

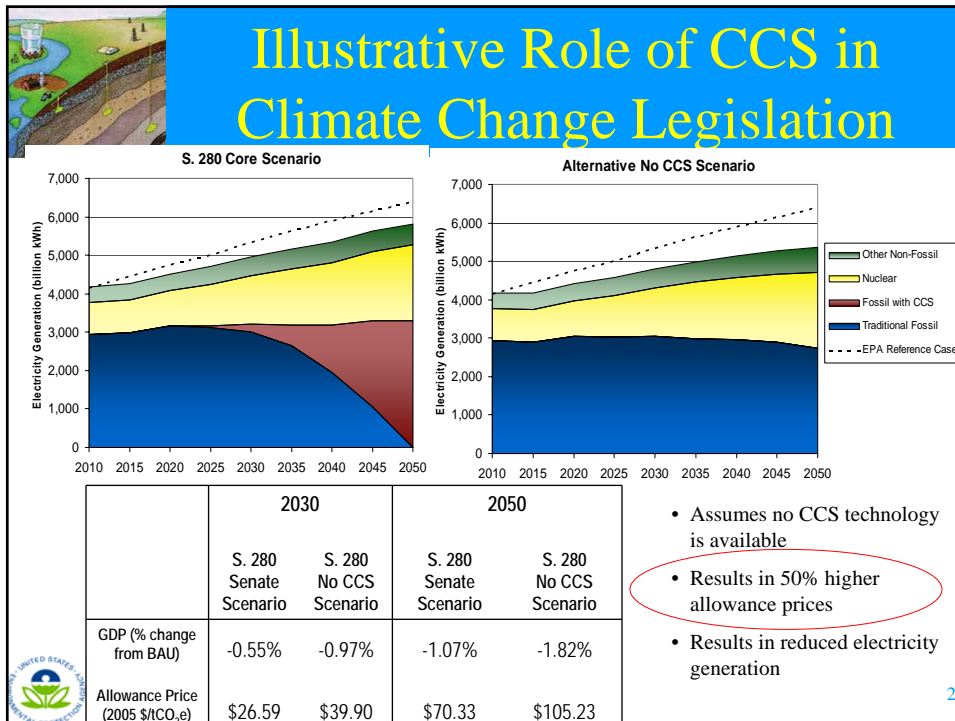
Workshop Overview

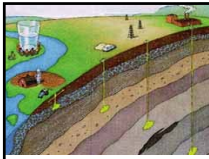
Proposed UIC Regulations for the Geologic Sequestration of Carbon Dioxide



Cynthia C. Dougherty, Director, Office of Ground Water and Drinking Water
 Brian J. McLean, Director, Office of Atmospheric Programs
 U.S. Environmental Protection Agency

EPA Public Workshop: Geologic Sequestration of CO₂
 Hotel Washington, Washington D.C.
 December 3-4, 2007





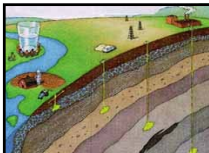
Successful Deployment *Geologic Sequestration of CO₂*

- While Carbon Capture and Storage (CCS) is not a “silver bullet,” it is a key climate change mitigation technology
- Ensuring that permitting regulations are in place will enable commercial-scale CCS projects to move forward
- Clear guidelines will reduce uncertainty for project proponents
- Past experience gives us confidence that we can work closely with key stakeholders to develop well-designed regulatory approaches

“By harnessing the power of geologic sequestration technology, we are entering a new age of clean energy – where we can be both good stewards of the Earth, and good stewards of the American economy.” - EPA Administrator Stephen L. Johnson



3

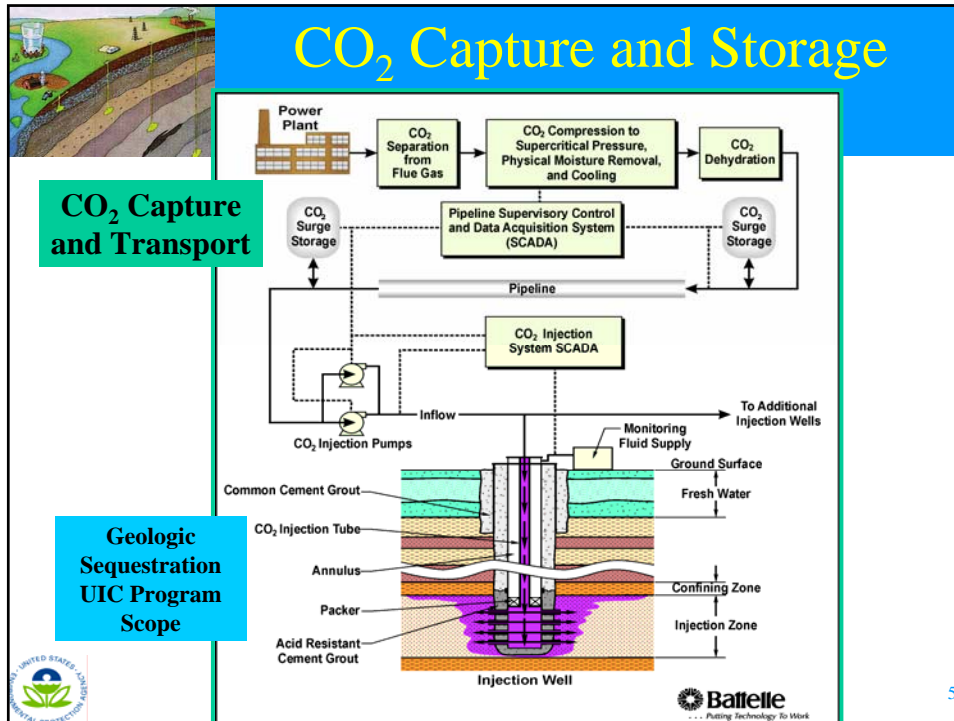


EPA Coordination

- EPA is working closely with DOE to leverage existing efforts and technical expertise
- Within EPA, the Office of Water (OW) and Office of Air and Radiation (OAR) are collaborating on all activities related to geologic sequestration in order to:
 - Ensure that cross-programmatic goals are achieved
 - Clarify relationship between various statutes (SDWA, CAA, etc.) and EPA regulations
 - Conduct technical and economic analyses
 - Develop risk management strategies
 - Work closely with key stakeholders to design appropriate regulatory frameworks



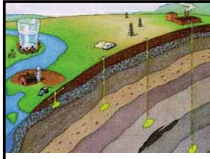
4



EPA's Underground Injection Control (UIC) Program

- The 1974 Safe Drinking Water Act (SDWA) requires EPA to develop minimum federal regulations for state and tribal UIC programs to *protect underground sources of drinking water*
 - The UIC program regulates underground injection of all fluids – liquid, gas, or slurry
 - Natural gas storage, oil & gas production, and some hydraulic fracturing are exempt from UIC requirements
- The existing UIC program provides a regulatory framework for geologic sequestration of carbon dioxide

6



UIC Program Activities

- Published UIC Class V Experimental Technology Well Guidance (March 2007)
 - Receiving permits for initial geologic sequestration pilot-scale projects and commercial projects
 - Holding Technical Workshops (ongoing)
 - Coordinating with EPA's Office of Air and the Department of Energy on CO₂ analysis of impacts of geologic sequestration on underground sources of drinking water
 - Conducting public workshops to engage stakeholders
- Developing proposed rule (Summer 2008)



7

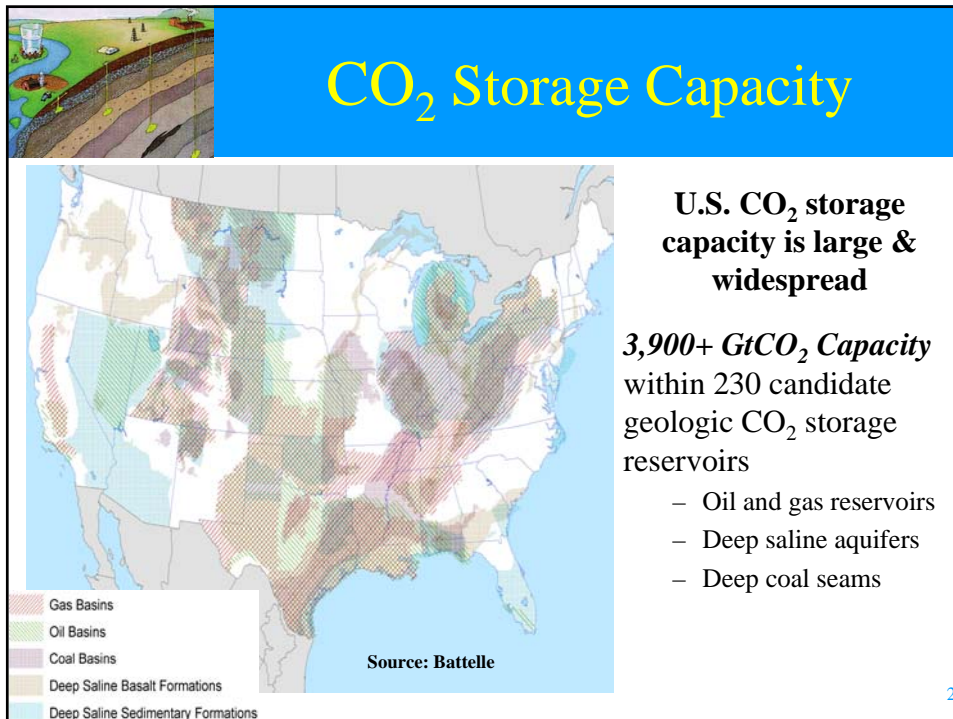
EPA's Proposed Rulemaking Process

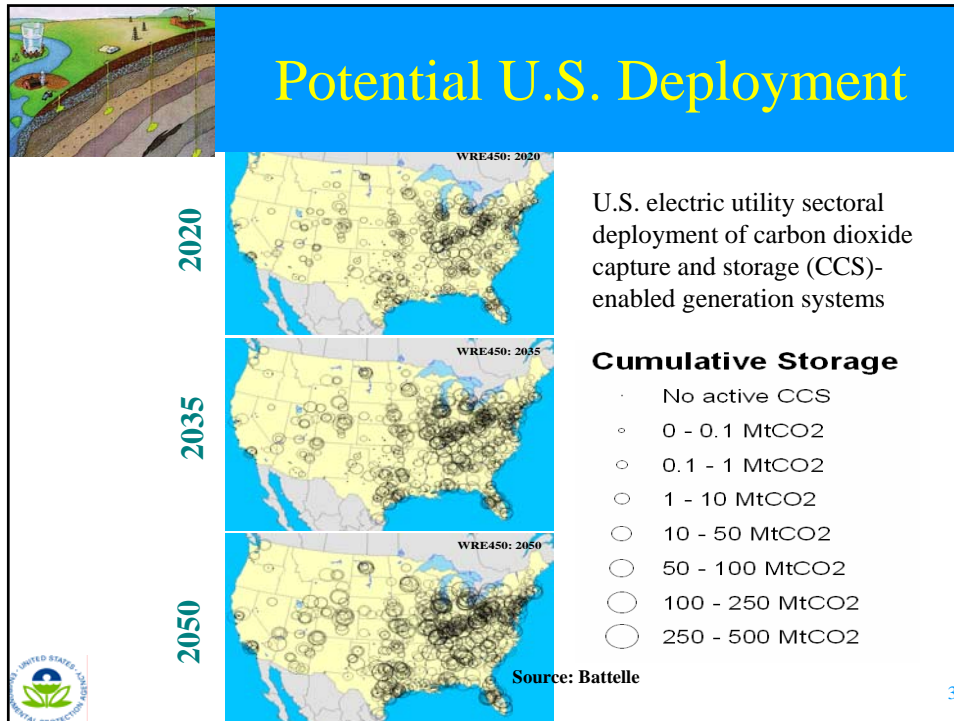
Geologic Sequestration of Carbon Dioxide under the Safe Drinking Water Act's Underground Injection Control Program



Stephen F. Heare, Director, Drinking Water Protection Division
Ann M. Codrington, Chief, Prevention Branch
*U.S. Environmental Protection Agency
Office of Ground Water and Drinking Water*

EPA Public Workshop: Geologic Sequestration of CO₂
Hotel Washington, Washington D.C.
December 3-4, 2007

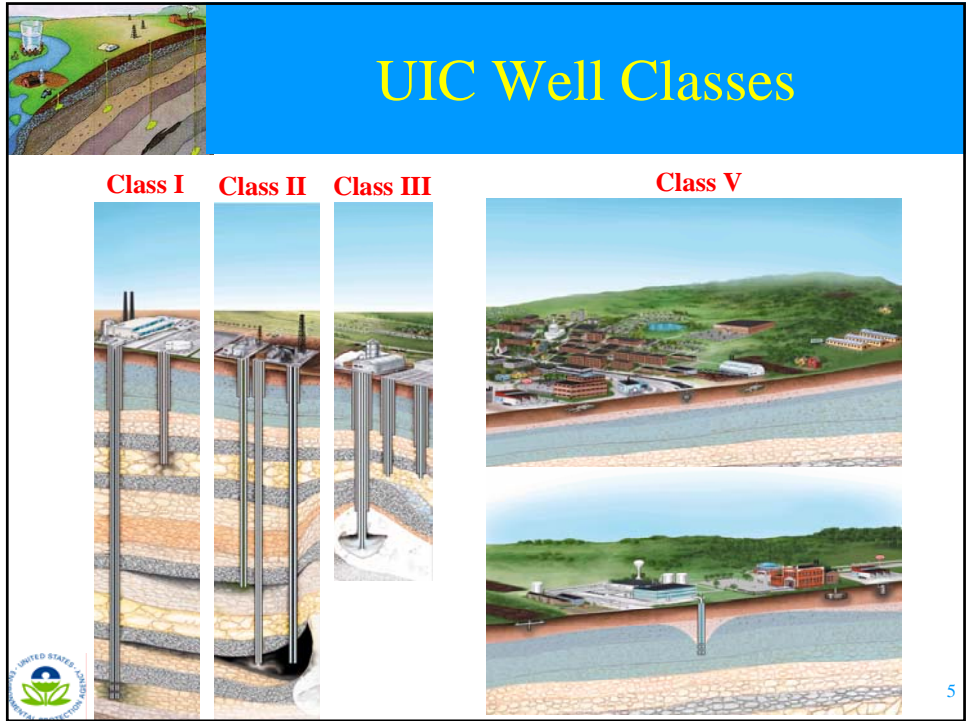




EPA's Underground Injection Control Program


- The 1974 Safe Drinking Water Act (SDWA) requires EPA to develop minimum federal regulations for state and tribal Underground Injection Control (UIC) programs to *protect underground sources of drinking water*
 - The UIC program regulates underground injection of all fluids – liquid, gas, or slurry
 - Natural gas storage, oil & gas production, and some hydraulic fracturing are exempt from UIC requirements
- The existing UIC program provides a regulatory framework for geologic sequestration of carbon dioxide

4




UIC Well Classes


Class I




Class II




Class III

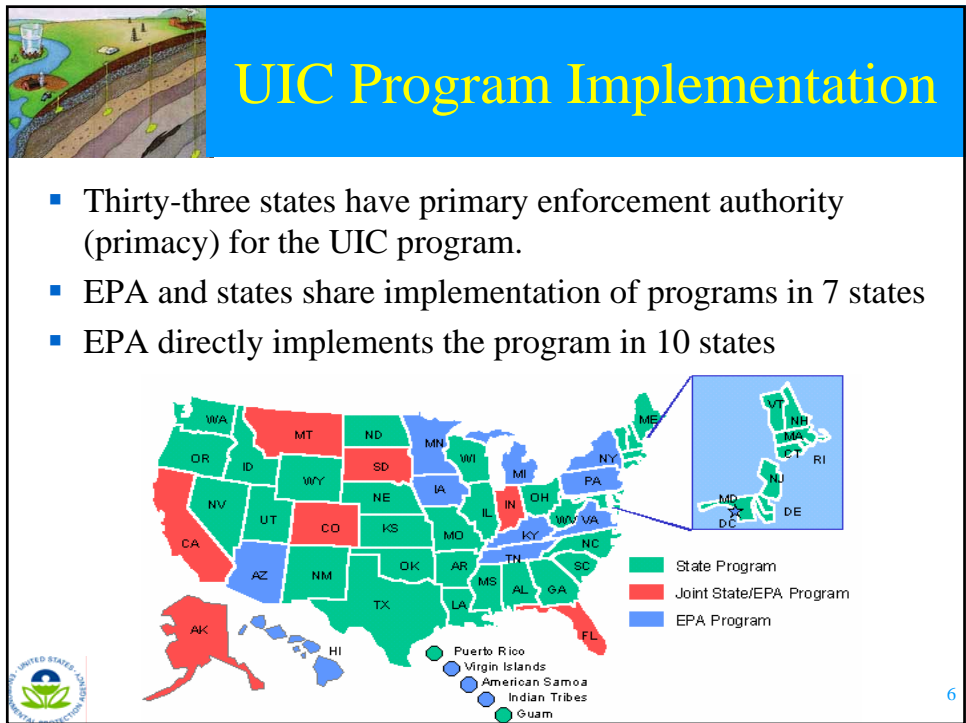


Class V



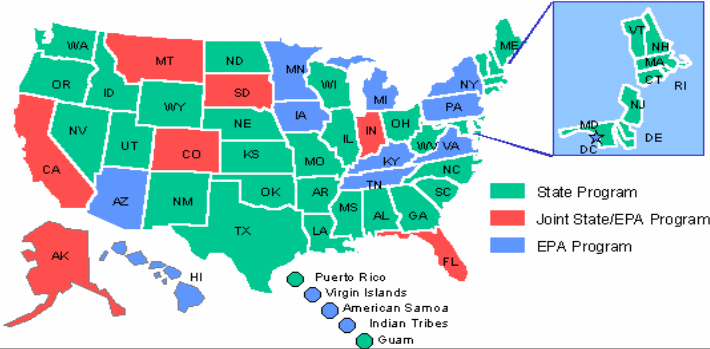


5

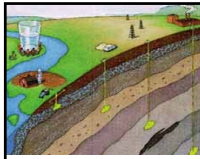


UIC Program Implementation

- Thirty-three states have primary enforcement authority (primacy) for the UIC program.
- EPA and states share implementation of programs in 7 states
- EPA directly implements the program in 10 states



6

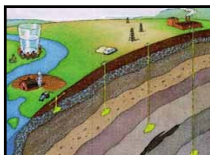


Increased Interest in Geologic Sequestration of CO₂

- **Congressional Interest**
 - House and Senate hearings and legislation
 - Government Accountability Office (GAO) study commissioned
- **Diverse Stakeholder Community**
 - **Federal** – EPA’s Offices of Ground Water and Drinking Water, Air and Radiation, and Research and Development; Department of Energy
 - **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** – National Resources Defense Council, World Resources Institute, Environmental Defense, and others
 - **Industry Groups** – British Petroleum, American Petroleum Institute, Occidental Petroleum, Schlumberger, Edison Electric Institute, and others



7

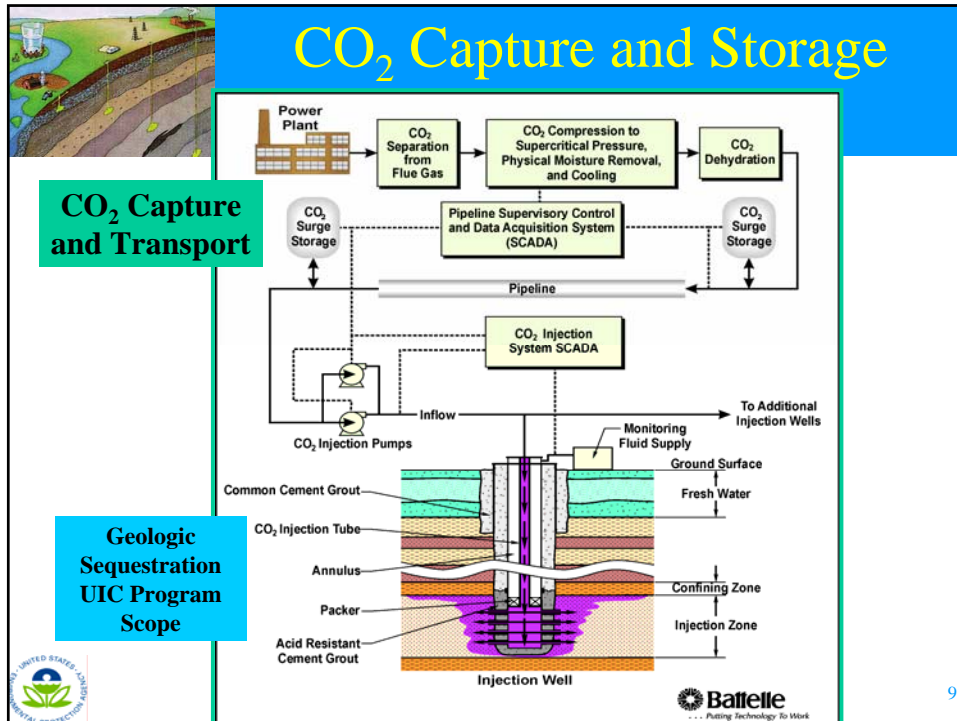


Geologic Sequestration: *Projects Underway*

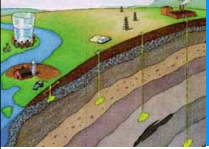
- DOE is leading U.S. efforts
 - Carbon Sequestration Leadership Forum, Regional Sequestration Partnerships, FutureGen, and Core R&D
- DOE GS Pilot Projects
 - 12 small/medium scale projects will be underway by 2008 in 9 states; EPA and states receiving, reviewing and issuing permits (Class II and Class V)
 - DOE recently announced awards for the first large scale (demonstration) geologic sequestration projects to take place between 2008 – 2017
 - International geologic sequestration projects are underway in countries such as Norway, Canada, Australia, and Algeria



8




- ## Proposed Rulemaking Scope *Geologic Sequestration of CO₂*
- Scope guided by Safe Drinking Water Act mandates
 - Fluids must be injected in a manner that does not endanger underground sources of drinking water
 - UIC program provides a foundation for managing well siting and construction, operation, and closure
- 10




Proposed Rulemaking Scope *Geologic Sequestration of CO₂*

- Geologic Siting Criteria
- Area Of Review
- Well Construction Standards
- Mechanical Integrity Testing
- Operation and Monitoring Requirements
- Well Closure and Post-Closure Care, Financial Responsibility, and Monitoring
- Public Participation and Communication




11

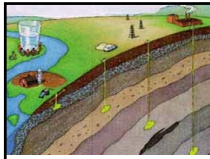


Rulemaking Process *Proposed Rulemaking Phase*

1. Gather and analyze data
2. Hold stakeholder discussion(s)
3. Draft documents
 - Economic Analyses
 - Vulnerability Analysis
 - Background Documents
 - Proposed Regulations and Preamble
4. Obtain agency/interagency approval
5. Publish proposal in *Federal Register*
6. Obtain public comments



12



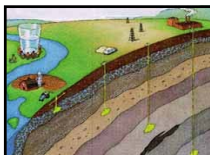
Rulemaking Process

Final Rulemaking Phase

- Respond to Comments
- Address new data with Notice of Data Availability in *Federal Register* (if appropriate)
- Draft or revise documents for final rule
- Obtain agency/interagency approval
- Publish final rule in *Federal Register*



13



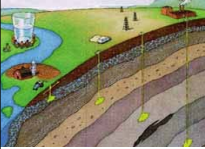
EPA Rulemaking Activities

Sample of Data Collection and Analysis

- Develop background documents:
 - Organics leaching, dissolution of metals, co-injection of constituents other than CO₂
 - Storage capacity, pressure build-up, alterations to ground water flow regimes
- Assess key vulnerabilities of CO₂ injection (e.g. human health, sources of drinking water, habitat)
- Develop decision tool (will assist in site selection, risk reduction, monitoring plans)
- Conduct EPA Technical Workshops on well construction, siting, modeling, reservoir simulation and other topics




14




Milestones *Geologic Sequestration of CO₂*

Activity	Milestone
Data Collection and Analysis	Ongoing
Two Stakeholder Meetings	December 2007/February 2008
Interagency Review of Proposed Rule	Late May - Early June 2008
Administrator's Signature of Proposed UIC Rule	July 2008
Public Comment Period for Proposed Rule	July – October 2008
Notice of Data Availability (if appropriate)	2009
Final UIC Rule for GS of CO ₂	Late 2010 / Early 2011



15




Questions and Discussion *Proposed UIC Rule for GS of CO₂*

Thanks for your participation!

More information about the UIC Program

- 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



16

Geologic Sequestration of Carbon Dioxide

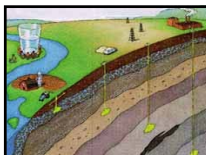
Potential Modifications to Existing Underground Injection Control Program Regulations



Suzanne Kelly
U.S. Environmental Protection Agency
Office of Ground Water and Drinking Water

EPA Public Workshop: Geologic Sequestration of CO₂
Hotel Washington, Washington D.C.
December 3-4, 2007

1



UIC Program Background

- The Underground Injection Control (UIC) Program protects Underground Sources of Drinking Water (USDW); a USDW is any aquifer or portion of an aquifer that:
 - contains water that is less than 10,000 PPM total dissolved solids
 - contains a volume of water such that it is a present, or viable future, source for a Public Water System
- 33 States have primary enforcement authority (primacy) for the UIC program; EPA and States share program implementation in 7 States; EPA directly implements the entire UIC Program in 10 states
- More than 750 billion gallons of fluid are injected each year. There are between 650,000 and 850,000 injection wells in the U.S.



Class I Wells
deep disposal of
manufacturing process
waste, mining waste,
municipal wastewater,
RCRA & radioactive waste



Class II Wells
produced brines,
crude oil (storage),
drilling fluids and muds,
and polymers



Class III Wells
"solution mining" w/
fresh water (salt),
sodium bicarb (uranium),
or steam (sulfur)

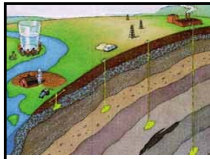


Class IV Wells
Banned except as
part of authorized
clean-up activities



Class V Wells
storm water runoff
industrial wastewater,
car wash water,
sanitary waste,
agricultural waste,
aquifer recharge

2

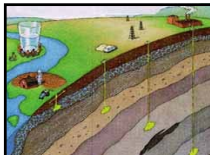


UIC Program Background (continued)

- The Safe Drinking Water Act (SDWA) requires EPA to develop minimum federal regulations for state and tribal Underground Injection Control (UIC) Programs to protect underground sources of drinking water
 - The UIC Program regulates underground injection of *all fluids* – liquid, gas, or slurry
 - Natural gas (hydrocarbon) storage, oil & gas production, and some hydraulic fracturing are exempt from UIC requirements
 - The existing UIC program *provides a regulatory framework for the Geologic Sequestration of CO₂*



3

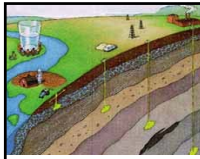


UIC Program Background (continued)

- **Class I** – Technically sophisticated, stringently regulated deep injection wells with detailed siting, monitoring, and closure requirements. Examples include:
 - Wells that accept hazardous fluids
 - Wells that accept non-hazardous industrial fluids
 - Wells that accept municipal wastewater
- **Class II** – Wells used by oil and gas operators for waste fluid disposal, enhanced recovery (ER), and hydrocarbon storage
- **Class III** – Wells associated with solution mining (e.g., extraction of uranium, copper, and salts)
- **Class IV** – Wells used to inject hazardous or radioactive waste into or above a USDW (banned)
- **Class V** – Any injection well that is not contained in Classes I to IV; Initial GS pilot projects permitted as Class V experimental wells



4

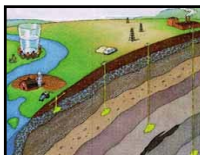


Rule Announcement

- Released the UIC Class V Experimental Technology Well Guidance (March 2007)
- EPA and primacy states are receiving, reviewing and issuing UIC permit applications for geologic sequestration (GS) projects (2007 and ongoing)
- Holding Technical Workshops (ongoing)
- Coordinating with EPA's Office of Air and the Department of Energy on GS of CO₂ impacts on USDWs
- EPA's Administrator, Steve Johnson, announced on October 11, 2007, that EPA would develop a **Proposed Rule** for commercial scale GS of CO₂ by Summer 2008



5

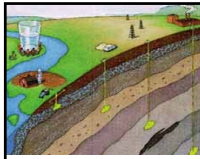


Key UIC Program Elements

- Geologic Siting
- Area of Review
- Well Construction
- Mechanical Integrity Testing
- Operation and Monitoring
- Well Closure and Post-Closure Monitoring
- Public Participation



6

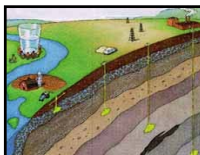


Technical Workshops and Conferences

- EPA has been tracking activities related to GS of CO₂ for years
- EPA initiated formal stakeholder involvement via meetings and workshops in 2003
- Recent workshops include:
 - UIC State Managers' Workshop
 - Held January 2007 with over 125 attendees
 - Well Construction and Mechanical Integrity Testing Workshop
 - Held March 2007 with over 50 attendees
 - Geologic Setting, Area of Review, and Abandoned Well Technical Workshop
 - Held July 2007 with over 70 attendees
- Planned workshops:
 - Monitoring, Measurement, and Verification (January 16, 2008)
 - Financial Responsibility and Long Term Liability (2008)



7

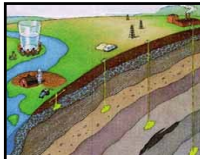


Findings on Key Program Elements

- Geologic Setting:
 - Proper evaluation is the cornerstone of effective and safe GS of CO₂
 - Regulatory standards should be performance based
 - Additional information is needed on the type and amount of geologic data for appropriate site characterization
- Area of Review (AoR):
 - Existing regulations may not be adequate
 - Fixed radius calculation is inappropriate given the unique properties of CO₂ and injected volumes
 - Need quality data for modeling flow and transport
- Well Construction:
 - Current standards may be sufficient for safe injection of CO₂
 - More data on the effects of a CO₂ rich environment on well construction materials are desirable



8

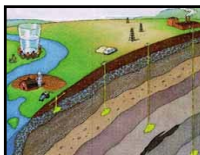


Findings on Key Program Elements

- Mechanical Integrity Testing (MIT):
 - Additional analyses are needed on performance of existing MIT practices
 - New techniques for verifying well integrity should be explored
- Operation and Monitoring:
 - Injection pressures should not exceed fracture pressure
 - Minimum injection depth may need to be established
 - Current program monitoring frequencies may need to be increased



9

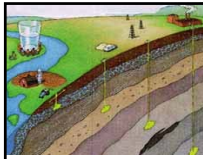


Findings on Key Program Elements

- Well Closure and Post-Closure Monitoring:
 - Current standards (i.e. plugging) may not be adequate for wells in a CO₂ rich environment
 - Existing regulations provide for post closure care but adequacy may be in question due to the long term nature of these projects
- Public Participation:
 - Existing regulations provide for public participation
 - These requirements may need enhancements due to the large area of review



10



Next... Interactive Stakeholder Panel

Interactive Panel: Perspectives and Considerations for Approaching Proposed Regulations for Geologic Sequestration of Carbon Dioxide

More information about the UIC Program:

- 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



Summary of DOE's Regional Carbon Sequestration Partnerships



*Pre-Workshop to the
Proposed UIC Regulations for
Geologic Sequestration of
Carbon Dioxide*

*John Litynski
Carbon Sequestration Program*

December 3rd, 2007

National Energy Technology Laboratory



Office of Fossil Energy



Presentation Outline

- **Brief Introduction to Carbon Sequestration Program**
- **Accomplishments of Characterization Phase**
- **Validation Phase Highlights**
- **Status of Deployment Phase**



03292007

Technological Carbon Management Options

Pathways for Reducing GHGs -CO₂

Reduce Carbon Intensity

- Renewables
- Nuclear
- Fuel Switching

Improve Efficiency

- Demand Side
- Supply Side

Sequester Carbon

- Enhance Natural Sinks
- Capture & Store

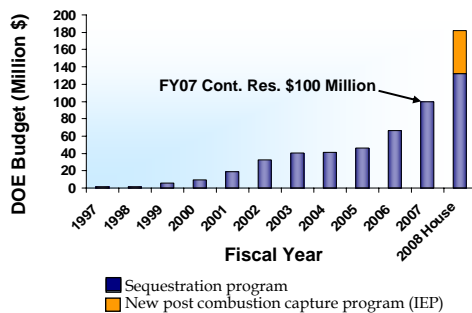
All options needed to:

- Affordably meet energy demand
- Address environmental objectives



03/29/2007

Sequestration Program Statistics FY2007

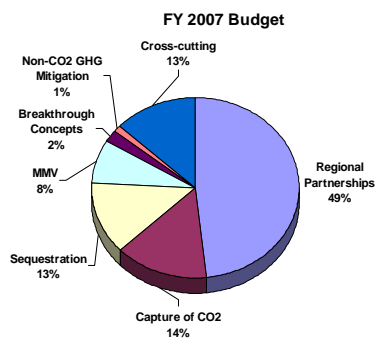


Strong industry support
 ~ 39% cost share on projects

Federal Investment to Date
 ~ \$360 Million

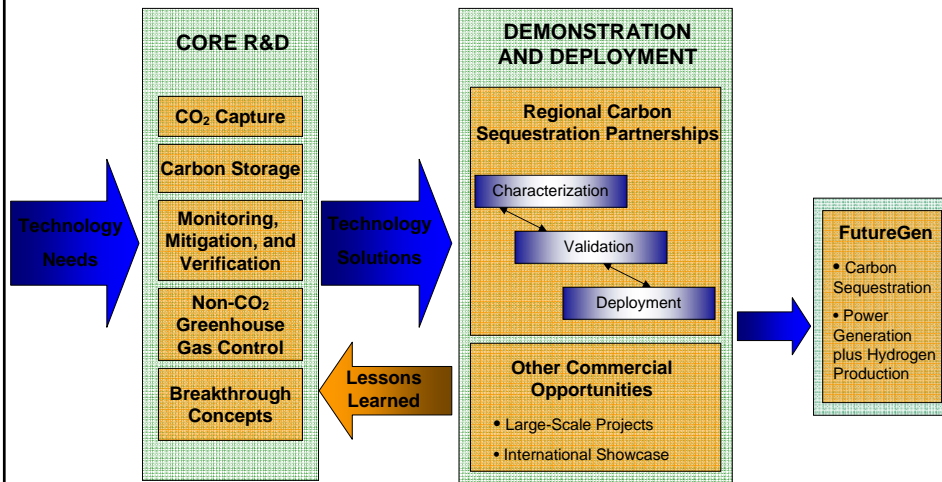
Diverse research portfolio

~ 70 Active R&D Projects



03/29/2007

DOE's Carbon Sequestration Program



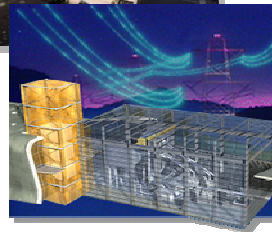
03292007

Before CO₂ Can be Stored...it Must be Captured

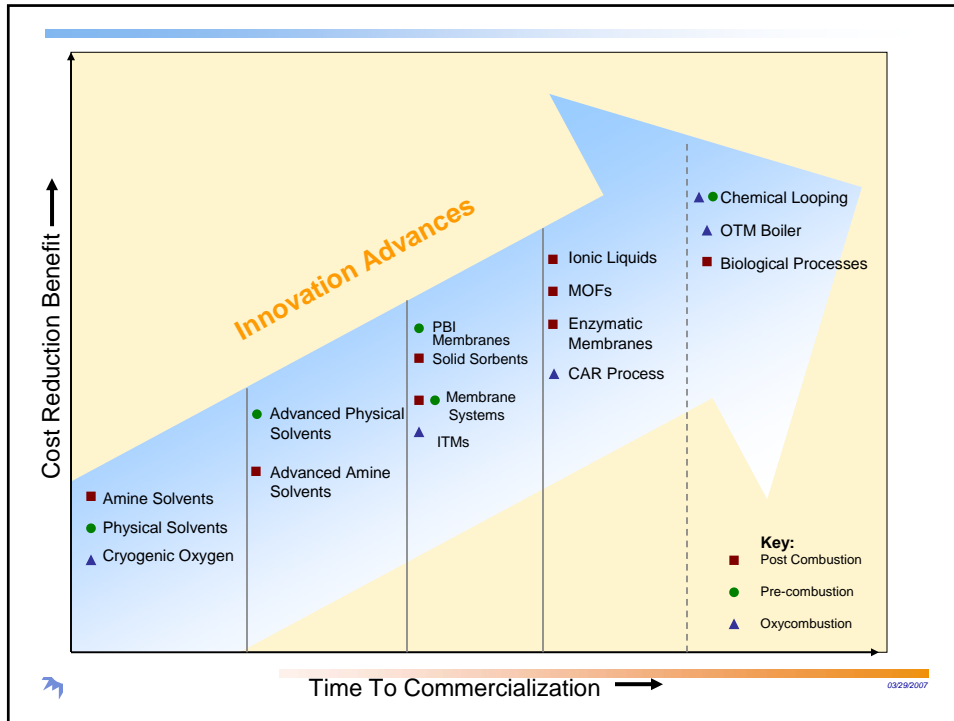
Separation and concentration of CO₂ from fuel or flue streams:

Three general classes of capture technology:

- Pre-combustion (IGCC)
- Post-combustion
- Oxy-firing combustion



03292007



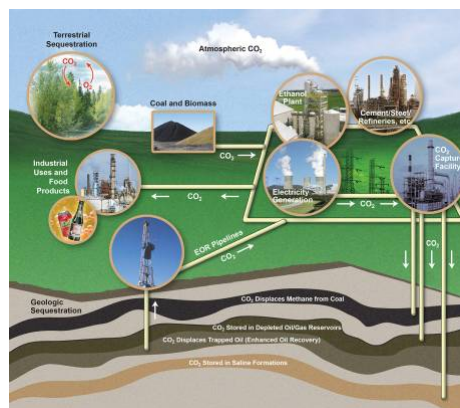
Once Captured, CO₂ Needs to be Stored

Storage locations include:

- Underground reservoirs (geological)
 - Enhanced oil recovery
 - Depleted oil and gas fields
 - Saline aquifers
 - Unmineable coal beds
- Trees, grasses, soils, or algae (terrestrial)
- Dissolved in deep oceans

Developing new technology

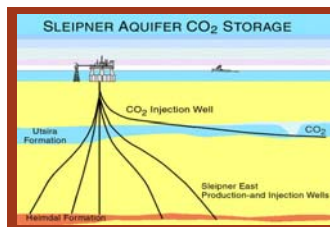
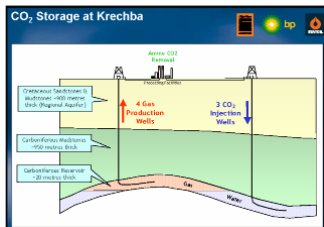
Demonstrating existing technologies at scale



Geologic Sequestration Is Already Under Way

Million Tonnes per year injections

- Statoil at Sleipner since '96
- BP at In Salah
- EnCana EOR project with CO₂ storage in the Weyburn field



03/29/2007

Regional Carbon Sequestration Partnerships

Characterization Phase (2003-2005)

- Characterize regions for most promising CCS opportunities
- \$16M DOE funds

Validation Phase (2005 - 2009)

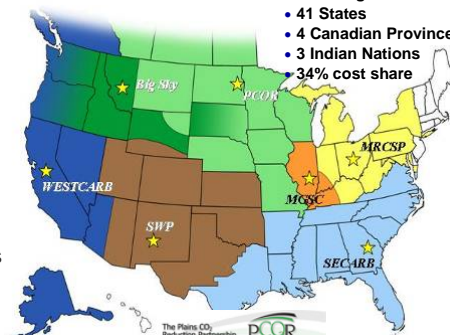
- Validate technologies through field testing in geologic and terrestrial sinks
- \$112M DOE funds

Deployment Phase (2008-2017)

- Large volume deployment tests of sequestration technology
- up to \$470M DOE funds

Representing:

- >350 Organizations
- 41 States
- 4 Canadian Provinces
- 3 Indian Nations
- 34% cost share

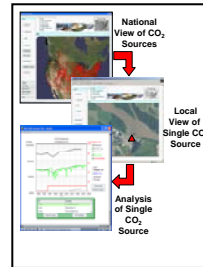


03/29/2007

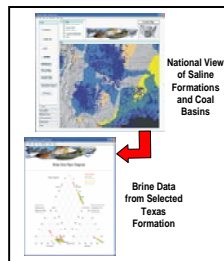
Characterization Phase Accomplishments

National Carbon Sequestration Database and Geographical Information System (NATCARB)

- Relational database and geographic information system (GIS)
- Integrates data from the RCSPs and various other sources
- Provides a National view of the carbon sequestration potential in the U.S. and Canada



CO₂ Sources



CO₂ Sequestration Site



- Allows users to estimate the amount of CO₂ emitted by sources in relation to geologic formations that can provide safe, secure sequestration sites over long periods of time

03/29/2007

Characterization Phase Accomplishments

Completed regulatory review and gap analysis – IOGCC Report 2005

Public outreach

- Documentary of Carbon Sequestration
- Focus groups used to gauge public opinion
- Outreach materials - websites and fact sheets

Developed regional action plans for regulatory permitting, MMV, outreach, and project implementation

Identified promising opportunities for validation phase



03/29/2007

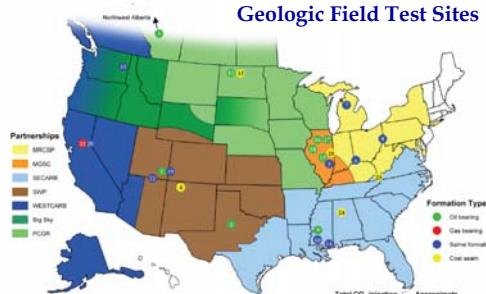


Validation Phase Field Tests

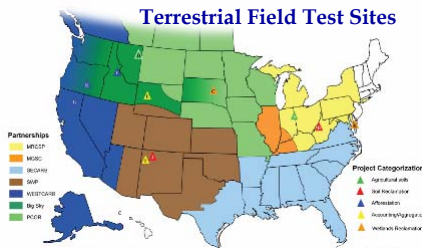
Geologic Tests (25 injection tests)

- Validating geologic formation capacities
- Validating injectivity
- Monitoring mitigation and verification technologies (reservoir modeling)
- Permitting requirements
- Public outreach and perception
- Testing formation seals
- Investigating well bore construction methods

Geologic Field Test Sites



Terrestrial Field Test Sites



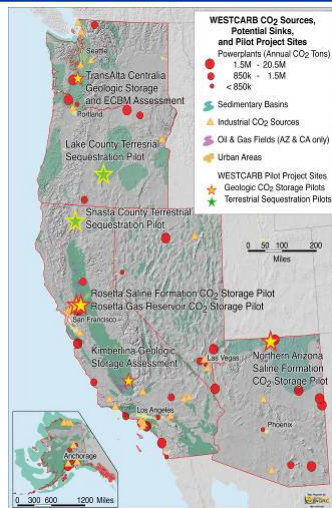
Terrestrial Tests (11 field tests)

- Tree-plantings
- No-till farming
- Wetlands restoration
- Land management: grasslands, grazing lands
- Fire management
- Forest preservation
- Monitoring, mitigation, and verification technologies
- accounting protocols for trading markets (CCX)



03/29/2007

West Coast Regional Carbon Sequestration Partnership California Energy Commission



Source: California Energy Commission, 2006

- Partnership covers 6 states and 1 Canadian province
- Significant consumer of electricity and fossil fuels
- Long history of oil production
- CO₂ storage capacity greater than 200 billion tons
- Geologic Field Tests
 - Stacked depleted gas and saline formation test
 - Deep saline injection in Arizona



03/29/2007

Big Sky Carbon Sequestration Partnership Montana State University – Bozeman, MT

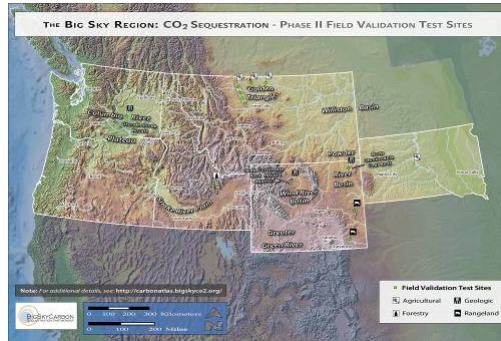
Partnership covers 6 states

Extensive reactive carbonate and basalt formations

CO₂ storage capacity about 300 billion tons

Geologic sequestration efforts

- Pilot injection (SW Wyoming)
- Kevin Dome characterization study (north central Montana)
- Basalt characterization (eastern Washington)



03/29/2007

Plains CO₂ Reduction Partnership UND, Energy and Environmental Research Center



Represent 9 states and 4 Canadian provinces

Over 130 billion tons storage capacity in oil, coal, and saline formations

Geologic Demonstrations

- Williston Basin, North Dakota.
- Zama, Alberta. Acid gas Injection with EOR
- Lignite Coal, North Dakota

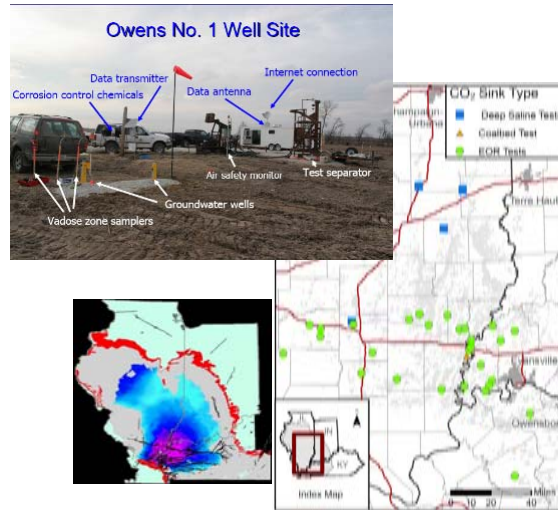


Source: UND, EERC 2005

03/29/2007

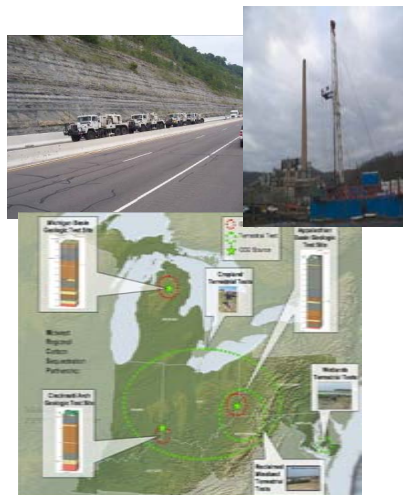
Midwest Geological Sequestration Consortium Illinois State Geological Survey

- **Covers Illinois Basin**
- **Large storage potential**
 - Over 35 billion tons in different formations
- **Six field tests proposed from portfolio of 34**
 - 4 sites selected
 - Injection initiated
 - 11 oil operators involved
 - Coal seam site selected
 - Saline site selected
- **Conducting structural characterization using seismic imaging**



03/29/2007

Midwest Regional Carbon Sequestration Partnership Battelle Laboratories



- **Covers much of the Midwest and Mid Atlantic Region of the United States**
- **Nations engine room**
 - 21% of U.S. electricity production
 - 75% from coal
- **Significant geologic storage capacity**
 - Over 55 billion tons of CO₂
- **Three Geologic demonstrations**
 - Appalachian Basin – well drilled
 - Cincinnati Arch – seismic complete
 - Michigan Basin – injection Dec 07

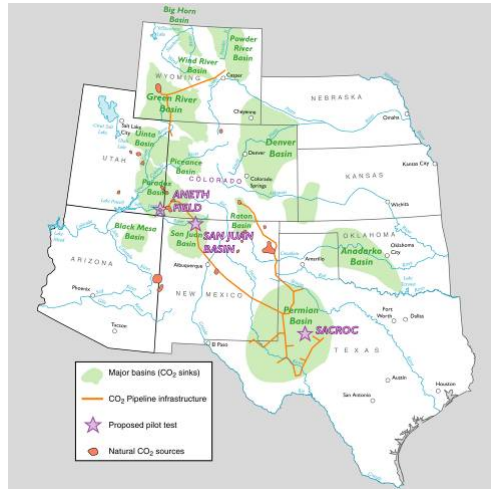


Source: Battelle, 2006

03/29/2007

Southwest Partnership on Carbon Sequestration New Mexico Institute of Mining and Technology

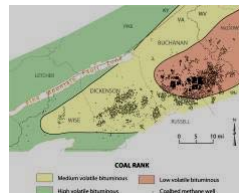
- Partnership covers 8 states
- Large potential capacity throughout the major basins - Over 55 billion tons
- 30 year history of CO₂ EOR and pipeline industry
- Geologic Sequestration Tests
 - 2 CO₂ Sequestration/EOR Tests in the Paradox and Permian basins
 - 1 Coal bed sequestration and methane recovery test – San Juan Basin, NM



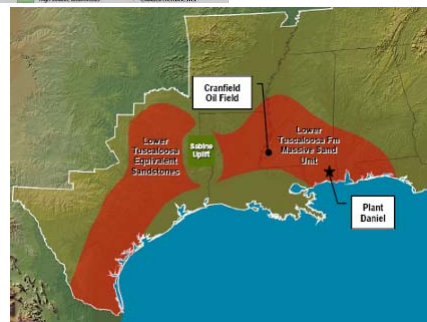
03/29/2007

Southeast Regional Carbon Sequestration Partnership Southern States Energy Board

- Partnership covers entire Southeastern and Gulf Coast of the United States
- Large potential capacity
 - Over 400 billion tons in oil, coal, and saline formations
- Nearly 30% of national CO₂ emissions from the region
- Geologic sequestration tests
 - Stacked saline test – Cranfield Oil Field
 - Deep saline test in Mississippi
 - Two coal bed storage tests in Alabama and Appalachia



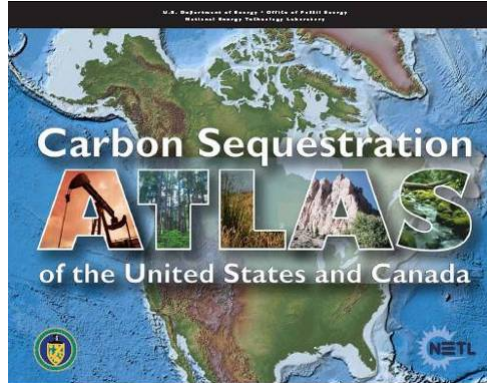
Source: Virginia Center for Coal and Energy Research, Virginia Tech



03/29/2007

Carbon Sequestration Atlas of the United States and Canada

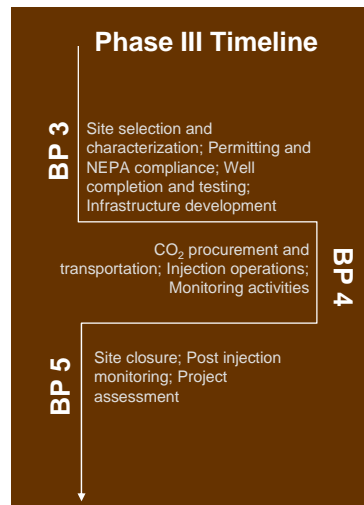
- First version of the Carbon Sequestration Atlas of the U.S. and Canada
- Methodology developed by experts in the U.S. and Canada involved in the Partnerships
- Provides both a National and Regional Summaries of CCS opportunities
- Development of Atlas II underway (November 2008 release goal)
- Focus of Atlas II is adding new info on basins/formations; documenting procedures; defining storage “resource”



03/29/2007

Deployment Phase *Scaling Up Towards Commercialization*

- FY 2008-2017 (10 years)
- Seven Large Volume Sequestration tests in North America
- Injection rates from 250,000 to 1,000,000 tons per year for several years
- Scale up is required to provide insight into several operational and technical issues in different formations



03/29/2007

Deployment Phase Status

- **Three projects awarded in September 2007**
- **Plains CO₂ Reduction Partnership, UNDEERC**
 - Williston Basin EOR/Sequestration
 - Alberta Basin Acid Gas Storage Project
- **Southeast Regional Carbon Sequestration Partnership**
 - Tuscaloosa massive sandstone formation
 - “Early” and “Anthropogenic” Tests
- **Southwest Regional Carbon Sequestration Partnership**
 - Jurassic age Entrada formation



Benefits of the RCSP Initiative

- **Better understanding of regional opportunities**
- **Test and refine geologic models**
- **Measure fate of CO₂; identify best MMV technologies**
- **Best management practices to address site selection, well design, operations, monitoring, and closeout**
- **Engagement of regional stakeholders**



Regional Carbon Sequestration Partnerships

	California Energy Commission http://www.westcarb.org/
	New Mexico Institute of Mining and Technology http://www.southwestcarbonpartnership.org/
	Montana State University http://www.bigskyco2.org/
	University of North Dakota, Energy & Environmental Research Center http://www.undeerc.org/pcor/
	University of Illinois, Illinois State Geological Survey http://www.sequestration.org/
	Battelle Memorial Institute http://www.mrcsp.org/
	Southern States Energy Board http://www.secarbon.org/



03/29/2007

Additional Information

National Energy Technology Laboratory
Site Map



THE ONLY U.S. NATIONAL LABORATORY DEVOTED TO FOSSIL ENERGY TECHNOLOGY

- ABOUT NETL
- KEY ISSUES & MANDATES
- ON-SITE RESEARCH
- TECHNOLOGIES
 - Oil & Natural Gas Supply
 - Coal & Power Systems
 - Carbon Sequestration
 - Overview
 - CO₂ Capture
 - CO₂ Storage
 - Monitoring, Mitigation, Verification
 - Non-CO₂ Greenhouse Gases
 - Breakthrough Concepts
 - Regional Partnerships
 - Systems & Analysis
 - FAQs
 - Contacts
 - Hydrogen & Clean Fuels
 - Technology Transfer
- ENERGY ANALYSES
- SOLICITATIONS & BUSINESS
- CAREERS & FELLOWSHIPS
- NEWSROOM
- CONTACT NETL

Home » Technologies » Carbon Sequestration

Technologies
Carbon Sequestration

NETL's Carbon Sequestration Program is helping to develop technologies to capture, purify, and store carbon dioxide (CO₂) in order to reduce greenhouse gas emissions without adversely influencing energy use or hindering economic growth. Carbon sequestration technologies capture and store CO₂ that would otherwise reside in the atmosphere for long periods of time.



Worldwide CO₂ emissions from human activity have increased from an insignificant level two centuries ago to more than 23 billion tons today. The U.S. Energy Information Administration predicts that, if no action is taken, the United States will emit 8,800 million tons of CO₂ by 2030, a 33 percent increase above 2000 emission levels.

Wyburn Carbon Dioxide Sequestration Project

The Carbon Sequestration Program contributes significantly to the President's goal of developing technologies to substantially reduce greenhouse gas emissions. By 2012, NETL envisions having a technology portfolio of safe, cost-effective, commercial-scale greenhouse gas capture, storage, and mitigation technologies, leading to substantial deployment and market penetration.

NETL's primary Carbon Sequestration research and development (R&D) objectives are: (1) lowering the cost and energy penalty associated with CO₂ capture from large point sources, and (2) improving the understanding of factors affecting CO₂ storage permanence, capacity, and safety in geologic formations and terrestrial ecosystems. Once these objectives are met, new and existing power plants and fuel processing facilities in the U.S. and around the world will have the potential to be retrofitted with CO₂ capture technologies.

Carbon capture and sequestration begins with the separation and capture of CO₂ from power plant flue gas and other stationary CO₂ sources. At present, the

NEWS & FEATURES // [»](#)

- Carbon Sequestration Program Environmental Reference Document
- An Introduction to Carbon Capture and Sequestration (Video: 00:07)
- Interdisciplinary, General Engineer/Physical Scientist, 05-8011201-12013
- Carbon Sequestration Technology Roadmap (PCF-5-588)
- Carbon Sequestration Program Outreach Plan (PDF-143088)
- DOE Advances Commercialization of Climate Change Technology
- Regional Carbon Sequestration Partnerships Program Adds Canadian Provinces

EVENTS CALENDAR // [»](#)

- 7th Annual Carbon Capture & Sequestration Conference to be held May 2008

PUBLICATIONS & PROJECTS // [»](#)

- Carbon Sequestration Reference Sheet
- Carbon Sequestration Project Portfolio (PCF-12028)
- The Carbon Sequestration Newsletter, 11/07

http://www.netl.doe.gov/technologies/carbon_seq/index.html



03/29/2007

Questions ?

