CENTER FOR THE NEW ENERGY ECONOMY

Colorado State University

Patrick Cummins
November 6, 2018

Prologue

The Role of Coal in the West

Western Interstate Energy Board

Benjamin Lim and Max Vilgalys

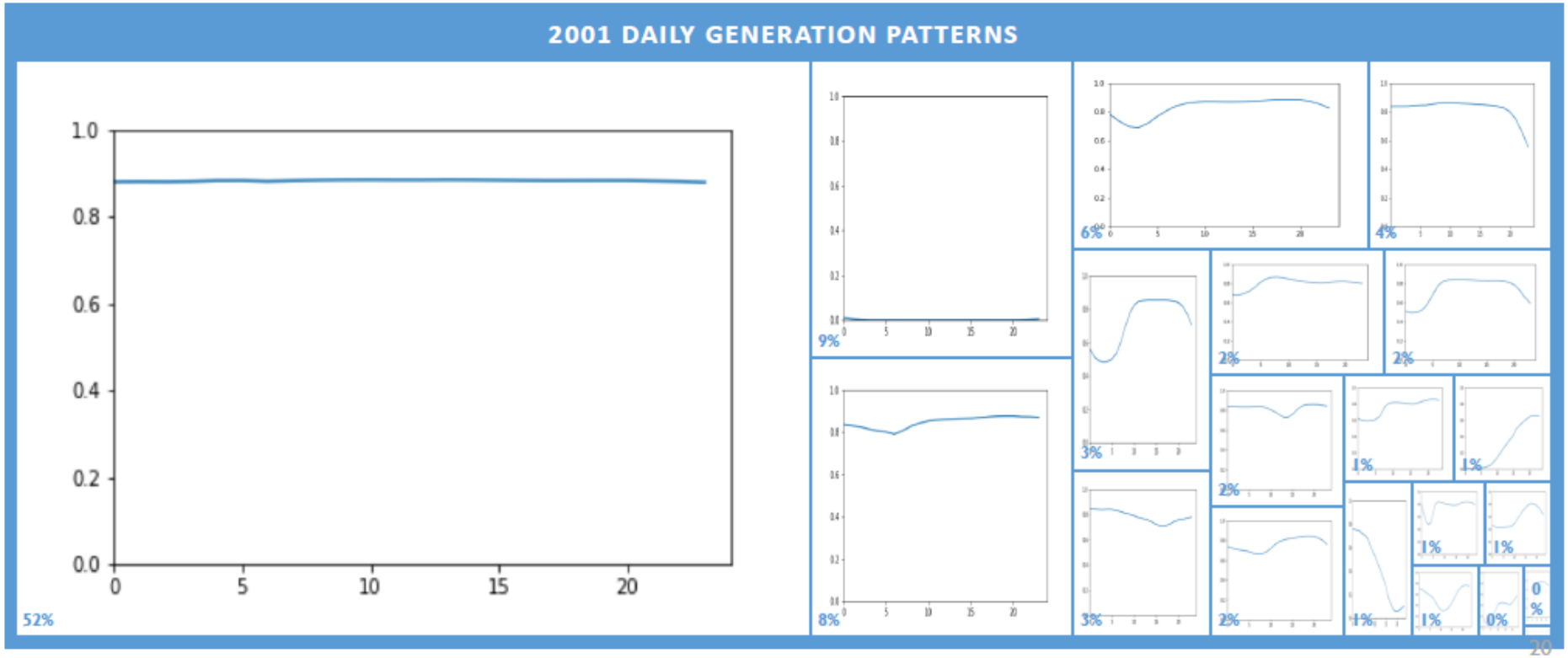
Stanford University

August 2017

Western Interstate Energy Board

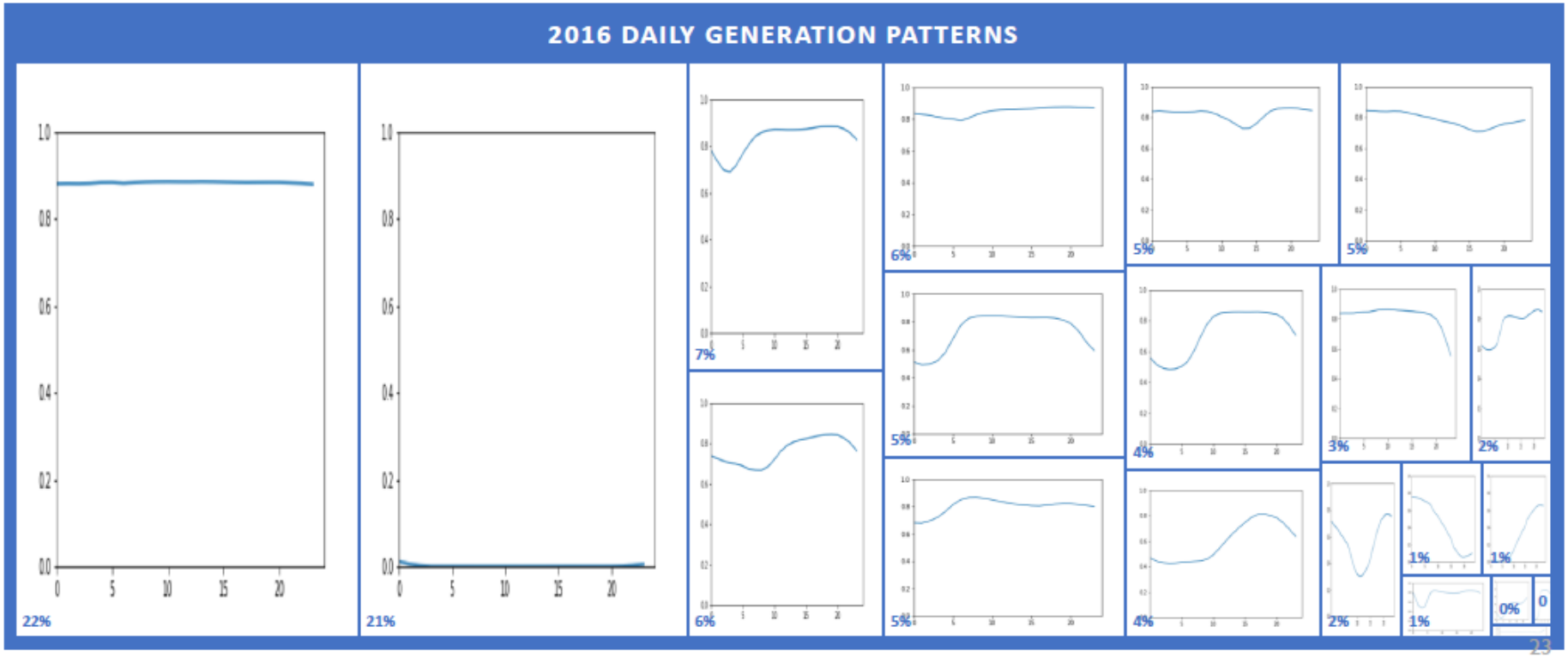
Generation Patterns of Western Coal Plants - 2001

52% of the Unit-Days were baseload generation



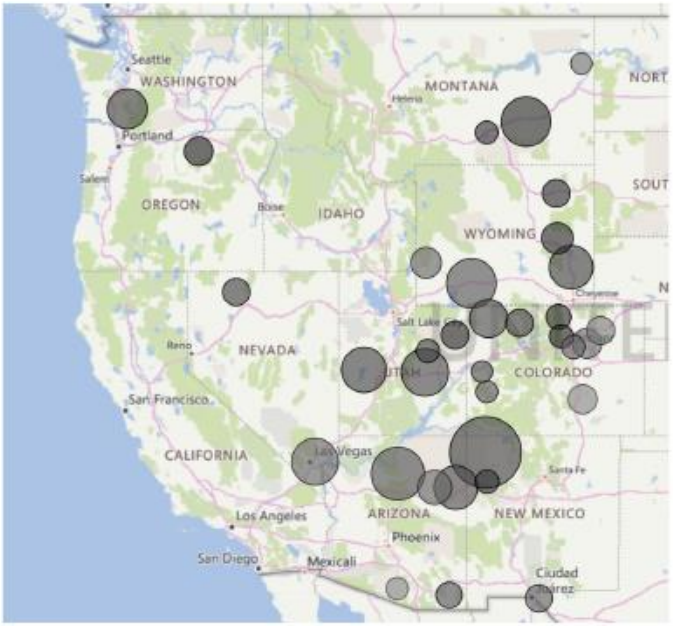
Generation Patterns of Western Coal Plants - 2016

In the last 15 years, coal unit operation has shifted dramatically

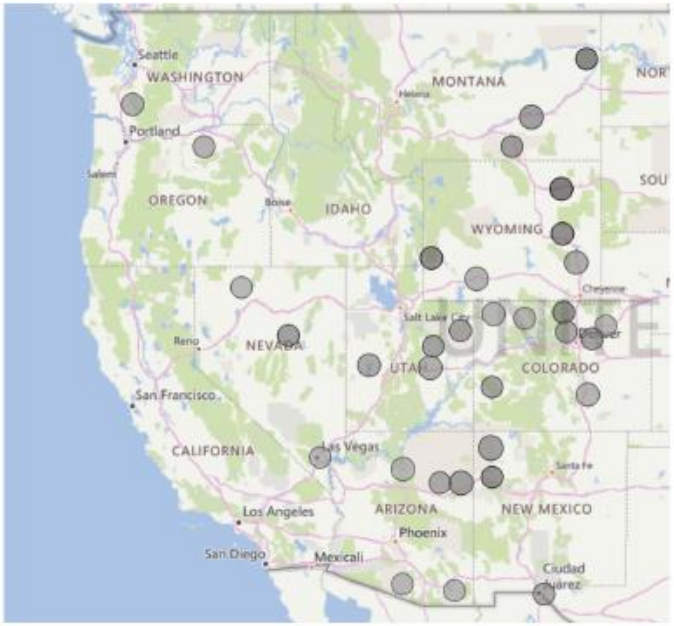


Generation and Percent Baseload Days

2001



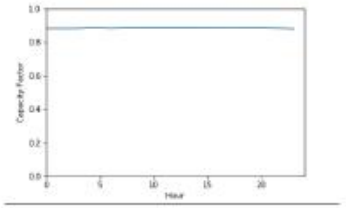
2016



= 300 million MWh

= 0% of the time like this:

= 100% of the time like this:



Size is Total Generation (MWh)

Saturation is Percent Baseload Days

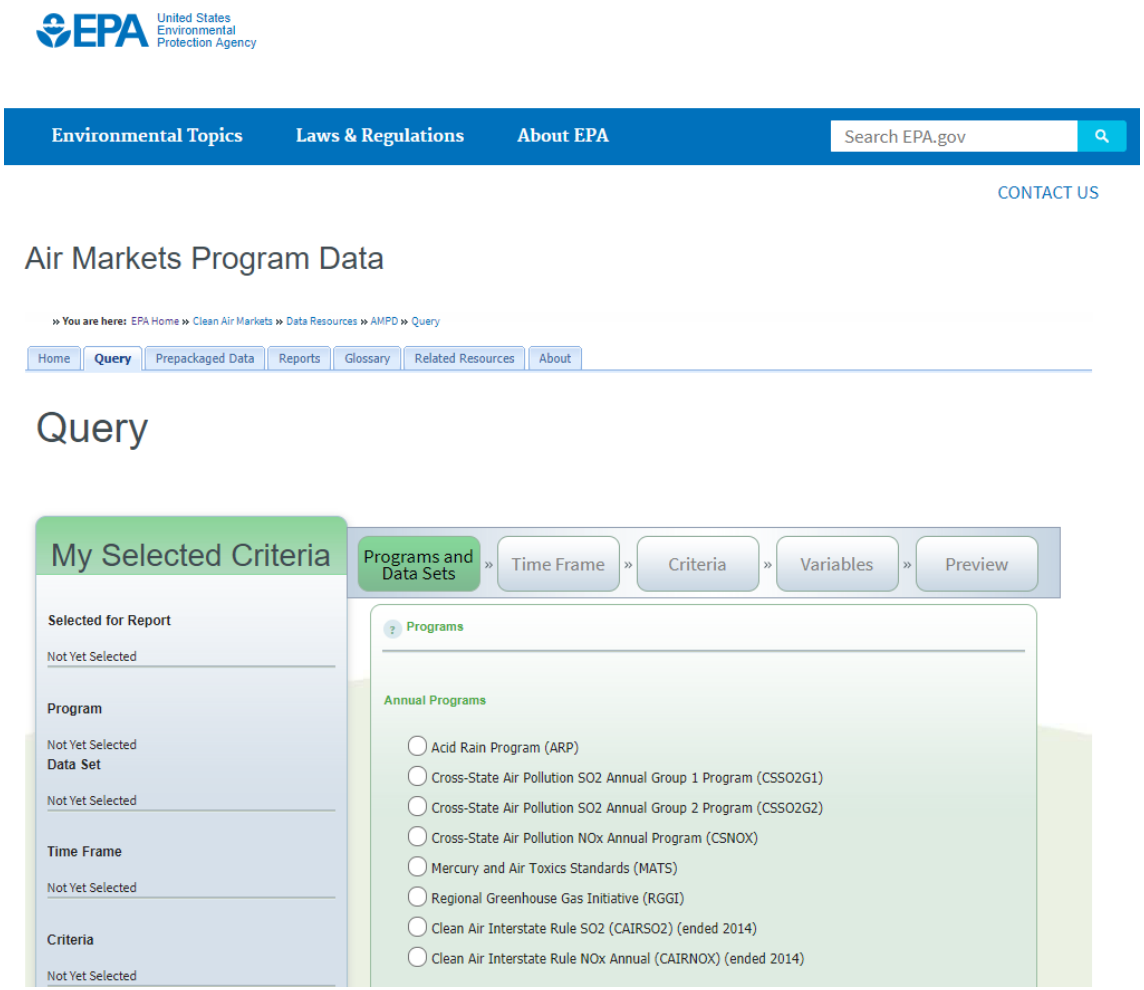
32

In Summary

- **Baseload operation** has decreased from **52%** of coal unit operating days in **2001** to **22% in 2016** in the Western U.S.
- Individual coal units in the Western U.S. with baseload operation greater than or equal to 50% of days in the year decreased from **53 units in 2001 to 11 in 2016**.
- **Since 2011**, the majority of coal units have spent **less than 30%** of their days in **baseload** operation.
- **Offline operation** increased from **9%** of coal unit operating days in **2001** to **21% in 2016**
- Baseload operation resource **consumption of Coal decreased by 72%** and **NG increased by 145%** from 2001 to 2016

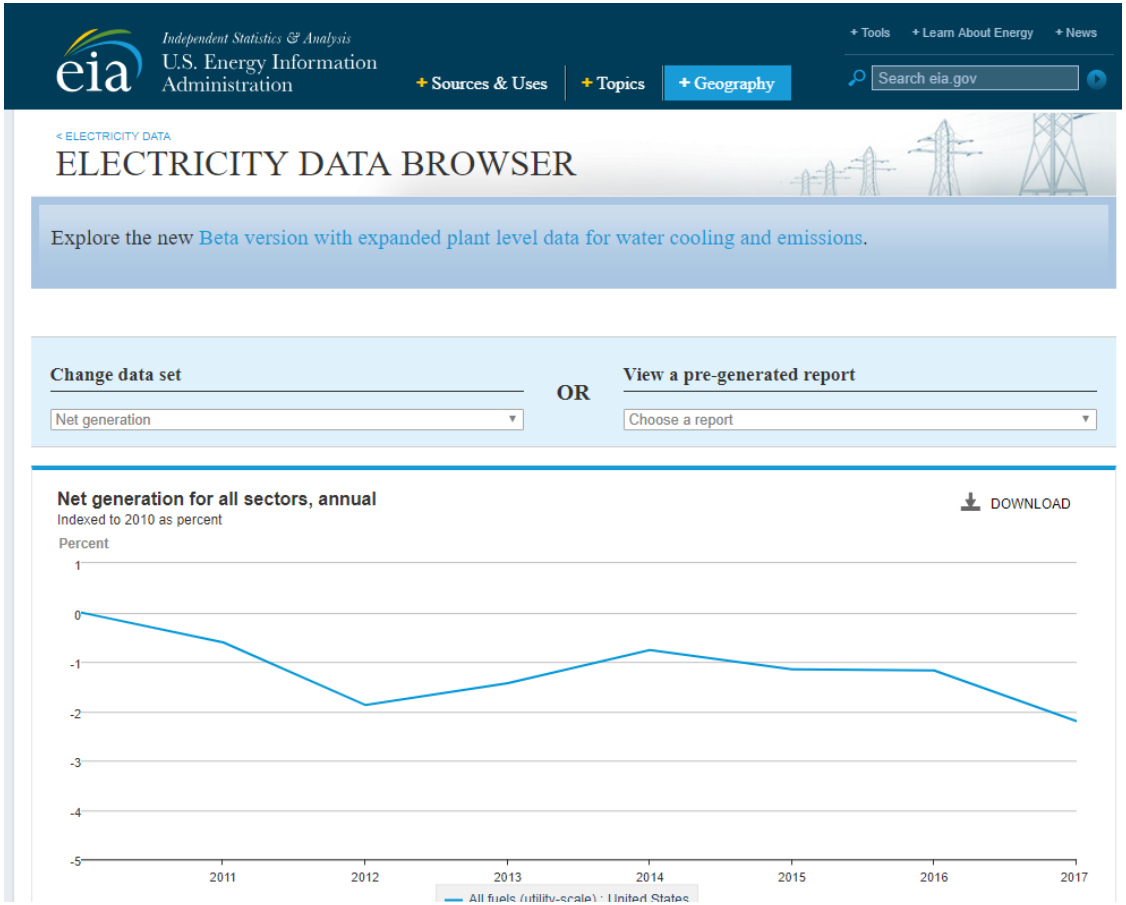
Data Sources

Source for State and Unit-Level Emissions Data: https://ampd.epa.gov/ampd/

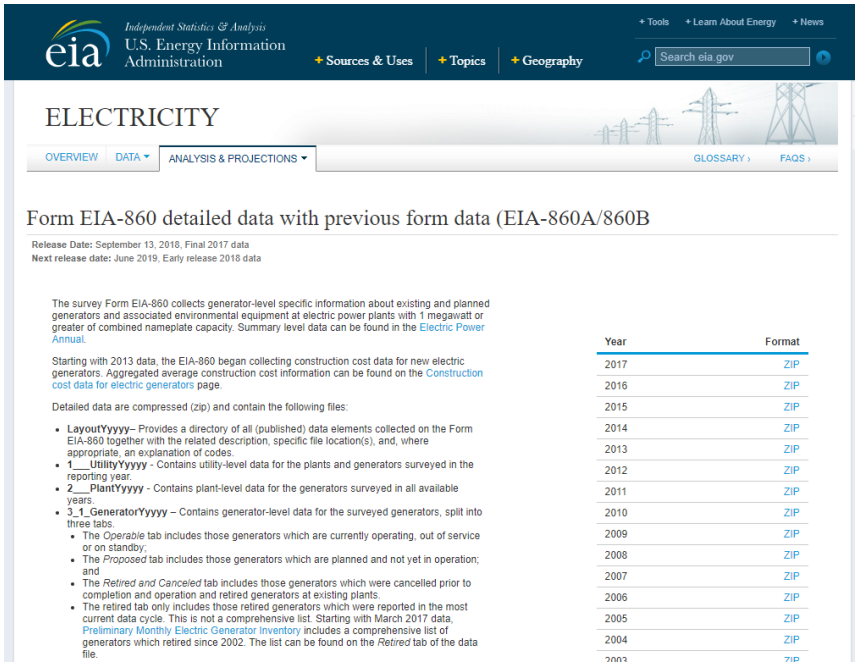


Source for State-Level Generation Data: https://www.eia.gov/electricity/data/browser/

(New Beta Version with plant level data, including emissions)
https://www.eia.gov/beta/electricity/data/browser/#/topic/1?agg=2,0,1&fuel=vtvv&geo=g&sec=g&freq=M&start=200101&end=201710&ctype=linechart&ltype=pin&maptype=0&rse=0&pin=



Sources for Unit Level Data on Generators



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Form EIA-860 detailed data with previous form data (EIA-860A/860B

Release Date: September 13, 2018, Final 2017 data
Next release date: June 2019, Early release 2018 data

The survey Form EIA-860 collects generator-level specific information about existing and planned generators and associated environmental equipment at electric power plants with 1 megawatt or greater of combined nameplate capacity. Summary level data can be found in the Electric Power Annual.

Starting with 2013 data, the EIA-860 began collecting construction cost data for new electric generators. Aggregated average construction cost information can be found on the Construction cost data for electric generators page.

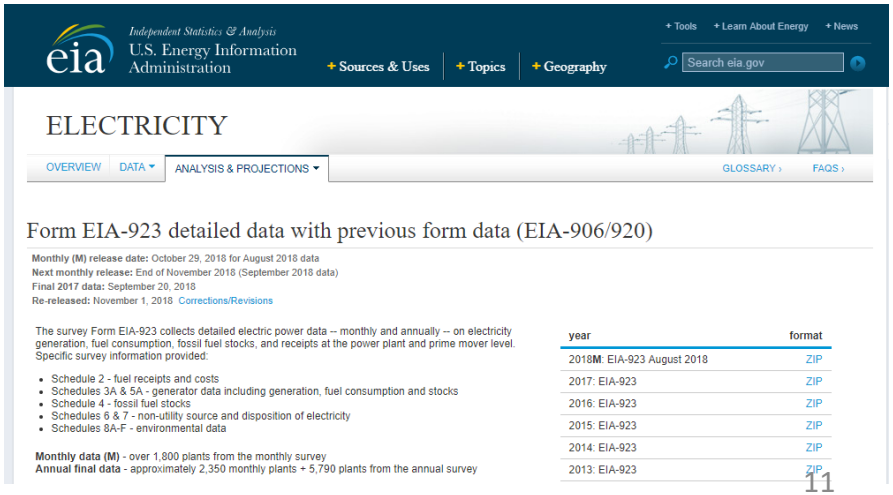
Detailed data are compressed (zip) and contain the following files:

- **LayoutYyyyy**– Provides a directory of all (published) data elements collected on the Form EIA-860 together with the related description, specific file location(s), and, where appropriate, an explanation of codes.
- **1___UtilityYyyyy** - Contains utility-level data for the plants and generators surveyed in the reporting year.
- **2___PlantYyyyy** - Contains plant-level data for the generators surveyed in all available years.
- **3_1_GeneratorYyyyy** – Contains generator-level data for the surveyed generators, split into three tabs.
  - The *Operable* tab includes those generators which are currently operating, out of service or on standby;
  - The *Proposed* tab includes those generators which are planned and not yet in operation; and
  - The *Retired and Canceled* tab includes those generators which were cancelled prior to completion and operation and retired generators at existing plants.
  - The retired tab only includes those retired generators which were reported in the most current data cycle. This is not a comprehensive list. Starting with March 2017 data, Preliminary Monthly Electric Generator Inventory includes a comprehensive list of generators which retired since 2002. The list can be found on the *Retired* tab of the data file.

Year	Format
2017	ZIP
2016	ZIP
2015	ZIP
2014	ZIP
2013	ZIP
2012	ZIP
2011	ZIP
2010	ZIP
2009	ZIP
2008	ZIP
2007	ZIP
2006	ZIP
2005	ZIP
2004	ZIP
2003	ZIP

https://www.eia.gov/electricity/data/eia860/

https://www.eia.gov/electricity/data/eia923/



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Form EIA-923 detailed data with previous form data (EIA-906/920)

Monthly (M) release date: October 29, 2018 for August 2018 data
Next monthly release: End of November 2018 (September 2018 data)
Final 2017 data: September 20, 2018
Re-released: November 1, 2018 Corrections/Revisions

The survey Form EIA-923 collects detailed electric power data -- monthly and annually -- on electricity generation, fuel consumption, fossil fuel stocks, and receipts at the power plant and prime mover level. Specific survey information provided:

- Schedule 2 - fuel receipts and costs
- Schedules 3A & 5A - generator data including generation, fuel consumption and stocks
- Schedule 4 - fossil fuel stocks
- Schedules 6 & 7 - non-utility source and disposition of electricity
- Schedules 8A-F - environmental data

Monthly data (M) - over 1,800 plants from the monthly survey
Annual final data - approximately 2,350 monthly plants + 5,790 plants from the annual survey

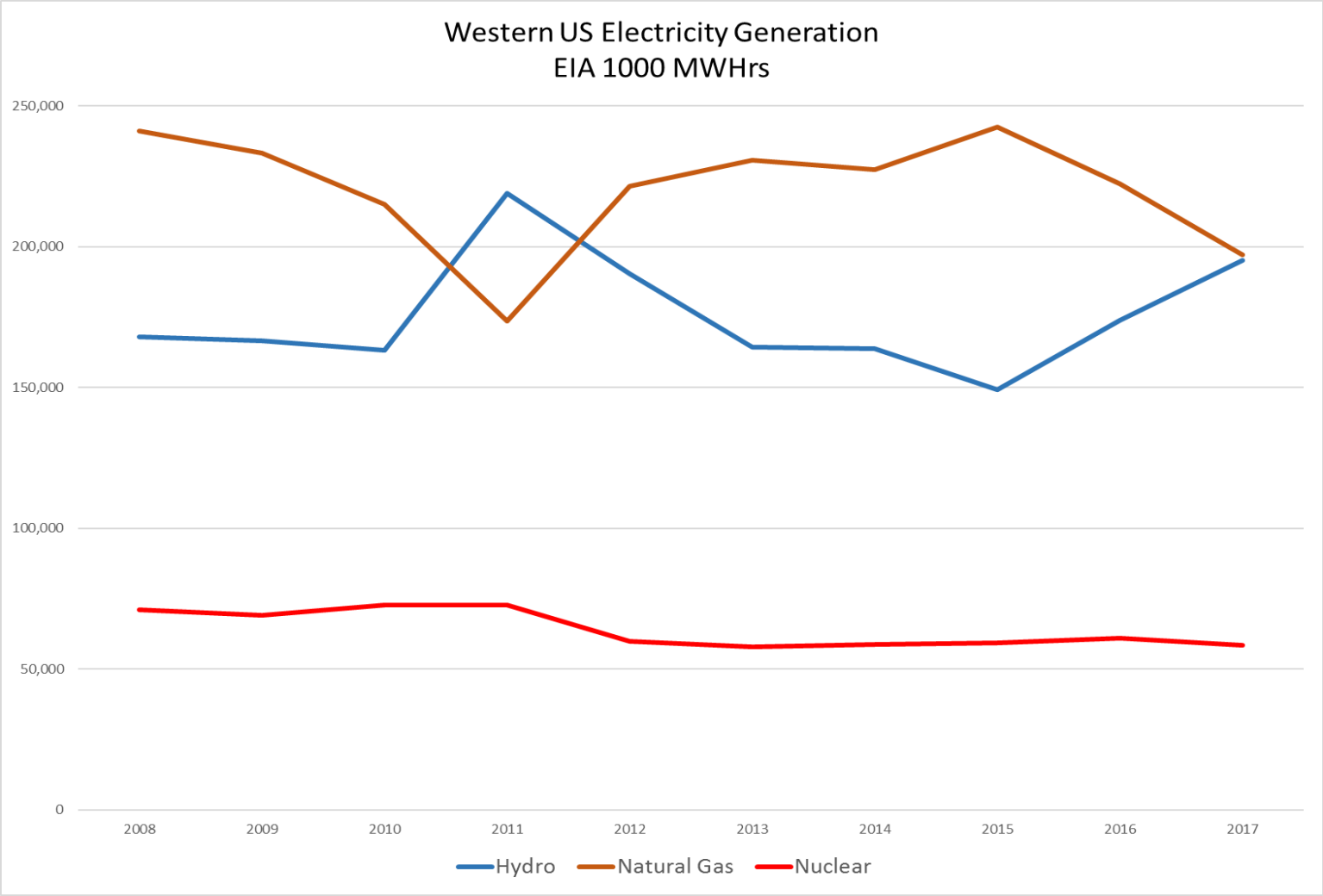
year	format
2018M: EIA-923 August 2018	ZIP
2017: EIA-923	ZIP
2016: EIA-923	ZIP
2015: EIA-923	ZIP
2014: EIA-923	ZIP
2013: EIA-923	ZIP

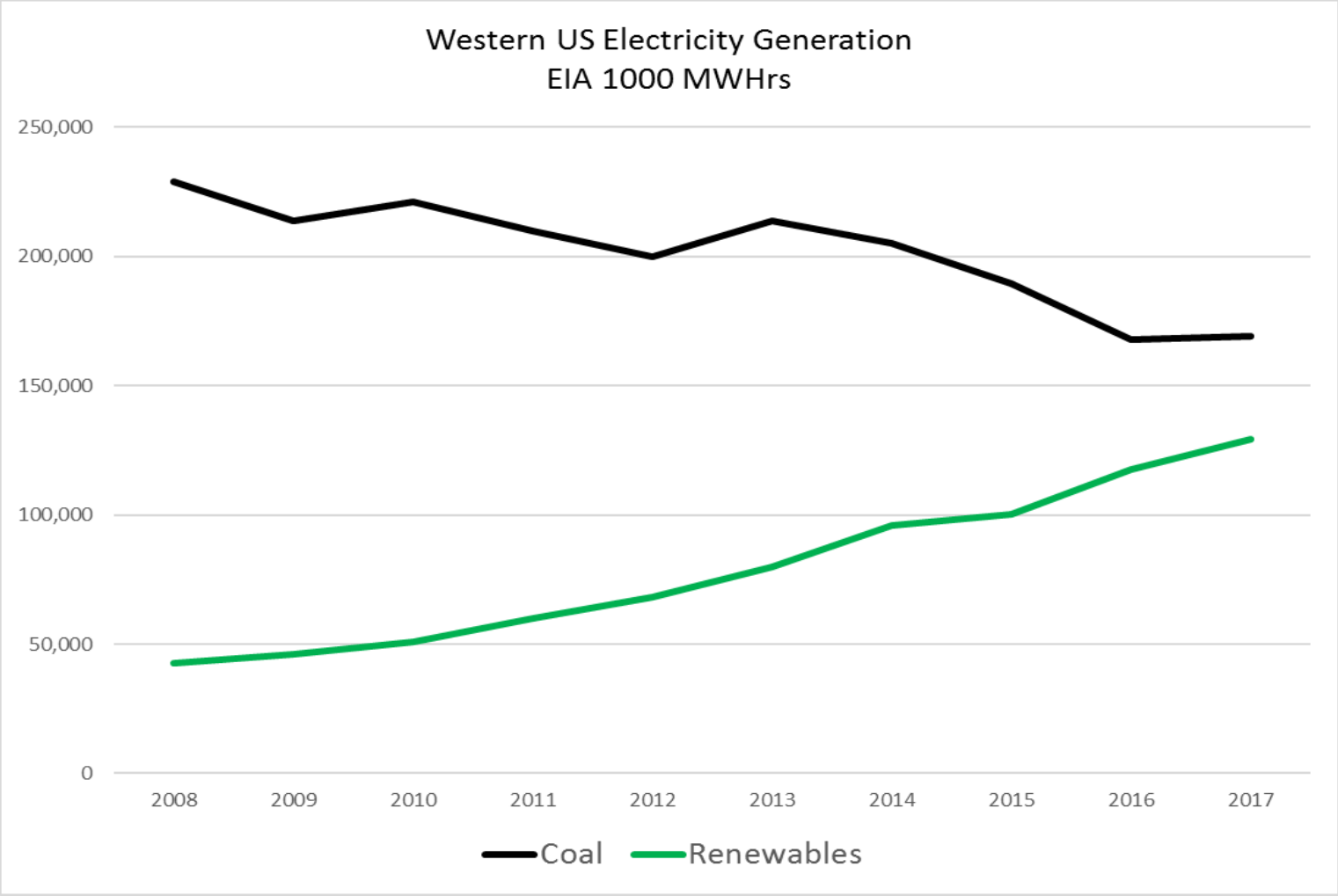
Generation Trends

Electricity Generation Trends on the 11-State Western Grid

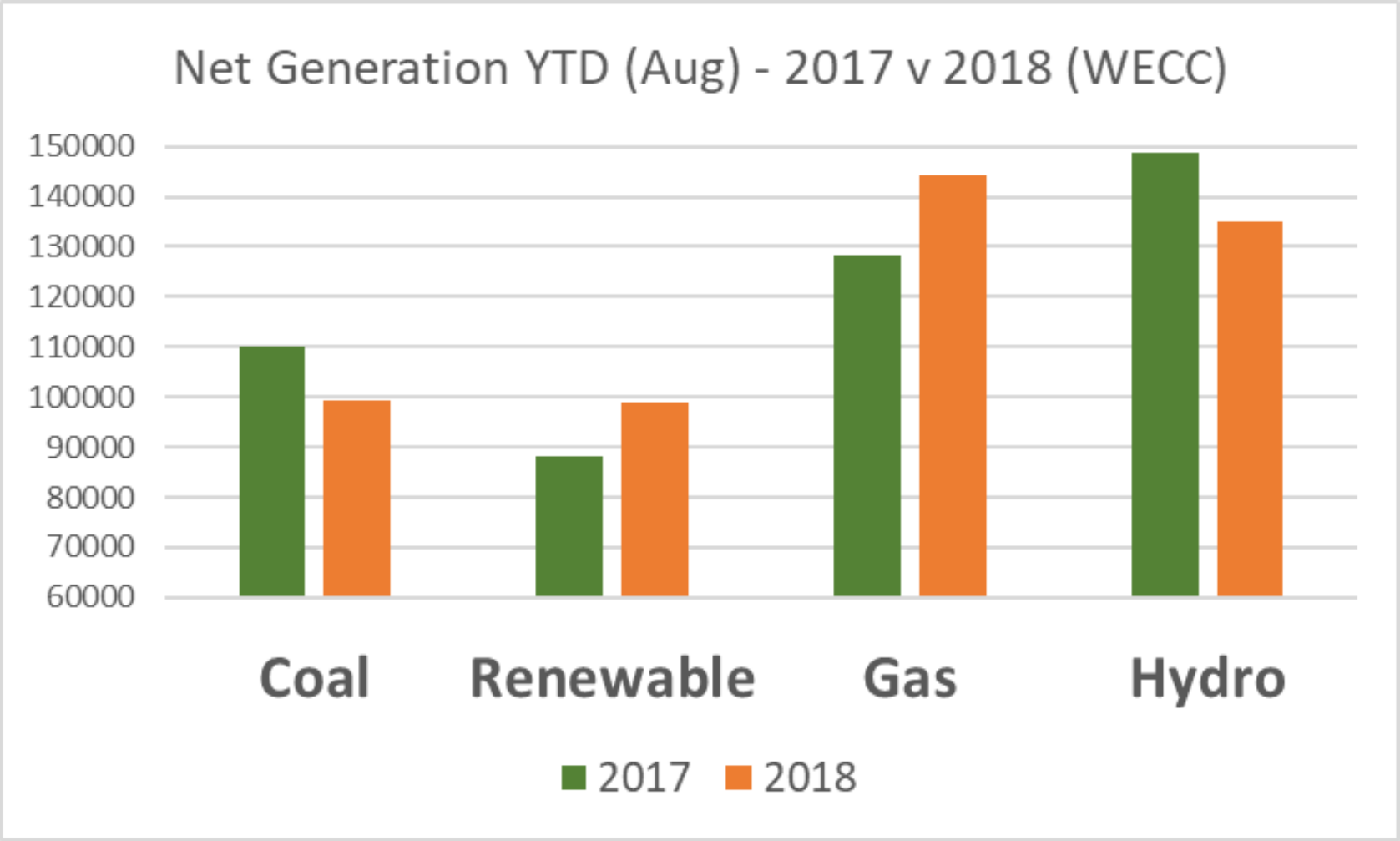
- No increase in total generation since 2008
- 2017 vs. 2008
  - Coal **-26%**
  - Nuclear **-18%**
  - Hydro + Natural Gas **-4%**
  - Renewables **+205% (3X)**

The decline in coal and nuclear generation in the West since 2008 has all been offset by growth in renewables


Western US Electricity Generation
EIA 1000 MWHrs
250,000
200,000
150,000
100,000
50,000
0
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Hydro
Natural Gas
Nuclear

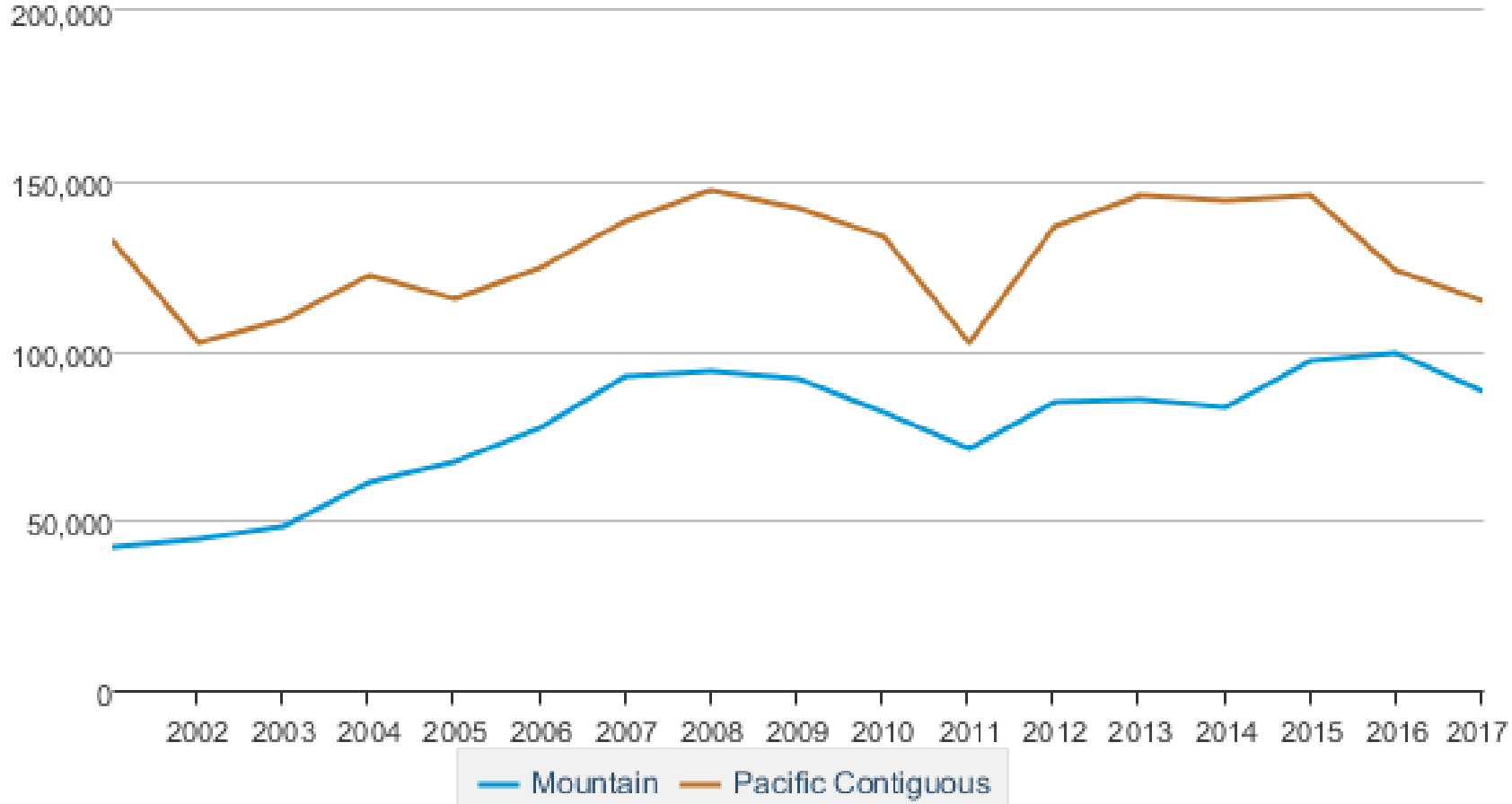

Western US Electricity Generation
EIA 1000 MWHrs
250,000
200,000
150,000
100,000
50,000
0
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Coal
Renewables

2018 YTD Data Shows Continuation of Recent Trends

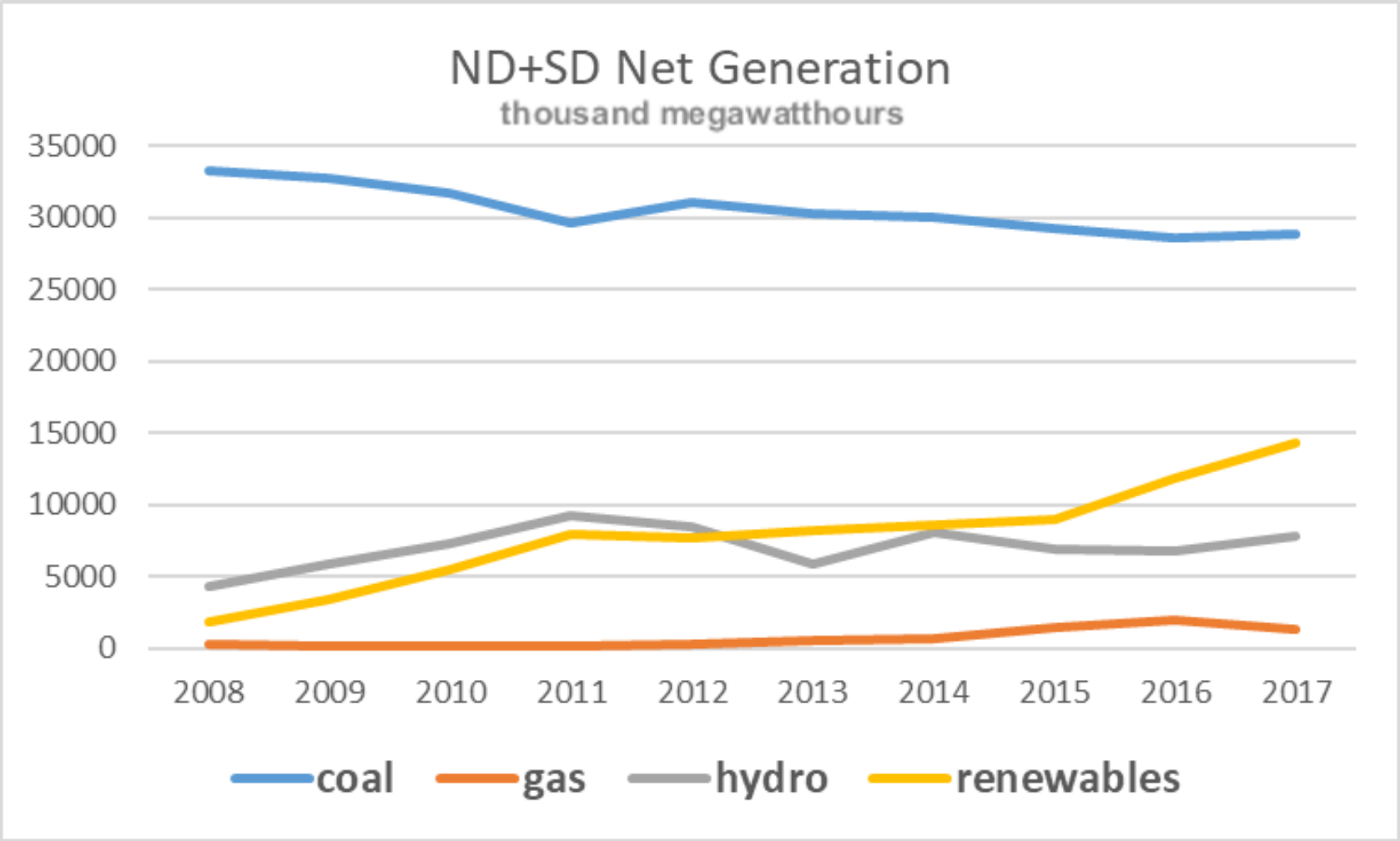


Net generation, natural gas, all sectors, annual

thousand megawatthours



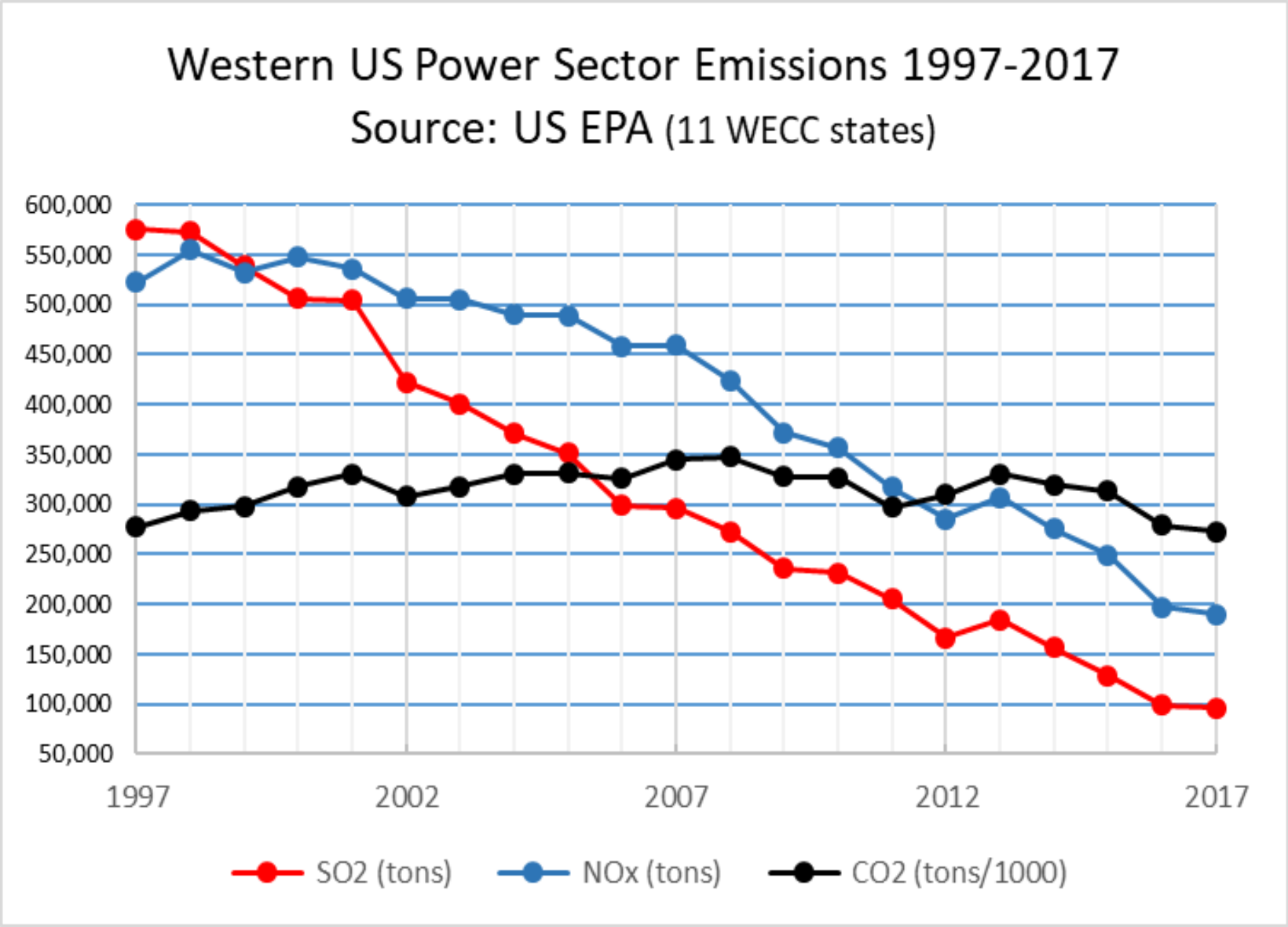
Data source: U.S. Energy Information Administration



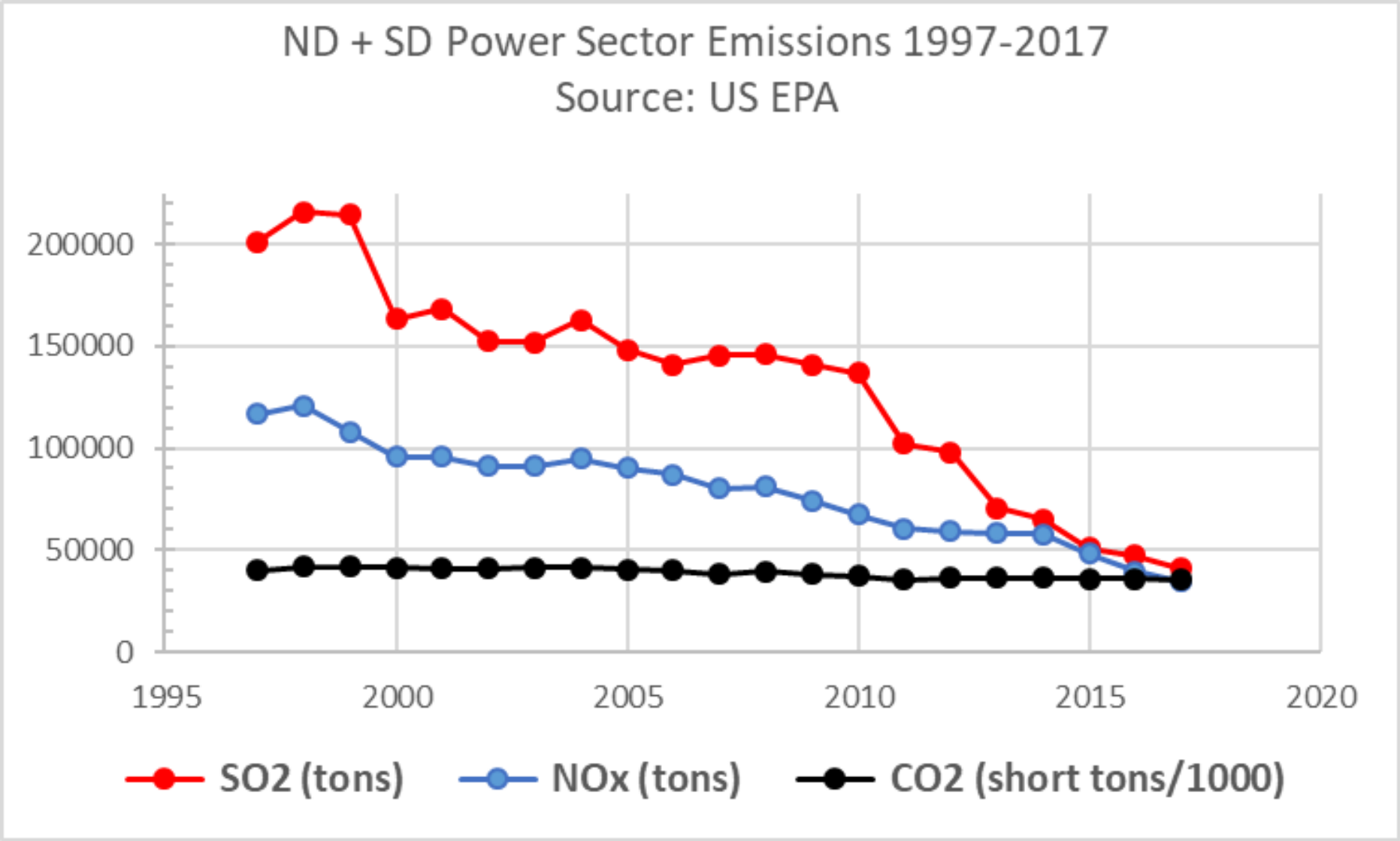
<u>……..2008-2017 Trends…….</u>

- Total Generation: **+32%**
- Coal Generation: **-13%**
- Renewables: **+7.7X**

Emissions Trends

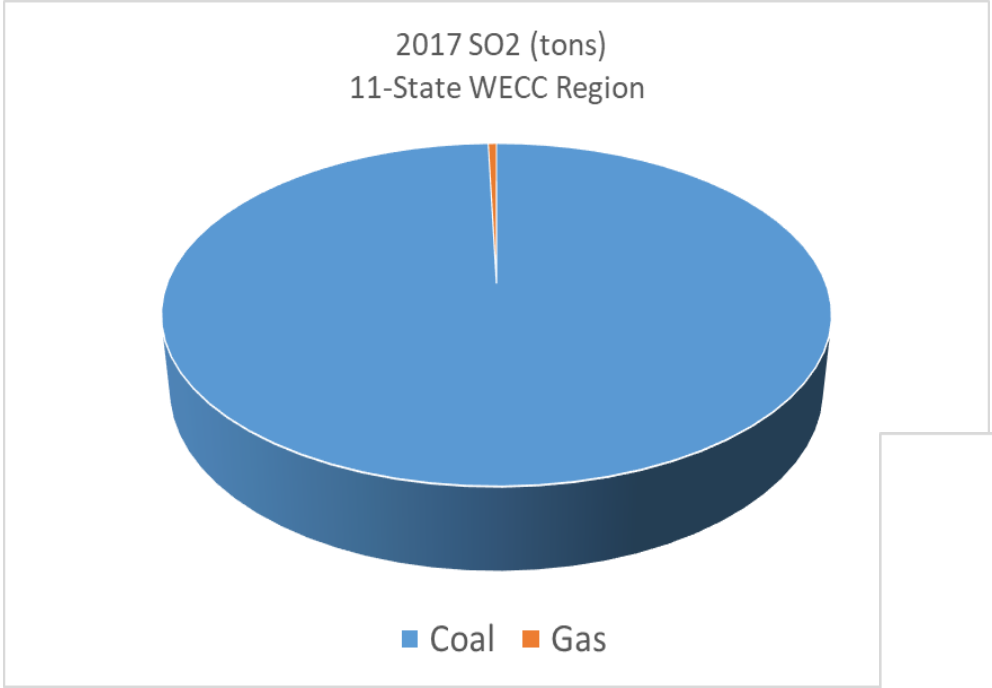


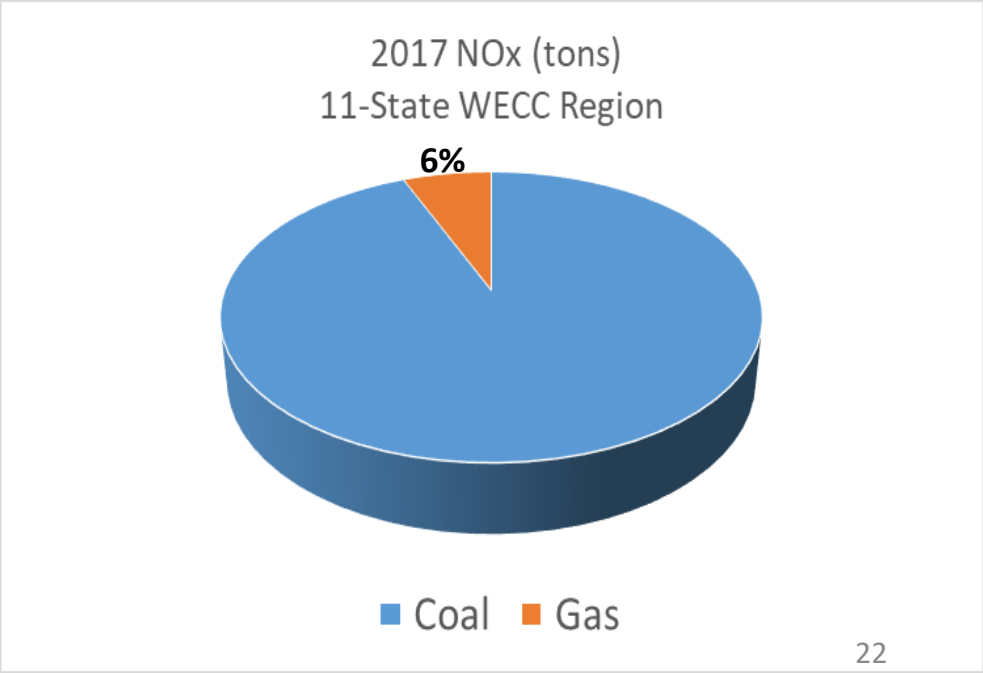
SO2: -83% **NOX: -64%** **CO2: -2% (-22% since 2008)**

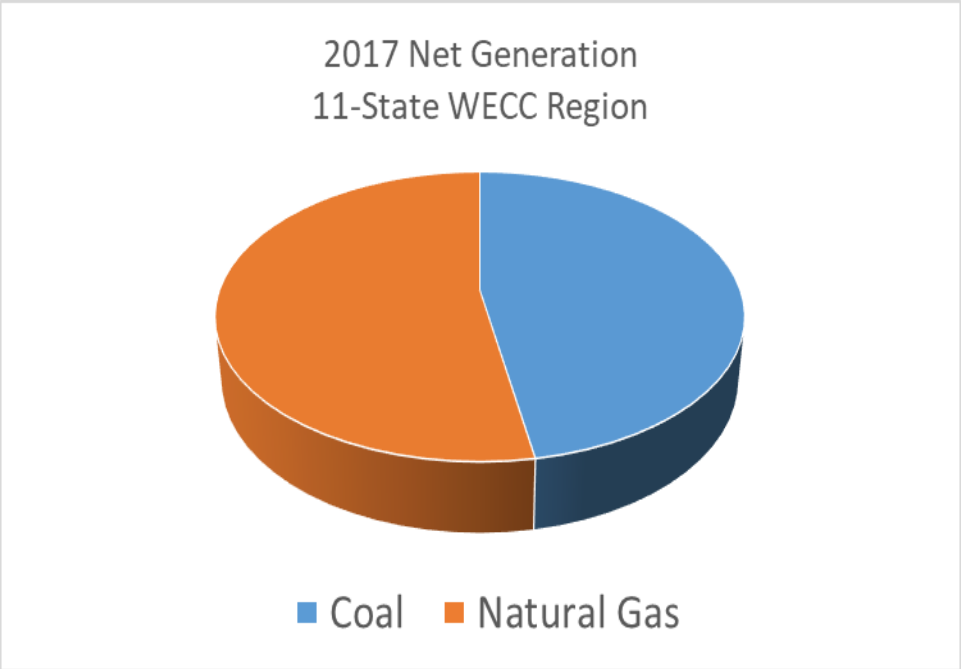


SO2: -80% **NOX: -70%** **CO2: -11% (-10% since 2008)**

Western Power Sector Emissions of SO2 & NOx: Coal v. Gas

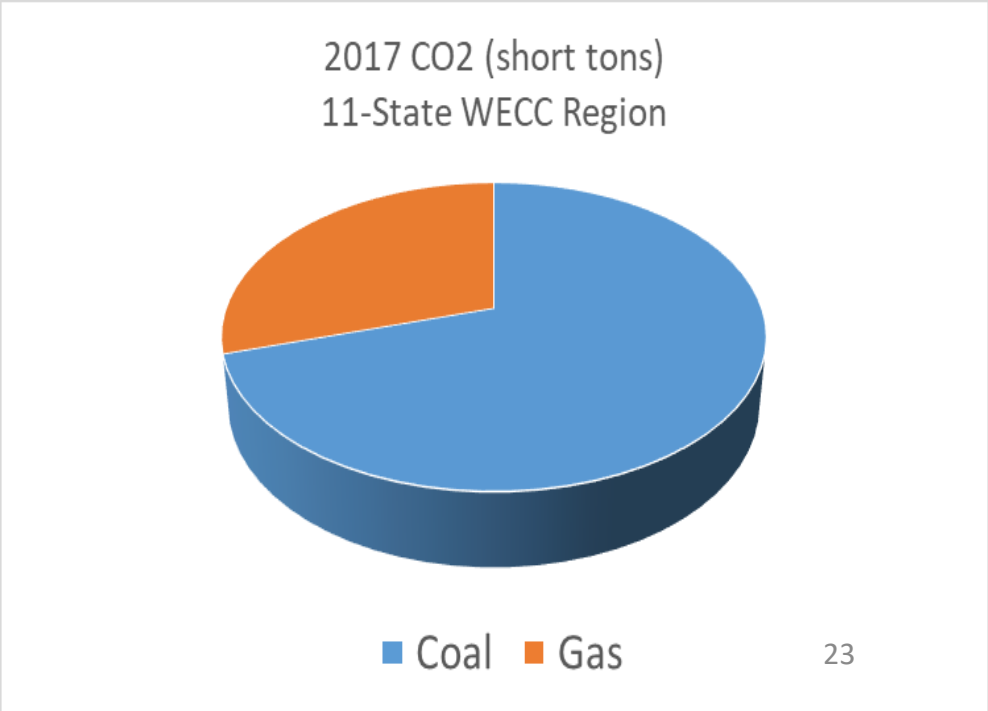




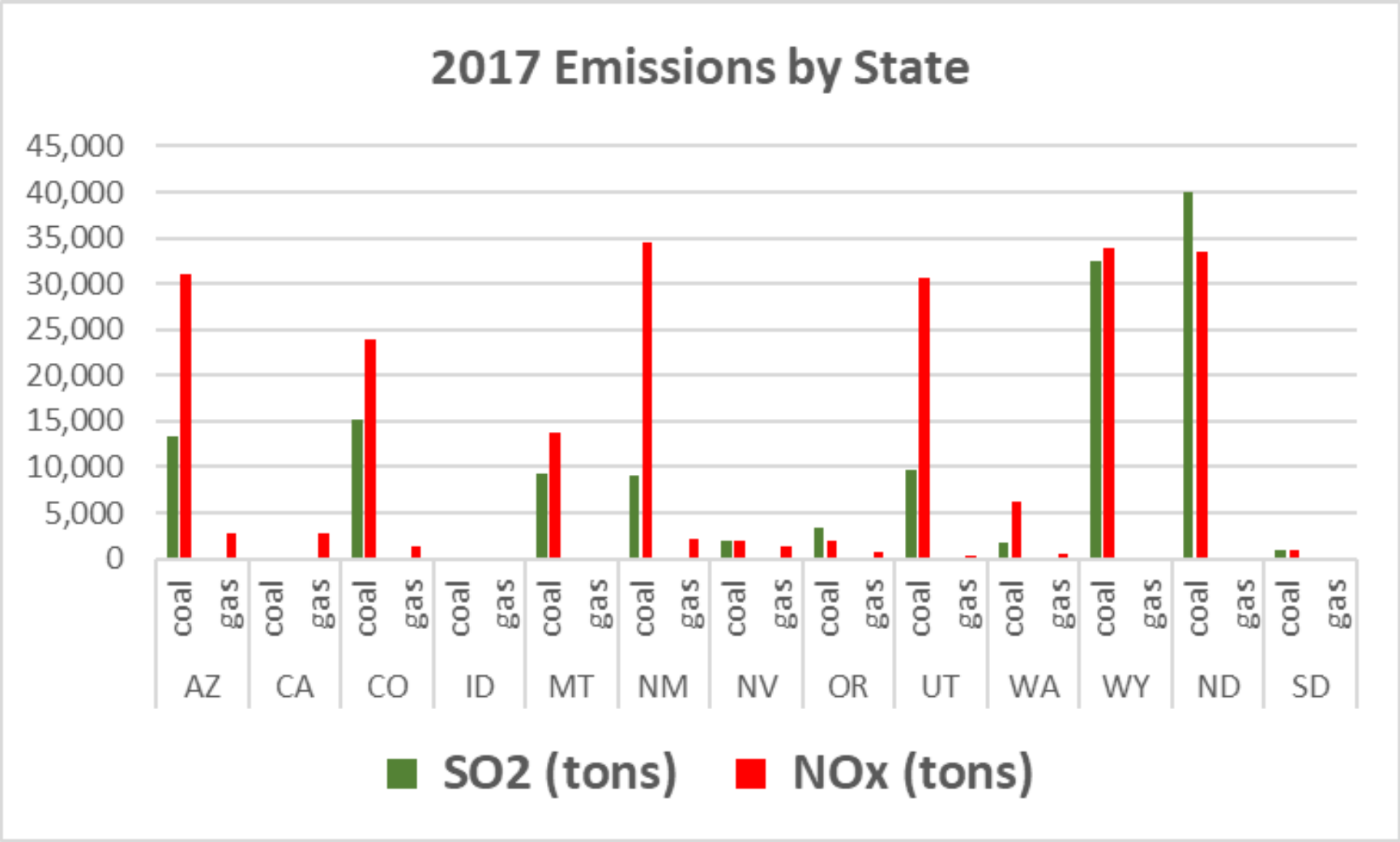


Gas: 53% of fossil generation
30% of CO2 emissions

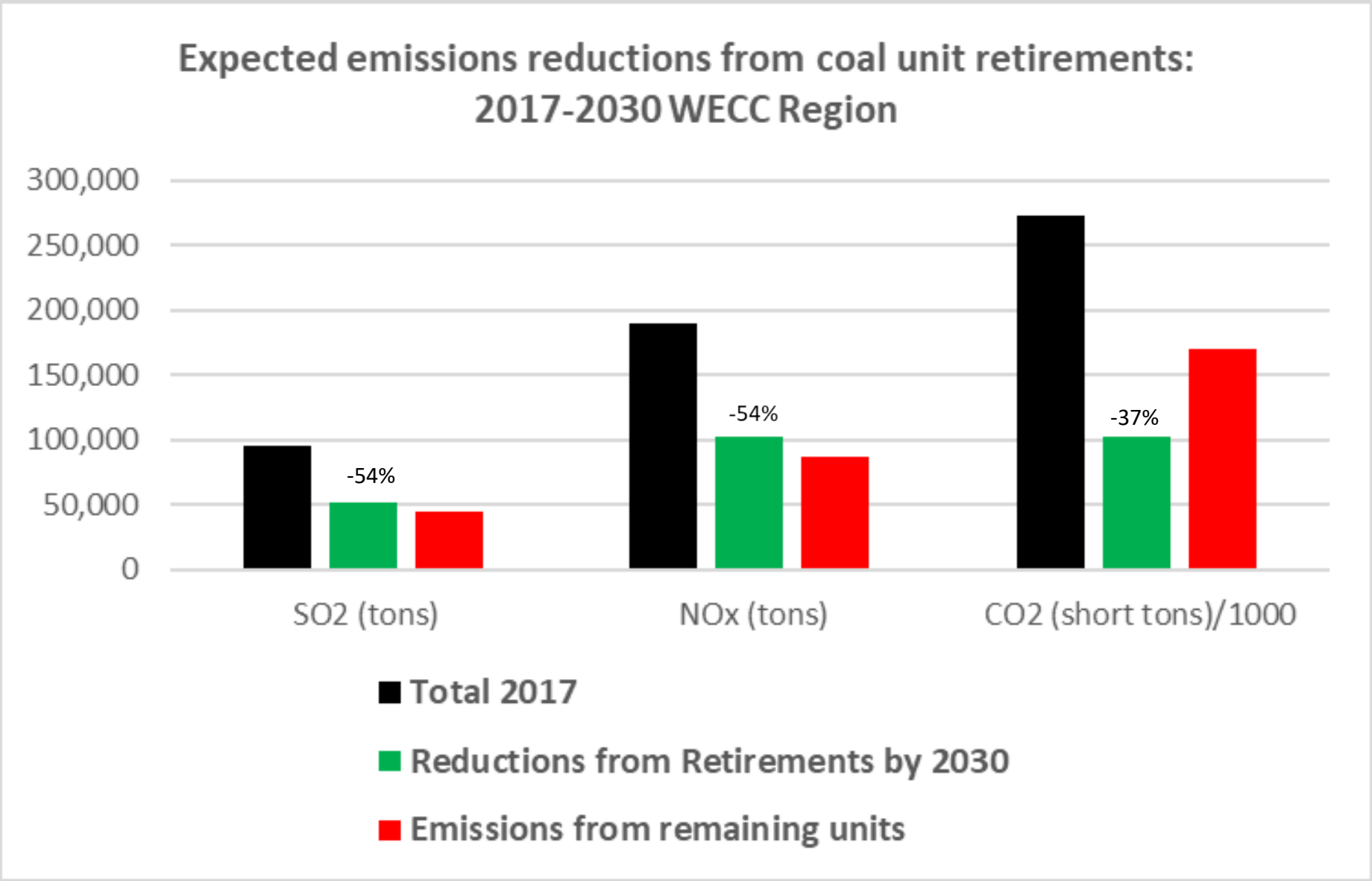
2017 Gas CO2/MWhr = Coal x 0.38



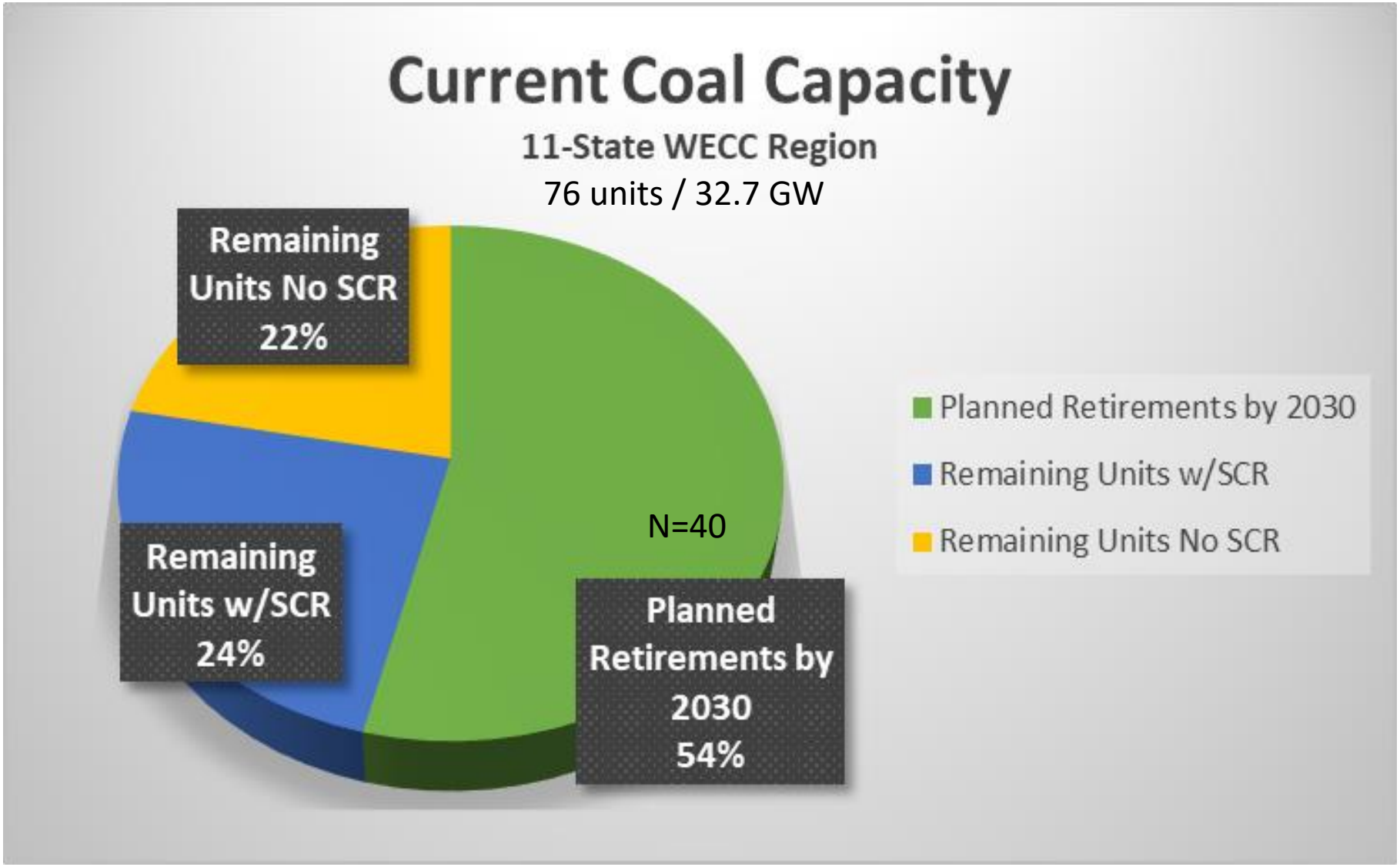
Western Power Sector Emissions

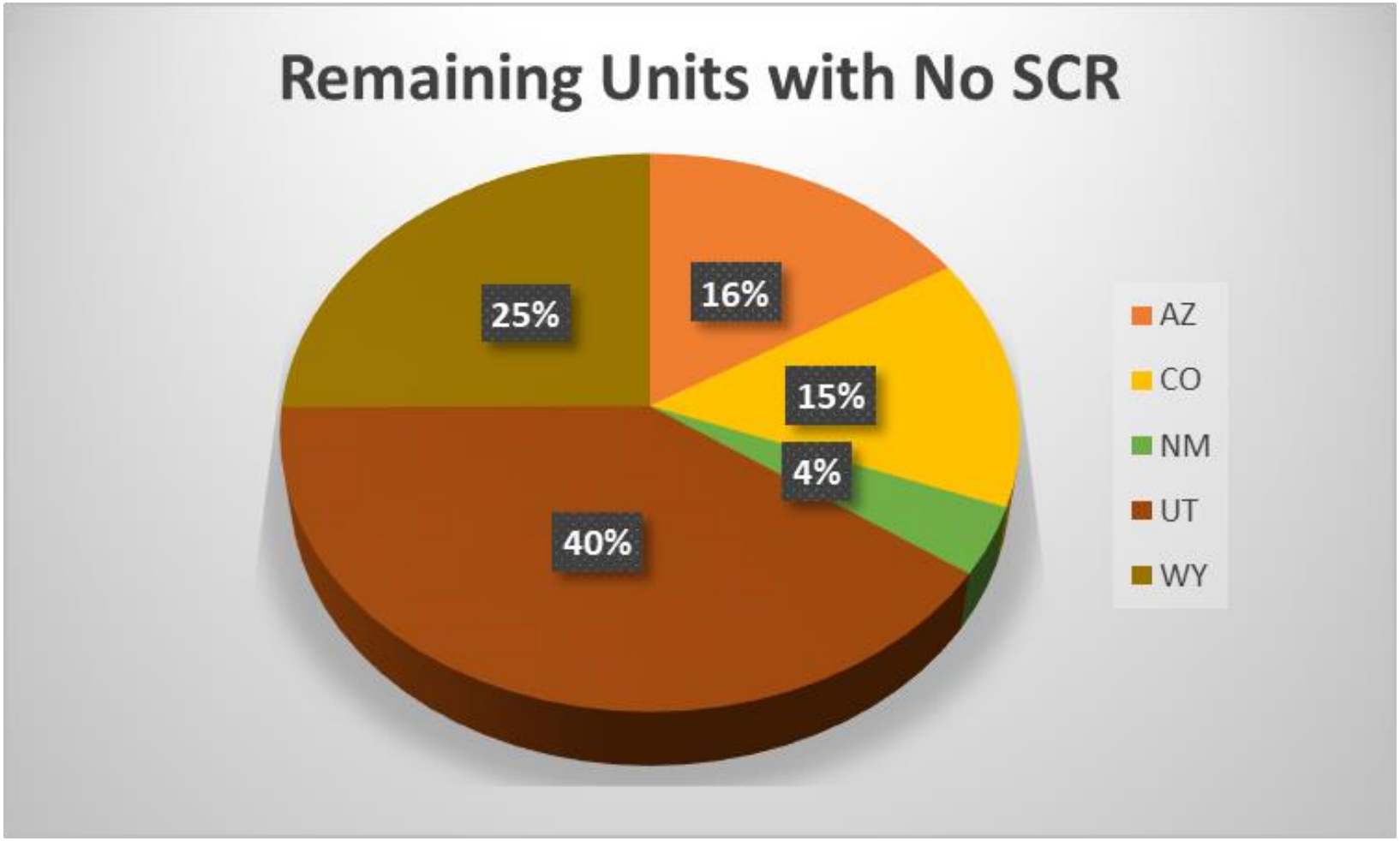


Forecasting Emissions & Identification of Sources for Further Evaluation



NOTE: Significant additional NOx controls installed over the period 2017-2019 which are not fully reflected in the 2017 data. Baseline emissions data and emissions forecast must be revised to reflect these controls once they are fully operational and data is available.


Current Coal Capacity
11-State WECC Region
76 units / 32.7 GW
Remaining Units No SCR 22%
Remaining Units w/SCR 24%
Planned Retirements by 2030 54%
N=40
Planned Retirements by 2030
Remaining Units w/SCR
Remaining Units No SCR



- 2017 average emission rate of remaining units with no SCR = 0.21 #/mmbtu
- ND - no SCRs on 11 existing coal units(?). Avg. rate = 0.23 #/mmbtu

Factors influencing future generation and power sector emissions in the West

- Coal unit retirements / utilization rates / additional controls
- Gas prices / gas capacity (new and existing)
- Nuclear retirement (Diablo Canyon (CA) – 2024-25)
- Hydro variability (incl. with droughts)
- Cost of Renewables / federal tax policy for renewables
- State climate and energy policies
- Demand / energy efficiency / demand-side management
- Electrification (esp. transportation)
- Transmission capacity / additions
- Regional wholesale electricity markets (ISO / RTO; other)
- Energy storage technologies and costs
- Grid modernization
- Federal energy and environmental policy
- Utility IRPs
- Corporate and city renewable energy and sustainability goals

Next steps and Questions

What data and analysis is wanted / needed?

- Historical capacity factors

What about SO2?

What about gas units?

- 96% of 2017 NOx emissions from sources >100TPY
- Only 19 gas units >100TPY NOx in 2017
- Remaining 4% of NOx from 535 gas units

Enforceable emissions limitations vs. likely operation/emissions

IRP assumptions