



# 2017 Ohio State Infrastructure Report

(January 1, 2017 – December 31, 2017)

May 2018

## 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 38.2 percent of the total installed capacity in Ohio while coal represents approximately 51.3 percent. In PJM natural gas and coal account respectively for 37 and 32 percent of total installed capacity.
- **Interconnection Requests:** Natural gas represents approximately 75 percent of new interconnection requests in Ohio.
- **Deactivations:** Approximately 581 MW of capacity in Ohio retired in 2017. This represents approximately 28 percent of the 2084 MW that retired RTO-wide in 2017.
- **RTEP 2017:** Ohio RTEP 2017 projects total nearly \$1.37 billion in investment. Approximately 38 percent of that represents supplemental projects.
- **Load Forecast:** Ohio load growth is nearly flat, averaging between 0.1 and 0.6 percent per year over the next 10 years. This aligns with PJM RTO load growth projections.

- **2021/22 Capacity Market:** Ohio cleared 615 MW more Demand Response and Energy Efficiency resources than in the prior auction.
- **6/1/15 – 12/31/17 Performance:** Ohio's average locational marginal prices were generally aligned with PJM average LMPs. Coal accounted for 43.1 percent of generation produced in Ohio.
- **Emissions:** 2017 carbon dioxide, sulfur dioxide, and nitrogen oxide emissions are all slightly down from 2016.



# Planning

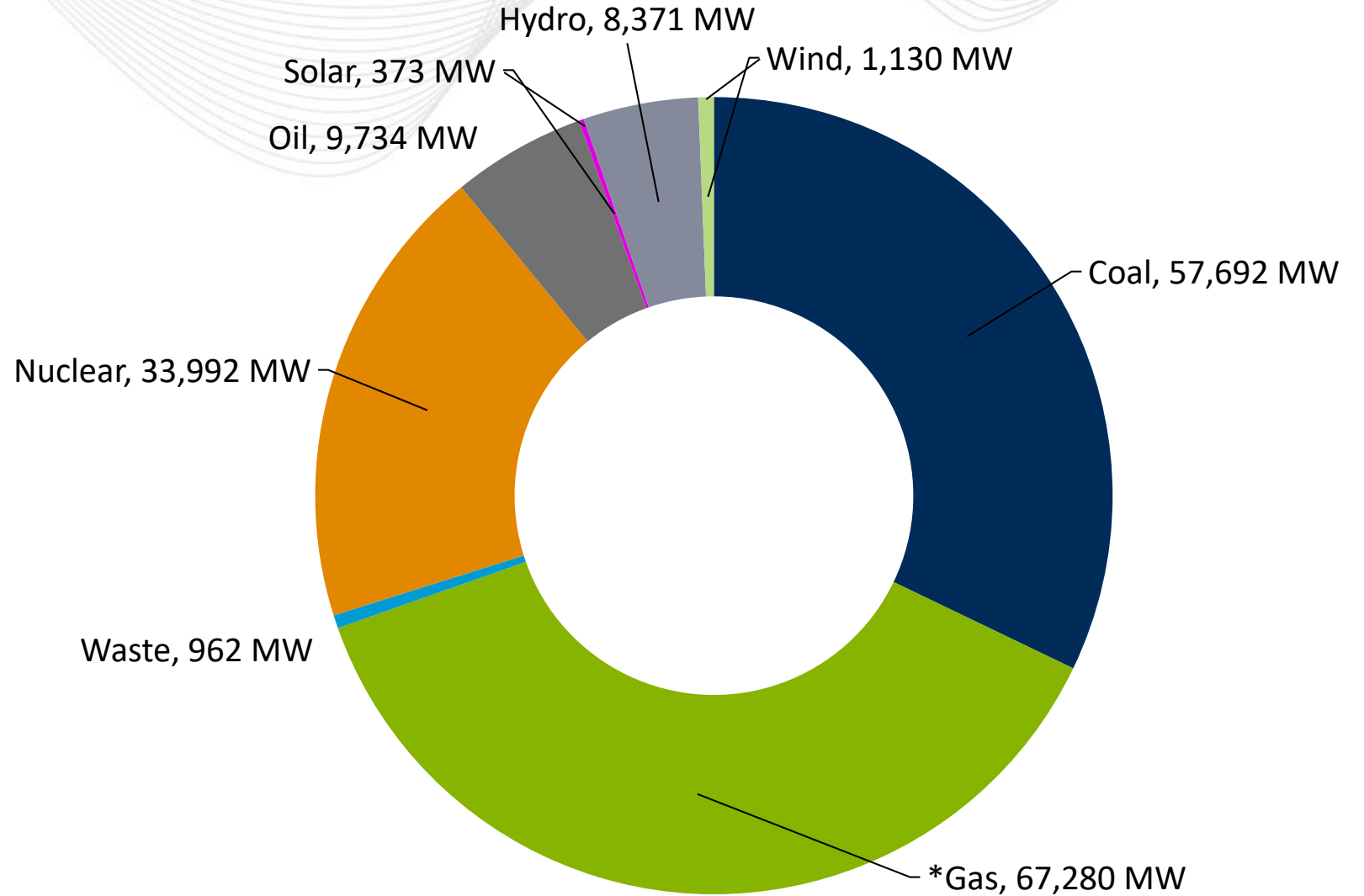
## Generation Portfolio Analysis

# 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





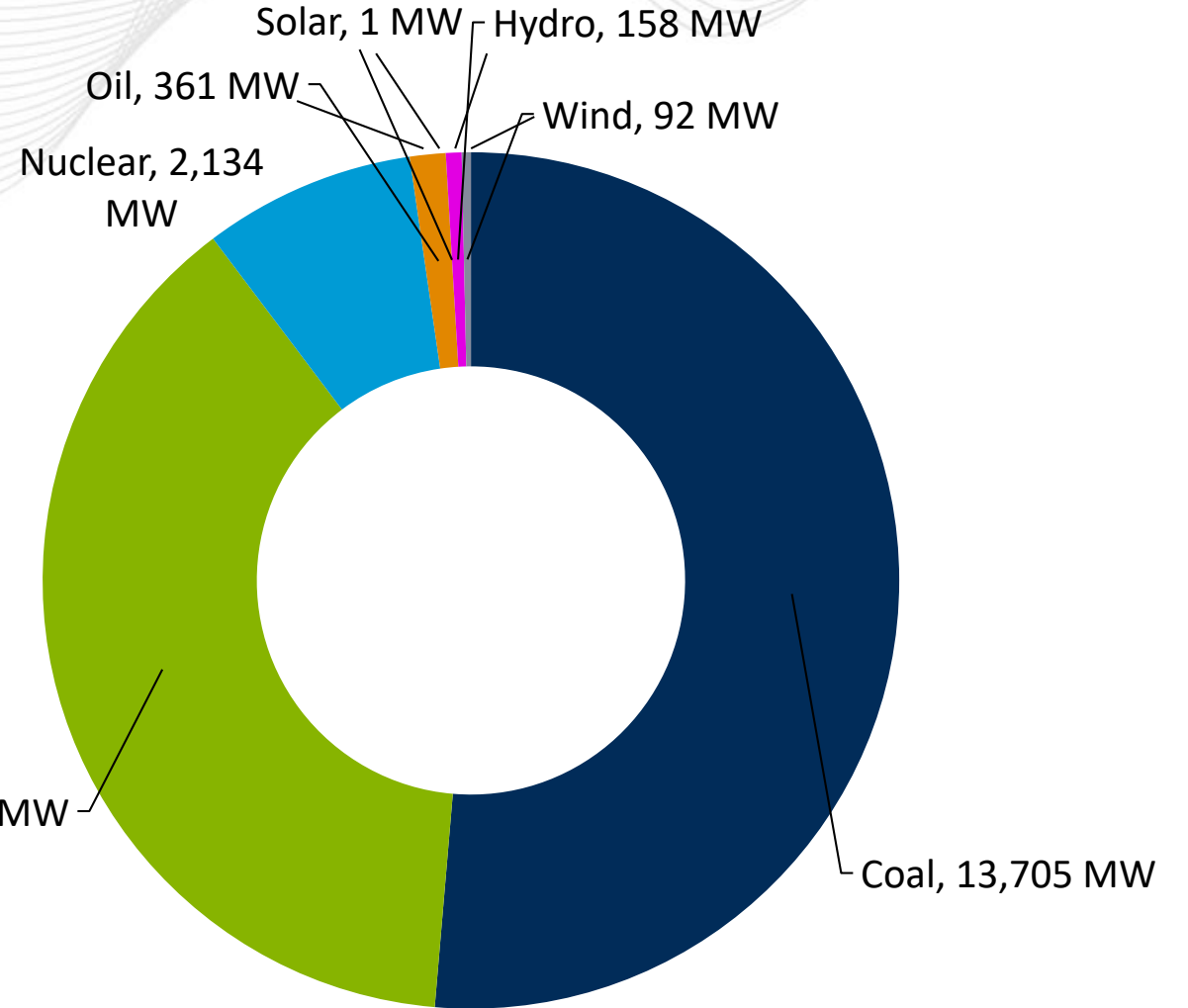
# Ohio – Existing Installed Capacity

(MW submitted to PJM, December 31, 2017)

## Summary:

Natural gas represents approximately 38.2 percent of the total installed capacity in the Ohio territory while coal represents approximately 51.3 percent.

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

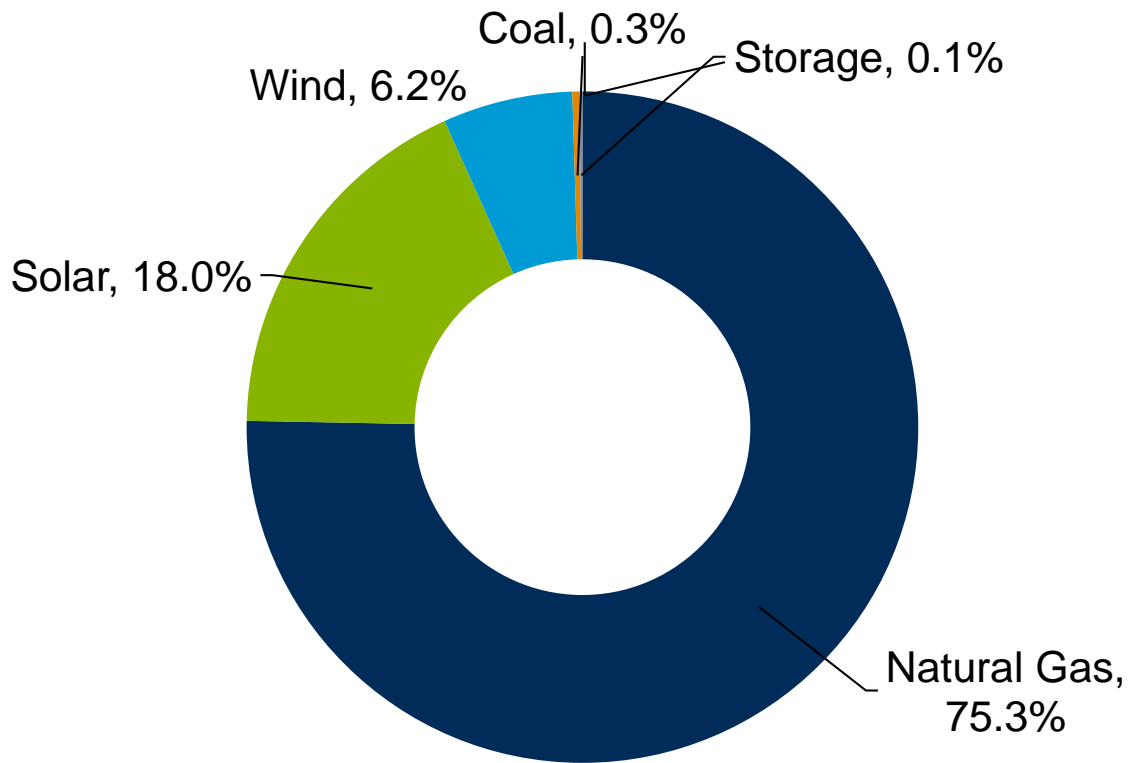


* Gas Contains	
Natural Gas	10,182.8 MW
Other Gas	57.2 MW



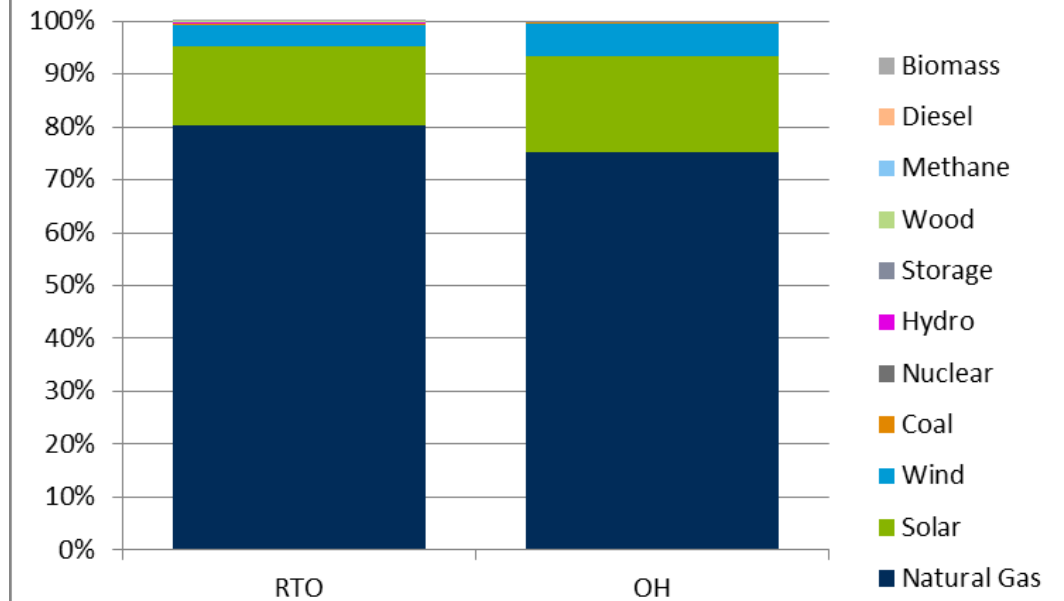
Natural gas represents approximately 75 percent of new interconnection requests in Ohio.

Total MW Capacity by Fuel Type



Fuel Source	Capacity, MW	Nameplate Capability, MW
Natural Gas	9,352.7	9,990.0
Solar	2,231.9	4,512.3
Wind	776.0	5,467.5
Coal	43.0	43.0
Storage	17.0	59.7
<b>Total</b>	<b>12,420.7</b>	<b>20,072.5</b>

Fuel as a Percentage of Projects in Queue





# Ohio – Interconnection Requests

(As of December 31, 2017)

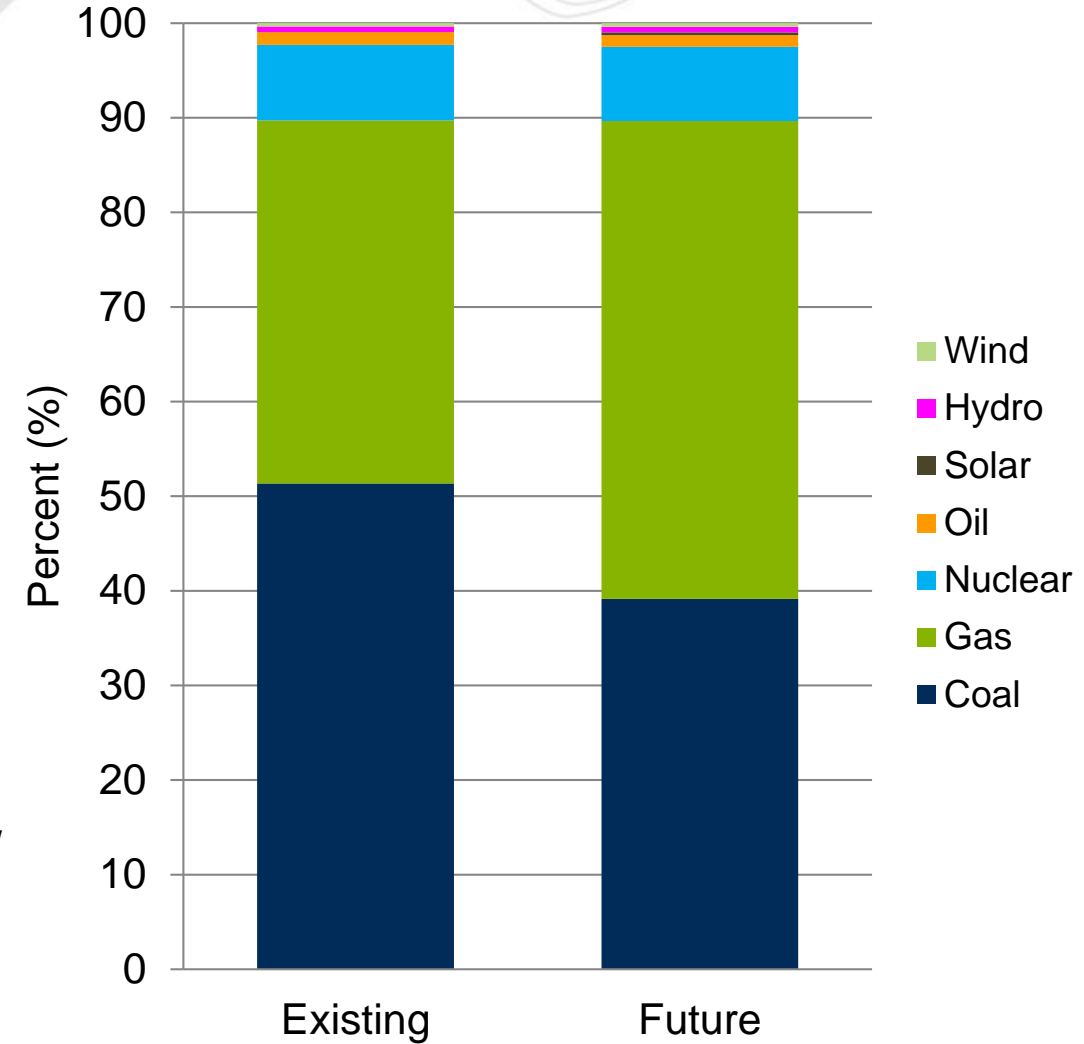
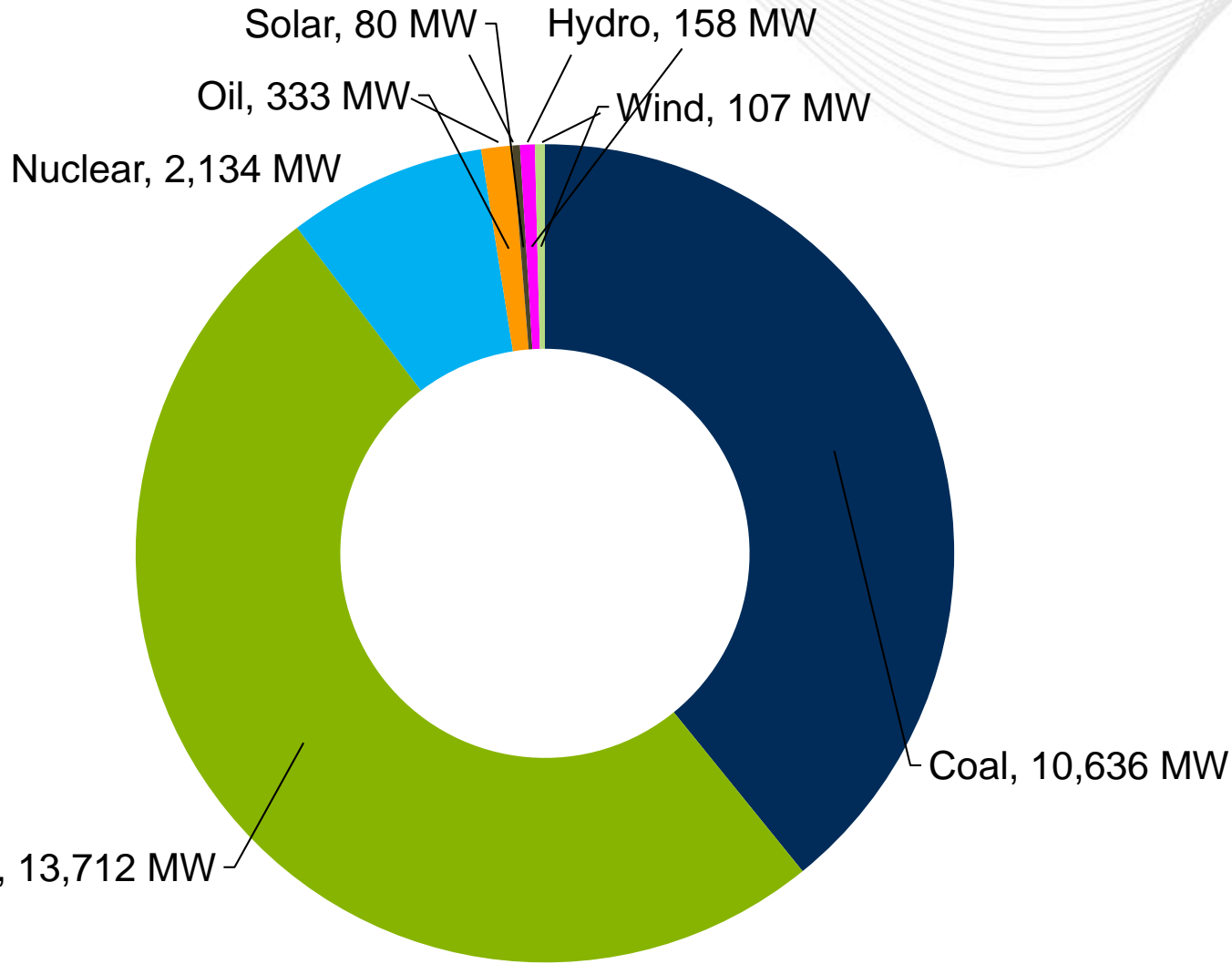
	Complete				In Queue						Grand Total	
	In Service		Withdrawn*		Active		Suspended**		Under Construction**			
	MW	# of Projects	MW	# of Projects	MW	# of Projects	MW	# of Projects	MW	# of Projects	MW	# of Projects
<b>Non-Renewable</b>	2,727	45	17,444	60	7,967	17	-	1	1,446	7	29,584	130
<b>Coal</b>	289	16	8,883	15	20	1			23	2	9,215	34
<b>Diesel</b>	7	1									7	1
<b>Natural Gas</b>	2,416	19	8,236	25	7,930	15			1,423	4	20,005	63
<b>Nuclear</b>	16	1									16	1
<b>Oil</b>			5	1							5	1
<b>Other</b>			320	4							320	4
<b>Storage</b>	-	8	-	15	17	1	-	1	-	1	17	26
<b>Renewable</b>	266	16	2,976	141	2,499	69	371	16	138	8	6,250	250
<b>Biomass</b>	-	1	-	1							-	2
<b>Hydro</b>	112	1	76	8							188	9
<b>Methane</b>	51	10	26	9							77	19
<b>Solar</b>	1	1	1,616	69	2,142	57	27	4	63	5	3,849	136
<b>Wind</b>	102	3	1,257	54	356	12	344	12	76	3	2,136	84
<b>Grand Total</b>	<b>2,993</b>	<b>61</b>	<b>20,420</b>	<b>201</b>	<b>10,465</b>	<b>86</b>	<b>371</b>	<b>17</b>	<b>1,584</b>	<b>15</b>	<b>35,834</b>	<b>380</b>

\*May have executed final agreement

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

# Ohio – Future Capacity Mix

Based on known queued interconnection requests and deactivation notices through December 31, 2022 as of December 31, 2017, adjusted to reflect the probability of commercialization as indicated by historical trends specific to an interconnection request's state/zonal location and fuel type.





# Ohio – Progression History Interconnection Requests

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

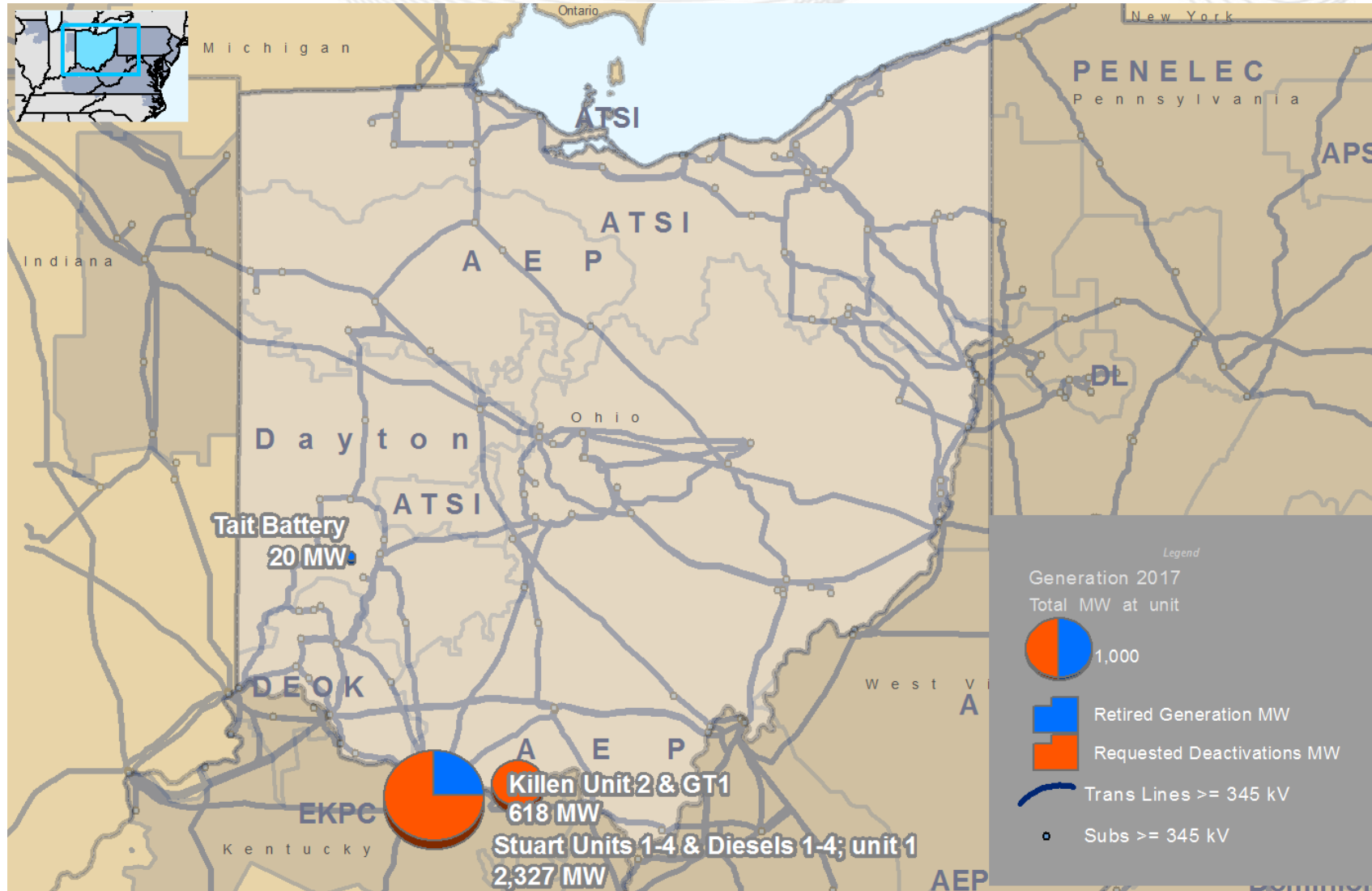


## Projects that withdrew after a final agreement

	Number of Projects	Capacity, MW	Nameplate Capacity, MW
ISA	7	3,249	3,475
WMPA	7	9	27

14.2% of requested capacity megawatt and 22.4% of projects reaches commercial operation

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



Unit	MW Capacity	TO Zone	Age	Actual Deactivation Date
Tait Battery Storage	0	Dayton	4	12/13/2017
Stuart 1 (joint owned unit)	580.6	Dayton	46	9/30/2017

## Summary:

- Two units in Ohio deactivated in 2017.
- 10 generating units totaling 2,084 MW of capacity deactivated in PJM in 2017.



# Ohio – Deactivation Notifications Received in 2017

Unit	MW Capacity	TO Zone	Age	Projected Deactivation Date
Stuart Diesels 1-4	9.2	Dayton	48	6/1/2018
Stuart 2 (joint owned unit)	580	Dayton	47	6/1/2018
Stuart 3 (joint owned unit)	580.4	Dayton	45	6/1/2018
Stuart 4 (joint owned unit)	577	Dayton	43	6/1/2018
Killen GT1	18	Dayton	35	6/1/2018
Killen 2	600	Dayton	35	6/1/2018

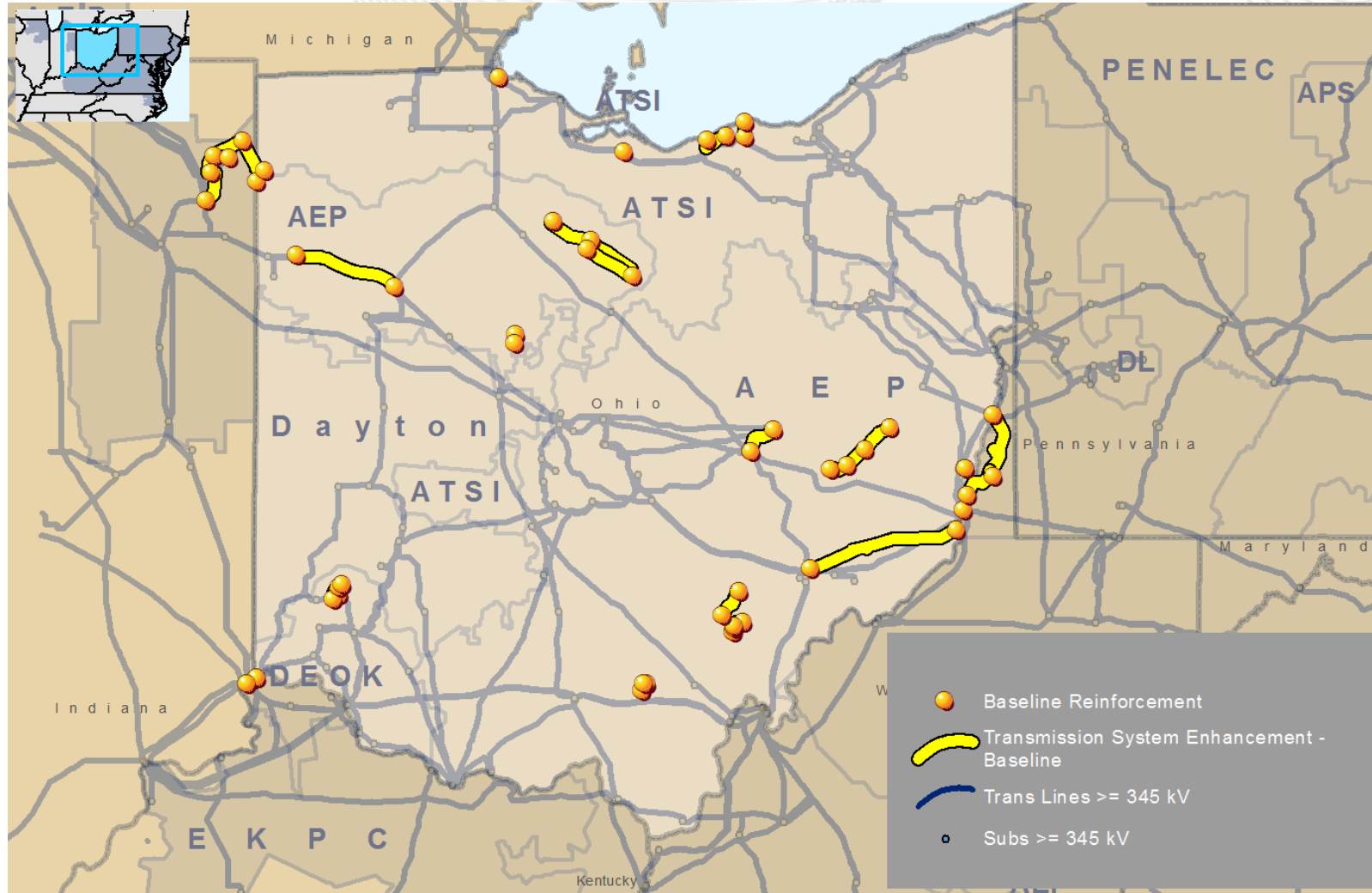
## Summary:

- In 2016, six generating units in Ohio announced their intention to deactivate, all in 2018.
- In 2017 there were a total of 12 PJM generating units that announced their intent to deactivate, ranging in date from 2018 - 2020.



# Planning

## Transmission Infrastructure Analysis



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



# Ohio – 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
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 Willington 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					
b2833	Reconductor the Maddox Creek - East Lima 345 kV circuit with 2-954 ACSS Cardinal conductor	Baseline Load Growth Deliverability & Reliability	12/1/2021	\$ 18.2	AEP	1/12/2017
b2830	Expand Garver 345 kV sub to include 138 kV. Install 1-345 kV breaker, 1-345/138 kV 400 MVA transformer, 6-138 kV Breakers and bus work. Connect local 138 kV circuits from Todhunter, Rockies Express, and Union.	Baseline Load Growth Deliverability & Reliability	6/1/2018	\$ 18.7	DEOK	1/12/2017



# Ohio – 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
b2898	Reconductor the Beaver - Black River 138kV) with 954Kcmil ACSS conductor and upgrade terminal equipment on both stations	Baseline Load Growth Deliverability & Reliability	6/1/2021	\$ 20.0	ATSI	6/8/2017
b2897	Reconductor the Avon – Lorain 138 kV section and upgrade line drop at Avon	Baseline Load Growth Deliverability & Reliability	6/1/2021	\$ 13.5	ATSI	6/8/2017
b2826	Install 300 MVAR reactor at Ohio Central 345 kV substation	Operational Performance	6/1/2018	\$ 10.0	AEP	2/9/2017
	Install 300 MVAR reactor at West Bellaire 345 kV substation					
b2753	Remove/Open Kammer 345/138 kV transformer #301	Short Circuit	5/31/2020	\$ 50.7	AEP	3/9/2017
	Complete sag study mitigation on the Muskingum – Natrium 138 kV line					
b2942	Install a 100MVAR 345kV shunt reactor at Hayes substation	Operational Performance	10/31/2017	\$ 10.7	ATSI	9/14/2017
	Install a 200MVAR 345kV shunt reactor at Bayshore substation					
b2885	Install a new 138/69 kV station (Rhodes) to serve as a third source to the area to help relieve overloads caused by the customer load increase.	TO Criteria Violation	3/1/2018	\$ 13.0	AEP	5/31/2017
	Install a new Ironman Switch to serve a new delivery point requested by the City of Jackson for a load increase request.					
	Replace Coalton Switch with a new three breaker ring bus (Heppner).					
	New delivery point for City of Jackson					



# Ohio – 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
b2888	Retire Poston substation. Install new Lemaster substation.	Baseline Load Growth Deliverability & Reliability	12/31/2018	\$ 27.0	AEP	5/31/2017
	Remove and retire the Poston 138kV station.					
	Install a new greenfield station, Lemaster 138kV Station, in the clear.					
	Relocate the Trimble 69 kV AEP Ohio radial delivery point to 138 kV, to be served off of the Poston – Strouds Run – Crooksville 138 kV circuit via a new three-way switch. Retire the Poston-Trimble 69kV line.					
b2791	Rebuild Tiffin-Howard, new transformer at Chatfield	TO Criteria Violation	6/1/2021	\$ 20.4	AEP	5/31/2017
	New 138kV & 69kV protection at existing Chatfield transformer.					
b2794	Construct new 138/69/34kV station and 1-34kV circuit (designed for 69kV) from new station to Decliff station, approximately 4 miles, with 556 ACSR conductor (51 MVA rating).	TO Criteria Violation	6/1/2021	\$ 12.7	AEP	5/31/2017
b2791	New 138/69kV transformer with 138kV & 69kV protection at Chatfield station.	TO Criteria Violation	6/1/2021	\$ 20.4	AEP	5/31/2017
b2797	Rebuild the Ohio Central-Conesville 69kV line section (11.8 miles) with 795 ACSR conductor (128 MVA rating, 57% loading). Replace the 50 MVA Ohio Central 138-69kV XFMR with a 90 MVA unit.	TO Criteria Violation	6/1/2021	\$ 20.6	AEP	5/31/2017
b2792	Replace the Elliott transformer with a 130 MVA unit, Reconductor 0.42 miles of the Elliott – Ohio University 69 kV line with 556 ACSR to match the rest of the line conductor (102 MVA rating, 73% loading) and rebuild 4 miles of the Clark Street – Strouds R	TO Criteria Violation	6/1/2021	\$ 5.8	AEP	5/31/2017

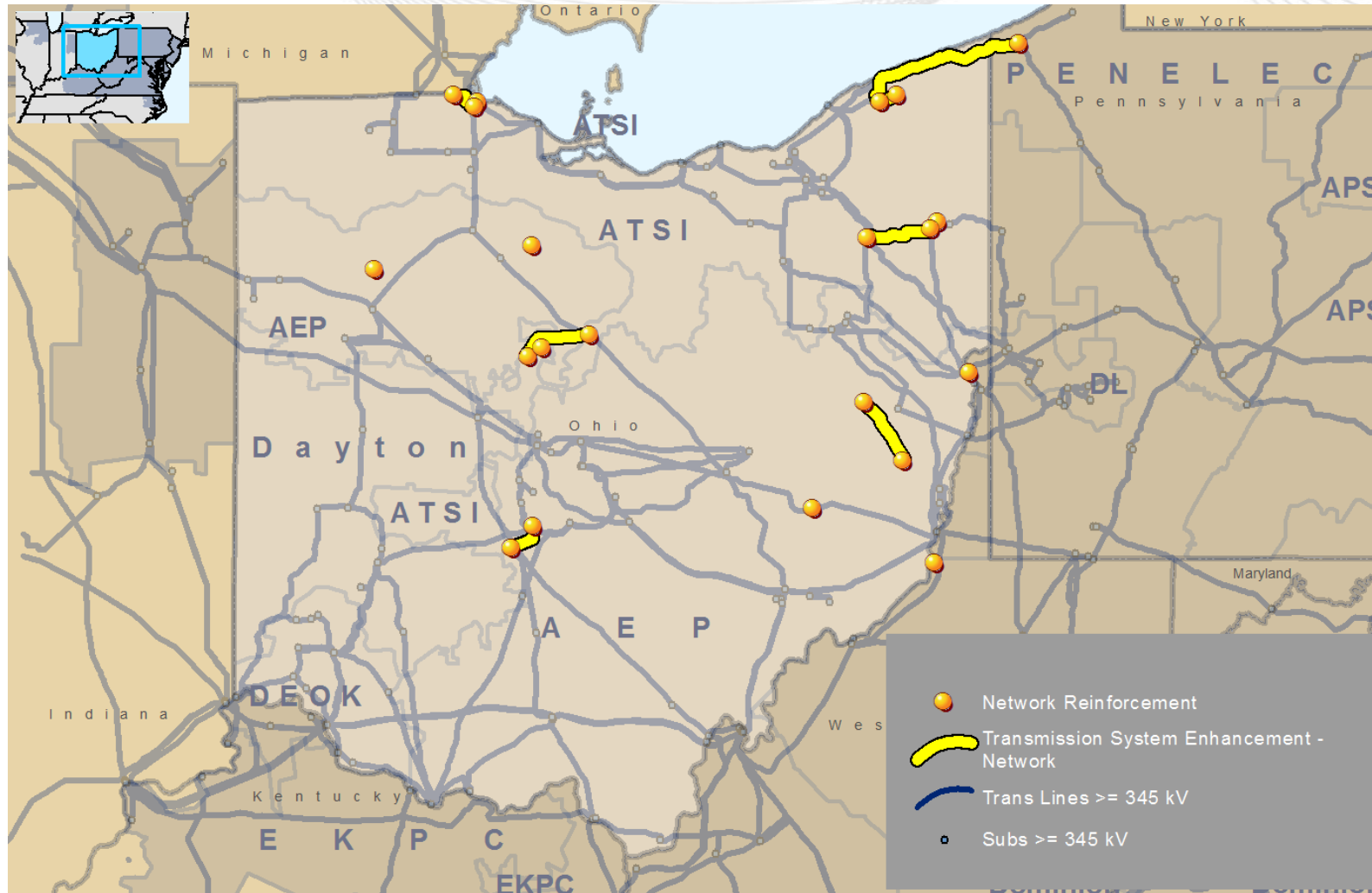


# Ohio – RTEP Baseline Projects

(Greater than \$5 million)

Project ID	Project	Project Driver	Required In Service Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Review
b2890	Rebuild 23.55 miles of the East Cambridge – Smyrna 34.5 kV circuit with 795 ACSR conductor (128 MVA rating) and convert to 69 kV.	TO Criteria Violation	6/1/2021	\$ 36.3	AEP	5/31/2017
	East Cambridge: Install a 2000 A 69 kV 40 kA circuit breaker for the East Cambridge – Smyrna 69 kV circuit.					
	Old Washington: Install 69 kV 2000 A two way phase over phase switch.					
	Antrim Switch: Install 69 kV 2000 A two way phase over phase switch.					
b2791	Rebuild portions of the East Tiffin-Howard 69kV line from East Tiffin to West Rockaway Switch (0.8 miles) using 795 ACSR Drake conductor (129 MVA rating, 50% loading).	TO Criteria Violation	6/1/2021	\$ 20.4	AEP	5/31/2017
	Rebuild Tiffin-Howard 69kV line from St. Stephen’s Switch to Hinesville (14.7 miles) using 795 ACSR Drake conductor (90 MVA rating, non-conductor limited, 38% loading).					
b2942	Install shunt reactors at Hayes and Bayshore substations	Operational Performance	10/31/2018	\$ 10.7	ATSI	9/14/2017
b2890	Rebuild East Cambridge-Smyrna. Install breakers as East Cambridge. Install switches as Old Washington and Antrim.	TO Criteria Violation	6/1/2021	\$ 36.3	AEP	5/31/2017
b2958	Add 2 138kV 3000 A 40 kA breakers, disconnect switches, and update relaying at Sand Hill station.	TO Criteria Violation	7/1/2017	\$ 7.3	AEP	11/2/2017
	Cut George Washington – Tidd 138kV circuit into Sand Hill and reconfigure Brues & Warton Hill line entrances.					





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.





# Ohio – RTEP Network Projects

(Greater than \$5 million)

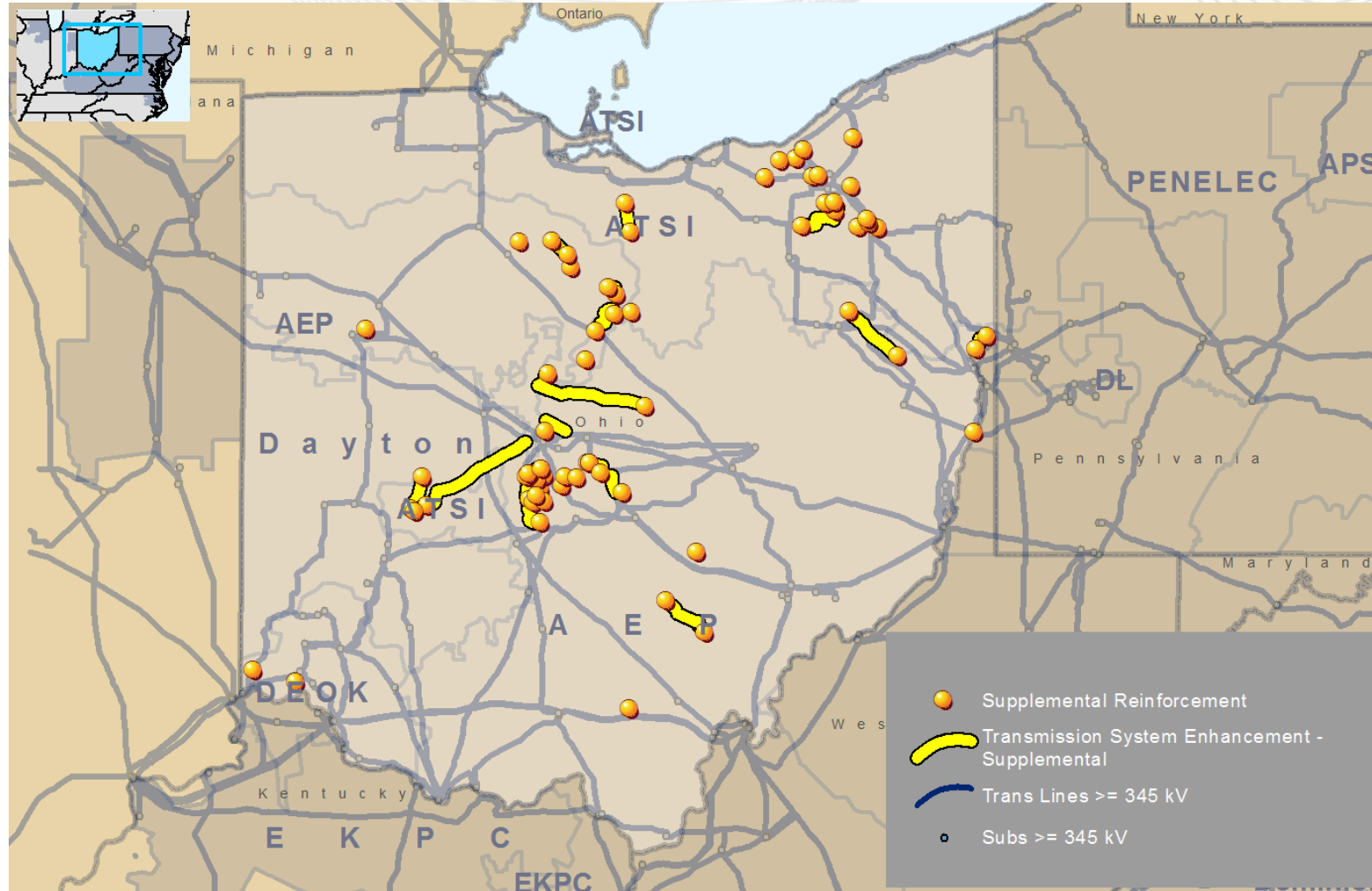
Project ID	Description	Project Driver	Queue	Required In Service Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Review
n2115	Construct a new switching station, including four 138 kV circuit breakers, relays, 138 kV revenue metering, SCADA, and associated equipment	Generation	U4-028	11/1/2012	\$ 5.9	AEP	10/12/2017
n4317	Install one 345 kV breaker at the Leroy Center 345 kV	Merchant Transmission	Y3-092	12/31/2017	\$ 203.0	ATSI	10/12/2017
n4318	Reconduct Leroy Center - Spruce 138 kV line	Merchant Transmission	Y3-092	12/31/2017	\$ 8.9	ATSI	10/12/2017
n5194	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker SN-GEN5(B287	Generation	AB1-105	10/20/2017	\$ 13.0	ATSI	10/12/2017
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker SR-W.BUS(B17						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker STRGEN.4(B14						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker TR-GEN6(B295						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker TRW.BUS(B298						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA BreakerB5218(GEN B						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker BVR VLY(B456						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker GEN.6-E.B(B5						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker GEN.7-E(B453						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker B5213(GEN B						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker HIL-W.B(B280						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker HL-GEN3(B278						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker S.CAN-W(B290						
	At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker BVR VLY(B459						
At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker GEN.3-E(B279							
At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker GEN.4-E.(B11							
At Sammis substation- Replace 345kV Circuit Breaker with a 80kA Breaker GEN.5-E(B284							



# Ohio – 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
n5196	Install a new AB1-105 Interconnect SS. 345kV 3-breaker ring bus, Hannah-Highland line.	Generation	AB1-105	10/20/2017	\$ 8.7	ATSI	10/12/2017
n5258	Install 138kV three breaker ring bus connector station for new customer generation addition along the Galion-Roberts South 138kV line	Generation	AB2-131	6/1/2019	\$ 5.1	ATSI	10/12/2017
n5286	AB1-107 GT-1 SS - Construct a 138kV three breaker ring bus interconnect substation on the Bayshore-GM Powertrain line.	Generation	AB1-107	10/20/2017	\$ 5.2	ATSI	10/12/2017
n5327	Construct a new nine (9) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement at or near the existing Ormet 138 kV station site.	Generation	AB2-093	2/15/2020	\$ 13.0	AEP	10/12/2017
n5352	To accommodate the interconnection on the Kammer – Vassell 765 kV circuit a new three (3) circuit breaker 765 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed 40 miles east of	Generation	AB2-067	6/1/2020	\$ 25.0	AEP	10/12/2017
n5457	Reconductor/rebuild the AEP portion of the Adkins-Beatty 345 kV line.	Generation	AC1-069	12/1/2019	\$ 26.0	Dayton	10/12/2017
n5473	Reconductor the Nottingham - Yager 138 kV line.	Generation	AC1-103	10/21/2020	\$ 30.4	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.



# Ohio – TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1185	Remote end work at Dublin, Bethel Road, and Roberts Stations.	6/30/2017	\$ 18.1	AEP	1/5/2017
	Construct 138 kV Britton Station, tapping the existing Davidson – Dublin underground circuit to serve new customer owned station and load.				
	Build a new 138 kV overhead circuit from Britton to Davidson.				
	Reconfigure Davidson Station to improve reliability.	12/31/2017			
s1189	Construct 138 kV Sumac Station to serve the new customer station and load adjacent to Amlin station. Construct Cole 345/138 kV station by tapping the Beatty – Hayden 345 kV circuit. String a 138 kV circuit from Cole to Amlin on existing towers, providing	6/30/2018	\$ 42.1	AEP	1/5/2017
s1190	Install a new Clouse 138/69 kV station at the intersection of the West Lancaster – Zanesville 138 kV line and the South Fultonham – New Lexington 69 kV line.	12/15/2017	\$ 18.1	AEP	1/5/2017
s1191	Rebuild the Corridor – Jug Street 345 kV line as a double circuit line with one side served at 345 kV and the other at 138 kV to provide a third source to Jug Street station.	12/1/2019	\$ 17.0	AEP	1/5/2017
s1201	Rebuild West Mount Vernon-South Kenton 138kV Line between West Mount Vernon and North Waldo (477ACSR).	12/1/2020	\$ 70.3	AEP	1/5/2017
s1206	Rebuild Sterling 138kV station in the clear.	12/1/2018	\$ 9.0	AEP	1/5/2017
s1210	Loop the Clark-Urbana 138kV line (~5 miles) and East Springfield-Tangy 138kV line (~3,5 miles) into the existing 69kV Broadview Substation with 336 ASCR conductor; Add two (2) 138/69kV transformers at Broadview substation	12/31/2019	\$ 32.0	ATSI	1/5/2017



# Ohio – TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1211	Network a radial line with multiple customer service points; Build a new 69kV line from Hanville to Carriage substation (approximately 12 miles) with 477 ACSR conductor; Rebuild Hanville into a four (4) breaker ring substation and Carriage into a five (5)	5/8/2017	\$ 27.0	ATSI	1/5/2017
s1213	Convert Aurora into six (6) breaker 69kV Ring Bus	4/30/2017	\$ 6.0	ATSI	1/5/2017
s1214	Expand Bingham 69kV substation for a five (5) breaker ring configuration; Add 2-14.4 MVAR Capacitor Bank; Allow for future ring bus expansion to 6 breakers and cap bank(s); Relay terminal end upgrades required	12/31/2017	\$ 7.0	ATSI	1/5/2017
s1215	Expand Dublin substation for a four (4) breaker ring configuration and reconfigure for a line-load-line-load lay-out; Relay upgrades required at terminal ends	12/31/2017	\$ 6.0	ATSI	1/5/2017
s1216	Expand Ontario 138kV substation for a four (4) breaker ring configuration and reconfigure for a line-load-line-load lay-out; Relay terminal end upgrades are also required	12/31/2017	\$ 5.0	ATSI	1/5/2017
s1220	Rebuild approximately 4 miles of 69kV line to a double circuit (336 ACSR) on existing ROW; Expand Chittenden substation to a five (5) CB ring bus and create the following lines: Chittenden-Darrow 69kV and Darrow-West Akron 69kV, Chittenden-Hudson Municipa	12/31/2018	\$ 10.5	ATSI	1/5/2017
s1222	Ivy 138kV: Install one (1) 138 kV breaker in the open bay position on the Q14 138kV line	12/31/2017	\$ 29.0	ATSI	1/5/2017
	Mayfield 138kV: Install four (4) 138 kV breakers in open bay positions on the Q1, Q2, Q3 and Q4 138 kV lines	12/31/2017			
	Harding 138kV: Install four (4) 138 kV breakers in open bay positions on the Q11, Q12, Q13 and Q14 138 kV lines	6/1/2018			
	Fowles 138 kV: Install two (2) 138 kV breakers in open bay positions on the Q2 and Q4 138 kV lines	6/30/2018			
	Jennings 138kV: Install one (1) 138 kV breaker in open bay position on the Q13 138 kV line	6/30/2018			
	Juniper 138kV: Install two (2) 138 kV breakers in open bay positions on the Q2 and Q4 138 kV lines	12/31/2018			
	Fox 138kV: Install four (4) 138 kV breakers in open bay positions on the Q11, Q12, Q13 and Q14 138 kV lines	12/31/2018			
Northfield 138kV: Install two (2) 138 kV breakers in open bay positions on the Q1 and Q3 138 kV lines	12/31/2018				





# Ohio – TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1224	Crestline Substation: Replace 69kV disconnect switches A8, A10 & A29 and upgrade main bus conductor.	4/11/2017	\$ 15.0	ATSI	1/5/2017
	Galion-Leaside 69 kV Line: Rebuild the Galion-Leaside 69 kV circuit, approximately 13 miles, and replace 7 line switches; reconductor with 477 ACSR, replacing multiple conductor types.	10/20/2017			
	Leaside Substation: Replace 69kV line relaying on B20 to Galion.	12/31/2017			
s1236	Reroute a 1 mile section of feeder to a different path into the Morgan 138kV substation. Install three 138kV breakers, replace one aging breaker. Reconfigure to a ring bus.	6/1/2019	\$ 5.4	DEOK	1/5/2017
s1287	Install a 138/69kV transformer and a 138/13kV transformer at Mitchell 138kV substation. Replace related circuit breaker and insulators.	6/30/2018	\$ 5.5	DEOK	5/31/2017
s1298	New 138kV protection at existing South Tiffin transformer	6/1/2021	\$ 21.8	AEP	5/31/2017
	Rebuild West Rockaway Switch-St. Stephen's Switch, Tiffin-Howard 69kV line. New protection at South Tiffin.				
	Replace CBs at Chatfield				
	Replace 69kV CB's A & B at Chatfield				
	Rebuild 69kV line from West Rockaway Switch-St. Stephen's Switch (10.6 miles) using 795 ACSR Drake conductor.				
Rebuild Hinesville-Howard (6.1 miles) using 795 ACSR Drake conductor.					
s1302	Retire remainder of the West-Wilson Road 40 kV line.	12/1/2017	\$ 22.3	AEP	5/31/2017
	Retire a portion of the Trabue-Galloway Road 40kV line.				
	Rebuild portions of the West-Wilson Road 40 kV line as 69 kV with 1033 ACSR conductor (125 MVA rating) to match the rest of the 69 kV through path and connect at Nautilus station				
	Reconnect the rebuilt portion of the 40kV line to the Trabue-Galloway Road line to create a 69 kV loop through Nautilus and Blair stations.				
	Retire West and North Galloway stations. Rebuild West-Wilson Road. Retire Traubue-Galloway Road line				
	Retire West 40kV Station and North Galloway 40kV Switch.				



# Ohio – TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1303	Rebuild Calcutta-North Wellsville 69kV line	9/1/2017	\$ 12.9	AEP	5/31/2017
	Install New 69kV T-Line exits at North Wellsville 69kV substation and revised relay settings.				
	Rebuild Calcutta-North Wellsville 69kV line section (6.4 miles) with the 1234 ACSR/TW conductor (90 MVA rating, non-conductor limited) to match the rest of the circuit, utilizing mostly single-circuit steel poles. Install ADSS fiber under-build.(The first				
	Install ADSS fiber under-build.(The first 1.0 mile from North Wellsville will be double-circuit, with the North Wellsville-Second Street 69kV attached)				
s1323	Rebuild 16.62 miles of the Hocking-Poston 138 kV line with 1033 ACSR (296 MVA rating) on steel poles.	12/1/2017	\$ 17.1	AEP	5/31/2017
s1325	Jug Street 138 kV Station will be expanded and modified into a two ring bus configuration to serve up to five additional 50 MVA, 138/34.5 kV customer transformers.	6/1/2017	\$ 9.1	AEP	5/31/2017
s1334	Replace CB's at Karl Road, Morse Road, and Clinton stations with 3000 A 63 kA circuit breakers.	12/31/2019	\$ 14.5	AEP	5/31/2017
	Reconfigure Karl Road				
	Add 3-138kV 3000 A 63 kA CB's at Karl Road to create a ring bus and cut in the other side of the existing double circuit tower line.				
s1342	Rebuild the around 6 miles line from Rhodes to Heppner and from Heppner to Lick with 1033 ACSR Build for future 138 kV conversion	3/1/2018	\$ 7.0	AEP	5/31/2017
s1373	Establish a new 138kV, breaker and a half station with 12-CBs (Babbitt Station). Cut existing Jug Street – Kirk 138kV circuit and run two single pole line extensions to the new Babbitt Station.	8/31/2018	\$ 22.6	AEP	9/11/2017
s1425	Rebuild the Carrollton-Sunnyside 138kV circuit. Install double-circuit steel poles with 6-wired 1234 ACSS/TW Yukon conductor. Future circuit rating = 335 MVA SN / 392 MVA SE (non-conductor limited).	12/1/2019	\$ 50.4	AEP	12/18/2017



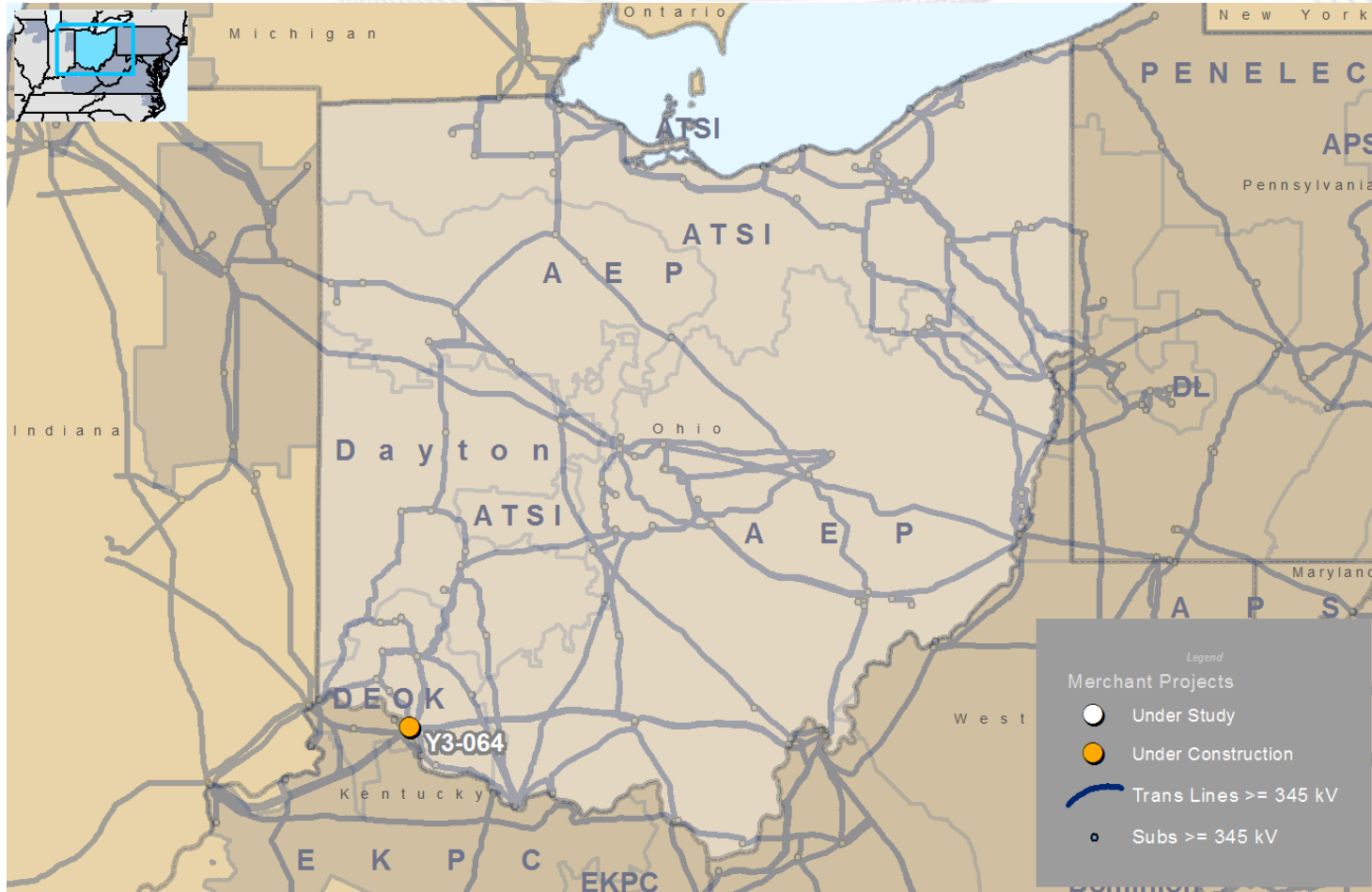


# Ohio – TO Supplemental Projects

(Greater than \$5 million)

Project ID	Description	Required Date	Project Cost (\$M)	TO Zone(s)	2017 TEAC Date
s1451	At Tidd station, replace 345/138kV transformer, install 138kV series reactor, install new 345kV 3-breaker string with new relay panels and SCADA. Reconnector the tie line from the 345 and 138 kV yard at Tidd.	12/1/2018	\$ 7.8	AEP	12/14/2017
s1212	Build a new single circuit 69kV Line, approximately 6 miles, from Sumner radial tap to Campbellsport substation (477 ACSR ).	7/27/2017	\$ 19.0	ATSI	1/5/2017
	Rebuild approximately 1.5 miles of 69kV Line from Ravenna to Sumner tap as double circuit (477 ACSR).	8/10/2017			
	Rebuild approximately 2.5 miles of 69kV as double circuit (477 ACSR) to loop the Ravenna – West Ravenna 69kV Line into Campbellsport.	11/10/2017			
	Expand Campbellsport to a six breaker ring bus.				

# Ohio – Merchant Transmission Project Requests

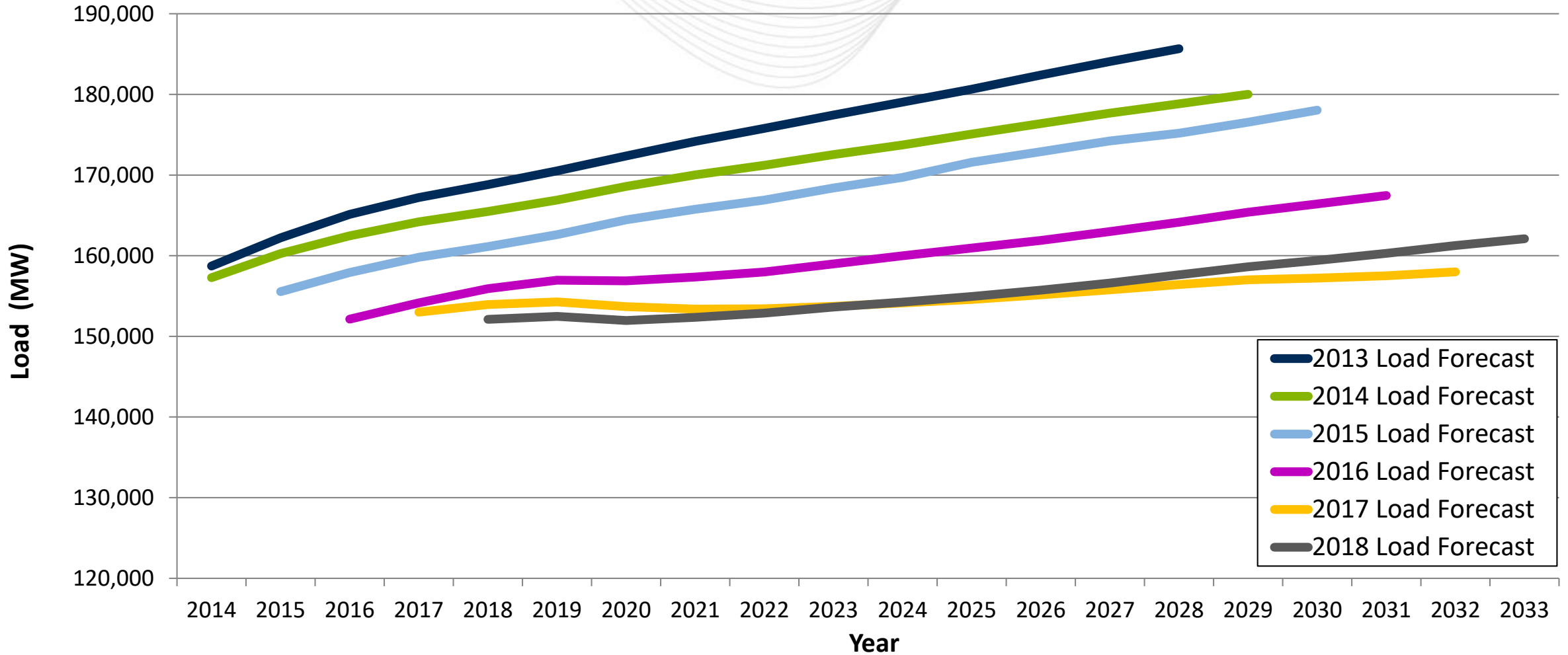


Queue	Project Name	MFO	Under Construction	In Service Date	TO
Y3-064	Pierce-Beckjord 138kV	160	Under Construction	04/03/19	DEOK

# Planning

## Load Forecast

## PJM RTO Summer Peak Demand Forecast





# Ohio – 2018 Load Forecast Report

Transmission Owner	Summer Peak (MW)			Winter Peak (MW)		
	2018	2028	Growth Rate (%)	2017/18	2027/28	Growth Rate (%)
American Electric Power Company *	10,415	10,935	0.5%	9,199	9,671	0.5%
American Transmission Systems, Inc. *	12,020	12,351	0.3%	9,810	10,044	0.2%
Dayton Power and Light	3,459	3,508	0.1%	2,917	2,932	0.1%
Duke Energy Ohio and Kentucky *	4,600	4,881	0.6%	3,732	3,921	0.5%
<b>PJM RTO</b>	<b>152,108</b>	<b>157,635</b>	<b>0.4%</b>	<b>131,463</b>	<b>136,702</b>	<b>0.4%</b>

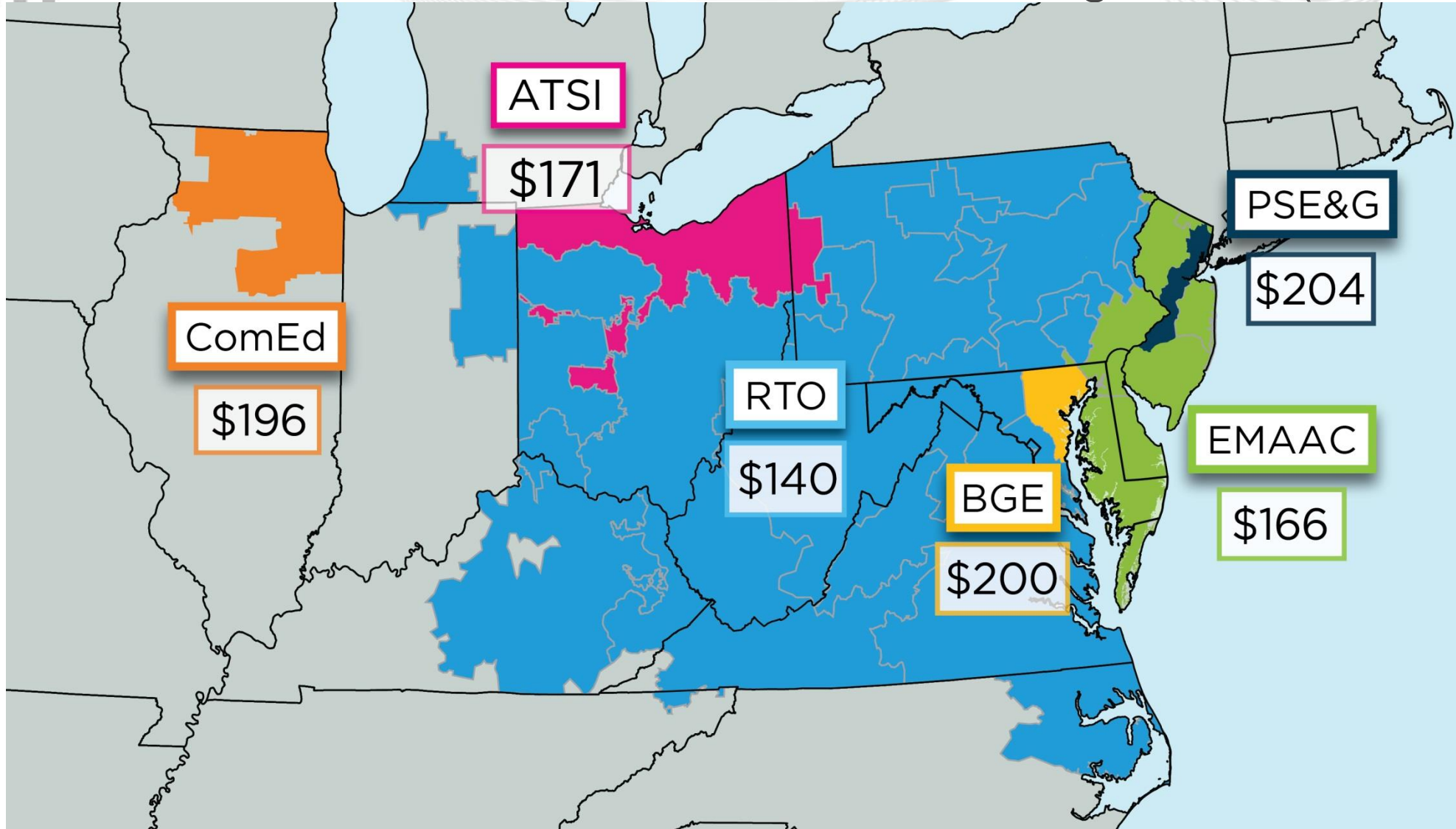
\* PJM notes that AEP, ATSI and Duke Energy serve load other than in Ohio. The Summer Peak and Winter Peak MW values in this table each reflect an estimated amount of forecasted load to be served by each of those transmission owners solely in Ohio. Estimated amounts were calculated based on the average share of each transmission owner's real-time summer and winter peak load located in Ohio over the past five years.

# Markets

## Capacity Market Results



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





	Cleared MW (Unforced Capacity)	Change from 2020/21 Auction
Generation	18,301	(1,722)
Demand Response	2,184	492
Energy Efficiency	348	123
<b>Total</b>	<b>20,833</b>	<b>(1,107)</b>

**RTO Locational Clearing Price**  
\$140

**ATSI Locational Clearing Price**  
\$171

*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>



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

(May 23, 2018)

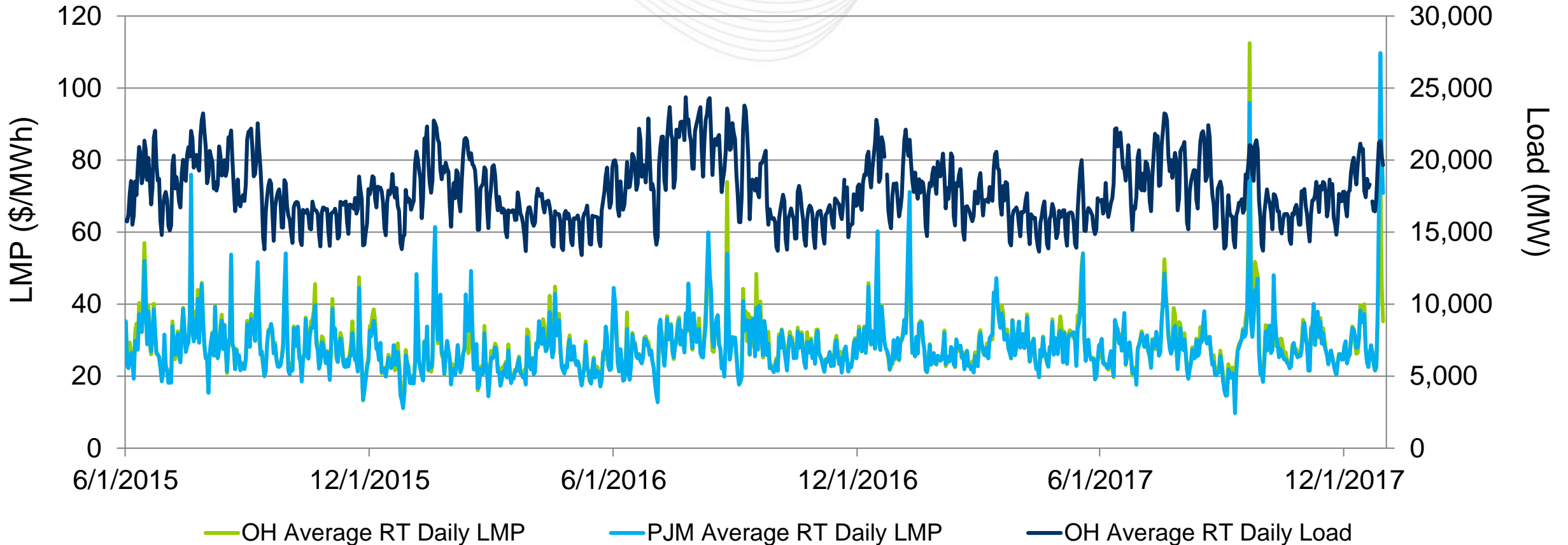
		Unforced Capacity
<b>Generation</b>	Offered MW	22,641
	Cleared MW	18,301
<b>Demand Response</b>	Offered MW	2,346
	Cleared MW	2,184
<b>Energy Efficiency</b>	Offered MW	378
	Cleared MW	348
<b>Total Offered MW</b>		<b>25,365</b>
<b>Total Cleared MW</b>		<b>20,833</b>

*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

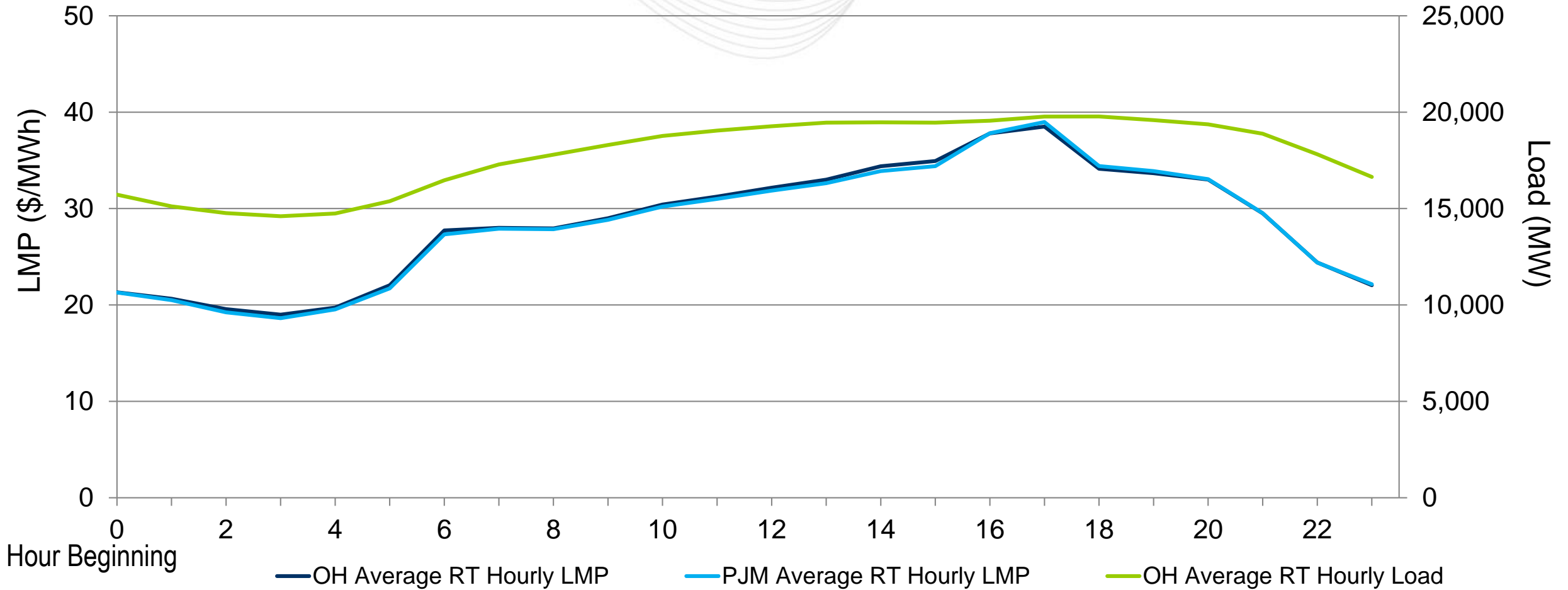
## Market Analysis

Ohio's average daily LMPs generally align with the PJM average daily LMP



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.

Ohio's hourly LMPs generally aligned with the PJM average.





# Operations Emissions Data

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

## PJM Average Emissions (lbs/MWh)

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

