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Standards of Performance for Existing Electric Utility Generating Units Under Clean Air Act (CAA) Section 111(d)

1. Recap of CAA Section 111(d)
2. Summary of U.S. Environmental Protection Agency's (EPA) Clean Power Plan Requirements (CPP)
3. DEQ's 111(d) Plan Approach
4. Overview of Proposed 15A NCAC 02D .2700 Rules



Recap of CAA Section 111(d)

- State-based program for existing sources.
- There are 3 main steps:
 - 1) EPA establishes guidelines that identify the **best system of emission reduction (BSER)** for the covered pollutant.
The BSER must be adequately demonstrated, considering cost, energy needs, and secondary environmental impacts.
 - 2) States design “plans” that establish a **standard of performance** and provides for implementation and enforcement.
 - 3) State submits the “plan” to the EPA for approval.



Recap of CAA Section 111(d)

What does the Statute Say?

- Section 111(d)(1)
 - States submit a plan which:
 - Establishes **standard of performance** for existing sources
 - Provides for implementation and enforcement of such standards
 - Statute and regulations allow States to consider factors, such as:
 - Remaining useful life of the existing source to which such standard applies
 - EPA has the authority to prescribe a plan if the State fails to submit a satisfactory plan and to enforce the provisions of a plan in cases where the state fails to enforce them.
- Definition of **standard of performance**, CAA Section 111(a)(1)

*“a standard for emissions of air pollutants which reflects the degree of **emission limitation** achievable through the application of the **best system of emission reduction** which (taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.”*
- North Carolina §111(d) Principles document, January 2014, pgs. 10-11
 - **Standard of performance** applied on a unit specific basis; prohibits “outside the fence” approaches to establishing emission guidelines



Recap of CAA Section 111(d)

How has EPA developed emission guidelines historically?

- CAA 111(d) and implementing regulations at 40 CFR Part 60, Subpart B
 - 40 years of regulatory actions, 4 pollutants, 5 source categories
- General principles followed to determine BSER
 - Degree of emission reduction achievable based on a demonstrated control technology
 - Technical feasibility (considering age, size, type, class, facility design)
 - Impact of demonstrated control technology on energy consumption, water pollution, waste disposal, and ambient air concentrations
 - Cost of applying control technology
- **Most importantly**
 - Each emission guideline established for emission points located within the facility, not any emission sources located outside of the facility.

EPA's Clean Power Plan

- Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule (80 CFR 64661-65120)
 - Signed August 3, 2015
 - Published October 23, 2015
 - Effective December 22, 2015
 - Codified in 40 CFR Part 60, Subpart UUUU
 - <http://www2.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants>
- Requires States to submit plans which reduce carbon dioxide (CO₂) rates or mass emissions from affected electric generating units (EGUs) by 2030 relative to 2012 levels
- Contains EPA's guidelines for state plans based on the application of BSER

Affected EGUs in North Carolina



Note: DEQ has determined that Elizabethtown and Lumberton Power should be excluded because they do not satisfy the applicability criteria under 40 CFR 60.5845 and 60.5850(a)(3), respectively.

North Carolina's 2016 Plan Submittal: Overall Approach

- Develop a State Plan consistent with §111(d) and 40 CFR 60, Subpart B
 - Determine BSER on a unit specific basis, within the fence line of the facility (BB1 type)
 - CO2 reductions achieved through heat rate improvement (HRI) at each EGU
- BSER determined for 3 groups of affected EGUs

Affected EGUs	DEQ's BSER Determination	Explanation
NGCC	BSER is efficient operation and maintenance of combustion turbine and heat recovery steam generator using natural gas as fuel during normal operations.	In the CPP, EPA found that the available emission reductions would likely be more expensive or too small to merit consideration as a material component of the BSER.
Coal-fired units with announced retirement and/or conversion to natural gas	BSER for Asheville Units 1 & 2 is no additional control based on remaining useful life.	NC Session Law 2015-110 requires Asheville Units 1 & 2 to retire by Jan. 31, 2020 and be replaced with new NGCC units.
All other coal-fired units	Source specific determination	See next slides

North Carolina's 2016 Plan Submittal: Basis for Coal-Fired EGU BSEER Determination

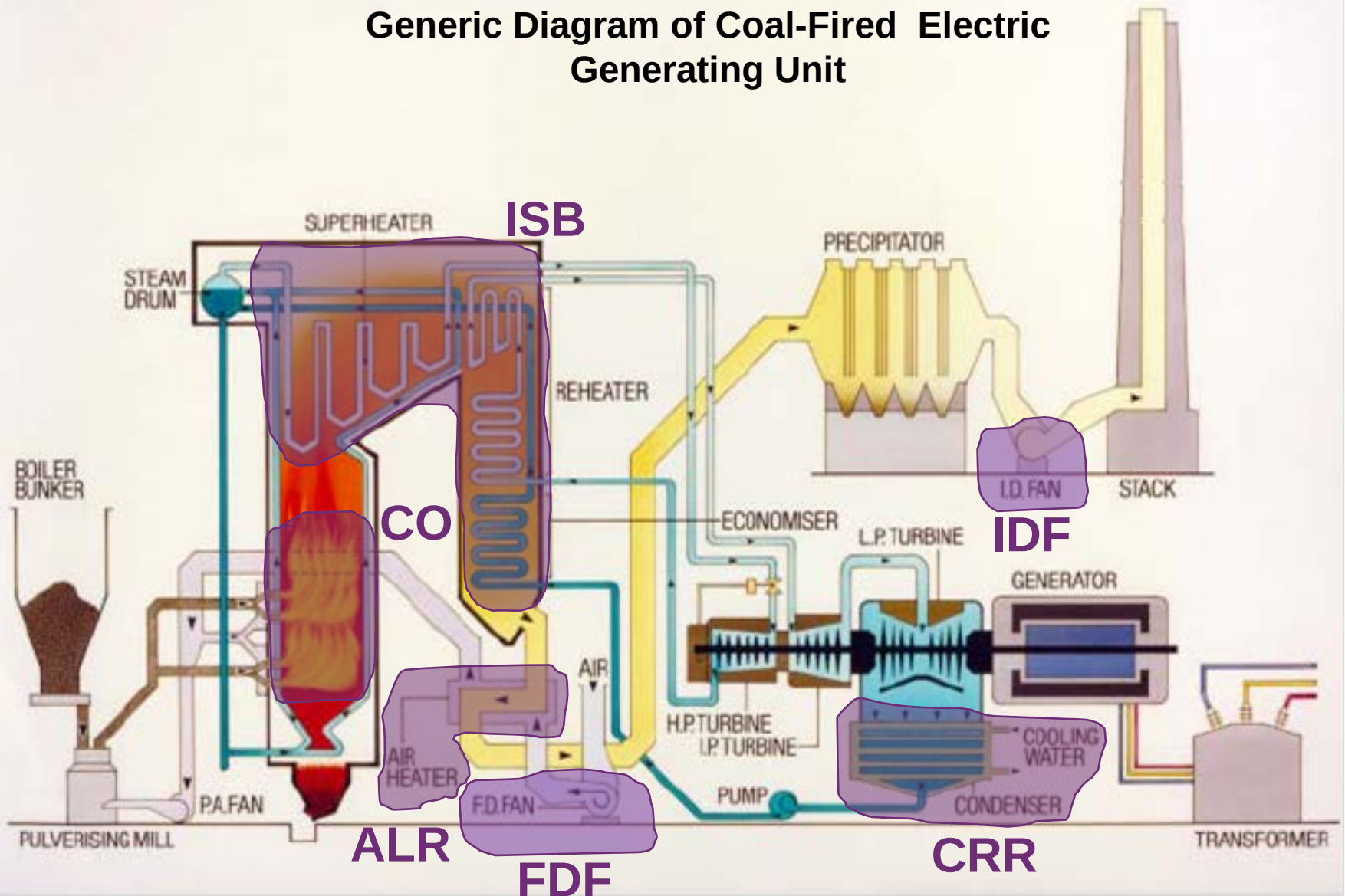
	Guiding Principles	Decision Criteria
1	Adequately demonstrated	What technology and/or work practices are currently available to improve heat rate in order to reduce CO2 emissions?
2	Ambient air concentrations	Does the technology and/or work practices result in increases in non-GHG pollutants (e.g., SO ₂ , NO _x , and mercury)?
3	Technical feasibility	Based on age, size, type, class, and design, can the technology and/or work practices be implemented at the EGU?
4	Non-air quality health and environmental impact and energy consumption	Does the technology and/or work practices reduce water usage, solid waste production, etc.? Is there an adverse impact on energy consumption associated with the implementation?
5	Application of DAQ engineering judgement and sound science	Recognize that: • HRI will degrade with time due to normal wear and tear; • HRI can vary greatly at part load operations; • HRI for a combination of measures will be less than the sum of individual measures
6	Cost	Is the average annual cost factor across project life $\leq$ 23 \$/ton CO2 as determined by EPA to be reasonable?
7	Emission reduction	What is the average expected heat rate improvement and CO2 reductions across project life considering forecasted operating capacity factor and degradation factor?

Potential BSER Measures

Potential Measure	Abbreviation
Controllable Loss Reduction (Maintain Unit Efficiency)	CLR
Intelligent Sootblowers	ISB
Air Heater Leakage Reduction	ALR
Combustion Optimization - CCM / Excess Air / Neural Network	CO
Online Condenser Cleaning	OCC
Induced and/or Booster Draft Fan Variable Frequency Drive	IBD
Air Heater Exit Gas Temperature Reduction	AHE
Boiler Feed Pump Motor Driven Variable Frequency Drive	BFP
Induced Draft Fan Replacement	IDF
Forced Draft Fan Variable Frequency Drive	FDF
Condenser Rebundle, Retubes, and Rebuilds	CRR
Turbine Upgrades (HI, IP, LP)	TUR
Helper Cooling Tower	HCT
Sliding Pressure Operation	SPO
Lower FGD Efficiency (as SO ₂ permit limits allow)	LFGD
Flue Gas Desulfurization (FGD) Auxiliary Load Reduction through Variable Frequency Drives	FGDA
Electrostatic Precipitator (ESP) (Power management, T/R set upgrades)	ESP



Generic Diagram of Coal-Fired Electric Generating Unit





Description of Proposed BSER Measures for Certain NC Coal-Fired EGUs

1) Air heater leakage reduction (ALR)

- Air heaters increase the temperature of pre-combustion air to improve combustion efficiency
- Typically designed as a rotating plate heat exchanger using hot exhaust gas – complex high temp system
- Measure Replaces old seals with high performance seals to reduce leakage between combustion air/exhaust gas and improve heat transfer

2) Combustion optimization with neural network (CO)

- Refers to adjusting combustion process to maximize combustion efficiency and minimize emissions of air pollutants as boiler operating conditions change
- Measure employs an automated control system to adjust parameters based on a mathematical model called a neural network that utilizes both real-time and historical unit operating data
- Allows predictive control of process to improve combustion efficiency

3) Condenser rebundle, retube, rebuild (CRR)

- Condensers cool steam back into a liquid so it can be recycled to the boiler and improve thermal efficiency
- Measure repairs/replaces components to improve heat transfer and fluid flow in the condenser



Description of BSER Measures

4) Controllable loss reduction (CLR)

- Measure consists of implementing a site-specific plan to collect data, evaluate performance, and take any required actions to improve boiler performance and heat rate
- Focuses on equipment/parameters not being tracked by existing data collection system
- Requires informing staff on the value and practice of collecting/reporting information on equipment performance and taking action

5) Forced/Induced draft fan variable frequency drive (FDF and IDF)

- Forced draft and Induced draft fans move combustion air and exhaust gas, respectively, through the boiler system
- Measure replaces fixed speed fans with variable frequency drive fans which can increase/decrease the fan speed in response to varying boiler operating conditions
- Allows for reduced fan power consumption when EGU is operated at less than full load

6) Intelligent soot blowing (ISB)

- Soot blowers use high pressure steam to remove slag deposits from heat transfer surfaces in boiler.
- Large boilers have ~200 soot blowers
- Measure employs an automated control system to monitor temperatures, evaluate heat transfer, and activate specific soot blowers as required, rather than at predetermined times
- Reduces the annual energy consumed for soot blowing and improve boiler efficiency

Example: Roxboro Unit 2 BSER Determination

- DEQ Assessment based on following unit specific information provided by EGU owner/operator

	Baseline (2012)	Future (2019)
Operational Data		
Net Heat Rate (Btu/kWh)	10,158	10,078*
CO2 Emissions (tons/yr)	3,939,610	3,913,047*
Net Generation (MWh)	4,151,161	3,583,308*
Heat Input (million Btu/yr)	42,167,493	36,112,579*
Annual Capacity Factor	66.7%	57.0%
Potential Measures	CLR, SPO, LFGD, ISB, ALR, CO, OCC, IBD, AHE, FGDA, BFP, IDFR, FDF, CRR, ESP, TUR, HCT	
Capital and O&M costs per measure	2015 costs reported as confidential business information Adjusted to 2019 \$s*	
Fuel Cost	\$3.84/million Btu reported by Duke Energy for 2014 Adjusted to 2019 fuel cost at \$3.92/million Btu*	
Measure life and HRI degradation factor	Confidential business information	

*Calculated by DEQ (see Supporting Basis document)



Example: Roxboro Unit 2 BSER Determination (Cont'd)

	Guiding Principles	DEQ's Assessment
1	Adequately demonstrated	17 measures identified 1 measure removed - increased electric grid reliability risk due to boiler tube or drum damage and possible unstable operation
2	Ambient air concentrations	2 measures removed – adversely impacts post combustion environmental controls
3	Technical feasibility	5 measures removed – technically infeasible or negligible HRI opportunity 3 measures removed – implemented prior to 2012 2 measures removed – implemented between 2012 and July 31, 2015
4	Non-air quality health, environmental and energy impact	None identified
		4 measures remain (CLR, FDF, IBD and ISB)



Example: Roxboro Unit 2 BSER Determination (Cont'd)

	Guiding Principles	DEQ's Assessment			
5	Application of engineering judgment and sound science	Performance of CLR can be reduced by half when used in conjunction with other measures			
6	Cost	CLR	FDF	IBD	ISB
	Average annual cost factor ≤ 23 \$/ton CO2 if implemented individually? If implemented with other measures?	Yes No	No Yes	Yes Yes	Yes Yes
	Cost effective BSER measures* Average annual cost effectiveness factor	FDF, IBD and ISB \$ 4/ton CO2			
7	Total heat rate improvement (Btu/kWh)	80			
	CO2 emissions reductions (tons/yr)	26,563			
	Percent reduction from 2012 baseline emissions	0.7%			
DEQ Conclusions		BSER for Roxboro Unit 2 is FDF, IBD and ISB.			

*Also offers significant reductions in CO2 emissions.



Proposed BSER Measures for Coal-Fired EGUs

Utility Company - Facility	Unit ID	BSER Measure
Duke Energy - Asheville	1	none
Duke Energy - Asheville	2	none
Duke Energy - Belews Creek	1	CLR and FDF
Duke Energy - Belews Creek	2	CLR and FDF
Duke Energy - Cliffside	5	none
Duke Energy - Cliffside	6	ALR, CO, FDF and ISB
Duke Energy - G G Allen	1	none
Duke Energy - G G Allen	2	none
Duke Energy - G G Allen	3	none
Duke Energy - G G Allen	4	none
Duke Energy - G G Allen	5	none
Duke Energy - Marshall	1	ISB
Duke Energy - Marshall	2	ISB
Duke Energy - Marshall	3	ALR, CO, FDF and ISB
Duke Energy - Marshall	4	ALR, CO, FDF and ISB
Duke Energy - Mayo	1A & 1B	none
Duke Energy - Roxboro	1	none
Duke Energy - Roxboro	2	FDF, IBD and ISB
Duke Energy - Roxboro	3A & 3B	ISB
Duke Energy - Roxboro	4A & 4B	ISB
Edgecombe Genco - Battleboro	1	none
Edgecombe Genco - Battleboro	2	none
Westmoreland Partners - Roanoke Valley Energy Facility I	1	none
Westmoreland Partners - Roanoke Valley Energy Facility II	1	none


Example

Rule Fiscal Impact Summary

- 23 Measures

Range in HRI	26 – 80 Btu/kWh
Cumulative Reduction in HRI	0.4% (relative to 2012 baseline)
Cumulative Reduction in CO2 Emissions	191,826 tons/yr 0.4% (relative to 2012 baseline)
Cumulative Initial Capital Cost	\$ 51,818,929
2019 Capital Recovery Cost	\$ 3,302,450 / yr
2019 O&M Cost	\$ 3,007,109 / yr
2019 Fuel Saving	\$ - 7,316,705 / yr
2019 Net Annual Cost	\$ - 1,007,146 / yr
Net Fiscal Impact	\$ -5,888,000



Overview of Proposed 15A NCAC 02D .2700 Rules

- **15A NCAC 02D .2701 Purpose And Applicability**

- Affected and excluded EGUs same as CPP
- Invalidates affected state rules if
 - all or any portion of 40 CFR 60 Subpart UUUU is (1) determined by court to be invalid or unconstitutional or stayed or (2) withdrawn, repealed, revoked or rendered of no force by the EPA, Congress or Presidential Executive Order.

- **15A NCAC 02D .2702 Definitions**

- Affected EGUs
- BSER measures
- Performance parameters



Overview of Proposed 15A NCAC 02D .2700 Rules (Cont'd)

- **15A NCAC 02D .2703 Standards of Performance Requirements for Carbon Dioxide**
 - Unit specific BSER measures
 - Coal Units - measures requiring technology implementation
 - Follow manufacturer's installation procedures and performance acceptance test procedures
 - Follow on-going manufacturer's maintenance requirements
 - Coal Units - measures requiring work practices
 - Personnel responsible for operation of each measure follow manufacturer's operating guidelines
 - NGCC Units
 - Operate and maintain combustion turbine with heat recovery steam generator using natural gas during normal operation according to manufacturer's recommended procedures
 - Alternative BSER
 - Affected EGU demonstrates to the Director application of alternative measures that would achieve an equivalent or greater HRI
 - Requires Director approval
 - Compliance Schedule – implement BSER measure or alternative BSER by September 1, 2019



Overview of Proposed 15A NCAC 02D .2700 Rules (Cont'd)

- **15A NCAC 02D .2704 Permitting**

- Permit application required to incorporate requirements into a Title V permit

- **15A NCAC 02D .2705 Monitoring, Recordkeeping and Reporting**

- Coal Units - measures requiring technology implementation

- Maintain onsite installation procedures and performance acceptance test results for review by DAQ
 - Maintain onsite records of completed maintenance activities for review by DAQ

- Coal Units - measures requiring work practices

- Maintain onsite records of operational procedures and documentation of forced or operational outages of the BSER measure

- NGCC Units

- Maintain onsite record of maintenance and operational procedures for review by DAQ

- Annual Compliance Report

- Operational data (heat input, net generation, heat rate)
 - Performance data (carbon dioxide rate and mass emissions)



111(d) Plan Schedule

- 9/9/15 EMC briefing
- 11/4/15 Draft rules 111(d) Plan to AQC & 30-day waiver request
- 11/5/15 Request to EMC to proceed to public hearing & 30-day waiver request
- 11/16/15 Public comment period begins
- Dec. 2015/Jan. 2016 Public hearings
- 1/15/16 End of comment period
- 2/2016 Hearing Officer's report to EMC for consideration
- By 2/22/16 File with RRC
- 3/17/16 RRC action
- 4/1/16 Effective date (if < 10 objections)

- ~mid-May through June - potential Legislative review
- 9/6/16 Deadline to submit plan to EPA



Thank you.

Questions?



Additional Reference Material

Department of Environmental Quality



EPA's BSER Determination

- System = integrated network of electrical grids that connect power generating sources with transmission and distribution sources
 - Enables BSER to be applied “outside” the existing electric generating units that actually produce the CO₂ emissions
 - BSER applied to 3 interconnections
- BSER based on 3 building blocks
 - BB1: Heat Rate Improvement – inside the fence line
 - BB2: Shift generation from coal to 75% natural gas combined cycle (NGCC) capacity level
 - BB3: Shift generation from coal and NGCC to renewable resources
- Emissions Standards in State Plans must be satisfied through one of the following:
 - 1 Uniform emission performance rate for:
 - Fossil Steam (Coal + Oil) units
 - NGCC units
 - 2 State rate goal
 - 3 State mass goal

North Carolina's Interim and Final Targets In EPA's Clean Power Plan

1

Uniform Emission Performance Rate (lb/MWh)

	NC's 2012 Baseline Rate	Interim Performance Rate: 2022-2029	Final Performance Rate: 2030
Fossil Steam	2,054	1,534	1,305
NGCC	853	832	771

2

North Carolina Rate Goal (lb/MWh)

	NC's 2012 Baseline Rate	Interim Rate Goal: 2022-2029	Final Rate Goal: 2030
NC Aggregate	1,778	1,311	1,136

3

North Carolina Mass Goal (annual tons)

	NC's 2012 Baseline Emissions	Interim Mass Goal: 2022-2029	Final Mass Goal: 2030
NC Aggregate	58,353,477	56,986,025	51,266,234

Department of Environmental Quality

Key Compliance Dates In EPA's Clean Power Plan

- Sept. 6, 2016 – **Final Plan** or Initial Submittal (with request for extension)
 - Sept. 6, 2017 – Initial Submittal update due if extension granted
 - Sept. 6, 2018 – Final Plan due if extension granted
- July 1, 2021 – Milestone status report due
- 2022-2029: Interim goal to be achieved
 - July 1, 2025: meet Interim Step 1 Goal for 2022-2024
 - July 1, 2028: meet Interim Step 2 Goal for 2025-2027
 - July 1, 2030: meet Interim Step 3 Goal for 2028-2029
- 2030: Final goal to be achieved
 - July 1, 2032 and every 2 years beyond

State Plan Options In EPA's Clean Power Plan

- Must define whether the state will achieve: **Federal emission performance rates** or **State rate-based goal** or **State mass-based goal**
- Choose between 2 types of Plans

Emissions Standards Plan

- **Performance Rate**
- **State Rate-Based**

- Regulates only the owners/operators of covered EGUs
- EGUs must meet their required performance rate or state-specific rate-based goal
- Similar to other Clean Air Act programs

State Measures Plan

- **Mass-Based**

- Consists of **federally enforceable** or combination of federally enforceable and **state only enforceable requirements**
- Must result in EGUs meeting the EPA's or state's mass-based goal
- Must be “quantifiable, verifiable, enforceable, non-duplicative and permanent”
- States can impose requirements on non-EGUs through state law (e.g., renewable energy, energy efficiency)
- If state measures don't perform as planned, federally enforceable backstop (e.g., final model rule) kicks in