



The MISO Grid: Transmission Plans and Market Trends

CSG Midwest, BILLD Legislative Conference
Madison, WI

Brian Tulloh*, Executive Director-External Affairs
August 29, 2022

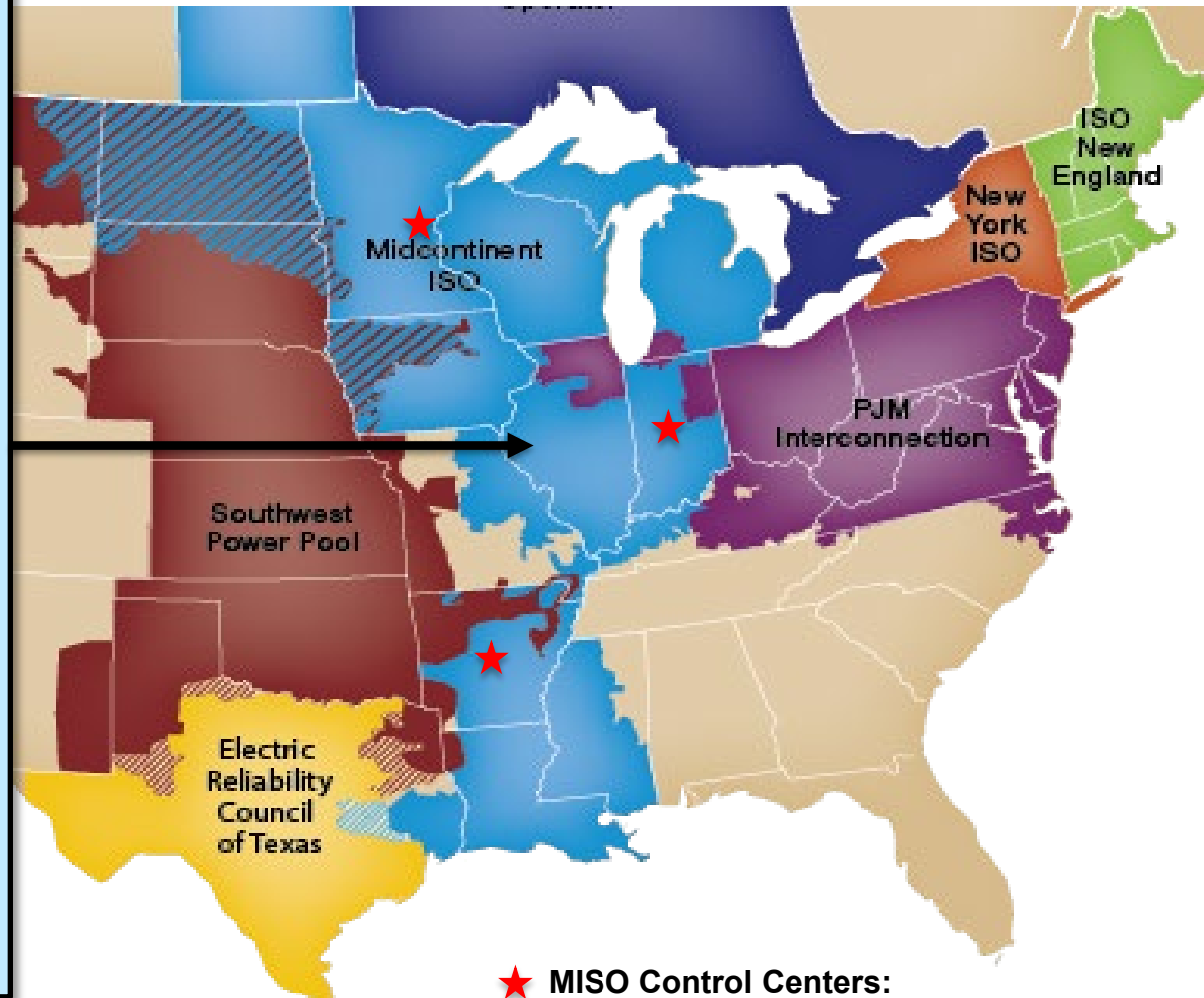
*email: btulloh@misoenergy.org

MISO & neighboring U.S. electric grid operators

MISO

(Midcontinent Independent System Operator)

- 15 states + Manitoba
- 42 million customers
- \$25 - 30 billion annual market
- > 6,600 generation units with >170,000 MW of capacity
- 68,500 miles of high voltage transmission lines
- > 190 member utilities
- > 460 market participants



★ MISO Control Centers:
Eagan, Indianapolis (HQ), Little Rock

What does MISO do?

1. Efficient Wholesale Market Management & Operations to Ensure Reliability

- Conduct day-ahead and real-time energy and operating reserves markets
- Manage least-cost, economic dispatch of generation units
- Monitor and schedule energy transfers on the high voltage transmission system



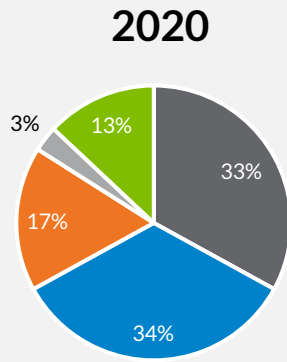
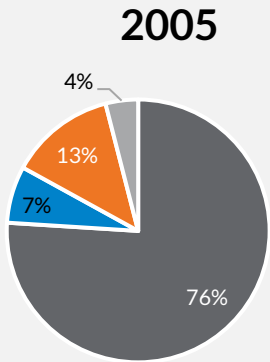
2. Comprehensive Regional Transmission Planning

- Long-range transmission planning
- New generator interconnection and retirement
- Long-range studies, such as Renewable Integration Impact Assessment (RIIA)

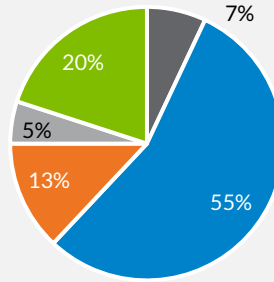
MISO's Vision: Be the most reliable, value-creating RTO

MISO's actions as part of the Reliability Imperative address emerging needs on the system as member resource fleets evolve

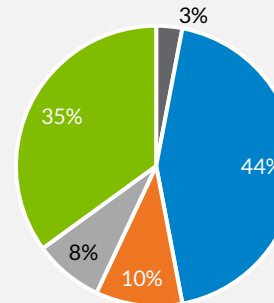
Resource fleet transition within MISO (% of energy generation)



2030 (Future 1)



2030 (Future 3)



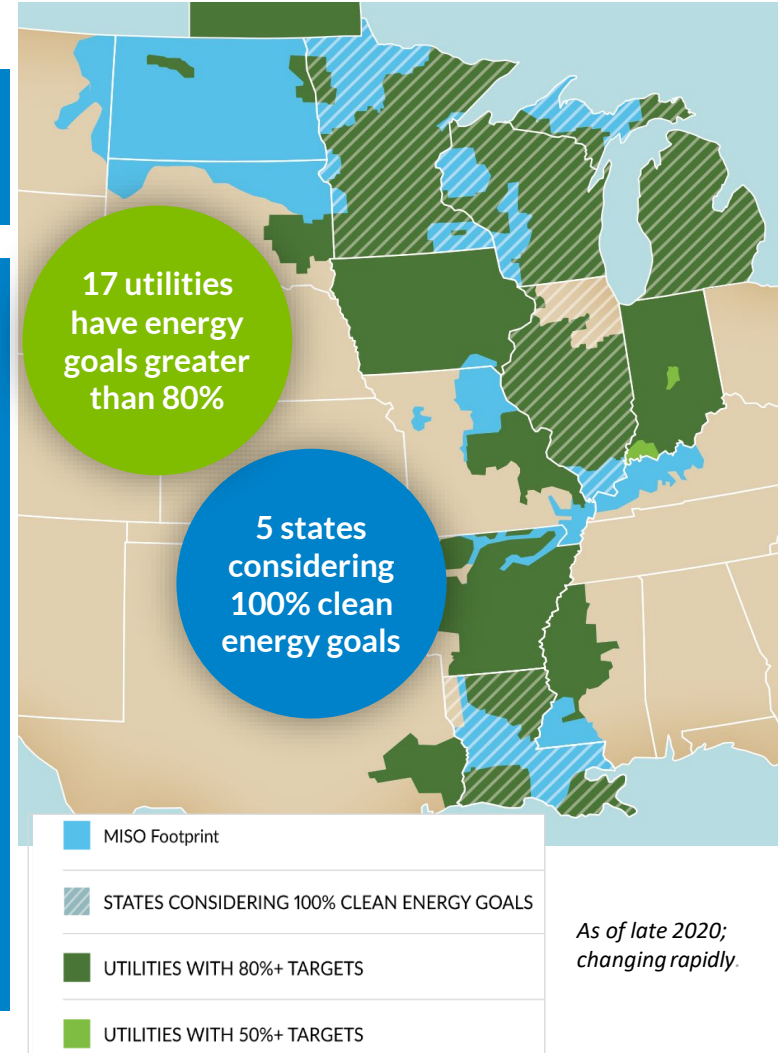
Long Range Transmission Planning (L RTP) is a key pillar of MISO's response to the region's Reliability Imperative

Trends:

- Accelerating retirement of traditional resources
- Increasing customer demand for renewables (~140 GW in interconnection queue, predominately solar)
- More decentralization (distributed resources) and electrification
- Increasing extreme events ...

MISO's Long Range Transmission Planning (LRTP) uses three "Futures" to incorporate & bookend uncertainty

Future 1	Future 2	Future 3
<ul style="list-style-type: none"> The footprint develops in line with 100% of utility IRPs and 85% of utility announcements, state mandates, goals, or preferences. Emissions decline as an outcome of utility plans. Load growth consistent with current trends. 	<ul style="list-style-type: none"> Companies/states meet their goals, mandates and announcements. Changing federal and state policies support footprint-wide carbon emissions reduction of 60% by 2040. Energy increases 30% footprint-wide by 2040 driven by electrification 	<ul style="list-style-type: none"> Changing federal and state policies support footprint-wide carbon emissions reduction of 80% by 2040. Increased electrification drives a footprint-wide 50% increase in energy by 2040.



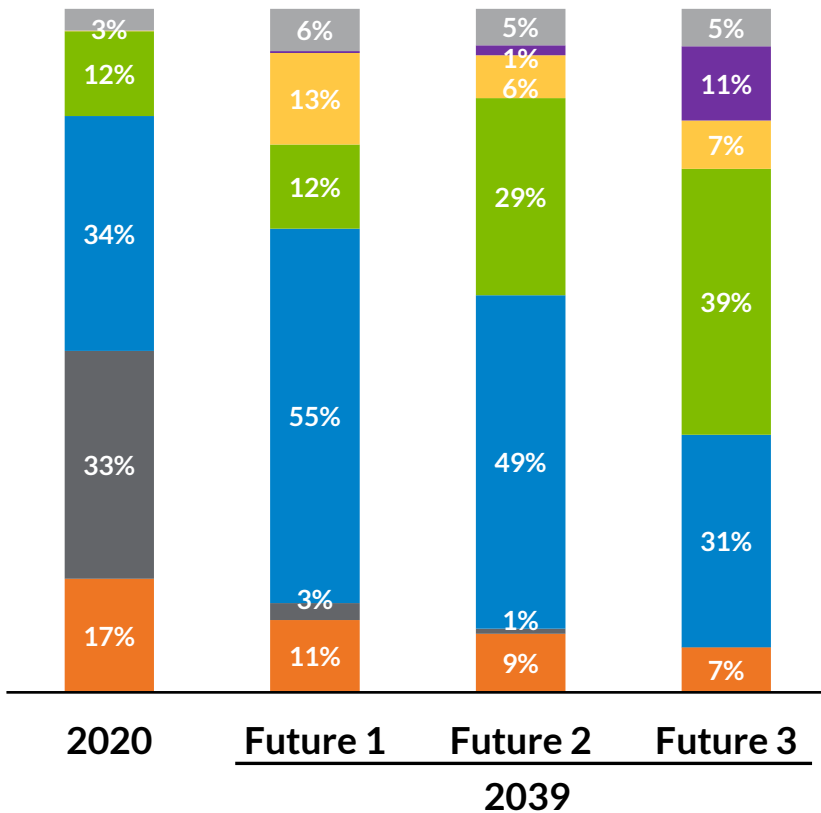
As of late 2020; changing rapidly.

IRP = Integrated Resource Plan

See: [MISO Futures Report for details.](#)

Future scenarios incorporate and build upon member plans to inform the resource transition and changing demand patterns

Generation Energy Mix



■ Nuclear ■ Coal ■ Gas ■ Wind ■ Solar ■ Battery ■ Other

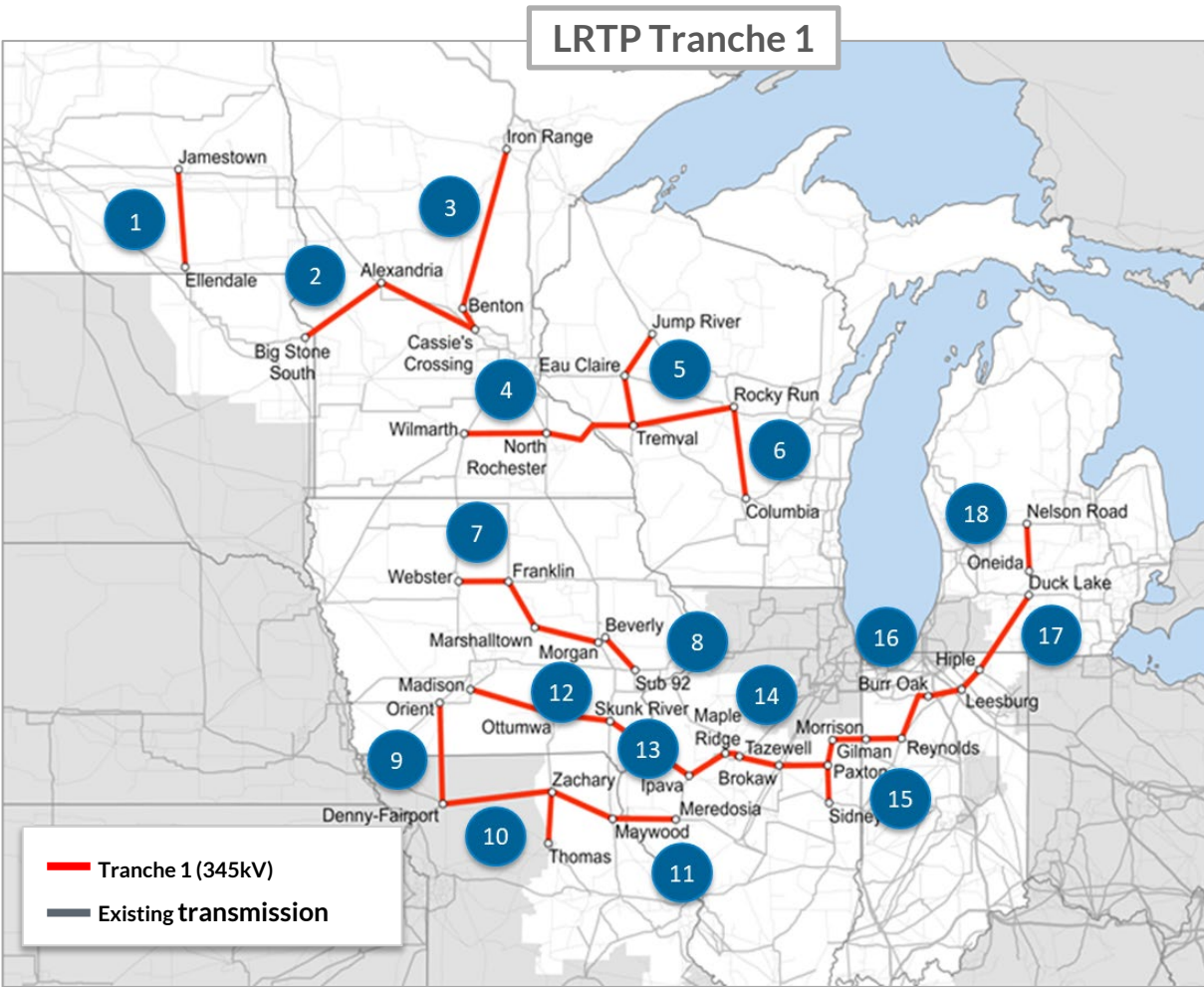
By 2039...

	Future 1	Future 2	Future 3
Additions	121 GW	170 GW	306 GW
Retirements	77 GW	80 GW	112 GW
Peak Load	136 GW	148 GW	164 GW
Emissions*	↓ 63%	↓ 65%	↓ 81%

* Resulting CO₂ emission reductions relative to 2005 levels

[See: MISO Futures Report for details.](#)

Tranche 1 represents the first iteration and includes 18 projects across the MISO Midwest subregion estimated at \$10.3 billion



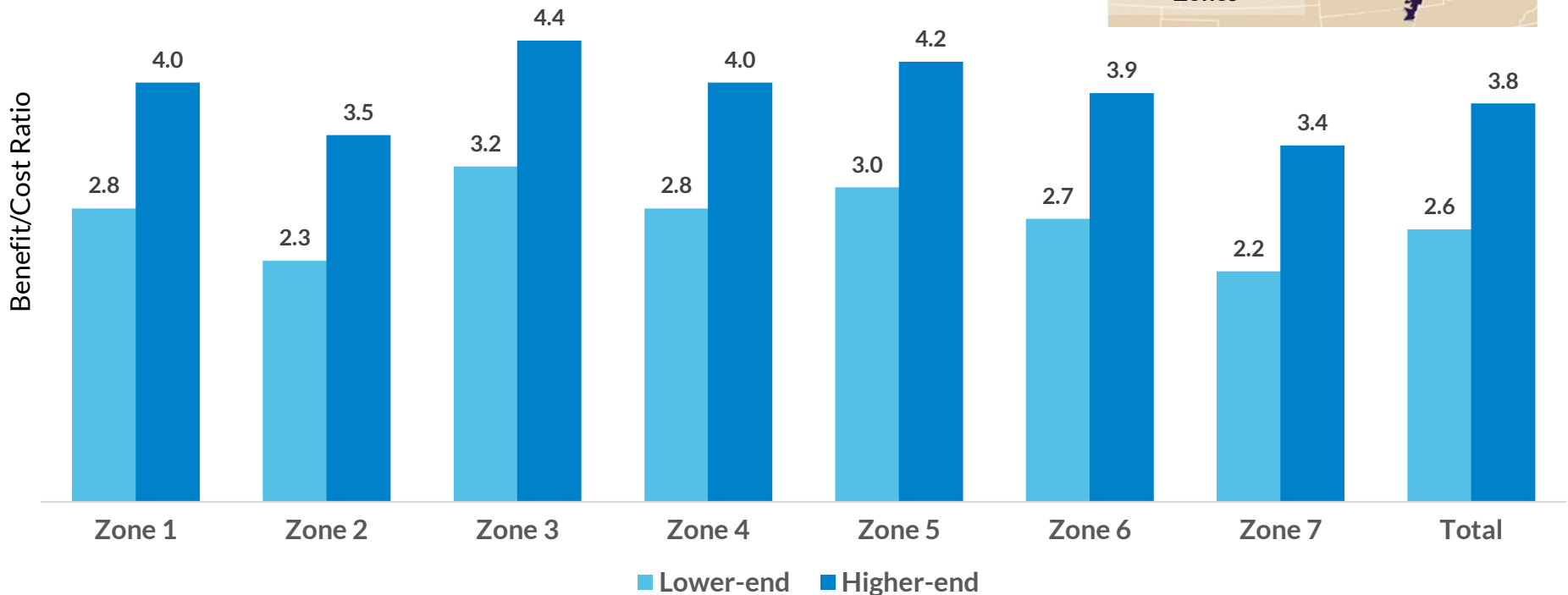
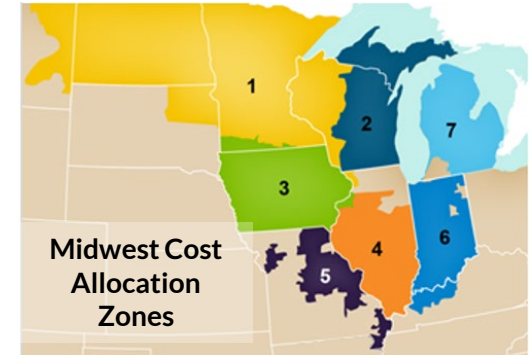
ID	Project Description	Est. Cost (\$M, 2022)
1	Jamestown – Ellendale	\$439M
2	Big Stone South – Alexandria – Cassie’s Crossing	\$574M
3	Iron Range – Benton County – Cassie’s Crossing	\$970M
4	Wilmarth – North Rochester – Tremval	\$689M
5	Tremval – Eau Clair – Jump River	\$505M
6	Tremval – Rocky Run – Columbia	\$1,050M
7	Webster – Franklin – Marshalltown – Morgan Valley	\$755M
8	Beverly – Sub 92	\$231M
9	Orient – Denny - Fairport	\$390M
10	Denny – Zachary – Thomas Hill – Maywood	\$769M
11	Maywood – Meredosia	\$301M
12	Madison – Ottumwa – Skunk River	\$673M
13	Skunk River – Ipava	\$594M
14	Ipava – Maple Ridge – Tazewell – Brokaw – Paxton East	\$572M
15	Sidney – Paxson East – Gilman South – Morrison Ditch	\$454M
16	Morrison Ditch – Reynolds – Burr Oak – Leesburg – Hiple	\$261M
17	Hiple – Duck Lake	\$696M
18	Oneida – Nelson Rd.	\$403M
Total Project Portfolio Cost		\$10.3B

Assumption on all in-service dates is by 2030

Costs as of 6/1/2022, and are subject to change (costs represent "overnight" costs)

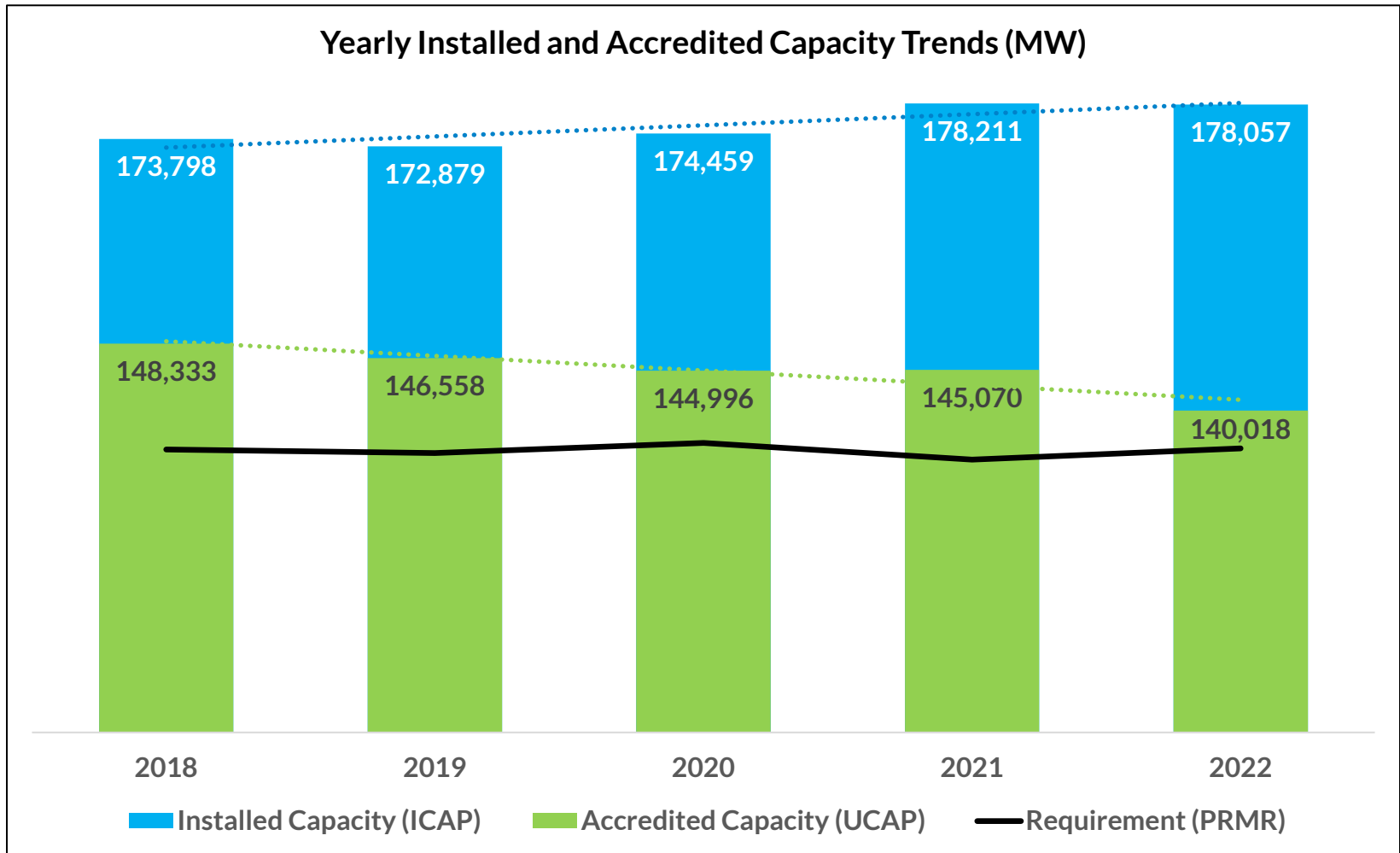
Benefits will be broadly distributed across the Midwest and deliver a benefit to cost ratio of at least 2.2 for all zones

Range of Benefit/Cost Ratio by Cost Allocation Zone
(20-year present value, 6.9% Discount Rate)



Values as of 6/1/2022

While total installed capacity has steadily trended up, accredited capacity is moving in the opposite direction due to the capabilities of the resource types selected



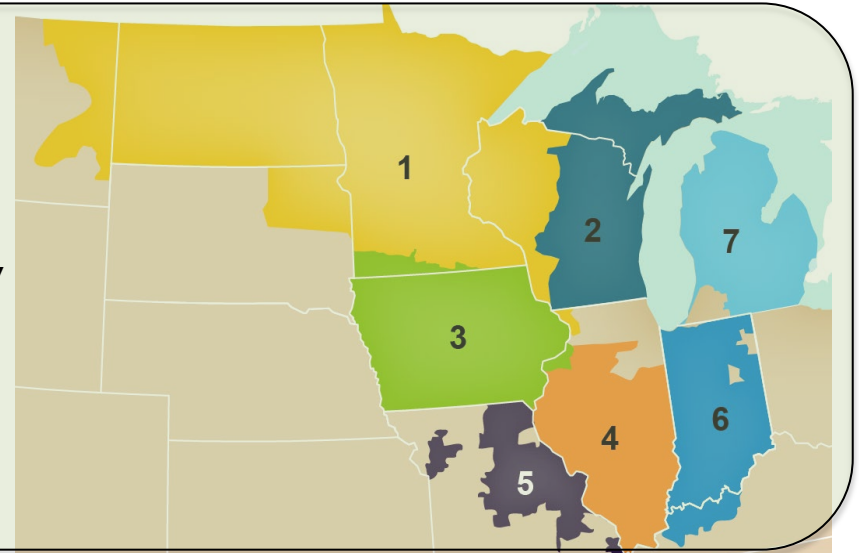
2022-23 PRA demonstrated capacity shortfalls in MISO North/Central resulting in capacity prices equal to CONE

MISO's North/Central sub-region

Capacity **shortage**: ~ 1,200 MW

Auction clearing price: ~ \$237/MW-day
(CONE)

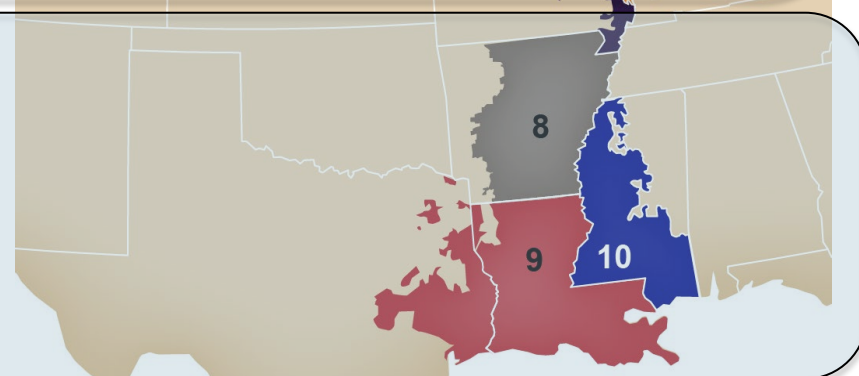
Load exposed to CONE: 8,000 MW



MISO's South sub-region

Capacity **surplus**: ~2,800 MW

Auction clearing price: ~ \$3/MW-day



And we will continue experience a growing and widening gap between resources and availability if the transition continues outpacing our ability to adapt



Decline in dispatchable generation

(from 84% in 2020 to as little as 57% in 2030, Future 3)



Growing fuel uncertainty for coal and gas

(25% of coal units had concerns about winter fuel supply in 2021)



Less certainty around imports from neighbors

(as their regions experience the same challenges as MISO)



Increased forced outage rates

(driven by aging thermal units and increased weather-dependent units)

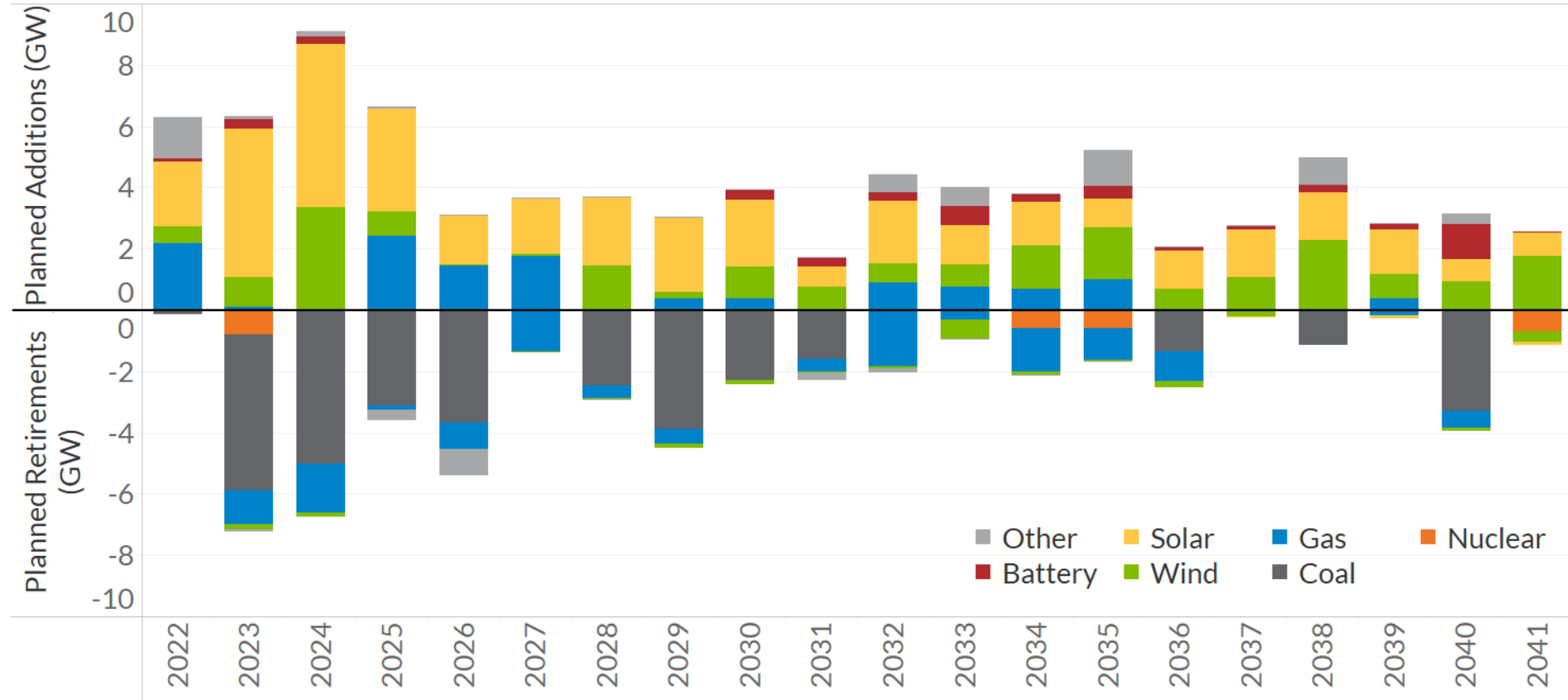


Public policy driving the pace of change

(e.g., EPA and state commissions driving fleet change and electrification)

MISO's preliminary 2022 Regional Resource Assessment shows addition of largely renewable resources, coupled with retirement of controllable resources...

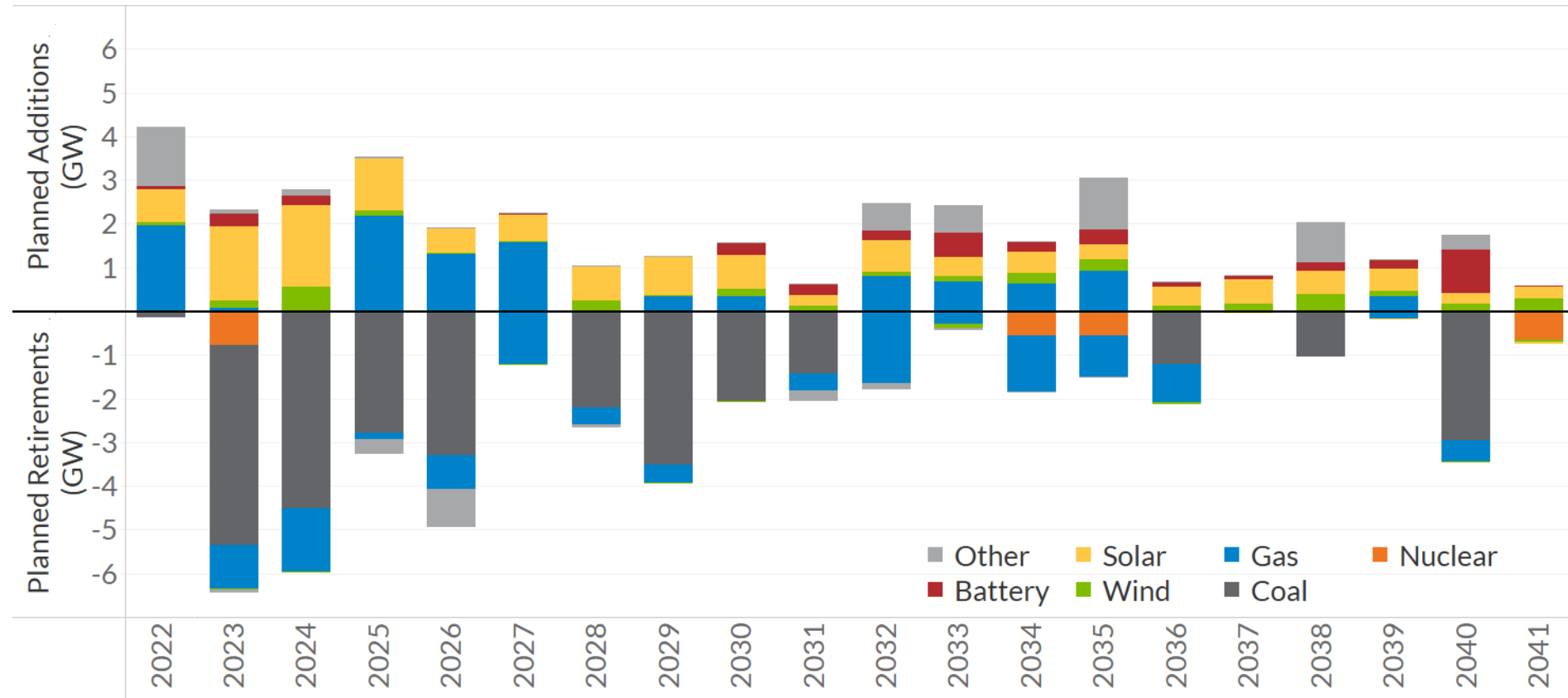
Nameplate Capacity
RRA 2022 Survey Results
Preliminary



The assessment includes information provided by members representing 75% of MISO's load

Looking at accredited capacity, planned additions are not on pace to make up for planned retirements

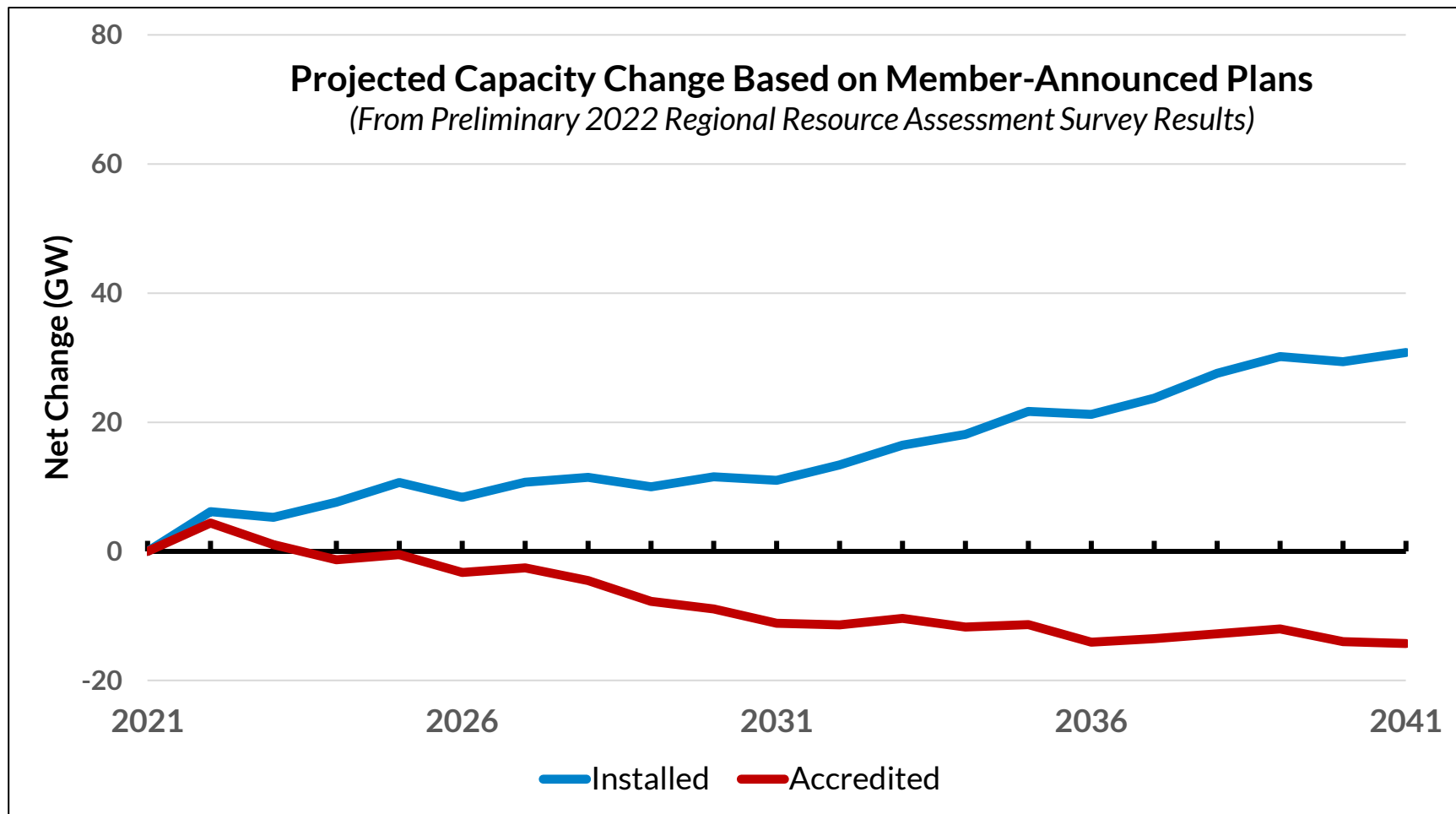
Estimated Accredited Capacity
RRA 2022 Survey Results
Preliminary



Estimated accredited capacity (% of nameplate):

~17% for wind; 35% for solar, ~ 88% for battery, 90% for coal, 90% for gas, and 95% for nuclear

Despite capacity additions, accredited capacity is projected to decline due to the rapid pace of retirements of controllable resources



*Future projections calculated as change from Future 1 2022 load assumption

Estimated accredited capacity: 16.6% for wind; 35% for solar, 87.5% for battery, 90% for coal, 90% for gas, and 95% for nuclear

MISO's Reliability Imperative efforts address the MISO changes that are necessary to reliably manage the changing resource portfolio

Market Redefinition

Aims to ensure that resources with needed capabilities and attributes will be available in the highest risk periods across the year

Long-Range Transmission Planning (LRTP)

Assesses future transmission needs holistically, reflecting utility/state plans for new generation; will also consider potential cost-allocation changes



Market System Enhancements (MSE)

Transforms MISO's legacy platform into a flexible, upgradeable, and secure system that can evolve for years to come; will also integrate advanced technologies to process increasingly complex information

Operations of the Future

Focuses on the skills, processes, and technologies needed to ensure MISO Operations can effectively manage the grid into the future under increased complexity