



# 2017 Indiana State Infrastructure Report

(January 1, 2017 – December 31, 2017)

May 2018

This report reflects information for the portion of Indiana 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

**Note: all Indiana-specific information in this slide deck refers only to the portion of Indiana served by PJM.**

- **Existing Capacity:** Natural gas represents approximately 35.3 percent of the total installed capacity in Indiana while coal represents approximately 59.0 percent. This differs from PJM where natural gas and coal are at 37 and 32 percent of total installed capacity.
- **Interconnection Requests:** Natural gas represents approximately 66 percent of new interconnection requests in Indiana.
- **Deactivations:** Indiana had no generation deactivations for deactivation notifications in 2017.
- **RTEP 2017:** Indiana RTEP 2017 projects total more than \$626 million in investment. Approximately 59 percent of that represents supplemental projects.
- **Load Forecast:** Indiana 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:** Indiana cleared 140 MW more Demand Response and Energy Efficiency resources than in the prior auction.
- **6/1/15 – 12/31/17 Market Performance:** Indiana's average daily locational marginal prices were generally similar to PJM average daily LMPs. Coal resources represented 59.0 percent of generation produced in Indiana while gas and wind resources represented 25.7 and 14.9 percent, respectively. Indiana exported 21.4% of the generation produced within the state.
- **Emissions:** 2017 carbon dioxide emissions rose slightly from 2016; 2017 sulfur dioxide emissions are down while 2017 nitrogen oxide emissions are consistent with those in 2016.



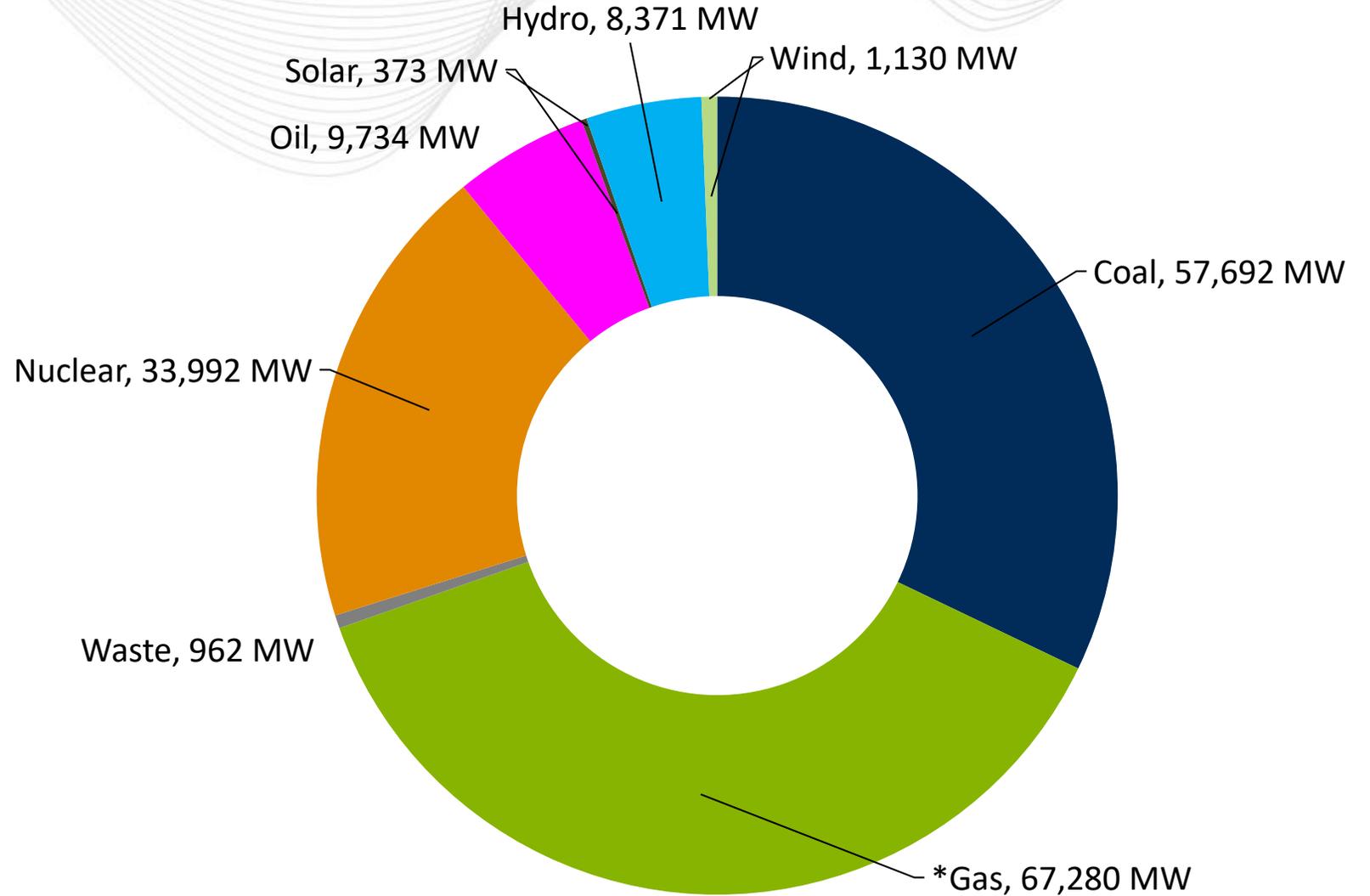
# Planning

## Generation Portfolio Analysis

# PJM – Existing Installed Capacity

(MW submitted to PJM, December 31, 2017)

In PJM, natural gas and coal make up nearly 70 percent of total installed capacity. Nuclear represents another 18.9 percent.

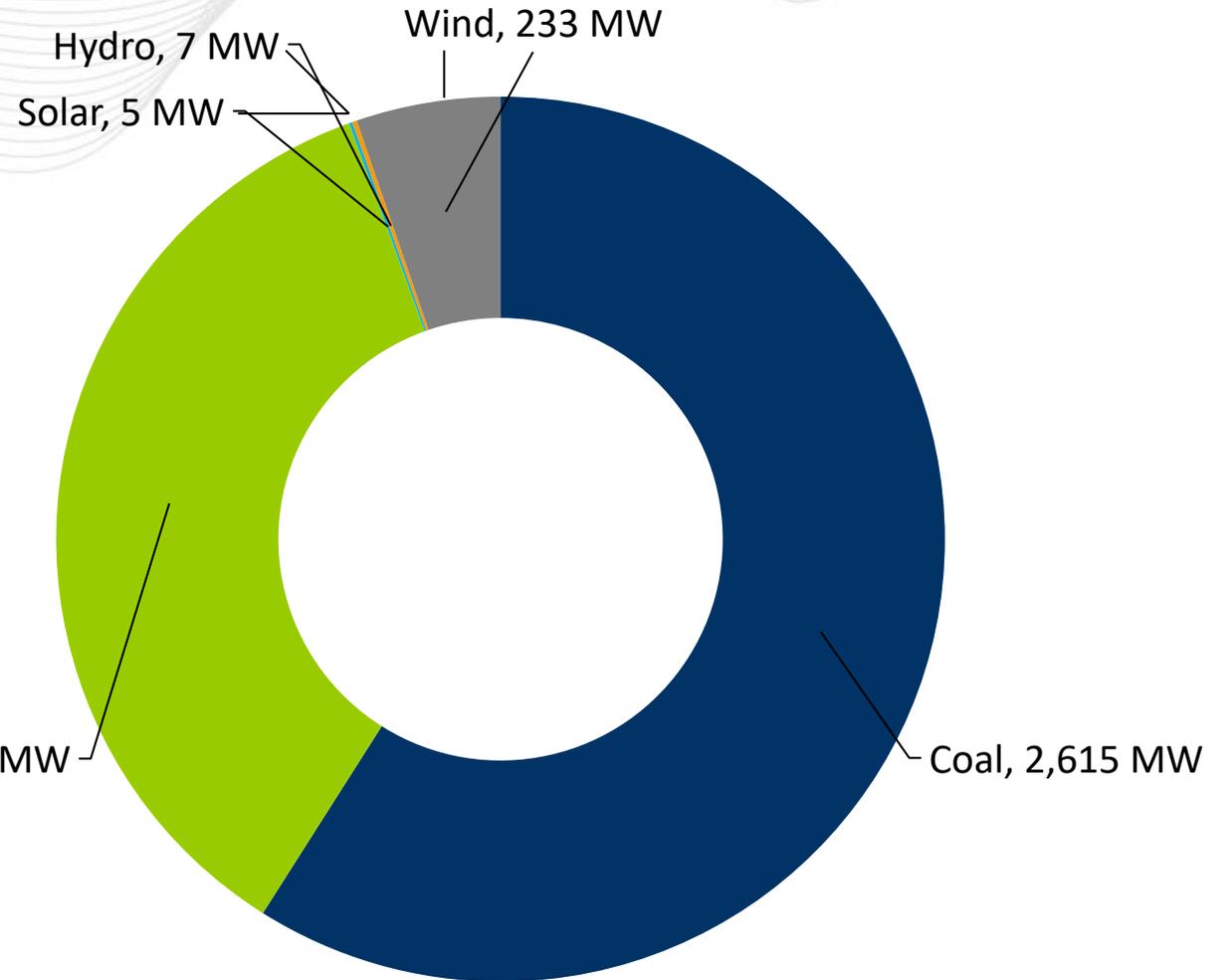


* Gas Contains	
Natural Gas	66,836.3 MW
Other Gas	443.8 MW

## Summary:

Natural gas represents approximately 35.3 percent of the total installed capacity in Indiana while coal represents approximately 59.0 percent.

Overall in PJM, natural gas represents approximately 37 percent of installed capacity while coal represents 32 percent.



* Gas Contains	
Natural Gas	1,566 MW
Other Gas	7.2 MW

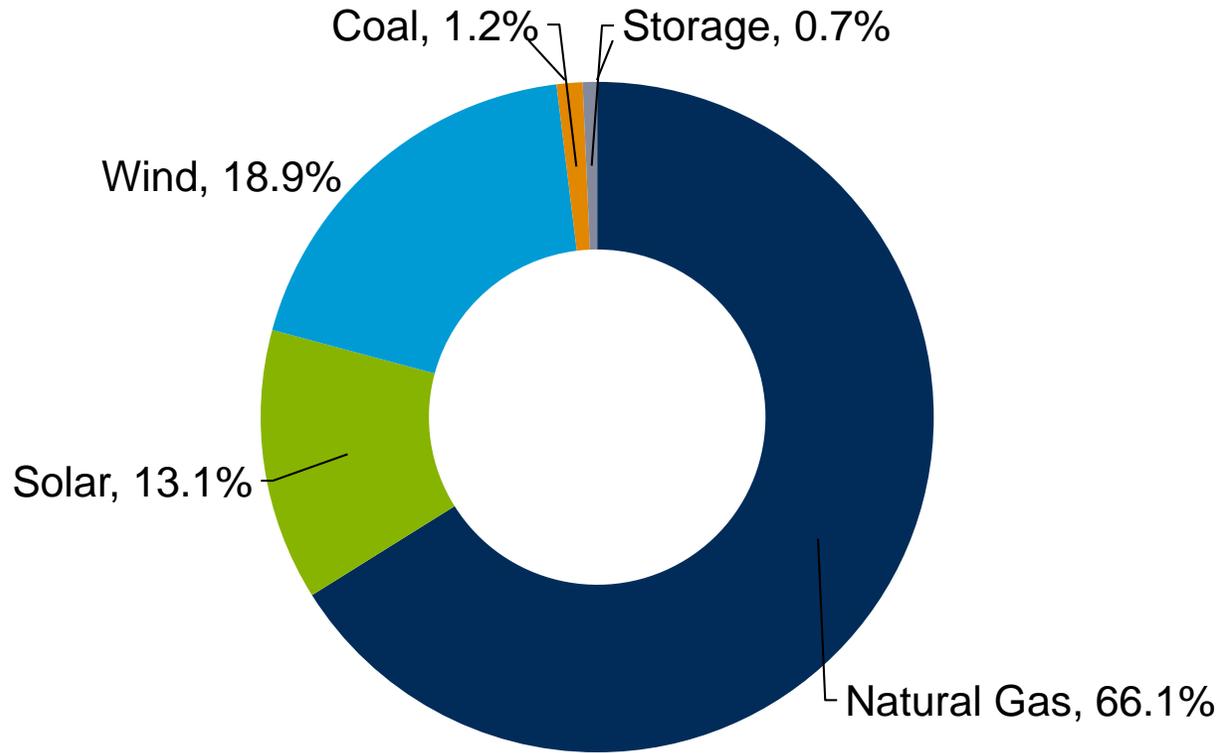


# Indiana – Interconnection Requests

(Requested Capacity Rights, December 31, 2017)

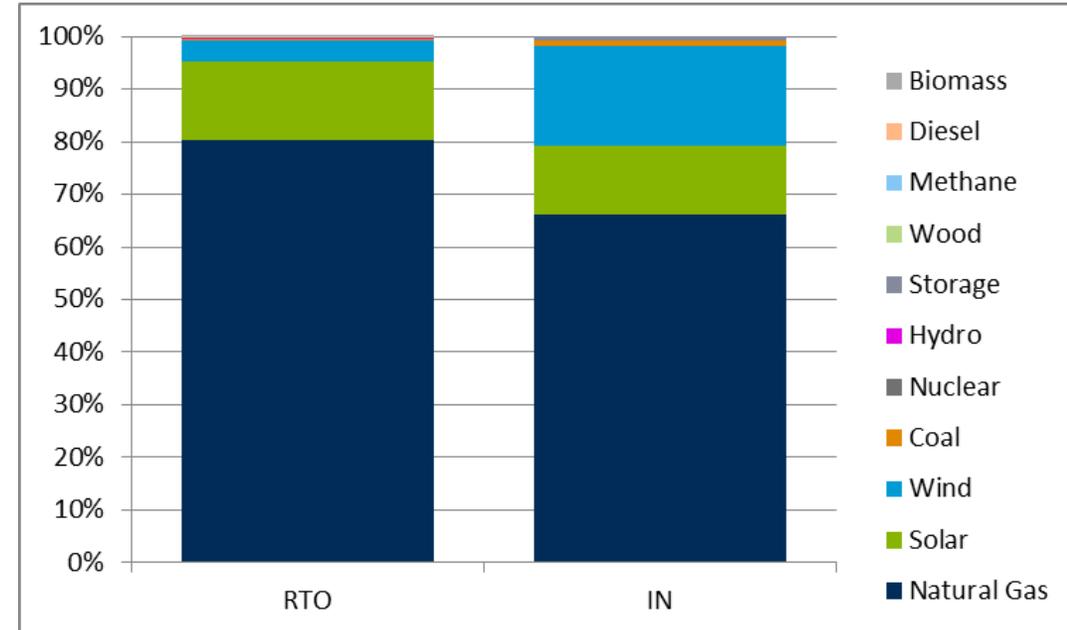
Natural gas represents approximately 66 percent of new interconnection requests in Indiana.

Total MW Capacity by Fuel Type



Fuel Source	Capacity, MW	Nameplate Capability, MW
Natural Gas	1,915.0	1,965.0
Wind	547.1	4,228.4
Solar	379.6	970.0
Coal	36.0	36.0
Storage	20.0	40.0
<b>Total</b>	<b>2,897.7</b>	<b>7,239.4</b>

Fuel as a Percentage of Projects in Queue





# Indiana – Interconnection Requests

(As of December 31, 2017)

	Complete				In Queue						Grand Total	
	In Service		Withdrawn*		Active		Suspended**		Under Construction**			
	MW	# of Projects	MW	# of Projects	MW	# of Projects	MW	# of Projects	MW	# of Projects	MW	# of Projects
<b>Non-Renewable</b>	76	5	2,651	6	1,220	6			751	3	4,698	20
<b>Coal</b>	30	3	901	2					36	1	967	6
<b>Natural Gas</b>	46	2	1,747	2	1,200	4			715	2	3,708	10
<b>Storage</b>			3	2	20	2					23	4
<b>Renewable</b>	359	13	1,251	37	864	19	62	3			2,537	72
<b>Methane</b>	8	2	4	1							12	3
<b>Solar</b>	5	3	145	4	380	8					530	15
<b>Wind</b>	346	8	1,103	32	485	11	62	3			1,996	54
<b>Grand Total</b>	<b>435</b>	<b>18</b>	<b>3,903</b>	<b>43</b>	<b>2,084</b>	<b>25</b>	<b>62</b>	<b>3</b>	<b>751</b>	<b>3</b>	<b>7,235</b>	<b>92</b>

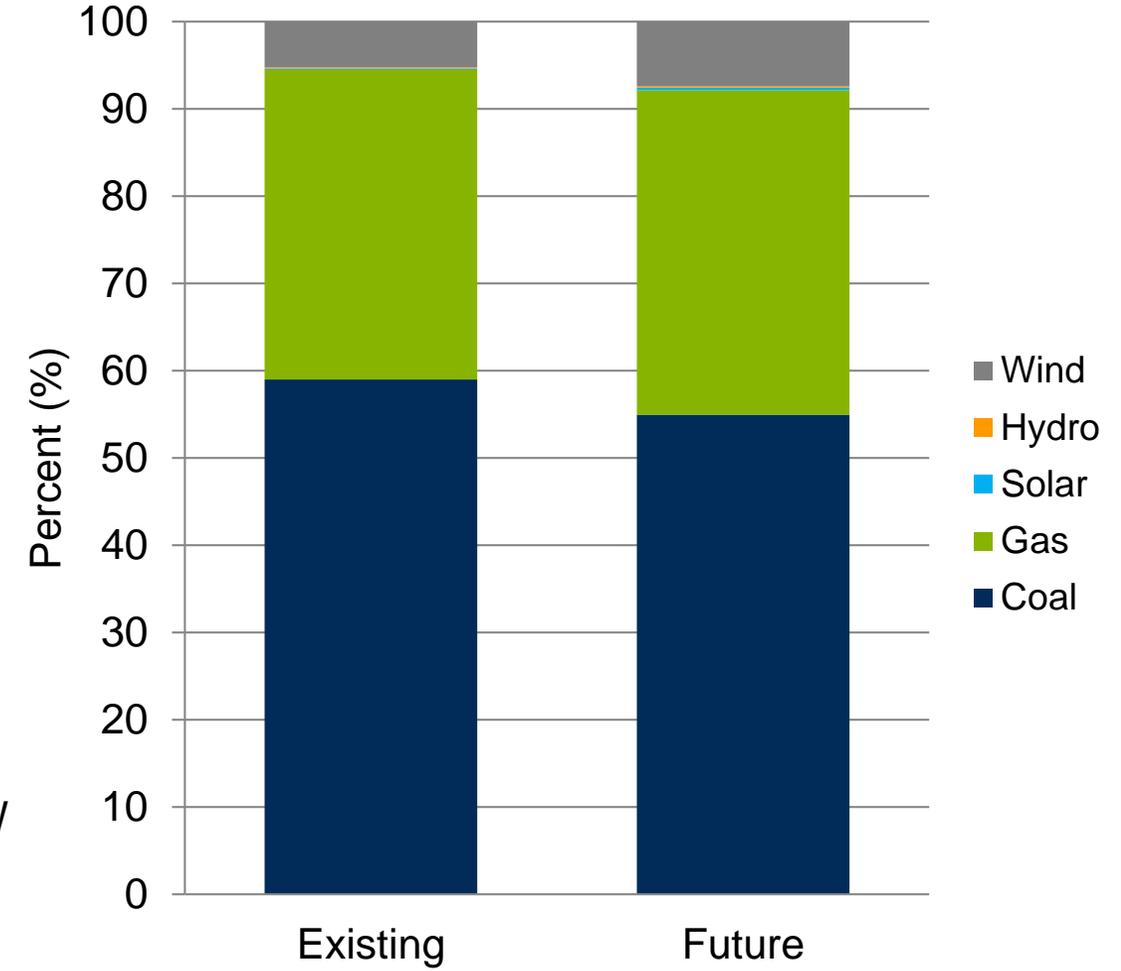
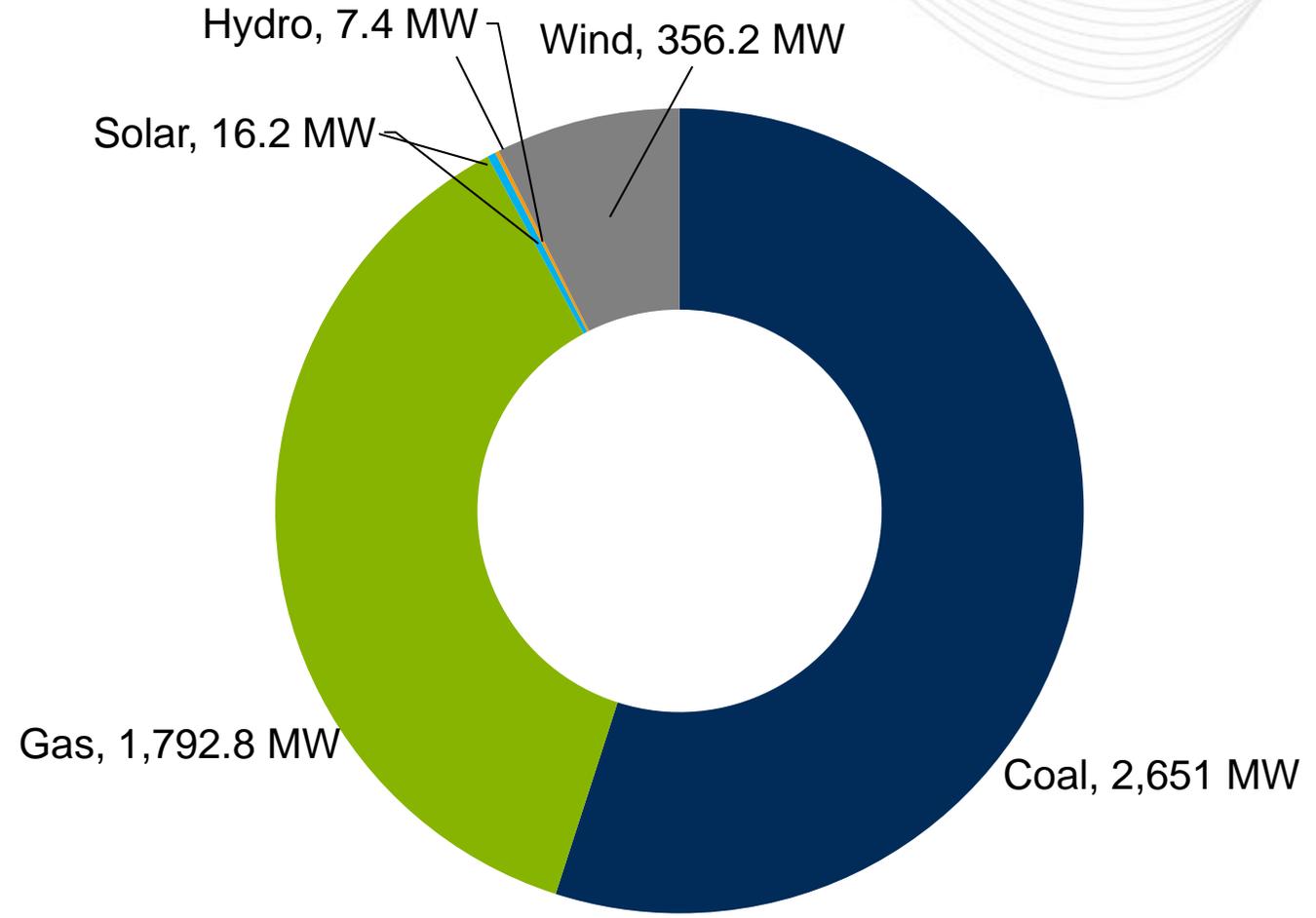
\*May have executed final agreement

\*\* Executed final agreement (ISA / WMPA)



# Indiana – 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.





# Indiana – Progression History Interconnection Requests

Projects under construction, suspended, in service, or withdrawn – As of December 31, 2017



## Projects that withdrew after a final agreement

22.3% of requested capacity megawatt and 29.9% of projects reaches commercial operation

	Number of Projects	Capacity, MW	Nameplate Capability, MW
ISA	1.0	48.0	240.0

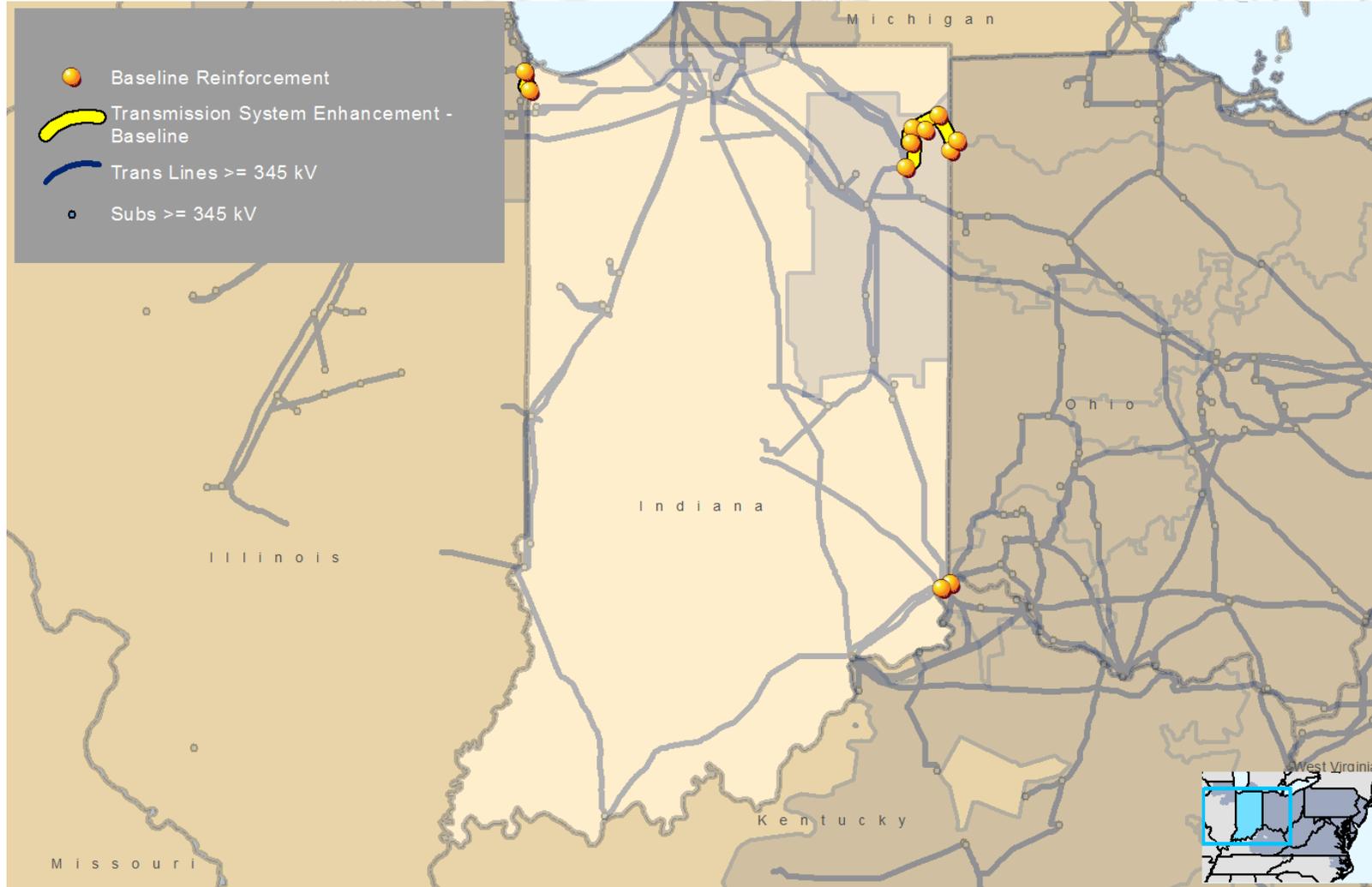


# Indiana – Actual Generation Deactivations and Deactivation Notifications Received in 2017

Indiana had no generation deactivations or deactivation notifications in 2017.

# Planning

## Transmission Infrastructure Analysis



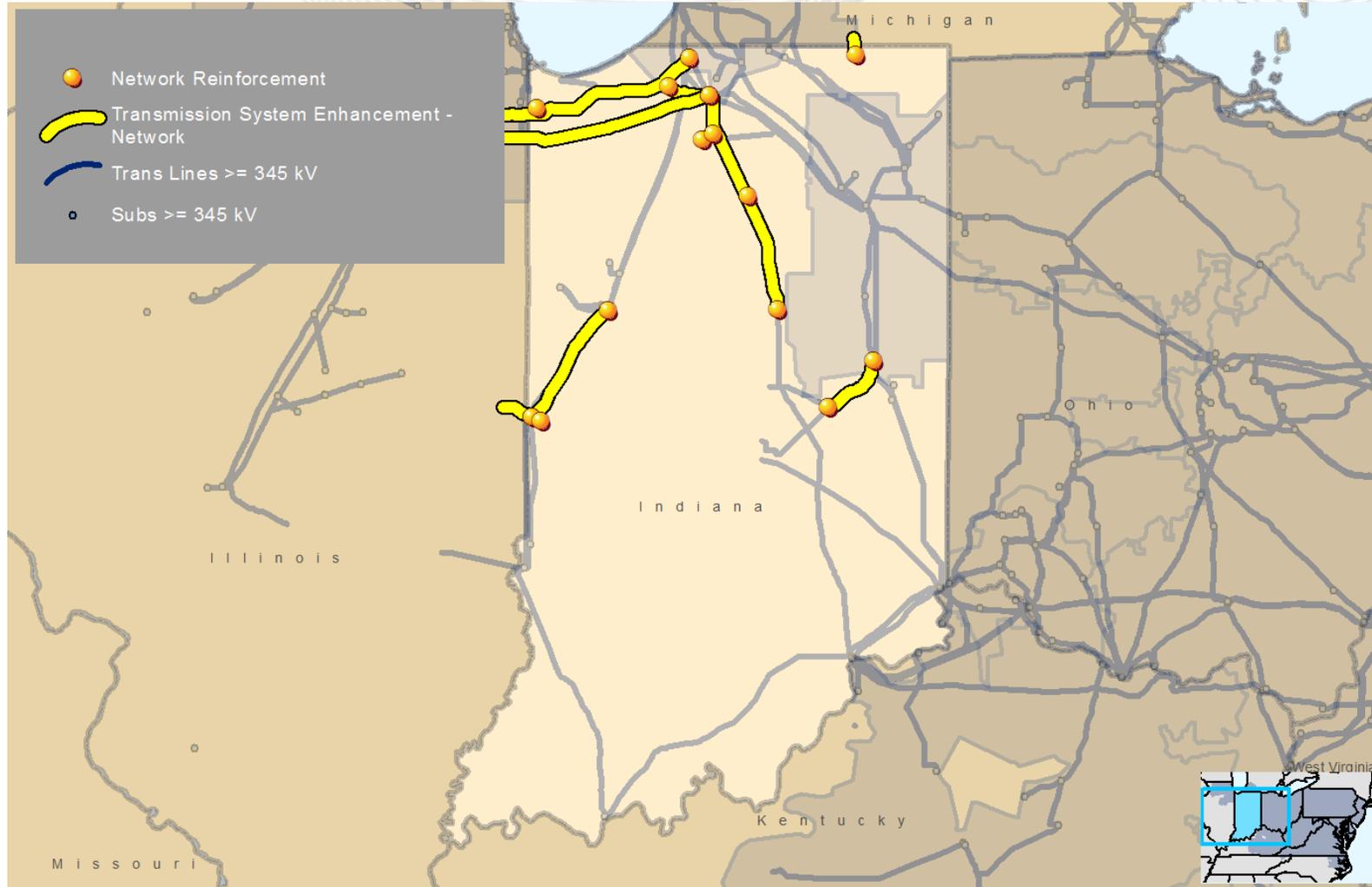
Note: Baseline upgrades are those that resolve a system reliability criteria violation.



# Indiana - RTEP Baseline Projects

(Greater than \$5 million)

Project ID	Project	Project Driver	Required In Service Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Review
b2971	Perform sag mitigation on the Burnham-Munster 345 kV circuit	Congestion Relief - Economic	6/1/2020	\$ 7.0	ComEd	11/9/2017
	Reconfigure Munster 345kV as ring bus				NIPSCO	
b2831	Upgrade the Tanner Creek - Miami Fort 345 kV circuit (DEOK portion) to achieve new ratings of 2151 MVA Summer Normal and 2151 MVA Summer Emergency	Baseline Load Growth Deliverability & Reliability	6/1/2021	\$ 7.8	DEOK	1/12/2017
	Upgrade Tanner Creek to Miami Fort 345 kV line (AEP portion) to achieve new ratings of 1825 MVA Summer Normal and 1868 MVA Summer Emergency		11/1/2018		AEP	
b2779	Expand Auburn 138 kV bus	Baseline Load Growth Deliverability & Reliability	6/1/2016	\$ 107.7	AEP	11/3/2016
	Construction a new 138 kV station, Campbell Road, tapping into the Grabill – South Hicksville 138 kV line					
	Reconstruct sections of the Butler-N.Hicksville and Auburn-Butler 69 kV circuits as 138 kV double circuit and extend 138 kV from Campbell Road station					
	Looped 138 kV circuits in-out of the new SDI Wilmington 138 kV station resulting in a direct circuit to Auburn 138 kV and in direct circuit to Auburn and Rob Park via Dunton Lake, and a circuit to Campbell Road; Reconductor 138kV line section between Dunt					
	Construct a new 345/138 kV SDI Wilmington Station which will be sourced from Collingwood 345 kV and serve the SDI load at 345 kV and 138 kV respectively					



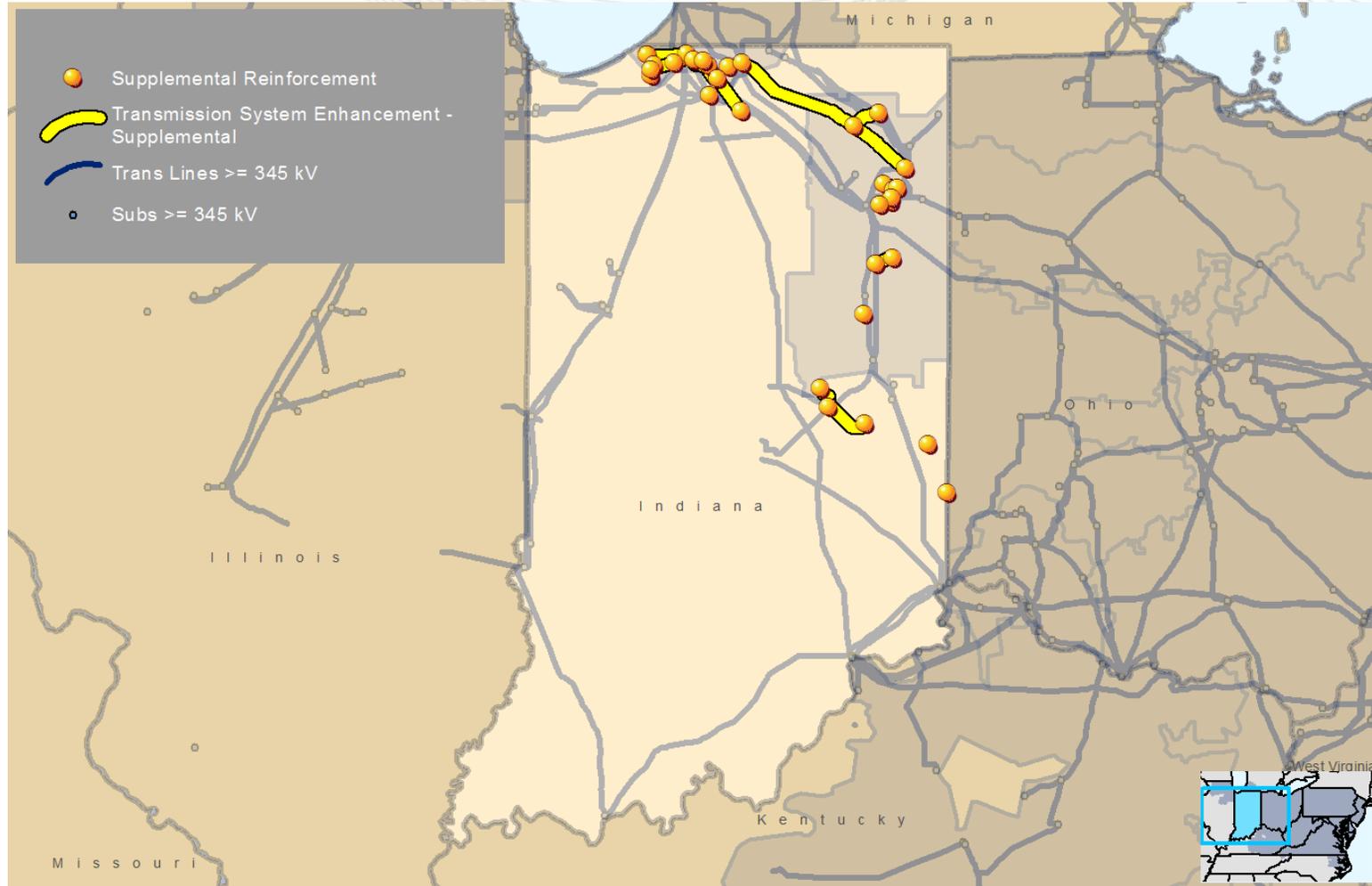
Note: Network upgrades are new or upgraded facilities required primarily to eliminate reliability criteria violations caused by proposed generation, merchant transmission or long term firm transmission service requests.



# Indiana - RTEP Network Projects

(Greater than \$5 million)

Project ID	Description	Project Driver	Queue	Required In Service Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Review
n4713	Sturgis-Howe 69kV T-Line Removal Right Of Way	Generation	X1-020	7/1/2019	\$ 6.0	AEP	10/12/2017
n4742	Telecommunications - Fiber Optic between Stations	Generation	X1-020	7/1/2019	\$ 34.7	AEP	10/12/2017
	765 kV Metering Greentown-Dumont 765kV T-Line Circuit Cut-In						
n5065	Reconductor or rebuild the Eugene – Dequine 345 kV line and replace the Dequine riser		Not Specified		\$ 88.3	AEP	10/12/2017
n5417	Construct a new three (3) circuit breaker 345 kV switching station along the Desoto – Fall Creek 345 kV Line	Generation	AB2-028	10/31/2018	\$ 5.6	AEP	10/12/2017



Note: Supplemental projects are transmission expansions or enhancements that are used as inputs to RTEP models, but are not required for reliability, economic efficiency or operational performance criteria, as determined by PJM.



# Indiana - TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1194	Build 69 kV line between Lincoln and a new 138/69 kV Berrywood station to provide loop service.	12/1/2018	\$ 38.7	AEP	1/5/2017
s1195	Tap the existing Hadley-McKinley 69 kV circuit and construct a new 69 kV double circuit extension to a new Melita 69 kV station, retiring Webster station and converting existing 34.5 kV transmission lines from Hillcrest to Melita (formerly Webster).	12/13/2017	\$ 24.0	AEP	1/5/2017
s1200	Construct a new 138/12 kV Aviation station and approximately 4.7 miles of new 138 kV line from Waynedale Station and a newly established Dalman Road switching station. Waynedale Station will be upgraded with modifications to the 138 kV and 12 kV systems.	12/31/2017	\$ 11.6	AEP	1/5/2017
s1278	At Dumont station, replace the existing 765/345kV 500MVA transformer T1 with new 765/345kV/34.5 750MVA transformer T3 and a spare T3SP 765/345kV/34.5 750MVA transformer along with associated equipment and protection.	12/29/2017	\$ 43.7	AEP	5/4/2017
s1279	Olive-Bosserman 138 kV Install a three way phase over phase switch, called Kuchar, near Liquid Carbonics station and construct a new 138 kV line between Bootjack and Kuchar. Construct two 138/12 kV distribution stations, Bootjack and Marquette, to replace Silver Lake 34.5 kV and Springville 69 kV stations. Cut the existing Olive – Bosserman line into New Carlisle station. Rebuild sections of the LaPorte Junction-New Carlisle/New Buffalo 34.5 kV line to 138 kV to establish Bootjack-Olive 138 kV circuit utilizing 795 ACSR conductor (251 MVA rating). Construct a 138 kV extension to Marquette station by tapping the Bosserman-Liquid Carbonics 138 kV line utilizing 795 ACSR conductor (251 MVA rating).	12/1/2019	\$ 36.8	AEP	5/4/2017



# Indiana - TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1309	Convert Gravel Pit station. Construct two new 138kV lines. Retire Bowman Creek.	12/1/2018	\$ 17.2	AEP	5/31/2017
	Replace and convert the existing Gravel Pit 34.5/12 kV station with a 138/12 kV station.				
	Construct two single circuit 138 kV lines (795 ACSR conductor, 251 MVA rating), approximately 6 miles total and tap the Jackson Road – New Carlisle 138 kV line (Edison – Kankakee 138 kV ckt).				
	De-energize sections of the Jackson Road – New Carlisle 138 kV line (Edison – Kankakee 138 kV ckt).				
	Retire the 34.5 kV tap line that at present is utilized to serve Gravel Pit station from the Jackson Road – Kankakee 34.5 kV ckt. In addition, retire Gravel Pit station.				
	Retire Bowman Creek 34.5 kV switch.				
s1316	Rebuild approximately 8 miles of 69 kV line between Albion and Kendallville stations (starting at structure 32) using 795 ACSR conductor (128 MVA rating) on the existing circuit centerline	6/1/2018	\$ 7.6	AEP	5/31/2017
s1324	Replace transformer at Jackson Road. Rebuild Jackson Road-Marhsall 69kV line. Convert Quinn and Vintage stations.	12/1/2018	\$ 32.0	AEP	5/31/2017
	Replace 138/34.5 kV transformer with a 138/69-34.5 kV transformer, replace 34.5 kV circuit breaker F, and add a new 69 kV breaker at Jackson Road station.				
	Convert Quinn to 69 kV				
	Construct Vintage 69 kV station to replace Lapaz				
	Rebuild and convert ~13 miles of 34.5 kV line between Jackson Road and Marshall (NIPSCO) to 69 kV utilizing 556 ACSR conductor (102 MVA rating).				
	Install 69 kV tie line metering at Marshall station				
s1326	Replace transformers and circuit breakers at Kankakee	12/1/2017	\$ 5.0	AEP	5/31/2017
	Replace existing Kankakee transformer #1 with a 138/69/34.5 kV 130 MVA transformer.				
	Replace 34.5 kV circuit breakers H, I, D and F with new 1200A 25kA circuit breakers along with associated equipment and protection.				

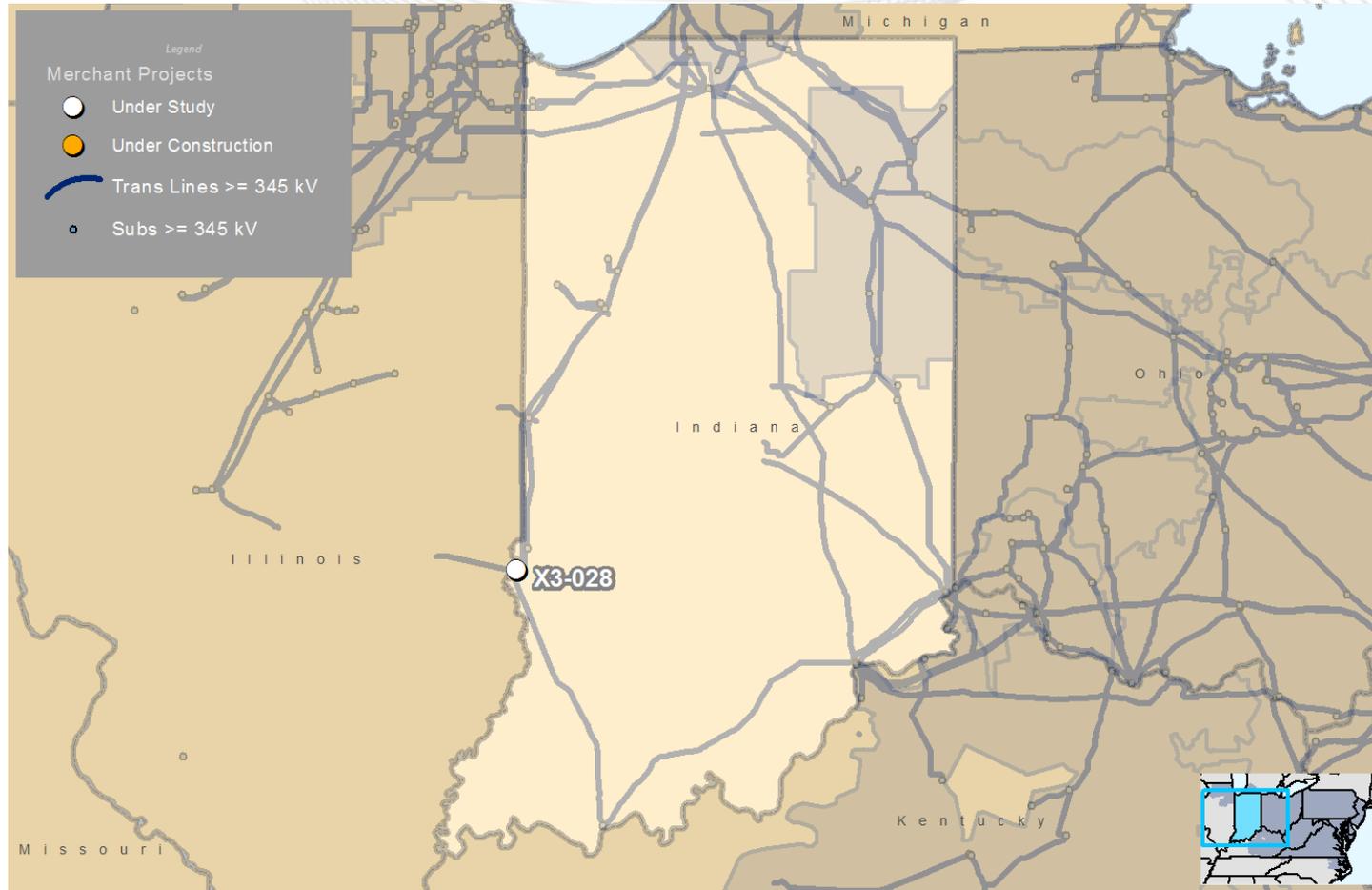


# Indiana - TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1335	Remote end work at New Carlisle station due to breaker addition at Tulip Road.	12/1/2017	\$ 7.5	AEP	5/31/2017
	Construct new Tulip Road station				
	Construct a new 34.5 kV Tulip Road station with one circuit breaker on the West Side line exit.				
	Terminate New Carlisle, West Side, Scrap Metals, and Edco lines into the new station.				
s1336	Rebuild approximately 65 miles of 138 kV double circuit tower line between Twin Branch and Robison Park stations using 795 ACSR overhead conductor (251 MVA rating).	6/1/2020	\$ 98.7	AEP	5/31/2017
s1372	Retire the old Liberty Center REMC switch and install a new 69kV 1200A 3 way PoP switch at structure at Meridian Road.	3/1/2018	\$ 10.6	AEP	9/11/2017
	Liberty Center REMC changes				
	Replace Bluffton and Liberty Center line switches with 1200A 61kA 1-way GOAB's. Rebuild the full 6.43 miles of the Liberty Center – Bluffton 69kV circuit utilizing 795 26/7 ACSR (129 MVA rating).				
	Retire line from the old Liberty Center Switch to structure 5 and build 0.58 miles using 4/0 ACSR from the new Liberty Center Switch to structure 5.				
s1419	At Fall Creek 138kV station, install six 138kV 3000 A 63 kA breakers to complete a breaker-and-a-half arrangement for all line exits at the station.	12/31/2017	\$ 7.7	AEP	12/18/2017
	Reroute and terminate the Delco and Pendleton 138KV lines to Fall Creek station exit locations.				
	Reroute and terminate the Madison and New Castle lines to Fall Creek station exit locations.				
s1423	Rebuild the 17.6 mile Bosman – Hartford City 34.5 kV line utilizing 795 ACSR 26/7 (64 MVA rating). This line will be built to 69kV standards but operated at 34.5kV	8/31/2018	\$ 13.6	AEP	12/18/2017
s1426	At Richmond station, replace 138kV Breaker C with a 3000A 40kA model and replace MOAB's U, V, W, and Y with 3000A MOAB switches.	11/30/2018	\$ 13.8	AEP	12/18/2017
	Rebuild College Corner 138kV station in the clear at the existing station site with ten 3000A 40 kA circuit breakers in a breaker and a half arrangement to terminate seven line positions. Replace the control house with a new DICM.				

# Indiana - Merchant Transmission Project Requests

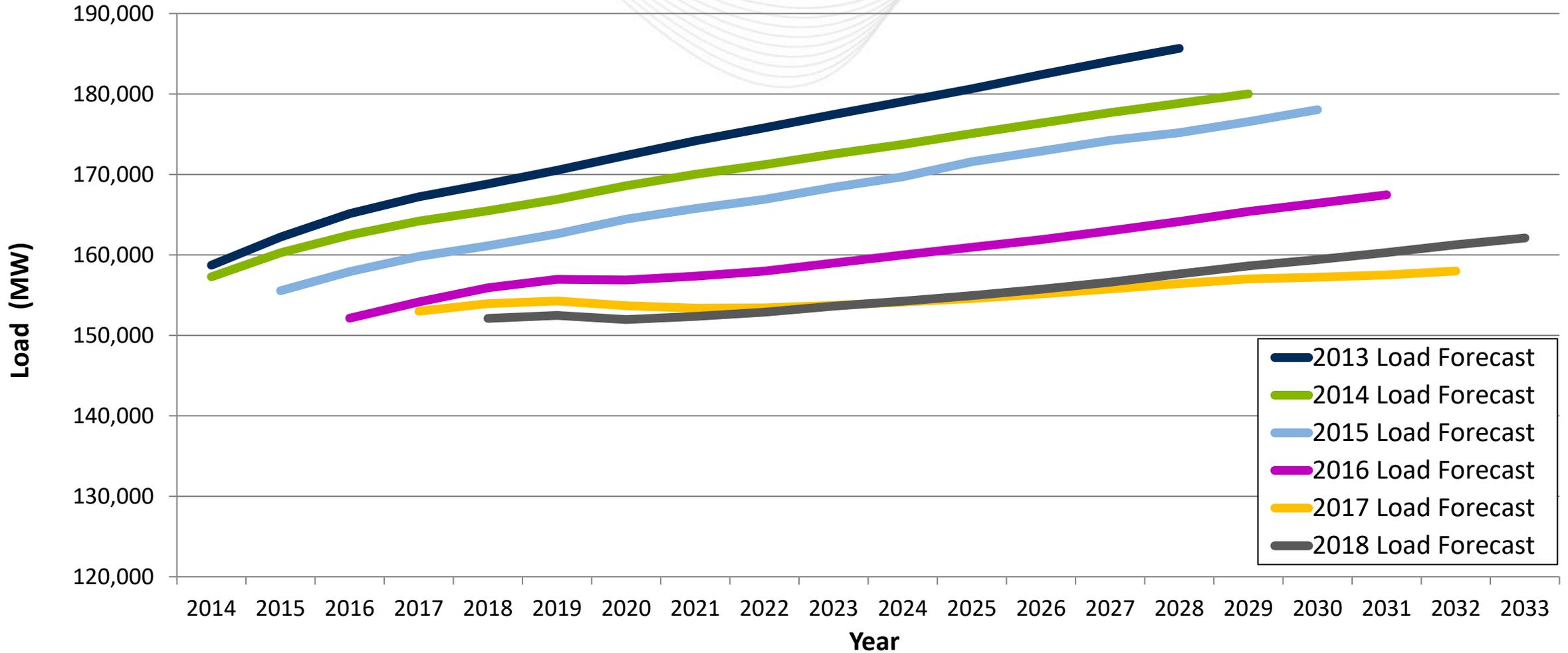


Queue	Project Name	MFO	Status	In Service Date	TO
X3-028	Breed 345kV	3,500	Active	12/31/2016	AEP

# Planning

## Load Forecast

## PJM RTO Summer Peak Demand Forecast



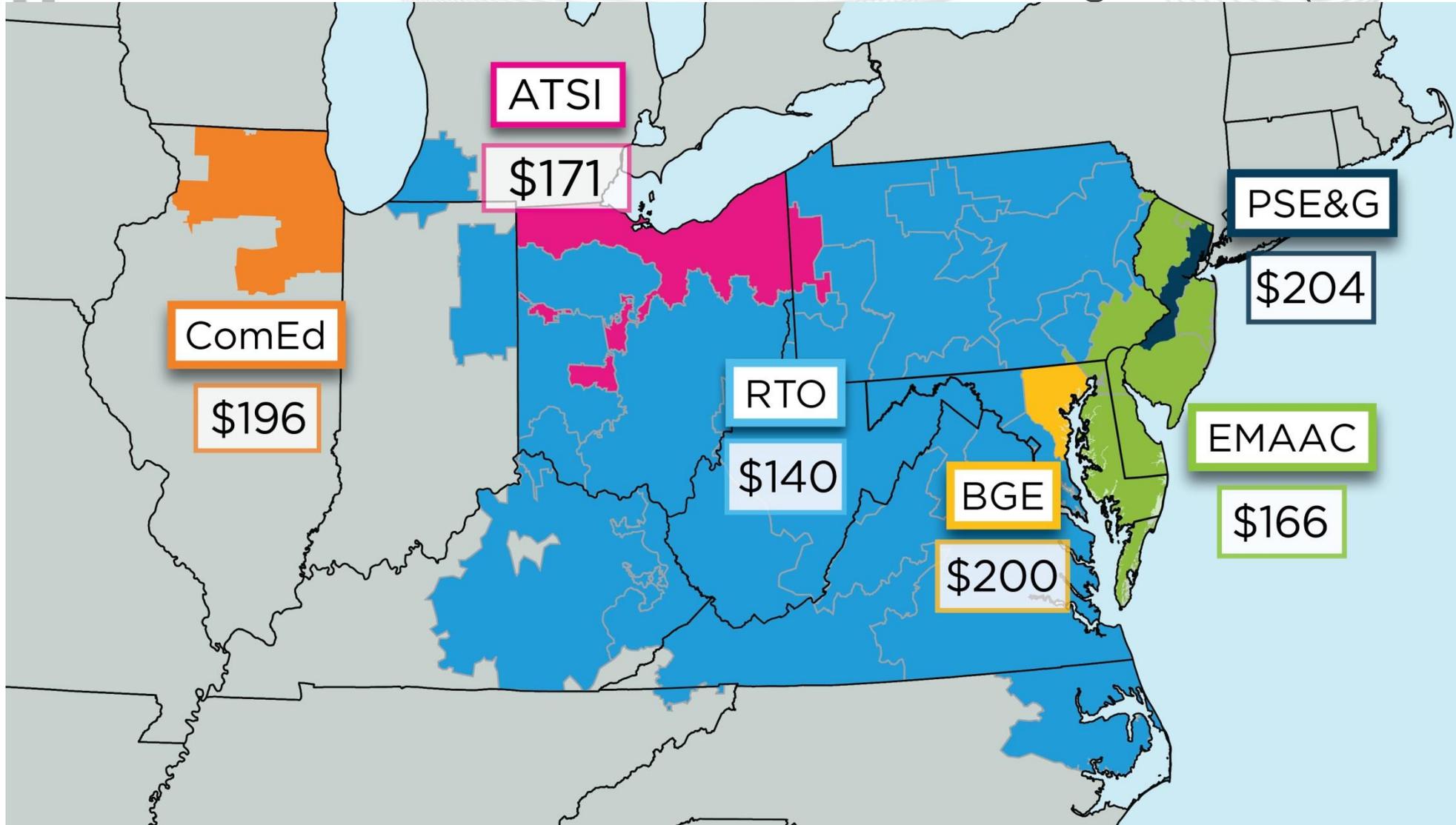
Transmission Owner	Summer Peak (MW)			Winter Peak (MW)		
	2018	2028	Growth Rate (%)	2017/18	2027/28	Growth Rate (%)
American Electric Power Company *	3,770	3,958	0.5%	3,212	3,377	0.5%
PJM RTO	152,108	157,635	0.4%	131,463	136,702	0.4%

\* PJM notes that American Electric Power Company serves load other than in Indiana. 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 Indiana. Estimated amounts were calculated based on the average share of American Electric Power Company’s real-time summer and winter peak load located in Indiana over the past five years.

# Markets

## Capacity Market Results

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





# Indiana - Cleared Resources in 2021/22 Auction

(May 23, 2018)

	Cleared MW (Unforced Capacity)	Change from 2020/21 Auction
Generation	2,643	403
Demand Response	297	127
Energy Efficiency	31	13
<b>Total</b>	<b>2,429</b>	<b>543</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>



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

(May 23, 2018)

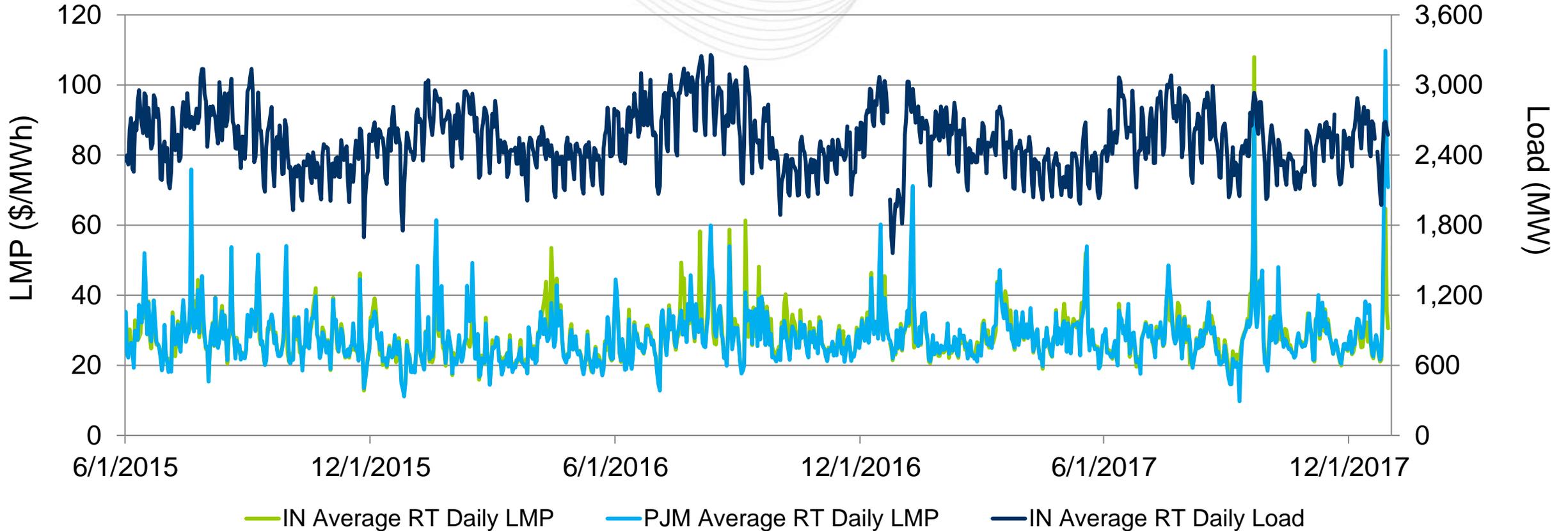
		Unforced Capacity
<b>Generation</b>	Offered MW	2,684
	Cleared MW	2,643
<b>Demand Response</b>	Offered MW	324
	Cleared MW	297
<b>Energy Efficiency</b>	Offered MW	35
	Cleared MW	31
<b>Total Offered MW</b>		<b>3,043</b>
<b>Total Cleared MW</b>		<b>2,972</b>

*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

Indiana's average daily LMPs generally aligned with PJM average daily LMPs.



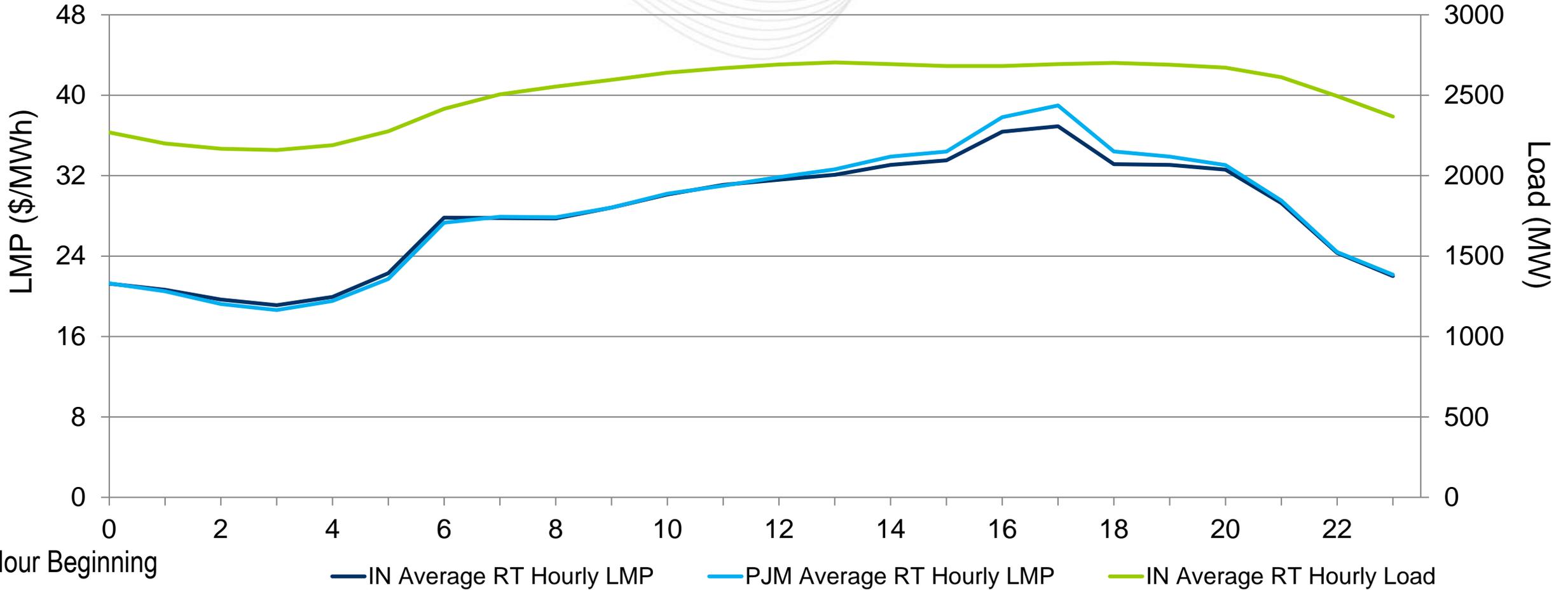
Note: The price spike on 9/21/2017 reflects the PJM shortage pricing event. The price spike starting 12/28/2017 reflects the beginning of the Cold Snap.



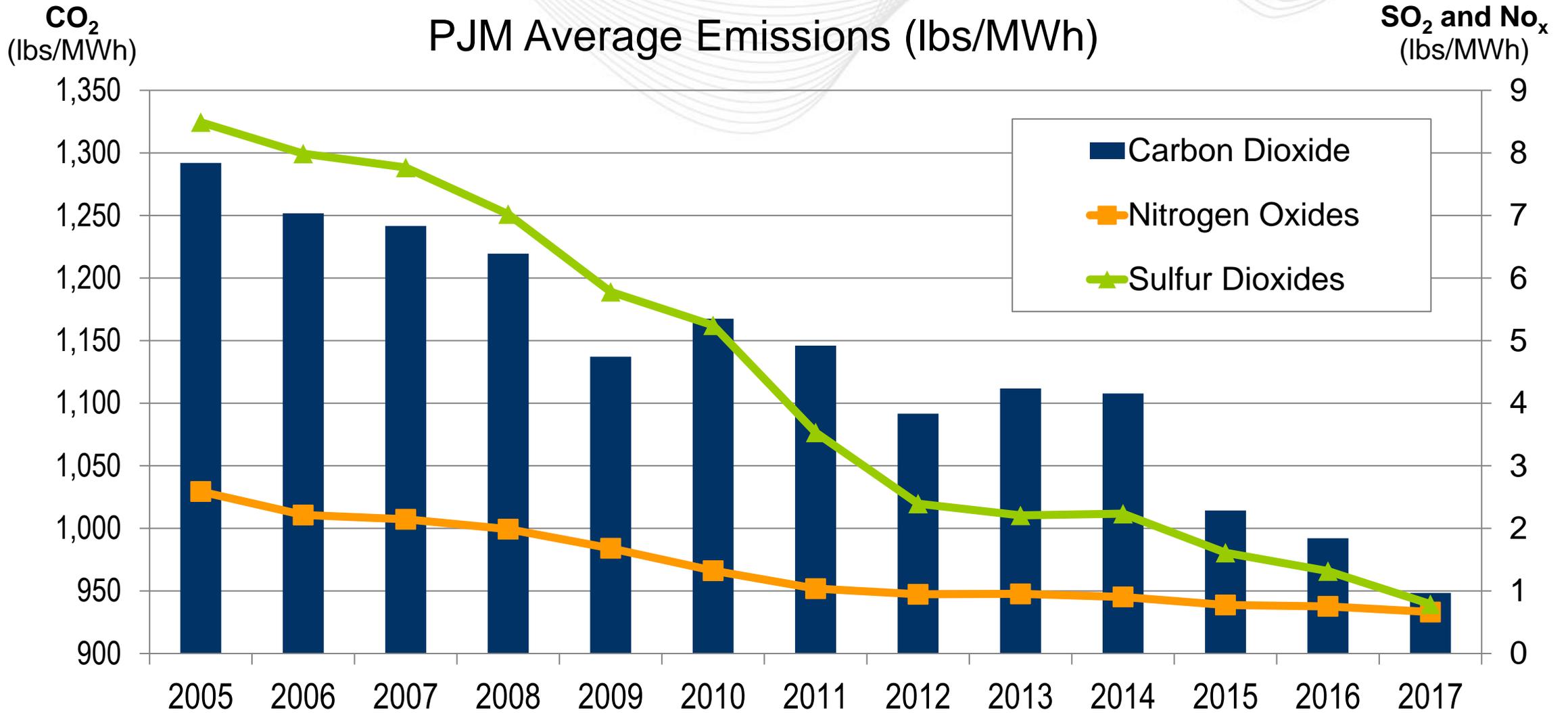
# Indiana – Hourly Average LMP and Load

(June 1, 2015 – December 31, 2017)

Indiana's hourly LMPs generally aligned with PJM average hourly LMPs.



# Operations Emissions Data



**CO<sub>2</sub>**  
(lbs/MWh)

## Indiana Average Emissions (lbs/MWh)

**SO<sub>2</sub> and NO<sub>x</sub>**  
(lbs/MWh)

