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2019 Economic Planning Study Results

Anna Torgerson, Economic Planning

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Introduction

- Process Overview and Timeline
- MTEP19 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 MTEP19 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% than current 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
- Age related Nuclear 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

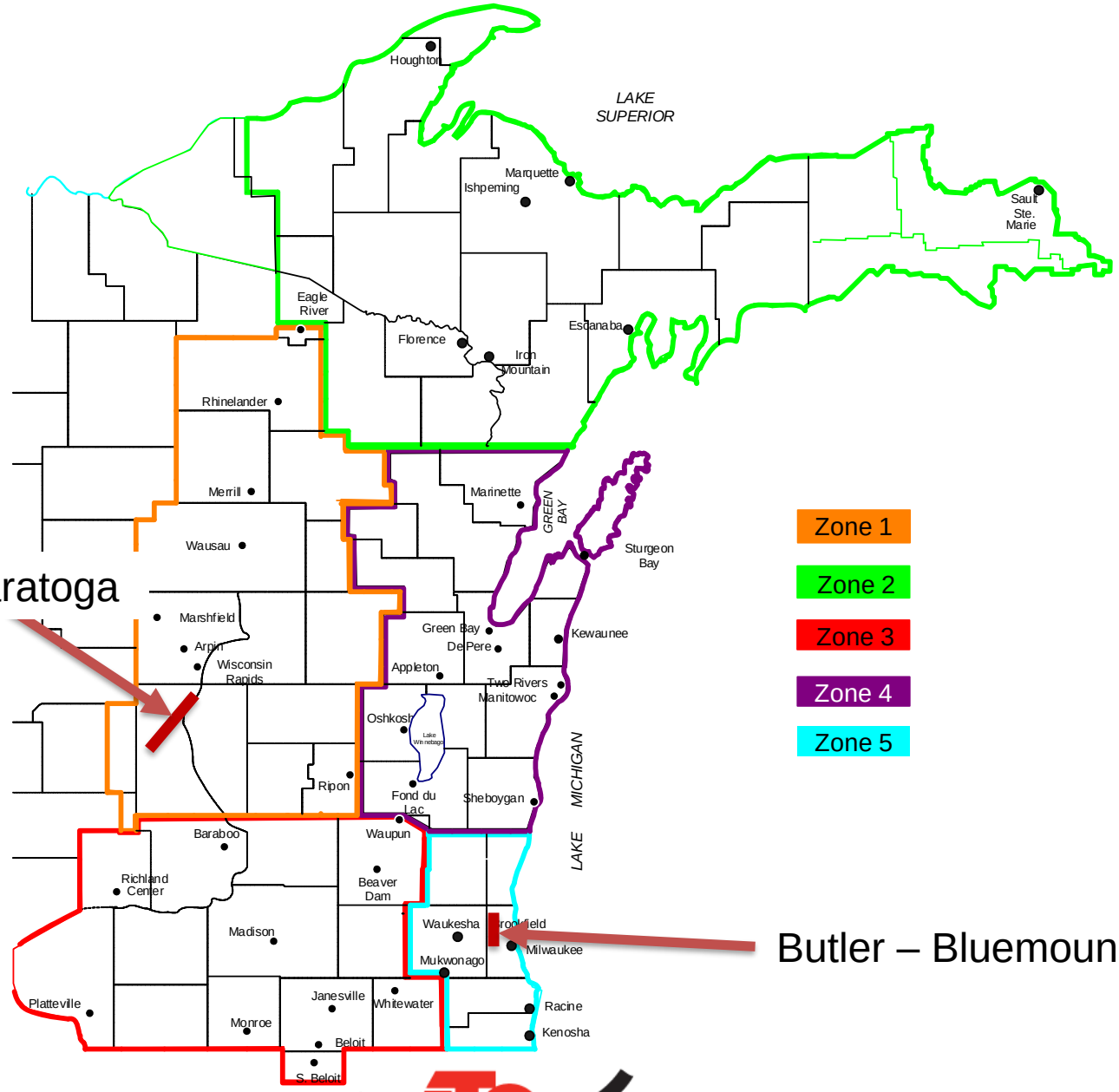
MISO MTEP19 Key Assumptions

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 = 1.0% Demand = 0.4%	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: 6.8 GW DR: 0.5 GW DG PV: 10.1 GW	EE: 5.0 GW DR: 0.2 GW DG PV: 4.5 GW	EE: 5.5 GW DR: 0.2 GW DG PV: 28.5 GW 2 GW storage	EE: - DR: 0.6 GW DG PV: 2.4 GW
Renewables ***By Year 2033*** **(% Wind and Solar Energy)**	39%	20%	25%	15%
Retirement	Coal: 19 GW Gas/Oil: 16 GW	Coal: 19 GW Gas/Oil: 16 GW	Coal: 19 GW Gas/Oil: 16 GW Nuclear: 2 GW	Coal: 9 GW Gas/Oil: 16 GW
CO2 Reduction Constraint ***From Current Levels by 2032***	20%	None	None	None
Siting Methodology	MTEP Standard	MTEP Standard	Localized	MTEP Standard

Source: MISO 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 (RAS) for constraint mitigation
- North Monroe – Bass Creek 138 kV
  - Driven by future assumed generation siting
- Eden – Wyoming Valley 138 kV
  - Driven by future assumed generation siting



Petenwell-Saratoga

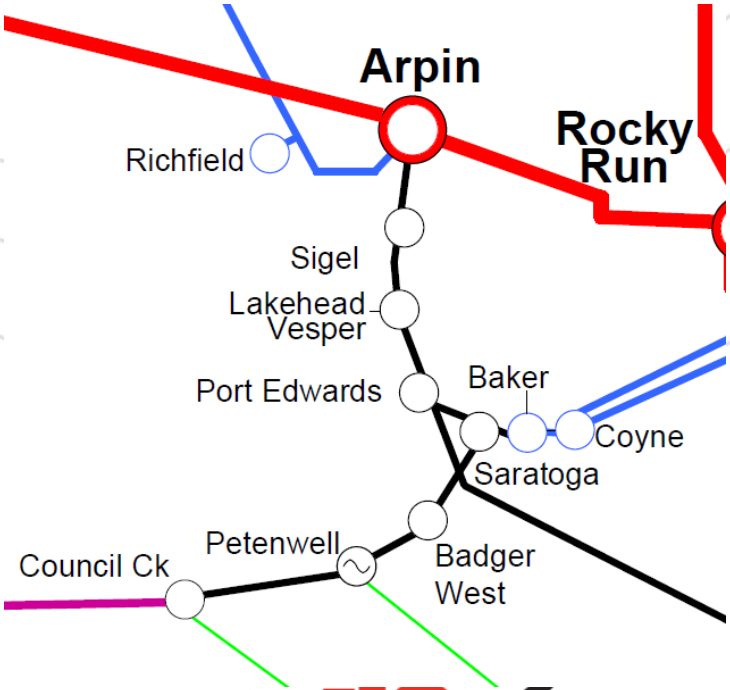
Butler – Bluemound

Petenwell – Saratoga 138kV

- New NERC study requirements increases cost of maintaining RAS
- A significant portion of the poles need to be replaced in 5-10 years
- Reliability issues in the area

Petenwell Area Alternatives

- Double Circuit X-33 (Arpin – Sigel 138kV)
- New Jackson County – Saratoga 161kV line
- Rebuild X-43 (Petenwell – Saratoga 138kV)



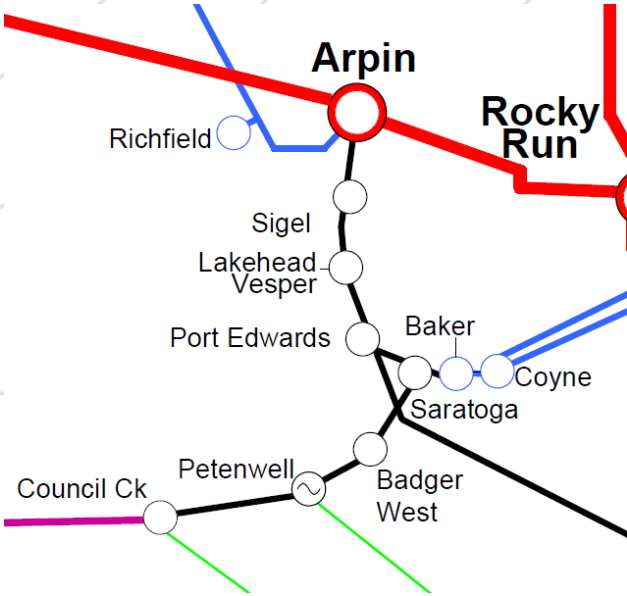
Petenwell MTEP19 Study Results

		MISO MTEP19 Planning Futures			
		AFC	CFC	DET	LFC
Alternatives	Build Double Circuit X-33	($102,096,171)	($78,375,129)	($130,154,804)	($135,685,790)
	Build Jackson County - Port Edwards 161kV	($26,515,842)	$505,474	($19,509,944)	$7,194,344
	Rebuild Petenwell - Saratoga	$9,439,437	$16,696,497	$10,876,704	$30,213,544

Note: Numbers are 2019 present value gross benefit from the Customer Benefit metric.

Petenwell Rebuild Sensitivities

- Rebuild and 69kV Asset Renewals
  - Rebuild X-43 Petenwell – Saratoga
  - Rebuild 69kV Castle Rock – McKenna – Lincoln
- Rebuild and Port Edwards Queue Solar
  - Rebuild X-43 Petenwell – Saratoga
  - Queue Solar J986 without DPP upgrades
- Rebuild and Retire Weston 3
  - Rebuild X-43 Petenwell – Saratoga
  - Retire Weston 3, 31 and 32 in 2022
  - Weston 4 assumed in-service



Petenwell Rebuild Sensitivity Results

		MISO MTEP19 Planning Futures			
		AFC	CFC	DET	LFC
Alternatives	Rebuild Petenwell - Saratoga	$9,439,437	$16,696,497	$10,876,704	$30,213,544
	Rebuild and 69kV Asset Renewal Rebuilds	$13,964,640	$18,522,220	$11,537,681	$32,922,902
	Rebuild and Port Edwards Queue Solar	$3,311,280	$7,358,320	$8,342,775	$21,686,954
	Rebuild and Retire Weston 3	$8,239,646	$17,064,711	$9,824,820	$30,493,315

Note: Numbers are 2019 present value gross benefit from the Customer Benefit metric.

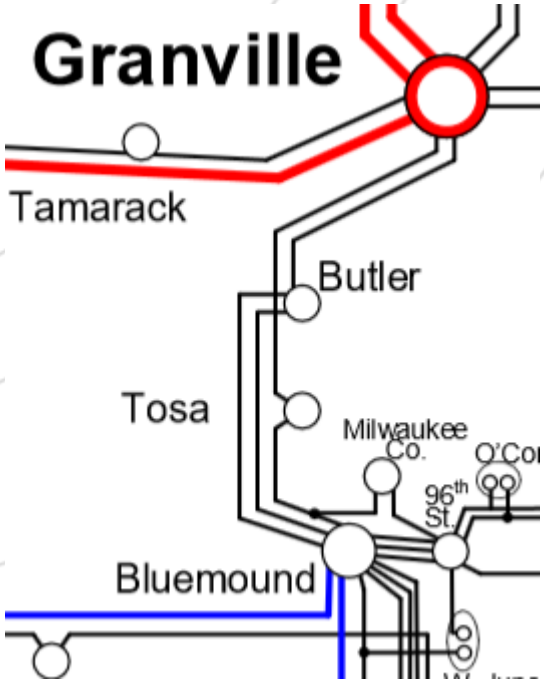
Initial Conclusions on X-43 Rebuild

- Improves Reliability Issues
- Lower Cost for Asset Renewal Projects
- IT Project Cost Savings
- Lowers Market Congestion
- Removes the need for Council Creek RAS
  - Saves time and money
- Support future Generation Interconnection Queue

- Project is currently in Appendix B with ISD of 12/2022

Economic Study Bluemound Alternatives

- Rebuild Granville-Bluemound 138kV Corridor to Double Circuit
- Rebuild Granville-Bluemound 138kV Corridor to Single Circuit
- Build New 345kV from Granville to Mill Rd and Tie in Cypress – Arcadian 345
- Non-Transmission Alternative (NTA)
  - 10MW 50MWH Battery at Bluemound
  - 10MW DG PV in WEC at various Milwaukee load points



Bluemound MTEP19 Study Results

		MISO MTEP19 Planning Futures			
		AFC	CFC	DET	LFC
Alternatives	Rebuild to Double Circuit	$19,505,095	$2,612,320	$7,887,287	$2,381,987
	Rebuild to Single Circuit	$3,993,819	$338,808	$1,722,682	$2,395,451
	Mill Rd Build 345kV	$14,350,036	$2,517,579	$4,031,783	($149,893)
	NTA	$32,850,572	$25,282,334	$23,869,216	$17,820,603

Note: Numbers are 2019 present value gross benefit from the Customer Benefit metric.

Initial Conclusions

- The corridor shows significant benefit by rebuilding to double circuit, but there is not enough benefit to justify a project ($20M)
- Mill Rd 345kV alternative rejected due to negative benefit
- The NTA alternative benefit is driven by cheaper generation costs and not reduction of congestion
  - Cost of $40M is greater than benefits
  - Adjust Battery Storage Modeling for more direct congestion mitigation

Next Steps

- Continued work with MISO and customers on Petenwell – Saratoga 138kV Rebuild
- Continued Analysis for NTA Solutions and Battery Modeling
  - Work with ABB and MISO on PROMOD HD Storage Modeling
- Timelines
  - February 2020 – Next Stakeholder Meeting

Questions

- ATC Economic Planning
- Dale Burmester
  - dburmester@atcllc.com
- Anna Torgerson
  - atorgerson@atcllc.com

Thank You For Your Time!