

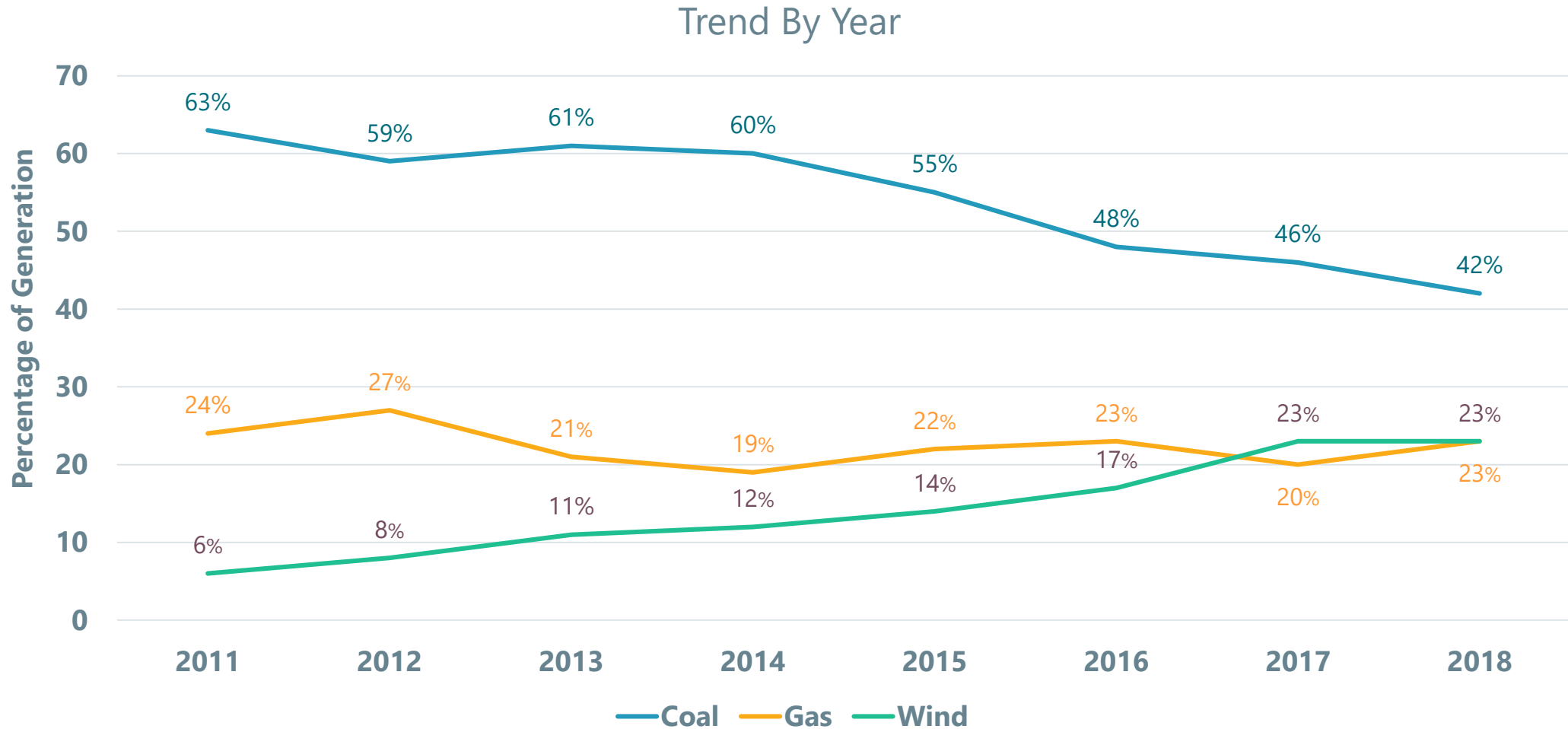
NEBRASKA WIND AND SOLAR CONFERENCE

CASEY CATHEY, TRANSMISSION
PLANNING AND SEAMS MANAGER

OCTOBER 29-30, 2019

CHANGING GENERATION MIX

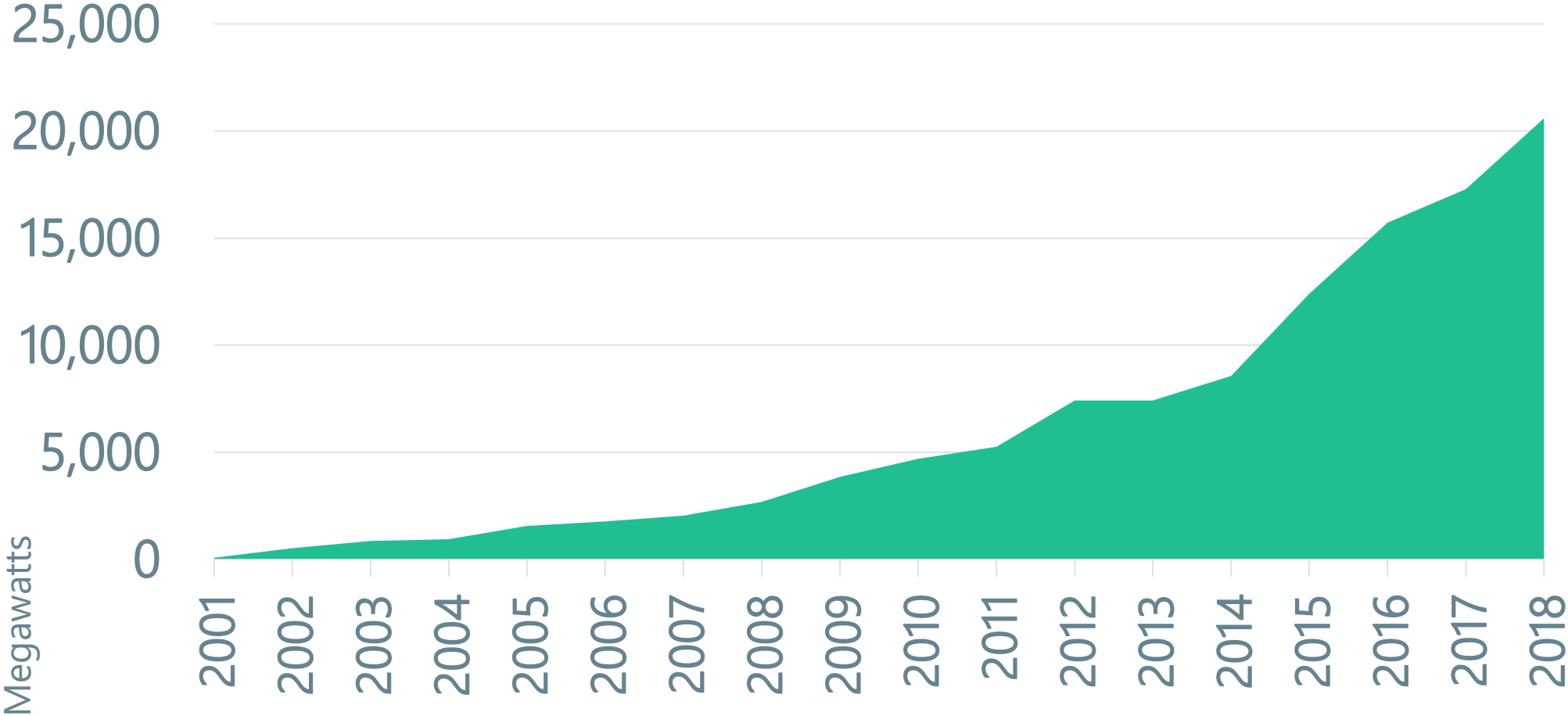
OUR EVOLVING ENERGY MIX



WIND AND SOLAR IN SPP



INSTALLED WIND CAPACITY BY YEAR

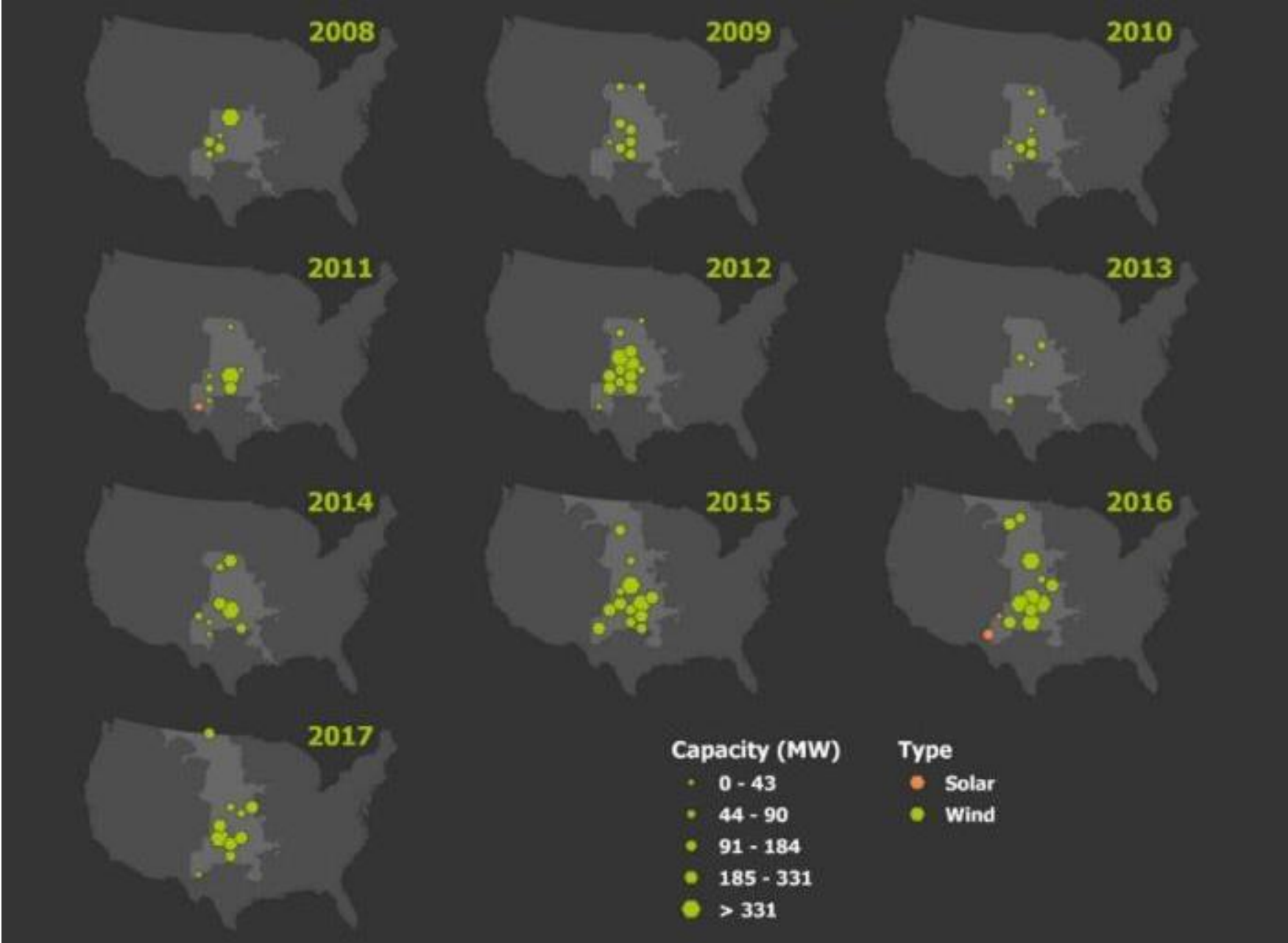


WIND IN SPP'S SYSTEM

- **21,578 MW** installed today
 - 11,029 turbines at 207 resources (most are 80m hub height)
 - Largest: 478 MW (Hale Wind Farm, TX)
- **9,065 MW**: Unbuilt wind w/signed interconnection agreements
- **50,210 MW**: Wind in all stages of study and development
- **~23 GW**: Forecast wind installation by 2020 (more than SPP's current minimum load)



DISTRIBUTION OF NEW RENEWABLE RESOURCES



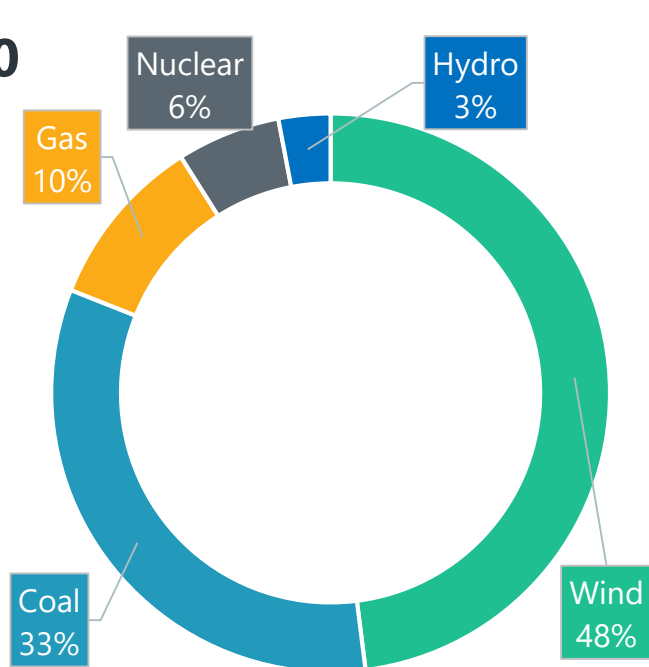
WIND PENETRATION IN SPP

- Maximum wind output: **16,972 MW** (9/11/2019)
- Minimum wind output (last 12 mos.):
146 MW (8/9/18 @ 10:47)
- Maximum wind penetration: **67.3%** (4/27/19)
- Average wind penetration (2018): **23.5%**
- Max 1-hour ramp: **3,700 MW**

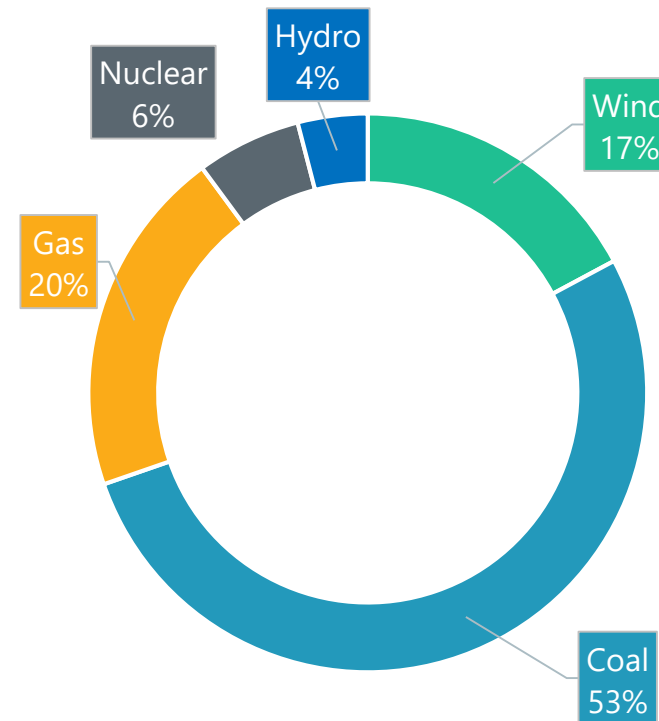
DIFFERENCE A DAY MAKES

- 12/20/18, record 16,283 MW of wind served 48% of load
- Next day, wind shrank to 17% and other sources ramped up
- We need diverse fuel mix to accommodate all circumstances

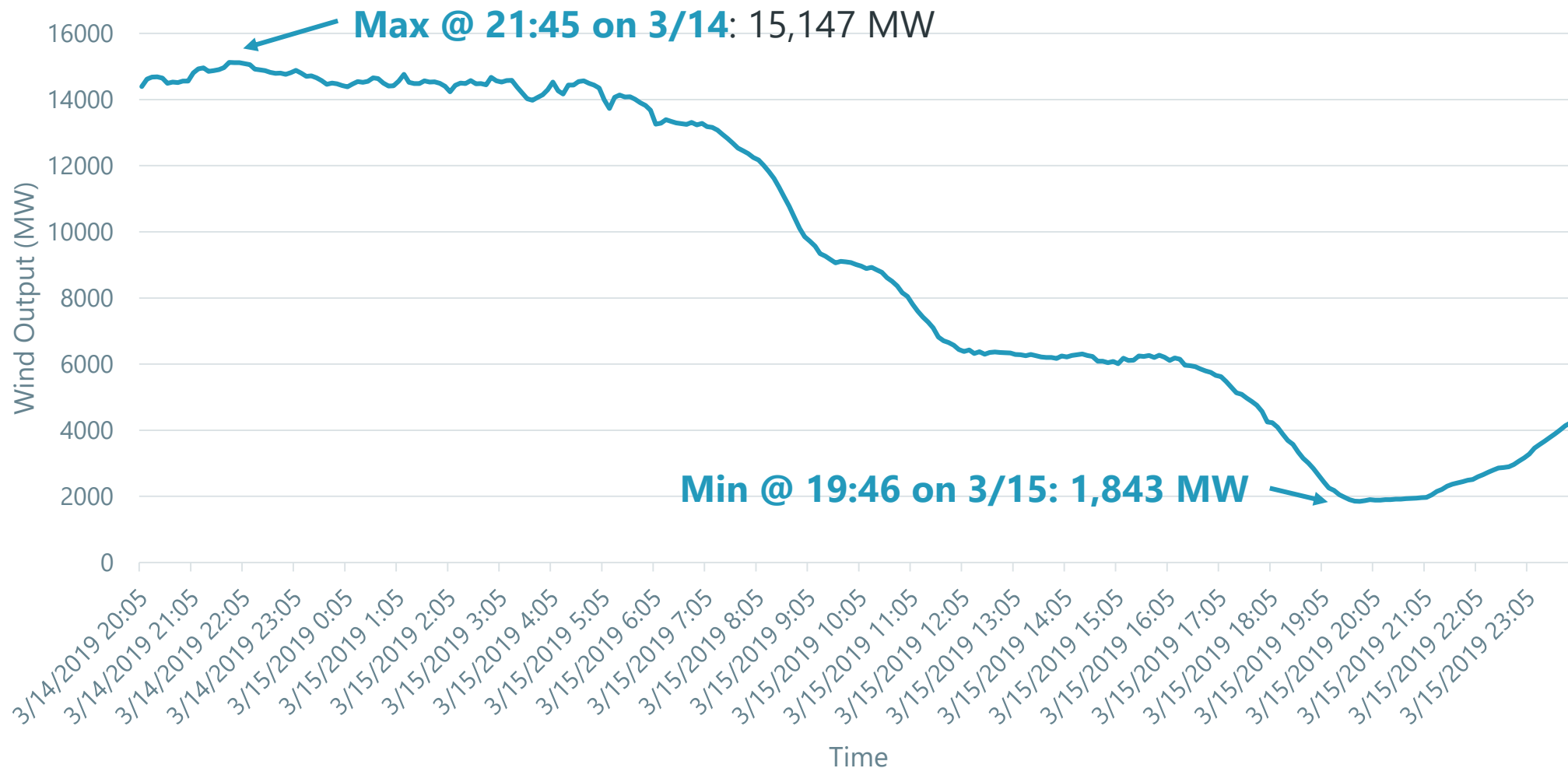
Dec. 20 @ 07:40



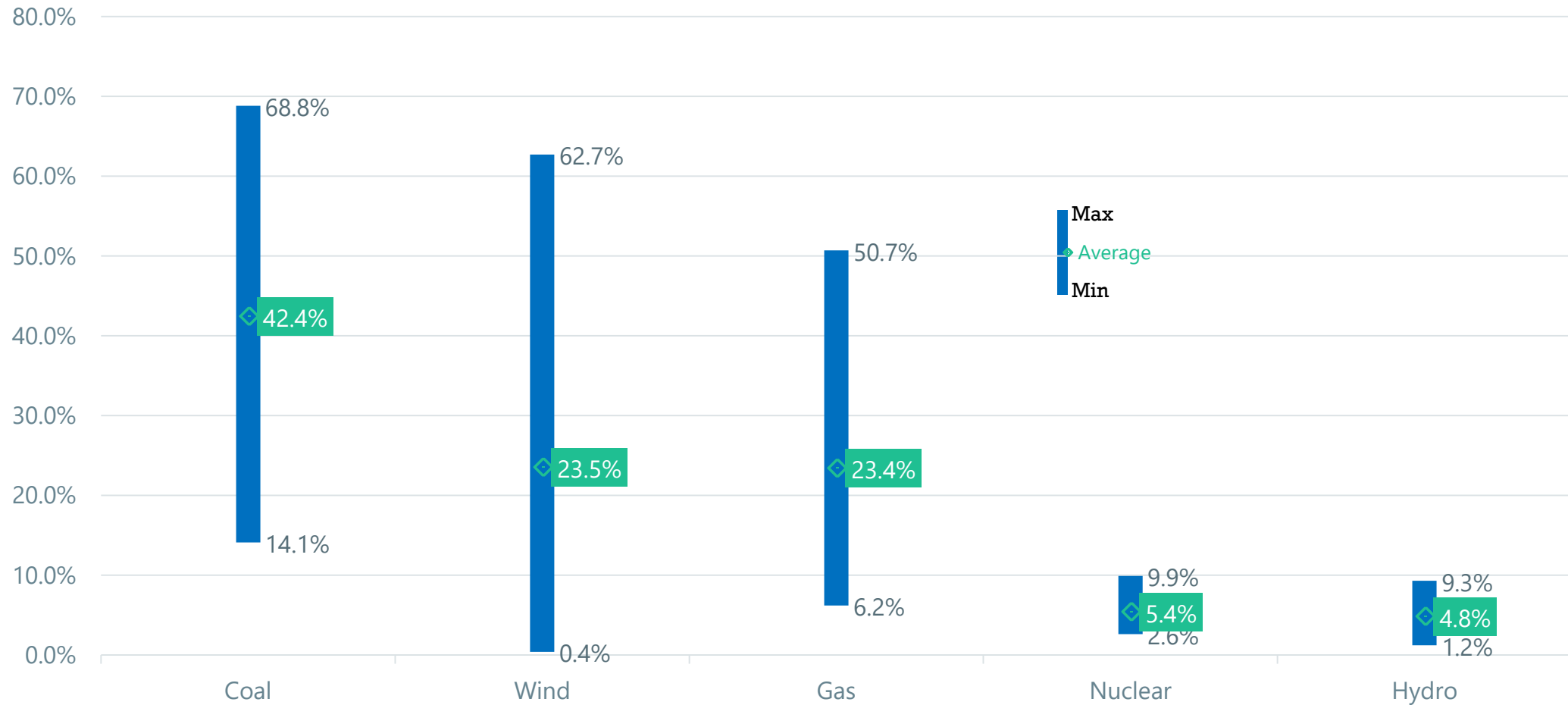
Approx.
24 hours later



WHY FUEL DIVERSITY MATTERS: SPP'S RECORD WIND SWING (13.3 GW IN 22 HOURS)



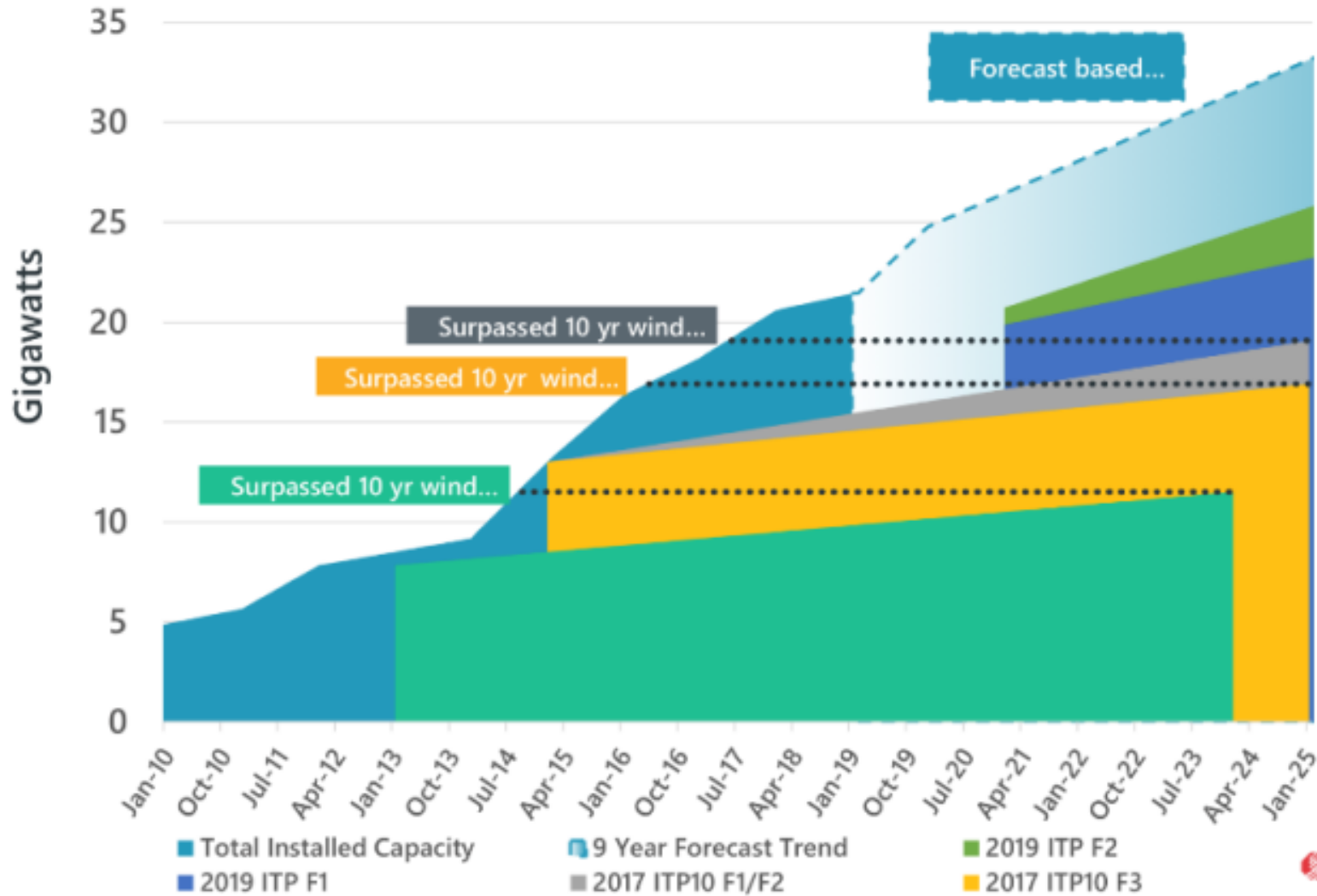
MIN AND MAX PERCENT OF GENERATION MIX BY FUEL TYPE



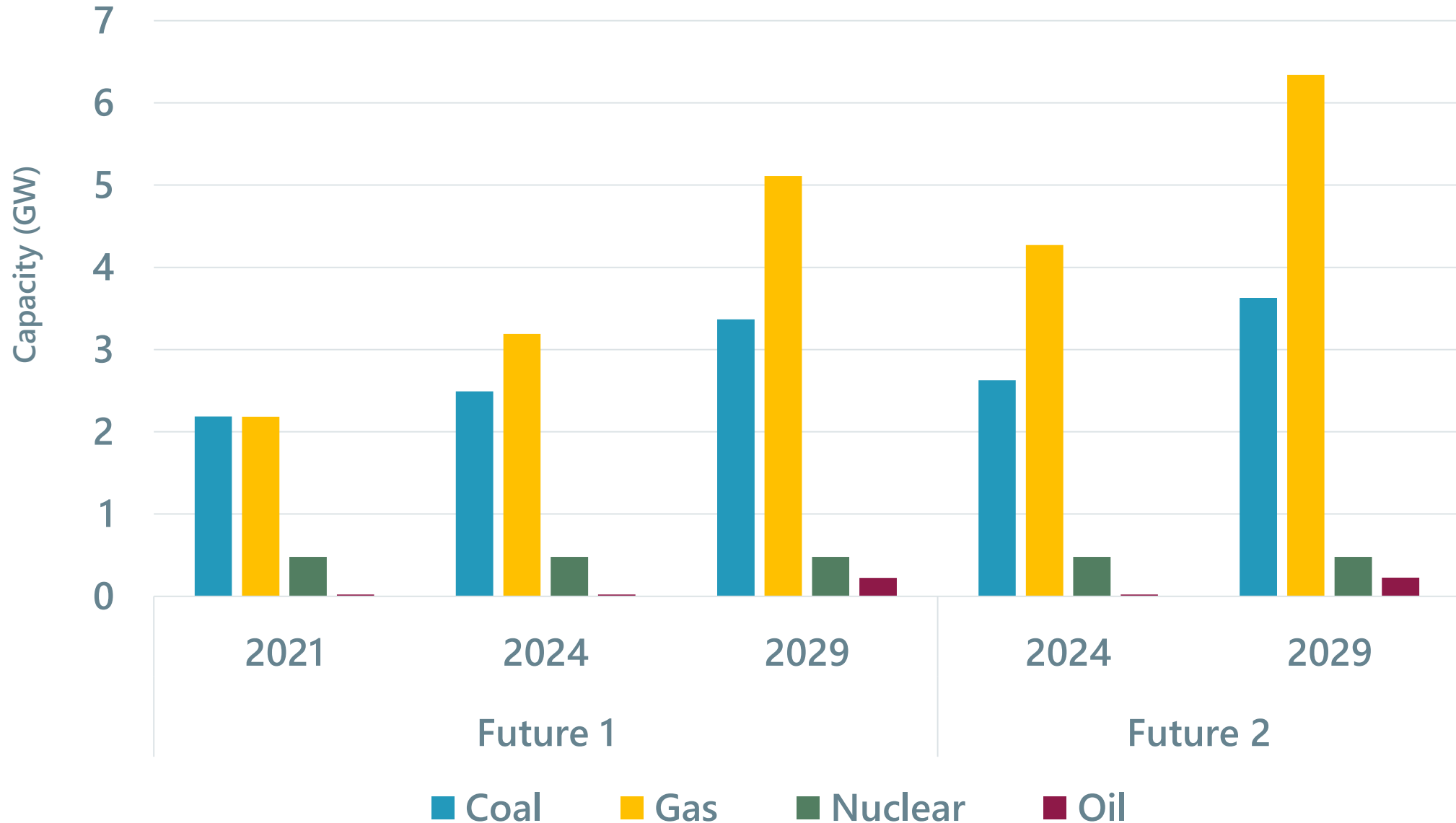
June 2018 – June 2019

WIND INTEGRATION COMPARISON

ITP VS. REAL-TIME



CONVENTIONAL GENERATION RETIREMENTS



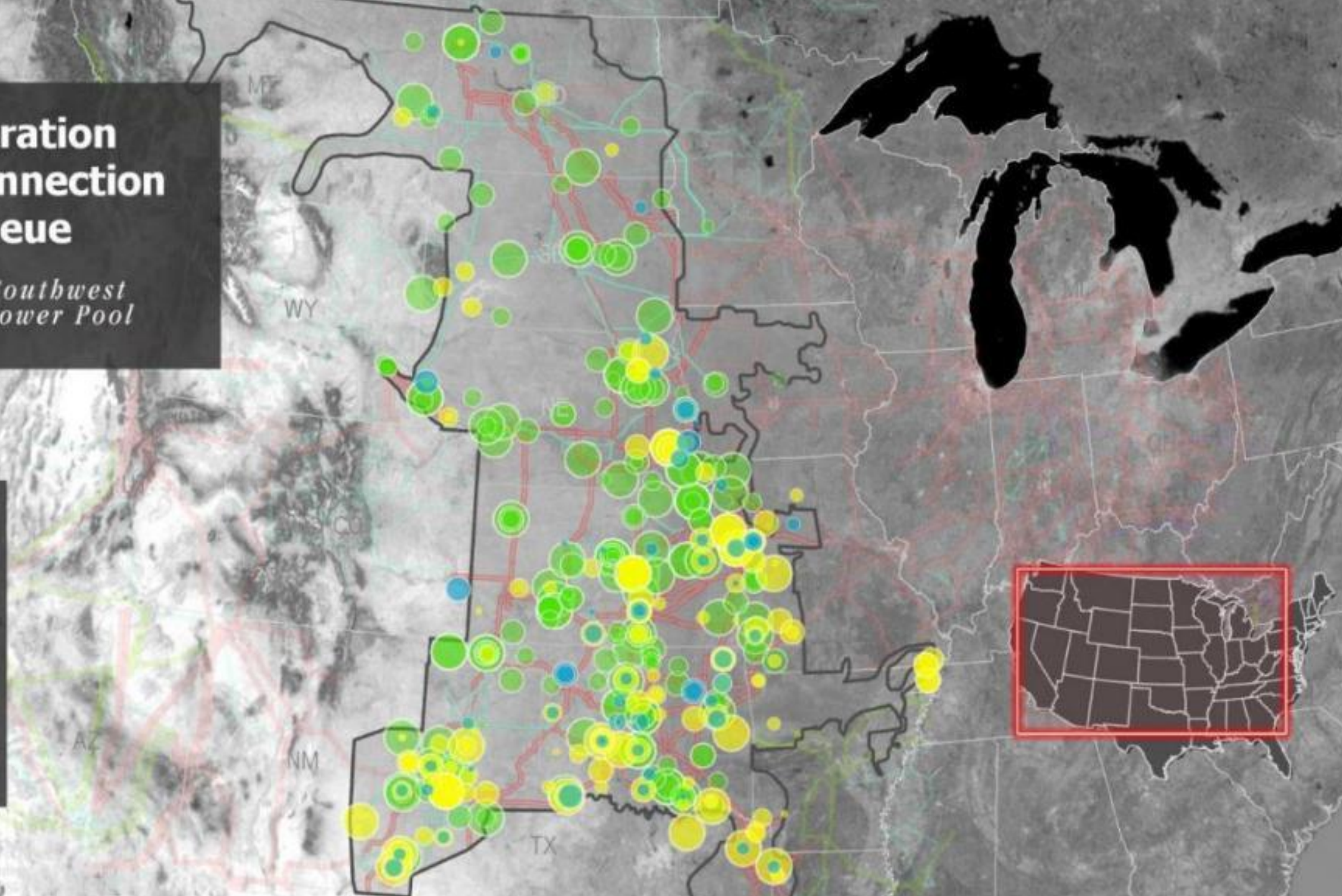
Generation Interconnection Queue

SPP Southwest
Power Pool

- Storage
- Solar
- Wind
- ≤40
- ≤90
- ≤160
- ≤250
- ≤600

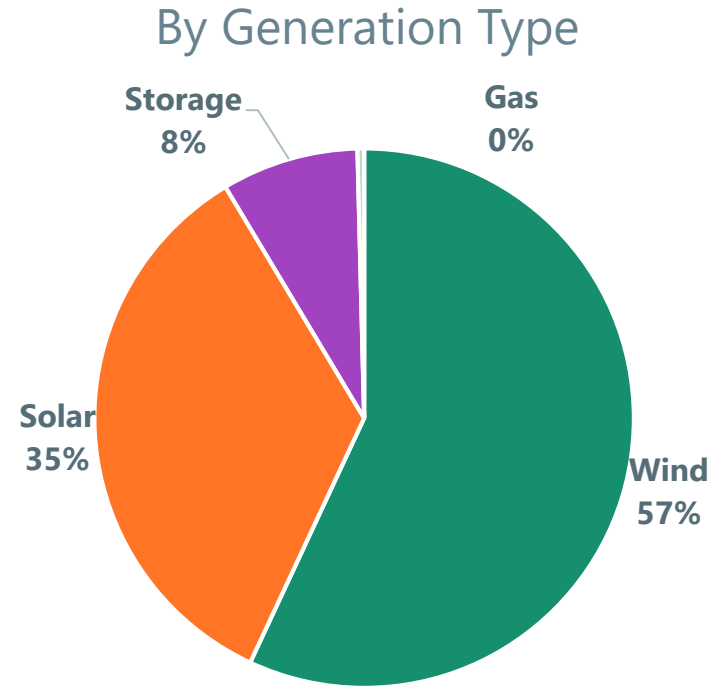
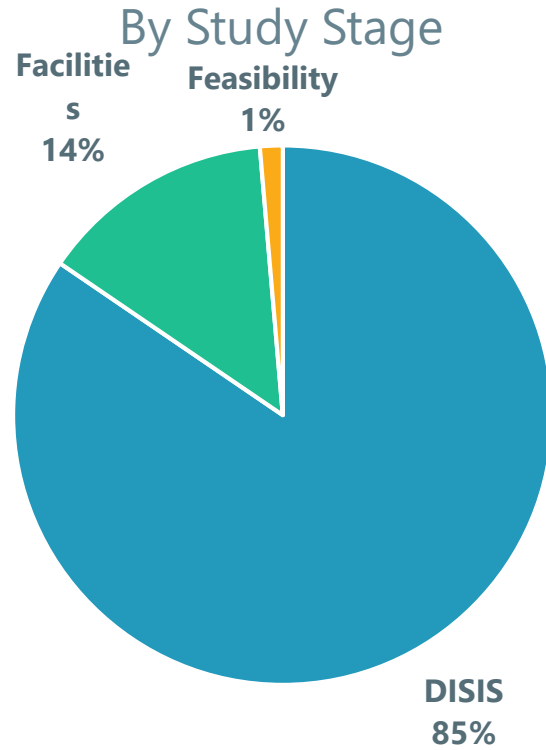


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PENDING GENERATOR REQUESTS

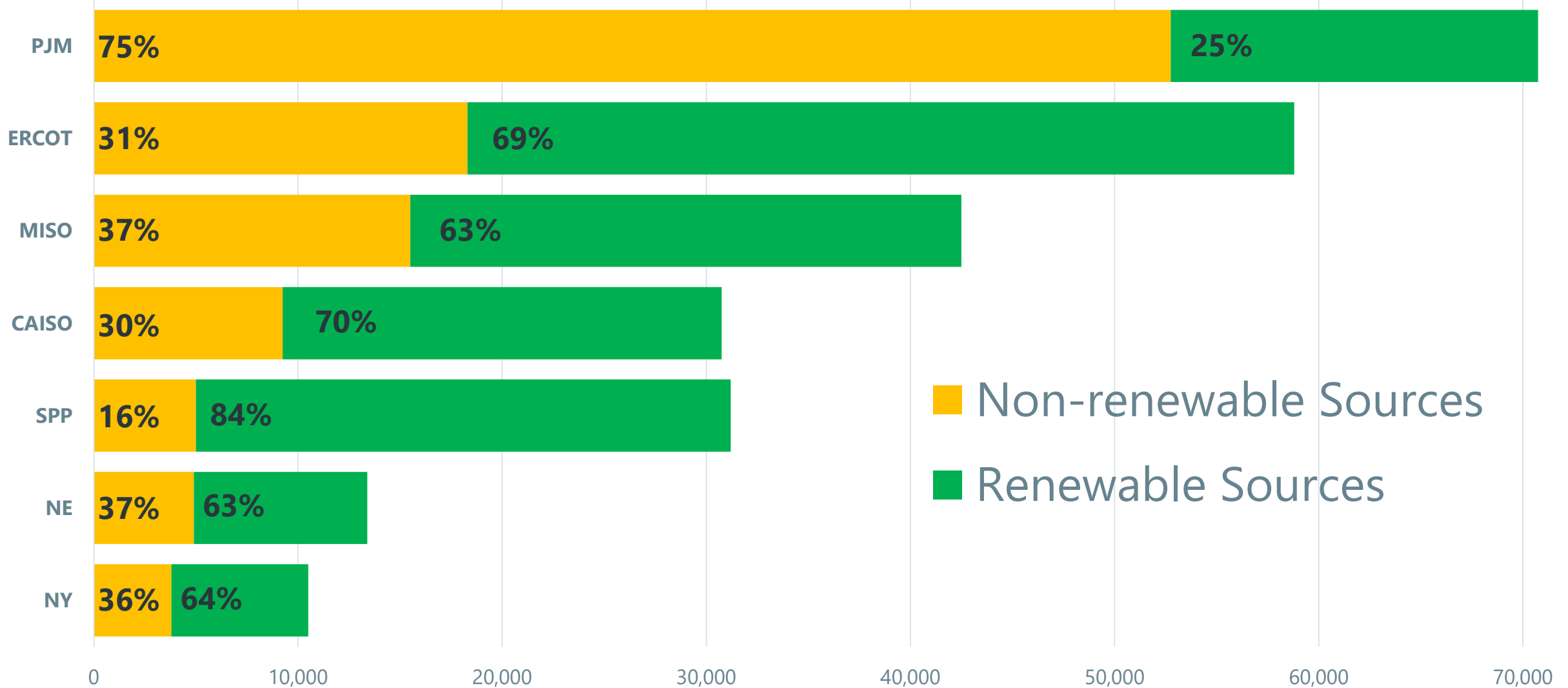
September 6, 2019



Megawatts (MW)

Stage	Wind	Solar	Storage	Gas	Other	Total
Feasibility Study		1150				1,150
Preliminary Impact						0
Definitive Impact	35,953	28,247	6,816	294	0	71,310
Facilities Study	11,520	332	20	37		11,909
TOTAL	47,473	29,729	6,836	331	0	84,369

NEW ELECTRICITY GENERATION IN U.S. RTOS



Source: NRDC analysis of S&P Global Market Intelligence data

STORAGE

- Energy
- Regulation Up
- Regulation Down
- Spinning
- Supplemental



STORAGE

- Energy
- Regulation Up
- Regulation Down
- Spinning
- Supplemental
- Long-term capacity
- Ramping
- 1-hr capacity
- Transmission solution
- Frequency Response
- Hybrid coupling



HOLISTIC INTEGRATED TARIFF TEAM

STAKEHOLDER-DRIVEN STRATEGIC PLAN



Ensuring reliability for a changing generation mix and new technologies



Enhancing Integrated Marketplace to reliably deliver low-cost energy to customers



Aligning transmission planning and cost allocation with SPP's market and consolidated Balancing Authority

HITT REPORT OVERVIEW

21 recommendations in four categories



5 Reliability



4 Marketplace



9 Transmission Planning & Cost Allocation



3 Strategic





12 recommendations are actions



9 recommendations are evaluations/studies

HITT RECOMMENDATIONS

Reliability

-  Essential & other reliability services (ERS/ORS)
-  ERS/ORS compensation model
-  Marketplace enhancements
-  Uncertainty market product
-  Additional operational tools

Marketplace

-  Congestion hedging improvements
-  Offer requirements for variable resources
-  Mitigation of unduly low offers that create uneconomic dispatch
-  Economic evaluations of reliability

 Implement




 Study/Evaluate



Planning & Cost Allocation

-  NRIS/ERIS modifications
-  Uniform Sch. 9 local planning criteria
-  New load addition modifications
-  Three-phase GI process effectiveness
-  B/C ratio for economic projects
-  Decouple Sch. 9 & 11 pricing zones
-  Byway cost allocation review process
-  Eliminate Z2 revenue crediting
-  Cost allocation for transmission storage

Strategic

-  Add tech advances to strategic plan
-  Keep seams a priority in strategic plan
-  Create storage white paper

Reliability



Study Essential Reliability Service (ERS) and Other Reliability Service (ORS)

- NERC defines ERS as:
 - Frequency support
 - Ramping and balancing
 - Voltage support
- ORS takes into account that as grid changes, SPP is not confident all reliability needs are captured in NERC's ERS definition
- ORS includes new technologies that change underlying nature of grid operations that are not traditional operator tools
- "Uncertainty product" is an example of ORS

Reliability



Study ERS and ORS

- SPP should perform comprehensive study to evaluate reliability challenges with changing generation resource mix
- Study should identify all ERS and ORS needed in future to keep the lights on

Reliability



Implement ERS/ORS compensation model

- Use study results from reliability recommendation #1 to establish compensation model for each ERS and/or ORS
- Review regulation service compensation to determine if service is appropriately valued
- Consider cost causation and whether technology that reduces need for regulation service should receive some of the compensation

Reliability



Study additional operational tools

Determine what additional operational tools are needed to ensure BES remains reliable in the future

Reliability



GO

Implement uncertainty market product

Continue to develop uncertainty product that addresses potential reliability issues associated with increased reliance on forecastable generation

Reliability



Implement marketplace enhancements

Continue Integrated Marketplace enhancements including:

- Ramping capability
- Fast-start resource logic
- Multi-day, longer-term market product

All analysis and data surrounding Ramp Product is here:

<https://spp.org/Documents/59864/rr361.zip>



FUTURE MARKET INITIATIVES

Longer Term Ramping/ Uncertainty Product

- Builds on current short term ramping product
- With more renewables, SPP's forecasting and uncertainty issues continue to grow past short-term into longer than 10-15 minute issues

Distributed Energy Resources

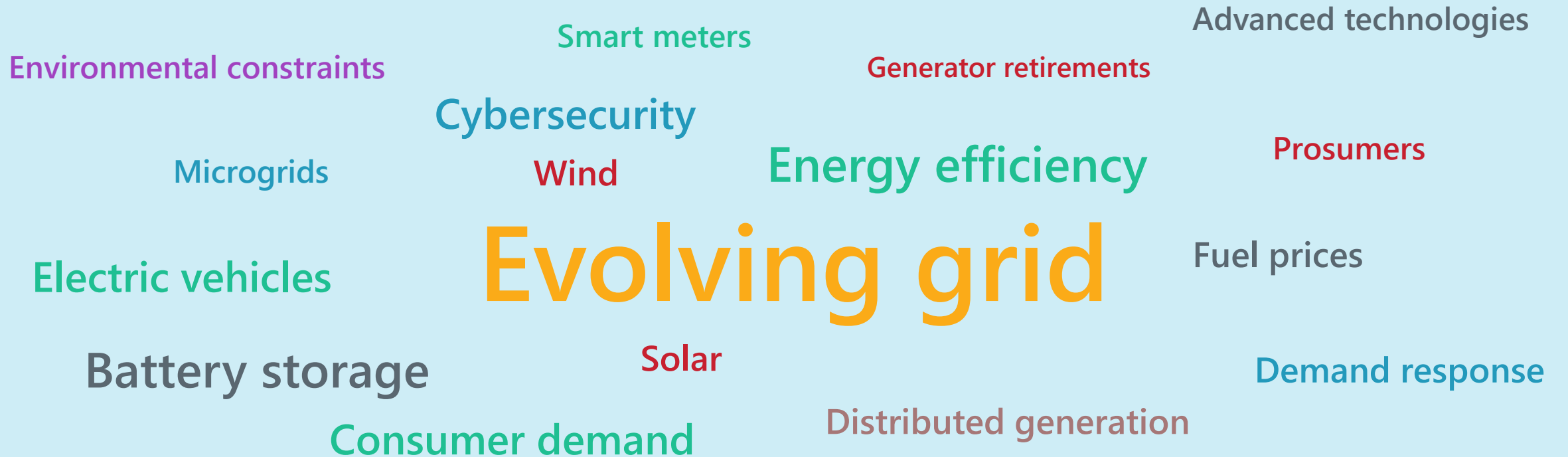
- Awaiting FERC Order
- Should allow for a broader spectrum of participation in SPP
- More flexibility is essential for coming changes

Coordinated Transaction Scheduling

- Most real time transactions in SPP are fixed transactions. Allowing transactions to be cleared by Market creates value for all participants.
- Should increase price convergence between seams with other RTOs



THIS ISN'T OUR PARENTS' ELECTRIC GRID



PLANNING FOR AN UNCERTAIN FUTURE