

Greenhouse Gas NSPS for New and Existing Sources

A large industrial power plant with a tall smokestack and a large building, set against a blue sky with wispy clouds. The building is a long, multi-story structure with a yellowish-brown facade and white accents. The smokestack is a tall, cylindrical structure on the left side of the building. The foreground shows a grassy field with some concrete pillars and a few trees.

Adam Yarina
NDEQ Air Toxics Coordinator

Overview

GHG Emissions and Regulation

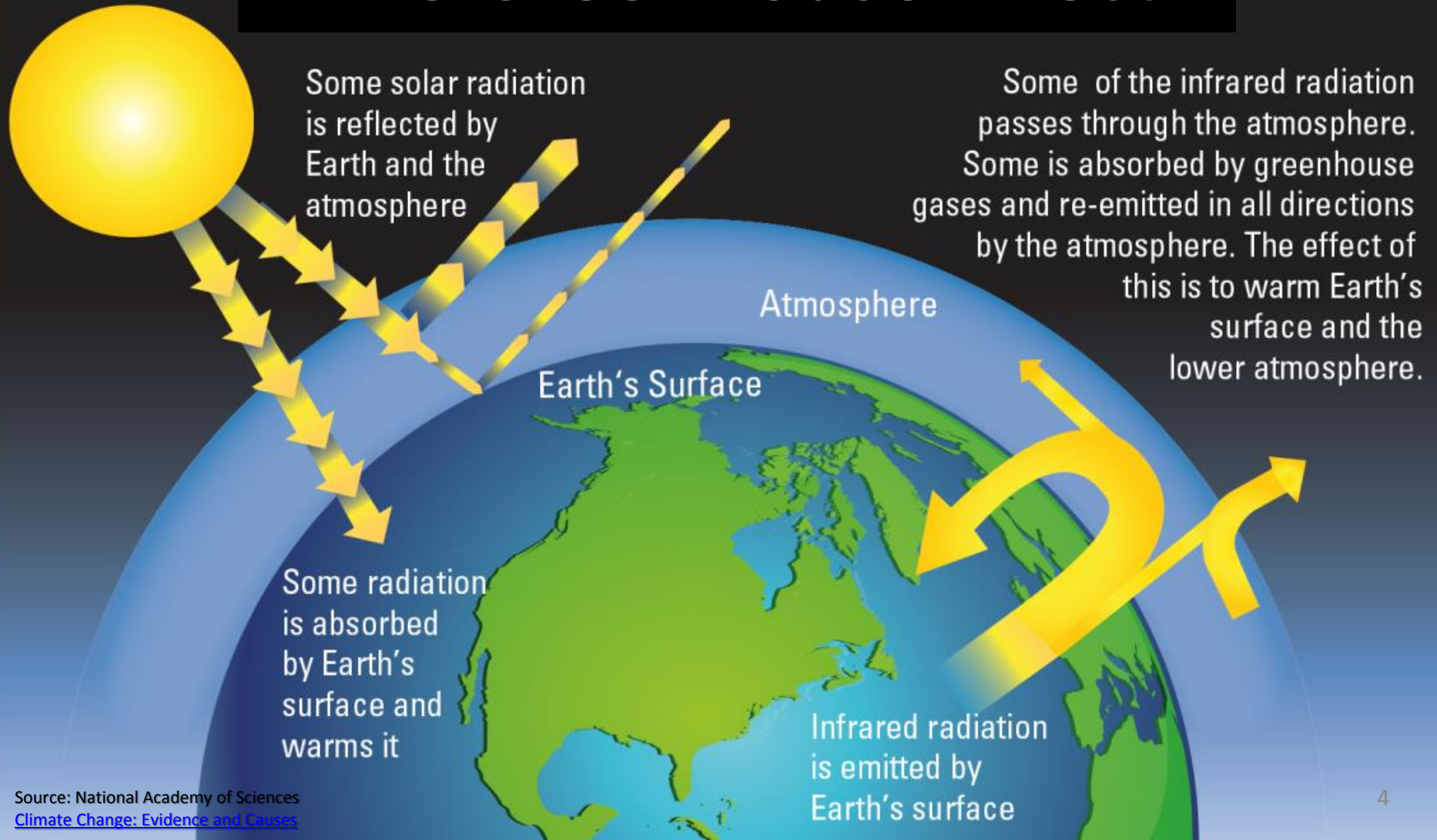
The Utility Power Sector

New Source Performance Standards

GHG NSPS & Emission Guidelines

Greenhouse Gas Emissions & Regulation

The Greenhouse Effect



U.S. GREENHOUSE GAS POLLUTION INCLUDES:



CARBON DIOXIDE (CO₂) 82%

Enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions (e.g., manufacture of cement).



FLUORINATED GASES 3%

Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes.

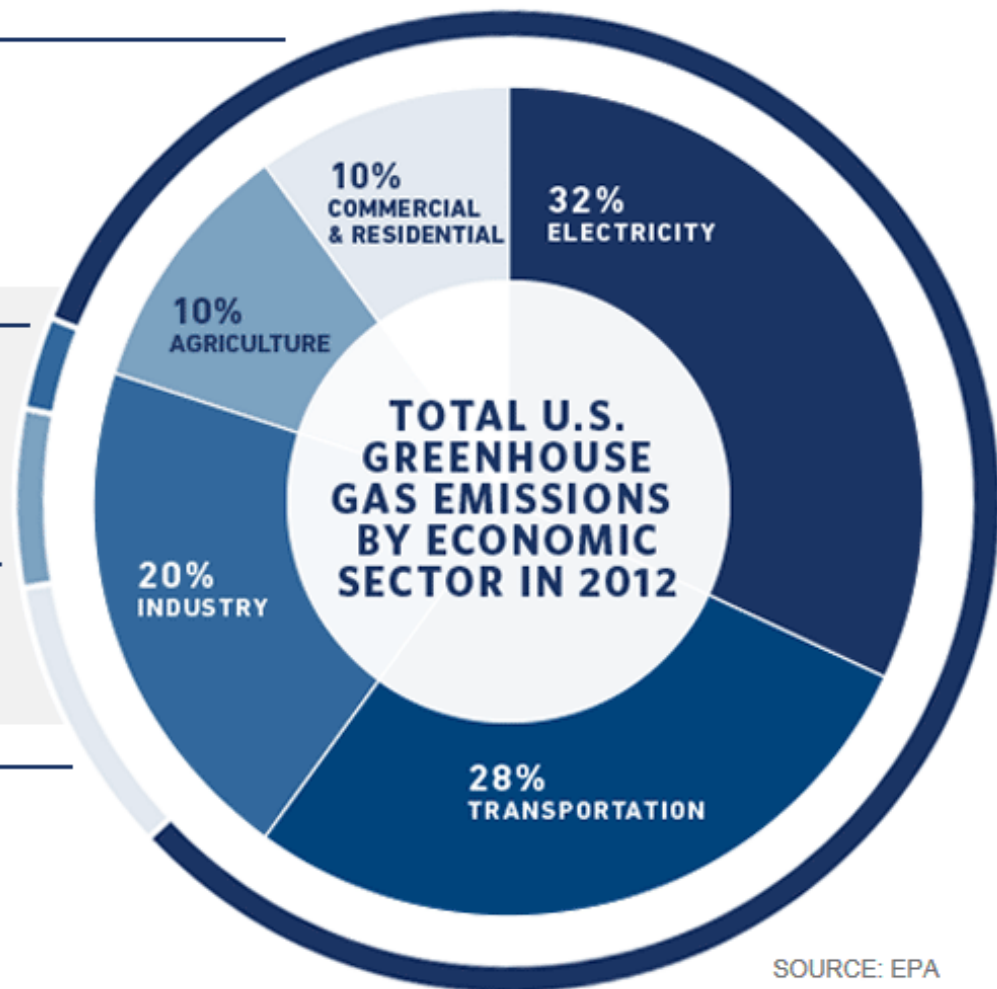
NITROUS OXIDE (N₂O) 6%

Emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.



METHANE (CH₄) 9%

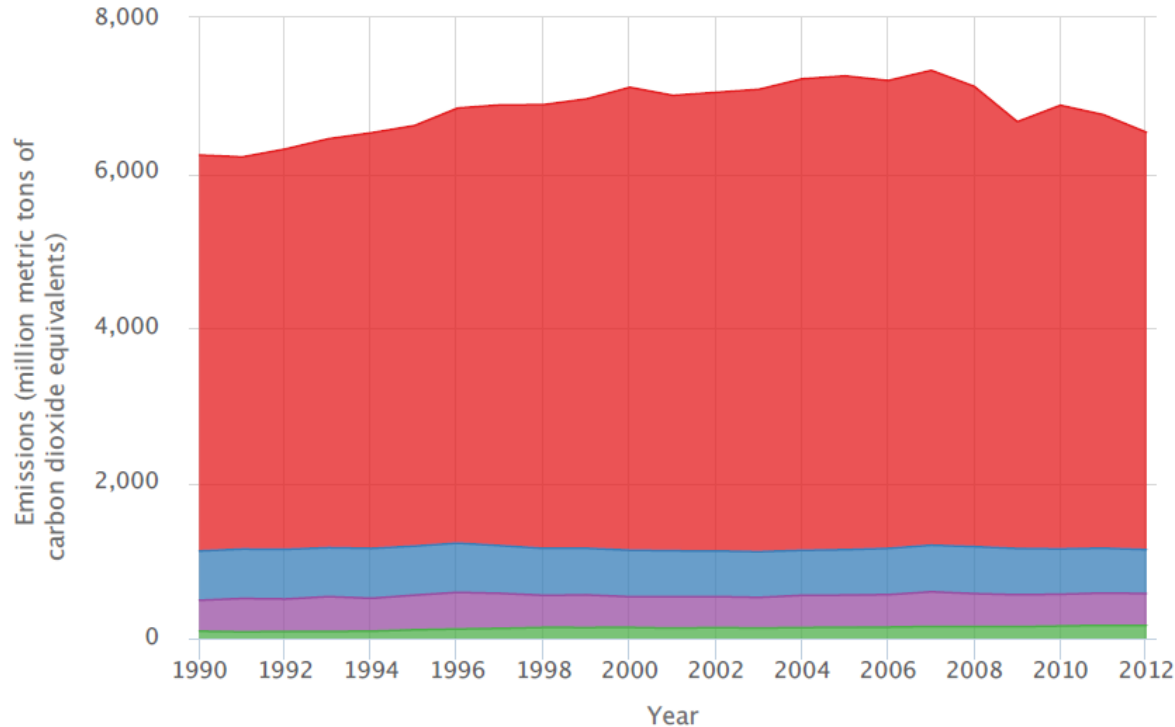
Emitted during the production and transport of coal, natural gas, and oil as well as from landfills.



SOURCE: EPA

Greenhouse Gas Emissions & Sources

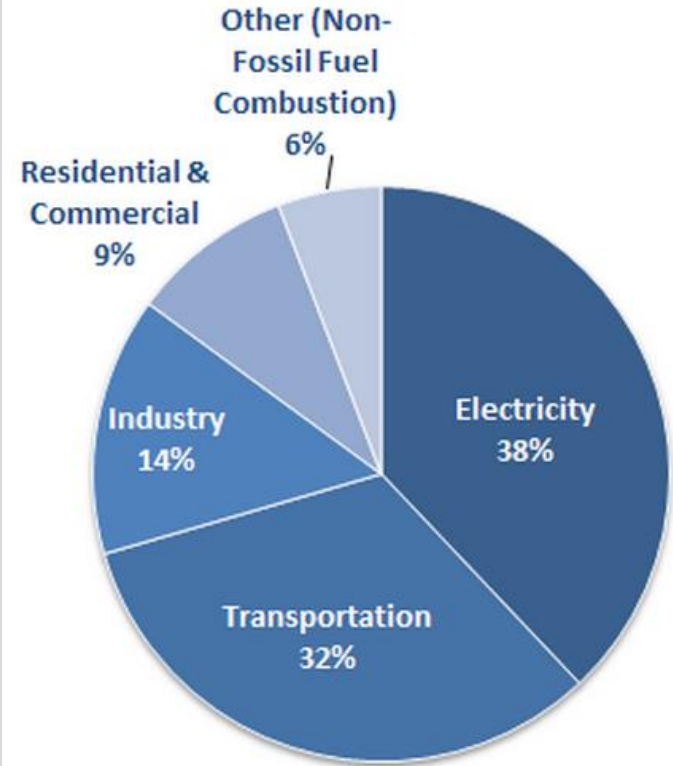
U.S. Greenhouse Gas Emissions by Gas, 1990-2012



■ Carbon dioxide ■ Methane ■ Nitrous oxide ■ Fluorinated gases

Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012.
<http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>

U.S. Carbon Dioxide Emissions, By Source



Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012*.

The Utility Power Sector



Gigawatts (GW)
1,000 MW



Megawatts (MW)
1,000 kW



Kilowatts (kW)
1,000 W



Watts
(W)



NPPD Gerald Gentleman Station

North Platte, NE

1,365 MW



NPPD Beatrice Power Station

Beatrice, NE

217 MW

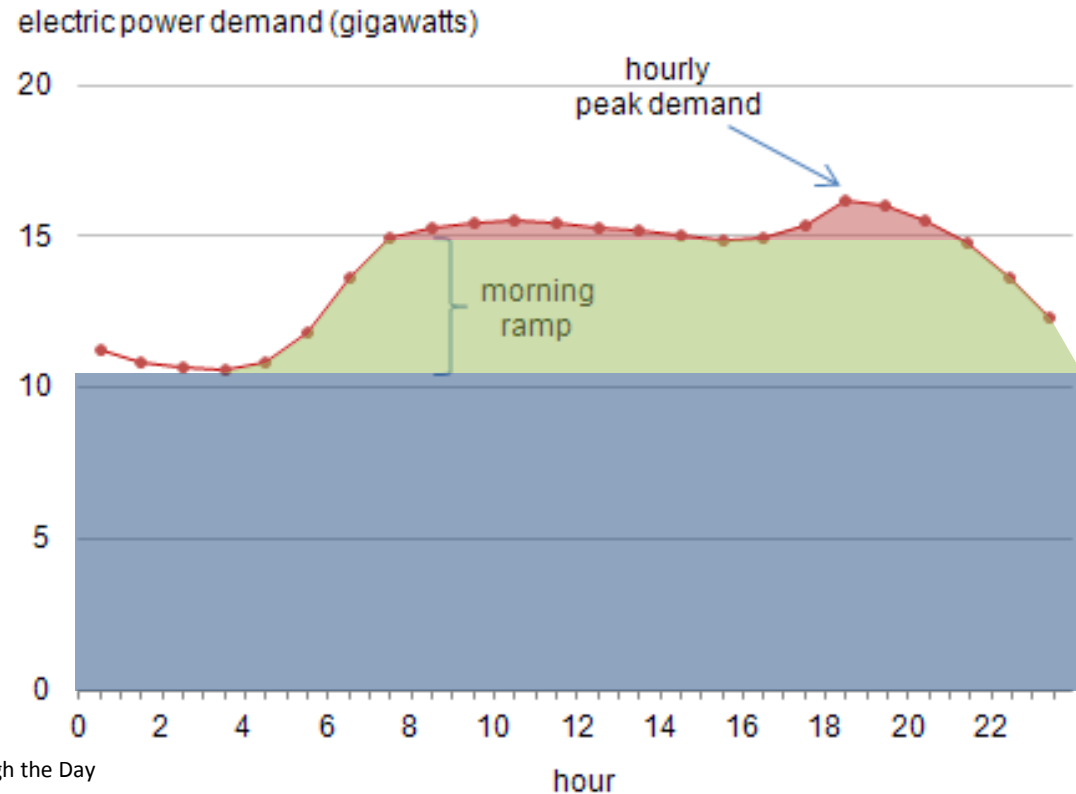


Broken Bow Wind LLC
Broken Bow, NE
1.6 MW/turbine



The Utility Power Sector Generating Capacity

Electric load curve: New England, 10/22/2010



Peak
Intermediate

Baseload

The Utility Power Sector

Simple- vs. Combined-Cycle

Simple-Cycle Systems

- Combustion only, no heat recovery
- Simpler, less expensive to build
- Faster and easier to respond to changing power demand

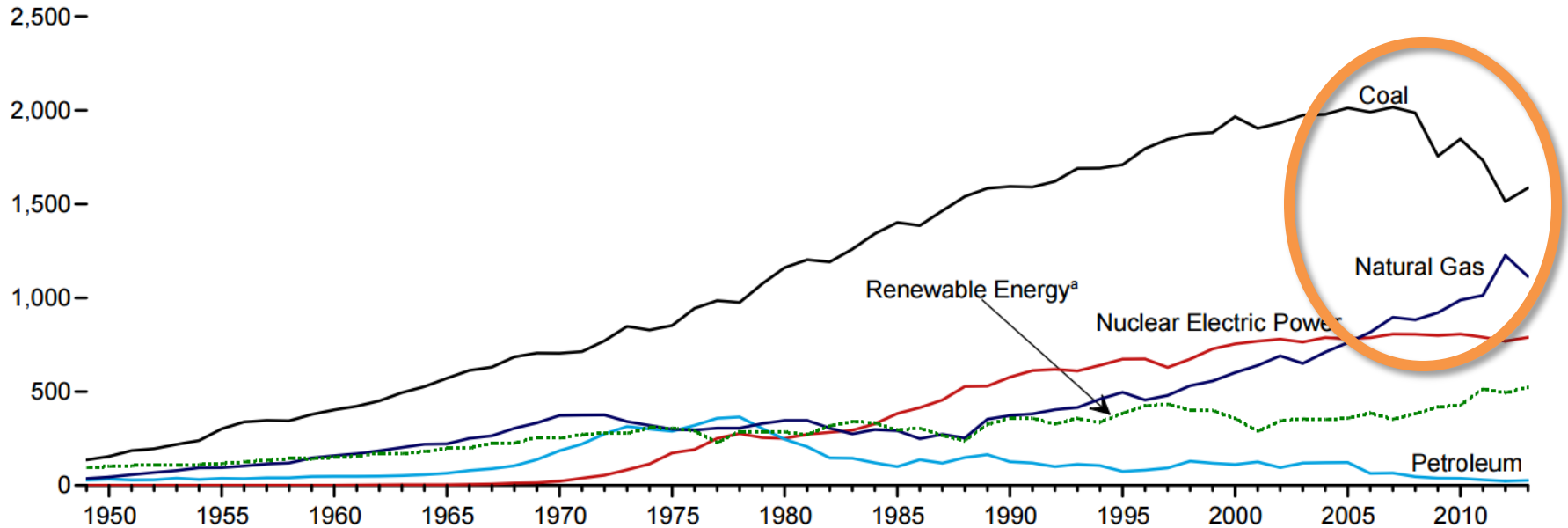
Combined-Cycle Systems

- Recover waste heat from combustion for reuse
- 50% more efficient than simple-cycle
- Cheaper long-term energy solution

The Changing Power Utility Sector

Figure 7.2 Electricity Net Generation
(Billion Kilowatthours)

Total (All Sectors), Major Sources, 1949–2013



^a Conventional hydroelectric power, wood, waste, geothermal, solar/PV, and wind.

^b Blast furnace gas, and other manufactured and waste gases derived from fossil fuels.

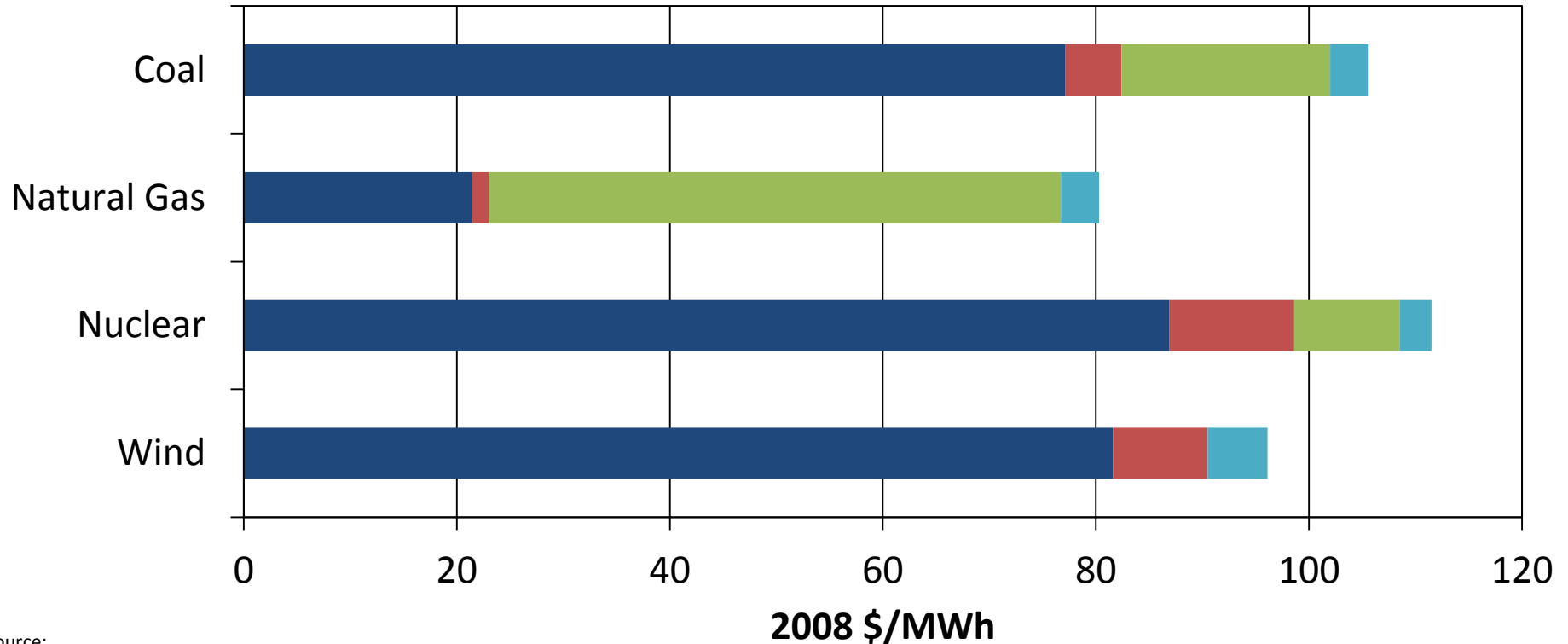
^c Conventional hydroelectric power.

Web Page: <http://www.eia.gov/totalenergy/data/monthly/#electricity>.

Sources: Tables 7.2a–7.2c.

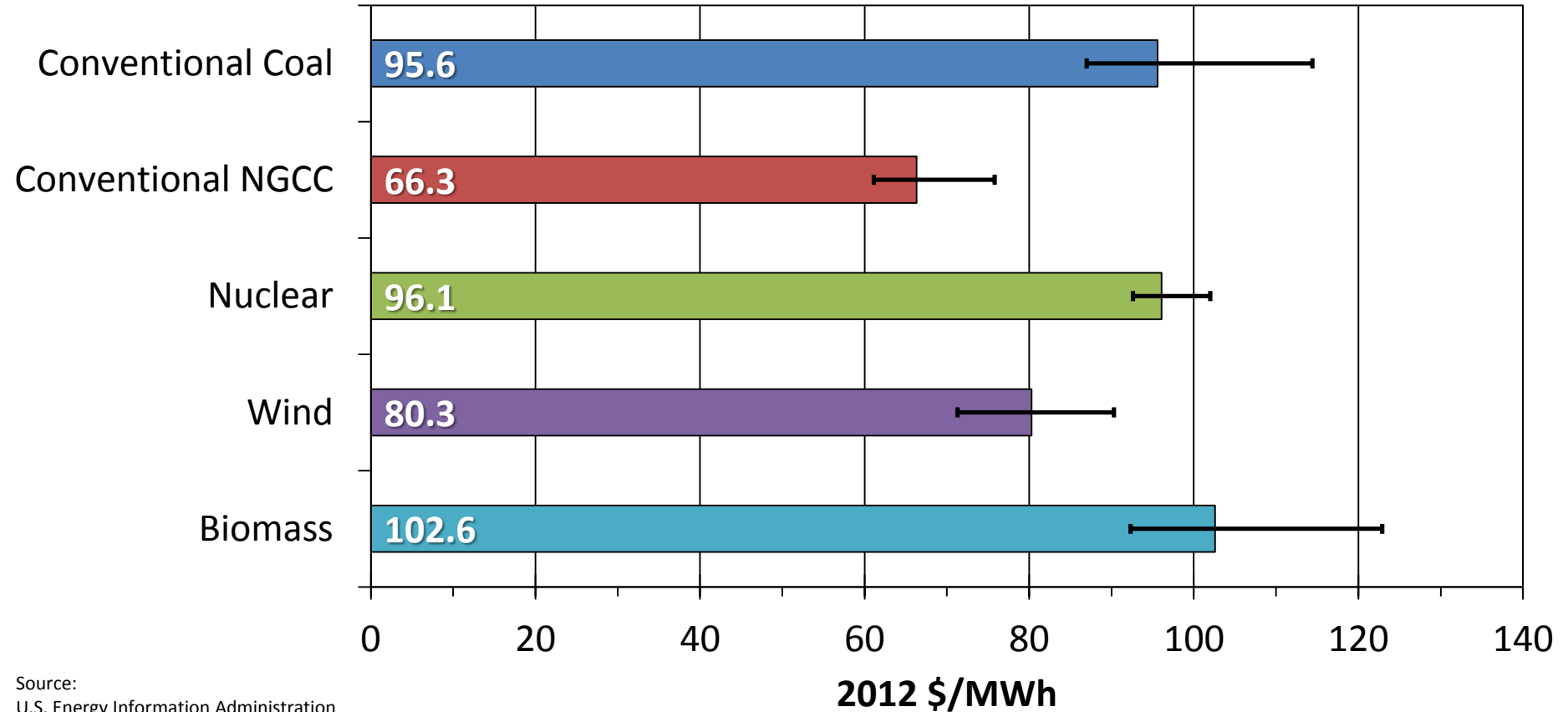
Levelized Cost of Electricity (LCOE)

■ Capital ■ O&M ■ Fuel ■ Transmission



Source:
U.S. Energy Information Administration
Annual Energy Outlook 2010, May 2010, DOE/EIA-0383(2010)
<http://www.eia.gov/forecasts/archive/aeo10/electricity.html>

Average LCOE of Generation Types



Source:
U.S. Energy Information Administration
Annual Energy Outlook 2014, April 30, DOE/EIA-0383(2014)
http://www.eia.gov/forecasts/aeo/electricity_generation.cfm

New Source Performance Standards

New Source Performance Standards

- CAA Section 111 (b) – NSPS
 - Applies to new stationary sources
 - Commence construction, modification, or reconstruction after applicable standards are published or proposed
- CAA Section 111 (d) – Emission Guidelines (EG)
 - Applies to existing stationary sources
 - Any source other than a new source
 - Required for any sources of an air pollutant that:
 - Is not elsewhere regulated under the CAA; and,
 - Would be subject if the existing source were a new source

New Source Performance Standards

- Standard of Performance:

-

- reflects

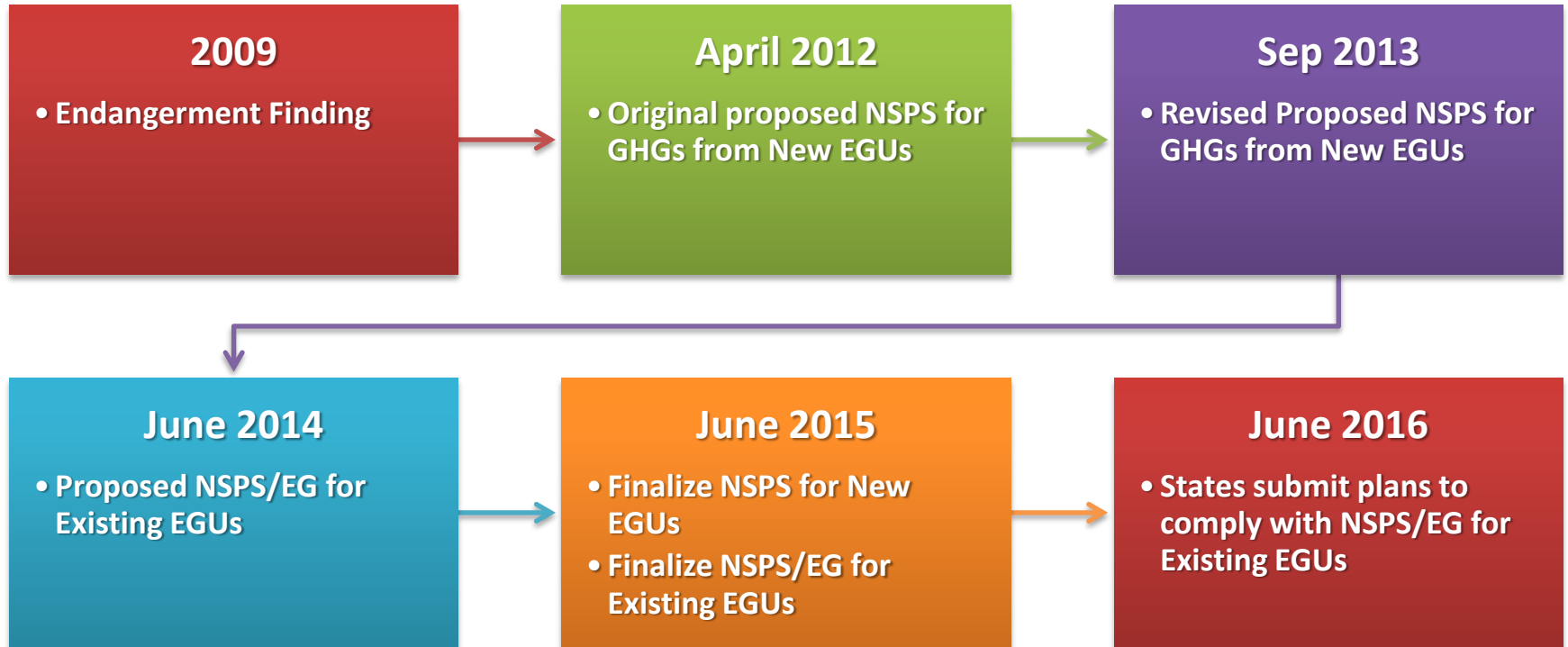
- the application of the best system of emission reduction which

- has been adequately demonstrated.”

New Source Performance Standards



New Source Performance Standards GHG Regulatory Timeline



GHG NSPS for New EGUs

GHG NSPS for New EGUs

Applicability

	Coal-fired EGUs	Natural Gas-fired EGUs
Build Date	After Jan 8, 2014	
Capacity	> 73 MW	
Fuel Usage	> 10% fossil fuel use on a 3-year rolling average basis	
Built for the purpose of supplying, and supplies...	One-third or more of its total potential electrical output	
	<u>AND</u>	
	More than 219,000 MWh net-electrical output to the grid...	
	...on an <u>annual</u> basis.	...on a <u>3-year rolling average</u> basis.
Not Subject	Oil-fired EGUs	
	Existing EGUs that undertake modification or reconstruction	

GHG NSPS for New EGUs

Emission Limits

	Coal-fired EGUs	Natural Gas-fired EGUs	
BSER Determination	Partial CCS	Natural Gas Combined Cycle	
Subcategories	–	≤ 250 MW	> 250 MW
Emission Standard (lb CO₂/MWh)	1,100		1,000
Compliance Options	12-operating-month rolling average; OR 84-operating-month rolling average	12-operating-month rolling average	
Compliance Determination	First 12-operating-months of data Rolling average updated each operating month thereafter		
Startup, Shutdown, & Malfunction	No exemption for startup or shutdown periods Affirmative defense for malfunctions		

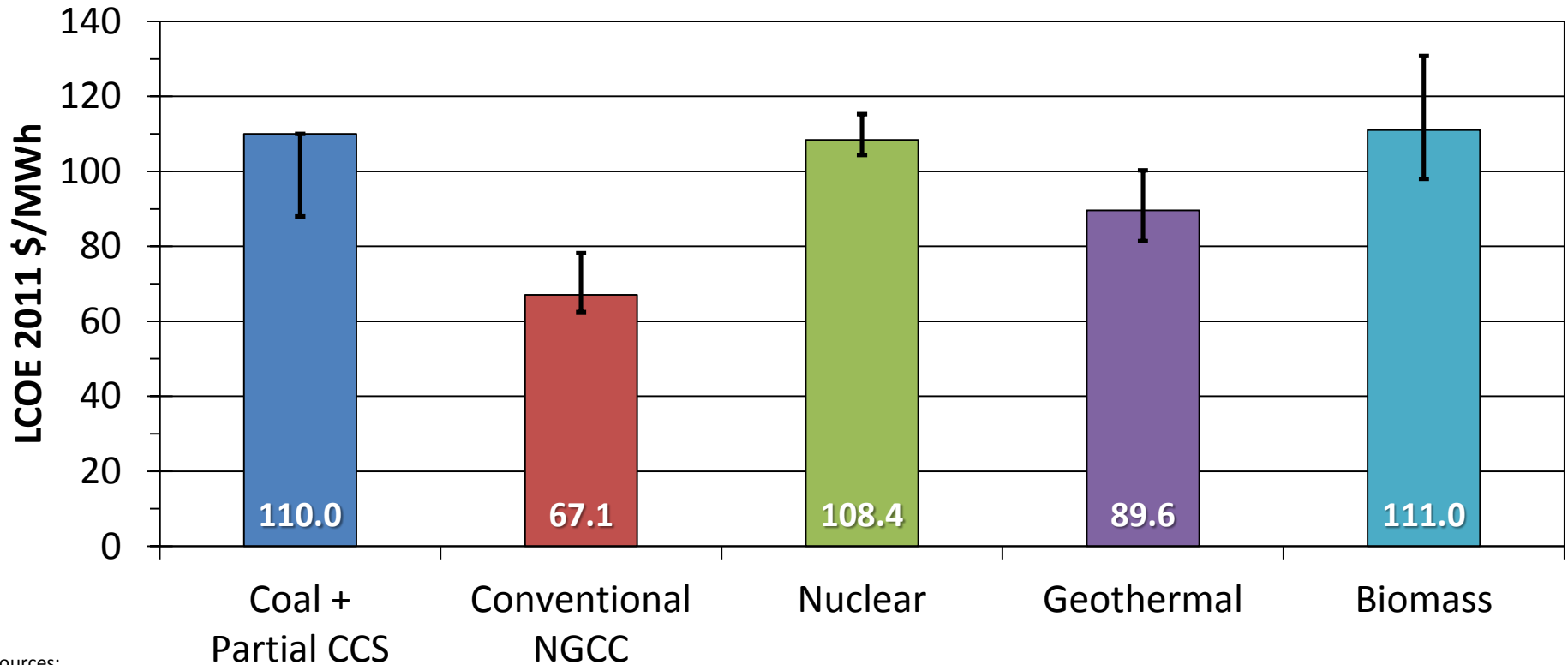
GHG NSPS for New EGUs

Other Requirements

	Coal-fired EGUs	Natural Gas-fired EGUs
Continuous Emissions Monitoring System (CEMS)	<p>Required for solid-fuel EGUs</p> <p>Must measure exhaust gas CO₂ concentration, flow rate, & moisture content</p>	<p>Optional</p> <p>If not used, must install fuel flow meter</p>
Other Monitoring Requirements	<p>Hourly EGU operating time & gross output in MWh; Site-specific monitoring plan</p>	
Recordkeeping	<p>Calculations for emissions data, CEMS, gross output; Maintained for 3 years total (2 years on-site) 10 years total for 84-operating-month compliance option</p>	
Reporting	<p>Quarterly emissions summary & excess emissions reports</p>	

Best System of Emission Reduction

LCOE of Coal + Partial CCS vs. Other Dispatchable Generation



Best System of Emission Reduction

BSER	Adequately Demonstrated	Reasonable Cost	Adequate Emission Reductions	Promotes Technological Innovation
Coal				
No CCS	✓	✓	✗	✗
Partial CCS	✓	✓	✓	✓
Full CCS	✓	✗	✓	✓
Natural Gas				
Simple-Cycle	✓	✗	✗	✗
Combined-Cycle	✓	✓	✓	✓
+ Partial CCS	✗	✗	✓	✓
+ Full CCS	✗	✗	✓	✓

GHG NSPS Emission Guidelines for Existing EGUs

GHG NSPS EG for Existing EGUs

- 111(d) standards differ from other air regulations (NSPS for new sources, NESHAPs)
 - EPA sets standard based on BSER, but states decide how to implement and achieve compliance
 - States develop 111(d) plans, submit them to the EPA for review and approval
 - States unable or unwilling to submit a satisfactory 111(d) plan in a timely manner will automatically be subject to a federal 111(d) plan

GHG NSPS EG for Existing EGUs

- The Clean Power Plan
 - Prescribes state-specific CO₂ emission reduction goals for the electric power sector
 - Based on the implementation of four major “building blocks” as BSER
 - Uses state-specific 2012 electric generation data as baseline
 - Two sets of proposed goals/buildings blocks

GHG NSPS EG for Existing EGUs

Rulemaking & State Plan Timeline



Sources:

EPA | Fact Sheet: Clean Power Plan & Carbon Pollution Standards Key Dates

<http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan-carbon-pollution-standards-key-dates>

GHG NSPS EG for Existing EGUs

2012 Baseline Electric Generation Data

Includes

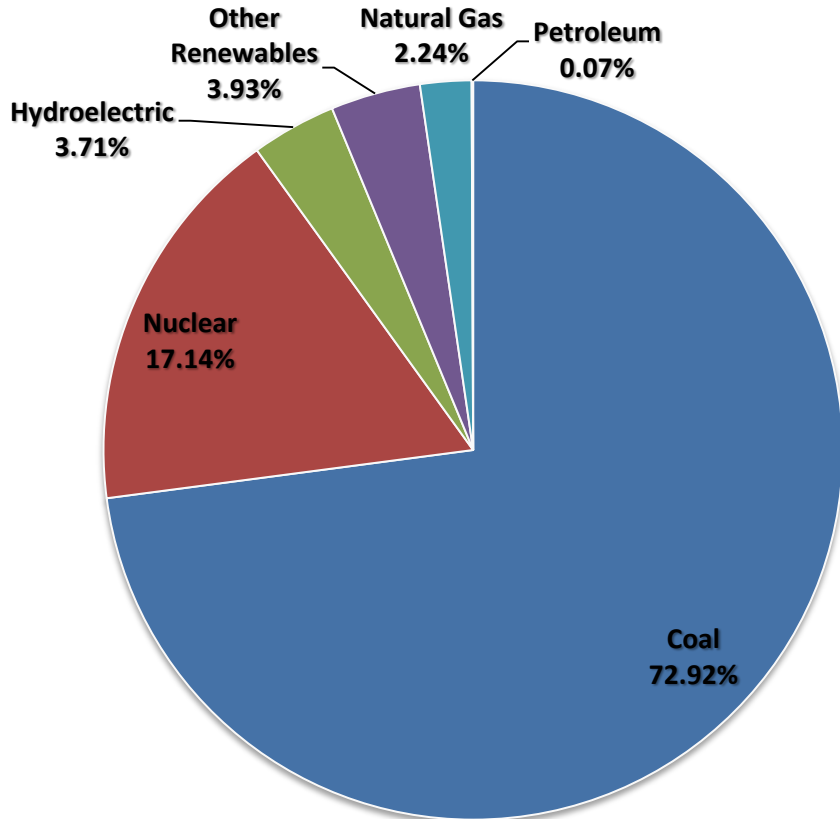
- Actual generation from all affected EGUs at electric utilities and independent power producers
- Existing non-hydro renewable generation
- 6% of state nuclear generation

Does Not Include

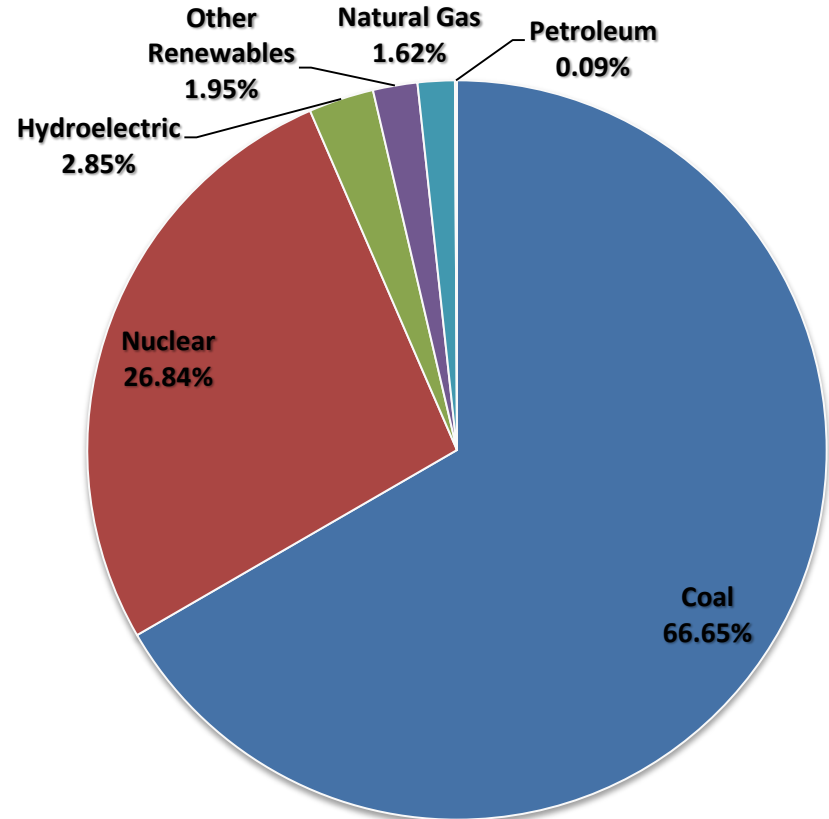
- Existing hydropower
- Industrial units not connected to the grid
- Units for which fossil fuel was less than 10% of heat input in 2012
- Units with a capacity of less than 25 MW

Nebraska Electric Power Generation

2012

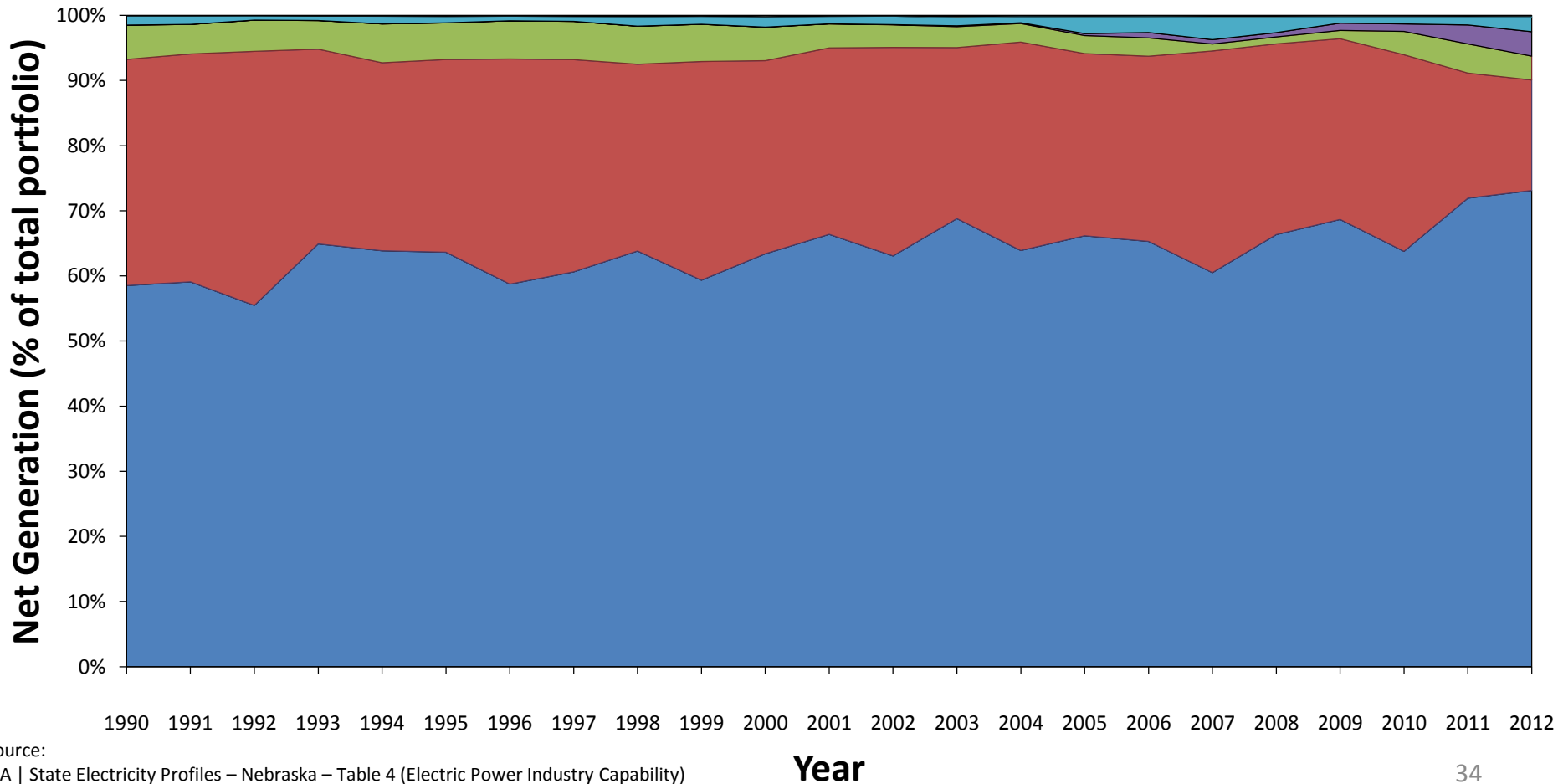


2001-2014 Annual Average



Nebraska Electric Power Generation

Coal Nuclear Hydroelectric Wind Natural Gas Biomass Petroleum



Source:
EIA | State Electricity Profiles – Nebraska – Table 4 (Electric Power Industry Capability)
<http://www.eia.gov/electricity/state/Nebraska/>

GHG NSPS EG for Existing EGUs

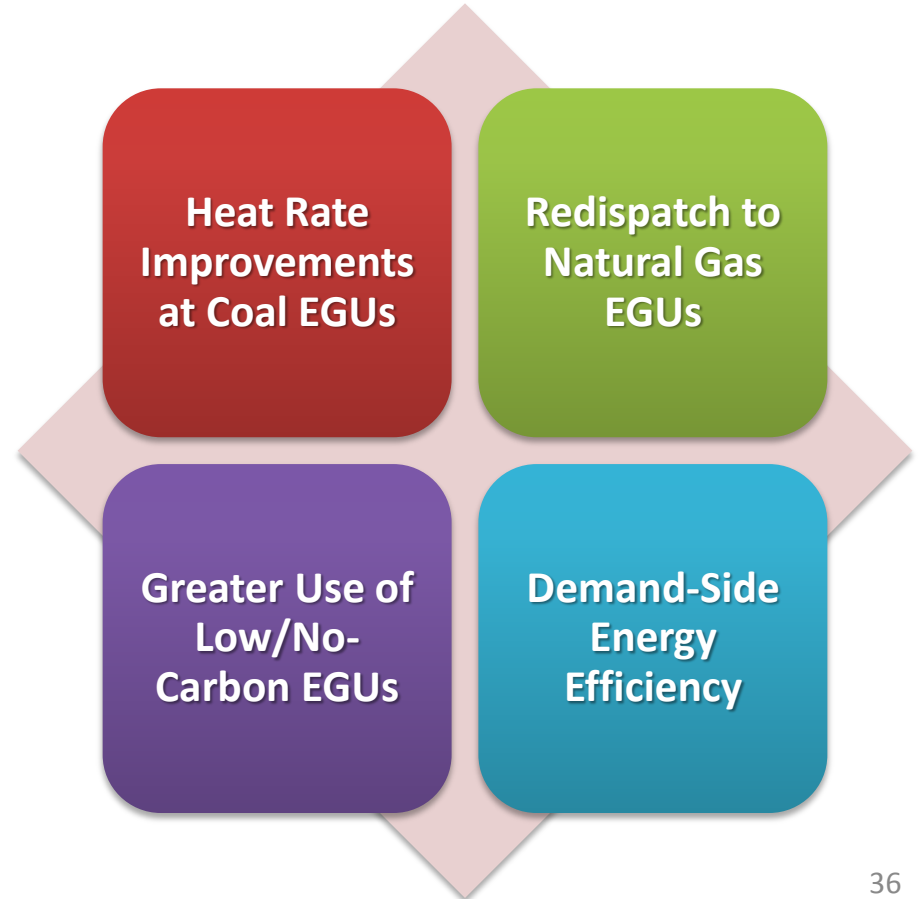
Applicability

	Coal-fired EGUs	Natural Gas-fired EGUs
Applicability Date	In operation or commenced construction <u>on or before</u> Jan 8, 2014	
Capacity	> 73 MW	
Fuel Usage	> 10% fossil fuel use on a 3-year rolling average basis	
Built for the purpose of supplying, and supplies...	One-third or more of its total potential electrical output	
	<u>AND</u>	
	More than 219,000 MWh net-electrical output to the grid...	
	...on an <u>annual</u> basis.	...on a <u>3-year rolling average</u> basis.
Not Subject	Oil-fired EGUs	
	EGUs that undertake modification or reconstruction <u>before</u> becoming subject to a state plan under these regulations	

GHG NSPS EG for Existing EGUs

Building Blocks for Emission Goals

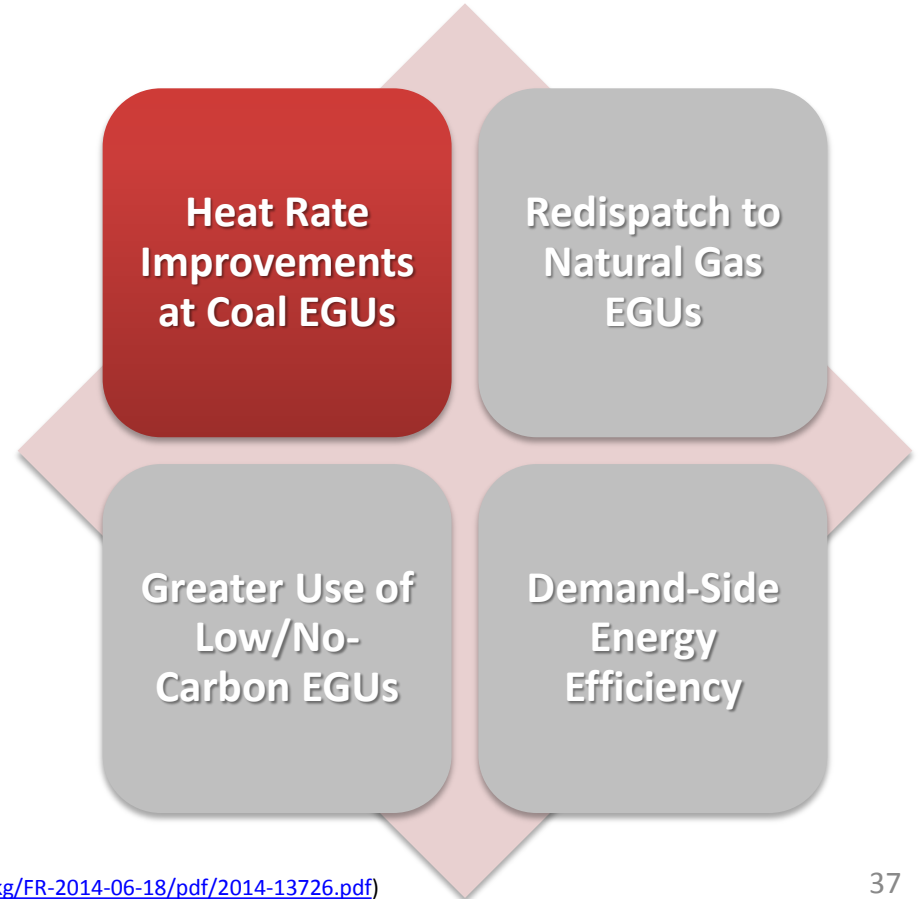
- Basis for state-specific CO2 emission goals
- Not mandatory
- Not all-inclusive
- States ultimately decide how to reach emission goals



GHG NSPS EG for Existing EGUs

Building Blocks for Emission Goals

- Efficiency improvements at existing coal EGUs
- Based on adoption of best practices and equipment upgrades
- Net cost of \$6-\$12 per metric ton of CO₂ reduction



Source:

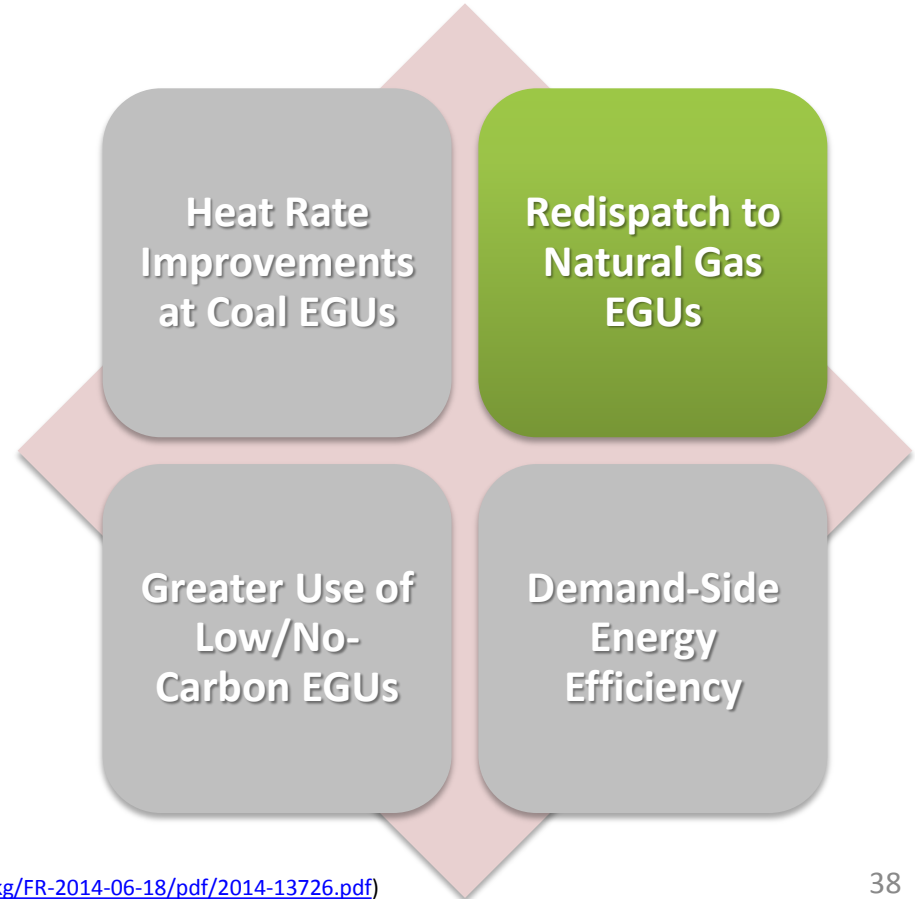
EPA | Clean Power Plan Proposed Rulemaking (79 FR 34830) (<http://www.gpo.gov/fdsys/pkg/FR-2014-06-18/pdf/2014-13726.pdf>)

VI. Building Blocks for Setting State Goals and the Best System of Emission Reduction

GHG NSPS EG for Existing EGUs

Building Blocks for Emission Goals

- Use existing natural gas combined-cycle units instead of existing coal
- Easier than converting or co-firing natural gas at coal EGUs
- Approximate cost of \$30/metric ton of CO₂



Source:

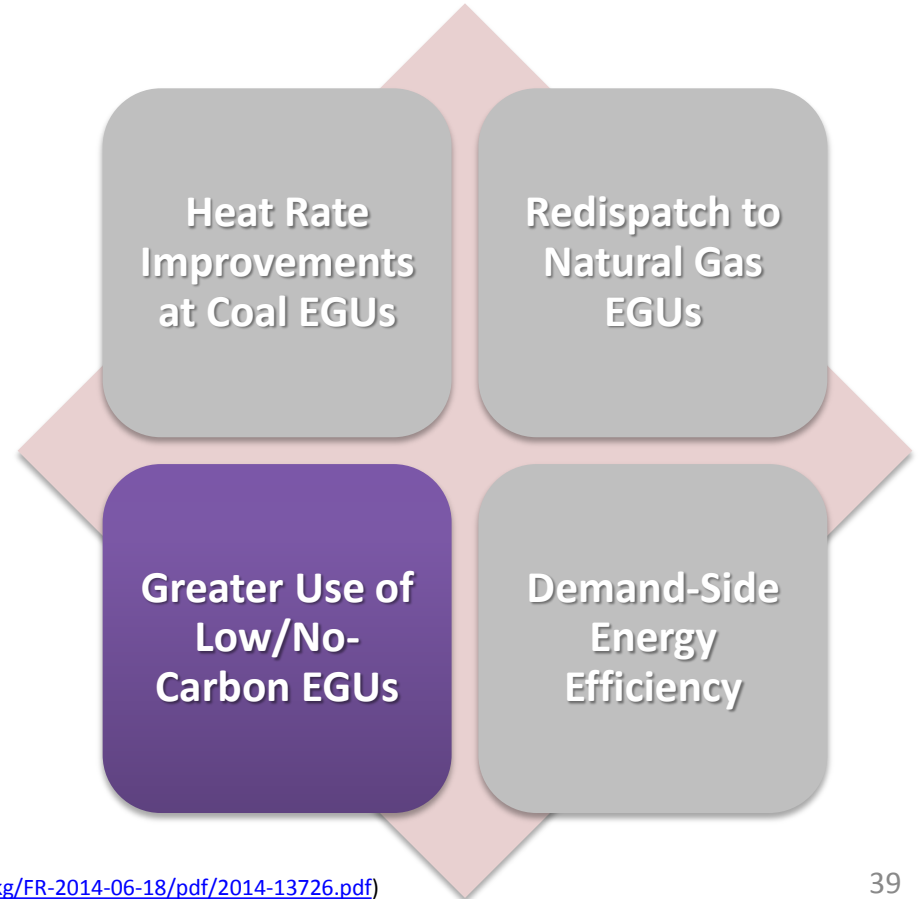
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VI. Building Blocks for Setting State Goals and the Best System of Emission Reduction

GHG NSPS EG for Existing EGUs

Building Blocks for Emission Goals

- Maintain nuclear fleet, preserve “at-risk” units
- Continue expansion of renewable energy generation
- Cost of \$10-\$40/metric ton of CO₂



Source:

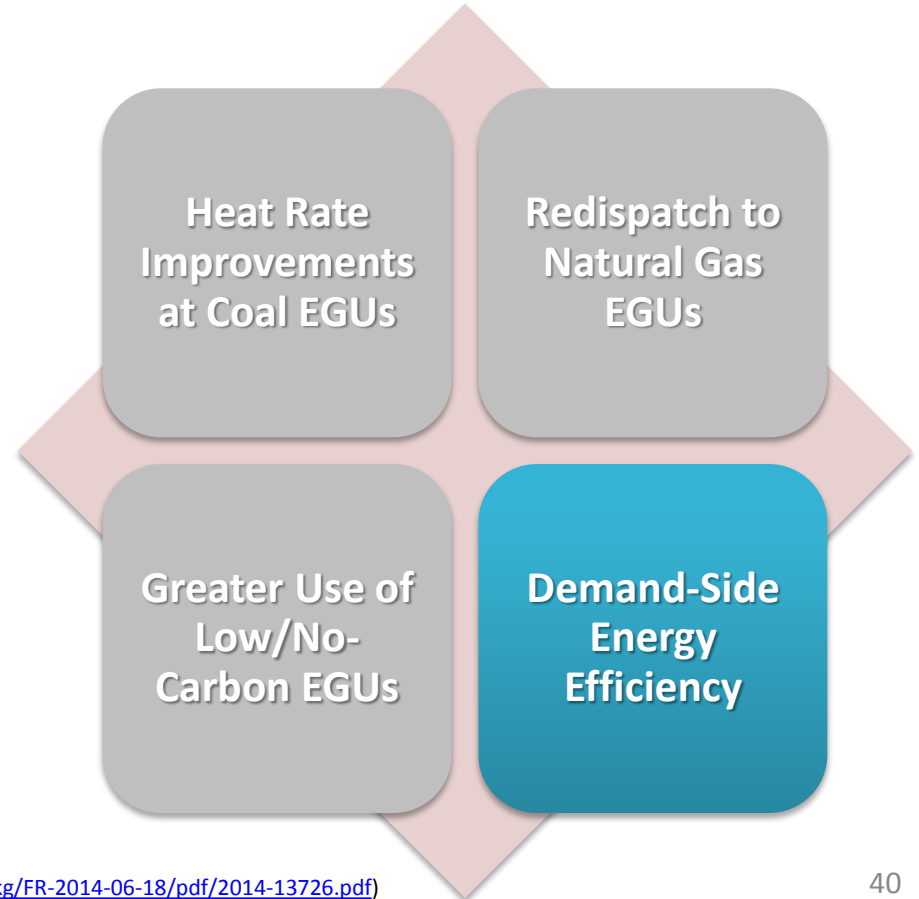
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VI. Building Blocks for Setting State Goals and the Best System of Emission Reduction

GHG NSPS EG for Existing EGUs

Building Blocks for Emission Goals

- Implement energy conservation measures to reduce demand
- “Best practices” scenario
- Cost of \$16-\$24/metric ton of CO₂



Source:

EPA | Clean Power Plan Proposed Rulemaking (79 FR 34830) (<http://www.gpo.gov/fdsys/pkg/FR-2014-06-18/pdf/2014-13726.pdf>)

VI. Building Blocks for Setting State Goals and the Best System of Emission Reduction

GHG NSPS EG for Existing EGUs

Building Blocks for Emission Goals

- Other building blocks considered
 - Partial CCS at existing coal EGUs
 - Natural gas co-firing or conversion at coal EGUs
 - New NGCC capacity
 - Heat rate improvements at oil-fired, gas-fired, NGCC, or simple-cycle EGUs
- Viable compliance options for states

Proposed Building Blocks

BSER Building Block	Nationwide		Nebraska	
Heat Rate Improvements to Existing Coal EGUs	6%			
Redispatch from Coal to Existing NGCC EGUs	70% NGCC Average Annual Capacity Factor			
Maintain and Increase Use of Low/No-Carbon EGUs	Preserve “At-Risk” Nuclear Capacity (5.8% of nuclear fleet)		Maintain at least 574,830 MWh of nuclear generation	
	13% Renewable Energy Use by 2030		Baseline (2012)	4%
			Interim Level (2020-2029)	8%
			Final Level (2030)	11%
Demand-Side Energy Efficiency (DSEE) Programs	2017 Savings	0.55%	0.29%	
	2020 Savings	3.04%	2.20%	
	2030 Savings	11.13%	10.95%	

Alternative Proposed Building Blocks

BSER Building Block	Nationwide		Nebraska	
Heat Rate Improvements to Existing Coal EGUs	4%			
Redispatch from Coal to Existing NGCC EGUs	65% NGCC Average Annual Capacity Factor			
Maintain and Increase Use of Low/No-Carbon EGUs	Preserve “At-Risk” Nuclear Capacity (5.8% of nuclear fleet)		Maintain at least 574,830 MWh of nuclear generation	
	9.4% Renewable Energy Use by 2025		Baseline (2012)	4%
			Interim Level (2020-2024)	6%
			Final Level (2025)	7%
Demand-Side Energy Efficiency (DSEE) Programs	2017 Savings	0.52%	0.29%	
	2020 Savings	2.43%	1.91%	
	2025 Savings	5.75%	5.51%	

CO2 Emission Reduction Goals

Rate-based Goals

$$\frac{\textit{lbs of CO}_2 \textit{ emitted}}{\textit{Megawatt hours (MWh) generated}}$$

- More flexible
- Greater certainty about EGU usage and dispatch mix
- Not subject to changes in electricity demand
- Prescribed by EPA

Mass-based Goals

$$\textit{tons of CO}_2 \textit{ emitted}$$

- More straightforward
- Greater certainty about absolute emission levels
- Requires forecasting of growth and demand
- State formulated, subject to EPA approval

Nebraska CO2 Emission Reduction Goals

Proposed Goals				
	2012 Baseline	Interim* (2020-2029)	Final (2030 and thereafter)	% Reduction
Rate-based (lbs CO2/MWh)	2,009	1,596	1,479	26.38
Mass-based (tons CO2)	27,185,051	21,596,487.1**	20,013,286**	

***Interim Goal targets represent overall annual averages for the entire performance period; Actual annual emissions may vary as long as the overall annual average is achieved.**

****Future Mass-based Goals were calculated based on Nebraska's 2012 electricity generation in MWh and are not official goals from the EPA.**

Sources:

EPA | Clean Power Plan Proposed Rule Technical Support Documents (<http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents>)

Nebraska CO2 Emission Reduction Goals

Alternative Proposed Goals				
	2012 Baseline	Interim* (2020-2024)	Final (2025 and thereafter)	% Reduction
Rate-based (lbs CO2/MWh)	2,009	1,721	1,671	16.82
Mass-based (tons CO2)	27,185,051	23,287,941.4**	22,611,360**	

***Interim Goal targets represent overall annual averages for the entire performance period; Actual annual emissions may vary as long as the overall annual average is achieved.**

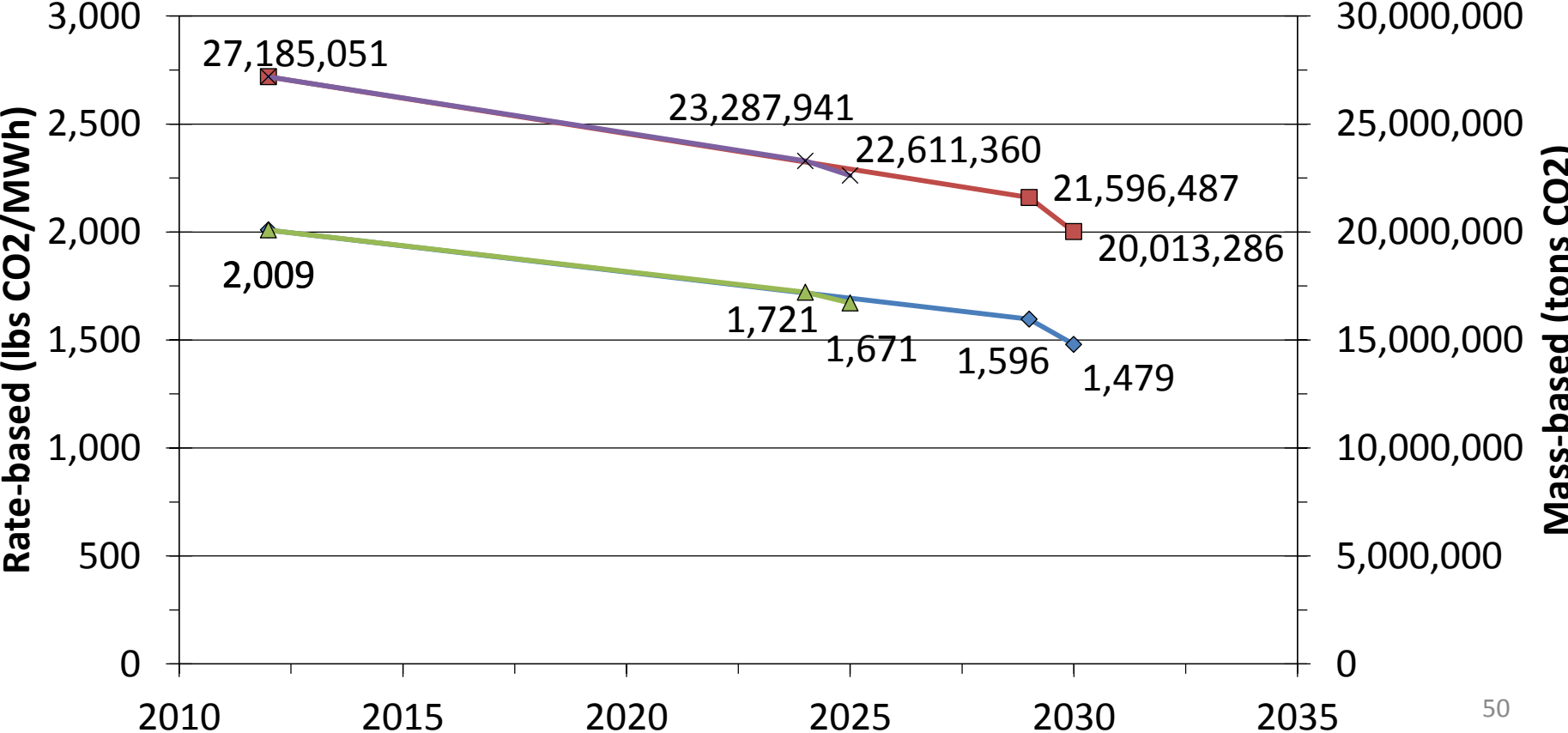
****Future Mass-based Goals were calculated based on Nebraska’s 2012 electricity generation in MWh and are not official goals from the EPA.**

Sources:

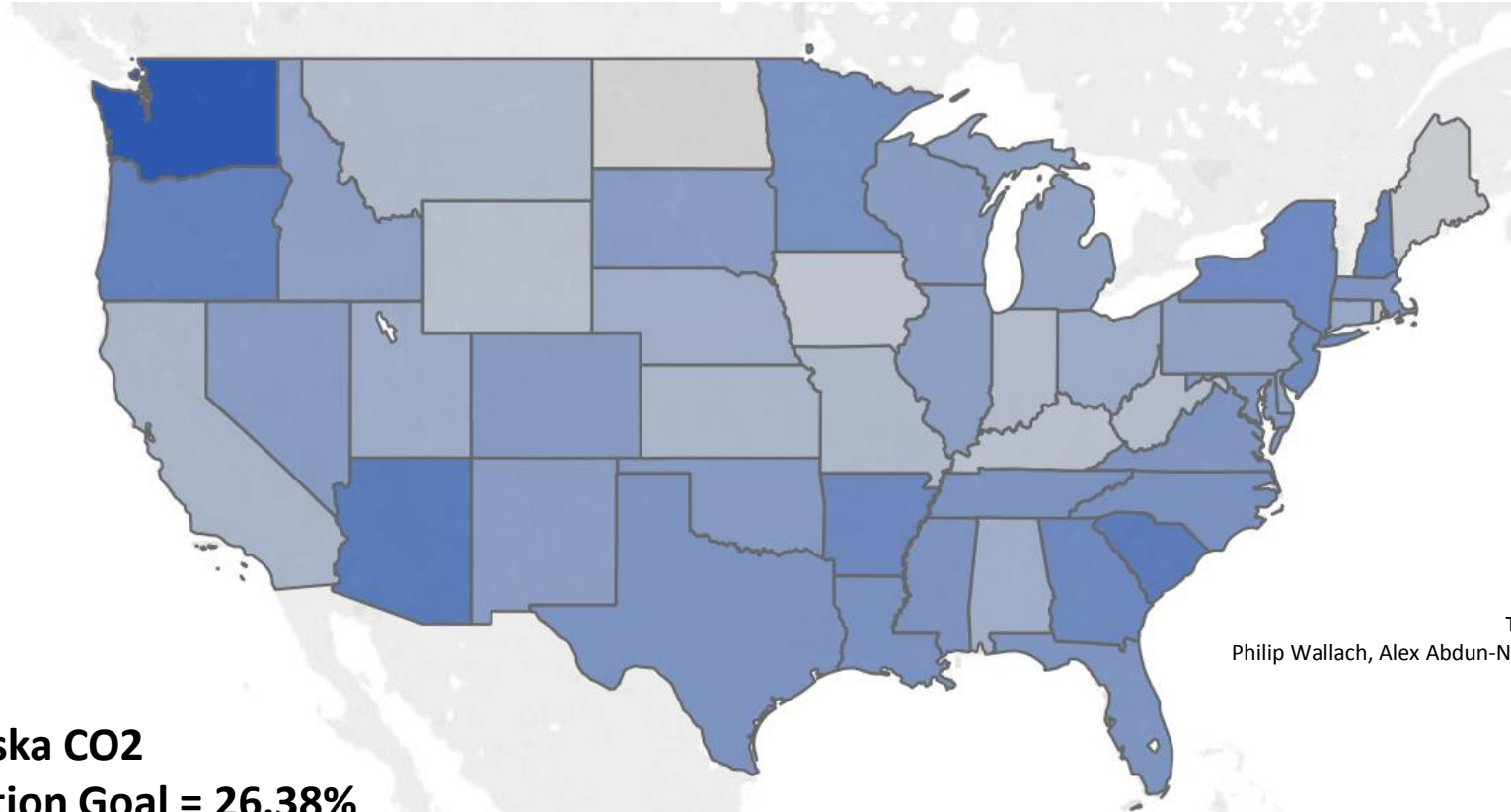
EPA | Clean Power Plan Proposed Rule Technical Support Documents (<http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents>)

Proposed and Alternative Proposed CO2 Emission Goals for Nebraska

- ◆ Proposed Goals - Rate-based
- ▲ Alt Proposed Goals - Rate-based
- Proposed Goals - Mass-based
- × Alt Proposed Goals - Mass-based



CO2 Reduction Goals Across the Nation



**Nebraska CO2
Reduction Goal = 26.38%**

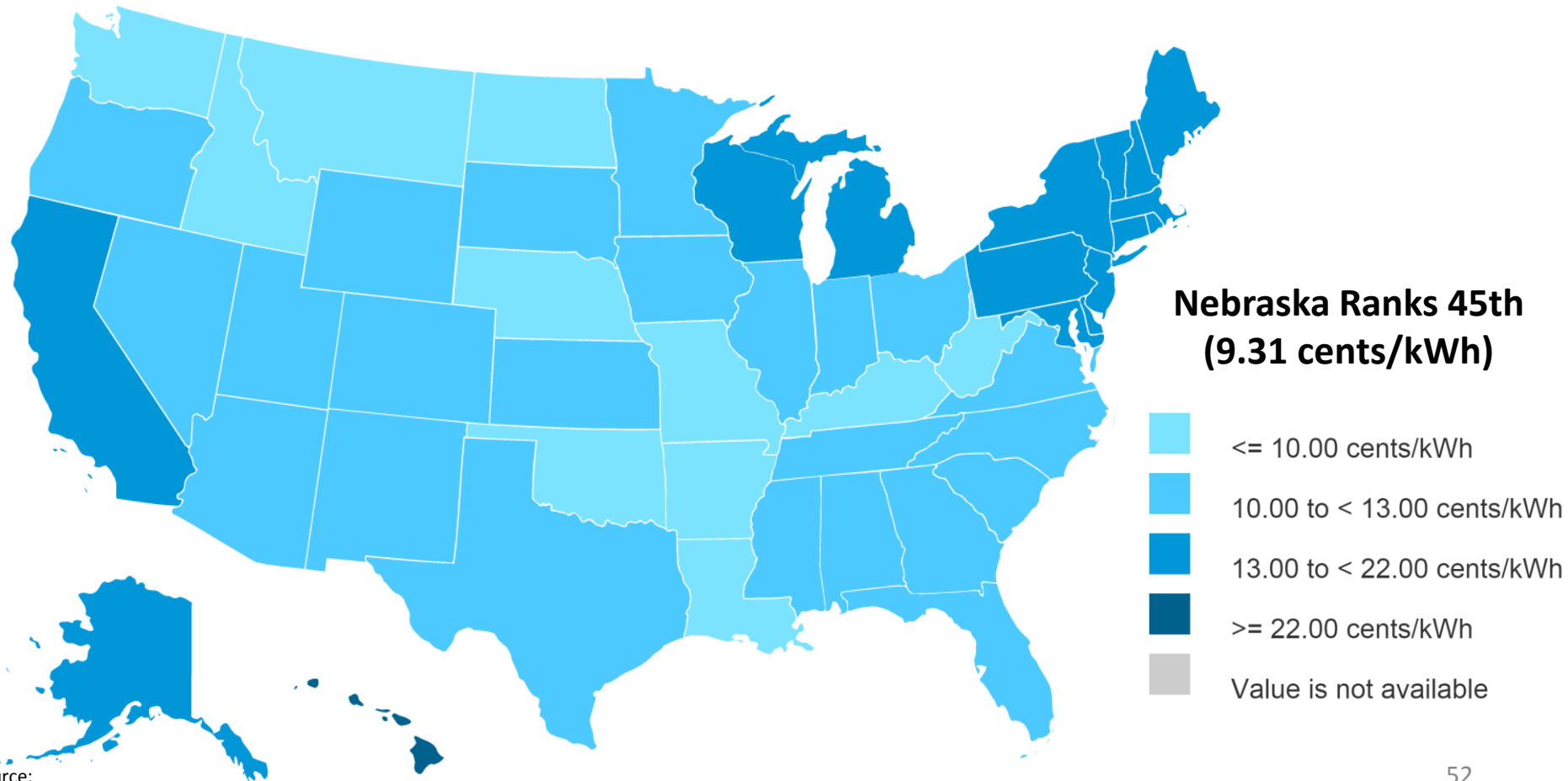
Total Percentage Reduction from 2012 to 2030



Graphic Credit:
The Washington Post
Philip Wallach, Alex Abdun-Nabi, & Grace Wallack

Data Source:
EPA | Clean Power Plan Proposed Rulemaking
Technical Support Document: Goal Computation – Appendix 1 and 2

Electricity Prices Across the Nation



Source:

EIA | State Profile and Energy Estimates – Average Retail Price of Electricity to Residential Sector, December 2014 (<http://www.eia.gov/state/rankings/?sid=NE#series/31>)

What Happens Next?



Sources:

EPA | Fact Sheet: Clean Power Plan & Carbon Pollution Standards Key Dates

<http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan-carbon-pollution-standards-key-dates>

Stay tuned...

