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2018 Economic Planning Study Results

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Introduction

- Process Overview and Timeline
- MTEP18 Futures Refresh
- Study Area Results
- Next Steps

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.

MISO MTEP18 Futures

- Accelerated Fleet Change (AFC)
- Continued Fleet Change (CFC)
- Distributed and Emerging Technologies (DET)
- Limited Fleet Change (LFC)

Accelerated Fleet Change

- Policy/Regulation targeting reduction in CO^2 emissions
- CO^2 reduction goal set at 20% lower than 2005 levels
- Increased demand on NG drives prices higher
- Increased retirement of coal to meet CO^2 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

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

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

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

MISO MTEP18 Key Assumptions

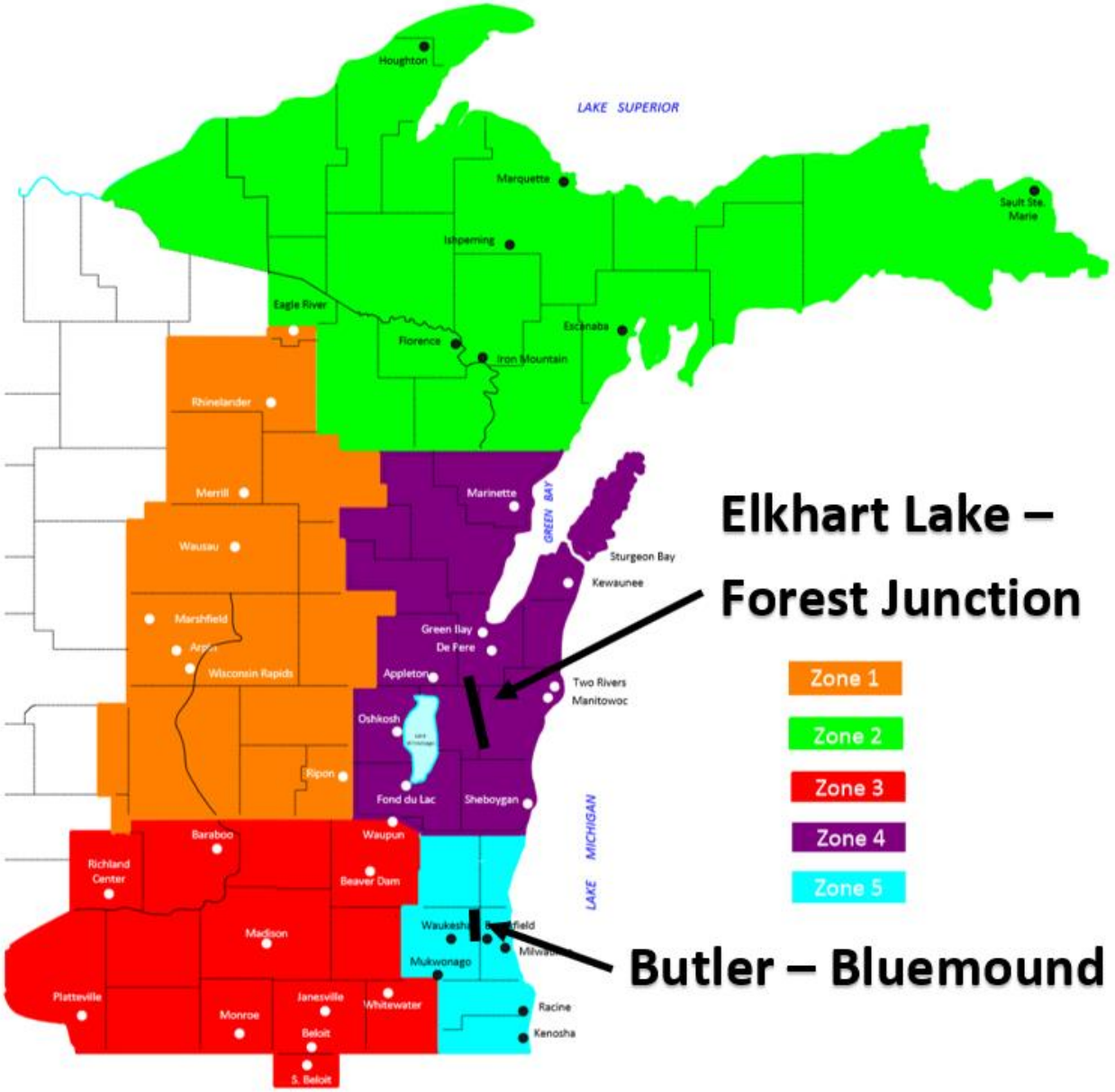
Future	Accelerated Fleet Change	Continued Fleet Change	Distributed & Emerging Tech	Limited Fleet Change
Net Demand & Energy Growth Rates	High (90/10)	Base (50/50)	Base + EV Energy = 1.1% Demand = 0.6%	Low (10/90)
Natural Gas Price Forecast	Gas: Base +30% Coal: Base	Base	Base	Gas: Base -30% Coal: Base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

Source: MISO September 27, 2017 Planning Advisory Committee
https://cdn.misoenergy.org/20170927%20PAC%20Item%2003d%20MTEP18%20Futures%20Results%20Review89925.pdf

Notable MTEP18 Congestion

- Badger West – Petenwell 138kV
  - This has an SPS that mitigates the constraint.
- Elkhart Lake – Forest Junction 138kV*
- Butler – Bluemound 138kV*
- Granville – Tosa 138kV
- Sunnyvale – Sherman St. 115kV

*Studied in 2018 MISO MCPS


Houghton
LAKE SUPERIOR
Marquette
Sault Ste. Marie
Ishpeming
Eagle River
Escanaba
Florence
Iron Mountain
Rhinelander
Merrill
Marinette
GREEN BAY
Wausau
Sturgeon Bay
Kewaunee
Marshfield
Green Bay
De Pere
Wisconsin Rapids
Appleton
Two Rivers
Manitowoc
Oshkosh
Ripon
Fond du Lac
Sheboygan
LAKE MICHIGAN
Baraboo
Waupun
Richland Center
Beaver Dam
Madison
Mukwonago
Racine
Kenosha
Platteville
Monroe
Janesville
Whitewater
Beloit
S. Beloit
Elkhart Lake –
Forest Junction
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Butler – Bluemound

Economic Study Elkhart Lake Alternatives

- Load Move
- 10MW Battery at Elkhart Lake
- Reconductor
- Uprate to Maximum Operating Temperature
- Series Reactor

Elkhart Lake MTEP18 Study Results

	MISO MTEP18 Planning Futures			
	AFC	CFC	DET	LFC
Load Move	$1,608,126	$1,668,001	$5,341,415	$1,787,787
Elkhart Lake Battery	($3,773,248)	$1,360,688	($1,841,374)	($47,506)
Reconductor	$39,905,794	$9,144,807	$1,025,002	$4,994,627
Uprate	$16,086,130	$2,284,808	$58,963	$2,142,633
Series Reactor 20ohm	$38,197,360	$7,453,043	$1,760,763	$3,441,565

Note: Numbers are 2018 present value gross benefit from the Customer Benefit metric.

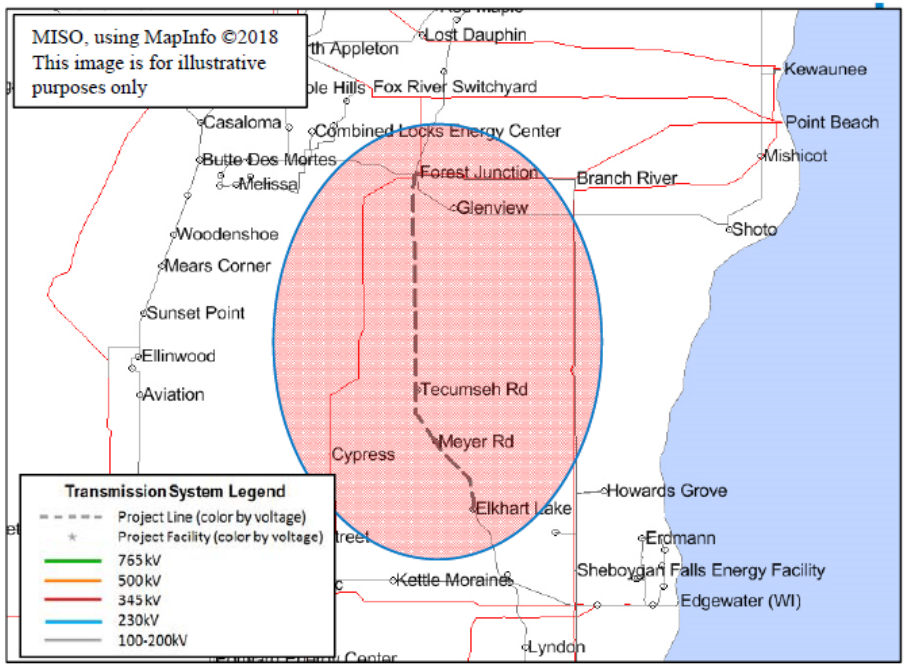
Initial Conclusions

- Uprating Forest Junction-Elkhart Lake-Saukville to maximum operating temperature does not relieve all congestion (around 40%).
- Reconductoring Forest Junction-Elkhart Lake-Saukville has high economic benefit but also high cost.
- A Battery at Elkhart Lake causes congestion on Elkhart Lake-Saukville. A battery at Saukville does not have a high enough shift factor to economically justify building a battery for this specific application.

Elkhart Lake Series Reactor

- Cost of $1.2 Million
- 40 Year Customer Benefit of $11.2 Million
- Minimum reduction of shadow price of 88%.
- The Series Reactor is targeted for Appendix A.
- MISO's Board will vote on the Series Reactor in December.

Project 2: Add Series Reactor on Forest Junction to Elkhart Lake 138kV



Project 2 relieves most of the congestion on Forest Junction – Elkhart Lake 138kV line

Total Shadow Price(k$/MW-yr)			Total Binding Hours		
RT	DA	Projected	RT	DA	Projected
110	106.3	86	236	1567	327

Project 2 brings benefit exceeding its cost to both MISO and local transmission pricing zone

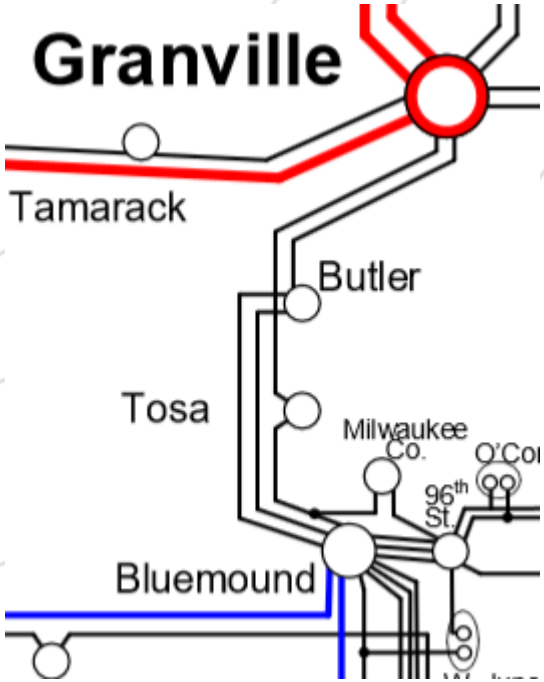
- B/C to MISO N/C: 3.55
- B/C to local TPZ: 5.62

Project 2 passes reliability no-harm test

Source: https://cdn.misoenergy.org/20180926%20PAC%20Item%2005a%20MCPS%20Project%20Recommendation277610.pdf

Economic Study Bluemound Alternatives

- Build Additional Bluemound-Granville 138kV
- 50MW Battery at Bluemound
- Uprate both Bluemound-Butler 138kV lines
- Build 3rd Oak Creek-Bluemound 230kV



Bluemound MTEP18 Study Results

	MISO MTEP18 Planning Futures			
	AFC	CFC	DET	LFC
Build Blu. - Granville	$6,150,411	$23,582,893	$20,179,996	$12,338,708
Blu. Battery	($1,140,854)	$1,461,196	($2,358,645)	($463,871)
Uprate Blu.-Butler	$987,424	$601,731	$7,954,734	$337,452
3rd Oak Creek - Blu 230	$3,994,275	$7,644,978	$4,227,447	$7,311,877

Note: Numbers are 2018 present value gross benefit from the Customer Benefit metric.

Initial Conclusions

- The corridor shows significant benefit by adding another circuit, at a yet to be determined cost.
- Uprating or reconductoring the lines have higher costs compared to benefits.
- The battery alternative at Bluemound would have to be very large to significantly reduce the amount of congestion.

Next Steps

- Continued work with MISO and customers on Series Reactor at Elkhart Lake
- Continued Analysis for Solutions at Bluemound-Butler
- Timelines
  - February 2019 – Next Stakeholder Meeting

Questions

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Thank You For Your Time!