

REINHOLD ENVIRONMENTAL[®]



2024 Reinhold/PCUG Round Table Presentation

Hosted by LG&E/KU and Co-hosted by Southern Co. and TVA
in The Marriott Resort Lexington Griffin Gate Hotel, Lexington,
KY on June 24-25, 2024

All presentations posted on this website are copyrighted by **REINHOLD ENVIRONMENTAL[®]** (RE). Any unauthorized attempts to print, to download, to modify, to incorporate into other presentations, to link to other websites or to obtain copies for any other uses than the training of attendees to RE Conferences is expressly prohibited unless approved in writing by RE or the original presenter. RE does not assume any liability for the accuracy or contents of any materials in this library which were presented and/or created by persons who were not employees or subcontractors of RE.

Review of EPA Section 111 CO₂ Rules

Reinhold Round Table 2024

Sean Behm

Environmental & Chemistry Manager, Miami Fort Power Plant

Vistra



Overview

Types of fossil fuel-fired power plants covered by this final rule

- New, modified, and reconstructed sources – Covered under 111(b)
 - New and reconstructed gas-fired combustion turbines
 - Modified coal-fired steam generating units
- Existing sources – Covered under 111(d)
 - Coal-, oil-, and gas-fired steam generating units

Technology-based standards

- Consistent with EPA's traditional approach to establishing pollution standards under the Clean Air Act, the final limits and emission guidelines are based on proven control technology.
- Emission guidelines for the longest-running existing coal units and standards for heavily-utilized new gas units are based on carbon capture and sequestration/storage (CCS) – an available and cost-effective control technology that can be applied directly to power plants to significantly limit carbon dioxide (CO₂) emissions.

Reduces climate and other health-harming pollution

- The climate and health benefits of this rule significantly outweigh the compliance costs.
- Between 2024 and 2047, the regulatory impact analysis projects net climate and health benefits systemwide of \$370 billion, which is an annualized net benefit of \$20 billion.
- Expected to avoid up to 1.38 billion metric tons of CO₂ systemwide through 2047

Equivalent to 3.5 months of overall US CO₂ emissions

CCS Demonstrations

- 1) Petra Nova – Parish Generating Station, Thompsons, TX
 - Operational from 2017. 240 MW equivalent. Shut down May 2020 for economics. Restarted Sep 2023. CO₂ use: EOR
- 2) Project Tundra – Milton R. Young lignite-fired plant, North Dakota
 - 455 MW U2 plus 85 MW slipstream from 250 MW U1. Construction begins in 2024.
 - Funding requirement is “not that projects demonstrate CCS in general, but demonstrate improvements in efficiency, effectiveness, cost, operational and environmental performance of existing technologies”
- 3) Project Diamond Vault – Madison Unit 3 – Lena, LA
 - 600 MW CFB unit, firing 70% pet coke, 30% bit coal. Construction by end of 2025, with commercial operation starting in 2028
 - Government IRA through 45Q tax credits makes the project financially viable
- 4) Slipstreams: Argus cogen plant, AES Warrior Run (18 MW), AES Shady Point (16 MW), Southern Barry (25 MW)



Summary of Final Standards and Guidelines

- **New gas-fired combustion turbines:**
 - Base load turbines (>40% capacity factor): initial "phase one" standard based on efficient operation of combined cycle turbine; "phase two" standard based on 90% capture of CO₂ with a compliance deadline of Jan. 1, 2032
 - Intermediate turbines (between 20% and 40% capacity factor): standard based on efficient operation of simple cycle turbine
 - Low load turbine (less than 20% capacity factor): standard based on low-emitting fuel
- **Existing coal-fired steam EGUs:**
 - "Long-term" units (plan to operate on or after Jan. 1, 2039): standard based on 90% capture of CO₂ with a compliance deadline of Jan. 1, 2032
 - "Medium-term" units (plan to operate on or after Jan. 1, 2032, with a commitment to cease operation before Jan. 1, 2039): standard based on 40% co-firing with natural gas with a compliance deadline of Jan. 1, 2030
 - Units that commit to cease operation by Jan. 1, 2032 are not subject to the rule
- **Existing oil and natural gas-fired steam EGUs:**
 - Standards based on routine operation and maintenance, with different levels of stringency for base load, intermediate, and low load units

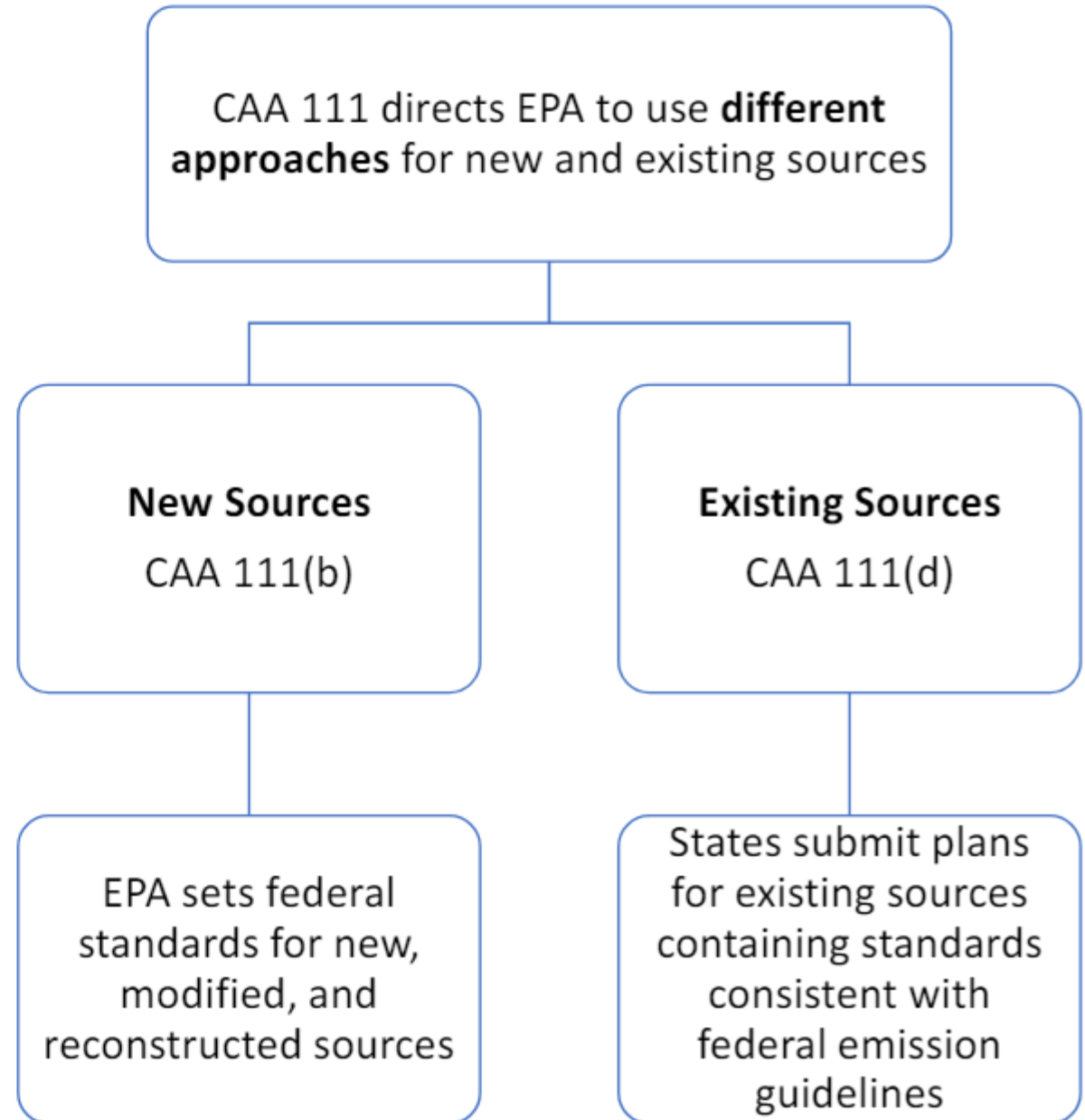


Key Changes Since Proposal

- Existing coal-fired steam generating units
 - Two subcategories for existing coal-fired steam generating units – instead of four as proposed
 - “Long-term” units – plan to operate on or after Jan. 1, 2039
 - “Medium-term” units – plan to operate on or after Jan. 1, 2032 and permanently cease operation before Jan. 1, 2039
 - Providing an applicability exemption for units that plan to permanently cease operation by January 1, 2032
 - Extending the compliance date from January 1, 2030, to January 1, 2032, for existing coal-fired steam generating units to meet a standard of performance based on implementation of 90% CCS
- New combustion turbines
 - Have expanded applicability of most stringent “base load” standard to units operating above 40% capacity factor
 - Have moved compliance deadline for CCS-based standard for base load units to 2032 (was 2035 at proposal)
 - Have removed low-GHG hydrogen co-firing as a BSER pathway for base load and intermediate units
 - Minor changes to “phase one” efficiency-based standards for base load and intermediate units
- Adjustments for reliability
 - Revised subcategories, longer compliance timeframe for CCS installation, a suite of compliance options
 - Addition of two reliability-related instruments as an additional layer of safeguard to support power companies, grid operators, and states in maintaining the reliability of the electric grid during the implementation of these final rules.
- EPA is not finalizing proposed requirements for existing fossil fuel-fired stationary combustion turbines.



Clean Air Act Section 111





Final Standards for New Stationary Combustion Turbines

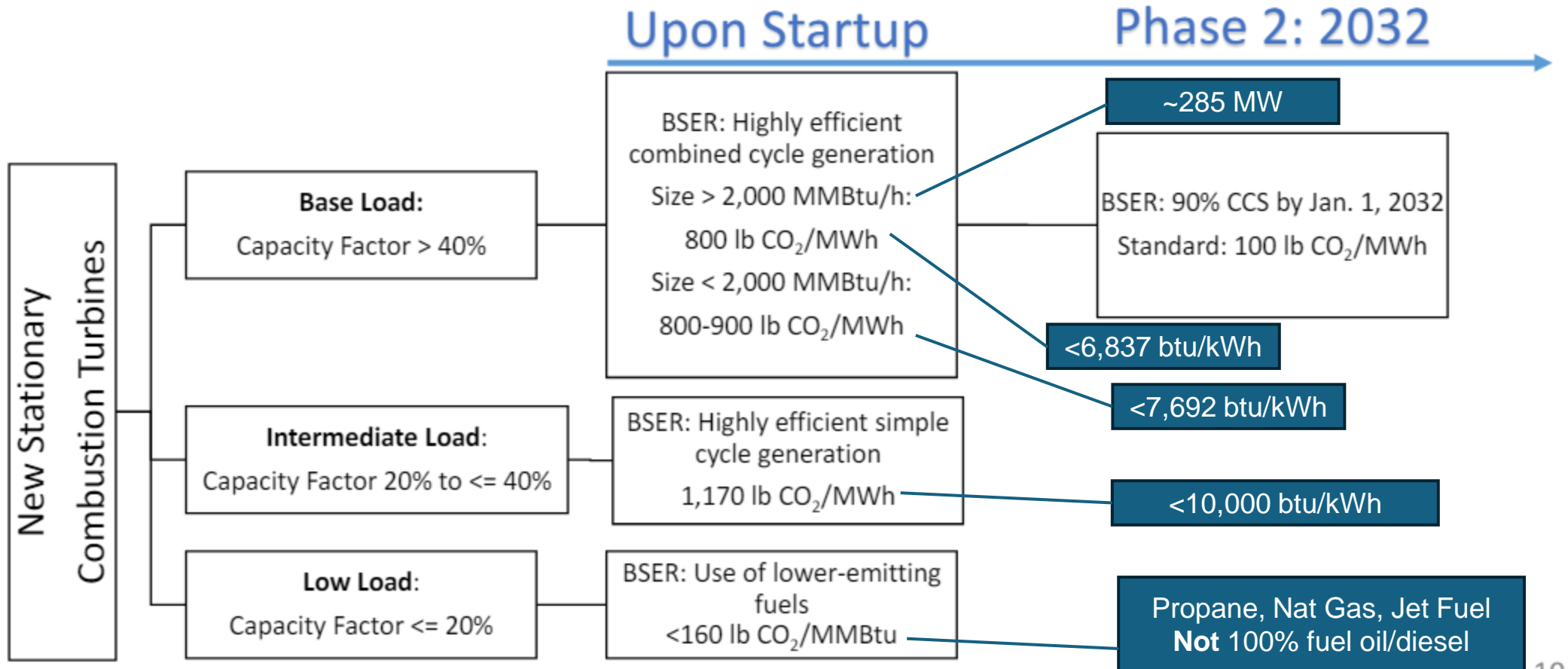
- Clean Air Act Section 111(b)
- For source categories that cause or contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare, CAA section 111 requires EPA to establish standards of performance for new sources
- Standards must be set based on what is achievable through the application of the best system of emission reduction (BSER)
 - Cost (must not be “exorbitant,” “greater than the industry can bear,” or “unreasonable”)
 - Non-air quality health and environmental impacts
 - Energy requirements
 - Control measures that have been adequately demonstrated



Final Standards for New Stationary Combustion Turbines

- Standards effective from date of proposal publication (May 23, 2023)
- Three subcategories: base load, intermediate load, low load
- Standards are technology neutral, affected sources may comply with it by co-firing hydrogen

$$\text{Heat Rate (btu/kWh)} * 0.117 = \text{CO}_2 \text{ lb/MWh} - \text{Gas Units}$$



Implications of New CT Rule

- Fuel oil only CT installs not permitted
 - Must be dual fuel or lower emitting fuel, and < 20 % capacity factor
- Simple cycle CTs must operate < 40% capacity factor
 - If additional use is expected, could install multiple turbines and operate intermittently in off-peak season. Could dispatch comparably to other resource-limited units [risk adders based on remaining hours available]
 - Only 4.3% of SC CTs met the <10k heat rate limit in 2023 (8/186)
- If CCS (or equivalent... green H₂, etc) is not feasible beyond 2032, could operate combined cycle units intermittently (<40% capacity factor)
 - Potentially operate at full capacity during peak season, alternate operation in shoulder months or cycle units on weekends, etc.



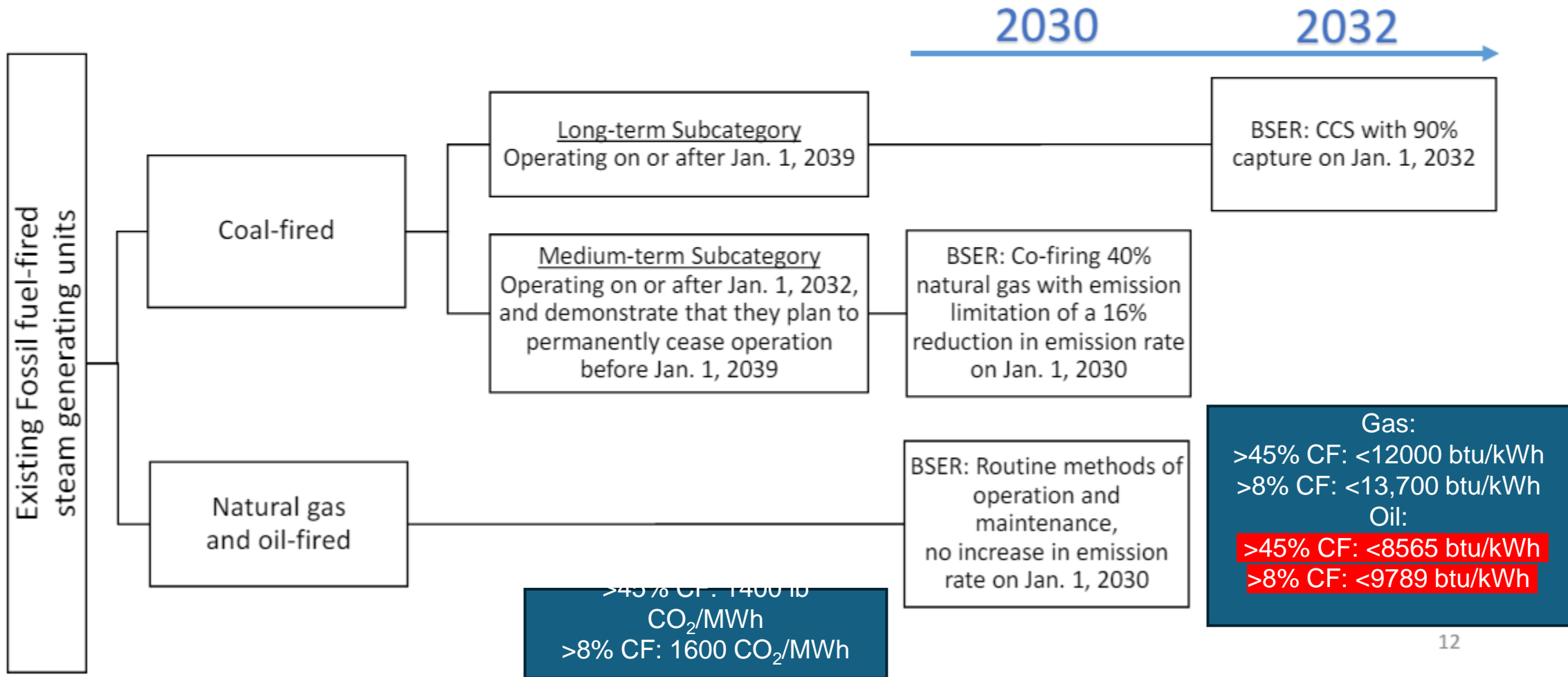
Final Emission Guidelines for Existing Fossil Fuel-Fired Sources

- Clean Air Act Section 111(d)
- Required in certain circumstances once EPA issues New Source Performance Standards for new, modified and reconstructed sources.
- Do not impose requirements directly on sources.
- Inform states as they develop, submit and implement required plans that set standards for existing sources.
- Emission standards must be set based on what is achievable through the application of the best system of emission reduction (BSER)



Final Emission Guidelines for Existing Steam Generating Units

- Two subcategories for existing coal-fired units, depending on operating horizon: (1) Units operating on or after Jan. 1, 2039 and (2) Units that are operating on or after Jan. 1, 2032, and demonstrate they plan to permanently cease operation before Jan. 1, 2039
- Units that demonstrate they plan to permanently cease operations before Jan. 1, 2032 are not subject to these standards





State Plans for FINAL Emission Guidelines

State Plan Submission Deadline

- Submission within 24 months after publication of the final emissions guidelines

State Plan Components

- Requirements specific to these emission guidelines to ensure transparency, including a website hosted by EGU owners/operators to publish documentation and information related to compliance with the state plan

Compliance Deadlines

- January 1, 2030, or January 1, 2032, depending on subcategory
- Compliance must be demonstrated annually
- States may include a mechanism in their plans to extend the compliance date by up to one year for affected EGUs installing a control technology that experience and subsequently provide documentation of a delay entirely outside of the owner/operator's control (e.g., permitting- or construction-related) that makes it impossible to commence compliance by the compliance deadline

Meaningful Engagement

- General implementing regulations (Subpart Ba) apply, and require states to describe their meaningful engagement with pertinent stakeholders, including communities that are most affected by and vulnerable to emissions from these EGUs, and reliability authorities
- Helps ensure that the priorities, concerns and perspectives of these communities are heard during the planning process



State Plans for Final Emission Guidelines

Presumptive Standards of Performance

- For each subcategory, EPA has determined a BSER and degree of emission limitation and is providing a corresponding methodology for establishing presumptively approvable standards of performance
- Expressed as rate-based emission limitations (i.e., limitations on the amount of a regulated pollutant that can be emitted per unit of output, per unit of energy or material input, or per unit of time)

Remaining Useful Life and Other Factors (RULOF)

- As provided in subpart Ba, under certain circumstances, states may apply a less stringent standard to a particular source based on that source's remaining useful life and other factors
- RULOF is intended as a limited variance from the EPA's determinations to address unusual circumstances at particular facilities

Increments of Progress (IoPs) and Reporting Obligations

- Will serve as clear, transparent, and enforceable implementation checkpoints between state plan submittal and the compliance dates. Similarly, reporting obligations for affected EGUs that have demonstrated they plan to permanently cease operating provide transparency to stakeholders
- States may generally choose the calendar dates for their IoPs

RULOF – Remaining Useful Life and Other Factors

- 40 CFR § 60.24a
- A state may apply a standard of performance that is less stringent than (or has a longer compliance schedule) than otherwise required based on:
 - Unreasonable cost of control resulting from plant age, location, or basic process setup
 - Physical impossibility or technical infeasibility of installing necessary control equipment; or
 - Other circumstances specific to a facility
- Must demonstrate why this EGU is different than the BSER



State Plans for Final Emission Guidelines

Compliance Flexibilities

- States may incorporate compliance flexibilities, such as emission averaging, trading, and unit-specific mass-based compliance, into their state plans, subject to parameters laid out by EPA in the emission guidelines, including:
 - For mass-based compliance flexibilities, EPA is requiring the use of a backstop emission limitation applied to individual sources
 - EPA is providing a presumptively approvable methodology for unit-specific mass-based compliance for affected EGUs in the long-term coal-fired subcategory
- If a state chooses to incorporate compliance flexibilities into their state plans, the state must demonstrate that the plan achieves a level of emission reduction equivalent to each source individually achieving their rate-based standard of performance, and the state must document and justify any assumptions underlying the calculation of the aggregate standard of performance or mass limit/budget
- EPA believes that the use of compliance flexibilities, within the parameters specified in the emission guidelines, can create an incentive for overperformance and may also provide some additional operational flexibility to states and affected EGUs in achieving the required level of emission reduction

Implications of 111(d)Rule – Coal Units

- Coal units must:
 - retire by 2023
 - convert fully to gas (by 2030)
 - convert to dual fuel (by 2030, through 2039)
 - implement CCS by 2032 to stay online long term
 - Per IRA, CCS to geologic formations - \$85/metric ton
 - Typical coal unit (~9700 btu/kWh, bit coal) produces 1 ton CO₂ / MWh
 - 90% carbon capture in a 500 MWh (full load ATC) worth \$918k/day
- EPA mentions the IRA is what makes CCS economically viable

Implications of 111(d) Rule– Gas & Oil Units

- Gas and fuel oil units must:
 - Meet capacity factor requirements based on heat rate (potentially less than 45% or 8%)
 - In 2023, 52% (85/163) of gas ST units would meet the >45% CF limit
 - Another 21% (34/163) would meet the >8% limit. The other 27% would be limited to < 8% CF (44/163)
 - Rules are much more stringent for oil units since fuel oil produces significantly more CO₂ per BTU (more C, less H in fuel)
 - In 2023, 0 oil ST units would meet the >45% CF limit
 - Another 1% (1/161) would meet the >8% limit. The other 99% would be limited to < 8% CF (160/161). Only DTE Monroe met the limit (on fuel oil)
 - No real means of operating >8% capacity factor on a fuel oil unit?



Support for Reliability

EPA developed a four-point plan to address reliability throughout the implementation period.

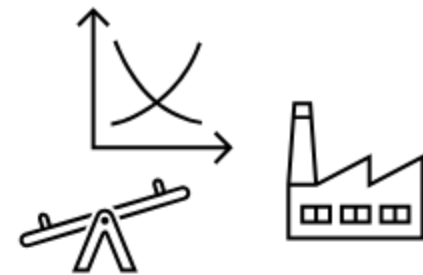
- 1) **Rule Structure**. EPA adjusted the compliance timeframe by 2 additional years for coal-fired units, to provide more time to install CCS, and streamlined the subcategories. The EPA is not regulating existing natural gas fired turbines at this time, which creates more time for a comprehensive approach, including for reliability.
- 2) **RULOF Provisions**. EPA articulated how states can use the Remaining Useful Life and Other Factors (RULOF) provisions to address reliability in state plans, as well as in state plan revisions, should circumstances change.
- 3) **Compliance Flexibilities**. Several important flexibilities are included: a flexible annual average compliance period, emissions trading/averaging, and mass-based compliance equivalency are allowed in circumstances that uphold the environmental integrity of the rule, and a 1-year compliance extension is available for new and existing units for implementation delays outside of the control the owner/operator.
- 4) **Reliability Mechanisms**. The final rule adds two optional reliability-related instruments as an additional layer of safeguards. A short-term mechanism to provide flexibility for units responding to grid emergencies and a reliability assurance mechanism for units with retirement dates with a documented and verified reliability need.

EPA completed analyses of the reliability and resource adequacy implications of these final rules, including high growth and combined regulation sensitivity analyses, that show these final rules can be implemented without adverse consequences for grid reliability. EPA will continue to engage extensively with all reliability related authorities.



Two Additional, Optional Mechanisms to Support Reliability

EPA's approach to supporting reliability is multifaceted, as it has always been. We listened to stakeholders and included adjustments to key provisions that will support planning and reliability -- like subcategories and time to meet the standards. We also added two reliability-related mechanisms that are voluntary for states to include in state plans for existing sources.



Short Term Mechanism		Reliability Assurance Mechanism
New or existing units during certain specified grid emergencies, like extreme weather events which can include hurricanes, wildfires, and winter storms.	Who	Existing units with cease operations dates.
Units responding to emergencies have access to greater compliance flexibility for those time periods.	What	Extensions can be granted extensions where there is a documented reliability need but is insufficient time for a state plan revision.
Short-lasting, mostly occurring over a few hours and in some rare instances can last for a few days.	When	Units have access to up to a 1-year extension – but no longer than what is substantiated through documentation.
A unit must submit documentation, for annual compliance purposes, demonstrating the hours in which it operated out of schedule due to a qualified grid emergency.	How	A unit must substantiate that is needed to maintain reliability and have fulfilled all reporting requirements.
Grid emergencies that qualify for flexibility under this mechanism are energy emergency alerts (EEA) as defined by the North American Reliability Corporation. EEA levels 2 and 3 qualify for flexibility under this mechanism	More Details	Extensions exceeding 1 year in duration must be addressed through a state plan revision. EPA will seek the advice of Federal Energy Regulatory Commission (FERC) for extensions longer than 6 months.

Resource Adequacy

“Resource Adequacy Analysis: Vehicle Rules, Final 111 EGU Rules, ELG and MATS RTR Technical Memo” – April 2024

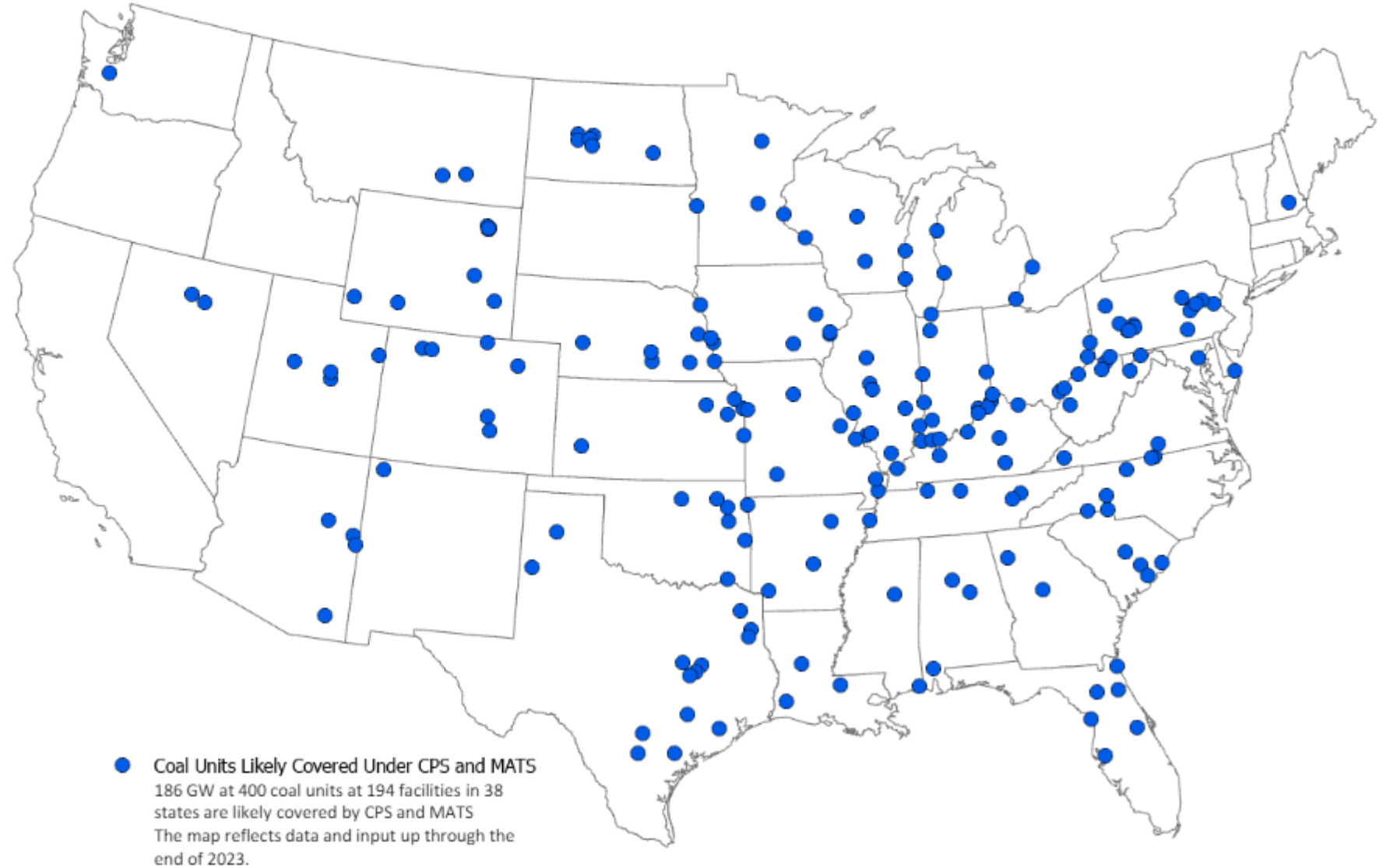
Table 1. Operational Capacity Summary (2028, 2030, 2035, 2040, 2045)

Capacity (GW)	2028	2030	2035	2040	2045
Base Case Operational Capacity	1,378	1,431	1,737	2,139	2,570
Minus Cumulative Incremental Policy Case Retirements					
Coal	-9	-11	-24	-16	-21
Oil/Gas	2	1	5	5	5
Natural Gas Combined Cycle (NGCC)	0	0	0	0	0
Natural Gas Combustion Turbines (NGCT)	0	0	0	0	0
Nuclear	0	0	0	0	0
Minus Cumulative Incremental Policy Case Derates					
Coal	0	0	-4	-4	-4
Plus Cumulative Incremental Policy Case Additions					
NGCC	0	-1	-1	-3	-3
NGCT	1	4	12	14	22
Wind	15	16	16	7	10
Solar	2	5	5	7	11
Storage	0	-1	8	2	1
Other	0	1	1	0	0
Policy Case Operational Capacity	1,390	1,446	1,760	2,156	2,595



Potentially Covered Coal-Fired Units: 2023

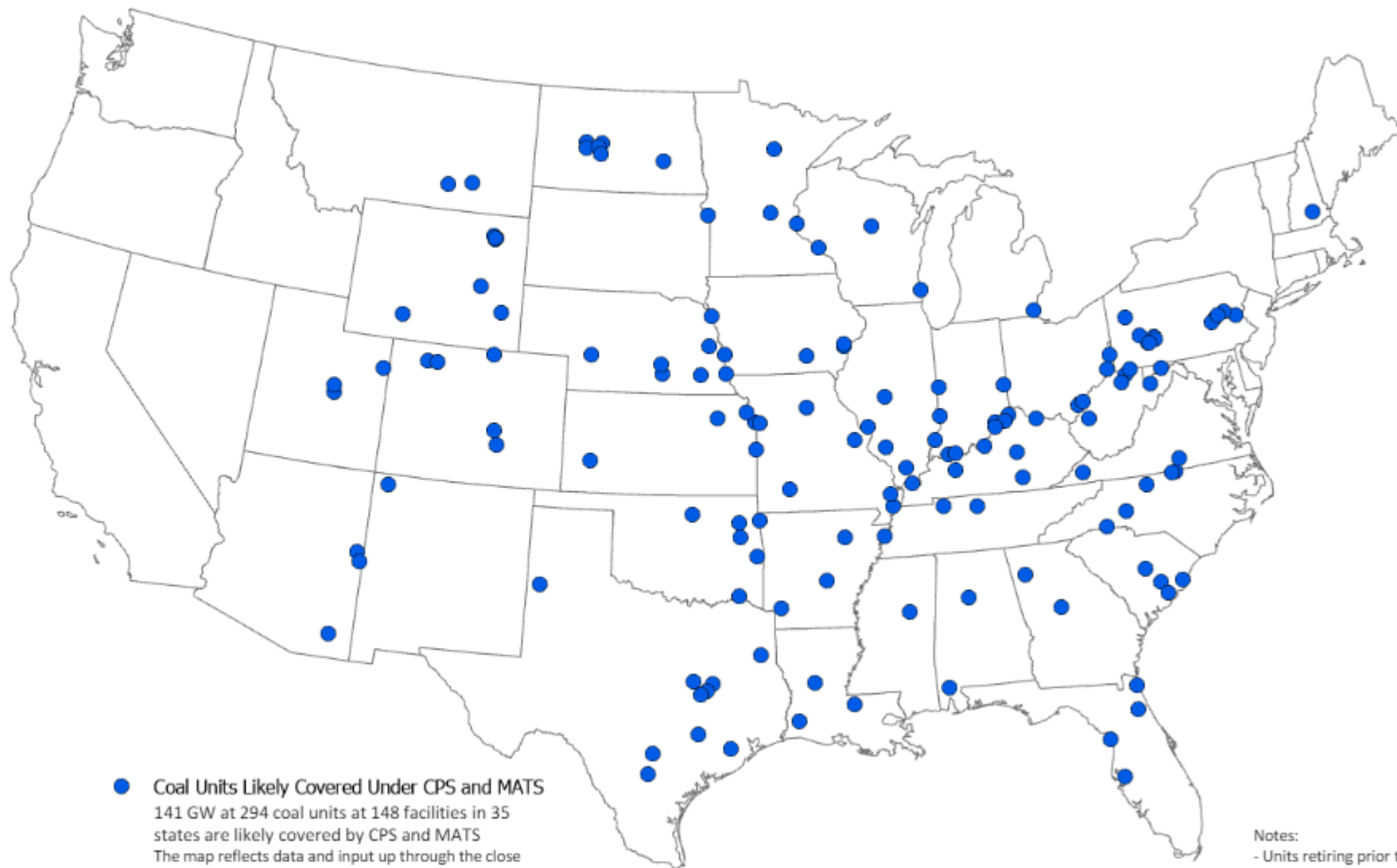
- Today, about 186 GW of coal-fired power plants are operating nationwide, this is 38% less than 10 years ago.
- Many of these have announced plans to retire or convert to natural gas (see following maps)





Potentially Covered Coal-Fired Units: 2029

- This map shows units for which EPA is not aware of plans to retire or switch to natural gas by 2029.
- Over the next 5 years, EPA is aware of 45 GW that have announced plans to retire or convert to natural gas, leaving a coal-fired fleet of 141 GW.
- These plans to retire or change fuel are among the many factors states and power plant owners can consider as they make decisions about CPS subcategories and/or controls for these units.
- The units on this map may be likely to be in the medium-term or long-term CPS subcategories.



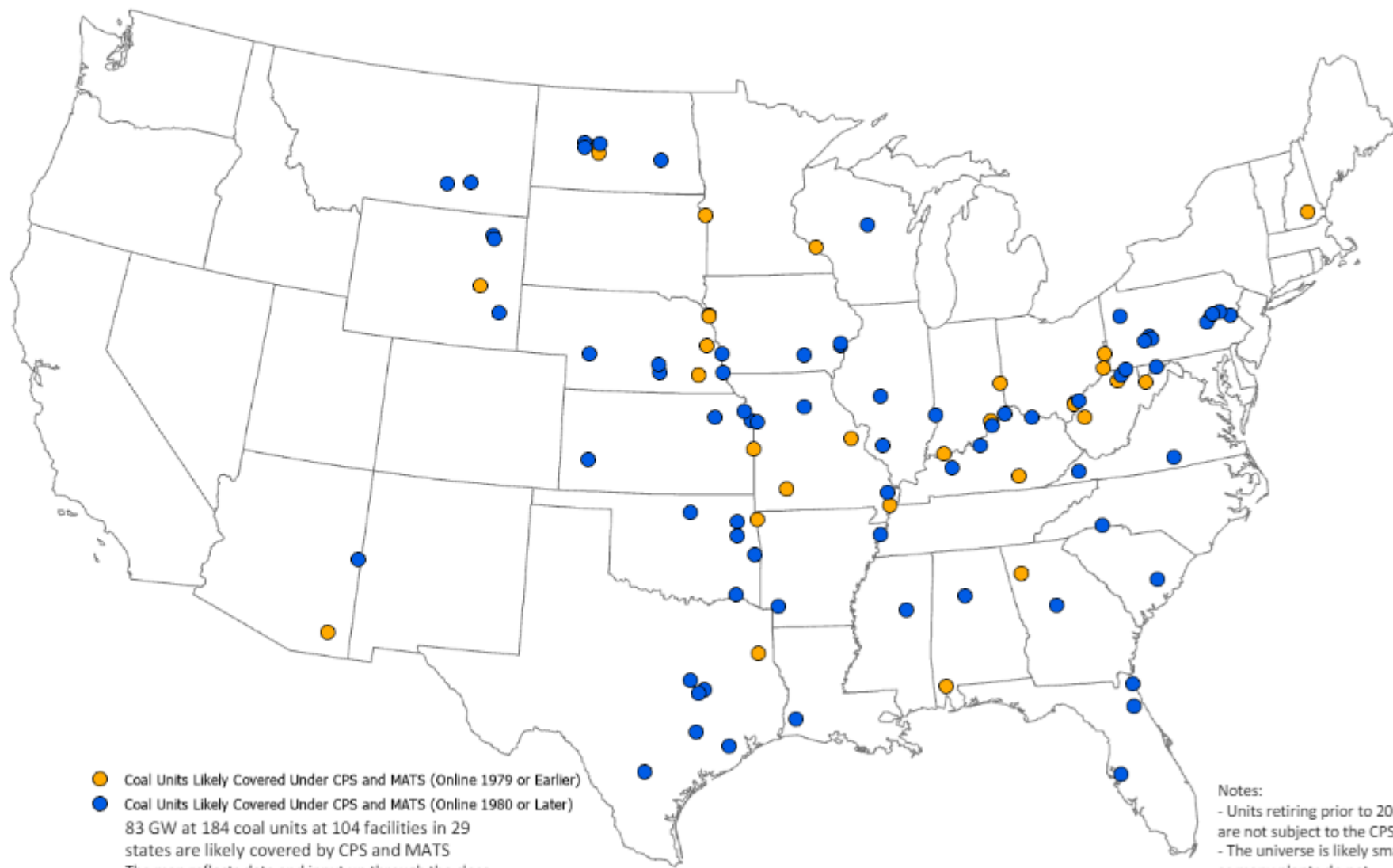
● Coal Units Likely Covered Under CPS and MATS
141 GW at 294 coal units at 148 facilities in 35 states are likely covered by CPS and MATS
The map reflects data and input up through the close of comment period (August 8, 2023), but may not reflect more recent announcements.

Notes:
- Units retiring prior to 2032 are not subject to the CPS rule
- The universe is likely smaller, as many plants do not announce retirement plans this far in advance



Potentially Covered Coal-Fired Units: 2039

- This map shows units for which EPA is not aware of plans to retire or switch to natural gas by 2039.
- Over the next 15 years, EPA is aware of 103 GW that have announced plans to retire or convert to natural gas, leaving a coal-fired fleet of 83 GW.
- Of the remaining coal-fired fleet, 36 GW will be over 60 years old by 2039.
- The units on this map may be even more likely to be in the medium-term or long-term CPS subcategories.



● Coal Units Likely Covered Under CPS and MATS (Online 1979 or Earlier)
● Coal Units Likely Covered Under CPS and MATS (Online 1980 or Later)
83 GW at 184 coal units at 104 facilities in 29 states are likely covered by CPS and MATS
The map reflects data and input up through the close of comment period (August 8, 2023) but may not reflect more recent announcements.

Notes:
- Units retiring prior to 2032 are not subject to the CPS rule
- The universe is likely smaller, as many plants do not announce retirement plans this far in advance

Questions?