



Energy Storage in PJM

Emily Barrett

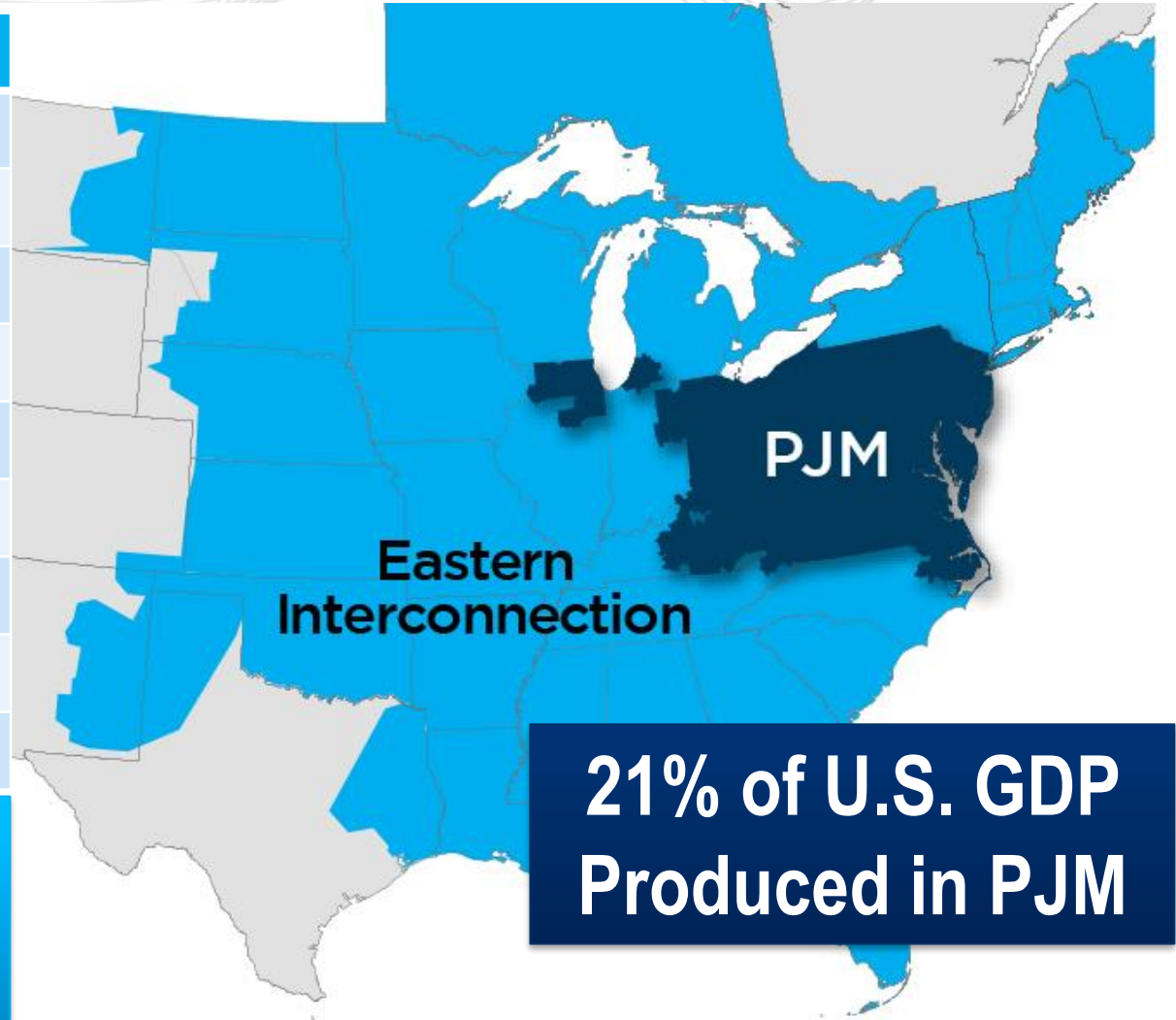
Sr. Lead Market Design Specialist

May 29, 2024

Key Statistics

Member companies	1,090
Millions of people served	65+
Peak load in megawatts	165,563
Megawatts of generating capacity	180,772
Miles of transmission lines	88,185
Gigawatt hours of annual energy	770
Generation sources	1,439
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 2/2024

A large green gear-shaped icon with a white rounded rectangle in the center containing text.

Markets

- Energy
- Capacity
- Ancillary services

A large orange gear-shaped icon with a white rounded rectangle in the center containing text.

Operations

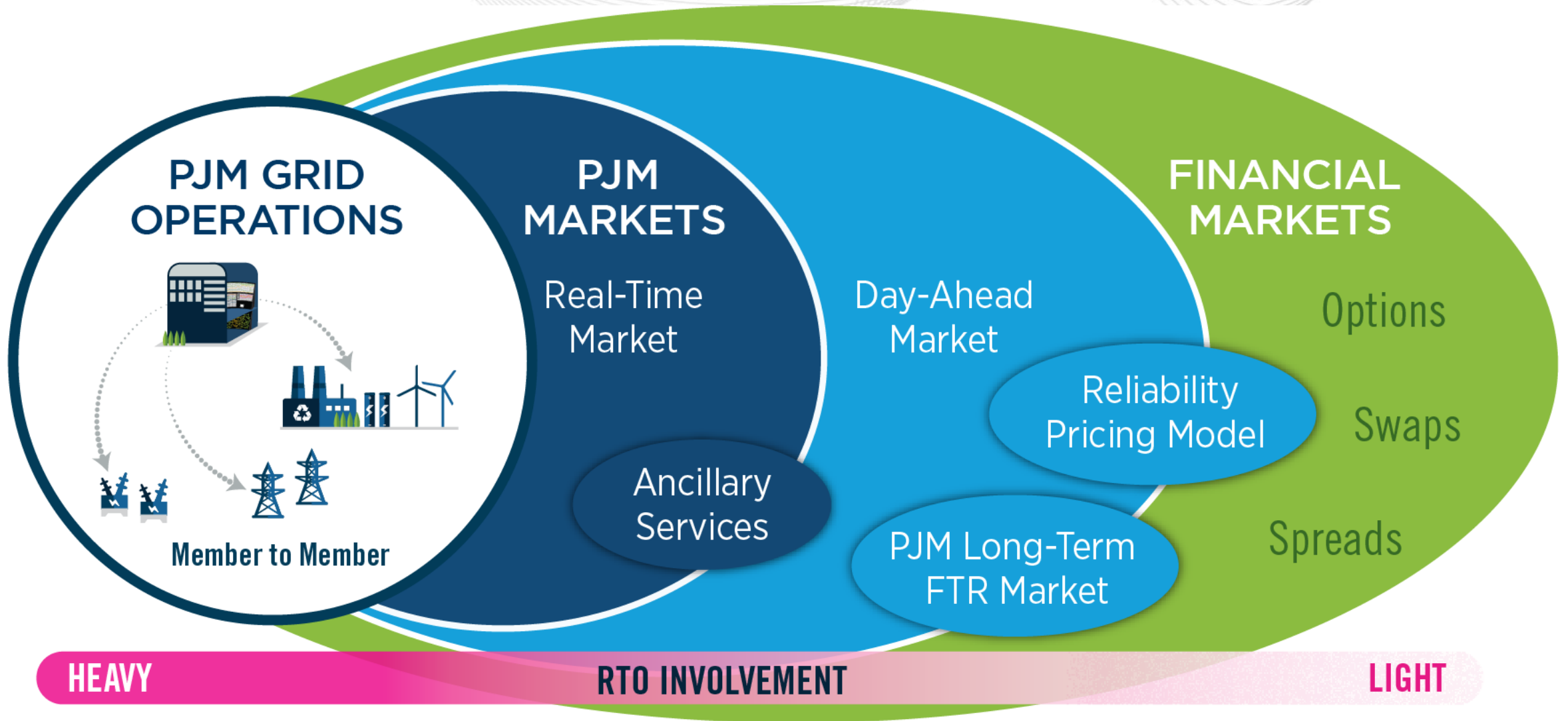
- Grid operations
- Supply/demand balance
- Transmission monitoring

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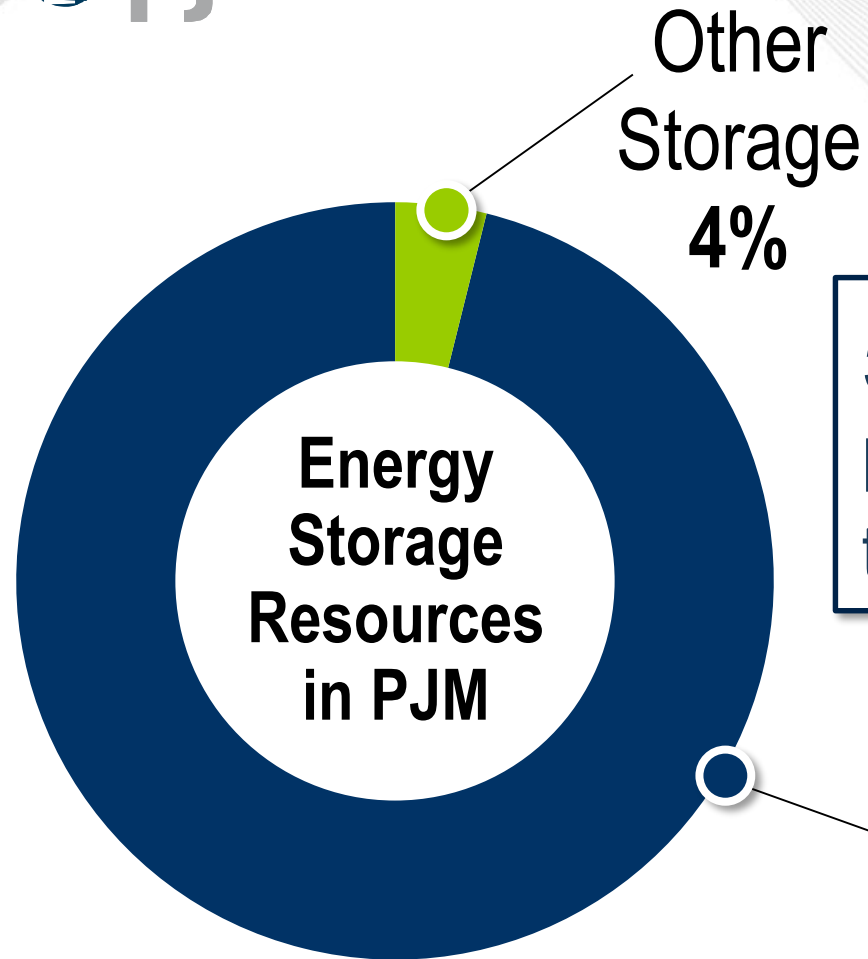
Regional Planning

- 15-year outlook







Over 5,300 MW of Energy Storage in PJM




Other Storage is about ~300 MW of mostly batteries. 

50% Batteries connected to the distribution system. 

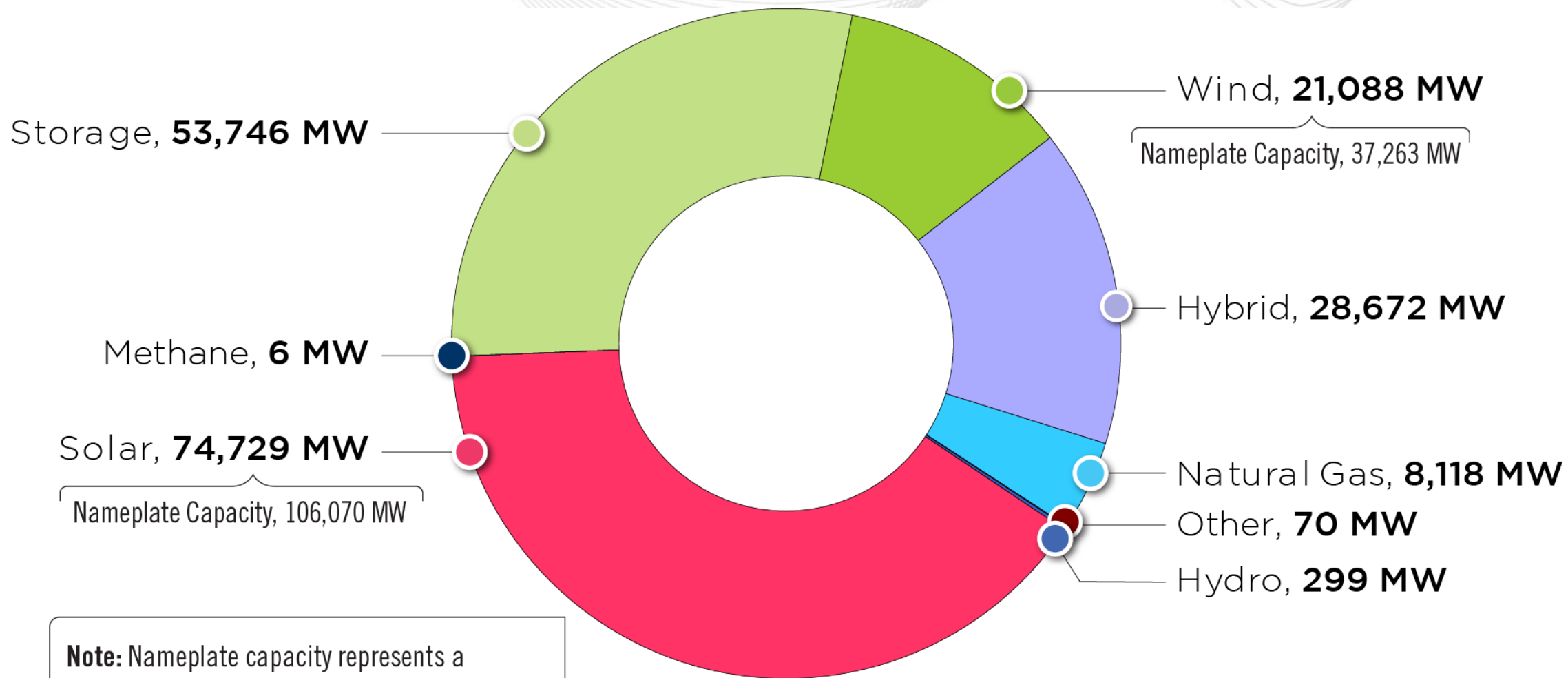
50% Connected to the Bulk Electric System. 

Pumped Hydro 96%

Pumped Hydro currently participates in capacity, energy, regulation and reserves. 

Data taken from Generation Queue and EIA 860

Queued Generation Fuel Mix – Requested Capacity Interconnection Rights



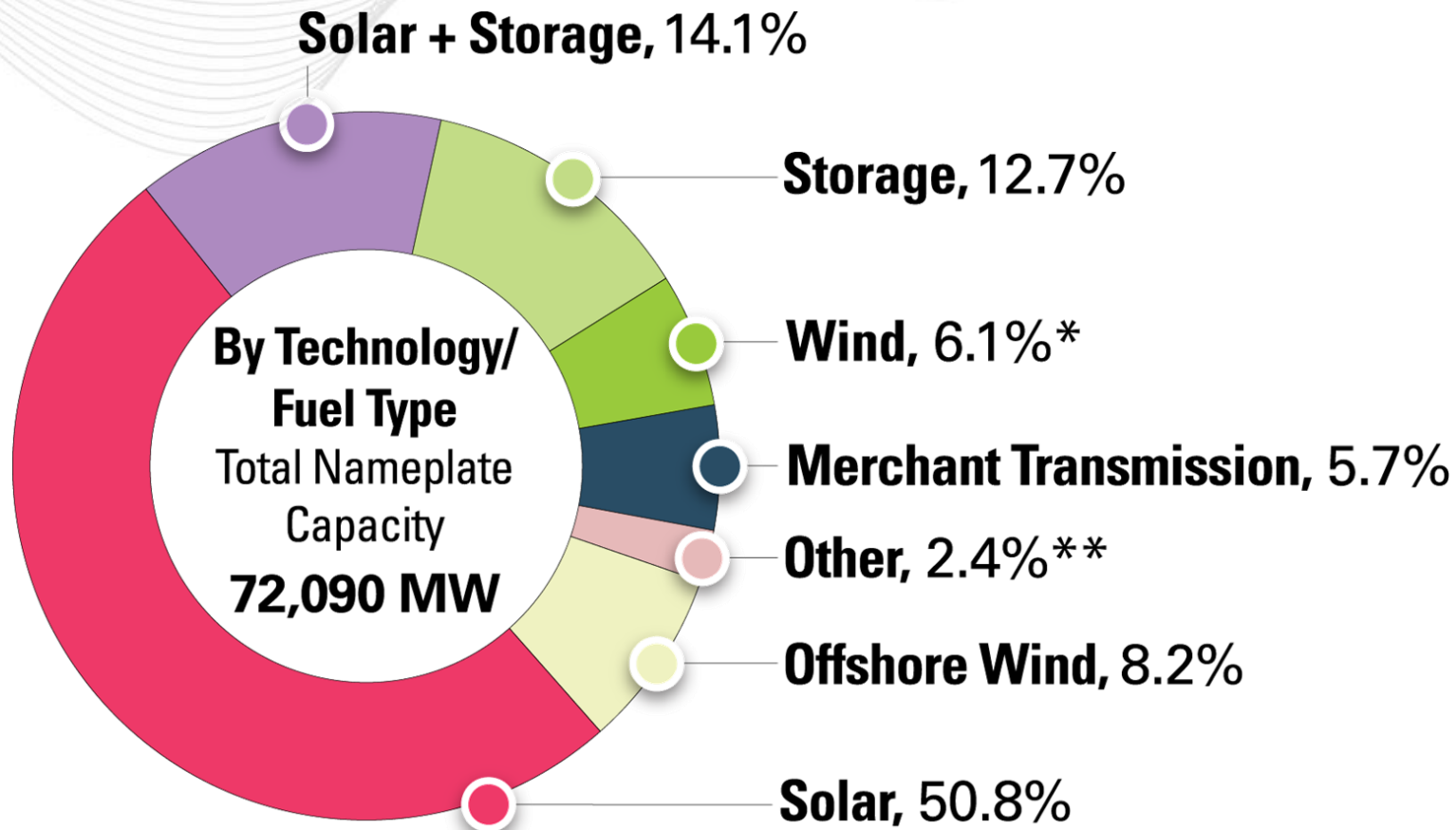
Note: Nameplate capacity represents a generator's rated full power output capability.

As of Dec. 31, 2023



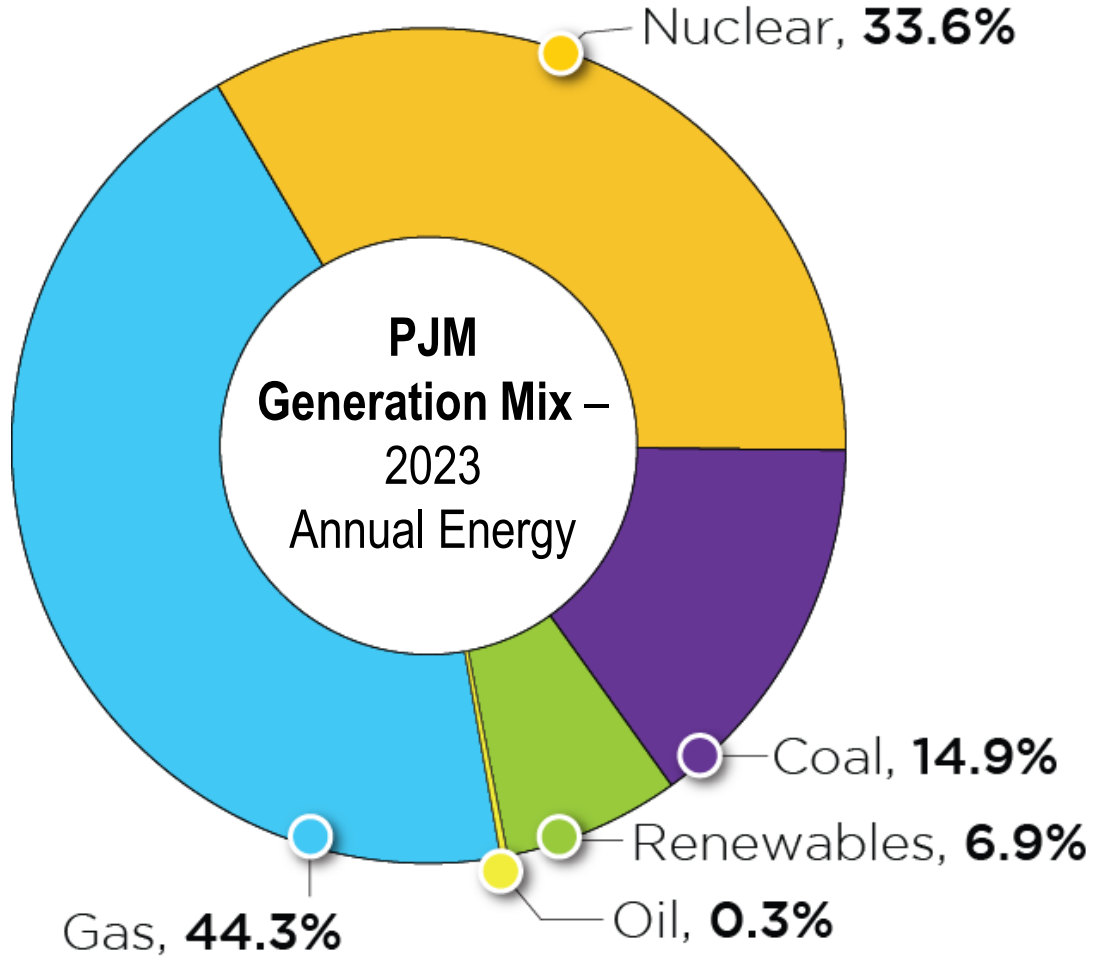
Projects To Clear PJM Interconnection Process in 2024 and 2025

By State	Number of Projects	Total Nameplate Capacity (in MW)
DE	5	1,184
IL	82	13,798
IN	69	13,475
KY	39	4,125
MD	6	1,288
MI	8	887
NC	25	1,775
NJ	25	1,528
OH	72	8,613
PA	108	5,055
VA	162	19,012
WV	15	1,350
Total	616	72,090



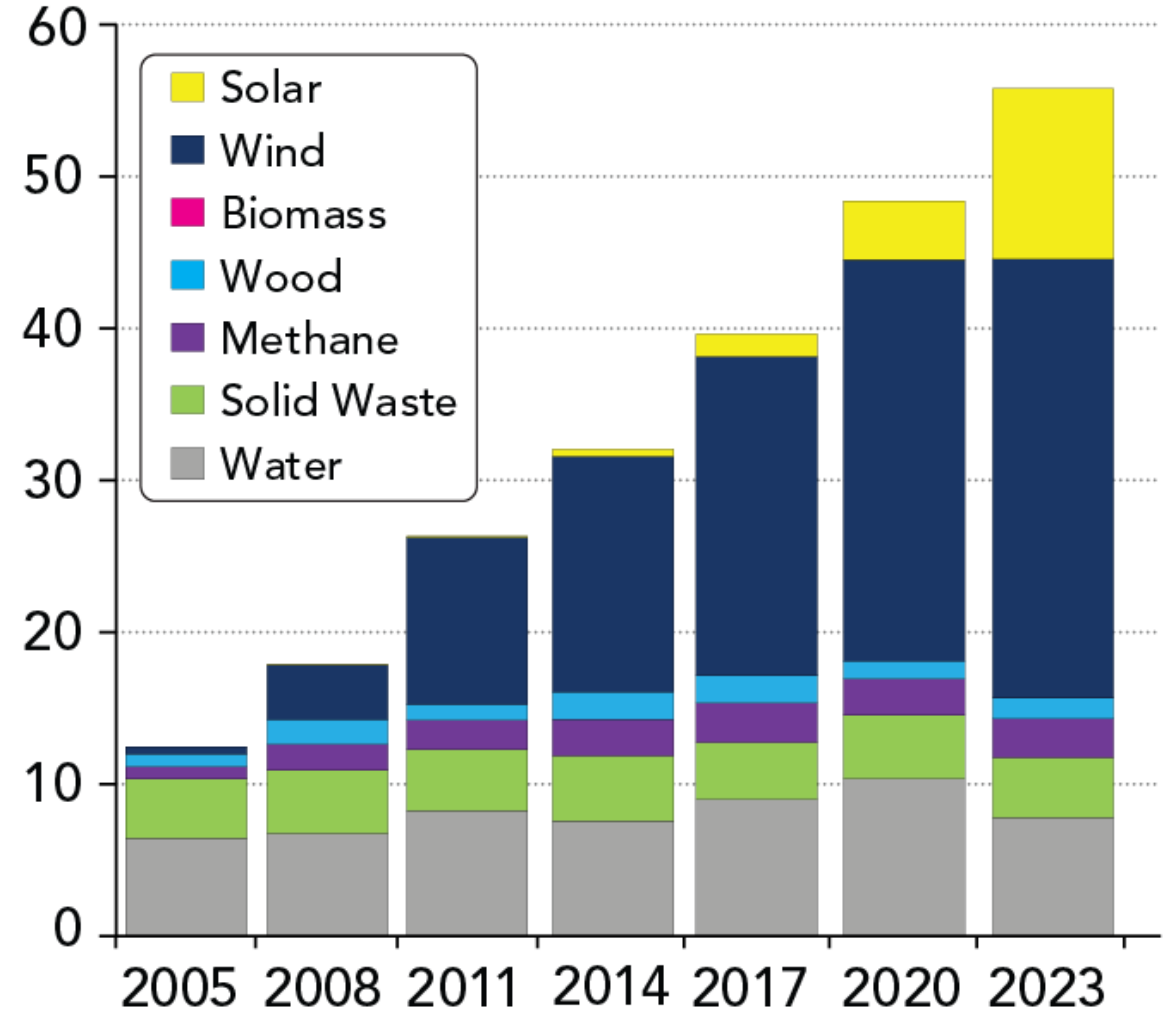
*Includes one combined Wind & Solar facility of 199 MW
 **Other: Natural Gas (1,647 MW, 2.3%) and Hydro (51 MW, 0.1 %)

Percentage of Renewable Energy Is Small but Growing



As of 12/2023

MWh (millions)





**Grid Frequency Regulation
from Data Centers**

**Frequency Regulation from
Light Rail Battery**



**Capacity & Ancillary
Services from Campus
Cogen**



**Energy & Frequency Regulation
from Solar-Storage Microgrid**

**876 kW solar
+ 580 kWh
storage**

**PJM
wholesale
power plant**

**Also:
backup
during grid
outage**

- Hopewell Valley Central HS
- Owned by Public Service Electric and Gas Company (PSE&G)



Effective
Load
Carrying
Capability



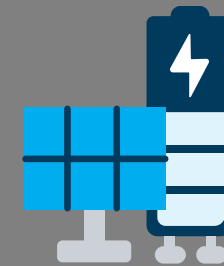
Operating
Reserves and
Regulation
Enhancements



Energy
Storage
Model



Solar-Battery
Hybrid
Resources



DER
Aggregation
Model





Energy Generation by Fuel Source in 2022 and 2023

	2022		2023		Change in Output
	GWh	Percent	GWh	Percent	
Coal	167,604	20.0%	120,876	14.7%	(27.9%)
Nuclear	271,522	32.3%	273,489	33.5%	0.7%
Gas	335,707	40.0%	363,660	44.3%	8.3%
Hydroelectric	9,570	1.1%	9,392	1.1%	(1.9%)
Hydro – Pumped Storage	6,093	0.7%	6,097	0.7%	0.1%
Wind	31,491	3.8%	28,937	3.5%	(8.1%)
Waste	4,056	0.5%	3,993	0.5%	(1.6%)
Oil	2,699	0.3%	2,677	0.3%	(0.8%)
Solar	9,242	1.1%	11,098	1.4%	20.1%
Battery	25.4	0.0%	28.7%	0.0%	12.7%
Biofuel	1,371	0.2%	1,2656	0.2%	(7.7%)



PJM Uses Effective Load Carrying Capability in Capacity Market Accreditation

ELCC sets a cap on how much resource adequacy value a resource can provide.

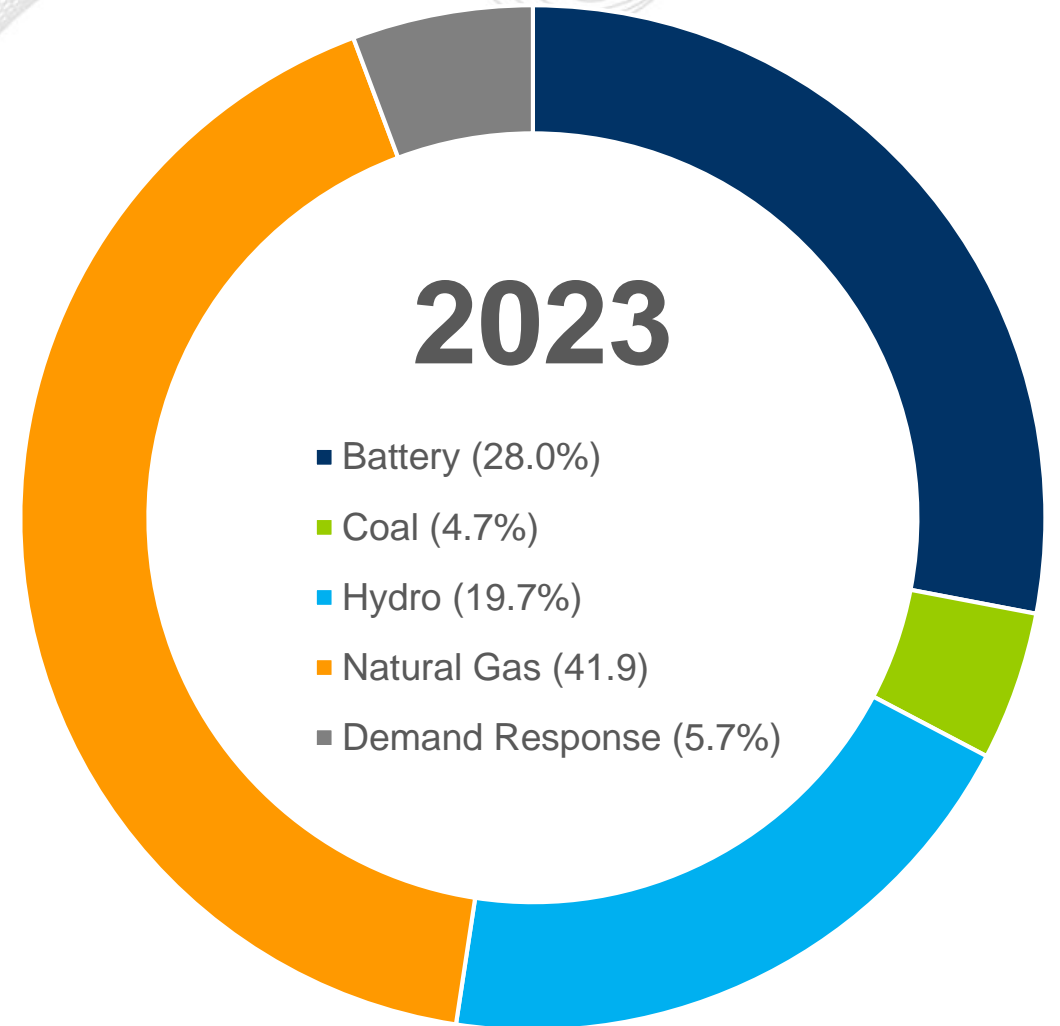
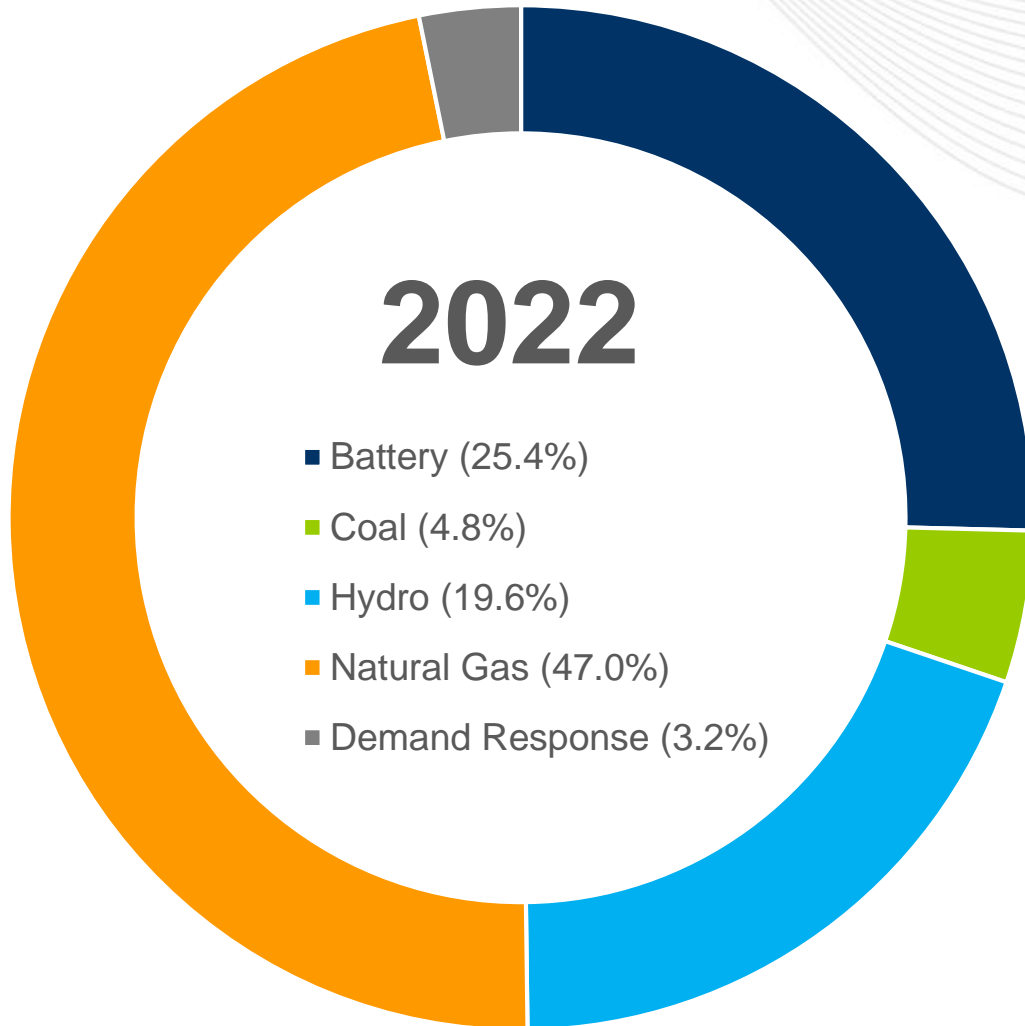
ELCC compares hourly output of a resource (or class) to the hourly output of all other resources and hourly load patterns to measure the extent to which the resource (or class) improves reliability.

WHY?

Under high deployment of variable resources and limited-duration resources, periods of high load shed risk can shift.

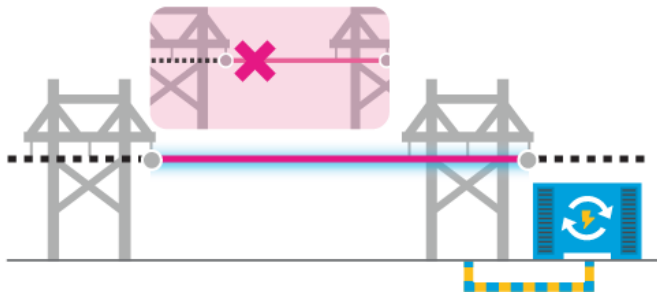
	2025/2026 BRA ELCC Class Ratings
Onshore Wind	35%
Offshore Wind	60%
Fixed-Tilt Solar	9%
Tracking Solar	14%
Landfill Intermittent	54%
Hydro Intermittent	37%
4-hr Storage	59%
6-hr Storage	67%
8-hr Storage	68%
10-hr Storage	78%
Demand Resource	76%
Nuclear	95%
Coal	84%
Gas Combined Cycle	79%
Gas Combustion Turbine	62%
Gas Combustion Turbine Dual Fuel	79%
Diesel Utility	92%
Steam	75%

Source: <https://www.pjm.com/-/media/planning/res-adeq/elcc/2025-26-bra-elcc-class-ratings.ashx>



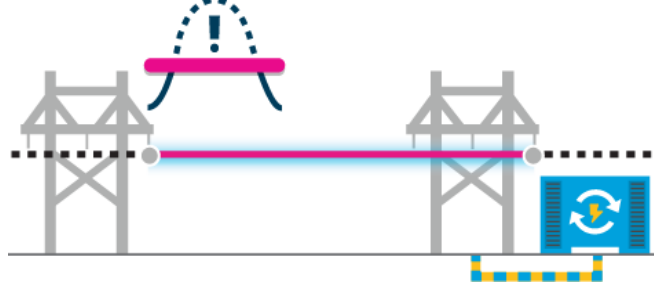
N-1 Relief

- Power injection to support grid stability during contingency
- Increase operational capacity of existing line



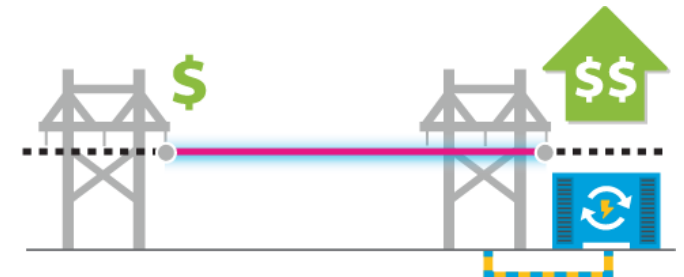
Peak Load Relief

- Inject power downstream of thermal constraints during peak hours
- Avoids or defers new



Congestion Management

- Injects power downstream of congested transmission facilities
- Reduces net load payment and other costs to customers



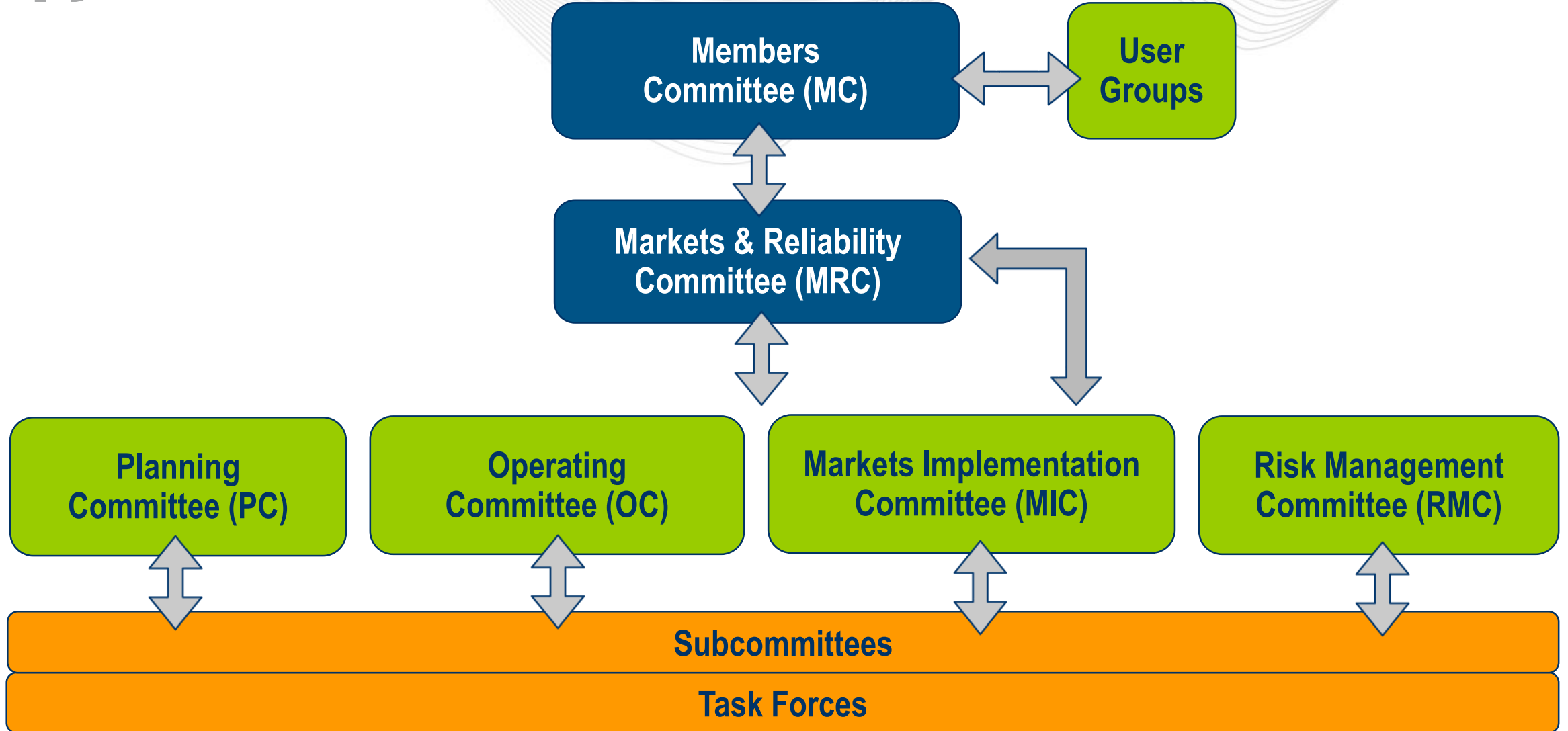
Comprehensive Topics on Reserve and Energy Market

Immediate-Need Scope

Addresses current synchronized reserve performance concerns, observation on reserve price formation implementation, and deployment of reserves

Longer-Term-Need Scope

Addresses future system needs for reserve and flexibility, with evaluation of the Operating Reserve Demand Curve (ORDC), operational metrics, and enhancements or additional market products or solutions (ramping, multi-interval, etc.)



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Market Design

PJM Interconnection

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