Minnesota's Electric Transmission System

Annual Adequacy Report
January 15, 2021

Submitted by
The Minnesota Department of Commerce
In consultation with the Minnesota Public Utilities Commission

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Introduction

Minnesota Statute 216C.054 requires the Commissioner of the Department of Commerce, in consultation with the Minnesota Public Utilities Commission (PUC), to submit an Annual Transmission Adequacy Report to the Legislature. The report is to provide a nontechnical discussion of Minnesota's current electric transmission system and a summary of the transmission planned or in process that is intended to maintain electric service reliability as well as comply with the requirements of state policy goals.[1]

This report first summarizes why electric transmission is needed and its current status in Minnesota—including an update on ongoing or planned transmission projects. The report then summarizes how transmission lines are regulated at the state and federal level, provides regulatory updates for 2020, and finally, summarizes long-term challenges and potential solutions.

The PUC issued the route permit in May 2012 for the last of the four CAPX transmission projects—the Minnesota portion of the Hampton-to-La Crosse 345-kV line. Since 2012, the PUC has issued three (3) route permits for larger high-voltage transmission lines (345-kV or above). Of these, construction was completed on one and started on the other in 2020. In June 2020—following over eight (8) years of planning, environmental review, permitting and construction—Minnesota Power energized a new 225-mile, 500-kilovolt line from Manitoba to Grand Rapids (the Great Northern Transmission Project). In addition, construction is underway on the 50-mile Huntley-Wilmarth 345 kilovolt (kV) transmission line connecting Xcel Energy's Wilmarth Substation, north of Mankato to ITC's Huntley Substation.

In 2020, Minnesota utilities applied for and received route permits for two small (less than three-mile long) 115-kilovolt transmission projects, both in Becker County. Three other transmission line projects are in the state permitting process. Two of these are single purpose lines proposed to connect wind-energy projects to the grid, and the other is a nine and one-half mile long 115-kilovolt line in Becker and Otter Tail Counties.

Regarding potential future projects, the most recent transmission owners Biennial Transmission Projects Report (2019) includes an extensive list of smaller transmission enhancements the utilities believe are needed to maintain system reliability over the next five to ten years.[2] The Minnesota utilities are not currently proposing any specific new high voltage "backbone" projects. The report also shows that Minnesota electric utilities are exceeding the renewable energy standards (RES) in Minnesota Statute section 216B.1691.

Looking further ahead, partly due to low wind and solar generation costs, some Minnesota utilities now have more aggressive renewable energy goals than required by the RES statute.[3] Meeting these company goals may require more transmission lines.[4] Therefore, given the long lead time required to plan and build large transmission network upgrades, the PUC in August 2020 required the transmission owners in their next biennial report (due in 2021) to determine what transmission upgrades will be needed to meet these company goals.[5]

[1] Minnesota Statutes 216C.054
[2] http://www.minnelectrans.com/report-2019.html
[3] Minnesota Biennial Transmission Projects Report Compliance Filing, August 14, 2020
[4] See, for example, CAPX2050 Vision Report, March 2020
[5] Minnesota PUC Order Accepting Biennial Transmission Report, Docket No. E-999/M-19-205

The primary entity responsible for planning and operating the high-voltage grid for our region is the Midcontinent Independent System Operator, Inc. (MISO). Despite likely high transmission network upgrade costs, many new wind and solar projects are currently requesting MISO approval to connect to the high voltage grid throughout the region, including in Minnesota and neighboring states.[6] To address the changing generation resource mix, MISO has started several initiatives, including a long-range regional transmission planning effort, reviews of enhanced transmission technology, and battery storage planning. These efforts are intended to help evaluate approaches and tradeoffs on how best to deliver reliable, low cost, low-carbon energy to consumers in Minnesota and the entire MISO region over the next decade and beyond.[7]

Report Summary

- Minnesota's Regional Transmission Organization (e.g., MISO) works with its member electric utilities to operate the electric transmission system in Minnesota and surrounding states to achieve reliability, regional coordination and efficiency.
- Even though we are using the transmission system in a highly efficient manner, the changing generation mix to clean energy resources and our participation in the broader regional energy markets has strained the transmission grid, which was not designed for the purposes for which it is currently being used and expected to be used in the future.
- Minnesota needs highly dependable electricity for computers and other sensitive equipment in our homes and businesses, so it is necessary to continue to upgrade and enhance our transmission infrastructure as needed to match expected use of the system and provide room for expansion in the future.
- The way that we build transmission is affected by state and federal policies, rules and laws that facilitate the construction of certain types of generation and transmission and restrict other types in the state, region and across the United States.
- It can take eight years or more to plan, permit, and construct new large transmission lines. Therefore, long-range transmission planning is needed to keep up with evolving electric generation technologies.
- New MISO efforts on long-range transmission planning are targeted at developing a coherent roadmap intended to maintain grid reliability, lower total delivered electricity costs over the long-run and enable future changes in the generation resource mix. These new efforts also include MISO coordination with the Southwest Power Pool (SPP) regarding the transmission upgrade requirements that can be triggered by new generation projects proposed in the others transmission network.
- Minnesota has been and will continue to be involved in numerous regional and national efforts to ensure that electric transmission lines are planned and constructed in a reliable, cost-effective and environmentally responsible manner for the State's economic future and the needs of its businesses and citizens and to maintain the State's jurisdiction over the provision of essential services to ensure safe, adequate and efficient utility services at fair, reasonable rates.

[6] See https://api.misoenergy.org/PublicGiQueueMap/index.html for a helpful map of the existing MISO queue

[7] See, for example, MISO Long Range Planning Update, System Planning Committee, December 7, 2020

Why Transmission Matters: Overview

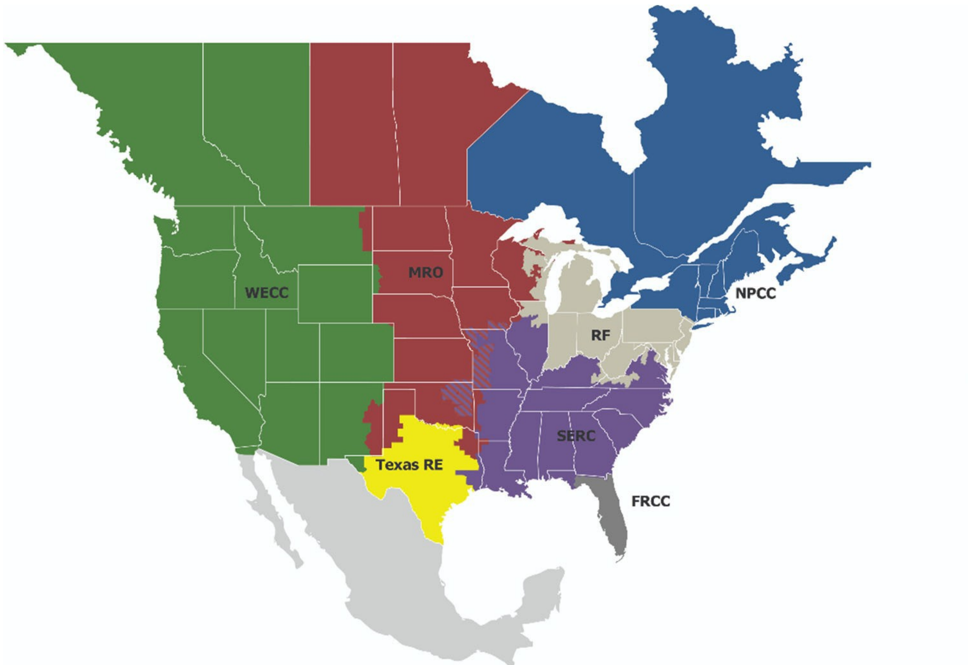
Generally, electricity is delivered to consumers via three main steps: 1) electricity is produced at various generation facilities, 2) it is then transmitted on an integrated system of high voltage transmission lines and 3) is delivered to consumers through a distribution system of smaller power lines. As the link between the production (generation) of electricity and delivery (distribution) to consumers, transmission plays a vital role in helping to ensure that consumers have low-cost, reliable energy. Further, as more generation facilities are added to the distribution system (also known as distributed generation), the dynamic and interconnected nature of the electricity system requires transmission to adapt to resulting changes in electricity flows. The transmission system can be impacted by changes in either supply or demand for energy and power.

While it is a critical component in providing electric service, transmission accounts for a much smaller percentage of utility costs than either generation or distribution facilities. For example, transmission may account for 10 percent of the costs of providing electric service while generation and distribution would make up the other 90 percent. Utilities that move large amounts of power over long distances tend to have relatively more transmission costs as a percentage of total costs due to the length of the transmission lines and the line losses experienced in the transport of electricity.

When the original transmission facilities in Minnesota were built in the 1960s, they were designed primarily to interconnect an individual utility's generation and distribution facilities, and secondarily to interconnect neighboring utilities to each other to provide additional backup power and reliability. Over time, the focus on interconnecting utilities has grown to include interconnecting broader regions, even as the need to connect a utility's generation and distribution systems remains. This evolving design enables utilities to access other generation or transmission systems if something goes wrong on an individual utility's system. This interconnection with other electric systems provides a more reliable system overall than isolated systems and allows utilities to access lower cost power from other suppliers, or purchase power on a temporary basis rather than building a generation facility that may be used only occasionally. More recently, there has been a need to adapt transmission systems to respond to changes in distribution systems. Transmission helps companies and states engage in a greater degree of specialization and thus allows the system of interconnected utilities to operate more efficiently and reliably than if each utility or state were operated on a stand-alone basis.

The nation's transmission grid is split into three (3) sections: The Eastern Interconnection, the Western Interconnection, and the Electric Reliability Council of Texas (ERCOT). Reliability of the transmission grid in the area of the Eastern Interconnection in which Minnesota is located is overseen by the Midwest Reliability Organization (MRO), as shown in Map 1 and as discussed below.

Map 1: Map of Regional Reliability Areas



Electricity follows the laws of physics: it follows the path of least resistance. Electricity placed onto the interconnected transmission grid could be withdrawn at any other place within the interconnection as long as there is no congestion on the transmission system. Moreover, the electrical system must be balanced in real time, meaning that the amount of electricity being produced at any given time must essentially equal the amount of electricity being used by consumers. Because in most cases electricity cannot yet be stored in a cost-effective manner, the transmission system helps maintain this balance at a lower cost by allowing electricity to flow through the broader electrical system where possible.[8]

Minnesota's Transmission System: Planning for the Future

Determining the amount of transmission infrastructure needed to provide economic and reliable electric service in Minnesota requires balancing the risks of building too much transmission with the risk of building too little. However, these risks are not symmetrical. If more transmission capacity is built than needed to deliver electric service from available generation resources, the system will be relatively free of transmission constraints, but will be higher cost than is necessary to provide adequate service.

[8] Technologies to store electricity for later use includes batteries, pumped hydro, compressed air, flywheels, and the transmission system itself. For example, "pumped storage hydro" in effect stores the electricity in the potential energy of water, by using electricity at times when little power is being used for other purposes to pump large amounts of water into a reservoir. Later, when electricity is needed or more expensive, this reservoir water is sent through a hydro-power turbine, generating electricity. This technology's use is restricted due to the need for both a large amount of water to make it viable and large ponds to store the water and generate the hydropower. Storage is discussed further below.

Importantly, on the other hand, if too little capacity is built for the delivery of electric service from existing and new generation resources, the transmission cost component of providing electricity service may be lower, but there could be a cost to Minnesota's overall economy. Economic costs could include less reliable power, curtailment of low-cost generation and use of higher cost generation resources would result in higher overall costs than the cost of building transmission.

2020 Transmission Projects

In 2020, the Minnesota Public Utilities Commission issued route permits for two small (less than three miles long) 115 kilovolt transmission projects, both in Becker County: The Lake Eunice 115 kV HVTL Upgrade and the 2.2-mile Detroit Lakes Public Utilities 115 KV HVTL project. Three other transmission line projects are in the permitting process. Two of these are proposed by developers to connect their large wind energy projects to the grid: Plum Creek Wind 345 kV HVTL and Big Bend 161 kV HVTL. The third project, the 9.5-mile Frazee to Erie 115 kV HVTL, is proposed by Great River Energy and Otter Tail Power in Becker and Otter Tail Counties.[9]

Biennial Transmission Report

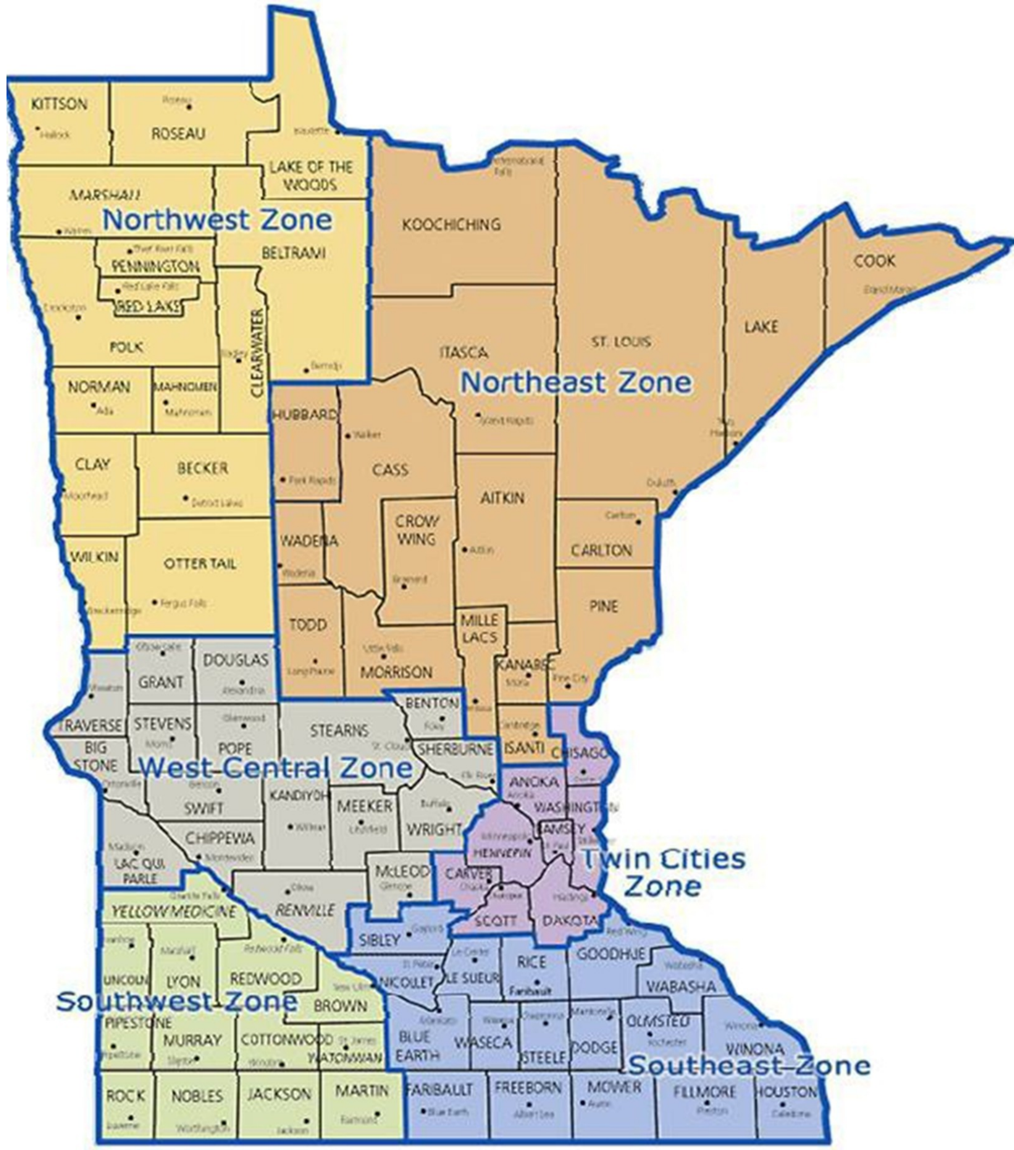
Minnesota Statute 216B.2425 requires utilities that own or operate electric transmission facilities in the state to report by November 1 of each odd-numbered year on the status of the transmission system, including present and foreseeable inadequacies and proposed solutions. The last Biennial Transmission Report was filed on November 1, 2019.

The sixteen participating utilities also jointly maintain the following website that provides information about transmission planning and projects: http://www.minnelectrans.com.

Detailed information (including maps) on all transmission inadequacies is broken down into six (6) geographic zones of the state: Northeast, Northwest, West Central, Twin Cities, Southwest and Southeast. The transmission-owning utilities operating in these six geographical zones work together to develop each zone's report. The six zones in the state are shown in the map below.

[9] Department of Commerce PPSA Annual Summary 2020

Map 4: Geographic Zones for Transmission Reporting



The 2019 Biennial Transmission Projects Report identified approximately 95 separate transmission inadequacies across the state, including 41 new issues identified in the 2019 Biennial Report. The 2019 Report identified projects in the Northeast Zone for Minnesota Power and Great River Energy; in the Southeast for Xcel Energy and ITC Midwest; and in the Northwest for Otter Tail Power. Several of these projects may require a certificate of need and a route permit. However, no specific, larger "backbone" transmission line projects are currently planned.

The report describes ongoing efforts in the Northeast Zone, in what is called the North Shore Loop. The North Shore Loop refers to an approximately 140-mile portion of 115 kV and 138 kV transmission lines in the northeastern Minnesota transmission system that is used by Minnesota Power and Great River Energy to serve customers along the North Shore of Lake Superior and the interior of the arrowhead.

Since 2015, all seven (7) of the coal-fired generating units located in the arrowhead have been idled, retired, or converted to natural gas. In 2015, the two units at the Laskin Energy Center were converted from coal-fired baseload units to natural gas peaking units. Also, in 2015, Minnesota Power retired one of the units at Taconite Harbor. With Commission approval of its 2015 Integrated Resource Plan, Minnesota Power idled the other two Taconite Harbor units in the fall of 2016 with all coal-fired operations to cease at the facility by 2020.

As a result of the rapid changes in generation in the North Shore Loop, several transmission projects throughout and adjacent to the area have been implemented since 2016. These and other projects listed below are necessary to ensure the continued reliability of the transmission system in the area by restoring redundancy, addressing unacceptably low voltage, voltage stability concerns, and mitigating transmission line and transformer overloads. Planned upgrades related to the transitional changes in the North Shore Loop include the following list of projects (MPUC tracking number and actual/planned year of completion listed in parenthesis):

- Minntac 230 kV Bus Reconfiguration (2015-NE-N10, Completed 2016),
- Forbes 230/115 kV Transformer Addition (2015-NE-N11, Completed 2016),
- North Shore Switching Station & Cap Banks (2017-NE-N7, Completed 2017),
- Babbitt Capacitor Bank (2017-NE-N8, Completed 2017),
- ETCO Capacitor Bank (2017-NE-N9, Completed 2017),
- Forbes 3T Breaker Replacement (2017-NE-N10, Completed 2017),
- 18 Line Upgrade (2017-NE-N17, Completed 2018),
- North Shore Transmission Line Upgrades (2017-NE-N19, Completed 2019),
- Two Harbors 115 kV Project (2017-NE-N20, Completed 2019),
- North Shore STATCOM (2017-NE-N15, Completed 2019),
- Laskin-Tac Harbor Transmission Line Upgrades (2017-NE-N21, Planned 2019-21),
- 38 Line Upgrade (2019-NE-N11, Planned 2020),
- Mesaba Junction 115 kV Project (2017-NE-N23, Planned 2020-21),
- Laskin-Taconite Harbor Voltage Conversion (2017-NE-N2, Planned 2021),
- Forbes 37 Line Upgrade (2019-NE-N2, Planned 2022),
- Forbes Tie Breaker Addition (2017-NE-N6, Planned 2022),
- Babbitt Area 115 kV Project (2019-NE-N10, Planned 2023).

Renewable Energy Standard Compliance

In addition to reporting on transmission in general, the Minnesota utilities are required in this report to determine any transmission upgrades needed to meet upcoming milestones of the Minnesota Renewable Energy Standard (RES). The 2019 Biennial Transmission Projects Report indicates that utilities meet or exceed the present RES requirements through 2030 and expect to have enough renewable generation and transmission to meet future RES milestones.

In part because of increasingly lower wind and solar energy generation costs, most Minnesota utilities now have more aggressive renewable energy goals than required by the RES statute.[10] Meeting these goals with large wind and solar projects located in more rural areas may require more transmission lines.[11] Therefore, given the long lead time required to plan and build large transmission network upgrades, in August 2020, the Public Utilities Commission issued an order requiring the Minnesota Transmission Owners in their next biennial report (due in 2021) to identify what new transmission will be needed to meet the companies publicly stated goals.[12]

CapX2050 Transmission Vision Study

The transmission lines built over the last decade as part of the CapX2020 initiative have already reached capacity,[13] so in March 2020, a consortium of 10 upper Midwest utilities (the CAPX2020 group) issued a new report.[14] The CAPX 2050 report was not a transmission planning study, but is intended to educate and inform Upper Midwest policymakers and other stakeholders of the implications of a future that is even more reliant on wind and solar resources.

Among other things, the report discussed four (4) critical findings related to dispatchable and non-dispatchable resources that are necessary to continue operating a safe, reliable, and affordable grid:

- Dispatchable resources support the electric grid in ways that non-dispatchable resources presently cannot and therefore, some dispatchable resources will be necessary.
- The ability for system operators to meet real-time operational demands will be more challenging and therefore, we will need to develop new tools and operating procedures to address the challenges.
- More transmission system infrastructure will be needed in the upper Midwest to accommodate the transition of generation resources.
- Non-dispatchable resources alone will be incapable of meeting all consumer energy requirements at all times and therefore, we will need to understand and promote a future electric grid that can continue to meet consumer energy requirements safely, reliably and affordably.

MISO Long-range Transmission Planning

The Midcontinent Independent System Operator (MISO) is responsible for planning the high-voltage transmission system in our region. Because of the evolving generation mix, emerging transmission constraint problems, and the long lead time required for new large transmission projects, regulatory and government leaders have begun encouraging MISO and other transmission operators to engage in long-range planning.

On June 13, 2019, the Organization of MISO States (OMS) board approved a statement of principles for long-range transmission planning to help guide MISO away from reliability-based, short-term incremental transmission

[10] Minnesota Biennial Transmission Projects Report Compliance Filing, August 14, 2020
[11] See, for example, CAPX2050 Vision Report, March 2020
[12] Minnesota PUC Order Accepting Biennial Transmission Report, Docket No. E-999/M-19-205
[13] Sections of the CAPX projects are “double-circuit capable” with only one circuit currently constructed. See, e.g. Hampton to La Crosse Minnesota PUC route permit order, May 2012
[14] CAPX2050 Report, March 2020

planning.[15] In addition, on September 17, 2019, the governors of the States of Arkansas, Iowa, Michigan, Minnesota, Wisconsin and the premier of Manitoba submitted a letter to MISO requesting a new long-range study of the transmission system.[16] On September 8, 2020, on behalf of the Midwestern Governor's Association, Minnesota Governor Tim Walz and Iowa Governor Kim Reynolds sent an additional letter to each of the regional transmission system operators: MISO, Southwest Power Pool, Inc. (SPP) and PJM Interconnection L.L.C. (PJM) encouraging their on-going long-range transmission planning efforts.[17]

MISO initiated their long-range planning effort this past summer and is in the process of developing a long-range study in order to better assess what upgrades over the next 20 years may be needed. Details on how the long-range "roadmap" will be used to evaluate specific potential transmission project reviews and approvals are still evolving.[18] Initial overview information on the effort is also available in recent MISO presentations.[19]

MISO and SPP have begun a related but separate process to evaluate potential joint projects that would reduce transmission upgrade costs when proposed new generation projects affect both transmission networks. Initial planning for this joint MISO/SPP effort, started in December 2020.[20]

Transmission, Reliability and Power Costs

Adequate transmission is essential to ensure that Minnesotans have reliable electric service. When there are areas with shortages in transmission capacity, there are more frequent power outages and lower power quality (which can affect sensitive equipment such as computers). Since Minnesotans depend heavily on reliable power in their homes and businesses, it is critical to ensure that electric service is as reliable as reasonably possible to minimize the cost to Minnesota's economy in lost production, disruption and potential harm to systems that depend on electricity. For example, electricity is needed to run the pumps that deliver natural gas, oil and other fuels to consumers. In addition, for most utilities the largest users of electricity are mining and manufacturing businesses that rely on electricity to produce and deliver products.

Inadequate transmission capacity also increases the cost of power delivered on the system. The entire electric system starts by using the least-cost generators available and adds power from generators that are increasingly more expensive to operate as demand increases. Electricity follows the path of least resistance, meaning it moves from more congested to less congested transmission lines. When there is not enough transmission capacity, certain paths on the system become congested, causing operators of the electric system to decrease the amount of electricity produced by cheaper generators in congested areas and increase electricity produced by more expensive generators in areas free of congestion. As a result, when transmission congestion leads to the use of higher-cost generation facilities to produce electricity, the cost of power goes up.

Roles of Entities Involved in Transmission

Numerous entities can have an impact on the design and cost of the transmission system that serves Minnesota. For example, because transmission lines located outside of the state help serve Minnesota customers, utilities that own those facilities, and the states that regulate those utilities, can affect the design and cost of the transmission grid. While transmission owning utilities are involved in these matters, so are other nonutility organizations, including the following:

[15] OMS Long-Range Planning Principles
[16] MGA Initial Letter to MISO Long-Range Planning, September 17, 2019
[17] September 8, 2020 MGA Letter to RTOs
[18] MISO Long-Range Planning Roadmap
[19] See, for example, MISO Long Range Planning Update, System Planning Committee, December 7, 2020
[20] SPP-MISO Joint Targeted Interconnection Queue Study Scope, December 11, 2020

1. **The Federal Energy Regulatory Commission** (FERC) regulates the wholesale rates that utilities charge for transmission service and the type of transmission services provided.

2. **MISO and SPP** do not own transmission or generation facilities, but work with utilities that voluntarily choose to be their members to operate the regional transmission system reliably and in the least-cost manner through energy and capacity markets.[21] MISO and SPP assist their members in developing long-term transmission plans for the region. MISO members currently operate in all or part of 15 states plus the Canadian province of Manitoba.[22] MISO cannot require its members to build new resources, nor is it responsible for the development of long-term plans for generation. FERC regulates the rates and practices of MISO and SPP.

3. **The North American Electric Reliability Corporation** (NERC) develops and enforces certain electric reliability standards for what is known as the "Bulk Power System" or "the grid." There are seven NERC Reliability Regions covering the United States and Canada, as shown in Map 1. Minnesota is in the "MRO" region, as noted above. NERC's other reliability organizations are the Western Electricity Coordinating Council, Inc. (WECC), Texas Reliability Entity (Texas RE), Northeast Power Coordinating Council, Inc. (NPPC), Reliability First (RF), SERC Reliability Council (SERC, the successor to the Southeast Electric Reliability Council), and Florida Reliability Coordinating Council, Inc. (FRCC). Because an outage in one part of the grid can affect other parts of the grid, NERC coordinates among these regions.

4. **The Midwest Reliability Organization** (**MRO**), with members in eight states (Illinois, Iowa, Minnesota, Montana, Nebraska, North Dakota, South Dakota and Wisconsin) and two Canadian Provinces (Manitoba and Saskatchewan), develops and ensures compliance with regional and interregional electric standards for the transmission system and performs assessments of the grid's ability to meet the demands for electricity.

5. **The Organization of MISO States** (OMS) is a self-governing organization of representatives from the regulatory commissions of 15 states, the City of New Orleans and the Canadian province of Manitoba. The regulatory commissions have certain authorities over transmission-owning utilities participating in MISO. The OMS examines various issues and makes recommendations to MISO, FERC and other relevant government agencies regarding matters that affect state jurisdiction and other regional transmission matters. The Minnesota Public Utilities Commission represents Minnesota in OMS. In addition, the Department of Commerce represents Minnesota as an associate member and, along with other Public Consumer Advocates such as the Minnesota Office of Attorney General's Residential Utilities and Antitrust Division, participates in the efforts and activities of OMS and MISO.

6. **The Minnesota Public Utilities Commission** requires Minnesota utilities to develop enough transmission to reliably serve load. The Commission also regulates the retail rates of Minnesota's investor-owned utilities, including the amount of transmission costs that can be recovered from their retail customers. In addition, while the Commission does not regulate the wholesale rates charged by Minnesota's investor-owned utilities, it does ensure that these utilities allocate transmission costs and revenues appropriately at the retail level, considering factors such as the types or classes of retail customers and their usage.

7. **The Division of Energy Resources at the Minnesota Department of Commerce** investigates matters pending before the Commission and makes recommendations to address proposals by utilities and others.

MISO and SPP are called Regional Transmission Organizations, which are responsible for moving electricity over large interstate areas. Despite this geographical definition, electric utilities can choose which Regional Transmission Organization to join and, if they meet the terms of the agreements, could switch to another Regional Transmission Organization.

[22] As shown in Map 2, below, MISO covers some or all the following states: Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Manitoba, Michigan, Minnesota, Mississippi, Missouri, Montana, New Orleans, North Dakota, South Dakota, Texas and Wisconsin.

Because it is heavily involved in Minnesota's electric transmission system, MISO warrants further discussion. As noted above, MISO is a Regional Transmission Organization (RTO) created and regulated by FERC. MISO is involved in numerous matters that are critical to the reliable and low-cost operation of the bulk transmission system. These activities include: planning for contingencies if large generation plants are retired or transmission components fail; conducting engineering analyses of the effects of various changes to the generation fleet or transmission components of the system as a whole; planning for transmission needs in the MISO region; coordinating with other RTOs in the Eastern Interconnection System; monitoring the day-to-day (and minute-to-minute) operations of the regional transmission system; determining which generation units will operate (from lowest to highest cost) in the energy market at any given time; addressing the operational effects of congestion on the transmission system; and analyzing where the greatest congestion exists. Staff of the Department of Commerce and Commission participate in various MISO workgroups and committees.

As noted above, the geographical area of MISO's region spans 15 states and, for reliability purposes, a Canadian province. To focus its review of the reliability of the transmission system, MISO established resource "planning reserve zones." In its planning, MISO focuses on ensuring that there are adequate electric resources to meet the needs in each zone and considers any limits on a region's ability to import or export electricity.

As shown in Map 3, below, most of Minnesota is part of Planning Reserve Zone 1, along with the western half of Wisconsin, portions of North Dakota, and certain parts of Montana, South Dakota, and Illinois. The 13 utilities in Zone 1 include: Central Minnesota Municipal Power Agency, Dairyland Power Cooperative, Great River Energy, Heartland Consumers Power District, Minnesota Municipal Power Agency, Minnesota Power, Missouri River Energy Services[23], Montana-Dakota Utilities, Northern States Power (Xcel Energy), Otter Tail Power, Rochester Public Utilities, the Southern Minnesota Municipal Power Agency, and Willmar Municipal Utilities.

How Much Transmission Is Enough

Minnesota's Transmission System

When the initial transmission system was designed and built over 60 years ago, items such as home computers, video games, cable TV and cellphones were unheard of. Few customers had air conditioners, and few plug-in appliances had been invented or available. Those transmission facilities were sized and constructed to meet the electricity needs of the population and economy at the time with some assumptions for growth based on certain expectations at that time.

While Minnesota's transmission system was initially built with more capacity than was needed at the time, the demand for electricity in the State has stretched the ability of the transmission system, both in terms of the quantity of electricity demanded and where the electric generation facilities would be located. In addition, the system has been aging. In response to increases in the demand for electricity and the changing location of electric generation facilities a high-voltage transmission backbone was constructed recently and more may be needed in the future in order to cost effectively integrate new renewable energy technologies. Moreover, Minnesota residents and industry also need acceptable power quality, meaning evenly delivered energy without power surges and other fluctuations that can affect computers and other sensitive electronic devices. A lack of capacity on the grid could lead to some locations in the state where power quality would become unacceptably poor. Further, in some locations and times, too much electricity is trying to flow on the lines causing congestion or "grid lock," resulting in economic and reliability problems in making sure electricity can be delivered where it is needed.

[23] Some of Missouri River Energy Services' members have joined MISO and some members joined SPP.

While the use of the transmission system varies with the overall demand for electricity and location of the supply, transmission planning requires a focus on the amount and timing of the highest demand and need to import or export electricity between regions. In some regions the need is to be able to export power. However, sometimes, the need to export power is when the demand for electricity is low, and the supply of electricity exceeds demand in an area. This imbalance typically occurs during overnight hours in the spring and fall when the demand for power is low and the generation of electricity from certain resources, such as wind, is high.

When planning for the supply of electricity, the highest demand for electricity (peak demand) during the day and the season is reviewed. While peak demand for electricity in the MISO region has typically occurred in the summer, MISO must also plan for meeting high winter loads. For example, temperatures in January and February of 2014 were exceedingly cold during the two "polar vortexes" experienced in that year. Further, cold weather and difficulties with generation facilities and demand resources in the southern part of MISO's region caused price spikes in the early part of January 2018 and again in late January 2019.

In addition, well-designed transmission systems help facilitate more efficient use of generation resources. A transmission system or "grid" that covers a broader region and multiple utilities, with access to a larger portfolio of generation resources, allows strategic use of the most efficient resources available on the grid at any given moment. Since the grid deploys least-cost generators first, having access to more generators can help reduce electricity prices. As indicated above, in its role as a regional transmission organization, MISO helps coordinate both regional transmission planning and operations. These functions help to mitigate potential inefficiencies that can result from a balkanized utility grid that is based on individual utilities planning and operating their systems solely to meet the needs of their customers in their own service territories. Being aware of the various costs of resources in its region, MISO can provide direction to its members on how to dispatch those resources more efficiently overall.

As a result, planning the transmission system means meeting not only the overall expected peak demand for power, typically in summer months, but also the demand for relatively high amounts of power during extreme weather and other circumstances. Moreover, when generation capacity is higher than the demand for electricity in a region, the need to move or export electricity increases.

Transmission planning also needs to consider changes in technologies and the economy. While excess transmission capacity could result in additional costs and environmental impacts, a shortage in transmission capacity would have negative effects on the cost and reliability of electricity. Thus, the overall goal is to have a transmission system that is sized appropriately to handle the demands to import and export power, allow for growth in the economy that may lead to an increase in demand, and to accommodate changes to the generation fleet. If the transmission system is planned assuming relatively low demand for power, such as occurs during a recessionary period, the transmission system would be unable to accommodate a recovery and growth in the economy. Also, if plans for transmission capacity ignore the potential growth in demand resulting from new technologies that require electricity to operate, the transmission system may not be able to meet the increase in demand.

The minimum time period that should be considered in planning for new facilities is the number of years that it takes to build new transmission lines (including assessing a need, conducting engineering analysis, working with local communities and landowners, obtaining needed permits and installing the lines). It can take a decade for a large transmission line to move from planning through permitting and construction to be placed in service. Thus, as the economy grows in the future, it will be necessary to ensure that the transmission system is ready to meet future needs.

Minnesota has avoided serious problems with its transmission system in part due to having one of the strongest energy conservation programs in the country. Minnesota's Conservation Improvement Program has, since its inception, conserved enough energy to push back by many years the need for building multiple major electric generation plants by offering industry, business and residents' various programs to save energy in their day-to- day operations. Therefore, while power usage continued to increase, the rate of growth has declined significantly and is essentially zero for some utilities.

Battery Storage as a Transmission Asset

Strategically placed generation and storage facilities could also help ensure reliable electric service, particularly when such resources are relatively low cost and located in areas where such resources can address congestion on the transmission system. For example, storage resources placed in strategic areas may delay or prevent the need to build new transmission.

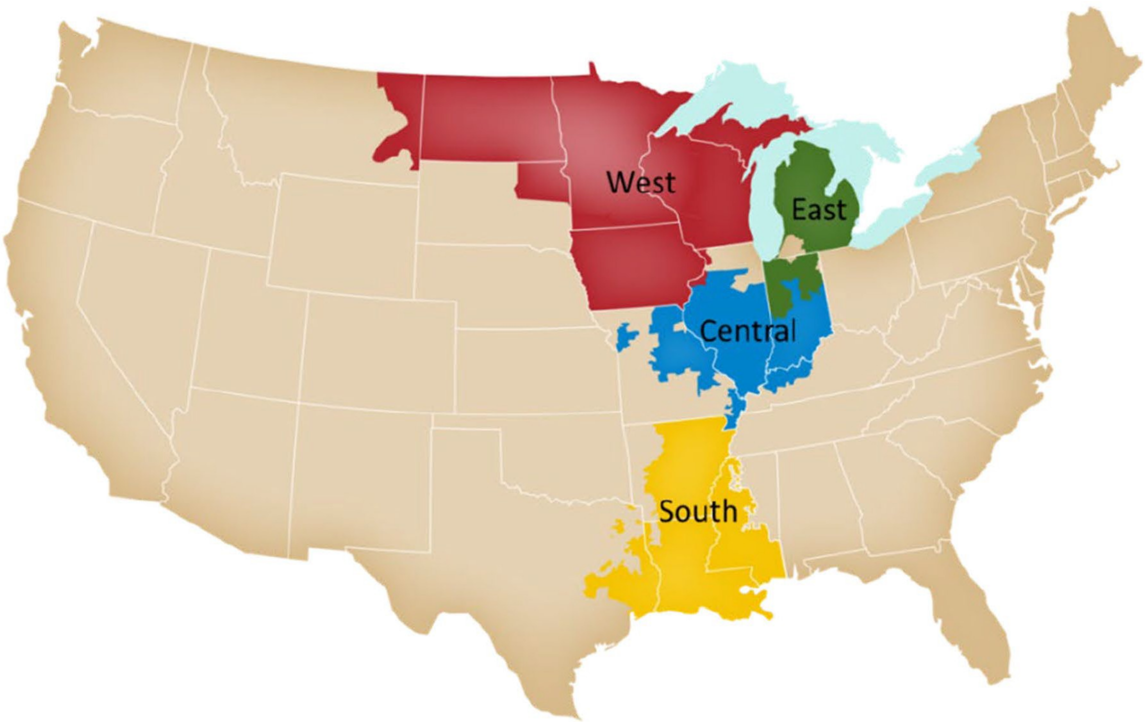
However, these programs should not be expected to put off needed changes to transmission indefinitely. Further, conservation might increase the need for new transmission if it occurs in an area where there are limits to the amount of generation that can be exported. For example, as more renewable energy has been added in and near Minnesota, there often is a greater need to build more transmission to export the power during off-peak hours when demand is low and renewable energy generation can be higher.

Federal and State Actions Related to Minnesota's Transmission Grid in 2020

Additions to transmission are needed not only due to factors in Minnesota, but also due to federal and regional governmental actions directly affecting the use of Minnesota's transmission grid (as well as other states' grids). Issues that developed in 2020 with potential effects on Minnesota are described in this section of the report.

In addition, these federal and state actions are often related to filings by MISO at the FERC, so an overview of MISO operations is provided below to help understand the underlying issues being addressed. Due to its wide swath and differences in certain areas, MISO divided its system into the following four geographical regions for transmission planning and ten geographical regions for resource adequacy: MISO East Region, MISO Central Region, MISO West Region, and MISO South Region. Map 2 below shows MISO's four (4) geographical regions for transmission planning.

Map 2: MISO Planning Subregions



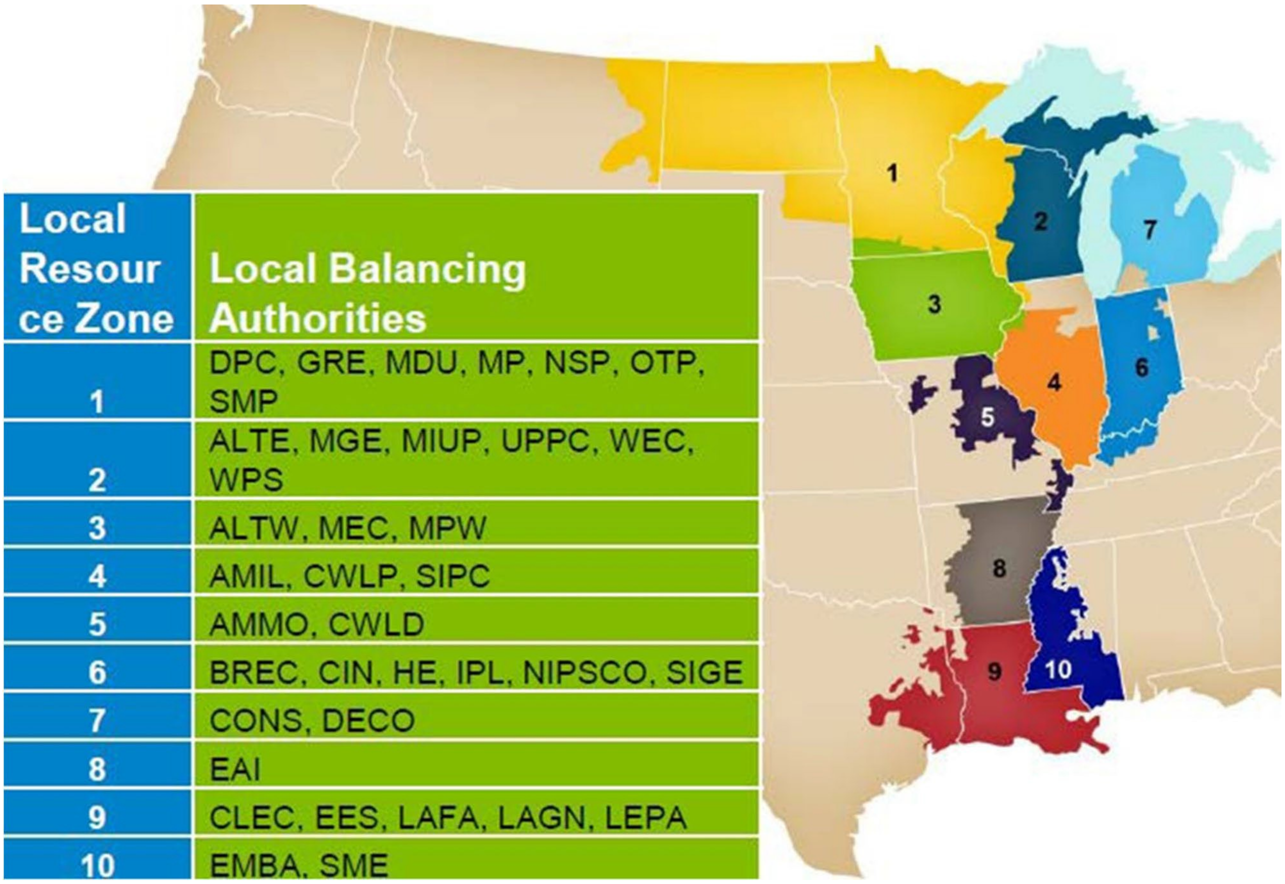
In addition, MISO has ten (10) "planning reserve zones" to focus on each region and to help ensure that there are adequate electric resources to meet the needs in each zone (also known as "resource adequacy"). See Map 3.

Minnesota is part of MISO's Planning Reserve Zone 1, along with the western half of Wisconsin, all of North Dakota and portions of Montana, South Dakota and Illinois. Utilities included in Zone 1 are Dairyland Power Cooperative, Great River Energy, Montana-Dakota Utilities, Minnesota Power, Northern States Power, Otter Tail Power and the Southern Minnesota Municipal Power Agency. The utility that serves Minnesota in Zone 3, in the southernmost part of Minnesota, is Interstate Power and Light[24], which sold its transmission resources to ITC Midwest, a transmission-only utility. Interstate also sold its distribution system to the Southern Minnesota Electric Cooperative.

[24] Noted in Map 3 as ALTW for Alliant Energy West.

Map 3: MISO'S Resource Planning Zones

Source: The Midcontinent Independent System Operator



Local Resource Zone	Local Balancing Authorities
1	DPC, GRE, MDU, MP, NSP, OTP, SMP
2	ALTE, MGE, MIUP, UPPC, WEC, WPS
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, CIN, HE, IPL, NIPSCO, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	EMBA, SME

Constraints on Power Transfers within MISO

The amount of electricity that MISO North can export to and import from MISO South has been limited since shortly after MISO integrated the Entergy region (MISO South) in 2013. SPP filed a complaint with FERC, claiming that MISO should pay for certain transfers that exceed 1,000 MW. Under a settlement, MISO is currently paying SPP and Joint Parties more than it previously did to transfer power over 1,000 MW. The annual cost to maintain the settlement is estimated to be up to $38 million and is dependent on the capacity factor usage of the interface.

Late in 2016 MISO launched a study, called the Footprint Diversity Study, on addressing the 1,000 MW limit. Of the 35 transmission projects that were studied to solve the congestion, none passed the benefit-to-cost ratio of 1.25 used within the Market Congestion Planning study process to assess which projects might be cost-effective. While there are significant potential savings in settlement costs, the minimal amount of physical congestion on the interface between MISO North/Central and MISO South within MISO's models did not provide enough economic benefit to justify a project. MISO is reanalyzing projects for the North-South interface as part of its MTEP21 long-range planning study. This analysis will continue into 2021.

MISO's Competitive Bid Process for Regional Transmission (Transmission Developer Qualification and Selection)

FERC requires MISO to have a Transmission Developer Qualification and Selection System and to eliminate federal (but not state) rights of first refusal on cost shared transmission projects. One of FERC's stated goals is to promote competition for the construction of transmission projects. Minnesota's existing certificate of need (CN) law requires the Commission to consider alternatives to proposed facilities, which can promote competition with FERC goals. Minnesota statutes also require a Minnesota utility ("incumbent electric transmission owner") to give notice as to whether or not it intends to build a high-voltage transmission facility that has been selected in a MISO planning process (passing MISO's various standards and engineering effects on the electrical grid). If the utility does not intend to build the facility, the Commission "may determine whether the incumbent transmission owner or another entity will build the electric transmission line, taking into consideration issues such as cost, efficiency, reliability, and other factors identified in [Minnesota law]." Generally referred to as Minnesota's "Right of First Refusal"—or ROFR—statute. In November 2020, as part of on-going litigation, a non-utility transmission line developer petitioned the United States Supreme Court to review an U.S. Court of Appeals Eighth Circuit decision about Minnesota's ROFR law.[25]

One such project near Mankato, referred to as "Huntley-Wilmarth," was approved by MISO in December 2016. The project establishes a transmission line to interconnect substations owned by Xcel Energy and ITC Transmission. The Commission granted the certificate of need and the route permit for the project on August 5, 2019. Construction of the line is ongoing.

MISO's Multi-Value Transmission Project Portfolio

In 2011, MISO approved a portfolio of 17 different transmission projects across the MISO North, Central and East footprint, the costs of which were regionally shared across the MISO footprint at the time. The projects, referred to as multi-value projects or "MVP" projects,[26] had a wide variety of goals, including to:

- Provide benefits in excess of costs under the scenarios studied. In this case the benefit-to-cost ratio for the MVP portfolio ranged from 1.8 to 3.0.
- Maintain system reliability by resolving various reliability violations defined by federal reliability standards. The MVPs addressed violations on approximately 650 transmission elements for more than 6,700 system conditions and mitigated 31 system instability conditions.
- Enable 41 million MWh of wind energy per year to meet renewable energy mandates and goals.
- Provide an average annual value of $1,279 million over the first 40 years of service, at an average annual revenue requirement of $624 million.
- Support a variety of generation policies by using a set of energy zones that support wind, natural gas and other fuel sources.

Two of the 17 MVP projects are in Minnesota: the 345 kV line between Brookings, South Dakota, and the Southeast Twin Cities and the 345 kV line from Lakefield Junction to Winnebago, Iowa. Overall, final construction costs for these projects were generally in line with cost estimates used by MISO when adjusted for inflation, with some projects under budget and some over. Overall project status and explanations of budget

[25] Summary of ROFR Petition to US Supreme Court
[26] MVP Report

exceedances are available from MISO.[27]

In Minnesota, the Commerce Department and Public Utilities Commission hold investor-owned utilities accountable for the costs proposed in certificate of need proceedings by not only comparing actual costs (escalated to current dollars) to estimated costs, but also preventing rate-regulated transmission owners from charging cost overruns to ratepayers without a proper vetting process. Rate-regulated utilities may charge ratepayers for cost overruns only if: 1) there was no competitive process used to select the project, 2) utilities can justify why it is reasonable to charge such cost overruns to ratepayers, and 3) the utility files a general rate case (cost overruns are not charged to ratepayers through rider rates prior to the rate case).

Planning for this MVP portfolio of transmission projects began in 2007. As of December 2020, all 17 MVP projects have been approved in state regulatory proceedings. Construction is now complete on 16 of the 17 projects. The last project to get regulatory approval, the Cardinal-Hickory Creek Project, has an estimated in-service date of 2023.

Distributed Energy Aggregation in Interstate Markets: FERC Order 2222

On September 17, 2020 FERC issued a new final rule intended to enable aggregators of distributed energy resource (DER) like small generators, rooftop solar, behind-the-meter batteries and electric vehicles to compete in all regional organized wholesale electric markets.[28] The underlying purpose is to remove what FERC sees as existing barriers to distributed generation and to increase the competitiveness of wholesale markets. MISO's compliance filing is due July 2021, a relatively short time frame for a complex order with potentially long-term implications to markets and reliability. MISO has approved a DER Task Force starting in January 2021 that would serve as a clearing house for discussions on MISO's Order 2222 compliance filing. The future of distributed energy resources as an alternative to and complement for high-voltage transmission upgrades will be part of MISO's new long-range transmission planning effort (summarized above).

FERC Proposed Rulemaking (NOPR) on Dynamic Line Ratings

There is increased industry interest in improving the operating capacity and efficient use of the existing high-voltage transmission system while longer range transmission capacity issues are addressed. These technologies are sometimes referred to generically as "Grid Enhancing Technologies." For example, transmission line ratings currently based on seasonal or static assumptions may allow less transmission system transfer capability than the transmission system can provide, leading to restricted flows and increased congestion costs. Conversely, static ratings can also lead to overloading a line under some conditions.

FERC released a draft line ratings notice of proposed rulemaking (NOPR) on November 19, 2020 that proposes to require transmission providers to implement ambient-adjusted ratings and seasonal line ratings on their lines, require RTOs to allow transmission owners to electronically update ratings at least hourly, and require TOs to share rating values and rating methodologies with the RTOs and the Independent Market Monitor.[29]

Ambient adjusted rating changes are based on temperature alone. More complicated, but potentially more valuable, Dynamic Line Ratings are based not only on forecasted ambient air temperature, but also on other weather conditions such as wind, cloud cover, solar irradiance intensity, precipitation, and/or on transmission line conditions such as tension or sag. The FERC NOPR provides extensive background on the technologies, potential benefits, and approaches to implementation.

[27] Summary provided at: https://cdn.misoenergy.org/MVP%20Dashboard%20Q3%202020117055.pdf
[28] FERC Order 2222 Press Release, dated September 17, 2020
[29] https://www.ferc.gov/media/rm20-16-000

Comments on the proposed rule are due in the last half of January. OMS has been working closely with MISO and the MISO transmission owners (TOs) for almost a year now to better understand how line ratings work in MISO and is likely to submit extensive comments.

MISO Storage as a Transmission Only Asset Tariff (SATOA)

On August 10, 2020 FERC accepted MISO's proposal that allows energy storage resources to be selected as transmission-only assets as part of the grid operator's annual grid expansion plans. FERC accepted the proposal despite various objections to MISO restricting these assets only to storage owned by transmission owners.[30] DTE Electric Company and other parties recently appealed this FERC decision to the United States Court of Appeals for the District of Columbia.

Complaint by Large Power Customers to FERC regarding MISO Transmission Owners' Return on Equity (ROE)

As discussed in prior reports, a group of industrial end-users filed a complaint at FERC in late 2013 seeking to reduce the allowed return on equity (ROE) of MISO Transmission Owners and limit capital structure ratios and incentive equity adders. At that time, MISO transmission owners had a base ROE of 12.38 percent. The complaint sought to decrease the transmission owners' base ROE over 300 basis points below the then-current base ROE, to 9.15 percent.

In 2015, MISO's Public Consumer Group, of which the Commerce Department is a member, provided testimony identifying the basis for decreasing the ROE to a reasonable level. FERC's Trial Staff filed briefs that were supportive of consumer advocates' positions. Transmission customers and consumer advocates argued that FERC's high ROEs imposed undue costs on consumers and distorted decision-making by encouraging utilities to build transmission rather than generation or distribution resources. While transmission resources are needed, it would not be appropriate to build only transmission to meet the electric needs of society since there must be an appropriate balance of production and delivery of electricity.

Because the Commission requires utilities under its ratemaking authority to offset high ROE transmission costs with high ROE transmission revenues, Minnesotans taking service from such utilities have been spared from paying high ROEs without the revenue offset. While these ratemaking decisions have reduced the harm of paying for high ROEs for such ratepayers in Minnesota, such benefits will be returned to Minnesota retail ratepayers only if utilities choose to provide a credit to Minnesota retail ratepayers for higher revenues or—as with utilities subject to the Commission's ratemaking—are required to do so. Even if Minnesota retail ratepayers receive the benefit of revenue offsets to reduce the high rates they pay for electric service, the distortion of utility decision-making remains an issue.

On December 22, 2015, Administrative Law Judge David H. Coffman issued his Initial Decision, determining that the allowed base ROE should be reduced by over 206 basis points (just over 2 percent), to 10.32 percent. On September 28, 2016, FERC approved Judge Coffman's Initial Decision, requiring MISO to refund the difference between the base ROEs of 12.38 percent and 10.32 percent, a reduction of over 200 basis points.

[30] SATOA Joint Request for FERC Rehearing, September 9, 2020. The Minnesota Department of Commerce joined in these comments.

On July 2017, MISO filed its compliance filing showing that the transmission owners provided sizable refunds to Minnesota utilities in February and June 2017 that were flowed back to Minnesota customers. The final refund decision at FERC, however, is still under appeal.

More recently, following multiple rehearing requests, on November 19, 2020, FERC issued Opinion No. 569-B, in which it made minor modifications to the discussion in, but largely reaffirmed, its previously-issued Opinion No. 569-A wherein FERC revised its return on equity ("ROE") analysis and methodology.[31] This FERC decision is currently also under appeal at the Court of Appeals for the District of Columbia.

Incentive ROEs for Transmission

In another long-running issue, FERC originally granted ROE adders of 100 basis points to companies that were transmission-only companies to encourage such structures. Previously, the Commerce Department participated with Joint Consumer Advocates to urge FERC to eliminate or reduce this ROE adder; FERC reduced the adder in half, to 50 basis points. The Commerce Department and other Consumer Advocates opposed FERC giving a bonus ROE of 50 basis points for ITC since changes in that utility's corporate structure called into question its independence from generation facilities. On Oct. 18, 2018, FERC reduced ITC's independence ROE adder from 50 to 25 basis points. FERC concluded that ITC is still "independent" following its acquisition by Fortis and GIC, but less independent than it was before, which means ITC is still eligible for an independence adder, but a smaller one. In September 2019 ITC appealed this FERC decision to the DC circuit and OMS has intervened in support of FERC (19-1190).

Additionally, the Joint Consumer Advocates and the Organization of MISO States filed separate protest comments with FERC on January 5, 2018, to oppose Ameren Service's request for 100 basis point ROE incentive adder (on top of their 10.32% base ROE), for the Illinois River & Mark Twain components of the Grand Rivers Project. Ameren did not support why this ROE incentive adder was needed, particularly since Ameren already has incentives for cost mitigation. On February 13, 2018, FERC denied Ameren's request for a 100-basis point adder. On March 30, 2018, the OMS and Joint Consumer Advocates filed a joint answer to Ameren's rehearing request. On November 5, 2018, on rehearing FERC granted a 50 basis point ROE incentive adder (reduced from the 100 basis point adder requested by Ameren Service).

In a FERC Order issued on March 21, 2019 in Docket No. PL19-3 FERC issued a Notice of Inquiry, seeking comments on the scope and implementation of its electric transmission incentives regulations and policy. The OMS (with Commission and Commerce Department supporting) filed comments with FERC recommending the evaluation of granting ROE incentive adders on a case-by-case basis.[32] The comments recommended keeping benefits to consumers at the forefront of any analysis to determine whether to grant or eliminate ROE transmission incentives and supported non-ROE incentives first for mitigation of transmission project risks. A FERC decision on the issue is still pending.

[31] FERC ROE Order November 2020

[32] Joint Comments on FERC Incentive Adders, July 1, 2020

U.S. Department of Energy (DOE) Defense-Critical Electric System Review

U.S Department of Energy (DOE) may include transmission infrastructure in an on-going evaluation of electric power system assets that may be crucial to national security. DOE's review of defense-critical electric infrastructure can result in designations of electric system assets that are identified as critical to national defense. DOE's review may also help identify and prioritize areas of the electric system that need additional investment and/or hardening against potential threats or disruptions. Transmission infrastructure in Minnesota that is deemed defense-critical may require increased security measures, additional investments and/or may be subject to emergency orders and rules issued by the Secretary of the Department of Energy in an emergency.

Challenges to Transmission Planning-Potential Impacts to Minnesota

New Transmission Projects Raise Concerns about Land Use and Land Rights

In recent years, a number of energy entities, including natural gas pipelines, electric utilities and crude oil pipelines, have sought approval to construct new energy projects in Minnesota. Since the siting process in Minnesota mandates a number of public meetings and hearings and other outreach efforts to potentially impacted residents, landowners and the general public, the legal framework and other issues regarding land rights and land use are also receiving close scrutiny. In addition to wanting to know what benefit their area of the state would derive from a project, landowners and other affected citizens naturally want to know what their rights are regarding such projects impacting their land so they may be assured that their rights are not infringed upon during the process.

To date, answers to affected citizens and landowners have been identified during established regulatory processes. The answer to "what benefit does this project have for my area or my State" is a key question that is addressed in the State's Certificate of Need process (Minnesota Statute 216B.243) and land rights questions are addressed in various parts of Minnesota's statutes.

To help stakeholders understand facility permitting proceedings before the Commission that affect them and to help them have more productive input into those proceedings, the Commission created the specially designated position of Public Advisor. This position is responsible for designing and implementing a program to better inform stakeholders and to advise them on how to have a meaningful voice in the permitting process.

Cost Responsibility for Mitigation

As utilities build more infrastructure, state regulators must ensure that utilities use cost discipline as they construct new resources. To encourage cost discipline and prevent ratepayers from paying more than is reasonable for new utility infrastructure, at a minimum, a utility must justify any cost recovery above the amount the utility originally indicated that the project would cost. This focus is important since decisions to approve or deny a project are based in part on cost effectiveness of the proposed facility. Consequently, it is important to minimize errors in estimation to avoid ill-informed decisions from being made that would result in higher system costs than necessary. Minnesota has built such discipline into its transmission approval process.

When utilities install infrastructure in an area, there are always mitigation measures employed to address local concerns. Thus, it is important to ensure that decisions made by a utility on behalf of local governments or citizens reasonably consider the cost implications noted above. Further, it is important that costs of any significant upgrades are equitably allocated to ratepayers, based on ratemaking principles such as cost-causation, cost minimization and administrative feasibility. Discussions about such issues have occurred and are likely to continue in the future.

Federal versus State Jurisdiction Over Siting and Construction

The federal government "opened up" the interstate electric transmission grid in the 1990s. Certain eastern states challenged the federal government's jurisdiction over interstate electric transmission lines. The challenge went to the U.S. Supreme Court, which upheld that FERC has legal and regulatory jurisdiction over electric lines used for interstate commerce. (States retain jurisdiction over small power lines that distribute power directly to retail electric customers.) After the Supreme Court reached its decision, FERC issued a policy statement saying that it would not "preempt" state regulation of transmission lines as long as transmission service is not detrimentally impacted by state actions.