



NATIONAL ENERGY TECHNOLOGY LABORATORY



SECARB Annual Stakeholders Meeting

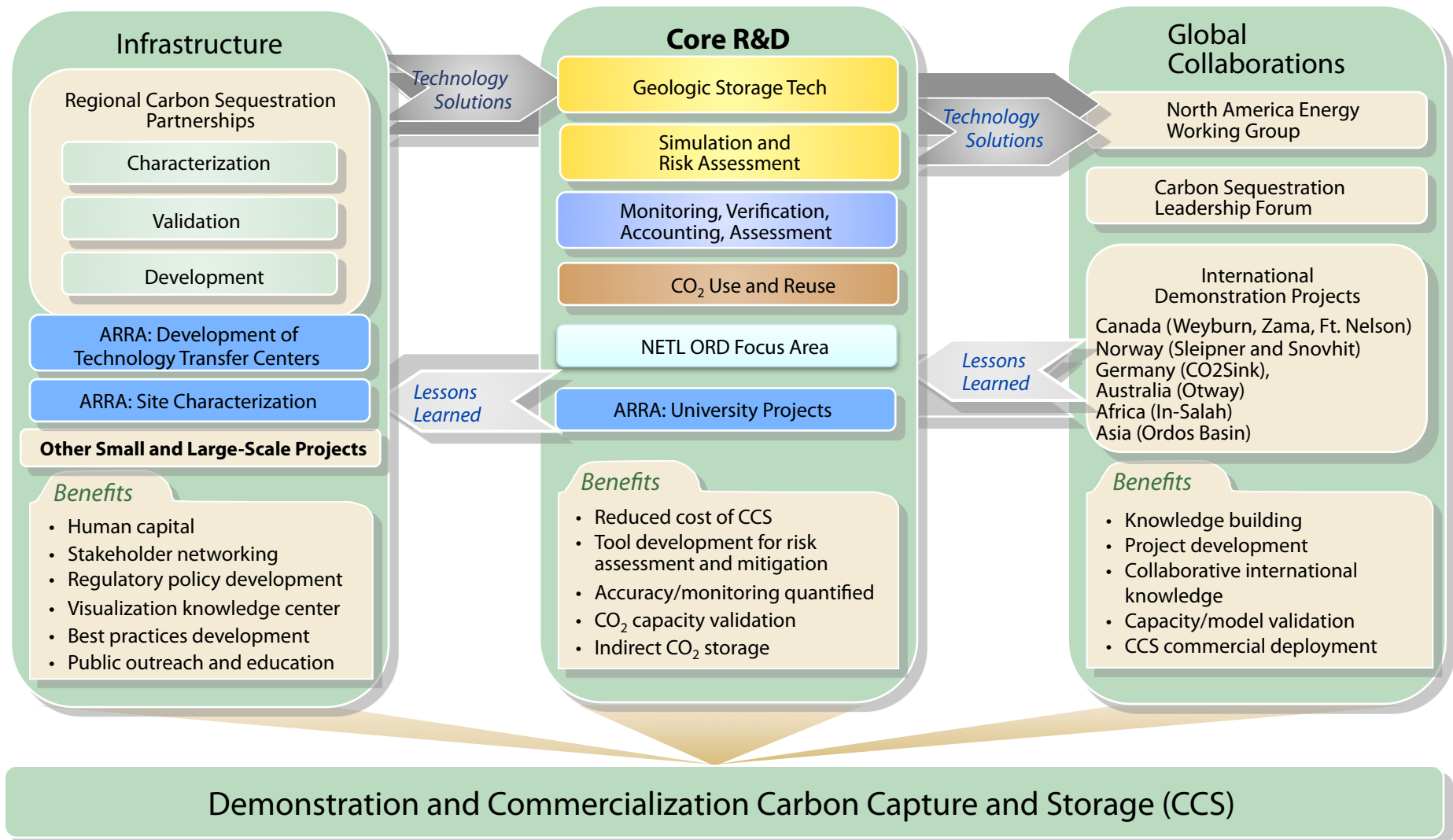
March 7, 2012

John Litynski, PE

Carbon Storage Technology Manager



CARBON SEQUESTRATION PROGRAM *with ARRA Projects*



Sequestration Program Total Funding

2012 Program Statistics

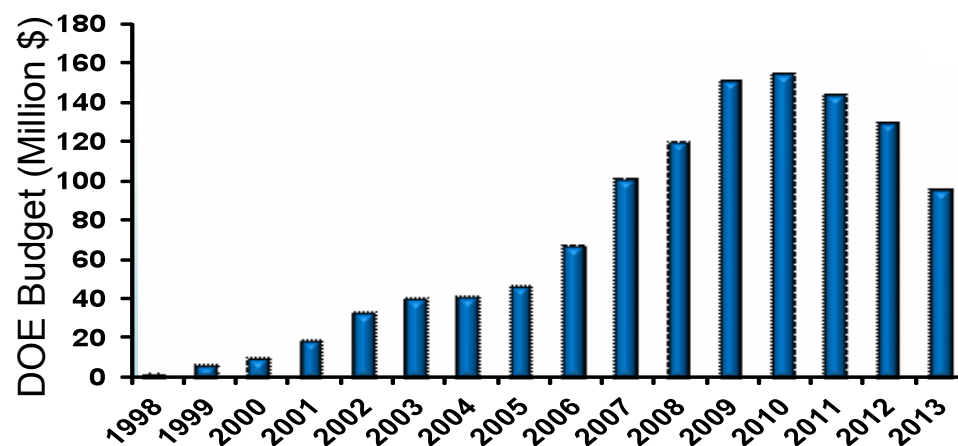
Core R&D Research

- *Geologic Storage*(Tech & SimRA)*
- *MVAA**
- *CO₂ Use and Reuse**

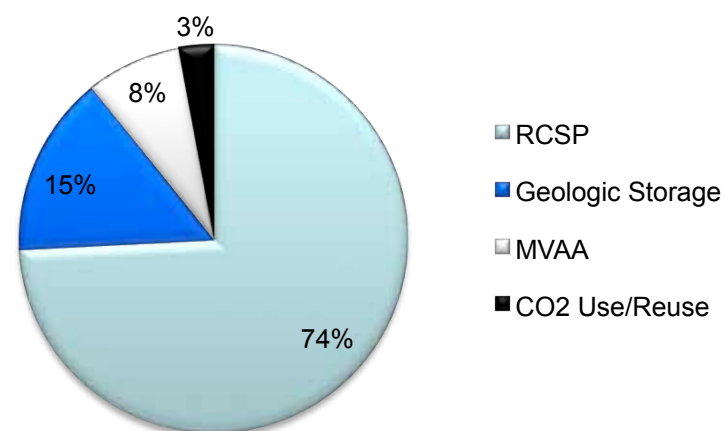
Regional Carbon Sequestration Partnership*

- *Large Scale Tests*
- *Small Scale Tests*
- *NATCARB*

Focus Area for GHG Control (NETL ORD)



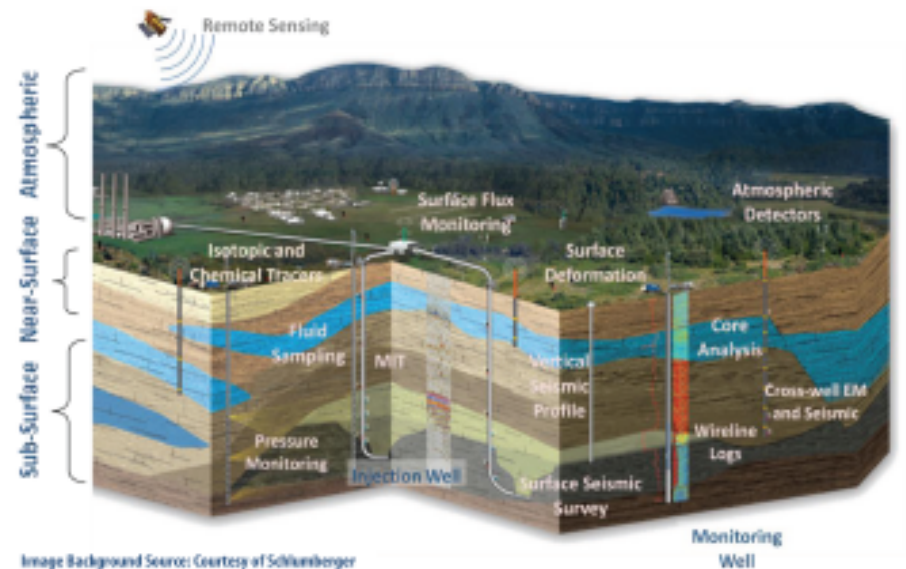
FY2012 Carbon Storage Budget



Carbon Storage Program Goals

Develop Technology Options That...

- **Deliver technologies & best practices that provide Geologic Carbon Storage (GCS) and CO₂ Utilization with:**
 - 99% storage permanence >1,000 years
 - Estimate capacity in reservoirs
 - Improve storage efficiency
 - Validation of Formation Classes
- **Supporting Activities**
 - Core R&D Projects
 - Infrastructure Development
 - International R&D Collaboration at Field Projects



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**

Core R&D Research Areas

Geologic Storage (Tech and SIMRA)

- Wellbore construction and materials
- Mitigation technologies for wells and natural pathways
- Fluid flow, reservoir pressure, and produced brines
- Geochemical effects on formation, brine, and organisms
- Geomechanical effect on reservoirs & seals

CO2 Use and Reuse

- Chemicals
- Polycarbonate plastics
- Minerals and cements (building products)
- EOR, EGR, and geothermal

MVAA Research Pathways

- Atmospheric and Remote Sensing Technologies
- Near surface monitoring of soils and vadose zone
- Subsurface monitoring in and near injection zone
- Intelligent monitoring systems for field management

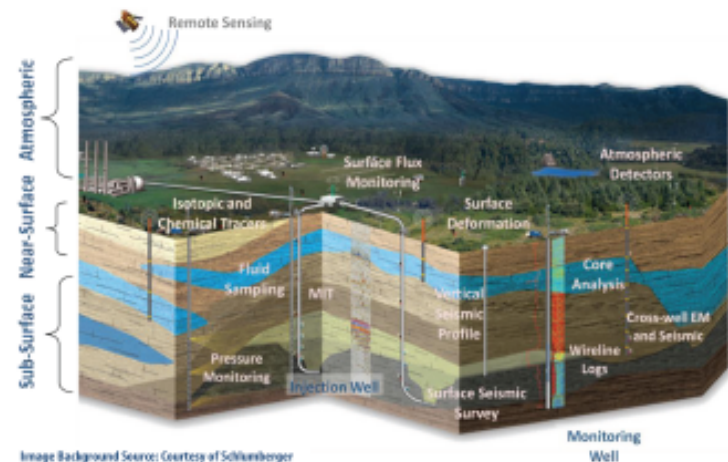


Image Background Source: Courtesy of Schlumberger

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
- 15+ awards

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.

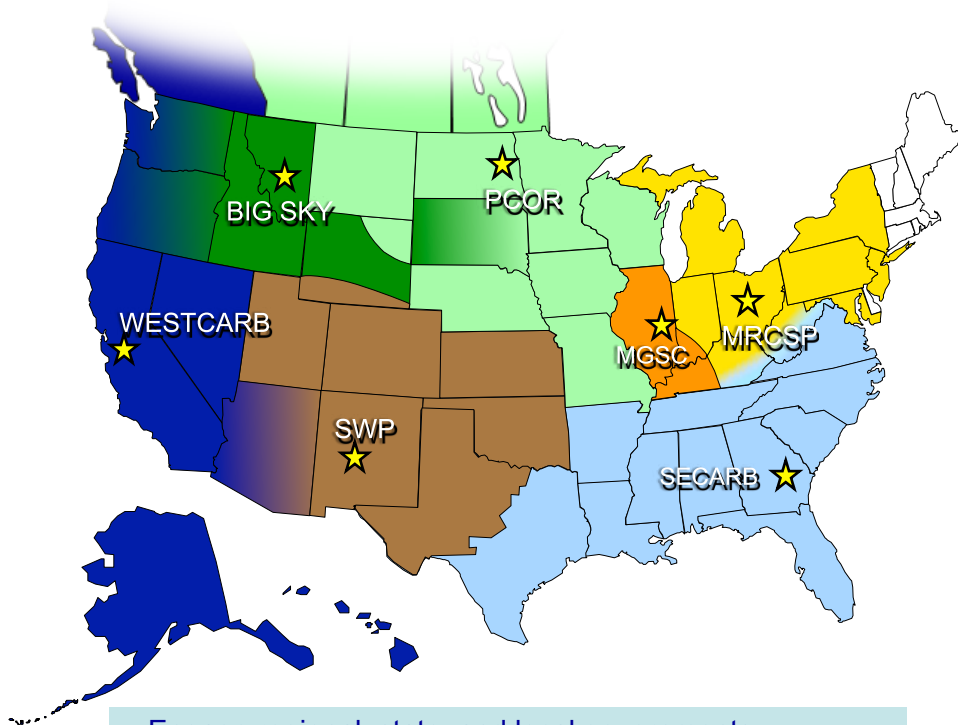
Regional Carbon Sequestration Partnerships *(Infrastructure)*

Regional Carbon Sequestration Partnerships

Developing the Infrastructure for Wide Scale Deployment

Seven Regional Partnerships

400+ distinct organizations, 43 states, 4 Canadian Provinces



- Engage regional, state, and local governments
- Determine regional sequestration benefits
- Baseline region for sources and sinks
- Establish monitoring and verification protocols
- Address regulatory, environmental, and outreach issues
- Validate sequestration technology and infrastructure

Characterization Phase (2003-2005)

Search of potential storage locations and CO₂ sources

Found potential for 100's of years of storage

Validation Phase (2005-2011)

18 injection tests in saline formations, depleted oil, unmineable coal seams, and basalt

Development Phase (2008-2018+)

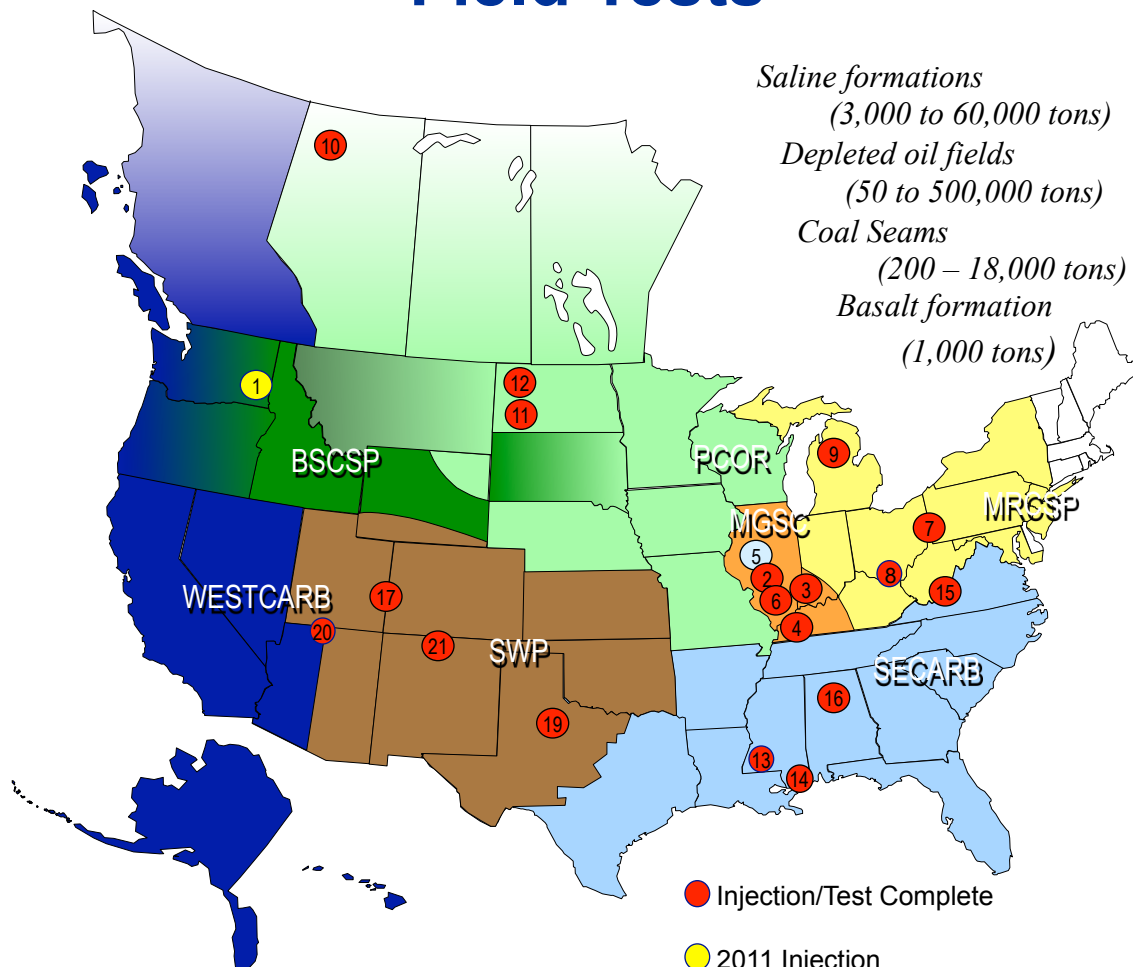
9 large scale injections (over 1 million tons each)

Commercial scale understanding

Regulatory, liability, ownership issues

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Small-Scale Geologic Field Tests



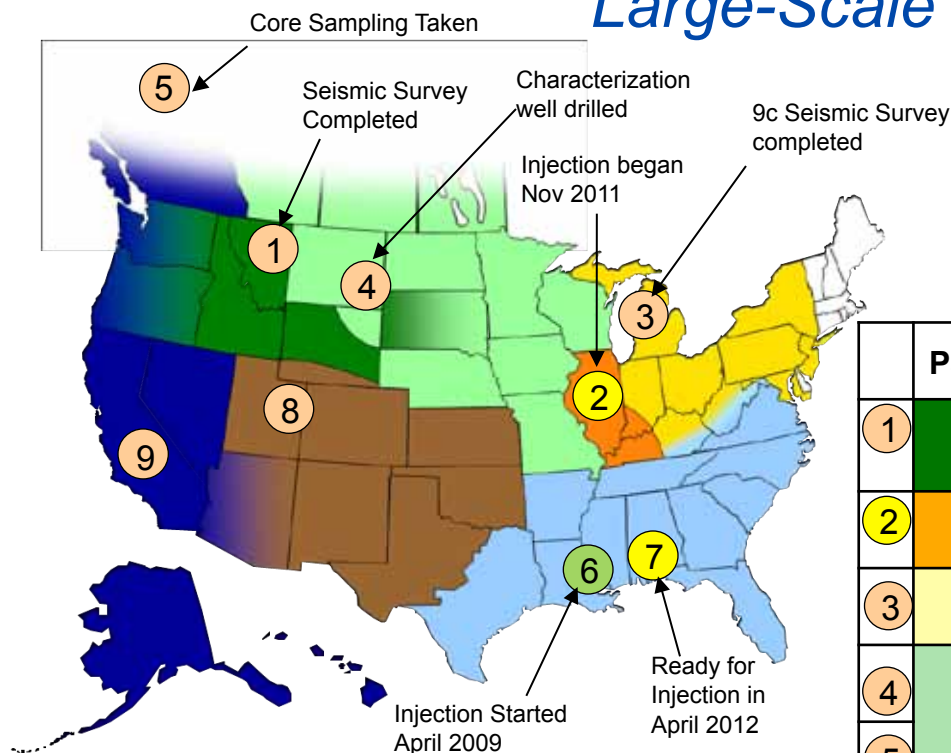
Completed 18 Injections

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
- 2011 Injection Scheduled
- Injection Scheduled 2012-2015

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

- ✓ Large-volume tests
- ✓ One injection commenced April 2009
- ✓ Remaining injections scheduled 2011-2015

	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-Niagran 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 Jurassic & Older Formations	1,000,000
9	WESTCARB	Regional Characterization	

Looking to the Future of RCSPs

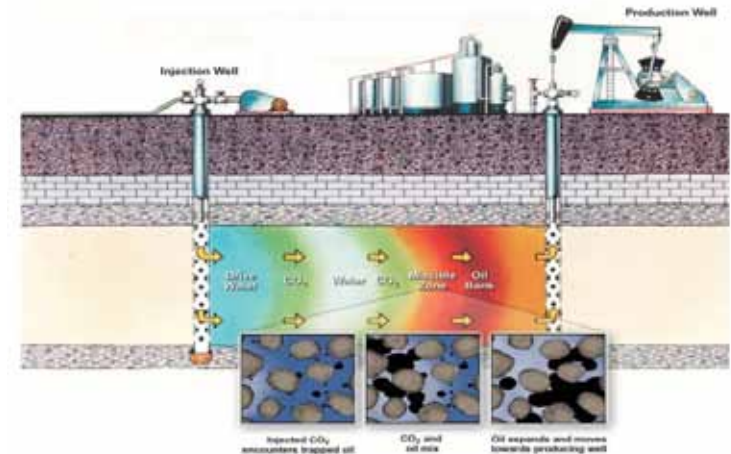
Drivers for Storage in EOR/EGR Opportunities

Economic Benefits

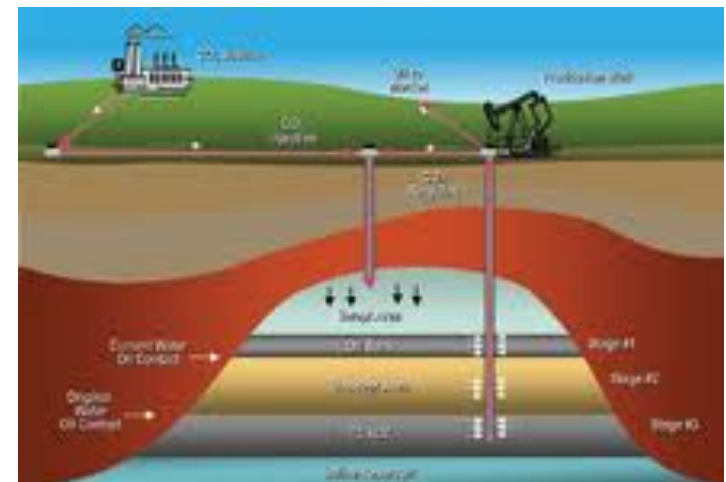
- Produce an additional 60 billion bbl of oil
- Balance trade deficit by over \$3.5 trillion
- Create 600,000 new jobs

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

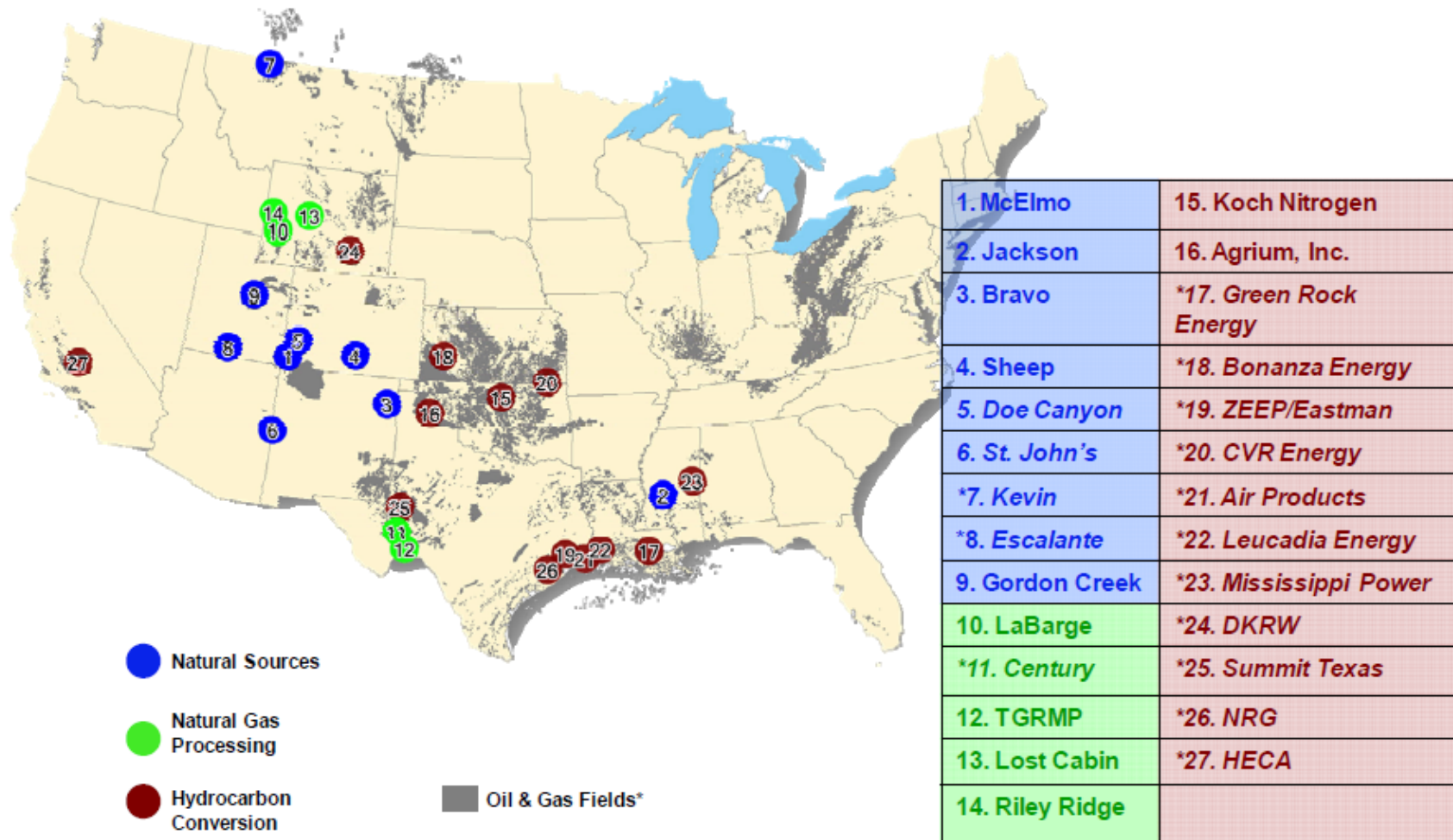


Business as usual EOR Operations (WAG)



Next Generation Storage/EOR Operations

Existing and Future Sources of CO₂ in the United States



Drivers R&D for CO₂ Storage/Utilization

- **EPA Regulations for storage**
 - Transition from UIC Class II → VI
 - GHG Subpart UU → RR Requirements
- **Economic Incentive**
 - 45Q monitoring requirements for EOR projects
 - State and federal EOR credits
- **Reservoir Surveillance can validate storage and increase hydrocarbon production**

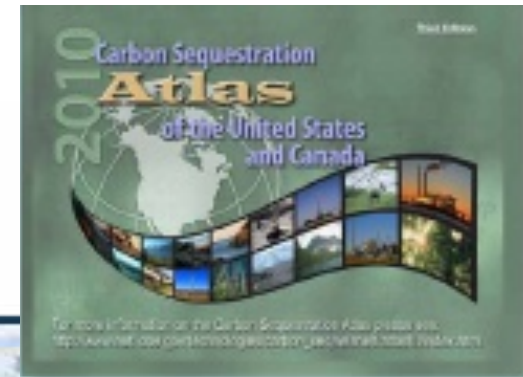
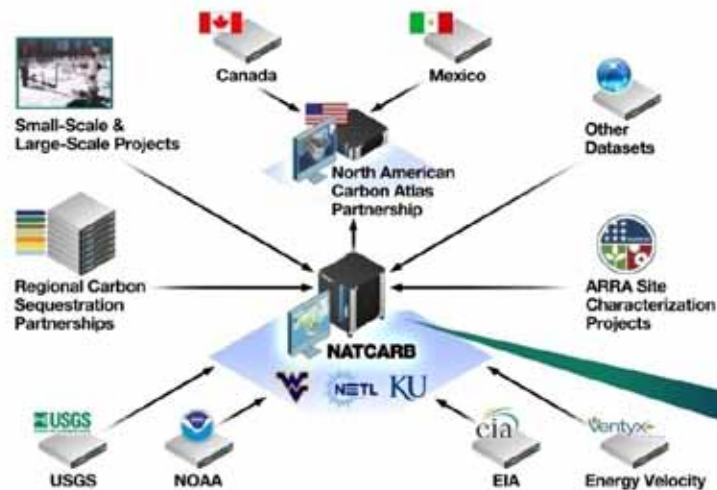
Key R&D Pathways to Address Storage/Utilization MVAA Requirements

- **Multi Phase/Fluid Flow – Key Issue**
 - Water, Oil, CH₄, Supercritical CO₂
- **Differentiating CO₂ emissions from natural leaks (RR, VI, 45Q)**
 - Tracers, open path systems, flux towers
- **Well Integrity and leakage through natural pathways (RR, VI, 45Q)**
 - Tracers, geophysics, satellites, tilt meters, advanced logging tools
- **Plume and Pressure Tracking (VI, 45Q)**
 - Advanced geophysics, geochemical, logging, satellite tools, field scale monitoring systems



Knowledge Sharing Products

North American Carbon Atlas and NATCARB



**Oil and Gas Fields
143 GT CO₂
Storage Resource**

ARRA Regional Technology Training

RCSPs Working Groups

- Geological and Infrastructure
- Monitoring, Verification, Accounting
- Simulation and Risk Assessment
- Capture and Transportation
- GIS and Database
- Water
- Public Outreach and Education



Worldwide CCS Project Database



Visit our website: www.NETL.DOE.GOV

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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*

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

Questions ?

