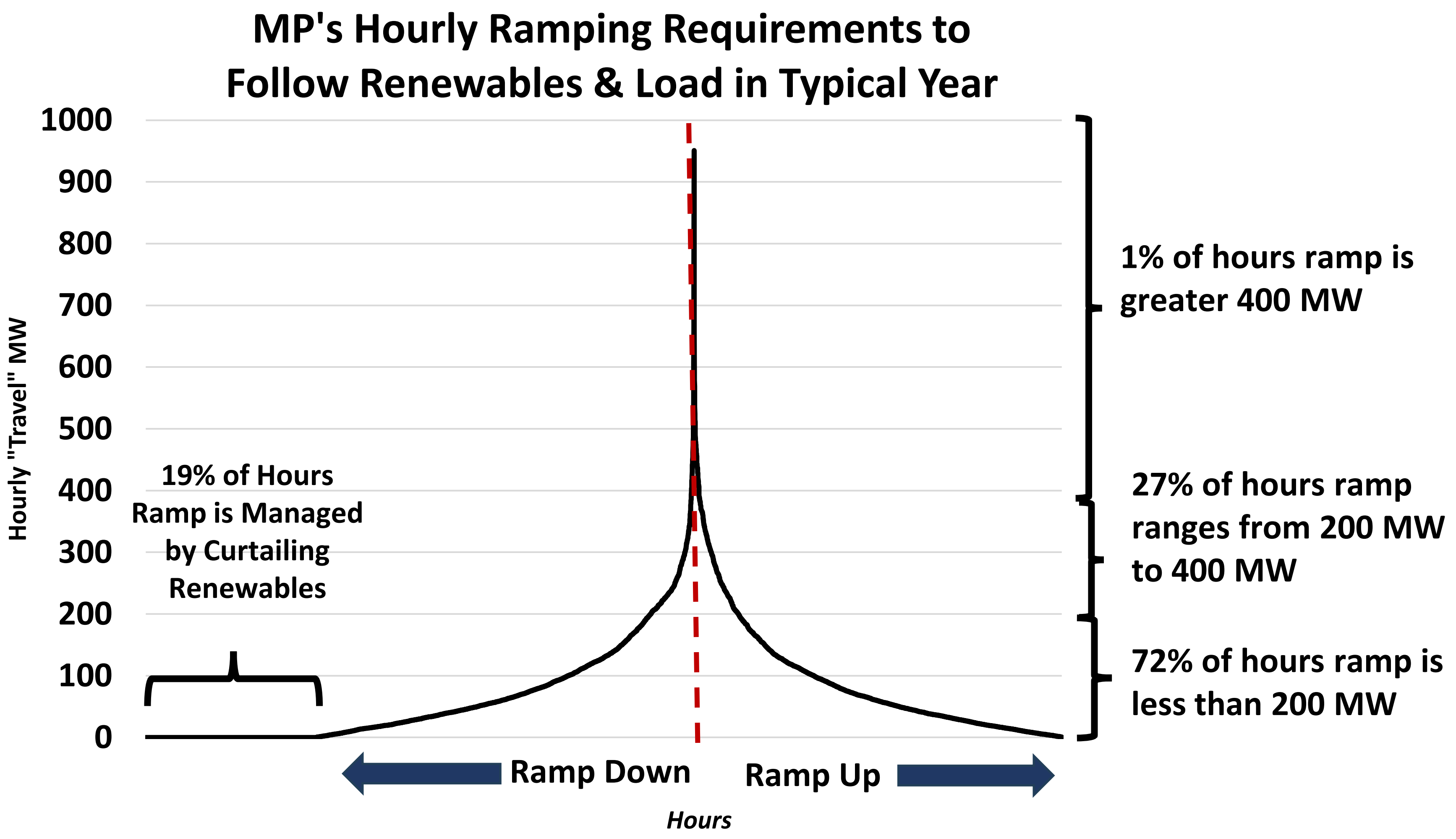
- As the generation portfolio evolves – Operational flexibility attributes need to be replaced and likely increased:
  - **Ramp Rate**: The rate, expressed in MW per minute, that a generator or net interchanges can change its output to follow changes in load or other resources (i.e. renewables).
  - **Ramp Duration**: Consecutive hours of a generator needing to increase or decrease output over a period of time.
  - **Cycling**: Capability of a resource to be committed and start-up and shutdown in subsequent hours or days.
  - **Rapid start-up**: Capability of a resource to be quickly started up for reliability or economic purposes.

MP System Ramp Rate Need Today



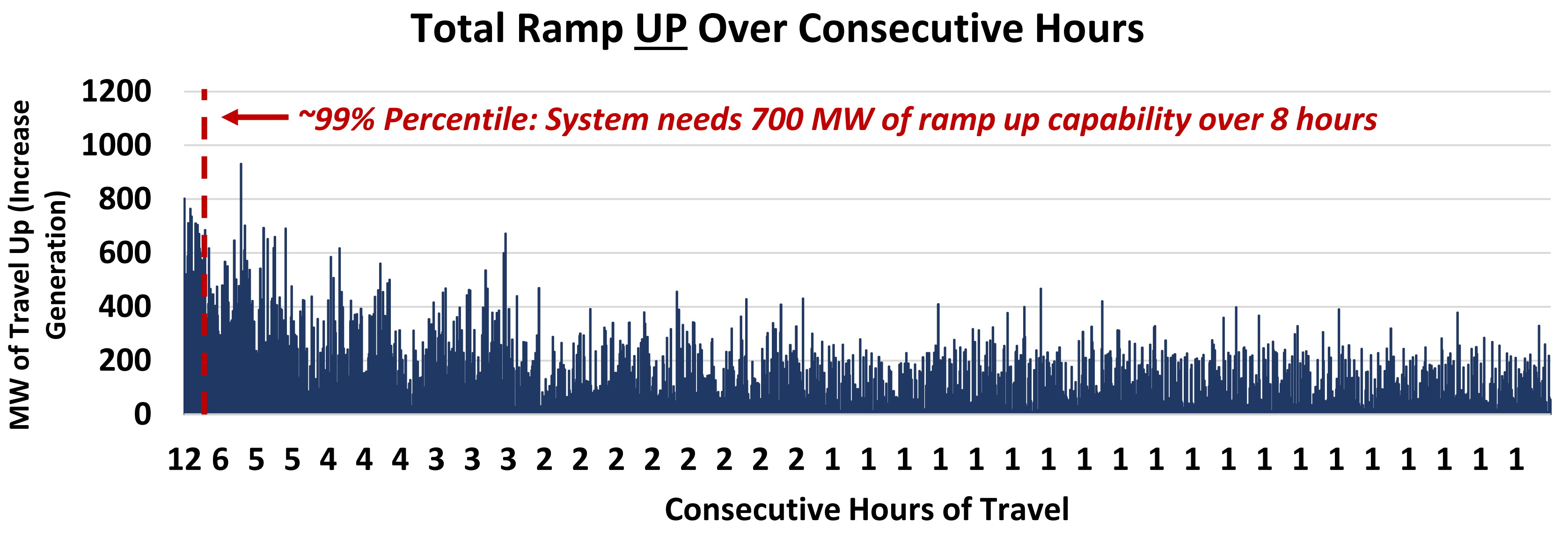
- Today MP's ramp is provided by baseload generation online.
- If all generation is online there is a total of 350 MW/Hr of ramp available
- The addition of NTEC increases the total ramp by 80 MW/Hr – resulting in total ramp of 430 MW/hr

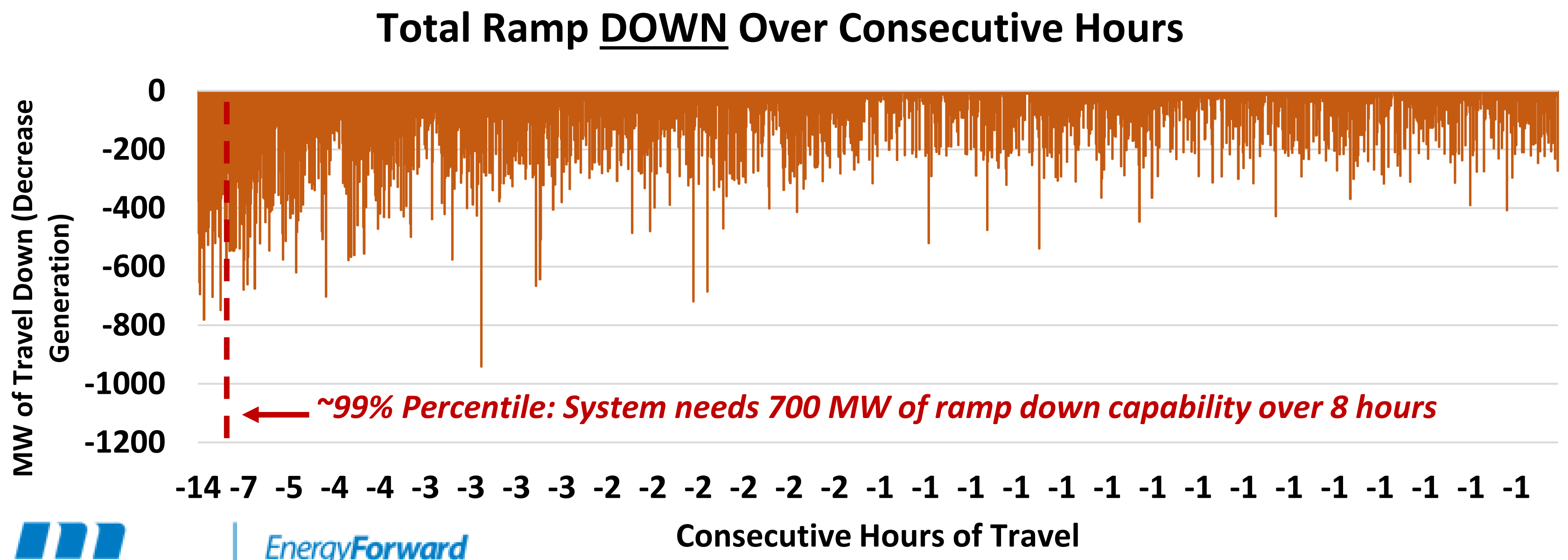
MP System Ramp Rate Need Post 700 MW of Renewables



- Addition of 700 MW of renewables increases the ramp needs of the system.
- Leaning on the system increases, unless today's ramp capability is maintained or replaced.

MP Ramp Duration Need Today





- There are times when MP needs to increase or decrease generation over consecutive hours to balance renewables and demand.
- MP Existing Portfolio Dispatch Range is 700 MW and increases to 780 MW with NTEC.

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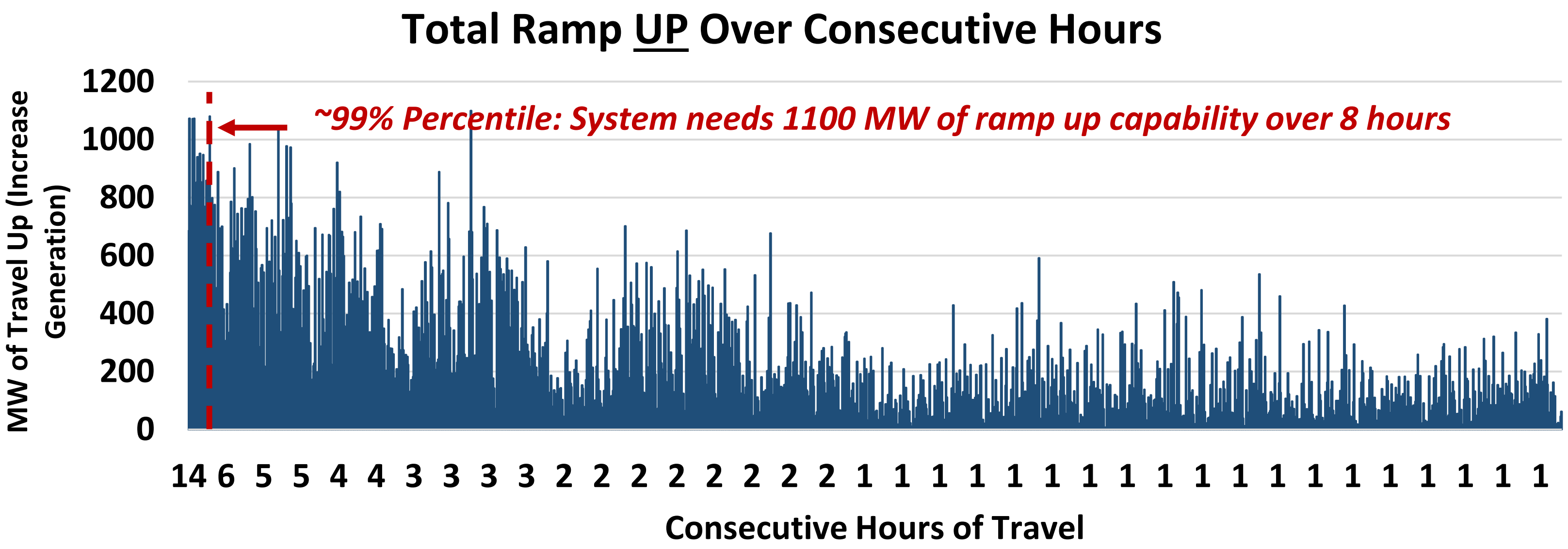
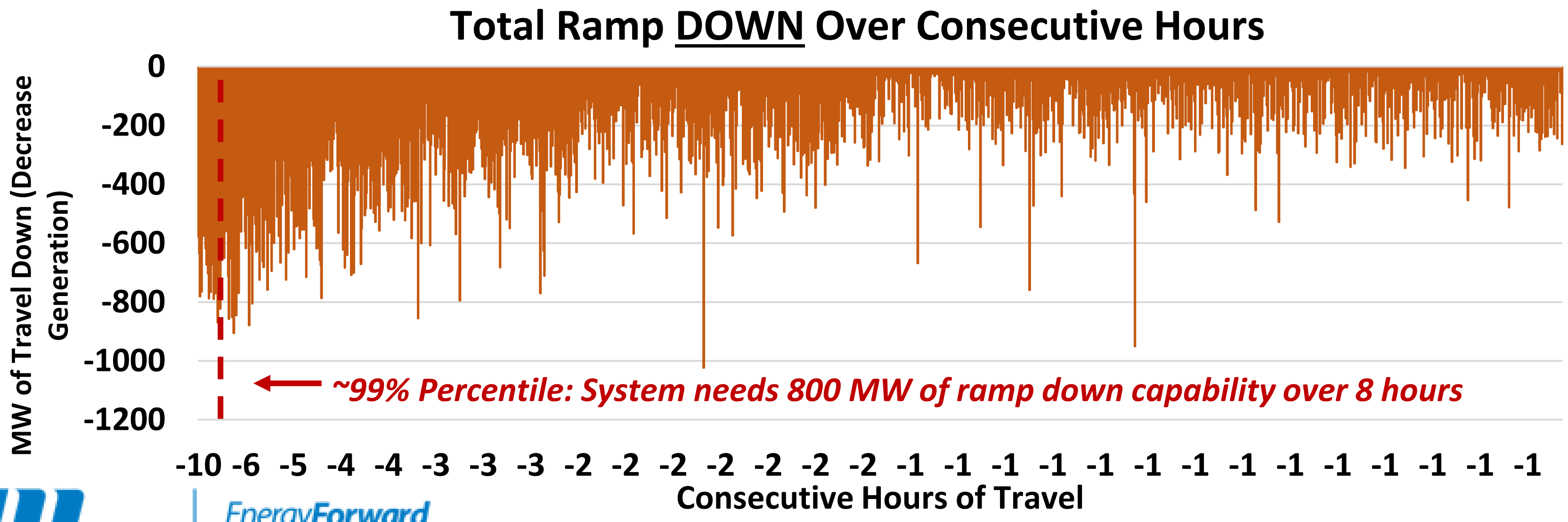
MP Ramp Duration Need Today Post 700 MW of IRP Renewables





- Additional 700 MW of renewables increase the ramp up needs, but had minimal impact on ramp down needs.

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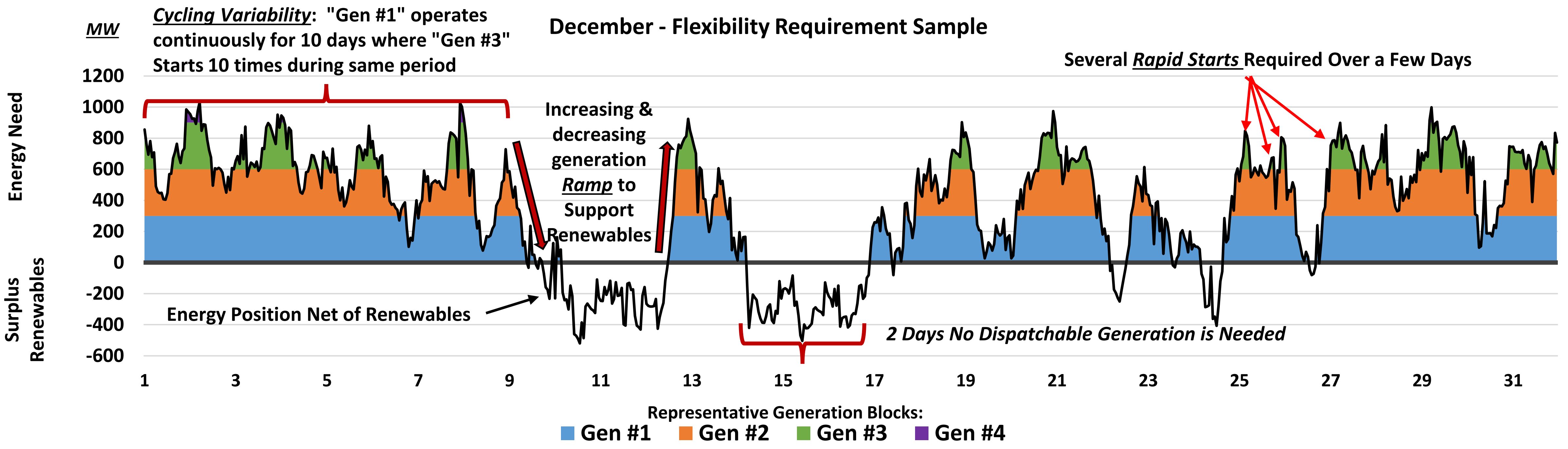
Flexibility Sample on MP’s System

Cycling is needed to optimize the diversity of MP’s renewable fleet and customer usage patterns.



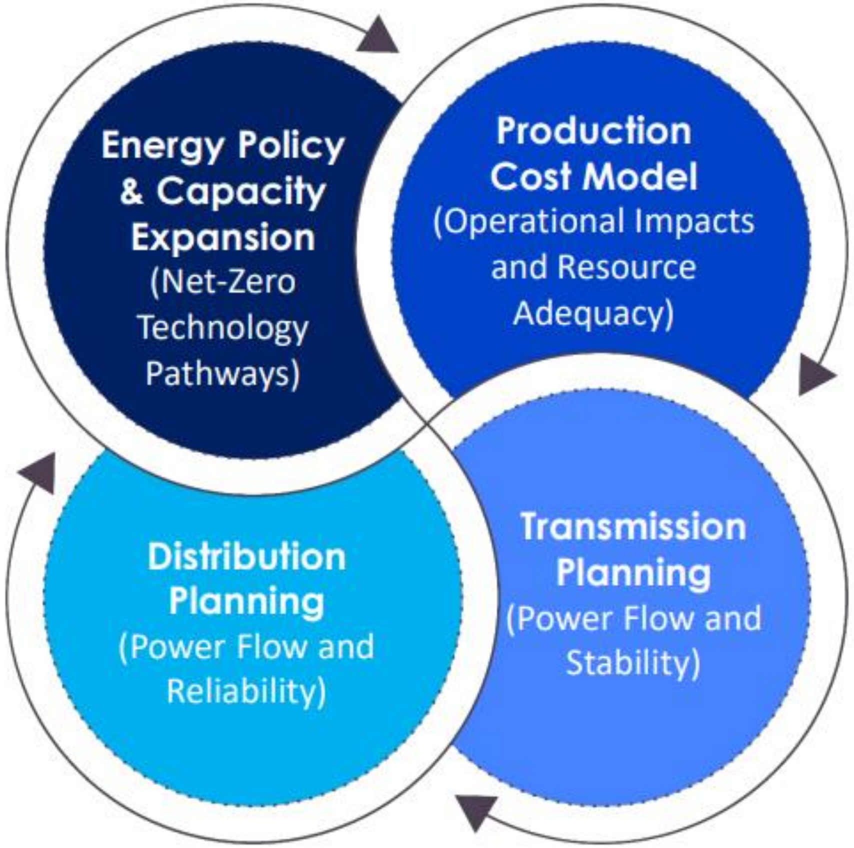
	Definition
Ramp Rate	Changing energy output within an hour
Ramp Duration	Changing energy output over several hours
Cycling	Start-up and shutdown in subsequent hours-days
Rapid Start	Quick start-up for reliability or economics (Future Study)

Grid Essential Reliability Services

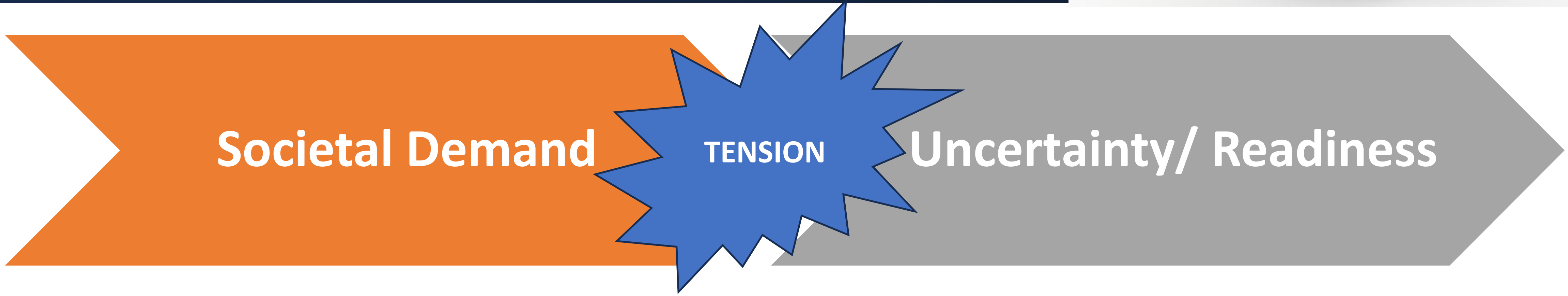
Integrated planning ensures MP plans a system with sufficient reliability services as we transition to 100% carbon free power supply.

Planning for adequate through transmission studies:

1. Voltage stability
2. Inertia
3. Frequency response
4. Short circuit



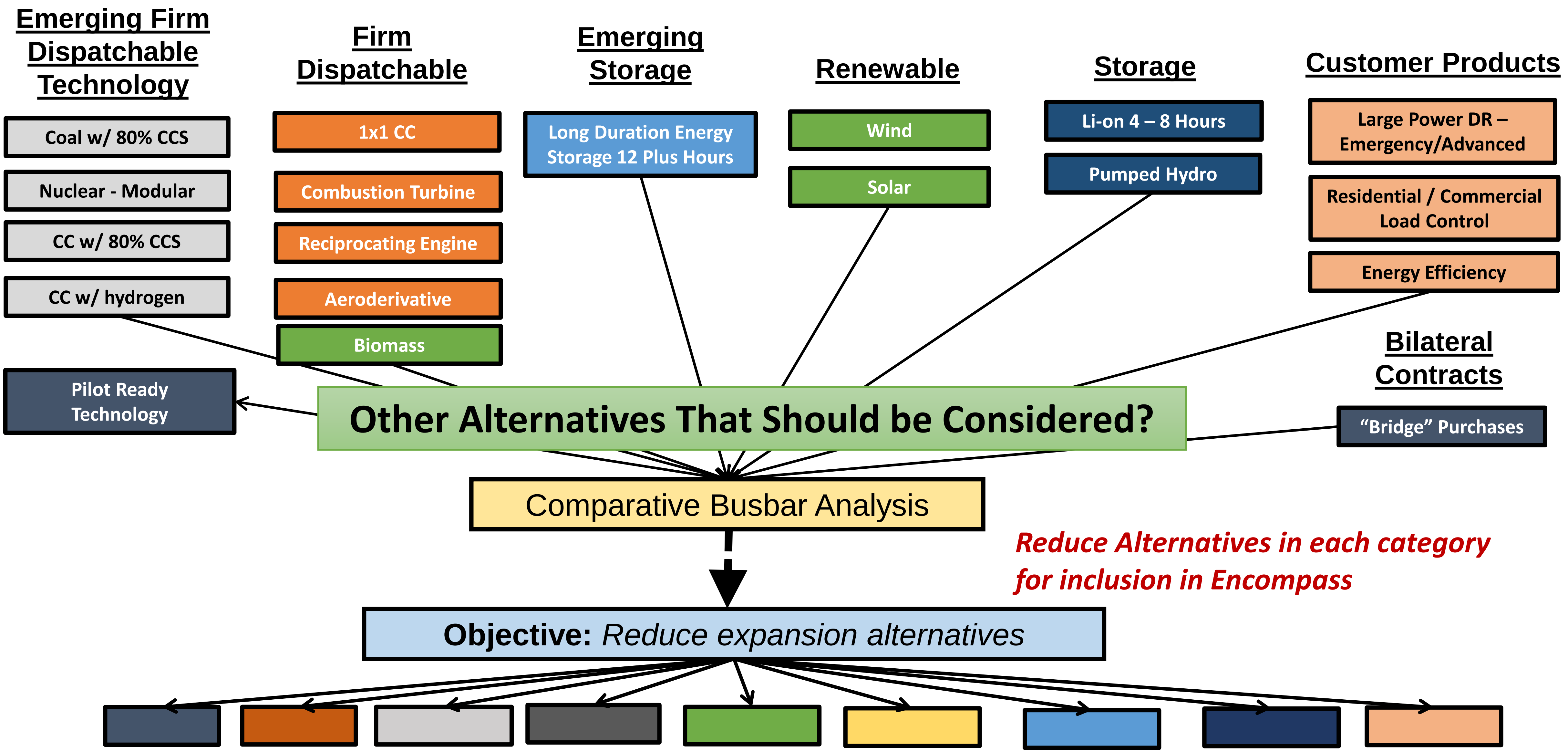
Balance Challenges and Expectations of Emerging Technologies



- Need for Technology Maturity
- Earlier Carbon Goals

- Serial Number One Project Risk
- Future Years Cost Uncertainty

Supply & Demand Side Alternatives – Looking Forward



Considerations for Alternatives Data Source

Approach in Previous IRPs:

Purchased Third-Party Technology Estimate (Burns & McDonnell), RFPs, and Peers

Data Source Considerations for 2025 IRP:

- Burns & McDonnell (third-party purchase)
- NREL (Research Institute)
- EIA (Government)
- Recent Wind/Solar RFP
- Others?

Technology Cost and Escalation Rates

Handy Whitman Index

- Long-term Capital Escalation Rate of 3%

GDPIPD Forecast

- Long-term O&M Escalation Rate 2.25%

Burns & McDonnell

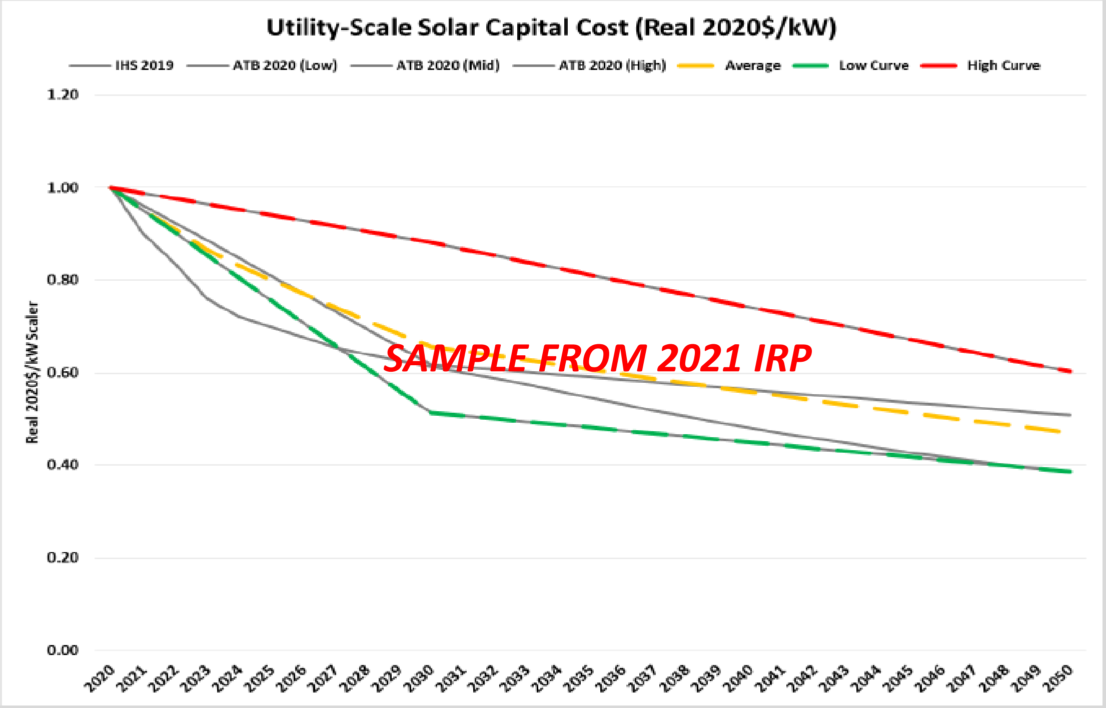
- Combustion Turbine
- Nuclear
- Aeroderivative
- Reciprocating Engine
- Long Duration Energy Storage
- Combined Cycle

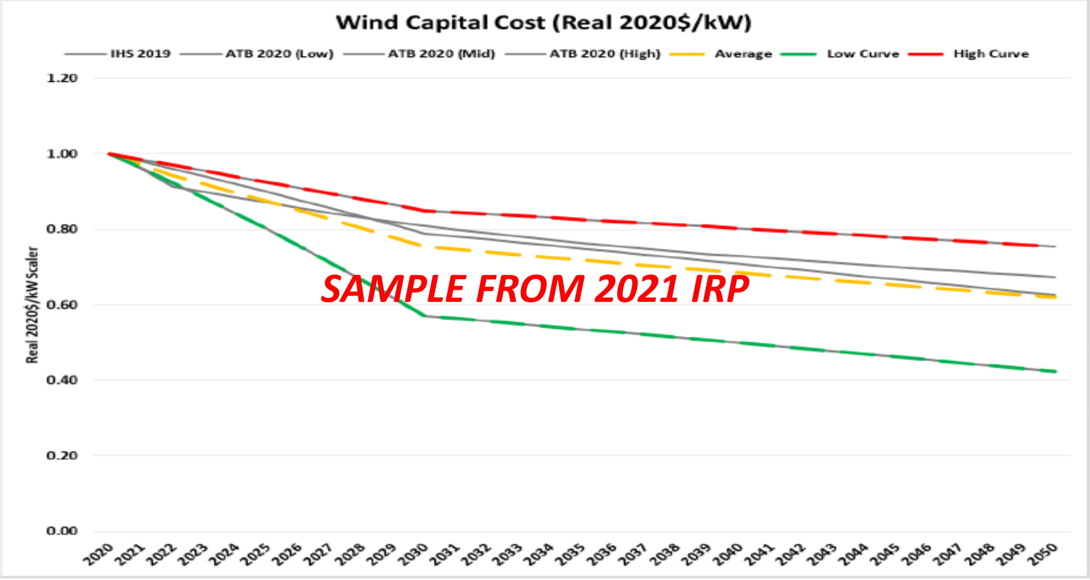
NREL/EIA/Recent RFPs

- Solar
- Wind
- Li-ion battery

Approach to Incorporating Technology Curves

- Technology advances are still occurring with wind, solar, storage.
- To capture those benefits in IRP modeling MP applies a forward cost curve – this assumes advances in technology that bring down cost.
- The impact of inflation is incorporated into the cost separately.
- We recommend using NREL and EIA forward prices curves for the following technologies:
    - Solar (NREL)
    - Wind (NREL)
    - Li-ion energy storage (NREL+EIA)





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Next Steps

- In June – Start discussion on customer energy needs, energy efficiency assumptions, and demand response/programs to model in the 2021 IRP
- Reliability criteria follow-up?

Next TAG Meeting

Fourth Meeting

Monday, June 17th
1 pm (CST)

GREAT PLAINS INSTITUTE

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Minnesota Power 2025 IRP Technical Advisory Group

June 17, 2024 | Webinar

Meeting Objective…Collaboration

1. Develop collective objectives and ground rules for this group.

2. Build a shared understanding of the key themes and strategic questions being addressed in the IRP.

3. Explore perspectives and key modeling assumptions to discuss at future meetings.

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TAG Tentative Schedule – General Themes

~~**March** – Kick-off/feedback on future meetings~~

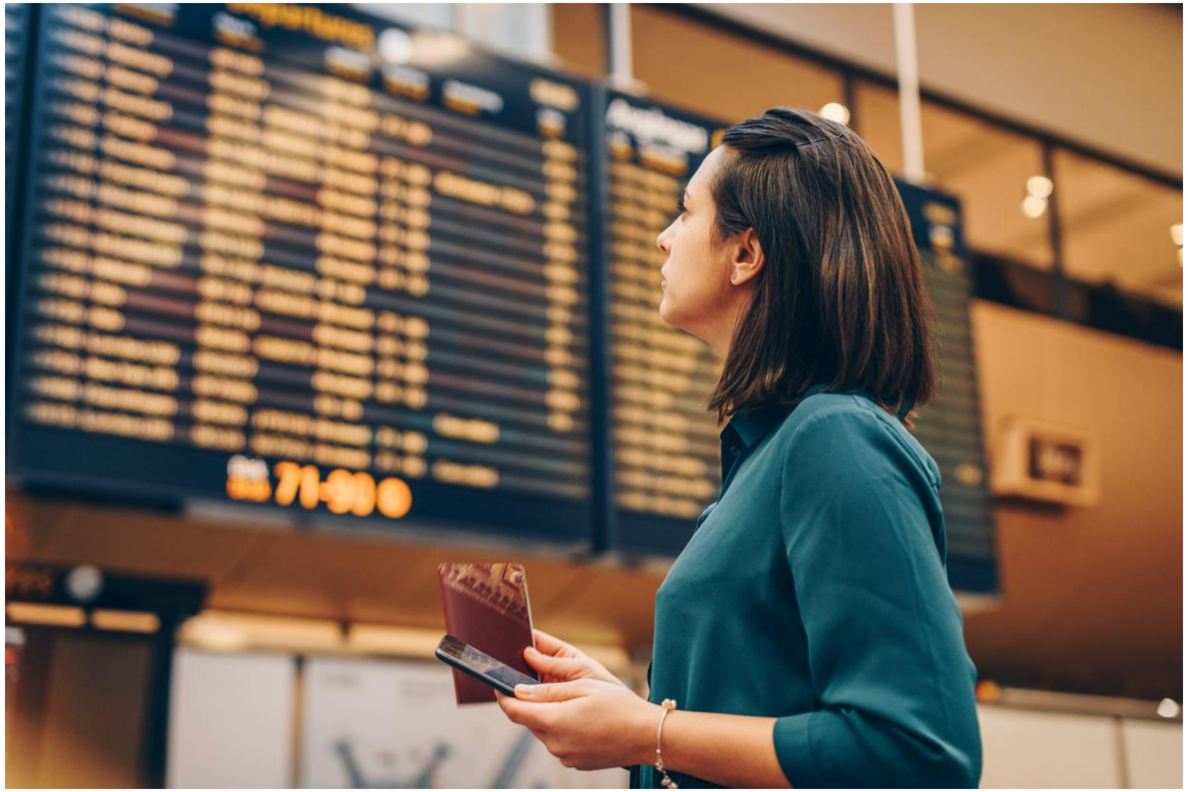
~~**April** – Reliability and Inflation Reduction Act (“IRA”)~~

~~**May** – Technology~~

June – Customer – Tech Follow-Up

July – EnCompass Modeling

August – Transmission / Distribution



Note: Some of the more complex topics, such as reliability & resource adequacy, will be discussed at several TAG meetings.

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Today's Agenda

Technology Follow-up & Customer - Outlook & Programs

1. Technology Continuation
2. Customer Load Outlook – Annual Forecast Report
3. Customer Programs
   - Energy Efficiency ("EE")
   - Electric Vehicles ("EV")
   - Solar – Distributed Generation ("DG")
   - Demand Response ("DR")
   - Residential Time-Of-Use ("TOU")

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Supply & Demand Side Alternatives – Looking Forward

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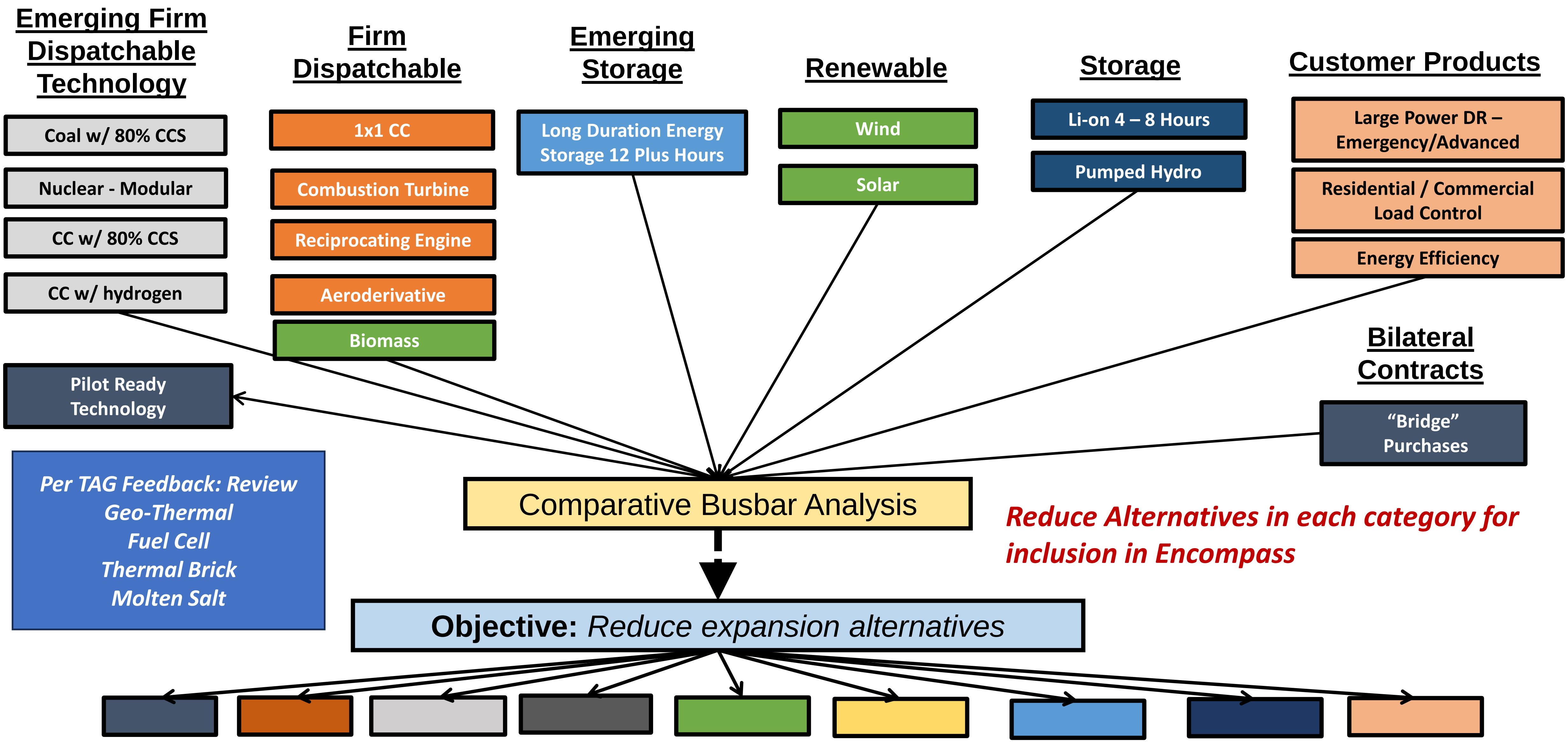

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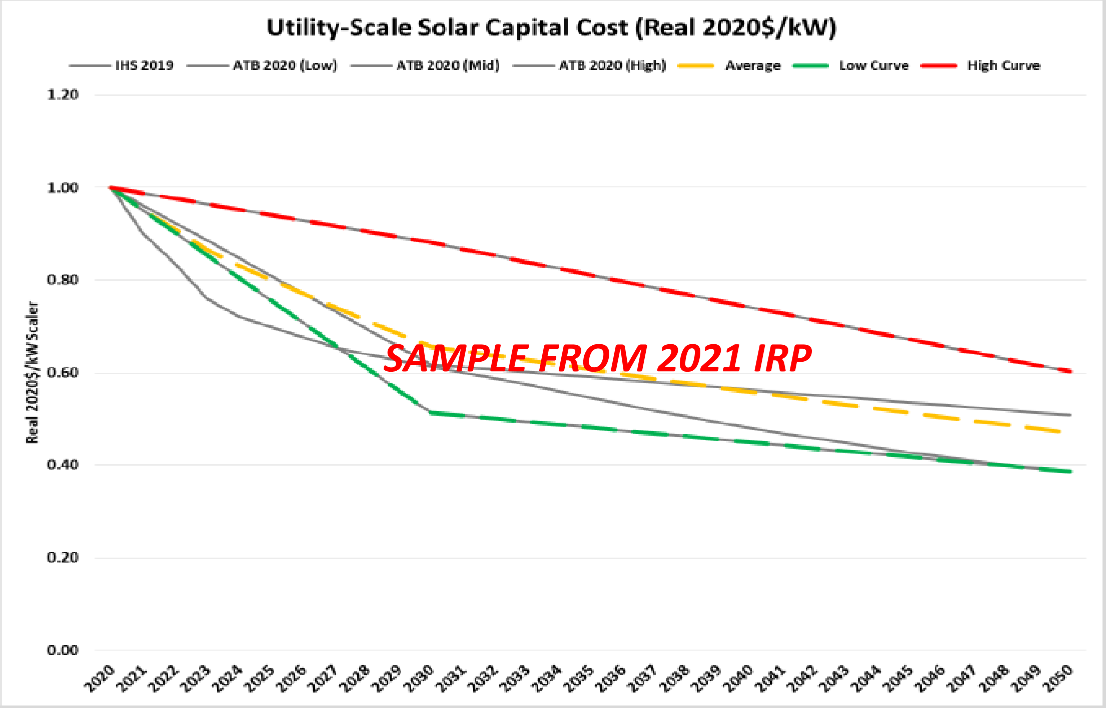
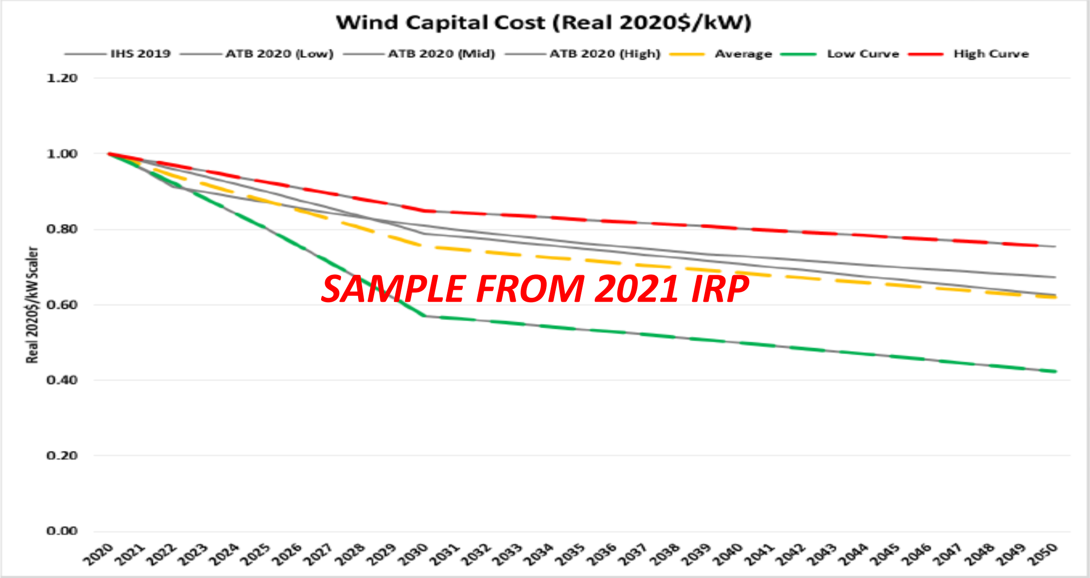




MN Power Technology Capability Matrix

**Tech specs in development for providing Grid Strengthening services*

	CCS	SMR	H2	Gas	Biomass	Wind	Solar	Li-Ion	PHES	LDES
Mature Technology				✓	✓	✓	✓	✓	✓	
Deployable by 2030				✓		✓	✓	✓		
Deployable by 2035				✓	✓	✓	✓	✓		✓
Deployable by 2040			✓	✓	✓	✓	✓	✓		✓
Established Capital /O&M Experience				✓	✓	✓	✓	✓		
Capacity Provided	✓	✓	✓	✓	✓			✓	✓	✓
Fuel Assurance (On-site Storage)	✓	✓	✓	✓	✓			✓	✓	✓
Long Duration Energy (multi-day)	✓	✓	✓	✓	✓					✓
Ramping/Flexibility		✓	✓	✓				✓	✓	✓
Cycle/Rapid Start			✓	✓				✓	✓	✓
Grid Strengthening	✓	✓	✓	✓	✓	*	*	*	✓	✓
No Environmental Life Cyle Impact										
MN Carbon Free Eligible	✓	✓	✓		✓	✓	✓	✓	✓	✓

Adoption of Emerging Technology at Scale

When is the Right Technology for MN Customers Ready?

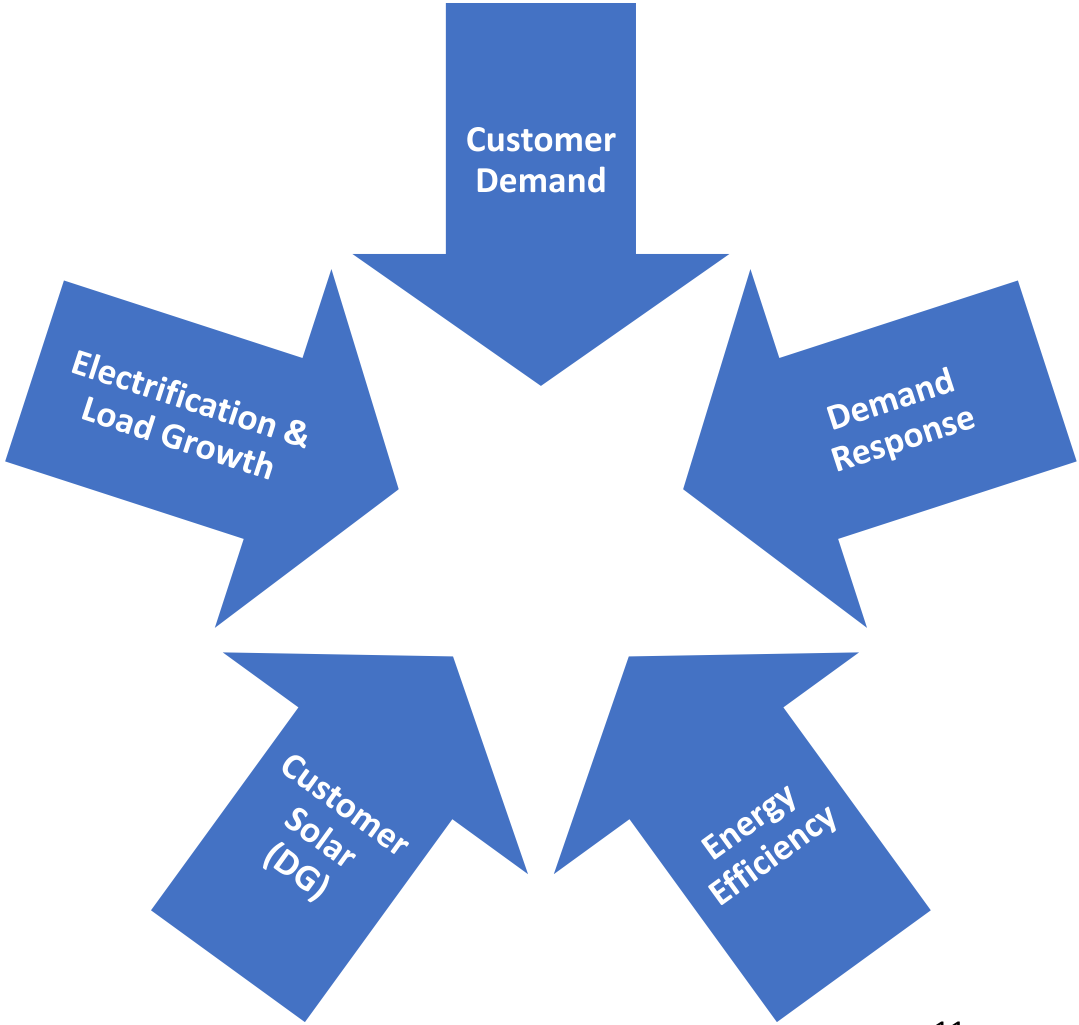
Move Too Early – Delay Using Future Technology?

Move Too Late – Slower Progress on Climate Objectives?

What is the Most Reasonable Pathway for Customers?

- Utilities are typically not early adopters -- cost and reliability risk evaluation
- Small pilots are needed
  - Helpful for positioning new tech for achieving 100% carbon free
  - But…typically higher cost and require creative funding options
- Want to see proven technology demonstrated at scale

Customer Load Outlook
Annual Forecast Report



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Annual Forecast Report

Process

1. Data Gathering
- Energy, customer count by sector
- Peak demands
- Weather (HDDs,CDDs, Peak day temperature and humidity)
- Electric revenue and prices, by sector
- National and Regional economic metrics

2. Data Preparation and Development
- Data screen and correction
- Weather data analysis
- Projections of industrial production indices (IPI)
- Simulations of regional economic development under each scenario (REMI)
- Detrend, deseasonalize, difference
- Identify any changes in variables from last year's database

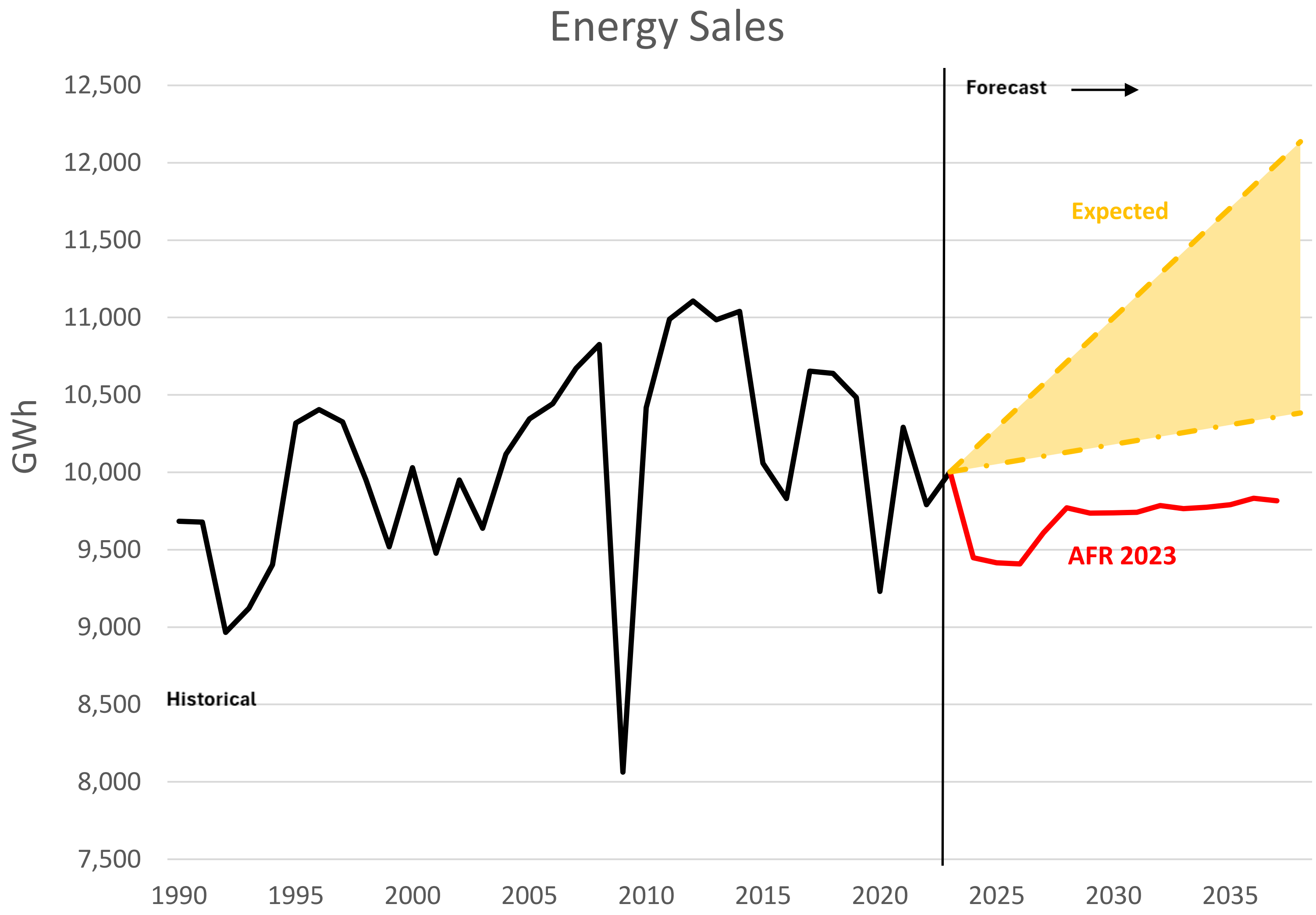
3. Specification Search
- Examine plausible variable combinations
- Explore alternative binary structures
- Generate and Rank all models by Out-Sample forecast error (CV testing)
- Filter model list for
  - Redundant/duplicate models
  - Statistical criteria (P-values & VIF)

4. Forecast Determination
- Assess plausibility of models
  - Projected growth rates
  - Intuitiveness of predictor variables
- Narrow potential model list

5. Forecast Review, Verification
- Gain consensus on optimal models
- Produce summary of findings and recommendations

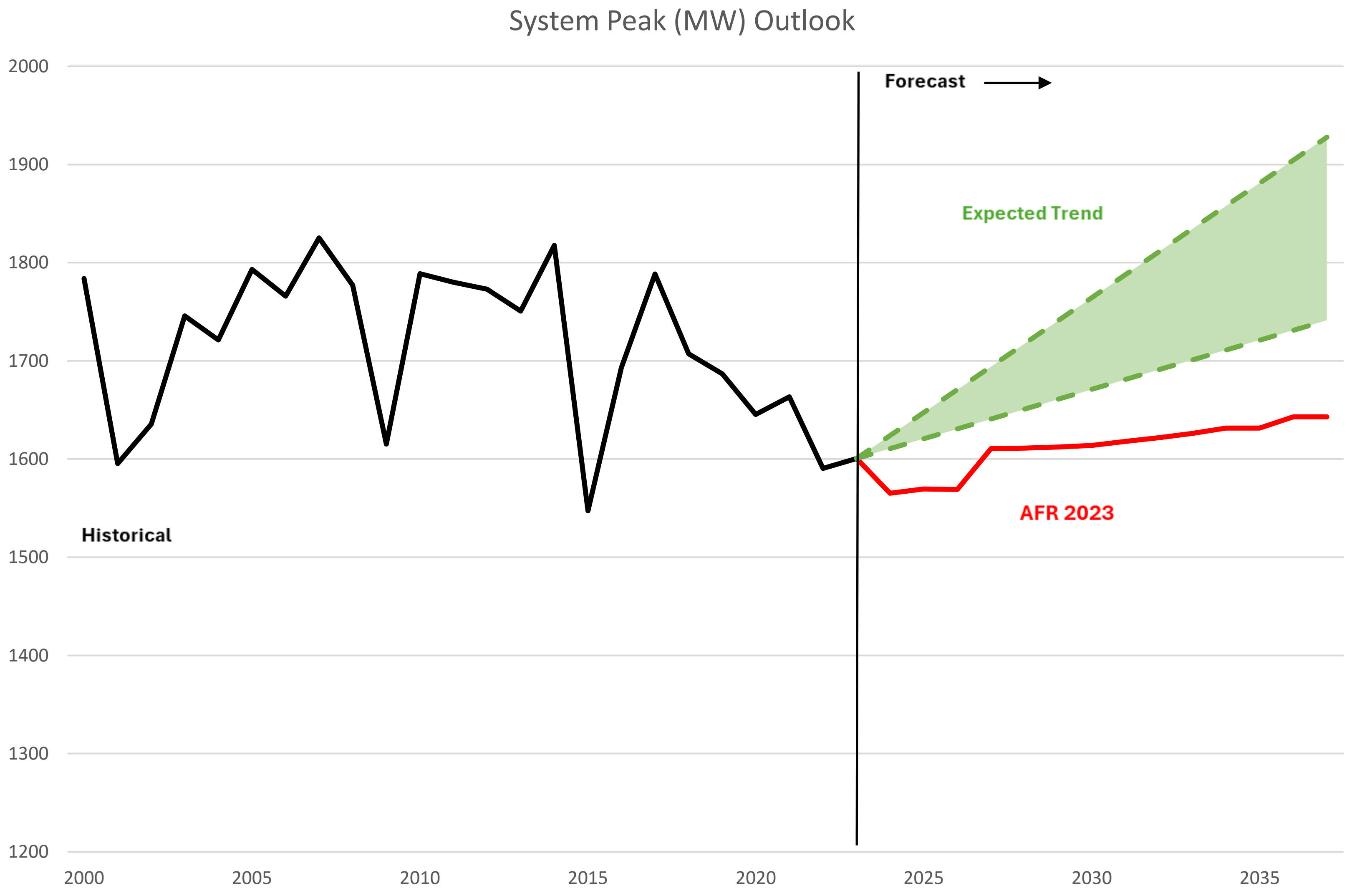
6. Company Review and Approval

2023 AFR Total Energy Sales & Outlook



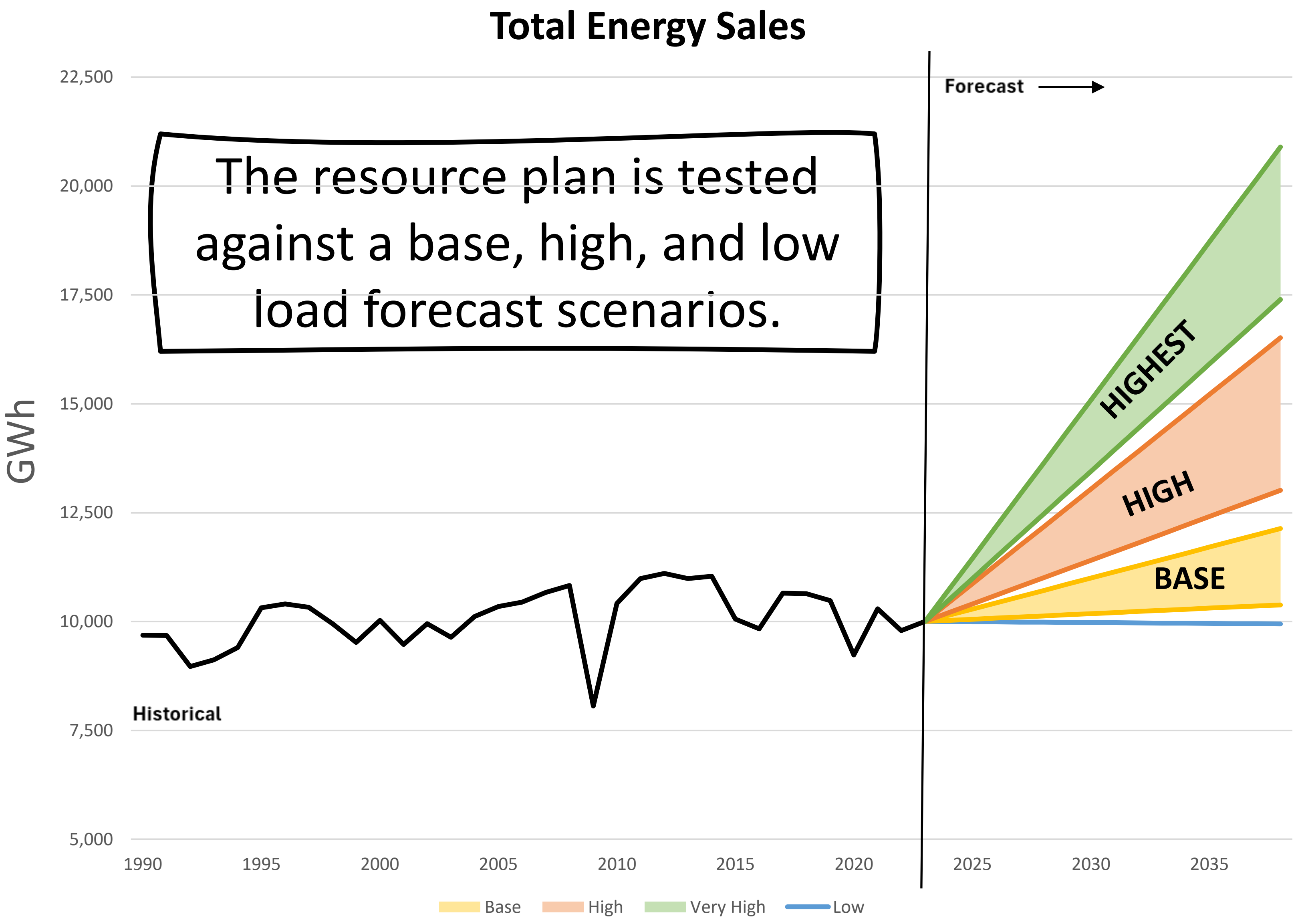
- 2023 actual energy sales were 5% higher than forecasted in AFR 2023
- Expected growth trend of ~400 GWh by 2038 (vs. 2023 actuals)
- Existing Industrial Customers
  - 35M dry ton taconite forecast
  - Shift New Range (Polymet) out one year to 2028-2029

2023 AFR System Peak Demand & Outlook



- 94 MW of system load growth by 2038
- Average annual growth rate expected to increase in 2024 AFR

Stressing Customer Demand Outlooks



Load Growth Opportunities within this IRP Study Period:

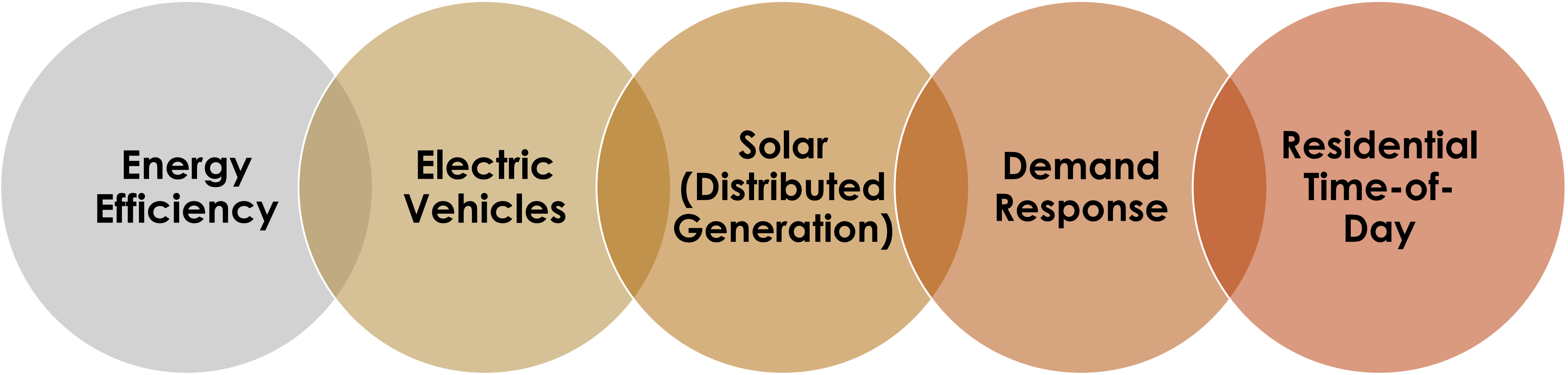
- Data Center
- Green Steel
- Increased Electrification

What load growth opportunities should MP be evaluating in the IRP?

How high should we stress load growth?

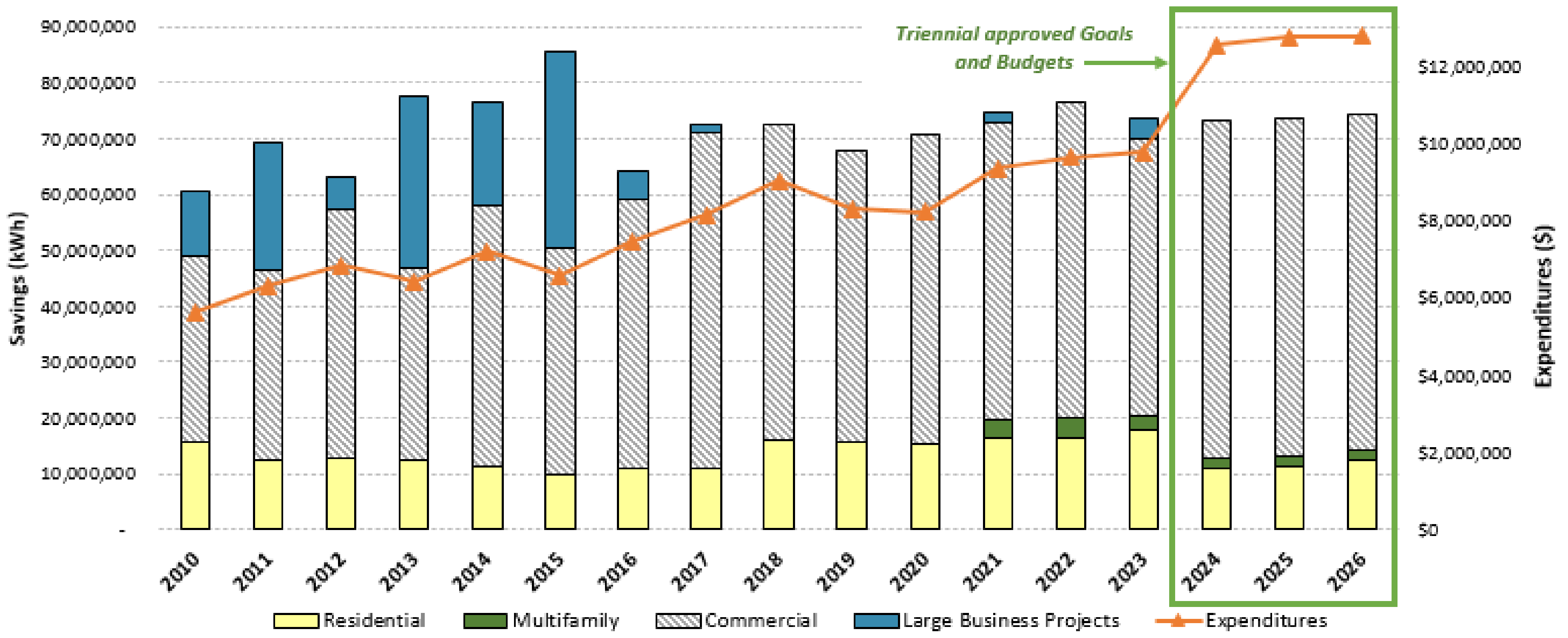
- Full electrification?
- 100% EV?
- Large industrial additions representing Data Center/Green Steel?

Customer Programs



Energy Efficiency Programs

- IRP assumptions consistent with the 2024-2026 Energy Conservation and Optimization ("ECO") plan
- Reduces sales by ~73 GWh/year
- Estimated EE cost for 2024-2026 is $0.17/kWh (2023 = $.013/kWh)



Minnesota Power has met or exceeded the state's energy savings goal since it went into effect in 2010.

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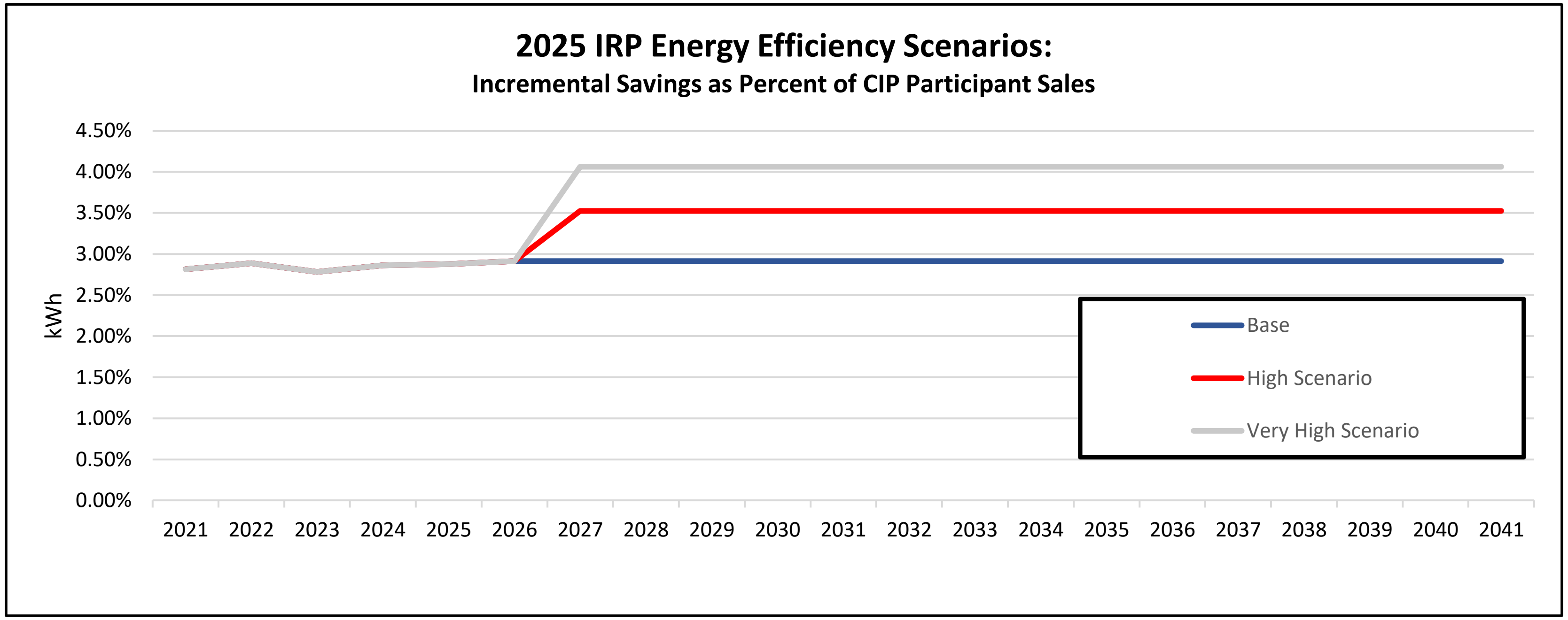
Energy Efficiency

- The base assumption reflected in the forecast is aligned with MP's current (2024-2026) triennial savings goals which equates to about 2.9% of ECO eligible retail sales.
- The High scenario reflects the equivalent of 3.5% of ECO eligible retail sales.
- The Very High scenario reflects 4% of ECO eligible retail sales.



The High and Very High scenarios will be included as "supply-side" resource alternatives. What energy efficiency scenarios should MP be evaluating in the IRP?

Electric Vehicles

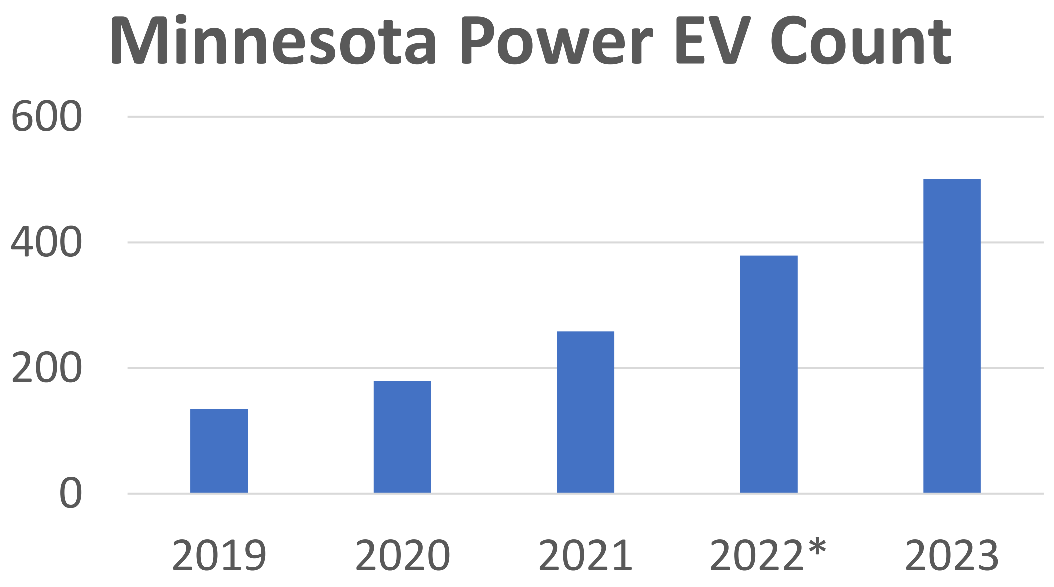
Continuous growth in EV rate participation, indicating that EV adoption in our area is growing.

-Modeled residential adoption

-Current serving 500 vehicles (0.25% penetration)

-Forecasting about 56,000 vehicles (26% penetration) by 2038)

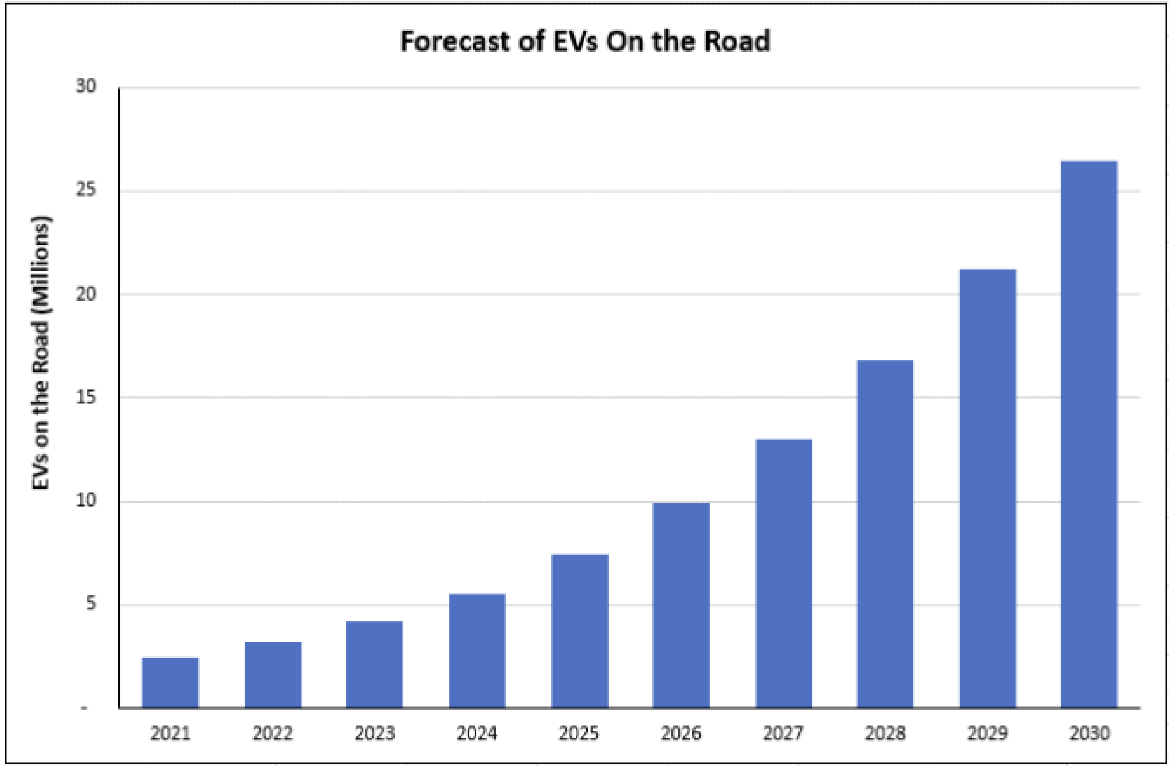
-IRP model will include a High EV Sensitivity



https://mn.gov/puc/activities/economic-analysis/electric-vehicles/

*2022 Data not provided- used straight line assumptions between 2021 and 2023

Figure 1. EEI Forecast of EV Stock: 26.4 Million EVs on U.S. Roads in 2030



Electric Vehicle Sales and the Charging Infrastructure Required Through 2030, EEI, June 2022
https://www.eei.org/-/media/Project/EEI/Documents/Issues-and-Policy/Electric-Transportation/EV-Forecast--Infrastructure-Report.pdf

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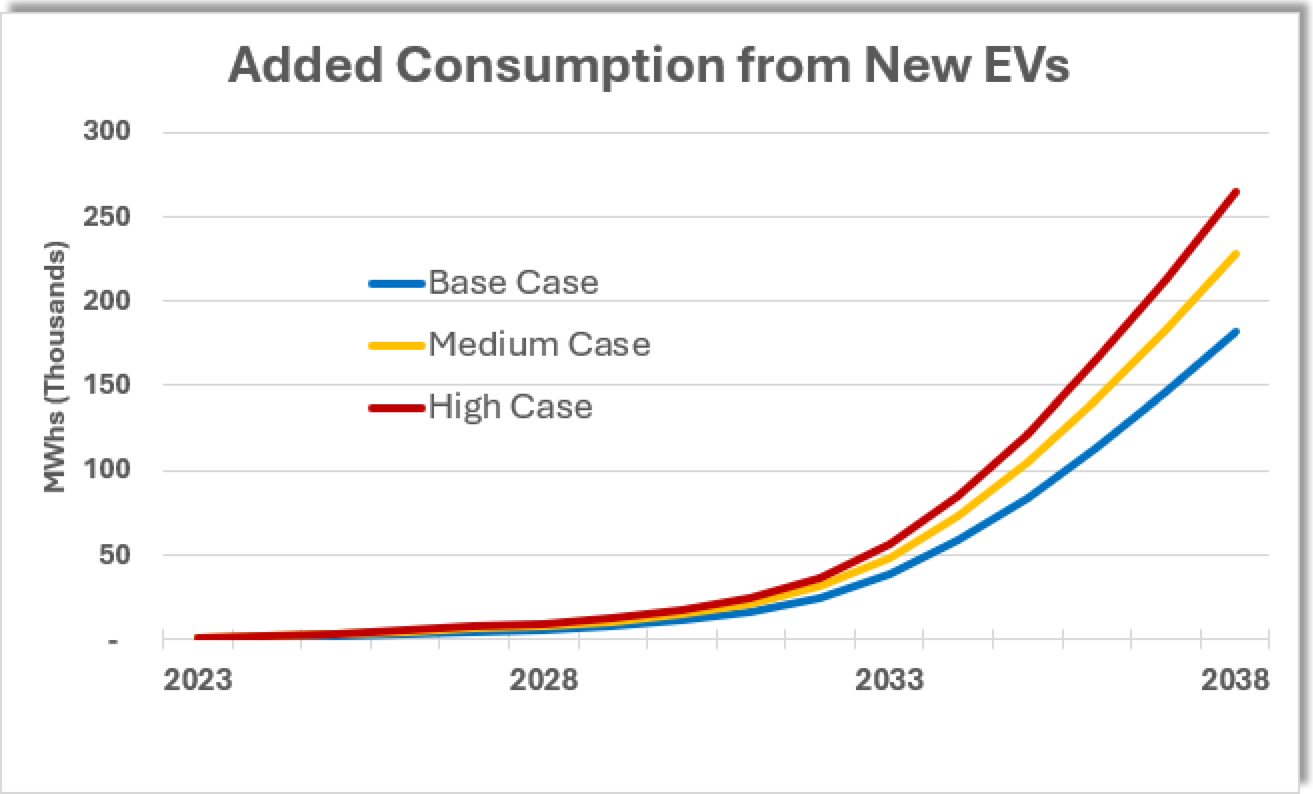
Electric Vehicles
IRP Planning Scenarios

- **Base Case**
  - ~ 2,400 EVs on MP's grid by 2028, 56,000 by 2038
  - Based on percent of total light vehicles, MP lags overall US by 8 years
- **Medium Case**
  - ~ 3,000 EVs on MP's grid by 2028, 70,000 by 2038
- **High Case**
  - ~ 3,400 EVs on MP's grid by 2028, 82,000 by 2038



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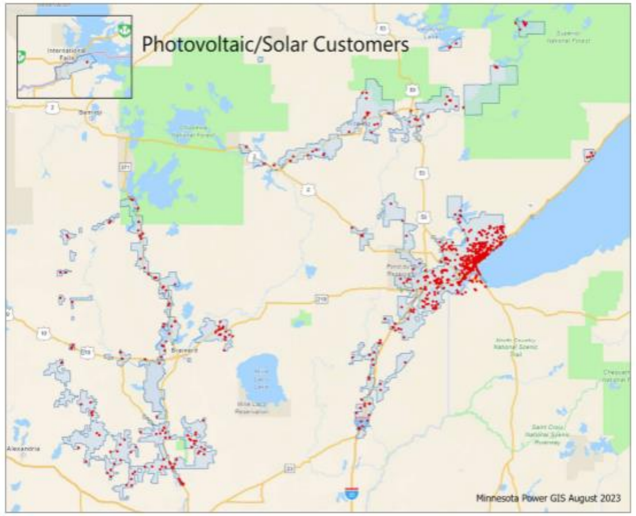
Solar – Distributed Generation

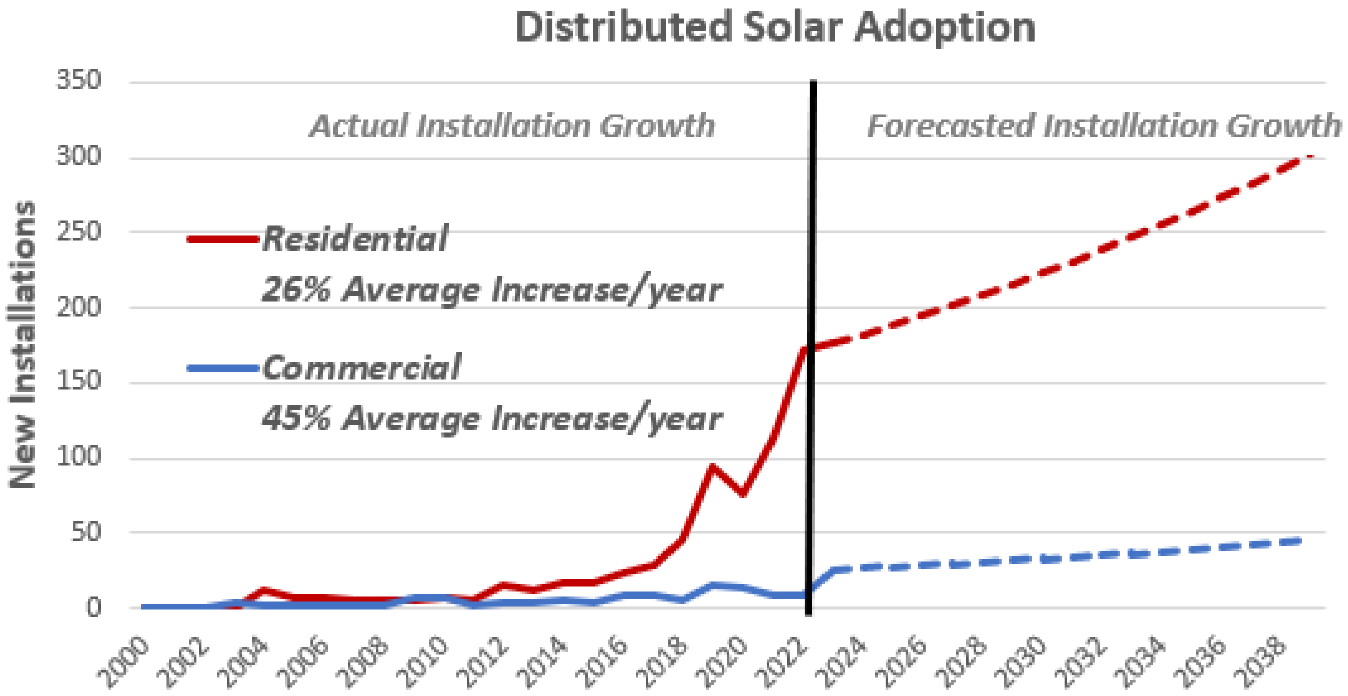
Currently about 10 MW of ≤40 kW projects installed

Expecting by 2038:

- 35 MW of new installations (45 MW Total)
- Displace about 46,000 MWh (2.0%) of MP sales to residential and commercial classes
- Pace of new installations increases over time

Modeling residential & commercial, based on historical adoption rates fitted to a technology curve. This modeling does not rely on a cash-flow or propensity model.





Residential & Commercial Demand Response

Dual Fuel

~7,150 Residential + ~500 Commercial & Industrial = 7,650 Total Dual Fuel Customers

~30MW of interruptible load during a typical winter peak

~4MW of interruptible load during a typical summer peak

Future DR Programs Sensitivity

- Hot Water Heater Cycling
- Air Conditioning Cycling

Industrial Demand Response

2025 IRP

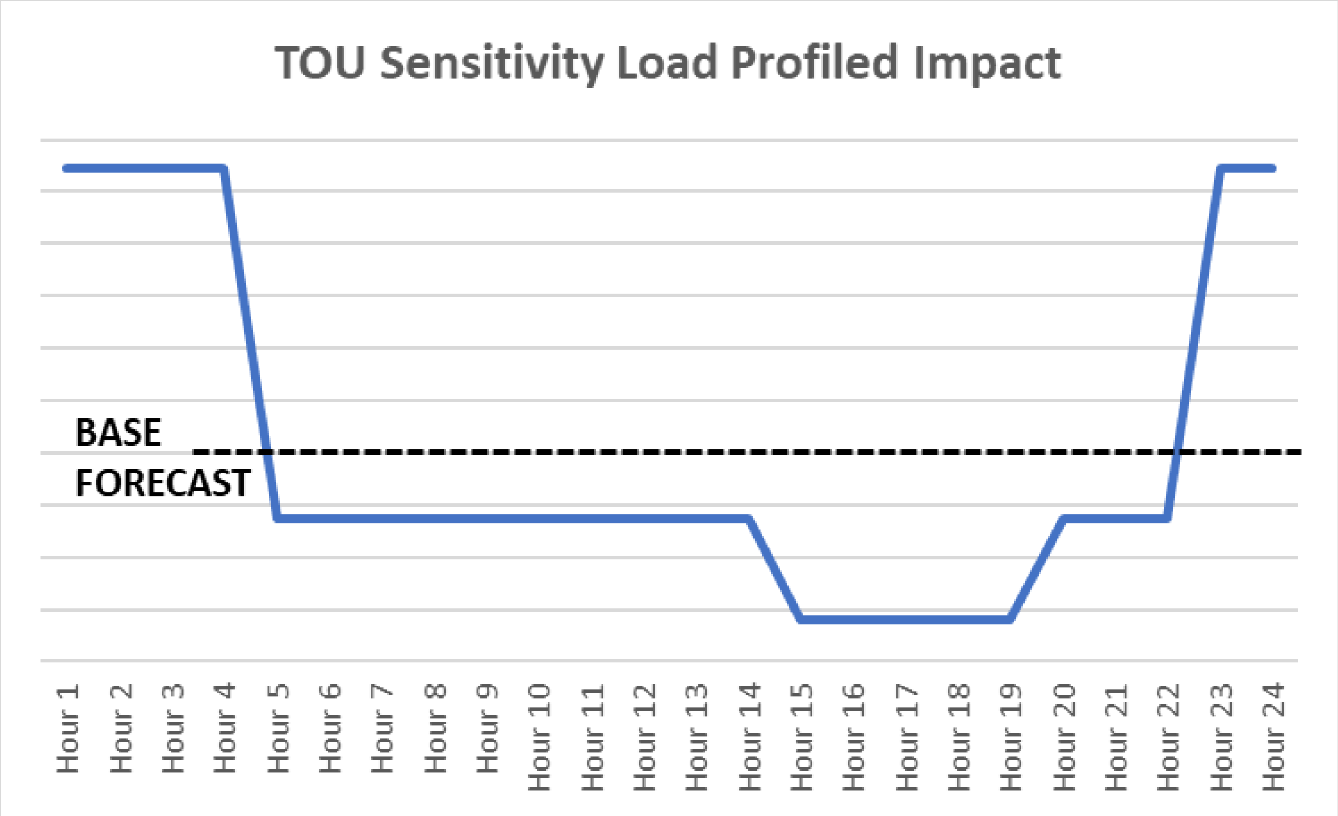
Modernize DR to meet company needs for 100% carbon free by 2040 state initiative.

- Seek feedback from LP and LL&P customers and stakeholders.
- Create DR program(s) to model in the IRP.
- Expanding conversations to include economic energy curtailments

- MP has the highest percentage of industrial DR in the state of MN, approximately 15% of peak load
- **Product A – Short-Term (~72 MW)**
  - One-year product
  - MISO emergency-only capacity
- **Product C – Market Surplus (~165 MW)**
  - Term three to six years (expires in May 2025 and May 2028)
  - MISO emergency-only capacity
  - MP facilitated capacity sale options for customer's excess demand response capability

Residential Time-Of-Use (“TOU”)

- The TOU sensitivity is modeled based on:
  - Reducing a small amount of load during off-peak and on-peak hours.
  - Increasing load during super-off-peak hours to keep the energy sales forecast neutral.
  - Reductions are based on initial evaluation results from the first phase of the transition to a TOU rate for residential customers.
  - Assumptions around customer behavior will continue to be informed and updated based on future evaluations as the transition progresses and more participants and data are available.
  - The TOU rate is applied to all of MP's residential customers.
- Reduction of energy use during peak hours results in a modest reduction in peak demand.



<u>TOU period definition</u>

- On-peak: 3pm - 8pm (weekdays)
- Super-off peak: 11pm - 5am
- Off-peak: all other hours

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Next Steps

- In July – Start discussion on Encompass modeling approach for this IRP…environmental cost, analysis design, set-up for capacity expansion analysis, etc.

- Customer, technology, or reliability criteria follow-up?

Next TAG Meeting

Fifth Meeting

Monday, July 15th
1 pm (CST)

FYI – Moving the July meeting to the 22nd is being contemplated

APPENDIX

Acronyms

CCS: Carbon Capture Sequestration. Represents both coal and gas-cc generation. Includes the entire process – CCS equipment, pipeline for transportation, and storage.

SMR: Small Modular Reactor Nuclear - Representative of a SMR tech.

H2: Hydrogen fuel fired in a CT or CC. Represents production of H2, pipeline delivery, and generator technology.

Li-Ion: Lithium-Ion battery storage. Represents both 4 hour and 8 hour storage.

PHES: Pumped Hydro Energy Storage.

LDES: Long Duration Energy Storage. Represents multiple emerging technologies in the 12 plus hours of storage space.

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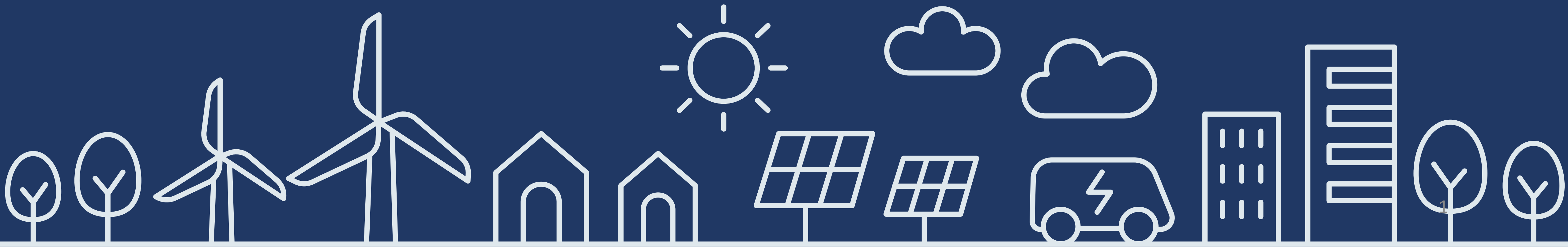
Minnesota Power 2025 IRP Technical Advisory Group

July 22, 2024 | Webinar



Meeting Objective…Collaboration

1. Develop collective objectives and ground rules for this group.

2. Build a shared understanding of the key themes and strategic questions being addressed in the IRP.

3. Explore perspectives and key modeling assumptions to discuss at future meetings.

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TAG Tentative Schedule – General Themes

~~**March** – Kick-off/feedback on future meetings~~

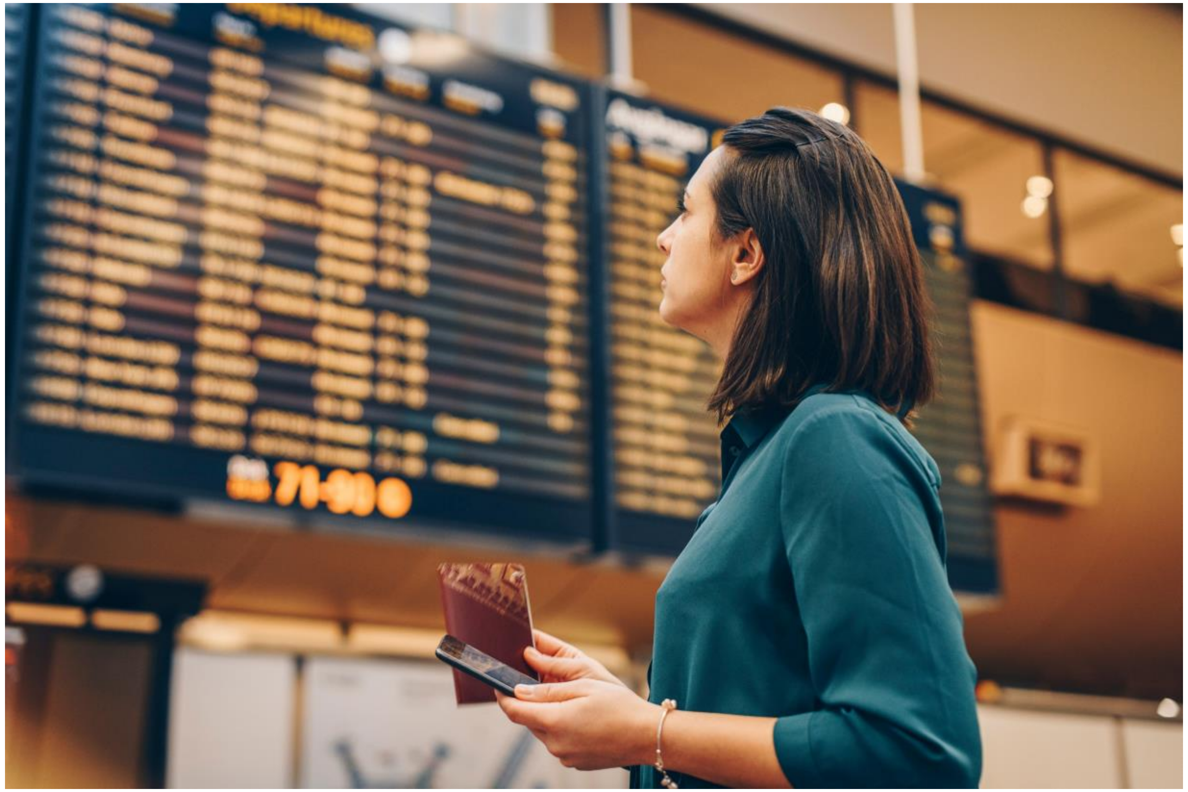
~~**April** – Reliability and Inflation Reduction Act (“IRA”)~~

~~**May** – Technology~~

~~**June** – Customer – Tech Follow-Up~~

~~**July** – EnCompass Modeling~~

August – Transmission / Distribution



Note: Some of the more complex topics, such as reliability & resource adequacy, will be discussed at several TAG meetings.

Today's Agenda

IRP Modeling

1. Analysis Design Approach
   - Capacity Accreditation
   - Long Duration Energy Storage Modeling
   - Capacity Expansion Modeling
2. Market Interactions
3. Environmental Cost / Carbon Regulation Cost
4. Sensitivity Analysis
   - Follow-up: Technology Curves

Capacity Accreditation Backdrop

- MISO Initiatives
  - Second Year of MISO Seasonal Accreditation Capacity (SAC)
  - DLOL
    - Resource Accreditation – FERC Filed
    - Outstanding Issues
      - Storage Modeling (Huge Issue)
      - Planned Outages (Model vs. Actual Schedule)
    - Load Side – PRMR – Initial Discussions - Final Design Not Defined or Filed
  - LMR Accreditation
    - Not Included in DLOL
    - MISO Working on Stand Alone Approach – Expected Q1 or Q2 2025

Capacity Accreditation Backdrop (Cont.)

- Reliability Based Demand Curve (RBDC)
  - FERC Approved for PY 25-26 Implementation
  - Objectives
    - Provide a More Gradual Slope Approaching Shortfall – More Indicative Capacity Price
    - Show More Capacity Clearing to Reflect Higher Levels of Reliability
  - Outcomes
    - Likely Increases Effective Planning Reserve Margin (PRM) by 3-4%
    - Higher PRM Clearing Prices
    - Less Available Uncleared Capacity for Replacement Capacity
- Summary
  - Very Challenging to Make Long-term Projections
  - Expecting Lower Accreditation for Wind and Solar Based on MISO DLOL Presentations

Thoughts on how to approach in the IRP?

Long Duration Energy Storage – Historical View

Approach in Previous IRPs:

- Simulate “Typical Two- Day” through entire study horizon
- Set a project selection optimization window
- Simulate production cost “8760” on selected portfolio

YES ENERGY

Form energy

Simulation Considerations for 2025 IRP:

- “Typical Two-Day” captures On-Peak/Off-Peak Day
- 2 days will be used for each month
  - 1st day of the month = On-Peak Day
  - 2nd day of the month = Off-Peak Day
- Demand uses a ranked peak algorithm to preserve peak load
- Remaining inputs are averaged across each day of the month
- Does not capture reliability events outside of “Typical Days”

Long Duration Energy Storage – Form Recommendation

Form Energy Approach

- Perform 8760 Capacity Expansion Planning
- Simulations in 7-Year segments
- Representative Grid stress
- Includes Reliability events that may fall outside typical days/weeks
- Simulates benefits to long duration storage systems
- Results in Increased run time for complex problems

Approach	Description	Rationale
8760 capacity expansion	Implement a chronology within capacity expansion optimization that includes all 8760 hours of the year, rather than a "typical day" or "typical week" methodology	Captures operational modes of multi-day energy storage across various time scales, including daily, monthly, and seasonal energy arbitrage Includes reliability events that may occur outside typical days/weeks and extend for several consecutive days at a time
Weather correlation	Use time series inputs which reflect weather-correlated system conditions, including load, renewable generation, commodity prices, etc.	Better represents grid stress conditions by capturing the overlap between periods of elevated demand and energy scarcity (for example, cold weather event that is correlated with both a demand surge and wind generation lull)
Multi-weather year analysis	Model the build and dispatch of multi-day storage resources across multiple weather year scenarios	Captures the reliability needs of the system across a range of grid stress conditions, which can vary dramatically across historical weather years

Source: *Long Duration Energy Storage Report*

Capacity Expansion Modeling

IRP Near-Term Planning:

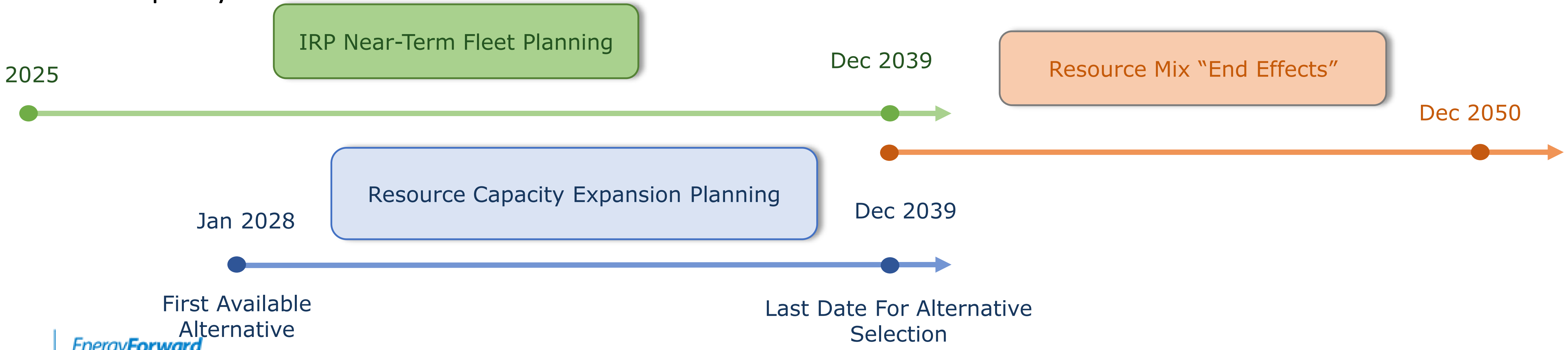
- Study existing fleet generation
- Establish a baseline for system planning (Load, Generation, Emissions, etc.)

Resource Capacity Expansion Planning:

- Resource alternatives will be made available to the model
- Retirement and refuel scenarios evaluated
- Reliability, Environmental, and Economic impacts studied
- Seasonal capacity needs

Resource Mix "End Effects"

- Resource Additions/Retirements/Refuel have been made
- Long-term portfolio performance has been evaluated
- Long-term Portfolio Revenue Requirements have been estimated



Balancing Traditional Planning with Enhanced Reliability Planning

Encompass Modeling

Traditional Planning – Capacity Expansion

Minnesota Power Reliability Criteria

Energy Adequacy

Operational Flexibility

Essential Services

Planning System Characteristics

POLICY

EPA releases proposal for limiting power plant carbon emissions

Highly anticipated proposal was meeting resistance from Republicans before its release

Minnesota House passes bill requiring carbon-free electricity by 2040

Kirsti Marohn January 27, 2023 5:51 AM

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Traditional Planning
- **Reliability: Capacity & Energy**
- **Sustainability: Carbon & Renewables**

Energy Adequacy
- **Fuel Assurance**
- **Long Duration Energy at High Output**

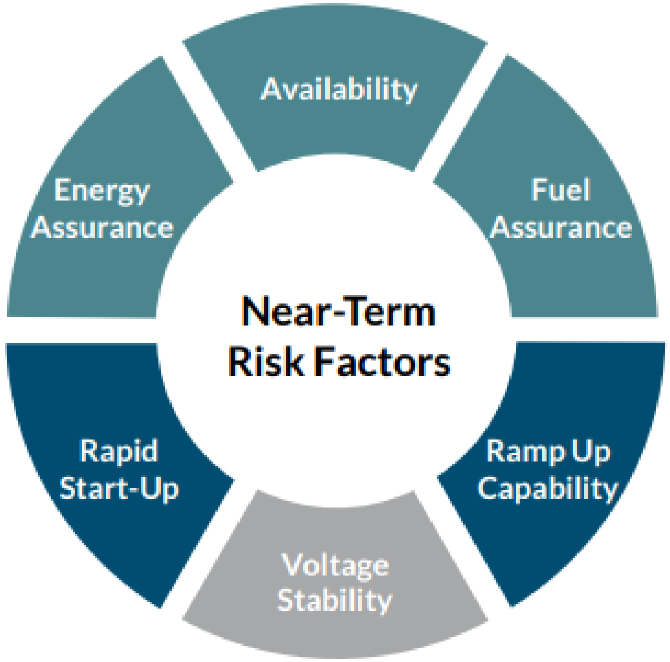
Operational Flexibility
- **Ramping**
- **Rapid Start-up/ Must-Run**

Essential Services
- **Voltage Stability /Reactive Power**
- **Inertia/Frequency Response/ Short Circuit Strength**

Encompass Modeling

<u>NEW</u> Layers as We Get Deeper in Decarbonization

MISO working on a "Reliability System Attributes" roadmap whitepaper to be published by end of 2023



ALSO….FERC, NERC, EPRI, and other proceedings addressing

Market Interaction: Sales & Purchases

Objective: Simulate Constrained Market Interaction

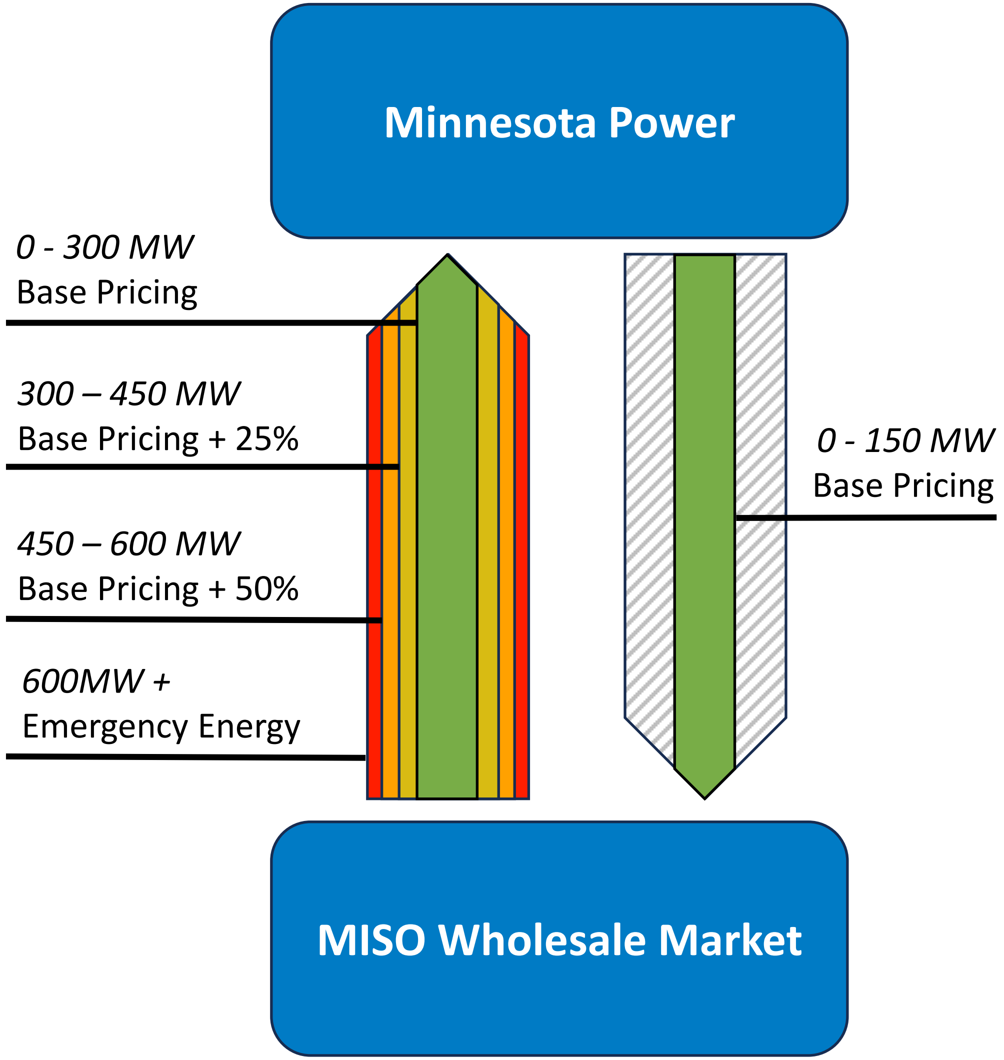
- High market sales = generation is built on the expectation of future sales revenue
- High market purchases = reliability concerns and exposure to future market prices

Market set-up in previous IRP

- Market prices follow a tiered structure
- Sales capped at 150 MW using base prices
- Emergency Energy rates for purchases over 600 MW

2025 IRP Market Simulation

- Continued use of a "Tiered" system?
  - Vary approach between capacity expansion & portfolio evaluation?
- Sensitivities around market price variability



State Environmental Costs

- Environmental Costs are presented in 2025 and 2035 values below; however, values are escalated yearly for modeling use.
- Use of Low/Mid/High values is based on the Planning Futures ordered by the MN PUC in Docket DOCKET NO. E-999/CI-07-1199; E-999/DI-17-53.

Environmental Costs for Criteria Pollutants (Metropolitan Fringe)*

	SO2			NOx			PM2.5		
$/Short Ton	Low	Mid	High	Low	Mid	High	Low	Mid	High
2025	$6,032	$10,948	$15,027	$3,276	$7,106	$9,741	$8,564	$15,567	$21,348
2035	$7,552	$13,705	$18,812	$4,104	$8,896	$12,194	$10,722	$19,489	$26,726

Environmental Externality Values (Metropolitan Fringe)^

	CO			PB		
$/Short Ton	Low	Mid	High	Low	Mid	High
2025	$1.47	$2.04	$2.61	$3,176	$3,505	$3,835
2035	$1.84	$2.55	$3.26	$3,976	$4,388	$4,801

Note: All values are nominal dollars

**Commision Docket E999/CI-14-643, Criteria Pollutants - January 3, 2018*

^Environmental Externality Values, Docket Nos. E-999/CI-93-583 and E-999/CI-00-1636 - June 6, 2016

State CO2 Environmental & Regulatory Cost

- **Environmental & Regulatory Costs are presented in 2025 or 2028 and 2035 values below; however, values are escalated yearly for modeling use.**
- **Use of Low/Mid/High values is based on the Planning Futures ordered by the MN PUC in Docket DOCKET NO. E-999/CI-07-1199; E-999/CI-22-236; E-999/CI-14-643.**

Environmental Costs for CO2 (Federal Social Cost of Carbon)*^

$/Short Ton	Low	Mid	High
2025	$143	$270	$397
2035	$214	$386	$559

Regulatory Costs for CO2*

$/Short Ton	Low	Mid	High
2028	$5	$40	$75
2035	$6	$47	$88

Note: All values are nominal dollars

**Future cost of carbon, DOCKET NO. E-999/CI-07-1199; E-999/CI-22-236; E-999/CI-14-643 - December 19, 2023*
^Table ES.1: Estiamtes of the Social Cost of Greenhouse Gases (SC-GHG, 2020-2080 (2020 dollars) found here:
https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

New PUC Orders for Applying Environmental Cost /Carbon Regulations in an IRP

Docket No. E-999/-07-1199; Docket No. E-999/-22-236; Docket No. E-999/-14-643

3. In their modeling scenarios, utilities shall consider environmental (that is, externality) costs in every year of the scenario to the extent that those costs exceed the regulatory (that is, internalized) costs for the same year.

4. When modeling environmental externality values and future regulatory costs for purposes of analyzing scenarios in a resource plan, utilities shall do the following:

   A. Model future regulatory costs in Encompass (or a comparable method using other models) in a manner that influences the selection of resource options.

   B. Model environmental externality values as post-processing add-ons under Encompass (or a comparable method using other models).

   C. Identify the future regulatory costs of each scenario as part of its Present Value of Revenue Requirement.

   D. Identify the externality costs of each scenario separately from the Present Value of Revenue Requirement.

Planning Futures Being Considered

		Carbon Dioxide (CO_2)*				Other Criteria Pollutants
		Prior to 2028		2028 and Thereafter		
Futures	EnCompass Case Name	Environmental Cost	Regulation Cost	Environmental Cost	Regulation Cost (2025)	Environmental Costs
Low Environmental Cost	CLE1S	$143		$160		Low
High Environmental Cost	CHE1S	$397		$438		High
Low Carbon Regulation Cost	CLCR1S				$5	
High Carbon Regulation Cost	CHCR1S				$75	
Mid Carbon Regulation	CMCR1S				$40	
Low Environmental Cost and Low Carbon Regulation Cost	CLER1S	$143		$155	$5	Low
High Environmental Cost and High Carbon Regulation Cost	CHER1S	$397		$363	$75	High
Reference Case	CREF1S	$270		$259	$40	Mid
"Customer Look": No Environmental Cost and No Carbon Regulation Cost	CCUST1S	-	-	-	-	-

Sensitivity Analysis Goals

- Inform regulators and stakeholders how plans might be modified if circumstances changed…for example, higher load growth or reduction in capital cost
- Develop understanding what key assumptions have largest impact on plan
- Educate when new resource alternatives become economic for customers
- Stress how robust various resource portfolios are under varying future conditions

Sensitivities for Consideration

- Renewable Availability
- Energy Market Interaction
- Technology Innovations
- Capital Cost
- Commodity Market Volatility
- Energy Market Volatility
- Fuel Market Volatility
- Customer Outlook Uncertainty
- Seasonal Demand Changes
- Resource/ Energy Adequacy
- Historical Years

Discussed at Last TAG

Commodity & Energy Market Volatility

Assumptions from 2021 IRP

Biomass:

+/- 15%

Coal:

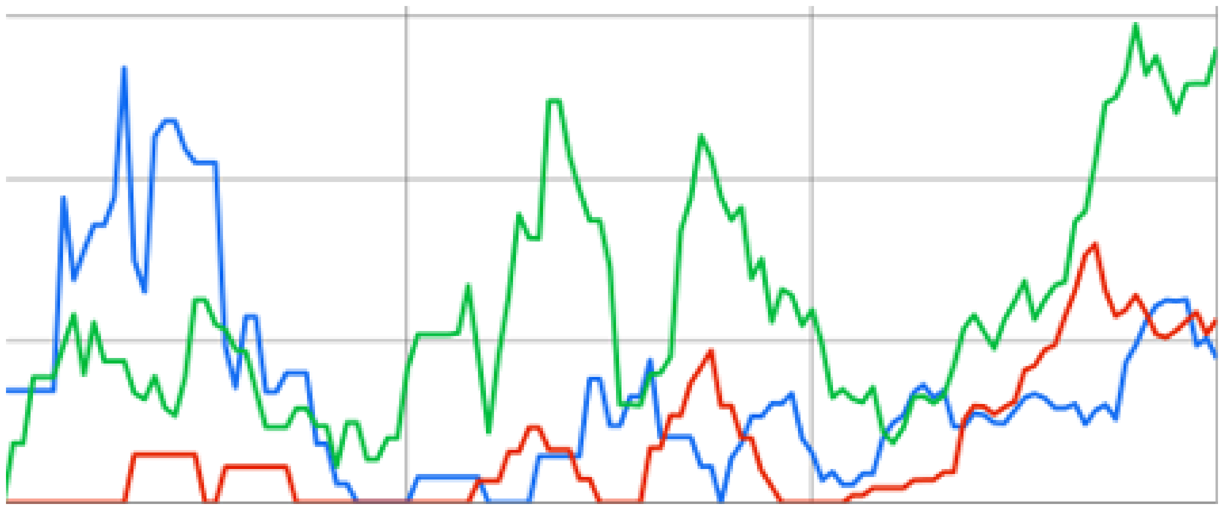
+20%. -10%

Natural Gas:

-50%, -25%, +25%, +50%, +100%

Wholesale Electric Market:

-50%, -25%, +25%, +50%



Still a reasonable approach?

Renewable Uncertainty

Last IRP Approach:

<u>Network Upgrade Cost for Renewable Interconnections – DISCUSS MORE AT NEXT TAG:</u>

Stress Lower than base assumption

New For 2025 IRP

<u>Renewable Energy Production</u>

Annual renewable energy production XX% lower than base – MP is researching based on our own wind and solar production history

Energy Market Interactions

Last IRP Approach

- No sales into the market
- No sales and purchases in market
- Market access reduced by 50%

Still reasonable approach for 2025 IRP?

MISO

Resource Adequacy Uncertainty

Last IRP Approach

- +/- 2% change in planning reserve margin
- +/- 2% change in MP's MISO coincident factor for peak demand

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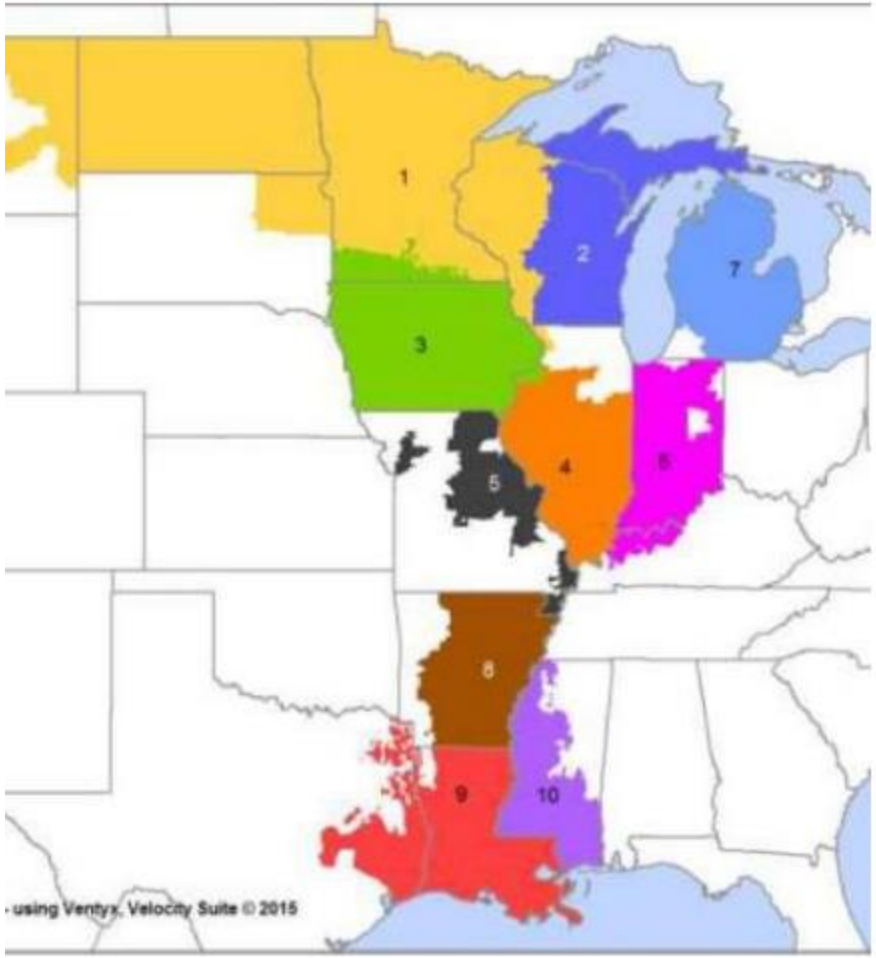
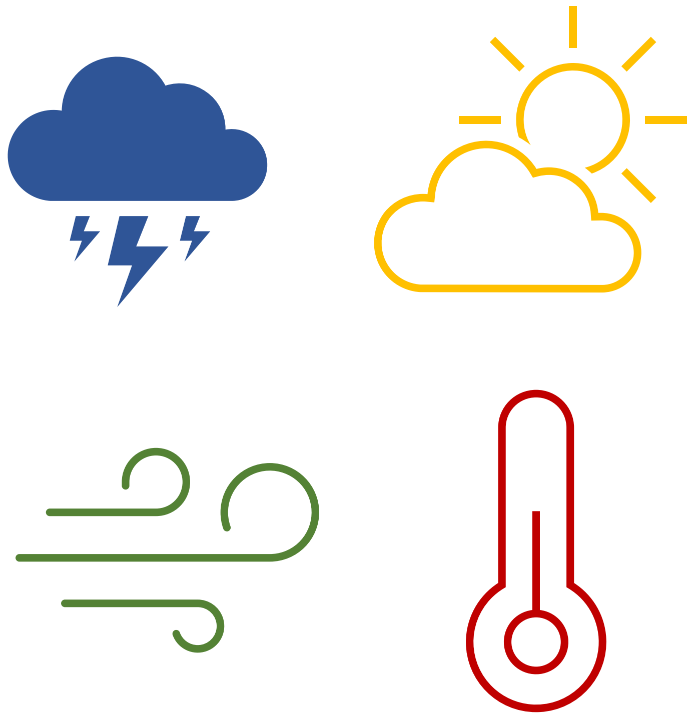
For 2025 IRP, how does it change given SAC, RBDC, and DLOL?



Historical Weather Year

New For 2025 IRP

- Set-up in EnCompass - model hourly historical profiles for:
  - Wind
  - Solar
  - Hydro
  - Market Energy Prices
  - Load
  - Fuel cost
- Minimum: will include 2021 & 2022…might add 2023 if time permits
- Purpose: To see how various portfolios perform during historical periods



Capital Cost Volatility for Alternatives

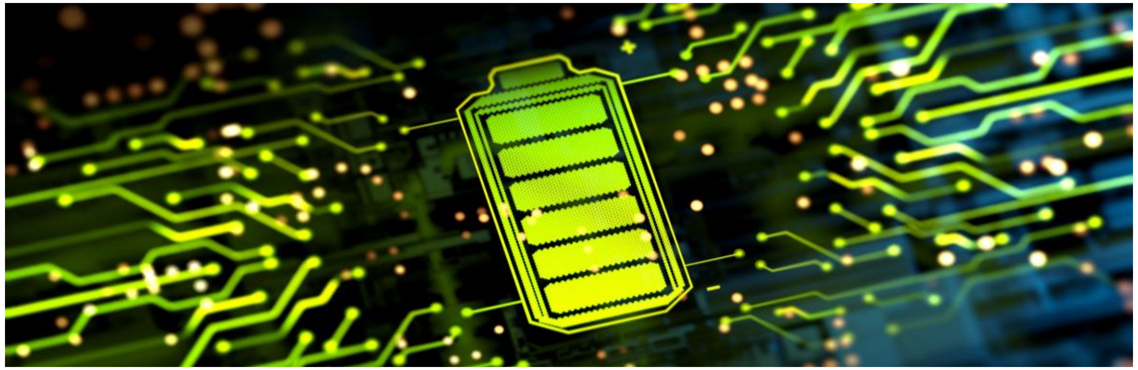
Last IRP Approach

<u>Capital Costs for non-wind/battery storage/solar alternatives:</u>

+/- 30% -- Based on recommendation *from Purchased Third-Party Technology Estimate*

For 2025 IRP do you apply this methodology to all technologies?

Inflation is driving cost for all techs, not just wind and solar – must be careful not to introduce bias into the analysis.



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Modeling Future Cost of Capital for Tech

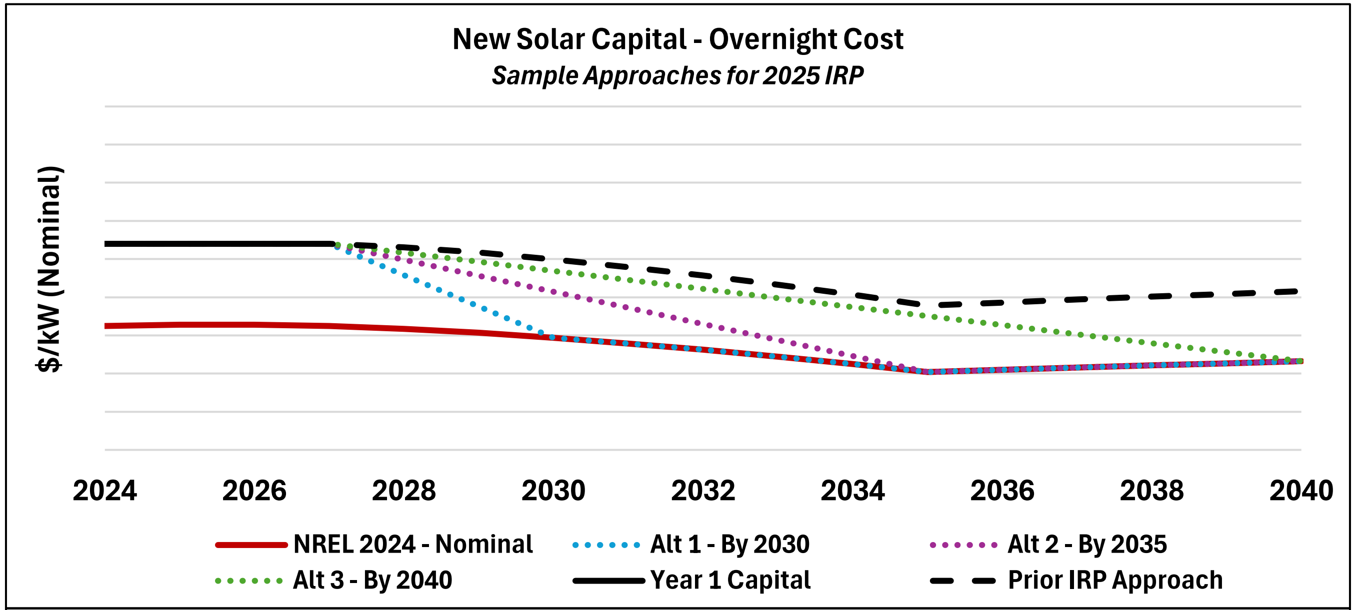
2021 IRP – Tech curves based on EPRI/EIA.

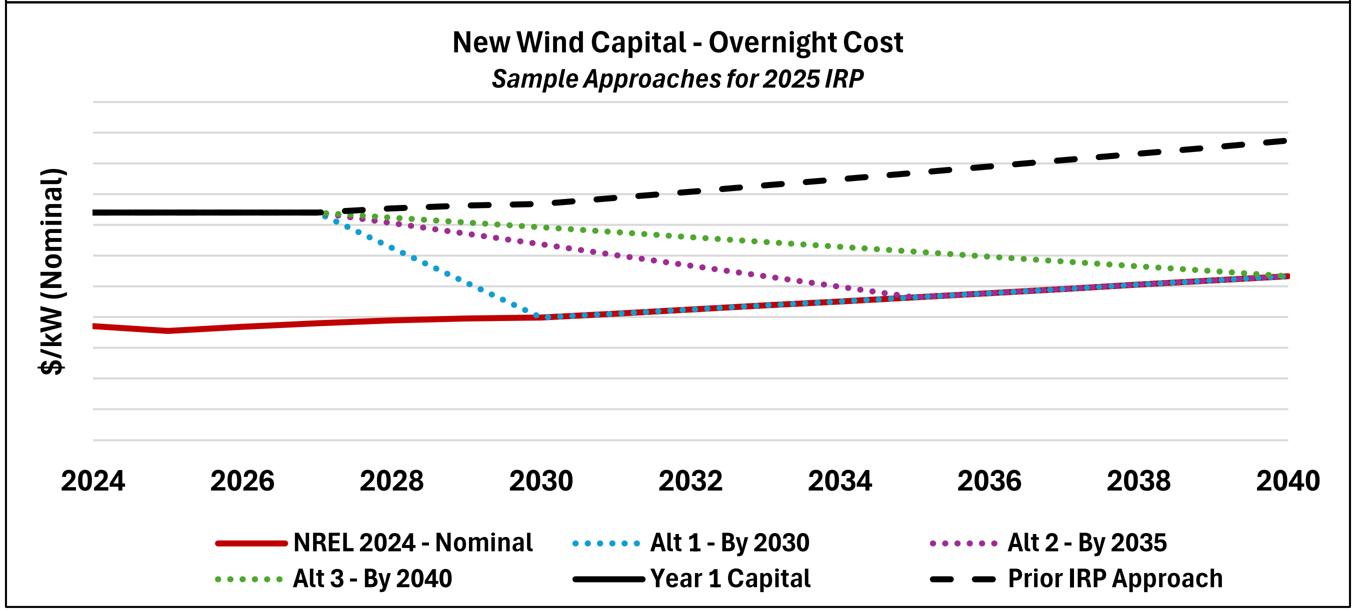
CHALLENGE: Starting point for capital is significantly higher than public forecast (i.e. NREL). This was not the case in the 2021 IRP.

Prior TAG meeting – heard stakeholder preference to show capital cost moving toward NREL forecast longer-term.

Timing – when does that occur…2030, 2035, 2040?

Does it apply to all technologies - due to industry wide inflation seen today???





Next Steps

- In August – Start discussion on how transmission and distribution planning is integrated into the IRP.
- Follow-up on questions from prior TAG sessions.
- August is the last scheduled TAG – Other topics stakeholders would like to see?

Next TAG Meeting

Fifth Meeting

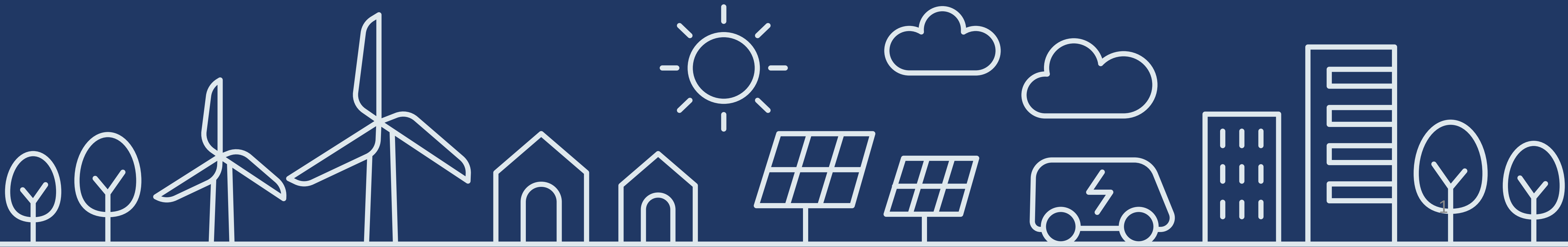
Monday, August 19th
1 pm (CST)

GREAT PLAINS INSTITUTE

cee Center for Energy and Environment

Minnesota Power 2025 IRP Technical Advisory Group

October 3, 2024 | Webinar



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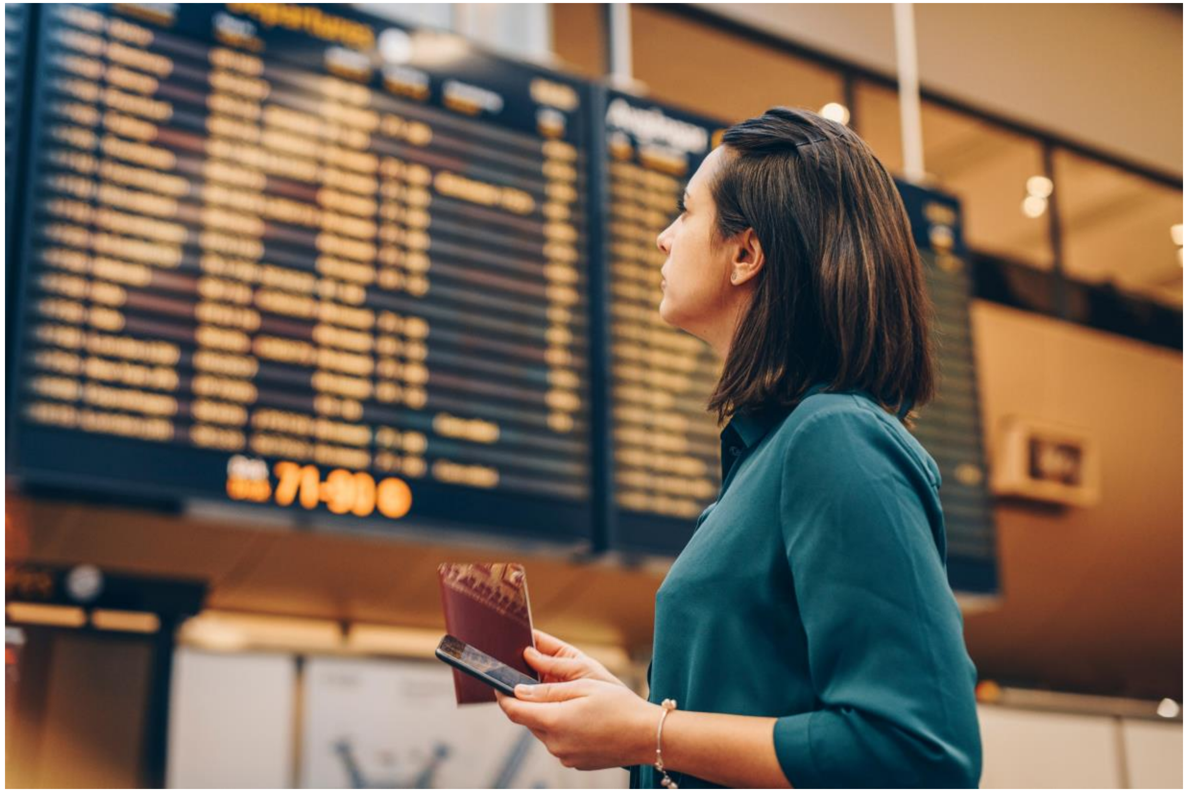
~~**October** – Transmission / Distribution~~



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Today's Agenda
IRP Modeling

1. Integrating Distribution Planning into IRP
2. Integrating Future Transmission Projects into IRP Planning
3. Analysis of Transmission System Impacts and Costs for IRP Scenarios
4. Network Upgrade Cost for New Generation
5. LMP Congestion Cost Modeling for Renewables
6. EnCompass Modeling Update

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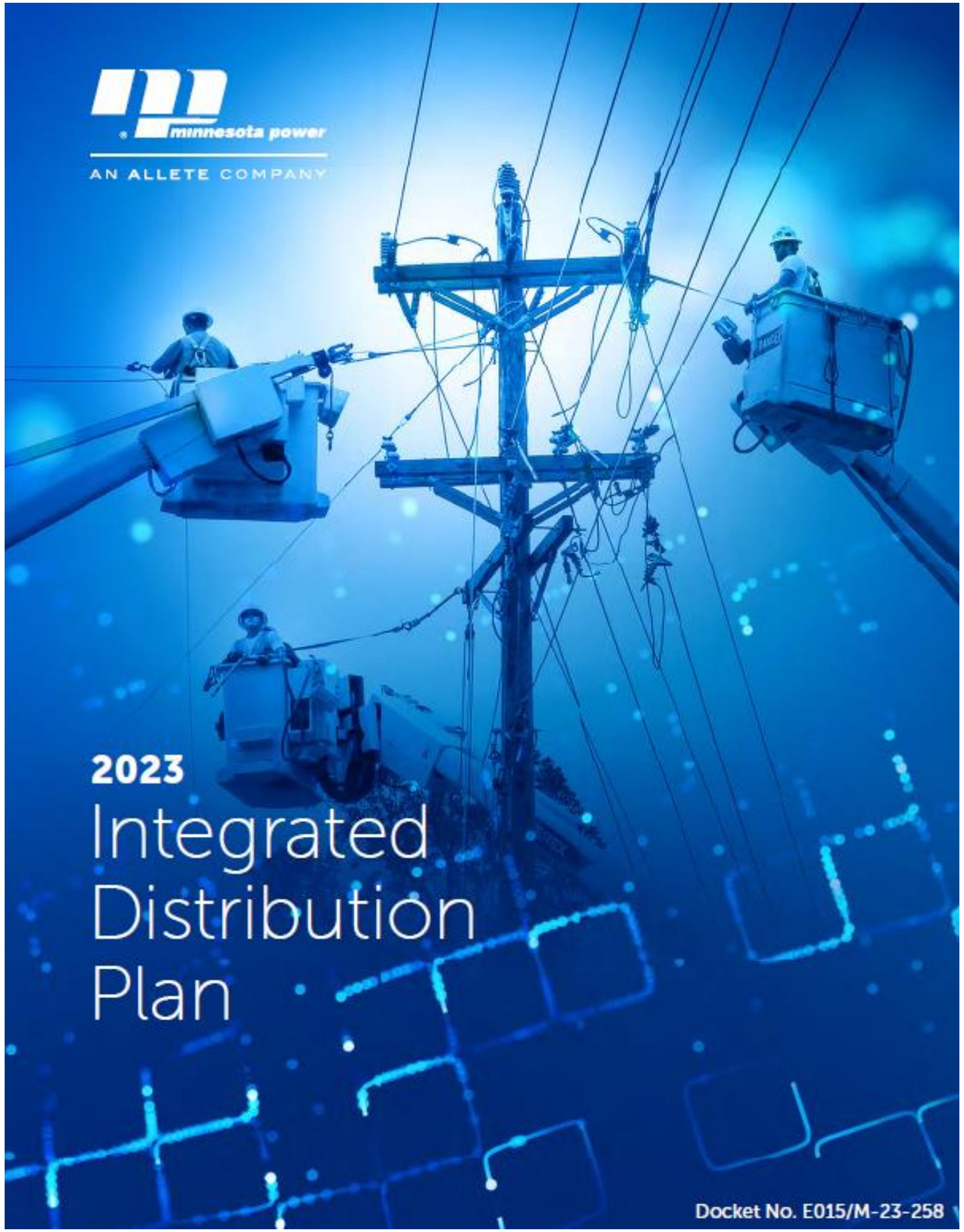
Integrated Planning in Action

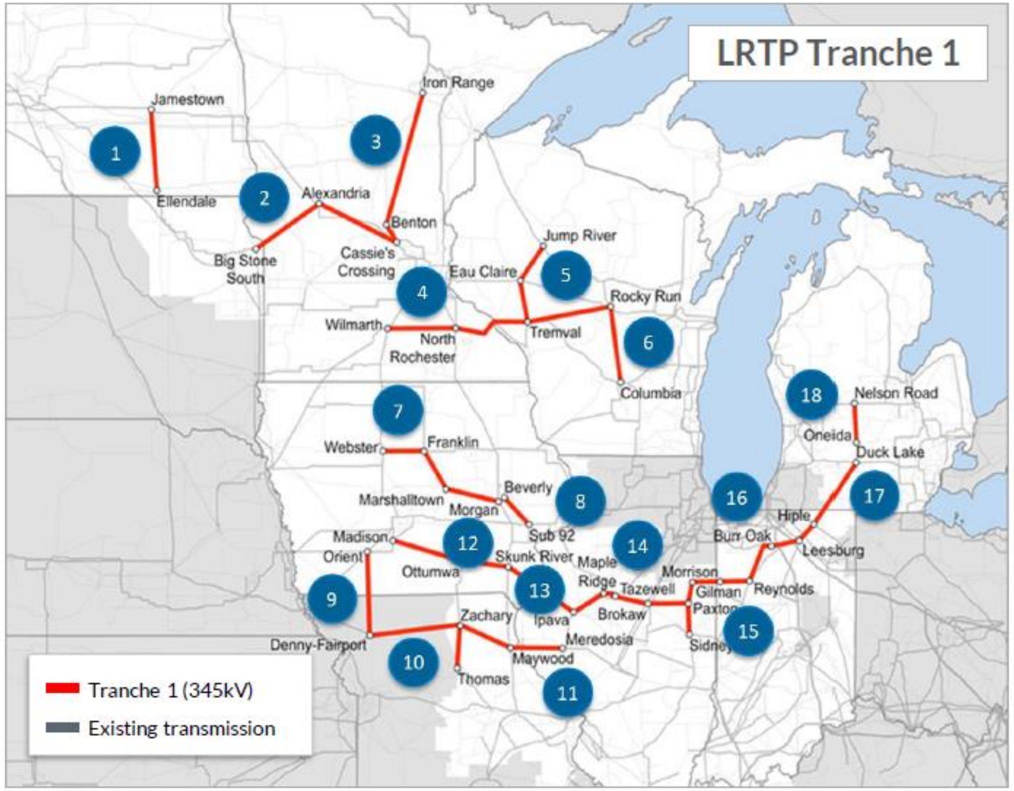
- Transmission & Distribution Planning and Resource Planning departments work in close collaboration with one another to ensure integrated system planning for the Company.
- Primary areas of active coordination will continue to be load forecasting and vetting of supply-side or demand-side non-wire alternatives.
- 2023 IDP Identified four non-wire opportunities through a Benefit-Cost analysis
    - Results identified a 1 MW (3 Hr) Battery at Kerrick, MN.



Integrated Distribution System Planning Update

- Moving to a new software Synergi to provide additional modeling capabilities.
- DSES rollout of 65-85MW of distribution connected solar installed by 2030 – ***Included in EnCompass analysis as a placeholder***.
  - Held first stakeholder meeting on 9/20 with one more on 10/7.
  - RFP requirements to be filed by 11/1.
  - Plan to issue RFP late Q1 or early Q2 2025.
- 2025 IDP planning has already started.
  - Distribution 2030 strategy meeting held in September.
  - Finalize the strategy then hire consultant to assist with roadmap and execution.

MISO Long Range Transmission Plan Tranche 1



Assumption on all in-service dates is by 2030

ID	Project Description	Est. Cost ($M, 2022)
1	Jamestown – Ellendale	$439M
2	Big Stone South – Alexandria – Cassie's Crossing	$574M
3	Iron Range – Benton County – Cassie's Crossing	$970M
4	Wilmarth – North Rochester – Tremval	$689M
5	Tremval – Eau Clair – Jump River	$505M
6	Tremval – Rocky Run – Columbia	$1,050M
7	Webster – Franklin – Marshalltown – Morgan Valley	$755M
8	Beverly – Sub 92	$231M
9	Orient – Denny - Fairport	$390M
10	Denny – Zachary – Thomas Hill – Maywood	$769M
11	Maywood – Meredosia	$301M
12	Madison – Ottumwa – Skunk River	$673M
13	Skunk River – Ipava	$594M
14	Ipava – Maple Ridge – Tazewell – Brokaw – Paxton East	$572M
15	Sidney – Paxson East – Gilman South – Morrison Ditch	$454M
16	Morrison Ditch – Reynolds – Burr Oak – Leesburg – Hiple	$261M
17	Hiple – Duck Lake	$696M
18	Oneida – Nelson Rd.	$403M
	Total Project Portfolio Cost	$10.3B

Projects in MN/Dakotas

LRTP Tranche 1 considered as a base assumption in transmission studies going forward

LRTP Project #3 Update

MP-GRE Northland Reliability Project

Similar to conceptual project identified in 2021 Integrated Resource Plan for resolution of regional voltage stability concerns following ceasing coal operations at Boswell Units 3&4*

Certificate of Need and Route Permit applications filed 8/1/2023, MPUC decision anticipated late 4Q 2024 or early 1Q 2025

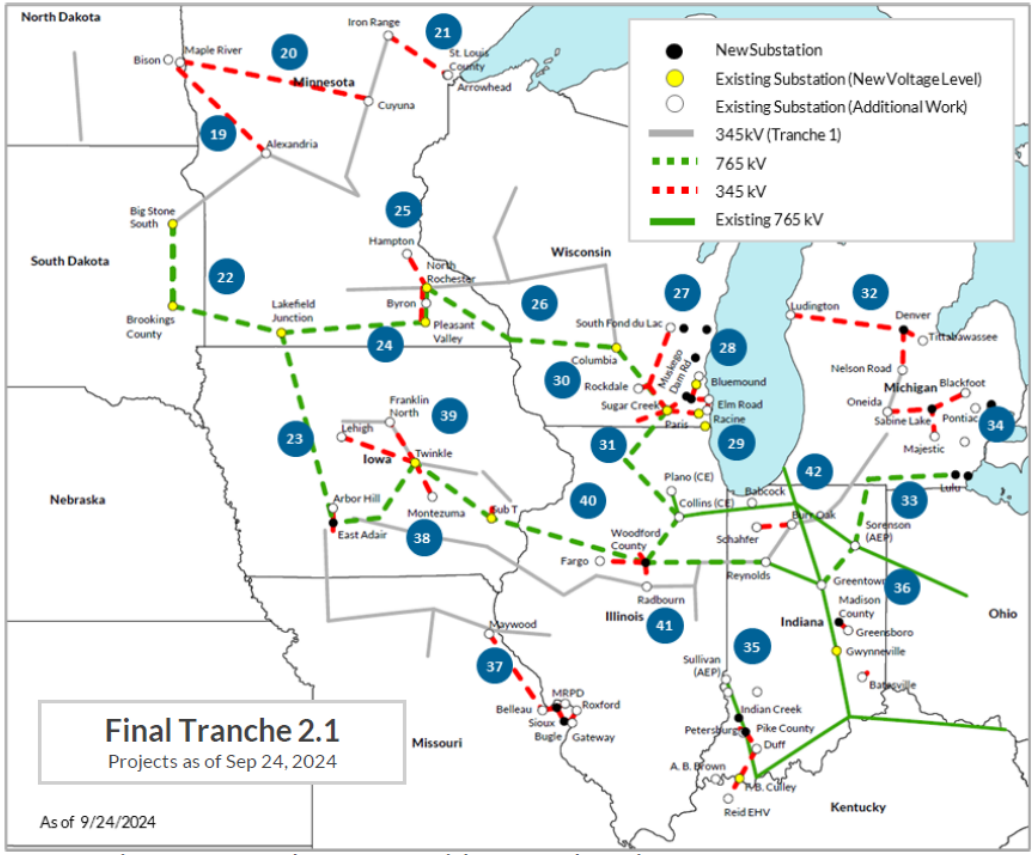
MISO Target In-Service Date 6/1/2030

Costs as of 6/1/2022, and are subject to change (costs represent "overnight" costs)

*Note: There are additional considerations for ceasing coal operations at Boswell Units 3&4 beyond regional voltage stability concerns. The LRTP project provides flexibility for determining the future of the Boswell Units, but is not sufficient by itself to definitively conclude the units may be retired

MISO Long Range Transmission Plan Tranche 2

Final LRTP Tranche 2.1 Portfolio



ID	Project Description	Predominate kV	Targeted ISD	Est. Cost ($M, 2024)
19	Bison - Alexandria	345	2032	$216
20	Maple - Cuyuna	345	2032	$908
21	Iron Range - Arrowhead	345	2032	$428
22	Big Stone South - Brookings County - Lakefield Junction	765	2034	$1,459
23	Lakefield Junction - East Adair	765	2034	$1,375
24	Lakefield Junction - Pleasant Valley - North Rochester	765	2034	$1,166
25	Pleasant Valley - North Rochester - Hampton Corner	345	2032	$222
26	North Rochester - Columbia	765	2034	$1,924
27	Rocky Run - Werner - North Appleton	345	2032	$212
28	South Fond du Lac - Rockdale - Big Bend - Sugar Creek - Kitty Hawk	345	2032	$1,102
29	Bluemond - Arcadian - Waukesha - Muskego - Elm Road - Racine	345	2032	$731
30	Columbia - Sugar Creek	765	2034	$743
31	Sugar Creek - Collins	765	2033	$733
32	Ludington - Denver - Tittabawassee & Nelson Road	345	2032	$1,553
33	Greentown - Sorenson - Lulu	765	2033	$1,310
34	Oneida - Sabine Lake - Blackfoot & Majestic	345	2032	$584
35	Southwest Indiana-Kentucky	345	2032	$743
36	Southeast Indiana	345	2032	$578
37	Maywood - Belleau - MRPD - Siuox - Bugle	345	2032	$888
38	East Adair - Marshalltown - Sub T	765	2034	$1,583
39	Lehigh - Marshalltown - Franklin North & Montezuma	345	2032	$588
40	Sub T - Woodford County - Collins & Reynolds	765	2033	$2,298
41	Woodford County - Fargo & Radbourn	345	2032	$422
42	Burr Oak - Schahfer	345	2032	$68
	Total Portfolio Cost		Total	**$21,830**

Projects in Northern Minnesota

Monitoring LRTP Tranche 2 progress. Not included as base modeling assumption

MISO BOD approval anticipated December 2024

- 24 projects across the MISO Midwest Subregion
- Estimated at $21.8 billion
- In service dates range from 2032 to 2034*

2

** Costs as of 9/19/2024 in 2024$. Tranche 2.1 project numbering starts at 19 to continue the LRTP project numbering from LRTP Tranche 1 that ended with 18.*

Transmission Impacts of Boswell Retirement

Update on Issues Identified in 2021 IRP

<table>
<tr><th>Category</th><th>Solution</th><th>Progress Update</th></tr>
<tr><td>Voltage Support & System Strength</td><td>Synchronous Condenser #1</td><td rowspan="3">Summary Report on System Strength & Voltage Support Impacts in Northeastern Minnesota filed July 2022 in Docket No. E999/CI-19-704
• Riverton STATCOM: Planned with ISD Late 2027-Early 2028
• HVDC Modernization Project (VSC): Planned with ISD 2028-2030
• Boswell synchronous condenser conversion feasibility study completed in 2022 and in process of being updated. Will be included with 2025 IRP</td></tr>
<tr><td>Voltage Support & System Strength</td><td>Synchronous Condenser #2</td></tr>
<tr><td>Voltage Support & System Strength</td><td>Synchronous Condenser #3</td></tr>
<tr><td>Voltage Support & System Strength</td><td>300 MVAR of Additional Capacitor Banks</td><td>Need & timing to be re-evaluated with updated power flow models for 2025 IRP</td></tr>
<tr><td>Local Power Delivery</td><td>Rebuild Lines</td><td>Iron Range – Blackberry 230 kV Lines Upgrade: In Progress with ISD late 2024</td></tr>
<tr><td>Local Power Delivery</td><td>Replace Transformer</td><td>Need & timing to re-evaluated with updated power flow models for 2025 IRP</td></tr>
<tr><td>Local Power Delivery</td><td>Build New Line</td><td>Need & timing to be re-evaluated with updated power flow models for 2025 IRP</td></tr>
<tr><td>Regional Power Delivery</td><td>Define NOMN interface & manage in real-time</td><td>Ongoing coordination with MISO to evaluate and respond to real-time indicators associated with the voltage stability issue, ensuring reliability</td></tr>
<tr><td>Regional Power Delivery</td><td>Upgrade existing Lines</td><td>Need & timing to be re-evaluated with updated power flow models for 2025 IRP</td></tr>
<tr><td>Regional Power Delivery</td><td>New regional extra high voltage transmission line</td><td>Northland Reliability Project: MISO LRTP Tranche 1 Project #3 with planned ISD June 2030, currently in regulatory review</td></tr>
</table>

References: 2021 IRP, Appendix F, Part 8, Table 9
May 21, 2024 Compliance Filing in Docket E015/RP-21-33

Transmission Impacts of Boswell Retirement

Refreshing transmission system impact modeling for Boswell Operational Scenarios Considered in the IRP

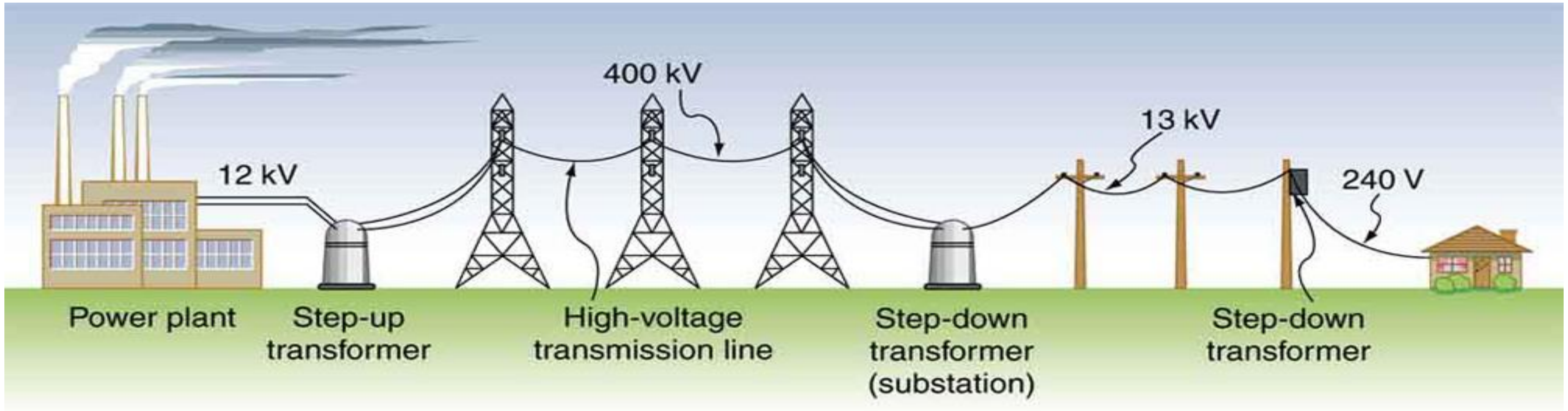
- Based on MISO MTEP24 Power Flow Cases
- Major Planned Projects Included or Added:
  - LRTP Tranche 1 (including Northland Reliability Project)
  - HVDC Modernization Project
  - Riverton STATCOM Project

NOTE: Above-listed projects are not included in 2029 cases

Table 8: Boswell Unit Scenarios Evaluated

Scenario	Boswell Unit 3	Boswell Unit 4
E1	Economic Operation	Baseload Operation
E2	Economic Operation	Economic Operation
S1	Shutdown	Baseload Operation
S2	Baseload Operation	Shutdown
S3	Shutdown	Shutdown

Source: 2021 IRP



Transmission Impacts of Hibbard Renewable Energy Center Retirement

- Transmission planning and operational impacts to be discussed in 2025 IRP

- Reviewing MISO Attachment Y2 study, internal studies, and operational experience to identify system impacts and network upgrades

- Much smaller in scale, but similar to discussion of Boswell from 2021 IRP

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Generator Interconnection Network Upgrade Costs

- MP's approach uses historical costs for projects in MISO's GI queue
  - All West cycles with results published since last IRP included (Aug 2017 - 2021)
  - Projects were grouped by fuel type – i.e. wind, solar, storage, etc.
  - Network Upgrades were sorted by three cost types:
    - **C1** - Base MISO Costs (TOIF, ERIS, NRIS, LPC except GRE, …)
    - **C2** - Backbone Costs (Backbone, Base Case, MWEX, GRE Coal Creek LPC)
    - **C3** - Affected Systems Costs (SPP, MPC, PJM, …)
  - Projects' cost impacts were added by size (MW), stage of DPP reached, and Annual MISO OMS Survey weightings

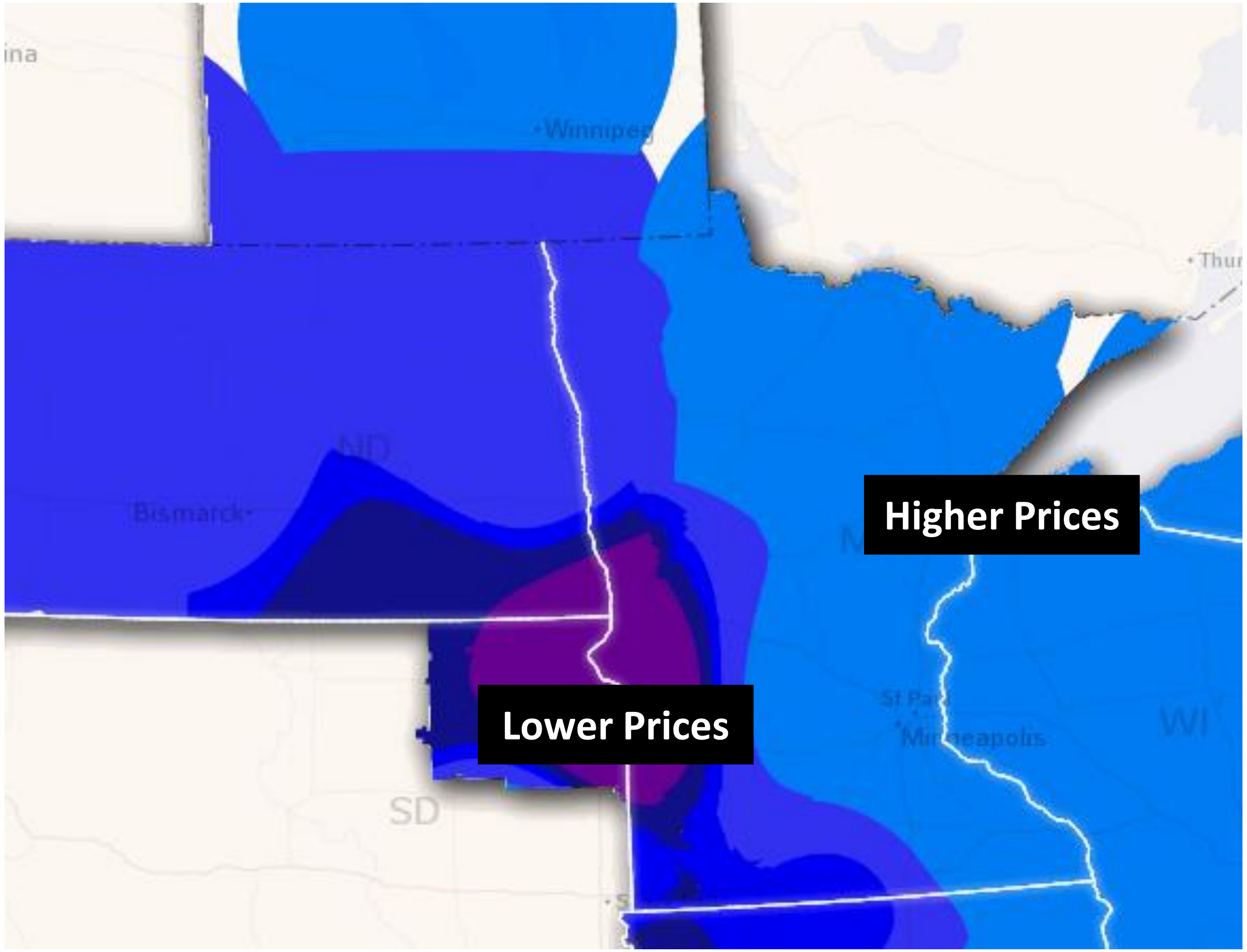
2023 MISO OMS Survey Percentages					
	Not Started	**Phase 1**	**Phase 2**	**Phase 3**	**GIA In-Progress**
Non-Intermittent	10%	10%	75%	90%	90%
Intermittent	10%	10%	50%	90%	90%

Generator Interconnection Network Upgrade Costs

Network Upgrade Costs (2024 Dollars)	Wind ($/MW)	Solar ($/MW)	Storage ($/MW)
C1: Base MISO Costs	$113,332	$129,509	$50,891
C2: Backbone Costs	$52,836	$3,049	$11,047
C3: Affected System Costs	$154,427	$56,136	$45,510
Base Case Interconnection Costs	**$320,000**	**$190,000**	**$110,000**
Low Interconnection Sensitivity (50% of C2 and C3)	*$220,000*	*$160,000*	*$80,000*

- Surplus Interconnection for any fuel type assumes no ($0/MW) Network Upgrade costs
- Final Base Case and Low Interconnection Sensitivity Costs were rounded to nearest ten thousand for convenience

MISO Market Cost for Delivering Renewables to Load

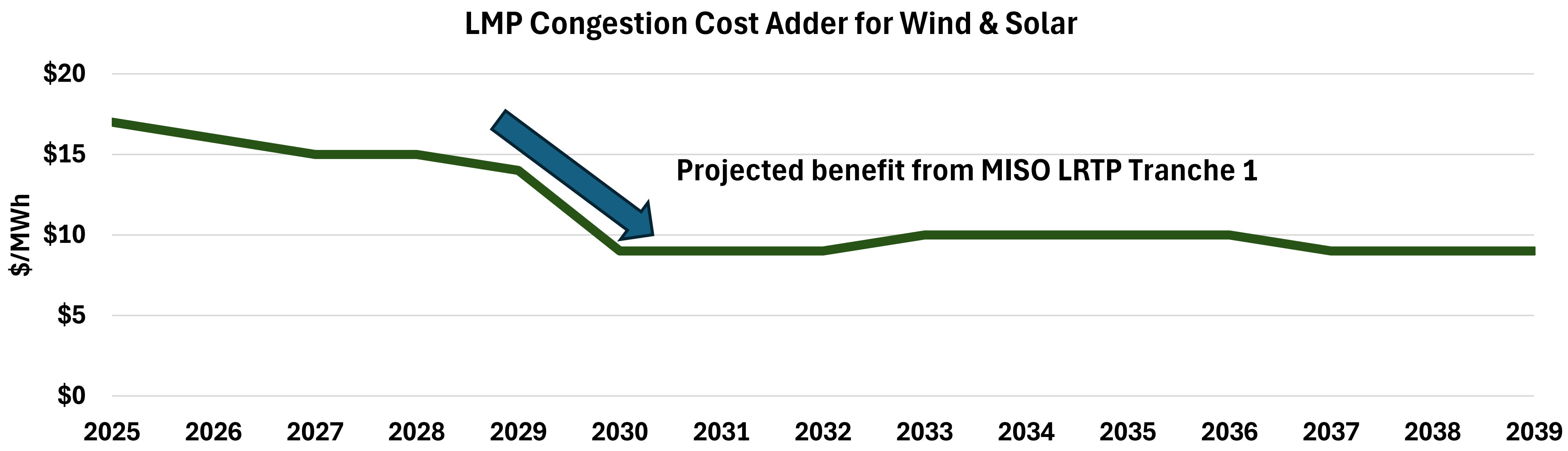


Issue: Historically, renewables are paid a lower price for energy than load and other generation resources.

This impact is incorporated into IRP long-term modeling by including a "LMP Congestion" adder to new wind and solar generation.

LMP Congestion Adder for New Wind and Solar

- Congestion adder represents the cost to deliver new wind and solar energy to Minnesota Power load.
- Methodology:
  - Forward congestion cost curve based on PROMOD LRTP model that included Tranche 1
  - Adjusted forward congestion/loss curve based on three years of actuals



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EnCompass Model Run Update

- We are seeing long-run times.
- The more granular we dispatch the longer it takes for the model to converge.
- More complex scenarios taking +18 hours to solve.
- Actions taken:
  - Increased MIPS to +150
  - Doubled resources available on the application servers – 64 processors and 512 GB RAM
  - Using scripts to get the model to process scenarios more efficiently


THANKS