

Current Regional Partnership Activities Summary, USA

Department of Energy National Energy Technology Laboratory Regional Carbon Sequestration Partnership Program

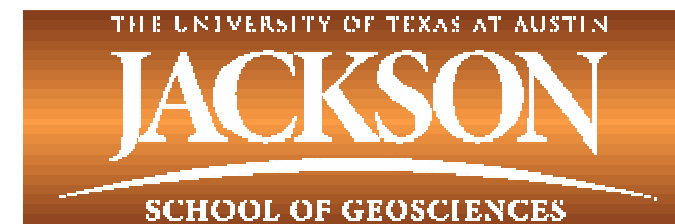


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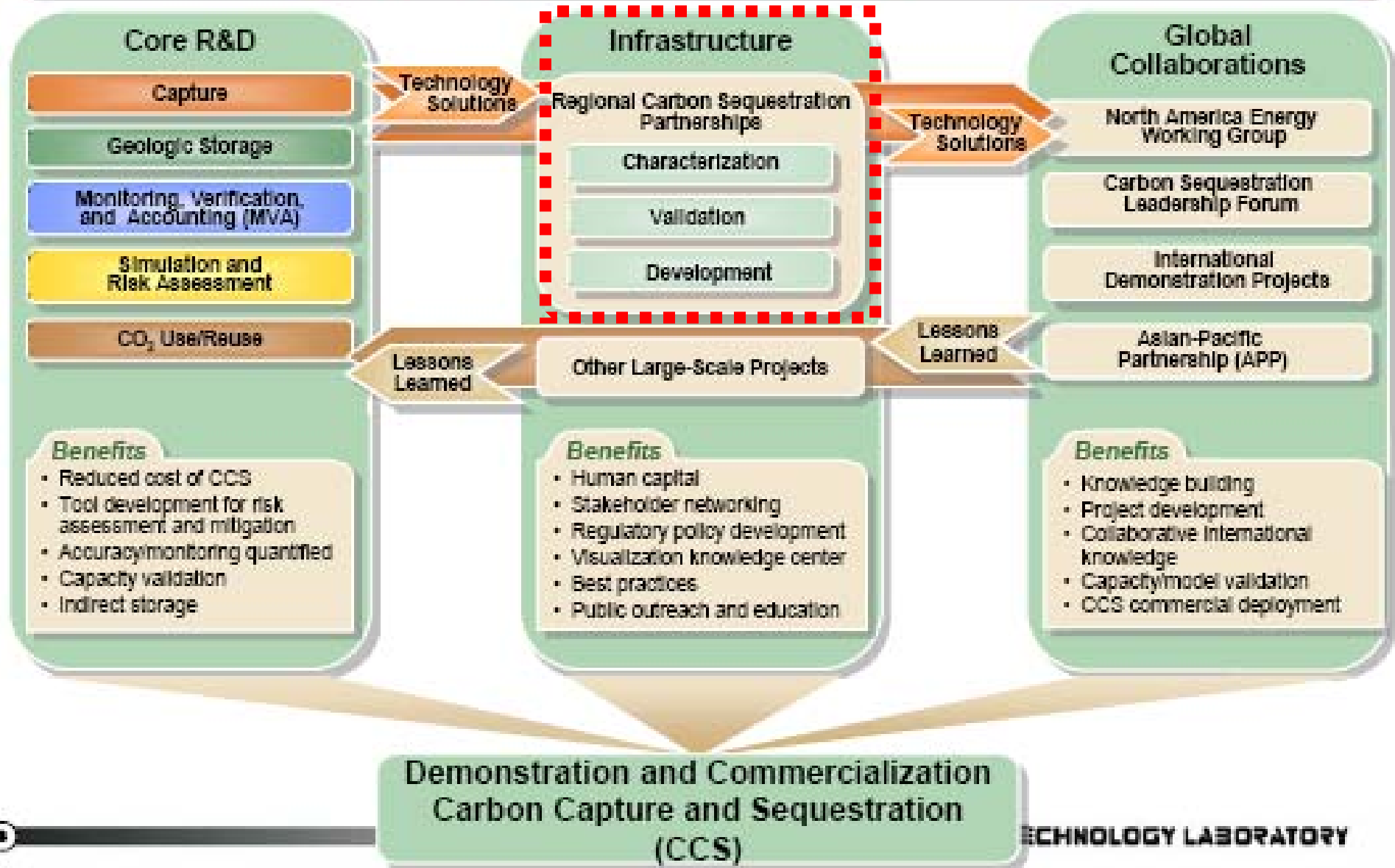


January 20, 2010
CAGS

Canberra, Australia



U.S. DEPARTMENT OF ENERGY • OFFICE OF FOSSIL ENERGY
 NATIONAL ENERGY TECHNOLOGY LABORATORY
CARBON SEQUESTRATION PROGRAM



U.S. Regional Carbon Sequestration Partnerships

Characterization Phase

- 24 months (2003-2005)
- \$16M DOE funds
- Atlas: 3,000 Gt storage
- Outreach, regulatory review

Validation Phase (2)

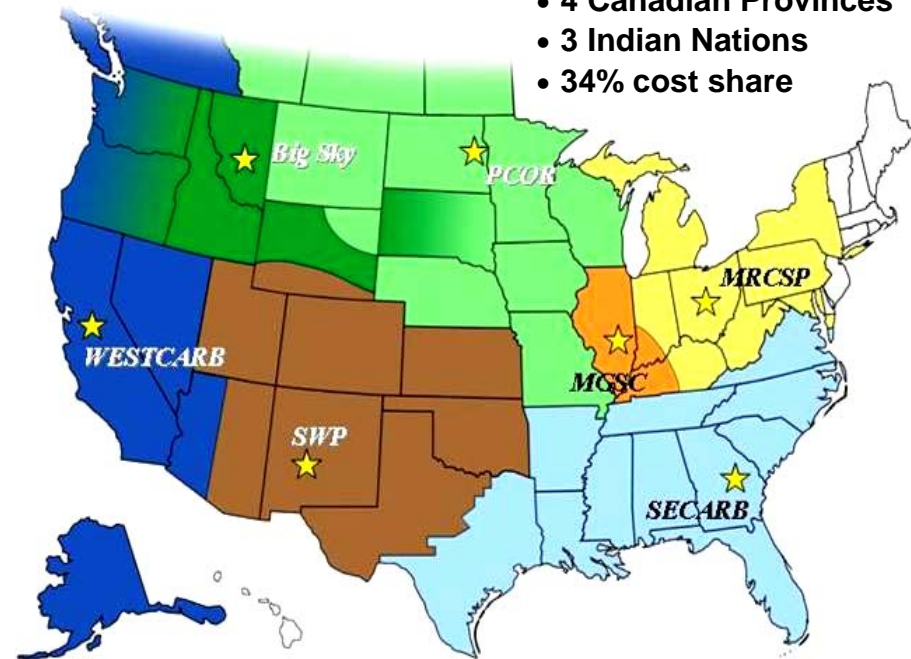
- 4 years (2005 - 2009)
- 7 Partnerships (41 states)
- 24 Geologic field validation tests; 11 terrestrial
- \$112M DOE funds

Deployment Phase (3)

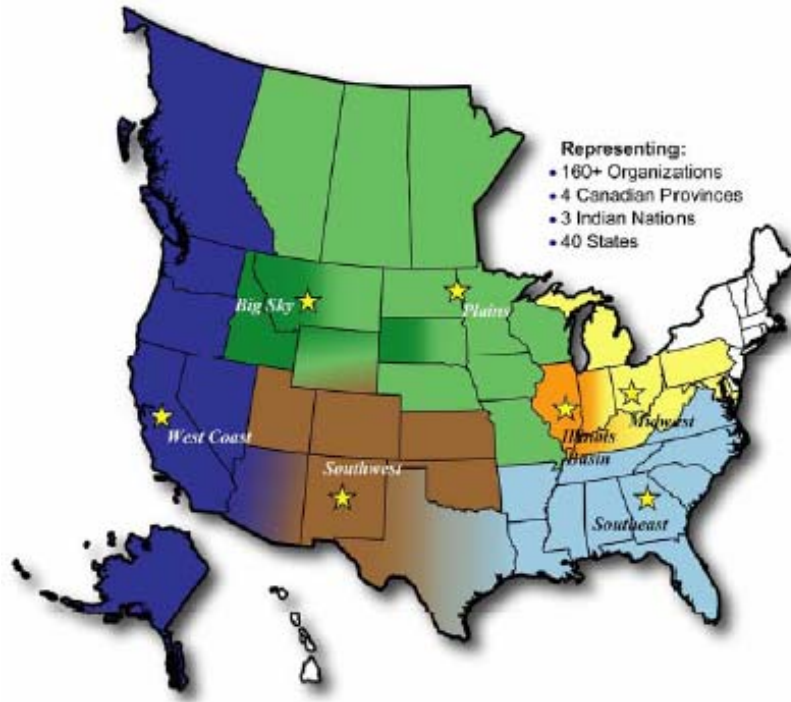
- 10 years (2008-2017)
- 4 projects awarded
- 7 projects expected
- \$460M DOE (\$1B total cost)

Representing:

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



Partnership Organization, Participation, and Aims



Regional Carbon Sequestration Partnership	Lead Organization
Big Sky Carbon Sequestration Partnership (BSCSP)	Montana State University
Midwest Geological Sequestration Consortium (MGSC)	Illinois State Geological Survey
Midwest Regional Carbon Sequestration Partnership (MRCSP)	Battelle Memorial Institute
Plains CO ₂ Reduction (PCOR) Partnership	University of North Dakota, Energy and Environmental Research Center
Southeast Regional Carbon Sequestration Partnership (SECARB)	Southern States Energy Board
Southwest Regional Partnership (SWP)	New Mexico Institute of Mining and Technology
West Coast Regional Carbon Sequestration Partnership (WESTCARB)	California Energy Commission

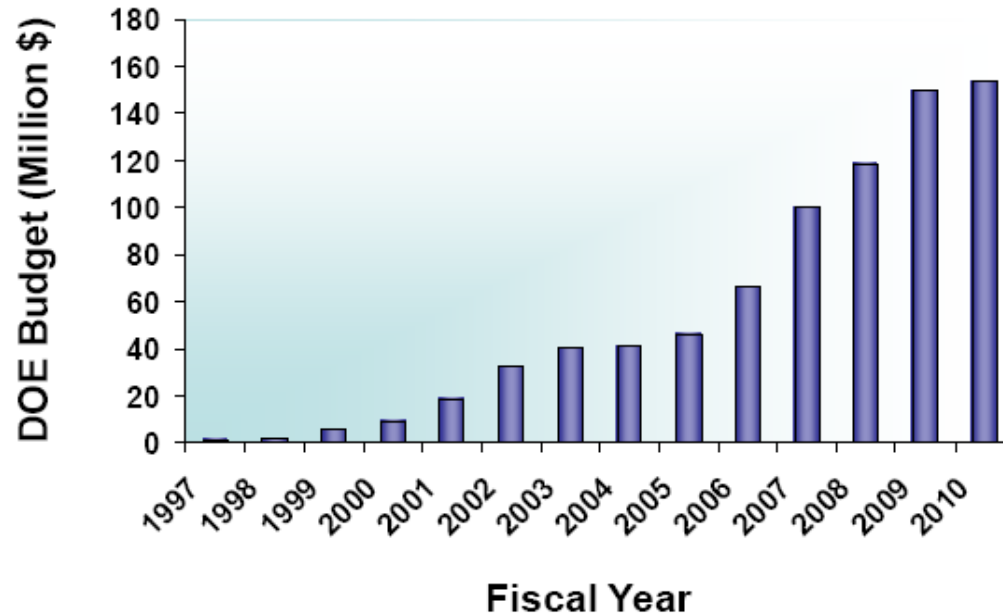
Regional Involvement:

Member States (Executive, Legislative and Regulatory)
 Industry and Electric Utilities
 Universities and National Laboratories
 NGOs and Trade Associations

Broad Common Programmatic Aims

- Assess Injectivity and Capacity
- Assess Storage Permanence
- Determine CO₂ extent and Leakage Pathways
- Develop Risk Assessment Strategies
- Develop Best Practices for Industry
- Engage in Public Outreach & Education
- Contribute to progress of Permitting

U.S. DOE's Carbon Sequestration Program Statistics



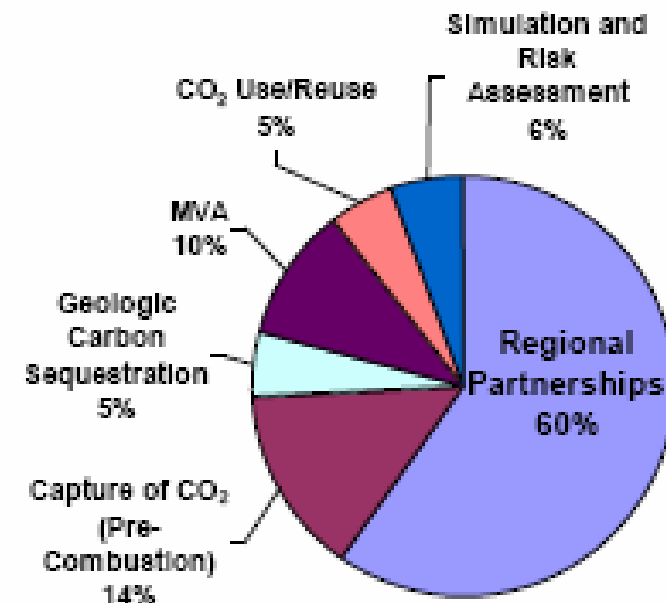
Strong industry support

~ 30% cost share on projects

Federal Investment to Date

~ \$631 Million

2009 RCSP Budget Breakdown



Diverse research portfolio

Nearly 100 Active R&D Projects

PHASE 2 PROJECTS: Validation Phase (2005-2009)

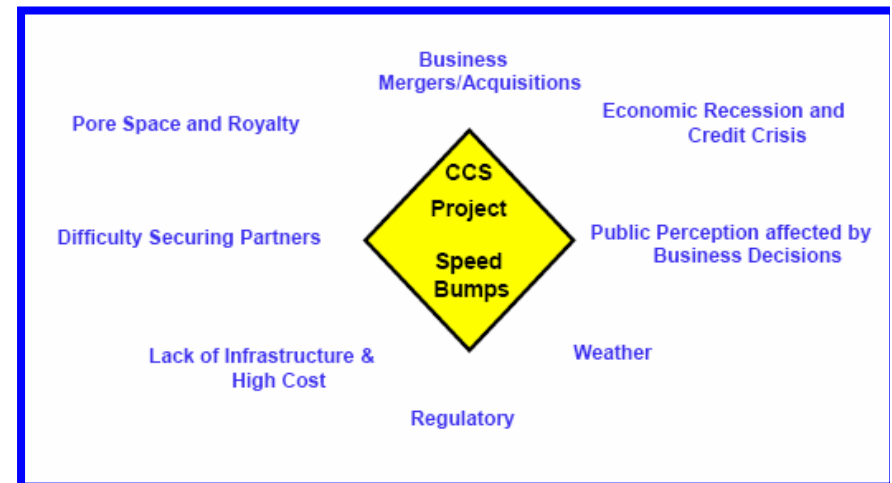
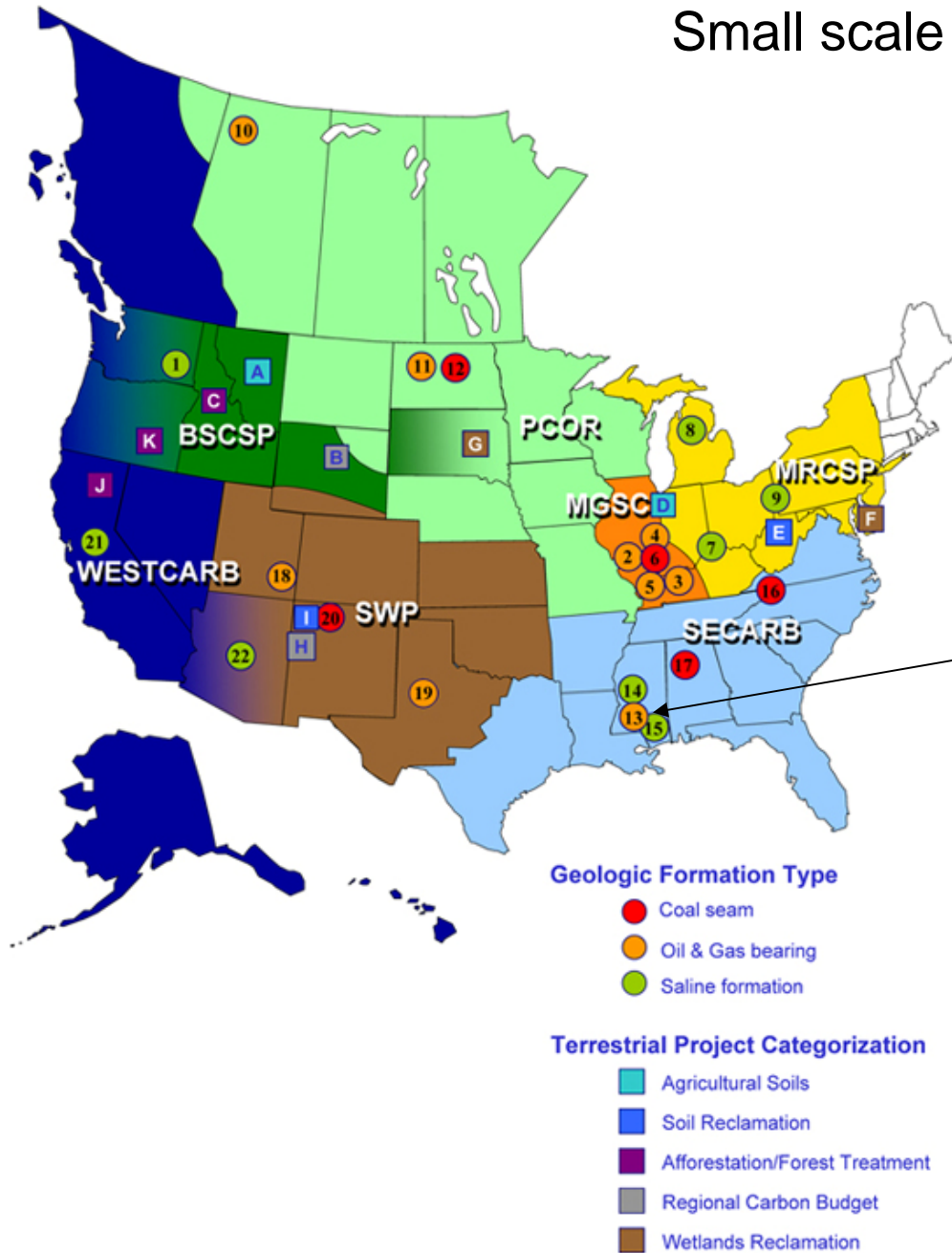
Small scale field tests

22 injection projects of various scale
~1.5-2.0 Mt CO₂ injected

Saline formations
Depleted oil fields
Coal seams
Basalt formations
Low permeability settings

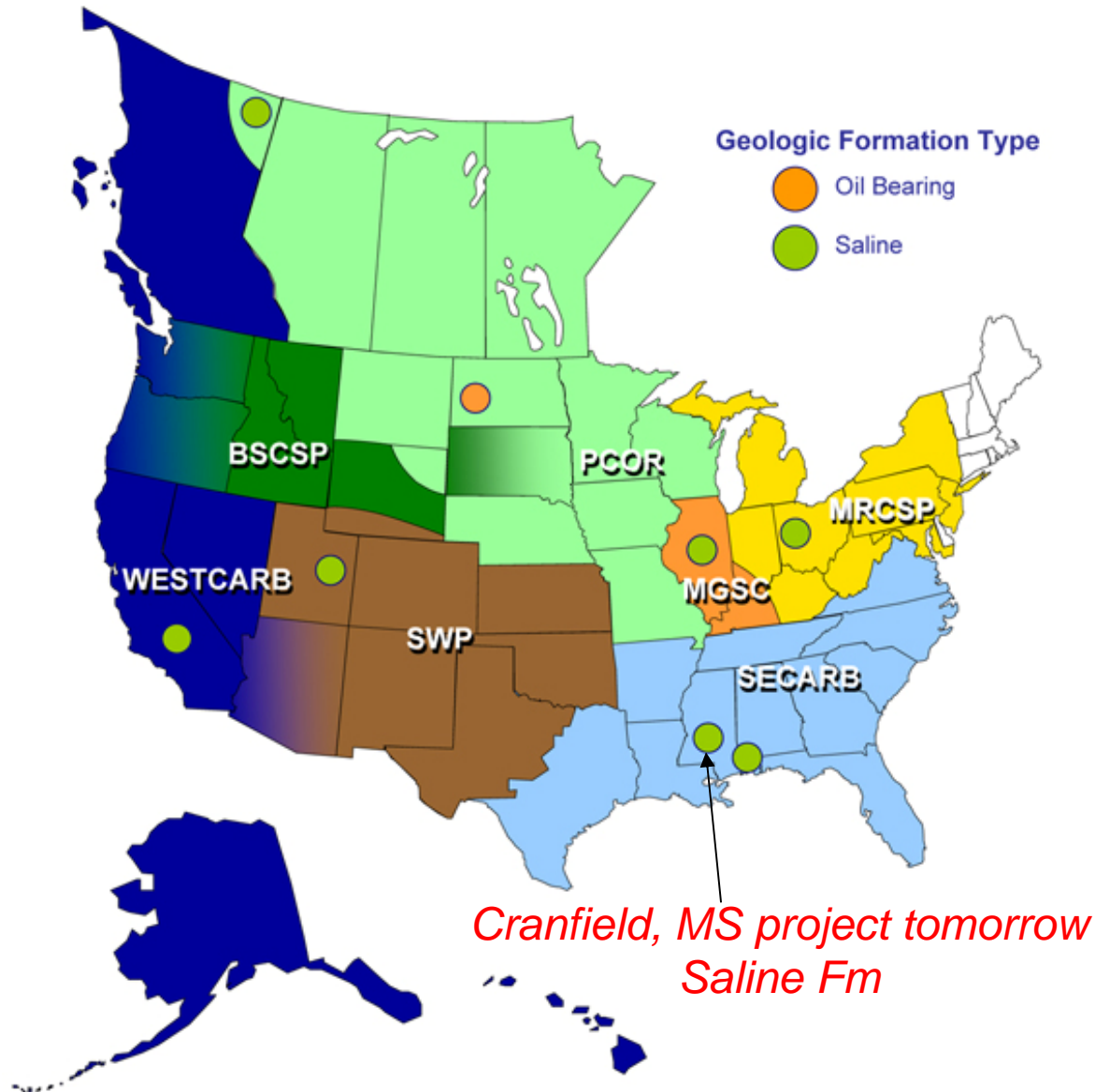
Cranfield, MS CO₂-EOR project tomorrow

Lessons Learned: “Learn by doing”



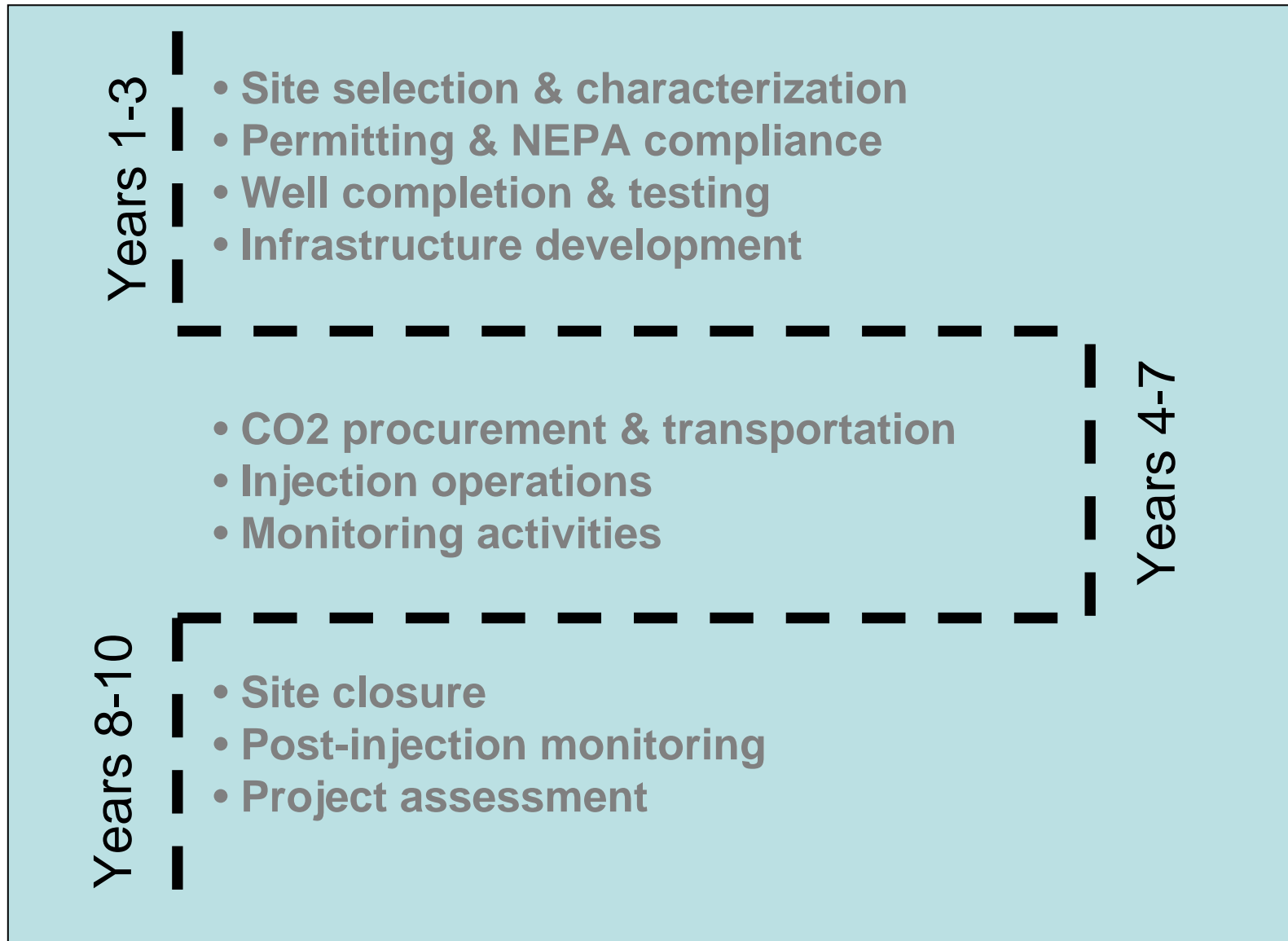
PHASE 3 PROJECTS: Development Phase (2008-2018)

Large scale (>1Mt Co2) geologic field tests



	Partnership	Geologic Province	Formation Type
●	BIG SKY CARBON SEQUESTRATION PARTNERSHIP	Nugget Sandstone	Saline Depth: 11,000 ft
●	MGSC	Mt. Simon Sandstone – Illinois Basin	Saline Depth: 5,000-7,000 ft
●	MRCSP MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP	Mt. Simon Sandstone – Cincinnati Arch	Saline Depth: 3,000-3,600 ft
●	The Plains CO ₂ Reduction Partnership	Williston Basin	Oil Bearing Depth: >12,000 ft
●	PCOR	Alberta Basin	Saline Depth: 5,000 ft
●	SECARB Southeast Regional Carbon Sequestration Partnership	Lower Tuscaloosa Formation	Saline Depth: 9,500- 10,500 ft
●	SWP SOUTHWEST PARTNERSHIP CO ₂ SEQUESTRATION	Farnham Dom	Saline Depth: 5,000+ ft
●	WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP westcarb.org	San Joaquin Basin	Saline Depth: 7,000+ ft

Phase 3: Development Timeline



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CARBON SEQUESTRATION

2008 ATLAS






OF THE
UNITED STATES
AND CANADA

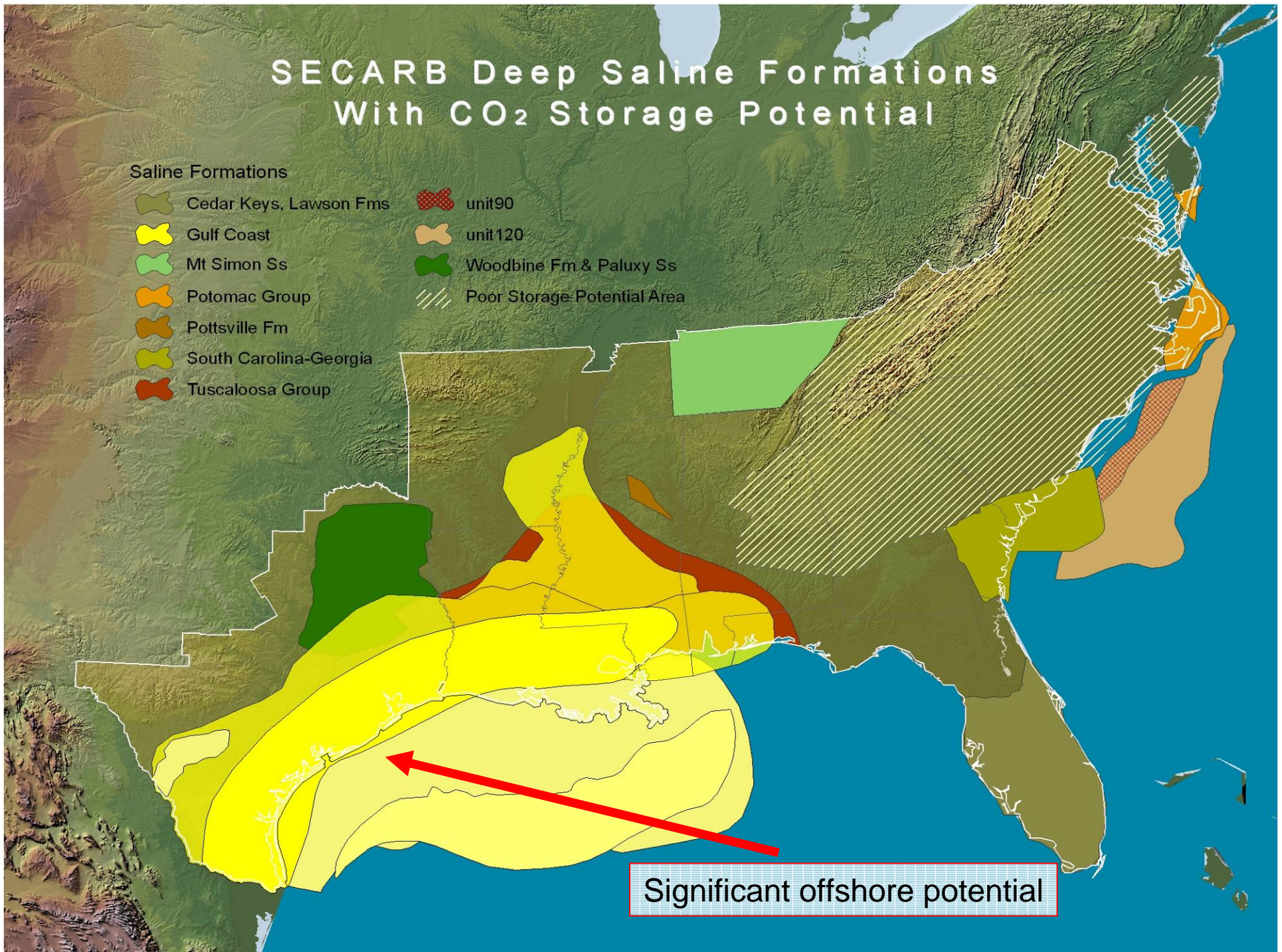


SECOND EDITION

SECARB Deep Saline Formations With CO₂ Storage Potential

Saline Formations

- | | | | |
|-----------------------------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------|-----------------------------|
|  | Cedar Keys, Lawson Fms |  | unit90 |
|  | Gulf Coast |  | unit120 |
|  | Mt Simon Ss |  | Woodbine Fm & Paluxy Ss |
|  | Potomac Group |  | Poor Storage Potential Area |
|  | Pottsville Fm | | |
|  | South Carolina-Georgia | | |
|  | Tuscaloosa Group | | |



CCS Best Practice Manuals

Critical Requirement For Significant Wide Scale Deployment
Capturing Lessons Learned

Best Practice Manual	Version 1 (Phase II)
Monitoring Verification and Accounting	2009
Site Characterization	2010
Simulation and Risk Assessment	2010
Well Construction and Closure	2010
Regulatory Compliance	2010
Public Education	2009
Terrestrial Sequestration Practices	2010



the ENERGY lab

Monitoring, Verification,
and Accounting
of CO₂ Stored in Deep
Geologic Formations

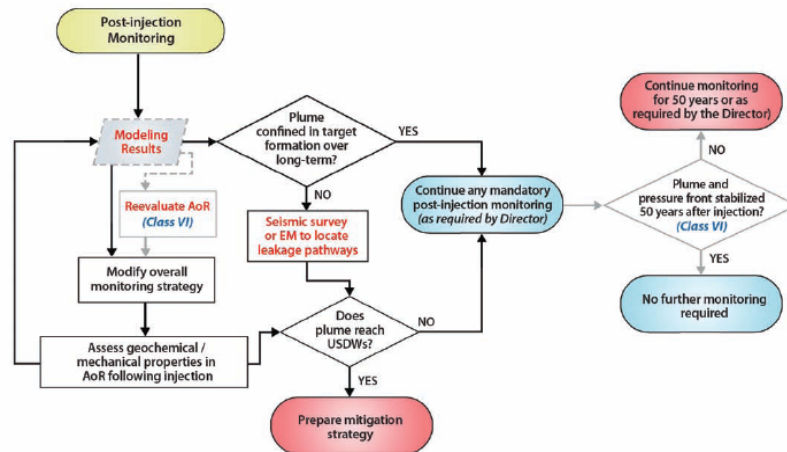
This graphic features a light blue background with a faint world map. It includes several small inset photographs: a person in a field, a wellhead in a desert landscape, a close-up of a wellhead, a truck on a road, an oil pumpjack, and a person working in a field.

Examples from MVA best practices manual

Table 5-1: List of RCSPs' Monitoring Tools for Phase II and Phase III Projects

Objectives	Primary Technologies	Secondary Technologies	Potential Additional Technologies
Atmospheric Monitoring Objectives: <ul style="list-style-type: none"> Ambient CO₂ Concentration CO₂ surface flux 		CO ₂ Detectors <i>(Ambient CO₂ Concentration)</i> Laser systems and LIDAR* <i>(Ambient CO₂ Concentration)</i>	Eddy Covariance <i>(Surface Flux)</i> Advanced Leak Detection System <i>(Surface Flux)</i> Isotopes
Near-Surface Monitoring Objectives: <ul style="list-style-type: none"> Groundwater Monitoring Fluid Chemistry Crustal Deformation Leak Detection Vegetative Stress Monitoring Vadose Zone Characterization 	Geochemical Analysis <i>(Groundwater Monitoring)</i> <i>(Fluid Chemistry)</i>	Advanced Water Quality Analysis <ul style="list-style-type: none"> Inorganics & Organics Isotopes Total Organic and Inorganic Carbon Aerial Photography <i>(Vegetative Stress)</i> <i>(Crustal Deformation)</i> Seismic Surveying <i>(Vadose zone characterization)</i> <i>(Leak Detection)</i> <ul style="list-style-type: none"> Shallow 2-D Seismic Soil and Vadose Zone Gas Monitoring <i>(Gas sampling)</i> Flux Accumulation Chamber <i>(Surface Flux)</i>	Tracers <i>(Leak Detection)</i> <ul style="list-style-type: none"> Noble Gases Mercaptans Stable Isotopes Perfluorocarbons Geophysics <i>(Leak Detection)</i> <i>(Vadose zone characterization)</i> <ul style="list-style-type: none"> Conductivity Induced Polarization Self-Potential Tiltmeters <i>(Crustal Deformation)</i> Remote Sensing <i>(Crustal Deformation)</i> <ul style="list-style-type: none"> Color Infrared Transparency Film Hyper-spectral – multispectral Synthetic Aperture Radar & InSar
Subsurface Monitoring Objectives: <ul style="list-style-type: none"> Groundwater Monitoring Soil Gas Monitoring Leak Detection Subsurface and Reservoir Characterization Plume Tracking Well Integrity Testing 	Water Quality Analysis <ul style="list-style-type: none"> Injection Fluid Monitoring Formation Fluid Monitoring Water Level Caprock Integrity <i>(Subsurface and Reservoir Characterization)</i> <ul style="list-style-type: none"> Geomechanical Analysis Core Collection Wireline Logging <i>(Well Integrity)</i> <ul style="list-style-type: none"> Temperature Noise Cement Bond Density Gamma Ray Sonic <i>(Acoustic)</i> Physical Testing <i>(Well Integrity)</i> <ul style="list-style-type: none"> Annulus Pressure Injection Volume/Rate Wellhead Pressure Downhole Pressure Downhole Temperature 	Seismic Surveying <i>(Reservoir Integrity)</i> <ul style="list-style-type: none"> Acoustic (2-D and 3-D) VSP 2-D and 3-D Geochemistry <i>(Reservoir Integrity)</i> <ul style="list-style-type: none"> Brine/Fluid Composition Tracer Injection/Monitoring Injection Well Logging <i>(Wireline Logging)</i> <i>(Plume Tracking)</i> <i>(Reservoir Integrity)</i> <ul style="list-style-type: none"> Temperature Logging Reservoir Saturation Tool Optical 	Geophysical Techniques <i>(Leak Detection)</i> <i>(Subsurface and Reservoir Characterization)</i> <i>(Plume Tracking)</i> <ul style="list-style-type: none"> Crosswell Seismic Microseismic <i>(Passive)</i> EMIT Magnetotelluric Sounding Resistivity and EM Electrical Resistivity Tomography Time-lapse Gravity Survey Electromagnetic Resistivity Wireline Logging <i>(Well integrity and Subsurface Characterization)</i> - Resistivity

Post-injection monitoring workflow



Other recently-funded DOE CCS efforts

ARRA funds (Stimulus)

- **Monitoring** – (\$35.8M) 19 projects to enhance the capability to simulate, track, and evaluate the potential risks of carbon dioxide (CO₂) storage in geologic formations.
- **Characterization** – (\$75.5M) 11 projects to conduct site characterization of promising geologic formations for CO₂ storage. (TX/GOM Offshore included)
- **Outreach** – (\$12.7M) 43 geologic sequestration training and research projects. The projects will offer training opportunities for graduate and undergraduate students that will provide the human capital and skills required for implementing and deploying carbon capture and storage technologies.



Further information:



www.netl.doe.gov/publications/press/press09_toc.html

www.netl.doe.gov/technologies/carbon_seq/partnerships/partnerships.html