

Planning for our evolving generation fleet

Working together to ensure continued reliability, affordability, and safety

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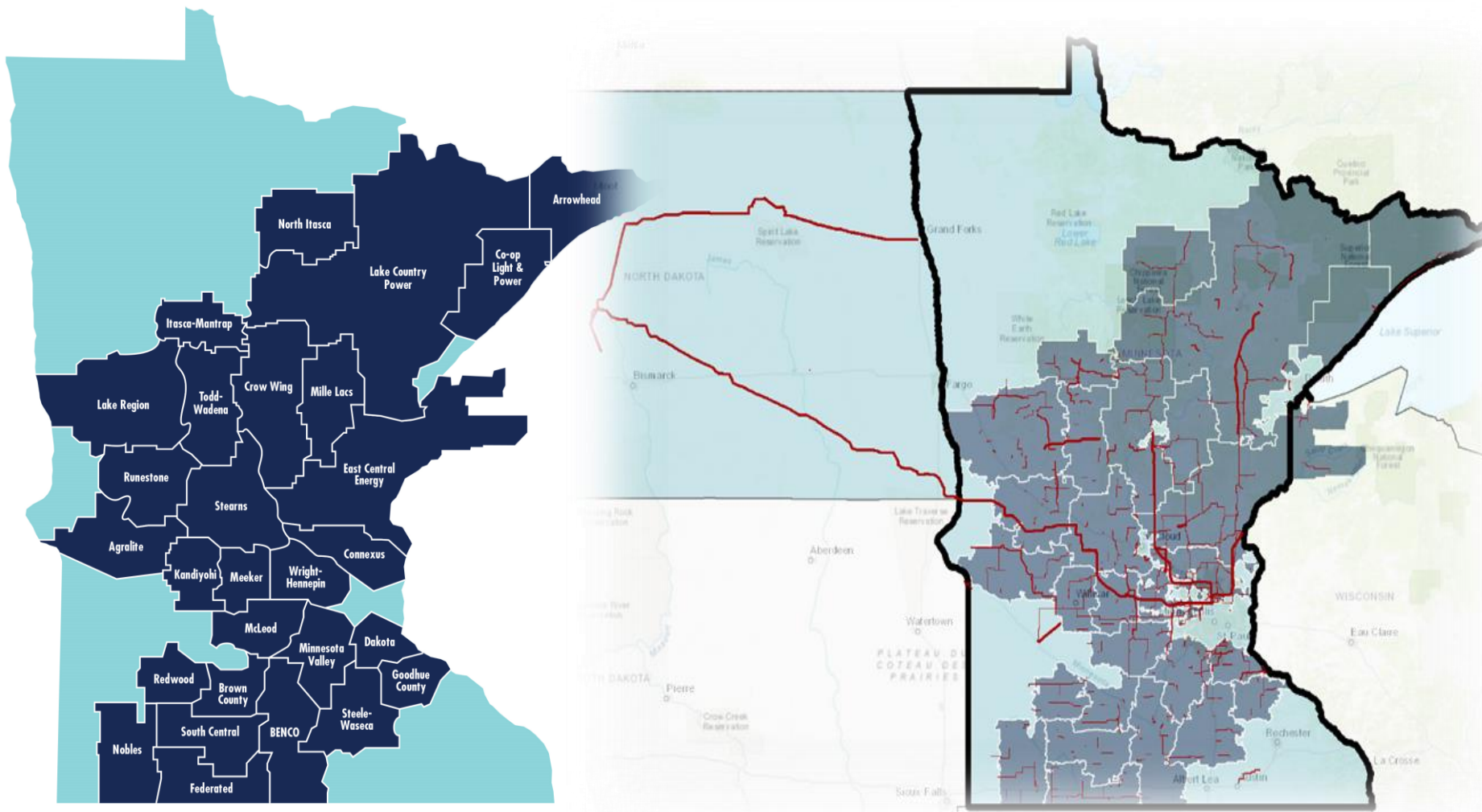
Vice President & Chief Transmission Officer

Rural Minnesota Energy Board

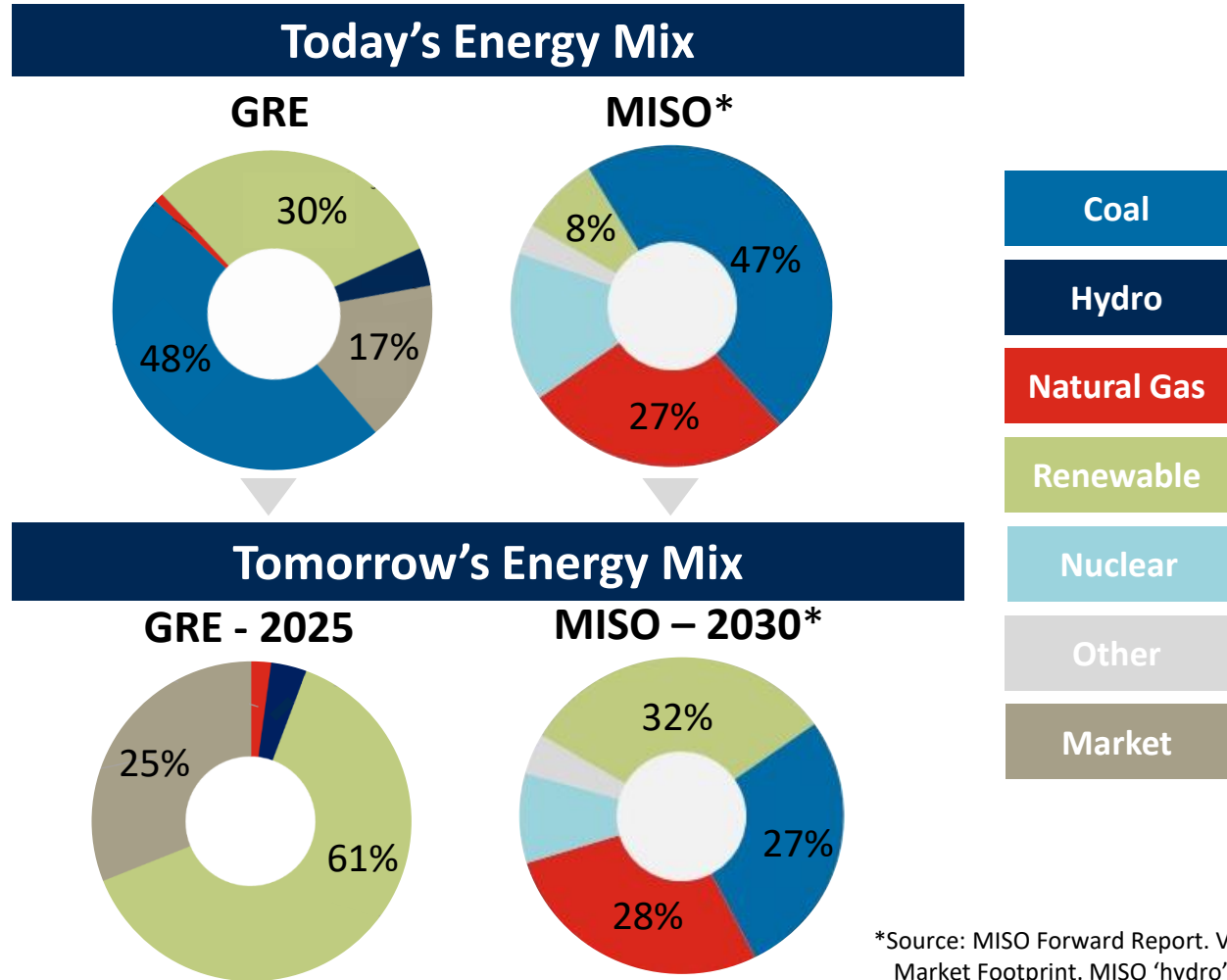
May 24, 2021

Great River Energy and our 28 member-owners

Collective Strength



Generation fleet transformation is driving the need for strategic transmission investments



*Source: MISO Forward Report. Values for the MISO Market Footprint. MISO 'hydro' included in 'other'

Values as of June 2020

Collaboration is key to enabling our combined goals reliably and affordably

Great River Energy

- 28 member-owner cooperatives
- ~700,000 member-consumers
- \$1.7 billion invested
- 5,508 miles transmission
- 111 transmission substations



MISO

- Independent, fuel-neutral, and not-for-profit grid operator responsible for maintaining reliability for 15 states
- Serves 42M customers
 - 52 transmission owners
 - 426 market participants
 - \$25B energy market



Grid North Partners

An evolution of CapX2020

- Joint initiative to upgrade and expand the electric grid to ensure continued reliable service for customers
- 10 utilities
 - Four states
 - 800+ miles of transmission completed

Multi-dimensional approach used to enable the generation fleet evolution



ISSUE IDENTIFICATION

Determination of needs for today and tomorrow to affordably maintain reliability. Root cause analysis for why transmission congestion is higher than projected.



NEAR-TERM OPTIONALITY

Solutions to reduce current congestion and provide greater renewable access with a shorter implementation timeline. Options complementary to longer-term solutions.



LONG-TERM SOLUTIONS

Development of a regional transmission plan for the next decade+ which allows a transformational evolution of our fleet while maintaining reliability and increasing resiliency.

ISSUE IDENTIFICATION



*“If you love wind, you must
love transmission”*

Clair Moeller – MISO President & COO

The previous buildout, completed in 2017, was a model of success - balancing least regrets with future scalability

The CapX2020 initiative successfully executed expansion of over 800 miles of transmission in four states

- ▶ Enabled the interconnection of over 4,000 MW of wind generation
- ▶ Continued reliable service for customers
- ▶ Complemented a wider multi-state transmission expansion
- ▶ Future expansion enabled on the same structures (some already developed)
- ▶ Each project required 8 to 13 years from concept to energization



The pace of change has exceeded expectations and continues to accelerate

Year 2030 Projected Total Installed Renewables in the Upper Midwest (nameplate capacity)

Projection 5 years ago¹

11 GW

Current projection²

20 GW

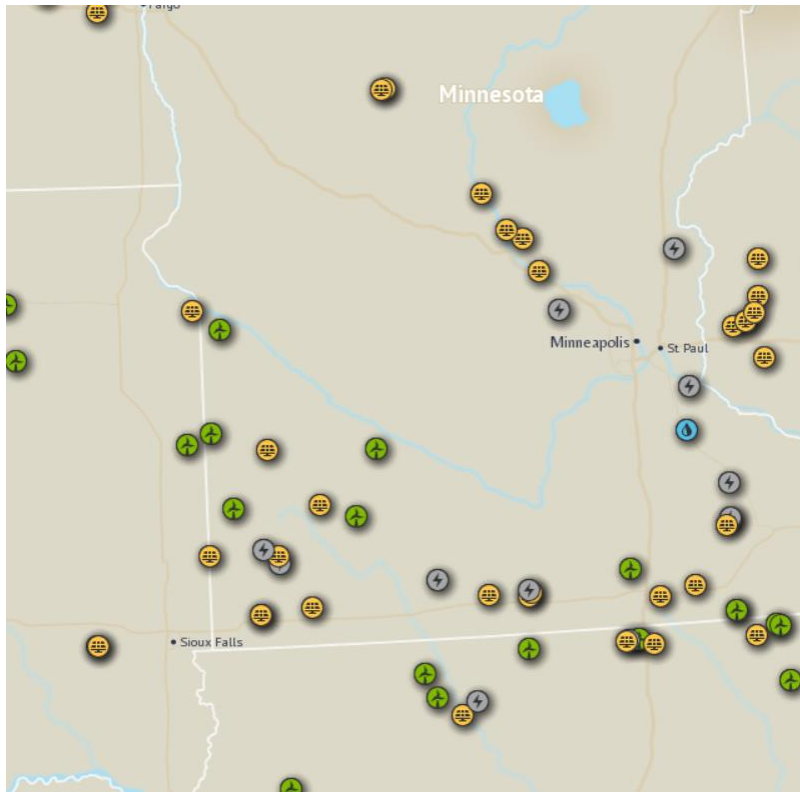
Current installed renewables: 11 GW

Image source: CERTs

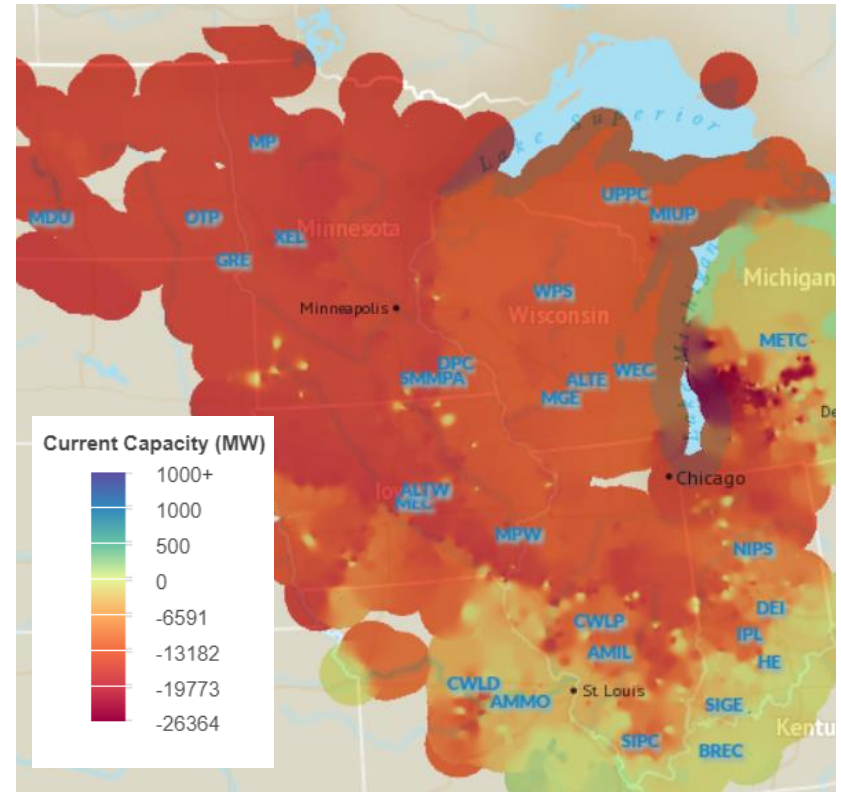
1. Source: MISO MTEP17 MVP analysis
2. Based on public announcements as of Q2 2020

Today, available transmission capacity is scarce

Interconnection Queue

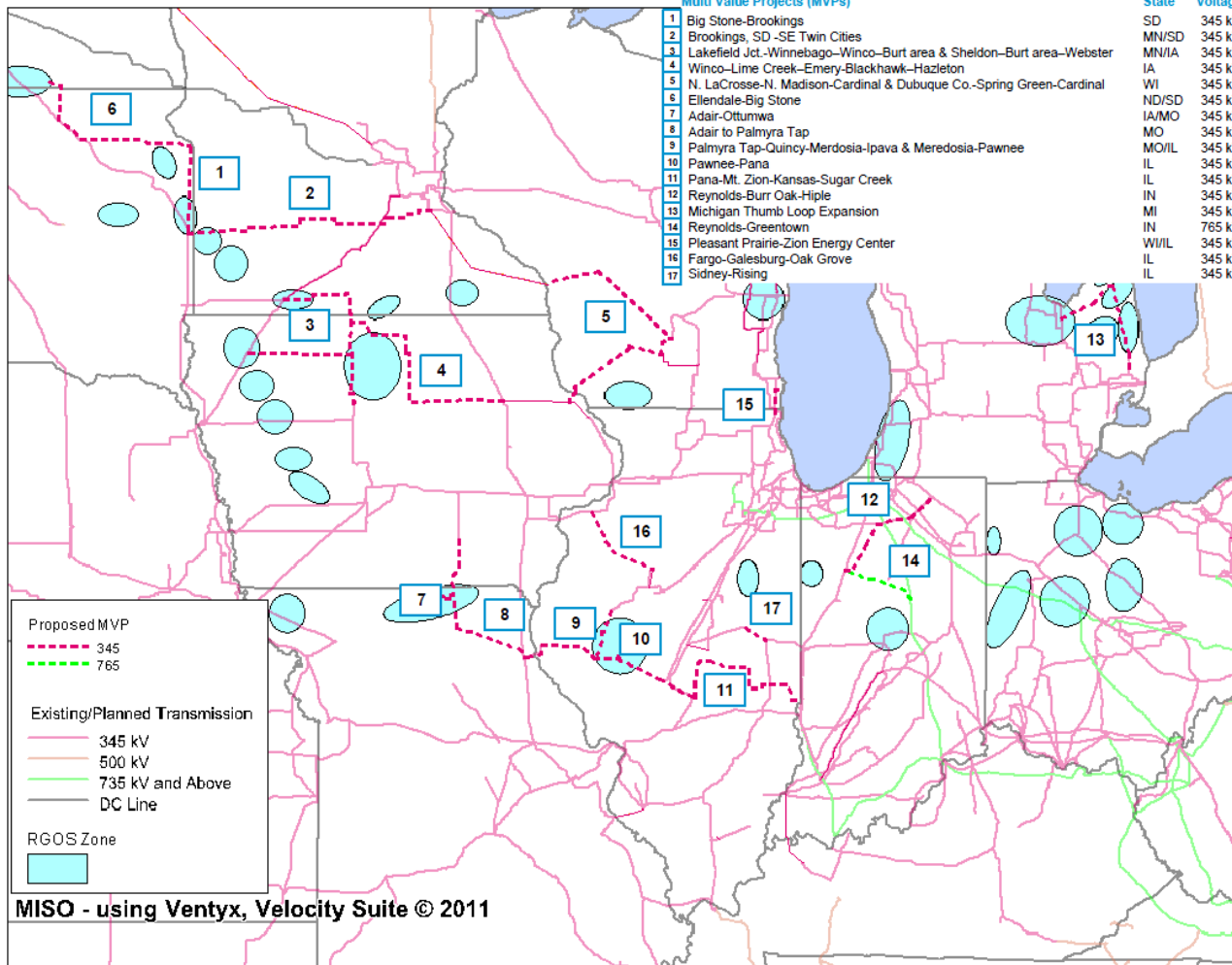


Available Interconnection Capacity



Images sources: MISO – Dated 5/20/21

While Multi-Value Projects created substantial transmission capacity for wind, today lines are fully subscribed



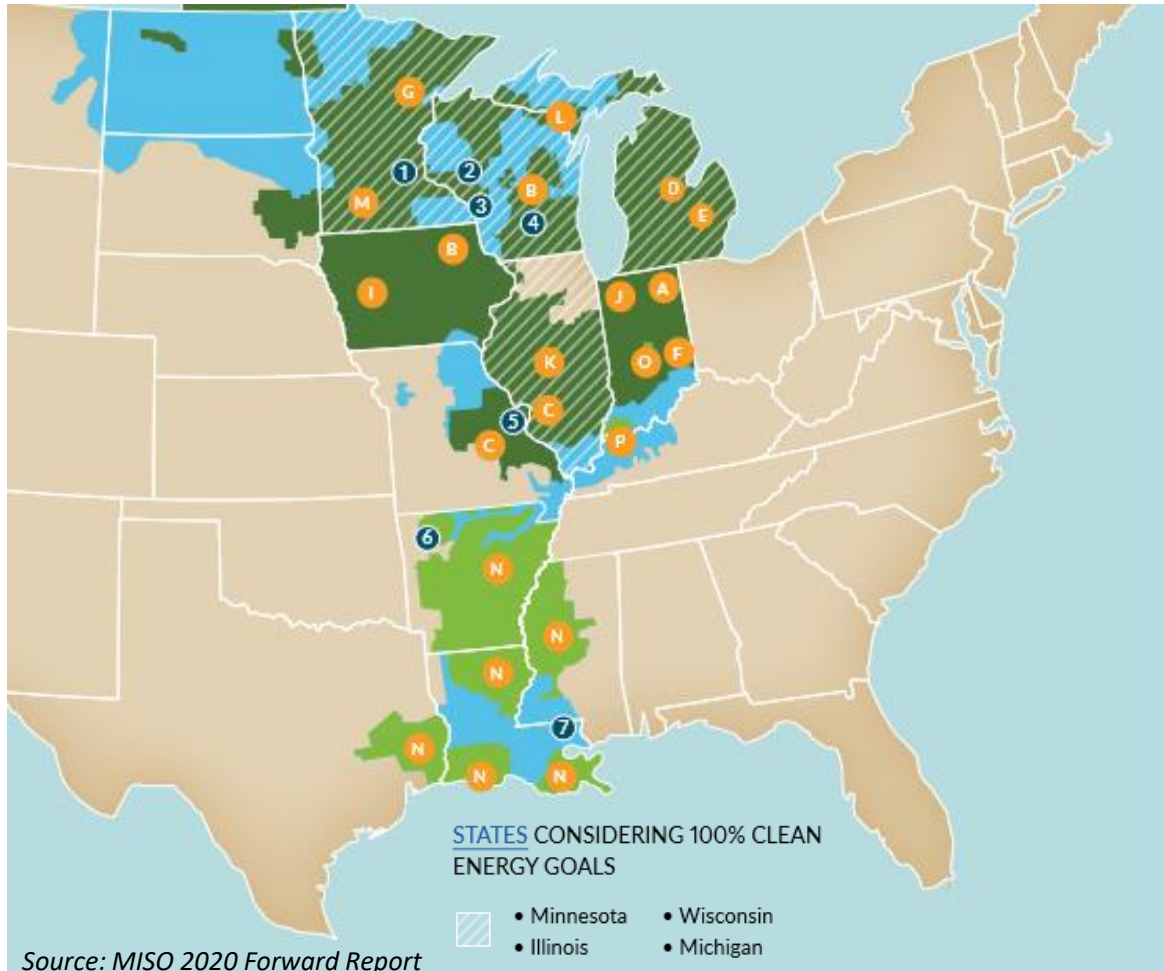
Multi-Value Projects (MVP) in MISO

- State policy driven
- 17 projects, enabling 30+ GW of wind
- Eight years of planning

“The 2011 MVP portfolio analysis was based on the need to economically and reliably help states meet their public policy needs... MVP portfolio analysis focused on identifying and increasing the benefits of the transmission portfolio, including the reliability, economic and public policy drivers... in a manner where its economic benefits exceed its costs.”

[2017 MVP TRIENNIAL REVIEW REPORT](#)

Minnesota is a leader in fleet evolution, but the regional nature of the grid requires everyone else to come along



MISO States, Cities, and Utilities with Decarbonization or Clean Energy Goals

CITIES WITH 100% CLEAN ENERGY GOALS

- | | |
|---|----------------------|
| 1 Minneapolis, Minn.
St. Paul, Minn. | 5 St. Louis, Mo. |
| 2 Eau Claire, Wis. | 6 Fayetteville, Ark. |
| 3 La Crosse, Wis. | 7 Abita Springs, La. |
| 4 Madison, Wis. | |

UTILITIES WITH 80%+ TARGETS

- A. [AEP](#)
- B. [Alliant](#)
- C. [Ameren](#)
- D. [Consumers](#)
- E. [DTE](#)
- F. [Duke](#)
- H. [Manitoba Hydro \(achieved, not a target\)](#)
- I. [MidAmerican](#)
- J. [Northern Indiana Public Service](#)
- K. [Vistra](#)
- L. [WEC Energy Group](#)
- M. [Xcel](#)

UTILITIES WITH 50%+ TARGETS

- G. [Great River Energy](#)
- N. [Entergy](#)
- O. [Indianapolis Power and Light](#)
- P. [Vectren/SIGE](#)

NEAR-TERM OPTIONALITY



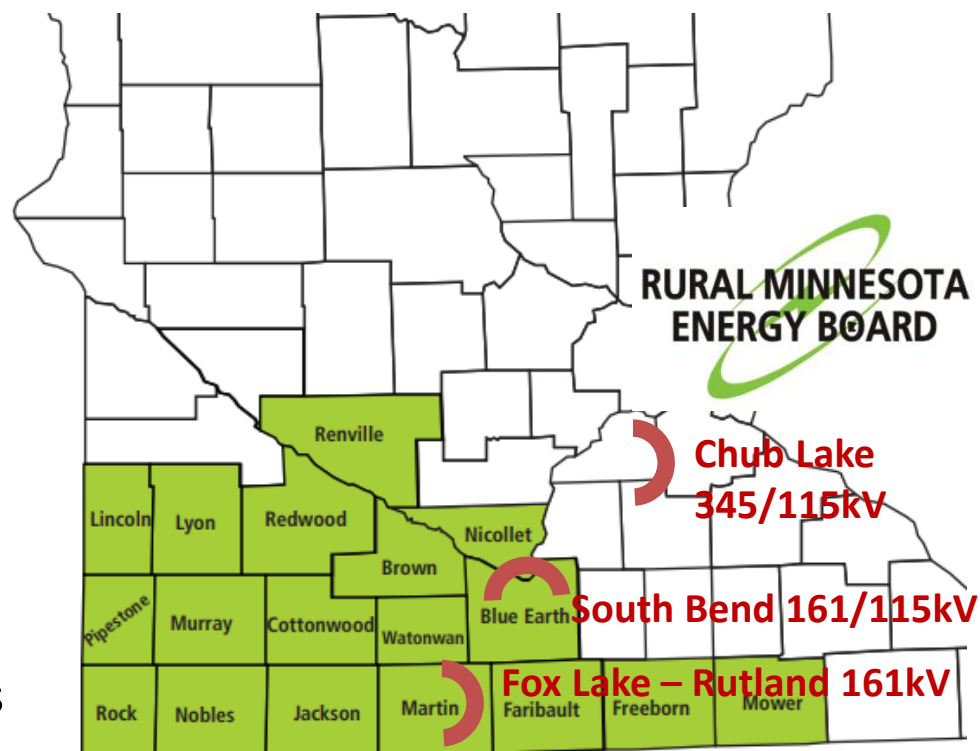
“The variability of non-dispatchable resources, even within a single day, could lead to several thousands of MW being transferred across the transmission system, with reversals in direction of flow occurring in an equal, but opposite magnitude during the same day”

CapX2050 Transmission Vision Report

Currently, congestion is preventing SW MN wind generators to produce to their full potential

- ▶ Currently, most local congestion driven by transmission outages to construct new transmission lines and planned generation outages
- ▶ As renewable penetrations rise constraints outside MN become limiting factor for MN generation
- ▶ In MISO, intermittent generation not required to “reserve” transmission space for 100% of output *e.g.*, this creates a condition for congestion
- ▶ Generation development outpaces transmission development

Key constraints causing congestion in 2021



GRE is working with MISO on implementing operational solutions to decrease congestion in the near-term



- ▶ Develop system reconfiguration recommendations (permanent and temporary) based on expected outages and congestion patterns
- ▶ Implement low-lead-time transmission solutions
- ▶ Explore greater use of ambient adjusted line ratings
- ▶ Collaborate with other parties affected by the same congestion patterns to increase impacts

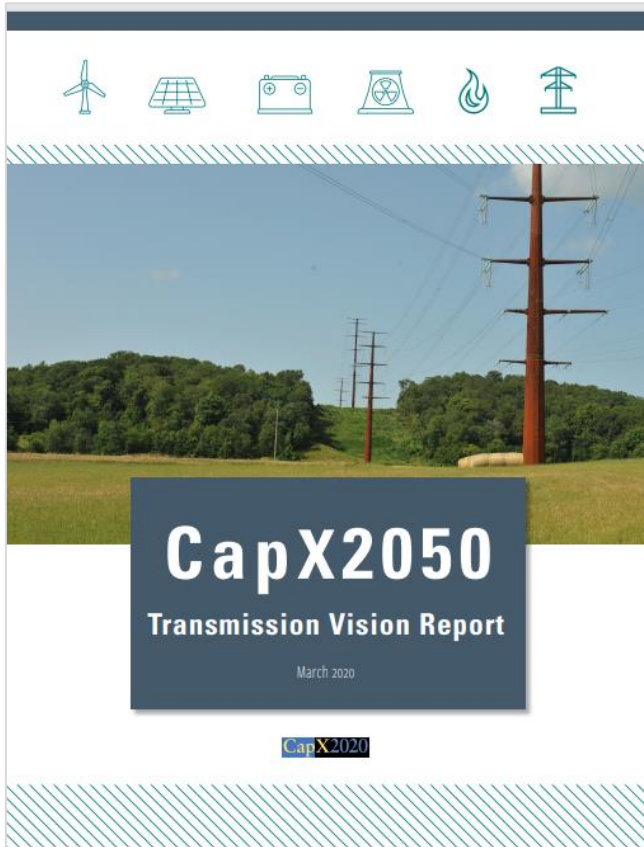
LONG-TERM SOLUTIONS



On regional transmission needs: “It’s not cost-effective to build the highway one lane at a time”

Pam Quinlan – Federal Energy Regulatory Commission (FERC) Chief of Staff

CapX2050 Transmission Vision Report identified key considerations for long-term solutions



KEY CONSIDERATIONS

- 1** Dispatchable resources support the electric grid in ways that wind and solar resources presently cannot
- 2** The ability for system operators to meet real-time operational demands will be more challenging
- 3** More transmission infrastructure will be needed in the Upper Midwest to accommodate the transition of resources
- 4** Wind and solar resources alone will be incapable of meeting all consumer energy requirements at all times

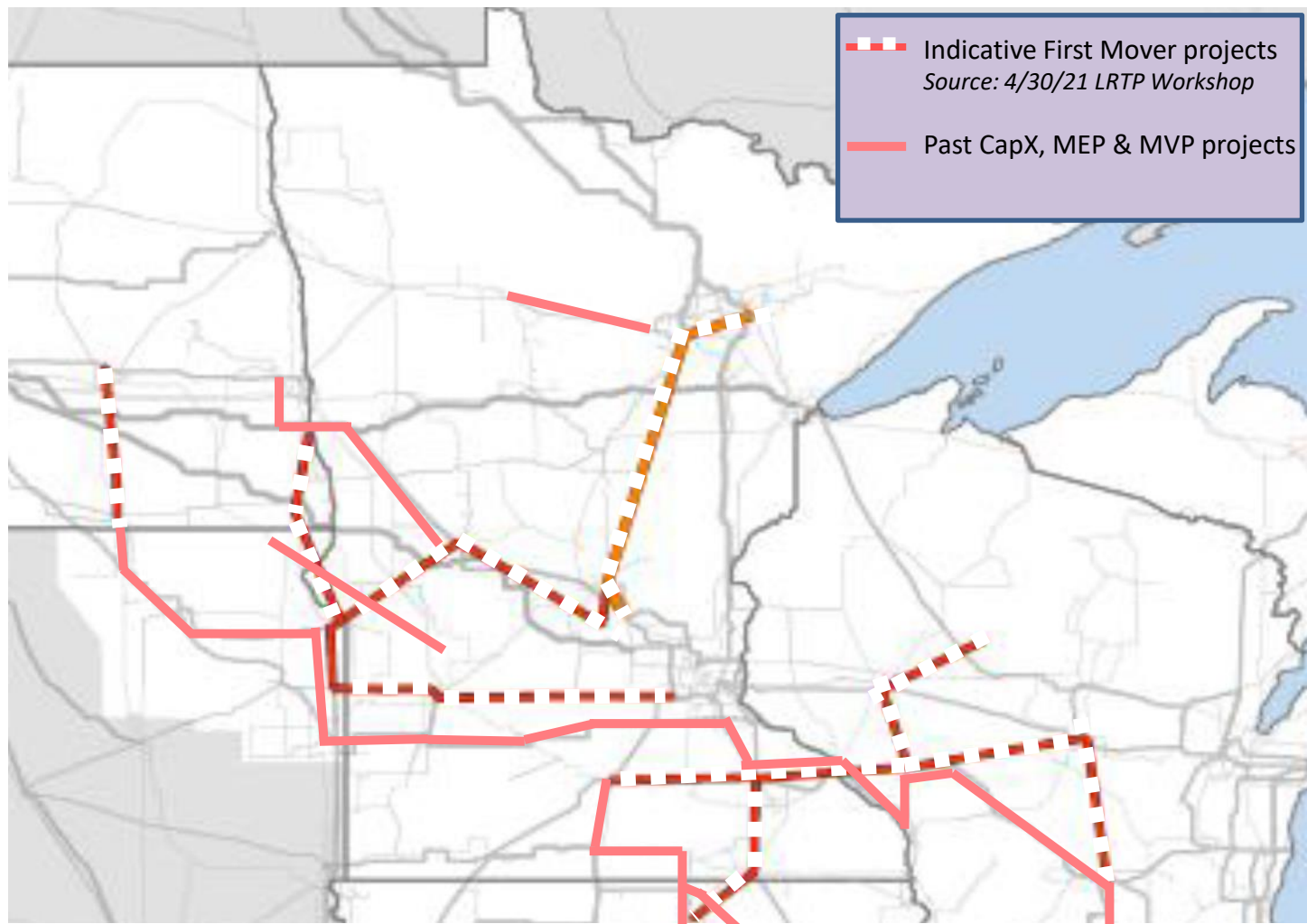
**We are actively partnering with MISO to identify
a long-term optimal transmission plan**

\$10B - \$30B



MISO estimated regional transmission investment to integrate the changing fleet for the 15-state region over the next decade

MISO is presently undertaking a multi-year long range transmission planning effort



Cost allocation remains the largest barrier to regional transmission development

Consensus in principle that costs should be distributed commensurate with benefits, but challenges in details around granularity, metrics, and certainty:

- ▶ **Granularity:** As each state and utility has different policy goals, allocation must capture multiple benefits including regional (pooling), reliability, and a fair share.
- ▶ **Metrics:** Previously transmission need was often a single driver, going forward transmission must simultaneously address multiple needs – some difficult to quantify.
- ▶ **Certainty:** Transmission is a 40+ year investment, cost allocations must balance what we know (historical trends) with what could be (future trends).

Minimizing impacts is a key consideration in all solution development

Consider
**EMERGING
TECHNOLOGY**



Connexus Energy Storage project – Ramsey, MN
Source: PV Magazine

Best utilize
**EXISTING
CORRIDORS**



Route selection for
Fargo – Monticello 345-kV line

Improve
**SYSTEM
RESILENCY**



2019 Winter Storm Wesley

Going forward

- ▶ We must act! On average it requires 8-10 years for transmission development
- ▶ Anticipate significant new regional transmission beginning in the next 10 years
- ▶ Collaboration is essential and GRE is helping drive many regional efforts to maintain reliability, affordability, and safety
- ▶ Accelerated pace of change will challenge all aspects of our industry

