Integrated Resource Plan (IRP) Stakeholder Outreach Meeting

AGENDA ITEMS

9:00 a.m. MISO MTEP Futures Overview – Bonnie Janssen, MAE
•Open to any interested participant

9:45 a.m. Environmental Policy Workgroup – Breanna Bukowski, MDEQ
•PA 341 Section 6t (1c and 1d)
•Workgroup Scope
•Timeline and Deliverables
•IRP and Environmental Regulations – Barry Marietta, DTE Energy
- Linda Hilbert, Consumers Energy
•IRP Modeling Discussion (time permitting)

10:45 a.m. Other Market Options Workgroup – Nick Evans, MPSC
•Workgroup Scope
•Market Options presentation – Laura Chappelle, Varnum Law
•Discussion of market options and technologies

11:45 a.m. – 1:15 p.m. Break for lunch - on your own

1:15 p.m. Forecasting, Fuel Prices & Reliability Workgroup – Eric Stocking, MPSC
• Workgroup Scope

3:00 p.m. Upper Peninsula Workgroup – Bonnie Janssen, MAE
• Workgroup Scope

4:00 p.m. Filing Requirements Workgroup – Cathy Cole, MPSC
• Workgroup Scope

4:30 p.m. Adjourn

MTEP17 Futures

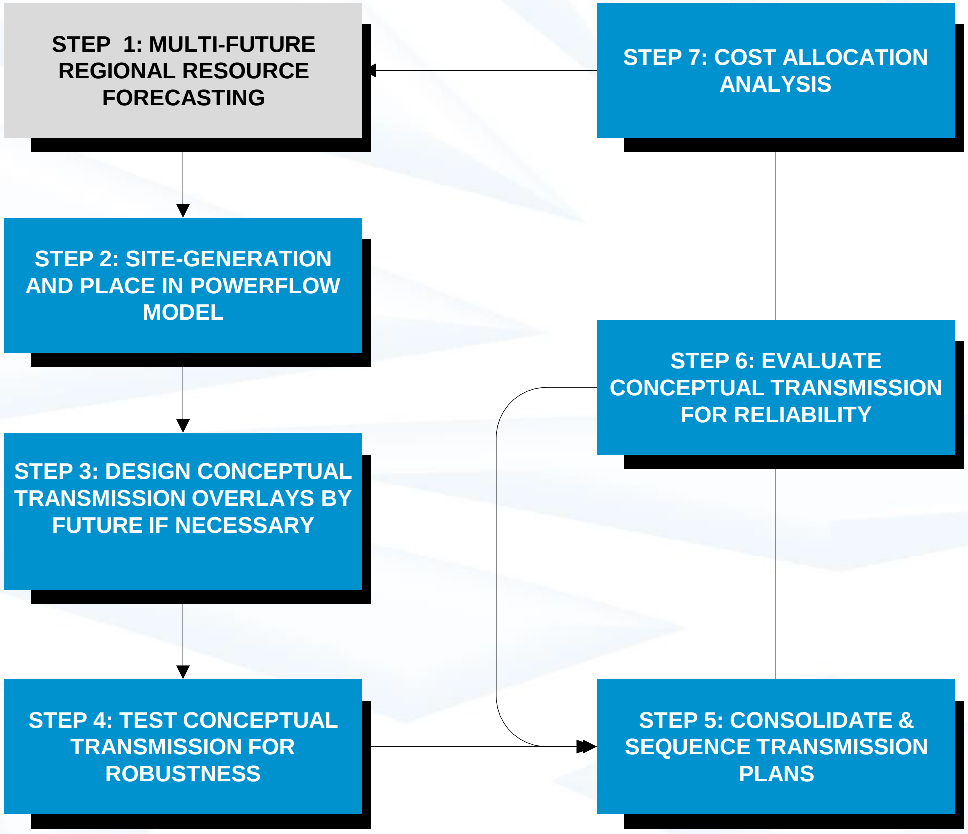
Summary of definitions, uncertainty variables, siting process, and resource forecasts

Excerpts from MISO's PAC meetings
Bonnie Janssen, MAE

Overview

- Futures narratives proposals
- Uncertainty variables definitions
- Timeline
- Next steps

MISO's Value Based Planning



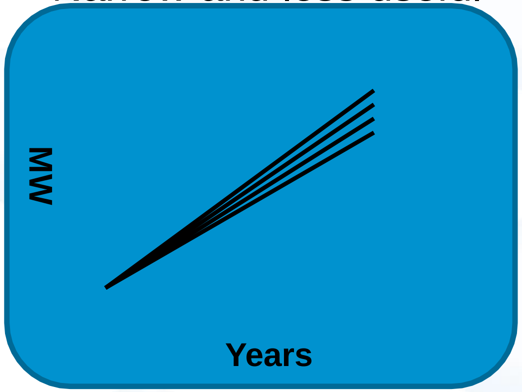
Objective of value based planning is to develop the most robust plan under a variety of scenarios – not the least-cost plan under a single scenario

- The "best" transmission plan may be different in each policy-based future scenario
- The transmission plan that is the best-fit (most robust) against all these scenarios should offer the most future value in supporting the future resource mix

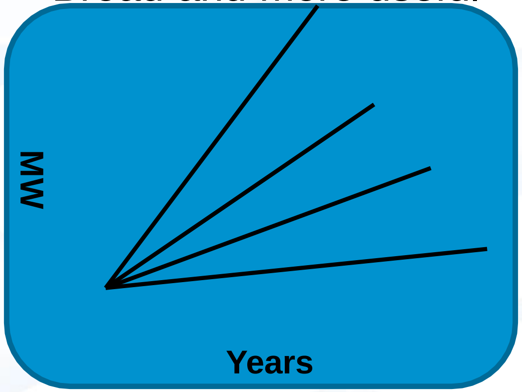
What are Futures?

- A prediction of what "could be" which guides the assumptions made about the variables within a model
- What is the question you are attempting to answer?
- Interchangeably also referred to as a "scenario"

Narrow and less useful



Broad and more useful



Why do we need Futures?

- To obtain multiple long term views of theoretical supply and demand resource availability given different policy and economic drivers
- To simulate likely or plausible real-life future system conditions and provide an envelope of outcomes that is sufficiently broad, rather than a single forecasted possibility
- Adequate bookends ensure that MISO continues to plan the system reliably and efficiently
- Different futures yield different “best plans”
- To perform Regional Resource Forecasting with multiple input assumptions

MTEP16 Preliminary Futures Matrix

Future	Demand and Energy Growth	Retirement Level (GW)	Natural Gas Price (2015 $/MMBtu)	Renewable Portfolio Standards (GW) N/C: North/Central S: South	CO_2 Cost
Business as Usual	0.8%	12 GW coal	$4.17	N/C: 4.2 Wind/ 1.4 Solar S: 0.3 Wind/0 Solar	N/A
High Demand	1.5%	12 GW coal	$3.25	N/C: 7.2 Wind/ 1.6 Solar S: 0.3 Wind/0 Solar	N/A
Low Demand	0.14%	12 GW coal	$5.00	N/C: 2.4 Wind/ 1.3 Solar S: 0.3 Wind/0 Solar	N/A
Generation Shift	0.8%	26 coal GW + 13.5 GW gas/oil age-related	$4.17	N/C: 17.4 Wind/ 3.8 Solar GW S: 1.2 Wind / 5.8 Solar GW	$25 / ton
Advanced Tech	0.8%	12 GW coal	$4.17	N/C: 17.4 Wind/ 3.8 Solar GW S: 1.2 Wind / 5.8 Solar GW	N/A

MTEP16 Futures Matrix

Future	Demand and Energy Growth	Retirement Level* (GW)	Peak Natural Gas Price (2015 $/MMBtu)	Incremental Renewables (GW) N/C: North/Central S: South	CO_2 Cost (2015 $/ton
Business as Usual	0.9%	No Additional	$4.30	N/C: 4.2 Wind/ 1.4 Solar S: 0 Wind/ 0 Solar	N/A
High Demand	1.6%	Age-related	$4.30	N/C: 7.2 Wind/ 1.6 Solar S: 0 Wind/ 0 Solar	N/A
Low Demand	0.2%	Age-related	$3.44	N/C: 2.4 Wind/ 1.3 Solar S: 0 Wind/ 0 Solar	N/A
Regional CPP Compliance	0.9%	14 GW coal + age-related	$5.16	N/C: 4.2 Wind/ 1.4 Solar S: 0 Wind/ 0 Solar + economically chosen wind/solar based on cost maturity curves	$25 / ton
Sub-Regional CPP Compliance	0.9%	20 GW coal + age-related	$5.16	N/C: 4.2 Wind/ 1.4 Solar S: 0 Wind/ 0 Solar + economically chosen wind/solar based on cost maturity curves	$40 / ton

*12 GW of MATS related coal-retirements are assumed in all Futures
Age-related retirement assumption applies to non-coal generation only

MTEP17 Futures Key Assumptions

Future	Existing Fleet	Policy Regulations	Accelerated Alternative Technologies
Gross Demand & Energy Growth Rates	Low (High for LRZ 9 industrial) Demand: 0.4% Energy: 0.4%	Mid Demand: 0.6% Energy: 0.7%	High (Low for LRZ 9 industrial) Demand: 0.9% Energy: 0.9%
Natural Gas Price Forecast	Low	Mid	High
Max DR/EE/DG Tech. Potential[4]	DR: 8 GW EE: 9.6 GW DG: 2.3 GW	DR: 9 GW EE: 10.8 GW DG: 2.8 GW	DR: 12.1 GW EE: 25.6 GW DG: 6.4 GW
Retirements	Coal: 8 GW[1] Gas/Oil: 16 GW[1] Total by 2031: 24 GW	Coal: 16 GW[2] Gas/Oil: 16 GW[1] Total by 2031: 32 GW	Coal: 24 GW[2] Gas/Oil: 16 GW[1] Total by 2031: 40 GW
Renewables	Mandates + Goals	Mandates + Goals + maturity cost curve	Mandates + Goals + maturity cost curve
MISO System CO2 Reduction Target	N/A	All units target 25%[3]	All units target 35%[3]
Renewable Tax Credit	Continues until 2022	Continues until 2022	Continues until 2022

1.Based on age-related retirement assumptions – total by year 2031
2. Coal retirements resulting from economics of carbon regulation derived from the CPP Mid-Term Analysis – total by year 2031
3. CO2 reduction on aggregate MISO fleet (measured by total of all units' output) by 2030 from 2005 levels
4.Technical Potential represents the maximum feasible potential under each scenario. Only economically viable programs will be implemented in the MTEP17 models (each program will be compared against supply-side alternatives)

DRAFT MTEP18 Futures Key Variables

MTEP 2018 Future	Stalled Fleet Change	Fleet Change	Accelerated Fleet Change
Demand and Energy	Low – 10/90 (High for LRZ9 industrial)	Base – 50/50	High – 90/10 (Low for LRZ9 industrial)
Natural Gas Price	Base –30%	Base	Base +30%
Demand Side Additions ***By Year 2031***	EE: 0.2 GW DSM: 3 GW	EE: 3 GW DSM: 4 GW	EE: 9 GW DSM: 7 GW
Renewable Additions ***By Year 2031***	5 GW	22 GW	52 GW
Generation Retirements ***By Year 2031***	Coal: 8 GW Gas/Oil: 16 GW	Coal: 16 GW Gas/Oil: 16 GW	Coal: 24 GW Gas/Oil: 16 GW
Resulting Carbon Reduction[1] ***From 2005 Levels***	~~Current levels:~~ 14%	25%	35%

1. Current carbon reductions are ~16% from 2005 levels

Slowed ← ***Rate of Fleet Transition*** → ***Accelerated***

EE: Energy Efficiency DSM: Demand Side Management

Existing Fleet

The existing generation fleet is largely unchanged. No carbon regulations are modeled, though some reductions are expected due to age-related coal retirements and renewable additions driven by renewable portfolio standards and goals as well as economics.

- *Natural gas prices remain low due to increased well productivity and supply chain efficiencies.*
- *Footprint wide, demand and energy growth rates are low to model a more static system with no notable drivers of higher growth; however, as a result of low natural gas prices, industrial production along the Gulf Coast increases.*
- *Low natural gas prices and static economic growth reduce the economic viability of alternative technologies.*
- *Thermal generation retirements are driven by unit age-limits. Nuclear units are assumed to have license renewals granted and remain online.*
- *Tax credits for renewables continue until 2022 to model existing policy.*

Policy Regulations

Carbon regulations targeting a 25% reduction across all aggregated unit outputs are enacted driving some coal retirements and an increase in natural gas reliance. Increased renewable additions are driven by renewable portfolio standards and goals, economics, and business practices to meet carbon regulations.

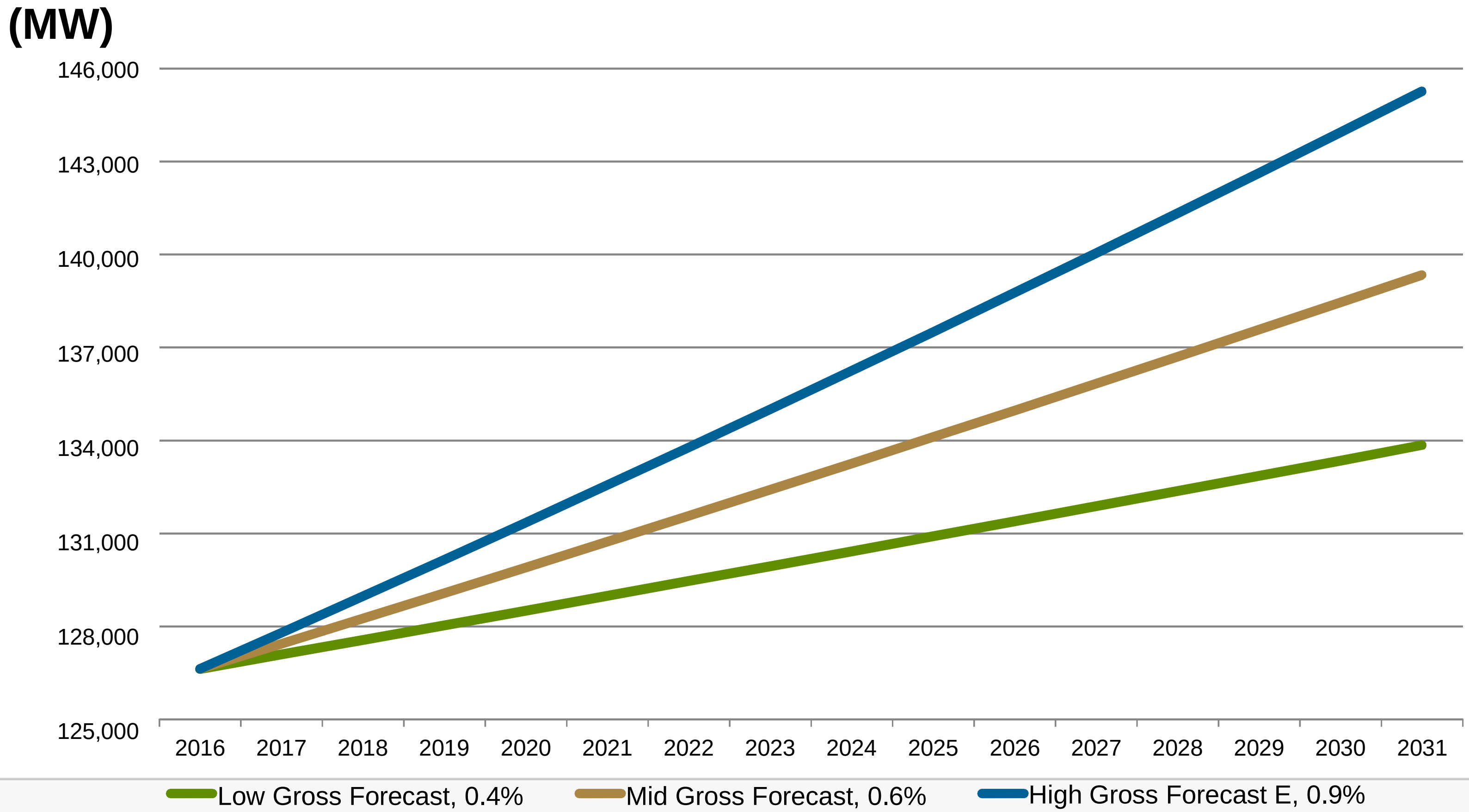
- *Demand and energy growth rates are modeled at a level equivalent to a 50/50 forecast.*
- *Natural gas prices are consistent with industry long-term reference forecasts.*
- *Current demand response, energy efficiency, and distributed generation programs remain in place and grow to help comply with additional regulations.*
- *Non-nuclear, non-coal generators will be retired in the year the age limit is reached. Coal units will be retired reflecting economics of carbon regulations. Nuclear units are assumed to have license renewals granted and remain online.*
- *Maturity cost curves for renewable technologies applied reflecting some advancement in technologies and supply chain efficiencies.*
- *Tax credits for renewables continue until 2022 to model existing policy.*

Accelerated Alternative Technologies

A robust economy drives technological advancement and economies of scale resulting in a greater potential for demand response, energy efficiency, and distributed generation as well as lower capital cost for renewables reflected in the maturity cost curves. Carbon reductions targeting 35% across all aggregated unit outputs are achieved.

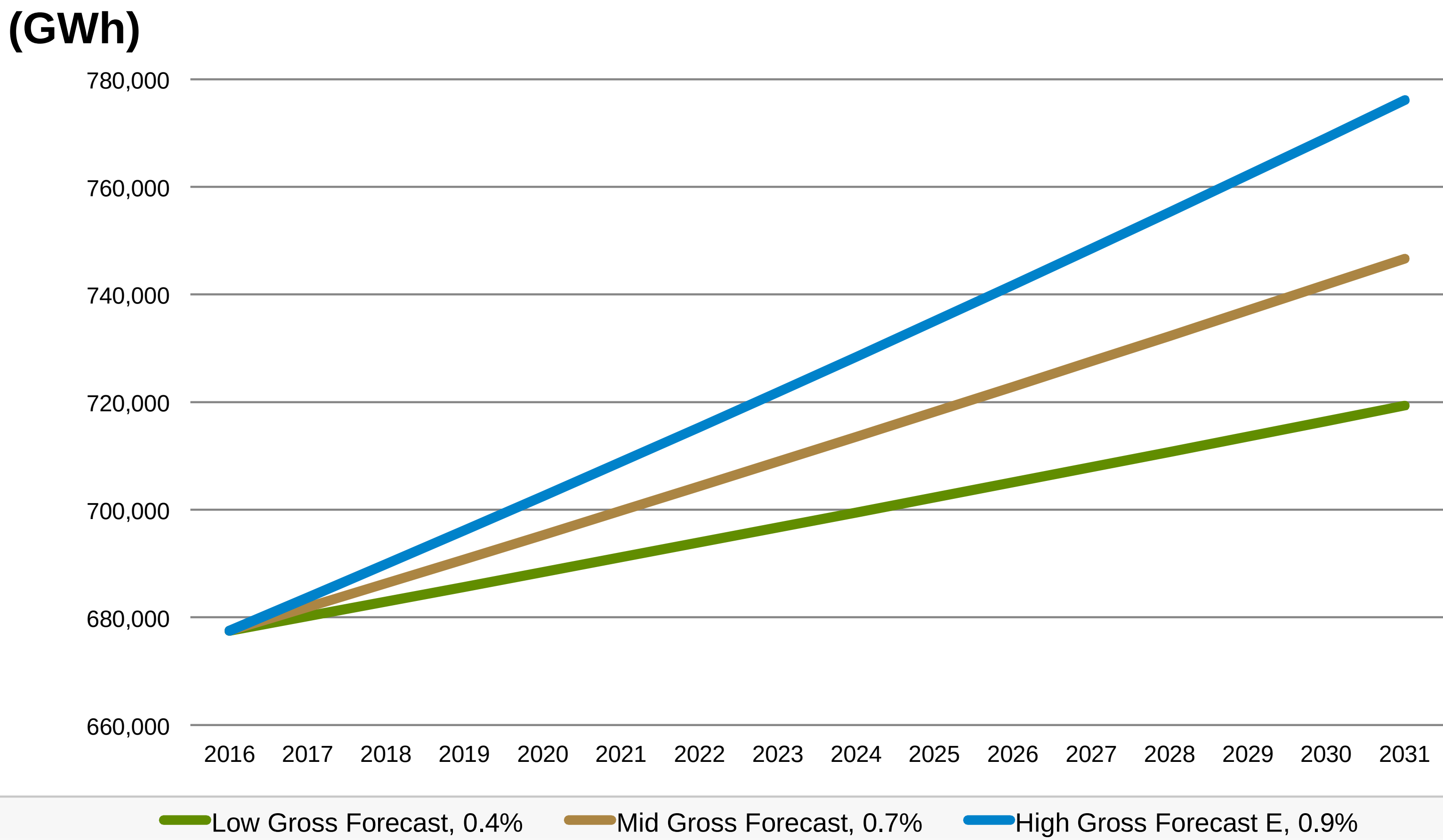
- *Natural gas prices are high due to increased demand.*
- *Robust economy leads to increased demand & energy consumption. Footprint wide, demand and energy growth rates are high due to a robust economy; however, as a result of high natural gas prices, industrial production along the Gulf Coast decreases.*
- *A robust economy drives technological advancement and economies of scale resulting in a greater potential for demand response, energy efficiency, and distributed generation as well as lower capital cost for renewables reflected in the maturity cost curves.*
- *Non-nuclear, non-coal generators will be retired in the year the age limit is reached. Coal units will be retired reflecting economics of carbon regulations. Nuclear units are assumed to have license renewals granted and remain online.*
- *Tax credits for renewables continue until 2022 to model existing policy.*

MTEP17 Gross Peak Demand Forecasts



- Mid forecast is aggregated 50/50 forecast from Load Serving Entities (Module E)
- High and low forecasts are indicative of a 90/10 and 10/90 forecast (respectively)
- High and low forecasts reflect LRZ 9 Industrial load being modeled low and high (respectively)

MTEP17 Gross Energy Forecasts



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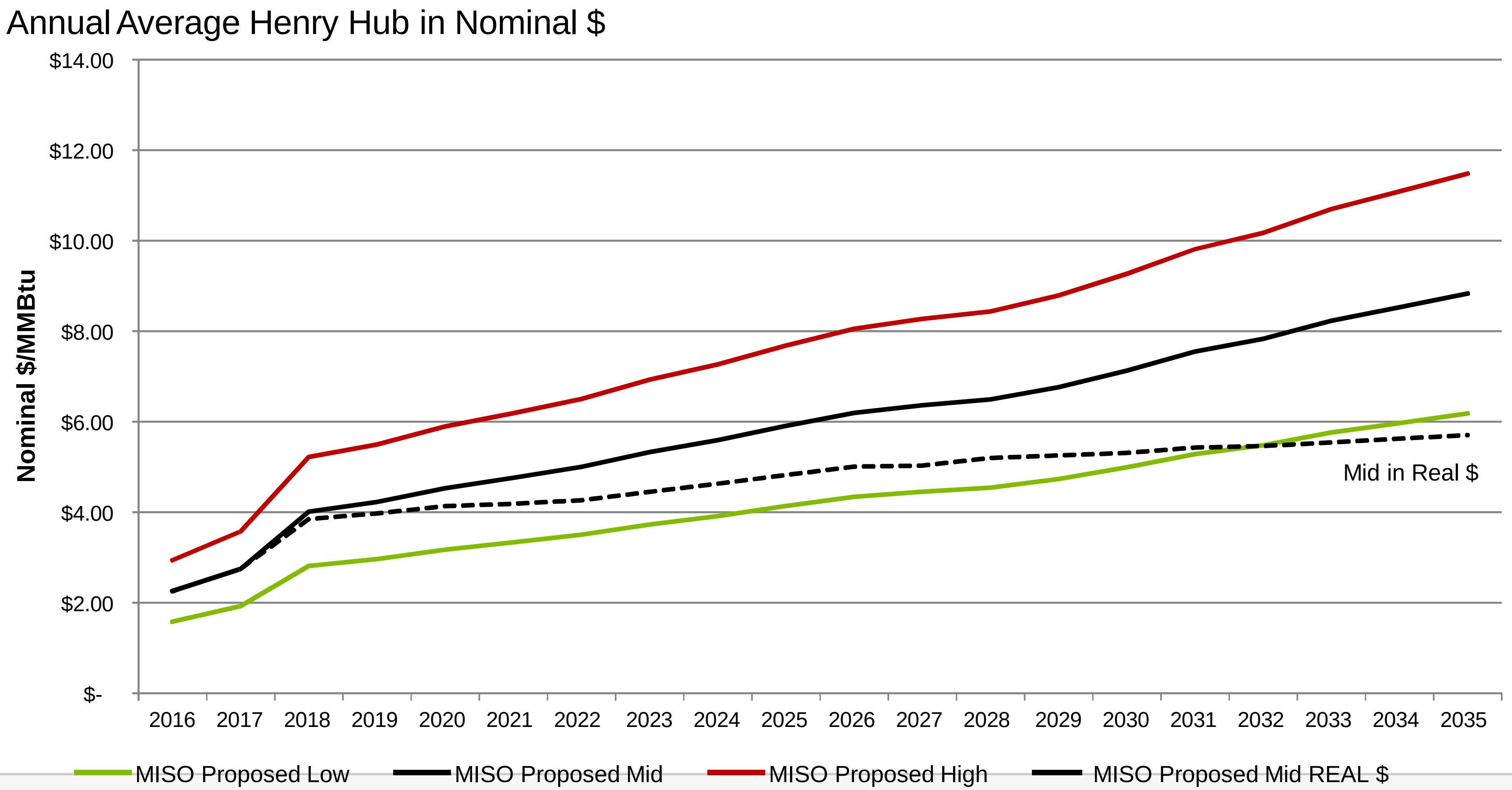
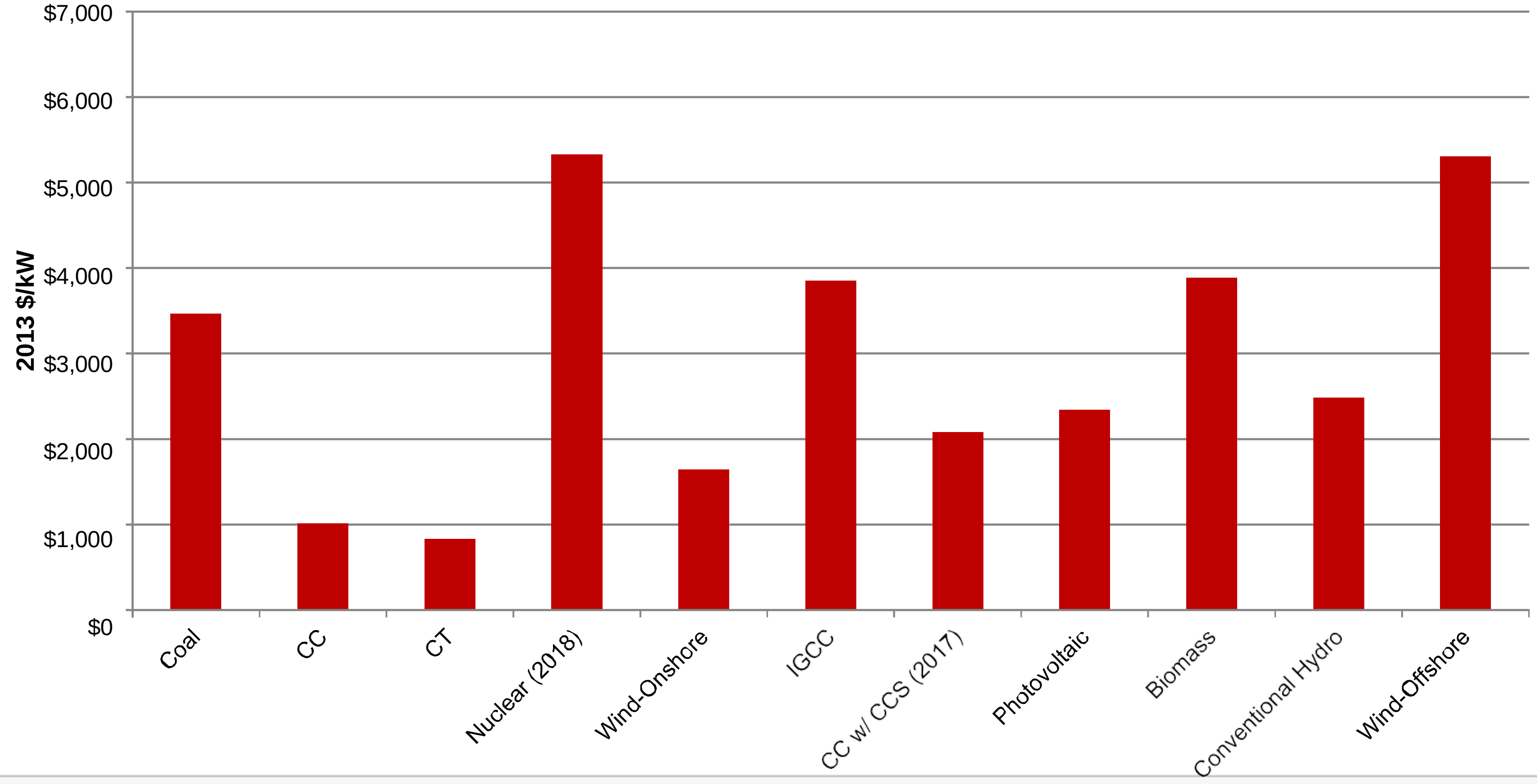
MTEP17 Natural Gas Price Bands



- Mid natural gas forecast references NYMEX for first two years and an average of EIA and Wood Mackenzie forecasts for the out years
- High and low bands are +/- 30% (>95% confidence interval)

MTEP17 Unit Capital Costs



- Costs referenced from the NREL ATB Report
- Solar values reflect a 20% adder for DC to AC conversion

Source: http://www.nrel.gov/analysis/data_tech_baseline.html

Appendix

Sector Weighting Rationale*

Existing Fleet

- Most realistic because it reflects current regulations
- Most likely due to assumptions are not dependent upon external political or technological catalyst
- Less likely due to some utilities/states planning to retire coal plants earlier than 60-year assumption
- Unlikely because the stay of the CPP will not be permanent
- Reduction of carbon emissions whether from policy or favorable economics of alternative technologies is much more likely than the status quo of the Existing Fleet future

Policy Regulations

- Less likely than Existing Fleet due to expectation that CPP regulations have lower likelihood given the CPP stay
- Given the current retirement of coal plants regardless of CPP regulation and robust economy in the AAT future, the Policy Regulations is the most realistic
- Assumes increased penetration of natural gas and renewables as replacements to coal and nuclear representing current system conditions
- Includes some policy drivers that may occur but may be slightly overstated in operational impacts
- Depicts compliance over the next 15-20 years under known state and federal regulations
- Most likely scenario for CO_2 emissions to be constrained is by the CPP or a roughly comparable alternative regulation

Accelerated Alternative Technologies

- Unrealistic because the Policy Regulations future already captures and depicts an over-optimistic scenario regarding the CPP compliance, but the high economic growth should be tested
- Robust economic assumptions are uncertain unless tax policies are changed
- The types of projects resulting from the AAT future would be better suited for the inclusion in the multi-year overlay analysis
- Least likely due to significant reduction of CO_2 emissions and large amounts of renewables sited at speculative locations with the combination of high load growth despite high electricity prices
- More rapid emission reductions are possible, but less likely
- Combination of assumptions are not plausible and would recommend using this as a separate sensitivity case

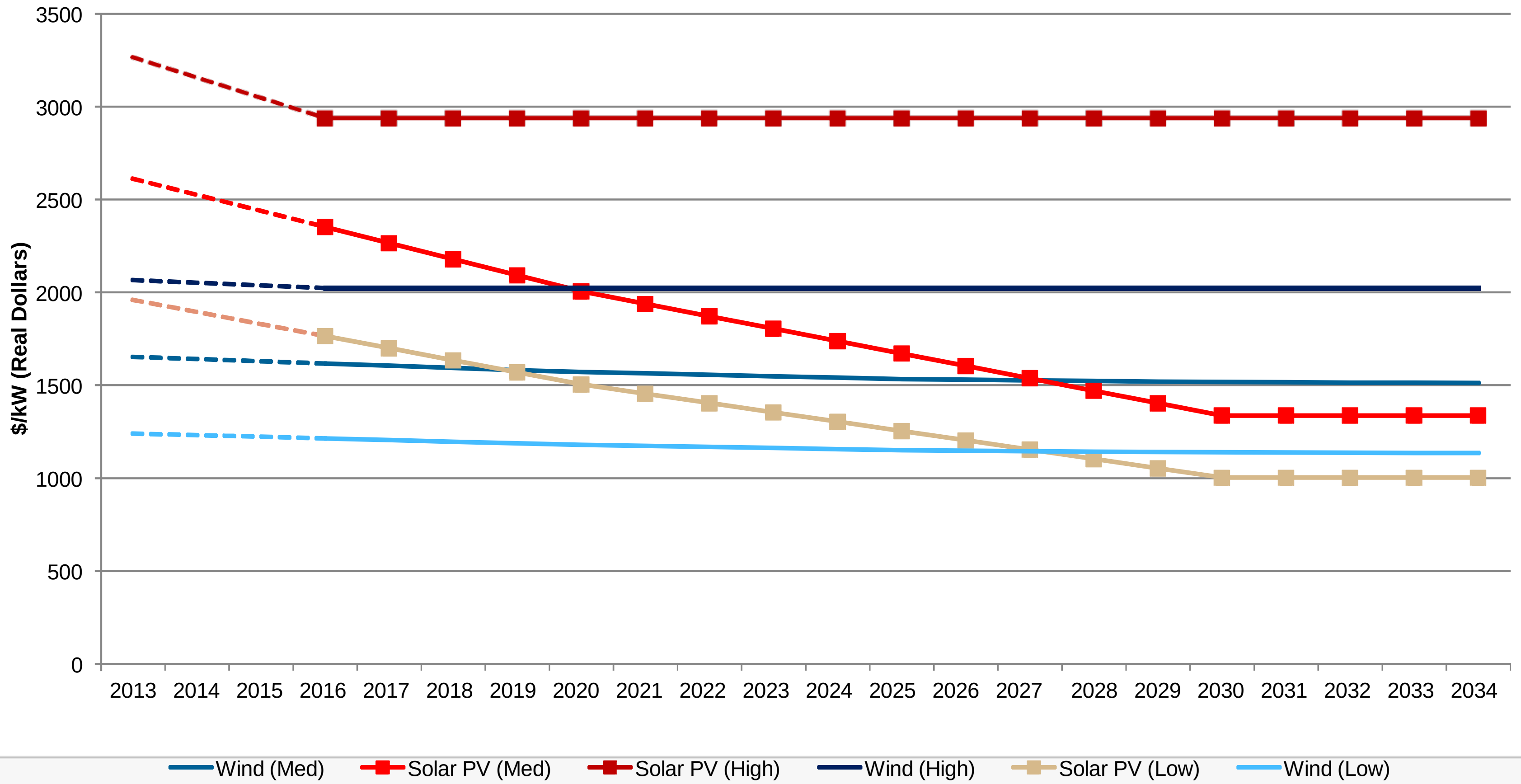
As shown at July 2016 Planning Advisory Committee

https://www.misoenergy.org/Events/Pages/PAC20160720.aspx

MTEP17 Retirement Methodology

- **Retirements, retrofits, and conversions related to Mercury and Air Toxics (MATS) are included as base model assumptions due to compliance by April 2016**
- **Thermal unit age-related retirements occur in the year in which the age threshold is reached in all futures**
  - Additional coal units will be retired in the Policy Regulations and Accelerated Alternative Technologies Futures to reflect economics of carbon reductions evenly between 2022 and 2026
  - Magnitude of carbon reduction driven coal retirements determined from the Mid-Term CPP Analysis
- **Nuclear units assumed to have license renewals granted and remain online**
- **Attachment Y and public and/or officially declared retirements (e.g. IRP) will be included**

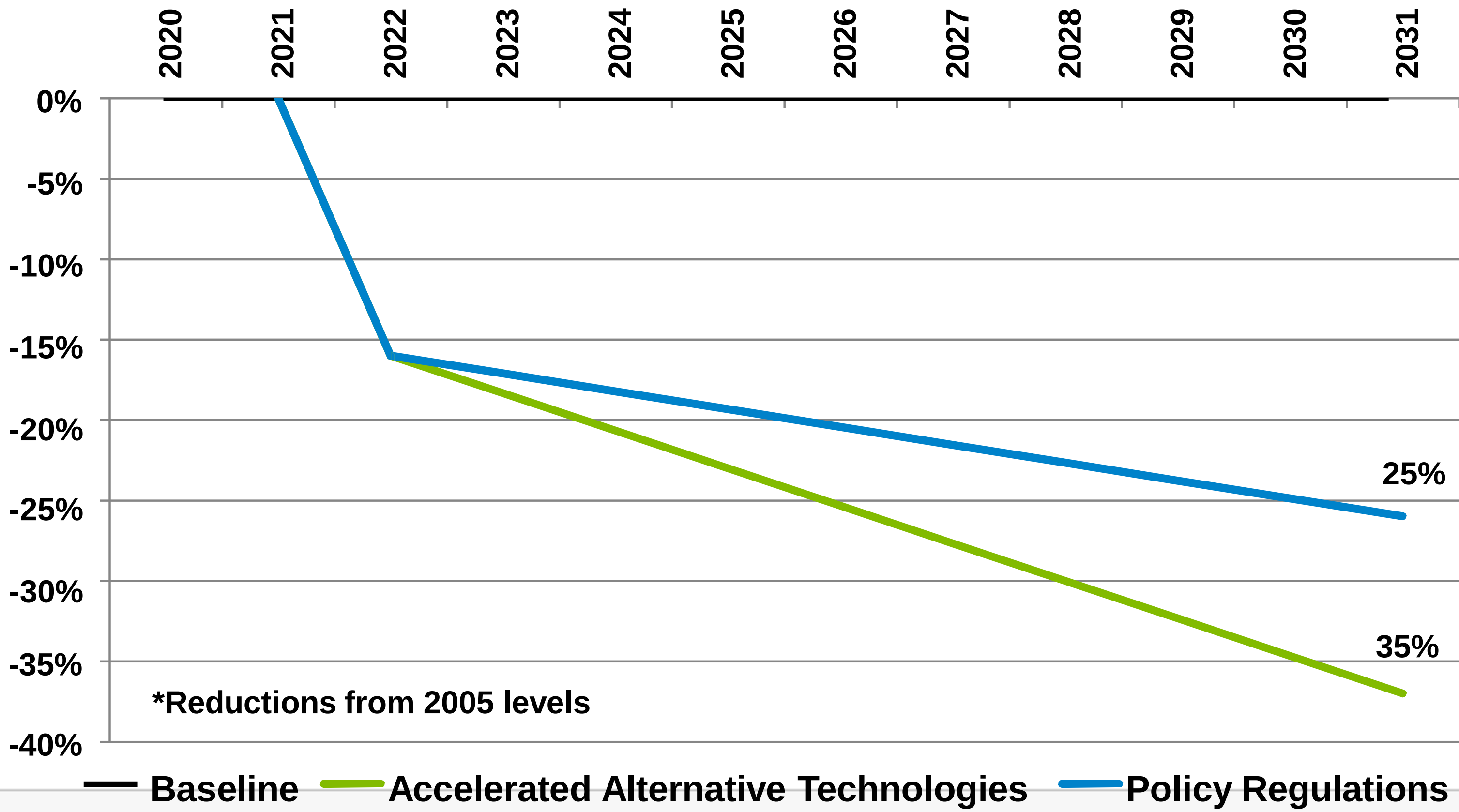
Renewable Cost Maturity Curves



- Base curves referenced from the NREL ATB Report
- Solar values updated to reflect a 20% adder for DC to AC conversion

Source: http://www.nrel.gov/analysis/data_tech_baseline.html

MTEP17 MISO CO_2 Constraints



MTEP17 futures apply CO_2 constraints to all units ensuring each Future reaches the targeted emission reductions

Demand Response, Energy Efficiency, & Distributed Generation Incremental Technical Potential

MTEP17 Targets		Low		Medium		High	
AEG Scenario*		Low Growth*		Existing Programs+*		CPP*	
		Capacity (GW)	Energy (GWh)	Capacity (GW)	Energy (GWh)	Capacity (GW)	Energy (GWh)
Technical Potential (2031)**	Demand Response	8.0	632	9.0	712	12.1	1,078
	Energy Efficiency	9.6	36,980	10.8	41,319	25.6	100,341
	Distributed Generation	2.3	3,791	2.8	4,199	6.4	13,264

Technical Potential represents the maximum feasible potential under each scenario, only economically viable programs will be implemented in the MTEP17 models (each program will be compared against supply-side alternatives)

**AEG Report: https://www.misoenergy.org/Events/Pages/DREEDG20160208.aspx*
*** Existing DR/EE/DG programs modeled as base assumptions and excluded from table*

State goals and mandates will be captured in all MTEP17 Futures, additional DR/EE/DG up to listed potential will be allowed to be economically selected

Demand Response, Energy Efficiency, & Distributed Generation Incremental Technical Potential

MTEP17 Targets		Low		Medium		High	
AEG Scenario*		Low Growth*		Existing Programs+*		CPP*	
2031 Potential**	Commercial / Industrial vs Residential	Capacity (GW)	Energy (GWh)	Capacity (GW)	Energy (GWh)	Capacity (GW)	Energy (GWh)
Demand Response	C/I	6.1	438	6.9	492	7.1	511
Direct Load Control	C/I	1.3	103	1.4	117	2.2	171
	R	0.4	36	0.4	38	1.3	122
Price-Responsive Demand	C/I	0.2	51	0.2	59	0.8	178
	R	0.0	5	0.0	5	0.5	95
High-cost Energy Efficiency	C/I	2.9	11,799	3.4	13,842	9.6	38,379
	R	3.8	13,041	4.1	13,997	6.6	23,521
Low-cost Energy Efficiency	C/I	2.8	11,380	3.1	12,547	8.8	35,295
	R	0.2	760	0.2	932	0.7	3,145
Distributed Generation	C/I	1.2	913	1.6	1,077	3.5	8,210
	R	1.1	2,878	1.2	3,121	2.8	5,054

**AEG Report: https://www.misoenergy.org/Events/Pages/DREEDG20160208.aspx ** Existing DR/EE/DG programs modeled as base assumptions*

Demand Response, Energy Efficiency, & Distributed Generation Capital and Energy Costs

AEG Scenario* (CPP*)		Low Growth*				Medium (Existing*)				High			
Year		1		20		1		20		1		20	
Commercial/Industrial vs Residential Programs		$/kW	$/MWh	$/kW	$/MWh	$/kW	$/MWh	$/kW	$/MWh	$/kW	$/MWh	$/kW	$/MWh
Demand Response	C/I	635	8,755	10	137	635	8,738	7	103	639	8,794	7	99
Direct Load Control	C/I	276	3,428	20	247	271	3,425	15	190	286	3,608	16	215
	R	195	2,131	8	92	194	2,117	6	68	259	2,828	6	70
Price-Responsive Demand	C/I	707	3,040	58	255	733	3,041	49	202	959	3,981	61	288
	R	250	1,441	30	185	248	1,433	23	143	1,227	7,090	114	652
High-cost Energy Efficiency	C/I	3,103	722	393	96	3,131	728	287	70	4,211	980	307	76
	R	1,781	404	275	82	1,810	411	213	63	1,983	450	233	66
Low-cost Energy Efficiency	C/I	1,220	303	151	44	1,207	300	115	35	1,594	396	112	93
	R	1,269	300	130	28	1,381	326	115	25	1,939	458	136	30
Distributed Generation	C/I	19,733	26,185	2,269	2,931	17,042	26,063	1,505	2,243	34,840	53,284	4,328	1,847
	R	6,272	1,816	723	282	6,214	1,801	552	214	6,810	1,974	332	184

**AEG Report: https://www.misoenergy.org/Events/Pages/DREEDG20160208.aspx ** Existing DR/EE/DG programs modeled as base assumptions*

MTEP17 Futures Matrix Draft

	Uncertainties																													
	Capital Costs												Demand and Energy					Fuel Cost (Starting Price)			Fuel Escalations			Emission Caps			Other Variables			
Future	Coal	CC	CT	Nuclear	Wind Onshore	IGCC	IGCC w/ CCS	CC w/ CCS	Compressed Air Energy Storage	Photovoltaic	Biomass	Conventional Hydro	Demand Response Level	Energy Efficiency Level	Demand Growth Rate	Energy Growth Rate	Natural Gas Forecast	Oil	Coal	Uranium	Oil	Coal	Uranium	SO_2	NO_x	CO_2	Inflation	Retirements	Renewable Portfolio Standards	Wind/Solar Cost maturity cost curves
Existing Fleet	M	M	M	M	H	M	M	M	M	H	M	M	L	L	L	L	L	M	M	M	M	M	M	-	M	-	M	L	M	-
Policy Regulations	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	-	M	M	M	M	M	M
Accelerated Alt. Tech.	M	M	M	M	L	M	M	M	M	L	M	M	H	H	H	H	H	M	M	M	M	M	M	-	M	H	M	H	M	M

MTEP17 Uncertainty Variables

Uncertainty	Unit	Low (L)	Mid (M)	High (H)
New Generation Capital Costs[1]				
Coal	($/KW)	2,603	3,470	4,338
CC	($/KW)	733	977	1,221
CT	($/KW)	622	829	1,036
Nuclear	($/KW)	3,994	5,325	6,656
Wind-Onshore	($/KW)	1,213	1,617	2,021
IGCC	($/KW)	2,890	3,853	4,816
IGCC w/ CCS	($/KW)	4,933	6,577	8,221
CC w/ CCS	($/KW)	1,581	2,108	2,635
Pumped Storage Hydro	($/KW)	4,124	5,477	6,873
Compressed Air Energy Storage	($/KW)	971	1,295	1,619
Photovoltaic	($/KW)	1,764	1,881	2,351
Biomass	($/KW)	2,880	3,885	4,799
Conventional Hydro	($/KW)	1,862	2,483	3,104

1. Plus maturity curve assumptions

Generation Unit Sizes for Siting

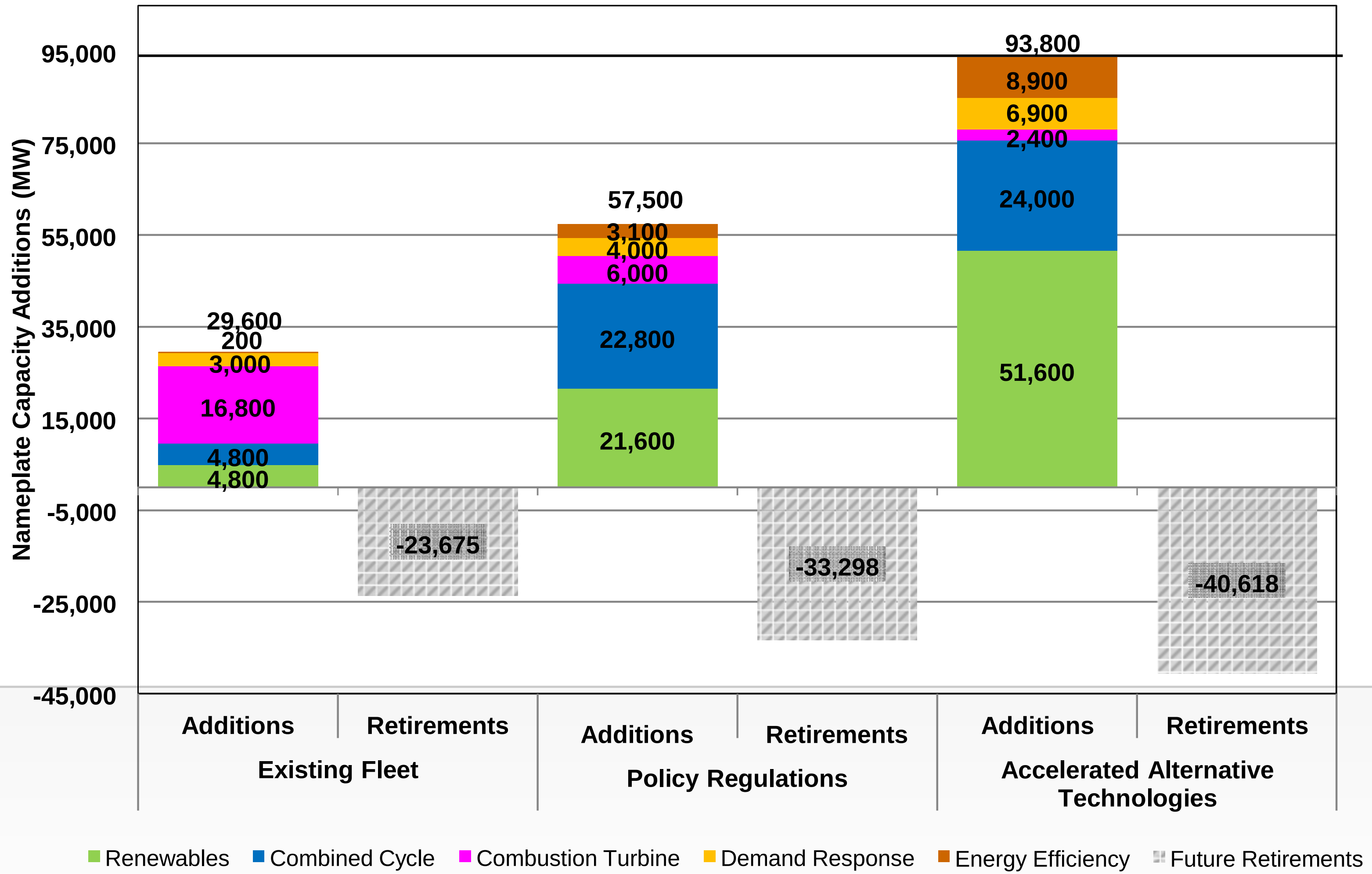
Unit Type	Size*
CC	600 MW
CT	300 MW
Solar	50 MW increments Matched to Site
Nuclear	1,200 MW
Wind	Matched to Site

**Sizes based on typical size in GI Queue as well as stakeholder feedback*

- **When possible, forecast units will match size of existing site or queued capacity**
  - **For simplicity, MISO will round up to nearest 100 MW**
- **Restrict total site capacity to 1,200 MW, unless justified**

MTEP17 MISO Nameplate Capacity Forecast

Year 2016 - 2031



MTEP17 Uncertainty Variables

Demand and Energy				
Baseline 20-Year Demand Growth Rate[2]	%	0.4%	0.6%	0.9%
Baseline 20-Year Energy Growth Rate[3]	%	0.4%	0.7%	0.9%
Demand Response Level	%	AEG Low Growth	AEG Existing Programs Plus	AEG CPP 111(d) Case
Energy Efficiency Level	%	AEG Low Growth	AEG Existing Programs Plus	AEG CPP 111(d) Case
Natural Gas				
Natural Gas[4]	($/MMBtu)	Forecast-30%	Combined NYMEX, EIA, and Wood Mackenzie	Forecast +30%

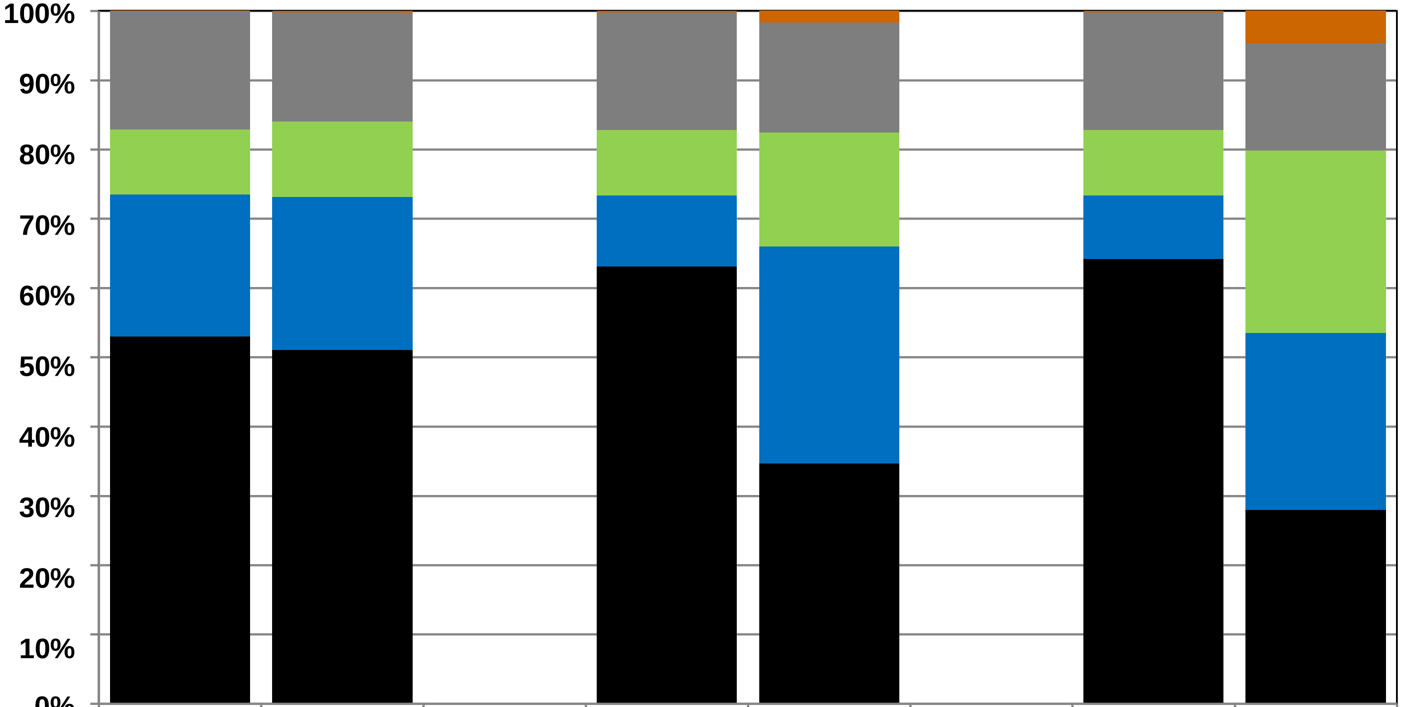
MTEP17 Uncertainty Variables

Emissions Costs/Constraints				
SO_2	($/ton)			
NO_x	($/ton)		Annual $155 Seasonal $300	
CO_2	(Tons)[7]		25% by 2030	35% by 2030
Other Variables				
Inflation	%		2.5	
Retirements	MW	Age-related oil/gas (55 years) & coal (65 years)	Age-Related oil/gas + 16 GW Coal Retirements	Age-Related oil/gas + 24 GW Coal Retirements
Renewable Portfolio Standards	%	State Mandates and goals	State Mandates and goals	State Mandates and goals
Cost Maturity Curves	%	None	Based on NREL ATB	Based on NREL ATB

1.Coal retirements resulting from economics of carbon regulation derived from the CPP Mid-Term Analysis; Age-related retirement assumption applies to non-coal, non-nuclear generation only
2. CO2 reductions apply to all units and are from 2005 levels

MTEP17 MISO Energy Comparisons by Future

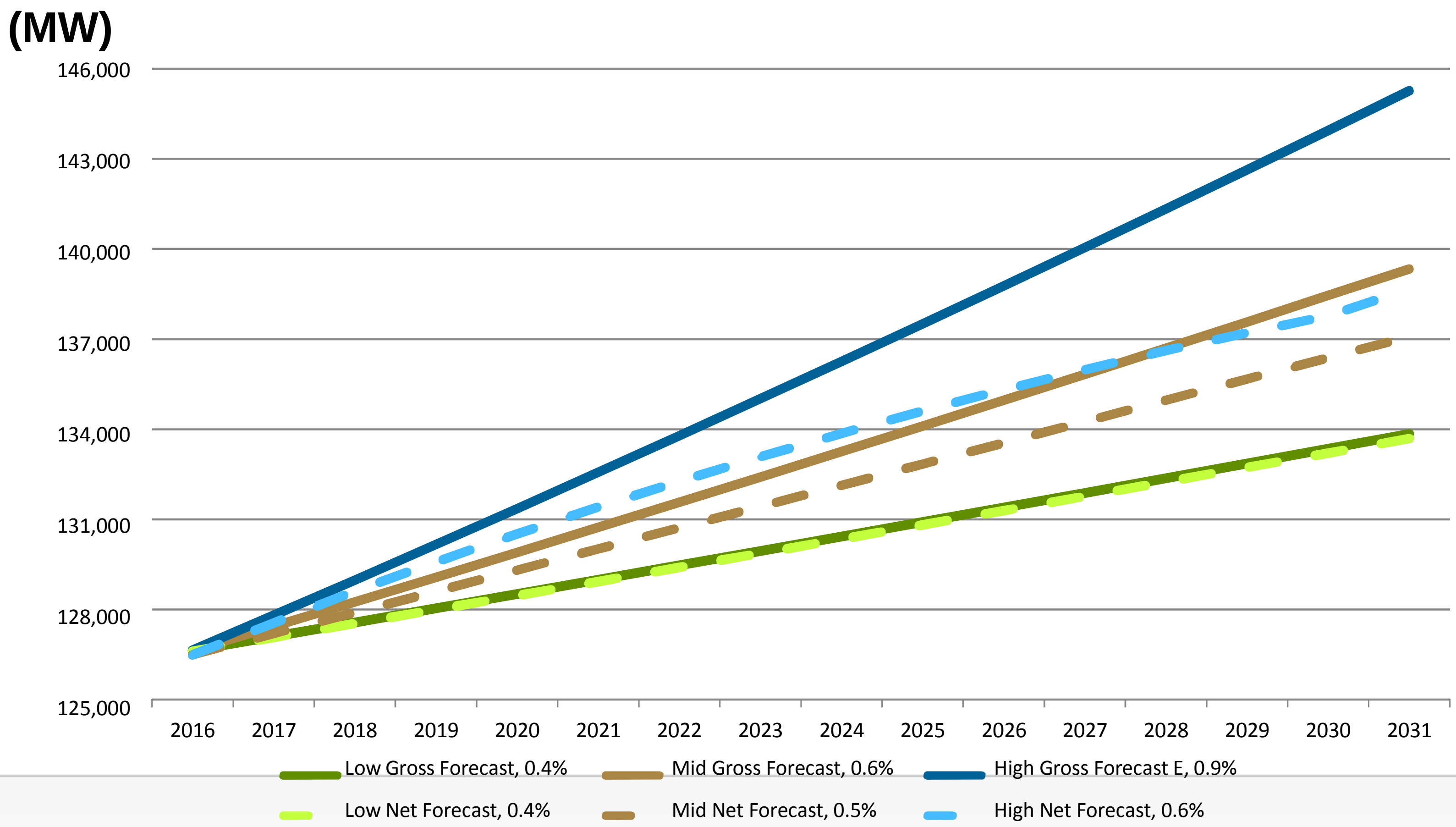
Year 2016 vs 2031



	EF 2016	EF 2031		PR 2016	PR 2031		AAT 2016	AAT 2031
DSM	0%	0%		0%	2%		0%	5%
Other	17%	16%		17%	16%		17%	15%
Renewable	9%	11%		9%	16%		9%	26%
Gas	20%	22%		10%	31%		9%	26%
Coal	53%	51%		63%	35%		64%	28%

EF: Existing Fleet Future
PR: Policy Regulation Future
AAT: Accelerated Alternative Technologies Future

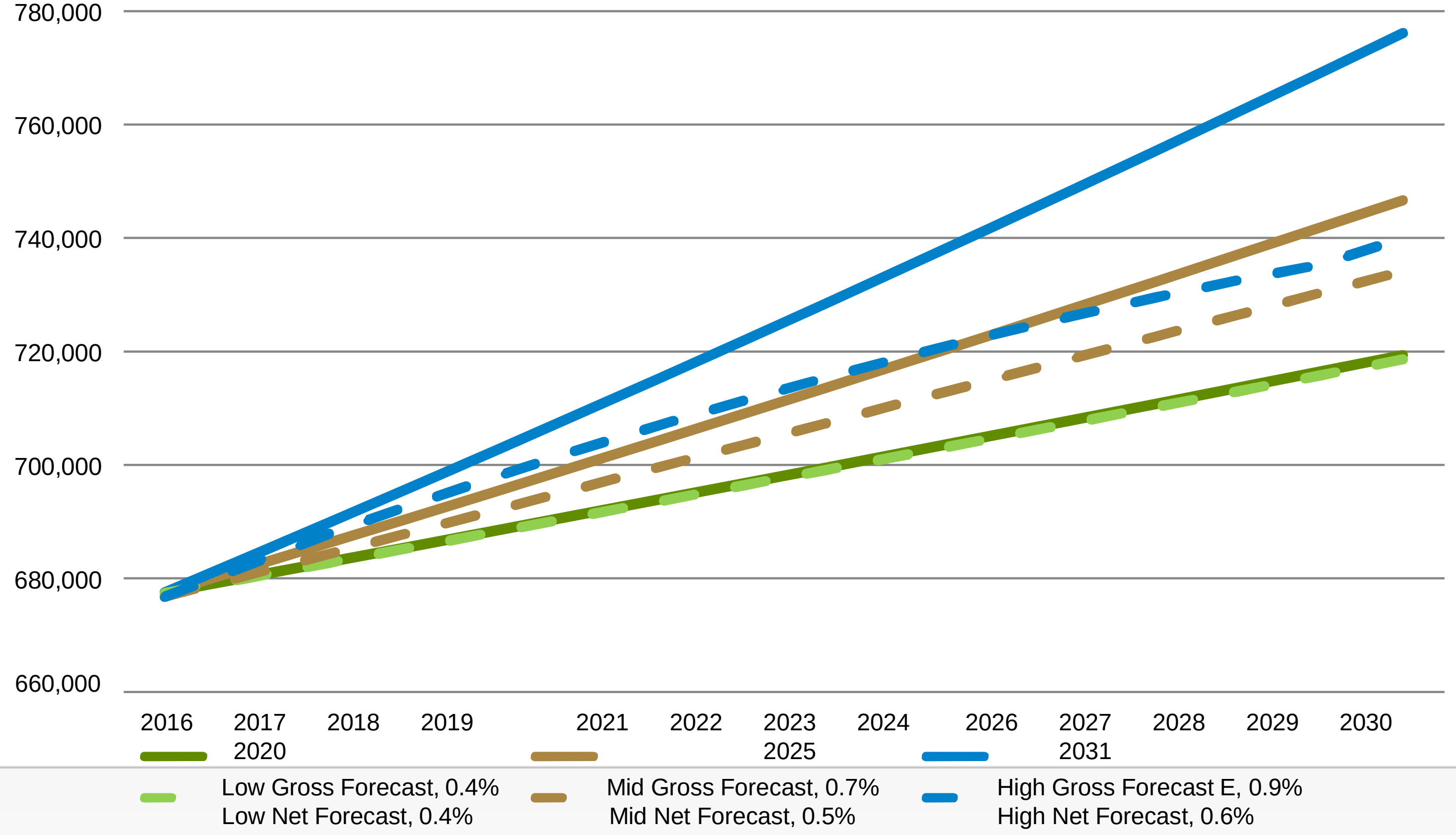
MTEP17 Gross and Net Peak Demand Forecasts



- Net Forecasts are the Gross Forecasts less economically selected energy efficiency programs
- High and low forecasts reflect LRZ 9 Industrial load being modeled low and high (respectively)

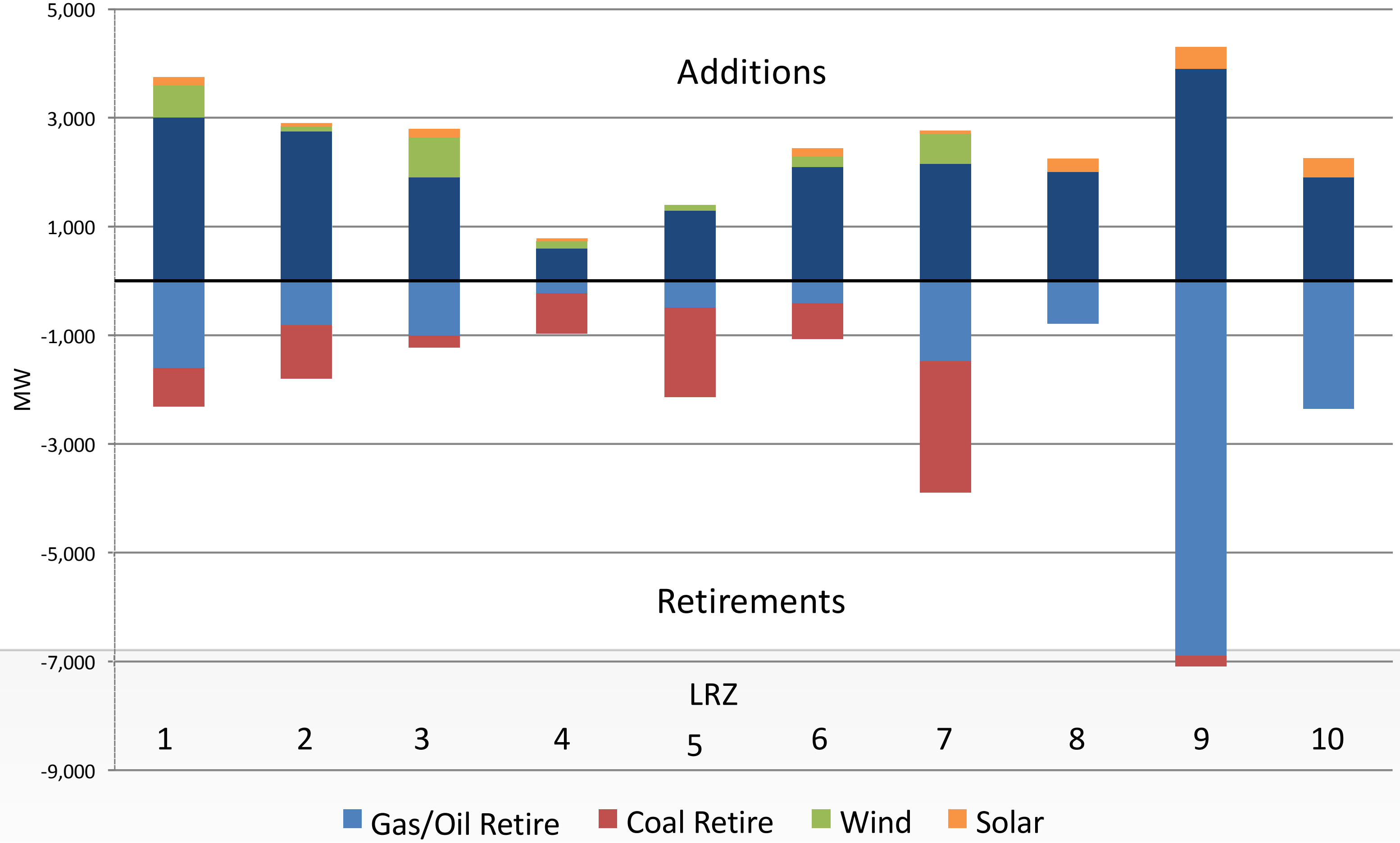
MTEP17 Gross and Net Energy Forecasts

(GWh)



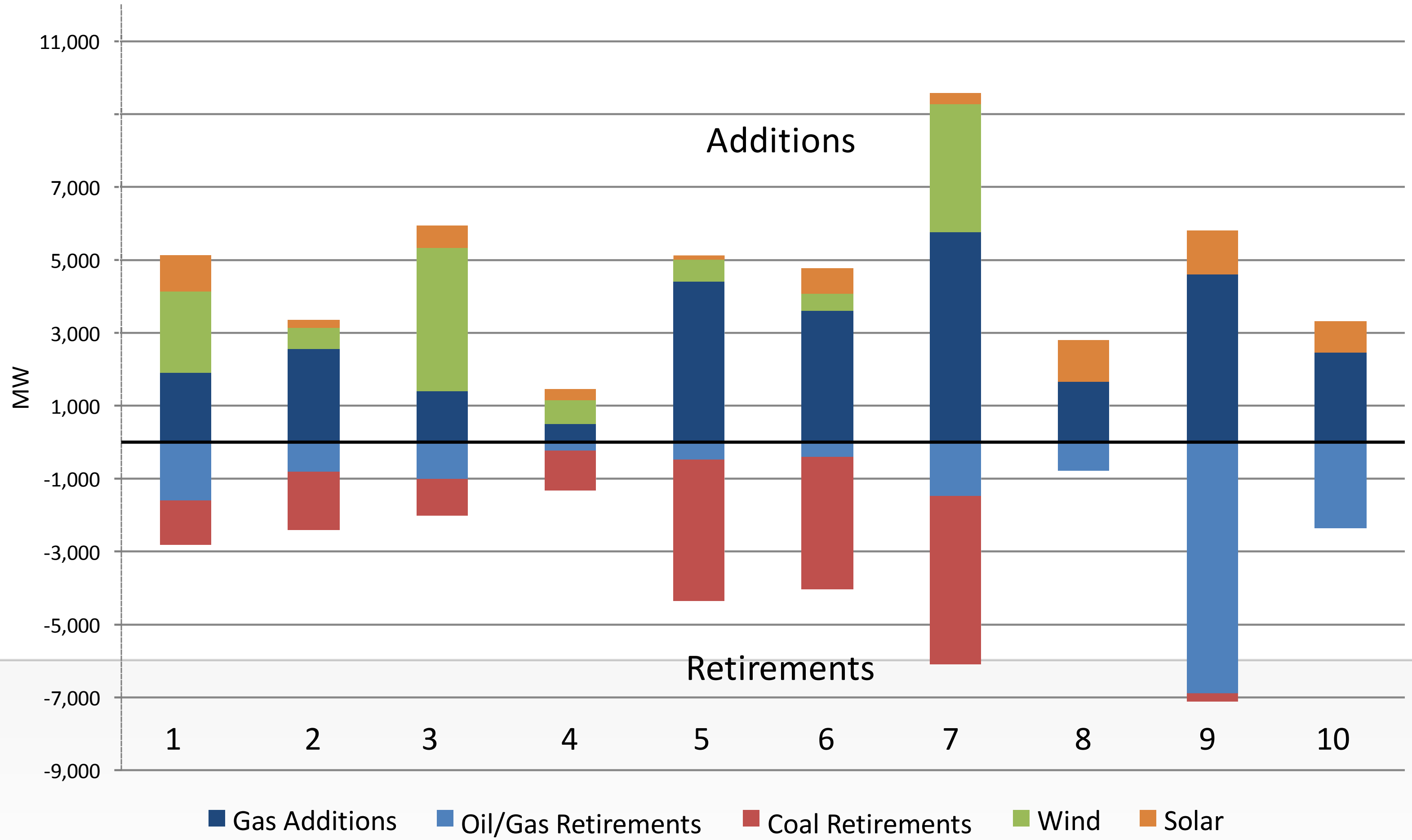
- Net Forecasts are the Gross Forecasts less economically selected energy efficiency programs
- High and low forecasts reflect LRZ 9 Industrial load being modeled low and high (respectively)

Capacity Additions and Retirements by LRZ Existing Fleet Future - 2031

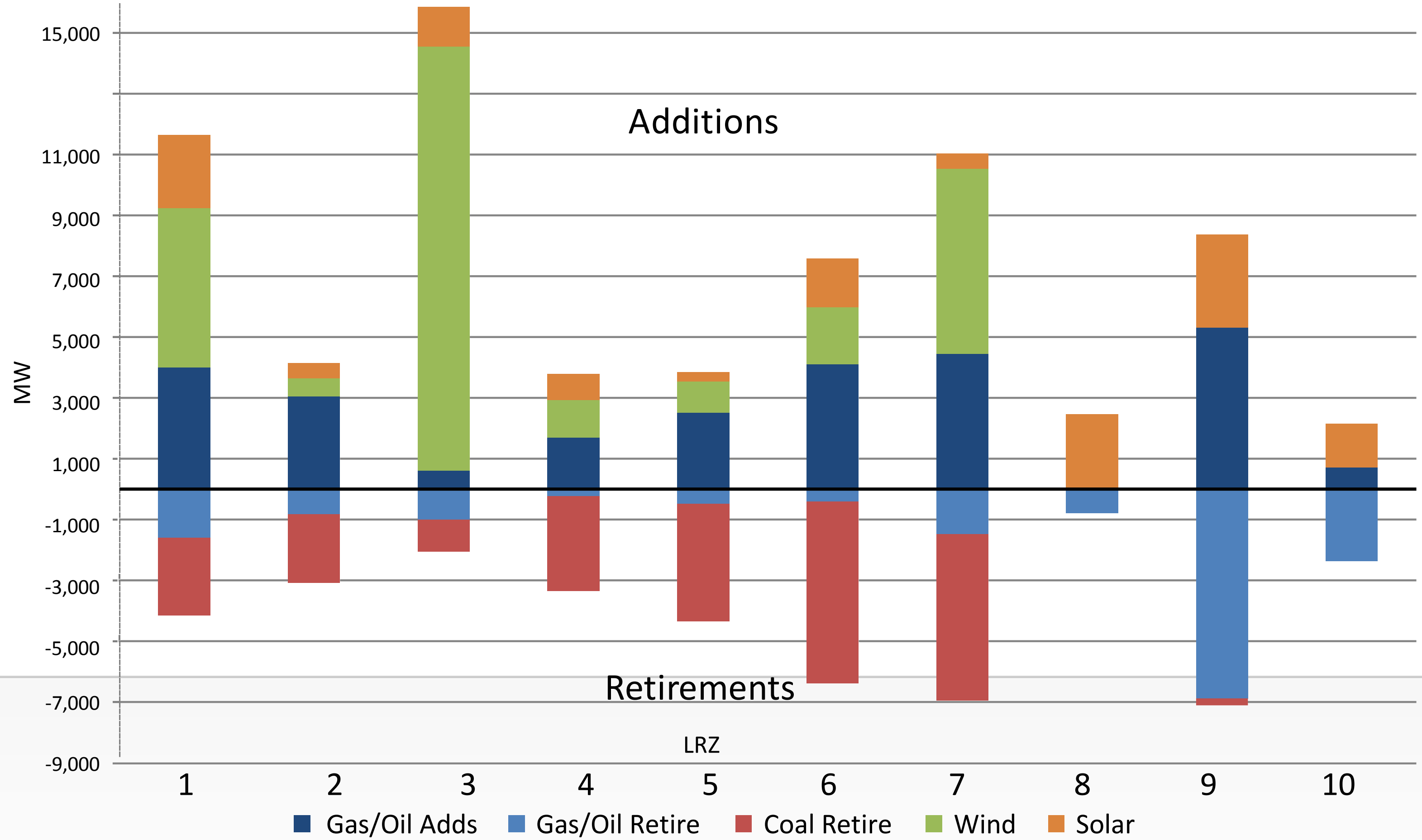


Capacity Additions & Retirements by LRZ - 2031

Policy Regulations Future

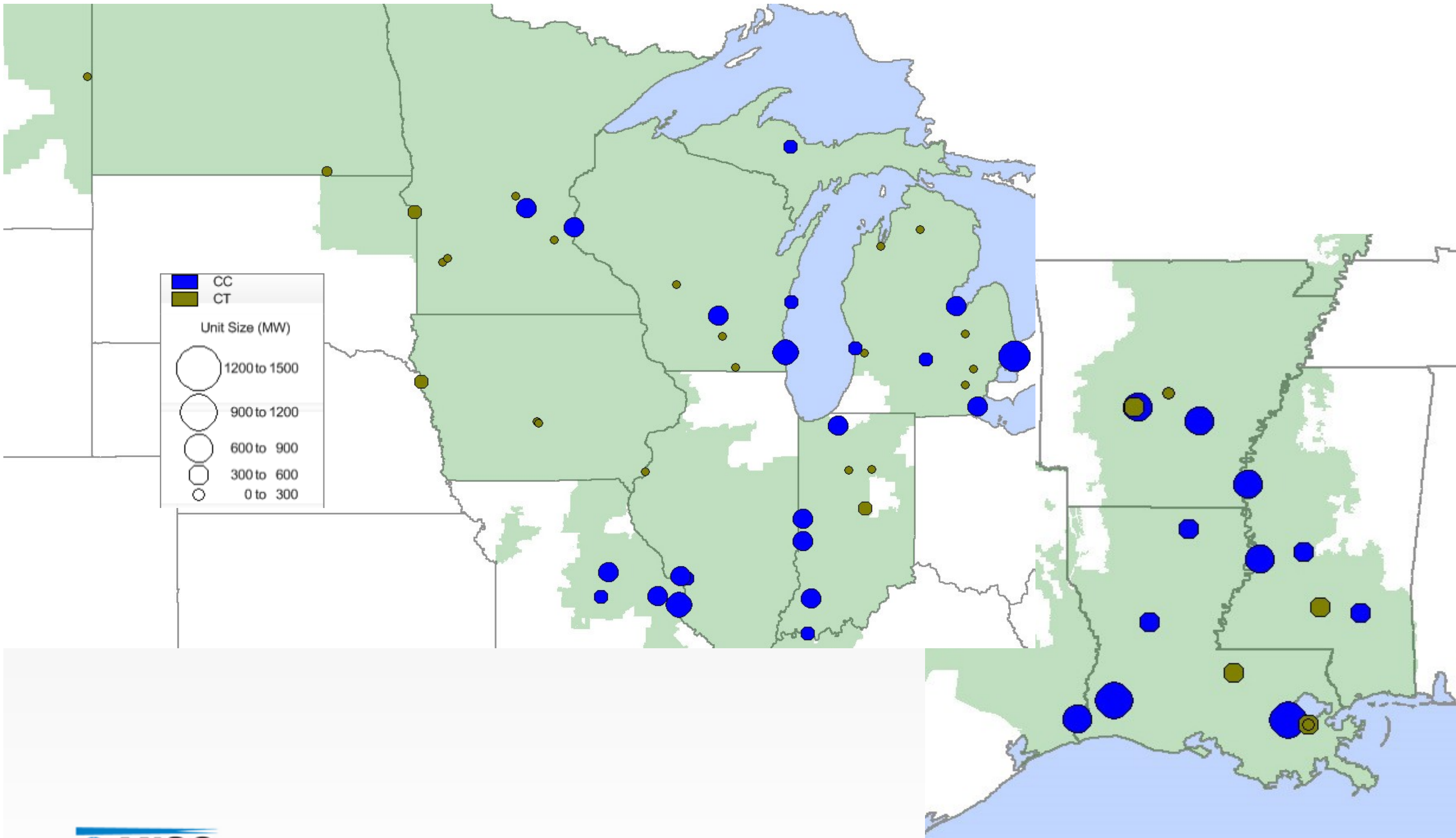


Capacity Additions and Retirements by LRZ
Accelerated Alternative Technologies Future - 2031



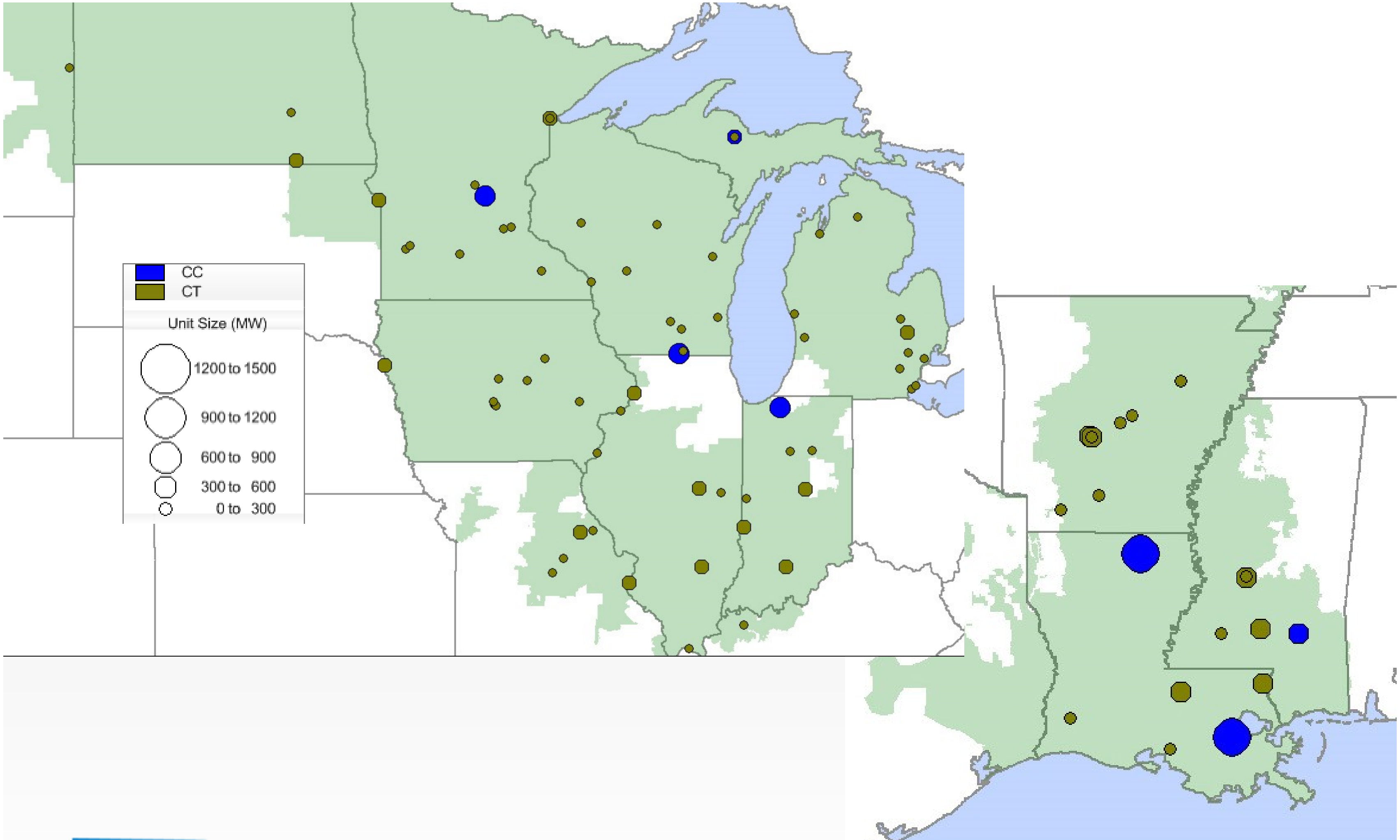
MISO Thermal Regional Resource Forecast Units

Policy Regulations Future

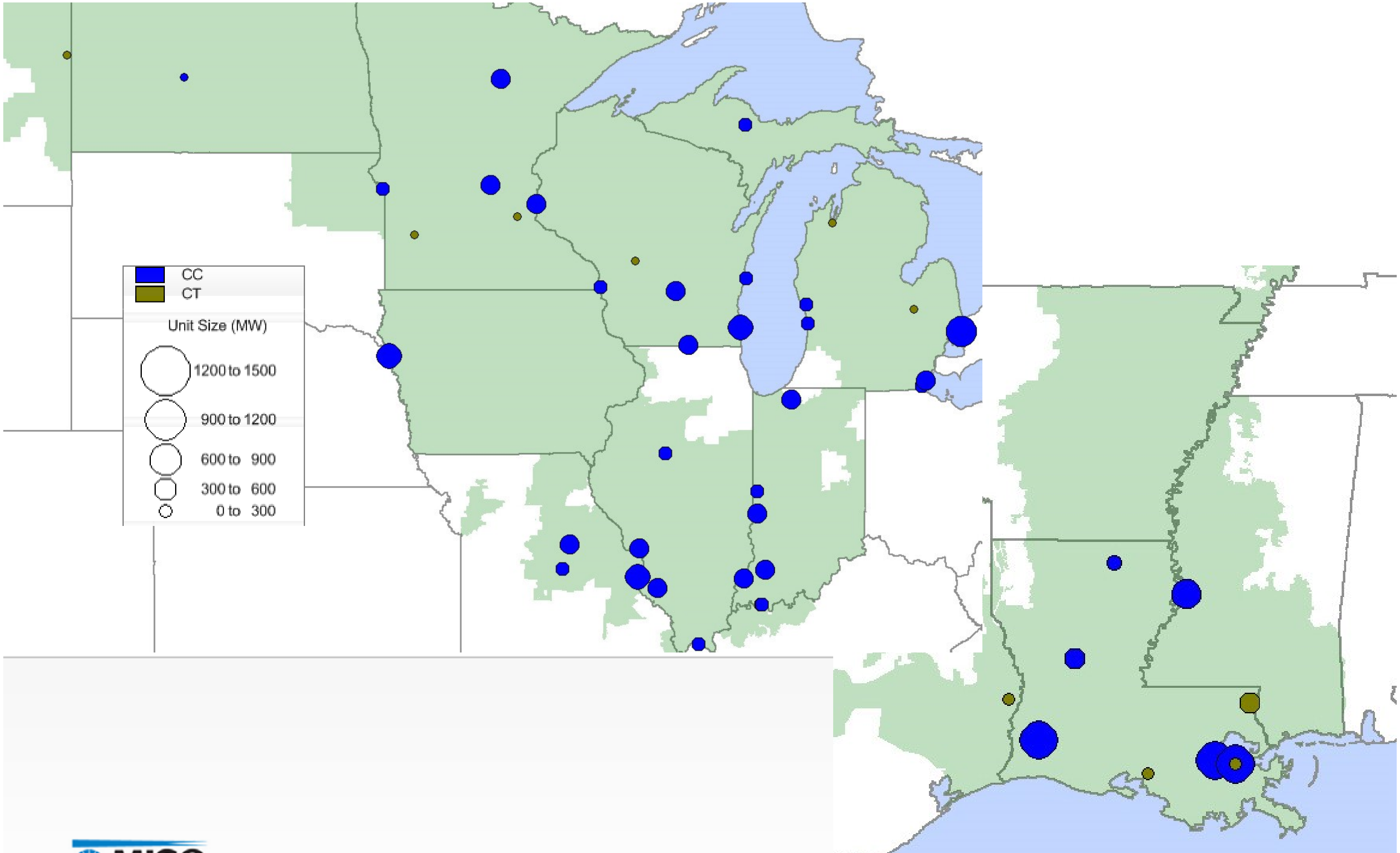


MISO Thermal Regional Resource Forecast Units

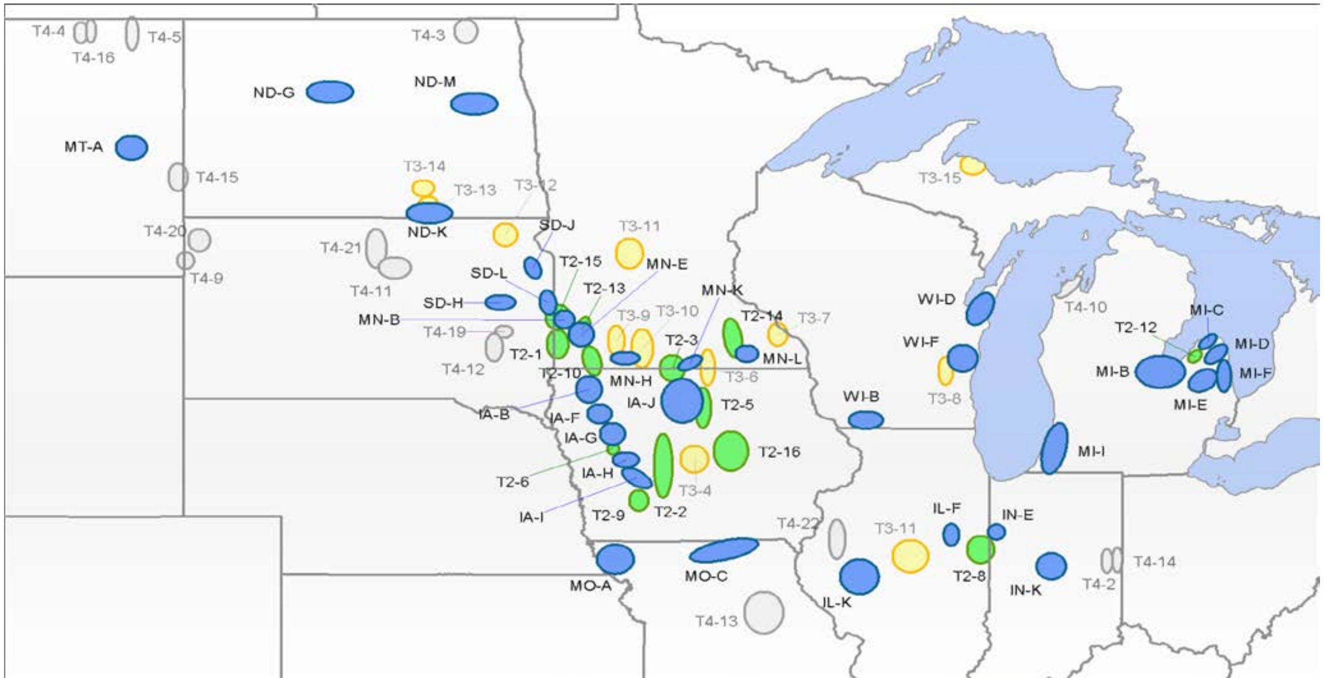
Existing Fleet Future



MISO Thermal Regional Resource Forecast Units
Accelerated Alternative Technologies Future



MISO Wind Siting



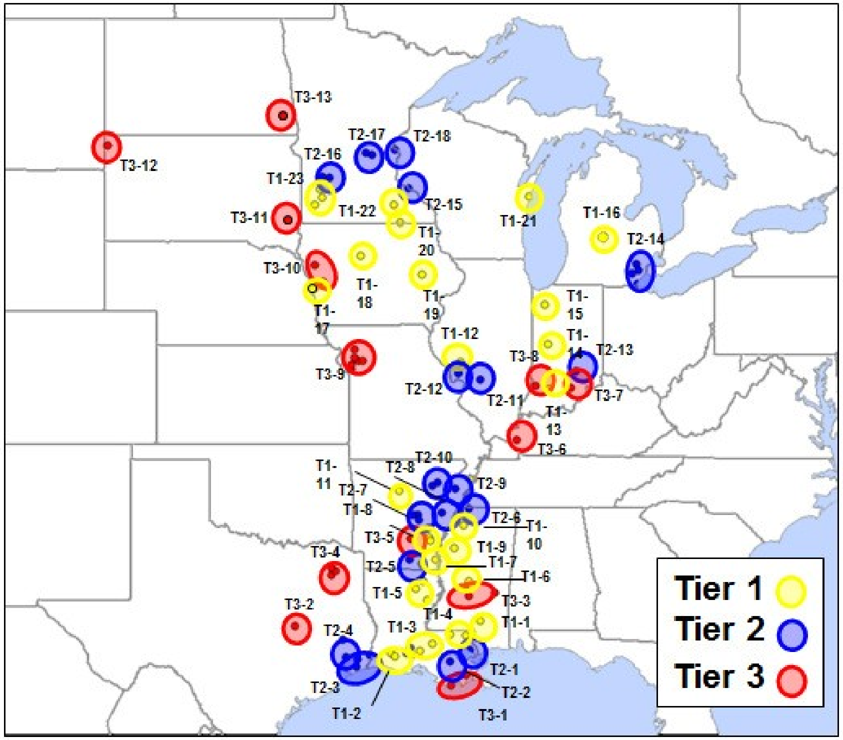
Wind Tier	Total Available Tier Capacity (MW)	Existing Fleet (MW)	Policy Regulations (MW)	Accelerated Alternative Technologies (MW)
Tier 1: RGOS Zones	15,810	2,400	12,000	15,810
Tier 2	15,795	--	--	14,190
Total	**31,605**	**2,400**	**12,000**	**30,000**

MISO Wind Siting by Tier

Wind Zone	Total Zone Capacity (MW)	Existing Fleet (MW)	Policy Regulations (MW)	Accelerated Alternative Technologies (MW)
IA-B	243	93	243	243
IA-F	586	93	586	586
IA-G	283	93	283	283
IA-H	433	93	433	433
IA-I	552	93	552	552
IA-J	909	93	619	909
IL-F	37	37	37	37
IL-K	1,190	93	618	1190
IN-E	156	93	156	156
IN-K	311	93	311	311
MI-B	437	93	437	437
MI-C	972	93	615	972
MI-D	732	93	615	732
MI-E	1,160	93	615	1160
MI-F	1,215	93	615	1215
MI-I	837	93	615	837
MN-B	39	39	39	39
MO-A	1,053	93	615	1053
MO-C	1,047	93	615	1047
MT-A	134	93	134	134
ND-G	852	93	615	852
ND-M	503	93	503	503
SD-H	318	93	318	318
SD-J	341	93	341	341
SD-L	275	93	275	275
WI-B	601	93	601	601
WI-D	594	92	594	594

Wind Zone	Total Zone Capacity (MW)	Accelerated Alternative Technologies (MW)
T2-1	1,240	1,240
T2-2	2,074	1,604
T2-3	1,291	1,291
T2-5	1,240	1,240
T2-6	267	267
T2-8	1,399	1,399
T2-9	858	858
T2-10	828	828
T2-11	1,895	1,602
T2-12	720	720
T2-13	382	382
T2-14	1,154	1,154
T2-16	2,447	1,605

MISO Utility-Scale Solar Siting



Note: Table represents utility-scale capacity sited in solar tiers. Remaining 40% of solar capacity demand-side sited.

Solar Tier	Total Available Tier Capacity (MW)	Existing Fleet (MW)	Policy Regulations (MW)	Accelerated Alternative Technologies (MW)
Tier 1	4,600	1,600	4,600	4,600
Tier 2	5,400[1]	--	1,800	5,400
Tier 3	4,550[1]	--	--	4,400
Total	**14,550**[1]	**1,600**	**6,400**	**14,400**

[1]Total capacity scaled to accommodate solar capacity expansion in Accelerated Alternative Technologies future.

MISO Utility-Scale Solar Siting by Tier

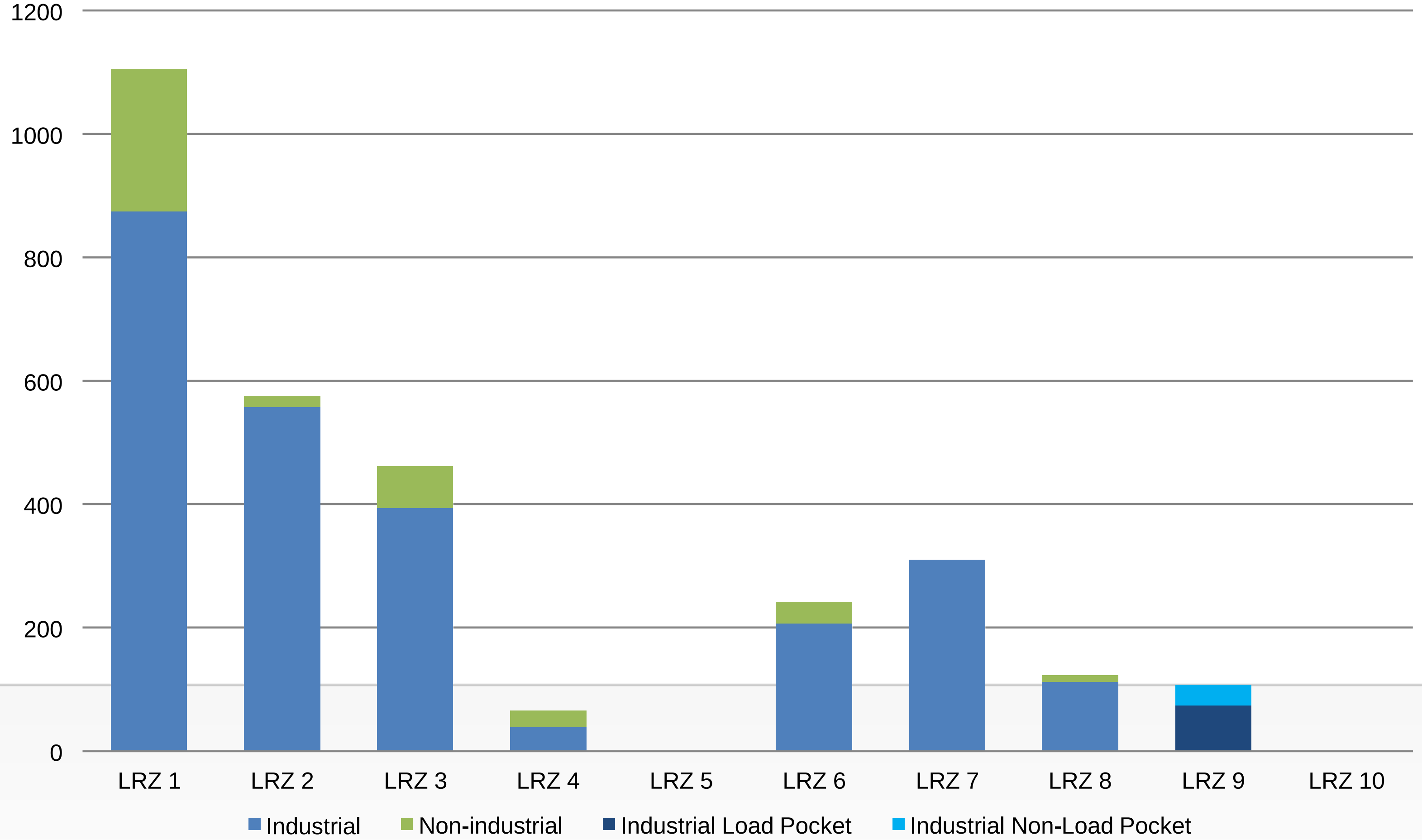
Solar Zone	Existing Fleet (MW)	Policy Regulations (MW)	Accelerated Alternative Technologies (MW)
Tier 1 - 01	100	200	200
Tier 1 - 02	100	200	200
Tier 1 - 03	100	200	200
Tier 1 - 04	100	200	200
Tier 1 - 05	100	200	200
Tier 1 - 06	100	200	200
Tier 1 - 07	100	200	200
Tier 1 - 08	100	200	200
Tier 1 - 09	100	200	200
Tier 1 - 10	50	200	200
Tier 1 - 11	50	200	200
Tier 1 - 12	50	200	200
Tier 1 - 13	50	200	200
Tier 1 - 14	50	200	200
Tier 1 - 15	50	200	200
Tier 1 - 16	50	200	200
Tier 1 - 17	50	200	200
Tier 1 - 18	50	200	200
Tier 1 - 19	50	200	200
Tier 1 - 20	50	200	200
Tier 1 - 21	50	200	200
Tier 1 - 22	50	200	200
Tier 1 - 23	50	200	200

Solar Zone	Policy Regulations (MW)	Accelerated Alternative Technologies (MW)
Tier 2 - 01	100	300
Tier 2 - 02	100	300
Tier 2 - 03	100	300
Tier 2 - 04	100	300
Tier 2 - 05	100	300
Tier 2 - 06	100	300
Tier 2 - 07	100	300
Tier 2 - 08	100	300
Tier 2 - 09	100	300
Tier 2 - 10	100	300
Tier 2 - 11	100	300
Tier 2 - 12	100	300
Tier 2 - 13	100	300
Tier 2 - 14	100	300
Tier 2 - 15	100	300
Tier 2 - 16	100	300
Tier 2 - 17	100	300
Tier 2 - 18	100	300

Solar Zone	Accelerated Alternative Technologies (MW)
Tier 3 - 01	350
Tier 3 - 02	350
Tier 3 - 03	350
Tier 3 - 04	350
Tier 3 - 05	350
Tier 3 - 06	350
Tier 3 - 07	350
Tier 3 - 08	350
Tier 3 - 09	350
Tier 3 - 10	350
Tier 3 - 11	300
Tier 3 - 12	300
Tier 3 - 13	300

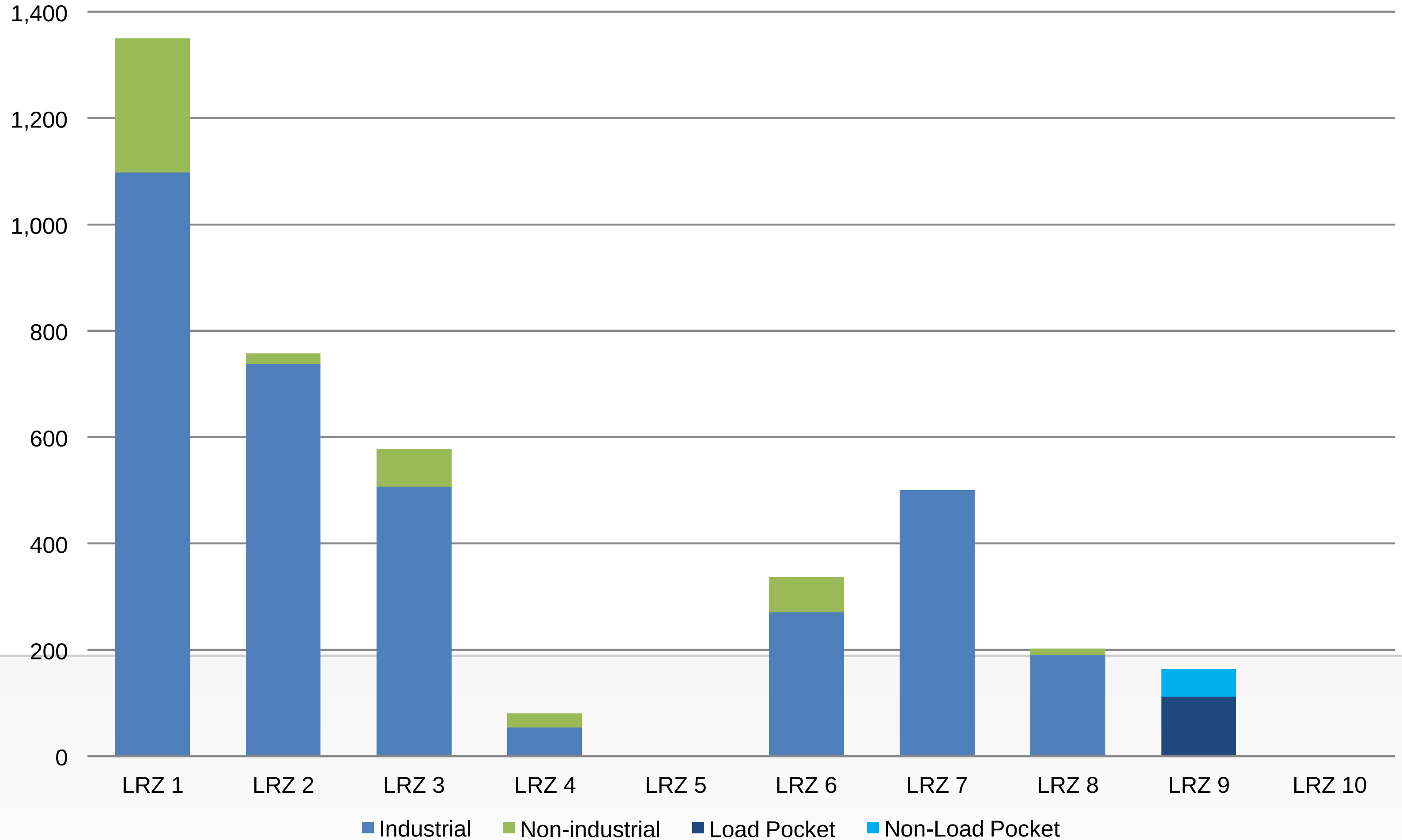
Demand Response Siting by LRZ - 2031

Existing Fleet Future



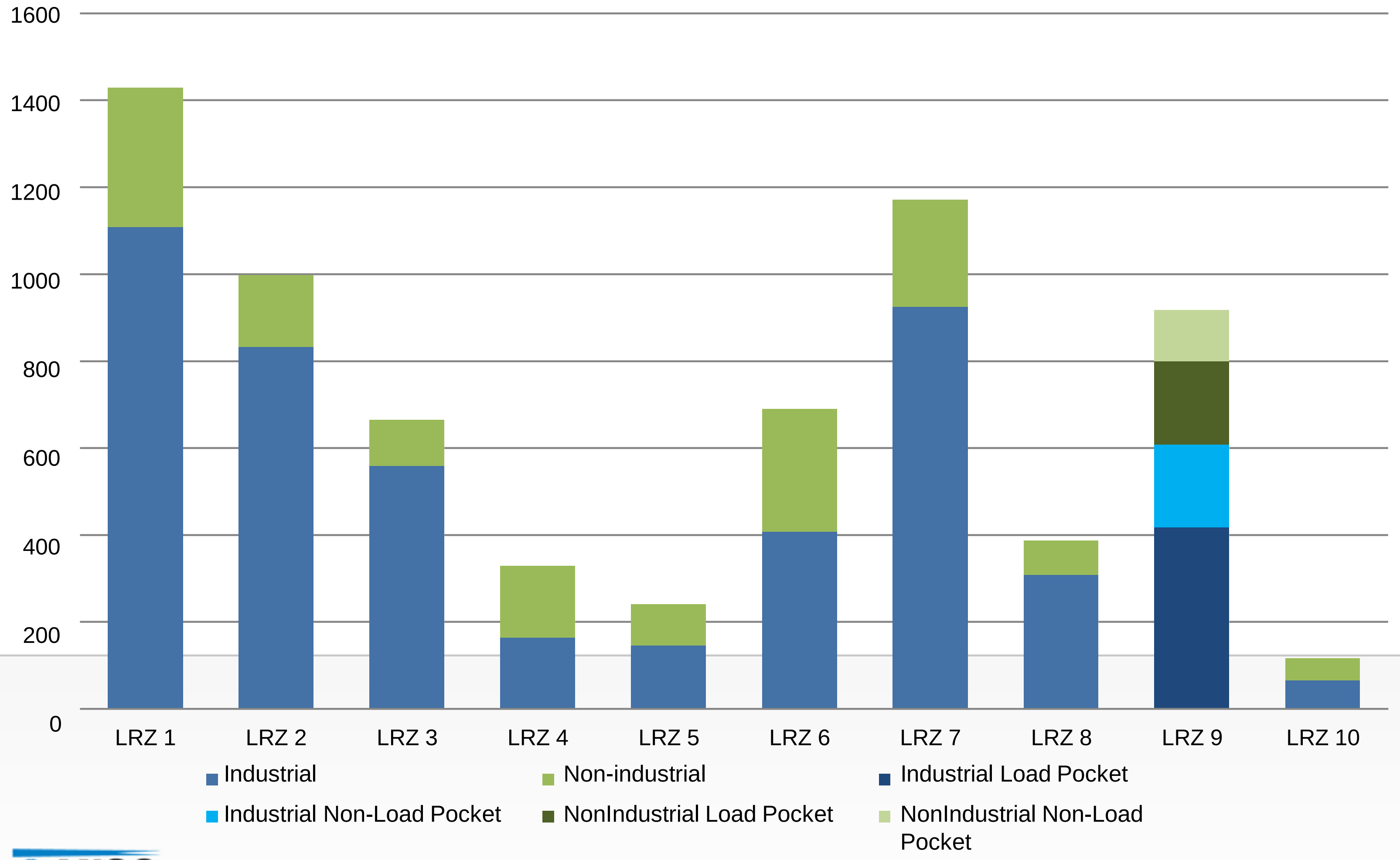
Demand Response Siting by LRZ - 2031

Policy Regulations Future



Demand Response Siting by LRZ - 2031

Accelerated Alternative Technologies Future



MTEP17 siting results meet Zonal Resource Adequacy Requirements

Existing Fleet											
		LRZ 1	LRZ 2	LRZ 3	LRZ 4	LRZ 5	LRZ 6	LRZ 7	LRZ 8	LRZ 9	LRZ 10
Percentage over zonal Local Clearing Requirement	2021	114%	150%	122%	166%	169%	153%	111%	112%	112%	127%
	2026	109%	147%	123%	160%	166%	153%	110%	118%	110%	127%
	2031	105%	158%	126%	157%	179%	152%	109%	127%	105%	129%

Policy Regulation											
		LRZ 1	LRZ 2	LRZ 3	LRZ 4	LRZ 5	LRZ 6	LRZ 7	LRZ 8	LRZ 9	LRZ 10
Percentage over zonal Local Clearing Requirement	2021	114%	153%	124%	172%	178%	154%	113%	115%	112%	133%
	2026	103%	164%	125%	190%	229%	165%	123%	132%	114%	161%
	2031	114%	191%	151%	240%	312%	170%	136%	165%	116%	233%

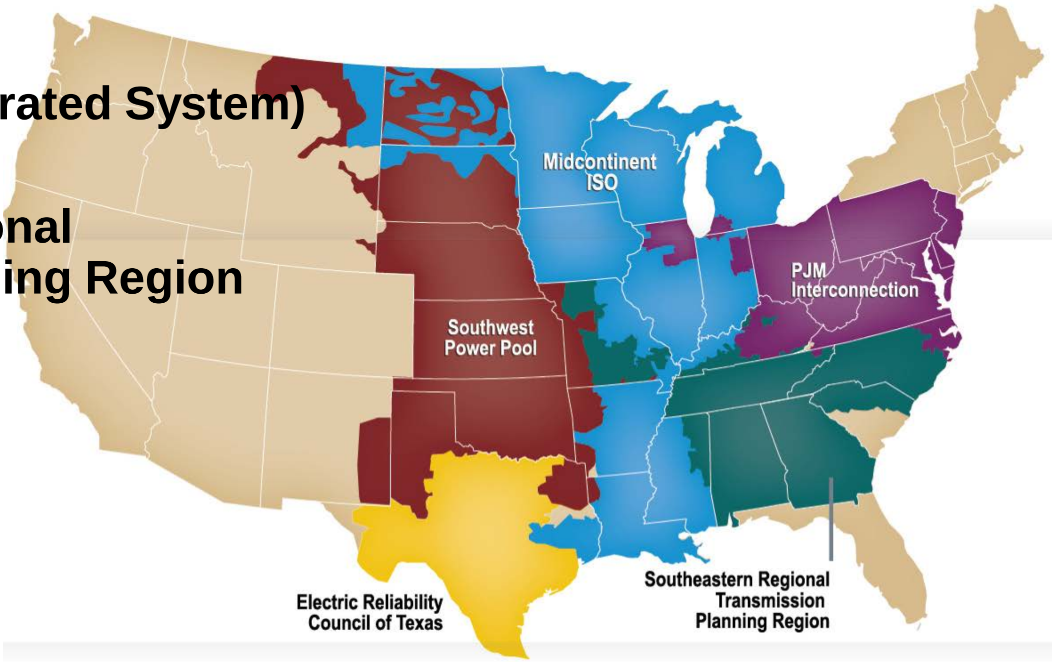
Accelerated Alternative Technology											
		LRZ 1	LRZ 2	LRZ 3	LRZ 4	LRZ 5	LRZ 6	LRZ 7	LRZ 8	LRZ 9	LRZ 10
Percentage over zonal Local Clearing Requirement	2021	130%	150%	158%	169%	166%	147%	117%	107%	107%	122%
	2026	124%	150%	153%	156%	154%	139%	118%	104%	102%	114%
	2031	116%	143%	150%	143%	160%	119%	115%	106%	102%	102%

MTEP Modeling of External Regions

- MISO's regional economic models include most of the Eastern Interconnection
- Consistent assumptions are applied to all regions to prevent biases driven solely from differing assumptions
- Regional differences modeled when available and appropriate (e.g. 50/50 demand and energy forecasts, natural gas transportation adders, site-specific wind and solar profiles)
- In MTEP17 Futures, carbon reduction assumptions consistent with MISO's were applied to all regions in the Policy Regulation and Accelerated Alternative Technologies Futures
  - Assumed policy driven coal retirements for external regions was assumed at the same percentage of coal fleet as MISO
  - Age-base retirements use consistent age-limits from MISO fleet analysis
- MISO regularly coordinates with neighboring regions to update base data and information

MTEP Resource Forecast Regional Definitions

- **MISO**
- **PJM**
- **SPP (Includes Integrated System)**
- **NYISO**
- **Southeastern Regional Transmission Planning Region**
  - **SERC**
    - SOCO
    - Duke
    - AEC
    - CPL
    - SC
    - SCEG
  - **TVA Region**
    - TVA
    - AECI
    - LG&E



References

Additional information on the MTEP17 Futures can be found in the following meeting materials:

- **January 20 Planning Advisory Committee – MTEP17 Futures Update**
  - https://www.misoenergy.org/Events/Pages/PAC20160120.aspx
- **February 17 Planning Advisory Committee – MTEP17 Futures Update**
  - https://www.misoenergy.org/Events/Pages/PAC20160217.aspx
- **February 23 MTEP17 Futures Development Workshop**
  - https://www.misoenergy.org/Events/Pages/MTEP17Futures20160223.aspx
- **March 16 Planning Advisory Committee – MTEP17 Siting Process Review**
  - https://www.misoenergy.org/Events/Pages/PAC20160316.aspx
- **March 30 MTEP17 Futures Development Workshop**
  - https://www.misoenergy.org/Events/Pages/MTEP17Futures20160330.aspx
- **April 20 Planning Advisory Committee – MTEP17 Futures Development Update**
  - https://www.misoenergy.org/Events/Pages/PAC20160420.aspx
- **April 28 MTEP17 Futures Development Workshop – Siting Process**
  - https://www.misoenergy.org/Events/Pages/MTEP17Futures20160428.aspx
- **May 18 Planning Advisory Committee – MTEP17 Futures Update**
  - https://www.misoenergy.org/Events/Pages/PAC20160518.aspx
- **June 15 Planning Advisory Committee – MTEP17 Futures Weighting & PAC Siting Update**
  - https://www.misoenergy.org/Events/Pages/PAC20160615.aspx
- **July 20 Planning Advisory Committee – MTEP17 Futures Weighting & PAC Siting Update**
  - https://www.misoenergy.org/Events/Pages/PAC20160720.aspx
- **August 22 – N/C Region Economic Planning Users Group – EGEAS Draft Results and Siting**
  - https://www.misoenergy.org/Events/Pages/EPUG20160822.aspx
- **August 25 – South Region Economic Planning Users Group – EGEAS Draft Results and Siting**
  - https://www.misoenergy.org/Events/Pages/EPUG20160825.aspx
- **September 21 Planning Advisory Committee – MTEP17 Futures Resource Forecast Results**
  - https://www.misoenergy.org/Events/Pages/PAC20160921.aspx

Environmental Policy Workgroup
9:45 am

Workgroup Lead: Breanna Bukowski

Michigan Department of Environmental Quality

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bukowskib@michigan.gov

Environmental Policy IRP Stakeholder Meeting

March 30, 2017

MPSC – Lake Michigan Hearing Room 1

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DEQ

Today's Agenda

- Introduction
  - PA 341 Section 6t (1c and 1d)
  - Workgroup Scope
  - Timeline and Deliverables
- Environmental Regulations
  - DTE Presentation – Barry Marietta
  - Consumers Energy – Linda Hilbert
- IRP Modeling Discussion (time permitting)
  - Scenarios and Sensitivities
- Wrap-up
  - Questions
  - Next Steps

PA 341
Section 6t (1c and 1d)

Requires:

- Commission within 120 days of the effective date of the Act and every 5 years thereafter to commence a proceeding that:
  - o Establishes modeling scenarios and assumptions each utility should include in development of their IRP
- Identification of significant state or federal environmental laws or formally proposed state or federal environmental laws and how each would affect utilities

Scope of Environmental Policy Workgroup

- Assist in the development of a straw man proposal by:
  - Identifying any state or federal environmental law or proposed law and determine how each would affect electric utilities in MI
  - Providing recommendations for any scenarios, sensitivities, or modeling parameters that should be **required** by utilities to include when they file IRPs

Timeline and Deliverables

- Between now and July:
  - May 1st – Next workgroup meeting; status report from workgroups due to stakeholders
  - May 24th - Meet to discuss consensus revisions based on larger group feedback
  - June 12th – Meet to finalize recommendations
  - June 19th - Final workgroup recommendations due to staff
  - By July 7th - Staff to prepare draft straw man proposal for last round of informal comment

Timeline and Deliverables cont…

- Between August and December:
  - August - Commission-initiated docket
    - Staff post initial draft straw man document
  - September - public hearing dates/locations announced
  - October (end) - deadline for written comments
  - Mid-November - Staff summary of all comments; complete recommended revisions to the initial straw man proposal
  - December - expected Commission Order

Significant Environmental Regulations

- Clean Power Plan (future uncertain)
- SEEG Rule – Steam Electric Effluent Guidelines
- 316 (b) - Requirements for Cooling Water Intake Structures
- CCR – Coal Combustion Residuals Rule
- CSAPR
- NAAQS
  - o SO2
  - o Ozone
- Others…

Possible Scenarios/Sensitivities to Consider

- Clean Power Plan Scenario(s)?
- MISO MTEP Futures
  - o 25% carbon reduction?
  - o 35% carbon reduction?
- Carbon Sensitivity
  - o Carbon reduction?
  - o Carbon tax?
- Other specific modeling recommendations?

Next Steps

- Review MISO's MTEP futures as a starting point for future discussions
  - Focus on two proposed futures with carbon reductions
- Provide written feedback/suggestions by April 20th
- Come prepared to discuss during the next stakeholder meeting on May 1st

DTE Energy®

Current and Future Environmental Regulations

MPSC IRP Stakeholder Meeting

March 30, 2017

Agenda

- National Ambient Air Quality Standards (NAAQS)
- Mercury and Air Toxics Standards (MATS)
- Clean Power Plan (CPP)
- Acid Rain Program (ARP)
- Cross-State Air Pollution Rule (CSAPR)
- Cooling Water Intake (316(b))
- Steam Electric Effluent Limitation Guidelines (ELG)
- Coal Combustion Residuals (CCR)

National Ambient Air Quality Standards (NAAQS) Overview

- NAAQS are set for ambient air by EPA for several pollutants that are common in outdoor air, considered harmful to public health and the environment, and that come from numerous diverse sources.
- These include sulfur dioxide (SO_2) & ozone which we will discuss today as well as particulate matter (PM), carbon monoxide (CO), lead, and nitrogen dioxide (NO_2), all of which are generated from combustion of fossil fuels.
- Primary standards are set to protect public health, including the health of at-risk populations such as people with pre-existing conditions, children, and older adults.
- Secondary standards are set to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.
- The NAAQS standards are reviewed periodically and may be revised based on the latest scientific information.

National Ambient Air Quality Standards (NAAQS) Overview

DTE Energy

- Once set, air monitors determine whether air quality in an area is in attainment (meets the NAAQS) or non-attainment (doesn't meet).
- Area designations are made by the EPA with recommendations made by State agencies .
- Designated non-attainment areas must develop plans to meet attainment within prescribed timelines determined by the severity of the non-attainment and pollutant.
- The plan for bringing an area into attainment is developed by the Michigan Department of Environmental Quality (DEQ) in conjunction with impacted sources and input from the public.
- DEQ works with the sources in the area to determine culpability, reductions required to achieve and maintain attainment, and develop a state implementation plan (SIP).

Sulfur Dioxide (SO_2) NAAQS in Wayne County

DTE Energy

- An area of Wayne County was designated as non-attainment for SO_2 in 2013 based on the revised 2010 NAAQS for SO_2.
- This area includes River Rouge and Trenton Channel Power Plants as well as other sources (U.S. Steel, Carmeuse Lime, EES Coke).
- DTE Energy worked closely with the DEQ over several years to develop a SIP that achieves and maintains attainment.
- This included modeling of emissions impacts in the area based on computer generated air dispersion modeling.
- Shutdown of Trenton High Side and River Rouge Unit 2 eventually were included in permits establishing significantly lower emissions limits for the plants.
- The SIP has been submitted to EPA, however EPA has not yet finalized the plan.

Sulfur Dioxide (SO_2) NAAQS in St. Clair County

DTE Energy

- The same 2010 NAAQS impacting Wayne County requires designations of attainment, non-attainment, or unclassifiable.
- After the set of designations that included Wayne County, EPA indicated they would address the other areas in future action.
- Sierra Club and EPA entered into a Consent Order that EPA would complete the designation process.
- The first phase of the Consent Order required designation of areas with large SO_2 sources in areas where monitors were not present through modeling.
- Belle River and St. Clair Power Plants fall into this category.
- A non-attainment recommendation for an area of St. Clair County that includes the two plants was submitted by MDEQ which EPA finalized in September 2016.
- DTE is working with MDEQ to develop a SIP for this area to achieve and maintain attainment.

Ozone NAAQS in Michigan

- In late 2015 the ozone NAAQS was lowered from 75 ppb to 70 ppb.
- DEQ made a recommendation to EPA of non-attainment for all of southeast Michigan based on monitored data in the area.
- Final EPA designation is expected in late 2017 with some uncertainty on the timeframe required for developing a SIP and achieving attainment.
- New regulations limiting NO_x beginning in 2017 which will be covered shortly could lessen the formation of ozone.
- DTE will work with MDEQ, industry, and other groups to develop a plan to address the ozone non-attainment area.

Mercury and Air Toxics Standards (MATS)

- MATS compliance date (April 16, 2016) has passed and all DTE units are compliant with regulations and in an ongoing phase of optimizing control equipment.
- MATS established limits on particulate matter (PM), acid gases and mercury.
- DTE complies with MATS through various methods.
- All plants have electrostatic precipitators (ESPs) which control PM.
- Monroe Power Plant has flue gas desulfurization (FGD) and selective catalytic reduction equipment (SCR) which allow for compliance with acid gas and mercury limits.
- The other coal-fired power plants have installed activated carbon injection (ACI) systems for mercury control and dry sorbent injection (DSI) systems for acid gas control.

Acid Rain Program (ARP)

- The Acid Rain Program (ARP) was instituted by EPA under the 1990 Clean Air Act amendments.
- The ARP is designed to reduce emissions of SO_2 and NO_X from electric utilities.
- DTE Energy's plants have been and remain fully compliant with the ARP.
- This compliance is achieved through a fuel blend of predominantly low-sulfur coal and emission controls such as the FGD & SCR systems at Monroe Power Plant.

Cross-State Air Pollution Rule (CSAPR)

- CSAPR is the most recent EPA regulation which target interstate transport of air pollution and replaces the Clean Air Interstate Rule (CAIR).
- The rule is a cap and trade program which establishes limitations on SO2 and NOX emission from electric utilities.
- Emission allocations for annual and “ozone season” emissions are set for each unit and are reduced over time.
- DTE has been and remains fully compliant with all interstate transport programs.
- Emission reductions and emission credits have allowed for compliance and DTE is well positioned for future compliance.

Cooling Water Intake Regulations – 316(b)

- EPA finalized regulations on cooling water intake under Section 316(b) of the Clean Water Act in 2014.
- The regulations impact cooling water intake structures (CWIS) at existing facilities in two main areas.
  - Impingement (organisms collected on the CWIS mesh screen)
  - Entrainment (organisms that pass through a CWIS mesh screen)
- Existing facilities are required to reduce fish impingement and determine controls required to reduce the number of aquatic organisms entrained.
- The regulations impact all of DTE's coal-fired power plants as well as the Fermi 2 nuclear generating plant.
- DTE is conducting studies to determine the best technology for reducing the environmental impacts of the cooling water intake structures at each of the facilities.

Steam Electric Effluent Limitation Guidelines (ELG)

- EPA issued its final rule related to wastewater discharge or effluent limitation guidelines (ELG) for steam electric power generators in late 2015.
- The rule requires additional controls to be installed with a compliance schedule ranging from 2019 to 2023.
- ELG disallows or severely limits the discharge of three wastewaters generated at DTE's coal-fired power plants which impact DTE.
  - FGD wastewater
  - Fly ash transport water
  - Bottom ash transport water
- Sluicing is a process in which water is used to transport solid material through pipes to a collection point.

Steam Electric Effluent Limitation Guidelines (ELG)

- Bottom ash transport water will not be permitted to be discharged which will require closed-loop recirculation of the water or a dry bottom boiler.
- Fly ash transport water will not be permitted to be discharged which will require conversion of fly ash sluicing to dry systems.
- The rule establishes more stringent requirements in the form of discharge limits for certain constituents from FGD wastewater systems.
- Technologies associated with FGD wastewater control are relatively new and provide some challenge.
- DTE is currently evaluating compliance options and design criteria for all three wastewater streams.

Coal Combustion Residual (CCR) Rule

- The EPA CCR rule became effective in October 2015.
- The rule broadly regulates landfills and impoundments at our operating coal plants.
- The rule relies on various self-implementation design and performance standards.
- The rule generally requires closure of impoundments and landfills at the end of their useful life, and closure of inactive impoundments by 2025.
- DTE operates three ash landfills, four surface impoundments, and one inactive impoundment.
- Current CCR obligations vary based on plant life cycle.
- Regardless of plant closure timing, DTE will have some ongoing requirements.
- DTE is in compliance with current requirements and will take measures to maintain compliance in the future.

Environmental Regulations make it into the IRP by a number of different pathways

DTE Energy

Environmental Regulations

Modeled in the Broad National Market Scenarios and detailed IRP models:

- Market prices
- Allowance Prices
- Emission caps

Uncertainty of new regulations (example CO_2)

Can be handled with Market Scenarios and sensitivities

Analysis completed comparing:

- Retrofit with equipment to comply
- Comply through market based options (allowance purchase)
- Retire and replace

IRP Alternatives considered are compliant with applicable regulations:

New Gas units have SCR technology, Low NO_X burners; MACT technology assumed on new units (capital cost and O&M assumptions)

Next Steps

- Review MISO's MTEP futures as a starting point for future discussions
  - o Focus on two proposed futures with carbon reductions
- Provide written feedback/suggestions by April 20th
- Come prepared to discuss during the next stakeholder meeting on May 1st

Other Market Options Workgroup 10:45 am

Workgroup Lead: Nick Evans
Michigan Public Service Commission
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Market Options and Advanced Technologies

Nicholas Evans
Michigan Public Service Commission
March 30, 2017

MPSC
Michigan Public Service Commission

Agenda

- Introduction and overview
- Market options presentation – Laura Chappelle
- Discussion
  - Acceptable market options and technologies.
  - Begin developing assumptions and modeling scenarios (time permitting).
- Next steps

Why Our Group Exists

Sec. 6t. (1) The commission shall, within 120 days of the effective date of the amendatory act that added this section and every 5 years thereafter, commence a proceeding and, in consultation with the Michigan agency for energy, the department of environmental quality, and other interested parties, do all of the following as part of the proceeding:

……

(f) Establish the modeling scenarios and assumptions each electric utility should include in addition to its own scenarios and assumptions in developing its integrated resource plan filed under subsection (3), including, but not limited to, all of the following:

….

(*iii*) **Any supply-side and demand-side resources that reasonably could address any need for additional generation capacity, including, *but not limited to***, the type of generation technology for any proposed generation facility, projected energy waste reduction savings, and projected load management and demand response savings. (emphasis added.)

Goals / Deliverables

- Develop assumptions and modeling scenarios that reflect various market options and advanced technologies.
- Incorporate our recommendations into a strawman proposal.
- Assist with revision of strawman proposal.

Informal Stakeholder Engagement

- Today – Introduction, presentations, and commencement of workgroup discussions.
- April – May – Group meetings, draft strawman proposal.
- June – Present strawman proposal
- June/July – Ending date for informal comments on strawman proposal
- July – Staff develops report including revised strawman proposal and summary of comments.
- Late July – Commission order initiates the formal collaborative.

List of Market Options and Advanced Technologies

- Energy Storage
- Independent Power Producers & Power Purchase Agreements
- Distributed generation
  - Solar photovoltaic
  - Biogas
  - Combined Heat and Power
  - Customer-owned backup generators
  - Microturbines
  - Fuel cells
- Voltage optimization
- Nuclear

More Technologies

- Natural gas-fueled combustion turbines
- Natural gas-fueled combined cycle units
- Advanced supercritical pulverized coal
- Carbon capture and sequestration
- Integrated gasification combined cycle units (IGCC)
- Reciprocating Internal Combustion Engines (RICE)

A little history…

- Capacity Need Forum (2004-2005)
- 21st Century Electric Energy Plan (2006)
- Indiana Michigan Power IRP (2011)
- Consumers Energy IRP (2013)
- Upper Michigan Energy Resources Corporation (UMERC) IRP (2017)

Capacity Need Forum (2004-2005)

- Alternative Generation Work Group identified four Promising Alternatives:
  1. Combined Heat and Power
  2. Wind Energy (rural wind farms)
  3. Landfill Gas
  4. Anaerobic Digesters
- Work Group identified four Emerging Energy Technologies:
  1. Solar Photovoltaic
  2. Urban Wind Generators
  3. Offshore Wind Generators
  4. Fuel Cells

Capacity Need Forum Conclusions

- The development of additional resources would be reasonable and prudent.
- Recommended a portfolio of low-cost options that can be implemented within the next five years, including enhanced energy efficiency, additional renewable resources, additional transmission capacity, combustion turbines for peaking, and load management.
- Long term, the Forum recommended building one or two additional baseload coal plants on a staggered basis, with the first becoming operational around 2011 or shortly after. The need for additional base load plants should be assessed regularly in the future.

21st Century Energy Plan (2006)

- The Alternative Technologies Workgroup looked at:
  - Combined heat and power
  - Fuel cells
  - Reciprocating engines
  - Stirling engines
  - Microturbines
  - Combustion turbines
  - Advanced storage and battery systems
  - Smart Grid Technologies

21st Century Energy Plan - Alternative Technologies Workgroup Conclusion

"Among all the technologies analyzed by the Alternative Technologies Workgroup, only CHP is included in the expansion plan modeling, because it historically and continues to provide near-term contributions to Michigan's future electricity infrastructure. Many of the other DG technologies explored for the Plan project can provide specialized applications for power needs, fill important, but limited capacity roles, or are continuing to undergo commercial development."

Indiana Michigan Power 2011 IRP

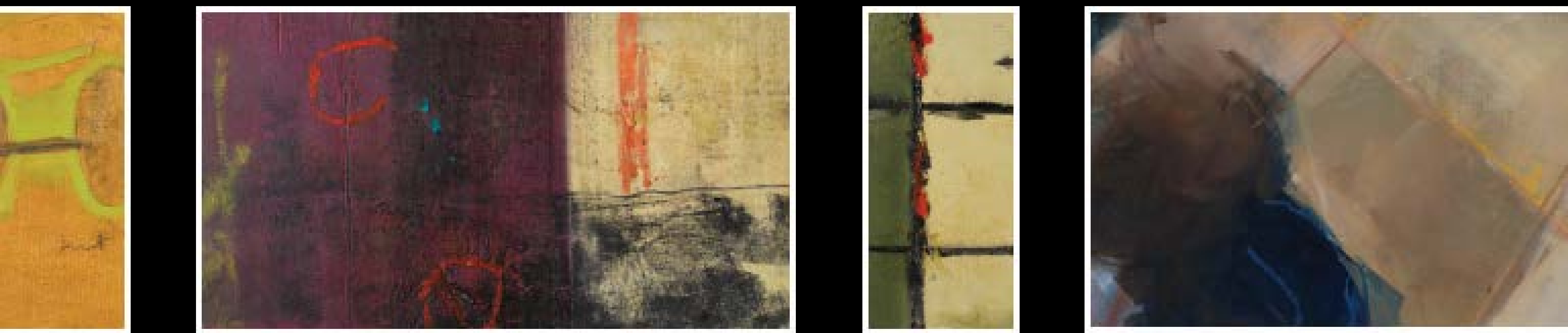
- Presented in Case No. U-17026.
- In addition to other technologies and options, the IRP discussed:
  - Integrated Volt VAR Distribution Infrastructure
  - IGCC
  - Circulating Fluidized Bed Combustion plant
  - Nuclear
  - NGCC
  - Simple cycle combustion turbines
  - Aeroderivatives
- The IRP also considered: roof-top solar, microturbines, combined heat and power (CHP), and residential and small commercial wind.

Consumers Energy 2013 IRP

- Presented in Case No. U-17429
- In addition to other technologies and options, the IRP evaluated:
  - Natural gas combustion turbines
  - NGCC
  - advanced supercritical pulverized coal w/ and w/o CCS
  - IGCC
  - Nuclear
  - Solar PV (1 – 150 kW installations)
  - Biogas
  - Power Purchase Agreements
  - Purchase of an existing facility
- The IRP included a distributed generation (DG) sensitivity - DG contributes up to 7% of total generation by 2040.

UMERC 2017 IRP

- Presented in Case No. U-18224.
- In addition to other technologies and options, the IRP evaluated:
  - Solar with battery backup
  - Smaller scale or customer-owned and sited distributed generation
  - New transmission infrastructure with market energy and capacity purchases.
  - Purchased power (without new transmission)
  - Combined cycle units.
  - Continuing to operate the Presque Isle Power Plant.



Michigan Independent Power Producers – Overview
MPSC: Integrated Resource Plan Outreach Meeting

Other Market Options Workgroup

March 30, 2017

Laura Chappelle and Tim Lundgren

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IPPs in Michigan – A Few Examples

- **PURPA**
  - CHP plants
    - Midland Cogeneration Venture (MCV)
  - Small renewables – hydro, biomass, landfill gas, waste-to-energy
- **Merchant generation plants**
  - New Covert Generation Plant (sells into PJM)
  - DPC Juniper Power Plant (now owned by Consumers Energy)
  - Renaissance Power Plant (now owned by DTE)
- **Self-generation facilities**
  - Michigan State University – TB Simon Power Plant
- **PA 295 – non-utility-scale renewable energy generation**
  - Invenergy
  - NextEra Energy Resources
  - Exelon
  - Geronimo Energy
  - Heritage Sustainable Energy
- **IPPs – Michigan Utilities**
  - CMS Energy's Dearborn Industrial Generation (DIG) and
  - TES Filer City Station

PURPA – Michigan Qualified Facilities - IPPs

- **Numerous small, QFs in Michigan (under 20 MW): A few examples (IPPC members):**
  - Boyce Hydro (10.50 MW)
  - Elk Rapids Hydro (0.76)
  - White's Bridge Hydro (0.75)
  - Tower-Kleber Hydro (2.86)
  - City of Beaverton Hydro (0.96)
  - Hillman Power – Biomass (18 MW)
  - Viking Lincoln/McBain (18 MW each)
  - Granger Landfill Gas (40 MW)
  - Kent County Waste-to-Energy (17 MW)

MPSC: Michigan Utility Scale Wind Farms – 2016 RE Report

Appendix I - Michigan Utility Scale Wind Farms

Michigan Utility Scale Wind Farms*

Project Name	County	Capacity (MW)	Turbine Size (MW)	Number of Turbines	Turbine Manufacturer	Developer	Power Purchaser	Commercial Operation Date
Apple Blossom	Huron	100	3.3	30		Geronimo Energy	Consumers Energy	Expected 12/31/2016
Beebe	Gratiot	81	2.4	34	Nordex	Exelon & Great Lakes Wind	Consumers Energy	December 2012
Beebe 1B	Gratiot	50.4	2.4	21	Nordex	Exelon	Municipal Utility	December 2014
Big Turtle	Huron	20	2.0	10	Gamesa	Heritage Sustainable Energy	DTE	December 2014
Big Turtle II	Huron	30	2.0	15	Gamesa	Heritage Sustainable Energy		Expected 12/31/2016
Brookfield	Huron	74.8	1.7	44	GE Energy	NextEra Energy	DTE	February 2014
Cross Winds	Tuscola	105.4	1.7	62	GE Energy	Consumers Energy	N/A	December 2014
Deerfield Wind	Huron	150	2	72	Vestas	RES Americas	Wolverine Power Cooperative	Expected 12/31/2016
Echo	Huron	112	1.6	70	GE Energy	DTE	N/A	September 2014
Garden I	Delta	28	2.0	14	Gamesa	Heritage Sustainable Energy	Consumers Energy**	September 2012
Gratiot County	Gratiot	212.8	1.6	133	GE Energy	Invenergy & DTE	DTE	June 2012
Harvest	Huron	52.8	1.65	32	Vestas	Exelon	Wolverine Power Cooperative	2008
Harvest II	Huron	59.4	1.8	33	Vestas	Exelon	Consumers Energy	November 2012
Lake Winds	Mason	100.8	1.8	56	Vestas	Consumers Energy	N/A	November 2012
Mackinaw City	Emmet	1.8	0.9	2	NEG Micon	Mackinaw Power	Consumers Energy	2001
McKinley	Huron	14.4	1.6	9	GE Energy	DTE	N/A	December 2012
Michigan Wind I	Huron	69	1.5	46	GE Energy	Exelon	Consumers Energy	2008
Michigan Wind II	Sanilac	90	1.8	50	Vestas	Exelon	Consumers Energy	January 2012
Michigan Wind III	Sanilac	153	2.4	63	Nordex	Exelon	Wolverine Power Cooperative	Expected 12/31/2016
Minden	Sanilac	32	1.6	20	GE Energy	DTE	N/A	December 2012
Pheasant Run Wind	Huron	74.8	1.7	44	GE Energy	NextEra Energy	DTE	December 2013
Pinnebog	Huron	51	1.7	30	GE Energy	DTE	DTE	Expected 12/31/2016
Sigel	Huron	64	1.6	40	GE Energy	DTE	N/A	December 2012
Stoney Corners	Missaukee & Osceola	60	2 - 2.5	29	Repower, Fuhrlander, Northern Power Systems	Heritage Sustainable Energy	Consumers Energy, DTE, Traverse City Light & Power	2008 - October 2012
Tuscola Bay Wind	Tuscola, Bay & Saginaw	120	1.6	75	GE Energy	NextEra Energy	DTE	December 2012
Tuscola Wind II	Tuscola & Bay	100.3	1.7	59	GE Energy	NextEra Energy	DTE Electric	November 2013
Totals		2,007.7	MW	1,093	Turbines			
Operational Totals		1,523.7	MW	883	Turbines			

Bold text indicates the wind farm is operational.

**Heritage may supply power and RECs from this wind farm to DTE under an "additional supply" provision in a separate contract.

* Prepared by MPSC Staff and includes all wind farms operational, planned or under contract with an MPSC-rate-regulated electric provider. Additional wind farms are included as MPSC Staff becomes aware of the pr

PA 295 – Renewable Energy IPPs

- **Former Sec. 33 – PA 295 (50/50 split)**

- **NextEra Energy Resources:**
  - Tuscola Bay 120 MW (Nov. 2012)
  - Tuscola Bay II 100 MW (Nov. 2013)
  - Pheasant Run 74.6 MW (Dec. 2013)
  - Pheasant Run II 74.8 MW (Feb. 2014)
  - Total Michigan Investment: $765 million

- **Invenergy:**
  - Gratiot County Energy Center – 110 MW (2012)
  - More than $3.8 million annually in tax payments, landowner payment and staff salaries.

A Few Important New Energy Provisions of PA 341/342 to Michigan IPPs

- **Qualified Facilities (QFs):**
  - **Section 6v – PA 341:** New PURPA implementation provisions for the MPSC
    - New Avoided Cost cases – MPSC
    - Avoided Energy/Capacity Costs in compliance with PURPA
    - Section 210(a) "encourage" cogeneration and small power production
    - Importance of ensuring PPAs
    - Section 6v(4)(b): non-discriminatory maintenance power; standby rates and conditions of service.

- **Renewable Energy – former PA 295 utility-scale IPPs:**
  - **Section 6s - PA 341: Certificate of Necessity**
    - Sec. 6s(4): broader intervention/standing of parities; certain existing suppliers of generation capacity
    - Sec. 6s(4)(d): MPSC may consider "any alternative proposal" by certain existing suppliers of generation capacity
    - Section 6s(6): utility financial incentive for non-affiliated PPAs

  - **Section 6t – Integrated Resource Plan**
    - Sec. 6t(6): MPSC may consider "alternative proposals"
    - Sec. 6t(13): utility financial incentive for non-affiliated PPAs

A Few Important New Energy Provisions of PA 341/342 to Michigan IPPs

- **IPPs – Self-Service Power**
  - Section 10a(12) – PA 341
  - Importance of standby rates; fair interconnection standards and rates, etc.

- **IPPs – Misc. Renewable Energy**
  - Section 6w – PA 341 – capacity needs, utilities/AESs
  - Section 61 – PA 342 – "customer requested" utility green pricing programs – renewable energy offerings
  - Section 28 – PA 342 – new RPS standards/goals: RECs provisions

Advantages of IPP Generation

- **Diversified** generation portfolio.
- **“Michigan-based”** Energy and Capacity.
- Important facilities to their **local communities**.
  - Tax base
  - Recreation
  - Environmental attributes
- **Distributed generation**, improves **grid reliability**.
- **Reduces ratepayer risk** because risk is assumed by the private owner.
  - builds without ratepayer risk of cost overruns.
  - operates without ratepayer risk of financial failure.
    - history of some natural gas plants: if these assets fail, often they become an inexpensive addition to the utility fleet
  - no ratepayer risk of run-on costs, such as ash disposal liabilities, Superfund or other long-term environmental liabilities, nuclear waste disposal costs, etc.

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Advantages of IPP Generation Cont…

- Utilities can draw on IPP expertise in particular technologies and in development projects, as well as efficiencies of private investment.
  - MI experienced this with the 50/50 model – IPPs could build at low, competitive costs, and so offer lower rates to ratepayers.

- Allows for increased flexibility in utility procurement to best fit the current needs of the utility.
  - Power can be obtained through a PPA.
  - IPP can build a turn-key plant and utility can purchase once it's ready for commercial operation.
  - IPP can build and build (merchant) and operate with an option-to-purchase agreement with the utility.

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PPAs: An Important Necessity for IPP Development

- Long-term contracts are critical for obtaining financing.
- Rates at either PURPA full “avoided cost” or negotiated.
- Utilities traditionally lack incentive to engage in these because no return on investment.
  - new statutory provision for incentives – coupled with the reduced risk advantages noted above, may change this calculus.
- PPAs have guaranteed output requirements that protect ratepayers from unexpected costs for underperforming units.
- Long-term pricing guarantees under PPAs not only help IPPS, but also benefit ratepayers as a hedge against volatility in fuel and other energy costs.
- “Option to purchase” arrangements under a PPA allow utilities to take advantage of PPA upsides, and acquire if plant fits generation portfolio need down the road.

How Can Tools in Michigan's New Energy Laws Work Together to Stimulate IPP Investment in MI?

- **New IRP process is stimulating interest, but to be effective and bring in IPP proposals, need the following:**
  - Non-utility proposals must be seen to have a real chance in the selection process – utilities cannot control everything
  - This will require significant Commission attention to non-utility proposals, and work with utilities to ensure that those proposals are actually considered by the utility
  - Commission will need to set a financial incentive that is both fair to ratepayers and that, coupled with a fair evaluation of the ratepayer benefits from reduced risk in IPP development, makes these projects attractive to IOUs.

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Discussion

Which of the previously-listed options and technologies should the utilities examine in their IRPs? Why?

List of Market Options and Advanced Technologies

- Energy Storage
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  - Combined Heat and Power
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- Advanced supercritical pulverized coal
- Carbon capture and sequestration
- Integrated gasification combined cycle units (IGCC)
- Reciprocating Internal Combustion Engines (RICE)

Next Steps

- Everyone should read the Alternative Generation Work Group Report found in the Capacity Need Forum Final Report. http://www.dleg.state.mi.us/mpsc/electric/capacity/cnf/
- Everyone should also read Chapter 5 of the 21st Century Energy Plan's Appendix – Volume II. http://www.dleg.state.mi.us/mpsc/electric/capacity/energyplan/
- Next meeting should discuss scenarios, assumptions and sensitivities.

Thank you for your participation today!

Integrated Resource Plan (IRP) Stakeholder Outreach Meeting

AGENDA ITEMS

9:00 a.m. MISO MTEP Futures Overview – Bonnie Janssen, MAE
- Open to any interested participant

9:45 a.m. Environmental Policy Workgroup – Breanna Bukowski, MDEQ
- PA 341 Section 6t (1c and 1d)
- Workgroup Scope
- Timeline and Deliverables
- IRP and Environmental Regulations – Barry Marietta, DTE Energy
  - Linda Hilbert, Consumers Energy
- IRP Modeling Discussion (time permitting)

10:45 a.m. Other Market Options Workgroup – Nick Evans, MPSC
- Workgroup Scope
- Market Options presentation – Laura Chappelle, Varnum Law
- Discussion of market options and technologies

11:45 a.m. – 1:15 p.m. Break for lunch - on your own

1:15 p.m. Forecasting, Fuel Prices & Reliability Workgroup – Eric Stocking, MPSC
- Workgroup Scope

3:00 p.m. Upper Peninsula Workgroup – Bonnie Janssen, MAE
- Workgroup Scope

4:00 p.m. Filing Requirements Workgroup – Cathy Cole, MPSC
- Workgroup Scope

4:30 p.m. Adjourn