



# 2018 Michigan State Infrastructure Report

(January 1, 2018 – December 31, 2018)

May 2019

This report reflects information for the portion of Michigan within the PJM service territory.

## 1. Planning

- Generation Portfolio Analysis
- Transmission Analysis
- Load Forecast

## 2. Markets

- Capacity Market Results
- Market Analysis

## 3. Operations

- Emissions Data

- **Existing Capacity:** Natural gas represents approximately 32.7 percent of the total installed capacity in Michigan while nuclear represents approximately 66.8 percent. No coal resources are installed in Michigan within the PJM territory. This differs from PJM where natural gas and coal are at 40.2 and 30.7 percent of total installed capacity.
- **Interconnection Requests:** Natural gas represents approximately 88.3 percent of new interconnection requests in Michigan.
- **Deactivations:** Michigan had no generation deactivations or deactivation notifications in 2018.
- **RTEP 2018:** Michigan RTEP 2018 projects total nearly \$227 million in investment. Approximately 80.5 percent of that represents supplemental projects. These investment figures only represent RTEP projects that cost at least \$5 million.
- **Load Forecast:** Michigan load growth is nearly flat, averaging 0.5 percent per year over the next 10 years. This aligns with PJM RTO load growth projections.

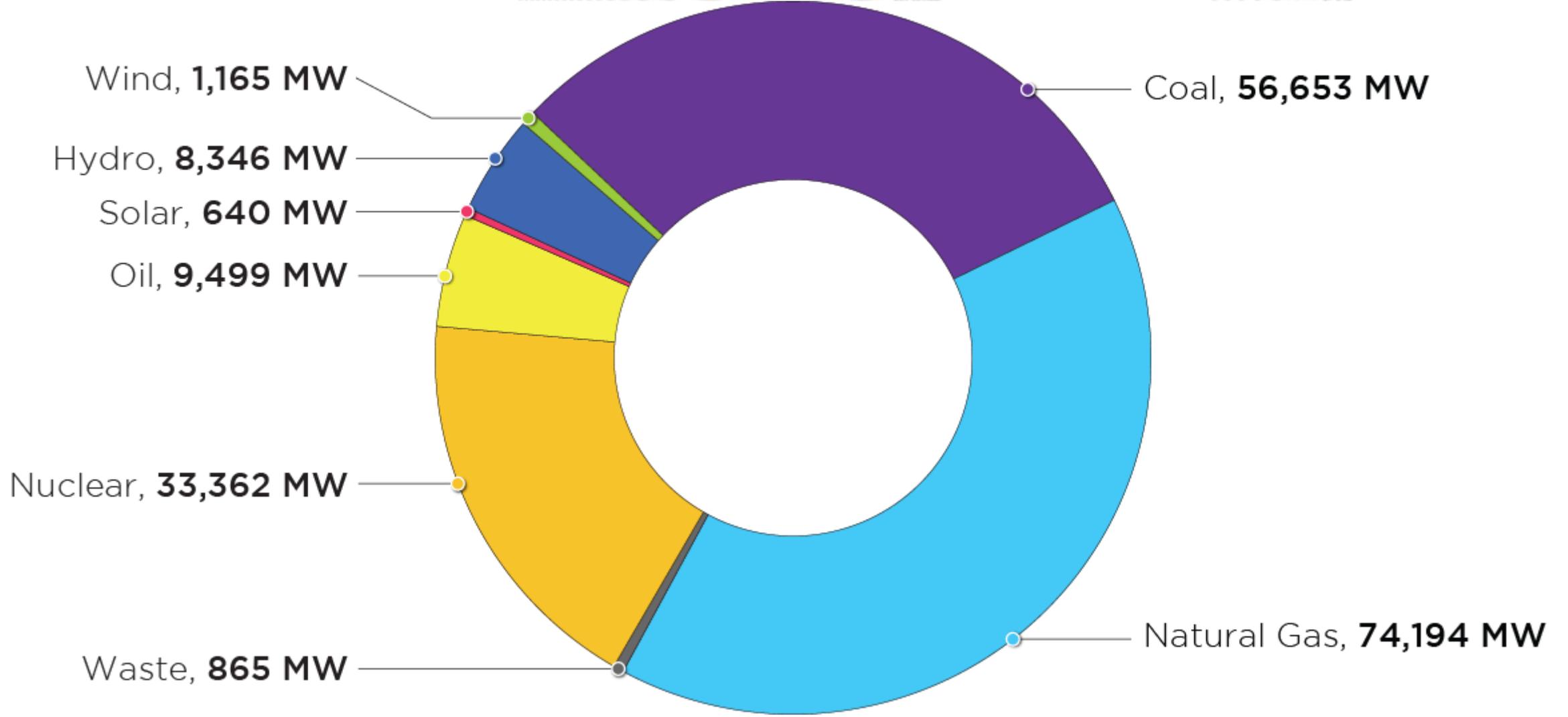
- **2021/22 Capacity Market:** Michigan cleared 34 MW more Demand Response and Energy Efficiency resources than in the prior auction.
- **1/1/18 – 12/31/18 Performance:** Michigan's average hourly locational marginal prices were lower than the PJM average hourly LMPs. Nuclear resources represented 71.4 percent of generation produced in Michigan while gas averaged 28.1 percent. Michigan exports 81.9 percent of the energy produced within the PJM portion of the state. This electricity could go to other states or portions of Michigan outside of the PJM region.
- **Emissions:** Due to the high percentage of nuclear within Michigan, carbon dioxide, nitrogen oxide, and sulfur dioxide emissions have been flat for the past decade.



PJM operates bulk electric system facilities (and others monitored at lower voltages) in southwestern Michigan, including those of American Electric Power (AEP). Southwestern Michigan's transmission system delivers power to customers from native generation resources and those throughout the RTO – arising out of PJM market operations – as well as power imported interregionally from systems outside PJM.

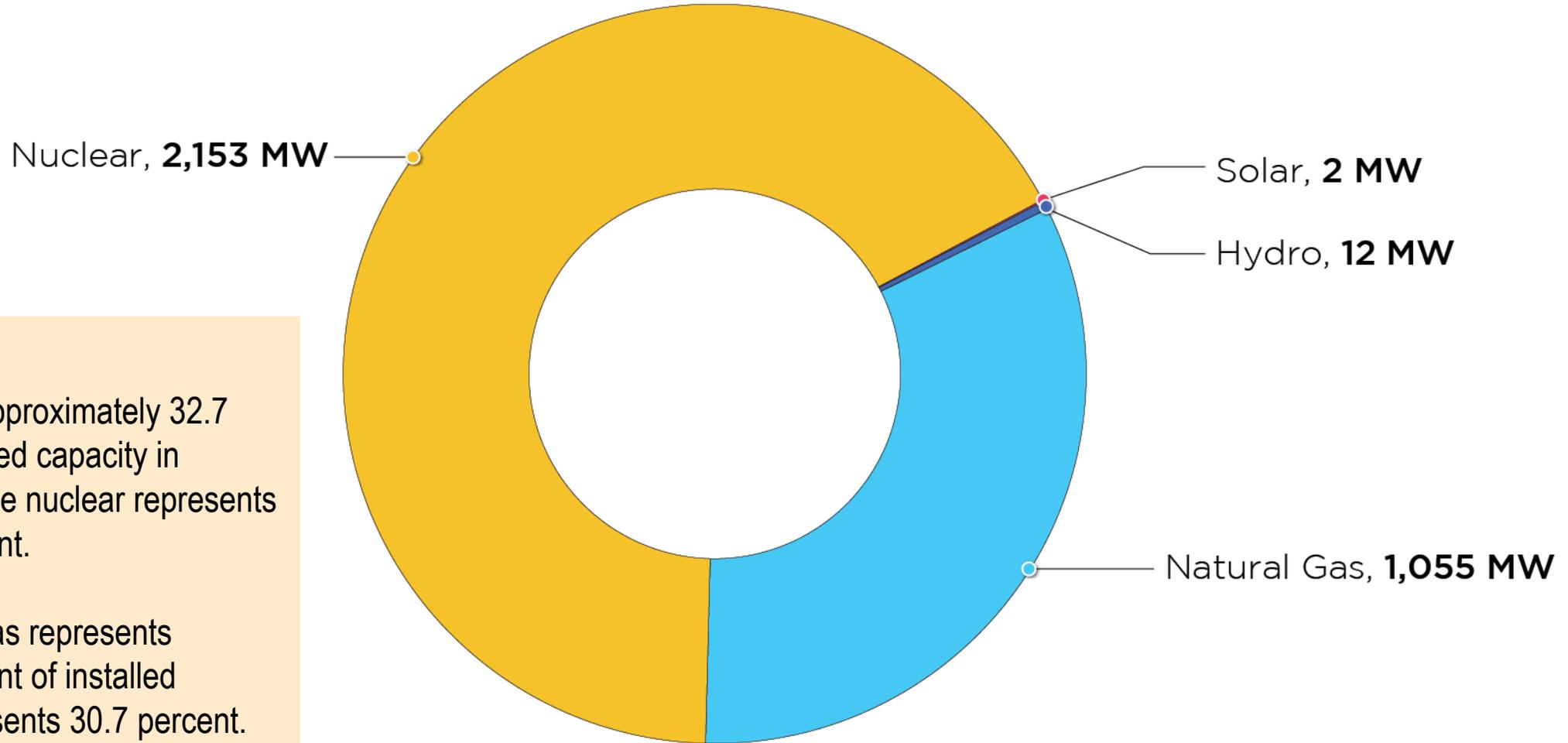
# Planning

## Generation Portfolio Analysis



# Michigan – Existing Installed Capacity

(MW submitted to PJM, December 31, 2018)

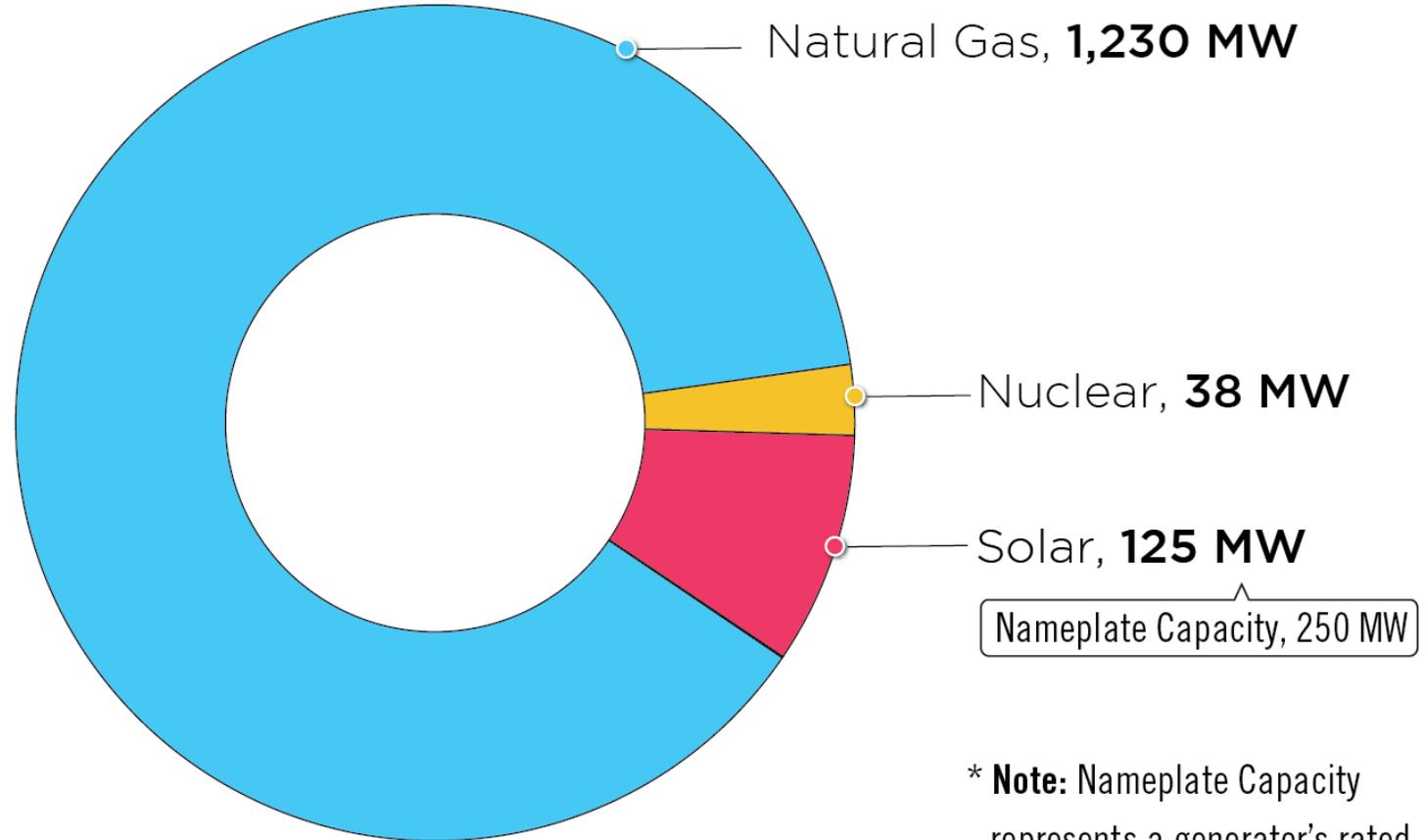


**Summary:**  
Natural gas represents approximately 32.7 percent of the total installed capacity in the Michigan territory while nuclear represents approximately 66.8 percent.  
Overall in PJM, natural gas represents approximately 40.2 percent of installed capacity while coal represents 30.7 percent.

# Michigan – Queued Capacity (MW) by Fuel Type

(as of December 31, 2018)

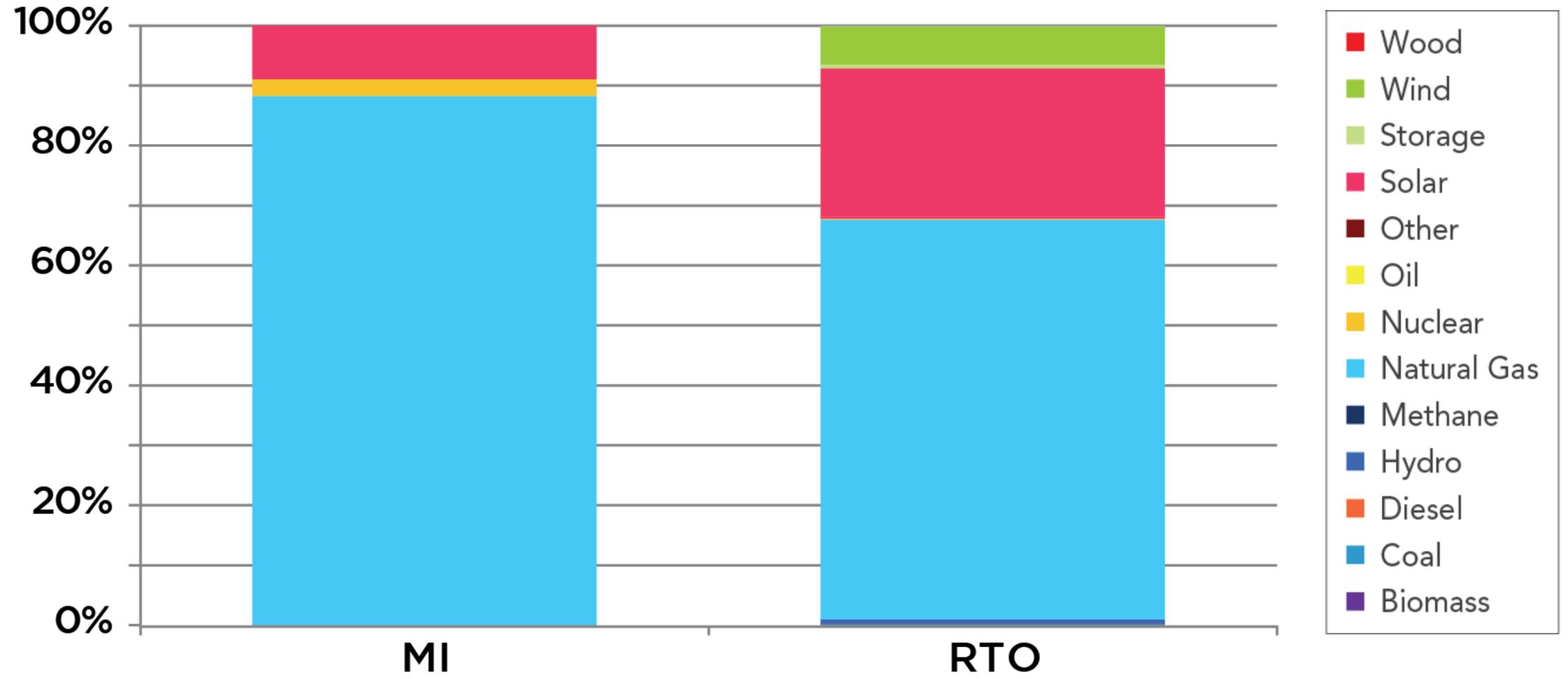
Natural gas represents approximately 88.3 percent of new interconnection requests in the Michigan territory.



\* **Note:** Nameplate Capacity represents a generator's rated full power output capability.

# Michigan – Percentage of Projects in Queue by Fuel Type

(as of December 31, 2018)





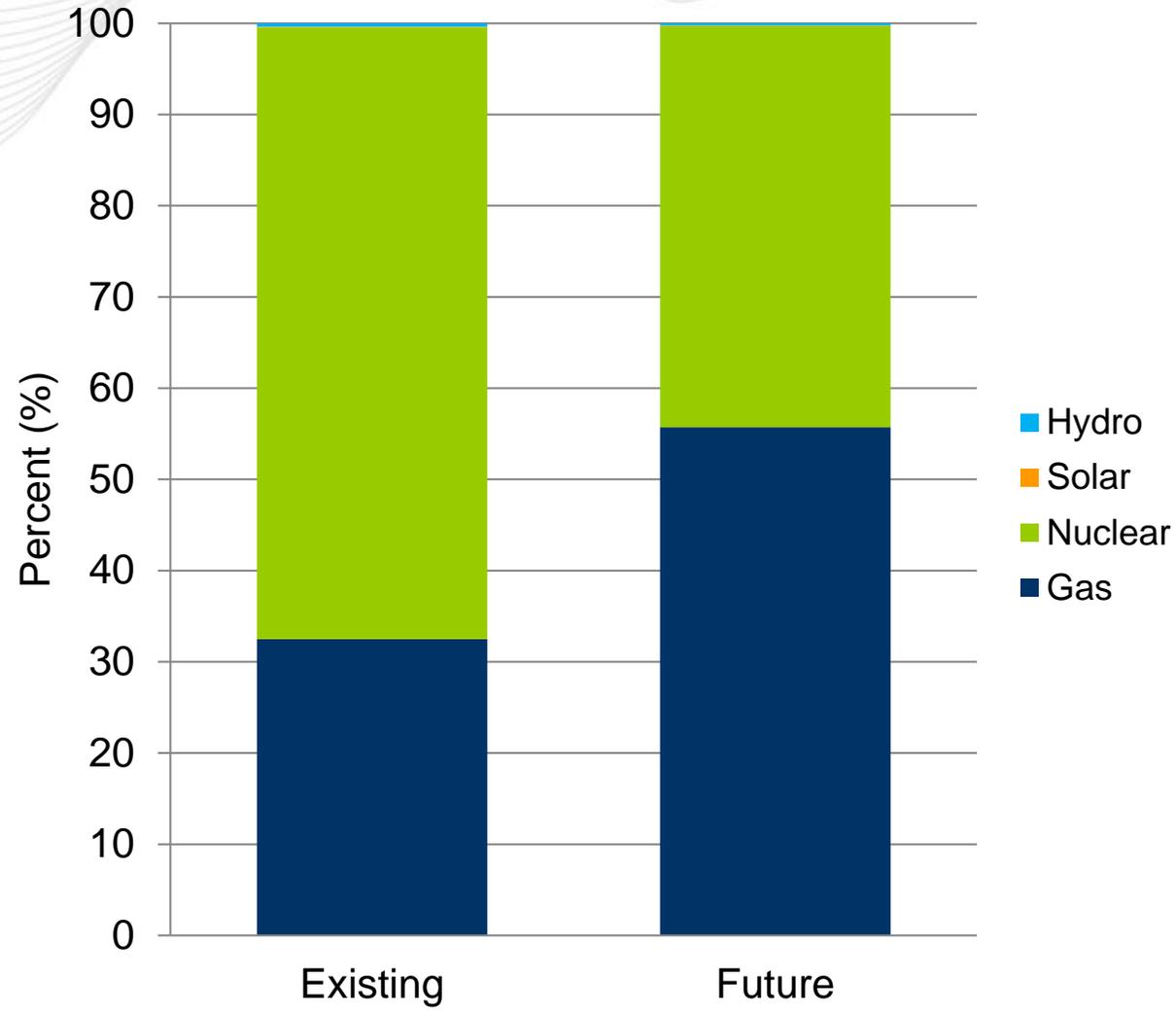
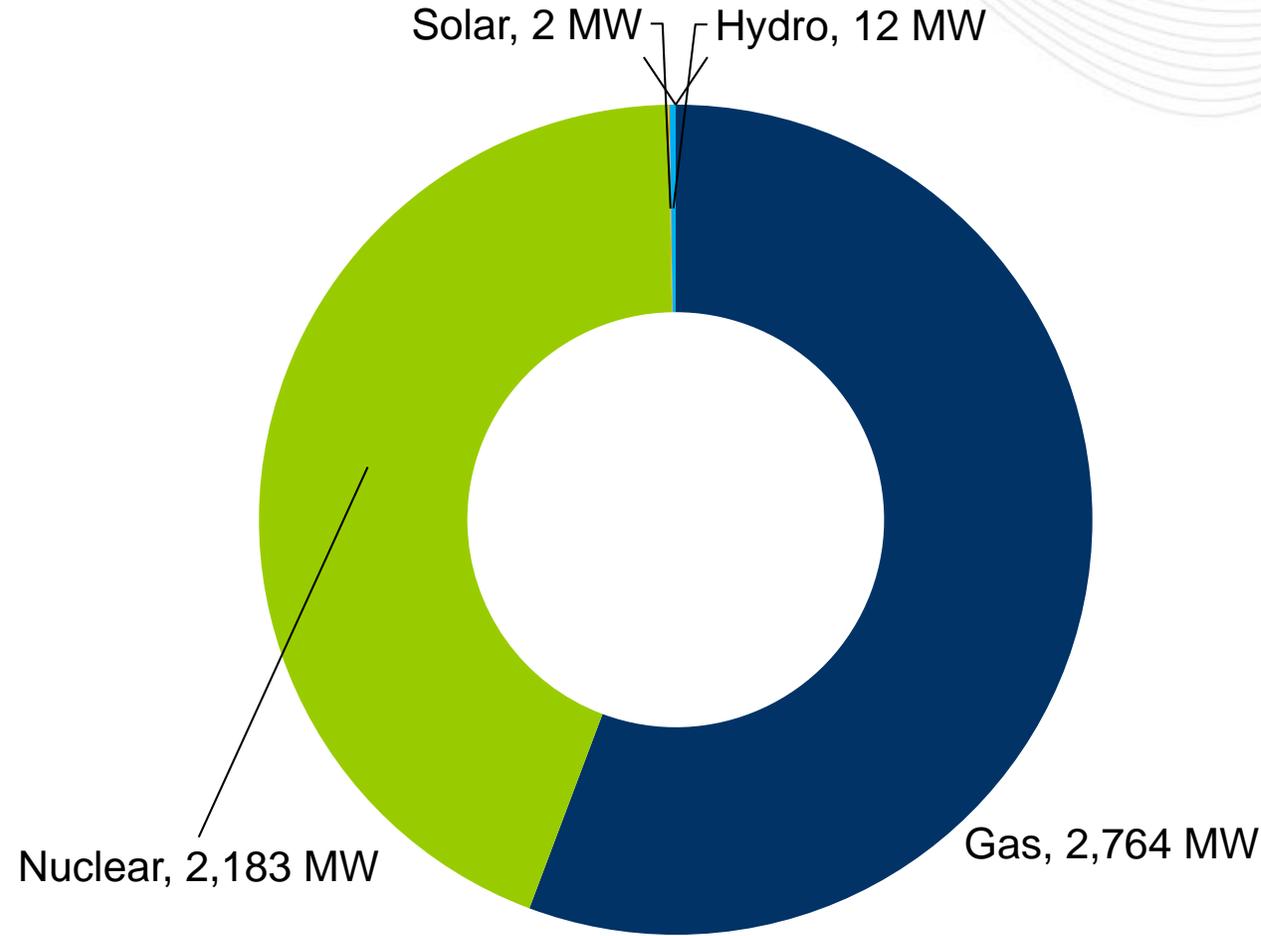
# Michigan – Interconnection Requests

(Unforced Capacity, As of December 31, 2018)

	Complete				In Queue				Grand Total	
	In Service		Withdrawn		Active		Under Construction			
	No. of Projects	Capacity, MW	No. of Projects	Capacity, MW	No. of Projects	Capacity, MW	No. of Projects	Capacity, MW	No. of Projects	Capacity, MW
<b>Non-Renewable</b>	4	1,222.0	2	1,120.0	3	274.0	1	994.0	10	3,610.0
Natural Gas	2	1,055.0	1	1,120.0	2	236.0	1	994.0	6	3,405.0
Nuclear	2	167.0	0	0.0	1	38.0	0	0.0	3	205.0
Other	0	0.0	1	0.0	0	0.0	0	0.0	1	0.0
<b>Renewable</b>	3	11.9	2	91.8	3	125.7	0	0.0	8	229.4
Methane	2	9.6	0	0.0	1	0.8	0	0.0	3	10.4
Solar	1	2.3	1	65.8	2	124.9	0	0.0	4	193.0
Wind	0	0.0	1	26	0	0.0	0	0.0	1	26.0
<b>Grand Total</b>	7	1,233.9	4	1,211.8	6	399.7	1	994.0	18	3,839.4

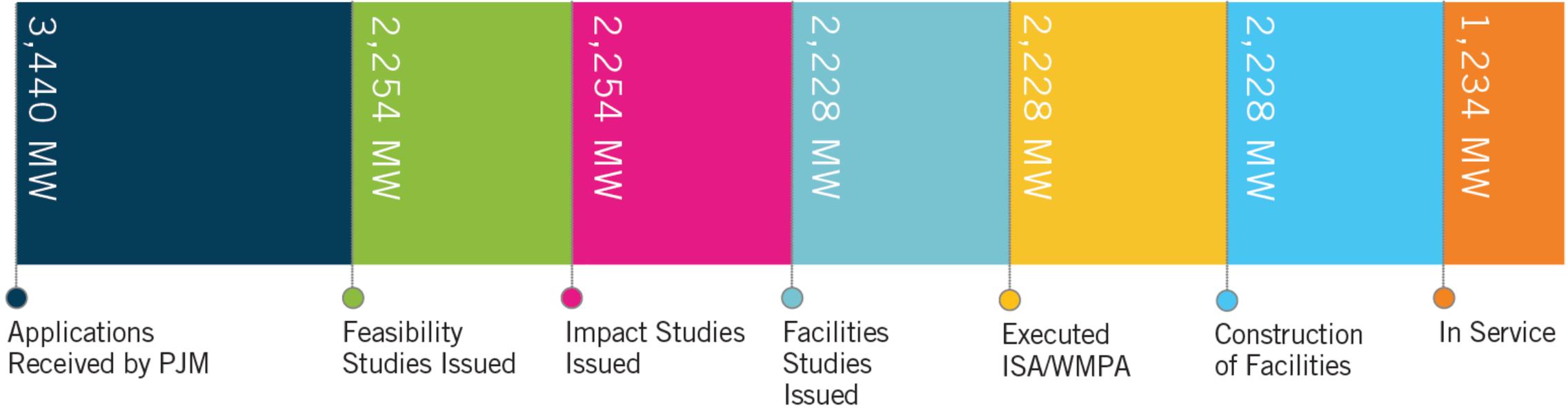
# Michigan – Future Capacity Mix

Based on known queued interconnection requests and deactivation notices through December 31, 2022, adjusted to reflect the probability of commercialization as indicated by historical trends specific to an interconnection request's state/zonal location and fuel type.



# Michigan – Progression History Interconnection Requests

Projects under construction, suspended, in service, or withdrawn (as of December 31, 2018)



**Percentage of planned capacity and projects reached commercial operation**

- 35.9 % requested capacity megawatt
- 58.3 % requested projects

# Michigan – Actual Generation Deactivations and Deactivation Notifications Received in 2018

Michigan had no generation deactivations or deactivation notifications in 2018.

# Planning

## Transmission Infrastructure Analysis



# Michigan – RTEP Baseline Projects

(Greater than \$5 million)

Michigan had no baseline project upgrades in 2018.

Note: Baseline upgrades are those that resolve a system reliability criteria violation.

# Michigan – RTEP Network Projects

(Greater than \$10 million)



Note: Network upgrades are new or upgraded facilities required primarily to eliminate reliability criteria violations caused by proposed generation, merchant transmission or long term firm transmission service requests.

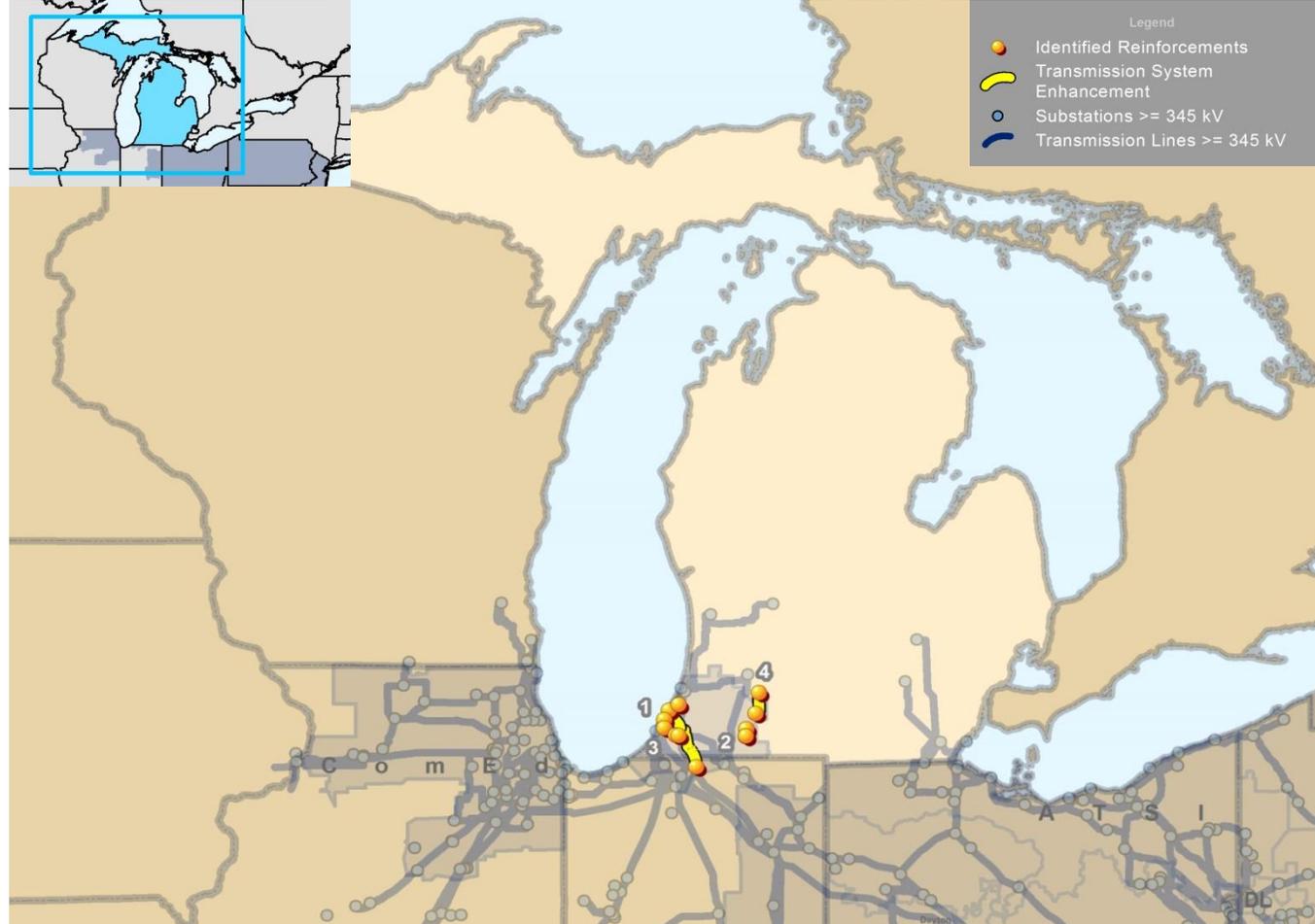


# Michigan – RTEP Network Projects

(Greater than \$5 million)

Map ID	Project	Description	Project Driver	Queue	Required In-Service Date	Project Cost (\$M)	TO Zone	2018 TEAC Review
1	n5487	Rebuild approximately 22 miles of Cook-Benton Harbor 345 kV line.	J873 (MISO)*	N/A	6/1/2020	\$44.32	AEP	9/13/2018

\* Note: J873 is a MISO DPP project.



Note: Supplemental projects are transmission expansions or enhancements that are not required for compliance with the following PJM criteria: system reliability, operational performance or economic criteria, pursuant to a determination by the Office of the Interconnection and is not a state public policy project.



# Michigan – TO Supplemental Projects

(Greater than \$5 million)

Map ID	Project	Description	Projected In-Service Date	Project Cost (\$M)	TO Zone	2018 TEAC Review
1	s1622	Rebuild roughly 43 miles from the Twin Branch to Riverside station with double-circuit 138 kV aluminum conductor steel cable (296 MVA rating).	12/1/2021	\$127.7	AEP	4/17/2018
		Rebuild the 6-mile double-circuit Benton Harbor 138 kV extension with double-circuit 138 kV aluminum conductor steel cable.	9/1/2021		AEP	4/17/2018
		Rebuild the 5-mile double-circuit Hickory Creek 138 kV extension with double-circuit 138 kV aluminum conductor steel cable.	12/1/2021		AEP	4/17/2018
2	s1435	Rebuild 69 kV Three Rivers station in the clear. New station name will be Ripple station.	8/22/2019	\$20.3	AEP	1/8/2018
		Replace two circuit breakers at Moore Park 69 kV station with new 40 kA breakers.	8/22/2019		AEP	1/8/2018
		Add motor-operated air breaker switch at Dock Foundry 69 kV station, towards Wheeler station.	8/22/2019		AEP	1/8/2018
		Rebuild approximately 5.7 miles of 69 kV line between Moore Park and Three Rivers using aluminum conductor steel cable. Upgrade line relaying and extension towards Corey and towards Three Rivers.	8/22/2019		AEP	1/8/2018



# Michigan – TO Supplemental Projects (cont.)

(Greater than \$5 million)

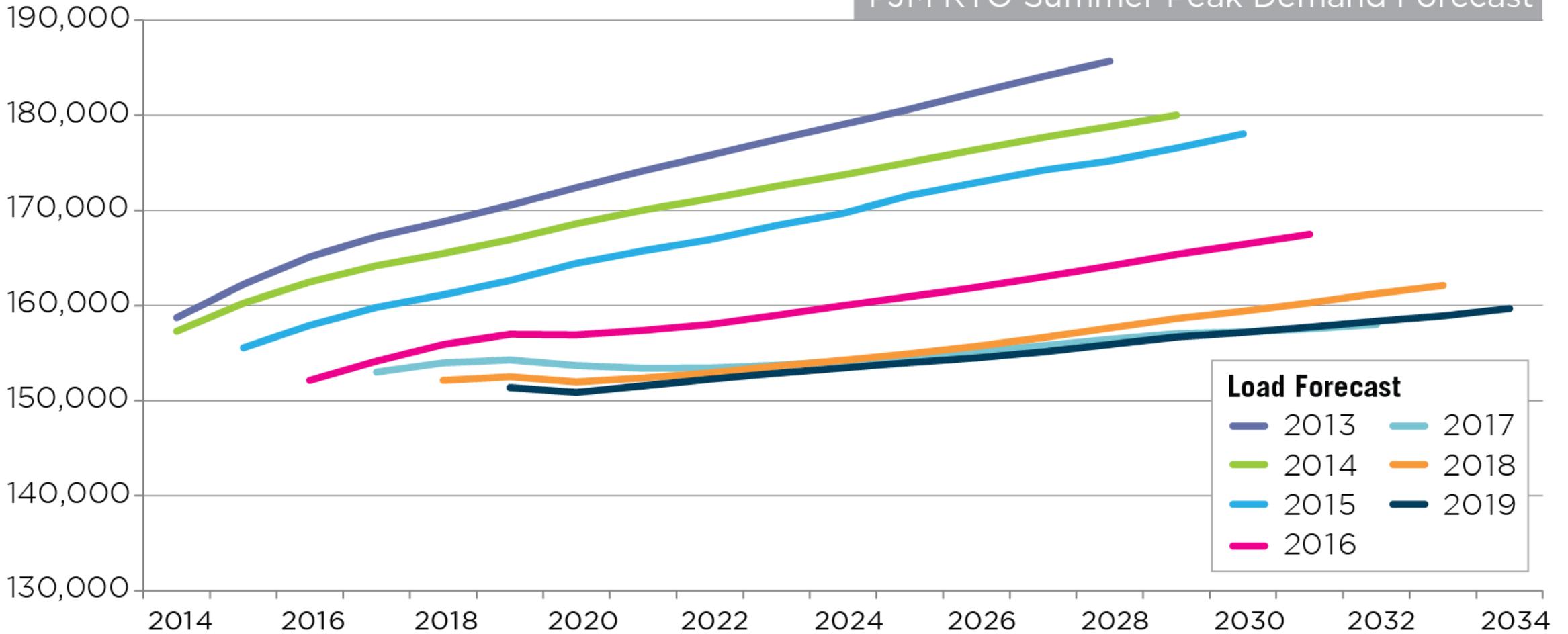
Map ID	Project	Description	Projected In-Service Date	Project Cost (\$M)	TO Zone	2018 TEAC Review
3	s1593	Relocate Derby - Bendix line exits and eliminate the need for underground 69/34 kV lines at Derby. Replace Bendix Tap Southwest pole.	6/1/2020	\$18.4	AEP	3/27/2018
		Eliminate underground 69 kV section at Oronoko. Rebuild approximately 1 mile of 34.5 kV as 69 kV double circuit. Build line extension to the proposed site for Kephart station.	6/1/2020		AEP	3/27/2018
		Rebuild Derby station in the clear. Proposed station will have two 138 kV circuit breakers, four 69 kV circuit breakers, one 34.5 kV circuit breaker, one dual voltage 138-69/34.5 kV transformer with a circuit switcher on the primary.	6/1/2020		AEP	3/27/2018
		Construct a new Kephart station with two 69 kV circuit breakers, one 34.5 kV circuit breaker, one 69/12 kV transformer, one 69/34.5 kV transformer, and three 12 kV circuit breakers. Construct a 69 kV yard that can accommodate 34.5 kV and 69 kV operation.	6/1/2020		AEP	3/27/2018
		At Berrien Springs, retire existing 34.5 kV yard, concrete platform and associated transmission equipment. Install two 69 kV circuit breakers and replace 69 kV circuit breaker on the primary side of Transformer No. 1.	6/1/2020		AEP	3/27/2018
		At Blossom Trail, install a dual-voltage 138-69/34.5 kV transformer, four 138 kV circuit breakers, one 138 kV circuit switcher, one 69 kV circuit breaker, one 34.5 kV circuit breaker, and a 34.5 kV ground bank.	6/1/2020		AEP	3/27/2018
		Replace Bendix tap switch with 69 kV phase-over-phase switch.	6/1/2020		AEP	3/27/2018
4	s1523	Rebuild Schoolcraft 69 kV station as Kalamazoo 69 kV station in the clear. Kalamazoo station will have a breaker-and-a-half configuration with six 69 kV circuit breakers, two 69/12 kV transformers, 12 kV bus with associated feeders, and a 14.4 MVAR cap bank.	12/12/2018	\$16.4	AEP	2/14/2018
		Install two 69 kV circuit breakers and install drop-in control module at Vicksburg to accommodate the new second line.	11/28/2018		AEP	2/14/2018
		Construct a new 5-mile 69 kV line between Kalamazoo and Vicksburg stations with aluminum conductor steel cable. Install fiber between Kalamazoo and Vicksburg Station. Extend Moore Park-Schoolcraft line into Kalamazoo.	12/11/2018		AEP	2/14/2018

# Planning

## Load Forecast

## PJM RTO Summer Peak Demand Forecast

Load (MW)





# Michigan – 2019 Load Forecast Report

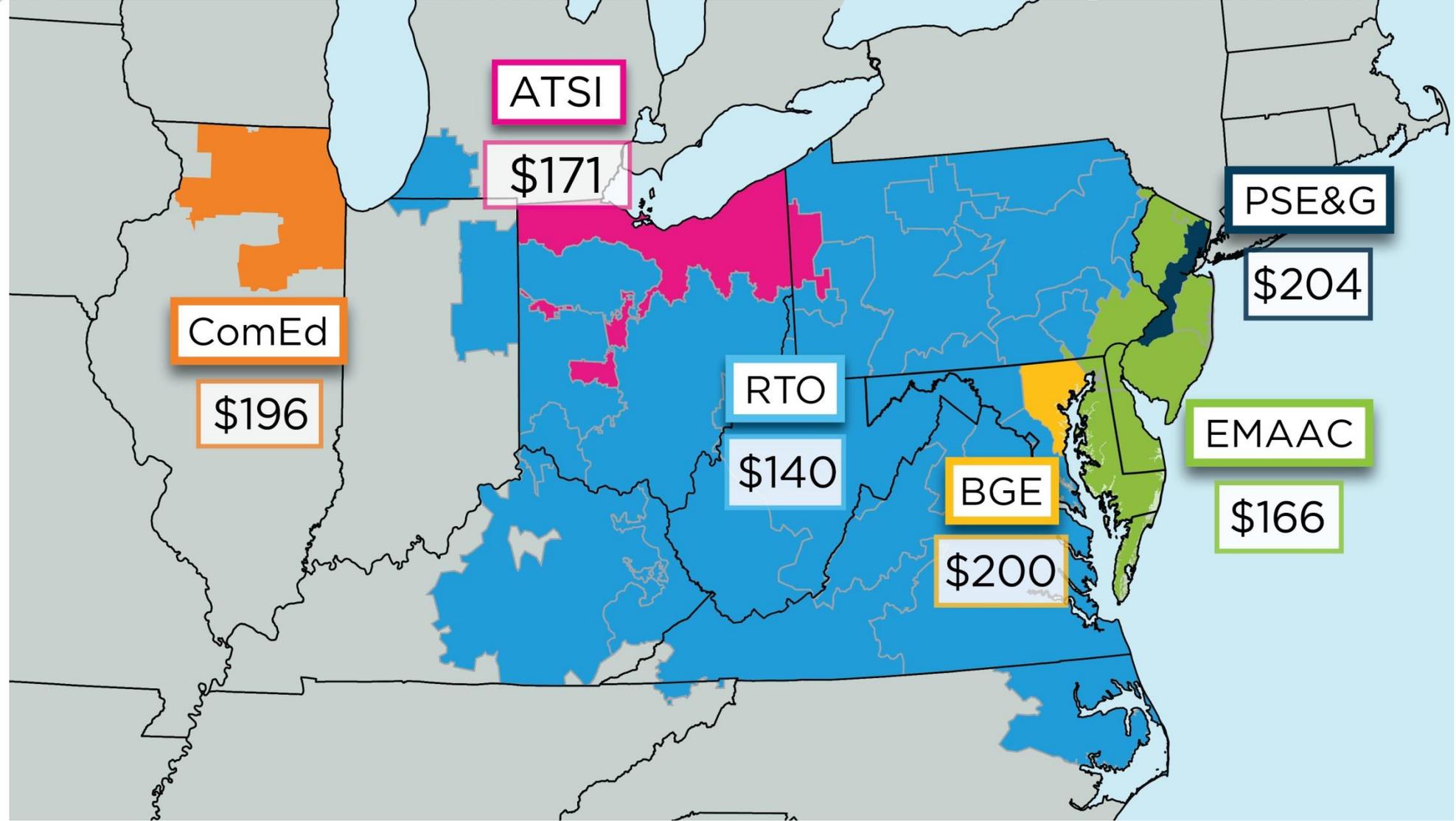
Transmission Owner	Summer Peak (MW)			Winter Peak (MW)		
	2019	2029	Growth Rate (%)	2018/19	2028/29	Growth Rate (%)
American Electric Power Company *	904	949	0.5%	676	708	0.5%
PJM RTO	151,358	156,689	0.3%	131,082	136,178	0.4%

\* PJM notes that American Electric Power Company serves load other than in Michigan. The Summer Peak and Winter Peak MW values in this table each reflect the estimated amount of forecasted load to be served by American Electric Power Company solely in Michigan. Estimated amounts were calculated based on the average share of American Electric Power Company's real-time summer and winter peak load located in Michigan over the past five years.

# Markets

## Capacity Market Results

# 2021/22 Base Residual Auction Clearing Prices (\$/MW-Day)





# Michigan – Cleared Resources in 2021/22 Auction

(May 23, 2018)

	Cleared MW (Unforced Capacity)	Change from 2020/21 Auction
Generation	1,154	(39)
Demand Response	59	31
Energy Efficiency	6	3
<b>Total</b>	<b>1,219</b>	<b>(4)</b>

## RTO Locational Clearing Price

\$140

*NOTE: Demand Response and Energy Efficiency are reported to PJM by Transmission Zone. The numbers above reflect the state's pro-rata share of cross-state zones for illustrative purposes.*



# PJM – 2021/2022 Cleared MW (UCAP) by Resource Type

	<b>Annual</b>	<b>Summer</b>	<b>Winter</b>	<b>Total</b>
<b>Generation</b>	149,616 MW	54 MW	716 MW	150,385 MW
<b>DR</b>	10,674 MW	452 MW	- MW	11,126 MW
<b>EE</b>	2,623 MW	209 MW	- MW	2,832 MW
<b>Total</b>	<b>162,912 MW</b>	<b>716 MW</b>	<b>716 MW</b>	<b>164,343 MW</b>



# Michigan – Offered and Cleared Resources in 2021/22 Auction

(May 23, 2018)

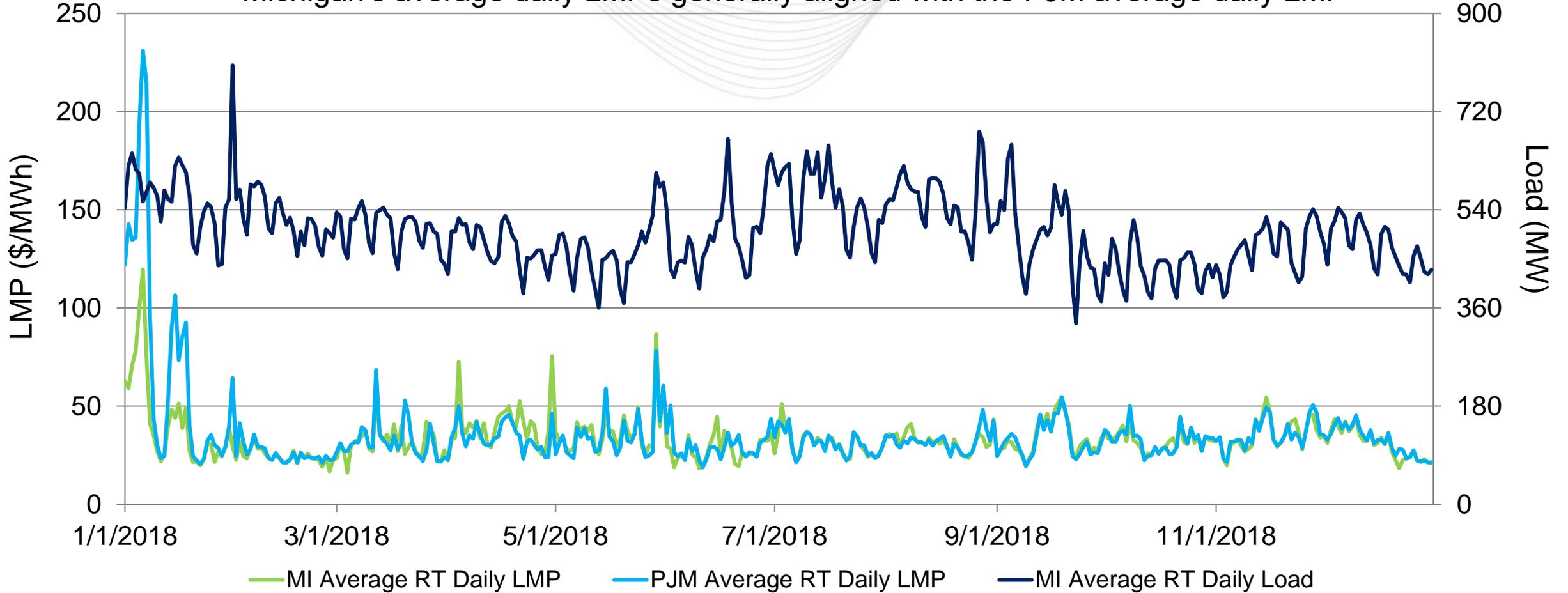
		Unforced Capacity
<b>Generation</b>	Offered MW	1,179
	Cleared MW	1,154
<b>Demand Response</b>	Offered MW	64
	Cleared MW	59
<b>Energy Efficiency</b>	Offered MW	7
	Cleared MW	6
<b>Total Offered MW</b>		<b>1,250</b>
<b>Total Cleared MW</b>		<b>1,219</b>

*NOTE: Demand Response and Energy Efficiency are reported to PJM by Transmission Zone. The numbers above reflect the state's pro-rata share of cross-state zones for illustrative purposes.*

# Markets

## Market Analysis

Michigan's average daily LMPs generally aligned with the PJM average daily LMP

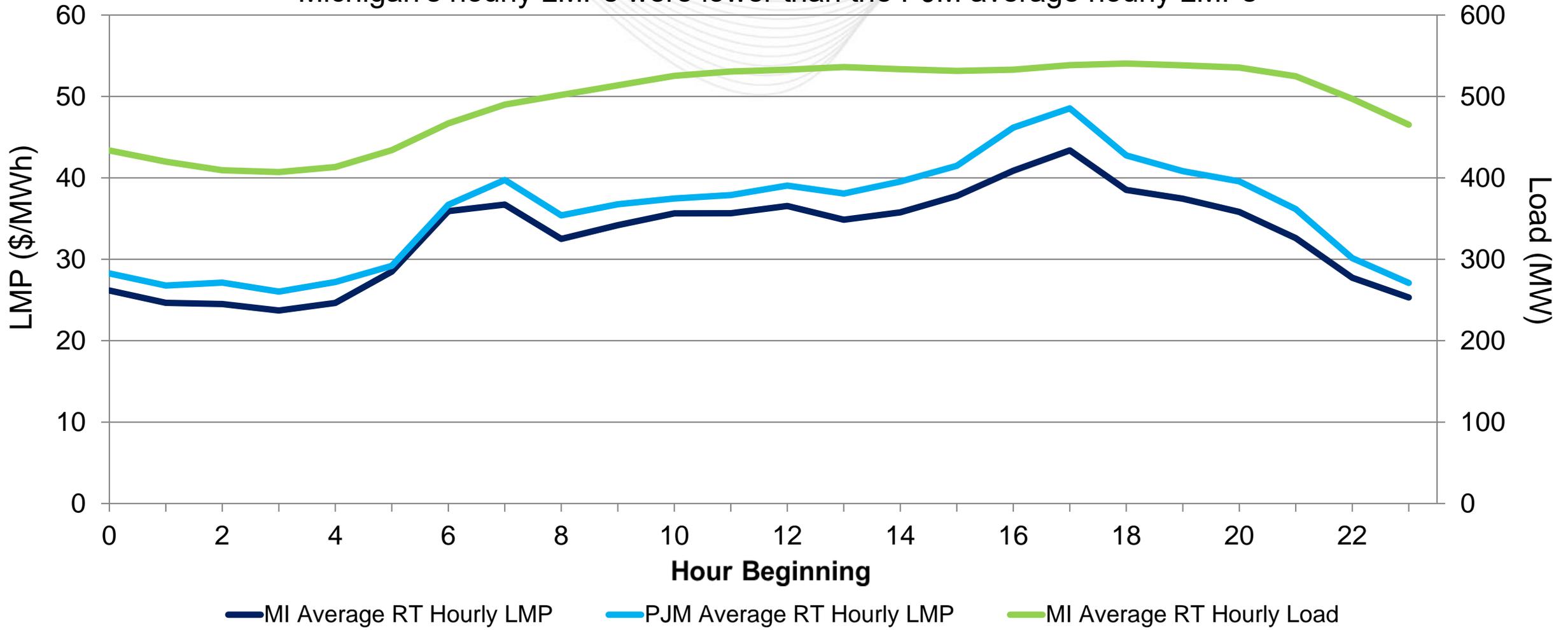


Note: The price spike in January reflects the Cold Snap that lasted from 12/28/17 to 1/7/2018.

# Michigan – Average Hourly LMP and Load

(January 1, 2018 – December 31, 2018)

Michigan's hourly LMPs were lower than the PJM average hourly LMPs



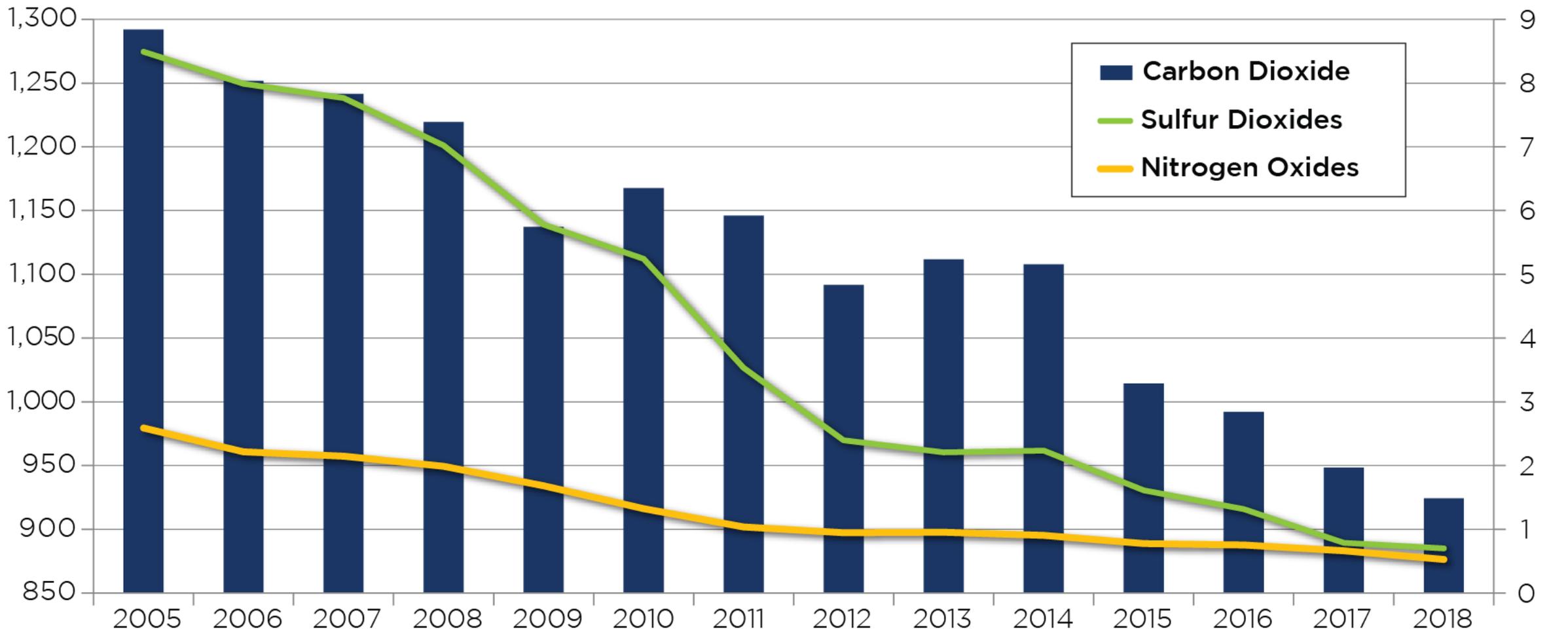
# Operations Emissions Data



# 2005-2018 PJM Average Emissions

CO<sub>2</sub>  
lbs/MWh

SO<sub>2</sub> and NO<sub>x</sub>  
lbs/MWh



Please note that PJM has historically used \$5 million as the threshold for listing projects in the RTEP report. Beginning in 2018, it was decided to increase this cutoff to \$10 million. All RTEP projects with costs totaling at least \$5 million are still included in this state report.

For a complete list of all RTEP projects, including those below the RTEP threshold of \$10 million, please visit the “RTEP Upgrades & Status – Transmission Construction Status” page on [pjm.com](https://www.pjm.com).

<https://www.pjm.com/planning/rtep-upgrades-status/construct-status.aspx>