The Role of Electricity Markets in Regional Planning and Achieving Climate Goals

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PJM Interconnection
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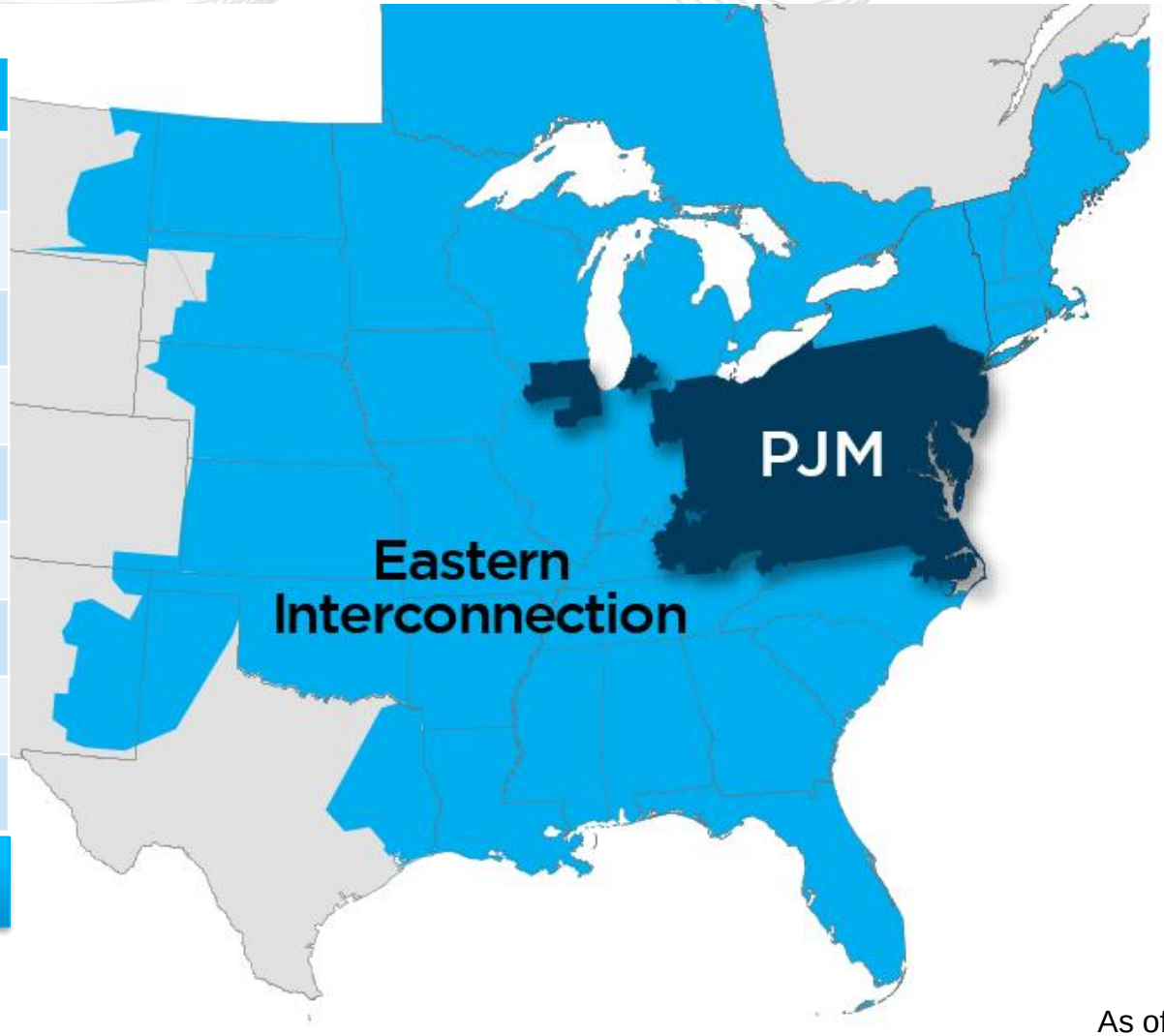
PJM as Part of the Eastern Interconnection

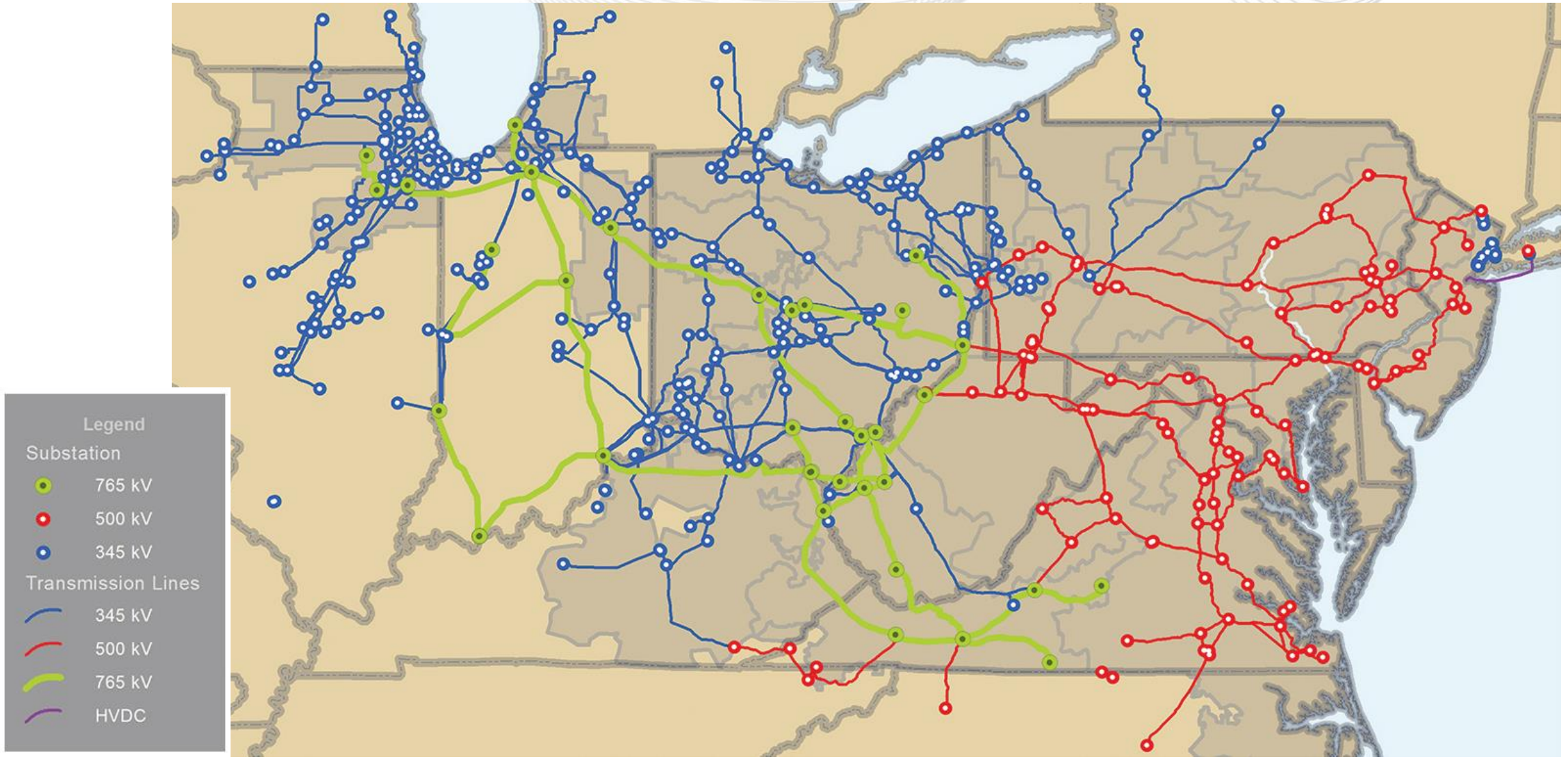
Key Statistics	
Member companies	1,040+
Millions of people served	65
Peak load in megawatts	165,563
Megawatts of generating capacity	185,378
Miles of transmission lines	85,103
2020 gigawatt hours of annual energy	757,284
Generation sources	1,424
Square miles of territory	369,089
States served	13 + DC

21% of U.S. GDP produced in PJM

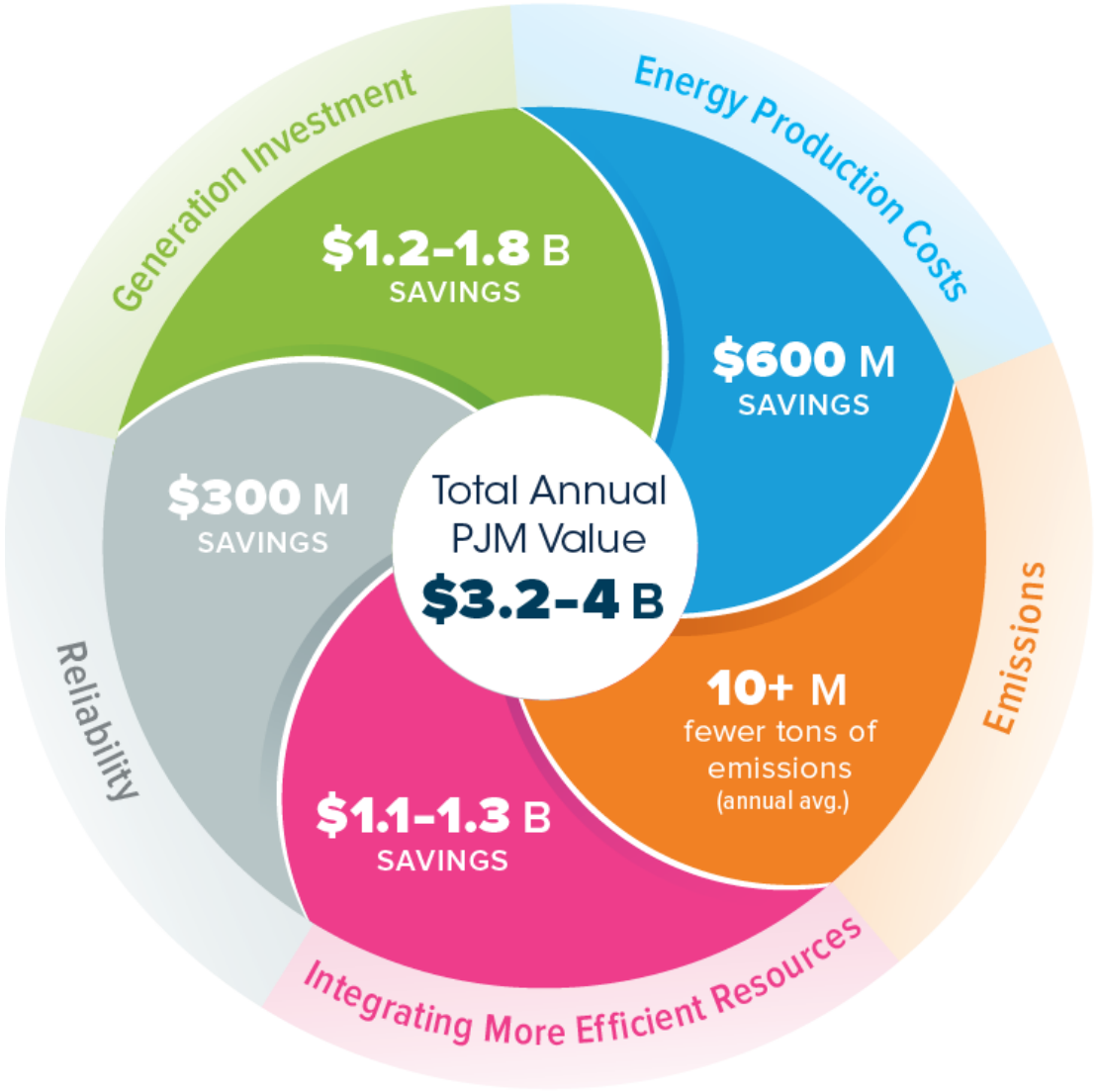


As of 2/2021

PJM Backbone Transmission



Value Proposition



All numbers are estimates.

PJM's Role as a Regional Transmission Organization

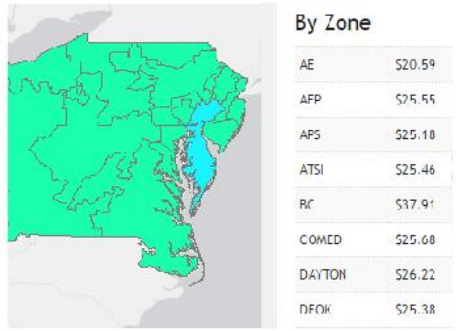
PLANNING

Planning for the future like...

OPERATIONS

Matches supply with demand like...

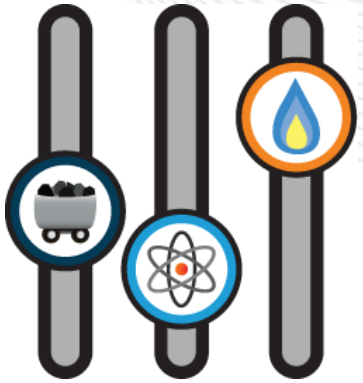
MARKETS



Energy Market Pricing like...

Industry Paradigm Shift

Changing market participant profiles



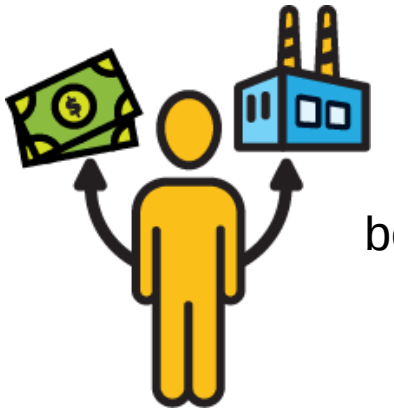
Changing fuel mix

Regulatory uncertainty

Energy efficiency

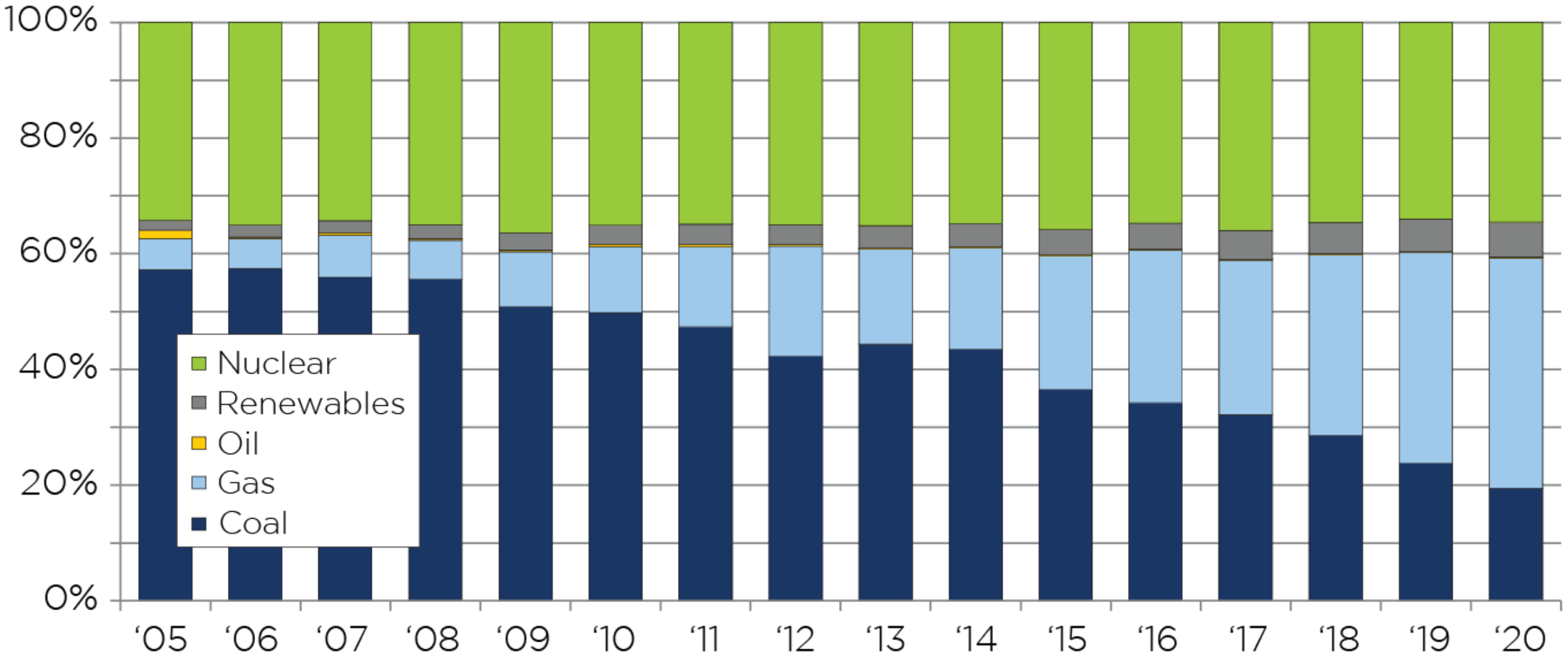
Renewable and distributed energy resource integration

Cybersecurity and system resiliency

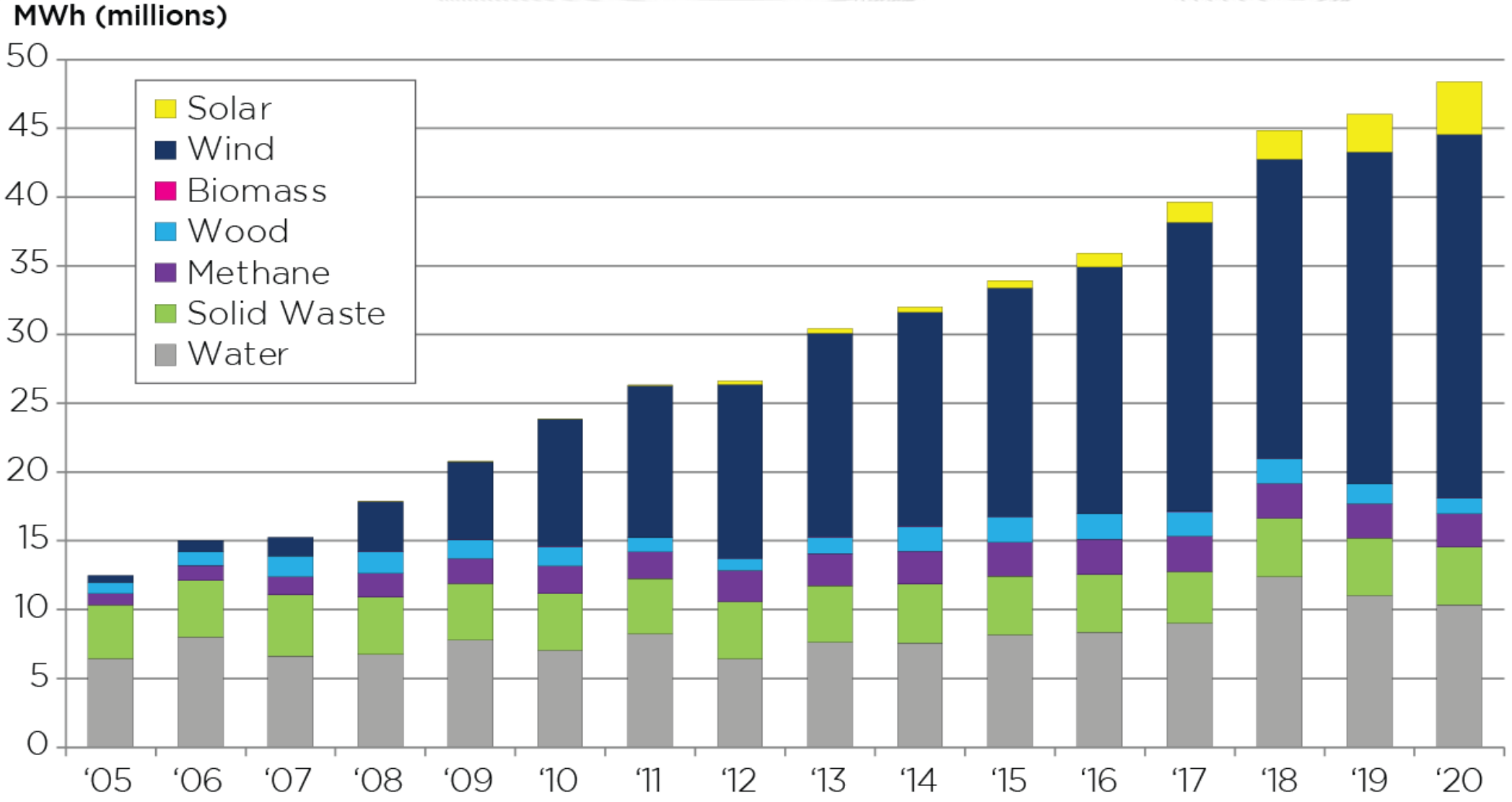


Customer behavior and choice

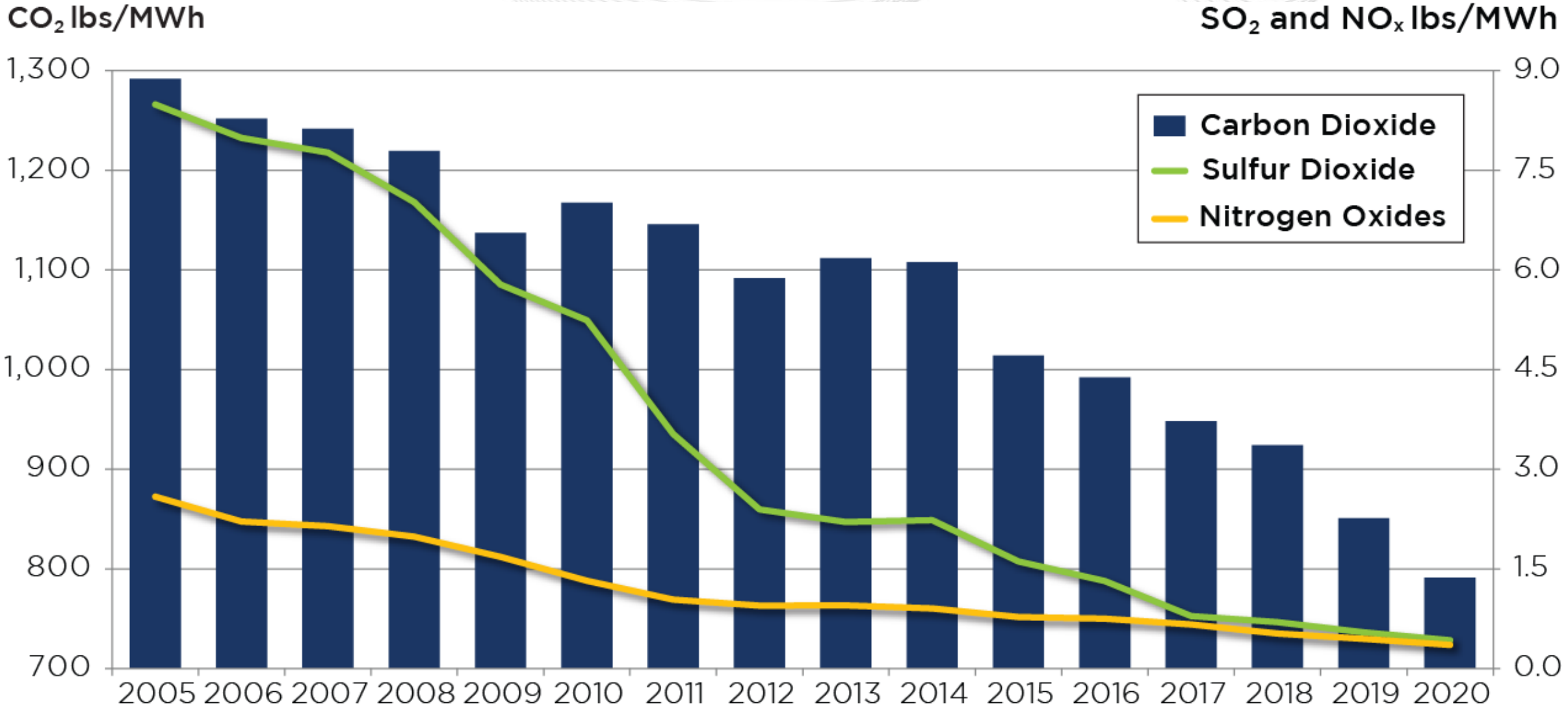
2005–2020 Annual Fuel Mix



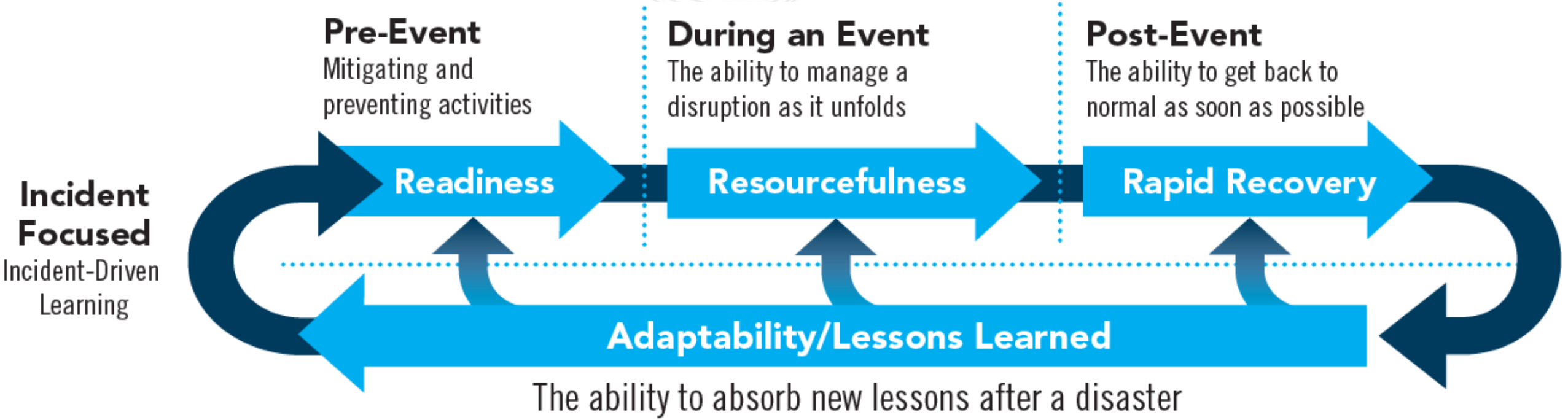
2020 Renewable Energy in PJM



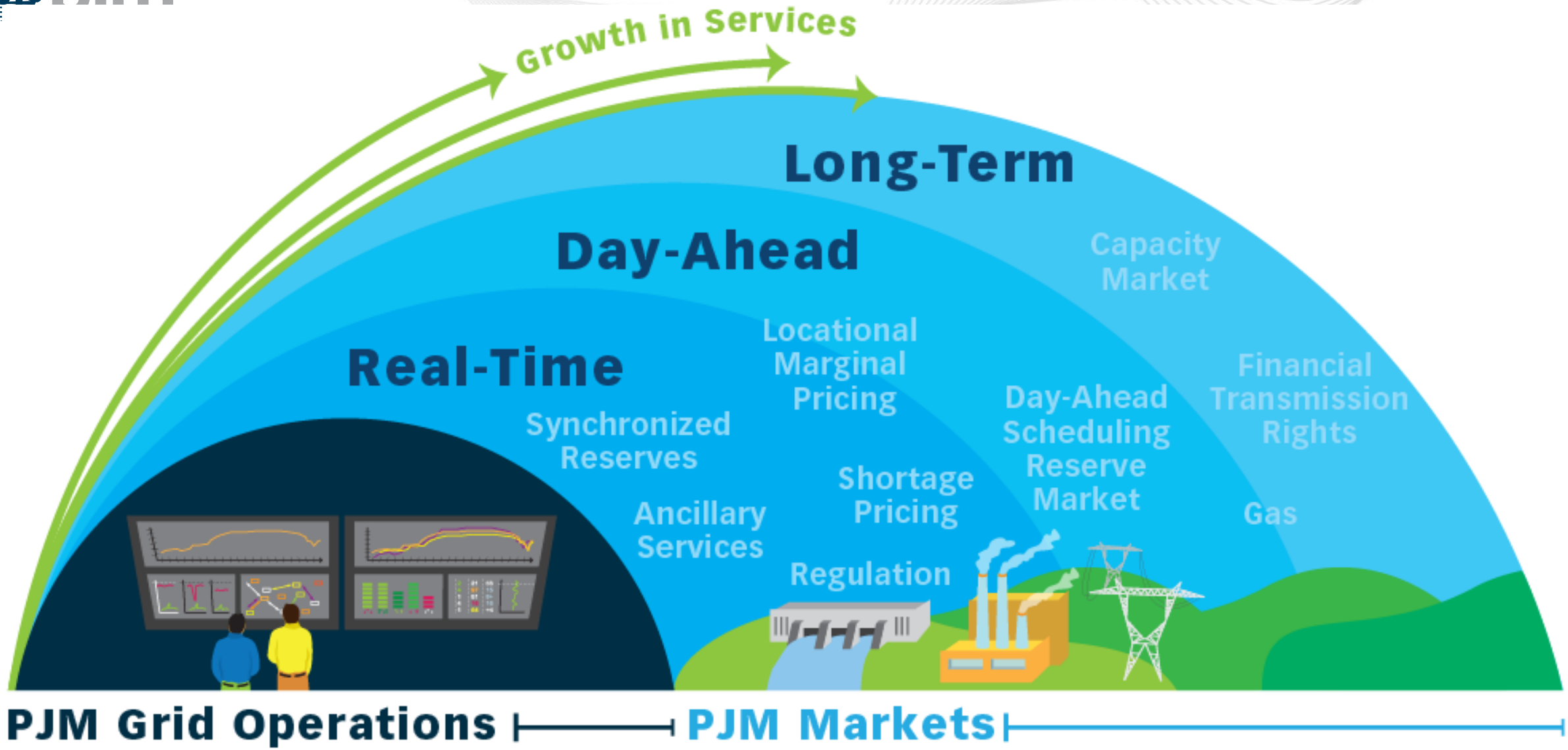
PJM System Average Emission Rates



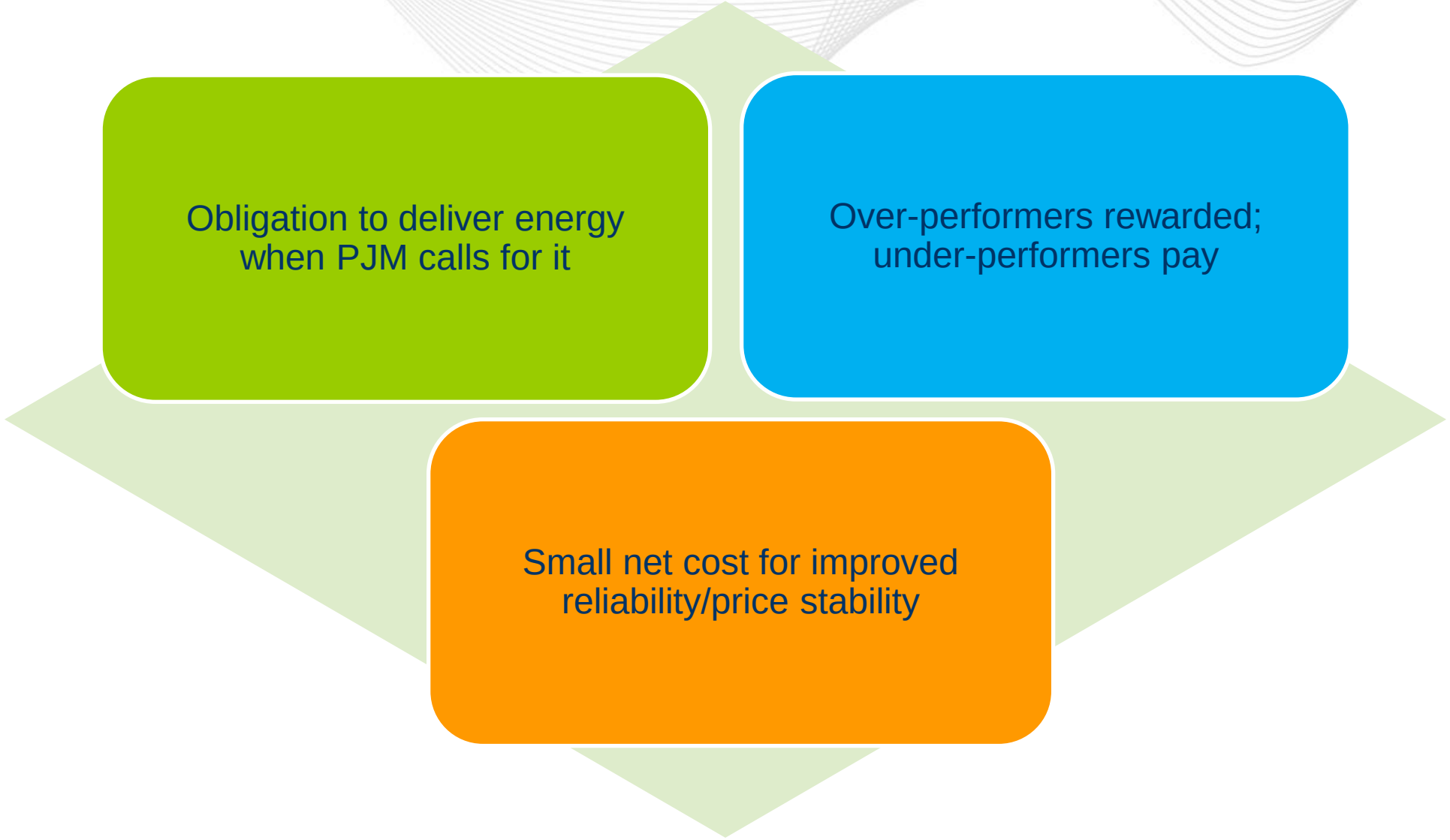
What Is Resilience?



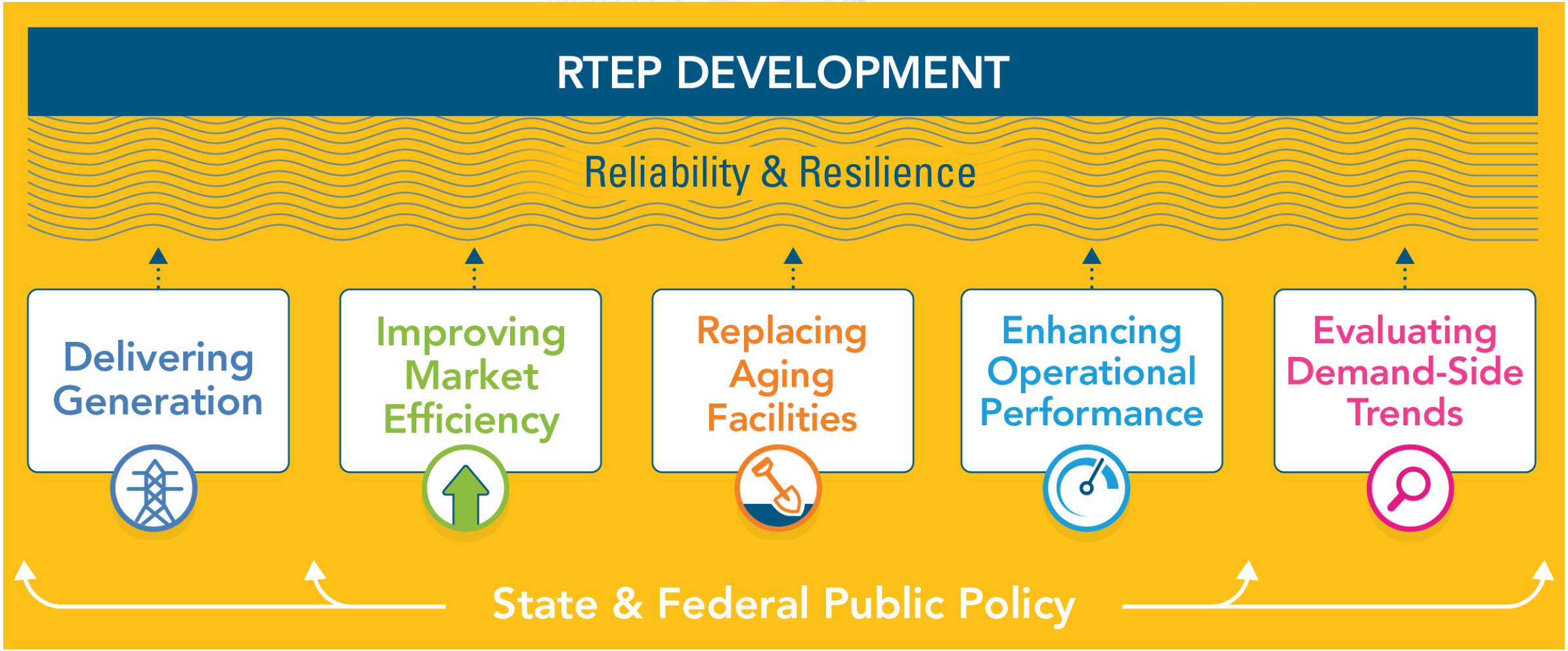
PJM Markets



Capacity Performance Features

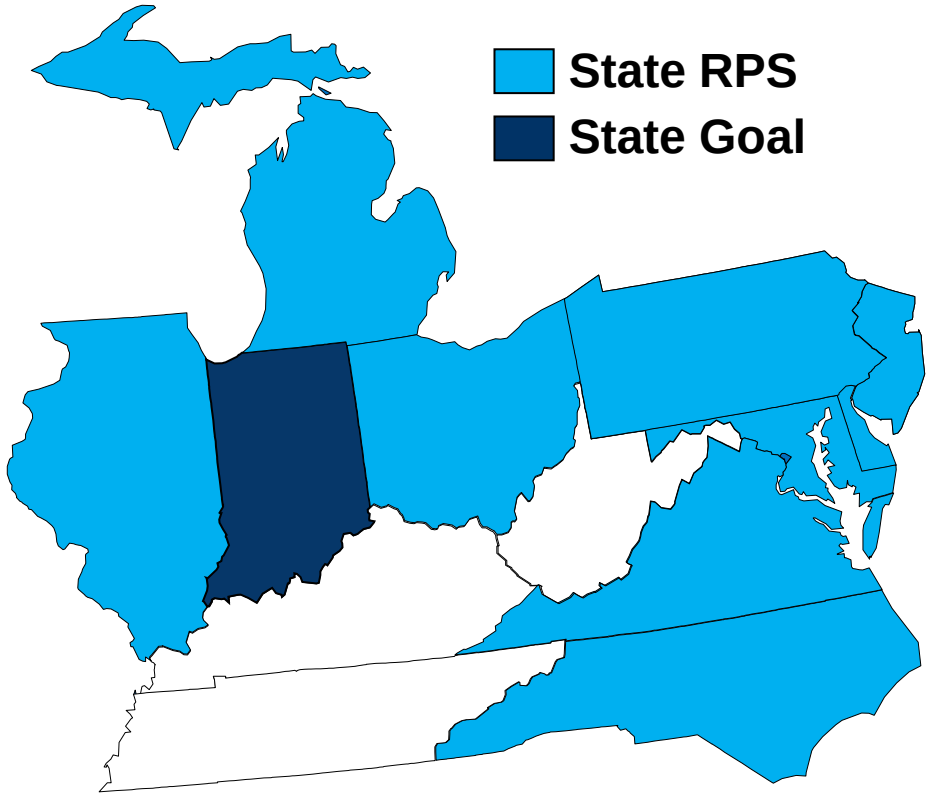


System Enhancement Drivers



PJM States With RPS

State Renewable Portfolio Standards (RPS) require suppliers to utilize renewable resources to serve an increasing percentage of total demand.



Feb. 2021

State RPS Targets*

- ☼ **NJ:** 50% by 2030**
- ☼ **MD:** 50% by 2030
- ☼ **DE:** 40% by 2035
- ☼ **DC:** 100% by 2032
- ☼ **PA:** 18% by 2021***
- ☼ **IL:** 25% by 2025-26
- ☼ **VA:** 100% by 2045/2050 (IOUs)
- ☼ **NC:** 12.5% by 2021 (IOUs)
- **OH:** 8.5% by 2026
- **MI:** 15% by 2021
- **IN:** 10% by 2025***

☼ Minimum solar requirement

* Targets may change over time, these are recent representative snapshot values
** Includes an additional 2.5% of Class II resources each year
*** Includes non-renewable “alternative” energy resources

Snapshot of DER in PJM Today

Wholesale DER

1 GW
Demand Response

Customer-sited generation:
Offers into capacity, energy and/or ancillary services markets

84%	15%	1%
Diesel	**Natural Gas**	**Other**

Remaining ~8 GW of DR is load modification without any generation
(e.g., industrial process management)

~2 GW
Generator

Front-of-the-meter generation: Offers into capacity, energy and/or ancillary services markets

Can be sited at customers

Mostly solar but also other fuels

Non-Wholesale DER

~10 GW
DER

- **Solar PV DER:** Retail/rooftop solar
- **Municipal DER:** Municipal electric company distribution-level generators
- **Process DER:** Industrial generators, combined heat and power
- **Resilience DER:** Emergency backup
- **Qualified Facilities:** Direct sales to distribution utilities

Reliability is Job One

Rationale for Refreshing PJM's Strategy

There is a broad set of trends reshaping the energy ecosystem, e.g.,

- States & stakeholders adopting decarbonization goals
- Intermittent resource penetration increasing rapidly, with changing mix
- DER proliferating rapidly, with limited visibility to us
- High investment in grid modernization
- Innovation in technology, business models, etc.

Across our footprint, we see these trends progressing at varied pace and impacting some stakeholders sooner than others.

These trends are impacting our ability to fulfill our fundamental functions.

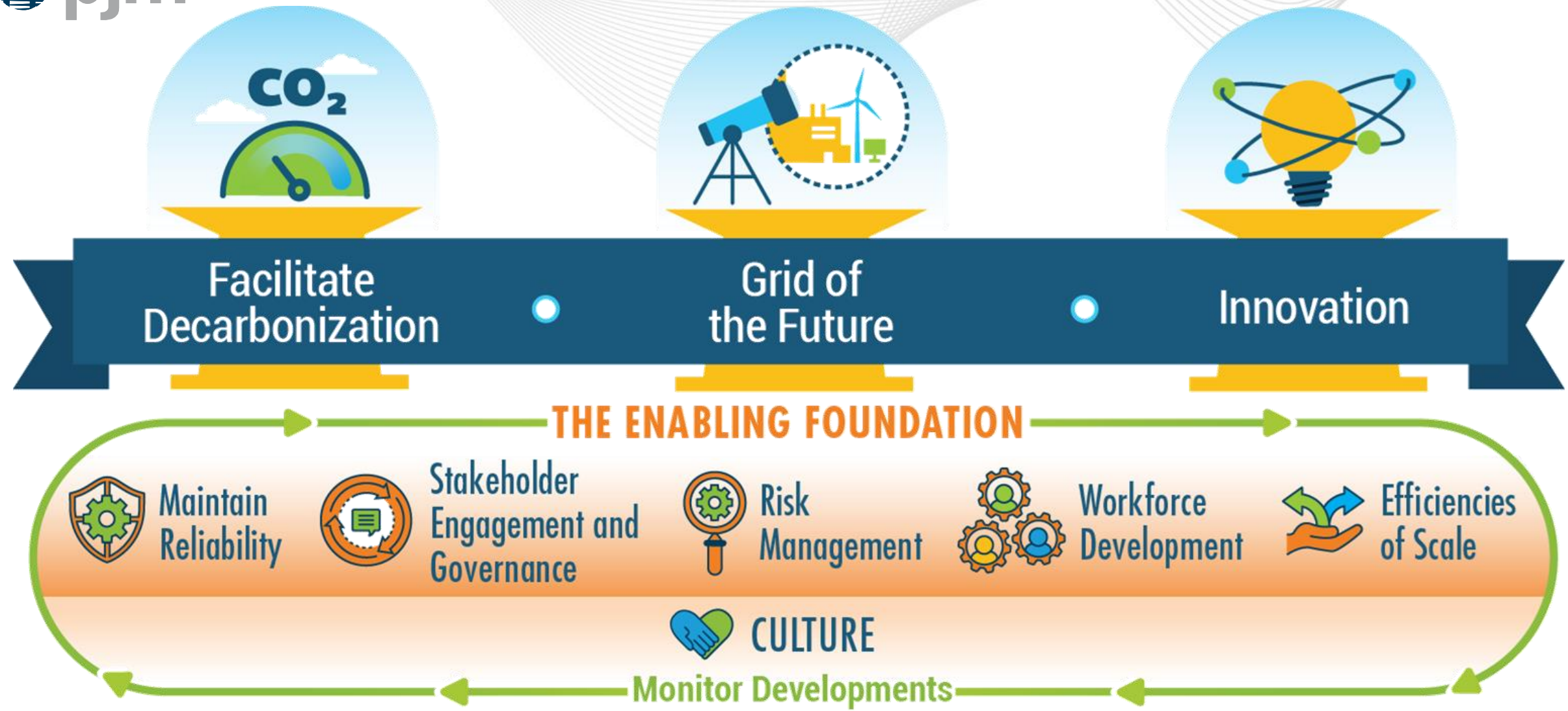
- Operations
- Markets
- Planning

This transition represents a significant change in our environment.

Continuing to deliver value to the region requires us to take a significant role in managing an efficient and reliable transition.

PJM needs to make sure our strategy reflects the factors driving our industry to continue to maximize our value to the region we serve.

Strategic Pillars



Appendix

Appendix – PJM Evolution

Joined in 1927

Joined in 1956

Joined in 1965

Joined in 1981

Joined in 2002

Joined in 2004

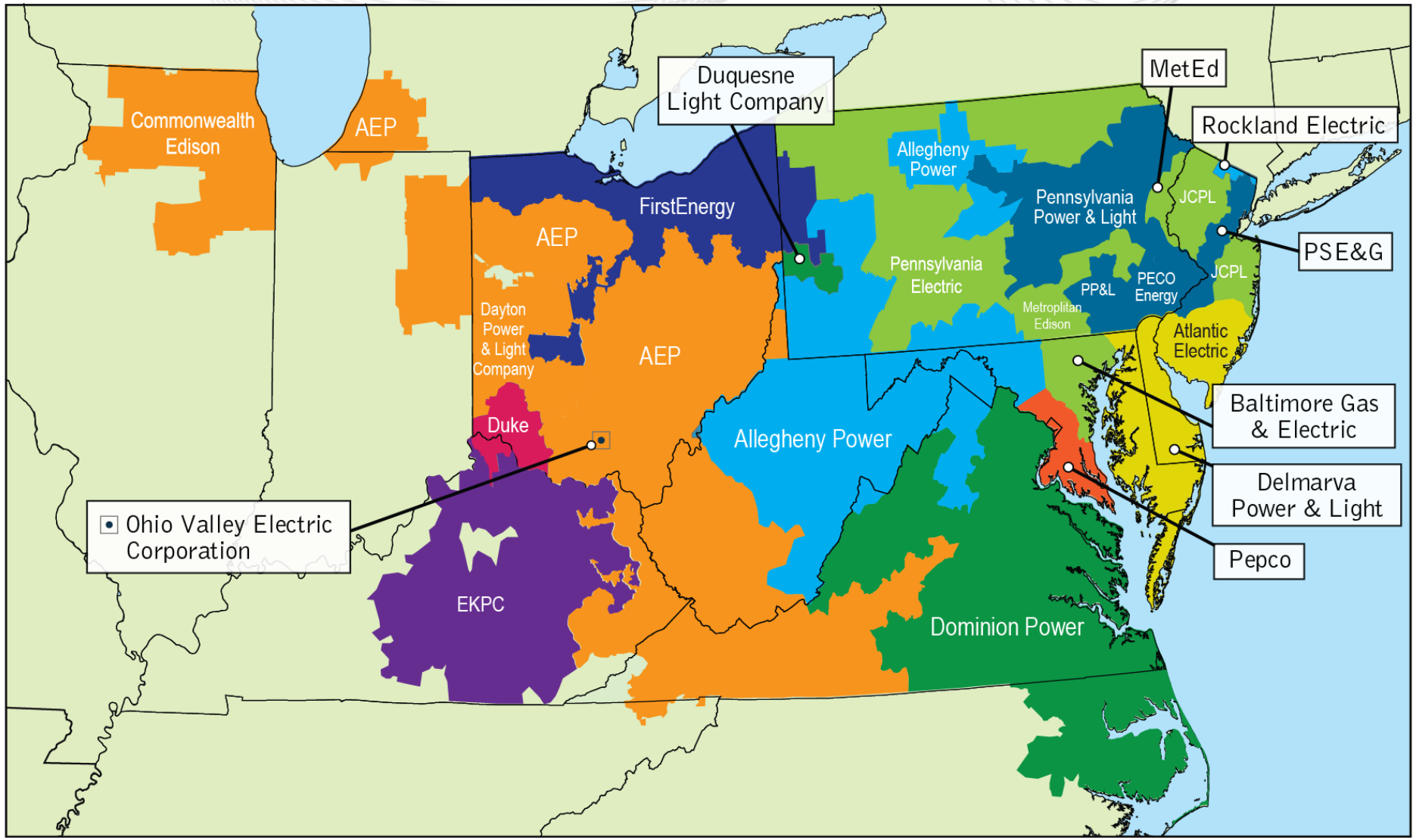
Joined in 2005

Joined in 2011

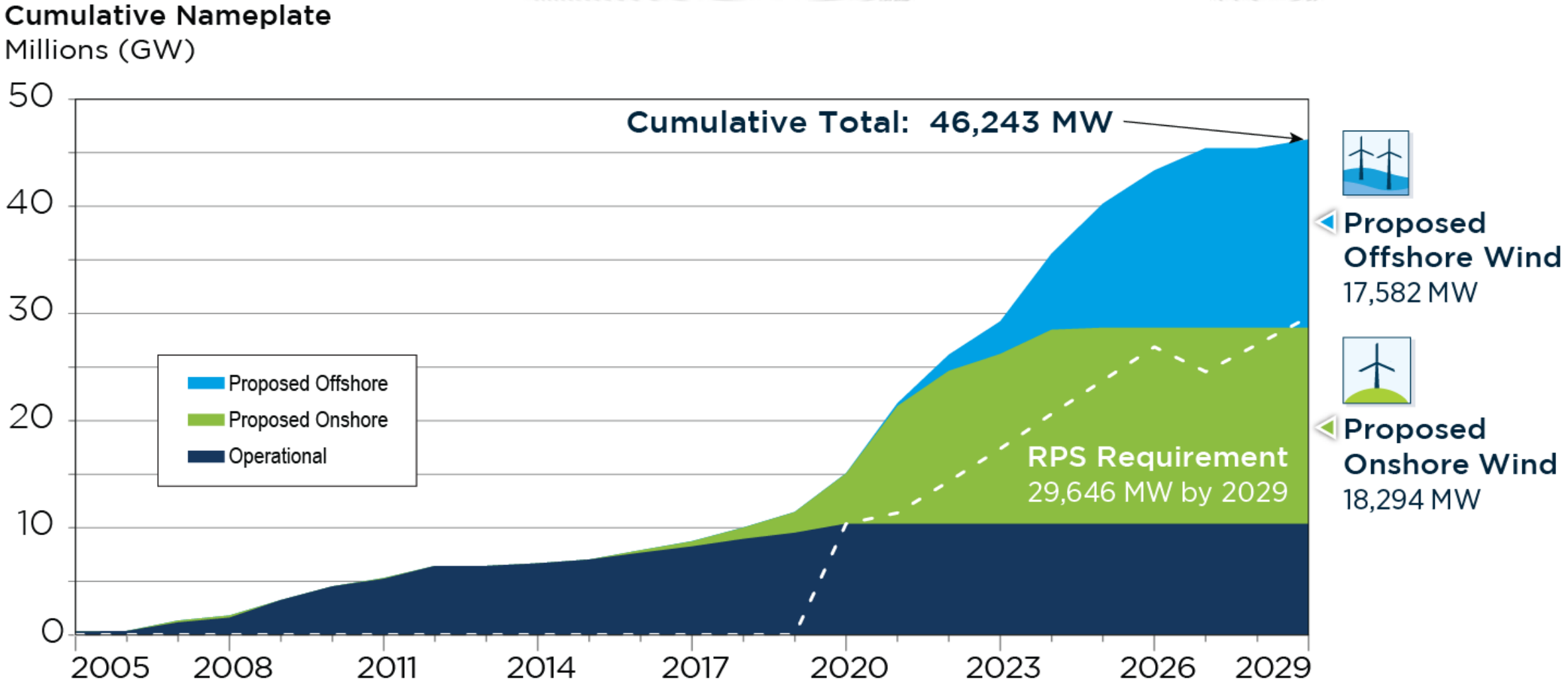
Joined in 2012

Joined in 2013

Joined in 2018

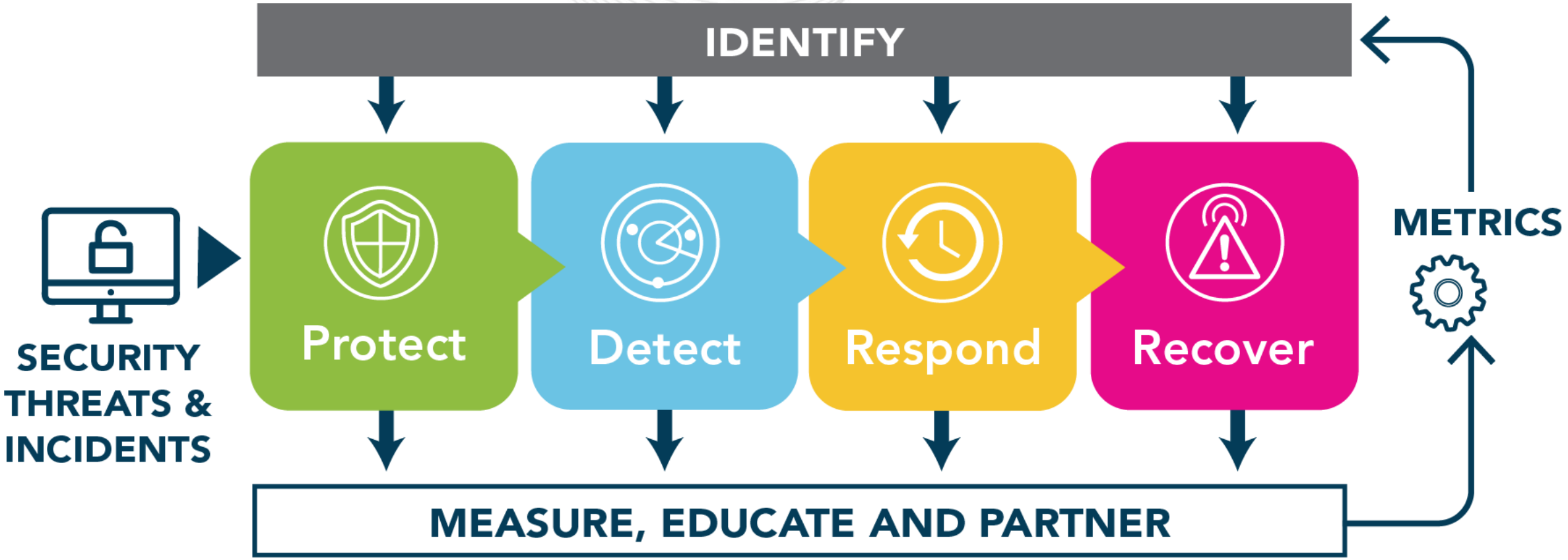


Appendix – Wind Installed Capacity in PJM: Operational & Proposed



As of December 31, 2020

Appendix – Managing Security Threats



Appendix – Cyber Resilience With Eyes Wide Open

Prevention

- Build security into the design
- Implement traditional controls
- Improve security controls

Resilience

- Focus on incident response
- Enhance scenario planning
- Plan and drill restoration scenarios

Collaboration

- Coordinate response plans
- Develop and maintain government relationships
- Leverage industry relationships
- Share best practices

Appendix – Facilitating the Reliable and Cost-Effective Decarbonization Transition

Major trends

We currently manage one of the most diverse groups of states in the country with regard to decarbonization policy.

Absent federal policy, we will continue to face this divergence over the next decade.

PJM is not a policymaker, but can play a key role in informing and facilitating policy choices.

Implications

Growth in ambition and differences in state decarbonization policies pose risk for our ability to administer efficient markets and effective planning.

Recognizing the magnitude of the climate change issue and the unique position PJM holds and the role we fulfill, PJM will enable decarbonization efforts by policymakers and consumers in a reliable, cost-efficient manner utilizing at-scale, market-based solutions whenever possible.

Our strategic intent and initial associated initiatives

We will facilitate pursuit of policy-maker and consumer decarbonization objectives by establishing ourselves as a trusted, unbiased policy adviser & driving consensus for at-scale, market-based solutions where possible.

- Convene stakeholders to develop a resource adequacy construct that better supports state and federal decarbonization goals
- Support states' decarbonization objectives using competitive, market-based solutions wherever possible
- Utilize State Agreement Approach to enable state decarbonization goals where appropriate
- Explore solutions to operating challenges associated with intermittent resource penetration

Appendix – PJM's Unique Position to Drive an Efficient Transition to the Grid of the Future

Major trends

Utility-scale wind and solar generation is increasing in our territory (from 3% today to as high as 100% under a Biden plan)

DER penetration is increasing in our territory (distributed PV projected to grow at 13% CAGR '19-'25)

Aggressive offshore wind agenda by certain PJM states

Aging transmission infrastructure and associated replacement spend

Implications

We need to:

- Ensure operational reliability and long-term resource adequacy with a higher share of intermittent resources
- Develop markets and planning criteria to incorporate DER
- Incorporate OSW into planning processes
- Continue to help drive transparency into supplemental project spend and encourage regional approaches while respecting CTOA limits

Our strategic intent and initial associated initiatives

We will be successful in facilitating an efficient transition to the grid of the future given our unique regional role and position operating and administering one of the largest grids in the U.S.

- Establish a clear vision of the future grid
- Develop Order 2222 compliance framework
- Evolve planning criteria to ensure reliability given increasing intermittent resources
- Ensure reliable and efficient integration of offshore wind
- Evolve interconnection process to better meet changing stakeholder needs
- Ensure resource adequacy construct accurately accounts for reliability value of resources
- Explore products to value grid reliability services
- Ensure system reliability given DER proliferation
- Define model of coordination with distribution utilities

Appendix – Fostering Innovation Will Be Essential to Responding to Major Trends Driving Change in the Power System

Major trends

Major trends like DER/intermittent resource growth and state decarbonization policies are driving changes across the power sector and will require us to adapt.

Increasing volume of data and advanced analytical tools are creating new opportunities to drive value for the region.

Implications

Increasingly complex power systems will require testing and implementing new technologies, market structures and operational practices.

Opportunity to leverage technology and innovation to create value for stakeholders.

New skillsets and mindsets are needed to drive required changes.

Our strategic intent and initial associated initiatives

We will create an environment to become a center for grid innovation in the U.S. by fostering innovative approaches to addressing challenges both internally and with our external stakeholder community.

- Build high-value data and analytics use cases
- Build a robust data & analytics foundation
- Enhance innovation process, frameworks & organization
- Foster innovative talent & culture