



An Introduction to PJM

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State Government Policy

February 28, 2023

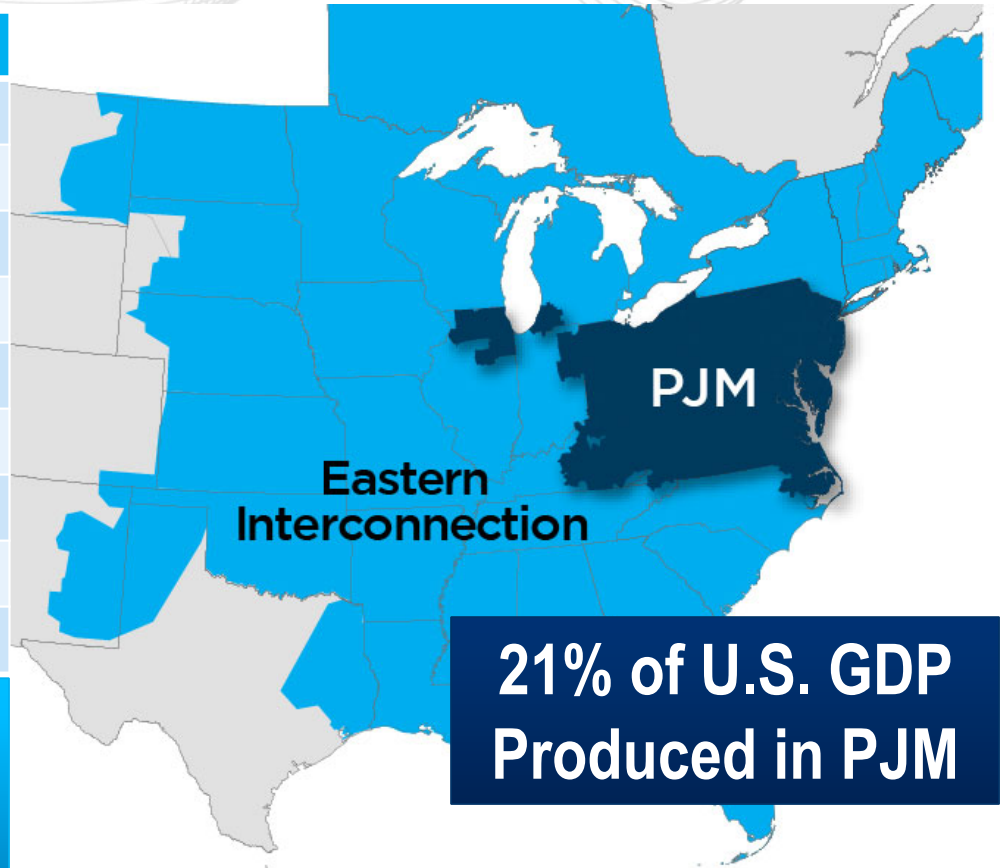


PJM as Part of the Eastern Interconnection

Key Statistics

Member companies	1,060+
Millions of people served	65
Peak load in megawatts	165,563
Megawatts of generating capacity	185,442
Miles of transmission lines	85,103
2020 gigawatt hours of annual energy	782,683
Generation sources	1,436
Square miles of territory	368,906
States served	13 + DC

- 26% of generation in Eastern Interconnection
- 25% of load in Eastern Interconnection
- 20% of transmission assets in Eastern Interconnection

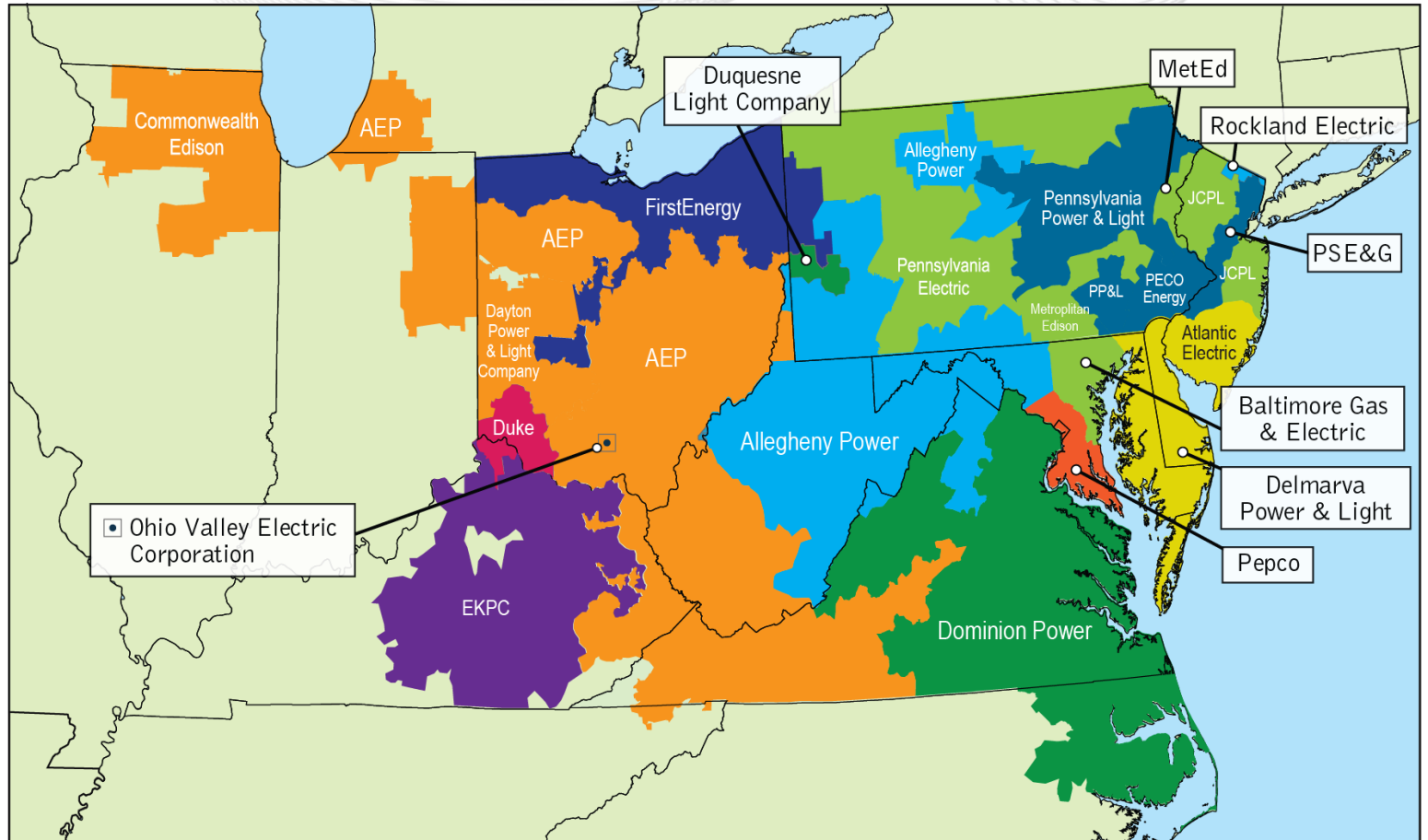


As of 2/2022



PJM Evolution

- Joined in 1927
- Joined in 1956
- Joined in 1965
- Joined in 1981
- Joined in 2002
- Joined in 2004
- Joined in 2005
- Joined in 2011
- Joined in 2012
- Joined in 2013
- Joined in 2018





PJM's Role as a Regional Transmission Organization

PLANNING



Planning for the future like...



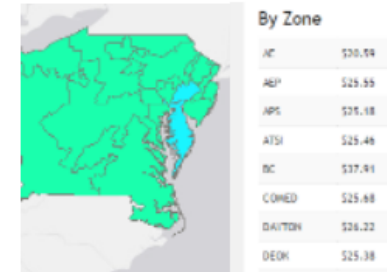
OPERATIONS



Matches supply with demand like...



MARKETS



Energy Market Pricing like...



Elements of a Regional Transmission Organization





How Is PJM Different from Other Utility Companies?

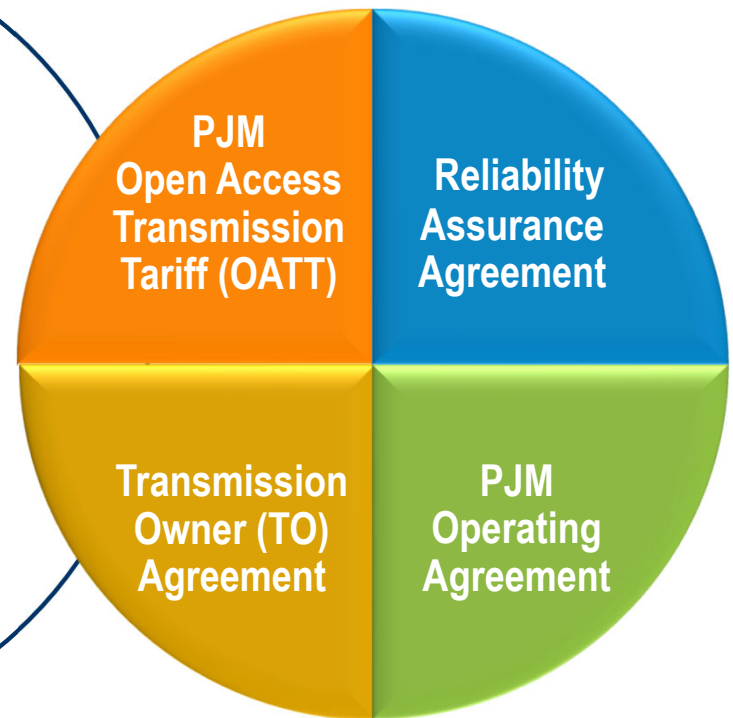
PJM Does:

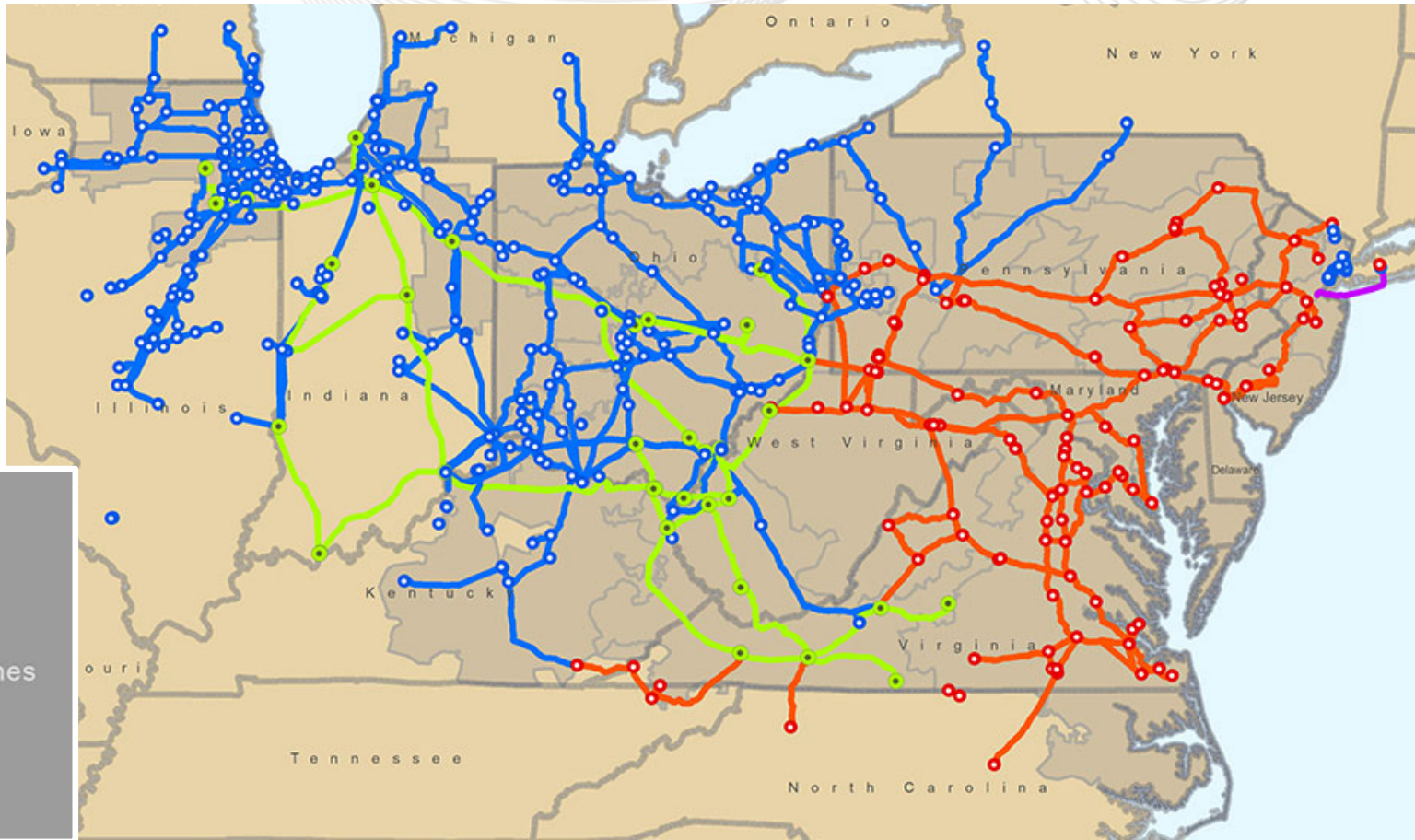
- Direct operation of the transmission system
- Remain profit-neutral
- Maintain independence from PJM members
- Coordinate maintenance of grid facilities

PJM Does NOT:

- Own any transmission or generation assets
- Function as a publicly traded company
- Take ownership of the system's energy
- Perform maintenance on generators or transmission systems (e.g., repair power lines)
- Serve or direct any end-use customers (retail)

PJM's Authority is Provided by Contract





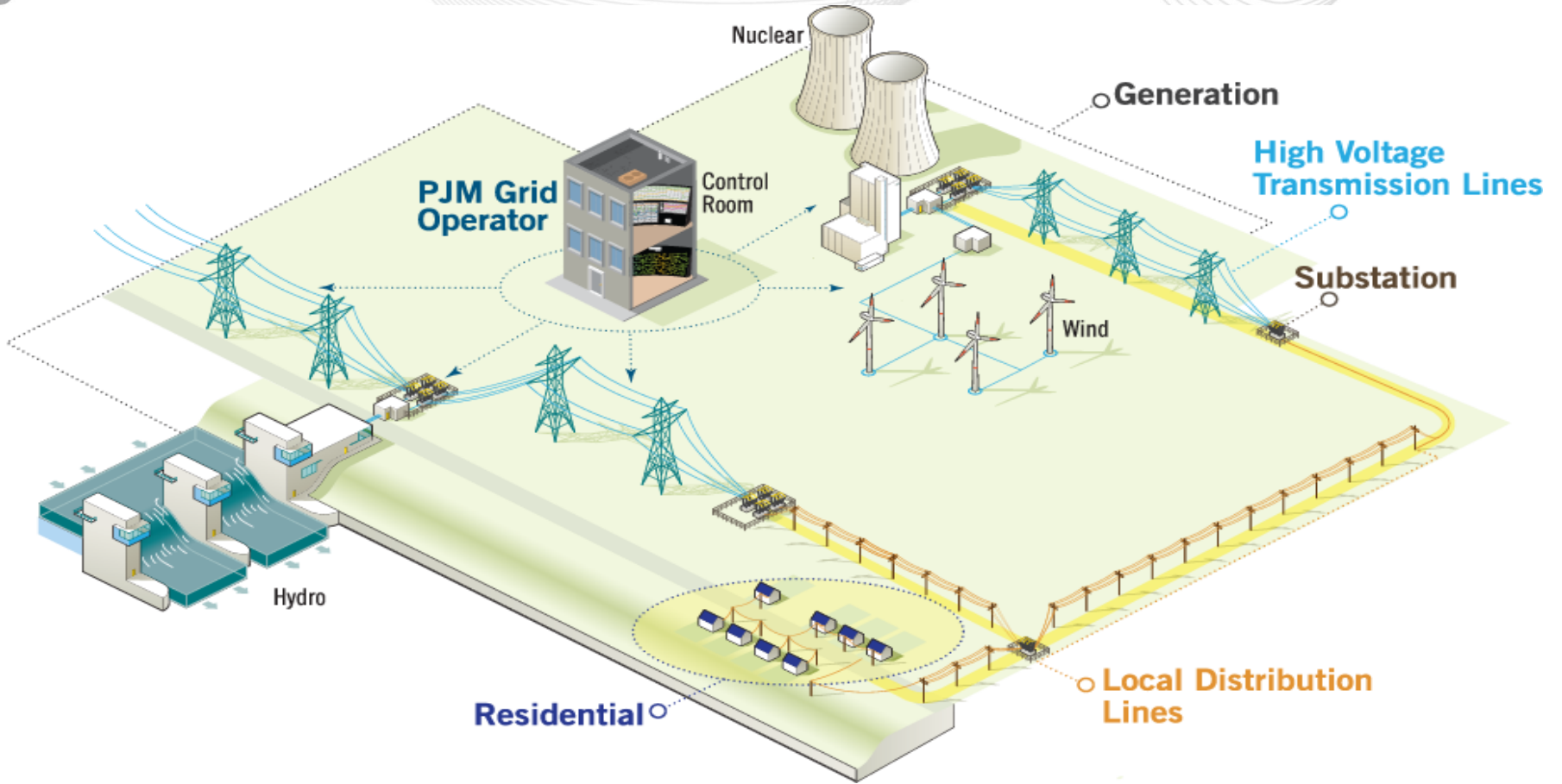
Legend

Substations

- 765 kV
- 500 kV
- 345 kV

Transmission Lines

- HVDC
- 765 kV
- 500 kV
- 345 kV





PJM's Control Room



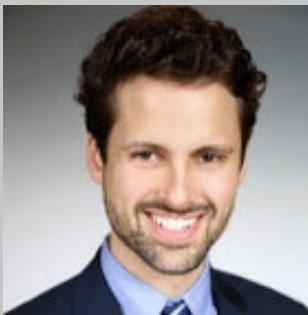
Energy 101

Exploring energy market fundamentals, trends, and opportunities in PJM.

Presented by Brian Kauffman
February 2023
Ohio Energy Management and
Savings Conference



Today's speaker

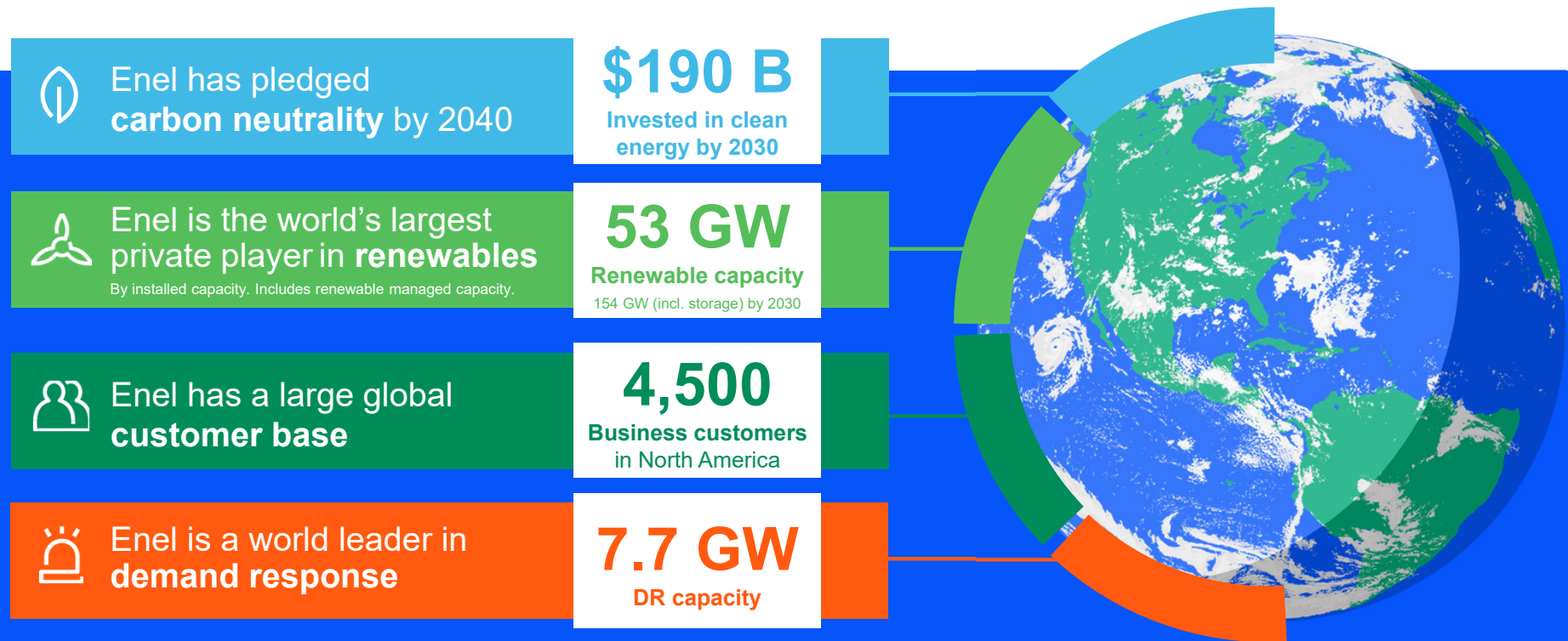


Brian Kauffman

Director of Regulatory Affairs, PJM Lead
Enel North America

- 10+ years experience in electricity business and policy
- Expertise in demand response and PJM electricity markets

We are Enel, a global leader in the energy transition



Enel is recognized for its leadership in sustainability



Named in Fortune Magazine's "Change the World" list (2015, 2017, 2018)



Included in the "A" List for Tackling Climate Change (2021)



Top spot Dow Jones Sustainability World Index (2021)



Named for making EV charging cleaner (2021)

Net Zero by 2040

Enel pledges complete decarbonization

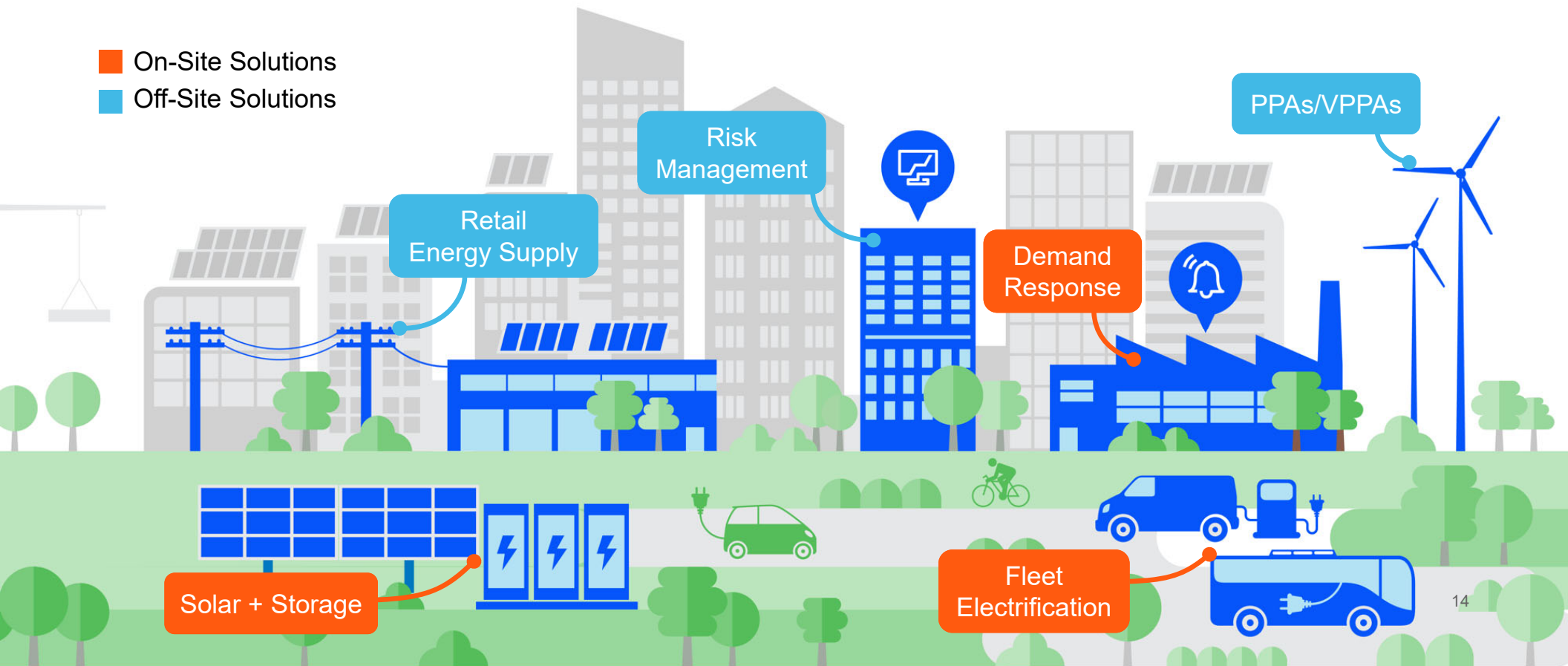


Enel commits to these UN Sustainable Development Goals

With expertise, resources and scale, Enel delivers solutions across the energy transition roadmap



- On-Site Solutions
- Off-Site Solutions



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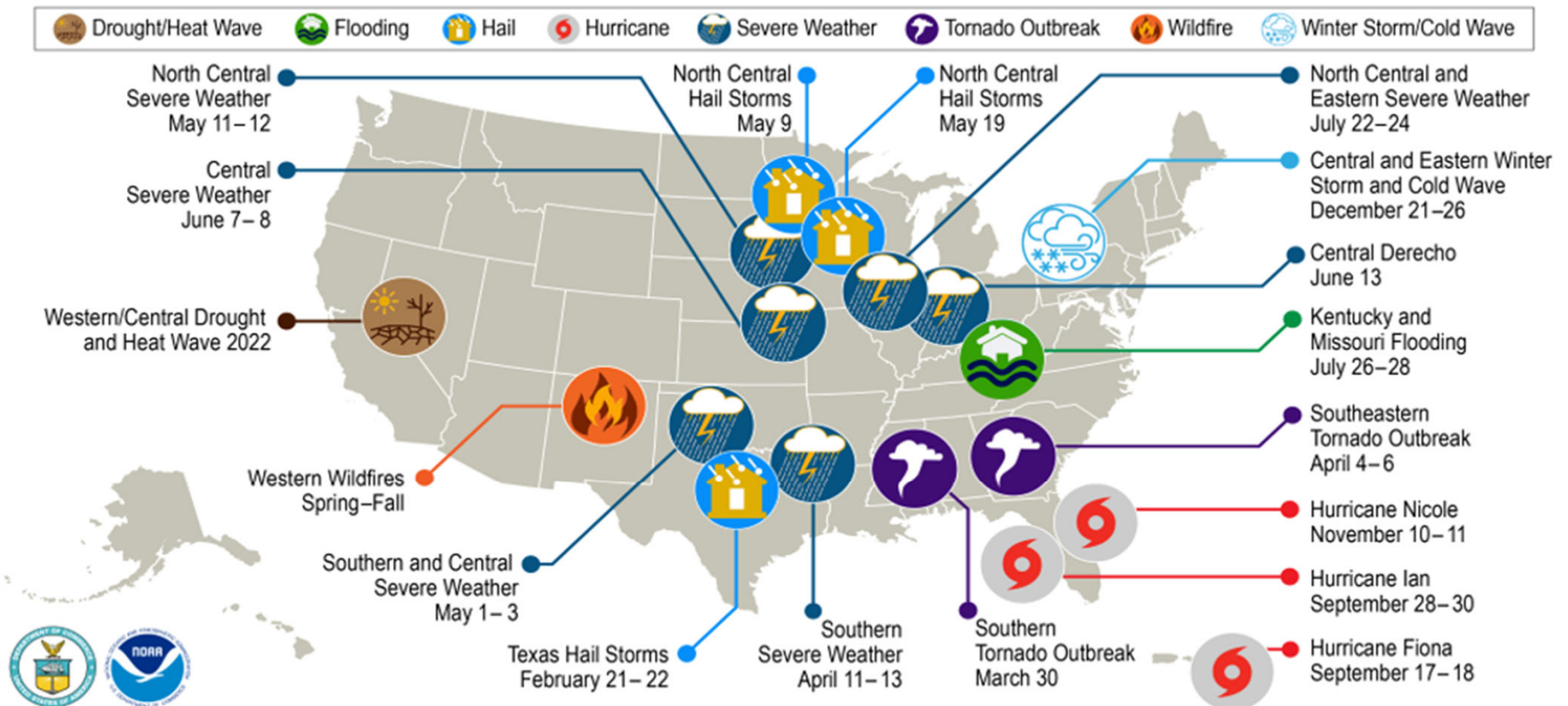
Intro to Demand Response

Extreme Weather Puts Pressure on the Grid



An increase in extreme weather events strains the grid requiring resilience

U.S. 2022 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the 18 separate billion-dollar weather and climate disasters that impacted the United States in 2022.

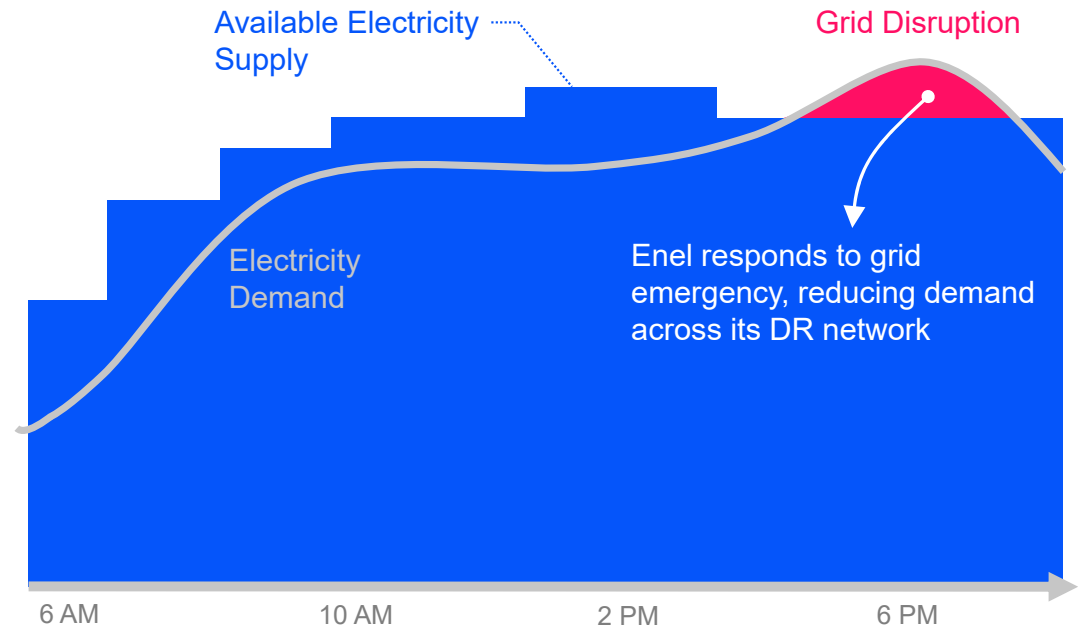
Demand Response (DR) Helps Grid Resilience



Demand response programs pay companies to reduce energy use in response to emergencies that threaten grid stability

Balancing supply and demand on the electricity grid is difficult and expensive

- Curtailing usage during grid emergencies is a **cost-effective alternative** to building more power plants
- Grid emergencies can be due to extreme weather, wholesale price spikes, or unexpected system issues

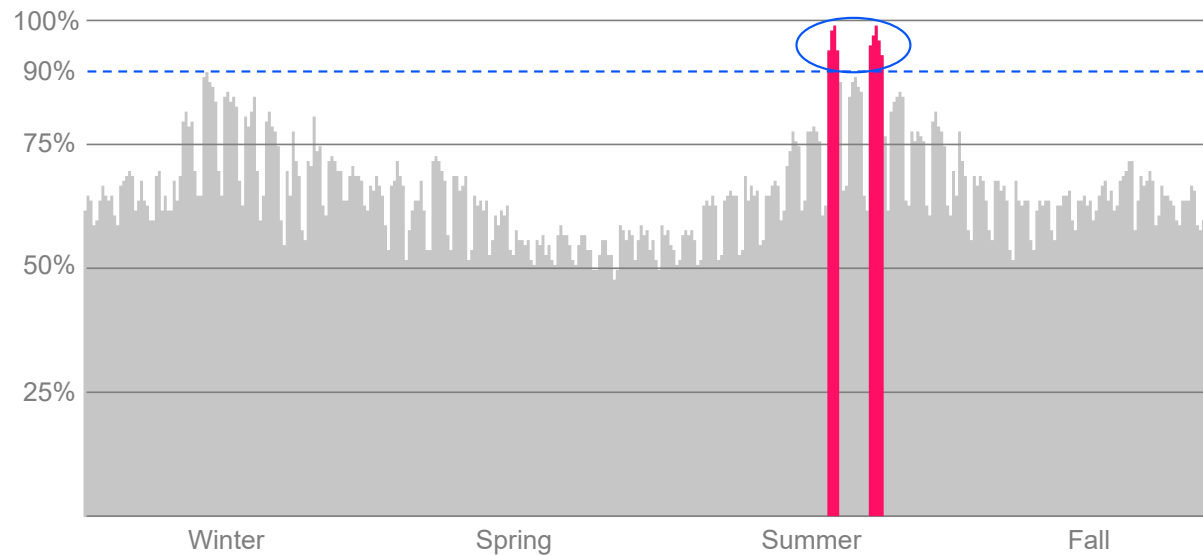


The Value of Demand Response

Demand response programs are a cost-effective alternative to infrastructure investments

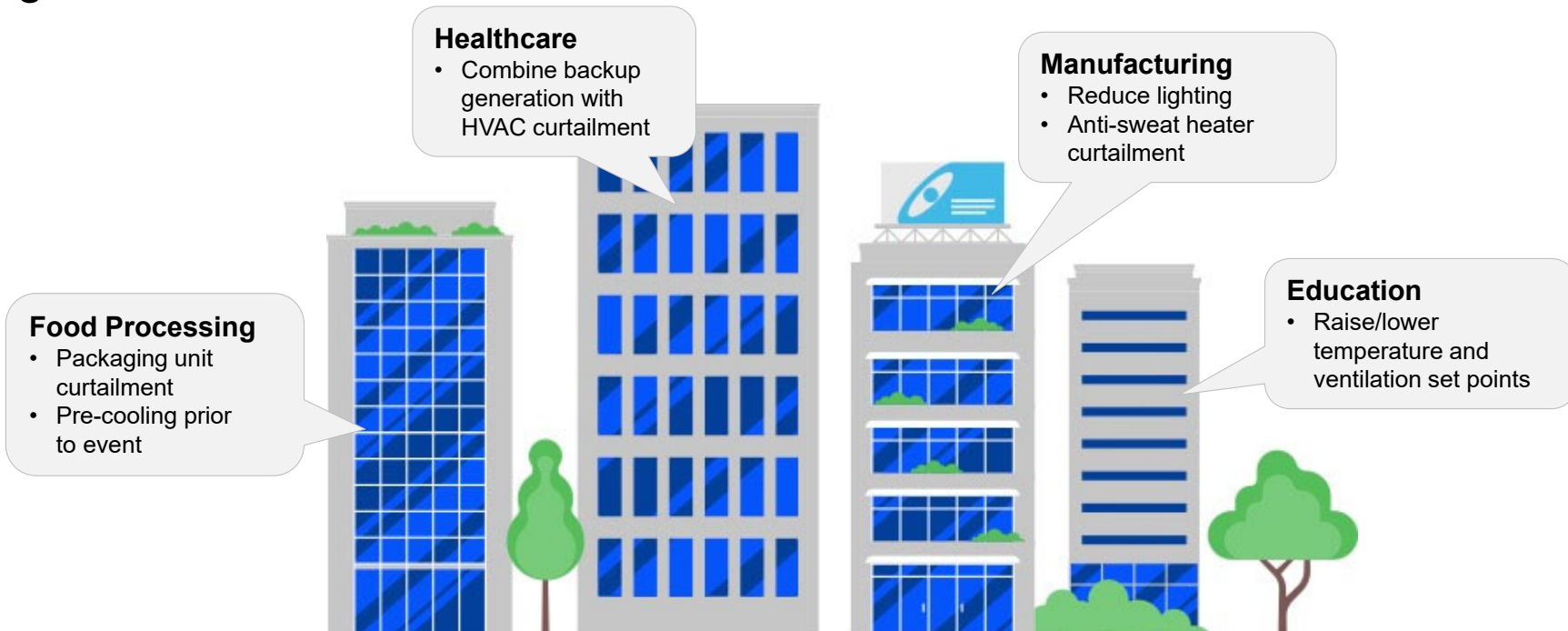


Annual Electricity Demand as a Percent of Available Capacity



- More than 10% of grid infrastructure costs are spent to meet peak demand that occurs **less than 1% of the time**
- Building a new power plant for that 1% of the time is **incredibly expensive**
- Demand response is a **fast and cost-effective** way to meet peak electric demand

How Demand Response Works. As many sites across industries reduce energy consumption simultaneously, the grid is relieved



When the electric grid needs resources, Enel “dispatches” assets and thousands of facilities across nearly every industry reduce electricity consumption.



PJM Introduction

PJM Interconnection

What is PJM?

PJM Interconnection is a **regional transmission organization (RTO) that coordinates the movement of wholesale electricity** in all or parts of 13 states and the District of Columbia. PJM is the world's largest electric grid, managing electricity transmissions across states to **ensure grid reliability**.

PJM Fast Facts



More than **65 million people** served by PJM



PJM 2020 Peak Demand: **146,816 MW**



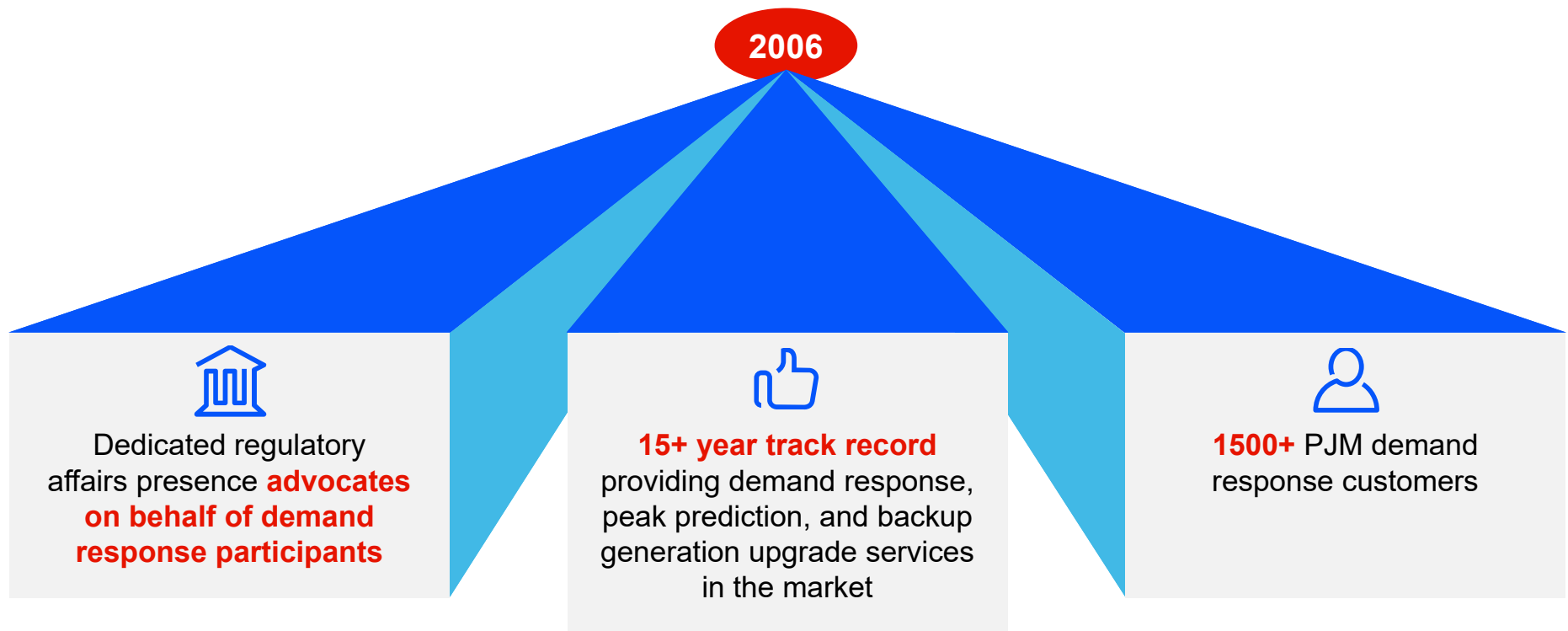
PJM 2022 DR Capacity: **8,812 MW**



Enel has paid PJM customers **more than \$750 million** for demand response participation since 2010



Enel has Partnered with Demand Response Customers in PJM since 2006





PJM ELRP



Program Guidelines

The PJM ELRP season runs from June 1 to May 31



Hours of Availability



Summer: 10 a.m. – 10 p.m. ET
Jun 1–Oct 31 2023; May 1–31 2024

Winter: 6 a.m. – 9 p.m. ET
Nov 1 2023 – Apr 30 2024

**including weekends and holidays*

Testing Requirements



PJM requires an **annual test** in the absence of any emergency dispatches

Dispatch Timing



Emergency events most likely to occur in **late afternoon in summer** and **early morning in winter**

Dispatch Frequency



Expect 1-2 emergency events each year. Emergency events are **rare but important**

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Your Facility may have Different Summer and Winter Nominations based on Site Energy Usage

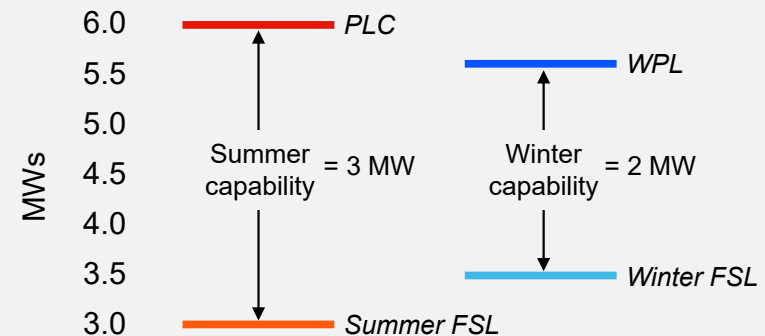


Your baseline may differ between summer and winter based on your facility's operations

- **Peak Load Contribution (PLC)**
Your average load during PJM's top 5 coincident peak load hours of the previous summer
- **Winter Peak Load (WPL)**
The average of your peak loads from 6 AM to 9 PM EPT on PJM's top 5 peak load days of 2 winters ago

You may also have different firm service levels (FSL, or the kW level to which you should reduce during a dispatch) during the summer and winter based on your capability

Example Nomination Calculation

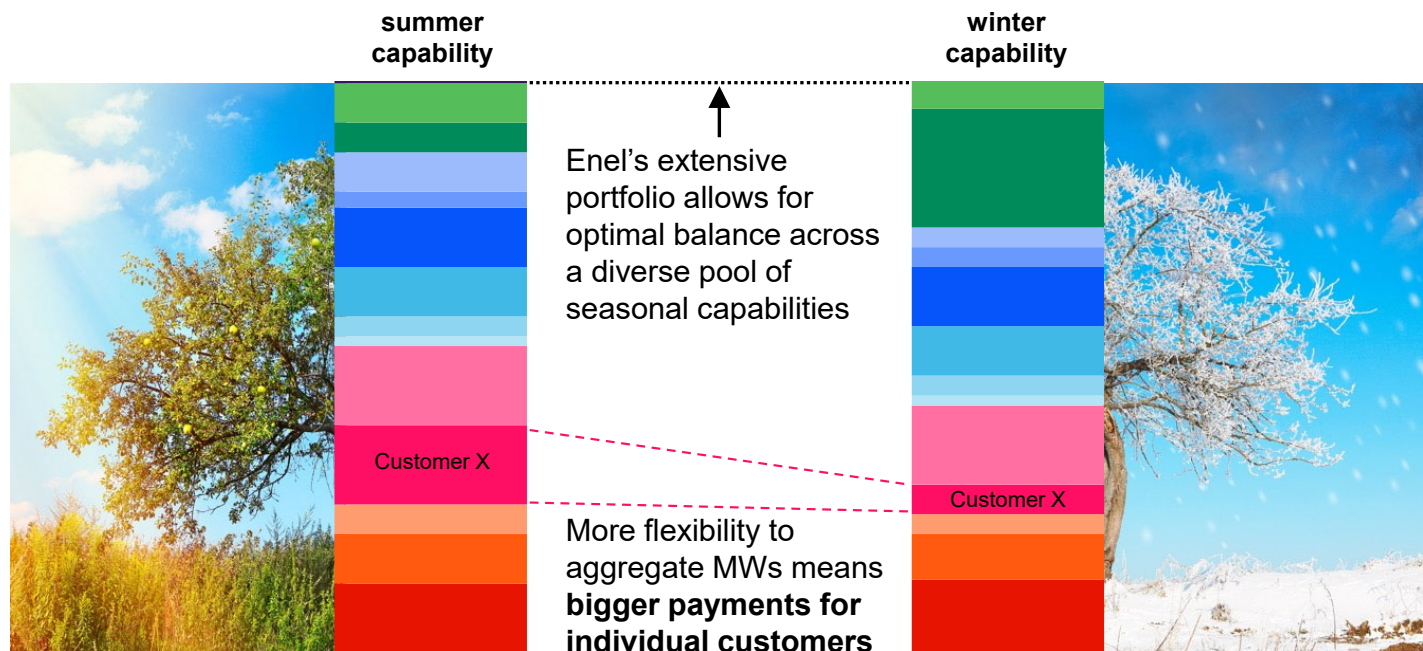


In isolation, this customer could only enroll 2 MW in CP (their lowest capability)

Enel Maximizes your Capability by Aggregating Seasonal Differences across our Portfolio



Enel has the largest, most diversified customer base in PJM—**1.75x larger** than the next largest CSP—allowing us to aggregate more effectively than anyone else



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PJM—Synchronized Reserve Market

PJM Synchronized Reserve Market

Earn Payments for Fast-Response Energy Flexibility



The Synchronized Reserve Market (SRM)

program provides short-term, fast-response support to the grid in case of an unexpected spike in demand or shortfall in supply:

- Participants have **10 minutes** to fully enact their participation plan
- Dispatches last **9 minutes** on average
- The program operates **24x7x365**



PJM Synchronized Reserve Market (cont.)



Facilities that participate in SRM have **stable energy use, regularly scheduled operations,** and can quickly and easily curtail load in one of two ways:



Automated Curtailment

Control systems adjust equipment or temperature set points to quickly reduce load, with minimal impact on operations



On-Site Generation

Generators equipped with remote control capabilities seamlessly transfer facility load. SRM-eligible generators must be able to transfer load within a few minutes

★ Because **dispatches only last a few minutes**, there are minimal operational disruptions

PJM Synchronized Reserve Market

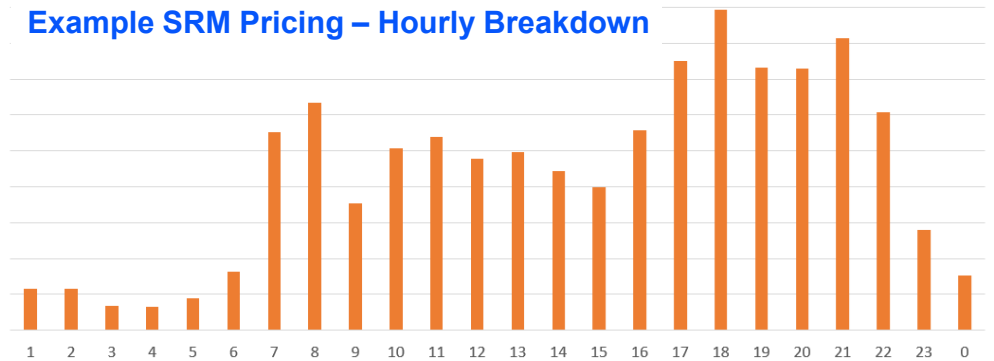
Optimize Earnings and Enrollment with Enel.



- **Your organization will be paid regardless** of whether an SRM event occurs, for the hours your facility is available to opt-in
- **Enel's proprietary bidding strategy** consistently delivers for customers with a no hassle, hands-free approach
- **Pricing varies by hour and zone.** Enel's bidding strategy ensures your facility participates during the most lucrative hours based on your operating schedule

Enel will bid your facility into the program on an **hourly basis**, based on a **set operating schedule**

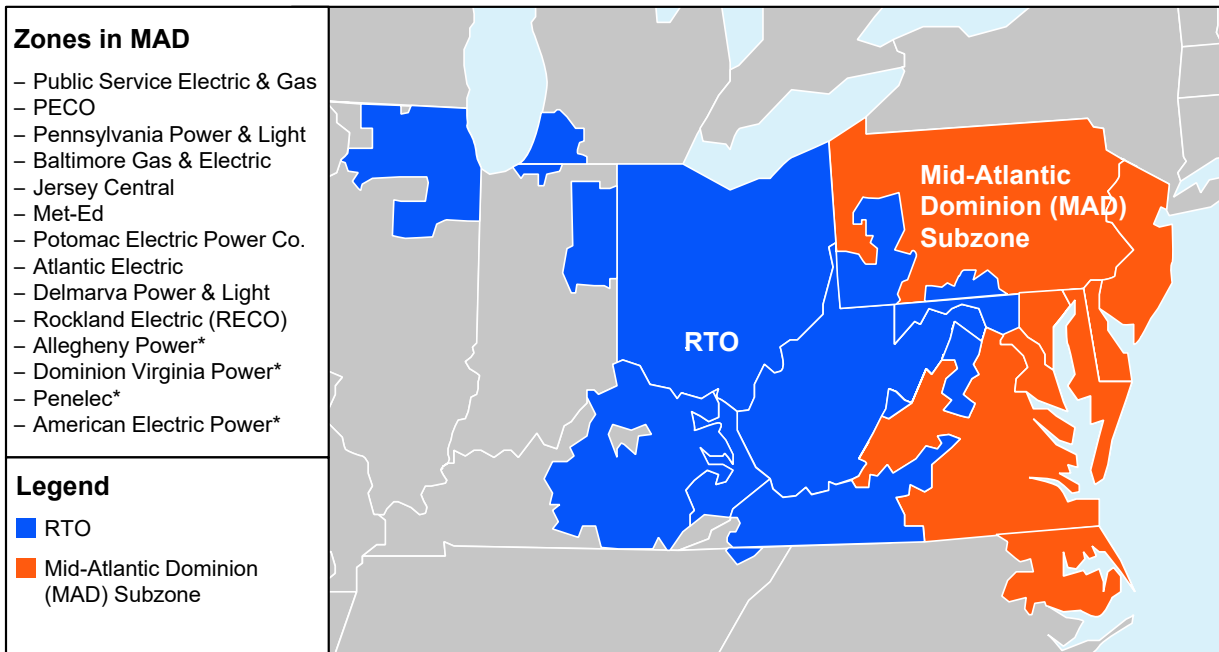
Example SRM Pricing – Hourly Breakdown



The more your facility can participate, the **more you will earn**

PJM Synchronized Reserve Market

Enrollment by Zone



SRM is available in all PJM zones

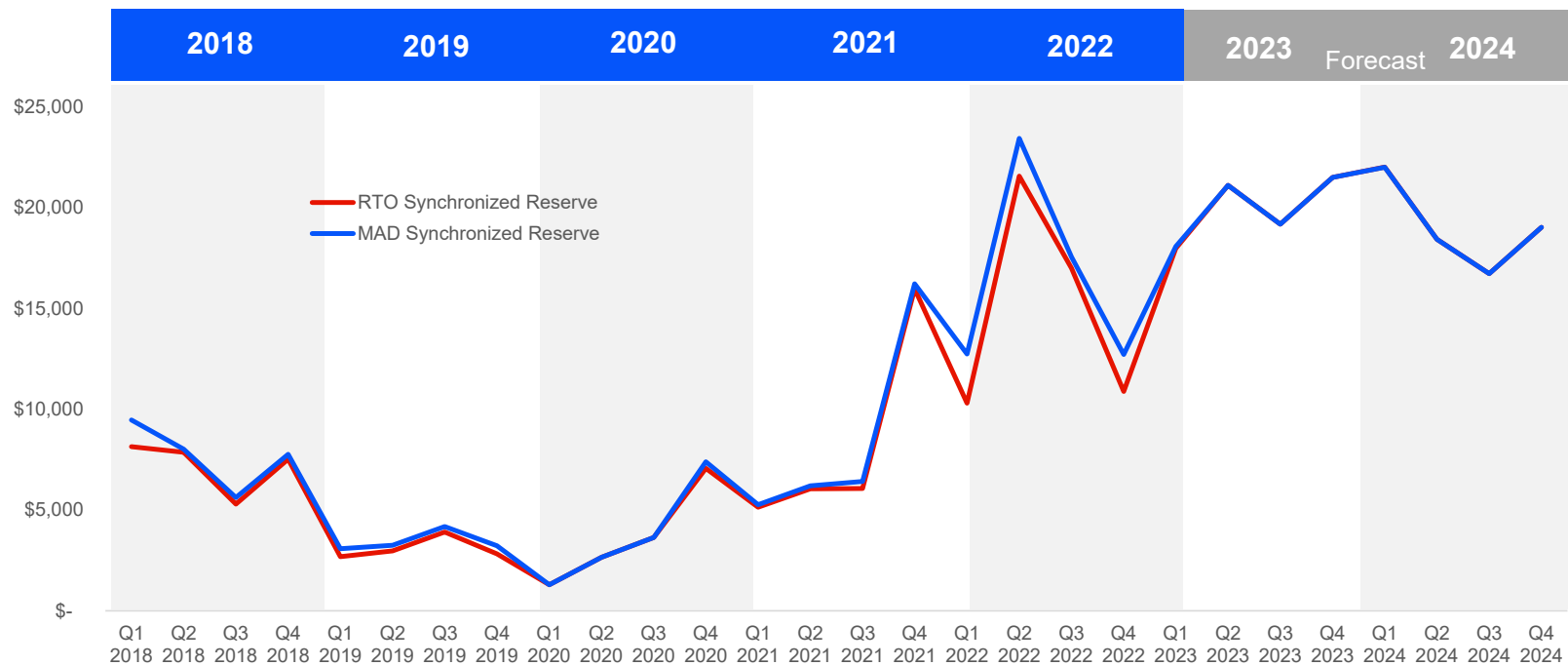
- PJM may dispatch the entire RTO, which includes the Mid-Atlantic Dominion (MAD) Subzone, or they may only dispatch MAD
- MAD-only dispatches have historically occurred **1-5 times** each year
- As a result, earnings for facilities located in the MAD subzone are **slightly higher**

*May be classified as MAD or RTO

Forecasted SRM Pricing



Prices are expected to increase in 2023 and beyond, driven by a PJM rule change that better compensates SRM participants for the grid value they provide



Earnings \$/MW-year	RTO	2018	2019	2020	2021	2022	2023	2024
	MAD	\$30,053	\$12,405	\$14,735	\$33,216	\$61,337	\$79,748	\$76,158
	\$33,047	\$13,749	\$15,062	\$34,083	\$65,649	\$79,844	\$76,158	



PJM DM Solution Comparison

The Demand Management Opportunity in PJM

Enel can help you choose your solution and maximize revenue



Wide variety of **demand response** and **demand management** solutions available in PJM to suit your unique operations and energy goals.

We can help define a custom solution. We start by understanding:

- How many kW can you reduce?
 - How much operational flexibility do you have?
 - Is your load profile stable and predictable?
 - How fast can you respond to a dispatch?
 - What is your tolerance for dispatches?
 - Do you have onsite generation? Is it/can it be permitted for DR use?
 - Does battery storage make sense for your site(s)?
- Enel is always monitoring the market to bring new opportunities to our customers to maximize their revenue.

Demand Response

Generator Upgrades

System Peak Predictor

ELRP

Battery Storage

SRM

Economic DR

Energy Efficiency

Comparison of Demand Management Programs in PJM

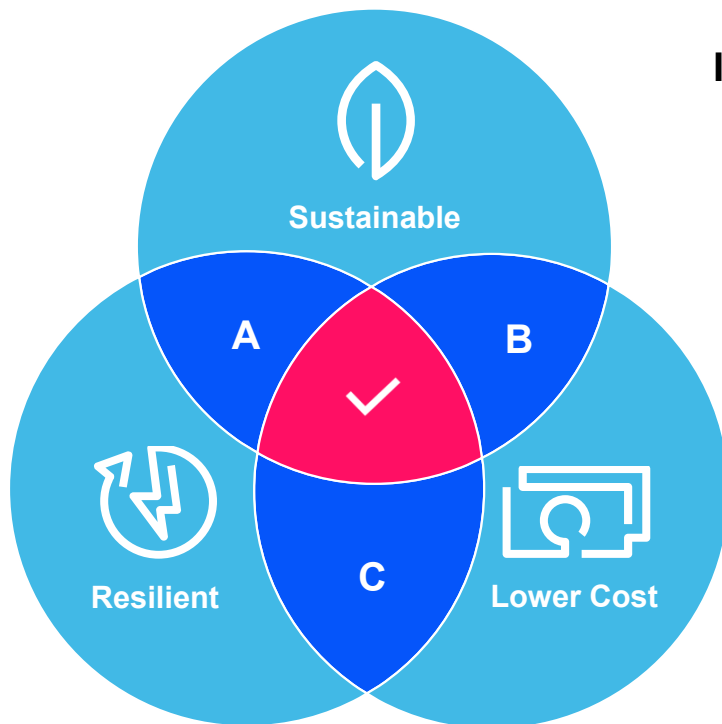


	ELRP	SRM	System Peak Predictor
Seasonality	Year Round	Year-Round	June 1 to September 30
Effort Required	<p>LOW</p> <ul style="list-style-type: none"> - 0-2 dispatches generally, varies by zone. Last mandatory dispatch was in 2022. - Dispatches range generally from 4-6 hours. Audit dispatch is 2 hours. - Get notified 30 minutes to 2 hours in advance. 	<p>HIGH</p> <ul style="list-style-type: none"> - 5-15 dispatches, varies by zone. Enel provides a deep expertise to develop a bidding strategy in which you'll see a return from your participation. - Dispatches are 9 minutes, on average, 30 minutes maximum. - Get notified 10 minutes in advance. 	<p>HIGH</p> <ul style="list-style-type: none"> - 8-12 "high alert" days, but no guarantee right days are identified. - Dispatches range from 3-4 hours. - Get alerted up to 1-week ahead, with 10:00 am day-of notice.
Reward Potential	<p>LOW</p> <p>Earn \$15-\$35K per year for agreeing to reduce 1 MW. Earn even if there are no emergency dispatches are called. Additional energy payments are available when emergency events occur.</p>	<p>HIGH</p> <p>Earn \$70-\$90K+ per year for agreeing to reduce 1 MW, 24x7. Earn even if there are no dispatches.</p>	<p>VARIES</p> <p>Save \$15-77K next year on capacity/PLC charge by reducing 1 MW on all 5CPs.</p>

A solid white horizontal bar.

Maximize Demand Response with Energy Storage

Discussion: How does your organization think about the energy transition?



It is often easy to get 2 of 3 but getting 3 of 3 is a challenge:

- A** **Resilient + Sustainable** but more expensive
microgrid in an area with low cost of power
- B** **Sustainable + Lower cost** but lacks resilience
simple solar project, but no back up power
- C** **Lower cost + Resilient** without sustainability benefits
traditional back up diesel generator or co-generation

✓ We can help you strike the right balance between **Sustainable + Resilient + Lower cost** by taking advantage of attractive incentives & market monetization programs

Value stream overview



Decreasing Costs

The solution provides on bill savings through:

- **Coincident Peak Reduction**
 - Network Service Peak Load (NSPL)*
 - Peak Load Contribution (PLC)
- **Demand Charge Management**
- **Energy Arbitrage**

Increasing Revenues

The solution generates revenue through participation in:

- **Demand Response programs**
 - Sync Reserves
 - Summer/Winter ELRP
- **Incentives**
 - State Rebates
 - Investment Tax Credit (ITC)
 - SREC (if solar paired)

Optimizing Site Performance

The solution optimizes the site's performance resulting in:

- Increased Sustainability
- Improved Resiliency
- Optimized on-site generation
- While minimizing disruptions to operations

Storage value stream example



Decreasing Costs

Value Stream: Transmission Charge Avoidance

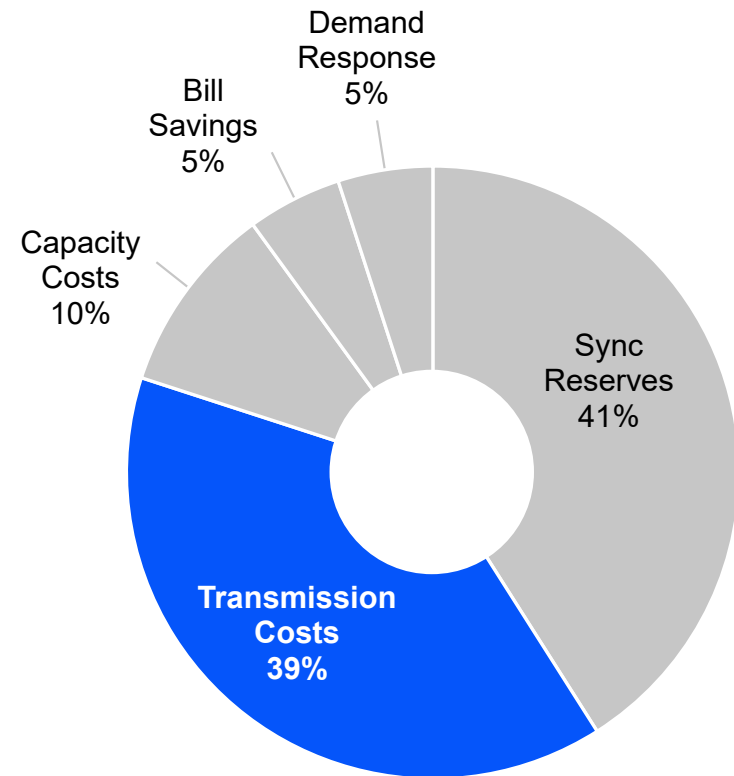
Program Name: Network Service Peak Load (NSPL)

Description:

Utility levies a coincident peak charge on commercial customers as measured by a facility's NSPL tag, or average demand during the top 1, 5, or 12 annual zonal peak hours (depending on the zone)

Enel Solution:

Enel software has a peak predictor that will lower a facility's load during probable NSPL events. Can additionally deploy battery storage during those events – to avoid NSPL charges



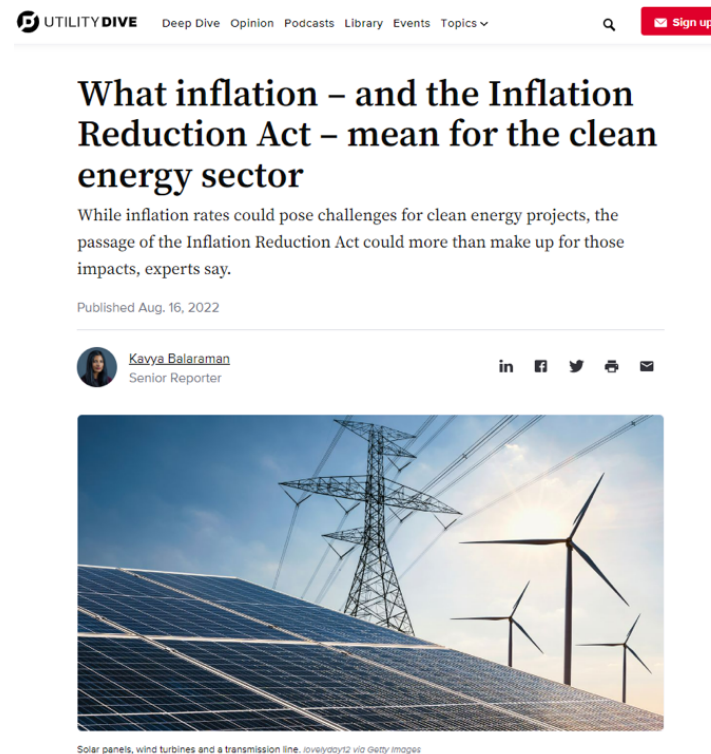
** Indicative breakdown. Will vary by utility zone and application.*

Recent passage of the Inflation Reduction Act has enabled on-site Solar and Storage in new markets



- **Extension of the solar tax credits:** Provide 10-year certainty, for both investment and production
- **New standalone storage ITC:** Reduce upfront capital costs of storage systems by 30% + potential for further reductions if specific conditions are met
- We expect there to be a rush of storage development in PJM, adding further stress on battery hardware supply chains and interconnection queues

The time to act is now!





Thank you!

Q&A

enel



Appendix

PJM Emergency Dispatch History

Enel has managed **more than 70** PJM emergency dispatches since 2007, but there have been **very few mandatory events since 2014**



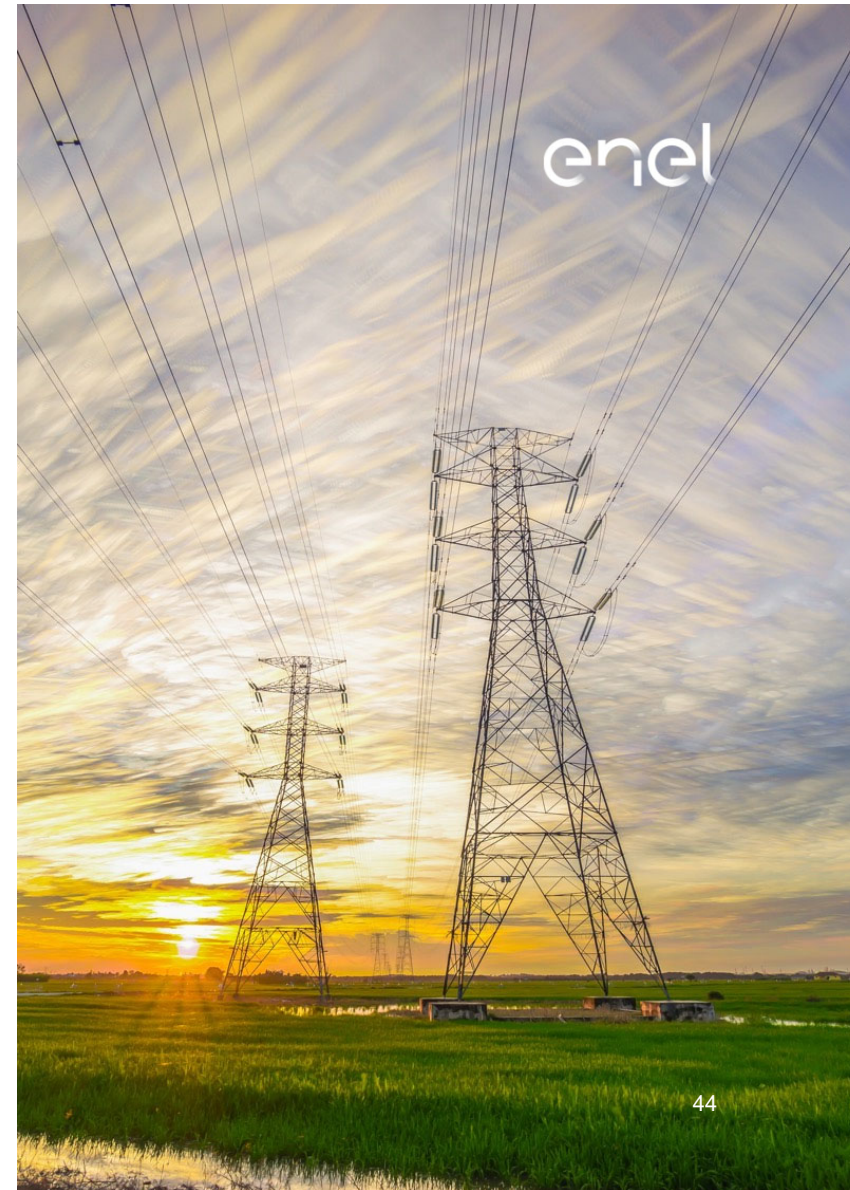
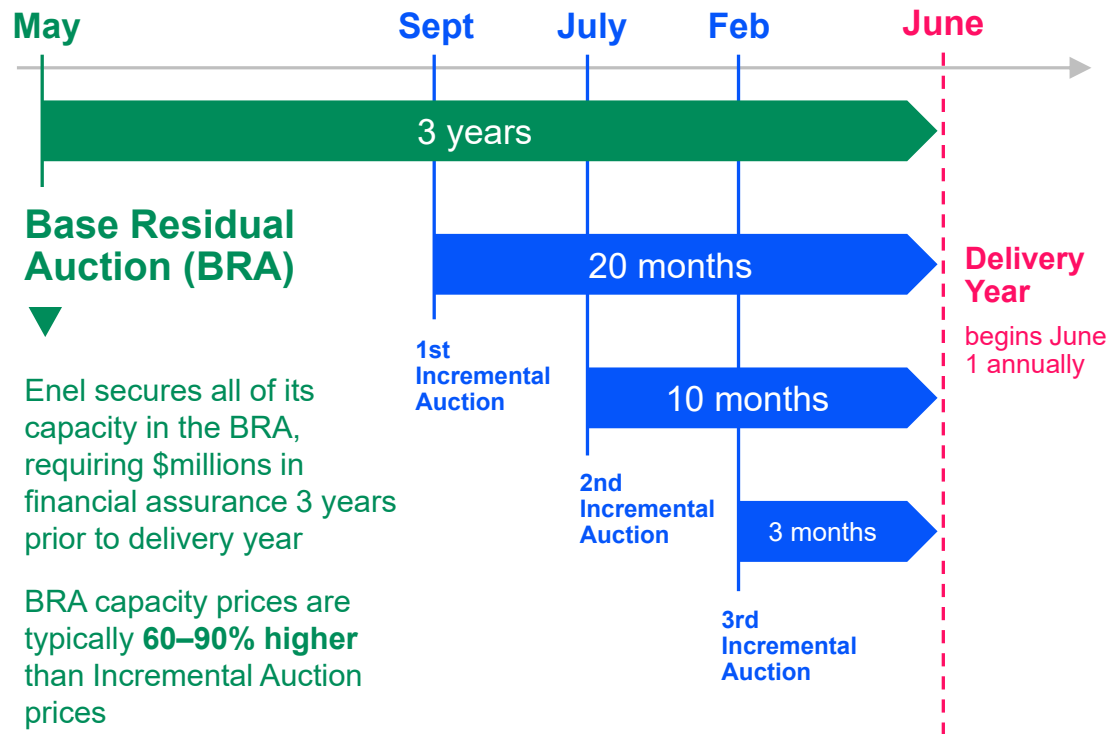
PJM Mandatory Events By Zone (2007–2021)

Zone	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Avg. Event
ACE	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2	3h 13m
AEP	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	3	4h
APS	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	5h 30m
ATSI	N/A	N/A	N/A	N/A	-	-	5	-	-	-	-	-	-	-	-	2	3h 24m
BGE	1	-	-	3	1	1	1	-	-	-	-	-	1*	-	-	2	3h 57m
ComEd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
DAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
DEOK	N/A	N/A	N/A	N/A	N/A	-	-	-	-	-	-	-	-	-	-	2	-
DLCO	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	2	4h
DOM	1	-	-	1	-	1	1	-	-	-	-	-	-	-	-	2	3h 40m
DPL	1	-	-	1	1	1	1	-	-	-	-	-	-	-	-	2	3h 20m
JCPL	1	-	-	1	1	1	1	-	-	-	-	-	-	-	-	2	2h 56m
MetEd	1	-	-	-	1	-	1	-	-	-	-	-	-	-	-	2	3h 33m
PECO	1	-	-	1	1	1	2	-	-	-	-	-	-	-	-	2	2h 57m
Penelec	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	2	2h 53m
PEPCO	1	-	-	4	-	1	1	-	-	-	-	-	1*	-	-	2	3h 40m
PPL	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	2h 53m
PSEG	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2	3h 13m
RECO	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	3h 20m

Note: Table excludes voluntary events in 2010 (1), 2011 (2), 2013 (2), 2014 (6), 2015 (1), and 2019 (1)

*Mandatory events in 2019 were limited to a small number of 2-hour advance notice customers in BGE and PEPCO

How Enel Secures DR Capacity in PJM



PJM Zonal Pricing 2020-2025



BRA Clearing Rates (\$/MW-year)	2020/21	2021/22	2022/23	2023/24**	2024/25**
Zone				Forecast	
Atlantic City Electric Company (ACE)	\$68,573	\$60,491	\$35,719	\$18,113	\$54,928
American Electric Power Co. Inc. (AEP)	\$27,933	\$51,100	\$18,250	\$12,492	\$32,428
Allegheny Power (AP)	\$27,933	\$51,100	\$18,250	\$12,492	\$32,428
American Transmission Systems, Inc. (ATSI)	\$27,933	\$62,535	\$18,250	\$12,492	\$36,240
Baltimore Gas and Electric Company (BGE)	\$31,405	\$73,110	\$46,173	\$25,602	\$50,229
Commonwealth Edison Company (ComEd)	\$68,664	\$71,376	\$25,170	\$12,492	\$55,070
The Dayton Power and Light Co. (DAY)	\$27,933	\$51,100	\$18,250	\$12,492	\$32,428
Duke Energy Ohio Kentucky (DEOK)	\$47,450	\$51,100	\$26,167	\$12,492	\$41,572
Duquesne Light Company (DLCO)	\$27,933	\$51,100	\$18,250	\$12,492	\$32,428
Dominion Virginia Power (DOM)	\$27,933	\$51,100	\$18,250	\$12,492	\$32,428
Del Marva Power and Light Company (DPL)	\$68,573	\$60,491	\$35,719	\$18,113	\$54,928
Del Marva Power and Light Company (DPL – SOUTH)	\$68,573	\$60,491	\$35,719	\$25,602	
Jersey Central Power and Light Company (JCPL)	\$68,573	\$60,491	\$35,719	\$18,113	\$54,928
Metropolitan Edison Company (Met-Ed)	\$31,405	\$51,100	\$34,963	\$18,113	\$39,156
PECO Energy Company (PECO)	\$68,573	\$60,491	\$35,719	\$18,113	\$54,928
Pennsylvania Electric Company (Penelec)	\$31,405	\$51,100	\$34,963	\$18,113	\$39,156
Potomac Electric Power Company (Pepco)	\$31,405	\$51,100	\$34,963	\$18,113	\$39,156
PPL Electric Utilities Corporation (PPL)	\$31,405	\$51,100	\$34,963	\$18,113	\$39,156
Public Service Electric and Gas Company (PSE&G)	\$68,573	\$74,566	\$35,719	\$18,113	\$59,619
Rockland Electric Company (RECO)	\$68,573	\$60,491	\$35,719	\$18,113	\$54,928

**Estimated pricing based on 3-year average, pending results of delayed PJM Base Residual Auction (BRA)

PJM Zonal Pricing 2022-2027



BRA Clearing Rates (\$/MW-year)	2022/23	2023/24**	2024/25**	2025/26**	2026/27**
Zone		Forecast			
Atlantic City Electric Company (ACE)	\$35,719	\$18,113	\$54,928	\$54,078	\$54,928
American Electric Power Co. Inc. (AEP)	\$18,250	\$12,492	\$32,428	\$32,517	\$32,428
Allegheny Power (AP)	\$18,250	\$12,492	\$32,428	\$32,517	\$32,428
American Transmission Systems, Inc. (ATSI)	\$18,250	\$12,492	\$36,240	\$36,339	\$36,240
Baltimore Gas and Electric Company (BGE)	\$46,173	\$25,602	\$50,229	\$50,366	\$50,229
Commonwealth Edison Company (ComEd)	\$25,170	\$12,492	\$55,070	\$55,221	\$55,070
The Dayton Power and Light Co. (DAY)	\$18,250	\$12,492	\$32,428	\$32,517	\$32,428
Duke Energy Ohio Kentucky (DEOK)	\$26,167	\$12,492	\$41,572	\$41,686	\$41,572
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Dominion Virginia Power (DOM)	\$18,250	\$12,492	\$32,428	\$32,517	\$32,428
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Jersey Central Power and Light Company (JCPL)	\$35,719	\$18,113	\$54,928	\$54,078	\$54,928
Metropolitan Edison Company (Met-Ed)	\$34,963	\$18,113	\$39,156	\$39,263	\$39,156
PECO Energy Company (PECO)	\$35,719	\$18,113	\$54,928	\$54,078	\$54,928
Pennsylvania Electric Company (Penelec)	\$34,963	\$18,113	\$39,156	\$39,263	\$39,156
Potomac Electric Power Company (Pepco)	\$34,963	\$18,113	\$39,156	\$39,263	\$39,156
PPL Electric Utilities Corporation (PPL)	\$34,963	\$18,113	\$39,156	\$39,263	\$39,156
Public Service Electric and Gas Company (PSE&G)	\$35,719	\$18,113	\$59,619	\$59,782	\$59,619
Rockland Electric Company (RECO)	\$35,719	\$18,113	\$54,928	\$54,078	\$54,928

**Estimated pricing based on 3-year average, pending results of delayed PJM Base Residual Auctions (BRA)

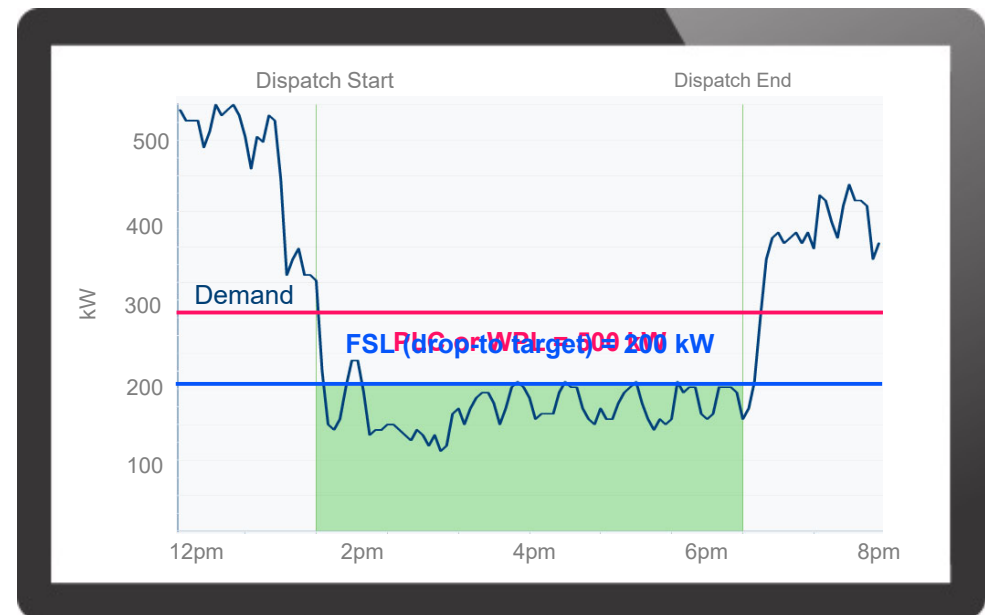
Calculating Your Performance



Summer performance is the difference between your **PLC** (Peak Load Contribution) and **FSL** (Firm Service Level, or drop-to target)

Winter performance is the difference between your **WPL** (“winter PLC”) and **FSL** (drop-to target)

- Summer and Winter performance are calculated the same way, but may have different baseline and drop-to-target
- In this example, the dispatch goal is to drop demand from 500 kW to 200 kW
- Overall performance is calculated based on the average performance over the duration of the dispatch



Dispatch Performance Calculations



Enel pays customers based on their **average performance over all event hours** to offset any hourly underperformance

Other CSPs cap performance at 100% per hour, significantly impacting payments

In this example, even with a 5% higher split from a competitor this company still earns **\$2,341 more with Enel**

Enrollment: 1,000 kW
Capacity Rate (\$/MW-year): \$46,173*
Customer Split: 60%
Performance Adjustment (\$/MWh): \$2,754*

Dispatch	Performance	Enel <i>Uncapped hourly performance adjustment</i>	Competition <i>Capped hourly performance adjustment</i>
Hour 1	400 kW	(\$1,653)	(\$1,653)
Hour 2	750 kW	(\$689)	(\$689)
Hour 3	1,350 kW	\$964	\$0
Hour 4	1,500 kW	\$1,377	\$0
Hourly Average	1,000 kW		
Total Performance Reduction		\$0	(\$2,341)
Total Payments		\$27,704	\$25,362

*Capacity and Performance Adjustment rates based on 2022/23 earnings for the Baltimore Gas & Electric zone in PJM

Historical PLC Hours

PLC hours typically occur weekday afternoons 4 PM – 6 PM in July and August



Peaks in previous years were almost all in July

2021			2020			2019			2018			2017		
Day	Date	Hour Ending	Day	Date	Hour Ending	Day	Date	Hour Ending	Day	Date	Hour Ending	Day	Date	Hour Ending
Tue	June 29	5 PM	Mon	July 6	3 PM	Wed	July 10	6 PM	Mon	June 18	5 PM	Mon	June 12	6 PM
Tue	July 6	5 PM	Thurs	July 9	6 PM	Wed	July 17	5 PM	Mon	Aug 27	5 PM	Tue	June 13	5 PM
Thurs	Aug 12	5 PM	Mon	July 20	5 PM	Fri	July 19	6 PM	Tue	Aug 28	5 PM	Wed	July 19	6 PM
Tue	Aug 24	6 PM	Mon	July 27	5 PM	Mon	July 29	5 PM	Tue	Sept 4	5 PM	Thurs	July 20	5 PM
Thurs	Aug 26	4 PM	Wed	July 29	6 PM	Mon	Aug 19	5 PM	Wed	Sept 5	5 PM	Fri	July 21	5 PM

Your PLC is calculated as your average demand during **PJM's 5 coincident peak summer hours**

Historical WPL Days



WPL days typically occur on consecutive weekdays in December and January

WPL days largely consecutive

2020/21 Sets WPL for Winter 2022/23		2019/20 Sets WPL for Winter 2021/22		2018/19 Sets WPL for Winter 2020/21		2017/18 Sets WPL for Winter 2019/20		2016/17 Sets WPL for Winter 2018/19	
Day	Date	Day	Date	Day	Date	Day	Date	Day	Date
Tue	Jan 28, 2021	Wed	Dec 18, 2019	Tue	Jan 22, 2019	Tue	Jan 2, 2018	Thu	Dec 15, 2016
Wed	Jan 29, 2021	Thu	Dec 19, 2019	Tue	Jan 29, 2019	Wed	Jan 3, 2018	Fri	Dec 16, 2016
Mon	Feb 8, 2021	Fri	Dec 20, 2019	Wed	Jan 30, 2019	Thu	Jan 4, 2018	Sat	Dec 19, 2016
Tue	Feb 17, 2021	Tue	Jan 21, 2020	Thu	Jan 31, 2019	Fri	Jan 5, 2018	Sun	Dec 20, 2016
Wed	Feb 18, 2021	Wed	Jan 22, 2020	Fri	Feb 1, 2019	Thu	Jan 18, 2018	Mon	Jan 9, 2017

Your WPL is your **facility's peak demand** 6 AM – 9 PM EST on the 5 days when PJM's grid peaked the prior winter

Your WPL calculation is **more advantageous than your summer PLC** calculation, which looks at your facility's demand during PJM's peak summer hours, regardless of the time of day your facility peaks

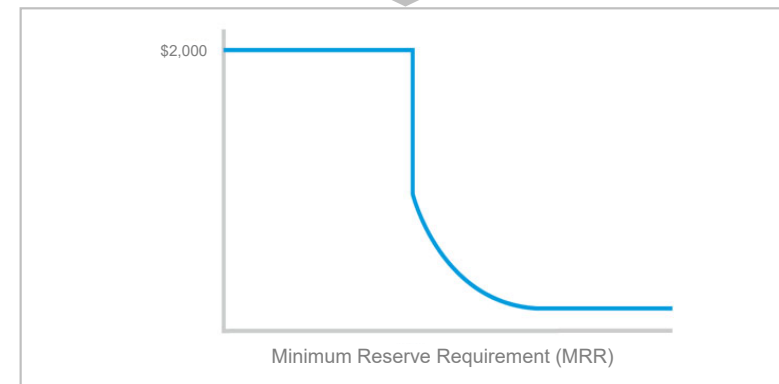
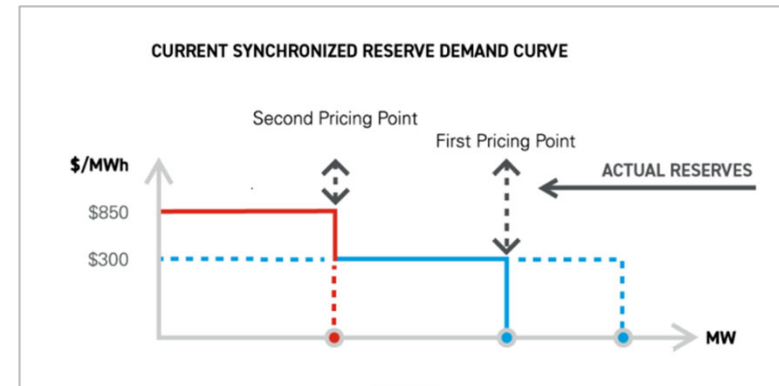
Forecasted SRM Pricing

Why are prices expected to increase?



PJM proposed two primary changes to the SRM pricing model, in an intentional effort to better compensate reserves resources for the grid reliability value they provide.

1. **Shift from a rigid step-function to a sloped demand curve pricing model.** The new pricing model provides PJM the flexibility to compensate reserves resources based on the *likelihood* that reserves will fall below the Minimum Reserve Requirement (MRR), rather than at pre-determined reserves thresholds
2. **Increase the maximum potential price paid to reserves resources from \$850/MWh to \$2000/MWh.** This new pricing is consistent with the maximum energy offer that can be made and is eligible to set locational marginal price (LMP) in PJM



Historical SRM Pricing and Events Summary



	Year	Revenue (\$/MW-yr)	# of Events	Total Dispatch Time (mins)	Avg. Duration (mins)
RTO	2019	\$12,405	13	112	9
	2020	\$14,735	12	83	7
	2021	\$33,216	12	116	9
	2022	\$59,726	15	350	**9
	4-yr Total	\$120,082	52	551	-
	Average	\$30,020	13	138	
MAD	2019	\$13,749	16	162	9
	2020	\$15,062	17	154	7
	2021	\$34,803	10	96	9
	2022	\$66,423	15	350	**9
	4-yr Total	\$129,317			
	Average	\$32,329			

Revenue estimates assume 24/7/365 enrollment

*Prices impacted by energy consumption changes due to COVID-19

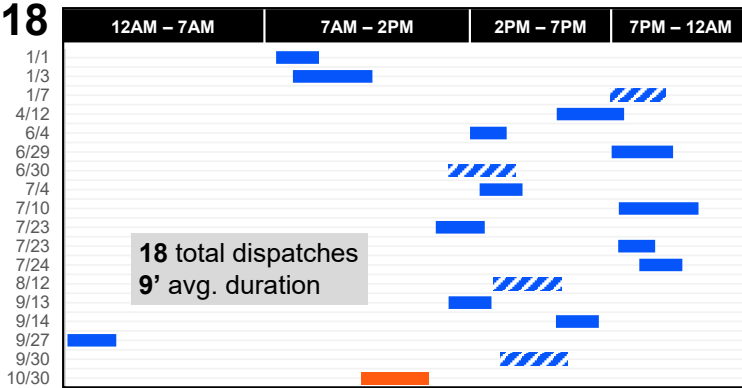
**Excludes dispatches on 12/23 & 12/24 which ran 230' across three events

Historical SRM Events

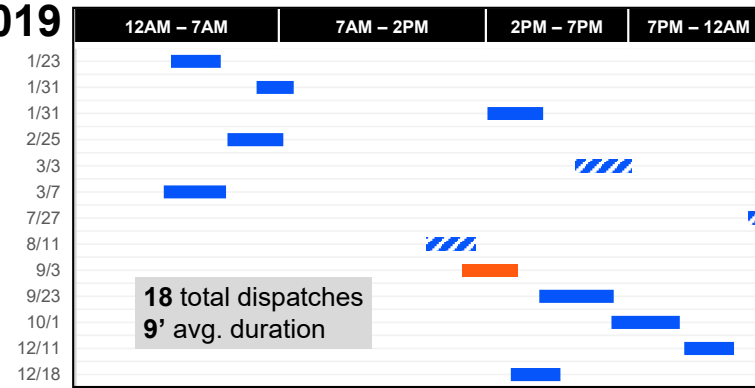
Participate only in the SRM events that fit your operating schedule



2018

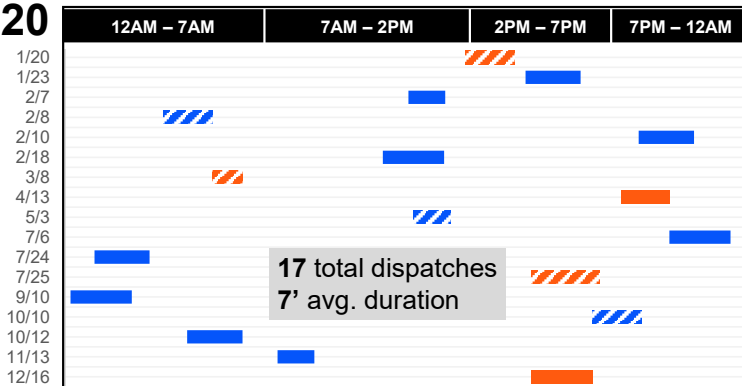


2019



Note: Graphs are not drawn to scale. Most dispatches are 10' or shorter.

2020



2021



Historical SRM Events

Participate only in the SRM events that fit your operating schedule



2019	12AM – 7AM	7AM – 2PM	2PM – 7PM	7PM – 12AM
1/23	3:30 AM, 8'	8:00 AM, 13'		
1/31	6:26 AM, 6'			7:15 PM, 9'
1/31			2:26 PM, 9'	
2/25	5:25 AM, 9'		2:22 PM, 6'	
3/3			5:31 PM, 9'	7:20 PM, 10'
3/7	3:05 AM, 10'	1:46 PM, 11'		
7/27				11:31 PM, 6'
8/11		12:14 PM, 8'		
9/3		1:39 PM, 9'		
9/23			4:06 PM, 12'	
10/1			6:56 PM, 11'	
12/11				9:08 PM, 8'
12/18			3:07 PM, 8'	

**18 total dispatches
9' avg. duration**

2020	12AM – 7AM	7AM – 2PM	2PM – 7PM	7PM – 12AM
1/20			2:06 PM, 8'	
1/23			4:17 PM, 9'	
2/7		12:06 PM, 6'		
2/8	3:44 AM, 8'			
2/10				8:15 PM, 9'
2/18		11:16 AM, 10'		
3/8	5:17 AM, 5'			
4/13				7:53 PM, 8'
5/3		12:23 PM, 6'		
7/6				9:22 PM, 10'
7/24	1:03 AM, 9'			
7/25			4:39 PM, 11'	
9/10	12:19 AM, 10'			
10/10			6:52 PM, 8'	
10/12	4:29 AM, 9'			
11/13		7:46 AM, 6'		
12/16			4:38 PM, 10'	

**17 total dispatches
7' avg. duration**

■ MAD-only
■ Weekend/Holiday

2021	12AM – 7AM	7AM – 2PM	2PM – 7PM	7PM – 12AM
1/24				10:39 PM, 7'
3/9	7:50 AM, 11'			
4/13			14:05 PM, 9'	
4/30			4:30 PM, 12'	
5/26		10:17 AM, 10'		
7/21			6:27 PM, 5'	
8/23			4:44 PM, 17'	
8/24		10:37 AM, 8'		
9/27			4:56 PM, 8'	
10/11		1:23 PM, 9'		
10/16	5:30 AM, 8'			
11/12			5:25 PM, 12'	

**12 total dispatches
9' avg. duration**

2022	12AM – 7AM	7AM – 2PM	2PM – 7PM	7PM – 12AM
1/3			5:27 PM, 9'	
3/3			5:20 PM, 7'	
4/6			3:45 PM, 10'	
4/13				9:25 PM, 28'
4/14		1:30 PM, 8'		
5/23				9:17 PM, 15'
5/26			6:09 PM, 6'	
6/22				7:06 PM, 7'
6/27				9:01 PM, 9'
7/7				9:21 PM, 8'
9/29			2:25 PM, 6'	
11/15	3:01 AM, 6'			
12/23				9:17 PM, 112'
12/24		7:23 AM, 31'		
12/24		9:23 AM, 88'		

**15 total dispatches
9' avg. duration*
*(excluding events on 12/23-24)**

Enel will Finance Equipment Upgrades to Maximize your SRM Enrollment—at no cost to you



Enel offers a range of options to enable your facility to capture the full value of SRM:



Seamless Power Transfer

Equipment upgrades for seamless transition when transferring load onto a generator

Control System Upgrade

Control system enhancements and remote load transfer capabilities increase dispatch reliability

Facility Strobe Alerts

Receive automated notifications of a dispatch event

Connected Capacity Increase

Wiring upgrades increase facility capacity supported by generator

Emissions Upgrades

Backup generators must comply with federal, state, and local emissions regulations or be subject to steep penalties

PJM Synchronized Reserve Market

How Enel Customers Participate



Climate-Controlled Agriculture

Enel **automatically transfers load onto backup generation via remote controls** when an SRM dispatch has been called, and automatically restores facility load when dispatch has ended



Steel Manufacturer

Receives automated **strobe alert** from Enel when an SRM dispatch has been called and **shuts off arc furnace**. Strobe continues until dispatch has ended



Cold Storage Facility

Receives automated **strobe alert** from Enel when an SRM dispatch has been called and **adjusts temperature set points on refrigerators and freezers** and turns off battery chargers until dispatch has ended

PJM Synchronized Reserve Market

Program Overview



PJM Synchronized Reserve Market	
Response Types	Curtailment and Generation (Non-Emergency Permits Required)
Payments	Capacity payments for hours of availability
Costs	No upfront, out-of-pocket costs to participate
Program Period & Hours	Year-round, Available 24x7x365. Rolling enrollments. Customers opt in/out on hourly basis and set schedules
Notification Lead Time	10 minutes
Response Duration	Up to 30 minutes (most events are <15 minutes)
Dispatch Frequency	10-20 events per year; no maximum
Dispatch Trigger	Short-term imbalances in Supply/Demand (generator outage, transmission, etc.)
Baseline Measurement	Usage immediately prior to dispatch, raw drop measurement
Testing Requirement	Full AT required, up to 3 may be required in some cases
Metering Requirement	Standard ESS, 1-minute data required
Annual Payments	Increasing to ~\$70K/MW-year in 2022
Penalties	Potential for retroactive loss of 22 days' revenue proportional to underperformance. Enel Portfolio can often shield customers from Penalties. Customer will never owe Enel or PJM any money.

Performance Measurement – Standard Dispatch



Participants must demonstrate immediate and sustained curtailment for length of dispatch

Example Dispatch

Dispatch Notification: 1:06 PM

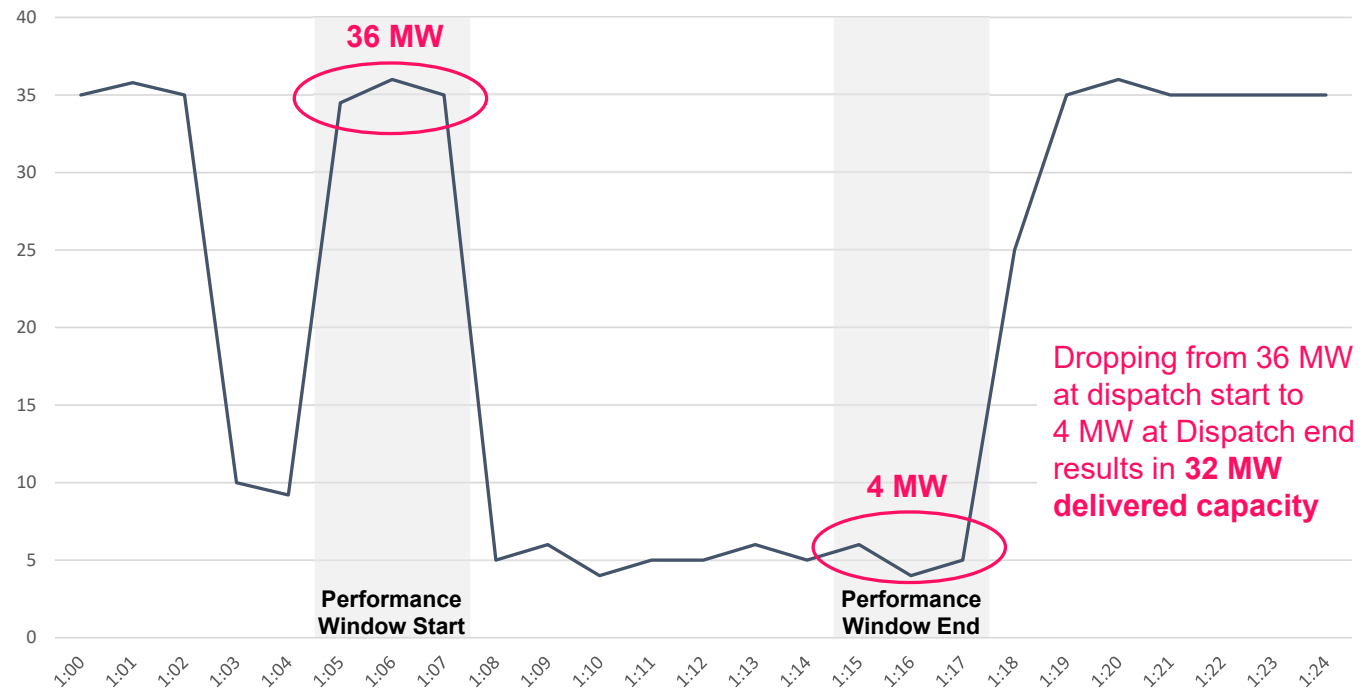
Dispatch End: 1:16 PM

Dispatch Start

PJM looks at **max load** in minutes-ending 1:05 – 1:07 PM (t-1, t-0, t+1)

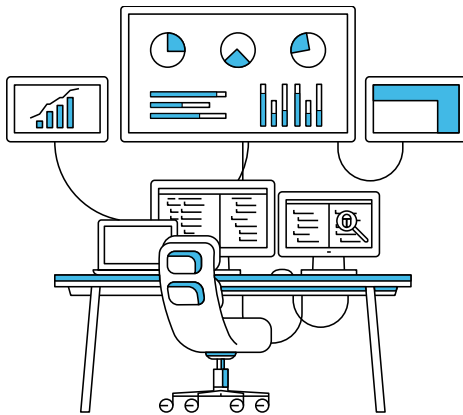
Dispatch End

PJM looks at **minimum load** in minutes-ending 1:15 – 1:17 PM (t+9, t+10, t+11)

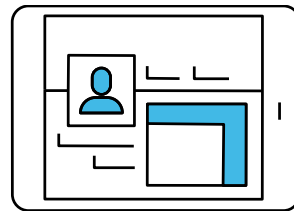


PJM Synchronized Reserve Market

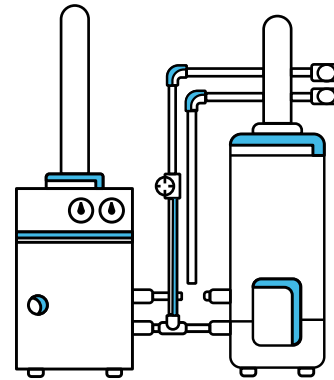
Next Steps



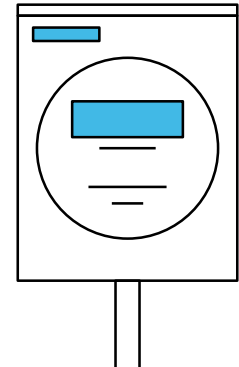
Conduct **interval data analysis** to identify available load



Determine **operating schedule** for enrollment



Perform any necessary **equipment upgrades**



Install **metering**, where required

Batch Load Customers in Synchronized Reserves

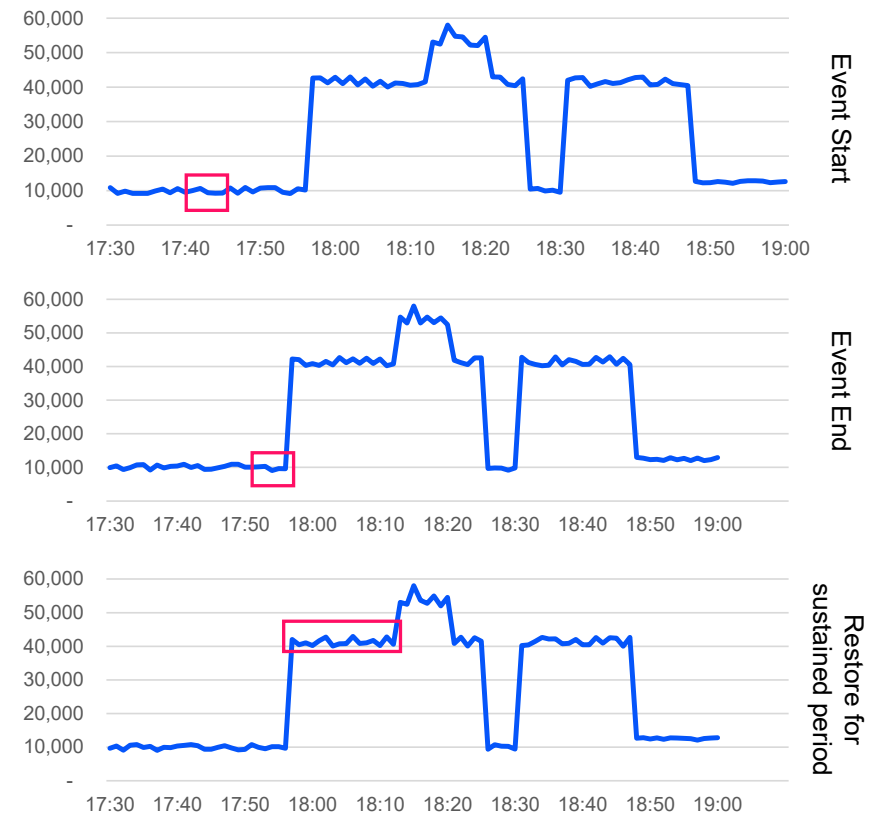


New rules allow intermittent load customers to enroll

Traditionally only customers with a steady load could participate in SRM demand response. Now, customers with an **intermittent energy profile** can participate.

Requirements:

1. Approval by PJM based on review of 6 months of Enel meter data at a 1 minute interval.
2. You must still curtail within 10 minutes of being notified of an event, even if you are mid-process.
3. If you are between batches, you must stay down until the event end, then come back online for sustained usage within 10 minutes of notification.



What is the value of flexibility?

Grid operators compensate for flexibility as a way to address system stress



Decrease costs and increase revenues to drive most economic value to the customer

BakerHostetler

PJM: Current Issues

Glenn S. Benson

February 28, 2023



Aggregated DERs under FERC Order 2222

- Issued in September 2020
- Requires reforms to remove barriers to the participation of distributed energy resource (DER) aggregations in PJM and other RTOs/ISOs.
- Establishes DER aggregators as a type of market participant that can use 1 or more participation models that accommodate its physical and operational characteristics

PJM Order 2222 Compliance Filing

- Submitted 2/1/22
- Seeks to balance needs of DER aggregators to participate in PJM's markets on a level playing field with other resource types, and the rights of relevant electric retail regulatory authorities and distribution utilities to ensure safe and reliable operations on the distribution system
- Would establish a single DER Aggregator Participation Model

PJM Order 2222 Compliance Filing – DER Participation Model

- Pre-registration coordination activities between DER aggregators and distribution utilities to determine locational and data components needed for the DER aggregators' registration with PJM
- A 60-day review period distribution utilities to, among other things, analyze a proposed registration for its reliability impact on distribution system.
 - PJM would then have 15 days to decide on the recommendation
- Locational requirements that support reliable operations and energy price formation, and are as geographically broad as technically feasible

PJM DER Participation Model

- Enabling of retail and wholesale participation while at the same time preventing double counting of the same product
- Balanced metering and telemetry requirements
- A coordination framework that balances market access with safe and reliable distribution system operations
- Would allow both homogenous and heterogeneous aggregations, subject to 100kW min in energy and ancillary service markets and a 5 MW max for individual component DERs

Implementation of PJM DER Participation Model

Proposes:

- an effective date of February 2, 2026, for the Tariff, Operating Agreement and Reliability Assurance Agreement revisions
- an effective date of July 1, 2023, for the revisions pertaining to the DER aggregator offering a planned DER capacity aggregation resource, so a resource can participate in the 2026/2027 delivery year base residual auction

Other PJM Issues

- Increasing reliance on gas-fired generation
 - Need for PJM to have real time information on gas supply arrangements of generators
 - Possibility of proposed rules requiring that PJM capacity resources to have firm fuel supplies
 - Need for PJM to evaluate extent to which new gas-fired generators will have access to firm gas
 - Grapple with implications of differences between gas pipeline business model and the power producer business model
 - Issue of market power in the gas markets under extreme weather conditions

Other PJM Issues

- Increasing role of renewable and intermittent resources
 - Current inefficient technology or unit-specific subsidy approach and inconsistent RPS rules versus:
 - Carbon pricing, or
 - A single, transparent PJM market for RECs
 - Importance of not integrating the REC market into the PJM energy or capacity market so tightly that it affects the prices of energy and capacity for all market participants, given that PJM states have a range of approaches to climate policy.

Other PJM Issues

- Adoption of new flexibility product versus improving Effective Load Carrying Capability calculations to reflect the relatively low marginal value of stand-alone renewables and the significantly higher marginal value of hybrids
- Need for incentives to existing and new entrant resources to unlock the significant flexibility potential that already exists and to stop creating incentives for inflexibility

Other PJM Issues

- A “circuit breaker” for when administrative pricing creates arbitrarily high price signals to which participants cannot respond.
- Improvements to rules allowing demand side resources to participate in the capacity market.
- Coal retirements and RMR tariff reform
- Capacity Performance Model Reform

Questions?

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Timothy C. Burdis

Sr. Manager, State Policy Solutions

A professional with nearly two decades of experience at PJM, Burdis works with PJM states on the interaction between wholesale and retail electric policies.

As senior manager of state policy solutions, Burdis manages a team of professionals who endeavor to harmonize emerging state electricity policies with wholesale market design and transmission system planning policies. His organization specifically focuses on: offshore wind development; clean energy development; resource adequacy evolution; grid modernization; and, grid security maintenance.

Before his current post, Burdis served as the business operations manager to PJM's General Counsel / Senior Vice President of Law, Compliance and External Relations. Here he managed a portfolio on matters relating to corporate governance, regulatory filings, development of policy and messaging, and long-term corporate strategy.

Prior, Burdis served as manager of policy analysis & strategy, managing a team of economists focused on the outreach and strategy development for state government engagement; focusing on policy assessment, market design and transmission planning. Additionally, he managed PJM's engagement with the Organization of PJM States, Inc. (OPSI) and its interaction with the company's Executive Team and Board of Managers.

Burdis started his career as an engineer working in PJM's markets and operations divisions.

He is pursuing his degree at the University of Pennsylvania Law School. He holds a Master of Science in Engineering from West Virginia University and a Bachelor of Science from Lebanon Valley College.

PJM Interconnection, founded in 1927, ensures the reliability of the high-voltage electric power system serving 65 million people in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. PJM coordinates and directs the operation of the region's transmission grid, which includes over 84,236 miles of transmission lines; administers a competitive wholesale electricity market; and plans regional transmission expansion improvements to maintain grid reliability and relieve congestion. PJM's regional grid and market operations produce annual savings of \$2.8 billion to \$3.1 billion.



Biographical Information

Glenn S. Benson, Partner, BakerHostetler, Washington, D.C.
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One of the country's leading representatives of onshore and offshore oil and gas producers on regulatory matters, Glenn Benson brings more than 24 years of experience and an uncommon familiarity with the Federal Energy Regulatory Commission (FERC) to his role on the BakerHostetler national Energy Industry practice team. He counsels clients across the energy industry on tariff and contract disputes before FERC, regulatory compliance and enforcement and the negotiation of commercial transactions, including power purchase agreements, interconnection agreements, pipeline precedent agreements, asset management agreements and oil and gas purchase and sale agreements.

Listed in The **Best Lawyers in America**® since 2015 in the area of energy law, Glenn's authority on nuanced litigation and complex energy policy issues has led to trusted positions advising and representing gas, electric and oil companies in every geographic region of the United States. It has also inspired a high-profile caseload: Glenn handled one of the first offshore natural gas pipeline open and nondiscriminatory access disputes before the U.S. Interior Department's Bureau of Safety and Environmental Enforcement (BSEE).

Memberships

- **Foundation of the Energy Law Journal:** Board of Directors (2005 to 2016)
- **Energy Law Journal:** Business Manager (2005 to 2016)
- **Energy Bar Association**
 - Committee on Natural Gas Regulation
 - Vice Chair (2007 to 2008) & Chairman (2008 to 2009)*
 - Committee on Oil Pipeline Regulation
 - Vice Chairman (2003 to 2004) & Chairman (2004 to 2005)*
 - Natural Gas Pipeline Committee (2000 to 2005)
 - Electric Utility Regulation Committee (2003 to 2005)
 - Generation and Power Marketing Committee (2002 to 2003)
 - Finance and Transactions Committee (2003 to 2004)
 - International Energy Transactions Committee (2003 to 2004)
 - Antitrust Committee (2003 to 2005)
 - Alternative Dispute Resolution Committee (2000 to 2001)

Education

- J.D., University of Virginia School of Law, 1993; Virginia Journal of International Law, Editor; Virginia Center for National Security Law, Chief Editor
- A.B., Syracuse University, 1990, magna cum laude

Brian Kauffman, Director of Regulatory Affairs, PJM Lead
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- 10+ years' experience in electricity business and policy
- Expertise in demand response and PJM electricity markets