Minnesota Power's Grid Modernization Report

Prepared September 1, 2016

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I. Strategic Overview

ALLETE's shared purpose is to be a leader in clean, safe, efficient and affordable energy products and services that fuel modern necessities and enrich quality of life. We are committed to providing exceptional customer value and superior shareholder returns. Through wise investments and strong partnerships, we will grow while answering the call to transform the nation's energy landscape.
A part of that call is to proactively engage in electric utility transition in response to ongoing energy and environmental policy change, at both the state and national levels, while achieving financial goals through the ALLETE regulated utility businesses of Minnesota Power and Superior Water Light & Power. Minnesota Power represents the largest share of ALLETE net income. The report discusses the actions and views of Minnesota Power in particular, though much of what is described translates to SWL&P as well. Both utilities work together closely to leverage synergies, sharing operational systems and expertise where applicable and appropriate.

In addition to Minnesota Power and Superior Water Light and Power, ALLETE is executing on a complementary growth platform involving energy infrastructure and related services through other businesses in the ALLETE family, including BNI Energy in North Dakota; ALLETE Clean Energy; ALLETE Renewable Resources; and U.S. Water Services. For the most current information on ALLETE's businesses, visit http://www.allete.com/OurBusinesses.

Minnesota Power (or "the Company") has a focus on anticipating and leading change as part of its strategic planning and overall operational philosophy. Our *Energy**Forward*** strategy includes transforming our generation fleet from less than 5 percent renewables in 2005 to 33 percent renewable resources, primarily through universal wind and hydro. In addition to fleet transition, Minnesota Power is committed to ongoing growth and optimization of our world-class Conservation Improvement Program ("CIP"), which includes continuing to set aggressive energy reduction goals (primarily with commercial and residential customers).

Grid modernization, which includes planning for, and building toward, a smarter energy infrastructure, is also a top corporate priority. It is driven by needs to upgrade the Company's electric distribution and metering systems; implement load control programs; and customer engagement strategies for improved reliability and energy efficiency, lower costs and more certain peak demand reductions. Minnesota Power's strategy is focused on small-scale smart grid investments in key areas to first test the efficacy of technologies and systems and then scale-up when cost-effective solutions are verified. As of the date of this report, Minnesota Power is the only investor-owned utility in the state of Minnesota with a significant advanced metering infrastructure ("AMI") penetration.[1] Other initiatives include the development of a time-of-use rate with critical peak pricing, distribution system power factor improvement and a conservation voltage reduction pilot. These initiatives complement long-existing, robust smart usage rewards programs that allow for further flexibility.

Minnesota Power has positioned itself well for the emerging trends and changes coming in all areas of its business, including both accommodating and incentivizing increased presence of Distributed

[1] Minnesota Public Utilities Commission Staff Report on Grid Modernization; Docket No. E999/CI-15-556, accessible through the Commission's eDockets website (link), March 2016.

Energy Resources ("DER"s) on its system. The Company must navigate these changes while keeping its core tenets of safety, reliability and affordability for its customers in the forefront. In addition to our current strategic positioning, Minnesota Power has encouraged collaborative stakeholder development through the regulatory process to ensure fair and balanced policy.

II. Current Landscape

A. Minnesota Power's Energy Mix

Minnesota Power was founded as a 100 percent renewable (hydroelectric) energy company in 1906. The Company grew to serve its unique customer mix with predominantly thermal (coal with some biomass) sources of generation. Minnesota Power produces the majority of its energy from coal-fired generation units, supplemented by a long-term purchase from Square Butte's Milton R. Young 2 ("Young 2") lignite coal generating station in North Dakota. Minnesota Power is now transforming the way it energizes communities, industries and businesses by rebalancing its generation mix. This includes incorporating more renewable power for customers, while reducing dependence on fossil fuels. The Company's execution of its *Energy**Forward*** fleet transition is systematically lowering the ratio of coal used to produce energy at Minnesota Power, while at the same time drastically lowering emissions from the reliable power supply produced by our remaining coal units. The percentage of coal-based generation on the Minnesota Power system has declined from about 95 percent in 2005 to approximately 75 percent today.

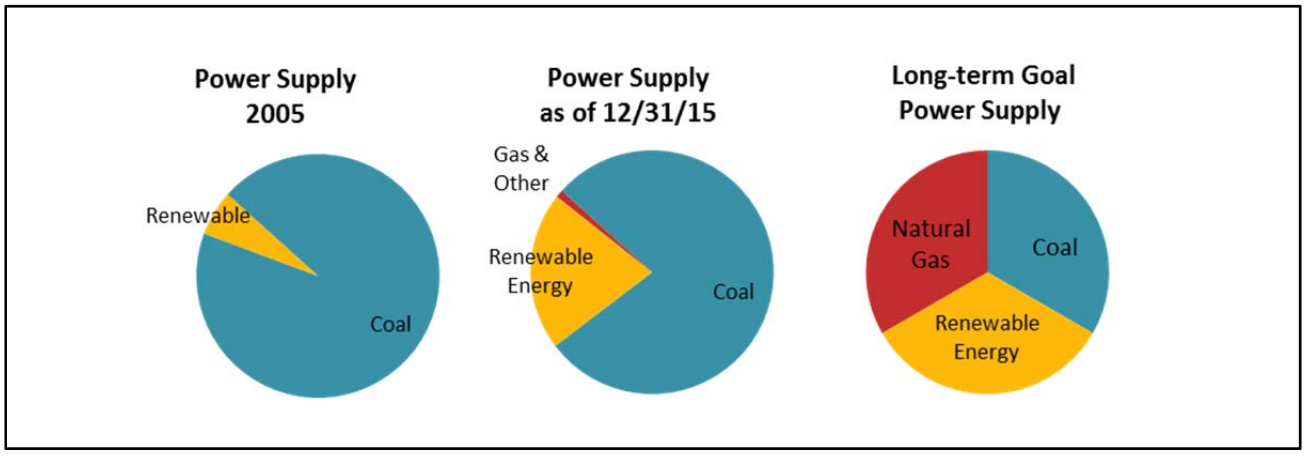


Figure 1: Minnesota Power's *EnergyForward*** Transition**

Additionally, major emission reduction projects at Boswell Energy Center Units 3 and 4, the two largest coal generators remaining on the Minnesota Power system, are contributing to the Company's significantly lower emission profile as environmental retrofits have been completed at each unit that reduce mercury emissions approximately 90 percent, as well as reducing levels of particulates, nitrous oxides and sulfur dioxide.

Over the past decade, the Company has undertaken a systematic effort to increase its deployment of renewable energy. In 2006 and 2007, Minnesota Power began purchasing the entire output of the Oliver 1 and Oliver 2 wind farms, built in North Dakota by NextEra Energy. In 2008,

Minnesota Power constructed Taconite Ridge near Mountain Iron, Minnesota, in the heart of the Iron Range. Taconite Ridge was the first commercial wind generation station in northern Minnesota. The Bison Wind Energy Center ("Bison") in North Dakota was developed in four phases between 2010 and 2014. Bison, now the largest wind farm in North Dakota with just under 500 megawatts, uses a premier wind resource to deliver clean energy to Minnesota Power's customers. These wind projects combined added more than 600 megawatts of renewable energy to the Company's generation portfolio.

As the state's largest producer of hydroelectric power with ten federally licensed facilities through the Federal Energy Regulatory Commission ("FERC"), Minnesota Power is a recognized leader in hydro power. In addition to its ten FERC-licensed hydro facilities, the Company also signed 15- and 20-year agreements to buy up to 383 megawatts of carbon-free hydroelectricity from Manitoba Hydro beginning in 2020. Minnesota Power is planning the construction of the Great Northern Transmission Line ("GNTL") to carry this Canadian hydropower to the heart of its industrial customer base on the Iron Range of Minnesota. As an integral part of *Energy**Forward***, Minnesota Power is further diversifying its renewable energy options to include solar generation.

B. Minnesota Power's Customer Mix Landscape

A division of ALLETE, Inc., Minnesota Power serves approximately 144,000 retail electric customers and 16 municipal systems across a 26,000 square mile service area in central and northeastern Minnesota. In 2015, industrial sales, primarily in the taconite mining, iron concentrate, paper, pulp, refining and pipeline industries, provided the largest portion of revenue. Many of these industrial customers operate 24 hours a day, 7 days a week, which results in a uniquely high load factor for Minnesota Power, as well as a much lower variation in demand than most utilities. Given the substantial revenue reliance on 24/7 power sources and transmission system sales, Minnesota Power has somewhat different dynamics with regard to grid modernization efforts and influencing DER deployment.

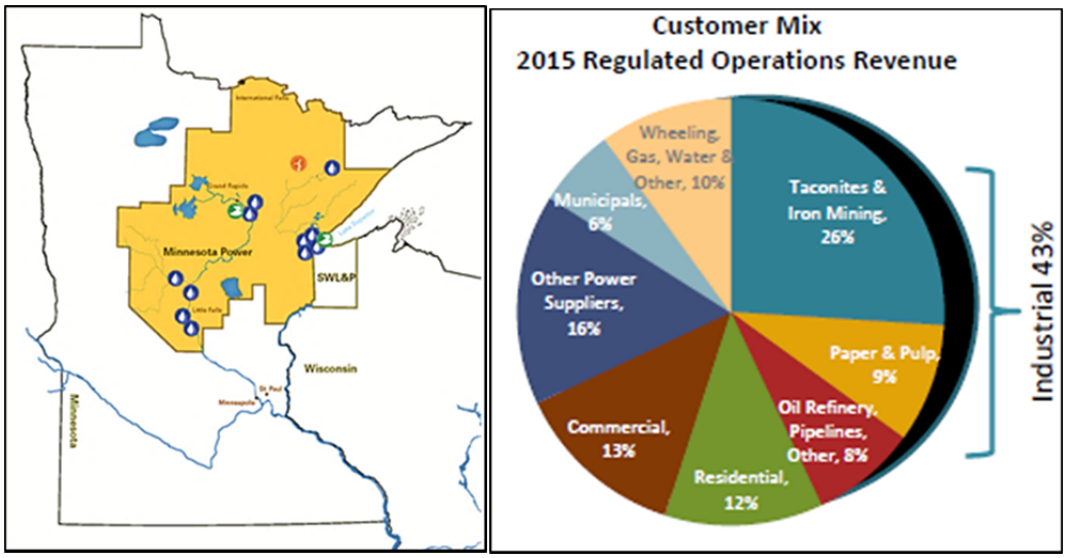


Figure 2: Minnesota Power's Service Territory and Customer Mix

Minnesota Power has nine Large Power customer contracts, serving at least ten megawatts ("MW") of load each: five taconite producing facilities (two are owned by one company and are served under a single contract), two concentrate reclamation facilities (both of which are owned by one company and are served under a single contract), and four paper and pulp mills. The processing of taconite, an iron-bearing rock used to make steel, requires large quantities of electric power. The Company also powers four wood products manufacturers and provides electric service to two crude oil pipelines and a refinery via contract through its affiliate, Superior Water, Light and Power Company. In part because of its high concentration of large customers and relatively low proportion of residential customers, Minnesota Power is expected to remain a winter-peaking energy provider for the foreseeable future.

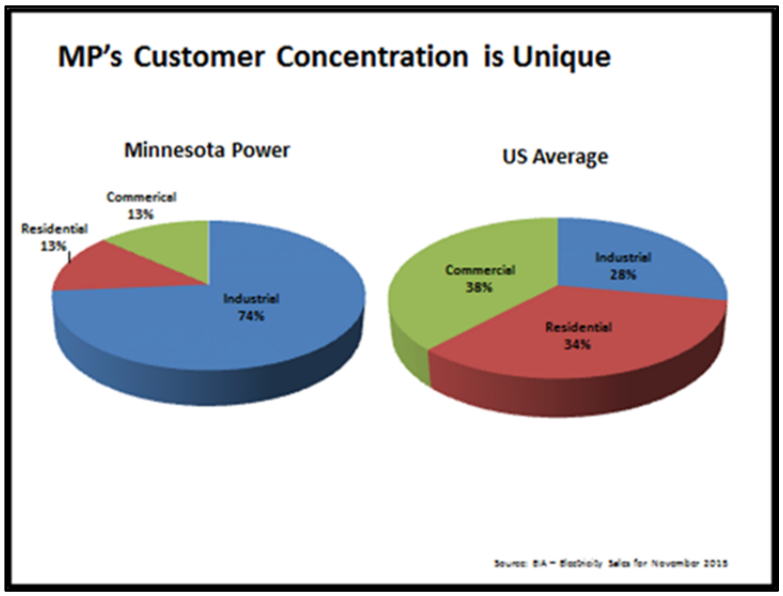


Figure 3: Minnesota Power's Customer Mix Compared to the National Average

While looking toward the future in meeting the needs of its customers and planning for new technology and innovation in its distribution system, the Company must also balance its initiatives with the realities of its customer mix and the region's capacity for DER and grid modernization investment. Most of Minnesota Power's service territory is rural. In Saint Louis County, Minnesota, for example, where Minnesota Power's largest city, Duluth (population ~80,000) is situated; the median household income is approximately $47,000 per year.[2] The median income by county in Minnesota Power's service territory ranges from around $43,000 to $53,000. This contrasts to more urban, metro-area counties, where median incomes range closer to $75,000 - $85,000. These geographic, customer demographic and economic considerations require an approach to grid modernization investments that matches customers' interests and economics.

[2] http://www.census.gov/quickfacts/table/IPE120214/27137

III. Trends in Distributed Energy Resources and Energy Efficiency

Minnesota Power has a longstanding history of working with its customers on the implementation of traditional, as well as innovative, DER and energy efficiency projects. DER comes in many forms, including:

- Solar photovoltaics (PV)
- Energy storage (ES)
- Electric vehicles (EVs) and charging infrastructure
- Demand response (DR)
- Combined heat and power (CHP)
- Other non-solar types of distribution generation (DG)
- Energy efficiency (EE) measures
- Smart thermostats

From backup power supply options to the newest solar technology, the Company is continuously monitoring the emerging trends of technology and energy efficiency opportunities to meet a diverse set of customer requirements and expectations. The primary areas of DER focus to date have been energy efficiency and solar PV, largely driven by state policy objectives and a supportive and/or evolving regulatory framework for each. Other emerging DER opportunities with growing prevalence in the market are energy storage, electric vehicles and smart thermostats. Combined heat and power has been a situational opportunity that has also recently regained traction in Minnesota and will continue to be an emerging topic of interest. Given the limited market saturation of EVs in Minnesota Power's service territory at this point, our focus is more broadly on education and outreach while charging infrastructure opportunities are considered. Energy storage is a promising technology that could help to address the variability of solar PV and other non-solar DG. Smart thermostats as part of expanded energy efficiency and/or load control initiatives show promise, but given Minnesota Power's limited saturation of electric heat and air conditioning load, the impact would be relatively small.[3] Energy efficiency, while cost-effective from a variety of evaluation perspectives, is more difficult to measure on an absolute basis. Instead, energy efficiency progress measurements rely mainly on modeling techniques and engineering estimations. As grid modernization efforts continue and more detailed metering data become available, accuracy of impacts will increase, and modeling techniques are anticipated to evolve.

A. Distributed Generation

The number of DG systems installed across Minnesota Power's service territory continues to grow each year with about 10-20 interconnections per year. As DG technologies become more efficient and less costly, Minnesota Power expects to see this trend continue and to grow. The quantity and location of customer installations, including larger industrial cogeneration, has provided for both growing energy and diversity of DG on Minnesota Power's system. Most of Minnesota Power's installed projects thus far have been smaller customer projects, primarily solar, and are widely dispersed throughout the system, with a growing prevalence in rural areas. A combination of factors affects this growth, including federal policy (tax incentives and Department of Energy grant investment through

[3] Minnesota Power's current saturation for all electric customers is about 10 – 12% of active service agreements.

efforts such as the SunShot Initiative and Solar Market Pathways), state policy (renewable energy standards with solar provisions and statewide incentives), tariff rates, cost of solar and energy provider incentive program offerings. Currently, Minnesota Power has nearly 170 net- metered DG installations, over 90 percent of which are solar.[4] Of those solar DG installations, roughly 80 percent received an incentive.[5] This represents less than 0.001 percent of total customers.

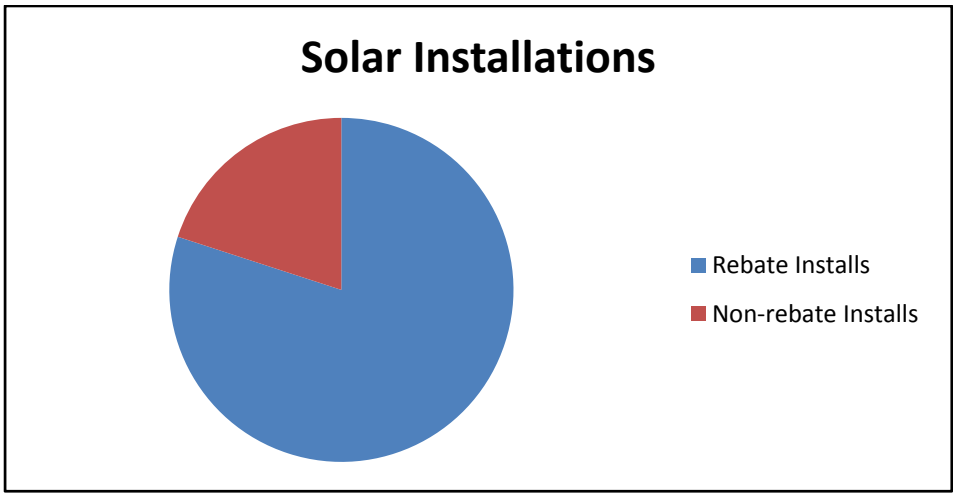


Figure 4: Minnesota Power's Percentage of Incentivized Solar Systems

[4] Qualifying Facilities Report, Docket No. E999/PR-16-9

[5] These incentives were typically offered through Minnesota Power's SolarSense program but could also have been awarded through the Made in Minnesota program, which is funded by investor owned utilities in Minnesota including Minnesota Power. Older installations may have participated in a state rebate program that is no longer available.

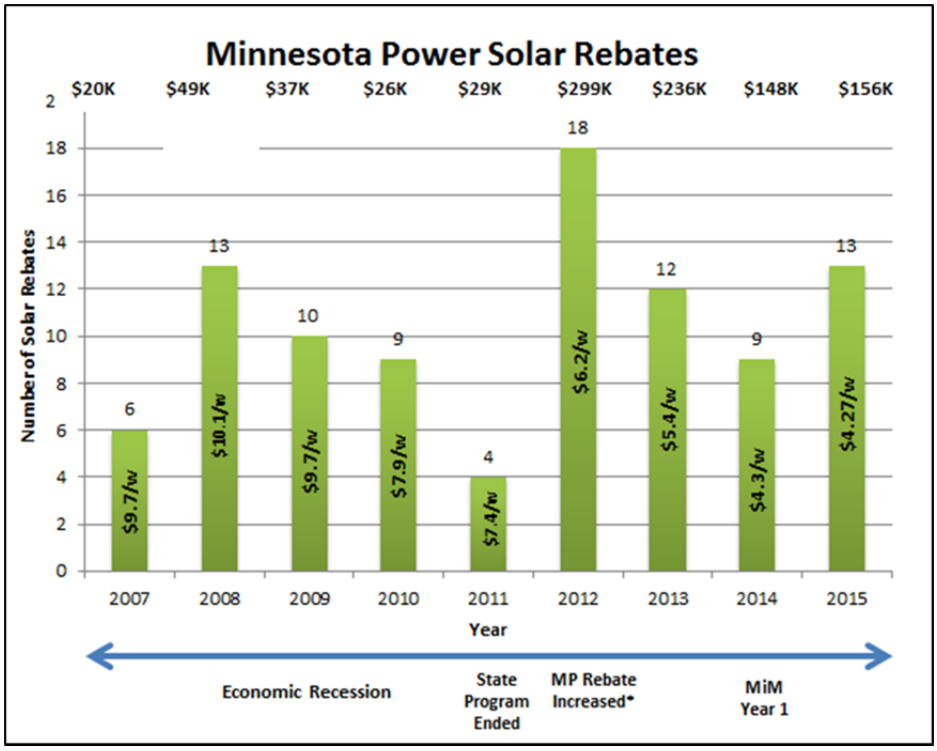


Figure 5: Minnesota Power's Solar Rebate Amounts per Year

The 2013 Minnesota legislative session saw the advent of many new policy mandates related to distributed energy. Minn. Stat. § 216B.164 was amended, introducing several changes, including an increase to the net-metering threshold capacity to less than 1,000 kilowatts, as opposed to the previous threshold capacity of less than 40 kilowatts. Related to this expanded net-metering policy, Minnesota Power continues to work diligently to further clarify and streamline the interconnection process, which is the subject of an ongoing regulatory proceeding.[6] This is intended to help ensure that timelines and processes are followed and to help align customer expectations with achieved outcomes. A key lesson learned from DG experience to date is the importance of forward thinking in regards to communication systems to ensure there is a control system to interact with these systems at a higher level. This will involve investment in communication system infrastructure upgrades.

While standards and processes will continue to evolve over time, there are several emerging trends that are becoming more prevalent in Minnesota Power's service territory. These trends include installation of systems with the intent to expand (i.e., modular applications); installation of multiple systems on a single site; and larger, more complex systems, some of which include battery backup. In order to balance costs and maintain safety and reliability as the number of installations continues to grow, consistency and transparency are critical elements in Minnesota Power's approach toward recognizing and responding to emerging customer and technology trends. It is important for customers

[6] At the state level, the Commission is currently re-examining and updating the Minnesota Standards for Interconnection of Distributed Generation that were established under its September, 28, 2004 Order in Docket E-999/CI-01-1023

and the Company that Minnesota Power is involved early in the process for new installations, and that the Company receives prompt notification regarding system additions, modifications or expansions to ensure system safety and reliability. As well, Minnesota Power is engaged in ongoing multi-stakeholder efforts to evaluate the costs and barriers to encouraging customer-owned generation. This includes a robust dialogue about the current status and evolution of infrastructure impacts, benefits, and costs.

Also during the 2013 legislative session, Minn. Stat. §216B.1691, the statute establishing Minnesota's Renewable Energy Standard ("RES"), was amended to include a Solar Energy Standard ("SES") that requires 1.5 percent of a public utility's retail sales, net of customer exclusions, to come from solar energy resources by 2020. The SES includes a provision that requires at least 10 percent of the 1.5 percent SES to come from solar energy generated by or procured from solar PV devices with a nameplate capacity of 20 kilowatts or less ("Small-Scale Carve-Out"). Minnesota Power has developed a solar energy strategy that incorporates three points of focus – customer, community, and utility. As such, there are several solar PV initiatives underway. For example, the Company is partnering with the Minnesota National Guard to build a 10 megawatt solar energy project on the Camp Ripley National Guard base near Little Falls, Minnesota. The Camp Ripley Solar Project will be the largest solar energy installation on any National Guard base in the United States, covering nearly 80 acres of land with photovoltaic panels. Additionally, Minnesota Power received Minnesota Public Utilities Commission ("MPUC" or "Commission") approval to offer northern Minnesota's first Community Solar Garden ("CSG") program. The CSG program will consist of energy from the combination of 1 megawatt and 40 kilowatt arrays. Finally, Minnesota Power has filed a proposal with the MPUC to nearly triple the amount of solar incentives available for customer-sited solar systems through its existing SolarSense rebate program.[7] This is part of the Company's efforts to expand customer offerings while working toward meeting the 10 percent Small-Scale Carve-Out. Under this proposal, the Company expects to see interconnections increase by five to ten times the levels historically seen, or around 100 interconnections per year, depending on system size and actual customer response rates. While this is significantly less than the 5,000 applications per month experienced by some California utilities, it does represent a significant increase in interconnection activity for Minnesota Power. To support these initiatives, Minnesota Power has added several full-time resources to assist with optimizing the customer experience, including a system wide approach toward strategically interconnecting DG.

B. Conservation and Energy Efficiency

Over the past decade, Minnesota has been a leader in supporting energy provider efforts to promote conservation and energy efficiency. The Next Generation Energy Act of 2007 ("NGEA") shifted focus from a spending requirement (i.e. expending minimum number of dollars in a fiscal year) to a performance-based system, with energy-saving goals of 1.5 percent of average retail sales for each electric and gas utility that operates in the state of Minnesota beginning in 2010. Since the passage of the NGEA, Minnesota Power has been refining and expanding upon its proven conservation program platform to deliver cost-effective savings and customer value. The Company remains dedicated to continuous program improvement and views ongoing Conservation Improvement Program incentives as part of its broader resource strategy; a strategy designed to provide a safe, reliable and affordable power supply while improving environmental performance.

[7] Docket No. E015/M-16-485

Energy-saving goals are set and achieved through CIP, where utilities must file plans with the Department of Commerce at least every three years. For Minnesota Power, the most recent three-year plan was submitted in June 2016 for the time period of 2017-2019, representing estimated energy-savings of 57,000 megawatt hours per year.

Minnesota Power offers a portfolio of programs to empower customers to make effective energy choices. These programs are tailored around delivering individual choice to customers. Together, with its customers, community stakeholders and trade allies, Minnesota Power has achieved success through its energy conservation programs, delivering energy savings at or above the 1.5 percent energy-savings goal since 2010, all while maintaining focus on targeted program objectives: quality installations, informed decisions, conservation first and safety. Figure 5 illustrates historical and recent achievements through CIP.

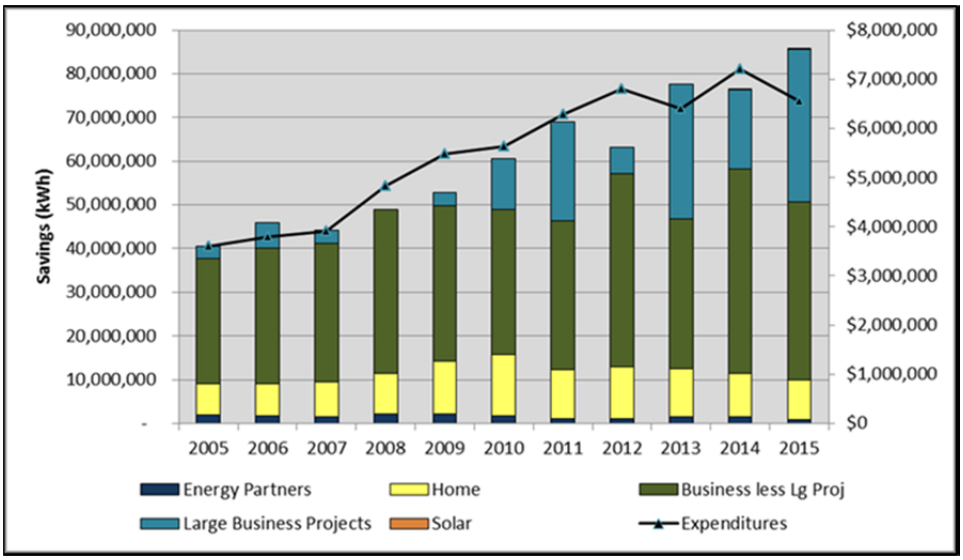


Figure 6: Minnesota Power's 2005-2015 CIP Achievements

It is important to note that a significant portion of the most cost-effective savings in the past has been achieved through a small number of very large, strategically planned customer projects, as noted by the Large Business Projects in Figure 6 above. There is a high degree of risk associated with assuming historical performance is sustainable for the 2017–2019 triennial period or that savings levels can be increased from one year to the next, particularly when a few projects have represented such a large portion of energy savings. As customer mix and opportunities shift, the Company will need to plan for more commercial and industrial programs to target smaller-scale projects than in the past, a greater number of smaller projects with lower savings potential, flexibility in program design and promoted technologies, and expanded and innovative methods of program delivery, all factors that will have a tie-in to grid modernization efforts. At this time, residential efficiency programs are less cost-effective than those for other customer groups and make up less than 20 percent of total CIP savings. Grid modernization efforts, particularly as they relate to “behind the meter” technologies, are anticipated to help expand opportunities in the residential sector, specifically for heating and cooling, which represents about 55 percent of typical residential energy use by technology, as well as water heating and appliances which collectively represent approximately 30 percent of residential energy use.

More recently, proposals to increase the demand-side savings as well as to consider supply-side efficiencies, such as opportunities for combined heat and power, volt/var optimization, and investments in other energy company infrastructure have been considered in policy discussions, as part of regulatory proceedings and at the Legislature. Minnesota Power is engaged in these conversations and is exploring opportunities that make sense as part of its resource planning and customer engagement strategies.

C. Key Technology Cost Competitiveness and Trajectory

Minnesota Power continuously evaluates and forecasts business model and enterprise risks and opportunities in all segments of its business, including those related to DER. Signposts, or significant changes to monitor, can include issues such as technology innovation, economics, energy policy developments or customer developments. The Company has several departments and cross-functional groups that conduct continuous external sensing on multiple different signposts in order to ensure Minnesota Power remains innovative, competitive and responsive to stakeholder demands. These departments and groups are scanning the environment to provide Minnesota Power senior management with the information needed to sense and respond accordingly to the changing business climate.

In addition to the internal departments and cross-functional workgroups that conduct external sensing and competitive intelligence gathering, Minnesota Power also formally evaluates new programs, resources and policy considerations through the state's Integrated Resource Planning ("IRP") process. This IRP process requires investor-owned utilities to file with the Commission a 15-year resource plan every two years. Through the IRP, the Company also evaluates numerous forecast scenarios for system growth that can result in various outcomes with a series of sensitivity impacts. This scenario planning allows the Company to maintain business cycle flexibility.

The combination of a public, formal resource-planning process that evaluates the energy provider's business forecast and forward-looking resource additions coupled with the Company's external sensing and analysis work ensures that Minnesota Power is aware of potential business model disruptors and can use external sensing information to adapt accordingly.

DER in Minnesota Power's service territory is growing, but at a relatively low rate. There are several factors that contribute to this, including relatively low average retail rates and the fact that DER is not currently cost competitive without an incentive. As has been seen nationally, however, installation costs are starting to trend downward.[8] For solar DG, about 70 percent of the cost today is in installation and 30 percent is in panels. Panel prices will continue to trend downward, but solar installers have indicated that their costs have come down as far as possible while still maintaining reasonable margins. Larger-scale renewable options can be more competitive in the market today, but even universal solar resources aren't on par with other renewable resource options such as wind.

As referenced earlier, the most prominent DER technology on the Company's system is solar, and Minnesota Power has a long-standing history of encouraging the adoption of customer-sited renewable energy systems through its SolarSense rebate program. SolarSense was first introduced in 2004 as a capacity-based incentive designed to complement the state of Minnesota Solar Electric Rebate Program. Following national trends, the cost of customer-based solar on both a residential and commercial scale has continued to decline. As costs for customers to install solar systems has decreased, so has the level of rebates that Minnesota Power has offered on a per kilowatt basis, resulting in more

[8] https://emp.lbl.gov/sites/all/files/tracking_the_sun_ix_report.pdf

overall installations with flat overall spending on rebates. This cost trend is indicative of consumers making decisions based on personal economics in addition to environmental ethos. There are a variety of factors that go into a customer's economic decision to install distributed energy resources including:

- Installed cost of solar system
- Upgrades required to structure or grounds prior to installing solar
- Interconnection costs
- Cost of financing
- Cost of ongoing operations and maintenance
- Incentives (Federal, State, Local, energy provider)
- Tax credits and ability to utilize them
- Estimated production, variability in production
- Estimated rate, rate projections and rate structure

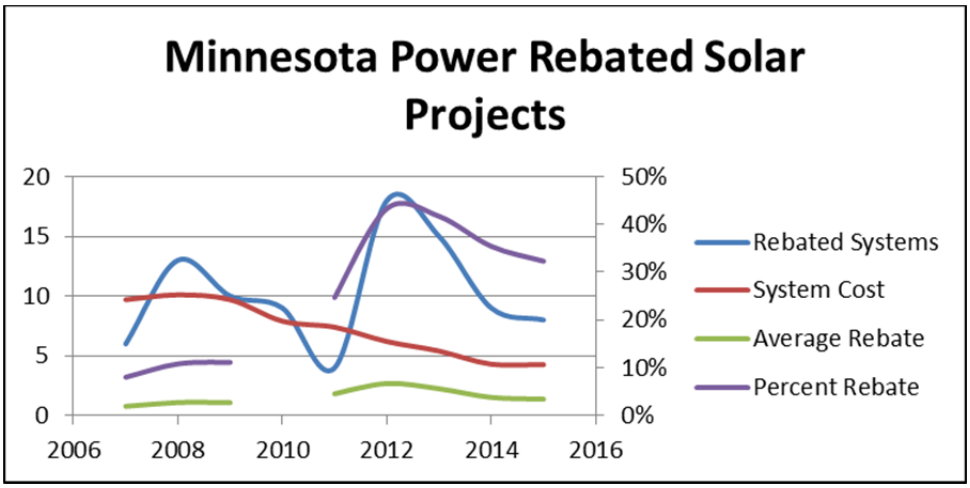


Figure 7: Minnesota Power's Rebated Solar Projects

To date, even with a dramatic reduction in solar costs, nearly all solar customers rely upon three different subsidies in order to increase the adoption rate of customer sited solar: 1) Federal Investment Tax Credits, 2) Net-Metering Tariffs, and 3) SolarSense rebates. In the immediate future, we expect all three of these subsidies to remain in effect in order to increase customer-sited solar to levels required within the 2013 Solar Energy Standard.

The concept of when DER, particularly DG, becomes cost-competitive with retail electric rates, known as grid parity, is dependent upon qualitative factors, such as policy decisions, as much as it is on technology advancements. Currently, rate structures for DG collect costs through a high-energy rate charge, which does not necessarily reflect the cost of serving a customer, but has the effect of benefiting the consumer economics of a DG system. Nationally, rate structures that more accurately reflect the cost of serving customers, such as demand, time-of-day pricing and higher fixed charges are being explored and implemented.

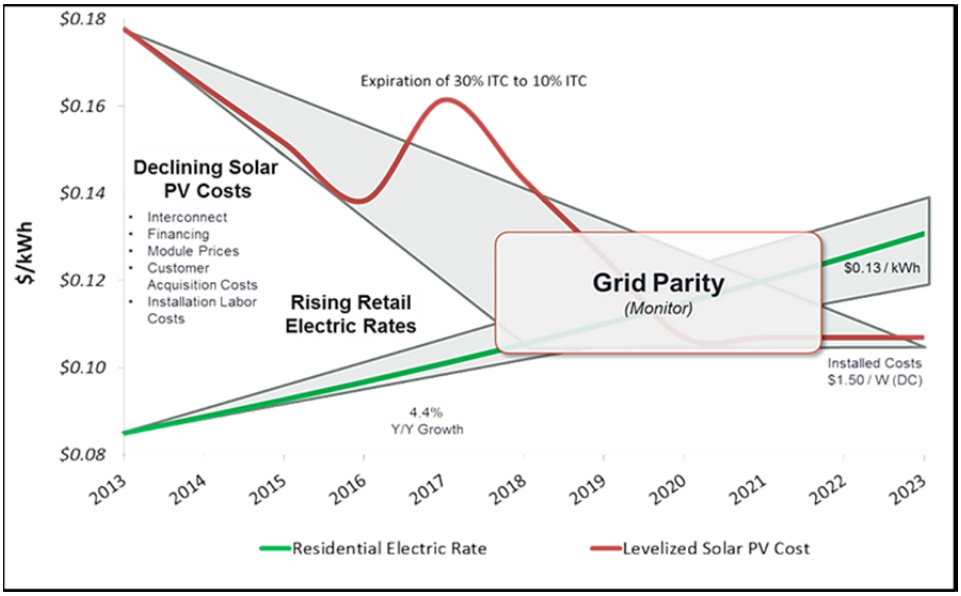


Figure 8: Solar Grid Parity Projections

Universal solar has also benefited from cost reductions throughout the industry and maintains a price advantage over customer-sited solar projects due to economies of scale. The cost of universal solar varies widely across the United States and depends upon the level of solar irradiance, scale of development size, availability of workforce, competition and cost of interconnection. Energy providers in Minnesota have recently begun to develop solar projects either through provider ownership or through power purchase agreements. Minnesota Power's own experience with universal solar pricing includes the Company-owned Camp Ripley Solar Project at an estimated $111 per megawatt hour, including distribution interconnection, and a 1 megawatt third-party Power Purchase Agreement from U.S. Solar at a price of $103.50 per megawatt hour. Xcel Energy has seen prices below $85 per megawatt hour on larger transmission-connected systems mostly focused on the southwestern portions of Minnesota. Pricing for universal solar continues to drop, with prices for the most competitive projects in the Southwestern United States being reported at under $40-$50 per megawatt hour. Midwestern wind pricing, by comparison, is estimated at $25 per megawatt hour. This is in contrast to many parts of the Southwest where solar is the low-cost energy resource.

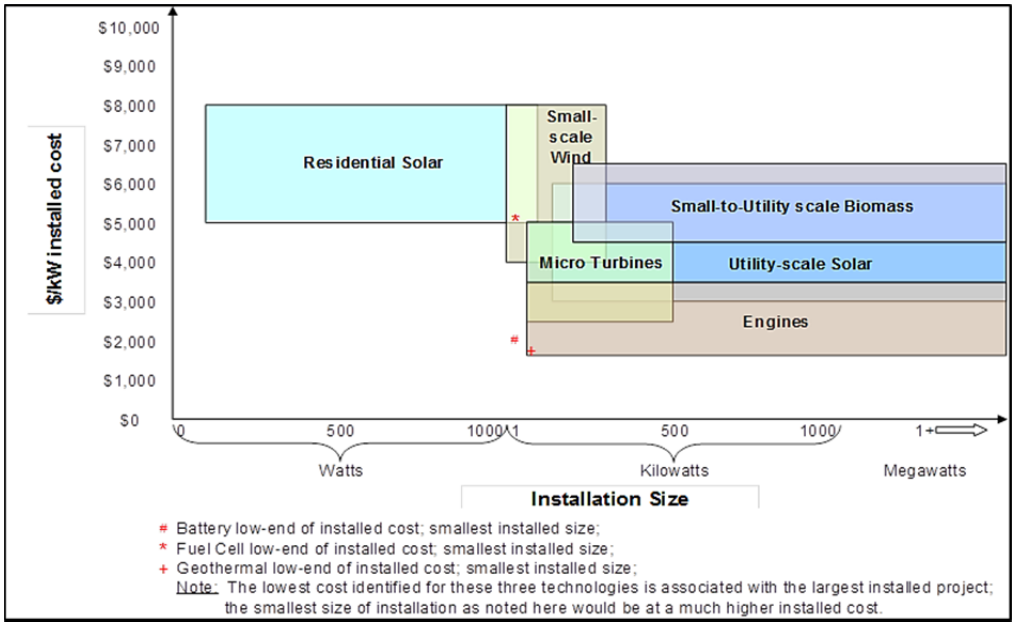


Figure 9: Installed Cost of DER Technologies

IV. Grid Modernization

Minnesota Power is an active and engaged participant in policy discussions about grid modernization both statewide and nationally. This serves to position the Company on a path of continual growth in understanding on grid developments and momentum toward continued thoughtful action in the future. While there is a wide range of definitions for grid modernization, in Minnesota, it is defined in the following way: "A modernized grid assures continued safe, reliable, and resilient utility network operations, and enables Minnesota to meet its energy policy goals, including the integration of variable renewable electricity sources and distributed energy resources. An integrated, modern grid provides for greater system efficiency and greater utilization of grid assets, enables the development of new products and services, provides customers with necessary information and tools to enable their energy choices, and supports a standards-based and interoperable utility network.'[9]

Grid modernization has been and remains a top priority at Minnesota Power. Upgrading the Company's electric distribution and metering systems, load control programs and customer engagement strategies will improve reliability and energy efficiency, lower costs and also possibly reduce peak demand. Minnesota Power recognizes that the current energy landscape in America is changing drastically, including technological advances, public policy actions and adjustment in the traditional energy provider business model. Because many of these changes are driven by customer actions, they are first manifested on the distribution system. Grid modernization efforts have been and will be instrumental to the Company's ability to provide new technology and increased functionality to its customers.

[9] Minnesota Public Utilities Commission Staff Report on Grid Modernization. March 2016. Docket No. E999/CI-15-556.

A. Customer Interest in Grid Modernization-Related Technologies

Minnesota Power continues to explore grid modernization activities, from operational efficiency and effectiveness perspectives, but also as they relate to customer interactions and potential product and service offerings. Through Minnesota Power's participation in the Department of Energy's Smart Grid Investment Grant ("SGIG") Program beginning in 2008, the Company was able to focus on small-scale power grid investments in key areas to test the efficacy of technologies and systems. This project included deployment of advanced metering infrastructure, distribution automation, load-control devices, a web portal to support enhanced feedback about usage, a residential time-based rate and energy-efficiency programs. Based on experience gained through this project, the Company was then able to increase its investment as cost-effective solutions were verified.

There were a number of insights gained as a result of Minnesota Power's SGIG project in terms of customer interest and further opportunities to explore as they relate to grid modernization. For the online web portal and enhanced feedback, customers indicated high interest and there was substantial initial engagement. However, this level of interest did not persist. For the time-based rate, there was higher-than-anticipated interest in the rate and low attrition over the course of the first 18 months of the rate deployment. This suggests that a time-based rate would generally be attractive, and something to seriously explore as grid modernization infrastructure and related support systems continue to expand.

In addition to pilot programs like those deployed under the SGIG, and the related actions they have helped to inform, Minnesota Power also conducts ongoing customer research through survey work, community engagement and program outreach. For example, a 2014 survey indicated that 33 percent of those surveyed were "interested and confident in solar" and 3.5 percent were "financially comfortable and willing to pay a 10 percent premium for solar." Primary motives for interest in solar were that it is good for the environment, cleaner, and there are perceived cost savings. Interestingly, confidence in solar dropped as survey questions went on, further reinforcing the nascent stage of the market, but also suggesting an opportunity. Broader survey work reinforced that reliability, safety and affordability are still the top priorities among customers in general, but there are emerging areas of interest involving energy-saving opportunities, self-generation and more proactive management of energy use.

As referenced earlier, a suite of other DER – from solar and storage, to smart thermostats and electric vehicles – is also emerging. They represent challenges as saturation levels grow, placing further stress on the power grid, but they also represent possibilities for deferring or even avoiding capital expense for generation, transmission and distribution. In addition, intriguing customer engagement opportunities may be developed where Minnesota Power can work with customers to be part of the solution for a more resilient, adaptive power grid. While saturation levels for these projects are also low at this point in time, Minnesota Power continues to scan the market for best practices to proactively utilize these technologies as part of its comprehensive distribution system planning. Meanwhile, it will be imperative to ensure that systems and infrastructure are in place or implemented in order to launch, leverage and evaluate these emerging opportunities. Importantly, public policy activities that affect the cost structure can drive customer interest in DER. Minnesota Power is active with diverse stakeholders and venues on public policies that support DER.

V. Planning for a Modern Power Grid

A. Minnesota Power's Distribution Values

Minnesota Power has a legacy of living its values by providing safe, reliable and affordable energy to its customers for over a century. These core values have remained unchanged and will continue to be the foundation upon which the Company will continue to provide electricity. In more recent history, all utilities have been challenged with the acceleration of technology cycles that impact assets that they manage. Asset strategy has been particularly challenging as the Company moves from mechanical assets, which have extremely long lives and require lower levels of maintenance, to implementing technology that has far greater functionality, yet much shorter asset lives, due to both physical and technological obsolescence. Figure 10 below illustrates the key tenets by which Minnesota Power is planning for the future of its grid.

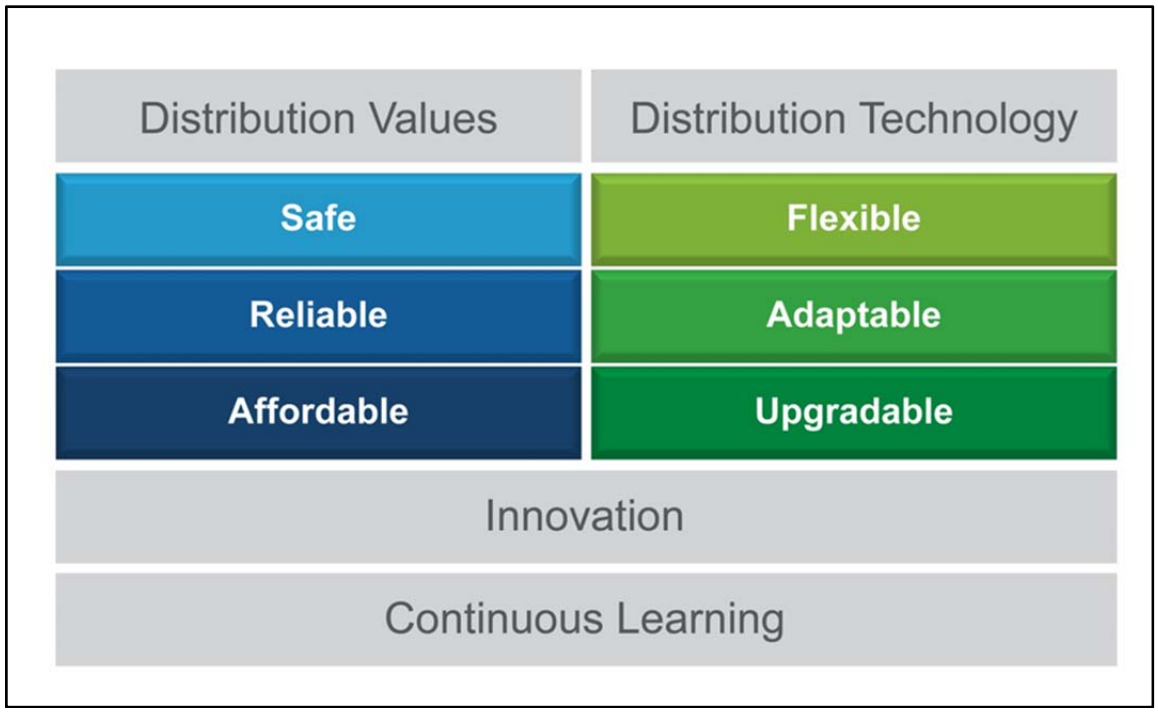


Figure 10: Minnesota Power's Distribution System Values

With this rapid technological change, Minnesota Power has developed a strategic view with regard to implementing technology that is first and foremost secure, but also flexible, adaptable and able to be upgraded without difficulty. Establishing partnerships and targeting specific technology projects with detailed project execution plans has allowed many grid modernization projects to be implemented in recent years, generally on a small scale, with specific objectives and criteria related to their implementation. This has been an excellent way to assess new technology, develop procedures and processes regarding their use, and develop scalable interfaces for new data streams.

B. Distribution System Planning

Minnesota Power continues to focus on providing reliable and low-cost energy, while making prudent technology investments to enhance customer experience and reliability. Central to this customer compact is the distribution system planning process which guides investments on the system. All system investments must be weighed by cost, number of customers served and practicality of expected results.

The distribution planning process to date has followed a very traditional model for Minnesota Power, taking into consideration load growth, system age, reliability statistics, customer needs and regulatory objectives looking through a 10-year planning window. Minnesota Power currently does not have a large enough penetration of DER for it to have a significant impact on the planning process; however, over the last decade, this planning process has grown to also include DER interconnection studies for projects that may have a larger impact on system performance. Early impacts of DER included interconnection studies of Community-Based Energy Development ("C-BED") projects which sought to connect universal wind to the distribution system. More recently, Minnesota Power has had the opportunity to study how larger-scale solar power plants could impact the planning process and has required further engineering consideration prior to their interconnection.

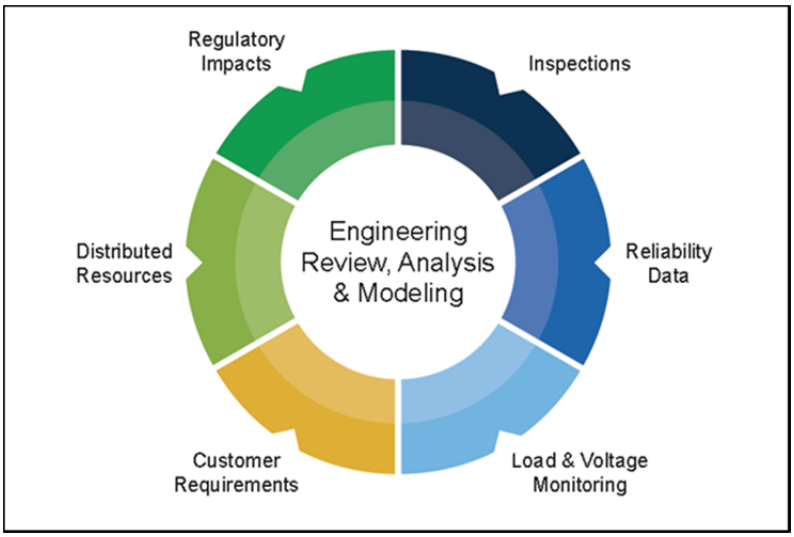


Figure 11: Minnesota Power's Distribution Planning Process

In the context of nationwide energy trends, Minnesota Power is comparable to other Upper Midwestern utilities with lower penetration rates of DER than other areas of the country. The current Minnesota utility mandate of 1.5 percent solar supply by 2020 is unlikely to significantly impact our planning process; however, many of the larger projects need significant engineering analysis to ensure service quality is not impacted by the system. The mandate will be met with new and existing projects, along with the innovative CSG program and traditional private net-metering applications. Despite the low impact of these mandates, Minnesota Power has still taken proactive steps to improve the planning process by integrating the activities with the transmission system planning process and setting goals for vastly improving the usability and exportability of the system model. With increased optionality and customer engagement, there are inherently greater complexities introduced to planning processes from

system, resource and support perspectives. Variable generating resources such as solar or wind pose both challenges and opportunities for power grid operators. The challenges have been more prevalent for utilities and states with higher small-scale solar saturation rates, such as California and Hawaii. In lower-saturation regions like the Midwest, the Company's sense is that these challenges have not been as pronounced.

C. Minnesota Power's Grid Modernization Principles

Minnesota Power continuously reviews all distribution investments and incorporates thoughtful and prudent modernization investments while still holding true to the core values that have sustained the Company for more than a century: safety, reliability and affordability. Most modernization improvements begin with analysis based on a foundation of data that has been collected through many of the information management systems in which the Company has invested. The capital utilized in modernization activities can generally be broken down into two specific categories:

A. Operational Technology ("OT") – Replacement of existing assets with modern asset designs that incorporate solid state components, sensors and communication technology to provide visibility, connectivity and data streams to system operations (i.e. AMI, voltage monitors, intelligent switches).
B. Information Technology ("IT") – Software and OT interface investments that allow for storage, reporting, and utilization of data and information in operations.

The confluence of these technology investments, combined with a customer-centric view, allows for prudent evaluation based on an ever-expanding foundation of data and information. This can provide more confidence in load research, modeling and forecasting as it provides more samples. This data can be used in rate design, class cost of service studies, new product offerings, etc.

The key to successful implementation of capital are the specific project execution plans, project metrics, cost, and anticipated vs. actual benefits derived from the modernization investments. Due to the nature of the uncertainty around the realization of potential benefits of modernization investments, the approach has been to target pilot-scale projects that incorporate optionality and scalability. This approach has yielded some tremendous benefits, including much more seamless integration of DER, due to both OT and IT investments that speed the process by which interconnection to the distribution system takes place.

VI. Minnesota Grid Modernization and Business Model Activity

There has been significant interest and stakeholder engagement in Minnesota on both grid modernization and evolving business models for utilities.

A. Grid Modernization

Minnesota's Grid Modernization Stakeholder Process, initiated by the MPUC in 2015,[10] has consisted of a series of stakeholder meetings and a formal report,[11] which addressed the current state of

[10] Docket No. E999/CI-15-556
[11] Minnesota Public Utilities Commission Staff Report on Grid Modernization. March 2016.

Minnesota's distribution systems, operation and planning in addition to examining emerging best practices in grid modernization work. The MPUC acknowledged that distribution planning is an integral part of a holistic approach to grid modernization. While individual utilities, including Minnesota Power, conduct internal distribution planning as a regular course of business, Minnesota has yet to develop a formal framework for distribution planning, as it has for Integrated Resource Planning. However, additional stakeholder meetings addressing these topics are expected in late 2016 as a continuation of the MPUC-initiated Grid Modernization Stakeholder Process.

The MPUC's Staff Report on Grid Modernization, the result of stakeholder processes described previously in this report, outlined grid modernization principles for the state of Minnesota. The Principles for Grid Modernization at the MPUC include:

- Maintain and enhance the safety, security, reliability and resilience of the power grid, at fair and reasonable costs, consistent with the state's energy policies;
- Enable greater customer engagement, empowerment and options for energy services;
- Move toward the creation of efficient, cost-effective, accessible power grid platforms for new products, new services and opportunities for adoption of new distributed technologies;
- Ensure optimized utilization of power grid assets and resources to minimize total system costs;
- Facilitate comprehensive, coordinated, transparent, integrated distribution system planning.

In addition to the principles identified by the State of Minnesota, Minnesota Power has developed the following set of unique Grid Modernization principles to guide its decisions and actions regarding the distribution system. They are as follows:

I. Effectively maintain and balance the core values that have sustained Minnesota Power for more than a century: safety, reliability and affordability;
II. Utilize grid modernization to increase system flexibility;
III. Right size grid modernization investments and prioritize for projects with the largest customer impact while also considering the right timing for technological implementation;
IV. Grid modernization investments and activities will remain customer focused – Minnesota Power will provide information, choices and options in how customers use and manage their energy;
V. Grid modernization efforts will serve as a platform for offering new customer products and services;
VI. Grid modernization efforts will include integrated distribution planning for Minnesota Power's power supply and delivery.

B. Business Model Stakeholder Process

Minnesota Power has also been a core member of a stakeholder-driven initiative to examine energy business model change in the state known as the Energy for the Twenty-First Century ("E21") Initiative. Minnesota has been a leader among states across the country - including New York, California and Hawaii - in addressing energy provider business model change. Unlike efforts to address energy provider business model change that has been driven by either legislators or regulators in other parts of the country, Minnesota's E21 Initiative, which began in 2014 and of which Minnesota Power was a founding member, was a grass-roots, stakeholder-driven process instituted to examine the evolving energy provider business model.

The E21 Initiative formally recognized, through its Phase I report published in December 2014, that "a growing and fundamental misalignment exists between the traditional energy provider business model (and the regulatory framework that supports it), and the realities of today's marketplace and Minnesota's public policy goals.[12]" Minnesota Power has been actively involved in statewide efforts to address and correct this misalignment. However, it is important to keep in mind, as stated earlier in this report, that Minnesota Power's unique customer mix provides a slightly different timeline for risks associated with rapid business model change. In 2015, approximately 25 percent of retail energy sales were to consumers connected to the electric distribution system, while the remaining 75 percent were delivered to major industrial segment customers via the electric transmission system.[13] This customer segment, in addition to taking the vast majority of sales, also requires a consistent power supply due to extremely high capacity factor as a result of 24-hour operations. Therefore, the percentage of the Company's revenue associated with residential and commercial customers, where this policy misalignment is most critically felt today, is about one-fourth.

Despite only one quarter of sales coming from customers connected to the distribution system, Minnesota Power remains actively engaged in the transition to a more customer-focused model that rewards utilities for performance outcomes that policymakers and customers want.

The E21 Phase I report discussed, among other things, the need for a modern and efficient power grid and the necessary planning function that would support it. The report noted that, "proactively planning for an intelligent, flexible, nimble, efficient, open and secure distribution system over the next several decades that can handle new distributed energy technologies and the complexity of many more actors on the system will require a coherent strategy." As a signatory to this consensus-driven report, Minnesota Power agrees with, and has actively participated in, stakeholder processes driven by the MPUC in 2015-2016 to further define the grid modernization and distribution planning processes in Minnesota.

C. Grid Modernization-Related Technologies and Greenhouse Gas Reduction

Strong environmental performance is a critical component of Minnesota Power's generation, transmission and distribution operations. Minnesota Power has already exceeded the state of Minnesota's renewable energy goals, and is well-positioned to meet future federal carbon regulations.

As discussed previously, Minnesota Power is already transforming its generating resources to reflect lower-emitting and less carbon-intensive generation sources, moving from a 95 percent carbon-emitting supply in 2005 to a 75 percent carbon-emitting supply presently with further plans to substantially reduce carbon prior to 2030. As part of its *Energy**Forward*** strategy, the Company is also maximizing the ability of its transmission assets, and importing North Dakota wind resources into its service territory through an existing DC line. The MPUC-approved Great Northern Transmission Line, which is expected to be in service by 2020, will allow Minnesota Power to add significant new Canadian hydropower generation to its energy portfolio. Under the planned approach, a combination of wind generation from North Dakota and hydropower from Manitoba will enhance the Company's flexibility to deliver renewable energy to the power grid.

[12] E21 Phase I Report. December 2014. http://www.betterenergy.org/sites/www.betterenergy.org/files/e21_Initiative_Phase_I_Report_2014.

[13] Minnesota Power 2015 Form 10-K. February 22, 2016

The Company anticipates that distribution-level grid modernization technology (and supporting rate designs) will serve to augment the generation and transmission initiatives already underway. However, the impact of grid modernization technology maturation is expected to have a modest impact toward the Company's overall greenhouse gas profile, due primarily to Minnesota Power's customer base and geographic location. As stated earlier, the majority of the Company's generation serves 24/7 industrial demand, reducing the potential for significant greenhouse gas emission reductions from grid modernization efforts alone. Also, the solar resources in the service territory are not similar to the solar resources available to customers in the Southwestern United States, for example. These two factors suggest that grid modernization efforts will be supplemental, but not central to, the Company's current path of reducing greenhouse gas emissions.

VII. Evolving Rate Design

A. Overview of Current Rate Designs

Minnesota Power has a number of rates, optional riders, initiatives and proposed incentives set up to accommodate on-site customer DER. Customers who generate power have the option of electing the Rider for Parallel Generation,[14] or the Rider for Distributed Generation[15] under which they are compensated for energy provided to Minnesota Power's system. The Company also has open dockets proposing options related to DER functions such as: rolling kilowatt hour credits,[16] standby service,[17] solar,[18] and electric vehicle charging.[19]

Currently, most DER customers are accommodated through the Company's Rider for Parallel Generation. This Rider is applicable to co-generators or small power producers rated at 100 kilowatts or less. Sellers with facilities rated at less than 40 kilowatts have the option of selling to the Company under the Average Retail Energy Rate, the Simultaneous Purchase and Sale Rate or the Time-of-Day Purchase Rate. Sellers with facilities rated above 40 kilowatts have the option of selling to the Company under the Time-of-Day Purchase Rate. The Company has also submitted the option of a rolling kilowatt hour credit to the Commission for approval. This rolling kilowatt hour credit option would be available to facilities rated at 40 kilowatts or greater and less than 1,000 kilowatts.

Another option available to all customers is the Rider for Distributed Generation. Under this rider the customer may sell all the energy produced by distributed energy resources to the Company, use all the DER energy to meet its own electric load requirements or use a portion of the energy from the DER system and sell the remaining to the Company. The Company purchases all capacity and energy made available by the customer's DER system. The capacity and energy is purchased by the Company under the negotiated rates, terms and conditions for such purchases as established through a power purchase agreement with the customer.

[14] Minnesota Power Electric Rate Book, Section V, Page 60.
[15] Minnesota Power Electric Rate Book, Section V, Page 82
[16] Docket No. E015/M-16-204
[17] Docket No. E999/CI-15-115
[18] Docket Nos. E999/M-14-321 and E999/M-16-342
[19] Docket No. E015/M-15-120

B. The Need for Alternative Rate Design & Minnesota Power's Current Alternative Rate Designs

Today in Minnesota, virtually all customers pay for the energy and system capacity that they consume through a flat per kilowatt hour rate, despite the fact that the underlying cost of producing energy varies considerably with time and the utility system must remain available under all conditions. Because the cost of producing energy varies by the hour but the price of consuming energy does not, there is no inherent financial incentive for customers to shift their energy consumption from times when it is more expensive for the provider to generate it to less expensive periods. As smart technologies advance and become more affordable customers will have additional options to manage their energy usage. An alternative rate design to the current flat fee per kilowatt hour could have the potential to drive customer behavior to use energy at less expensive periods.

Minnesota Power has communicated its intent to expand AMI conversion and related communications infrastructure,[20] which is foundational for time-based rate offerings that can increase the efficiency of energy markets. Further, the Company is evaluating investment in a Meter Data Management System ("MDM"), which would provide much more efficient automated data validation, editing and estimating functions and make it easier to bill customers under time-based rates, thereby increasing system functionality in providing products and services to customers.

In 2012, Minnesota Power submitted a plan with the MPUC to offer a residential Time-of-Day ("TOD") Rate Pilot Program which was ultimately made available for customer adoption in 2014.[21] Minnesota Power, on behalf of its customers, utilized a timely opportunity afforded through the Department of Energy's ("DOE") Smart Grid Investment Grant to deploy AMI in its service territory. As part of this Grant, Minnesota Power was able to focus on integrating technology, information and tools to help customers make informed decisions about how and when they use energy.

The Company received a higher-than-anticipated level of interest in the TOD rate and ultimately had more than 700 customers enroll during the five-week enrollment period. The TOD rate utilized the Company's current five-tier residential energy rate and added a discount for off-peak energy usage, an increased charge for on-peak energy usage and an even higher increase for energy used during critical peak periods. Based on post-event surveys after a twelve-month participation period, approximately 75 percent of participants indicated they took steps, beyond their normal practice, to reduce their energy use. Most customers noted they were excited for a new opportunity to save money and many customers were interested in the environmental and community benefits they believed the program would produce. Balancing current system realities with the desire to offer customers dynamic pricing options, in 2016 Minnesota Power has proposed continuation of its TOD rate offering to the existing pool of pilot program customers.

In addition to its TOD rate offering, Minnesota Power also has an active initiative regarding standby service. The purpose of standby service is to allow customers who own a distributed generation system to use the Company's electric service as temporary backup. These are direct enablers to customers with on-site generation. A 2015 Commission Order[22] stated that "all rate-regulated utilities shall file updated standby service tariffs no later than May 19, 2016." Minnesota Power filed for

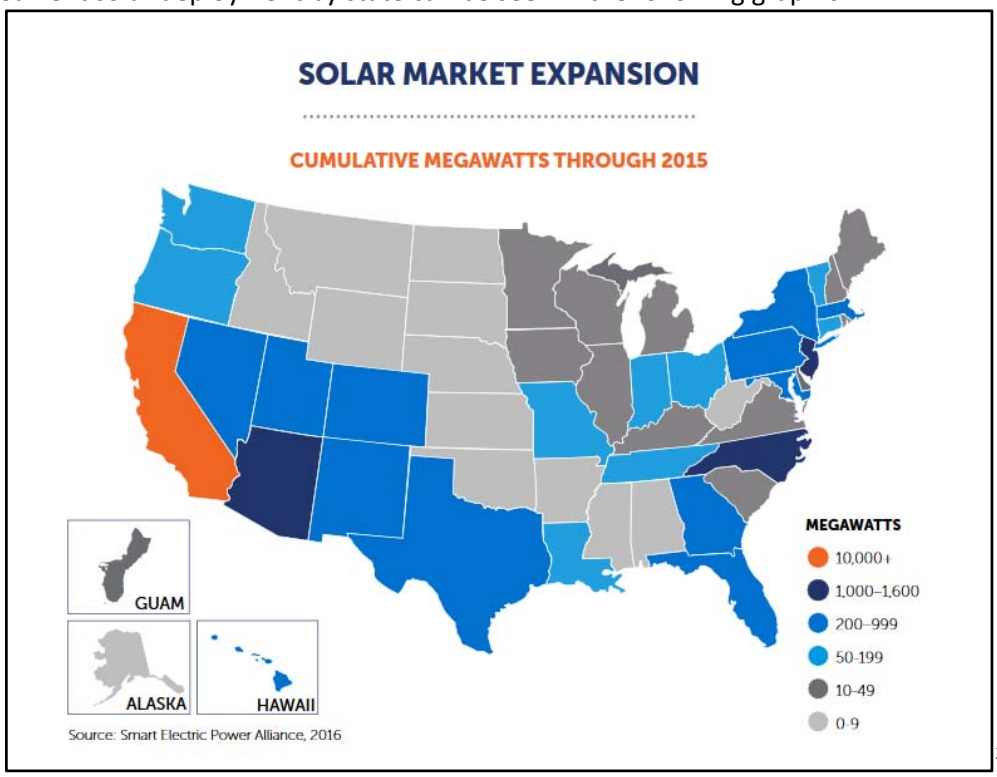
[20] Appendix G, Minnesota Power's Application for Approval of its 2015-2029 Integrated Resource Plan, Docket No. E015/RP-15-690. September 1, 2015.
[21] Docket No. E015/M-12-233
[22] Docket No. E999/CI-15-115

Commission approval a Rider for Standby Service, which is an update to the existing Rider for Standby Service.[23] The Company's proposed Standby rider is intended for commercial and industrial customers who have a DER system that is able to generate on a continuous basis.

New rate designs, such as standby, are not a "one-size-fits-all" solution. The best options for customers vary by customer classes. Currently, a customer who also has generation isn't taking on the same risks associated with generation as the energy provider. The customer has limited exposure to the energy market, and rates are often designed so that customers are paying only a portion or subset of the energy provider costs (energy/transmission/distribution/etc.).

C. Industry Trends and New Rate Options

Minnesota has been engaged in progressive DER policy development since the early 1980s with the development of the country's first net-metering rate. Net metering rates have now been adopted by more than 40 states. While taking the lead as a policy innovator, Minnesota has lagged behind many other states in the deployment of DER. The current deployment trends revolve around prolific growth of DER, particularly universal and private solar, in geographic areas where the solar resources are most efficient, retail energy costs are high, or incentives like net-metering are available for investment. Current solar deployment by state can be seen in the following graphic.



[24]

Figure 12: Solar Market Expansion

[23] Minnesota Power Electric Rate Book, Section V, Page 61.

[24] Smart Electric Power Alliance's 2015 Utility Solar Market Snapshot – July 2016

Many of the states with the largest DER penetration, such as California, Nevada and Arizona, are trending in different directions from a policy perspective, with California and Nevada seeking compromise on their net-metering policies to continue incentivizing private ownership of solar, and Nevada moving forward with larger public universal solar investments. For Minnesota Power and policymakers within Minnesota, it is generally understood that the current incentives are not sustainable for high penetration of DER, and the state's energy providers are developing programs to help the transition as solar capacity within the state increases. Currently, Minnesota statute allows for a public utility to file for reconsideration of net metering for eligible systems under certain situations. A public utility may request the commission to limit the cumulative generation of net-metered facilities upon a showing net metered-generation has reached 4 percent of the public utility's annual retail energy sales.

As we look for trends regionally within Minnesota's neighbors, including Iowa, Wisconsin, North Dakota and South Dakota, DER policy development has been more stagnant elsewhere than in Minnesota. This has mainly been attributed to low energy prices and different regulatory priorities for a state's respective utilities. In 2013, the Minnesota Legislature enacted a bill that contained several provisions designed to promote the growth of solar energy, one of which was the Xcel Community Solar Garden statute.[25] This statute spurred Xcel Energy's Community Solar Garden Program – Solar Rewards* Community into creation. There was a large surge of applications in the beginning which led to queue management, and other implementation issues that have been addressed in recent Commission proceedings.[26] To date, less than 1 megawatt of CSG solar has come to fruition through this program. Xcel has stated that it expects 200 megawatts to be online by the end of 2016, growing to 400-450 megawatts by the end of 2017.

An example of an alternative CSG program implemented under different statutory authority than the 2013 CSG statute is Minnesota Power's Community Solar Garden[27] pilot program. This program, which was filed with the Commission in 2015, offers a simple way for Minnesota Power customers to participate in solar without the need to install a system on their own home or business. A CSG is a solar array that is divided into blocks that customers can subscribe to in order to meet part or all of their energy needs. Solar garden subscribers will receive a credit for the energy produced from their subscription with their monthly billing. The cost for a residential customer who typically uses about 750 kilowatt hours a month and wants to replace their current energy with solar energy will range from about $81 for a customer that chooses a monthly subscription fee to about $95 a month for a customer that chooses a fixed charge per kilowatt hour.[28] Subscriptions will be offered in 1 kilowatt blocks and customers will be able to choose to purchase enough to cover all or a portion of their monthly electricity needs.

One of the most pressing challenges with DER is how to complement its presence with rates and programs that can reflect their fair market value. Generation markets have traditionally been built around supply and demand over a large regional area with the large market contributors, such as large coal and natural gas generators, monitored at the transmission system level providing price signals to

[25] 216B.1641 COMMUNITY SOLAR GARDEN
[26] Docket No. E002/M-13-867).
[27] Docket No. E-015/M-15-825
[28] Program pricing pending. For current details please visit: http://www.mnpower.com/Environment/CommunitySolar

the market. This market model will most likely need to be very different with the presence of DER, given the generally small size and distributed footprint located within an energy provider's footprint. The other major factor that needs to be considered with DER is that its value in supporting the distribution grid may be very dynamic and require a customer-owned inverter to interact with the system in order to maximize the benefit. The ideal market scenario for customers is that all generation sources take the same risks and compete together to both control costs and provide choice for generation sources based on their impact, however, this market scenario is most likely many years from coming to fruition in a meaningful way. As a result, energy providers in many areas of the country have offered or proposed other rate options that help to balance some of the factors that currently cause market issues with the presence of DER, such as: Demand Rates, Real-Time Pricing and Independent/Aggregated DER Markets.

These are just a few of the emerging DER trends throughout the country in this still-emerging space. Minnesota Power will continue to diligently monitor both failures and successes with these policies and note what might be applicable and the best fit for consumers of our energy.

VIII. Looking Forward

As public policy goals for energy continue to change dramatically from those that initially defined the industry in the early 20th century, the Company is well-poised to meet upcoming challenges and embrace opportunities. Policy goals in the early 20th century encouraged the development of large, central power stations and extensive new infrastructure development in order to deliver universal energy service; meet growing demand; and ensure affordability, reliability and safety. More than one hundred years later, policy goals related to energy have evolved from a sole focus on building infrastructure to also maintaining and evolving it. With that there has been a critical shift in focus from ensuring reliability to an increased concentration on resiliency. Public policy goals for the 21st century include clean power, innovative DER, advanced customer options and a more consumer-driven business model.

Minnesota Power's long-term plan is to enhance and create additional customer value through innovative product options, which will be incorporated into integrated distribution, transmission and power supply planning. The Company remains dedicated to providing safe, reliable and affordable energy to all of its customers, while also being responsive to new customer interests and evolving public policy goals.

Minnesota Power has positioned itself well for the emerging trends and changes coming in all areas of its business, including both accommodating and incentivizing increased presence of DER on its system. In addition to our current strategic positioning, Minnesota Power has also encouraged collaborative stakeholder development through the regulatory process to ensure fair and balanced policy.