



## Mission

*Safely generate and deliver reliable, low-cost, sustainable energy and provide outstanding customer service*

## Considerations In NPPD's Carbon-Emission Reductions

*EPRI Forum - UNL  
July 13, 2016*

**John McClure**

Vice President Govt Affairs

General Counsel



**Nebraska Public Power District**

*"Always there when you need us"*



# Electricity Enhances Life

## Vision

*Dedicated to  
enhancing the  
quality of life for  
Nebraskans, now  
and in the future*

# Electricity Fundamentals

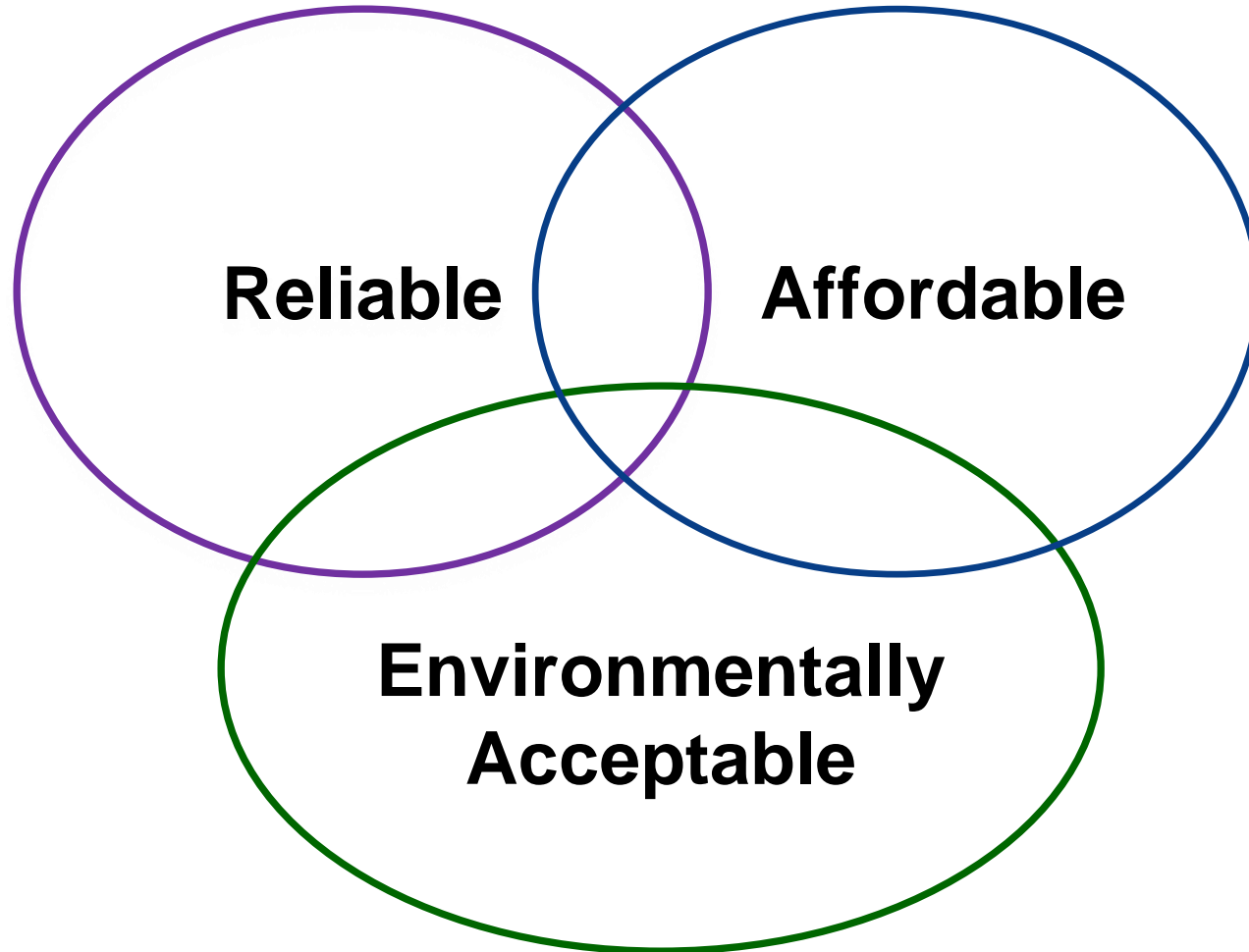
- **Unique** – generally produced instantaneously with need
- **Ubiquitous** – powers commerce, communication, comfort, and convenience
- **Universal Fuel** – natural gas, coal, uranium, wind, water, sun, biomass, oil and hydrogen are converted

# Current Industry Dynamics

## A Time of Major Change

- Growth of renewables
- Growth of natural gas
- Decline of coal
- Challenges to expand electric transmission
- Increasing environmental regulation
- Impact of integrated / regional markets
- Cyber & physical security
- Distribution technology
- Economics 101

**How can we provide electricity that is ...**

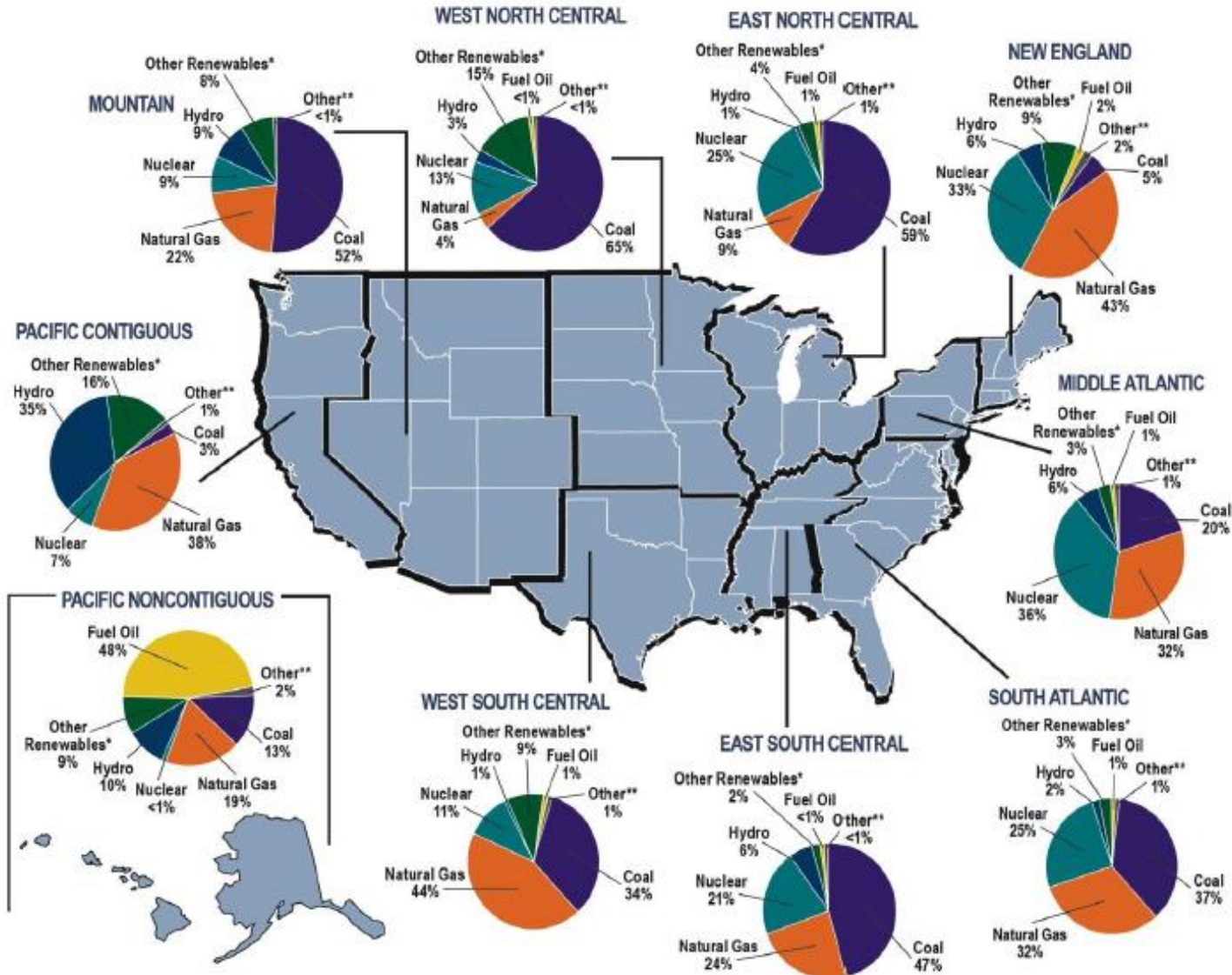


**The answers are complex**

# U.S. Electricity Fuel Mix

- The fuel mix is changing rapidly.
  - Wind, Solar & Natural Gas ↑
  - Coal & Nuclear ↓
- Fuel choices vary dramatically by region.
  - Powder River Basin Coal (Wyoming) has low-sulfur and low-cost compared to eastern coal
- Great Plains is wind rich.
- Natural gas is currently low-cost and plentiful for the near term, but history has shown price to be volatile/supply unpredictable.
  - Coal is still cheaper than natural gas in Nebraska
  - Fracking regulations
  - Pipeline capacity

# Regions Use a Diverse Mix of Fuels to Generate Electricity



\*Includes generation by agricultural waste, landfill gas recovery, municipal solid waste, wood, geothermal, non-wood waste, wind, and solar.

\*\* Includes generation by tires, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.

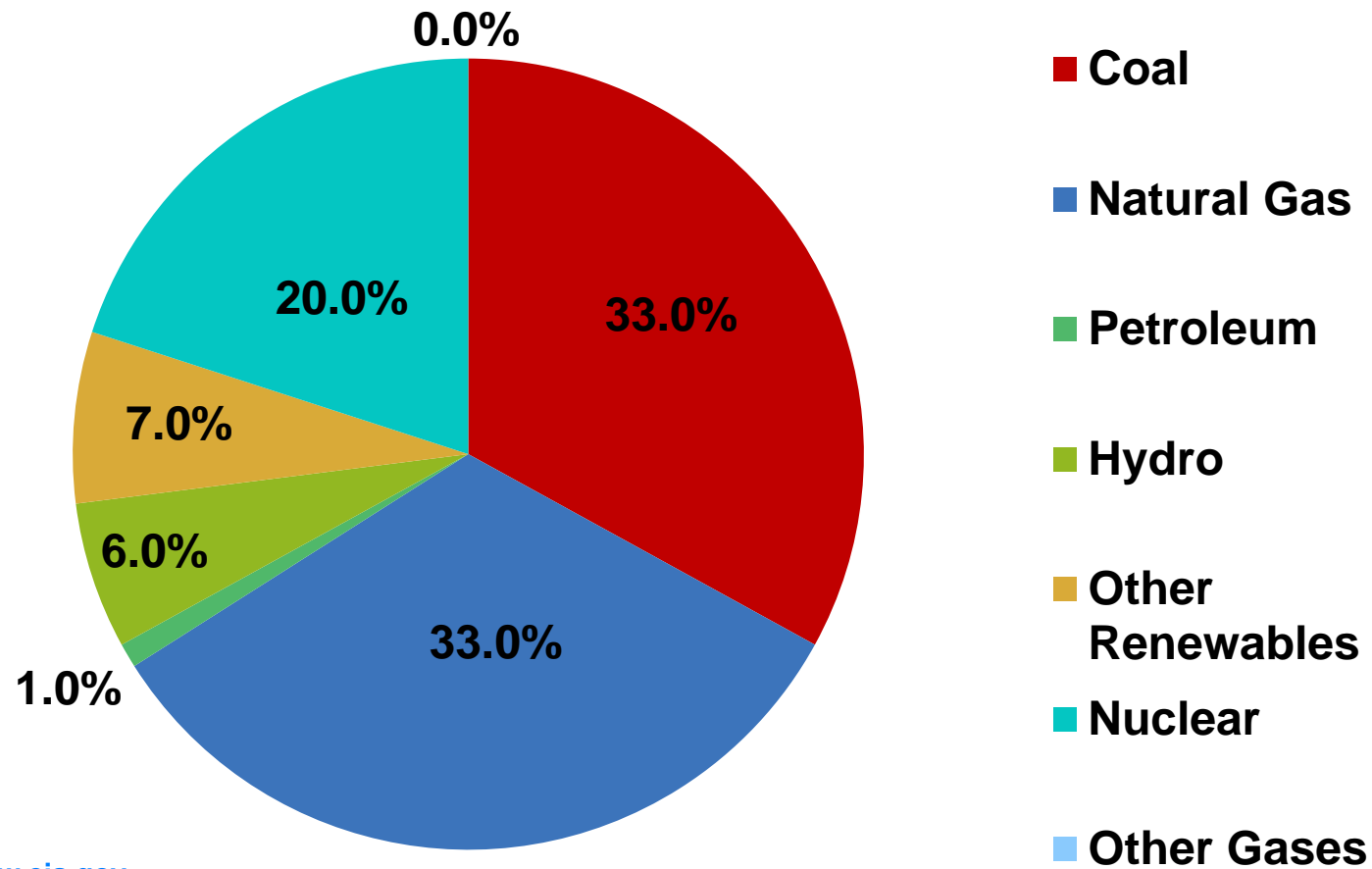
Sum of components may not add to 100% due to independent rounding.

Source: U.S. Department of Energy, Energy Information Administration, Power Plant Operations Report (EIA-923); 2014 preliminary generation data.

April 2015

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# 2015 U.S. Electricity Fuel Mix

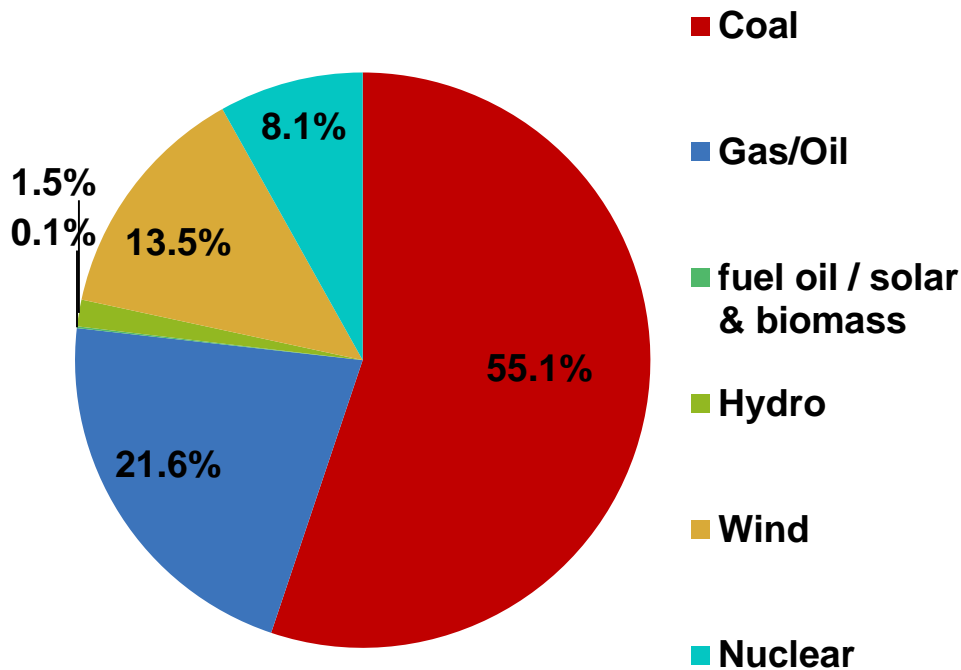


Source: [www.eia.gov](http://www.eia.gov)



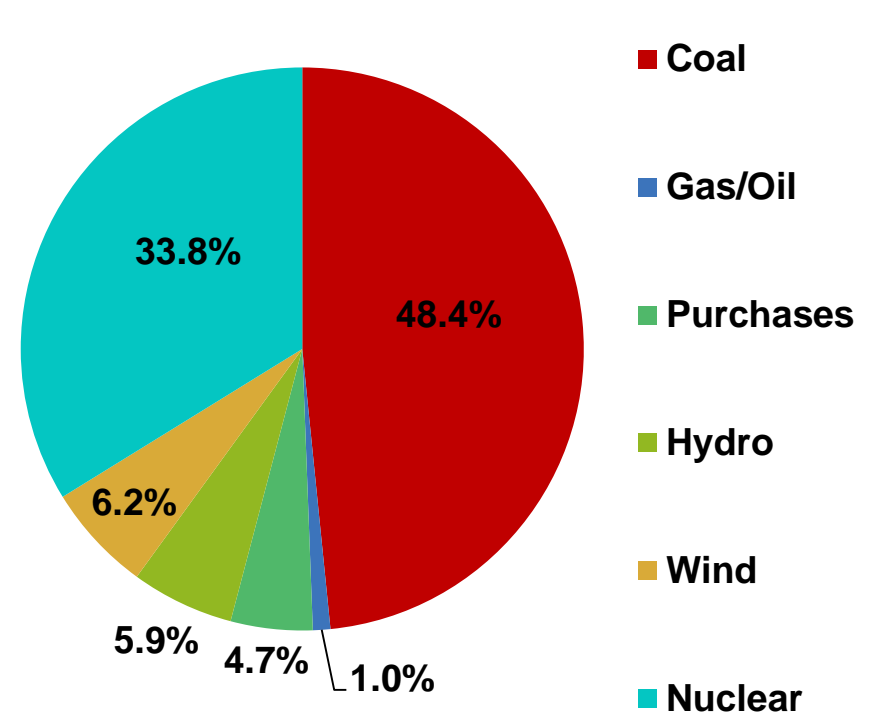
# 2015 Electricity Fuel Mix

## Southwest Power Pool



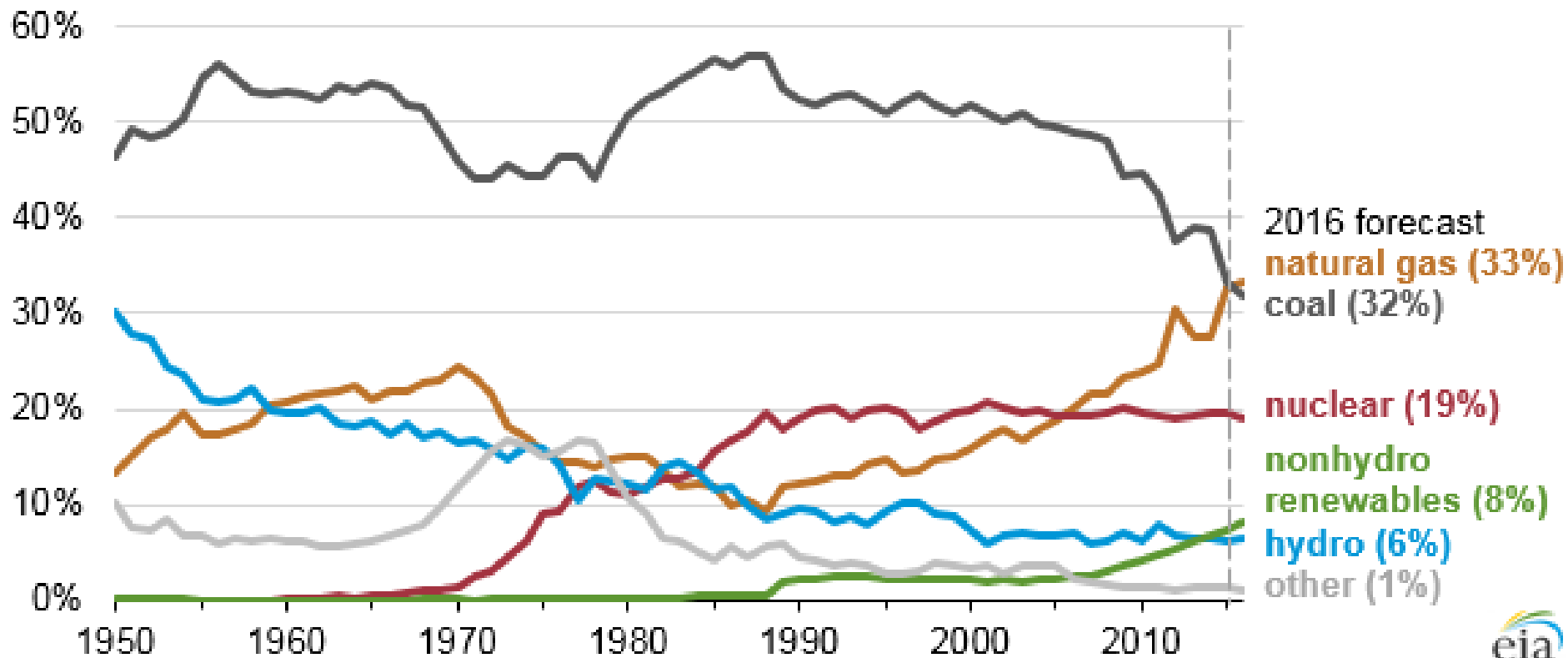
Source: [www.spp.org](http://www.spp.org)

## Energy Resources NPPD Owned & Purchased



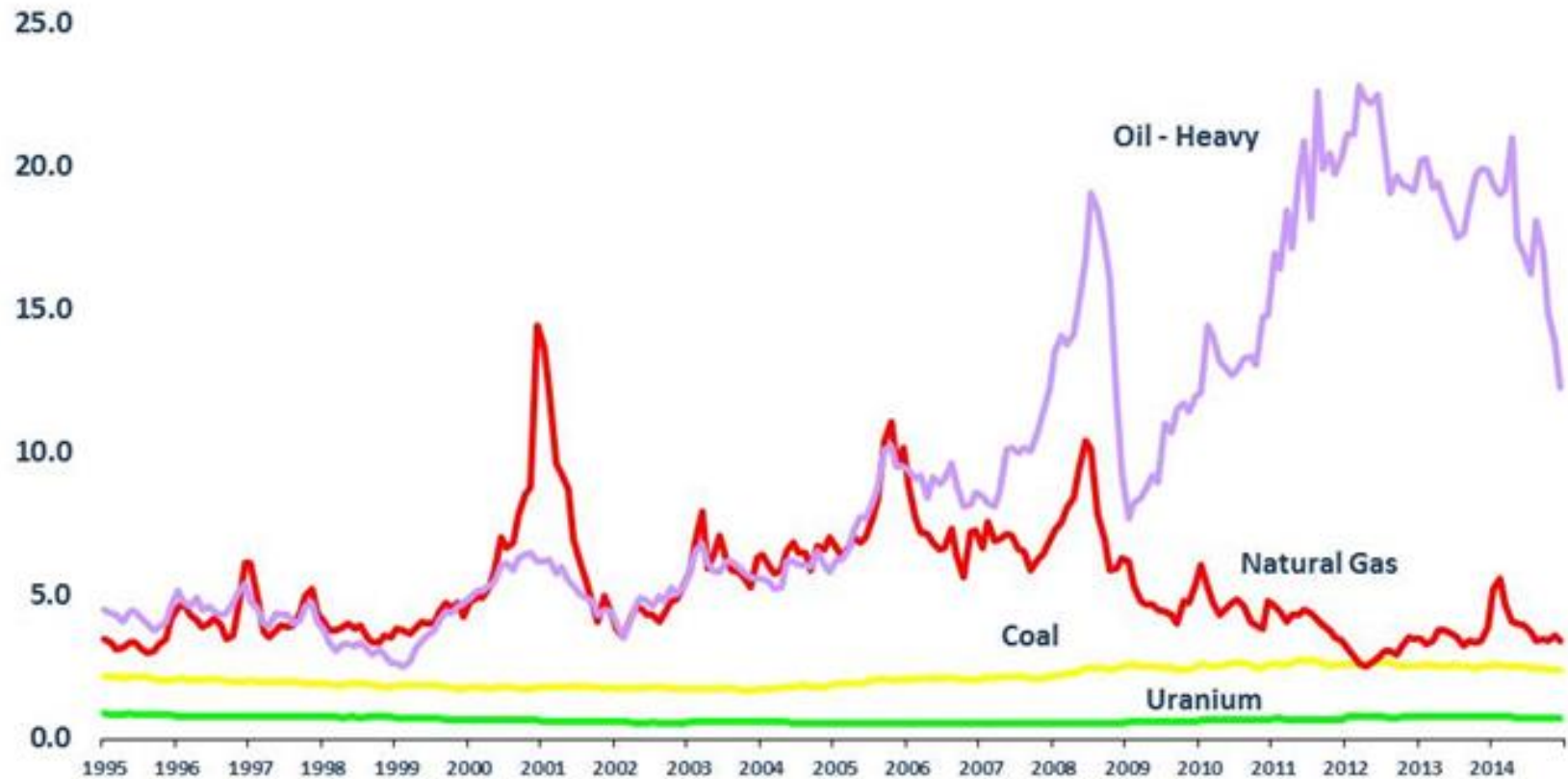
# Historical U.S. Electricity Fuel Mix

Annual share of total U.S. electricity generation by source (1950-2016)  
percent of total



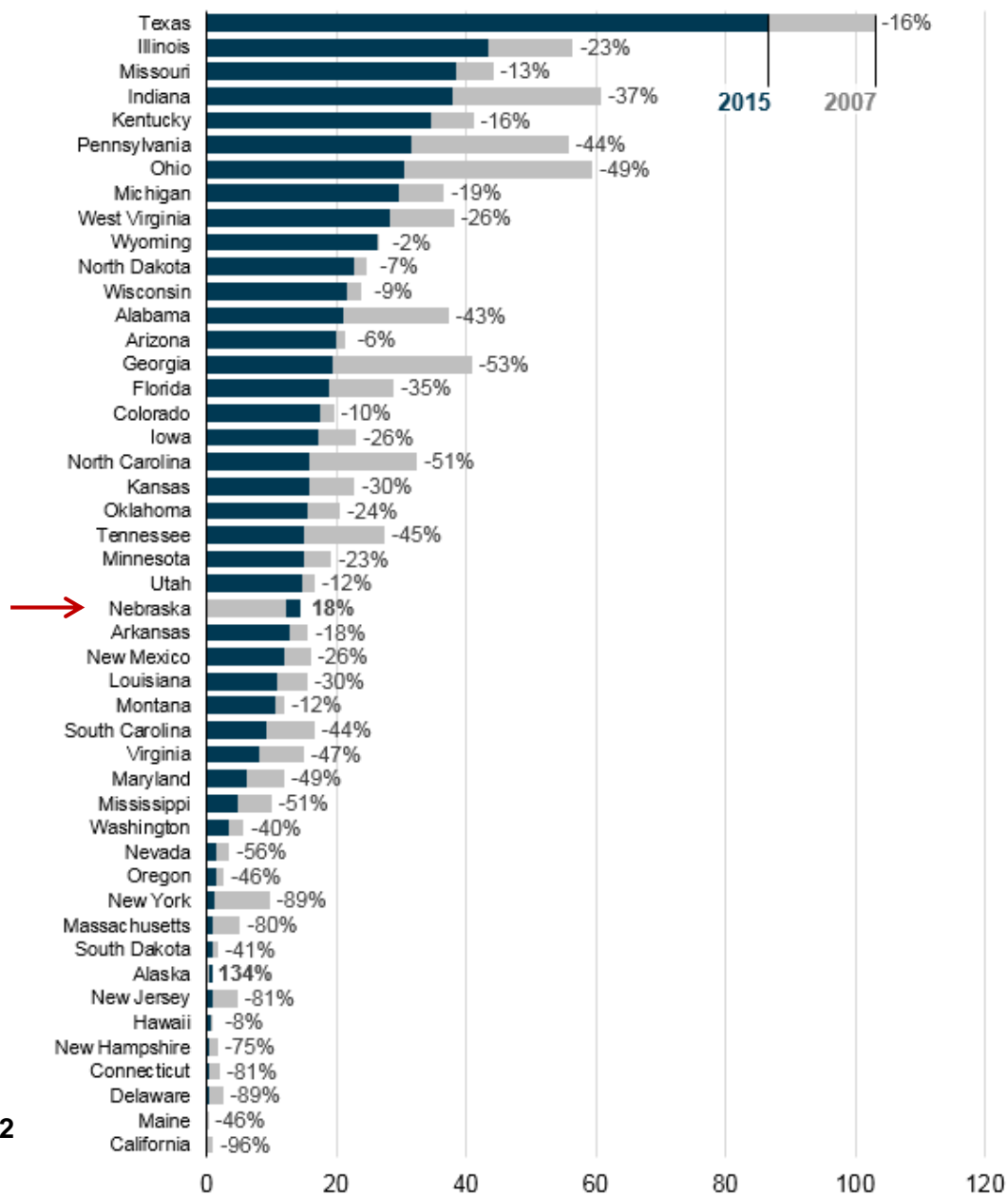
# Monthly Fuel Cost to U.S. Electric Utilities

1995 – 2014, In 2014 cents per kilowatt-hour



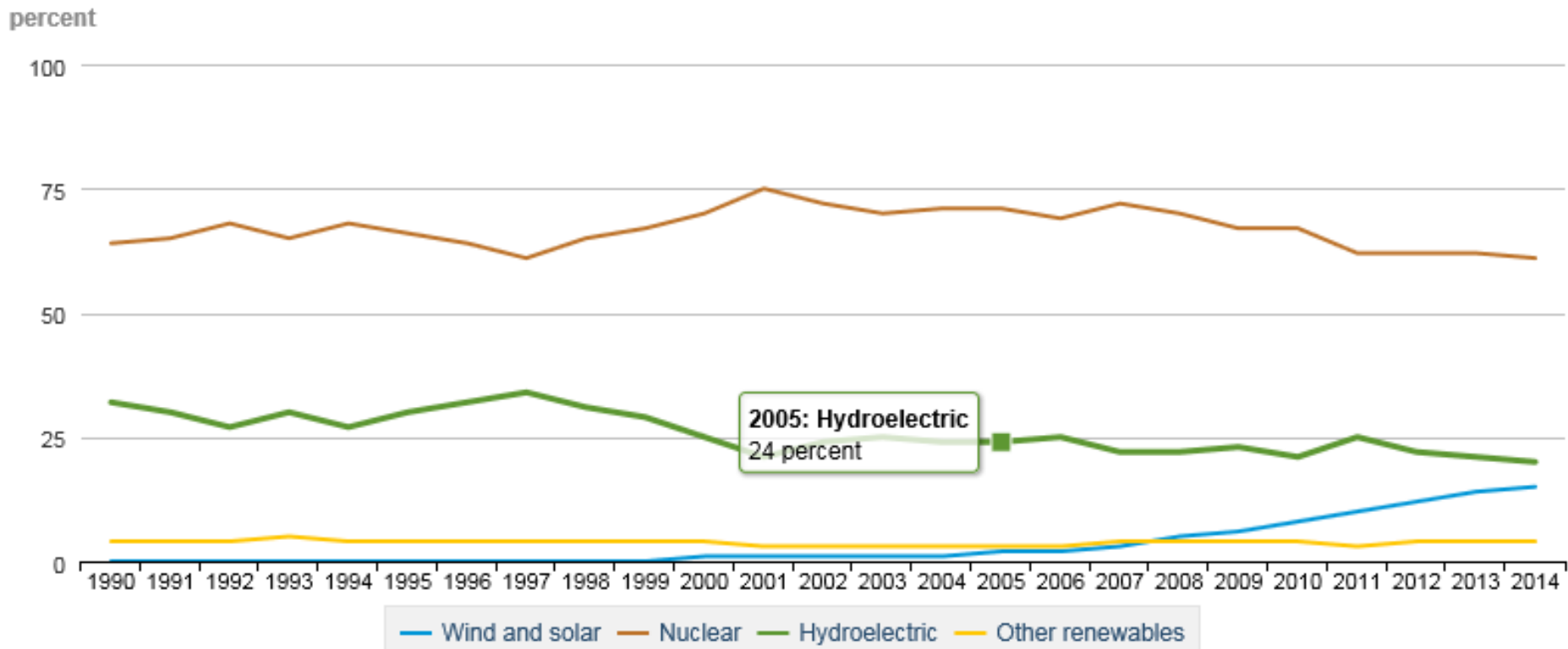
# Electric Power Consumption of Coal by State, 2007 and 2015

Electric power consumption of coal by state, 2007 and 2015  
million short tons



**Figure 9. Share of non-carbon generation by source, 1990-2014**

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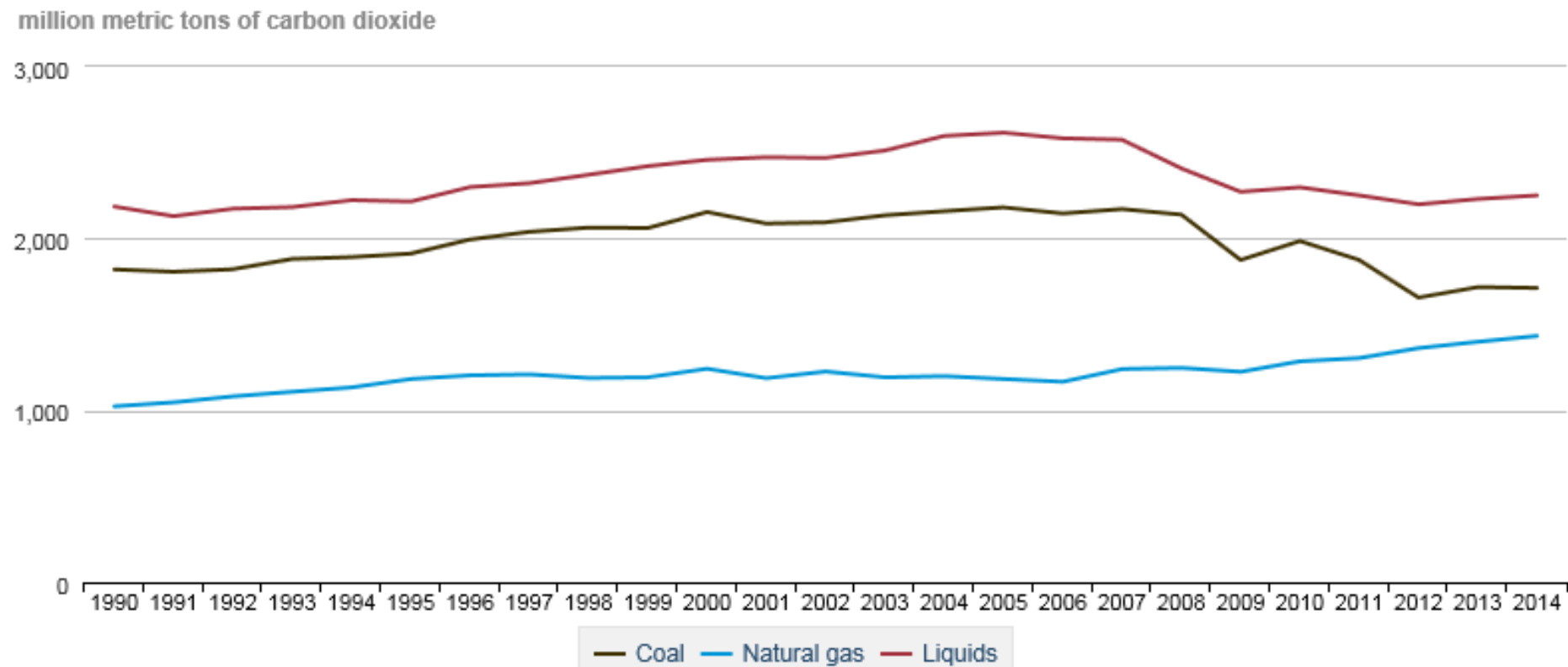


**Source:** U.S. Energy Information Administration, *October 2015 Monthly Energy Review*, Table 7.2b Electricity net generation: electric power sector. From 2004 to 2014, includes an estimate of distributed solar generation from the National Energy Modeling System, Table 16. Renewable Energy Generating Capacity and Generation.



**Figure 2. Energy-related carbon dioxide emissions by fuel, 1990-2014**

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**Source:** U.S. Energy Information Administration, *October 2015 Monthly Energy Review*, Table 12.1 Carbon dioxide emissions from energy consumption by source.

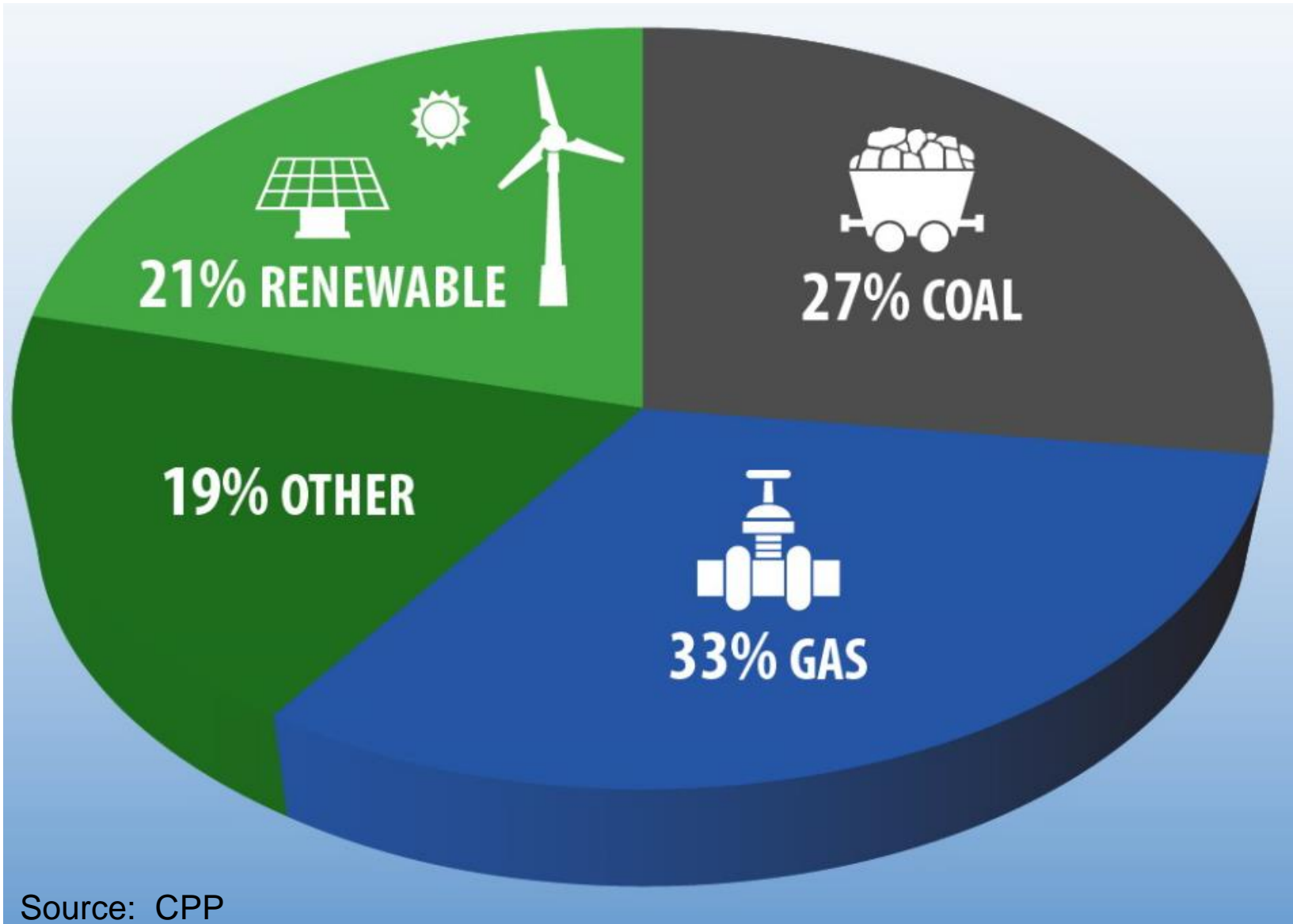


# Types of Generation

- **Baseload** (serve large loads from concentrated footprint)
  - Nuclear - *runs full power continuously*
  - Coal
  - Large Hydro
  - Some Natural Gas

} *More likely to follow load*
- **Intermediate** – *flexible; helps follow changing load condition*
  - Natural Gas
- **Peaking** – *quick start; meets high demand*
  - Natural Gas
  - Oil
  - Certain Hydro
- **Variable** – *improving costs, often dispatched first due to fuel costs*
  - Wind
  - Solar

# National Energy Mix in 2030

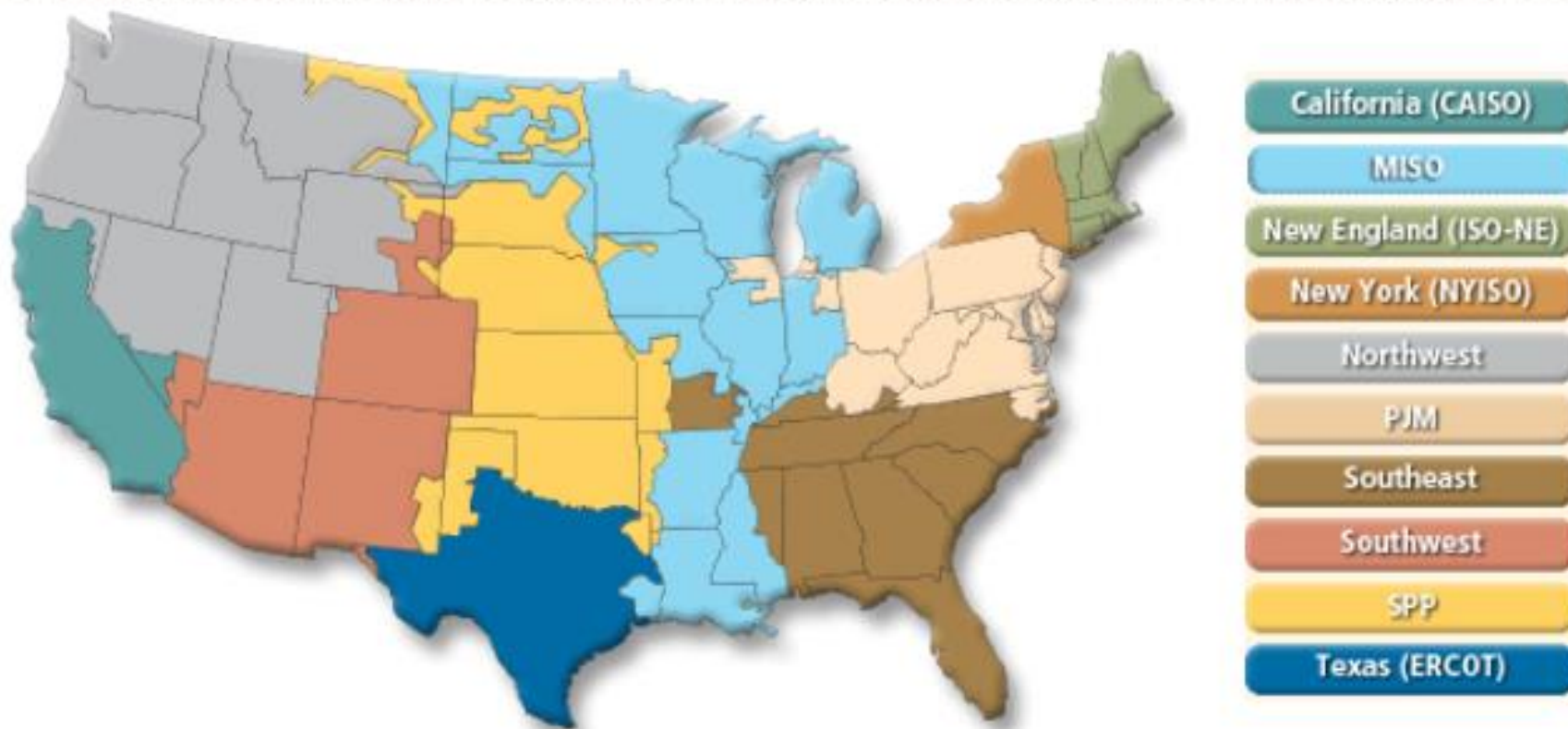


Source: CPP



# NPPD in the Southwest Power Pool

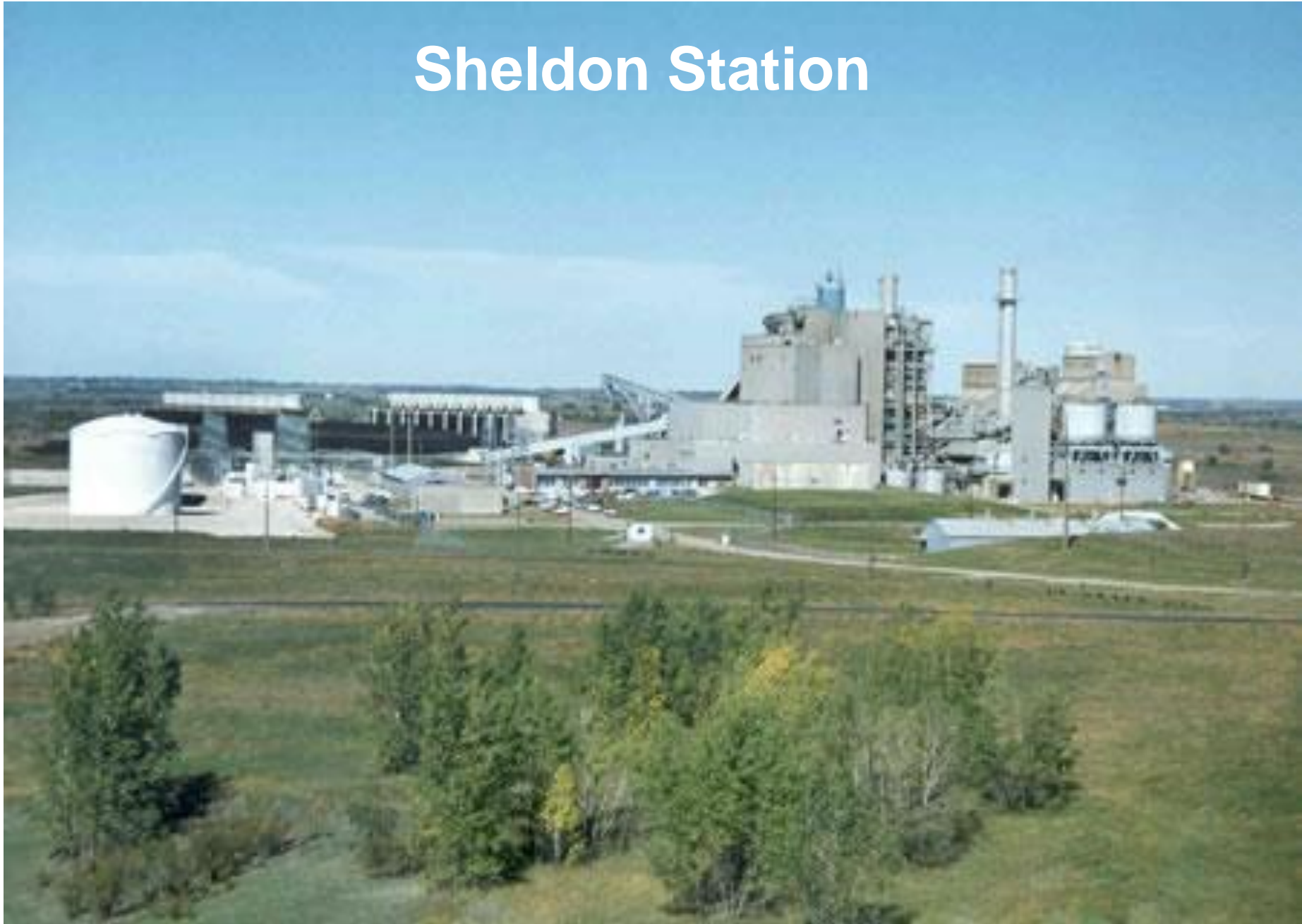
## Electric Power Markets: National Overview



# 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 current 12 wind farms to the state.
  - New wholesale power contracts encourage local renewables.
  - 10% new renewable goal for Nebraska customers by 2020, currently 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.

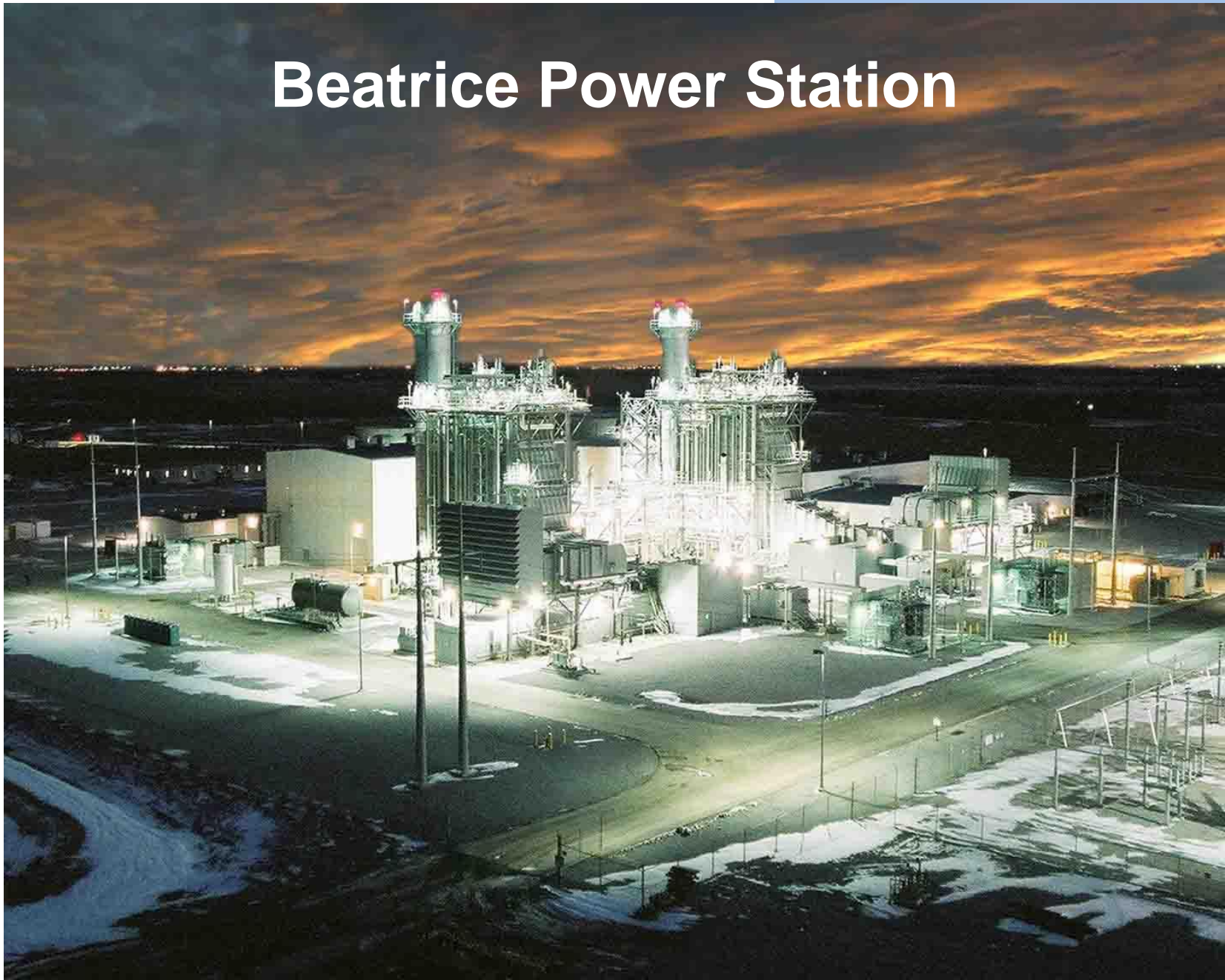
# Sheldon Station



# Cooper Nuclear Station



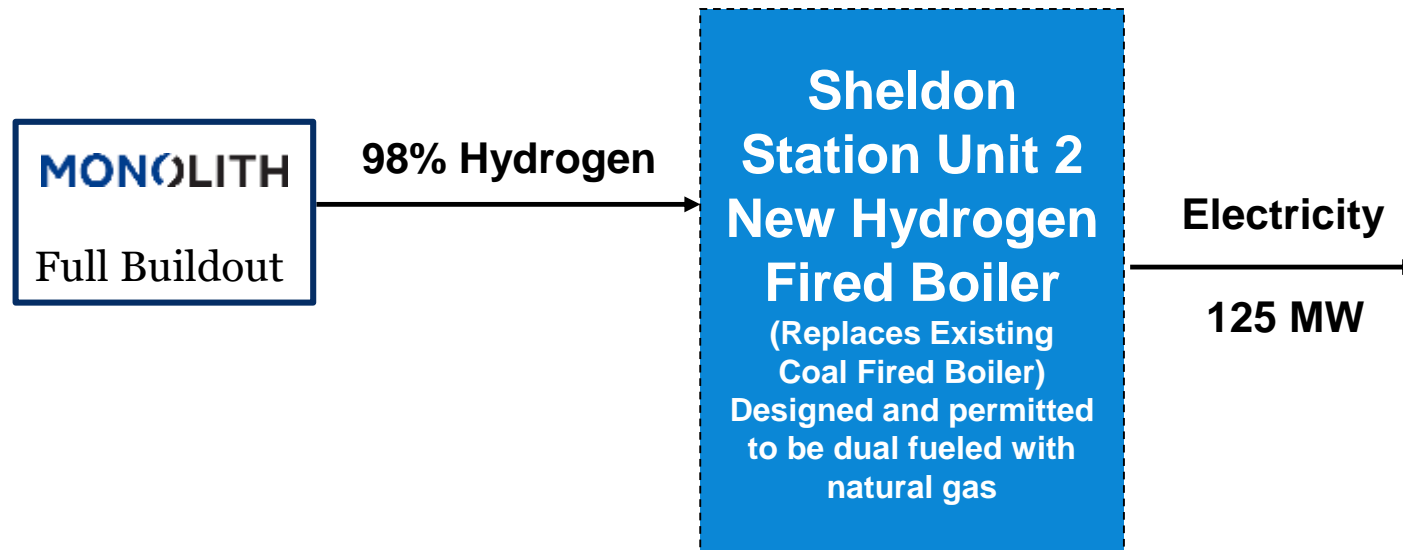
# Beatrice Power Station



# Ainsworth Wind Farm



# Repowering of Sheldon Station Unit 2 using Hydrogen at Full Commercialization



- **Carbon Free Electricity Generation**

- Reduces CO<sub>2</sub> by approximately 1,100,000 metric tons per year (*compared to burning coal at Sheldon Station Unit 2*).
- Approximately 10% reduction in statewide NPPD CO<sub>2</sub> emissions.

# Sustainable Benefits

- **Societal Benefits**

- ✓ Other hydrogen-use opportunities (hydrogen park)
- ✓ Test and research opportunities at University of Nebraska-Lincoln (UNL)
- ✓ Fuel provided by Monolith to generate 125 MW at high capacity factor

- **Environmental Benefits**

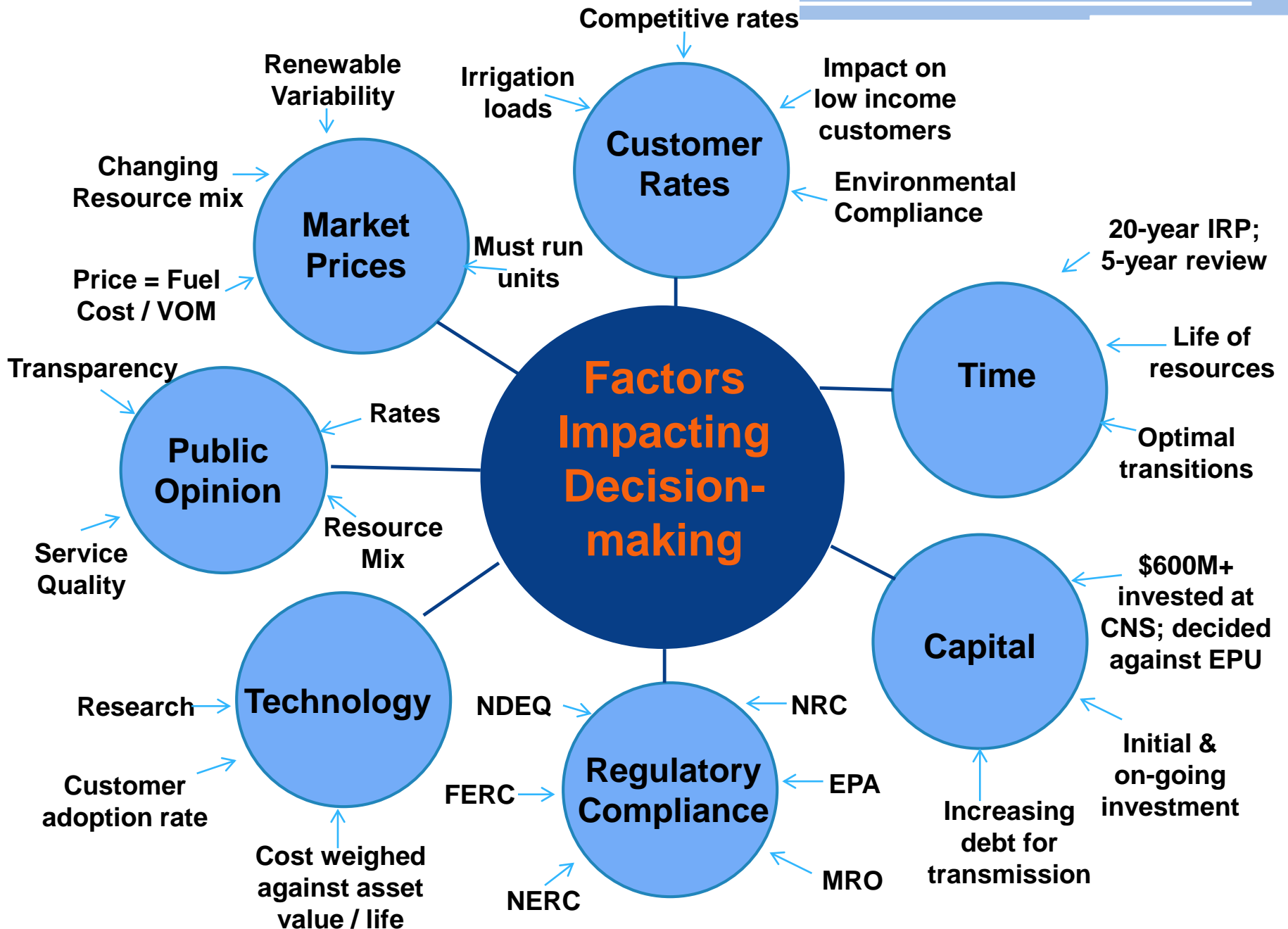
- ✓ No Carbon ( $\text{CO}_2$ )
- ✓ No  $\text{SO}_2$
- ✓ No Mercury
- ✓ No Particulate
- ✓ Lower  $\text{NO}_x$

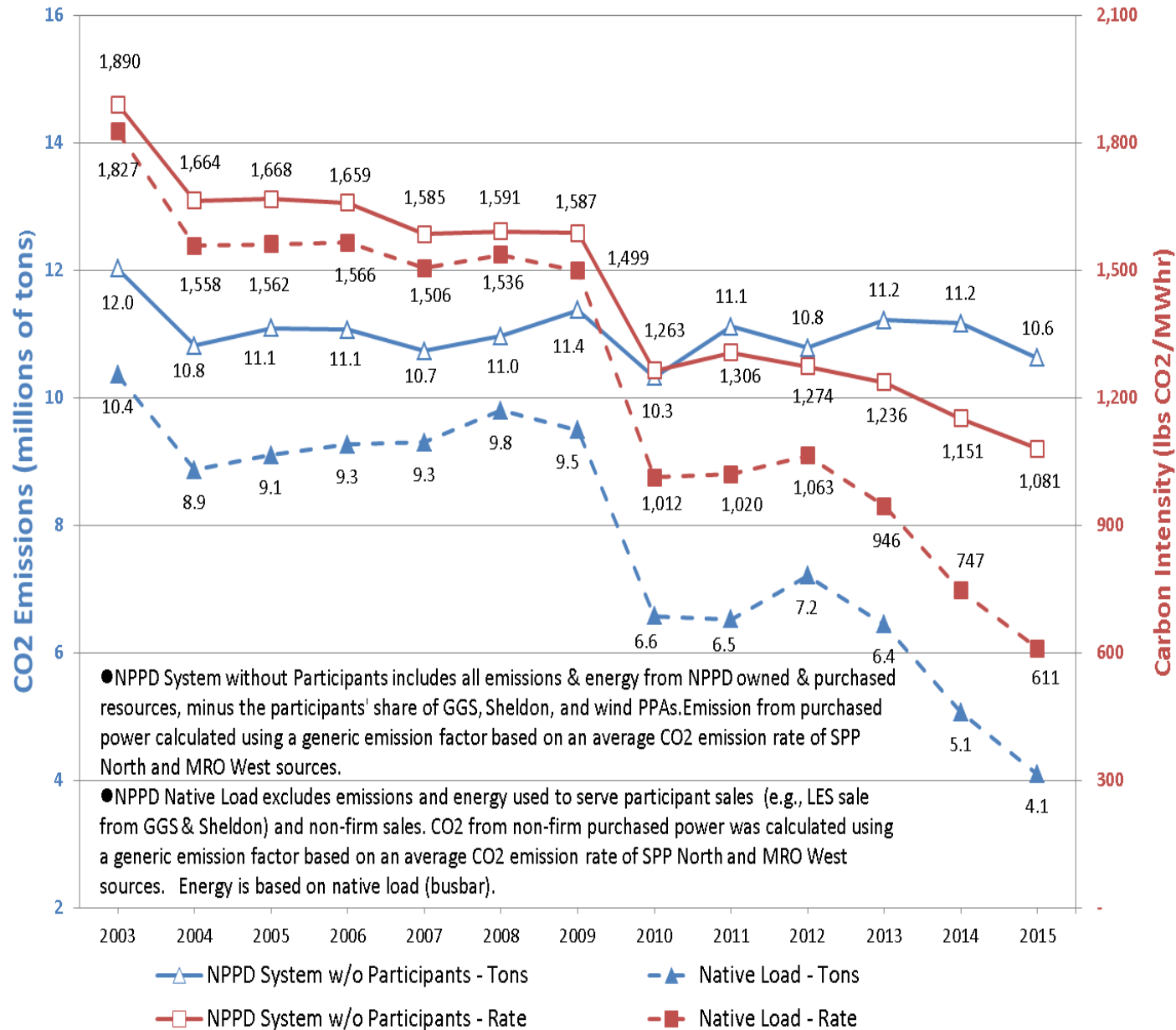


- **Economic Benefits**

- ✓ Positions Nebraska to be a leader in carbon black and hydrogen production
- ✓ Phase One: 50 direct, 50 secondary jobs; \$30M+ total impact
- ✓ Phase Two: 100 direct, 800 secondary jobs; \$600M+ total impact





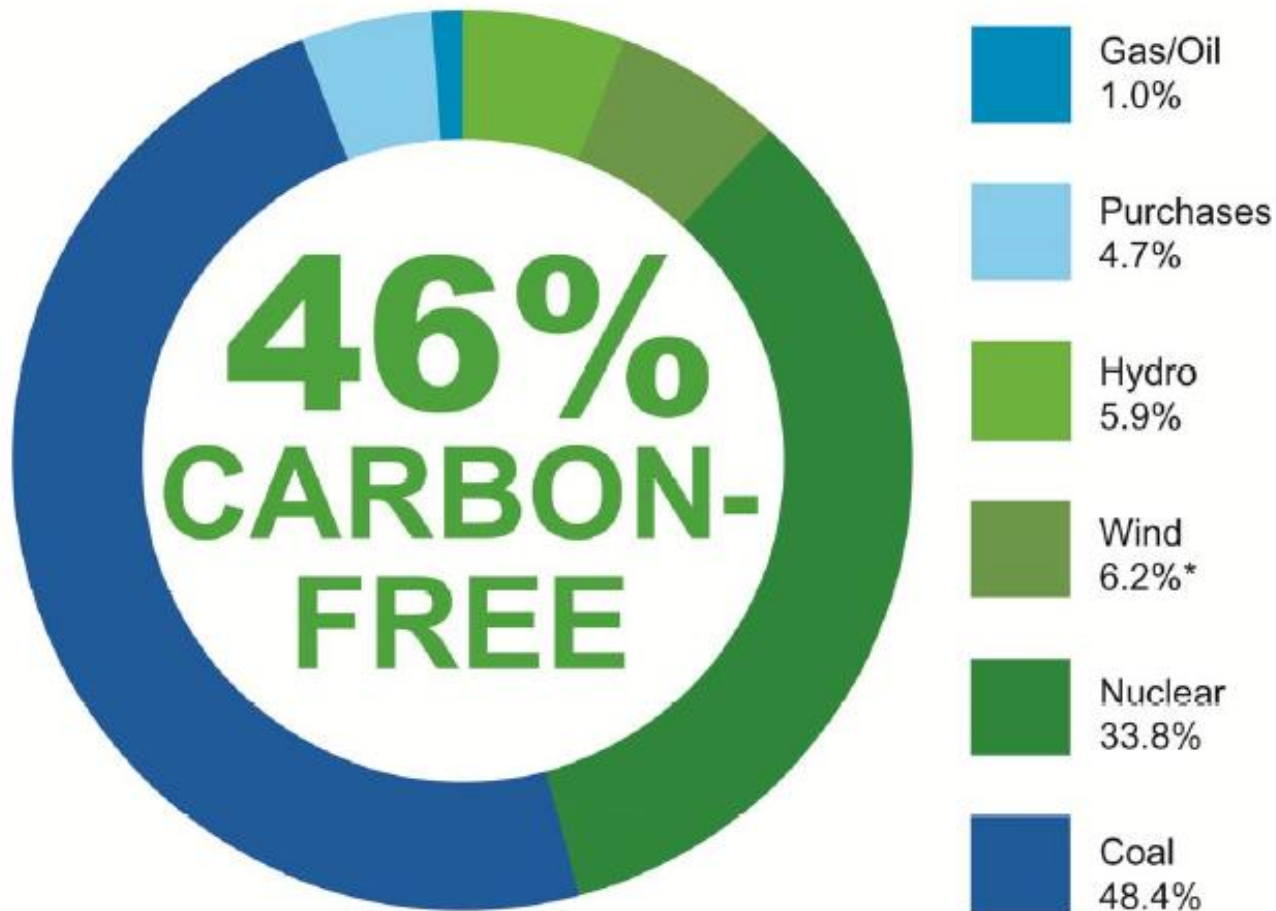


# NPPD's CO<sub>2</sub> Emissions

NPPD System without Participants vs. NPPD Native Load

# 2015 NPPD Energy Generation Resources

## Nebraska Customers & Market Sales



\* Prior to sale of environmental attributes.

# NPPD Believes:

- A diverse fuel mix serves Nebraskans best.
- Renewables will continue to expand which will require significant transmission expansion.
- Nuclear energy is clean and constant.
- Coal will play an important, but diminished role in the regional energy mix.
- NPPD must stay competitive in the market for customers' benefit.
- Embracing technologies is important for Nebraska and must be done economically considering existing infrastructure and future needs.

# Questions?

