NATIONAL ENERGY TECHNOLOGY LABORATORY

U.S. DOE Office of Fossil Energy National Energy Technology Laboratory

August 21-23, 2012

Pittsburgh, PA

Carbon Storage Research and Development Project Review Meeting

Presenter: John Litynski, PE

United States Department of Energy, National Energy Technology Laboratory,

WELCOME

Carbon Storage Program
Annual Project Review Meeting

- Annual requirement in all cooperative agreements and grants
- First complete program review of 126 carbon storage projects
  - 7 Regional Partnerships (Large scale injection projects)
  - 14 Infrastructure (Injection, Characterization, systems modeling)
  - 38 Geologic Storage
  - 28 Simulation and Risk Assessment
  - 26 Monitoring, Verification, and Accounting (MVA)
  - 6 CO2 Use and Reuse
  - 7 Training Centers
- Report on technical progress and financial status of projects
- 55 Posters
- Find opportunities for collaboration

Plenary Sessions

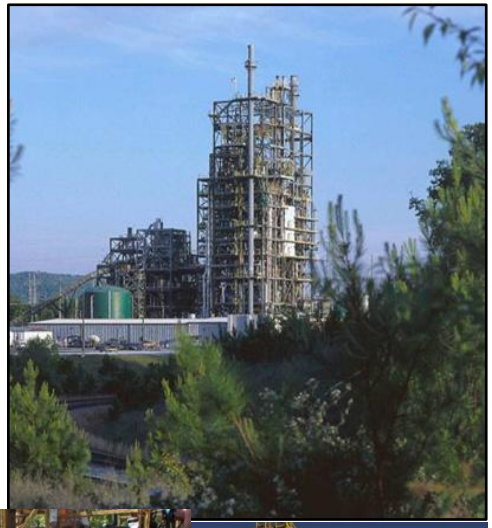
- Regional Carbon Sequestration Partnerships
- EPA Offices of Air and Water Regulatory Update
- Natural Resources Defense Council Perspective
- DOE's Cost Models and Benefits Analysis for CCUS R&D
- Major International Activities
- Chair of the NRC Induced Seismicity Report
- Future Carbon Storage R&D Opportunities

Carbon Storage Program 2012
Year in Review

Core Program Components

Office of Coal and Power R&D

Total FY 2012 Funding ~ $333 Million



- **Carbon Capture - $68.9 Million**
- **Carbon Storage - $115.4 Million**
- **Advanced Energy Systems- $99.9 Million**
  - Advanced Combustion Systems - $15.9 Million
  - Gasification - $39 Million
  - Turbines - $15 Million
  - Fuel Cells - $25 Million
  - Fuels - $5 Million

- **Cross Cutting Research - $49.1 Million**

CO_2 Utilization
Putting the "U" in CC*U*S

- **Lack of Climate legislation**
- **Low Natural Gas Prices**
- **High Oil Prices**
- **Regulations Impacting New Coal Fired Power Plants**
- **Demands a near term business case for deployment**

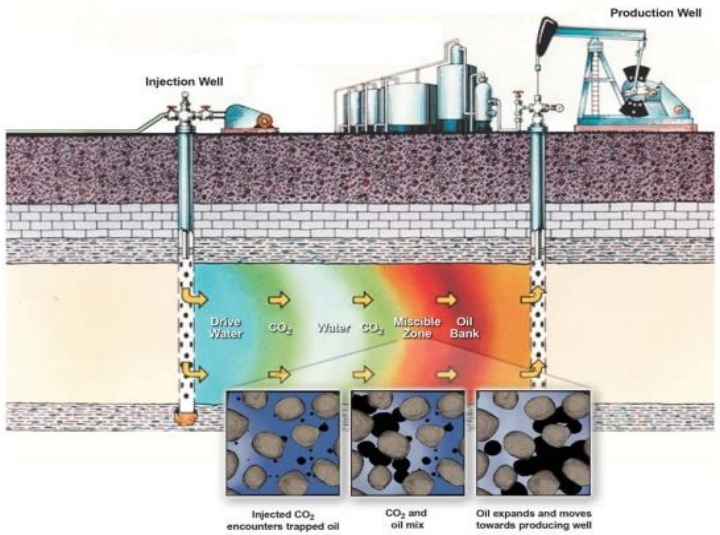
Drivers for Storage in EOR/EGR Opportunities

Economic Benefits

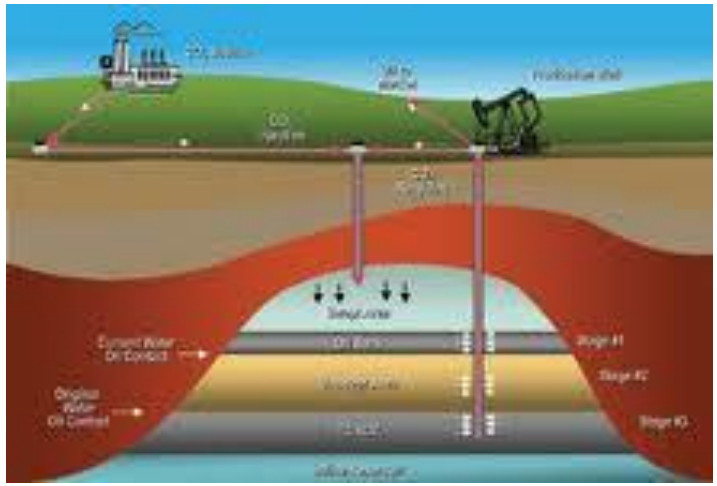
- Produce an additional 60 billion bbl of oil
- Balance trade deficit by over $3.5 trillion
- Create more than 600,000 new jobs

Technical Benefits

- Store over 20GT of CO2
- Develop infrastructure to support transition to future saline storage
- Validate storage and monitoring technologies
- Facilitate knowledge sharing between oil and storage industry to improve performance
- Potentially increase reserves of storage capacity and natural gas in coal and shale formations



Business as usual EOR Operations (WAG)



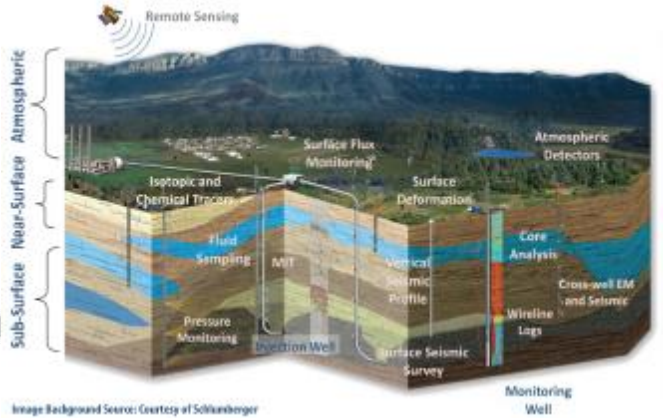
Next Generation Storage/EOR Operations

CCUS Goals

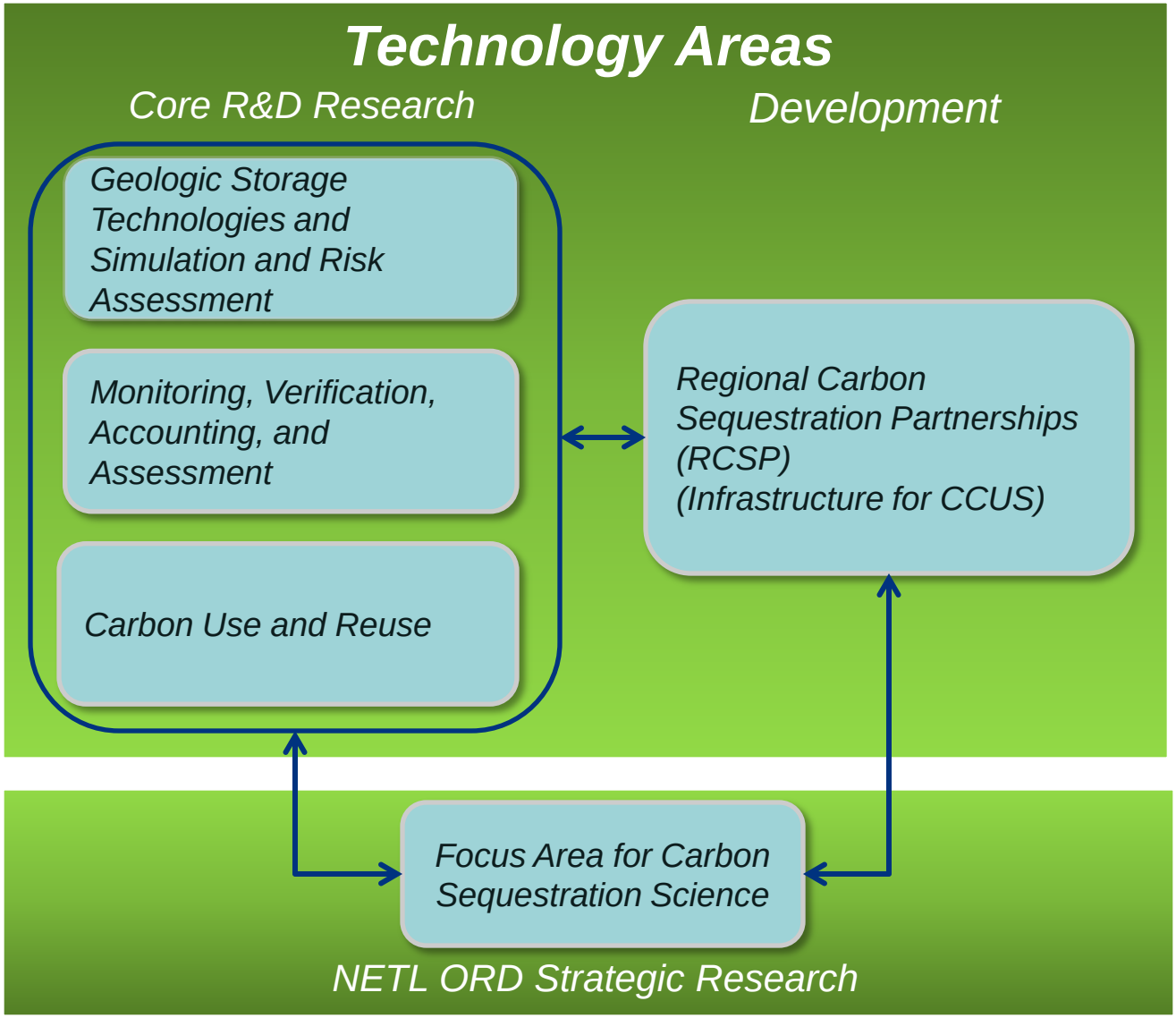
Keeping R&D on Track

Deliver technologies & best practices that validate:

- < 10% increase in COE with CCS at 90% capture (pre-comb.)
- < 35% increase in COE with CCS at 90% capture (post- & oxy-comb.)
- > 90% CO_2 capture
- **99% storage permanence****
- **Validate that capacity is sufficient and where we need it**
- **Validate Formation Classes & maximum storage efficiency**
- **Promote infrastructure for wide scale deployment**
- **Enhance domestic oil & gas production**



2012 Carbon Storage Program



Core R&D Workshop Overview

- **Oct 19-20, 2011 in Pittsburgh, Pennsylvania, USA**
- **Assess Research Gaps and Needs for Geologic Storage**
- **External Assessment (to NETL)**
- **Approximately 50 participants**
  - Academia, National Labs, Industry
- **Two segments; 1 ½ days**
  - Plenary presentations first half day
  - Breakout session discussions remainder of time
- **Results: Priorities to focus for current program**

Carbon Storage CCUS Program Plan

- **Available in Fall 2012**
- **Prioritization of R&D Goals**
- **2nd Generation Technologies**
  - Near and mid-term (2020)
- **Transformational Technologies**
  - Long-term (2030)

FY2012 Carbon Storage Technologies FOA

Geologic technologies and Sim/RA tools

"Developing Technologies to Ensure Permanent Geologic Storage"

- March 7 - FOA released
- April 17th – Applications Due
- Summer 2011 - Project selection
- Sept 30th – Projects Awarded
- Total funding available - ~$14M
- 17 Projects Selected for Award

High Priority Technical Areas

1 – Studies of existing wellbores exposed to CO2 and historical and failure rates

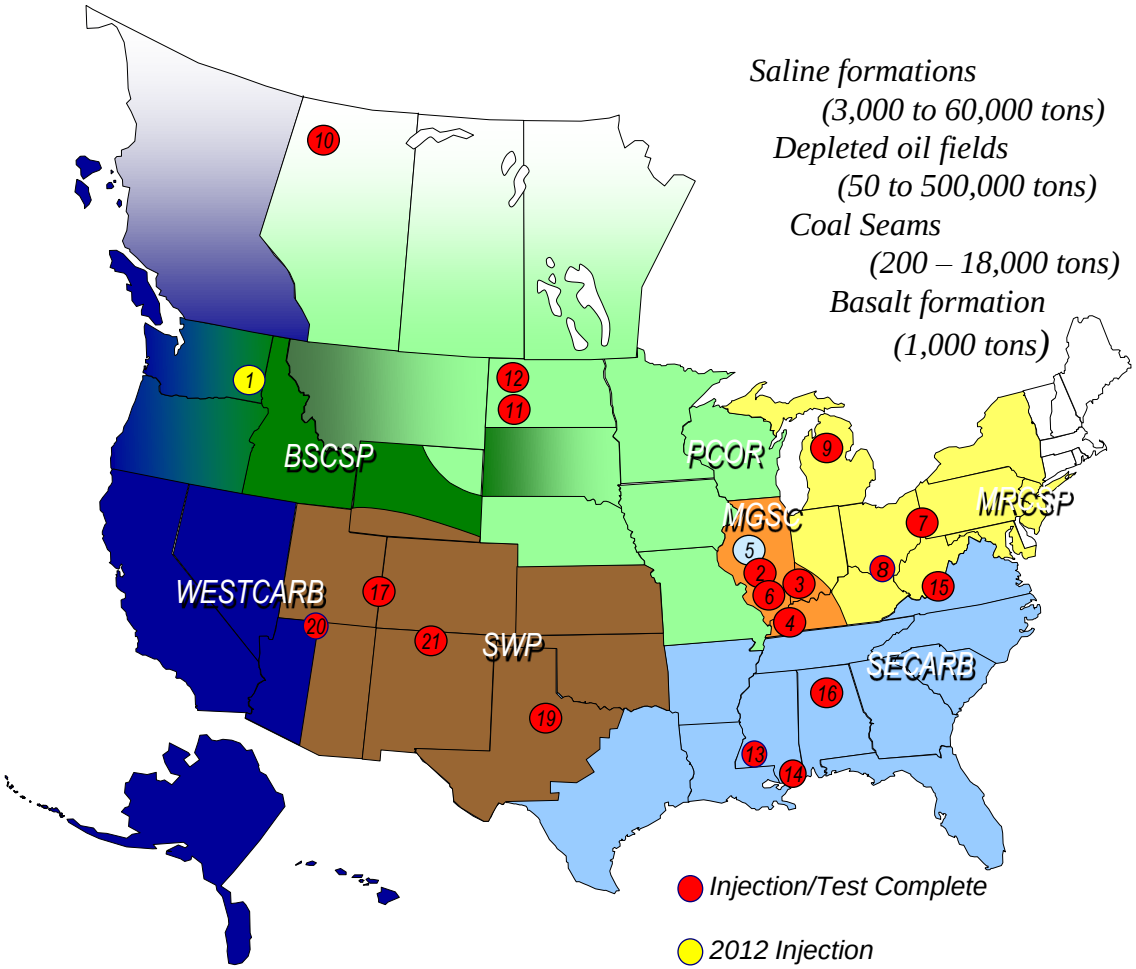
2 – Advanced wellbore and other leakage pathway integrity/mitigation technologies

3 – Field methods to optimize storage capacity and containment

4 – Enhancing simulation tools to improve prediction and enhance geologic storage performance

Contributing program goals of ensuring 99% permanence, improving storage efficiency and determining capacity.

Small-Scale Geologic Field Tests



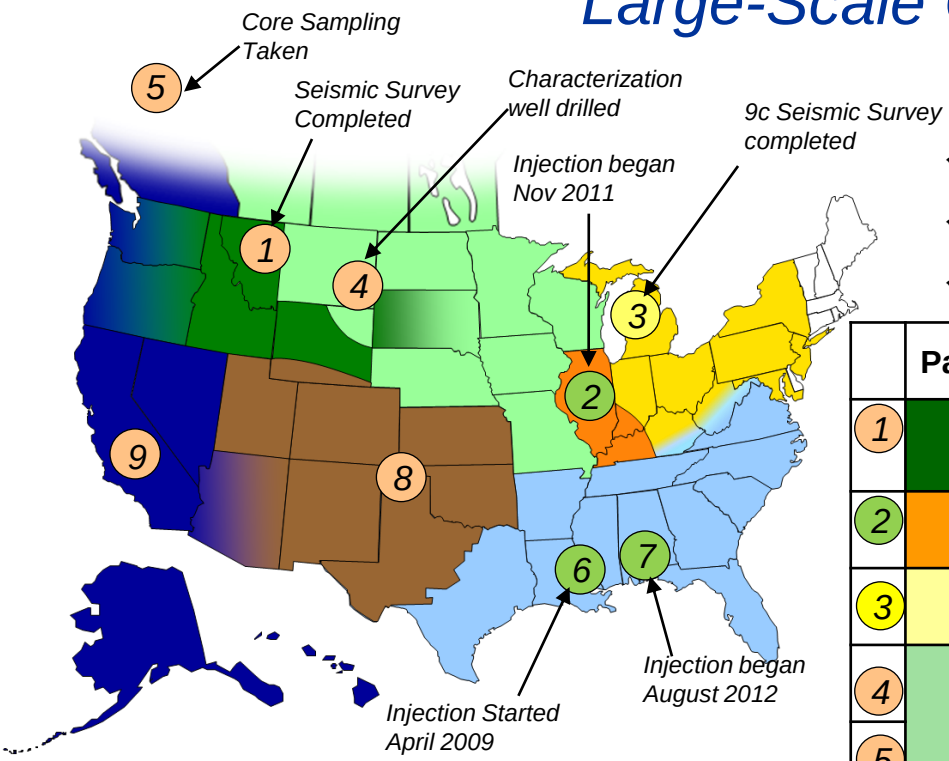
Completed 18 Injections

Over 1.35 M Tons injected

RCSP	Formation Type	Geologic Province
Big Sky	Saline 1	Columbia Basin
MGSC	Oil-bearing 2 3 4 Saline 5 Coal seam 6	Illinois Basin
MRCSP	Saline 7 8 9	Cincinnati Arch, Michigan Basin, Appalachian Basin
PCOR	Oil-bearing 10 11 Coal seam 12	Keg River, Duperow, Williston Basin
SECARB	Oil-bearing 13 Saline 14 Coal seam 15 16	Gulf Coast, Mississippi Salt Basin, Central Appalachian, Black Warrior Basin
SWP	Oil-bearing 17 18 Coal seam 19	Paradox Basin, Aneth Field, Permian Basin, San Juan Basin
WESTCARB	Saline 20	Colorado Plateau

RCSP Phase III: Development Phase

Large-Scale Geologic Tests



- Injection Ongoing
- 2012 Injection Scheduled
- Injection Scheduled 2013-2015

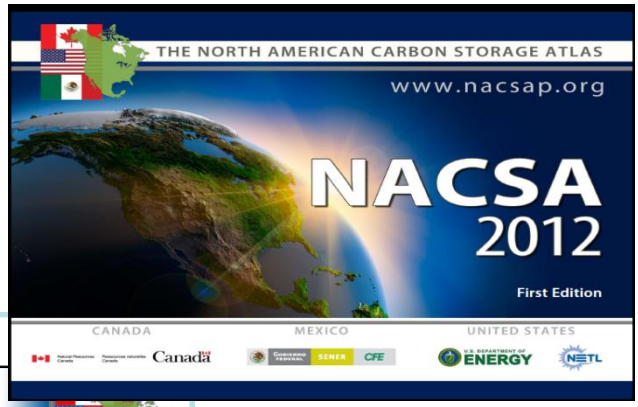
Note: Some locations presented on map may differ from final injection location

- ✓ *Large-volume tests*
- ✓ *Two projects currently injecting CO_2*
- ✓ *Remaining injections scheduled 2012-2015*

	Partnership	Geologic Province	Target Injection Volume (tonnes)
1	Big Sky	Nugget Sandstone	1,000,000
2	MGSC	Illinois Basin-Mt. Simon Sandstone	1,000,000
3	MRCSP	Michigan Basin-Niagaran Reef	1,000,000
4	PCOR	Powder River Basin-Bell Creek Field	1,500,000
5		Horn River Basin-Carbonates	2,000,000
6	SECARB	Gulf Coast – Cranfield Field- Tuscaloosa Formation	2,902,000
7		Gulf Coast – Paluxy Formation	450,000
8	SWP	Regional CCUS Opportunity	1,000,000
9	WESTCARB	Regional Characterization	

North American Carbon Atlas Partnership

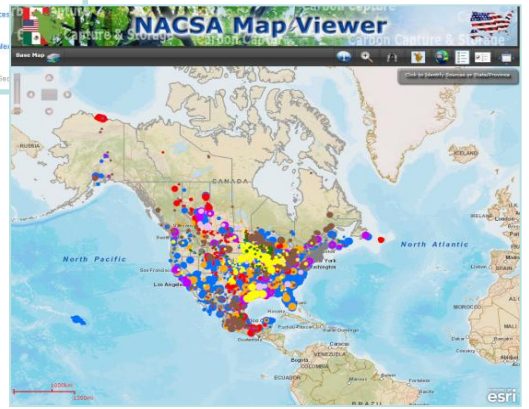
First coordinated effort between Canada, Mexico, and the United States to jointly publish a resource of data and information on CCS technologies, pressing issues, and current progress toward solutions



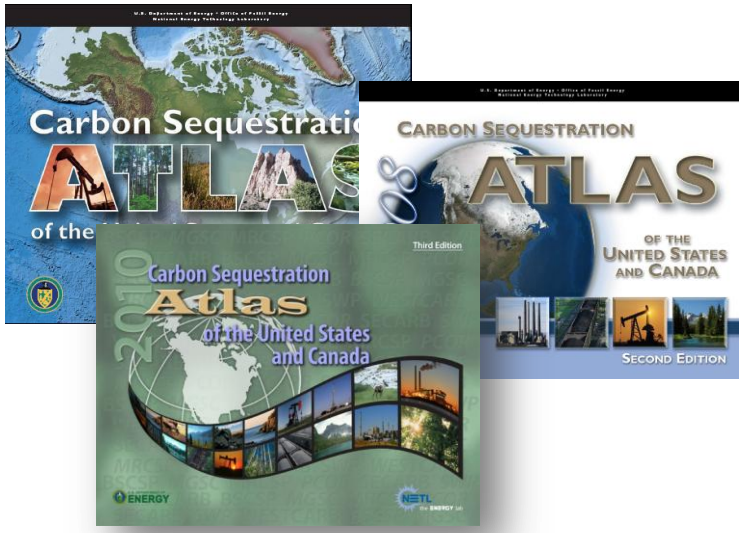
- **NACAP's Objective:**
  - Identify, gather, and ***share*** data of CO_2 sources and geologic storage potential

- **Development of this GIS-based CO_2 sources and storage database**

- **3 North American Products:**
  - NACSA website (http://www.nacsap.org/) – online version of NACSA, links to resources (English, Spanish, and French)



Carbon Sequestration Atlas of the United States and Canada



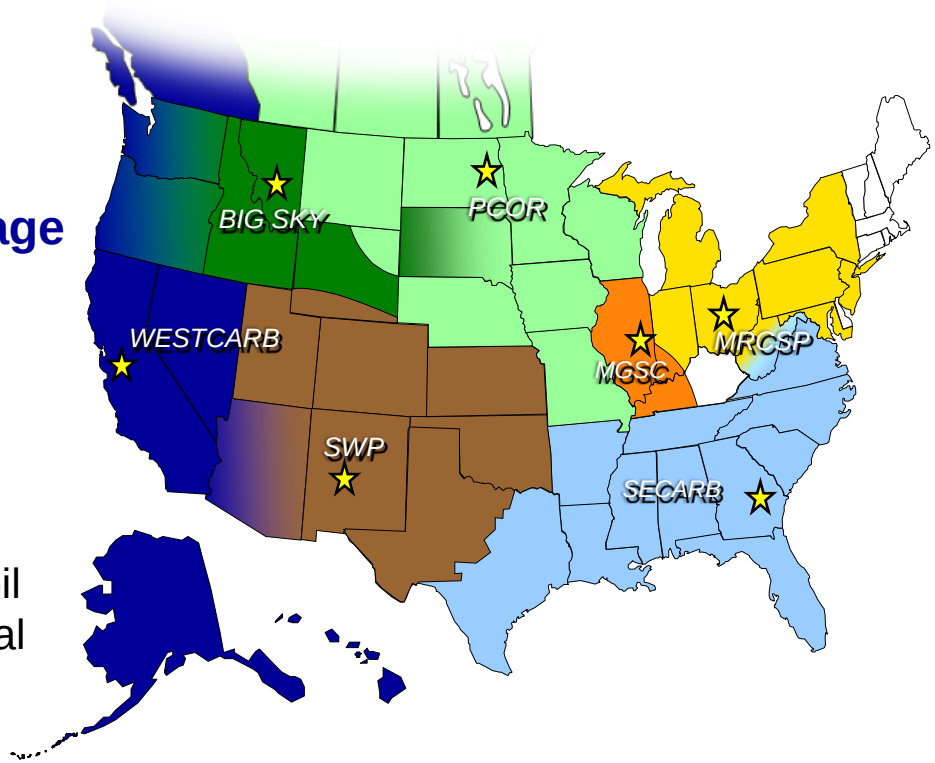
Atlas I - March 2007
Atlas II - November 2008
Atlas III - November 2010

U.S. 2012 Carbon Utilization and Storage Atlas -- ATLAS IV (Nov. 2012)

- Comparison of publically available methodologies for regional and site specific assessments

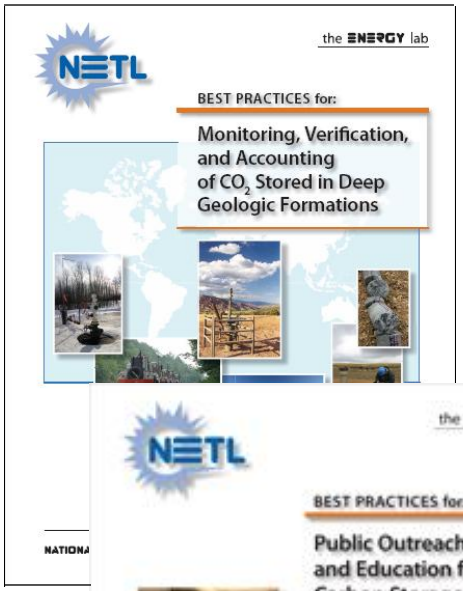
ATLAS V (Nov. 2014)

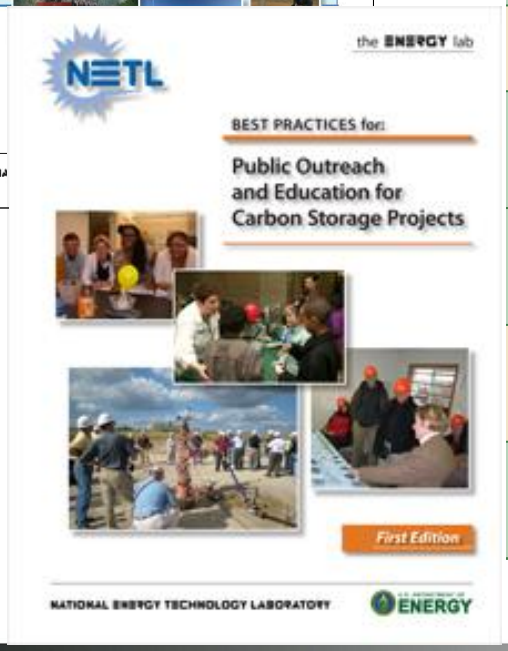
- Revised / Improved methodology for oil and gas formations and unconventional reservoirs (shale, unmineable coal, basalts)



CCS Best Practices Manuals

Critical Requirement For Significant Wide Scale Deployment - Capturing Lessons Learned





Best Practices Manual	Version 1 (Phase II)	Version 2 (Phase III)	Final Guidelines (Post Injection)
Monitoring, Verification and Accounting	2009/**2012**	2016	2020
Public Outreach and Education	2009	2016	2020
Site Characterization	2010	2016	2020
Geologic Storage Formation Classification	2010	2016	2020
**Simulation and Risk Assessment	2010	2016	2020
**Carbon Storage Systems and Well Management Activities	2011	2016	2020
Terrestrial	2010	**2016 – Post MVA Phase III**	

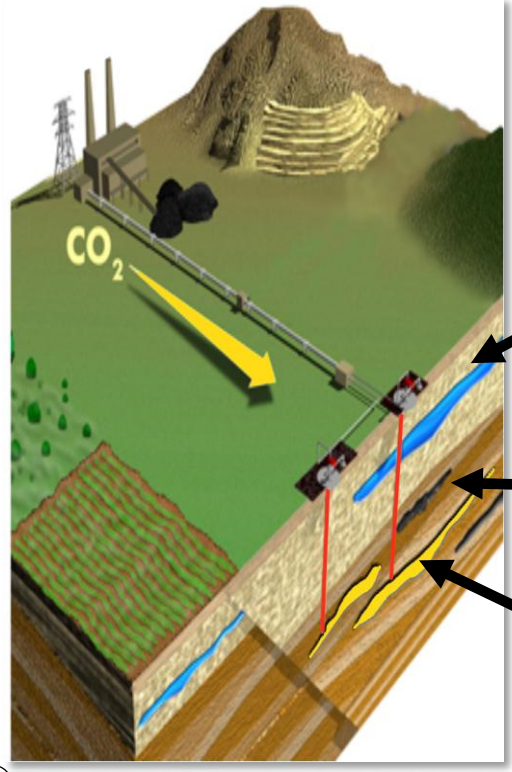
***Regulatory Issues will be addressed within various Manuals*

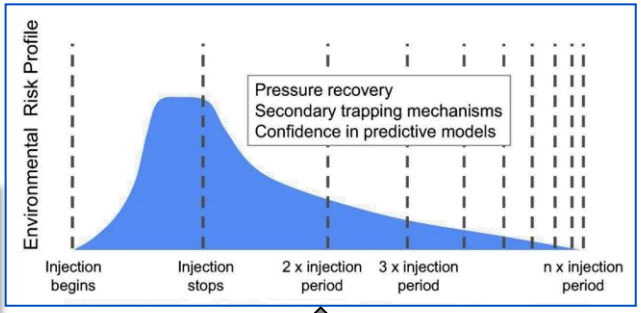
http://www.netl.doe.gov/technologies/carbon_seq/refshelf/refshelf.html

National Risk Assessment Partnership (NRAP)

Science-Based Quantification of Risk Profiles for CO_2 Storage

Berkeley Lab · Pacific Northwest National Laboratory · NETL · Los Alamos National Laboratory · Lawrence Livermore National Laboratory





Potential Receptors or Impacted Media

Release and Transport

Storage Reservoir

NRAP Technical Working Groups

- ***Groundwater Protection***
- ***Wellbore Integrity***
- ***Natural Seal Integrity***
- ***Reservoir Performance***

System-Level Risk Modeling

Strategic Risk-Based Monitoring

Data Exchange for Energy Solutions

EDX
Energy Data eXchange

- *R&D coordination & collaboration tool*
- *Share information across networks*
- *Rapid access through one site*
- *Online access for historical data*
- *Venue for newly released datasets*
- *Security, database design, and structure leverage DHS system*
- *Built to accommodate both open access and restricted access data*
- *Role-based security allows for groups or "communities" within the system*
- *Future FY13 roll outs will incorporate spatial/mapping tools, displays and other opportunities*

Designed for:

- *Fossil & renewable energy researchers*
- *Policy makers*
- *General public*

More information on EDX:
http://www.netl.doe.gov/publications/factsheets/rd/R%26D184%20.pdf

Now available at: https://edx1.netl.doe.gov

Questions

U.S. DOE Carbon Storage Program

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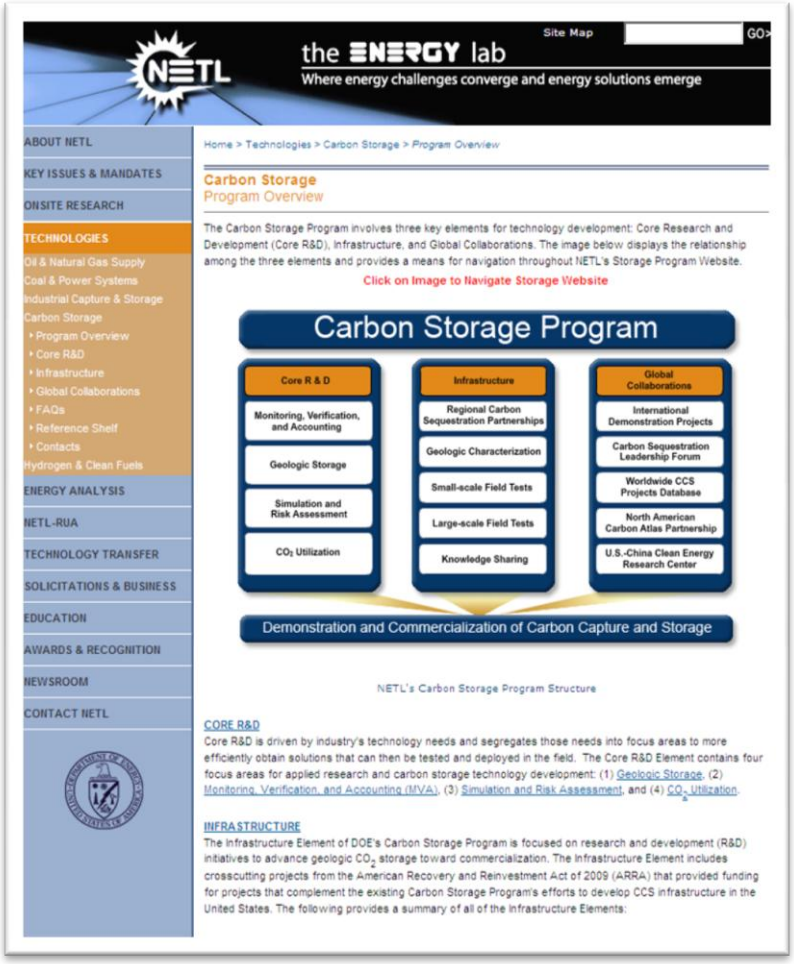

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