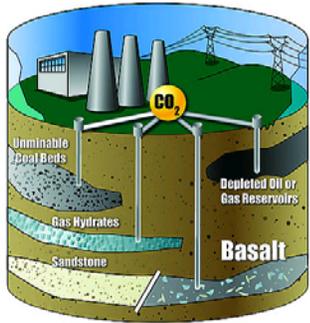


Geologic Sequestration of Carbon Dioxide EPA Proposed Rulemaking

**EPA Region 6 Ground Water Summit
February 5, 2009**



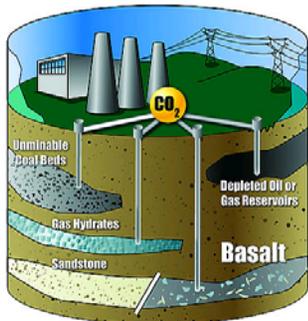
Brian Graves
Region 6 UIC Land Ban Coordinator
214-665-7193
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EPA's Proposed GS Rule: *Outline*

- Brief Underground Injection Control (UIC) Program Background
- Carbon Capture and Storage Basics
- Rule Proposal Development Process
- Components of the Proposed Rule
- Public Hearing Results
- Schedule for Final Rule

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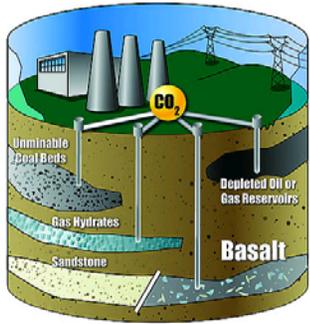


UIC Background

Safe Drinking Water Act (SDWA) Authority

- 1974 SDWA (Reauthorized in 1996)
 - Required EPA to develop minimum federal regulations for protection of Underground Sources of Drinking Water (USDWs)
 - USDW is defined in UIC regulations:
 - Any aquifer or portion of an aquifer containing $< 10,000$ mg/l total dissolved solids and which contains a volume of water such that it is a present, or viable future, source for a public water supply
- UIC Program regulates underground injection of all fluids – liquid, gas, or slurry
- Existing UIC program provides a regulatory framework (baseline) for the Geologic Sequestration of CO_2

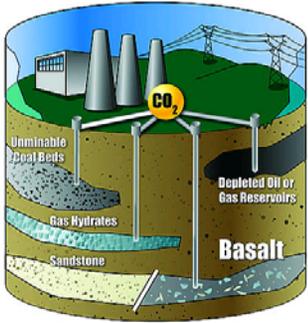




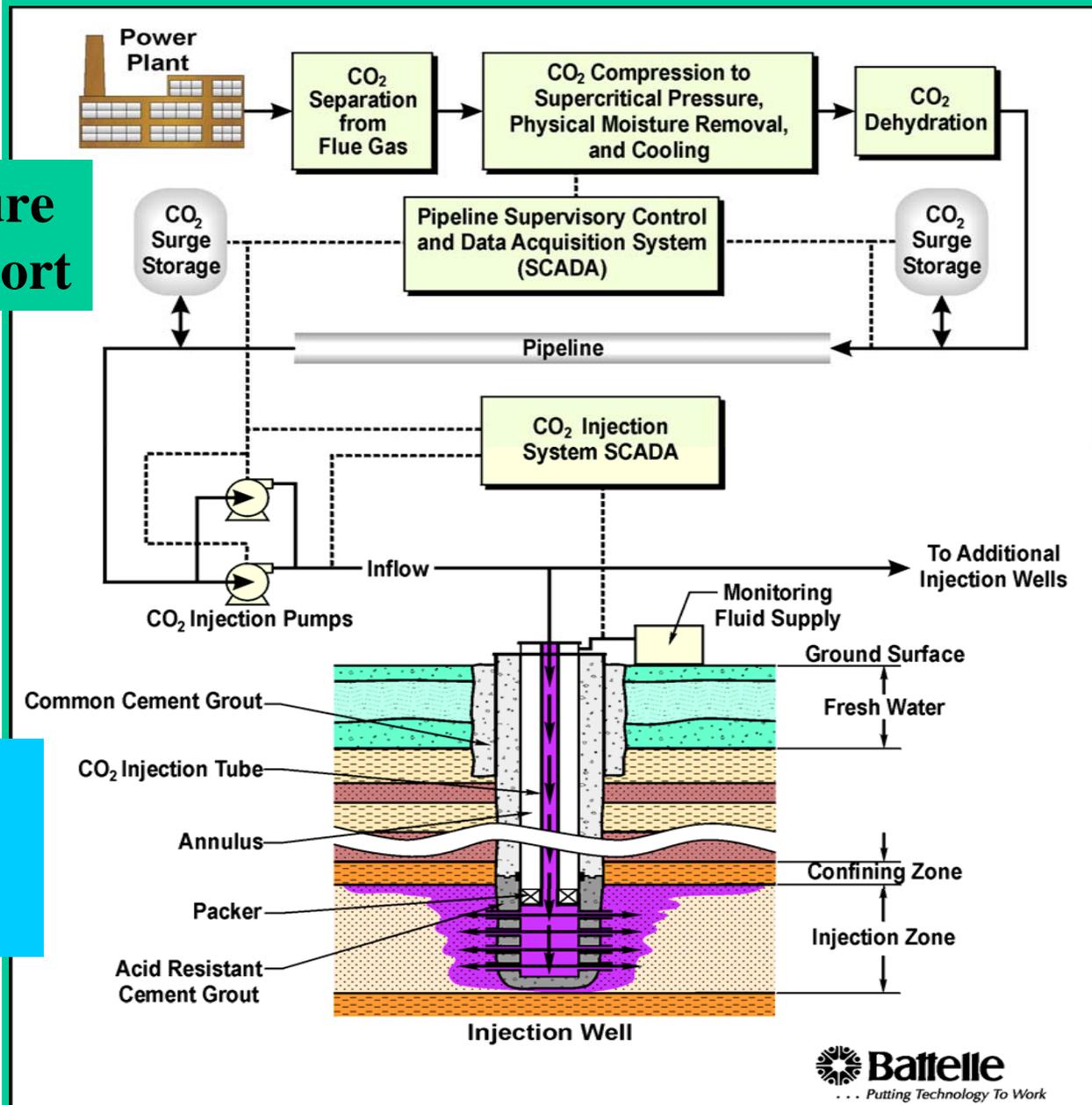
Carbon Capture and Storage/Geologic Sequestration of CO₂

- Important terms:
 - **CCS: *Carbon Capture and Storage*** (includes capture, transport, and injection of carbon dioxide for long term storage)
 - **GS: *Geologic Sequestration*** (the injection of carbon dioxide for long term storage)
- GS is one tool that can be used to reduce emissions of carbon dioxide to the atmosphere (there are others)
- GS rule addresses potential endangerment to USDWs from CO₂ injection activities
 - provides consistency across U.S.
 - provides transparency that will build public confidence

CO₂ Capture and Storage

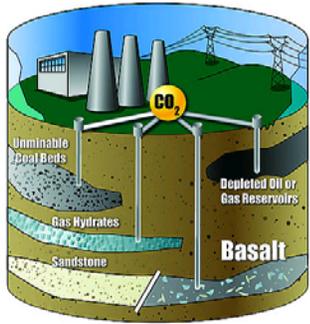


CO₂ Capture and Transport

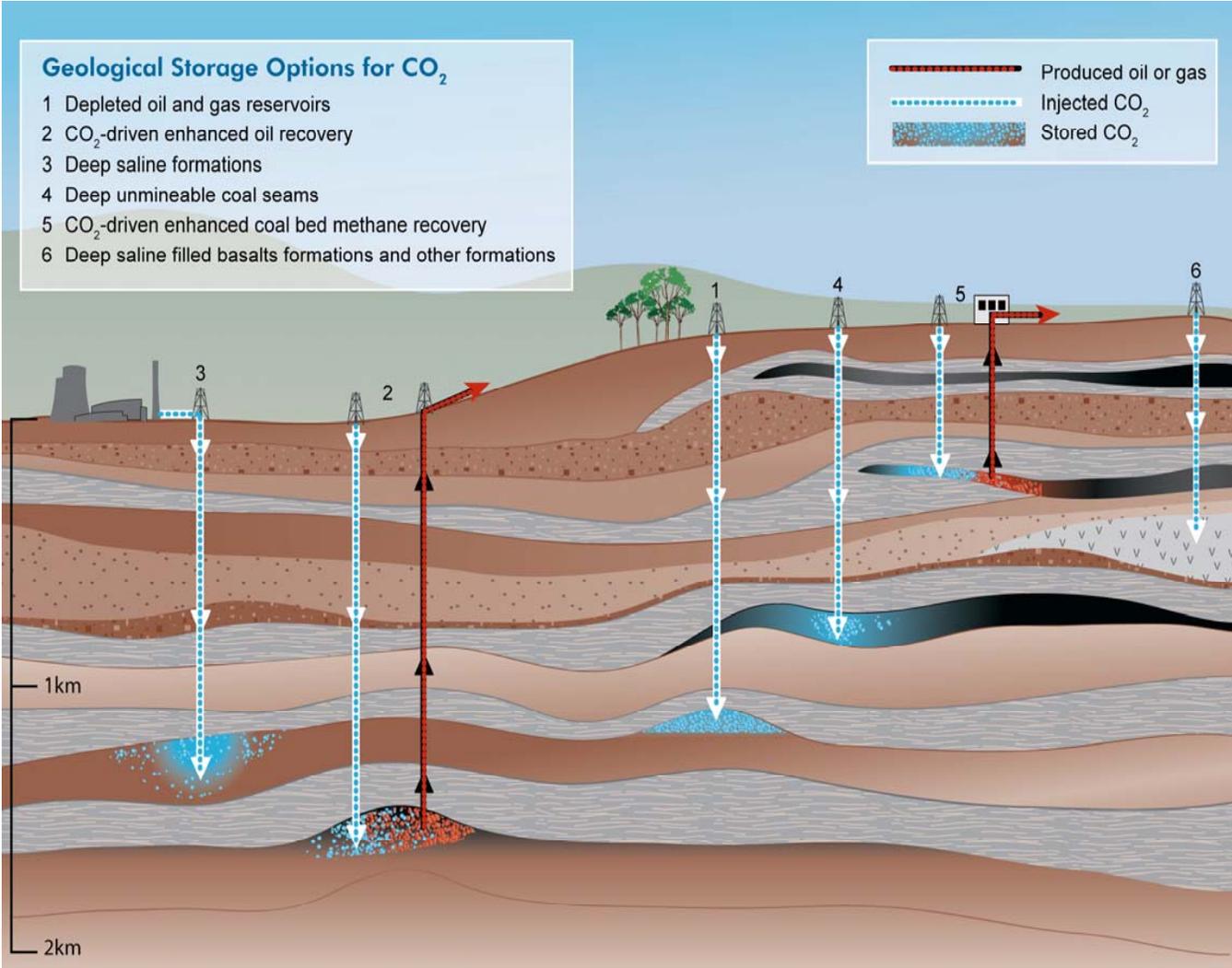


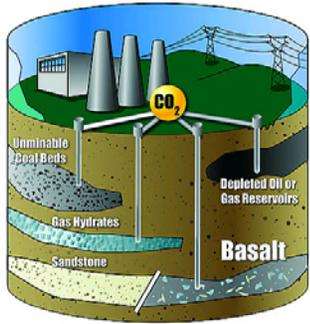
Geologic Sequestration UIC Program Scope



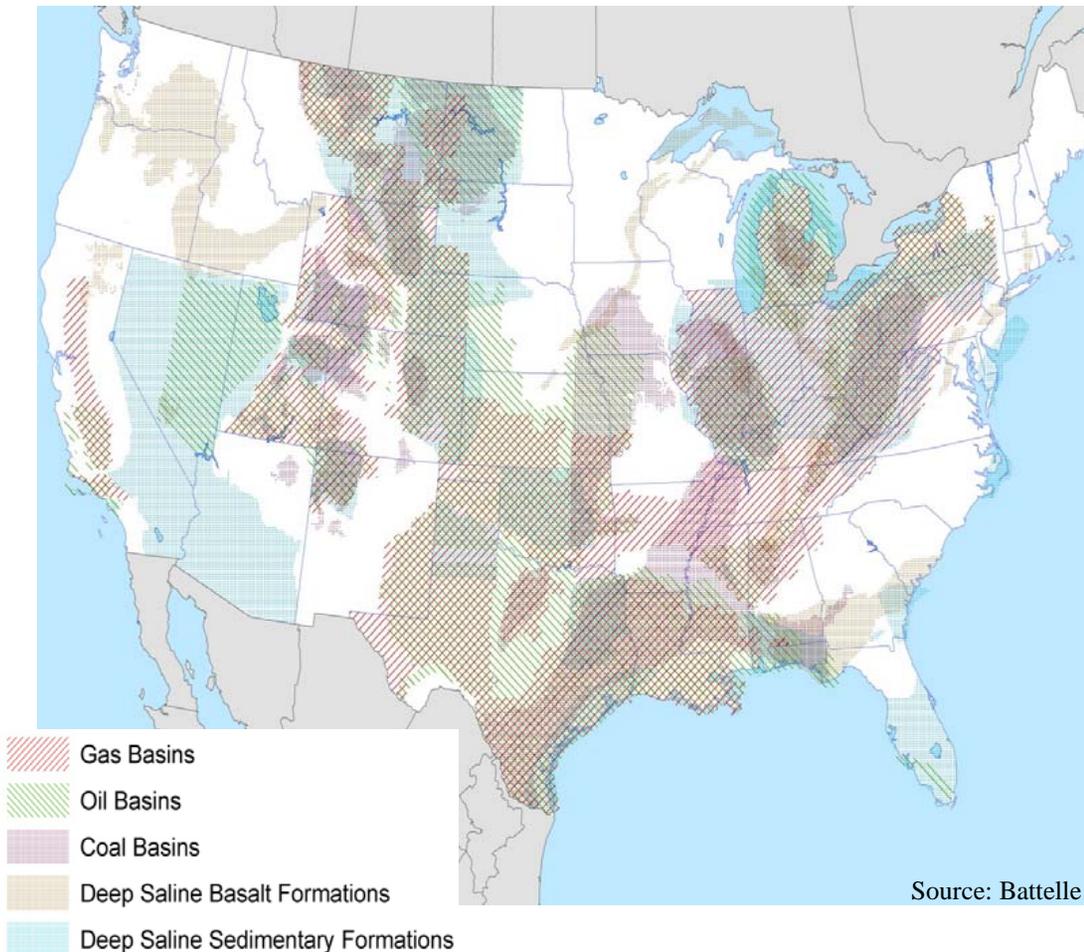


GS Target Formations

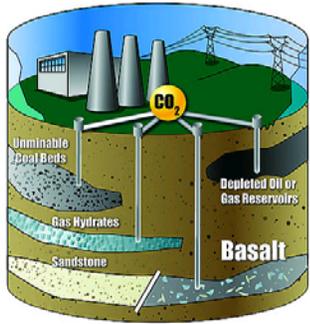




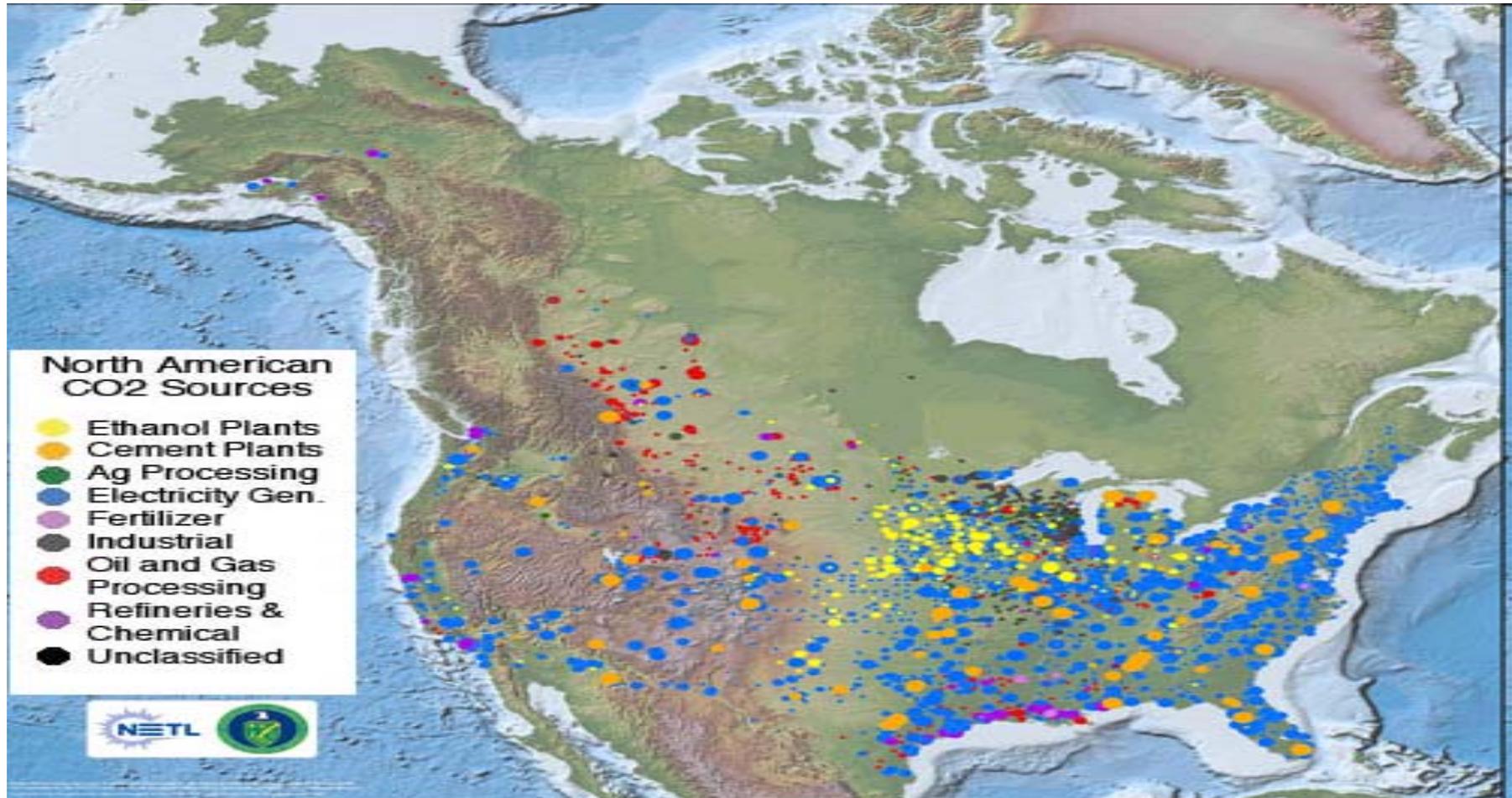
U.S. CO₂ Storage Capacity



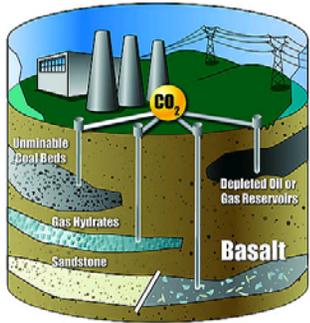
- **U.S. CO₂ storage capacity is large & widespread**
- **3,900+ GtCO₂ Capacity** within 230 candidate storage reservoirs
 - Oil and gas reservoirs
 - Deep saline formations
 - Deep coal seams
 - Basalt formations



North American CO₂ Sources

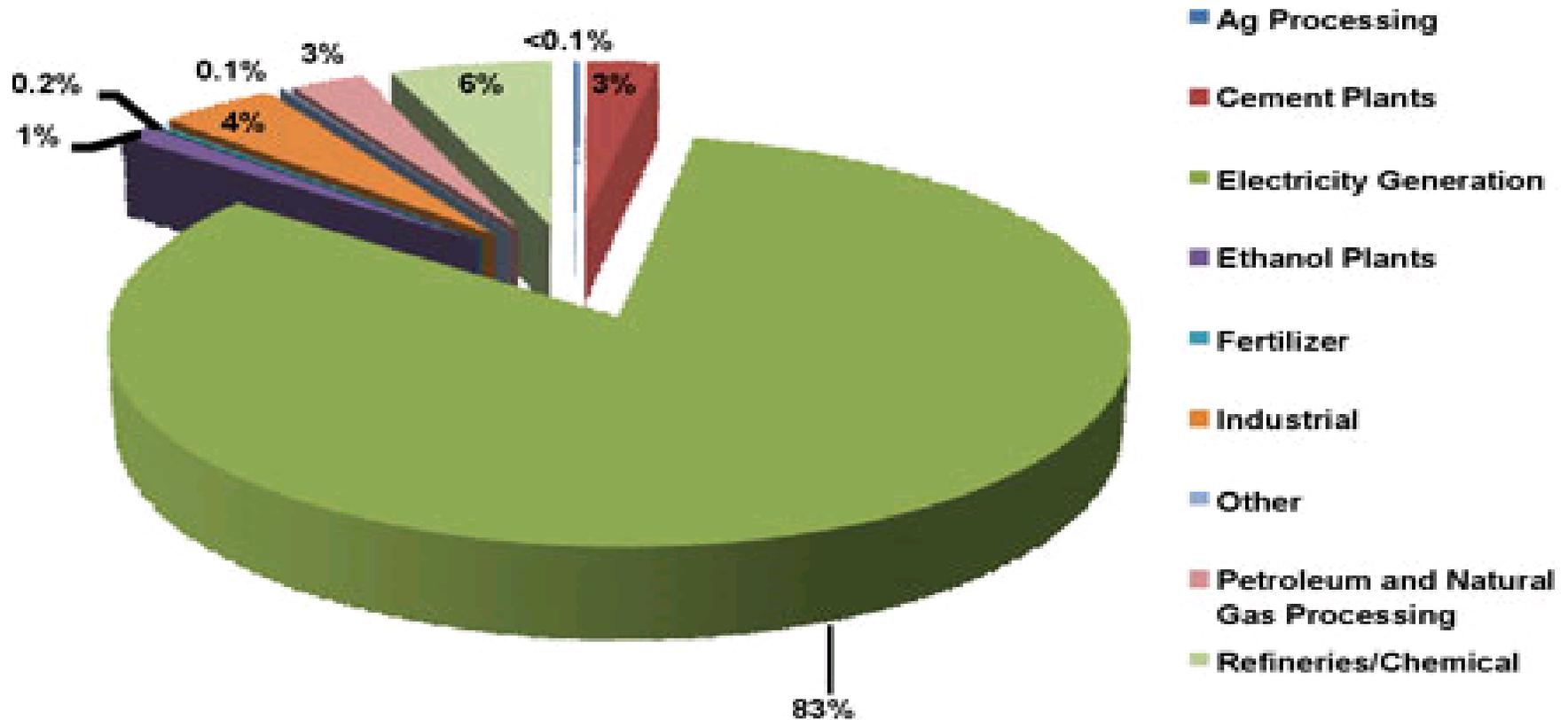


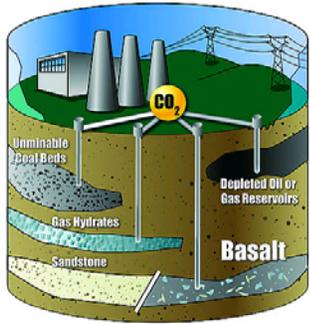
In 2007 U.S. CO₂ Emissions were 6 Gt



CO₂ Stationary Sources

Percentage CO₂ Stationary Source Emissions by Category

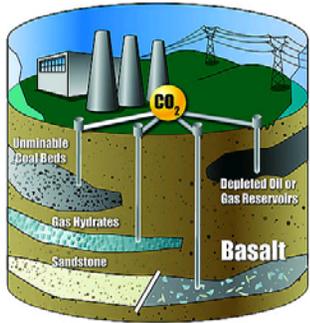




EPA's Proposed GS Rule: *Rule Development Process*

- EPA developed a Proposed Rule for GS of CO₂
 - Announced by EPA Administrator 10/11/07
 - Administrator signed proposal 7/15/08
 - Proposed rule published in Federal Register 7/25/08
 - Public hearings held September 30th and October 2nd
 - 120 day comment period + 30 day comment extension ended 12/24/08
- Proposed rule uses SDWA authorities and revises UIC Program for GS (Class VI wells)
- Priority placed on preventing endangerment of USDWs

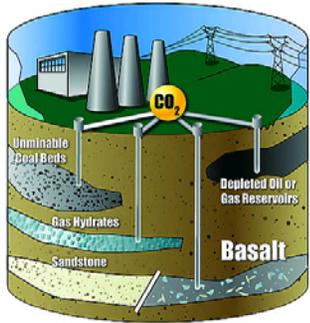




EPA's Proposed GS Rule: *Collaboration*

- EPA's Offices of Water and Air and Radiation worked to:
 - Clarify and address issues across EPA statutes (SDWA, Clean Air Act, etc.) and regulations
 - Coordinate technical and cost analyses for the proposal
 - Workgroup of ~48 members included DOE and 4 States (Texas, Arkansas, Alabama and Ohio)
 - EPA works closely with the Department of Energy (GS Lead)
 - EPA coordinating with:
 - Department of Transportation
 - Bureau of Land Management
 - United States Geological Survey



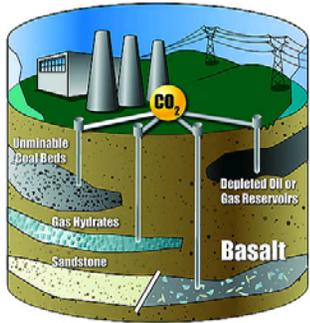


EPA's Proposed GS Rule:

Outreach to Stakeholders

- **Federal Advisory Committees** – National Drinking Water Advisory Council (NDWAC) and Clean Air Act Advisory Committee (CAAAC)
- **States** – Ground Water Protection Council (GWPC) and Interstate Oil & Gas Compact Commission (IOGCC)
- **Non-Governmental Organizations and Water Utilities** – National Resources Defense Council, World Resources Institute, Environmental Defense Fund, American Water Works Association (AWWA) and others
- **Industry Groups** – BP, Shell, Chevron, American Petroleum Institute (API), Schlumberger, Edison Electric Institute, etc.

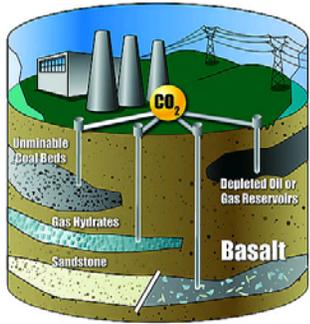




EPA's Proposed GS Rule:

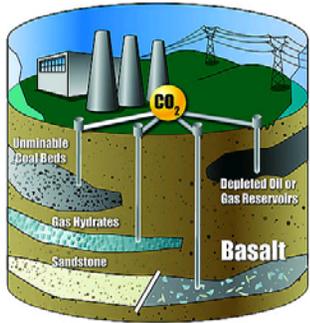
Workshops and Meetings

- **Technical Workshop Series (2005-2008)**
 - Modeling: Houston, TX 2005
 - Risk Assessment: Portland, OR 2005
 - Site Characterization: Berkeley, CA 2006
 - Well Construction and Mechanical Integrity Testing: Albuquerque, NM 2007
 - Area of Review: Washington, DC 2007
 - Measurement, Monitoring, and Verification: New Orleans, LA 2008
- **Two Stakeholder Meetings (2007 & 2008 in DC Area)**
 - EPA's rulemaking process
 - Technical and implementation challenges



EPA's Proposed GS Rule: *Goals of the Rulemaking Process*

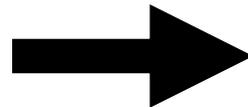
- Develop proposed rules that will protect USDWs
- Adapt existing UIC program requirements to unique needs of GS of CO₂ for long-term storage
- Develop adaptive approach to incorporate new data
- Use existing experience with industrial and enhanced oil/gas recovery injection



EPA's Proposed GS Rule: *Approach to Rulemaking*

Special Considerations for GS

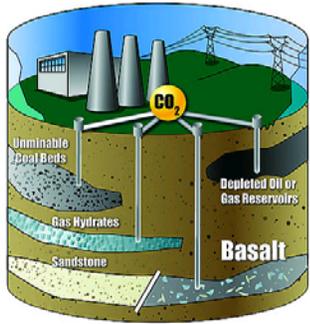
- Large Volumes
- Buoyancy
- Viscosity (Mobility)
- Corrosivity



UIC Program Elements

- Site Characterization
- Area Of Review
- Well Construction
- Well Testing and Operation
- Site Monitoring
- Well Plugging and Post-Injection Site Care
- Financial Responsibility
- Public Participation

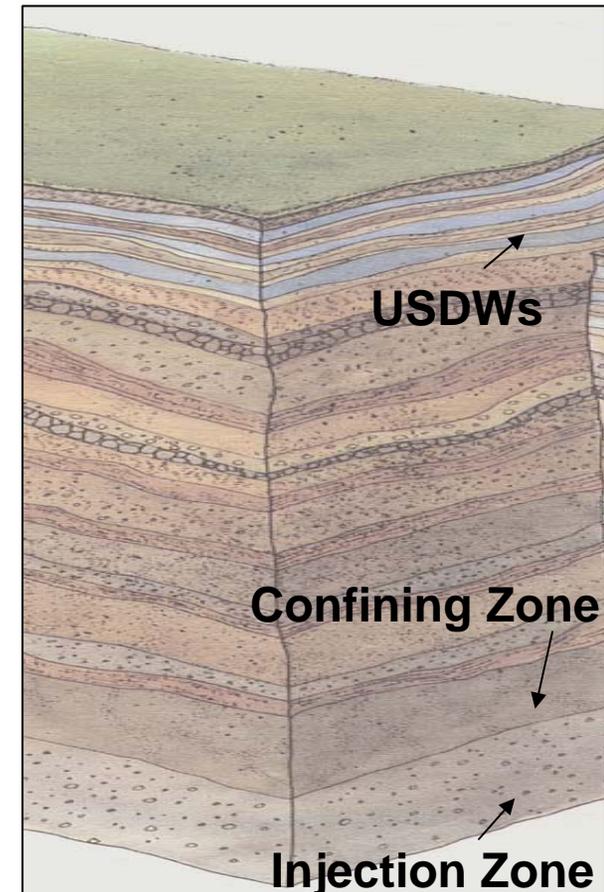
**Develop new well class
for GS – Class VI**

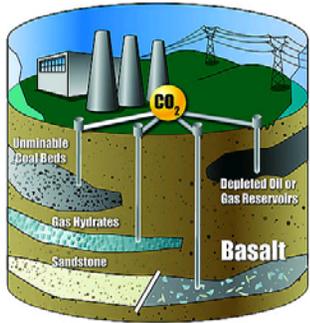


EPA's Proposed GS Rule: *Site Characterization*

Proposed Approach

- Injection zone that can accept fluids
- Confining zone (system) above the injection zone, that contains all fluids
- Director has discretion to require identification of additional confining zones
- Owners and Operators submit information on the following:
 - Structure and stratigraphy
 - Seismicity
 - Baseline geochemistry





EPA's Proposed GS Rule: *Area of Review (AoR)*

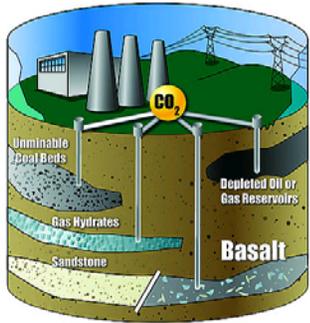
AoR: The region surrounding the project that may be impacted by injection activity



Proposed Approach

- Use computational modeling to define the AoR
- Identify and evaluate all artificial penetrations and other features that may allow upward migration of fluids
- Plug and or remediate as appropriate
- AoR reevaluation at a minimum of every 10 years
- Use phased corrective action at Director's discretion

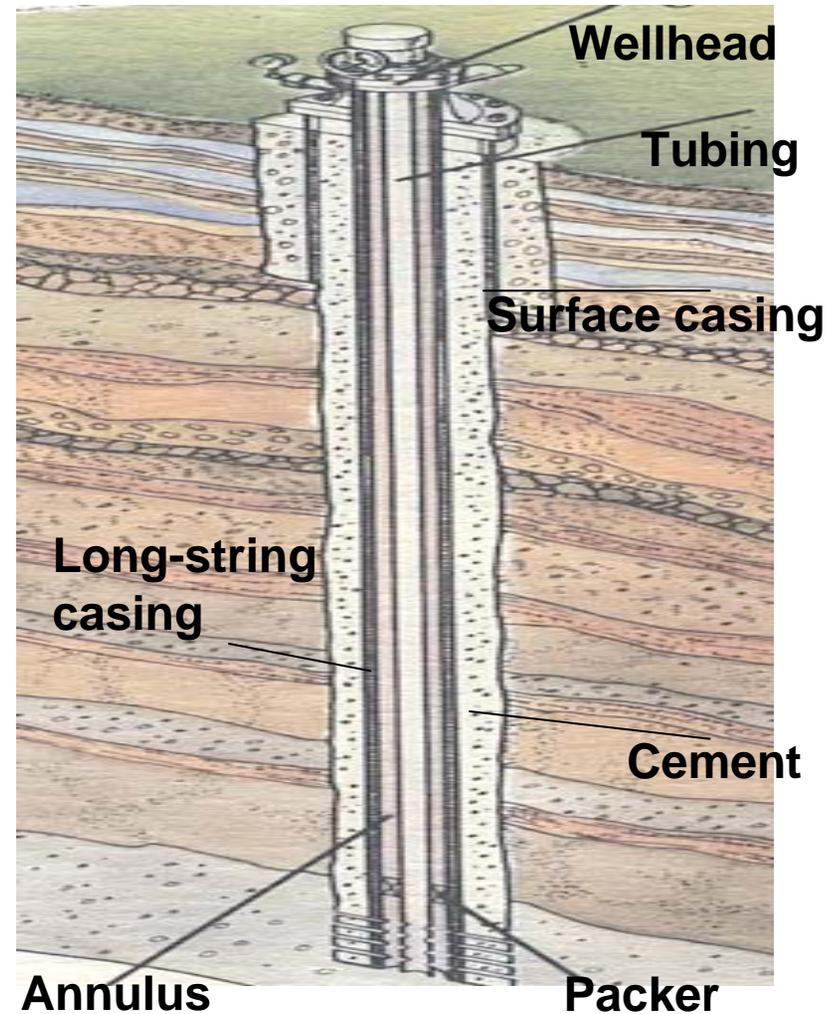


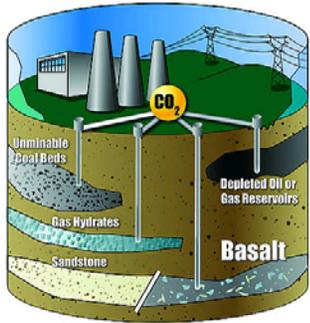


EPA's Proposed GS Rule: *Well Construction*

Proposed Approach

- Inject below the lowermost USDW
- Surface casing through the base of the lowermost USDW and cemented to surface
- Long-string casing cemented to surface
- Tubing and packer
- Well materials must be compatible with injectate and formation fluids



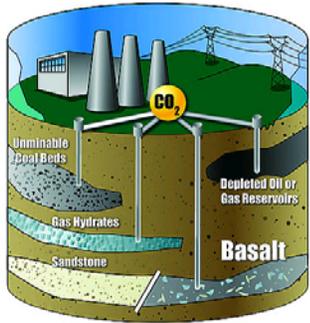


EPA's Proposed GS Rule: *Well Testing and Operation*

Proposed Approach

- Continuous internal well mechanical integrity tests (MIT) and annual external MITs
- Continuously monitor injection pressure, flow rate, and volumes
- Monitor the nature of the injected fluid
- Injection pressure should not exceed 90 percent of injection zone fracture pressure

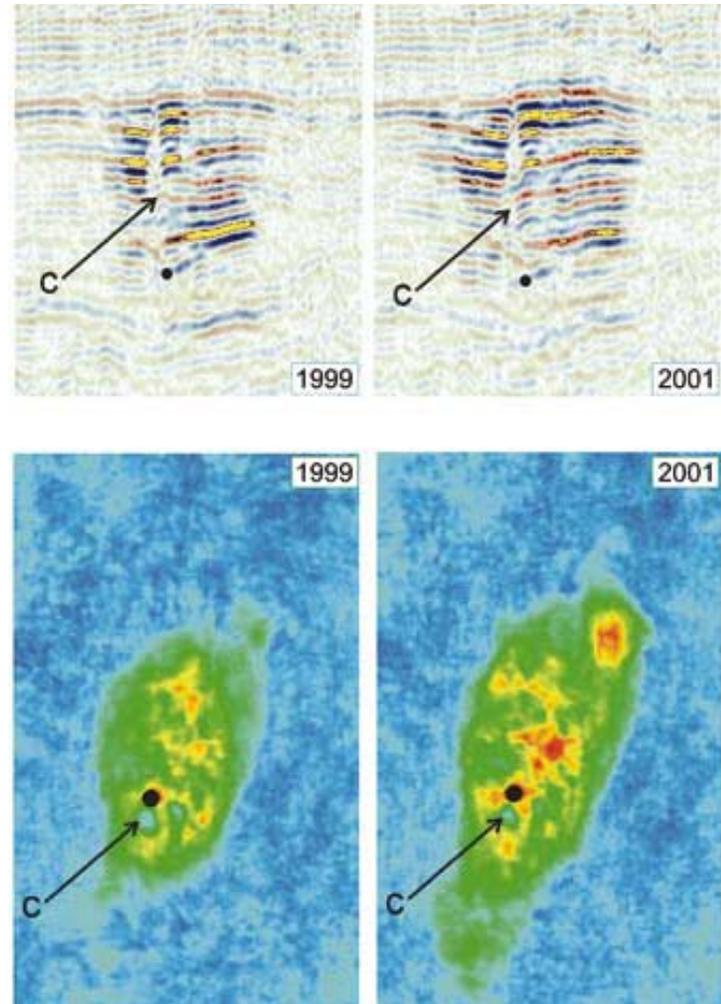




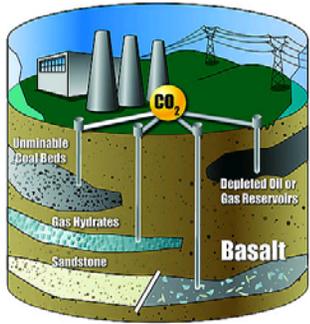
EPA's Proposed GS Rule: *Site Monitoring*

Proposed Approach

- Tracking of the plume and pressure front is required, but techniques, frequency, and spatial resolution are not specified
- Tracers are not required
- Surface-air and soil-gas monitoring are at the Director's discretion



Seismic Monitoring Results, Sleipner

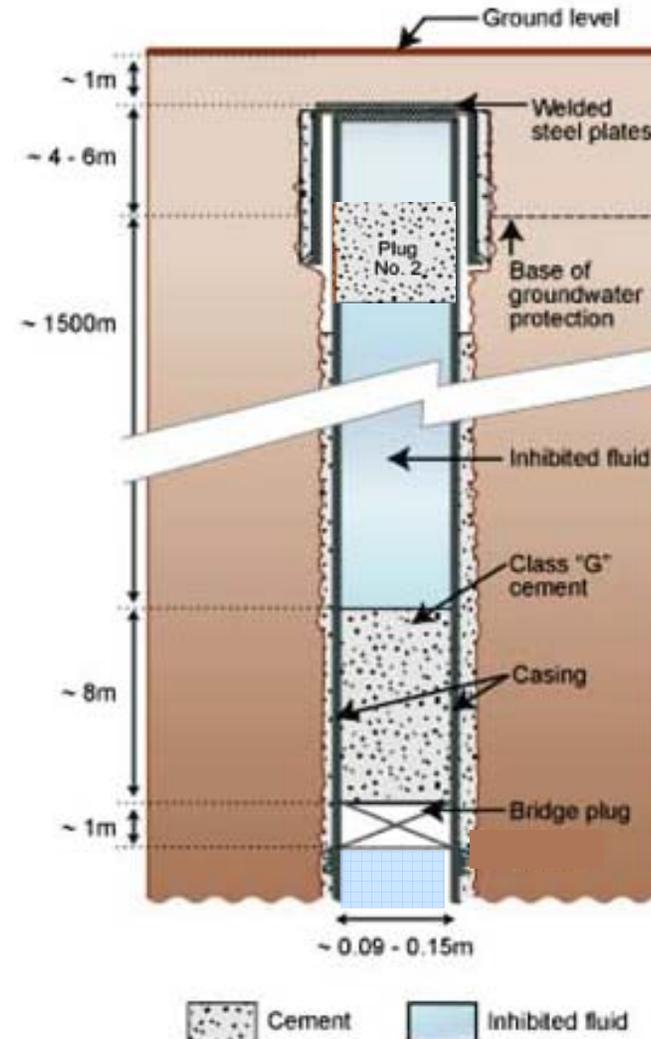


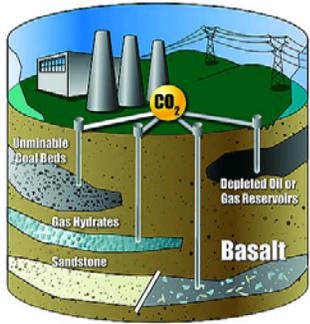
EPA's Proposed GS Rule:

Well Plugging and Post-Injection Site Care

Proposed Approach

- Well-plugging materials must be compatible with CO₂ stream
- Post-injection site care is set at a minimum of 50 years; unless the operator demonstrates that the GS project no longer poses an endangerment to USDWs



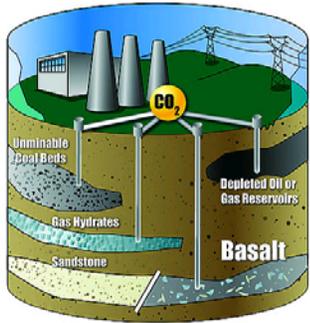


EPA's Proposed GS Rule: *Financial Responsibility*

Proposed Approach

- Demonstrate and maintain financial responsibility for corrective action, injection well plugging, post-injection site care, site closure, and emergency and remedial response



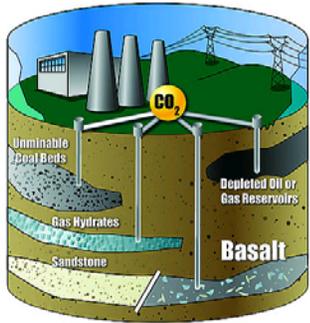


EPA's Proposed GS Rule: *Public Participation*

Proposed Approach

- 30-day comment period for permits following public notice
- Preparation of a responsiveness summary for the public record
- Proposal sought comment on:
 - Appropriate outreach techniques and technologies
 - Engaging the public early in permitting process before siting





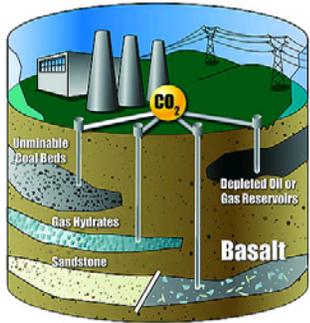
EPA's Proposed GS Rule:

Impacts on Existing UIC Wells (Class I, II, V)

Proposed Approach

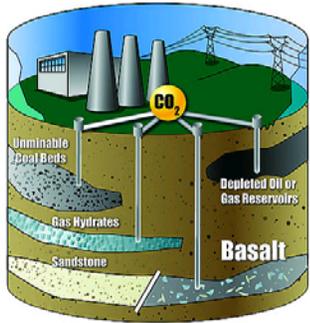
- CO₂ Enhanced Oil/Gas Recovery Wells (Class II) would not be required to apply for a Class VI permit until no oil or gas is being produced from the reservoir
- Existing Class I, II or V wells that transition to a Class VI permit must comply with all new regulations, except....
- “Cemented-in-place” mechanical components of the well would be grandfathered into the new permit at the Director’s discretion





GS Public Hearings and Comment Information

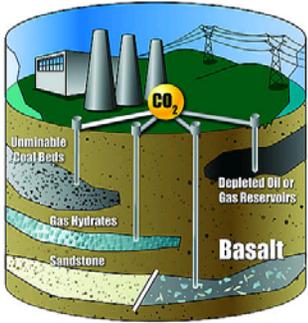
- Hearing Format: Summary of Proposal, public verbal comments, followed by an EPA Q&A panel
- September 30th in Chicago: 60+ participants
- October 2nd in Denver: 60+ participants
- Generally favorable comments with some technical recommendations at both hearings
- Denver meeting in afternoon had several presenters opposed to GS, UIC, and continued reliance on fossil fuels for energy production
- 151 groups made 365 submittals with thousands of comments



EPA's Proposed GS Rule: *Schedule*

Activity	Milestone
Technical Workshops, Data Collection & Analysis	Ongoing
Stakeholder Meetings	December 2007/February 2008
Interagency Review of Proposed Rule	Late May - Early June 2008
Administrator's Signature of Proposed Rule	July 15, 2008
Public Comment Period for Proposed Rule Included 2 Public Hearings on 9/30 & 10/02	July 25 – December 24, 2008
Notice of Data Availability (<i>if appropriate</i>)	2009
Final UIC Rule for GS of CO ₂	Late 2010 / Early 2011





Questions?

More information about the GS proposal:

- EPA Geologic Sequestration of Carbon Dioxide Website – http://www.epa.gov/safewater/uic/wells_sequestration.html
- Code of Federal Regulations: Underground Injection Control Regulations 40 CFR 144-148
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?sid=d6ee71a544eca89c533c825135913f13&c=ecfr&tpl=/ecfrbrowse/Title40/40cfrv22_02.tpl
- You can read the written comments that were submitted and access support material for the proposed rule at:
www.regulations.gov (docket ID is EPA-HQ-OW-2008-0390)