APPENDIX C: EXISTING POWER SUPPLY

Minnesota Power has a power supply portfolio that is made up of power purchase agreements and Company-owned assets, as well as contract purchases from other entities. The following Parts of this appendix detail Minnesota Power's existing power supply for the 2021 Integrated Resource Plan ("2021 Plan"):

- Part 1 explains Minnesota Power's mission and its reliability efforts to maintain the operational integrity of its generation resources throughout the 2021-2035 planning period. Part 1 also provides a description of each of these resources.
- Part 2 provides a summary of the Company's power sales and purchases used to meet short and long-term load and capability needs.
- Part 3 summarizes Minnesota Power's small power production as reported in the most recently completed Qualifying Facilities Report in accordance with Minnesota Rules 7835.1300 - 7835.1800.[1] This section also provides updated descriptions of existing distributed generation ("DG") projects.

Part 1: Generation Resources

Minnesota Power's Generation Operations mission is to operate, maintain and manage its generation assets in a manner that meets customer expectations, protects people and the environment, and provides a fair return for the Company shareholders. This mission is the driving force behind maintaining the operational integrity of the Company's generation resources and is supported by a robust, comprehensive and system-wide reliability effort.

Reliability Focus

Electric generating units serve a duty cycle that reflects their design and the power market demands for economic dispatch: baseload, intermediate load, and peak load. Preserving the usefulness of these assets requires capital investment and maintenance expenditures to sustain a unit's economic viability, availability and reliability for the duty cycle it is dispatched to serve. Minnesota Power generating units have traditionally served a baseload mission due to the large component of around-the-clock industrial service in the Company's customer base, which is evidenced by the Company's load factor of nearly 80 percent, one of the highest in the nation. Over time, the Company's mission of serving its customers with large baseload generation has changed with the large build-out of intermittent wind generation already placed in service and additional planned wind and solar for the future across the Midcontinent Independent System Operator ("MISO") footprint and within the Company's system. For context, Minnesota Power has added approximately 850 MW of wind power to its 1600 MW peak demand system since 2005.

Coupling the variable nature of renewable generation with low operating cost creates a potential need to decrease or take dispatchable generation offline during times when renewable generation is high and market demands are low. The degree of impact to dispatchable resources depends upon how much renewable energy is being generated and system demand. Currently, the impact of weather on renewable generation can be handled by backing down the Company's dispatchable units to lower loads, but as the renewable fleet on the system expands, there are times when dispatchable units need to be taken off-line to make room for renewable generation. Significantly increasing the number of on/off cycles of dispatchable generating units to accommodate the availability of renewable generation will change the

[1] Docket No. E999/PR-20-09.

generation maintenance strategy due to thermal stresses, as well as the wear and tear of starting and stopping equipment. A generation plant's operating strategy requires maintenance to ensure that the generating units are available to meet customer demands.

The Company continues to evolve maintenance programs to address impacts to generating unit operation, reliability, and maintenance costs while operating in a region where the generation fleet is continuing to evolve to increasingly cleaner energy sources. Minnesota Power continues to focus on reliability, while maintaining compliance with all pertinent regulations and environmental permits.

Elements of Minnesota Power's Reliability Efforts

Employee Training

The Company provides specific system training when operational and maintenance criteria change as a result of policy changes, equipment replacement and/or control modifications. Through recent apprentice and training efforts, the majority of all generation job functions are shaped through State of Minnesota Department of Labor and Industry indentured apprenticeships. Minnesota Power also provides ongoing training to meet and exceed State of Minnesota boiler licensure coverage at all locations.

To ensure safe, efficient operations and maintenance ("O&M") of Minnesota Power wind resources, a combination of formal and on-the-job training is provided to technicians. Formal training establishes proper expectations and promotes positive work habits and practices while enhancing employee's technical knowledge of installed equipment. On-the-job training constitutes the majority of employee's development for improving needed skills for maintaining equipment safely and reliably. Technicians have received advanced, formal training in wind turbine blade repair and other component-specific systems. These allow the technicians to perform more advanced tasks onsite while reducing reliance on outside providers.

Capital Investment

Minnesota Power continues to invest in base capital and asset preservation projects at its thermal and renewable sites to maintain the integrity of major unit components, including turbine, generator, boiler, auxiliaries, electrical infrastructure, control systems and pollution control equipment, wind turbine gearboxes, bearing and blading consistent with specifications from original equipment manufacturers ("OEM") and best practices learned across the industry. The Company also makes prudent capital investments at its hydro facilities to ensure safety and reliability of operation. These investments are made to the dams, head water reservoirs, and power houses. Hydro investments include maintenance and replacement of water control gates, gate hoist rehabilitation, concrete/structural rehabilitation, water conveyance structures such and flowlines and penstocks, head gates, as well as to the actual generating equipment

Predictive Maintenance

Minnesota Power continuously expands the use of predictive maintenance techniques to proactively respond to equipment condition trends and changes. Advanced Condition monitoring techniques leveraging modern technology are utilized to drive good equipment life cycle and business decisions. Increasing the frequency of inspections and automated condition monitoring of equipment are cornerstones of the adopted operational strategy of reliability-centered principles and behaviors.

Inspections

Routine engineering, insurance carrier and state required inspections are made at each generating facility. Non-destructive techniques, including dye penetration, borescope analysis, disassembly and visual inspection, along with wall thickness testing, provide important data. Coupled with maintenance trends and operating data, inspection results are used to make informed decisions. Minnesota Power performs continuous equipment condition monitoring as well as periodic inspections in line with industry best practice at generation sites. These tools are coupled with OEM guidance and can include but are not limited to online vibration monitoring and particle counters, quarterly oil sampling, monthly conditioned based monitoring meetings, weekly visual blade inspections, annual blade and gearbox inspections are completed at the wind sites. Each dam in the Hydro system is routinely inspected by maintenance personnel and Minnesota Power engineers, with supplemental inspections by our federal regulators and Independent Consultants. The Company's surveillance and monitoring plans for each dam discuss the frequency of regular surveys, underwater inspections, and other specialty measurements following Federal Energy Regulatory Commission ("FERC") guidelines. FERC requires gate inspections every ten years.

Enhanced Monitoring

Additional continuous monitoring equipment is provided to each generating unit on a prioritized basis. Plant distributed control systems, turbine supervisory systems, instrumentation replacement, flux probes and partial discharge equipment are frequently added to improve and monitor equipment conditions.

Internal/External Best Practices

Continued internal sharing and external scans of best operation and maintenance practices are considered and evaluated. A number of skilled employees maintain and practice in licensed disciplines. The organization has a long history of partnering with others in the utility sector (EEI, EPRI, AEIC, etc.)[2] to better understand industry trends and ideas. Optimizing coal quality/fuel blending system-wide, installing static exciters, and installing advanced emission reduction technology are three examples of internal sharing where practices have been applied to multiple sites.

Efficiency Monitoring

A long-standing efficiency metric that remains in place for all thermal plants is heat rate. It is used to monitor the generating unit's efficiency on an on-going basis. Major maintenance projects such as boiler chemical cleaning, boiler maintenance, burner repairs, fuel delivery repairs, and turbine overhauls are budgeted and scheduled to maintain or improve efficiency using heat rate as an indicator.

Prudent O&M along with capital expenditures support continued operations of the generating units. This includes, but is not limited to, the training and practices listed above which are examples of work that is performed to sustain the unit's reliability and availability and environmental compliance.

[2] Edison Electric Institute ("EEI") provides public policy leadership, critical industry data, strategic business intelligence, conferences and forums, and products and services. The Electric Power Research Institute, Inc. ("EPRI") is an independent, nonprofit organization that conducts research, development and demonstration relating to the generation, delivery and use of electricity for the benefit of the public. The Association of Edison Illuminating Companies ("AEIC"), organized in 1885, focuses its energies on finding solutions to problems of mutual concern to electric utilities, worldwide.

Generation Resource Descriptions

*Hibbard Renewable Energy Center ("HREC") — 46.9 MW (***[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** *Accredited Unforced Capacity ("UCAP"))*

Figure 1: Hibbard Renewable Energy Center

Hibbard Renewable Energy Center Units 3 and 4 operate as energy resources for Minnesota Power's system and are located in Duluth, Minnesota. HREC is capable of burning wood and wood wastes, coal and natural gas. Use of wood and wood waste fuels make much of the energy generated by HREC a qualified renewable energy product. HREC units have been providing a portion of the Company's regulated services and spinning reserves since 2004. HREC is capable of and originally designed for baseload operation and supports baseload energy generation when steaming capacity is available and energy is required for customers.

Since that time, capital improvements have been completed to refurbish the facility to utility standards. The boilers continue to provide steam that drives HREC 3 and 4 turbine generators based on market conditions and are contracted to provide large quantities of steam to the adjacent Verso Duluth Paper Mill (formerly NewPage). The Company intends to continue operating HREC for renewable energy and other ancillary services, along with being available to mitigate regional and local reliability needs. HREC is also being positioned to provide steam sales to the Duluth Mill if it resumes operations. With announcements in June of 2020 that Verso will be indefinitely idling this Duluth site, Minnesota Power is continuing to support the current owner's effort to explore sale options for the mill property.[3]

HREC boilers are fitted with electrostatic precipitators ("ESP"), a pollution control technology that will provide continued particulate emissions control during the operational life of the facility. HREC has increased the percentage of biomass to more than 90 percent of fuel supply, and reduced the percentage of coal fueling for the boilers in order to comply with environmental regulations maximum-achievable control technology ("MACT") and National Ambient Air Quality Standard ("NAAQS"). Capital improvements in recent years have focused

[3]The current economic life of HREC extends through 2029, as summarized in Minnesota Power's 2020 Remaining Life Depreciation Petition. Docket No. E015/D-20-701.

on refurbishing the existing boilers, to improve their efficiencies, wood handling, and ash handling systems to manage the increased wood burn.

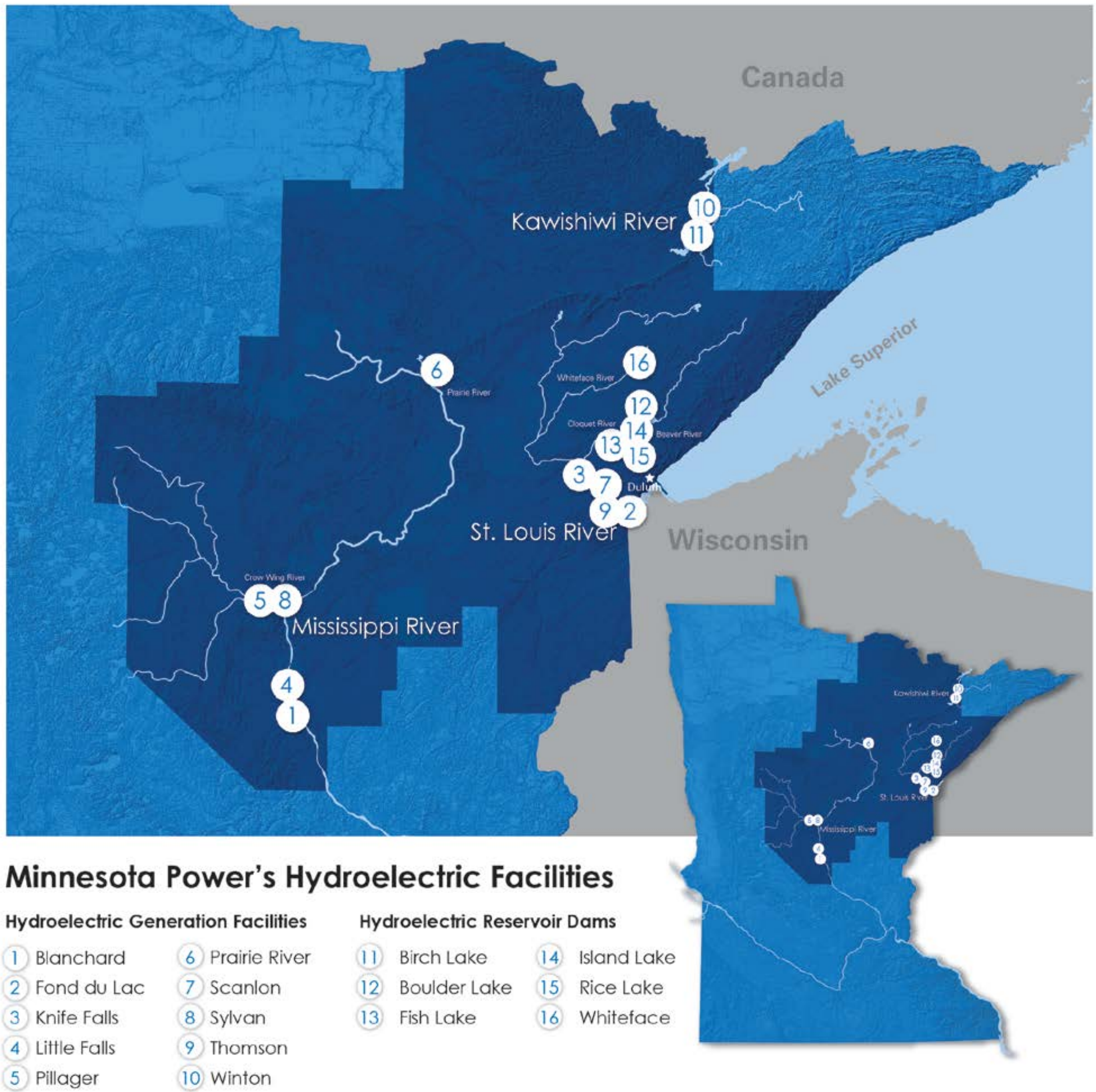
Current O&M practices will continue with routine maintenance inspections performed and corrective actions implemented as needed. Capital investments are continuously reviewed and prioritized across the generating fleet, including HREC, with a goal of maintaining current capacity in a manner that maintains reliability and availability throughout the 2021-2035 resource planning period.

Hydro Resources

*Hydro Resources — 121 MW (***[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** *Accredited UCAP)*

From its earliest days, Minnesota Power has used water to generate electricity and serve customers in northern Minnesota. Today, Minnesota Power is the largest hydro energy producer in the State, with generating capability of approximately 120 MW. The Company operates 10 hydro stations on five rivers that are part of three main river systems in central and northern Minnesota – the Mississippi River, St. Louis River and Kawishiwi River (Figure 2). Thomson Hydroelectric Station has been generating renewable power for more than 100 years, as have the Little Falls and Sylvan stations. In addition to maintaining dams at each hydro station, the Company also maintain six headwater storage reservoirs. The Company operates its stations and reservoirs under eight federal licenses. FERC oversees dam operations and safety in the United States, and FERC licenses specify operating parameters. Hydroelectric power will continue to be an important part of Minnesota Power's *Energy**Forward*** strategy, and along with investments in wind, biomass and solar energy, will help to build a cleaner and more sustainable energy future.

Figure 2. Map of Minnesota Power Hydro Resources



The facilities include[4] – Accredited UCAP (Name Plate):

- Little Falls Hydroelectric Station (Project #25324.2 MW)— **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
- Blanchard Hydroelectric Station (Project #346)— 13.8 MW **[TRADE SECRET DATA BEGINS]** [redacted] **TRADE SECRET DATA ENDS]**

[4] Project numbers refer to FERC license project number.

- Sylvan Hydroelectric Station (Project #2454)— 1.5 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
- Pillager Hydroelectric Station (Project #2663)— 1.4 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
- Prairie River Hydroelectric Station (Project #2361)— 0.3 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
- St. Louis River System (Project #2360)— 88.0MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
  - Knife Falls Hydroelectric Station— 1.4 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
  - Scanlon Hydroelectric Station— 1.1 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
  - Thomson Hydroelectric Station— 73.5 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
  - Fond du Lac Hydroelectric Station— 12.0 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**
- Winton Hydroelectric Station (Project #469)— 3.3 MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**

The four facilities that have FERC licenses that expire during the 15-year planning cycle of this Plan, representing about eight percent (9.4 MW Name Plate) of Minnesota Power's regulated hydroelectric capacity, are as follows:

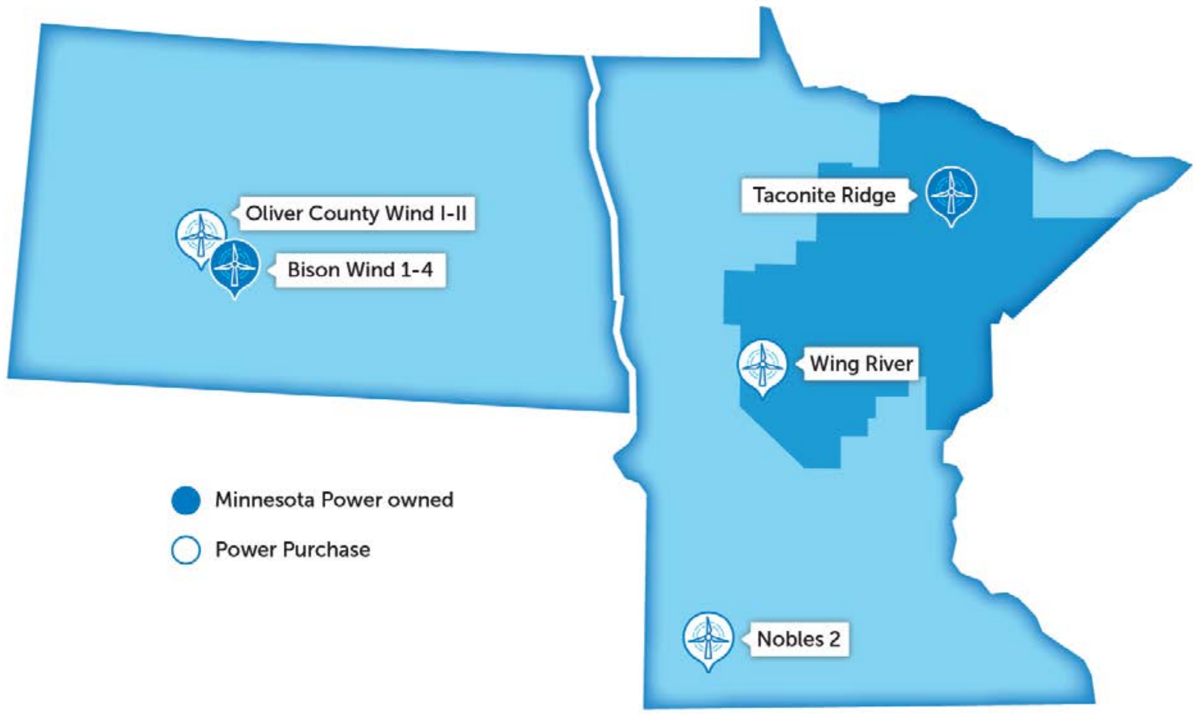
- Little Falls Hydroelectric Station – FERC license expires 2028
- Prairie River Hydroelectric Station – FERC license expires 2023
- Sylvan Hydroelectric Station – FERC license expires 2028
- Pillager Hydroelectric Station – FERC license expires 2028

Minnesota Power has identified that the useful life for these units extend beyond the planning period. The Company will continue to assess the need for capital refurbishments to all hydro stations, and will re-license facilities as necessary to continue to provide value to customers. The Company will continue to assess additional efficiency projects or bolt-on additions to its hydraulic generating fleet. All hydro assets are expected to be operated throughout the 2021-2035 forecast period. The useful economic operating life of Minnesota Power's hydroelectric facilities extends beyond the planning period for all units.[5]

[5] In previous Resource Plans, the hydroelectric facilities' remaining lives have been set based on the expiration of FERC licenses. Beginning with Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701), and going forward, all hydro facilities now reflect their projected operating lives.

Wind Resources

Figure 3. Minnesota Power Wind Resources



Bison Wind Energy Center —497 MW **[TRADE SECRET DATA *BEGINS*** [redacted] **TRADE SECRET DATA ENDS]** *Accredited UCAP)*

Bison 1 Wind Facility ("Bison 1")

Minnesota Power's Bison 1 is located near Center, North Dakota and was put into service in two phases during the time frame of 2010 through 2012, with the first phase consisting of sixteen 2.3 MW wind turbines and the second phase consisting of fifteen 3.0 MW wind turbines. The 2.3 MW turbines are geared units while the 3.0 MW turbines are direct-drive units without a gearbox.

Minnesota Power achieves delivery of the energy and accreditation of the capacity from this facility through its ownership of the high voltage direct current ("DC Line") between Center, North Dakota and Duluth, Minnesota. The current economic life of Bison 1 extends through 2045 for the Phase 1 installation and through 2046 for the Phase 2 installation, as summarized in the Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

Bison 2 Wind Facility ("Bison 2")

Minnesota Power's Bison 2 is also located near Center, North Dakota, and was put into service in 2012. The facility consists of thirty-five 3.0 MW direct-drive wind turbines. Like Bison 1, Minnesota Power achieves delivery of the energy and accreditation of the capacity from this facility through its ownership of the DC Line. The current economic life of the Bison 2 will extend through 2047, as summarized in the Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

Bison 3 Wind Facility ("Bison 3")

Minnesota Power's Bison 3 is located near Center, North Dakota and was put into service in 2012. The facility consists of thirty-five 3.0 MW direct-drive wind turbines. The Company achieves delivery of the energy and accreditation of the capacity from this facility through its ownership of the DC Line. The current economic life of the Bison 3 will extend through 2047, as summarized in Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

Bison 4 Wind Facility ("Bison 4")

Minnesota Power's Bison 4 is located near Center, North Dakota, and was put into service in 2014. The facility consists of sixty-four 3.2 MW direct-drive wind turbines. Like the other three Bison units, the Company achieves delivery of the energy and accreditation of the capacity from this facility through its ownership of the DC Line. The current economic life of the Bison 4 will extend through 2049, as summarized in Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

Taconite Ridge Wind Energy Center 25 MW — **[TRADE SECRET DATA *BEGINS*** [redacted] **TRADE SECRET DATA ENDS]** *Accredited UCAP)*

Taconite Ridge Energy Center consists of ten 2.5 MW wind turbines located on the Laurentian Divide in Mountain Iron, Minnesota, on United States Steel Corporation property. The wind facility was Minnesota Power's first and began operation in 2008. The current economic life of Taconite Ridge Energy Center extends through 2043, as summarized in the Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

Natural Gas Generation Resources

*Laskin Energy Center ("Laskin" or "LEC") — 99 MW (***[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** *UCAP)*

Figure 4. Laskin Energy Center

LEC is located in Hoyt Lakes, Minnesota and now employs nine full-time Minnesota Power employees after the facility's transition from coal to natural gas. Prior to the transition, there were 39 full time employees.

Laskin's two generating units, Laskin Units 1 and 2 ("LEC1&2"), are near identical boilers, similar in design and intended operation. The units are tangentially-fired steam generators and were both put into service in 1953. LEC1&2 each operate with a gross generation capability of approximately 52 MW gross (50 MW net) with 5 MW of existing station service steam to operate auxiliary equipment.

Originally known as the Aurora Steam Station, the facility was commissioned as a coal-fired facility in 1953 with a total station capability of 88 MW and was designed to serve the needs of an expanding taconite industry. LEC1&2 were uprated to the present capability in 1967 through boiler, control system, turbine, and generator upgrades.

In the spring of 2015, the facility was converted from coal to natural gas using the existing steam boilers, turbine generators, and auxiliary equipment.[6]

Existing Emission Control Equipment

Current operation and maintenance practices will continue with routine maintenance inspections performed and corrective actions implemented as needed. Capital investments are continuously reviewed and prioritized across the generating fleet, including LEC, with a goal of maintaining current capacity in a manner that maintains reliability and availability throughout the resource planning period.[7]

[6] Docket No. E-015/GP-13-978.

[7] These units have been well maintained through ongoing investments. The current economic life of LEC will extend through 2030, as is summarized in Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

Environmentally Compliant Coal Generation Resources

Boswell Energy Center ("BEC") — Units 3 and 4

Figure 5. Boswell Energy Center

BEC is Minnesota Power's largest thermal facility and only remaining baseload generation, with a capacity of nearly 1,000 MW when its units were originally installed. The facility is located in Cohasset, Minnesota. All four units have been fueled by low mercury, low-sulfur Powder River Basin coal from Wyoming and Montana. While Units 1 and 2 were retired at the end of 2018, BEC currently employs approximately 168 full-time Minnesota Power employees at its two remaining operational units (Units 3 and 4, including the fuel handling operations onsite).

Substantial investments have been made at the facility for environmental and efficiency related improvements since 2007, with the largest investment – the environmental retrofit of Unit 4 – completed in 2015.

BEC1&2, the first two units constructed at BEC, were placed in service in 1958 and 1960, respectively, and retired in 2018.

*Boswell Energy Center Unit 3 — 350 Nameplate MW (***[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** *UCAP)*

BEC3 was placed in service in 1973. The unit is a tangentially-fired steam generator. In 2009, Minnesota Power replaced the original turbine with a more efficient design that is able to operate at 389 MW gross capability and 350 MW net output without increasing the steam flow or consuming additional fuel.

In combination with the turbine efficiency upgrade on the unit, a major environmental upgrade was completed at BEC3 in 2009 to meet state and federal environmental requirements. Following the retrofit, the unit now employs low NO_x burners ("LNB"), over-fire air, and a selective catalytic reduction ("SCR") system for NO_x control, a spray tower absorber, which is also commonly referred to as wet flue gas desulfurization ("WFGD") for SO_2 control, and an activated carbon injection system and fabric filter for mercury and particulate matter ("PM") control.

BEC3 has historically operated at a high load factor, providing dispatchable energy in the Minnesota Power system and across MISO North. The Company has been analyzing the customer, community, and operational impacts of moving BEC3 to an economic dispatch operation. The Company recently announced that BEC3 will transition to an economic dispatch resource in 2021 and is proposed to be retired by year end 2029. The current economic life of BEC3 extends through 2035, as summarized in Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

BEC3 Existing Emission Control Equipment

As described above, BEC3 underwent a complete environmental retrofit during the period of 2007 to 2009, installing the most state-of-the-art emission control equipment available. Actual emission reductions from these investments include an 87 percent reduction in NO_x, 98 percent reduction in SO_2, 94 percent reduction in PM, and 90 percent reduction in mercury. The following is a more detailed description of the equipment used for emissions control at BEC3.

NO_x Control

BEC3 deploys new NO_x reduction technologies by utilizing a SCR system. In this system, a reactor is utilized to remove the NO_x from the flue gas with the use of ammonia as a reducing agent. The boiler flue gas enters the reactor, where ammonia, in conjunction with a specialized catalyst chemically transforms NO_x that is formed in the combustion process into nitrogen gas and water vapor. SCR is "selective" in that it predominantly affects the oxides of nitrogen.

In addition to the SCR reactor, BEC3 also utilizes special designs of both LNB and over-fire air for NO_x control similar to the other BEC unit. BEC3's LNB and over-fire air technology encompass a low NO_x concentric firing system which maximizes the NO_x reduction capabilities of the existing tangential firing systems in the boiler and a separated over-fire air windbox which works with the firing system to stage and separate the air and fuel mixture properly for maximum NO_x reduction.

SO_2 Control

BEC3 currently utilizes a WFGD unit for SO_2 control. WFGD is a widely-used technology for coal-fired utility boilers aimed at removing acid gases created in the coal combustion process. WFGD eliminates SO_2, hydrochloric acid, hydrofluoric acid, and to some extent, sulfur trioxide through direct contact with the sorbent, an aqueous, finely ground limestone slurry which is sprayed into the rising flue gas in the vessel and collected at the bottom of the vessel after it has chemically transformed the acid gas into the material gypsum.

PM and Mercury Control

BEC3 currently utilizes a fabric filter for control of PM in the combustion gases. In the distinctive design of the environmental control system at BEC3, the fabric filter also helps control mercury emissions through capture of a powdered activated carbon ("PAC") sorbent which is injected into the ductwork upstream of the fabric filter to react with, and capture the mercury in the flue gas.

Operations and Maintenance

O&M practices will continue, consistent with the Company's predictive and preventive maintenance programs, and will continue to apply to these advanced emission control systems, with maintenance inspections performed and corrective actions implemented as needed based on the operational needs of the facility in an economic dispatch operational mode until its retirement date on or before 2029. Capital investments will continue as appropriate in order to keep the unit used and useful to maintain capacity, reliability, safety, and dispatchability through the end of the unit's operational life.

Boswell Energy Center Unit 4 —582 Nameplate MW **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** *WPPI Accredited UCAP)*

BEC4 was the final unit constructed at BEC and was placed in service in 1980. The unit is a tangentially-fired steam generator and has been wet-scrubbed until 2015 when a circulating dry scrubber ("CDS") was commissioned. In 2010, after an increased number of forced outage incidents, Minnesota Power replaced the original turbine with a more efficient design that is able to operate at over 635 MW gross capability and 585 MW net capability, without increasing the steam flow or consuming additional fuel. In essence, the Company added 50 MW, dispatchable, capacity and energy as a result of this efficiency improvement project with no incremental emissions.

BEC4 operates at a high load factor, providing dispatchable energy in the Minnesota Power system and MISO North. WPPI Energy (formerly Wisconsin Public Power, Inc.) jointly owns BEC4 with Minnesota Power with a 20 percent ownership stake. On January 12, 2021, the Company announced it will be transforming BEC4 to a coal-free energy supply by 2035. The current economic life of BEC Unit 4 extends through 2035, as summarized in Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701).

BEC4 Existing Emission Control Equipment

BEC4 was originally constructed with first generation LNB and close-coupled over-fire air, and a then state-of-the-art wet spray tower absorber/particulate removal system. This system removes more than 85 percent of the SO_2 and over 97.5 percent of PM. Investments made in emission reduction technology since 2008 have resulted in continued improvements in emission reduction at BEC4. Following is a more detailed description of the equipment used for emissions control at BEC4.

NO_x Control

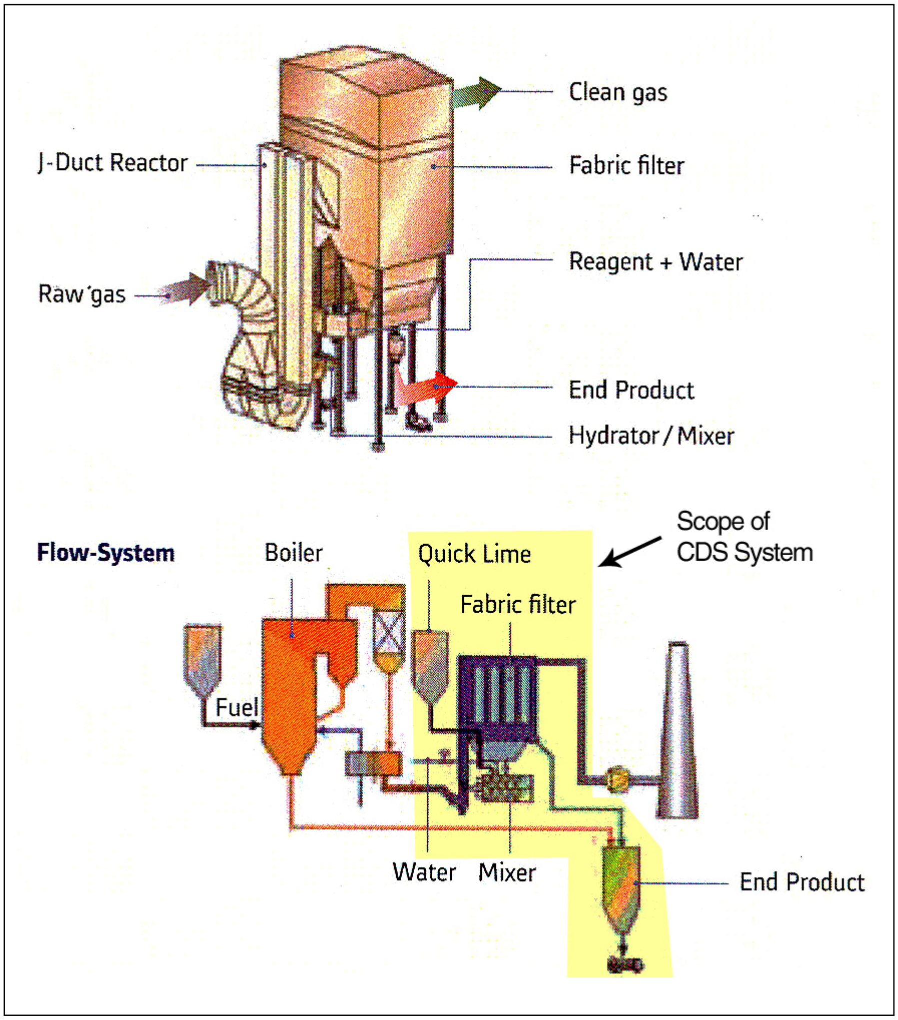
BEC4 deploys NO_x reduction technologies by utilizing the Mobotec selective non-catalytic reduction ("SNCR") system. This system, installed in 2008, includes a Rotamix technology. Within the Rotamix system for BEC4, fourteen boiler injection ports are used to deliver urea into the boiler to chemically transform NO_x that is formed in the combustion process into harmless nitrogen gas and water vapor. In 2010, the Company further increased its effectiveness in preventing the formation of NO_x with the replacement of the first generation LNB with new, state-of-the-art, LNB and separated over-fire air technology. In combination, these NO_x controls provide an approximately 55 percent annual reduction in NO_x emissions. Minnesota Power utilizes a combustion optimization neural network system, installed in 2010, to further optimize emission reduction performance.

SO_2, PM and Mercury Control (Alstom NID Technology)

BEC4 constructed a CDS in 2015 to replace the existing WFGD for SO_2 removal and the wet venturi scrubber for PM control. This new CDS also controls mercury emissions through a PAC injection system and fabric filter for mercury capture.

When the unit is operating at a high load profile we can use as much as 400 gallons per minute of wastewater from the site, which is an environmental and cost benefit. This is a positive impact on the environment and lowers the production costs of the facility.

Figure 6: CDS Flow Process Diagram



Powdered Activated Carbon

PAC systems, installed 2015, are a proven power plant mercury reduction technology that are able to achieve very high removal efficiencies (i.e., 90 percent). PAC is used to remove mercury from the flue gas. The injected carbon compound adsorbs the vaporized mercury from the flue gas and combines the mercury with carbon and fly ash particulate. The particulates are then captured by a fabric filter.

Minnesota Power is achieving greater than 86 percent mercury removal at BEC4 using PAC in combination with a fabric filter, and this use of multiple emission control technologies to reduce mercury is consistent with the intent of Minn. Stat. § 216B.682, subd. 3(a) to "demonstrate that [Minnesota Power] has considered achieving the mercury emissions reduction required...through multiple pollutant control technology." The Fabric Filter section provides additional detail on expected mercury emission reduction.

Fabric Filter (Alstom NID Technology)

The fabric filter, installed in 2015, also commonly referred to as a "bag house," is integral in optimizing mercury removal. When used in combination with PAC, a fabric filter is the most effective mechanism for capturing mercury. The fly ash and Mercury particles form a cake on the filter bags. The PAC captures the Mercury particles in the Flue Gas. Subsequently, the PAC particles are removed from the Flue Gas via the NID Fabric Filter (commonly referred to as a Baghouse). In addition to removing Fly Ash and the Mercury containing PAC particles, the particle caking of fly ash and PAC on the surface of the Fabric Filter Bags allows for additional retention time in the Flue Gas Stream that optimizes the amount of Mercury each particle of PAC can capture. The mercury particles adhere to the fly ash and PAC matter instead of exiting the stack.

Fabric filters use fiberglass or other fabric bag materials to collect total filterable PM, fly ash and mercury-laden carbon. The unique concept of combining use of the fabric filter with a CDS system is that a portion of the fly ash is recirculated to an absorber tower to assist in SO_2 removal. As the filters continue to collect additional fly ash, a portion is sent to storage/disposal. The system operates with a controlled loading of fly ash to optimize its performance.

Byproduct Ash Handling System ("Ash System")

Conversion of BEC4 to a retrofitted pollution equipment system changed the way fly ash and scrubber solids are managed at BEC. The BEC4 dry fly ash and scrubber solids are commingled, and pneumatically conveyed from the BEC4 CDS to a fly ash silo that was constructed as part of the BEC CDS retrofit, and then transported to the BEC Dry Ash Landfill via truck for disposal with other dry coal combustion residuals ("CCRs") from BEC. Upgrades to the dry ash handling infrastructure were constructed in order to accommodate the additional dry ash generated by the BEC4 CDS. The upgrades included expansion of the bottom ash foundation base layer in the landfill, anticipated more frequent final cover construction projects, a larger storm water sedimentation pond, landfill access ramp and haul road improvements to accommodate additional haul traffic, additional equipment to transport the increased fly ash volume, and additions to the ash maintenance building to accommodate additional staff and equipment. After the BEC4 retrofit was completed, some modifications in the way dry ash is managed at BEC have resulted in less ash being placed in the landfill, and build-out of the landfill is developing slower than expected. Those changes include the shutdown of BEC1&2, developing a beneficial use market for BEC3 fly ash resulting in almost 100 percent of the BEC3 fly ash being sent off site.

Operations and Maintenance

O&M practices will continue, consistent with the Company's predictive and preventive maintenance programs, and will continue to apply to these advanced emission control systems, with maintenance inspections performed and corrective actions implemented as needed. Capital investments will continue in order to keep the unit used and useful and to maintain capacity, reliability, safety, and dispatchability through the end of the unit's current economic life (2035, as summarized in Minnesota Power's 2020 Remaining Life Depreciation Petition (Docket No. E015/D-20-701)).

*Square Butte's Milton R. Young 2 — 439 MW Nameplate (***[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** *Accredited UCAP)*

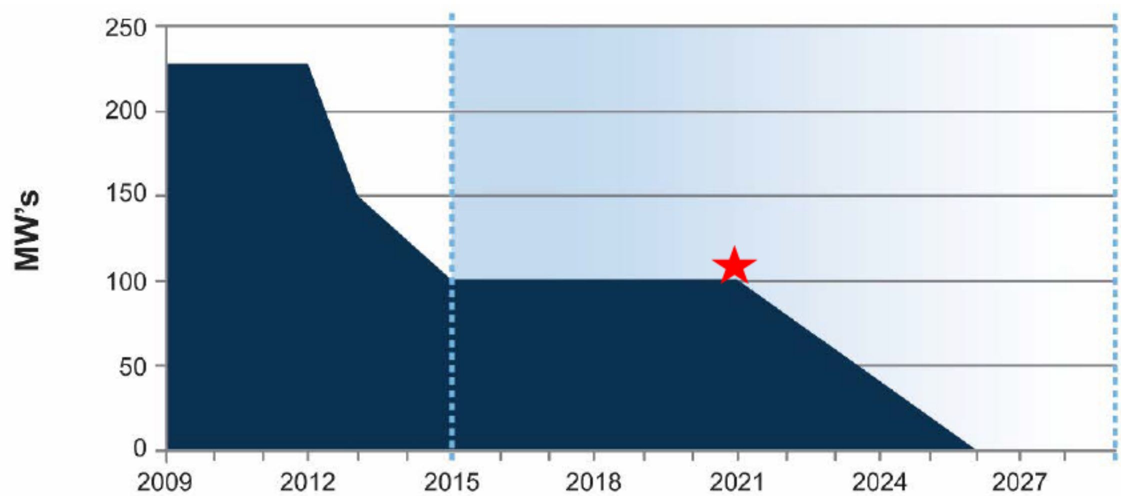
Milton R. Young 2 ("Young 2") lignite coal generating station in North Dakota operates as a baseload generation facility. Young 2 is owned by Square Butte Cooperative ("Square Butte"), managed by Minnkota Power Cooperative ("Minnkota") and provides energy sales to Minnesota Power and Minnkota. The Company's energy is transmitted via the DC Line running between the Square Butte Substation in Center, North Dakota and Minnesota Power's Arrowhead Substation near Duluth, Minnesota via the alternate current ("AC") transmission system.

Minnkota's share is routed on a 345 kV Center, North Dakota to Grand Forks, North Dakota transmission line. Minnesota Power transmission system personnel have operated and maintained the DC Line since it was commissioned in May 1977. Beginning in 2006, Minnkota could exercise an option to reduce the Company's entitlement by approximately five percent annually, down to a 50 percent share. Minnkota exercised all available options and, as of January 1, 2009, both Minnkota and Minnesota Power were limited to 50 percent of Young 2 generation, or approximately 227.5 MW each.

In 2009, in a major move to accelerate Minnesota Power's strategy of reducing carbon emissions and expanding renewable wind energy development, the Company obtained approval from the Minnesota Public Utilities Commission ("Commission") to purchase the DC Line and phase out of the long-term contract to buy coal-based electricity from Square Butte (Docket No. E015/PA-09-526).

Electricity generated at Young 2 is presently shared by Minnesota Power and Minnkota. Since 2014, the Company has been gradually reducing its 227.5 MW entitlement at Young 2, and by 2026 Minnesota Power will no longer take any of the Young 2 output for its customers. The gradual reduction of output taken by Minnesota Power from Young 2 is shown in Figure 7.

Figure 7: Minnesota Power's share of Young 2 Phase-out: 2015-2026



As operating agent, Minnkota is responsible for the operation and maintenance of Young 2. Minnesota Power's oversight through active participation on the operating committee ensures appropriate capital and O&M investments are being made to maintain long-term sustainability of the asset. Part of that effort includes upgrading the SO_2 and NO_x environmental controls. Enhanced SO_2 scrubbing equipment was installed in the 2010 timeframe and for NO_x, over-fire air was installed in 2007 and a SNCR system was installed in the 2010 timeframe. It is anticipated that Young 2 will continue to provide baseload generation to Minnesota Power through 2025, with the reductions as noted in Figure 7.

Taconite Harbor Energy Center ("THEC") 150 MW — **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** Accredited)

THEC is located near Schroeder, Minnesota, on the North Shore of Lake Superior, and was purchased from bankrupt LTV Steel Mining Co. in 2001. The three units at THEC were 75 MW tangentially-fired steam generators and were put into service in 1957, 1957, and 1967, respectively. These units each operated with a gross generation capability of 79 MW gross (75 MW net), with 4 MW of existing station service steam to operate auxiliary equipment.

Figure 8. Taconite Harbor Energy Center

Minnesota Power ceased coal-fired generation at THEC Unit 3 ("THEC3") in 2015, and the unit was retired-in-place. THEC Unit 1 ("THEC1") and Unit 2 ("THEC2") were idled in the fall of 2016. The Company sponsored a Community Advisory Panel of regional North Shore leaders from 2012 to 2016 which offered a communication platform for operating decisions. Since 2016, this group has met annually to discuss facility updates, security and potential repurposing and redevelopment options. The options included refueling the existing boilers with biomass, natural gas, or propane, or utilizing existing land and interconnect for new solar or energy storage. Unfortunately, these options were deemed to not be a good fit for the site and the existing infrastructure due to a variety of reasons. Some of these remissioning hurdles include no existing natural gas pipeline infrastructure, the wood basket for biomass is limited due to being located on Lake Superior, challenging topography for solar, and high costs to implement energy storage efficiently. After investigating several options for THEC, the Company determined that retirement in September 2021 is the best option for customers and the site.

Minnesota Power is investigating alternative redevelopment options for the site as well as potential uses for surrounding lands, including new economic and community development that would make use of existing infrastructure. These efforts will gain additional momentum upon approval of the 2021 Plan, and will continue to engage community leaders and the Company's economic development partners.

Solar

Camp Ripley 10 MW Solar Project

To embark upon its first utility scale solar opportunity, the Company identified a partner with aligned goals for a renewable energy future. Minnesota Power partnered with the Minnesota National Guard and installed a 10 MW solar array at Camp Ripley, near Little Falls, Minnesota, in 2016. This unique partnership leveraged the Company's energy expertise and Camp Ripley's available land to make progress in meeting both Minnesota's Solar Energy Standard ("SES") and the Department of Defense's cost savings and energy resiliency goals. In August 2014, the

Company and the Minnesota National Guard entered into a multi-faceted Memorandum of Understanding, which includes an agreement to work together on conservation programs, the 10 MW Camp Ripley Solar Project and backup generation technology. The 10 MW Camp Ripley Solar Project represents approximately one third of the Company's 33 MW of required solar generation to meet the SES, and at the time of construction was the largest solar project on any National Guard base in the nation.

Figure 9: Camp Ripley Solar Project

Part 2: Wholesale Power Transactions

Part 2 of Appendix C presents summary information on power sales and purchases used to balance Minnesota Power's power supply; the Company uses a combination long-term and short-term power purchases to meet customer requirements. This section provides information on committed transactions, a current transaction summary and a list of planned transactions.

Committed Transactions

Minnesota Power has several committed and continuing wholesale capacity and energy transactions over the study period from mostly renewable resources, including wind, hydro, and solar. The capacity purchases and sales are characterized as energy only, capacity only, or capacity and energy. The term "capacity only" refers to a purchase or sale of accredited capacity according to accreditation processes defined by MISO. The term "energy only" refers to a purchase or sale of power that does not include any accredited capacity. The term "capacity and energy" refers to a purchase or sale of power including accredited capacity and associated energy.

Current Transaction Summary

Capacity and Energy Purchases

Manitoba Hydro Electric Board ("MHEB")—250 MW: In May 2011, Minnesota Power entered into an agreement with MHEB for a 250 MW purchase beginning on June 1, 2020, and continuing through May 31, 2035 (Docket No. E015/M-11-938).

Florida Power & Light ("FPL")—50.6 MW: In July 2018, Minnesota Power entered into an amended agreement with FPL for a 50.6 MW purchase from the Oliver County wind project beginning on July 9, 2020, and continuing through July 9, 2040 (Docket No. E015/M-18-600).

FPL—48 MW: In July 2018, Minnesota Power entered into an amended agreement with FPL for a 48 MW purchase from the Oliver County wind project beginning in May 6, 2020, and continuing through May 6, 2040 (Docket No. E015/M-18-600).

Wing River Wind ("Wing River") Community Based Energy Development ("C-BED")—2.5 MW: In April 2007, Minnesota Power entered into a power purchase agreement with Wing River for a 2.5 MW purchase beginning in November 1, 2007, and continuing through November 1, 2027.

US Solar—1 MW: In March 2016, Minnesota Power entered into an agreement with US Solar for a 1 MW purchase from the Wrenshall Community Solar Garden beginning in December 2017 and continuing through November 2042. (Docket No. E-015/M-15-825).

Nobles 2 Wind—250 MW: In May 2017, Minnesota Power entered into a power purchase agreement with Tenaska for a 250 MW purchase from the Nobles 2 wind project beginning December 2020, and continuing until December 2040 (Docket No. E-015/M-18-545).

Capacity Only Purchases

Rockgen—25 MW: In June 2018, Minnesota Power entered into a power purchase agreement with Rock Gen for a 25 MW capacity purchase beginning June 1, 2019, and continuing through May 31, 2026.

<u>Capacity Only Sales</u>

Basin Electric Cooperative ("Basin")—100 MW: In July 2018, Minnesota Power entered into an agreement with Basin to sell 100 MW of capacity beginning June 1, 2025, and continuing through May 31, 2028.

[TRADE SECRET DATA BEGINS [redacted] **TRADE SECRET DATA ENDS]:** In June 2017, Minnesota Power entered into an agreement with **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** beginning June 1, 2022, and continuing through May 31, 2025**.** This capacity only sale was made available to Minnesota Power's large power customers through Product C that was submitted for approval in Docket No. E015/M-21-28.

[TRADE SECRET DATA BEGINS [redacted] **TRADE SECRET DATA ENDS]:** In September 2020, Minnesota Power entered into an agreement with **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** beginning June 1, 2022, and continuing through May 31, 2025. This capacity only sale was made available to Minnesota Power's large power customers through Product C that was submitted for approval in Docket No. E015/M-21-28.

Dairyland Power Cooperative ("DPC")—70 MW: In September 2020, Minnesota Power entered into an agreement with DPC to sell 70 MW of capacity beginning June 1, 2021, and continuing through May 31, 2022.

<u>Capacity and Energy Sales</u>

Oconto Electric Cooperative ("Oconto")—25 MW: In March 2018, Minnesota Power entered into an agreement with Oconto to sell 25 MW of Energy and Capacity beginning January 1, 2019, and continuing through December 31, 2026.

<u>Energy Only Purchases</u>

MHEB—Up to 133 MW: In July 2014, Minnesota Power entered into an agreement with MHEB for up to 133 MW of energy purchase beginning on June 1, 2020, and continuing through May 31, 2040.

<u>Energy Only Sales</u>

None at this time

Part 3: Small Power Production and Distributed Generation: Projects, Studies and Demonstration Activity

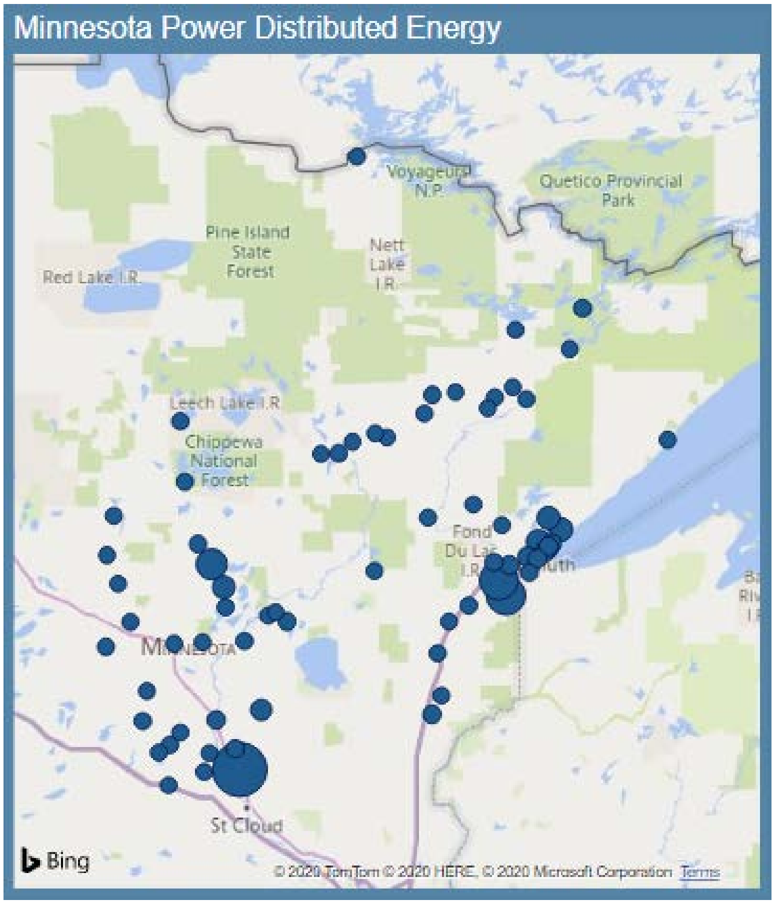
Part 3 of Appendix C summarizes Minnesota Power's small power production as reported in the most recently completed Qualifying Facilities Report in accordance with Minnesota Rules 7835.1300 - 7835.1800.[8] This section also provides updated descriptions of existing DG projects.

Distributed Generation Projects Overview

Due to Minnesota Power's successful focus on solar energy through programs such as SolarSense and Community Solar Gardens ("CSG"), the Company has seen an exponential growth of solar energy on its system. The Company's success has been driven by a focus on DG solar, along with technology becoming more efficient and cost effective. As shown in Figure 10 below, the DG installations have been widely dispersed throughout the service territory. The Federal Government has issued potential wholesale changes to energy markets through FERC that may include DERs in the future. The amount of small-scale Distributed Energy Resources ("DER") that has been installed comes with increased internal labor requirements to review, manage, and process these customer-driven projects. Typical projects that move through the SolarSense program are relatively small but when upgrades and modifications are required the labor burden and system upgrades do not provide benefit to the overall distribution grid, though the customer sees a benefit on their energy bill. While infrequent, there have also been instances when customers have power quality problems after installation. Strategically locating larger scale DER on distribution feeders with a system need would be more cost-effective and beneficial as these DERs would be easier to control, monitor, and maintain. The cost per kWh is also less expensive on larger scale projects when compared to smaller rooftop installations. Additional detail on customer DG project installations and Minnesota Power's involvement in community DG is provided in the remainder of this section.

[8] Docket E999/PR-20-09.

Figure 10: Capacity of Distributed Generation Projects



Distributed Generation and Small Power Production

For the period of January 2019 through December 2019, as reported in the March 2020 Qualifying Facilities Report,[9] Minnesota Power had a total of 402 interconnected qualifying facilities under the net energy billing rate, 15 of which were wind and 387 of which were photovoltaic systems (see Table 1). This represents a total of approximately 7,355.8 kW of customer DG installations.

[9] Docket E999/PR-20-09.

Table 1: Minnesota Power Net Metering Customers

Net Metering Customers			
	Total	Wind	Photovoltaic
Total Installations	402	15	387
Total Capacity (kW)	7,355.8	175.2	7,180.6
Total Net Exports to Minnesota Power (kWh)			
	Total	Wind	Photovoltaic
TOTAL	2,659,183	4,045	2,655,138
Total Net Imports from Minnesota Power (kWh)			
	Total	Wind	Photovoltaic
TOTAL	23,676,954	111,507	23,565,447
Total Net Metered Electricity Purchased by Minnesota Power (kWh)			
	Total	Wind	Photovoltaic
TOTAL	687,734	5,007	682,727

As is referenced in Minnesota Power's Qualifying Facilities Report, installations of net metered DG projects continue to be added each year. These projects receive a net energy billing rate. This rate applies to sellers with DG facilities rated at less than 1 MW. The net energy billing rate is generally paid out at the average retail rate, based on customer class.

Customer Renewable Energy Programs

Minnesota Power has a long-standing history of encouraging the adoption of renewable energy options through DG. The SolarSense rebate program has provided incentives for customers to install solar systems on their homes or businesses since 2004. While that program has successfully increased the amount of solar DG in the Company's service territory, the Company recognizes that not all customers have the ability to install solar on their site. In order to better accommodate varying customer needs, Minnesota Power introduced a CSG Pilot Program and SolarSense Low Income ("LI") Solar Pilot Program.

Community Solar Garden Pilot Program

The Company received final approval of the CSG Pilot Program on April 21, 2017. The CSG Pilot Program was intentionally designed to provide flexibility and optionality for customers who wish to participate in solar programs but do not have a site that is well-suited for a solar installation. Customers offset their energy use through subscriptions made in 1-kilowatt (kW) blocks, with each block representing a portion of the total generating capacity of the solar garden. At the end of each month, Minnesota Power calculates the total amount of solar energy produced by the garden that month, divides that production by the total number of subscription blocks in the program (1,040), and credits customer bills according to their number of subscription blocks. The CSG Pilot Program consists of a 1 MW solar array in Wrenshall, Minnesota and a 40 kW solar array on one of the most heavily trafficked thoroughfares in Duluth, Minnesota. The fully subscribed program offers three convenient ways for customers to participate: a onetime upfront payment, a fixed monthly subscription fee or a per-kilowatt hour ("kWh") charge.

SolarSense Customer Solar Program

Minnesota Power's SolarSense program has long encouraged the adoption of customer-sited solar photovoltaic installations by reducing the large upfront cost of installing solar and making individual solar a more viable option for residential and commercial customers. Since its initial implementation in 2004, the program has continuously evolved to meet the needs of customers and support a sustainable solar market in northern Minnesota. In 2017, the Company received approval to expand the SolarSense Customer Solar Program, nearly tripling the amount of incentives for customer-sited solar installations from 2017 to 2019.[10] The SolarSense program provides an incentive based on how much energy a customer's PV system is expected to produce. In 2019, Minnesota Power's SolarSense Customer Solar Program budget extension was approved by the Commission through the 2020 calendar year.[11] In 2020, the Company received approval to modify the amount of incentives for customer-sited solar installations from 2021-2024, and to convert the Low Income Solar Pilot Program into a grant program.[12] Between 2014 and 2020, the Company provided rebates to more than 220 solar projects. On July 1, 2020, the Company proposed an extension and modifications to the SolarSense Program, including the Low Income Solar Pilot Program. The extension and modifications were approved in the Commission's December 17, 2020 Order Approving Program Extension and Changes, In Part, with Modifications.[13]

SolarSense Low Income Solar Pilot and Grant Program

Minnesota Power's SolarSense Low Income Solar Pilot Program aims to expand participation in solar programs to all customers by exploring innovative ways to overcome solar adoption challenges that many low-income customers face and is the first of its kind in the state of Minnesota. These challenges included the large upfront cost of installing solar, home ownership status, physical condition of the home, split incentives inherent to a landlord/tenant arrangement, lack of information and more. The Company funded four solar projects that directly benefited low-income customers through this program. In the December 17, 2020 Order, the Commission approved the conversion from a pilot program into the Low Income Solar Grant Program.[14]

American Indian Community Housing Organization

The Low Income Solar Pilot Program funded a 14.4 kW solar array on the roof of the American Indian Community Housing Organization ("AICHO") building in 2017. The AICHO building serves as a central hub for the Native American community in the region, providing housing services for people suffering from long-term homelessness, transitional housing for survivors of domestic abuse and a 10-bed domestic violence shelter. The energy generated by

[10] Docket No. E015/M-16-485.
[11] Docket No. E015/M-16-485.
[12] Docket No. E015/M-20-607.
[13] Docket No. E015/M-20-607.
[14] Docket No. E015/M-20-607.

the solar array directly serves the shelter as well as indirectly serves the tenants of the 29 apartments through powering offices and the auditorium which provide services to all residents.

Figure 11: American Indian Community Housing Solar Project

RREAL and Tri-County Community Action Project

RREAL and Tri-County Community Action ("TCC") installed a 20 kW solar array at TCC's headquarters in Little Falls, Minnesota. Energy generated by the solar array benefits Low Income Home Energy Assistance Program ("LIHEAP") eligible households in central Minnesota. Preference is given to disabled veterans for this project. The solar array was installed in 2019 utilizing a grant from the Low Income Solar Pilot Program and was expanded in 2020 with additional funds from the program.

Lincoln Park Solar Project

Funds from the Low Income Solar Pilot Program were also used to fund a 40 kW solar array in the Lincoln Park neighborhood of Duluth, Minnesota. The project will benefit the Minnesota Assistance Council of Veterans and Minnesota Power customers facing utility disconnection. Construction of the array was completed in 2020.