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2018 Economic Planning Study Assumptions

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ATC Process Overview and Timeline

- **ATC Economic Project Planning – Per ATC Tariff**
 - **During February**, we hold an initial stakeholder meeting to review the market congestion summary and potential fixes and to discuss economic study scenarios, drivers, ranges, and assumptions.
 - **By March 1**, we work with stakeholders to request and prioritize new/other economic studies and recommend study assumptions.
 - **By April 15** – we identify preliminary areas of economic study, study assumptions and models and solicit further comments from stakeholders.
 - **By May 15** – we finalize areas of economic study, study assumptions and models to be used in analysis.
 - **By November 15** – we provide a summary of the results of the economic analyses to our stakeholders.

Introduction

- Process Overview and Timeline
- Quick MTEP18 Futures Refresh
- Forest Junction – Elkhart Lake Update
- Energy Storage Discussion
- Next Steps

MISO MTEP18 Futures

- Limited Fleet Change – (LFC)
- Continued Fleet Change – (CFC)
- Accelerated Fleet Change – (AFC)
- Distributed & Emerging Technology – (DET)

Limited Fleet Change

- Largely unchanged generation fleet
- Lower demand and energy growth rates
- No carbon emission regulations
- Age related coal retirements
- Lower renewable development targets
- Lower fuel costs

Continued Fleet Change

- Continued coal and age related retirements
- Transitioning of generation fleet to natural gas
- Mid level demand and energy growth rates
- Return to mid level fuel prices
- Current trend of renewable investment continues

Accelerated Fleet Change

- Policy/Regulation targeting reduction in CO² emissions
- CO² reduction goal set at 20% lower than 2005 levels
- Increased demand on NG drives prices higher
- Increased retirement of coal to meet CO² target
- Robust economy drives more technology advancement, resulting in more energy efficiency, distributed generation, and demand response
- Higher gross demand and energy, offset by tech advancement

Distributed & Emerging Technology

- Continued coal and age related retirements
- Higher energy usage driven by electric vehicles
- Electric Vehicles shift time of use for energy
- Return to mid level fuel prices
- Renewable siting is much more localized and urban

MISO MTEP18 Key Assumptions

Future	Limited Fleet Change	Continued Fleet Change	Accelerated Fleet Change	Distributed & Emerging Tech
Net Demand & Energy Growth Rates	Low (10/90)	Base (50/50)	High (90/10)	Base + EV Energy = 1.1% Demand = 0.6%
Natural Gas Price Forecast	Gas: Base -30% Coal: Base -3%	Base	Gas: Base +30% Coal: Base	Base
Max DR/EE/DG Tech Potential	EE: - DR: 3 GW	EE: 1 GW DR: 4 GW	EE: 7 GW DR: 7 GW	EE: 1+ GW DR: 4+ GW + 2 GW storage
Renewables By Year 2031 (% Wind and Solar Energy)	10%	15%	26%	20%
Retirement	Coal: 9 GW Gas/Oil: 17 GW	Coal: 16 GW Gas/Oil: 17 GW	Coal: 24 GW Gas/Oil: 17 GW	Coal: 17 GW Gas/Oil: 17 GW Nuclear: 2.5 GW
CO2 Reduction Constraint From Current Levels by 2032	None	None	20%	None
Siting Methodology	MTEP Standard	MTEP Standard	MTEP Standard	Localized

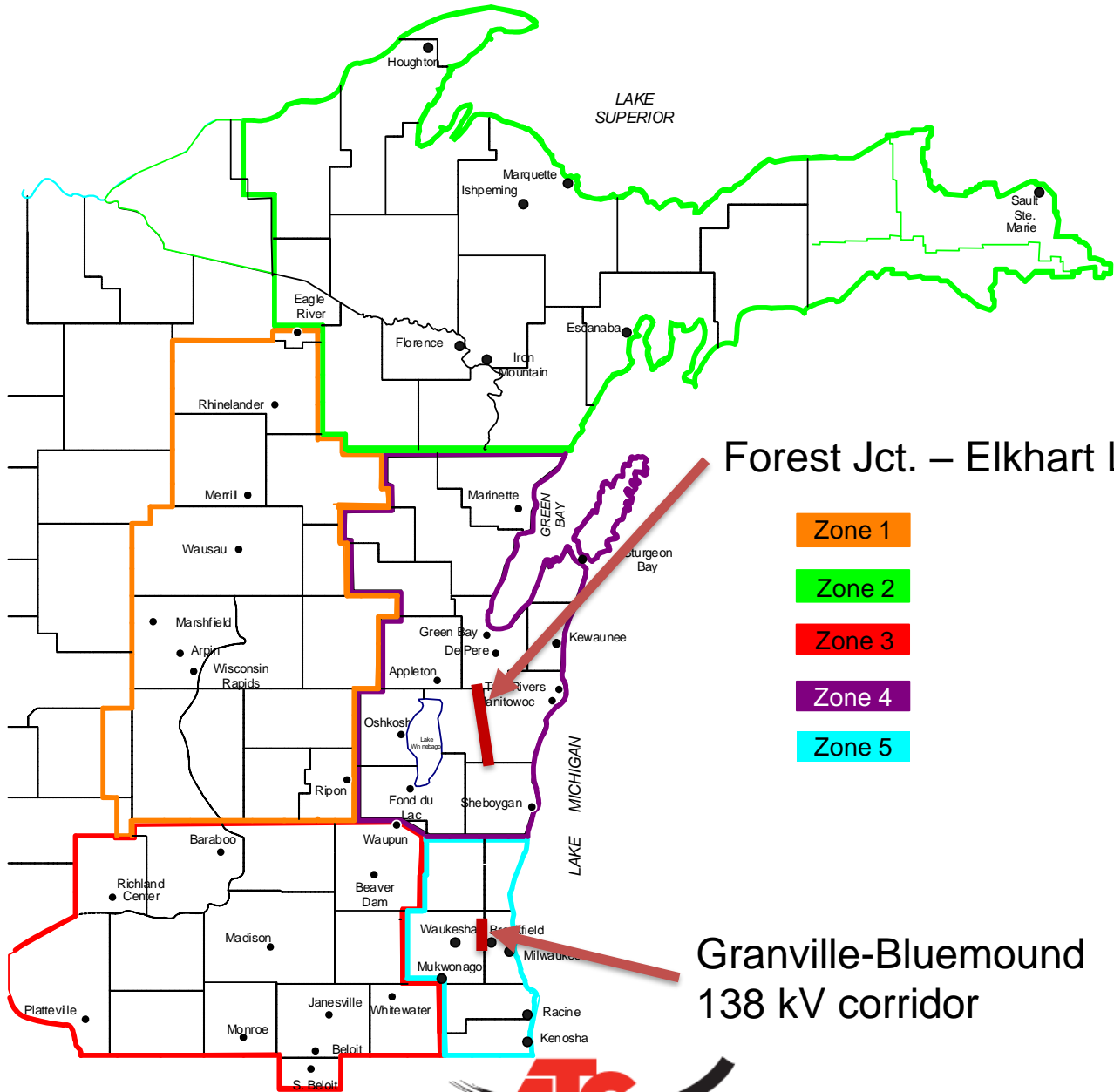
Source: MISO September 27, 2017 Planning Advisory Committee

<https://cdn.misoenergy.org/20170927%20PAC%20Item%20003d%20MTEP18%20Futures%20Results%20Review89925.pdf>



Notable MTEP18 Congestion

- Forest Junction – Elkhart Lake 138 kV
- Butler – Bluemound 138 kV
- Edgewater – Saukville 345 kV
- Petenwell – ACEC Badger – Saratoga 138 kV
 - This has an SPS that mitigate constraint



Forest Jct. – Elkhart Lake

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

Granville-Bluemound
138 kV corridor

Forest Junction – Elkhart Lake Update

- Reviewed various options
- Previous reviews did not account for entire length of line
- Options being investigated further
 - Upgrade existing conductor to maximum temperature
 - Just under half the spans are limiting
 - More detailed review determines exact number to replace
 - Replace existing conductor with large conductor
 - Need to determine capability of towers
 - Reconfigure load on double circuit
 - Reconfiguration may lead to issues on parallel circuit
 - Need to address concerns with load being served from one line

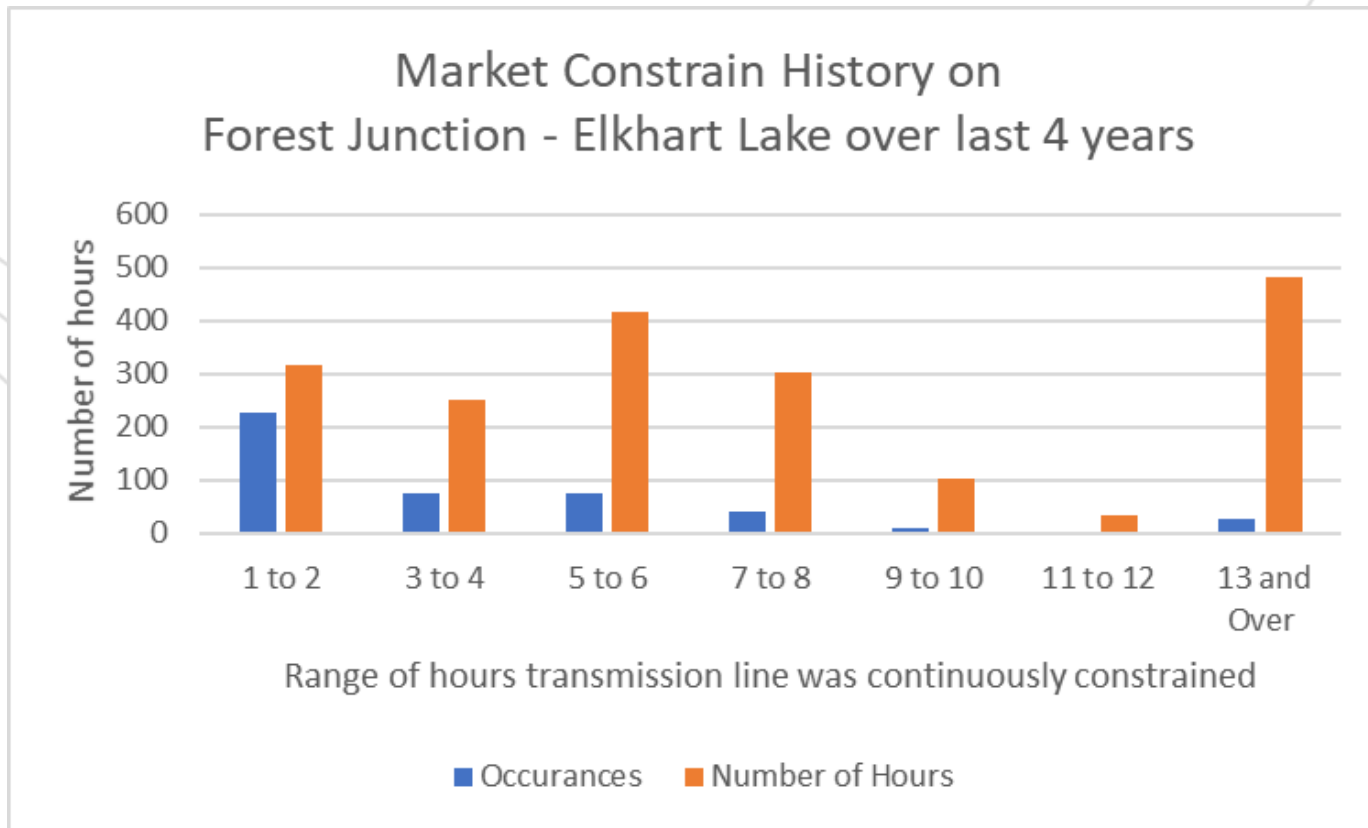
Energy Storage

- Emerging Technology
- Numerous applications
 - Frequency response
 - Demand management
 - Mitigates intermittency of renewables
- Unclear ability to fully participate in energy market

Energy Market Assumptions for Energy Storage

- Functions as a load during charging
- Functions as a generator during discharging
 - Energy storage options incur losses
- To be effective must mitigate market congestion
 - Sizing
 - Discharge duration
 - Constraint mitigation happens when redispatch is not needed
- ATC reviewed historical market data
 - Determine what types of solutions that could work
 - Sorted data into groups of constraint duration by hour

Historical Forest Junction – Elkhart Lake Market Constraint



Historical Forest Junction – Elkhart Lake Market Constraint

- Higher occurrence of short duration constraints
- Over 80% of constrained hours happen in periods of 3 hours or longer
- Can available generation respond in post contingent dispatch in a fast enough time frame?
 - ATC to investigate response time and availability of generation
 - Generation dispatch dependent on many factors
- Can a discrete change to the system impact value of battery sizing?
 - New load
 - Generation retirement

Next Steps

- **Project / Analysis Development**
 - Detailed investigation into Forest Junction – Elkhart Lake alternatives
 - Investigate Granville-Bluemound alternatives
 - Compile and answer additional stakeholder feedback
 - Further investigation of energy storage
- **2018 Futures Development**
 - Continued Review of MISO MTEP18 Development
 - Review of MISO PROMOD Models
- **Analysis of Projects**
 - Study Years – 2027 and 2032
 - Futures – All MISO MTEP18 Futures
- **Timelines**
 - May 15: Finalize Assumptions
 - November 15: Provide Analysis Update

Detailed MISO Futures Information

- MTEP18 Futures Development Summary
 - [June Planning Advisory Presentation](#)
- MTEP18 Resource Expansion and Siting Results
 - [September Planning Advisory Presentation](#)

Questions?

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Thank You For Your Time!

