

Clean Power Plan: Options for Coal and Coal Technologies

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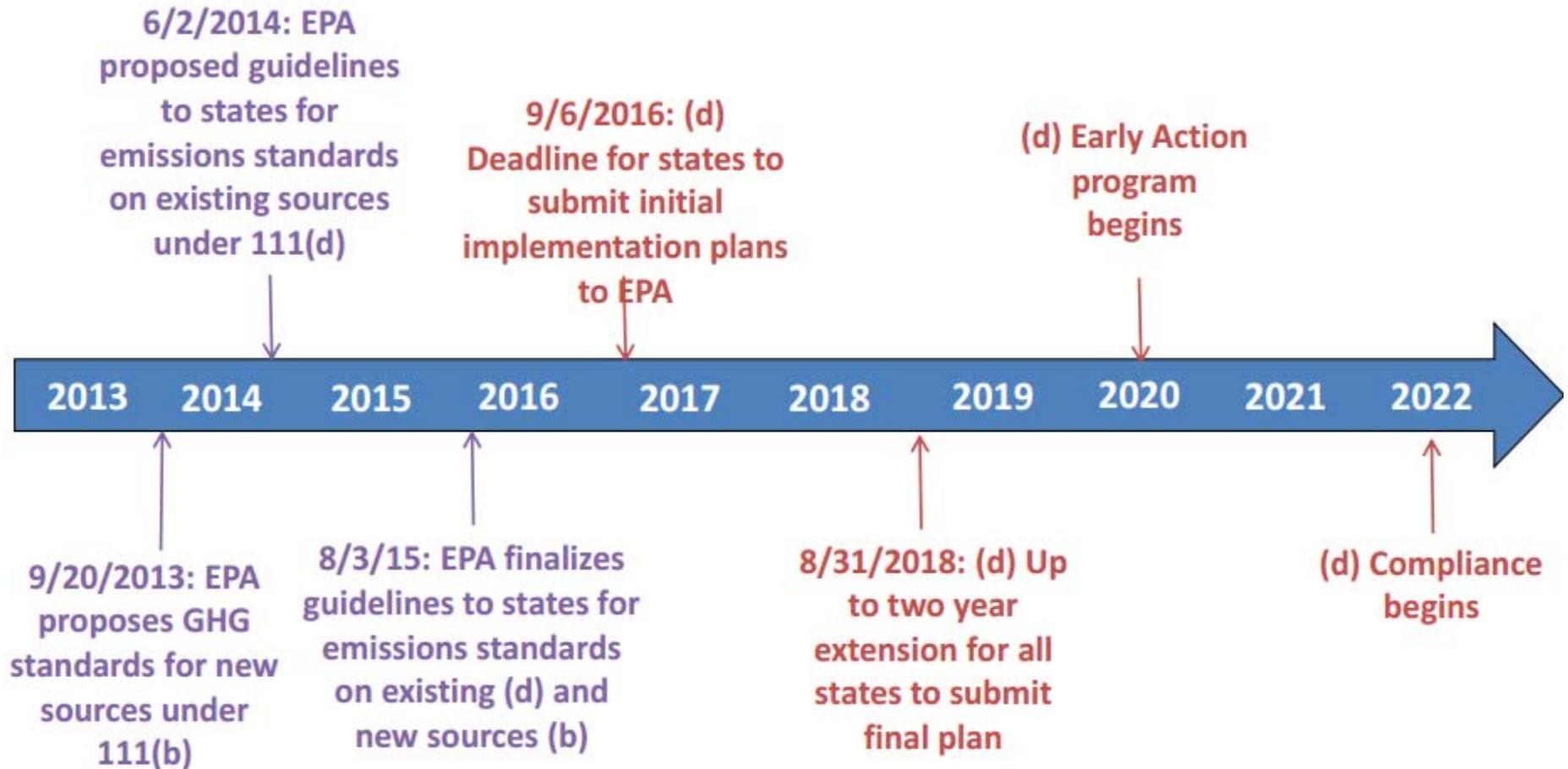
Office of Clean Coal and Carbon Management

111d Subcommittee on the Federal Clean Power Plan

14 January 2016

- **Overview**
- **New, Modified, and Reconstructed Sources**
- **CO₂ Storage Requirements**
- **Existing Sources:**
 - **Heat Rate Improvements**
 - **Natural Gas Co-firing**
 - **Biomass Cofiring**
 - **Carbon Capture and Storage**

Timeline



Modified / Reconstructed: Final Standards

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| Source | Description | Final Standard, Lb CO ₂ /MWh-gross |
|------------------------|---|---|
| New sources | Newly constructed EGU's | 1,400 |
| Modified sources | Modifications resulting in increase in hourly CO ₂ emissions (Lb/hr) > 10% | Best annual performance (Lb CO ₂ /MWh-g) during 2002 to the time of the modification |
| Reconstructed sources* | Large (>2,000 MBtu/hr heat input; ~200 MW) | 1,800 |
| Reconstructed sources* | Small (<2,000 MBtu/hr heat input) | 2,000 |

*Replacement of components at an existing facility to an extent that the fixed Capital cost of the new components exceeds 50% of the fixed capital cost required To construct a comparable new facility

Underground Injection Control: Class VI

Office of Fossil Energy



United States Environmental Protection Agency
Office of Water
Washington, DC 20460

Safe Drinking Water Act

Underground Injection Control (UIC) Program

Protecting Public Health and Drinking Water Resources

EPA 816-H-01-004
Draft May, 2010
www.epa.gov/safewater

Class I wells-
Isolate hazardous, industrial and municipal wastes through deep injection

Class II wells-
Inject oil and gas production wastes

Class III wells-
Minimize environmental impacts from solution mining operations

Class VI wells-
Minimize environmental impacts from geologic sequestration NEW

Class V wells-
Manage the shallow injection of all other fluids to prevent contamination of drinking water resources

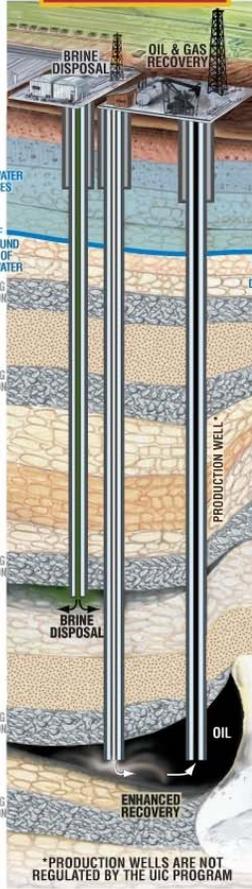
Class I wells-
Isolate hazardous, industrial and municipal wastes through deep injection



AVERAGE = 4000 FEET

HAZARDOUS AND NON-HAZARDOUS INDUSTRIAL WASTES

Class II wells-
Inject oil and gas production wastes



BRINE DISPOSAL

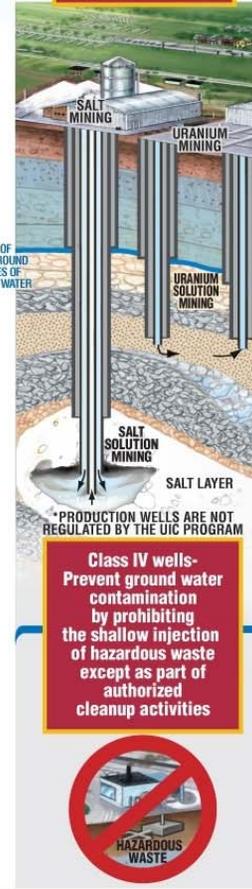
OIL & GAS RECOVERY

PRODUCTION WELL

ENHANCED RECOVERY

*PRODUCTION WELLS ARE NOT REGULATED BY THE UIC PROGRAM

Class III wells-
Minimize environmental impacts from solution mining operations



SALT MINING

URANIUM MINING

URANIUM SOLUTION MINING

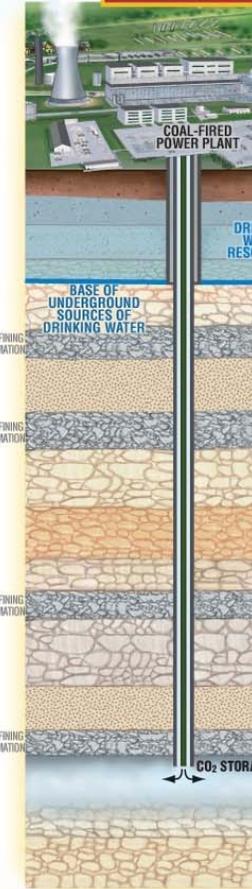
SALT SOLUTION MINING

SALT LAYER

PRODUCTION WELL

*PRODUCTION WELLS ARE NOT REGULATED BY THE UIC PROGRAM

Class VI wells-
Minimize environmental impacts from geologic sequestration NEW



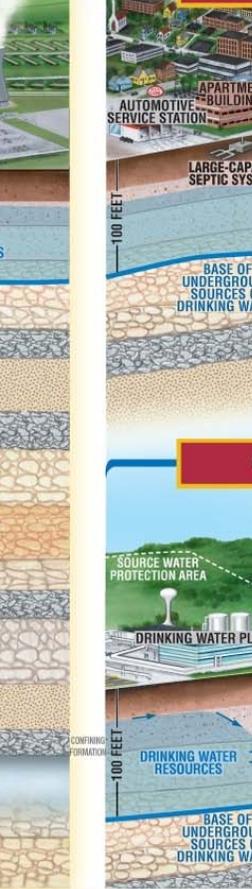
COAL-FIRED POWER PLANT

DRINKING WATER RESOURCES

BASE OF UNDERGROUND SOURCES OF DRINKING WATER

CO2 STORAGE

Class V wells-
Manage the shallow injection of all other fluids to prevent contamination of drinking water resources



100 FEET

DRINKING WATER RESOURCES

BASE OF UNDERGROUND SOURCES OF DRINKING WATER

Class V wells continued



100 FEET

DRINKING WATER RESOURCES

BASE OF UNDERGROUND SOURCES OF DRINKING WATER

In your community, there may be industrial waste disposal wells, storm water drainage wells, large-capacity septic systems, and other Class V wells. They are regulated and are not allowed to endanger drinking water resources.

All large-capacity cesspools are banned. New motor vehicle waste disposal wells are banned nationwide. Existing motor vehicle waste disposal wells in source water protection areas or other sensitive ground water areas must close or receive a permit.

Not drawn to scale

Subpart UU:

Current Reporting for all EOR Facilities

Requirements:

- Volume of CO₂ Received
- Source (If Known)

Subpart RR:

- Report basic information on CO₂ received for injection.
- Develop and implement an EPA-approved site-specific monitoring, reporting, and verification (MRV) plan.
- Report the amount of CO₂ geologically sequestered using a mass balance approach and annual monitoring activities.

- Class VI facilities must report under RR
- EOR facilities with a Class II permit may use RR or UU

Clean Power Plan: Existing Sources

Clean Power Plan Basics

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Step 1: Establish stringency

EPA determines the Best System of Emission Reduction (BSER) “adequately demonstrated”

BSER has three building blocks



Step 2: Compliance

Each state formulates its **own plan** to meet its prescribed goal

States can choose to comply on a **rate** basis or on a **mass** basis

States can choose to go it **alone**, use **emissions trading** or **cooperate**

Step 1: Establish Stringency: BSER and building blocks

- 1: Heat Rate Improvements at existing coal plants
- 2: Re-dispatch from coal to underutilized existing NGCC
- 3: Renewable energy deployment
- ~~4: End-use energy efficiency~~

States Choose How to Meet Goals

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- Efficiency improvements at higher emitting plants*
- Expanding use of existing NGCC units*
- New renewable energy, including wind, solar, geothermal, wave and tidal, hydropower*
- New nuclear power (including under construction)
- Nuclear uprates
- Carbon capture and storage (CCS) for existing EGUs
- Demand-side energy efficiency programs
- Combined heat and power (CHP)
- Waste heat to power (WHP)
- Transmission and distribution efficiency improvements
- Water system efficiency
- Use of certain biomass
- Co-firing or switching to natural gas
- Dispatch changes
- Working with utilities to consider retiring units that are high emitting
- Energy conservation programs
- Market-based trading programs

* Building Block for Rate / Mass Calculations

- Heat rate improvements at existing units
- Natural gas or biomass co-firing (or conversion)
- CCS retrofits at existing units count towards compliance (new units with CCS covered under 111(b))
- States also have the ability to allocate allowances to existing units when designing a mass-based plan
- States could also allocate allowances to further technology goals.
 - E.g., state could set up an advanced technology incentive pool, and could preferentially award allowances to advanced technologies, such as CCS, among others.

Any methods to reducing the overall rate (or mass) of CO₂ emitted from the plant

- Switching fuel sources to lower moisture coal
- Operational changes
- Capital Expenditures
 - Turbine Overhauls
 - VFD Motors
 - Condenser Cleaning
 - Etc.
- Combined Heat and Power *

EPA Reference:

- “Coal-Fired Power Plant Heat Rate Reductions”
 - Sargent & Lundy, prepared for EPA
 - www.epa.gov/sites/production/files/2015-08/documents/coal-fired.pdf

Natural Gas Co-Firing

- Boiler modifications to allow for dual-fuel usage
- High levels of co-firing may require changes to heat transfer surfaces within the boiler
- Need access to natural gas supply to enable co-firing opportunities
- Many applications already in-service
- Multiple configurations for co-firing, re-powering, and conversion

- Co-feed biomass in addition to Coal in the boiler
- Biomass must be properly prepared prior to blending
 - High moisture biomass is particularly problematic
- EPA's Science Advisory Board: Not all biomass is proven to be net negative at reducing greenhouse gases
- Any offsets must be consistent with EPA's "Framework for Assessing biogenic Carbon Dioxide Emissions from Stationary Sources"

Reference

<http://www3.epa.gov/climatechange/downloads/Framework-for-Assessing-Biogenic-CO2-Emissions.pdf>

Carbon Capture and Storage

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- Removal of CO₂ after combustion using chemical processes
- CO₂ typically compressed and used in geological applications, or converted to a value added resource
 - Largest usage of CO₂: Enhanced Oil Recovery
 - Storage in Saline formations in early stages of deployment
 - Some re-use applications
- Removed CO₂ must be sent to a facility that reports under subpart RR of the GHG Reporting Program
- Multiple DOE Loans, tax credits, and other financial mechanisms available to assist early adopter projects

Reference

www.energy.gov/FE

- DOE has provided technical experts to EPA throughout drafting process
- DOE has expanded its technical assistance capabilities, including:
 - A Cross-program website (energy.gov/TA)
 - Funding NGA policy academy
 - NASEO, NARUC, and university collaboration
- Continued work with EPA and FERC, coordinating reliability discussions
- Clean Coal: Outreach to states to inform policy makers