

Western Dakota Energy Association October 14, 2021

**The current electric grid in North
Dakota: maintaining reliability and
resilience**

**North Dakota
Transmission Authority**

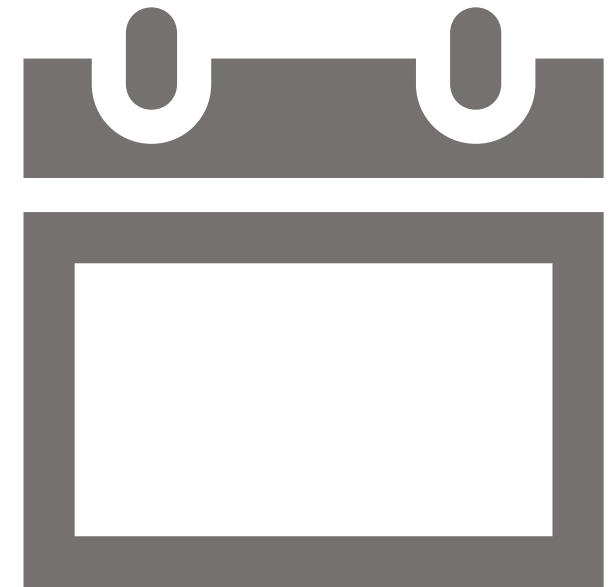
John Weeda

Director

October 14, 2021

North Dakota Transmission Authority (NDTA)

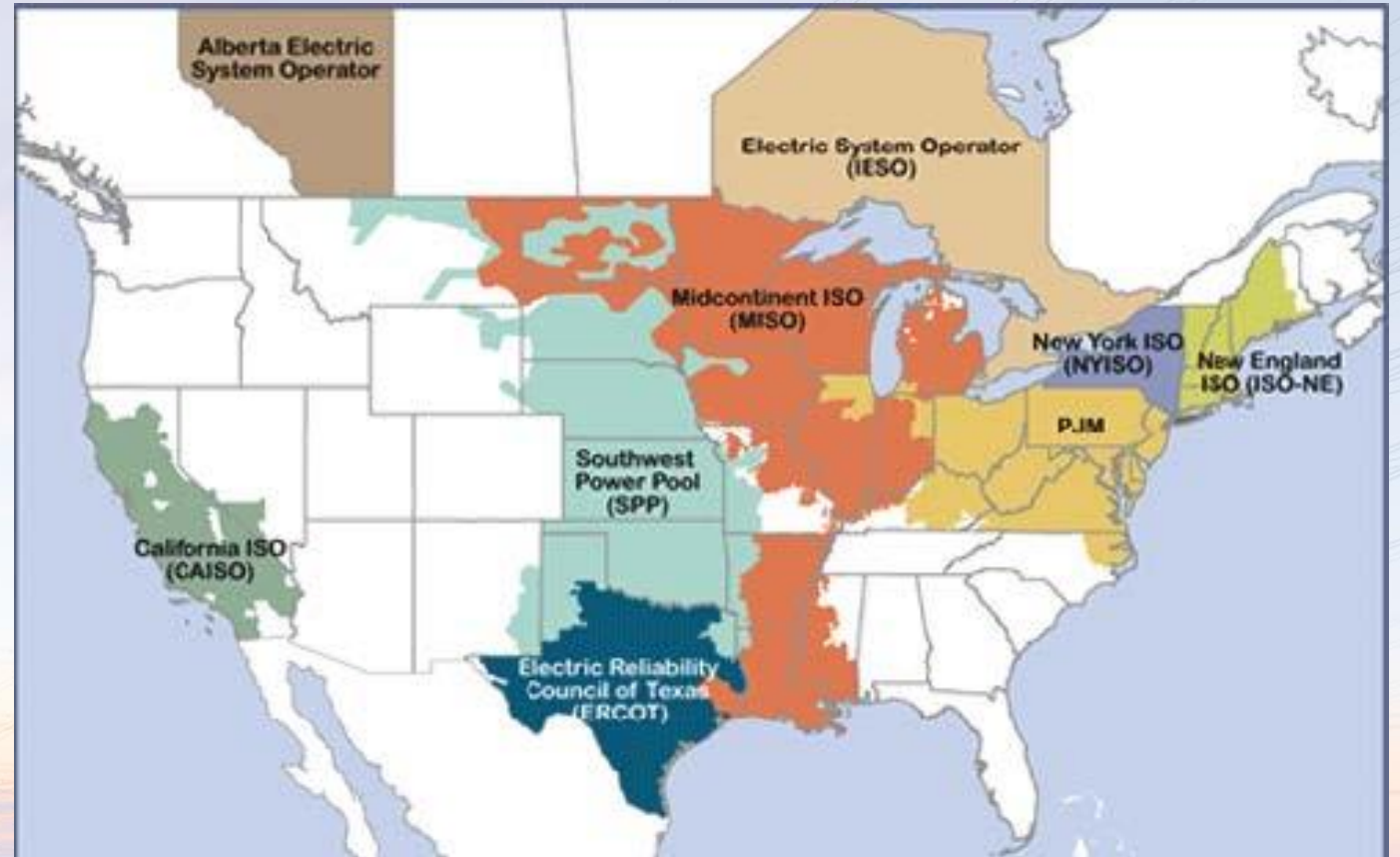
- Current Generation Resources and Utilization
- The current grid performance in ND
- MISO and SPP Transmission Studies
- Status of interconnection requests
- The challenges that lie ahead
- What opportunities will North Dakota have to grow while reducing the CO₂ footprint of exports



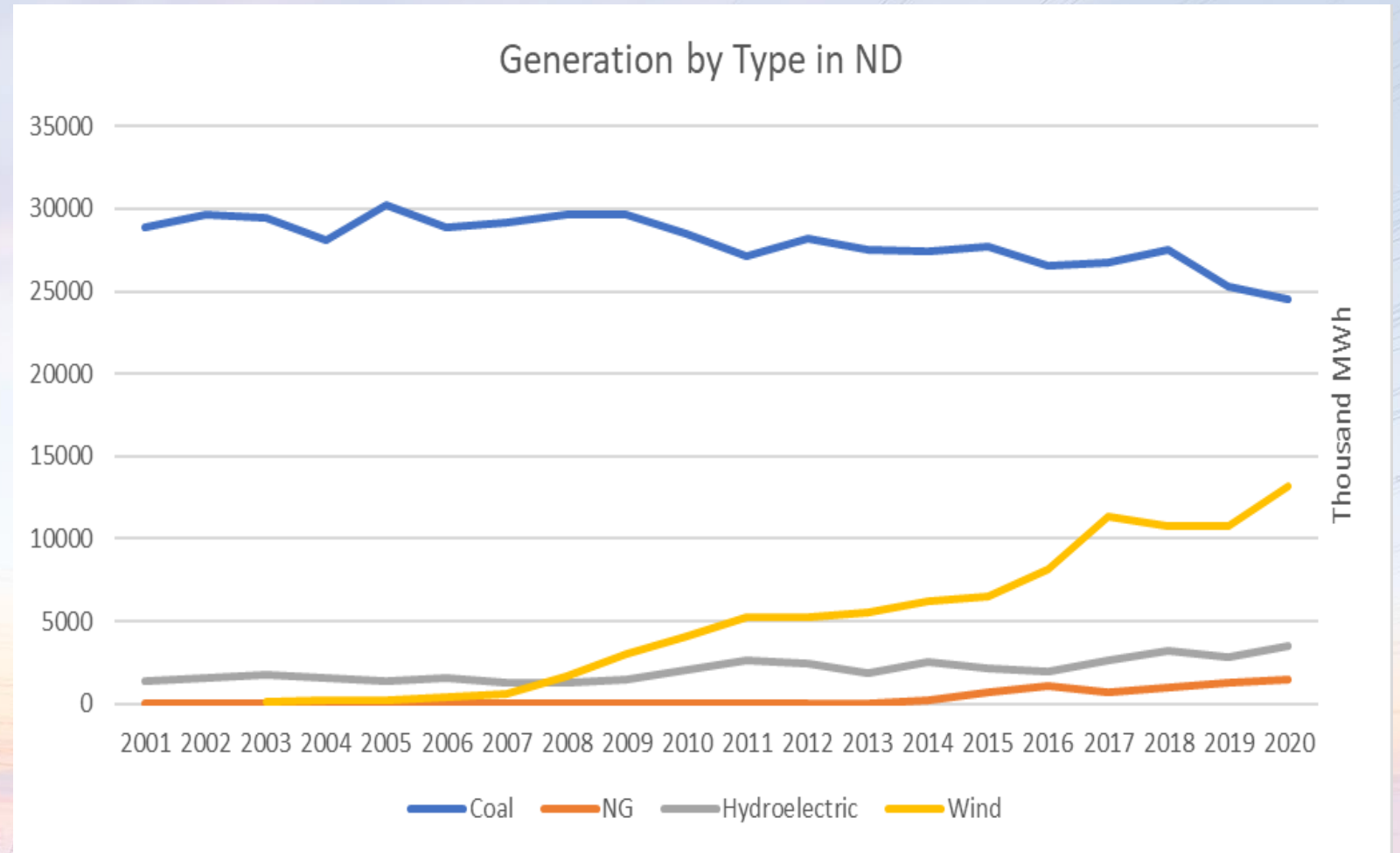
Current Generation Resources

- Renewable generation exceeds 4,000 MW with an average of 39.1% capacity factor. Newer wind projects are at 44.6% capacity factor thanks to newer technologies
- Coal fired thermal generation is at 4,048MW.
 - MDU plans to retire 100MW Heskett station in spring 2022
 - Rainbow Energy plans to close on purchase of Coal Creek Station this year
- Natural gas generation is at 586.3MW
- Hydro generation is at 614MW

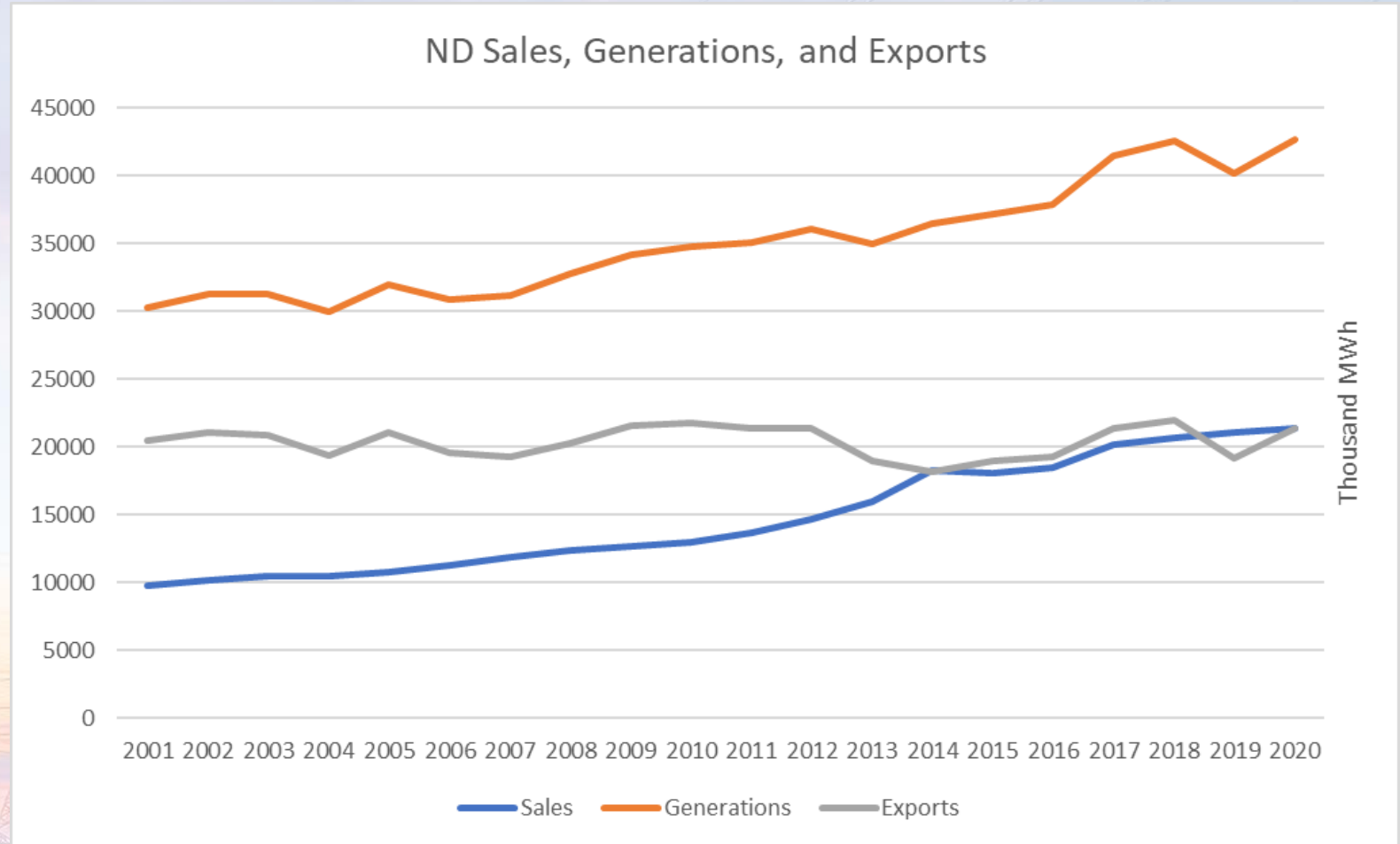
MISO and SPP Share North Dakota



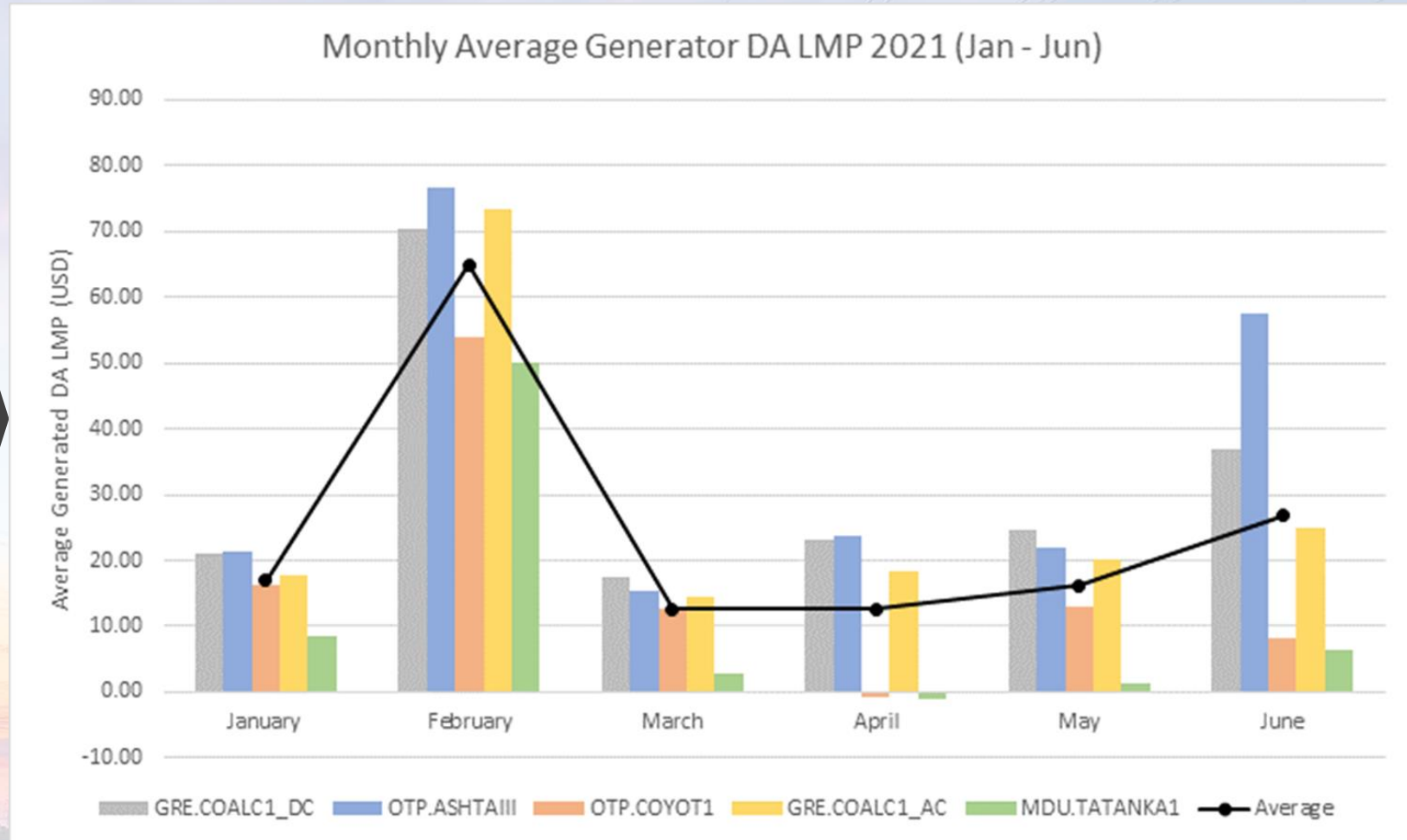
Generation by type in North Dakota



North Dakota Sales, Generations and Exports

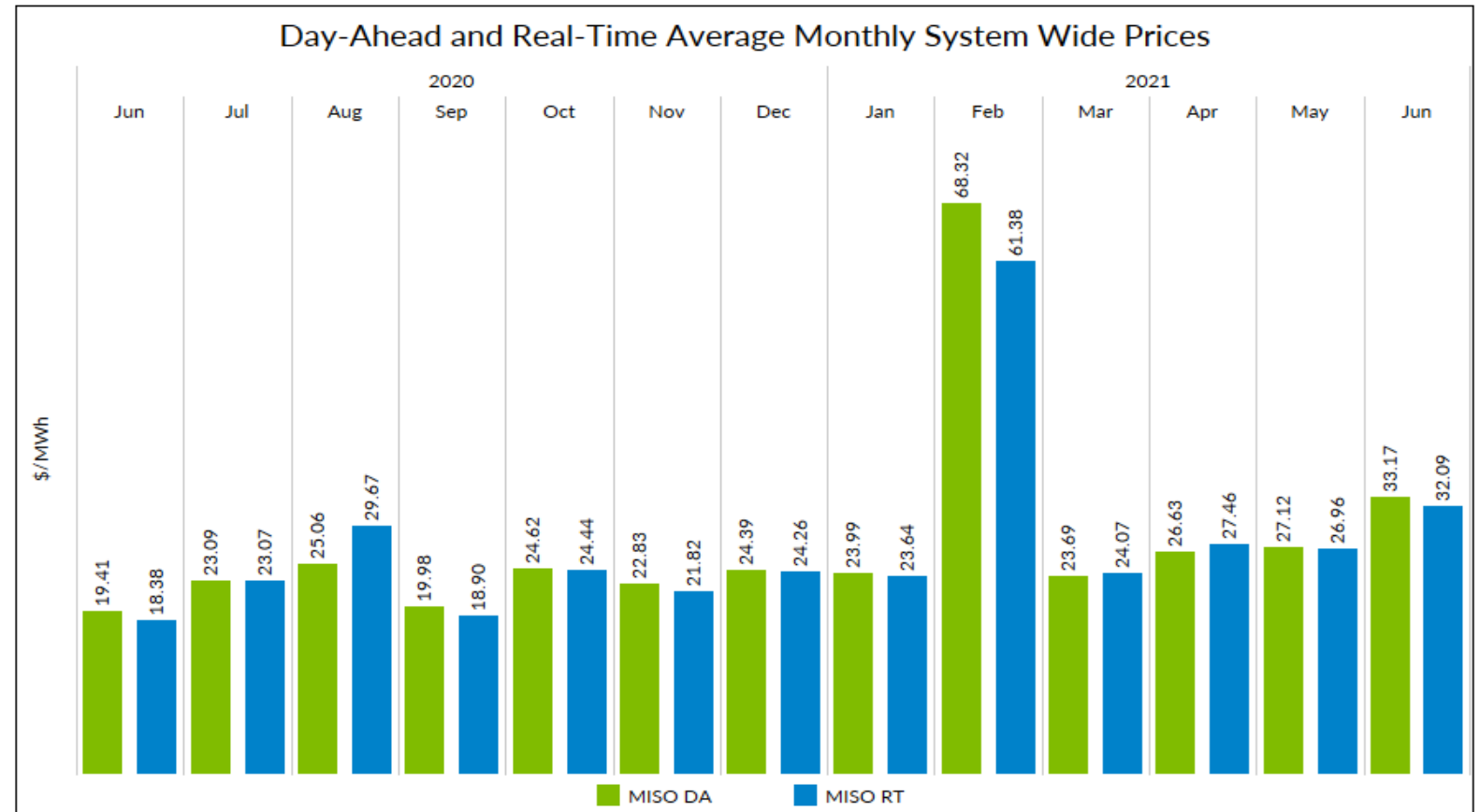


Impact in ND
nodes of one
Incident
(curtailment of
load by SPP)
on the market



MISO System-wide DA & RT Locational Marginal Pricing from February Incident

MISO System-wide Day-Ahead and Real-Time Locational Marginal Pricing

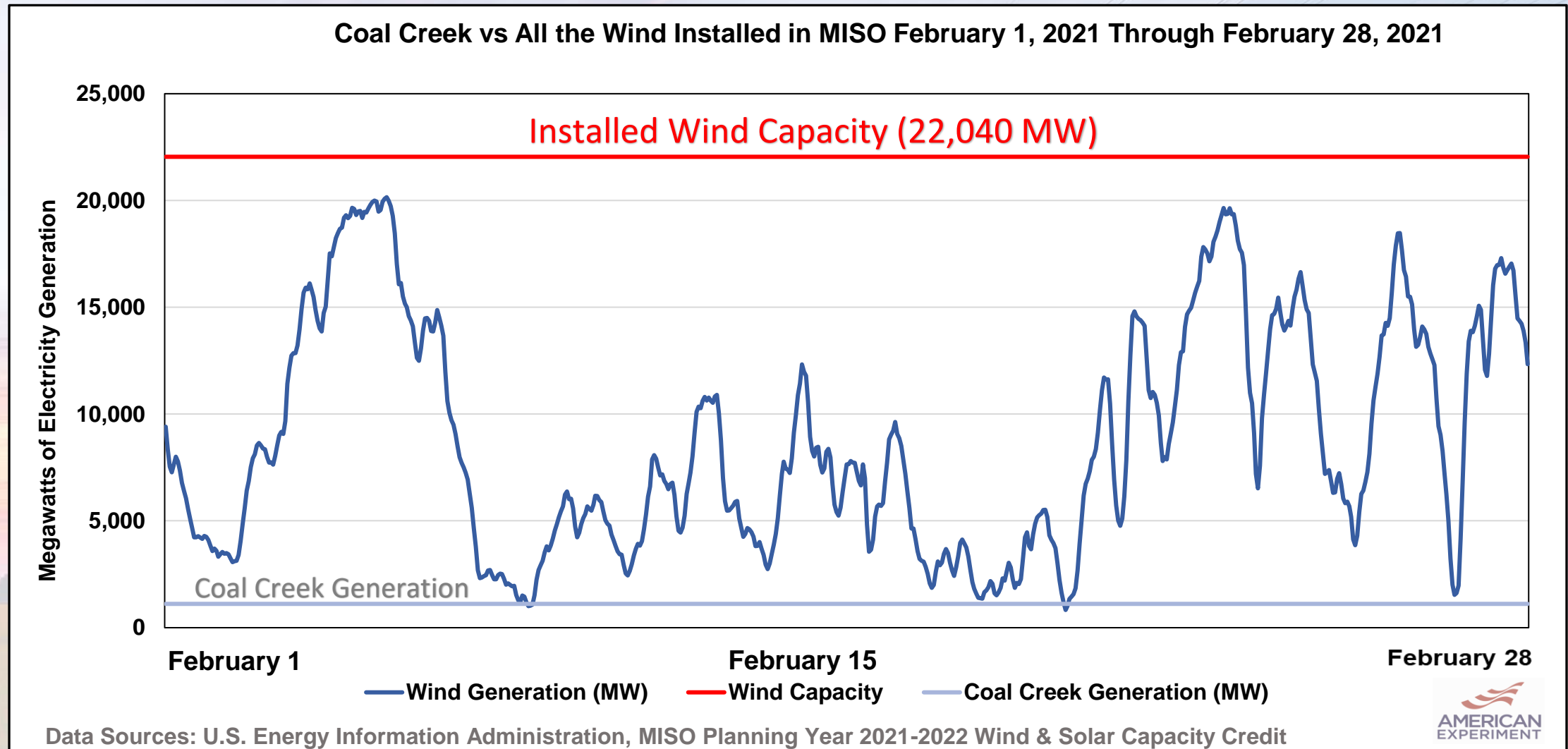


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Note: MISO System-Wide price is based on the monthly hourly average of the active hubs
Source: MISO Market and Operations Analytics Department

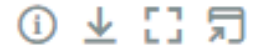


An Example of controlling base load vs. intermittent

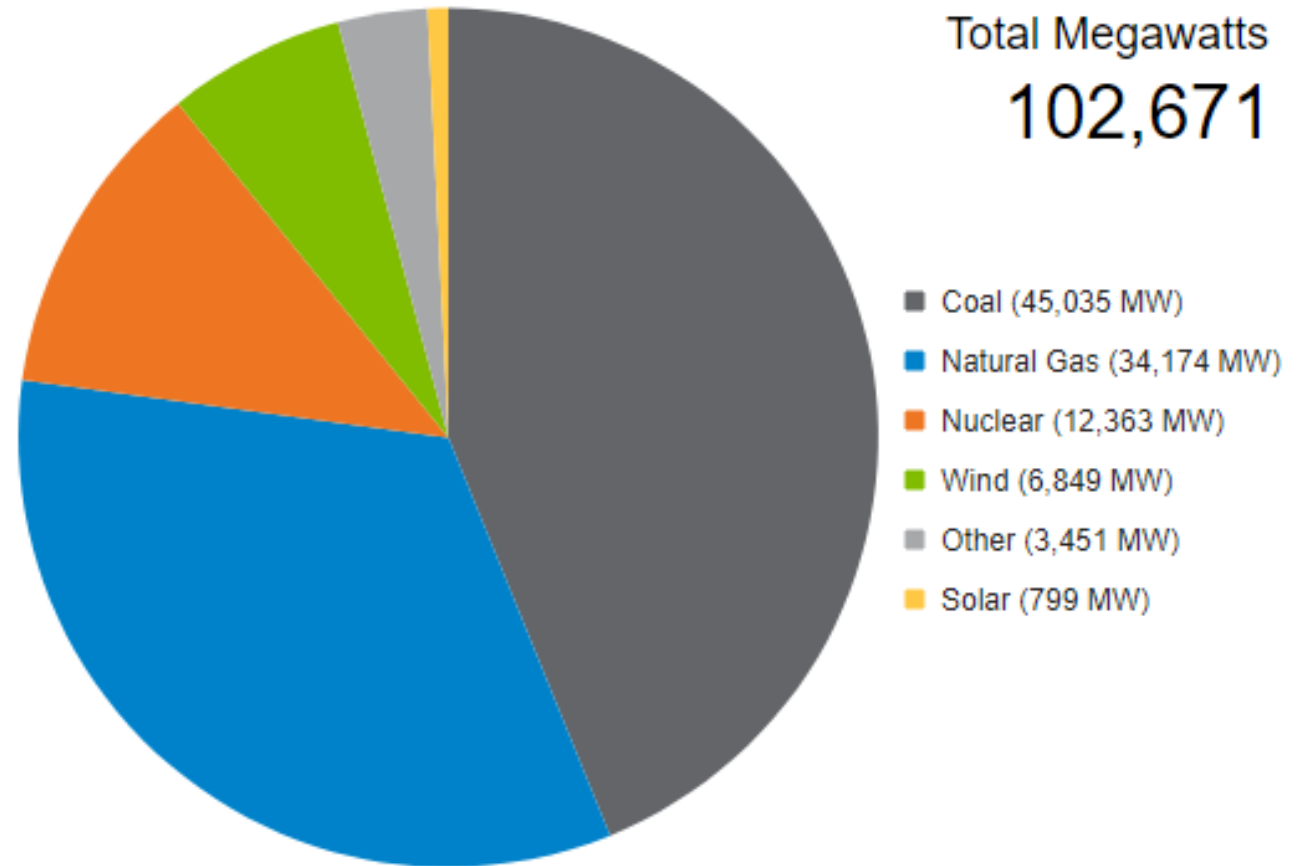


A typical MISO
fuel mix for
hot summer
day, major
dependence
on fossil fuel

Fuel Mix



18-Aug-2021 - Interval 12:55 EST

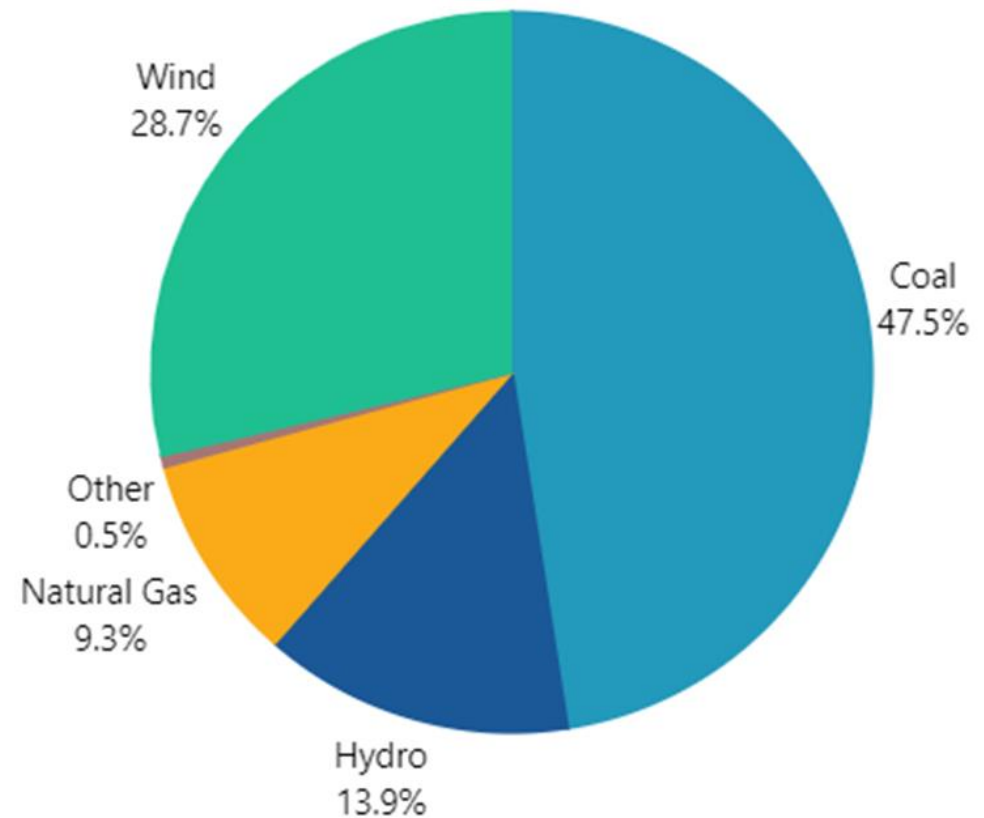


SPP Generation
Capacity Mix,
increasing
renewable but
dependent on
coal for
dispatchable

SPP Fuel Mix Pie

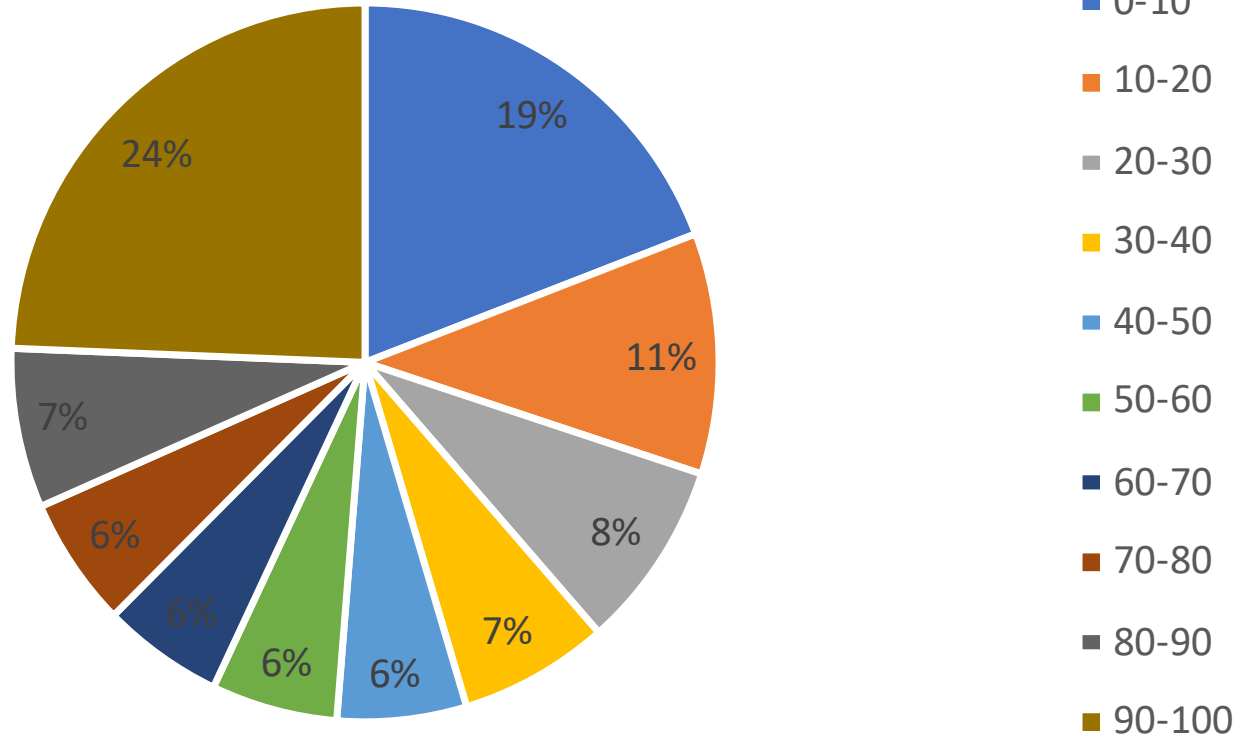
State: **North Dakota**

Date Range: **1/1/21 - 6/30/21**



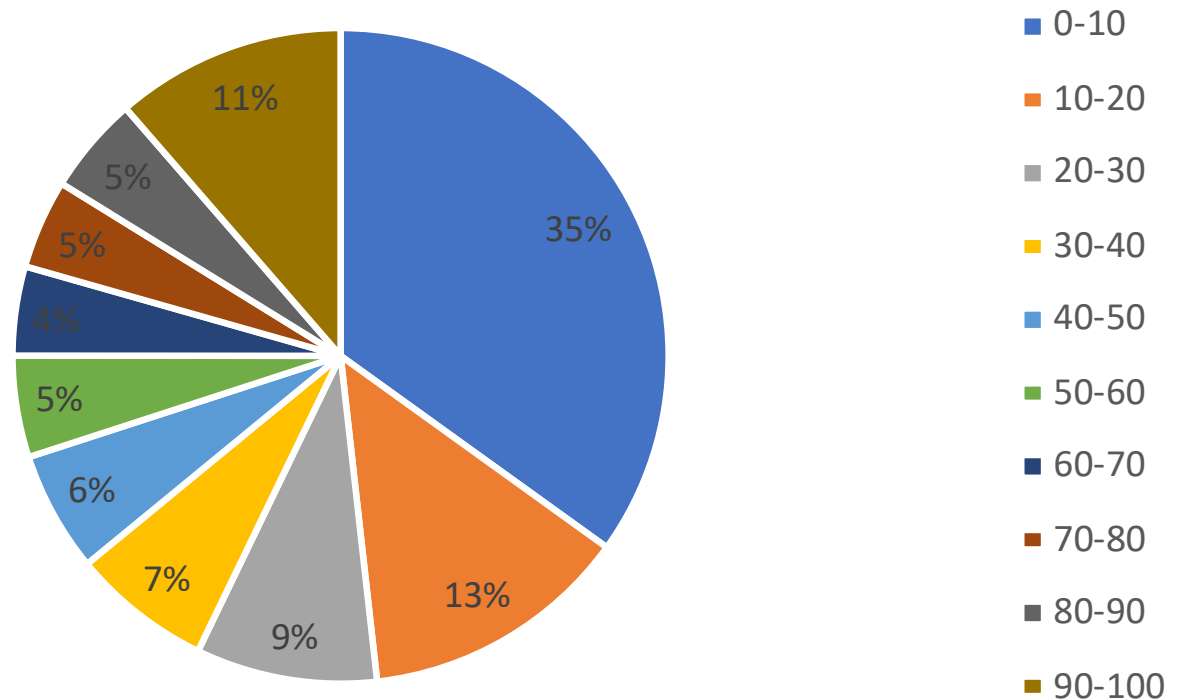
Available full
energy from
generic wind
565MW data

Percentage of Capacity Count

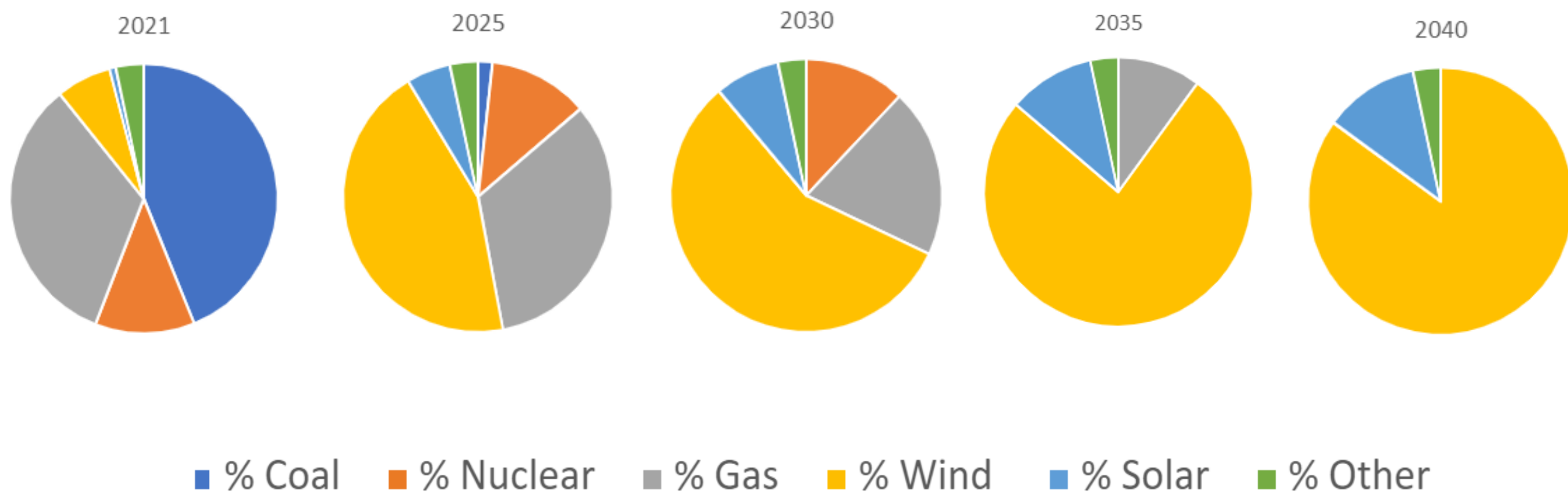


Available
energy for
generic wind
165 MW data

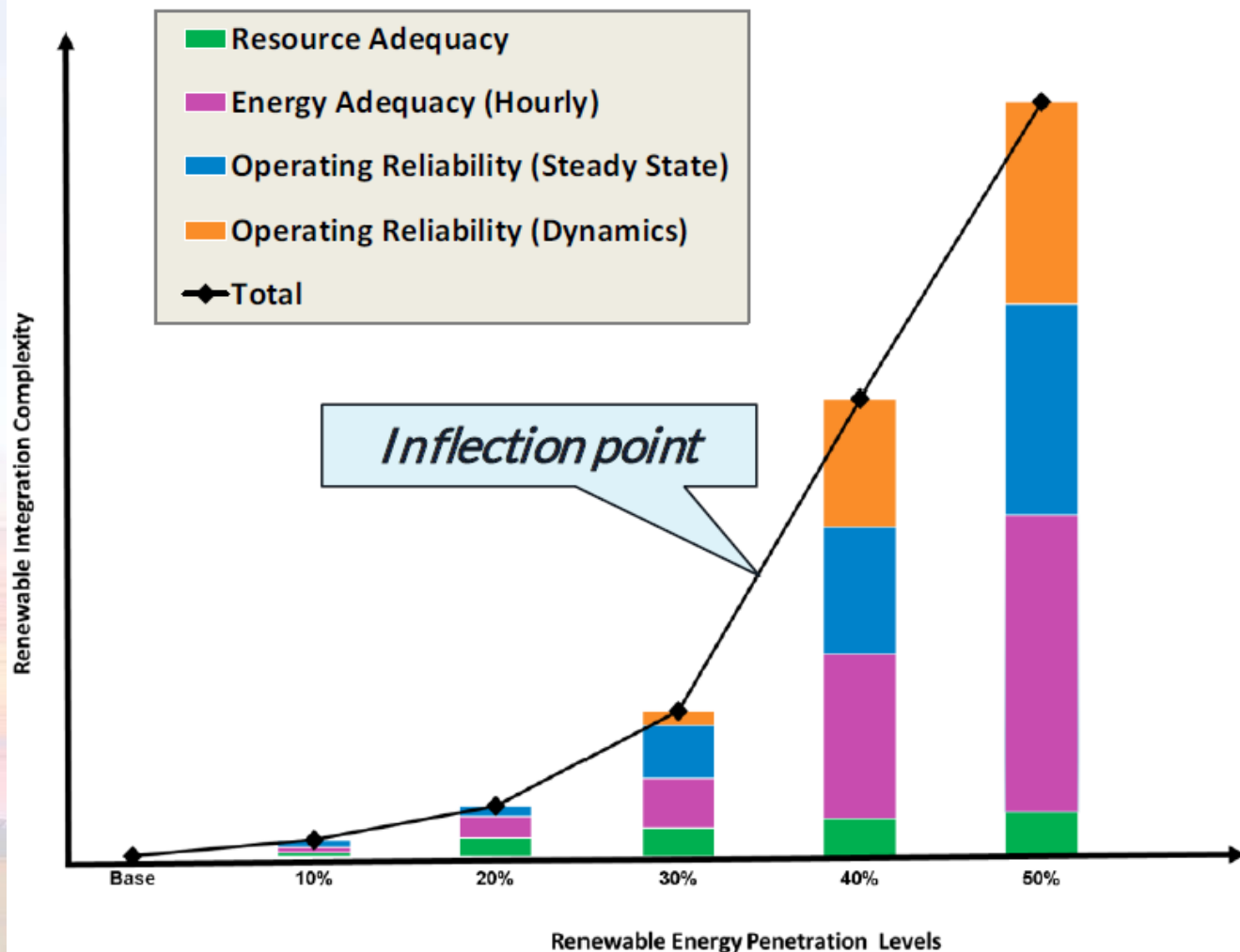
Percentage of Capacity Count



Hypothetical Transition 2021-2040

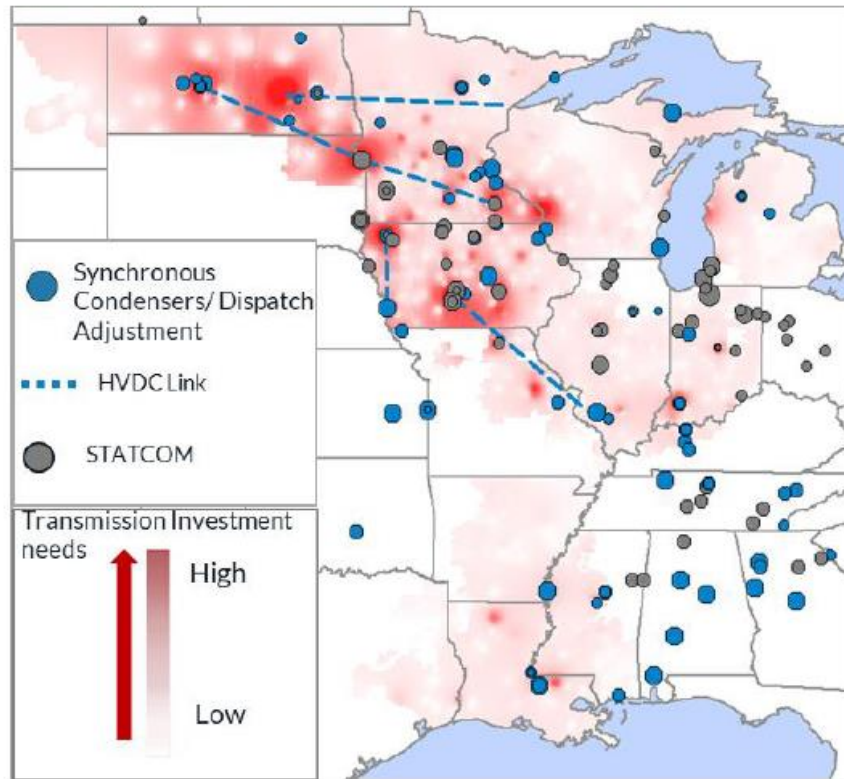


MISO's Renewable Integration Impact Assessment (RIIA) indicates integration complexity increasing sharply beyond 30% renewable penetration



1. Risk of losing load compresses into a small number of hours and shifts into the evening
2. Existing infrastructure becomes inadequate for fully accessing the diverse resources across the MISO footprint
3. Regional energy transfer increases in magnitude and becomes more variable leading to a need for increased extra-high voltage line thermal capabilities
4. Power delivery from low short circuit areas may need transmission technologies equipped with dynamic support capabilities
5. Frequency response is stable up to 60% instantaneous renewable penetration, but may require additional planned headroom beyond
6. Grid technology needs evolve as renewable penetration increases, leading to an increased need for integrated planning
7. Diversity of technologies and geography improve the ability of renewables to serve load

Work to date indicates expected portfolio changes will cause significant grid and stability issues requiring increased transmission investment



- Issues are driven by reduction in conventional generation and the increase in inverter based (i.e. wind/solar/battery) generation
- Regional energy transfer increases in magnitude and becomes more variable leading to a need for increased extra high-voltage line thermal capabilities
- Increase in renewable penetration causes different dispatch patterns of conventional generators, leading to several dynamic issues
- Power delivery from weaker areas may need transmission technologies equipped with dynamic-support capabilities

MISO has developed indicative roadmaps to guide LRTP efforts

Indicative Roadmaps (as of June 2021)

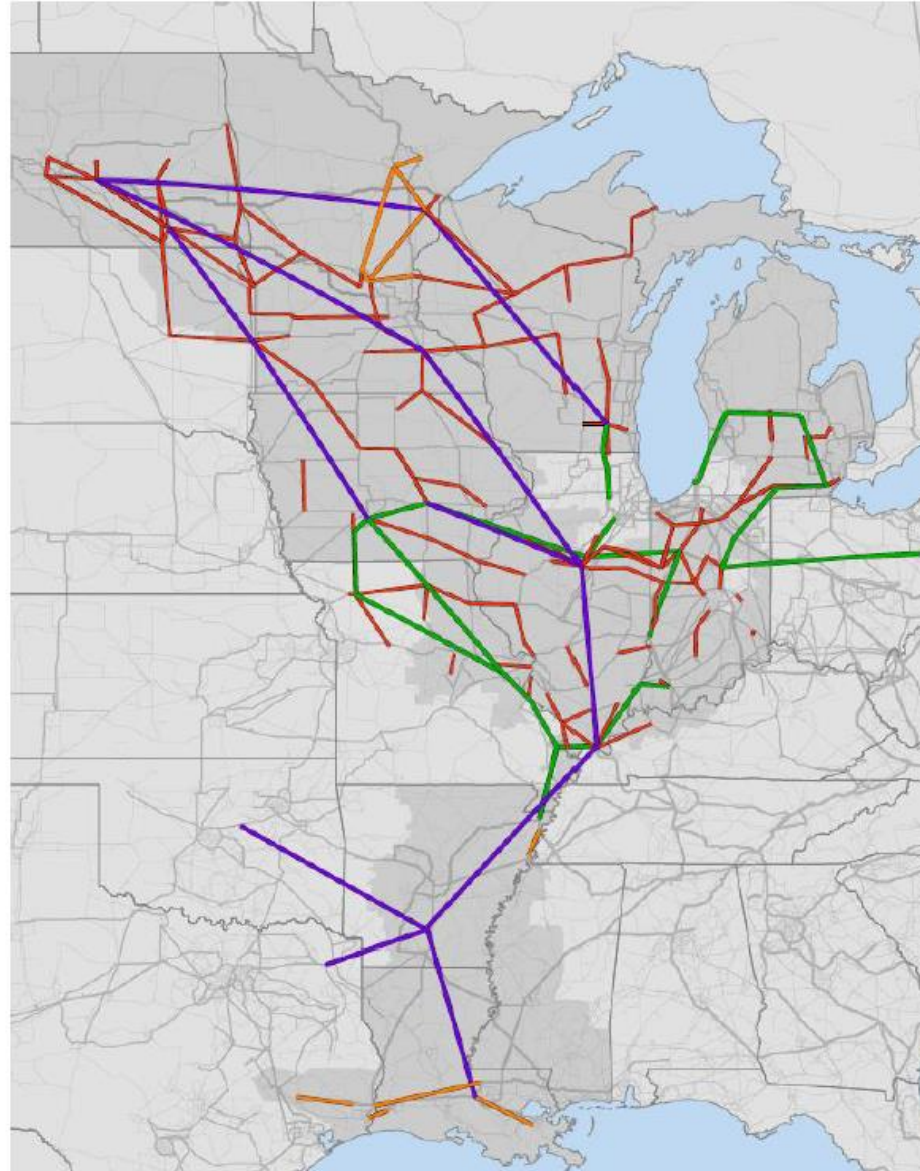
Voltage Level
(kV)

— 345

— 500

— 765

— DC Line



Future 1, 2, 3

Current Grid Interconnection Queue Status

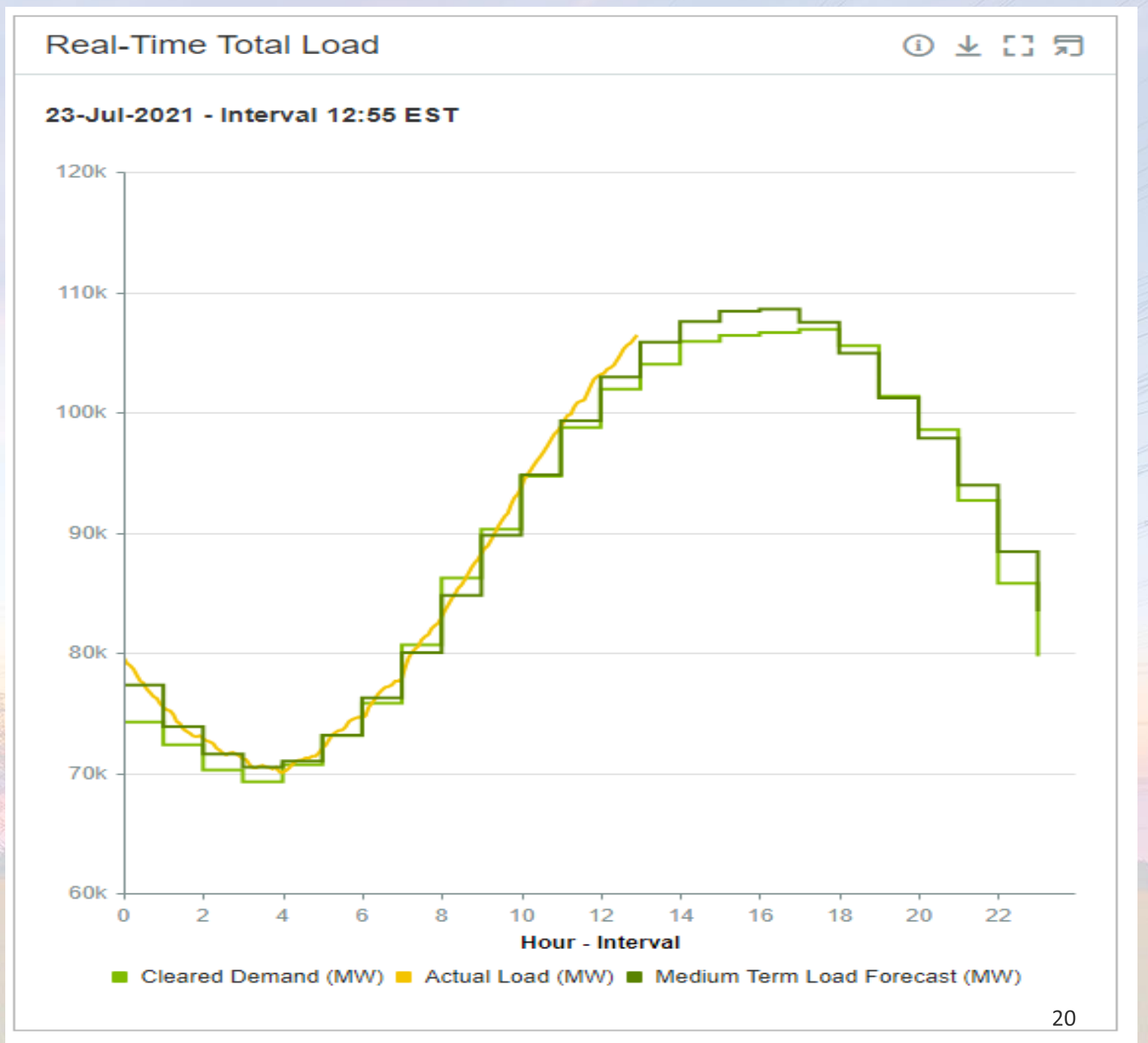
- MISO Queue contains 10 projects for a total of 2390 MW
 - This queue is reduced from 2700 MW last year
 - MISO Process for interconnection request includes approximately 505 days
- Minnkota Queue contains six projects for a total of 350 MW
 - This queue remains the same as last year
 - These six projects have all progressed into the impact study phase
- SPP queue contains 26 projects for a total of 5045 MW
 - This queue has increased from 2902 MW a year ago
 - The current GI Study lifecycle is 485 days

Total interconnection request 7785 MW of new generation

Transmission options

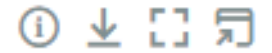
- Utilization of the CCS plant and DC line by Rainbow/Nexus
 - Operate with existing units with CO2 capture
 - Brings additional investment to Mclean County and the area
 - Collaborate with others to bring compatible business to the area near CCS
 - Offer variety of “products” on the line
- Other “merchant line” options outside the CCS DC line
 - MISO planning map shows priorities
 - Transmission owners interested in new markets to the east and to the west
- MISO grid planning and tariffs
 - Long wait for tariff agreement (who pays) as well as line justification

Example of
MISO real time
load for a
summer day,
usually quite
accurate

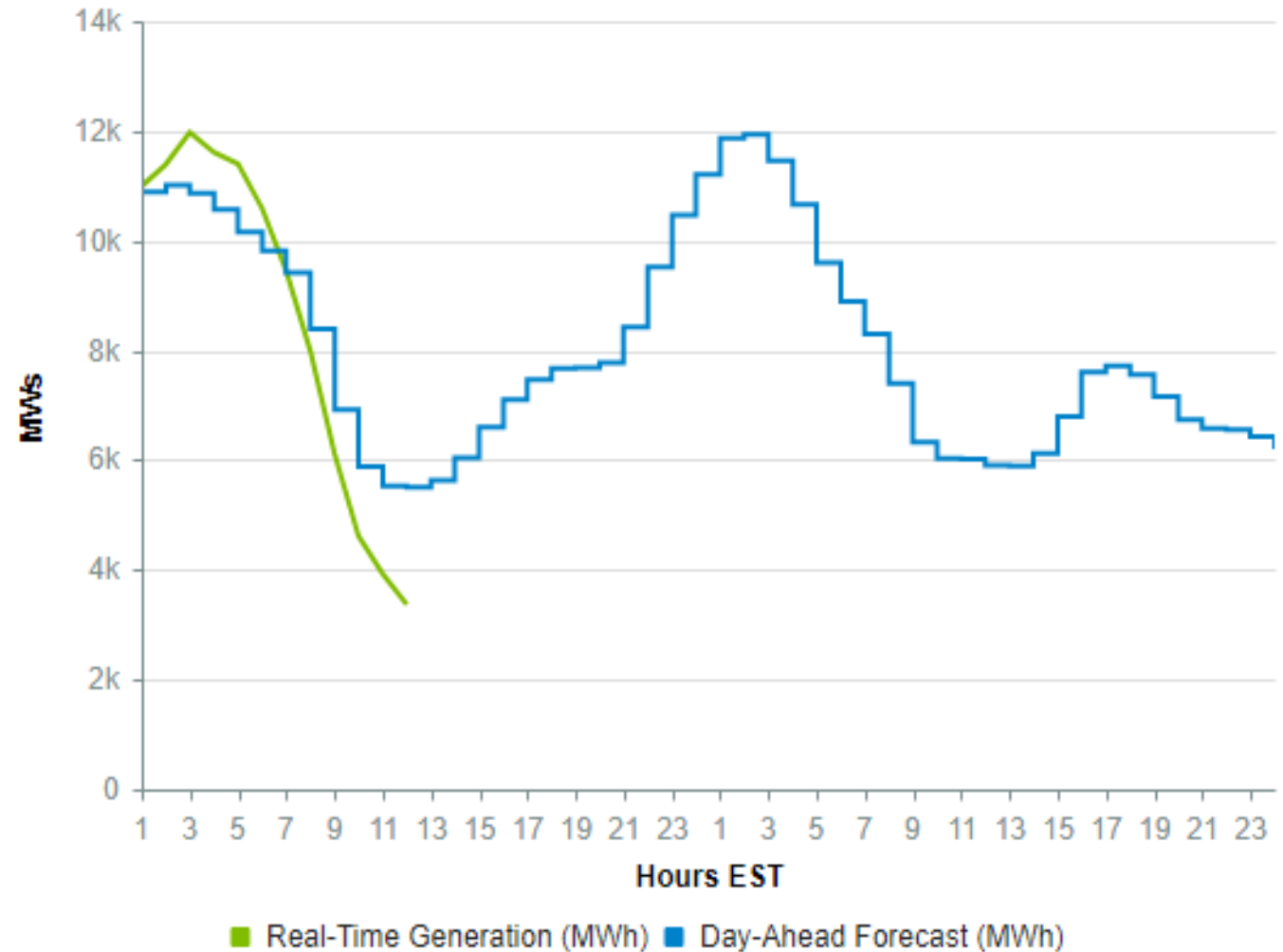


Example of
available wind
in MISO
forecast and
actual, wind is
variable

Day Ahead and Real-Time Wind



23-Jul-2021 - Interval 12:00 EST



A summary of the challenges

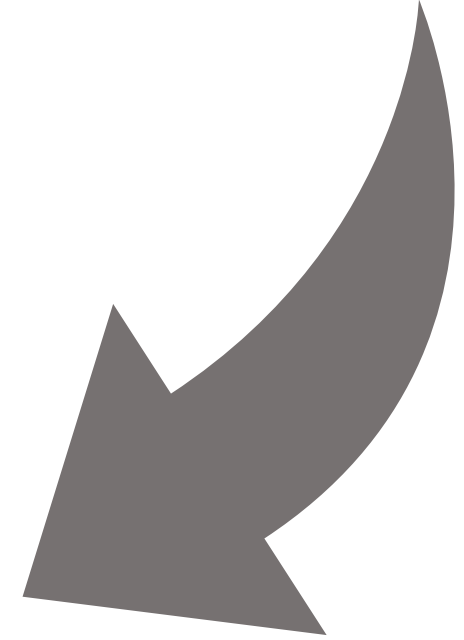
- The current data and the news on renewable electricity and carbon goals do not match
- The ISOs do not have control over generating resource selection
- Long term scenario models predict grid stability issues more prevalent in ND than most other locations in the grid for both MISO and SPP
- There is no clarity on agreement to financing transmission and grid devices needed for stabilizing an evolving grid
- No clear communication on achieving the controls challenges along with the multiplication of cyber challenges

Challenges continued

- History tells us that major transmission build takes around 10 years from conception to in service
- Dispatchable resources are being retired **AND** demolished at an alarming rate (does this increase value of remaining)
- Volatility in fuel, especially natural gas, changes the economics of options in a few month even without grid stress
- On site fuel showed benefit during the February incident
- Will the public accept the magnitude of transmission that need to be built, the right of way, the visual impacts, etc.
- Will tax credits continue to influence resource choices?

What can North Dakota do?

- Enable current generation resources through business-friendly environment and fair policy and carbon capture
- North Dakota is currently a leader in wind generation and wind capacity factor will keep wind development coming back whenever transmission is available (Rate of return in ND is high)
- NDTA will continue to engage potential transmission owners and encourage MISO and SPP identifying lines needed to serve additional generation and foster merchant transmission
- Continue to be a voice for reliable and resilient solutions as the grid evolves
- Loss of existing generation resources will likely never return in kind- these resources add to grid stability
- The states around us are wanting to know more about ND ability to reach carbon neutral and still maintain “all of the above” energy policy



Opportunities for North Dakota

- Challenges are often business opportunities
- We know additional wind generation is one of ND's easiest opportunities
- Added transmission also brings opportunities especially for construction
- Dispersed generation involves more transmission per MW than large stations built in the past
- Work with MISO and SPP to adjust modeling to carbon neutral future
- Work all aspects of ND energy together to achieve carbon neutral
- Be realistic about the demand for low carbon resources but realistic with our goals.