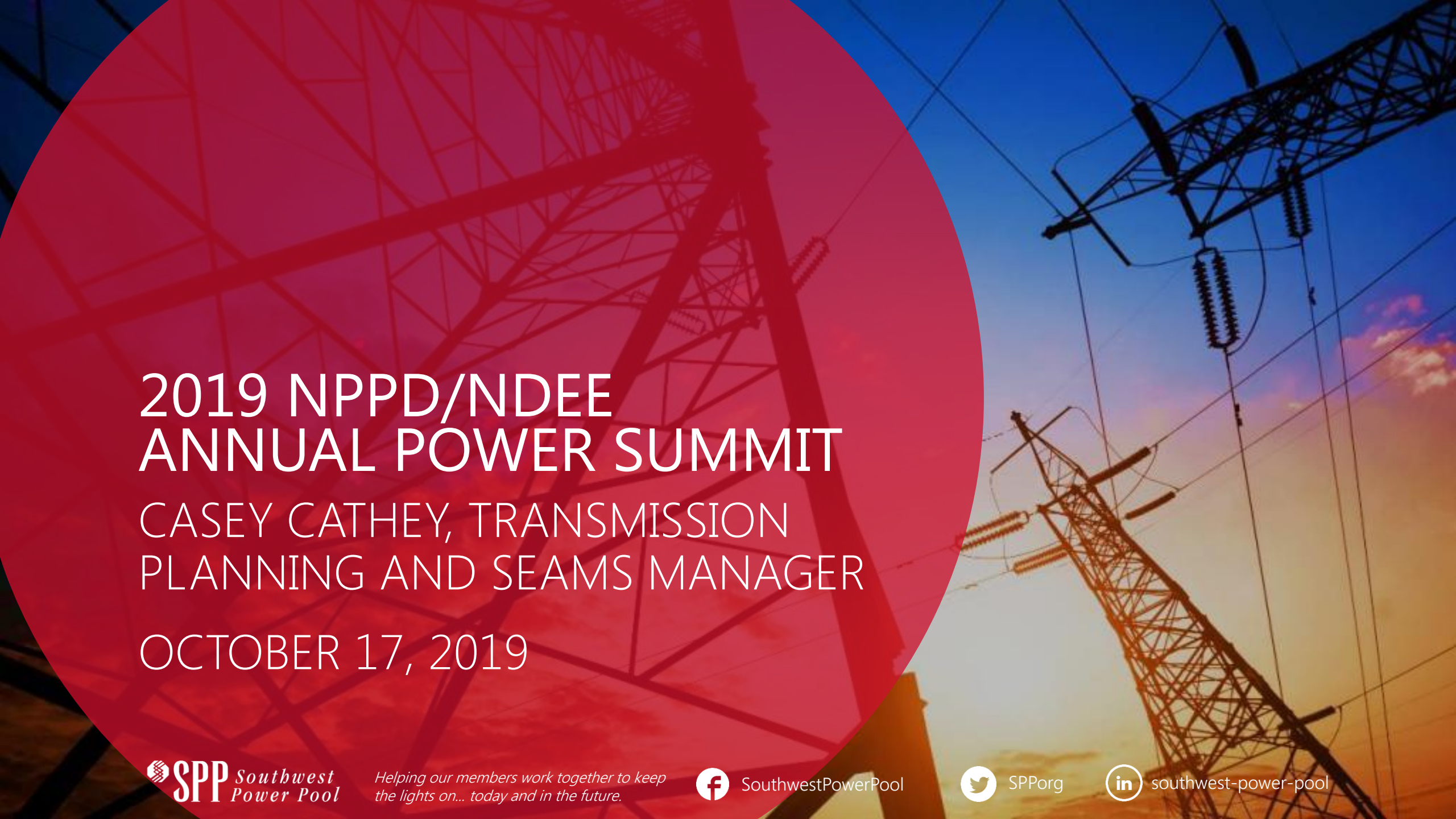


2019 NPPD/NDEE ANNUAL POWER SUMMIT

CASEY CATHEY, TRANSMISSION PLANNING AND SEAMS MANAGER

OCTOBER 17, 2019

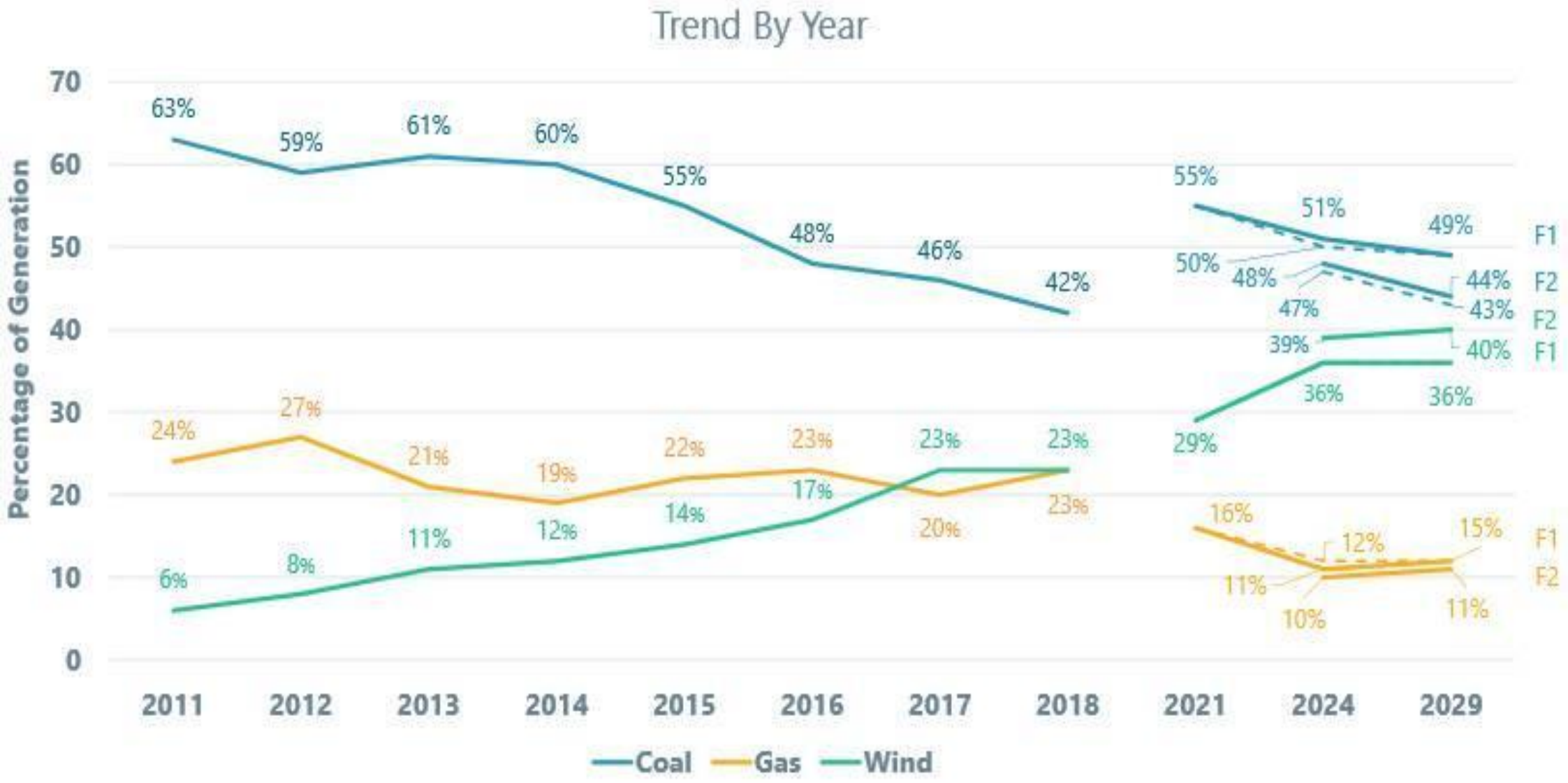
SPP Southwest Power Pool

Helping our members work together to keep the lights on... today and in the future.

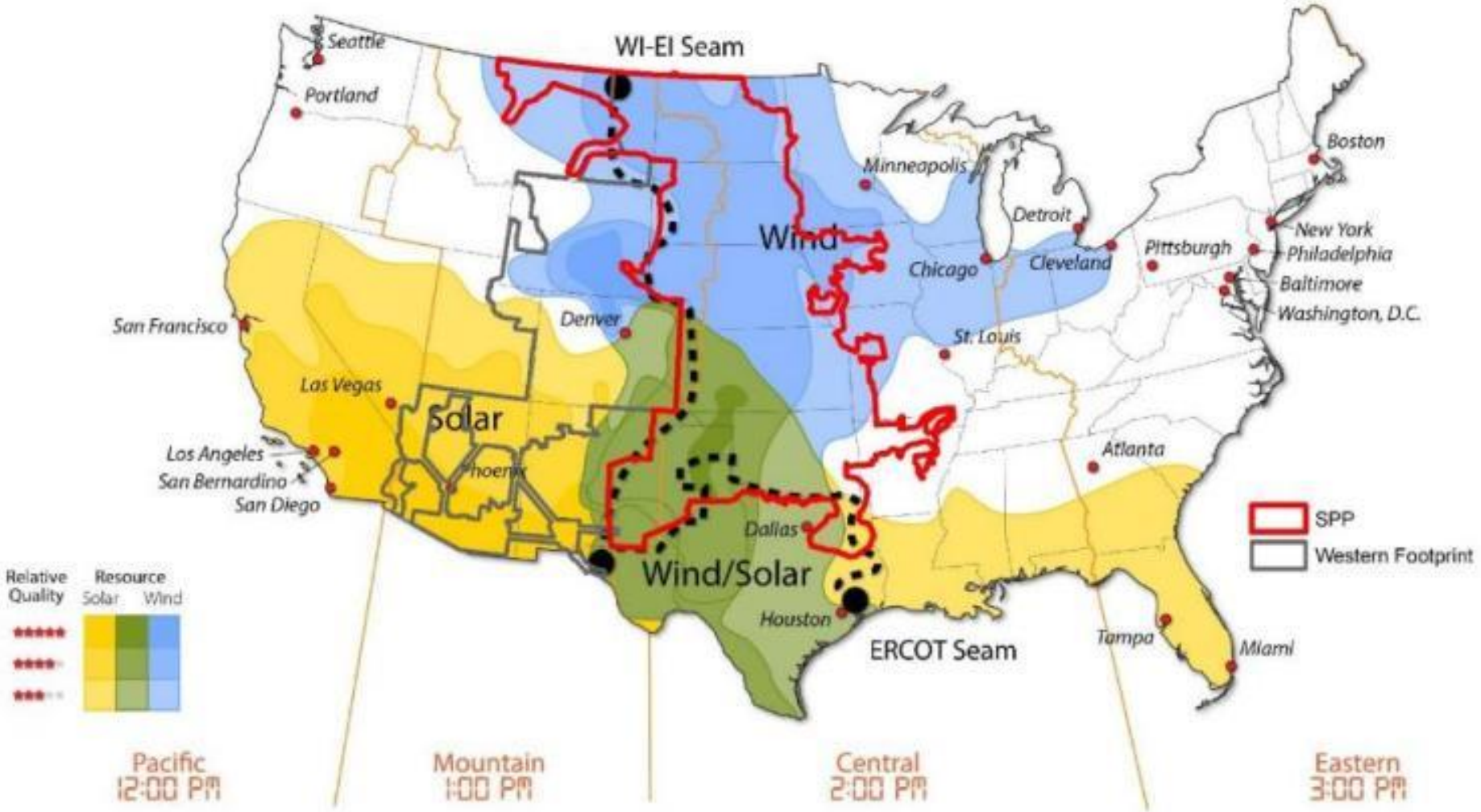
SouthwestPowerPool SPPorg southwest-power-pool

CHANGING GENERATION MIX

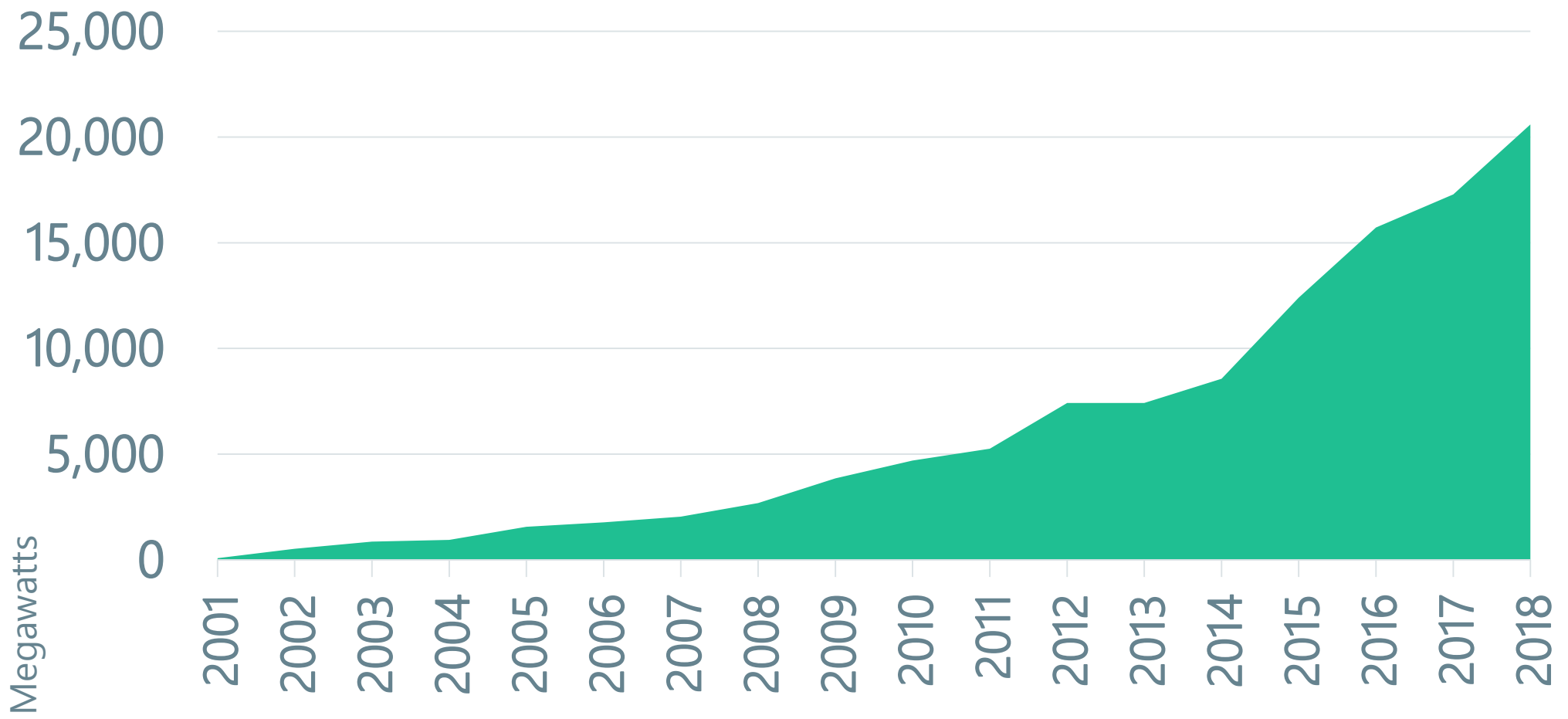
OUR EVOLVING ENERGY MIX



WIND AND SOLAR IN SPP

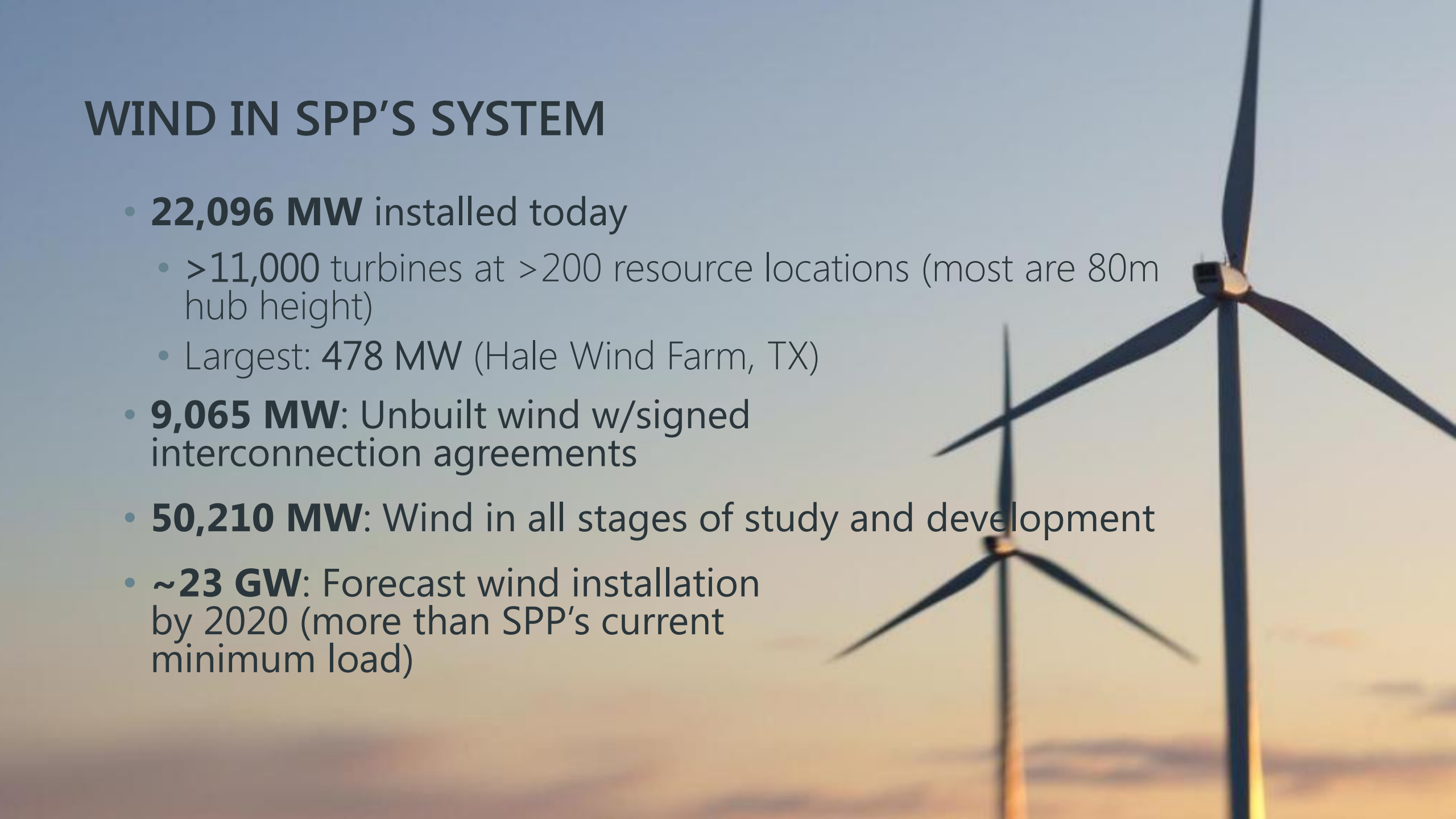


INSTALLED WIND CAPACITY BY YEAR



WIND IN SPP'S SYSTEM

- **22,096 MW** installed today
  - >11,000 turbines at >200 resource locations (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)



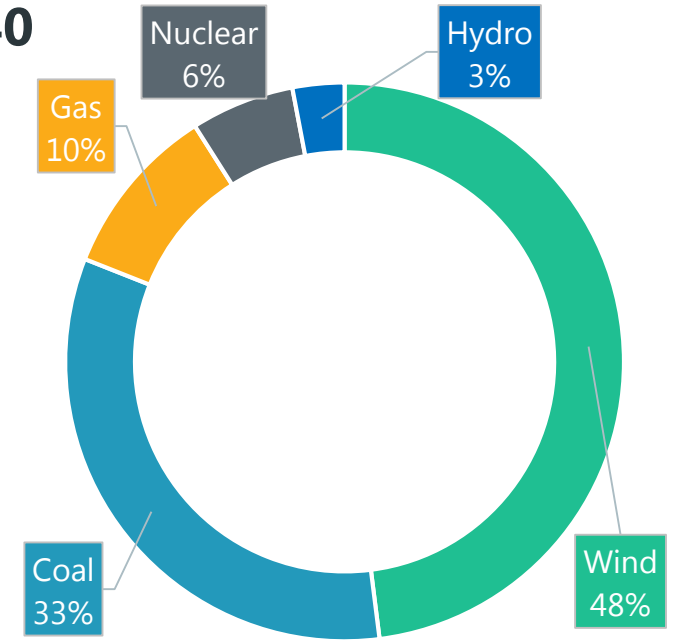
WIND PENETRATION IN SPP

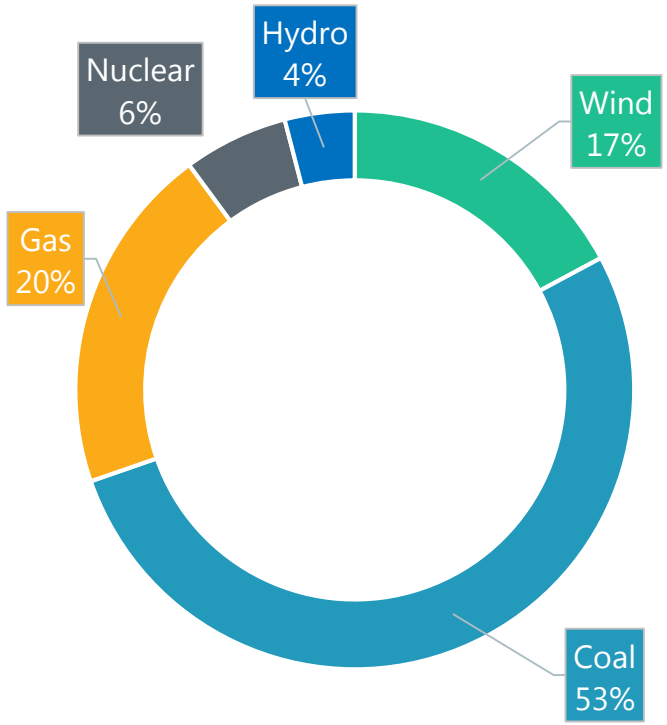
- Maximum wind output: **16,972 MW** (9/11/2019)
- Minimum wind output (last 12 mos.):
  146 MW (8/9/18 @ 10:47)
- Maximum wind penetration: **67.3%** (4/27/19)
- Average wind penetration (2018): **23.5%**
- Max 1-hour ramp: **3,700 MW**

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

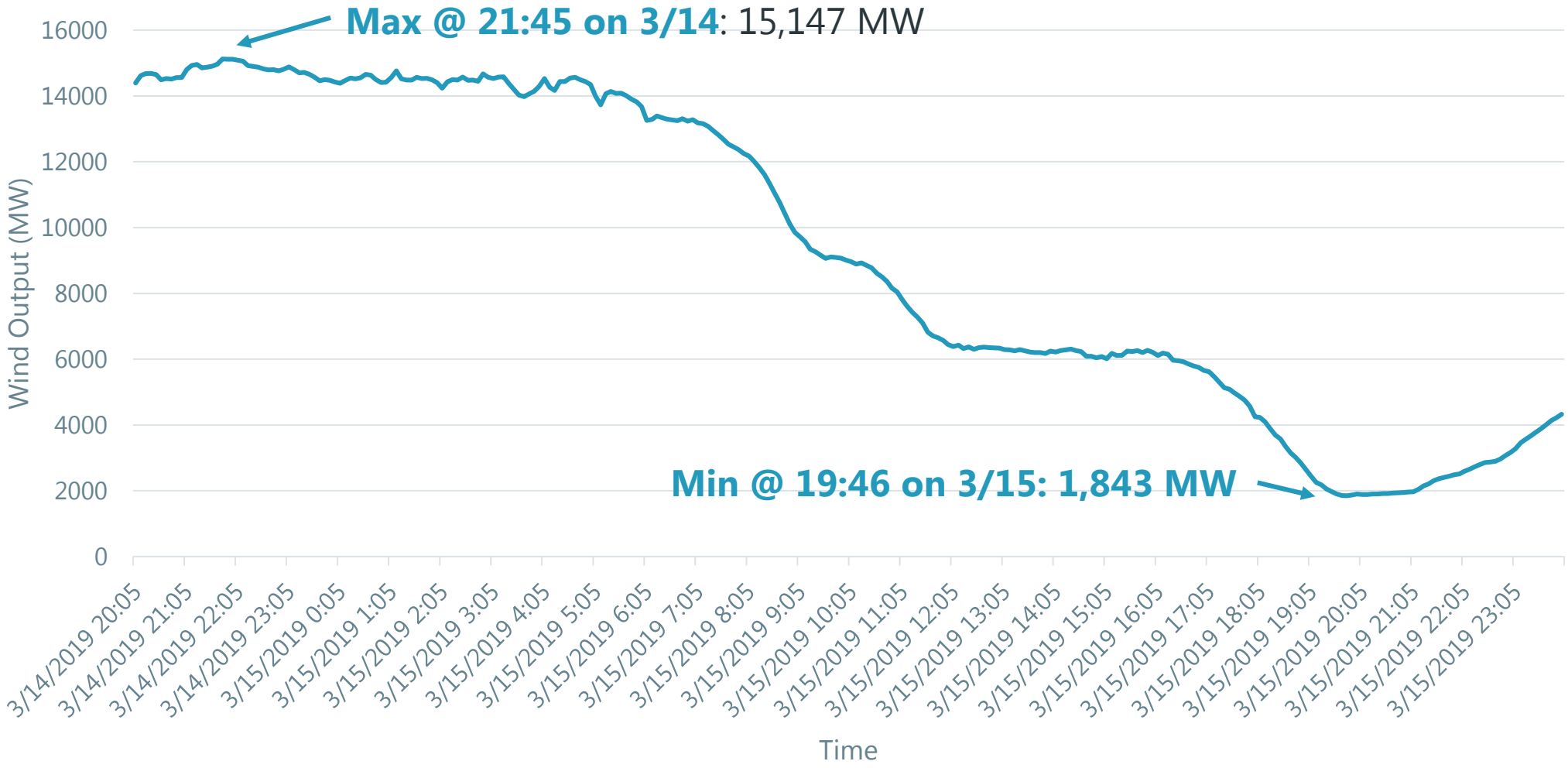
Dec. 20 @ 07:40



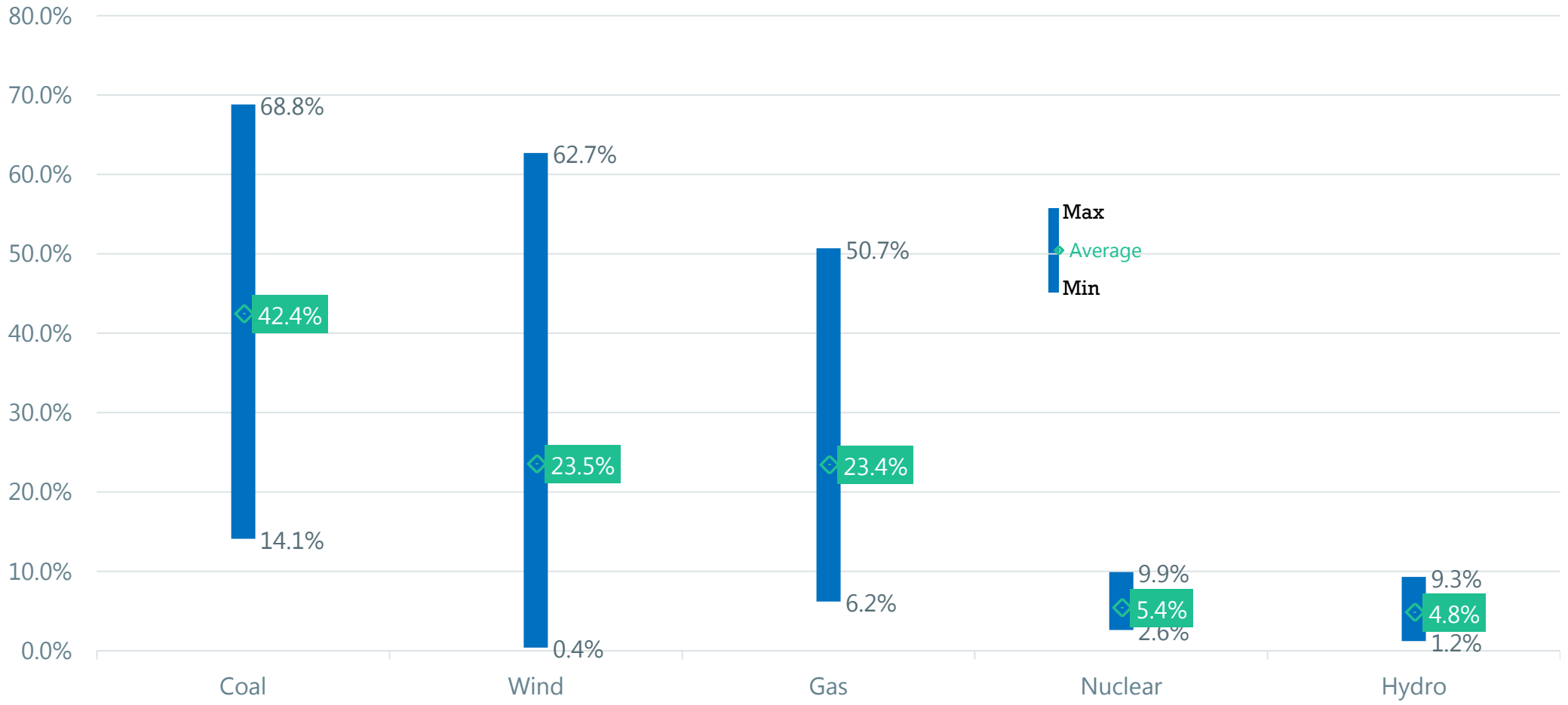


Approx. 24 hours later

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



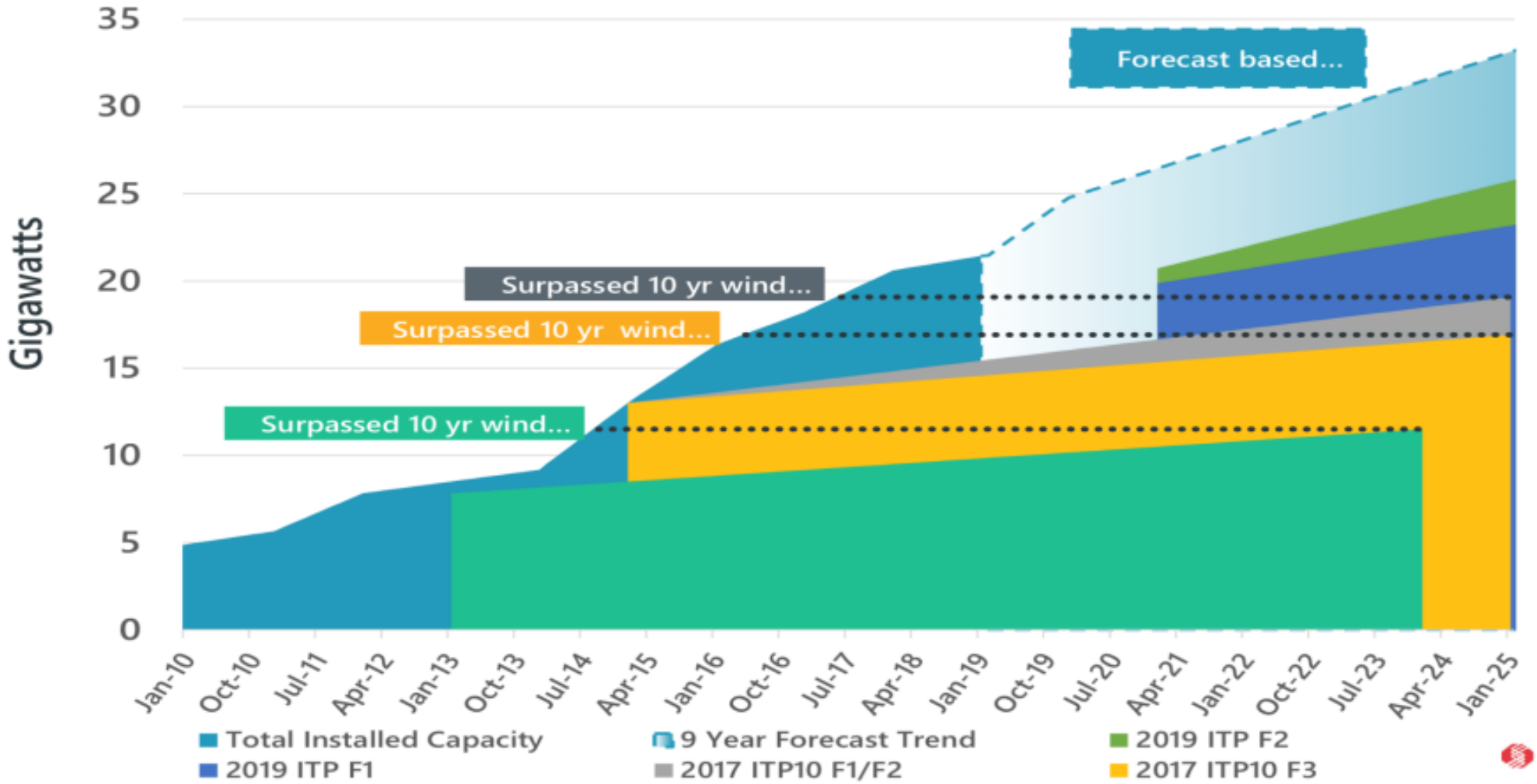
MIN AND MAX PERCENT OF GENERATION MIX BY FUEL TYPE



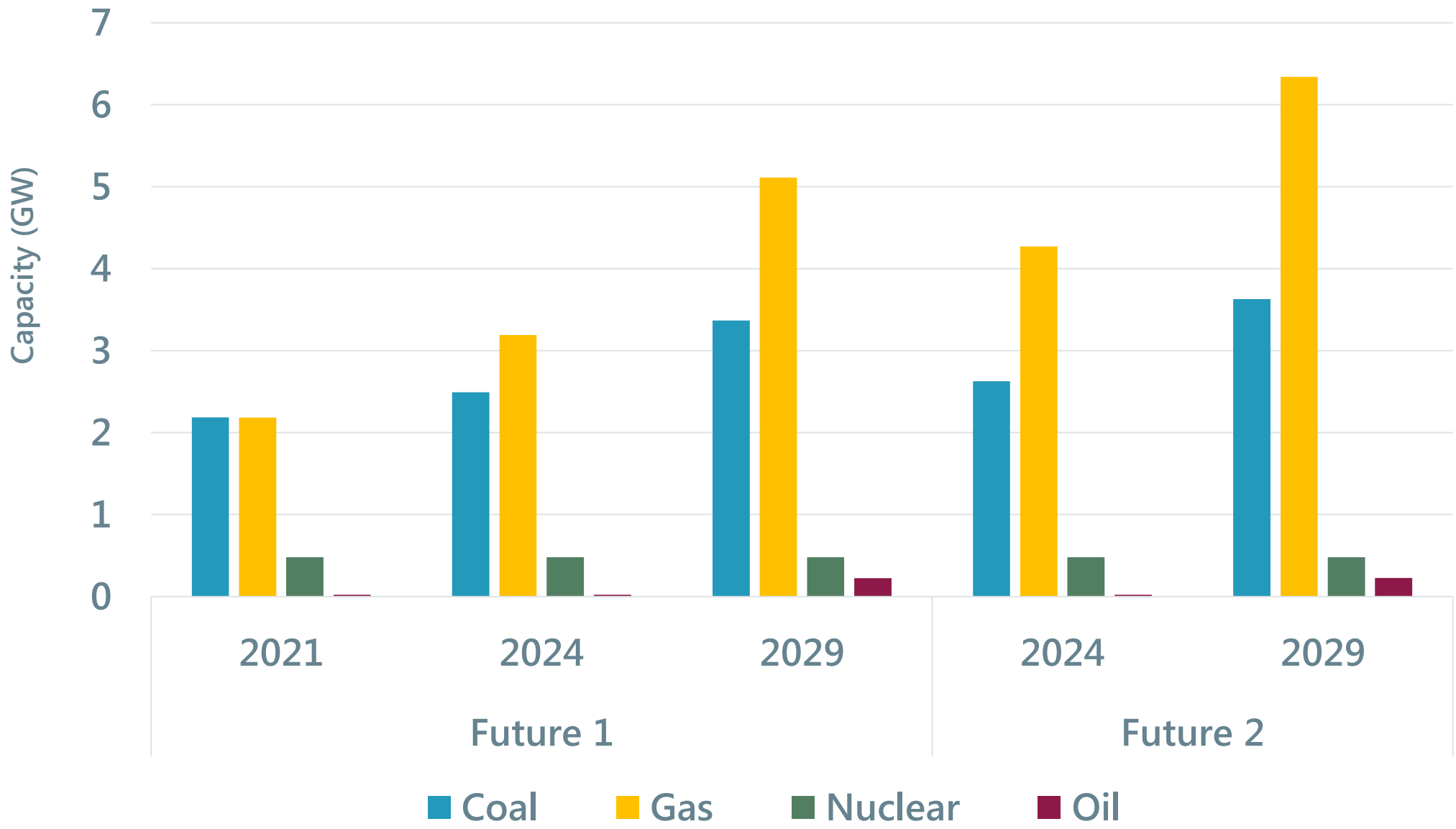
June 2018 – June 2019

WIND INTEGRATION COMPARISON

ITP VS. REAL-TIME



CONVENTIONAL GENERATION RETIREMENTS



Generation Interconnection Queue

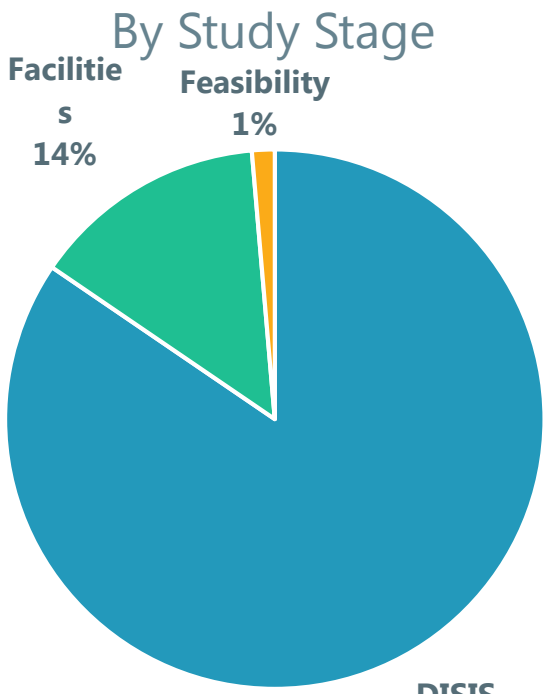
SPP Southwest Power Pool

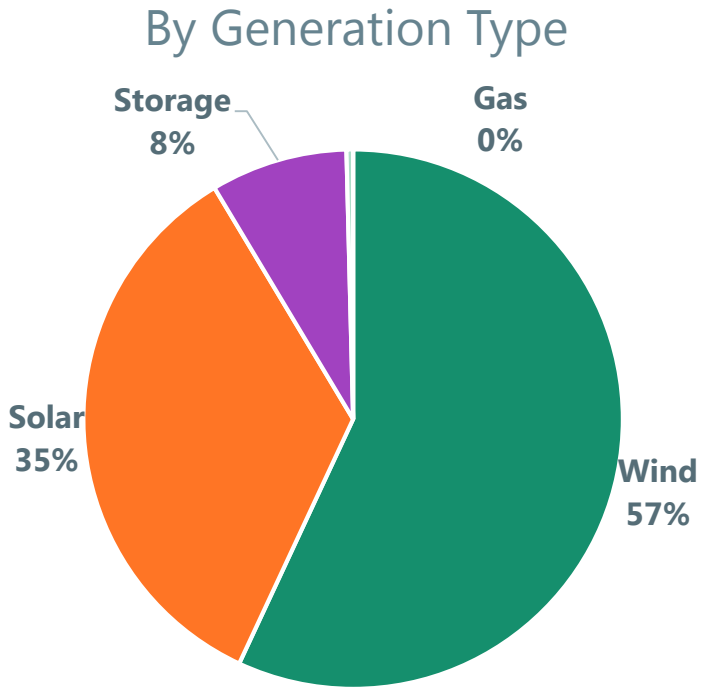
- Storage
- Solar
- Wind

- ≤40
- ≤90
- ≤160
- ≤250
- ≤600

PENDING GENERATOR REQUESTS

September 6, 2019

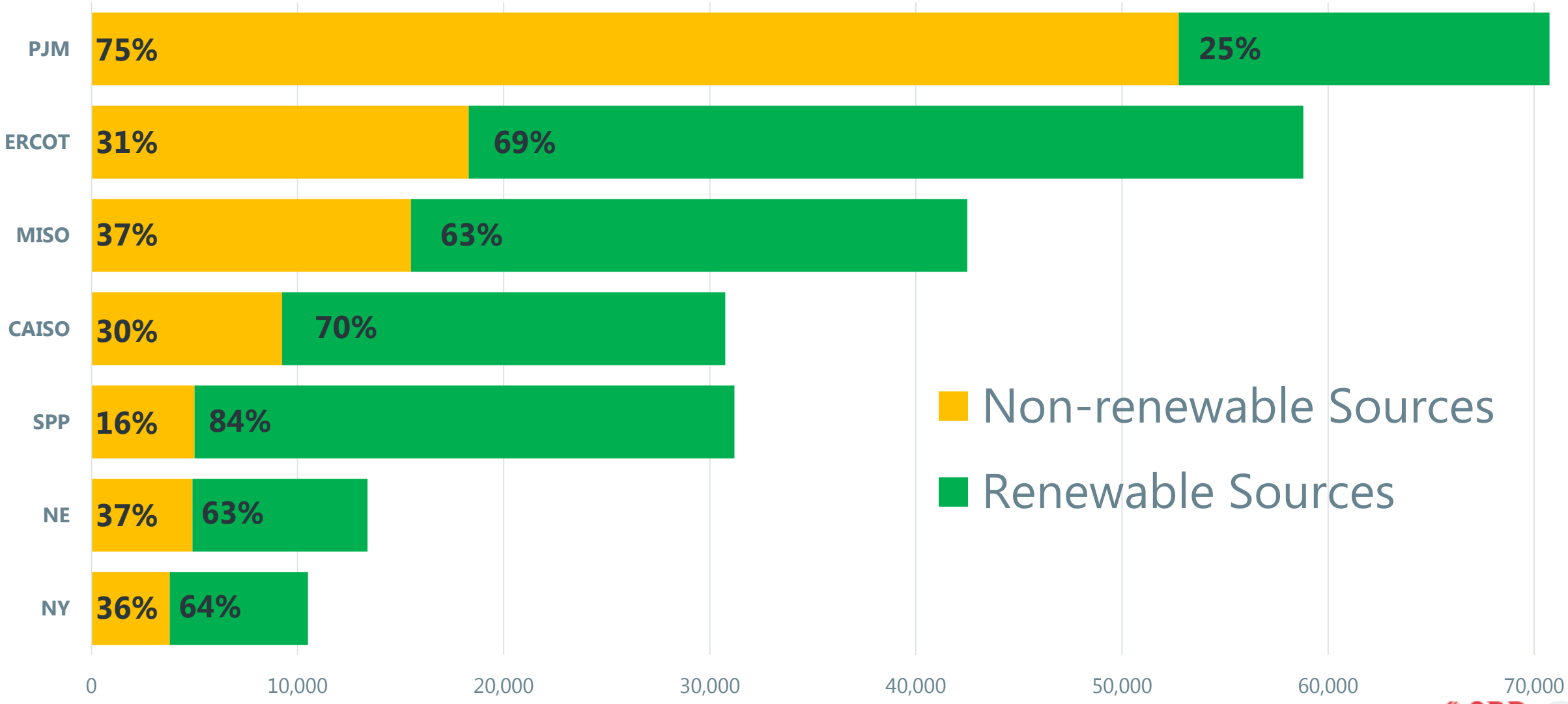




Megawatts (MW)

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

HOLISTIC INTEGRATED TARIFF TEAM

STAKEHOLDER-DRIVEN STRATEGIC PLAN

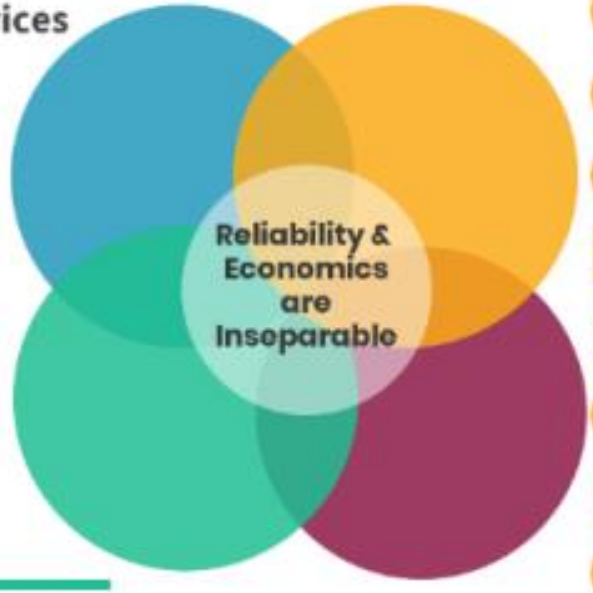
HITT RECOMMENDATIONS

Reliability

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

Marketplace

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



Planning & Cost Allocation

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

Strategic

- GO Add tech advances to strategic plan
- GO Keep seams a priority in strategic plan
- GO 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

GO 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

Implement uncertainty market product

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

Reliability

GO 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


Coordinated Transaction Scheduling
Economic Decommitment
NDVER to DVER Conversion
Ramp Product
Longer Term Ramping/ Uncertainty Product
FERC Order 841
Integrated Marketplace
Regulation Up Market for VERS
Essential Reliability Services
Fast Start Resources
Enhanced VER Data for Forecasting
Distributed Energy Resources
DVER Regulation Enhancement
Multi-Day Unit Commitment

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

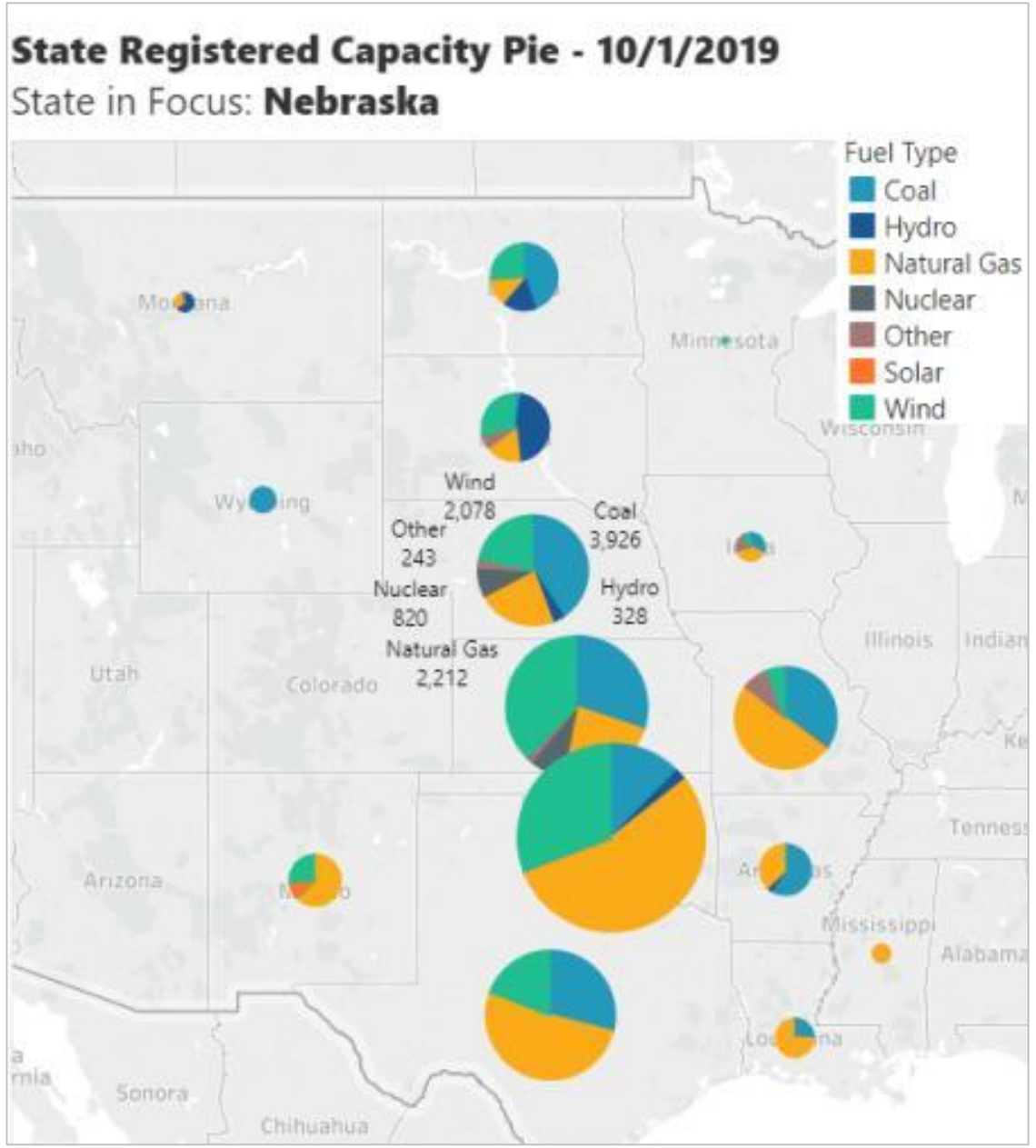
Coordinated Transaction Scheduling

- 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

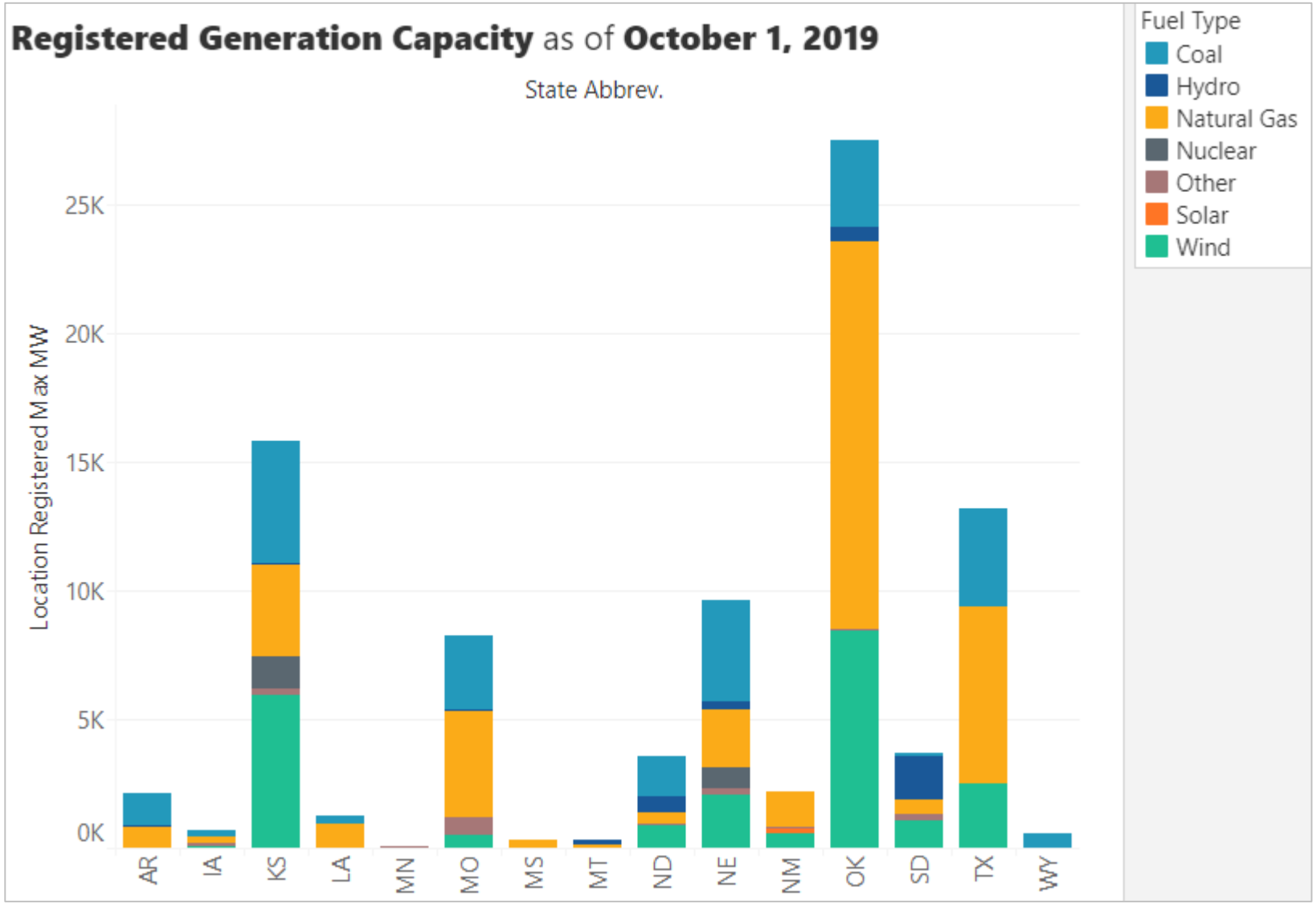
STATE-LEVEL DATA

NEBRASKA

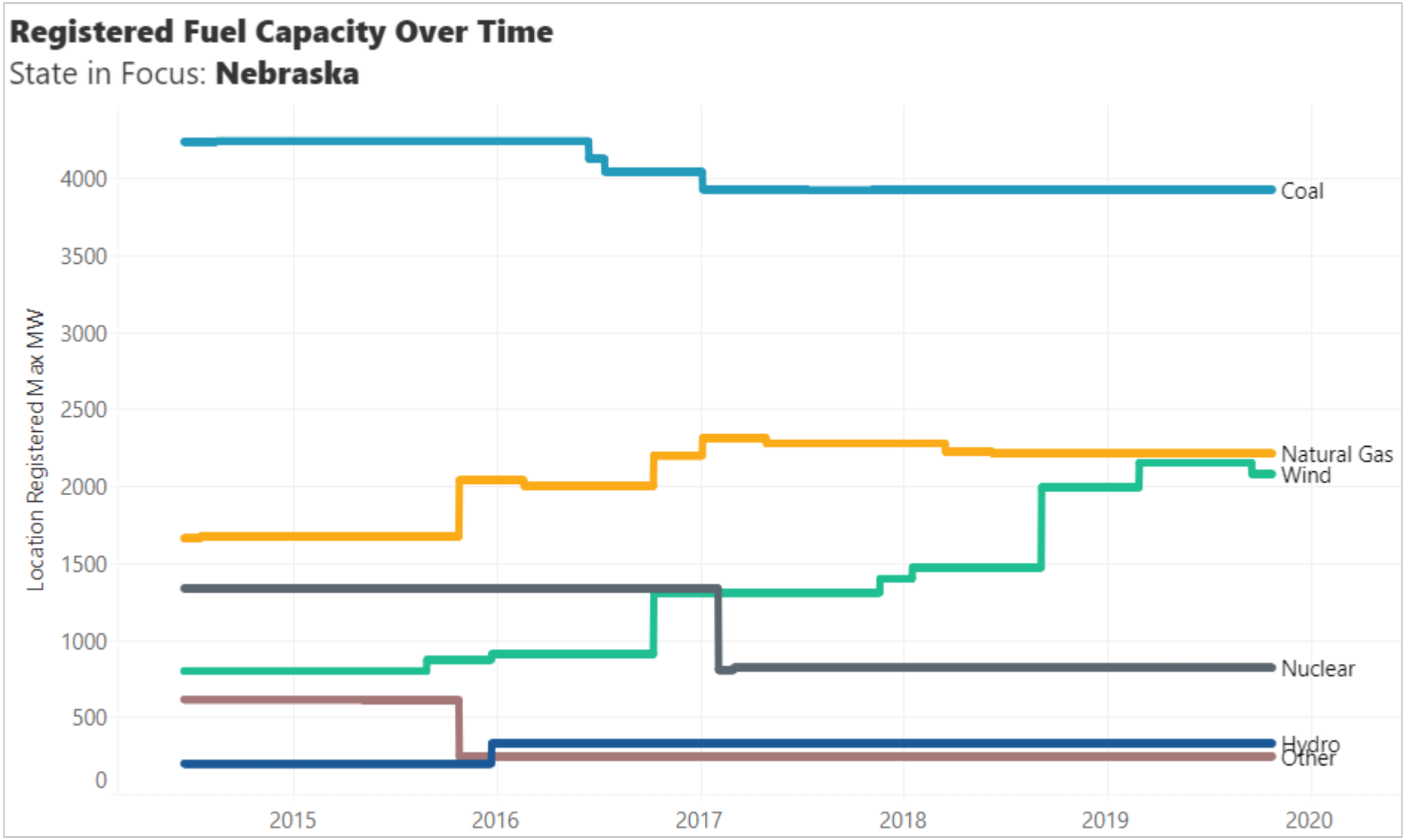
REGISTERED CAPACITY



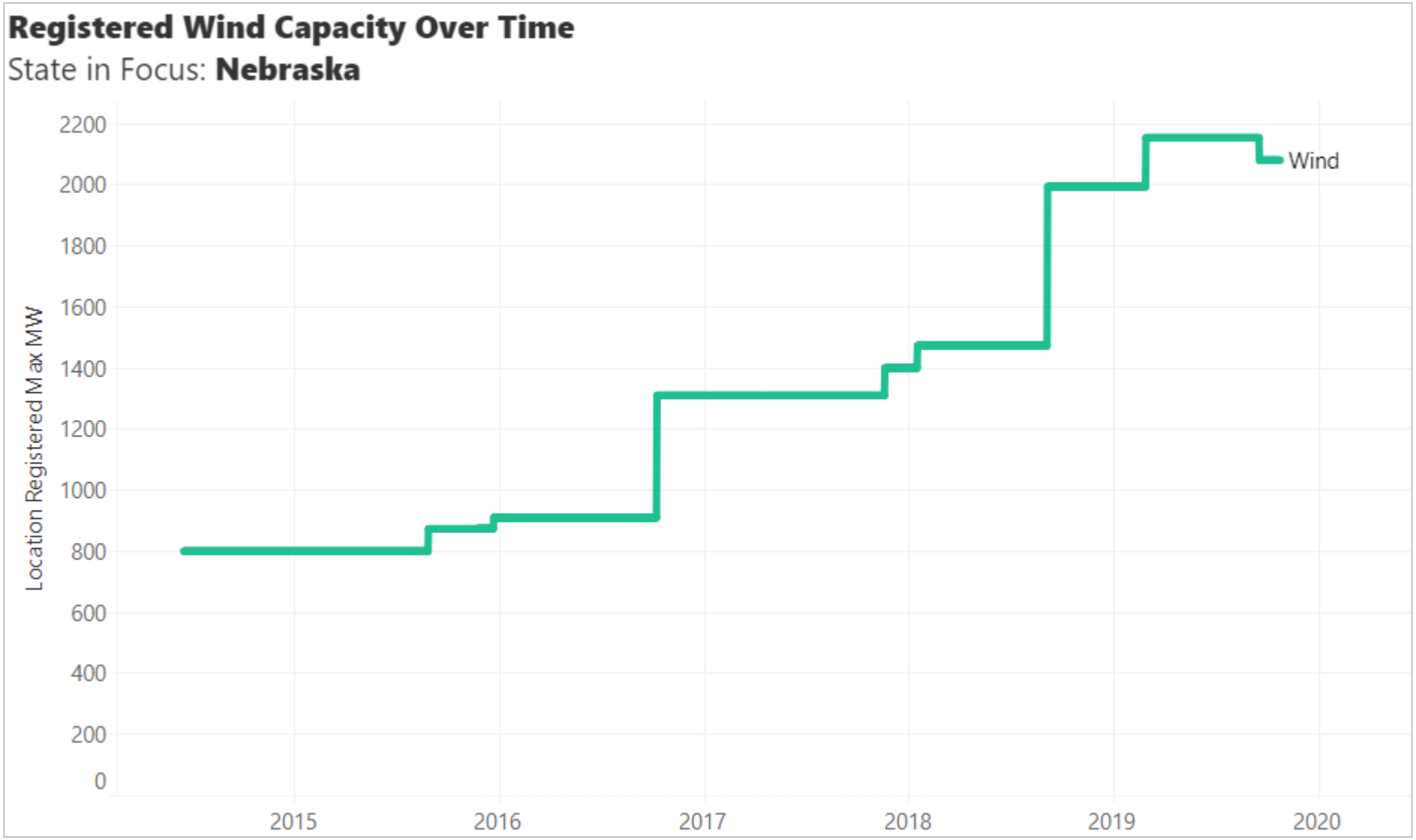
REGISTERED CAPACITY



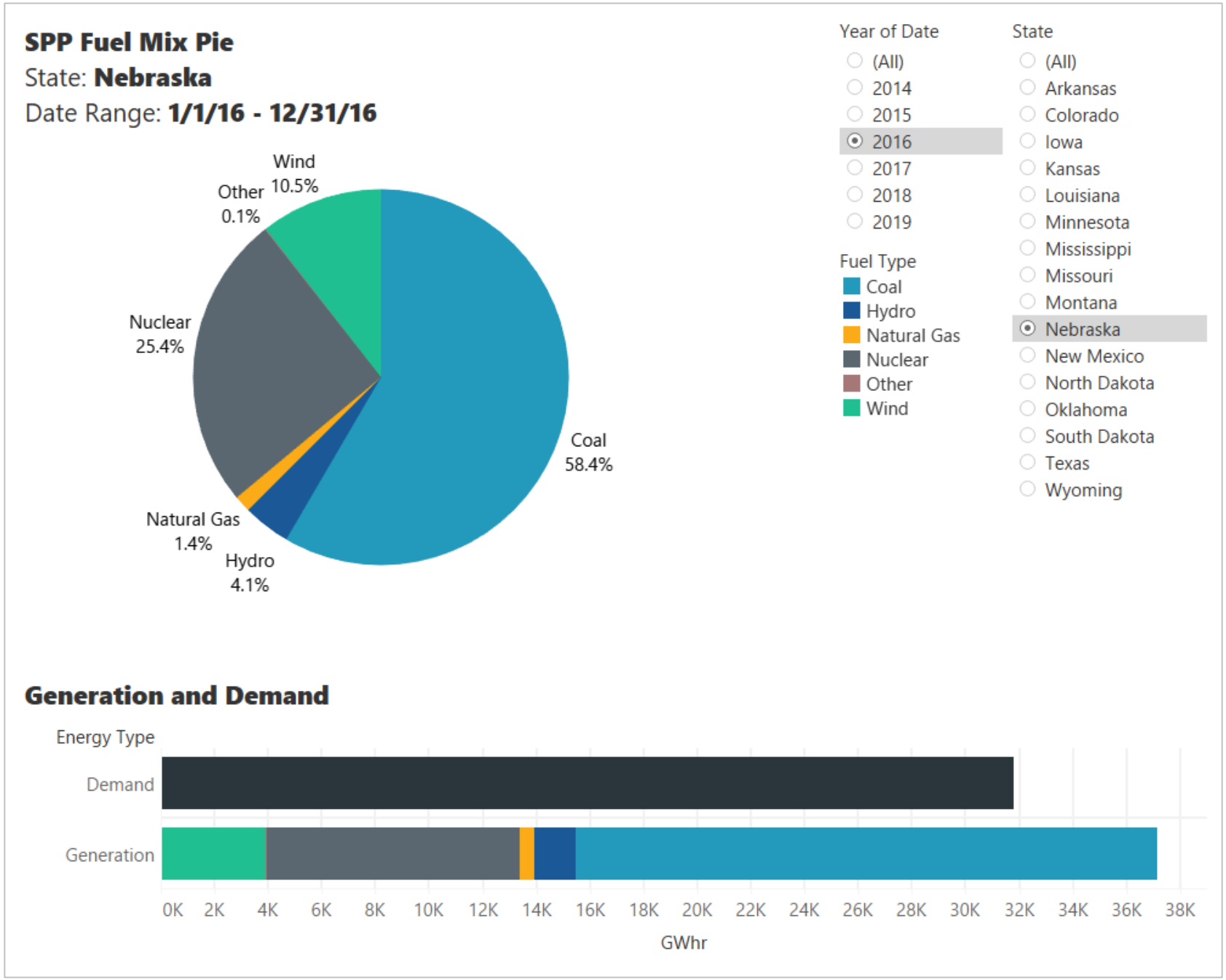
REGISTERED CAPACITY



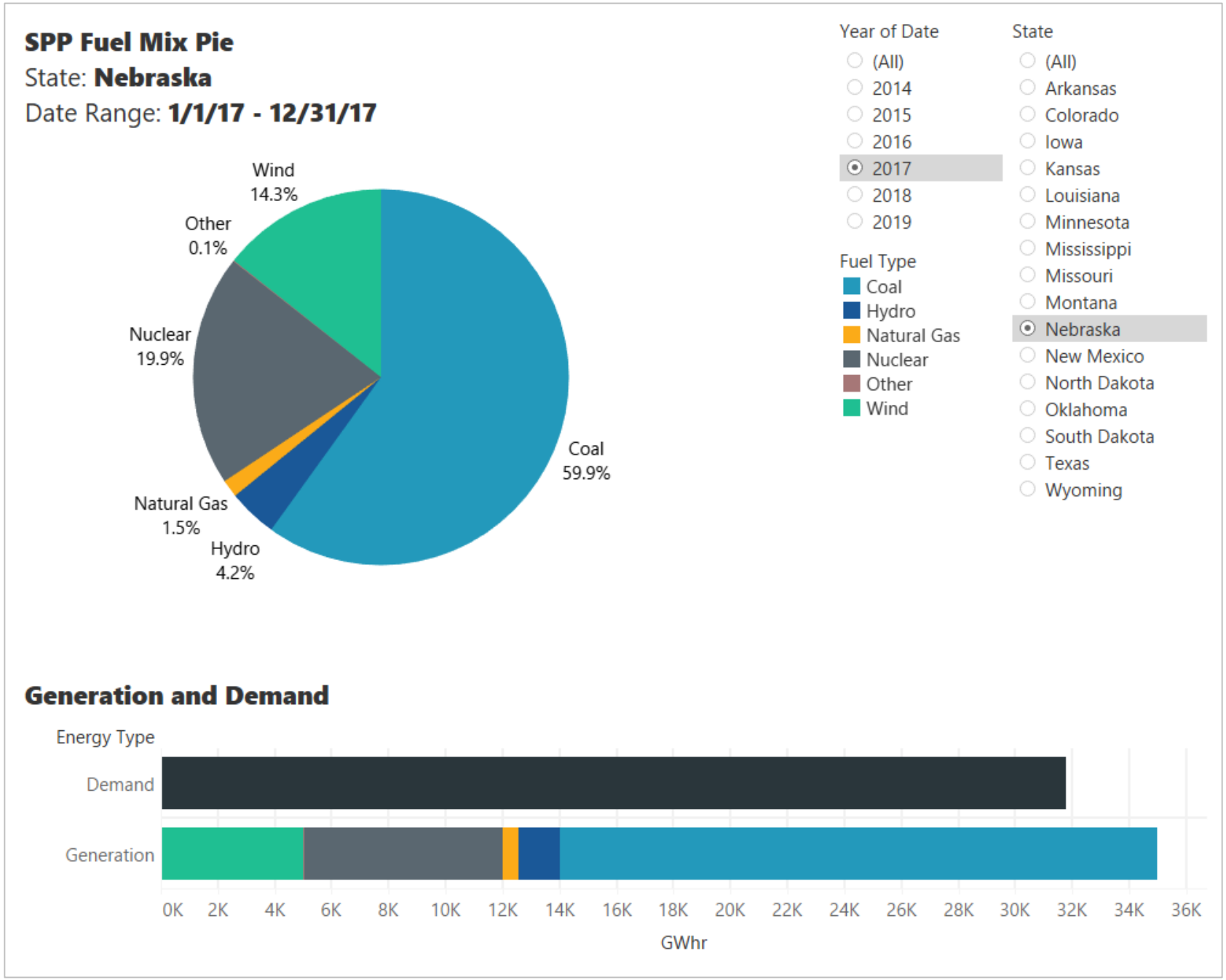
REGISTERED CAPACITY



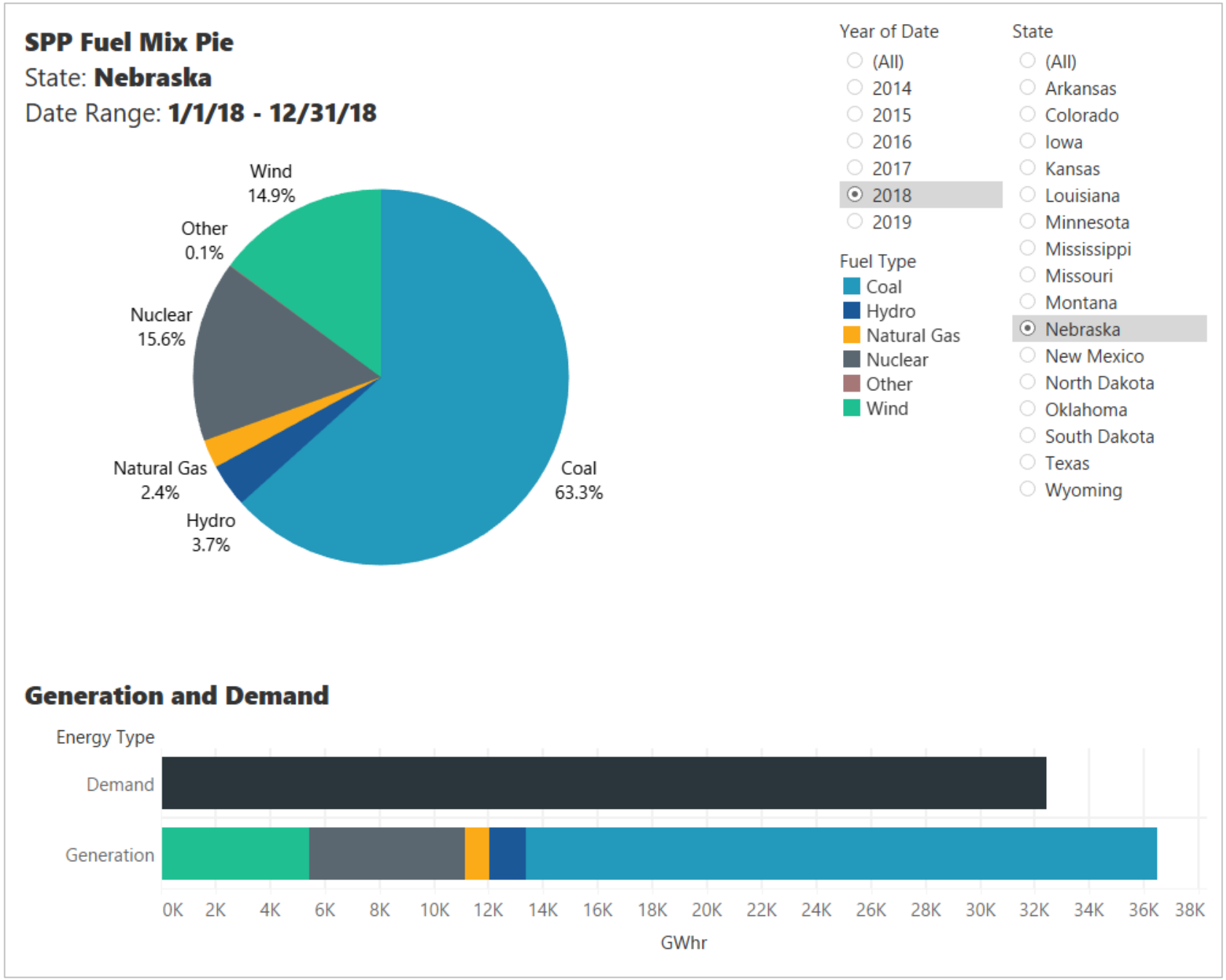
2016


SPP Fuel Mix Pie
State: Nebraska
Date Range: 1/1/16 - 12/31/16
Wind 10.5%
Other 0.1%
Nuclear 25.4%
Coal 58.4%
Natural Gas 1.4%
Hydro 4.1%
Year of Date
(All)
2014
2015
2016
2017
2018
2019
Fuel Type
Coal
Hydro
Natural Gas
Nuclear
Other
Wind
State
(All)
Arkansas
Colorado
Iowa
Kansas
Louisiana
Minnesota
Mississippi
Missouri
Montana
Nebraska
New Mexico
North Dakota
Oklahoma
South Dakota
Texas
Wyoming
Generation and Demand
Energy Type
Demand
Generation
0K 2K 4K 6K 8K 10K 12K 14K 16K 18K 20K 22K 24K 26K 28K 30K 32K 34K 36K 38K
GWhr

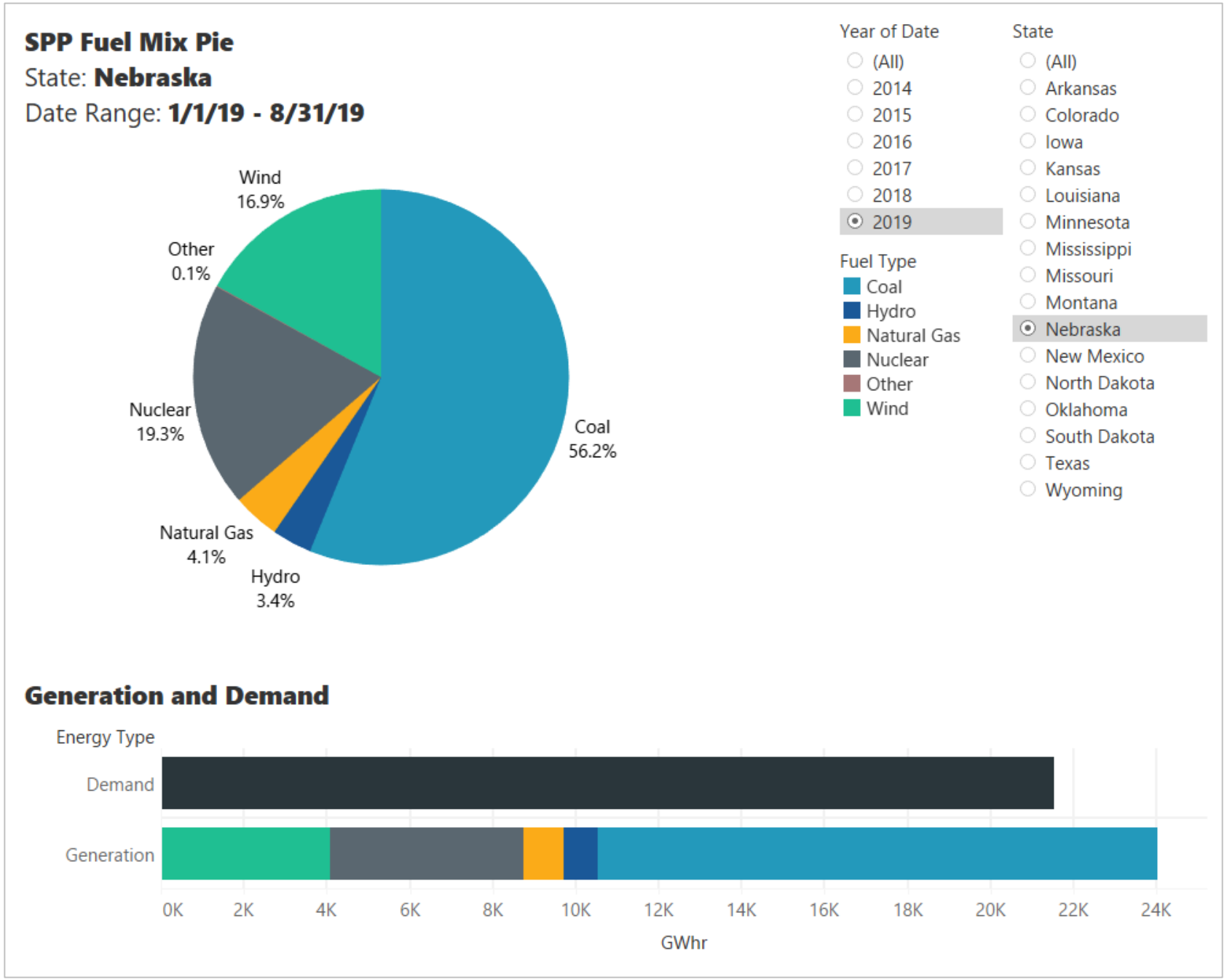
2017


SPP Fuel Mix Pie
State: Nebraska
Date Range: 1/1/17 - 12/31/17
Wind 14.3%
Other 0.1%
Nuclear 19.9%
Natural Gas 1.5%
Hydro 4.2%
Coal 59.9%
Year of Date
(All)
2014
2015
2016
2017
2018
2019
Fuel Type
Coal
Hydro
Natural Gas
Nuclear
Other
Wind
State
(All)
Arkansas
Colorado
Iowa
Kansas
Louisiana
Minnesota
Mississippi
Missouri
Montana
Nebraska
New Mexico
North Dakota
Oklahoma
South Dakota
Texas
Wyoming
Generation and Demand
Energy Type
Demand
Generation
0K 2K 4K 6K 8K 10K 12K 14K 16K 18K 20K 22K 24K 26K 28K 30K 32K 34K 36K
GWhr

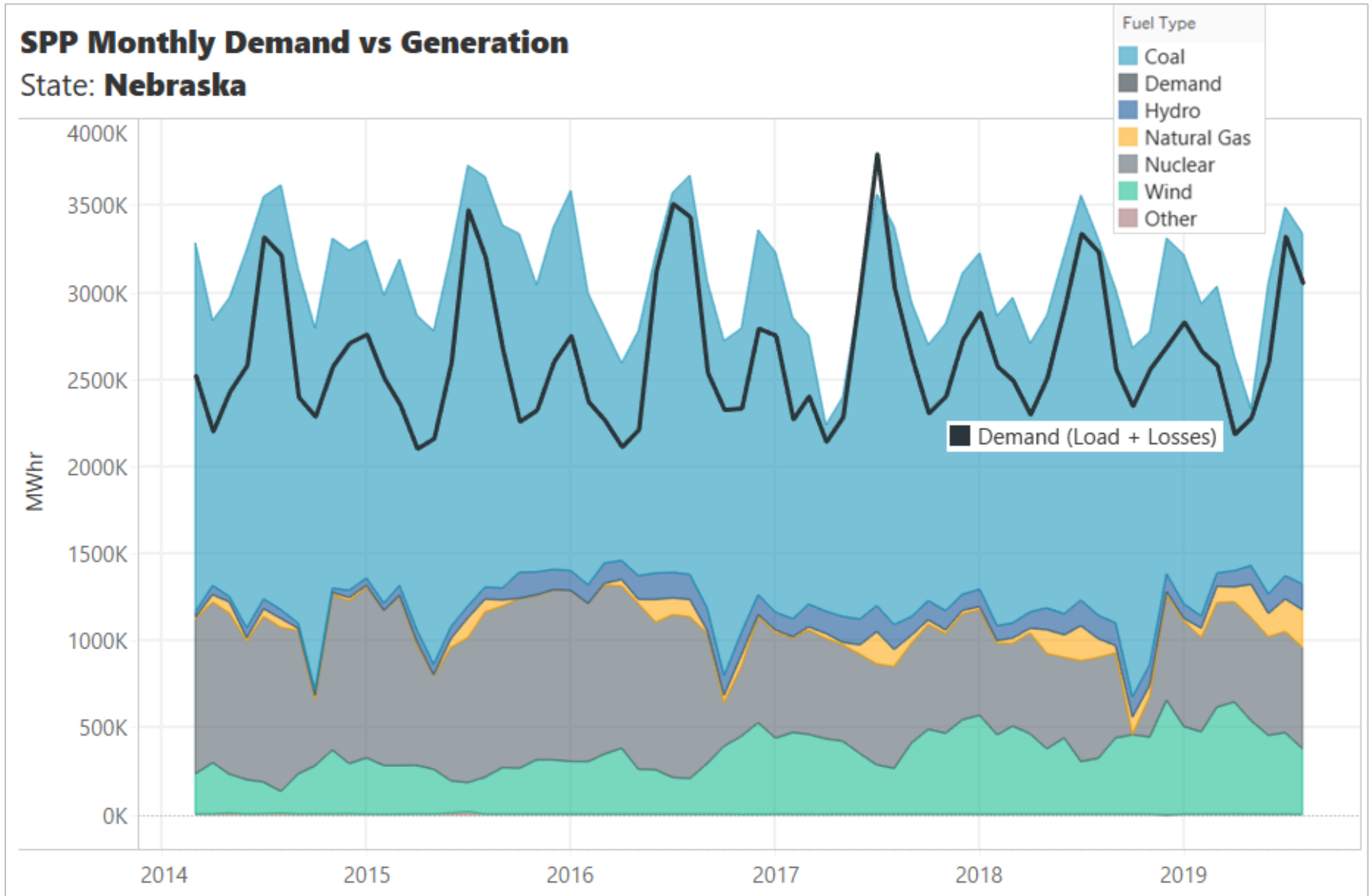
2018


SPP Fuel Mix Pie
State: Nebraska
Date Range: 1/1/18 - 12/31/18
Wind 14.9%
Other 0.1%
Nuclear 15.6%
Natural Gas 2.4%
Hydro 3.7%
Coal 63.3%
Year of Date
(All)
2014
2015
2016
2017
2018
2019
Fuel Type
Coal
Hydro
Natural Gas
Nuclear
Other
Wind
State
(All)
Arkansas
Colorado
Iowa
Kansas
Louisiana
Minnesota
Mississippi
Missouri
Montana
Nebraska
New Mexico
North Dakota
Oklahoma
South Dakota
Texas
Wyoming
Generation and Demand
Energy Type
Demand
Generation
0K 2K 4K 6K 8K 10K 12K 14K 16K 18K 20K 22K 24K 26K 28K 30K 32K 34K 36K 38K
GWhr

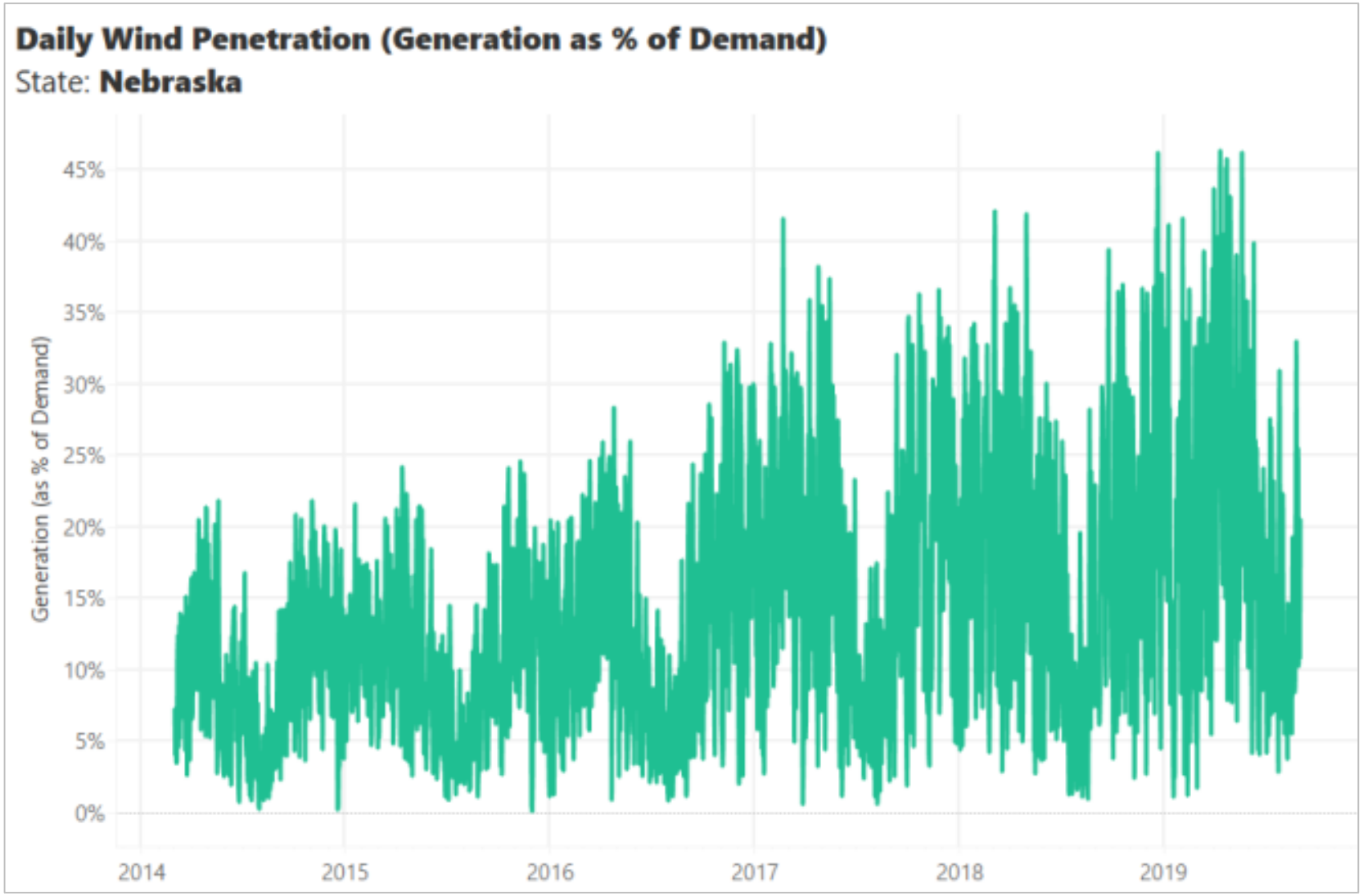
2019 SO FAR


SPP Fuel Mix Pie
State: Nebraska
Date Range: 1/1/19 - 8/31/19
Wind 16.9%
Other 0.1%
Nuclear 19.3%
Natural Gas 4.1%
Hydro 3.4%
Coal 56.2%
Year of Date
(All)
2014
2015
2016
2017
2018
2019
Fuel Type
Coal
Hydro
Natural Gas
Nuclear
Other
Wind
State
(All)
Arkansas
Colorado
Iowa
Kansas
Louisiana
Minnesota
Mississippi
Missouri
Montana
Nebraska
New Mexico
North Dakota
Oklahoma
South Dakota
Texas
Wyoming
Generation and Demand
Energy Type
Demand
Generation
0K
2K
4K
6K
8K
10K
12K
14K
16K
18K
20K
22K
24K
GWhr

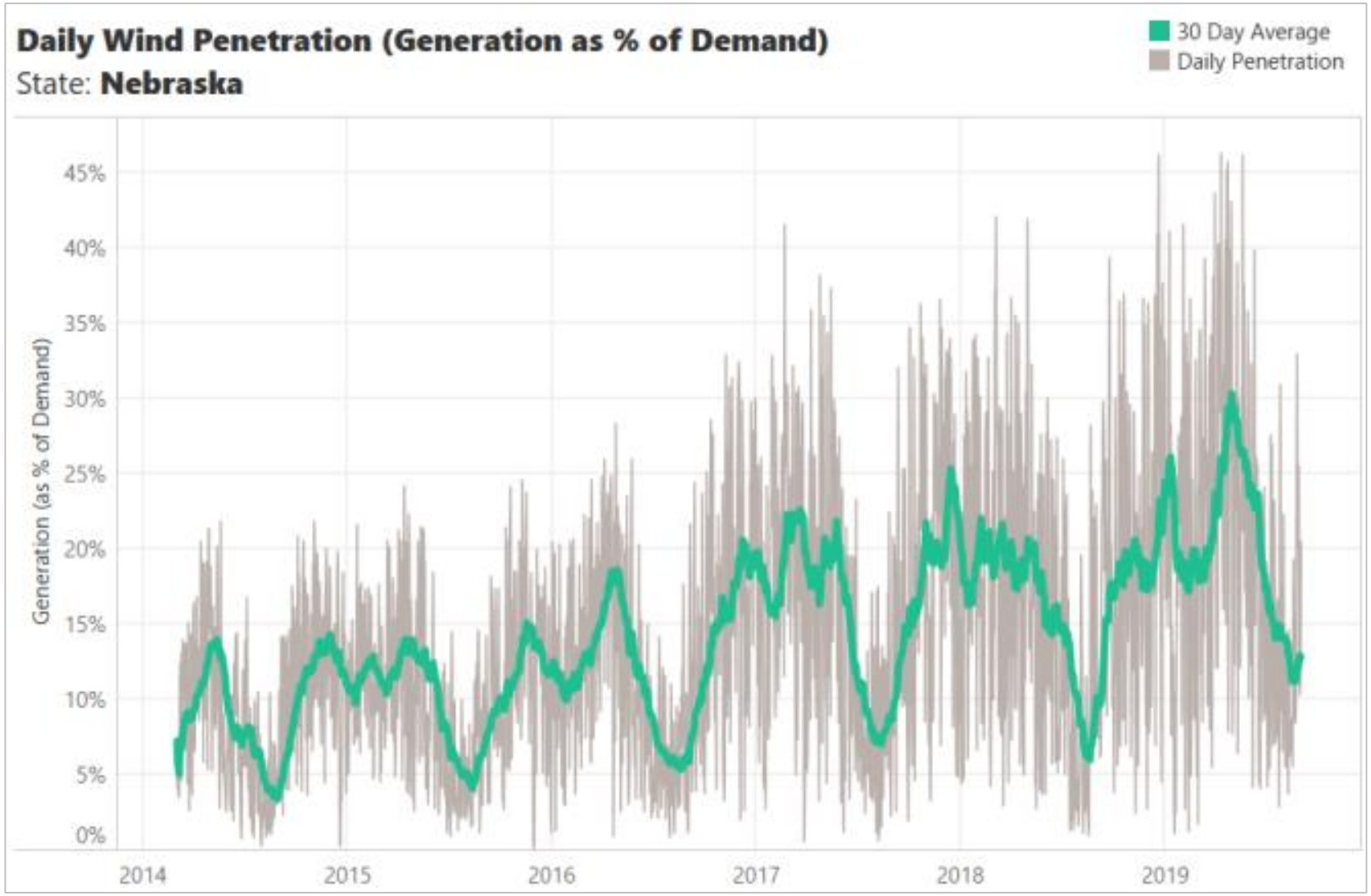
ALL GENERATION (BY FUEL) VS DEMAND ENERGY



DAILY WIND PENETRATION LEVELS



DAILY WIND PENETRATION LEVELS



THIS ISN'T OUR PARENTS' ELECTRIC GRID

Advanced technologies

Smart meters

Environmental constraints

Generator retirements

Cybersecurity

Prosumers

Microgrids

Wind

Energy efficiency

Evolving grid

Fuel prices

Electric vehicles

Battery storage

Solar

Demand response

Distributed generation

Consumer demand

PLANNING FOR AN UNCERTAIN FUTURE