

# ED&T Committee Renewable Generation and Transmission

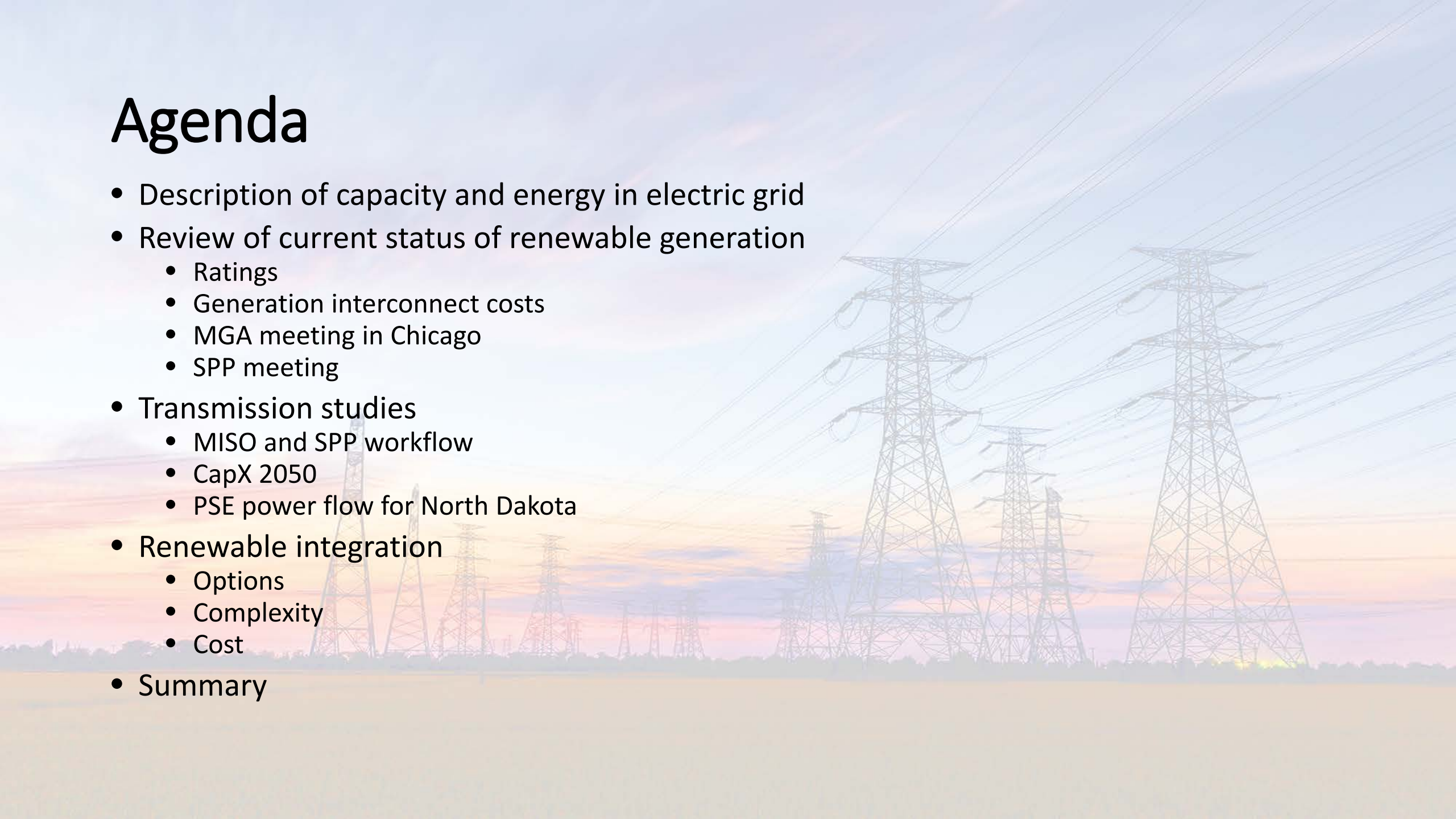
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ND Transmission Authority

# Agenda

- Description of capacity and energy in electric grid
- Review of current status of renewable generation
  - Ratings
  - Generation interconnect costs
  - MGA meeting in Chicago
  - SPP meeting
- Transmission studies
  - MISO and SPP workflow
  - CapX 2050
  - PSE power flow for North Dakota
- Renewable integration
  - Options
  - Complexity
  - Cost
- Summary



# A few basics about electricity

- Electricity is generated and used simultaneously
- Electricity has two important parts
  - Capacity- the ability to generate to meet the maximum demand at any time
  - Energy- the “traded commodity” as MWhr that gets the work done
- Renewable energy has an additional traded factor- renewable energy certificates (RECs)
- Batteries can be used to delay time of use from time of generation

# A few basics about transmission

- The transmission grid must be in service at sufficient capacity for the demand at that moment
- The grid is operated in a manner that provides reliable service
  - Loading limited to prevent overload
  - Enough redundancy to survive loss of a line
  - Ability to trip generation as needed to avoid transients
  - Control of generation to manage location and quantity of generation
  - Last resort is to shed load on the customer side

# North Dakota is a leader in wind energy 2018 production statistics

Per Capita Rank	MW Rank	State	Thousand MWh	Population (thousands of residents)	Per Capita Energy Production Rank (thousand MWh / resident)
1	8	North Dakota	10764	760.1	14161.3
2	2	Oklahoma	27593	3943.1	6997.8
3	3	Iowa	21682	3156.1	6869.9
4	4	Kansas	19280	2911.5	6622.0
5	1	Texas	75686	28701.8	2637.0
6	7	Minnesota	11320	5611.2	2017.4
7	6	Illinois	12807	12741.1	1005.2
8	5	California	13639	39557.0	344.8

# Transmission interconnects may be “up against a wall”

- Emmons-Logan project last 100 MW interconnect triggered high cost in part due to affected system impact in SPP
- Ruso project high cost affected by the Minnesota / Wisconsin congestion for lack of transmission
- A South Dakota project suffered a similar fate
- Next project is forecasted to trigger the same high cost

## Why?

Long term battle over who pays is now being pushed to the next generation interconnect. It happens to be wind, but would be triggered by any other generation source

# Why the sudden problem

- Interconnect transmission mitigation costs have been rising
- Transmission planners have been using every legitimate trick in the book to make interconnects work
- They are out of options to stretch the grid further without major costs
- They are not picking on wind or any other resource-all go through a similar modeling program to assess system impacts

Even transmission planner professionals got surprised by the suddenness of the change in cost

# What about SPP part of North Dakota?

- Situation is also tight there- for example the SPP system impact from the Emmons Logan project
- Growth in the Bakken almost without rival to other parts of the country
- Transmission needs are more focused on BEPC 345KV backbone and buildout from there
- Larger generation interconnect queue and wait time in the queue problematic for response to needs in the Bakken for either fossil or renewable energy development

# Capacity factors for Wind generation show the ND advantage

2018 State Data	Nameplate Capacity (MW)	Total Generation (MW)	Capacity Factor
North Dakota	3229.00	1232.14	38.16
Minnesota	3765.60	1298.76	34.49
Iowa	8386.70	2482.26	29.60
Wisconsin	736.20	224.24	30.46
Michigan	1901.90	610.12	32.08
Indiana	2309.80	640.68	27.74
Missouri	959.40	336.65	35.09

# Generation options for meeting capacity obligations

- Dispatchable generation like gas fired and lignite fired demonstrate annually ability to meet full load- most accredited at rated capacity or higher
- Wind generation accredited at 15% of nameplate
- Solar generation accredited at about 50%

## Why?

1. Rating is correlated to how much a resource can contribute to meeting peak demand which occurs during daytime
2. The sun shines during the day, but wind blows most at night
3. Many in industry are beginning to think that only dispatchable generation should be given capacity credit

# Transmission Capacity Study by PSE

- A transmission capacity study is currently underway on behalf of the ND Transmission Authority
  - Review of power flow within the ND electric grid
  - Assess opportunities that remain within the current system
  - Identify factors that are contributing to high generation interconnect costs
  - Provide guidance on future development
  - Assess impact of generation options
- Study report expected by the end of 2019
- Work is being coordinated with BEPC, CapX2050 and wind industry as well as Power Forecast 2019

# SPP meeting with BEPC

- BEPC presented their projections to SPP for capacity
  - Recently approved projection of approximately 1500 MW capacity growth
  - Continue to expect high load factor
  - Summarized transmission needs
- SPP was supportive
  - SPP was impressed by their tour of BEPC systems
  - Discussed the challenge of the SPP interconnect queue
- Summary-BEPC has a good handle on the growth and is working closely with SPP to make sure the needs are met

# MidGrid Meeting on September 23-24

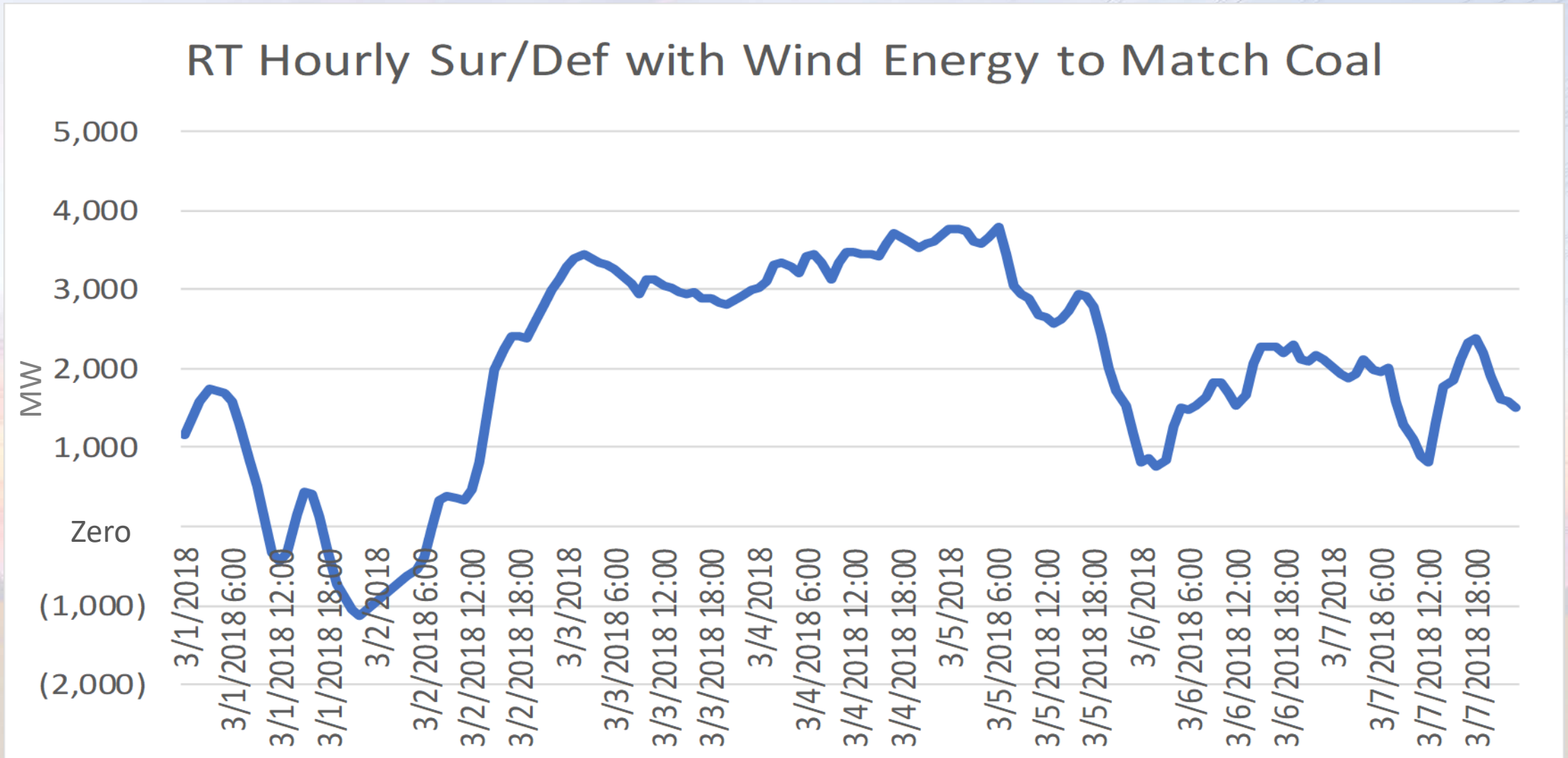
- North Dakota represented by Reice Haase and John Weeda
- Most states in the upper MISO region present
- One Common interest- **Need additional transmission**
- Most states reported economic development as their primary driver
  - Minnesota reported 100% carbon free goal as a driver
  - Resilience was a driver for some
  - ND explained our “all of the above” approach to energy
  - Most states mentioned importance of low cost options
- MGA will hold follow-up meetings with each state in effort to quantify common ground- November 12 in ND
- MISO and SPP both participated in the meeting
- Many questions- build transmission then generation or vice versa, who pays, type, etc.

# Efforts to quantify the future of the grid with high renewable generation

- PSE preliminary information of cost of renewable options
- Xcel Energy report to MGA
- MISO grid complexity analysis
- ND growth largely capable of being met with lignite, gas and a small amount of other options
- Majority of wind development intended for export
- Growing interest in commercial scale solar

# Generation data from one week in the off-peak season

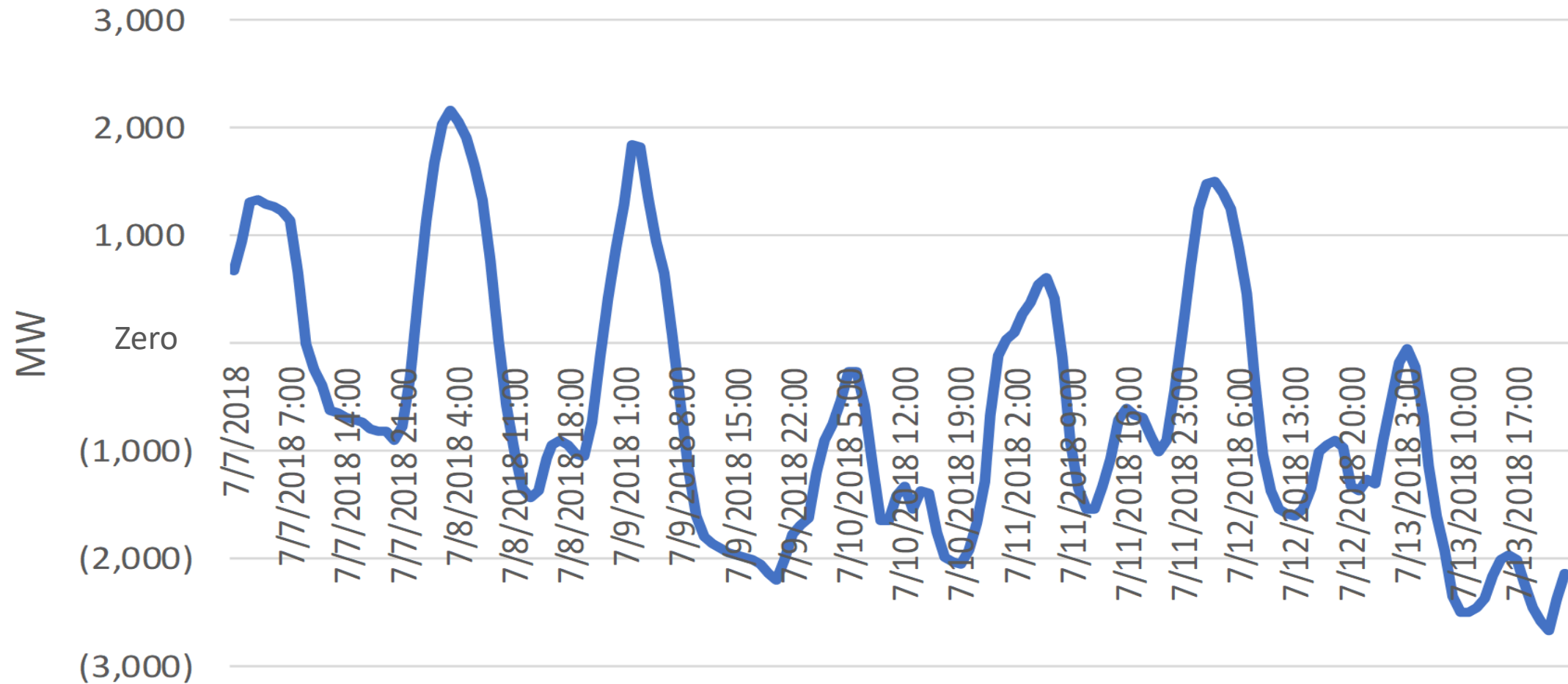
3000 MW replaced by wind, solar and batteries



# Generation Data from one week in the Peak season

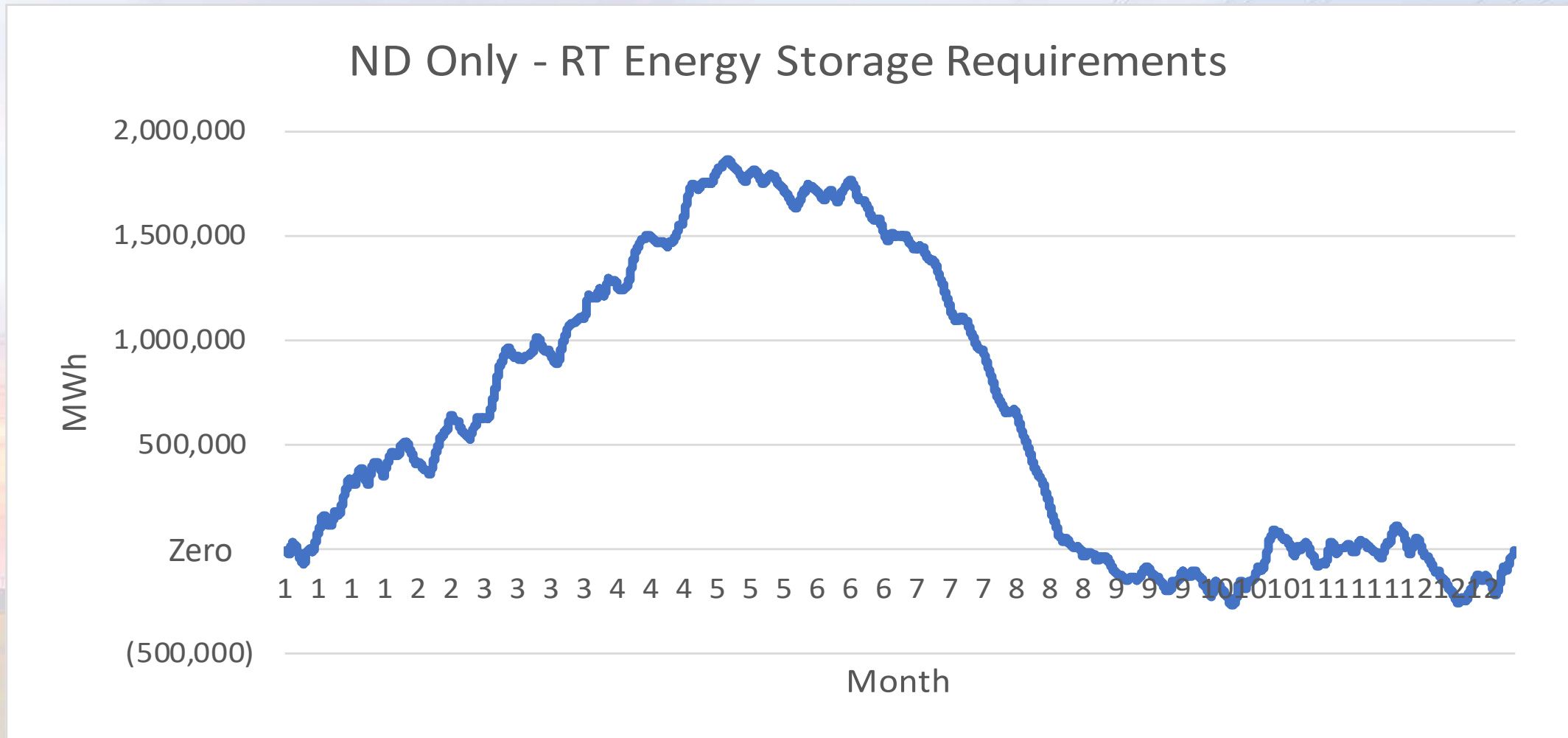
3000 MW replaced by wind, solar and batteries

## RT Hourly Sur/Def with Wind Energy to Match Coal



# Storage requirements on annual basis

3000 MW replaced by wind, solar and batteries

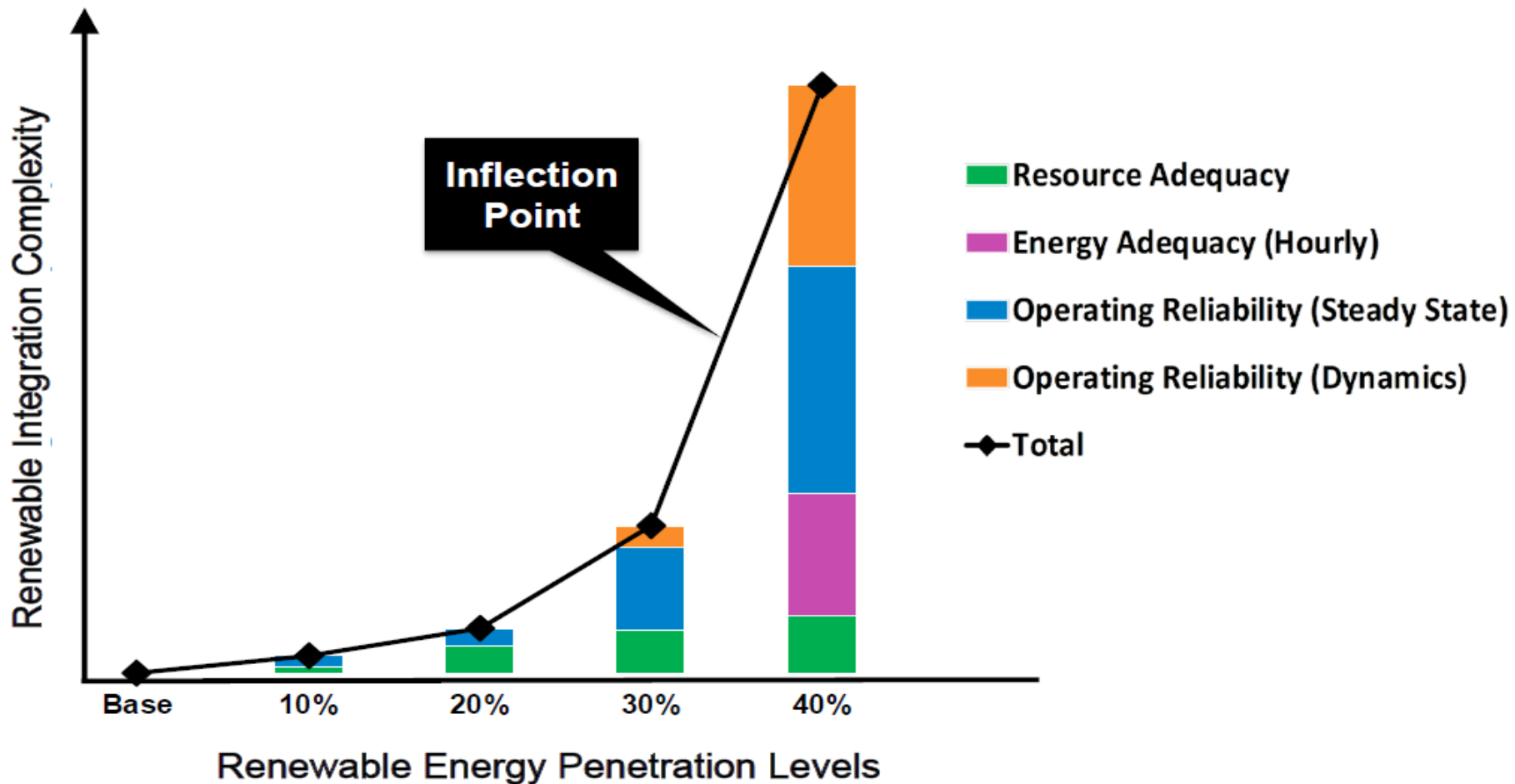


# *Preliminary* Comparison of alternatives for ND using available data

1. 3000 MW of wind and solar combined with storage to demand profile like 2018 actual from fossil fuel
  - \$474B
2. 30% of 3000 MW of wind and solar combined with storage to demand profile met by the 30% of 2018
  - \$142.3B
3. Building 3000 MW of simple cycle gas generation
  - \$1.8B as dispatchable resource
4. Build 3000MW of combined cycle gas generation
  - \$4.5B as dispatchable resource
5. Adding carbon capture to 3000MW of lignite
  - \$30B with approximately 300MW loss of capacity
6. Overbuild wind- \$1,500, 000 per MW times overbuild

***These numbers are indicative only and not for decision making***

# MISO's Renewable Integration Impact Assessment (RIIA) shows that integration complexity increases sharply at 30% - 40% renewable penetration



# Complexity

- Explosion of number of devices that need to be controlled by system operations
- More openings for cyber security risks
- Need to design against more failure modes
- Learn how to address system events that require immediate reaction to avoid system collapse, etc.
- With complexity comes cost
- CAISO information also reflects this complexity and cost with solar

# Summary

- Additional transmission capacity for any kind of generation is likely to be impacted by cost and complexity
- Basic Expectations
  - Reasonable cost
  - Reliability of the grid
- Establish a method to define a vision for ND and continue coordination with other states and utilities
  - Support the CapX2020 transmission study
  - Explore all options and continue engagement with MGA, MISO, SPP and others
- Continue the “all of the above strategy”