

Transmission Planning and Development Primer for Midwestern Policy Makers

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Prepared by the Great Plains Institute for the Midwestern Governors Association



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Electricity is a unique commodity in that there is no appreciable storage capability within the system. As such, supply and demand on the electric grid must be matched in real time to keep the grid operating reliably. The transmission system facilitates the movement of electricity across large geographic areas from where it is generated to where it is consumed, enabling the wholesale electricity market to connect customers to the region's lowest cost suppliers.

Figure 1. Simplified view of electric grid architecture

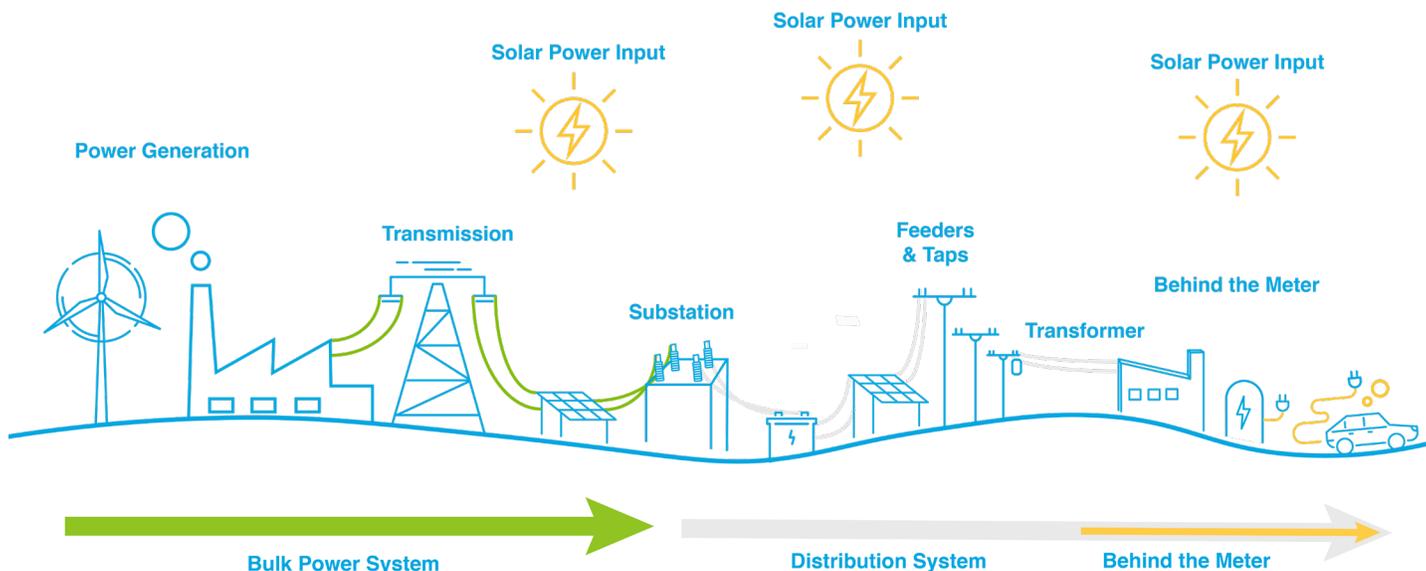


Figure authored by Great Plains Institute, April 2021.

For large swaths of the country, the transmission grid is planned through multi-state processes. This involves regional transmission organizations (RTOs), state regulatory commissions, utilities, consumer advocates, technology providers, and other interested stakeholders working together to identify where and when new transmission lines are needed to keep the system reliable and efficient. The Midcontinent Independent System Operator ([MISO](#)), Southwest Power Pool ([SPP](#)), and PJM Interconnection LLC ([PJM](#)) (see figure 2) each serve as RTOs and facilitate transmission planning in the Midwestern Governors Association footprint. While this esoteric network of stakeholders and planning processes might not make frequent headlines, these are the primary venues where the grid of the future is being planned.

Figure 2. Overview of RTOs serving Midwestern Governors Association states

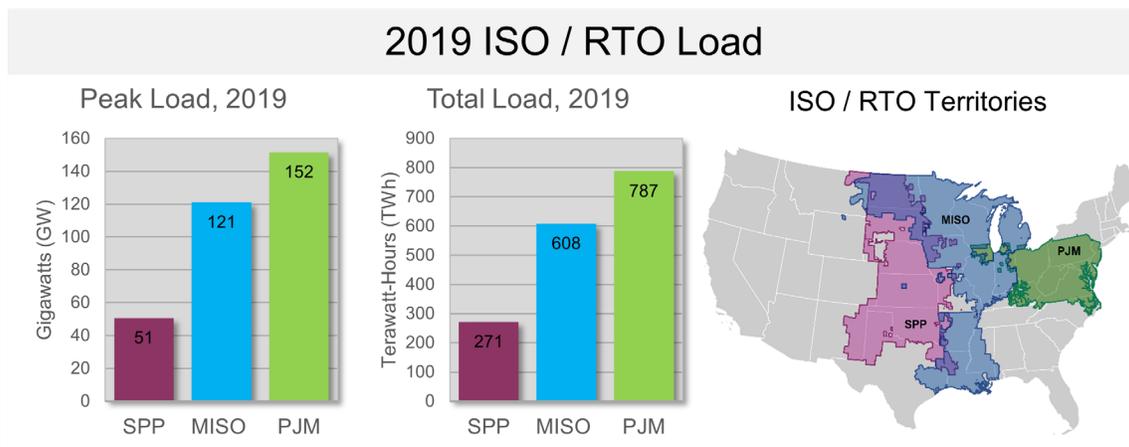


Figure 2 (cont.). Overview of RTOs serving Midwestern Governors Association states

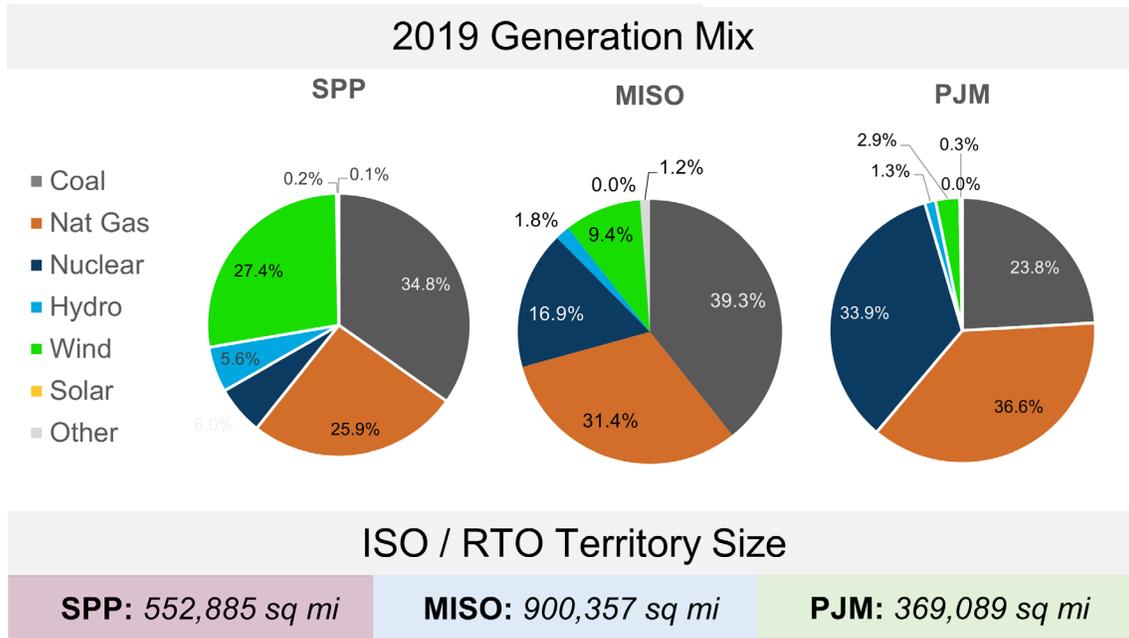


Figure authored by Great Plains Institute, December 2020.

KEY TAKEAWAYS FOR POLICY MAKERS:

- The transmission system is a critical component to expanding renewable energy generation in the region by enabling system balancing, interconnection of new generation resources, and delivery of renewable energy output within and between states.
- Early and comprehensive transmission planning is the most important step in building a reliable, resilient, and efficient electric grid that is critical to states' economic development initiatives.
- The transmission grid is planned via a regional process involving states, utilities, developers, and RTOs and should include state-level energy policies. Governors and their staffs, along with other state energy policy leaders, should regularly communicate state energy policies and goals to their designated public utilities commission members and RTO(s).
- The type of power generation developed by states and utilities has significant implications for the transmission grid. Meanwhile, planning and building regional transmission lines takes about ten years, making regional collaboration vital.

HOW IS THE TRANSMISSION GRID PLANNED IN MIDWESTERN GOVERNORS ASSOCIATION STATES?

As RTOs, MISO, PJM, and SPP are responsible for conducting regional transmission planning that coordinates the grid needs of member utilities and their respective customers. A collaborative process is used to identify grid investment needs for the next 5–10 years based on reliability requirements and opportunities to provide lower-cost energy to customers across the RTOs footprints.

Transmission planning happens in two different ways: bottom-up and top-down planning. Bottom-up planning is driven by utilities identifying needs and solutions on their systems, then bringing those to the RTO to facilitate coordination across utilities. Top-down planning looks at the RTO's system as a whole to identify regional solutions, typically to achieve cost savings or to comply with public policies. Some top-down planning exercises, called interregional planning studies, span multiple RTOs.

There are four main reasons to build transmission projects:

- 1. Reliability:** The grid must be planned in accordance with several reliability standards that the North American Electric Reliability Corporation maintains and enforces. Aging and failing grid elements must also be replaced to maintain reliability.
- 2. Economics:** The economic planning process prioritizes connecting areas of low-cost generation to customer demand, which can save money for individual customers, states, and the region.
- 3. Public policy:** State and federal public policies can drive specific transmission needs.
- 4. Interconnection:** Connecting new generation projects to the transmission network often requires transmission upgrades to ensure reliability.

In practice, a given transmission project may respond to any or all of these project drivers, or other localized issues like replacing aging equipment or interconnecting a new large customer, which are not typically done through the regional process, but by the local utility. It is the RTO's job to facilitate regional coordination of its member utilities' own planning processes to ensure customers in the region obtain the most value for every dollar spent on transmission infrastructure.

In addition to each RTO conducting its planning, Federal Energy Regulatory Commission (FERC) Order 1000 requires the RTOs to coordinate across their "seams," which are the areas where RTO member utilities' system intersect (see figure 2). These seams are historically a source of congestion on the grid because the two markets that create the seam are being separately optimized.

In top-down planning, some RTOs use a set of scenarios developed in partnership with member utilities and other stakeholders. These scenarios provide the data needed to identify and evaluate transmission projects. Futures include assumptions about electricity demand, new generation technology costs and locations, retirements of existing power plants, and state and federal public policies. They also make assumptions on the growth of emerging technologies, such as energy storage and electric vehicles. These assumptions are intended to create "bookends" of what may happen in the future, thus ensuring that transmission projects coming through the RTO planning processes are likely to provide value no matter what. Note that MISO and SPP use this scenario-based approach, while PJM creates a base-case scenario of existing resources and grid infrastructure, then adds and removes generation resources based on the interconnection queue and retirement processes.

STATE POLICIES AND THE TRANSMISSION GRID

RTOs are required under FERC Order 1000 to incorporate public policies into regional planning processes. State policies, such as renewable portfolio standards or carbon reduction targets, can drive specific assumptions and constraints within RTO planning studies. The aim of such analysis is to identify pathways for achieving state

policies for minimal cost. When several states have policies in place, the RTO is tasked with evaluation of regional opportunities to meet policy objectives more efficiently than on a go-it-alone approach.

States in the Midwest are implementing carbon reduction and economic development policies that will drive changes on the grid. Solar and wind generation will likely continue to be added to the grid at an accelerating rate, while distributed energy resources and electrification-driven load growth will impact system planning and customer engagement. A growing body of literature shows that as renewable generation continues to be deployed across the Midwest, the transmission grid will be increasingly important to balance supply and demand on a daily and seasonal basis, and to leverage the region's geographic and temporal diversity so energy is always available when and where it is needed, even during times of low in-state production (See appendix B).

As state policies and market forces enable new technologies like energy storage and grid-enhancing technologies to bolster the grid, transmission planning processes must continue to evolve to optimize investments. As these new technologies cannot fully replace the need for wires to move energy throughout the market footprint, an integrated approach to optimizing the grid is becoming increasingly important to meet public policy goals efficiently.

ROLE OF THE STATES IN REGIONAL TRANSMISSION PLANNING

While RTOs are federally regulated, states have jurisdiction over retail electricity rates and the investments regulated utilities make that drive those rates. In most states, public utilities commissions or equivalent commissions oversee resource planning activities of the investor-owned utilities in the state. Through these proceedings, commissions guide the long-term generation portfolios of the utilities in the state, which in turn have implications for transmission system needs. Note that not all states have formalized long-term planning processes like integrated resource planning, but the commission may instead evaluate new generation or grid infrastructure projects on a case-by-case basis.

In addition to the in-state processes, public utilities commissions also participate directly in RTO stakeholder processes both independently and in collaboration with their peer state commissions. In MISO, SPP, and PJM, the states belong to the Organization of MISO States ([OMS](#)), the [Regional States Committee](#), and the Organization of PJM States ([OPSI](#)) respectively.

In these bodies, the states work together to develop positions on a variety of market, planning, and governance issues. For example, the OMS provides input to MISO's planning process regarding the following:

- Its planning principles and objectives.
- The scope of each annual MISO Transmission Expansion Planning process.
- Modeling inputs and assumptions used to identify transmission needs and related cost/benefit analyses for proposed solutions.
- Any concerns or reconsideration requests regarding transmission projects that are eligible for regional cost allocation and meet certain criteria.

In addition to commissions, many states also have other agencies or government entities that engage in resource planning and other dockets at the commission to advocate on behalf of consumers in the state. Furthermore,

authority over siting of electric infrastructure lies with local government entities in some states. Utilities and developers responsible for building approved transmission projects submit applications to the appropriate entities in each state to initiate these evaluation processes.

CHALLENGES IN THE PLANNING PROCESS

Managing uncertainty: High-voltage, regional transmission lines take about ten years to plan and build, so planners must constantly manage uncertainty regarding the capabilities and costs of generation technologies, including renewables, energy storage, natural gas power plants, and other technologies. Planners must also anticipate the implications of public policies on grid needs. Planning Futures scenarios are intended to help manage this uncertainty by ensuring any new transmission projects show value for the region across a wide range of possible future system conditions.

Determining cost sharing in a diverse footprint: Another challenge is the sheer cost of transmission and the negotiations that must take place to determine who pays for new infrastructure. The RTOs approve multiple billions of dollars in transmission investment each year, and expenditure of that scale must be thoroughly scrutinized. Legal precedent states that costs should be allocated to those who benefit from a given transmission project. However, those benefits must be modeled into the future, which means they are subject to the same assumptions that go into the Futures. In diverse regions like MISO PJM, and SPP, public policy goals and opinions on planning assumptions vary significantly, making it a challenge to develop the support needed to plan and approve regional transmission projects.

RTO-to-RTO seams: There are also significant challenges to effectively planning interregional transmission projects across RTO seams. FERC Order 1000 requires that RTOs coordinate with each other to identify interregional solutions that are more efficient than regional solutions. But FERC Order 1000 does not require joint planning using consistent models and assumptions across multiple RTO regions to identify transmission needs and solutions. The result is often a mismatch between transmission system needs, resulting in identified solutions that do not often show benefits for both regions. While MISO and PJM identified and approved their first interregional transmission solution in 2019, MISO and SPP have not yet done so after four rounds of joint planning studies dating back to 2016.

APPENDIX A: SUPPLEMENTAL BACKGROUND INFORMATION

What is a regional transmission organization—and where does it fit into the electric system?

The United States electric grid is a multi-layered, highly complex, and dynamic system that is planned and operated across multiple jurisdictions and governance and oversight bodies. Regional transmission organizations (RTOs) have many roles that shape the electric system, two of which are to coordinate and execute the planning of the transmission system and run the wholesale electricity market that helps ensure the system's efficient and reliable operation. RTOs are voluntary organizations made up of member utilities, and their footprints reflect that utility membership. Because these entities facilitate interstate commerce, they are federally regulated by the Federal Energy Regulatory Commission (FERC). It is important to note that while FERC regulates the RTOs, states still regulate the utilities that make up the RTOs and their retail rates and thus have authority over the resource planning decisions of many of each RTO's members.

Figure A-1. Map of Regional Transmission Organizations across the United States (and parts of Canada)

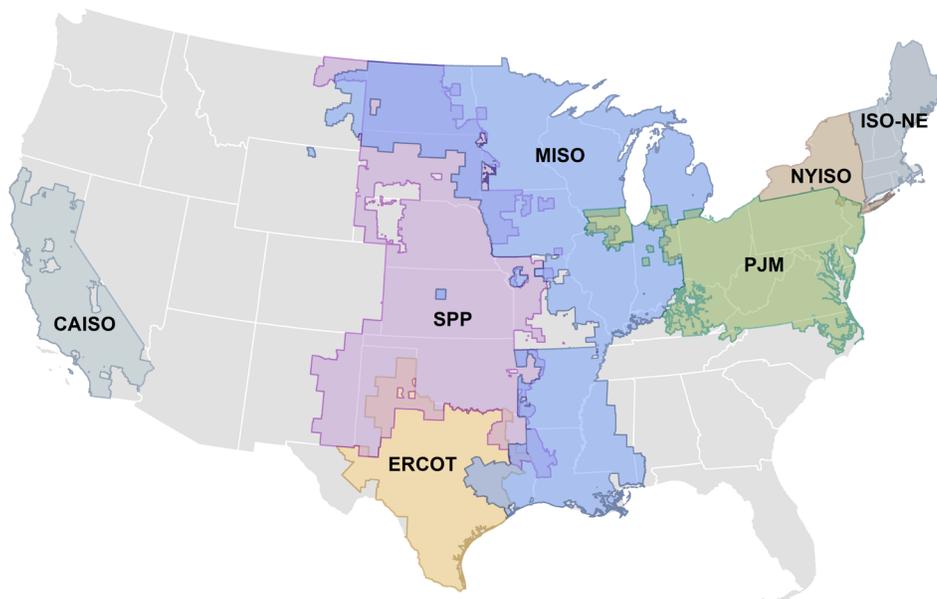


Figure authored by GPI, March 2021

RTOs and independent system operators (ISOs)—which are terms often used interchangeably to describe the same entities—run wholesale electricity markets, which serve to support the reliable operation of the grid in as cost-effective manner as possible. These markets instruct power plants in the region to generate power in a centrally coordinated manner, taking transmission constraints and other reliability requirements into account to ensure load on the system is met and customers' lights stay on. Before the creation of RTOs and ISOs, these functions were carried out independently by each utility. By pooling resources through these markets, customers save millions of dollars every year through reduced electric rates.

RTO markets and planning processes are complex, deeply technical, and inherently political. To minimize conflict and maximize public benefit, market rules and planning processes are shaped by a comprehensive stakeholder process in which utilities, state regulators, developers, consumer advocates, and other interested stakeholders debate and ultimately develop the transmission plans and market rules that shape the system in each RTO or ISO.

At the end of these stakeholder discussions, each RTO files any needed changes to its tariff, its ultimate governing document, with FERC, which can approve or deny proposed changes.

What is the Federal Energy Regulatory Commission?

The Federal Energy Regulatory Commission, or [FERC](#), is an independent, federal entity that regulates the interstate transmission of natural gas, oil, and electricity whose authority is established in the Federal Power Act. The commission assists consumers in obtaining economically efficient, safe, reliable, and secure energy services at a reasonable cost through appropriate regulatory and market means, and collaborative efforts.

A series of orders from FERC (Orders 888, 890, 2000, and 1000) fundamentally changed the electric system by establishing minimum requirements for RTOs, requiring utilities to allow open access to their transmission systems at standard rates, and requiring open and transparent local and regional transmission planning, among other things.

What is the North American Electric Reliability Corporation (NERC)?

The North American Electric Reliability Corporation ([NERC](#)) is a non-profit, international regulatory authority. Its purpose is to ensure grid reliability and security by developing and enforcing reliability standards, including those that ensure the reliability of the grid in the transmission planning process. NERC oversees six regional reliability organizations within its footprint which spans the continental United States, Canada, and the northern portion of Baja California, Mexico. In the Midwest, the regional reliability organization is the Midwest Reliability Organization. These six entities carry out compliance monitoring and enforcement activities on behalf of NERC to further assure grid reliability and security.

APPENDIX B. ADDITIONAL RESOURCES ON GRID NEEDS AND RENEWABLE GENERATION DEPLOYMENT

Bloom, Aaron, et al. *Transmission Planning for 100% Clean Electricity*. Energy Systems Integration Group (ESIG), 2021.

Bloom, Aaron, et al. *The Value of Increased HVDC Capacity Between Eastern and Western U.S. Grids: The Interconnections Seam Study*. National Renewable Energy Laboratory (NREL), 2020.

Clack, Chris, et al. *Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S.*. Americans for a Clean Energy Grid (ACEG), 2020.

Midcontinent Power Sector Collaborative. *A Road Map to Decarbonization in the Midcontinent: Electricity Sector*. Great Plains Institute, 2018.

Larson, Eric, et al. *Net-Zero America: Potential Pathways, Infrastructure, and Impacts*. Princeton University, 2020.

Prabhakar, Aditya, et al. *MISO's Renewable Integration Impact Assessment (RIIA) Summary Report*. Midcontinent Independent System Operator, 2021.

Tscuchida, T. Bruce, et al. *Unlocking the Queue with Grid-Enhancing Technologies: Case Study of the Southwest Power Pool*. Working for Advanced Transmission Technologies (WATT) Coalition, 2021.

Weiss, Jergen, et al. *The Coming Electrification of the North American Economy: Why We Need a Robust Transmission Grid*. WIRES, 2019.

ScottMadden. *Informing the Transmission Discussion: A Look at Renewables Integration and Resilience Issues for Power Transmission in Selected Regions of the United States*. Prepared by ScottMadden for WIRES. WIRES, January 2020.