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2019 Economic Planning Study Kickoff

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Introduction

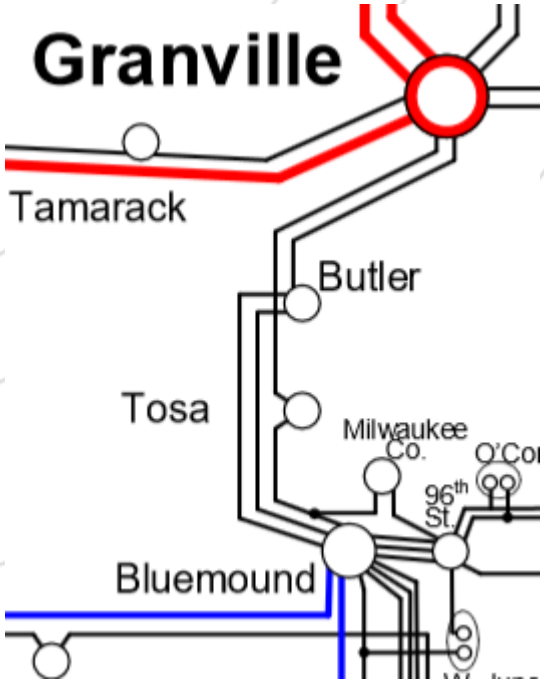
- 2018 Study Follow up
- Process Overview and Timeline
- 2019 Futures Development
- Next Steps

Elkhart Lake Series Reactor

- Cost of $1.3 Million
- 40 Year Customer Benefit of $11.2 Million
- Minimum reduction of shadow price of 88%
- MISO's Board approved project in December 2018

ATC 2018 Economic Study Area Alternatives

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



ATC 2018 Economic Study Results

	MISO MTEP18 Planning Futures			
	AFC	CFC	DET	LFC
Build Bluemound – Granville 138	$6,150,411	$23,582,893	$20,179,996	$12,338,708
Bluemound Battery	($1,140,854)	$1,461,196	($2,358,645)	($463,871)
Uprate Bluemound-Butler	$987,424	$601,731	$7,954,734	$337,452
3rd Oak Creek – Bluemound 230	$3,994,275	$7,644,978	$4,227,447	$7,311,877

Note: Numbers are 2018 present value gross 40 year benefit from the Customer Benefit metric.

ATC 2018 Economic Planning Study

- Additional Bluemound – Granville 138kV cost estimate is much higher than economic benefits (eliminated solution)
- Bluemound Battery Storage is not beneficial in all futures (eliminated solution)
- Uprate Bluemound – Butler cost estimate is much higher than economic benefits (eliminated solution)
- 3rd Oak Creek – Bluemound 230kV cost estimate is much higher than economic benefits (eliminated solution)

MTEP18 Next Steps

- Continue Elkhart Lake project
- More precise study of Bluemound alternatives in 2019?
  - Study in MTEP19?
  - Different Alternatives of line?
  - Uprate/Reconductor/Rebuild sensitivities of corridor?
  - Battery Alternatives at other locations?

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.

2019 Futures Development

- Utilize the MISO MTEP models and futures
- Review MISO models and provide updates as necessary
  - Review generation interconnection request in MISO Queue
  - Review load profiles and demand and energy growth
  - Better modeling of time of use industrial customers
  - Most updated transmission topology
- Ensures greater alignment with MISO stakeholder process

MISO MTEP19 Futures

- Similar Futures as MTEP18

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

Limited Fleet Change

- Largely unchanged generation fleet
- Age related coal retirements
- Low demand and energy growth rates
- Low renewable/technology development
- Low fuel costs

Continued Fleet Change

- Age related retirements of coal and natural gas
- Transitioning of generation fleet to natural gas
- Mid level demand and energy growth rates
- Current trend of renewable/technology investment
- Mid level fuel prices

Accelerated Fleet Change

- Policy/Regulation targeting reduction in CO^2 emissions causing increased coal retirements
- Increased demand on NG drives prices higher
- Robust economy drives more technology advancement, resulting in more energy efficiency, distributed generation, and demand response
- Higher gross demand and energy

Distributed & Emerging Technology

- Age and economic related coal retirements
- Higher energy usage driven by electric vehicles
- Mid level fuel prices
- Renewable siting is much more localized and urban
- High usage of demand side generation and management
- Retirements of nuclear based on licenses

MISO MTEP19 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 = 1.0% Demand = 0.40%
Fuel Forecast	Gas: Base -30% Coal: Base -3%	Base	Gas: Base +30% Coal: Base	Base
Supply Side CC/CT/Wind/Solar (GW)	9.6 / 9.6 / 3.6 / 4.8	13.2 / 15.6 / 10.8 / 9.0	13.2 / 9.6 / 42 / 20.2	20.4 / 1.2 / 10.8 / 14.2
Demand Side Additions By Year 2033	EE: - GW DR: 0.6 GW DG PV: 2.4 GW	EE: 5.0 GW DR: 0.2 GW DG PV: 4.5 GW	EE: 6.8 GW DR: 0.5 GW DG PV: 10.1 GW	EE: 5.5 GW DR: 0.2 GW DG PV: 28.5 GW Storage: 2 GW
Renewable Penetration Level By Year 2033	15%	20%	39%	25%
Generation Retirements *By Year 2033*	Coal: 9 GW Gas/Oil: 16 GW	Coal: 19 GW Gas/Oil: 16 GW	Coal: 19 GW Gas/Oil: 16 GW	Coal: 19 GW Gas/Oil: 16 GW Nuclear: 2 GW
CO2 Reduction Constraint *From Current Levels by 2030*	None	None	20%	None
Siting Methodology	MTEP Standard	MTEP Standard	MTEP Standard	Localized

Source: MISO February 5, MTEP19 Futures Summary
https://cdn.misoenergy.org/MTEP19%20Futures%20Summary291183.pdf

Demand and Energy Growth Rates

	MTEP 18 Method			MTEP 19 Method		
	Low (10/90)	Base (50/50)	High (90/10)	Low (10/90)	Base (50/50)	High (90/10)
Demand	0.23%	0.47%	0.70%	0.00%	0.29%	0.59%
Energy	0.25%	0.49%	0.74%	0.00%	0.43%	0.85%

Source: MISO February 5, MTEP19 Futures Summary
https://cdn.misoenergy.org/MTEP19%20Futures%20Summary291183.pdf

Demand Side Additions

	MTEP 18				MTEP 19			
	EE	DR	DG PV	Storage	EE	DR	DG PV	Storage
Limited Fleet Change	-	2GW	2.3GW	-	-	0.6GW	2.4GW	-
Continued Fleet Change	-	3GW	2.8GW	-	5.0GW	0.2GW	4.5GW	-
Accelerated Fleet Change	5GW	4GW	6.4GW	-	6.8GW	0.5GW	10.1GW	-
Distributed & Emerging Technology	2GW	3GW	2.8GW	2GW	5.5GW	0.2GW	28.5GW	2GW

Source: MISO February 5, MTEP19 Futures Summary
https://cdn.misoenergy.org/MTEP19%20Futures%20Summary291183.pdf
MISO October 16 2018, MTEP18 Futures Summary
https://cdn.misoenergy.org/MTEP18%20Futures%20Summary111488.pdf

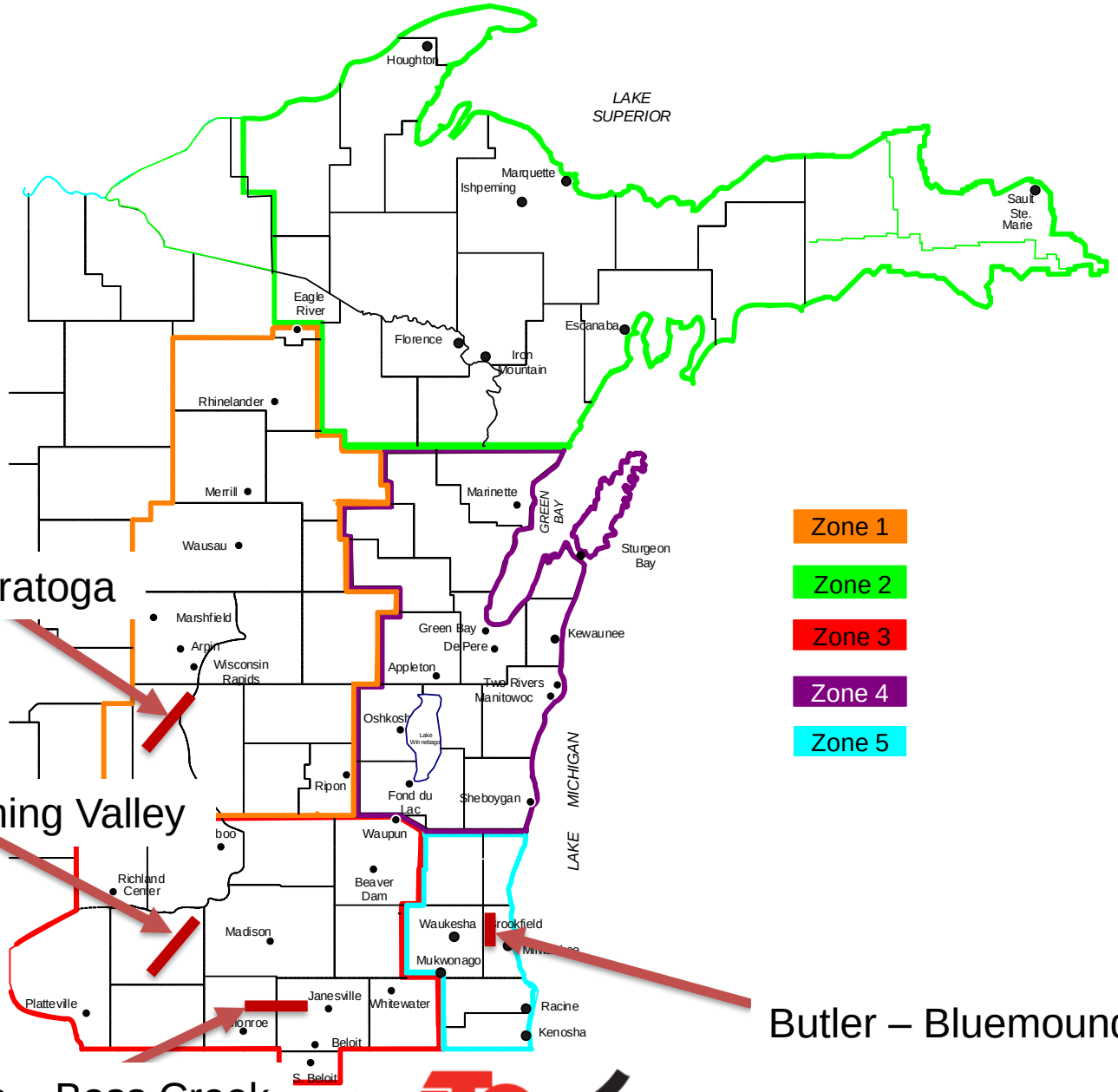
Renewable Penetration Levels

	Limited Fleet Change	Continued Fleet Change	Accelerated Fleet Change	Distributed & Emerging Technology
MTEP18	10%	15%	30%	20%
MTEP19	15%	20%	39%	25%

Source: MISO February 5, MTEP19 Futures Summary
https://cdn.misoenergy.org/MTEP19%20Futures%20Summary291183.pdf

Notable MTEP19 Congestion

- Butler – Bluemound 138 kV
- Petenwell – Saratoga 138 kV
  - This has a remedial action scheme for constraint mitigation
- North Monroe – Bass Creek 138 kV
  - Driven by future generation siting
- Eden – Wyoming Valley 138 kV
  - Driven by future generation siting



Petenwell-Saratoga

Eden – Wyoming Valley

Butler – Bluemound

North Monroe – Bass Creek

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Stakeholder and Customer Feedback

- ATC is soliciting stakeholders and customers for new/other economic studies, recommended study assumptions changes, and study areas for our 2019 study
- ATC requests feedback in areas where Public Policy Requirements may drive transmission needs.
  - Public Policy Requirements are enacted statutes (i.e., passed by the legislature and signed by the executive) and regulations promulgated by a relevant jurisdiction, whether within a state or at the federal level, including duly enacted laws or regulations passed by a local governmental entity, such as a municipal or county government. Stakeholders are encouraged to provide ATC with Public Policy Requirements. ATC utilizes transmission needs driven by Public Policy Requirements in its assumptions when performing economic analysis of study areas. The transmission needs driven by Public Policy Requirements that will be included in ATC's finalized assumptions will be posted prior to May 15th.

Next Steps

- Project / Analysis Development
  - Review of Congestion
  - Investigate impacts of generation expansion and retirement on congestion
  - Stakeholder Feedback
- 2019 Futures Development
  - Continued Review of MISO MTEP19 Development
  - Update model with interconnection projects that may impact congestion
- Analysis of Projects
  - Study Years – 2023, 2028 and 2033
  - Futures – All MISO MTEP19 Futures
- Timelines
  - April 15: Define Preliminary Assumptions
  - May 15: Finalize Assumptions
  - November 15: Provide Analysis Update

Questions?

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Thank You For Your Time!