

Perspectives on the *State of the Industry*



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Nebraska Public Power District






"Always there when you need us"

**NPPD/NDEQ
Power Summit**

October 17, 2019

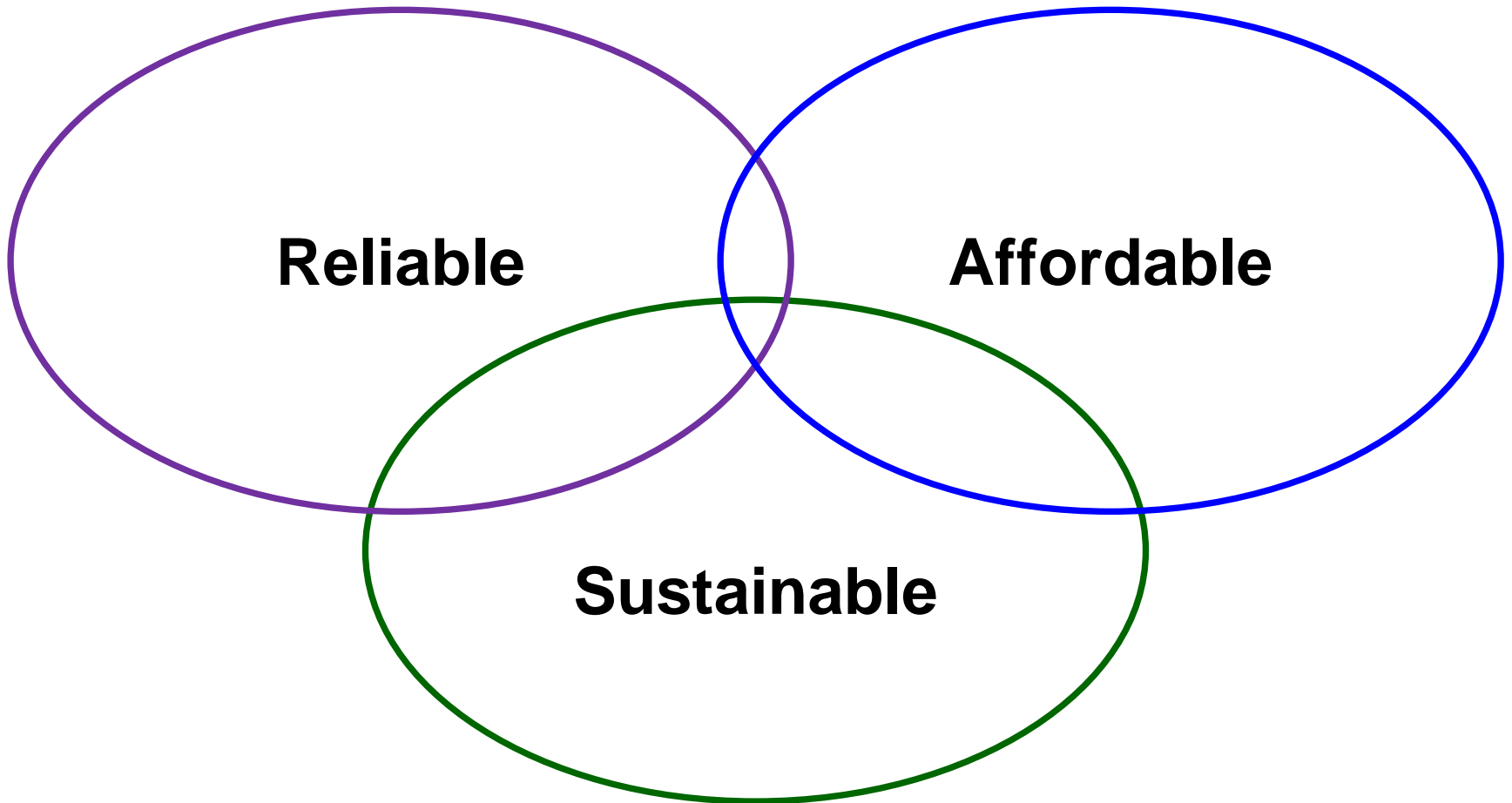
Current Industry Dynamics

A Time of Major Change

- Changing energy mix
 - Renewables 
 - natural gas up 
 - Coal 
 - Nuclear 
 - Distributed generation 
- Challenges to expand electric transmission
- Demand destruction / energy efficiency
- Increasing concerns about carbon
- Impact of integrated / regional markets
- Cyber & physical security
- Economics 101 – Supply vs. Demand

Three Simple Questions

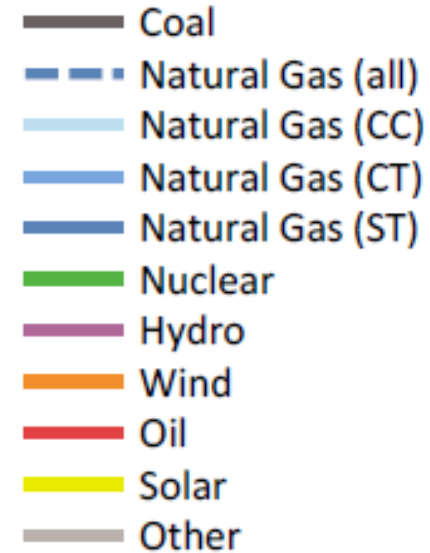
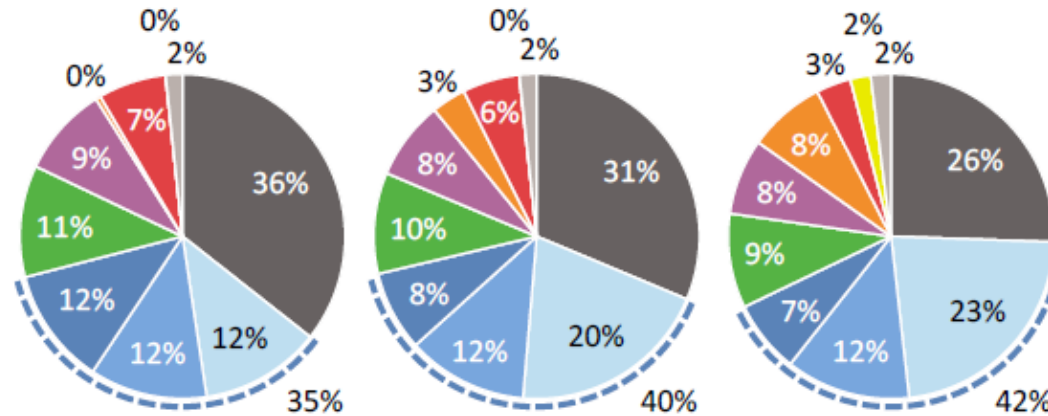
How can we provide electricity that is....



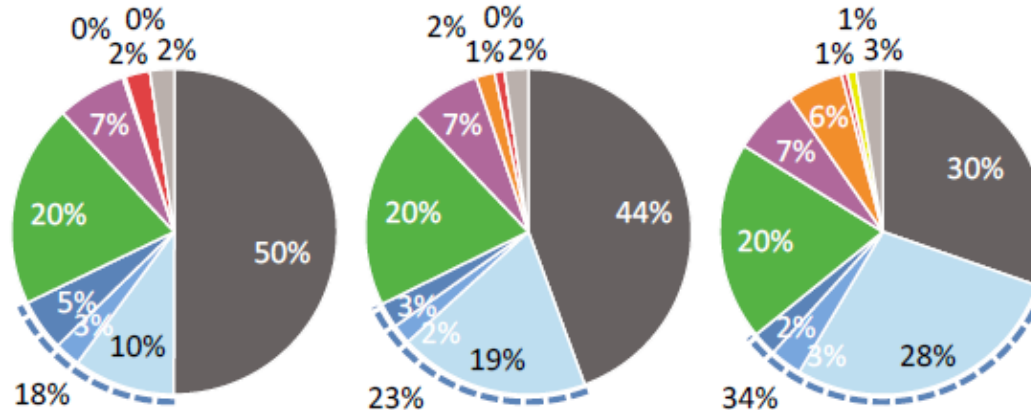
The Answers are Complex

Changes in U.S. Capacity and Generation Mix Over Time

U.S. Capacity



Generation Mix



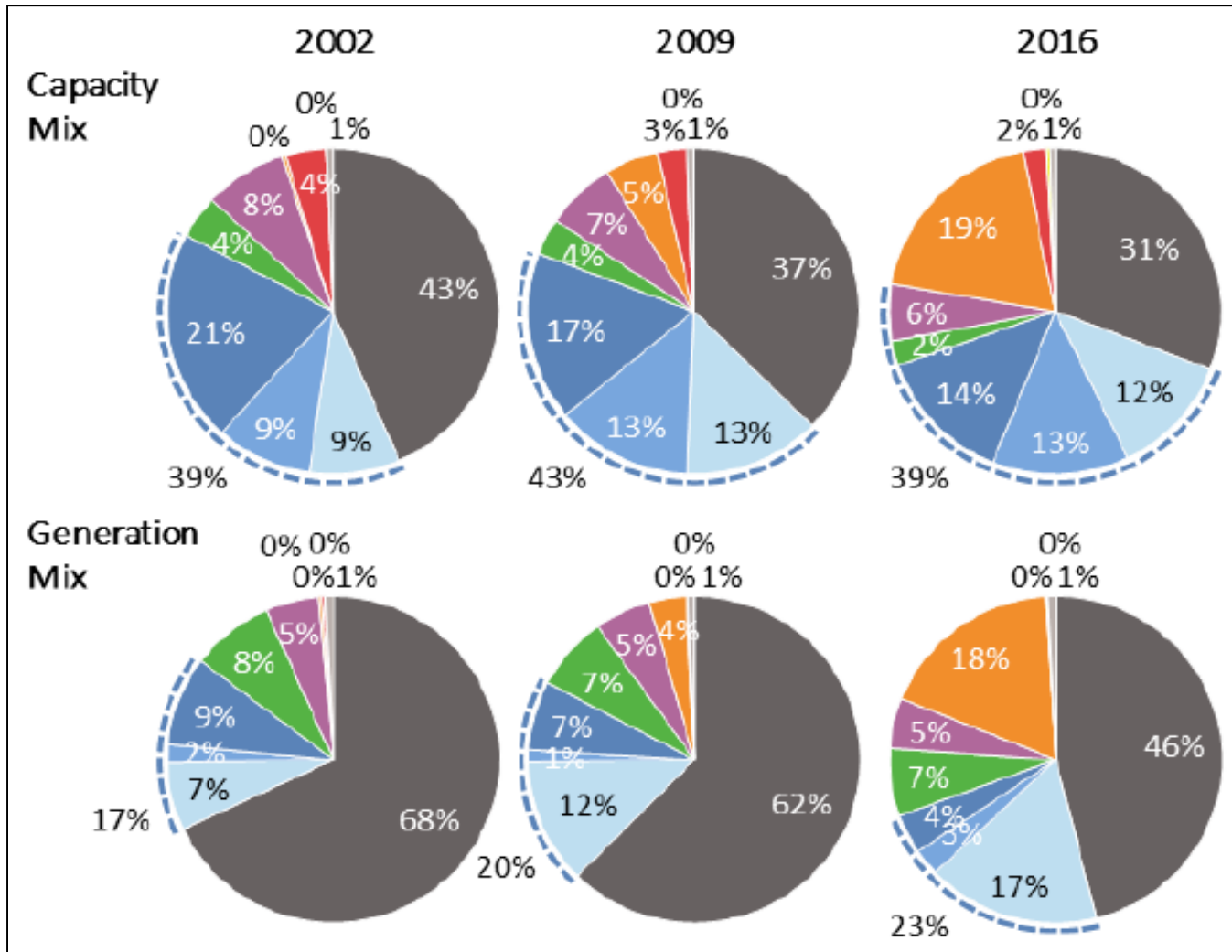
2002

2009

2016

The grid was, on average, more diverse in 2016 than in 2002 in terms of both capacity and generation.

Central Regional Profile



- Coal
- Natural Gas (all)
- Natural Gas (CC)
- Natural Gas (CT)
- Natural Gas (ST)
- Nuclear
- Hydro
- Wind
- Oil
- Solar
- Other

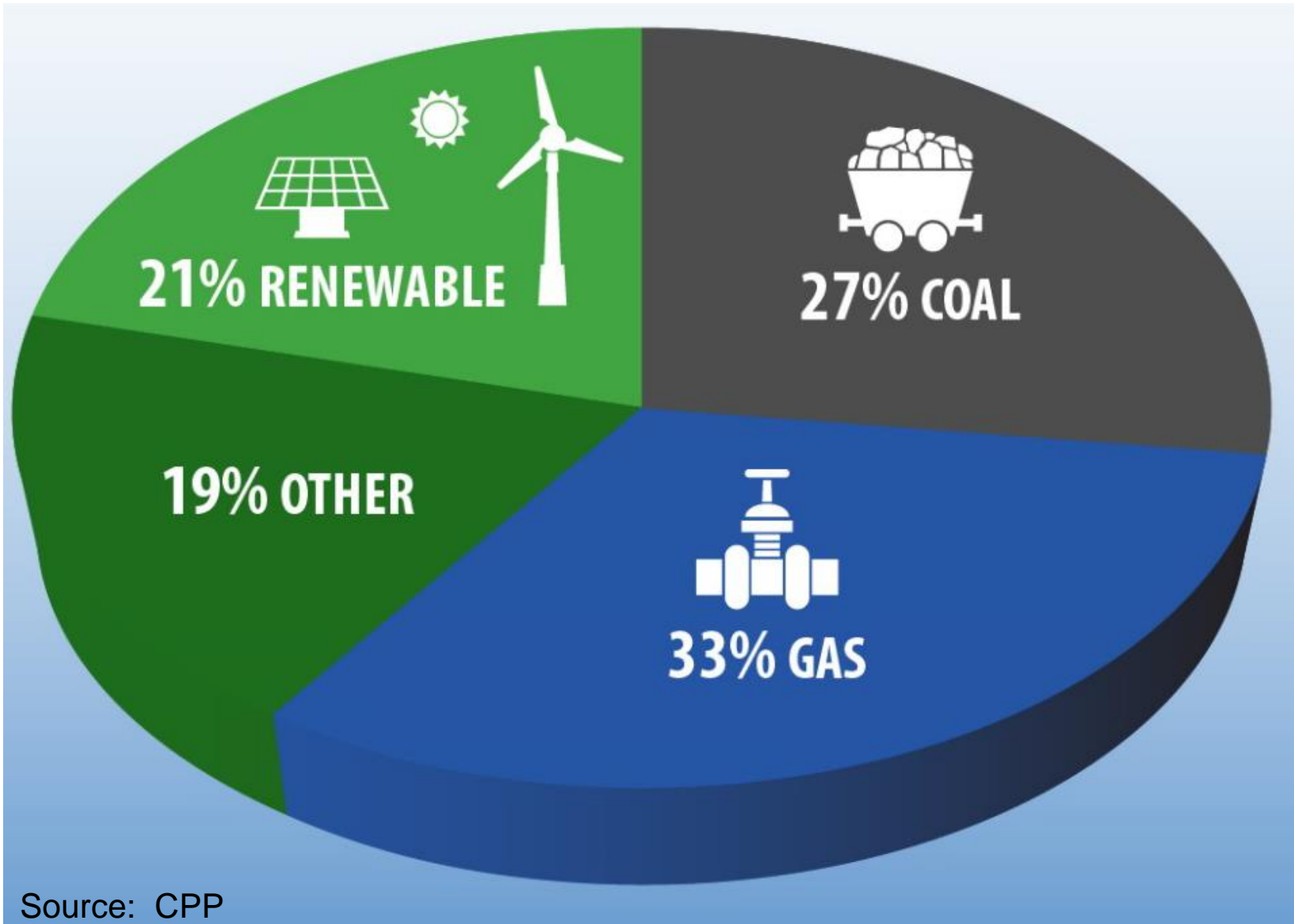
Data Sources: U.S. EIA, SNL Energy, ABB Energy Velocity Suite, NERC

Source: DOE Reliability Study

https://energy.gov/sites/prod/files/2017/08/f36/Staff%20Report%20on%20Electricity%20Markets%20and%20Reliability_o.pdf

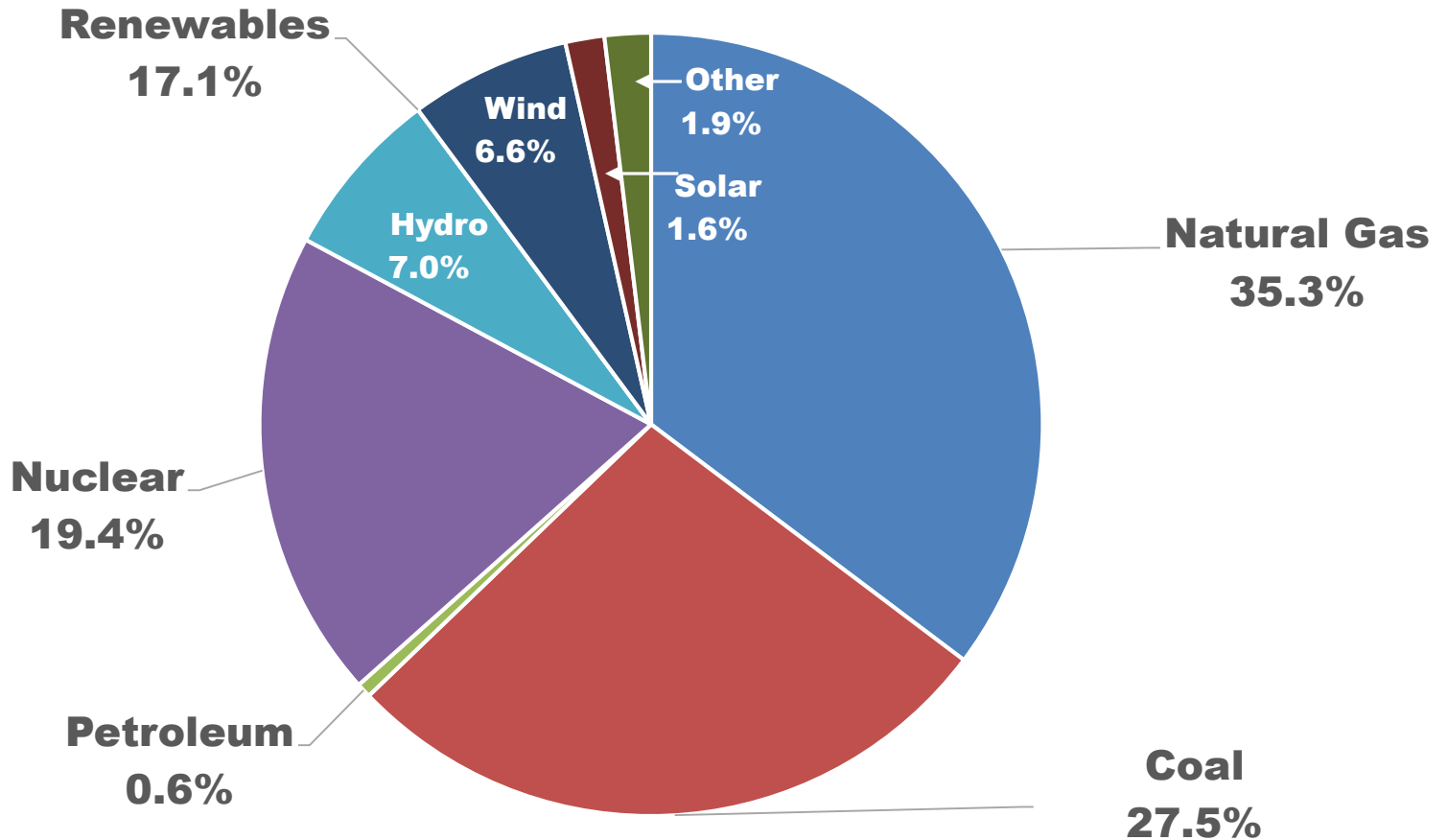
National Energy Mix in 2030

Under Obama Clean Power Plan



Source: CPP

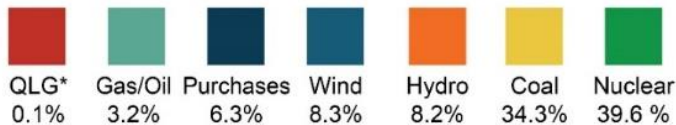
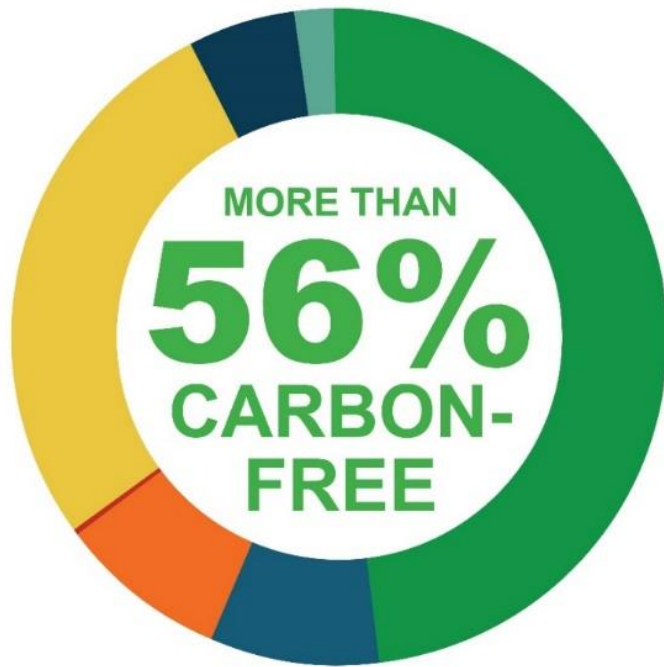
2018 U.S. Fuel Sources for Electricity



2018 Electricity Fuel Mix

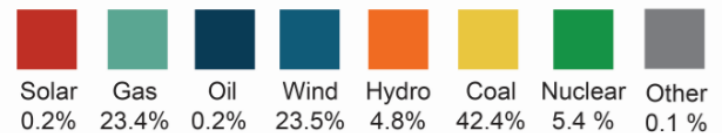
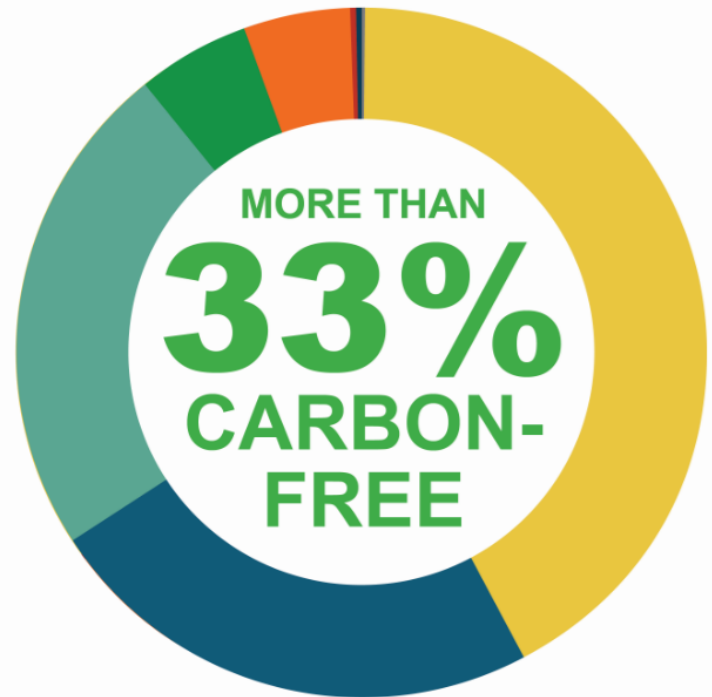
2018 NPPD Energy Generation Resources

Nebraska Customers



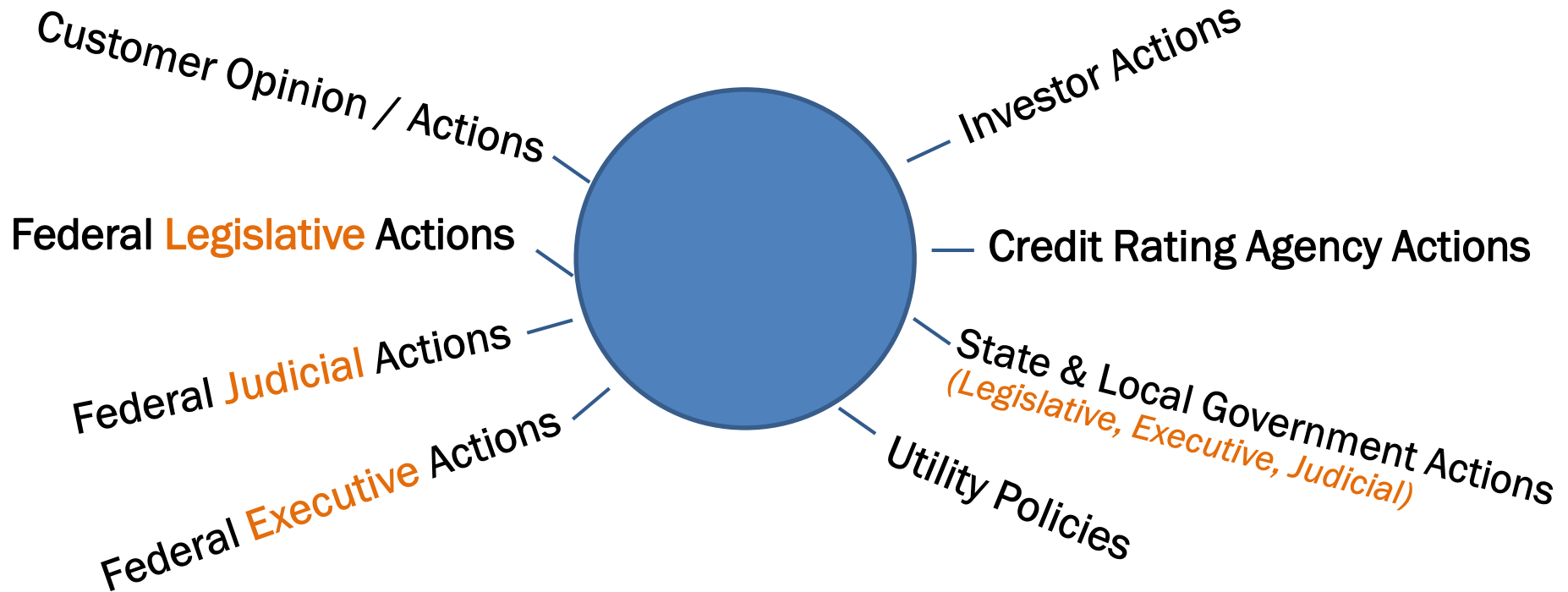
*Qualifying Local Generation (QLG) includes renewable energy facilities installed by our wholesale customers and in NPPD retail communities.

2018 Southwest Power Pool Energy Generation Resources



Diversity is our Strength!

Drivers of Decarbonization

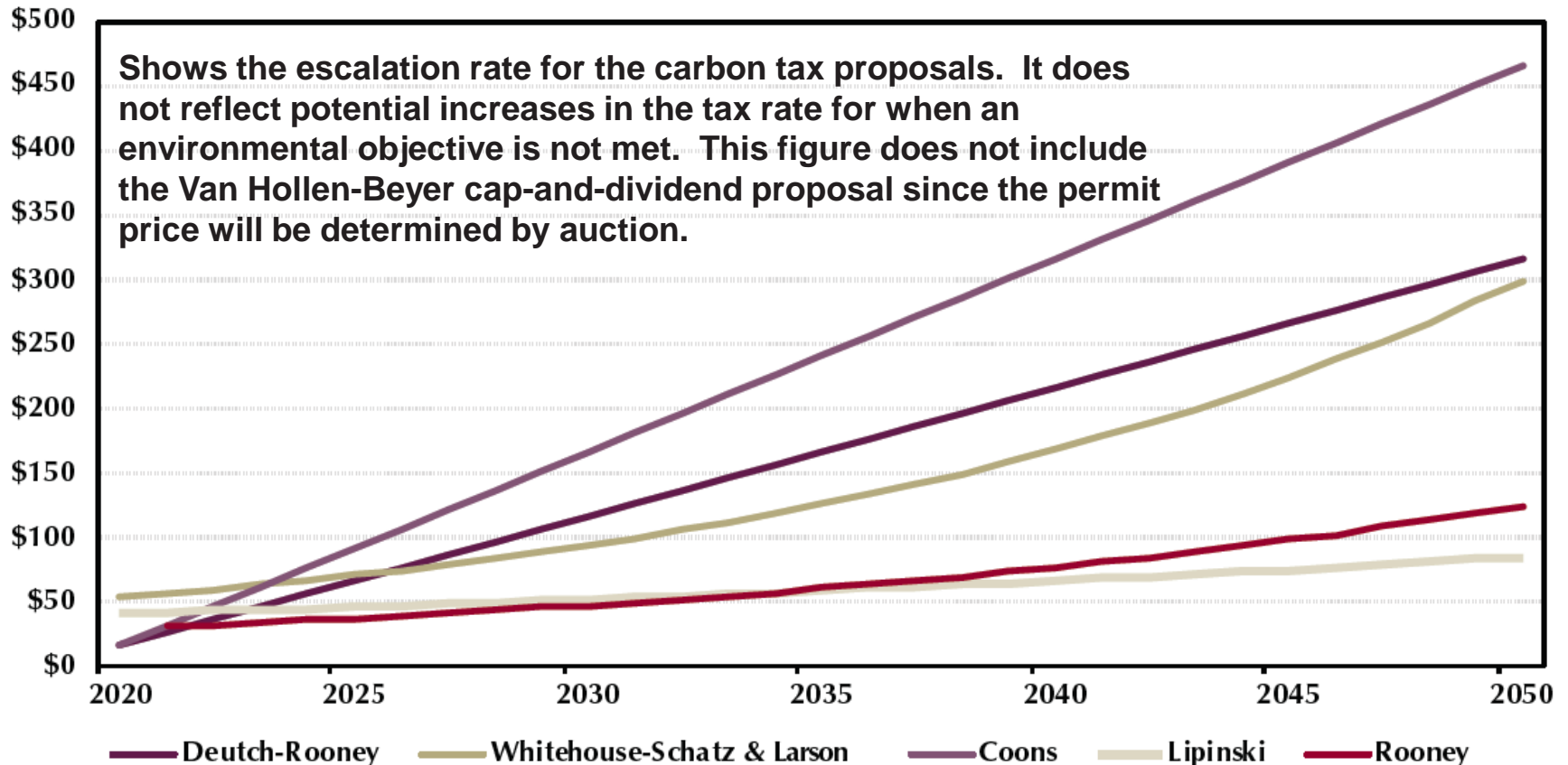


Federal Carbon Policy Timeline

- **2007 Massachusetts v. EPA**
 - 5-4 Supreme Court decision
 - Greenhouse gases are air pollutants
- **2008 Waxman Markey (Cap & Trade)**
 - Approved in House 219-212; never taken up in Senate
- **2014 Obama Clean Power Plan Proposed**
- **2015 Paris Agreement**
- **2016 Obama Clean Power Plan Stayed by Supreme Court**
- **2018 Trump Affordable Clean Energy Rule Proposed / Published July 2019**
- **2019 Democratic Controlled House of Representatives**
 - Numerous hearings on climate but action in 2019 unlikely
- **2019 Republicans in House & Senate beginning to acknowledge Carbon Policy Significance**
- **2020+**
 - New administration?
 - Democratic Congress?
 - Carbon restrictions? (tax, fee, or other regulation)

Comparison of Carbon Pricing Proposals in the 116th Congress

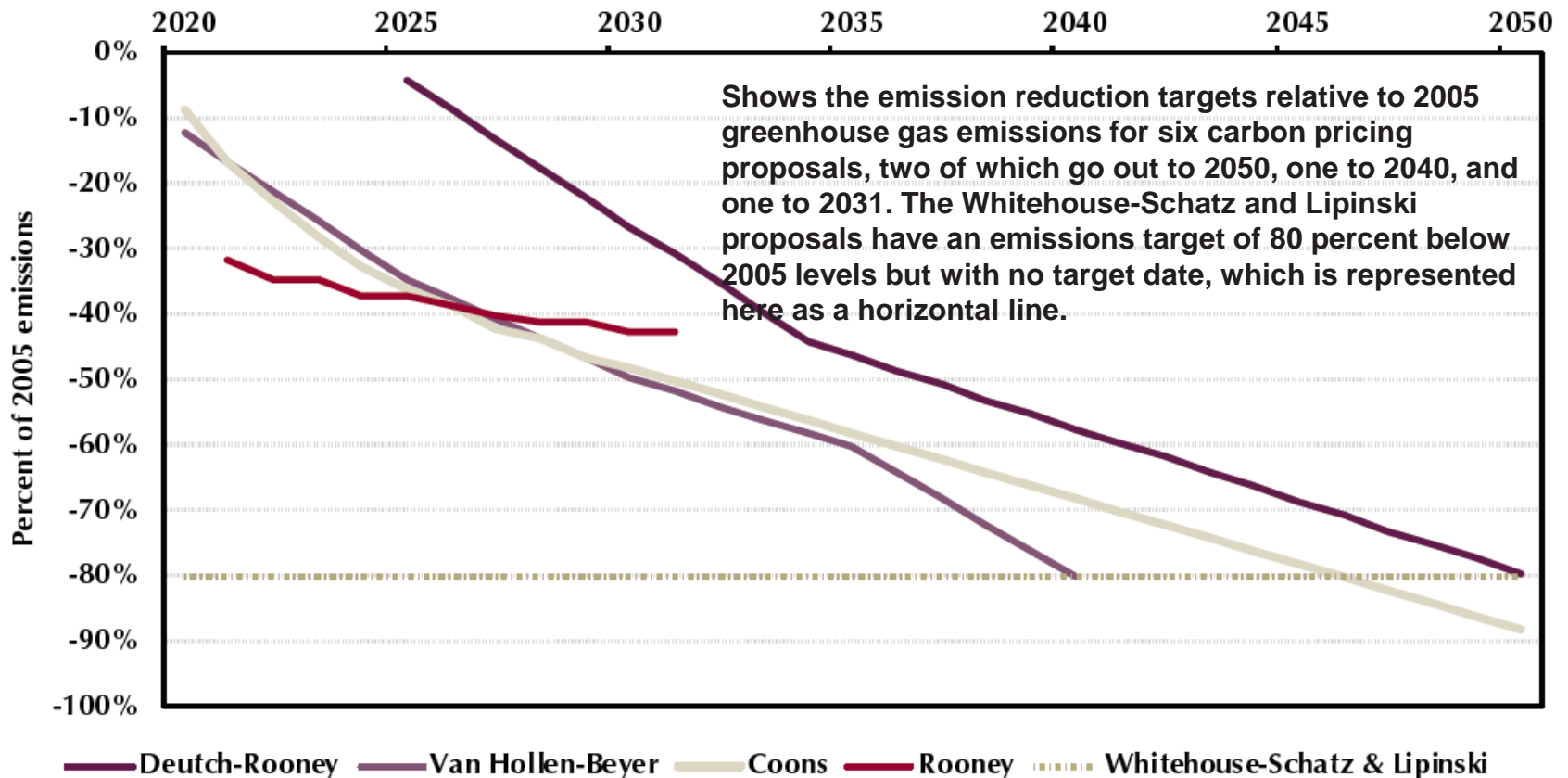
Figure 1: Tax rate for carbon tax proposals (\$/metric ton)



<https://www.c2es.org/site/assets/uploads/2019/07/carbon-pricing-proposals-in-the-116th-congress.pdf> [c2es.org]

Comparison of Carbon Pricing Proposals in the 116th Congress

Figure 2: Emission reduction target for carbon pricing proposals



<https://www.c2es.org/site/assets/uploads/2019/07/carbon-pricing-proposals-in-the-116th-congress.pdf> [c2es.org]

Climate is Increasingly the Subject of Energy Policy Actions

- **Governors**

- Promoting policies to support principles of Paris Agreement
 - Grew from 3 states to 25 states in two years

- **State Legislatures**

- 24 states have carbon reduction targets
 - Several are tied to Paris Agreement
 - Some states are more aggressive with 80-100% carbon reduction by 2050
- Carbon reduction / elimination legislation in multiple states
 - *California, Washington, New Mexico, Colorado, Hawaii, Maine and New York*
- Common theme is 80 ➡ 100% carbon reduction by 2050

- **Cities**

- More than 350 mayors have adopted goals of Paris Agreement

Climate is Increasingly the Subject of Energy Policy Actions

- **Big Business**

- Numerous companies have carbon reduction goals and similar expectations of their suppliers including electricity suppliers

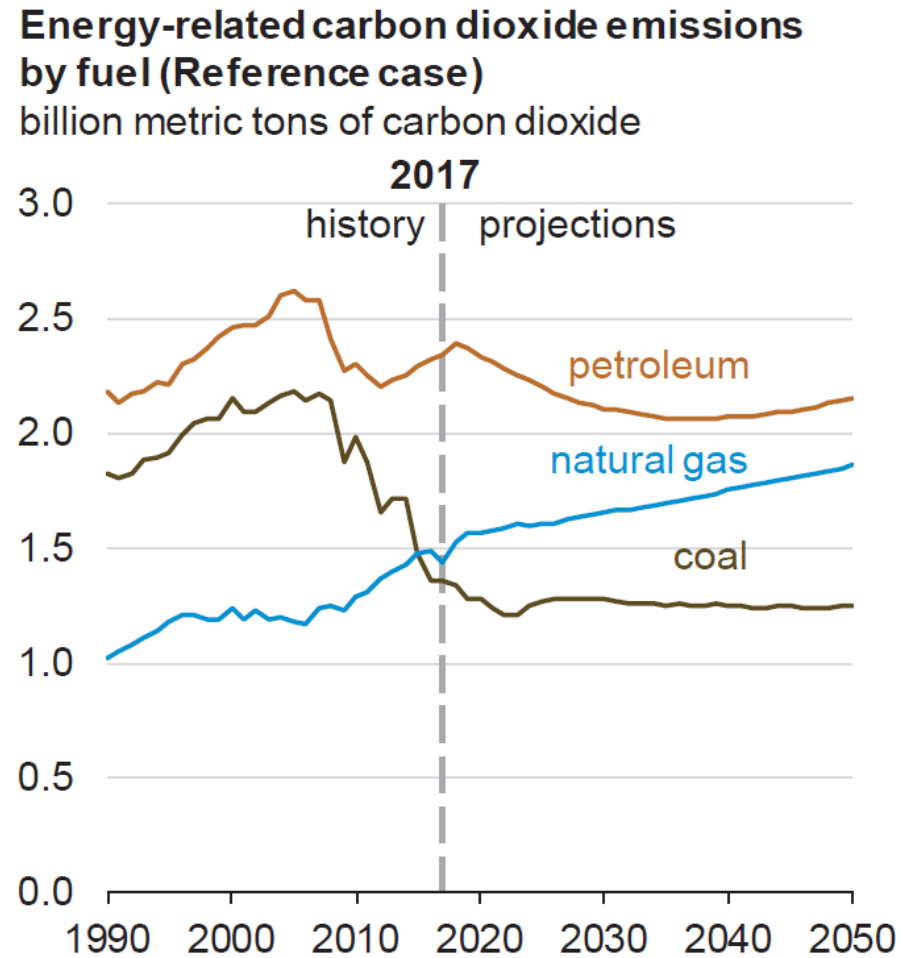
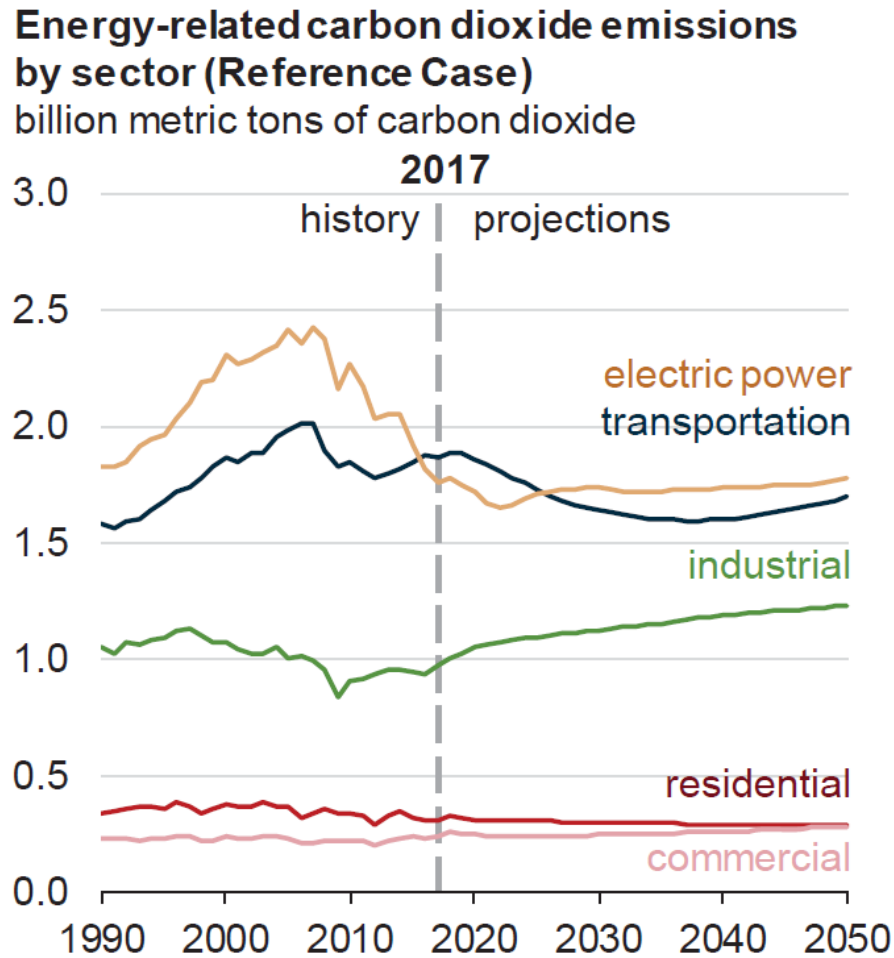
- **Investors**

- There are growing demands by certain investors for companies to disclose / reduce carbon emissions

- **Utilities**

- Many electric utilities have established carbon reduction goals

Energy-related Carbon Dioxide Emissions Mirror the Trends in Energy Consumption Across Cases



Decarbonization Summary

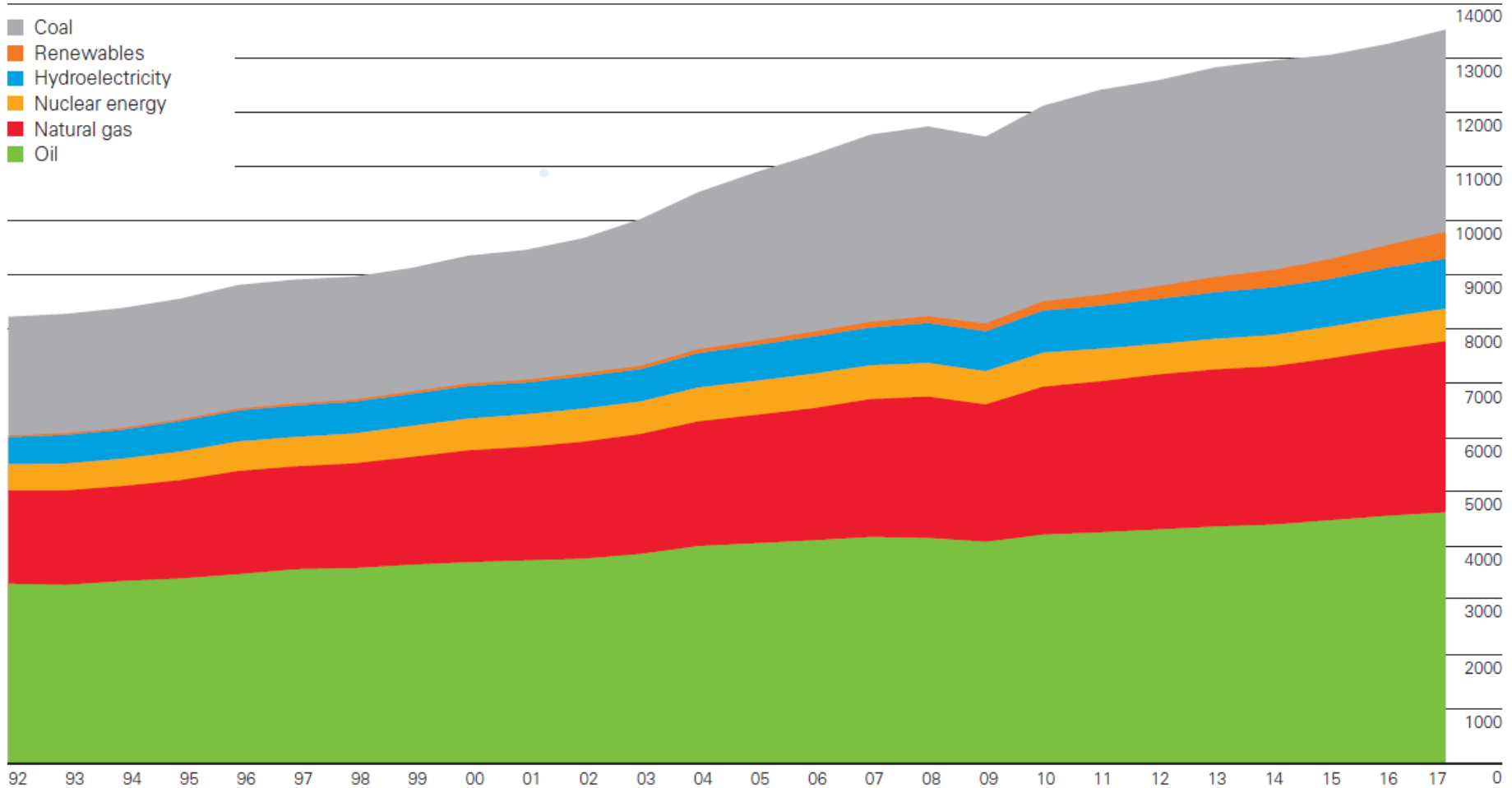
- Decarbonization of electricity production is a priority topic among electricity generators.
- Decarbonization is driving corporate decisions throughout the business world.
 - Financial Institutions
 - Technology Companies
 - Manufacturers
 - Retailers
- Decarbonization of the electric industry
 - has public support.
 - is getting significant attention in Washington DC, State Capitols and Local Governments.

NPPD's Efforts to Reduce Carbon

- NPPD has been positioning itself for less carbon intensive generation for more than 10 years.
 - ✓ Cooper Nuclear Station.
 - 500 MW recapture
 - 20-year license extension to 2034
 - ✓ Construction of Beatrice Power Station.
 - ✓ Brought eight of first dozen wind farms to the state.
 - ✓ New wholesale power contracts encourage local renewables.
 - ✓ 10% new renewable goal for NPPD's Nebraska customers by 2020, is nearly met.
 - ✓ Energy efficiency at power plants and with end-use customers.
- Nebraska's access to renewable energy will further decarbonize.
- Planned use of hydrogen at Sheldon Station.

World consumption

Million tonnes oil equivalent



World primary energy consumption grew by 2.2% in 2017, up from 1.2% in 2016 and the highest since 2013. Growth was below average in Asia Pacific, the Middle East and S. & Cent. America but above average in other regions. All fuels except coal and hydroelectricity grew at above-average rates. Natural gas provided the largest increment to energy consumption at 83 million tonnes of oil equivalent (mtoe), followed by renewable power (69 mtoe) and oil (65 mtoe).

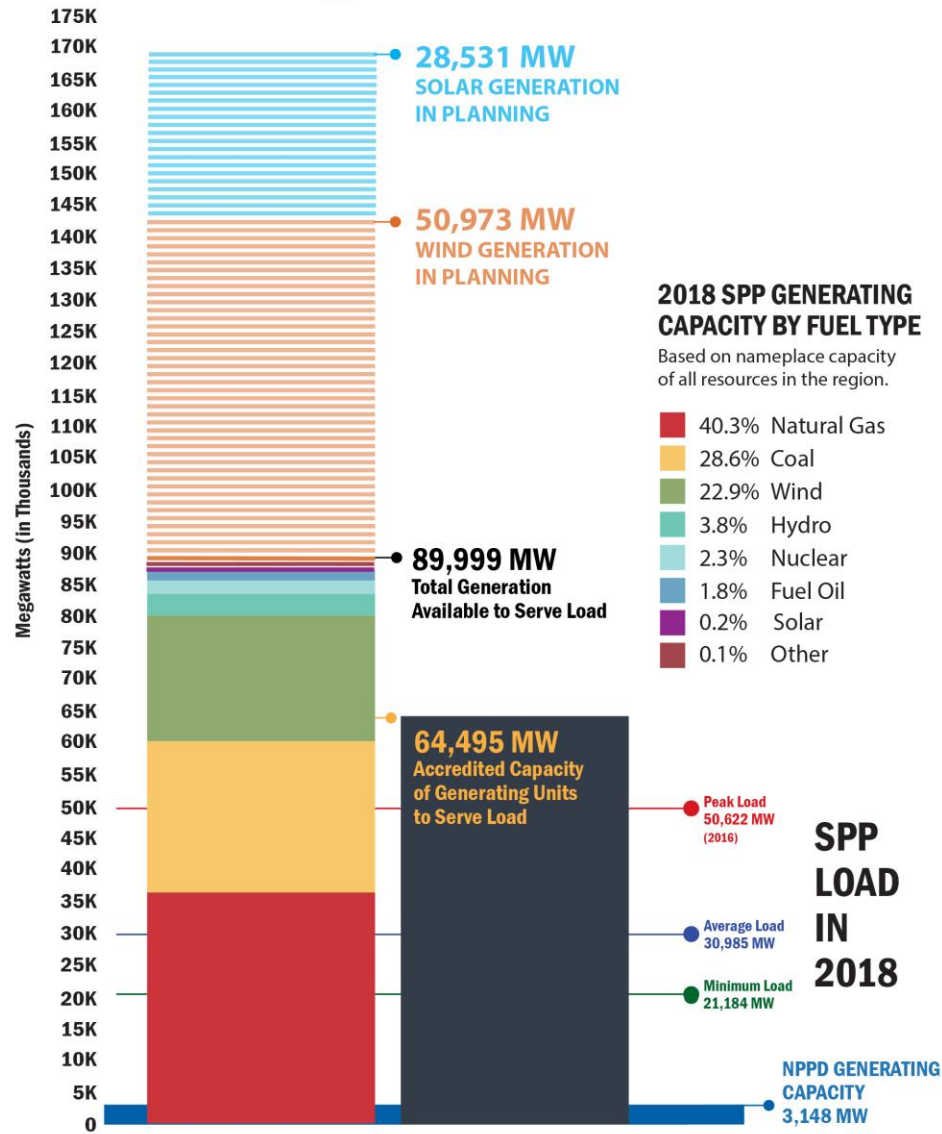
<https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf>

The Southwest Power Pool

Electric Power Markets: National Overview



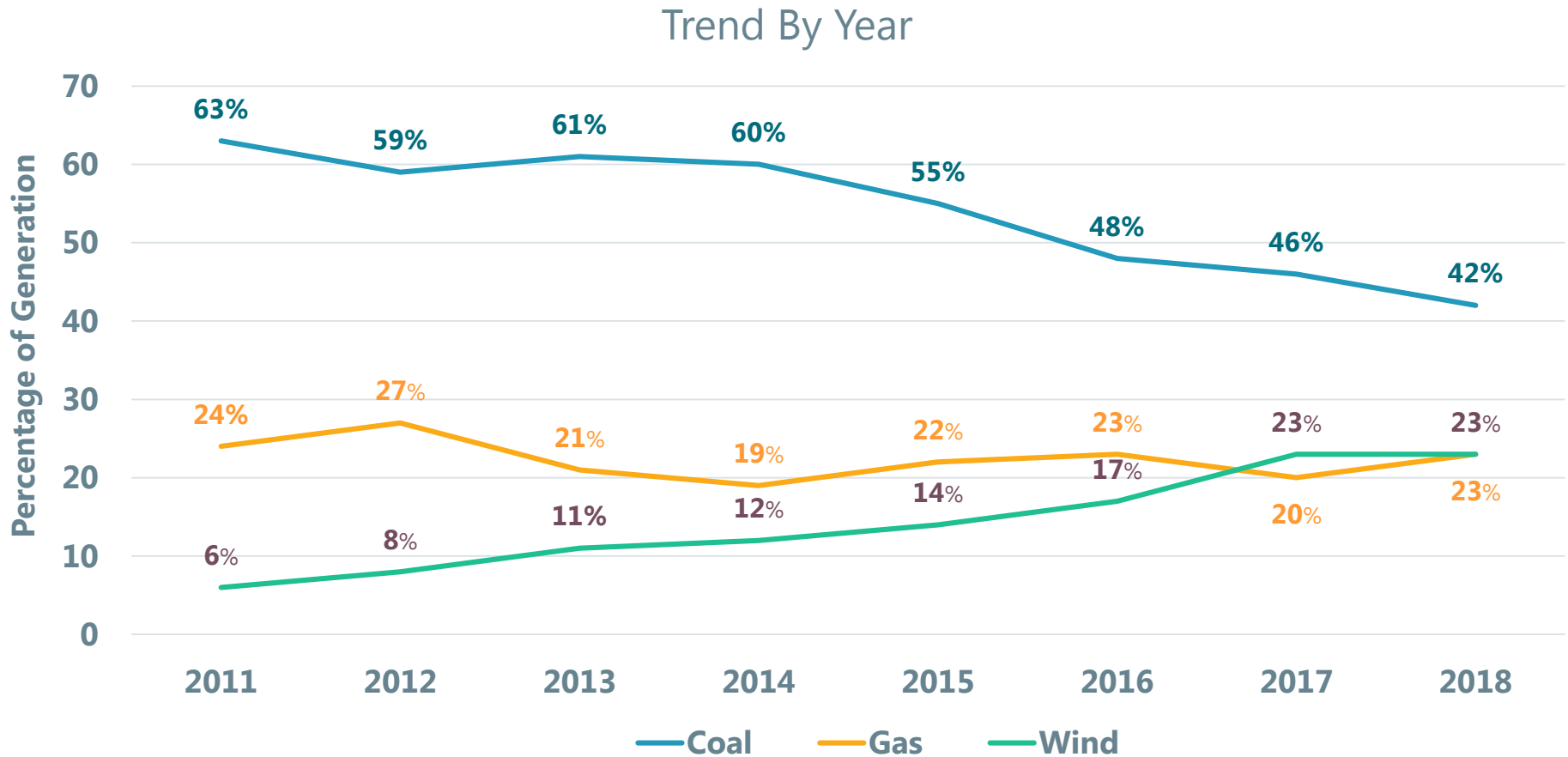
Current and Projected Southwest Power Pool (SPP) Energy Generation Portfolio



SPP Data Graph created by Corp. Communications Dept



SPP EVOLVING ENERGY MIX



WIND IN SPP'S SYSTEM

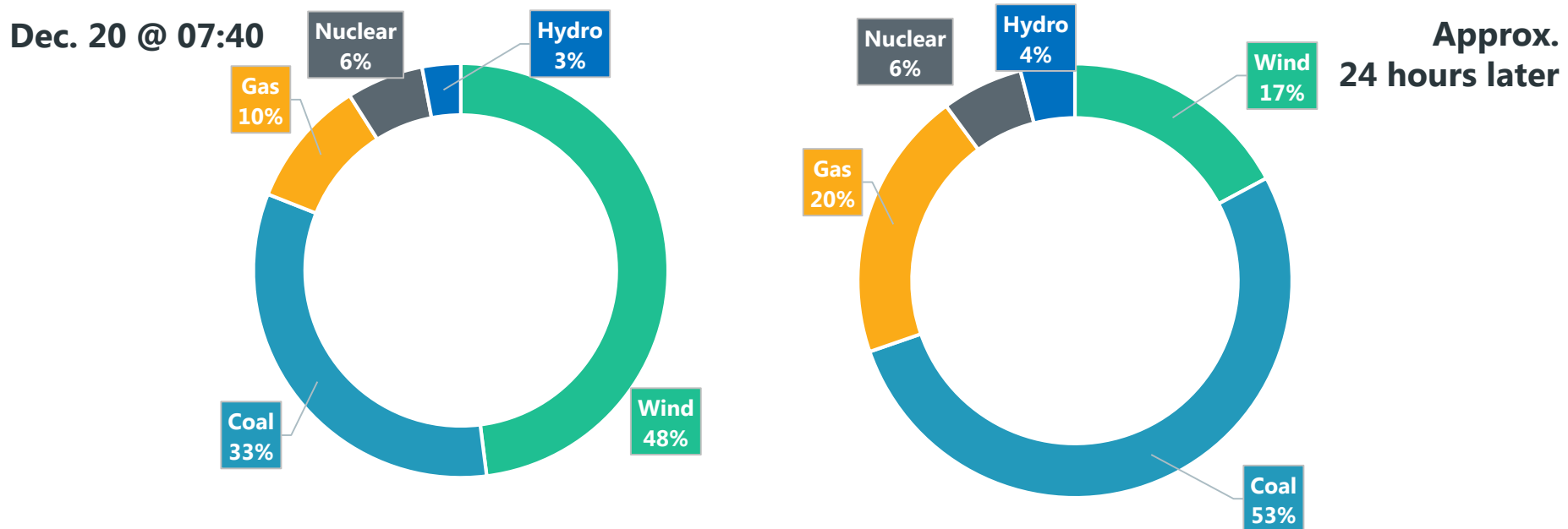
- **21,578 MW: Wind installed today**
 - 11,029 turbines at 207 wind resources (most are 80m hub height)
 - Largest wind resource: 478 MW (Hale Wind Farm in Hale County, TX)
- **9,065 MW: Unbuilt wind w/signed interconnection agreements**
- **50,210 MW: Wind in all stages of study and development**
-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

WIND PENETRATION IN THE SPP SYSTEM

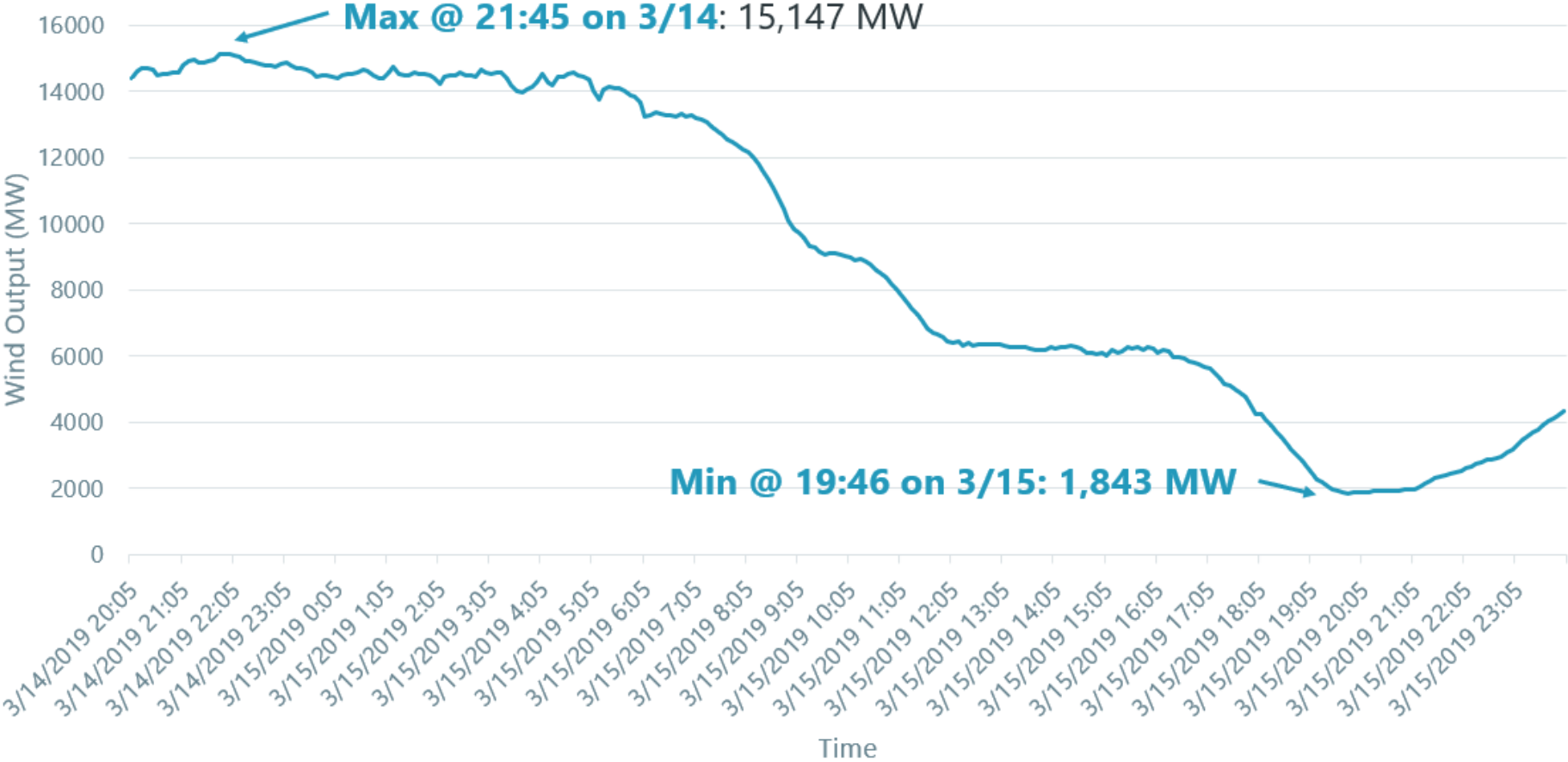
- Maximum wind output: 16,972 MW (9/11/2019)
- Minimum wind output (last 12 mos.): 146 MW (8/9/18 @ 10:47)
- Maximum wind penetration: 67.3% (4/27/19)
- Average wind penetration (2018): 23.5%
- Max wind swing in one day: >13 GW on March 14-15, 2019 (14.8 GW to 1.8 GW in 18 hours)
- Max 1-hour ramp: 3,700 MW

THE DIFFERENCE A DAY MAKES

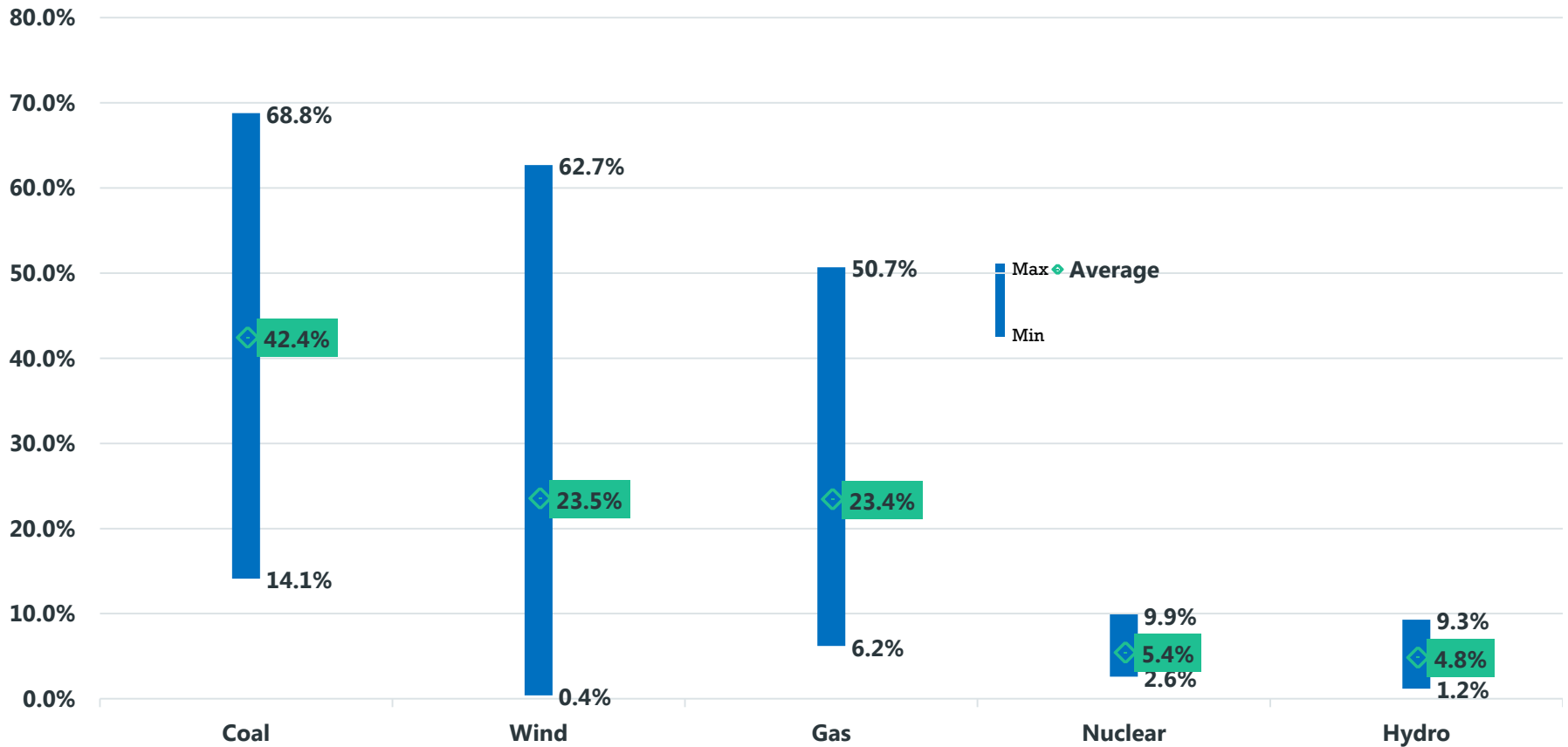
- On Dec. 20, 2018 at 07:40, a record output of 16,283 MW of wind power served 48 percent of our load. A day later, wind shrank to 17 percent of our generation mix, and other sources like coal and gas ramped up to serve load. This illustrates the value of a diverse fuel mix able to accommodate a wide variety of operational circumstances!



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



MIN/MAX % OF GENERATION MIX BY FUEL TYPE



June 2018 – June 2019

Questions?

