SECARB Annual Stakeholders’ Briefing
Update on Sequestration Program and RCSP Initiative
March 9, 2011
Traci D. Rodosta, RCSP Coordinator

March 2011
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
  - +/- 30% capacity in reservoirs
  - $10/ton CO₂ Utilization
  - Validation of Formation Classes

- **Supporting Activities**
  - Core R&D Projects
  - Infrastructure Development
  - International R&D Collaboration at Field Projects
U.S. DEPARTMENT OF ENERGY • OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY
CARBON SEQUESTRATION PROGRAM with ARRA Projects

Core R&D
- Pre-combustion Capture
- Geologic Storage
- Monitoring, Verification, and Accounting (MVA)
- Simulation and Risk Assessment
- CO₂ Utilization
- ARRA: University Projects

Benefits
- Reduced cost of CCS
- Tool development for risk assessment and mitigation
- Accuracy/monitoring quantified
- CO₂ capacity validation
- Indirect CO₂ storage

Infrastructure
- Regional Carbon Sequestration Partnerships
  - Characterization
  - Validation
  - Development
- ARRA: Development of Technology Transfer Centers
- ARRA: Site Characterization
- Other Small and Large-Scale Projects

Benefits
- Human capital
- Stakeholder networking
- Regulatory policy development
- Visualization knowledge center
- Best practices development
- Public outreach and education

Global Collaborations
- North America Energy Working Group
- Carbon Sequestration Leadership Forum
- International Demonstration Projects
  - Canada (Weyburn, Zama, Ft. Nelson)
  - Norway (Sleipner and Snovhit)
  - Germany (CO2Sink), Australia (Otway)
  - Africa (In-Salah)
  - Asia (Ordos Basin)

Benefits
- Knowledge building
- Project development
- Collaborative international knowledge
- Capacity/model validation
- CCS commercial deployment

Demonstration and Commercialization Carbon Capture and Storage (CCS)
Sequestration Program Total Funding

2010 Program Statistics

Strong industry support
~ 39% cost share on projects

Diverse research portfolio

105 Active R&D Projects
60 ARRA Projects (FY10 -$120M )
Regional Carbon Sequestration Partnerships

Developing the Infrastructure for Wide Scale Deployment

Seven Regional Partnerships

400+ distinct organizations, 43 states, 4 Canadian Provinces

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)
- 20 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

- 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
### RCSP Phase III: Development Phase

**Large-Scale Geologic Tests**

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

<table>
<thead>
<tr>
<th>Partnership</th>
<th>Geologic Province</th>
<th>Target Injection (metric tons)</th>
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<tbody>
<tr>
<td><strong>1</strong> Big Sky</td>
<td>Nugget Sandstone</td>
<td>&gt;1,000,000</td>
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<tr>
<td><strong>2</strong> MGSC</td>
<td>Illinois Basin-Mt. Simon Sandstone</td>
<td>1,000,000</td>
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<td><strong>3</strong> MRCSP</td>
<td>Michigan Basin-St. Peter Sandstone</td>
<td>1,000,000</td>
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<td><strong>4</strong> PCOR</td>
<td>Powder River Basin-Bell Creek Field</td>
<td>&gt;1,000,000</td>
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<td><strong>5</strong> SECARB</td>
<td>Horn River Basin-Carbonates</td>
<td>&gt;1,000,000</td>
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<td><strong>6</strong> SWP</td>
<td>Regional Jurassic &amp; Older Formations</td>
<td>1,000,000</td>
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<td><strong>9</strong> WESTCARB</td>
<td>Central Valley</td>
<td>TBD</td>
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Note: Some locations presented on map may differ from final injection location.
Carbon Storage

Key FY2011 Program Documents

• DOE CCS Roadmap – Dec 2010

• Carbon Sequestration (Storage) Technology Program Plan – Feb 2011


• Best Practice Manuals
  – Storage classes
  – Technical manuals
## CCS Best Practice Manuals

**Critical Requirement For Significant Wide Scale Deployment - Capturing Lessons Learned**

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<tbody>
<tr>
<td>Monitoring, Verification and Accounting</td>
<td>2009</td>
<td>2017</td>
<td>2020</td>
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<tr>
<td>Public Outreach and Education</td>
<td>2009</td>
<td>2016</td>
<td>2020</td>
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<tr>
<td>Site Characterization</td>
<td>2010</td>
<td>2016</td>
<td>2020</td>
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<tr>
<td>Geologic Storage Formation Classification</td>
<td>2010</td>
<td>2016</td>
<td>2020</td>
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<tr>
<td><strong>Simulation and Risk Assessment</strong></td>
<td>2010</td>
<td>2017</td>
<td>2020</td>
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<tr>
<td><strong>Well Construction, Operations and Completion</strong></td>
<td>2011</td>
<td>2017</td>
<td>2020</td>
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<tr>
<td>Terrestrial</td>
<td>2010</td>
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<td>2016 – Post MVA Phase III</td>
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**Regulatory Issues will be addressed within various Manuals**

National Carbon Sequestration Atlas Highlights
Hundreds of Years of Storage Potential

U.S. Emissions
~ 6 GT CO₂/yr
all sources

Oil and Gas Fields
143 GT CO₂ Storage Resource*

Saline Formations
1,653 - 20,213 GT CO₂
Storage Resource*

Unmineable Coal Seams
60-117 GT CO₂ Storage Resource*

• DOE’s Carbon Sequestration Program
• DOE’s International Collaborations
• DOE’s National Risk Assessment Partnership (NRAP)
• Regional Carbon Sequestration Partnership (RCSP) Activities
• Refined CO₂ source estimates and CO₂ storage potential across the RCSP regions
• Worldwide CCS projects, CCS regulatory issues
• NATCARB’s improved databases and GIS system


Leveraging International Geologic Storage R&D Projects

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<thead>
<tr>
<th>Project Number</th>
<th>Project Name</th>
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<tbody>
<tr>
<td>1</td>
<td>Weyburn-Midale Project</td>
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<tr>
<td>2</td>
<td>PCOR Zama Field Validation Test</td>
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<td>3</td>
<td>PCOR Ft. Nelson Demonstration Test</td>
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<td>4</td>
<td>Sleipner Project</td>
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<td>5</td>
<td>Snøhvit Field LNG and CO2 Storage Project</td>
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<td>6</td>
<td>CO2SINK Project (Ketzin)</td>
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<td>7</td>
<td>CarbFix</td>
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<td>8</td>
<td>In Salah Gas Storage Project</td>
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<td>9</td>
<td>Otway Basin Project - CO2CRC</td>
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<td>10</td>
<td>Ordos Basin Project</td>
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