



"Managing Climate Change and Securing a Future for the Midwest's Industrial Base"



***MRCSP, Michigan Basin Field Demonstration
Briefing, March 2007***

Overview of the Midwest Regional Carbon Sequestration Partnership (MRCSP)

- **What:** Demonstrate the safety and effectiveness of carbon sequestration and develop best approaches to carbon sequestration in the region
- **Who:** 30+ member team, led by Battelle and drawing from the research community, energy industry, non-government organizations, and government
- **Why:** Part of a national effort sponsored by the U.S. Department of Energy's National Environmental Technology Laboratory (DOE/NETL) to develop robust strategies for mitigating carbon dioxide (CO₂) emissions
- **When:** Phase I launched, fall 2003; Phase I report available on web; Phase II runs October 2005-September 2009
- **Where:** Seven-state region of IN, KY, MD, MI, OH, PA, WV

Carbon Dioxide (CO₂) Emissions and Sequestration

- The atmospheric concentration of CO₂ is rising, partly attributable to the combustion of fossil fuels that power the global economy
- Research suggests that the continued build up of CO₂ in the atmosphere will increase the greenhouse effect, warm our atmosphere and trigger a variety of impacts
- Efforts are underway to develop the means to reduce CO₂ emissions as an element in an overall strategy to stabilize concentrations of CO₂ in the atmosphere
- A variety of solutions will be needed as more fossil fuels are used around the world for industrial development

Carbon Sequestration

- As part of a broad portfolio of technologies, carbon sequestration can play an important role in stabilizing atmospheric CO₂ concentrations
- Sequestration is the controlled, permanent storage of CO₂ in the earth
- Terrestrial sequestration removes CO₂ already in the atmosphere and takes advantage of natural processes, such as photosynthesis, to increase the amount of carbon stored in plants and soils that serve as long-term pools or “sinks”
- Geologic sequestration involves injecting CO₂ into formations such as depleted oil wells, unmineable coal seams and very deep saline reservoirs to permanently store CO₂ in the earth

The MRCSP Region: The Nation's Engine Room

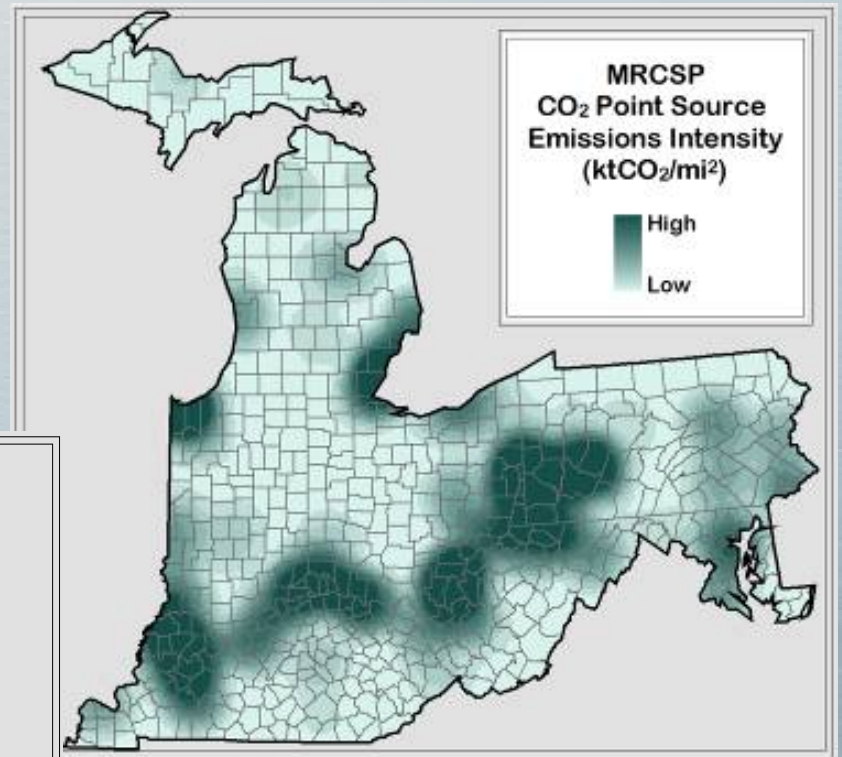
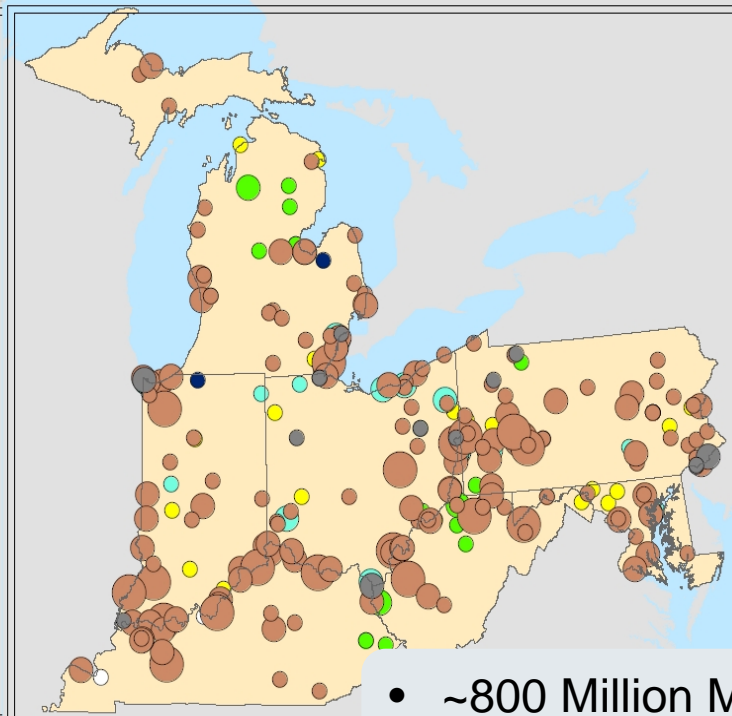
- One in six Americans
- 1/6 of U.S. Economy
- 1/5 of U.S. Electricity Generated
 - $\frac{3}{4}$ From Coal

MRCSP Large CO₂ Point Sources (100+ kt CO₂/yr)

- Cement
- Ethanol
- Ethylene
- Gas processing
- Hydrogen
- Iron & steel
- Power
- Refineries

ktCO₂/yr

- 100 - 2,000
- 2,000 - 10,000
- 10,000 - 20,000

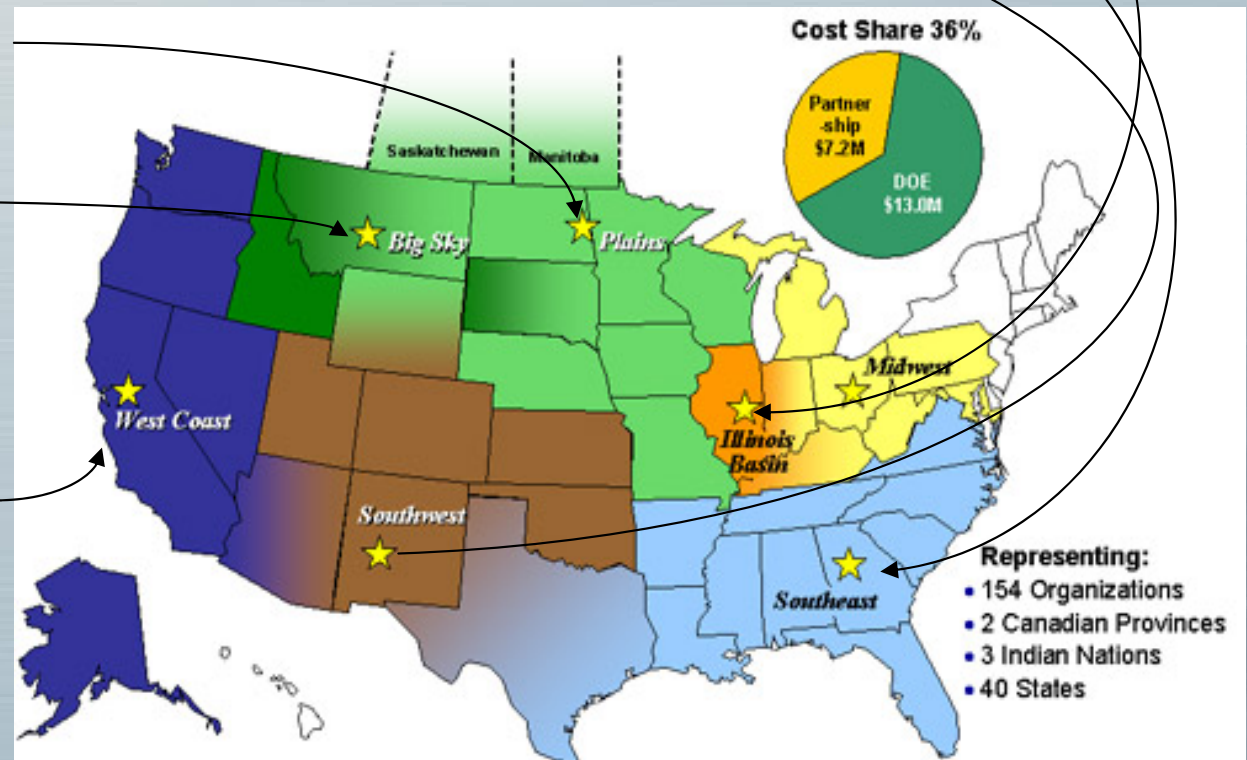


- ~800 Million Metric Tons (MMT) CO₂/year
- ~300 Large Point Sources

The MRCSP is One of Seven DOE Regional Partnerships Across the U. S.

The other six are:

- Geological Carbon Sequestration Options in the **Illinois Basin**
- **Southeast** Regional Carbon Sequestration Partnership
- **Southwest** Regional Partnership for Carbon Sequestration
- **Plains** CO₂ Reduction Partnership
- **Big Sky** Regional Carbon Sequestration Partnership
- **West Coast** Regional Carbon Sequestration Partnership



See <http://www.netl.doe.gov/coal/Carbon%20Sequestration/partnerships/index.htm> for more information from NETL on the seven partnerships.

MRCSP Phase II Partners



U.S. Department of Energy/NETL



MRCSP Activities in Phase I

- Identified CO₂ sources in the MRCSP Region
- Assessed the technology options and cost of capturing CO₂ from these sources
- Identified more than 500 billion metric tons of potential storage capacity in the region's deep geologic formations, forests, agricultural and degraded land systems – enough for more than 200 years of carbon dioxide emissions from our region's existing large point sources
- Identified issues for technology deployment, including safety, economics, regulations and public acceptability
- Engaged the public and their elected officials to inform them about carbon sequestration and to obtain their feedback on the project
- Developed recommendations for potential small-scale validation testing during a second phase of DOE/NETL's partnership program

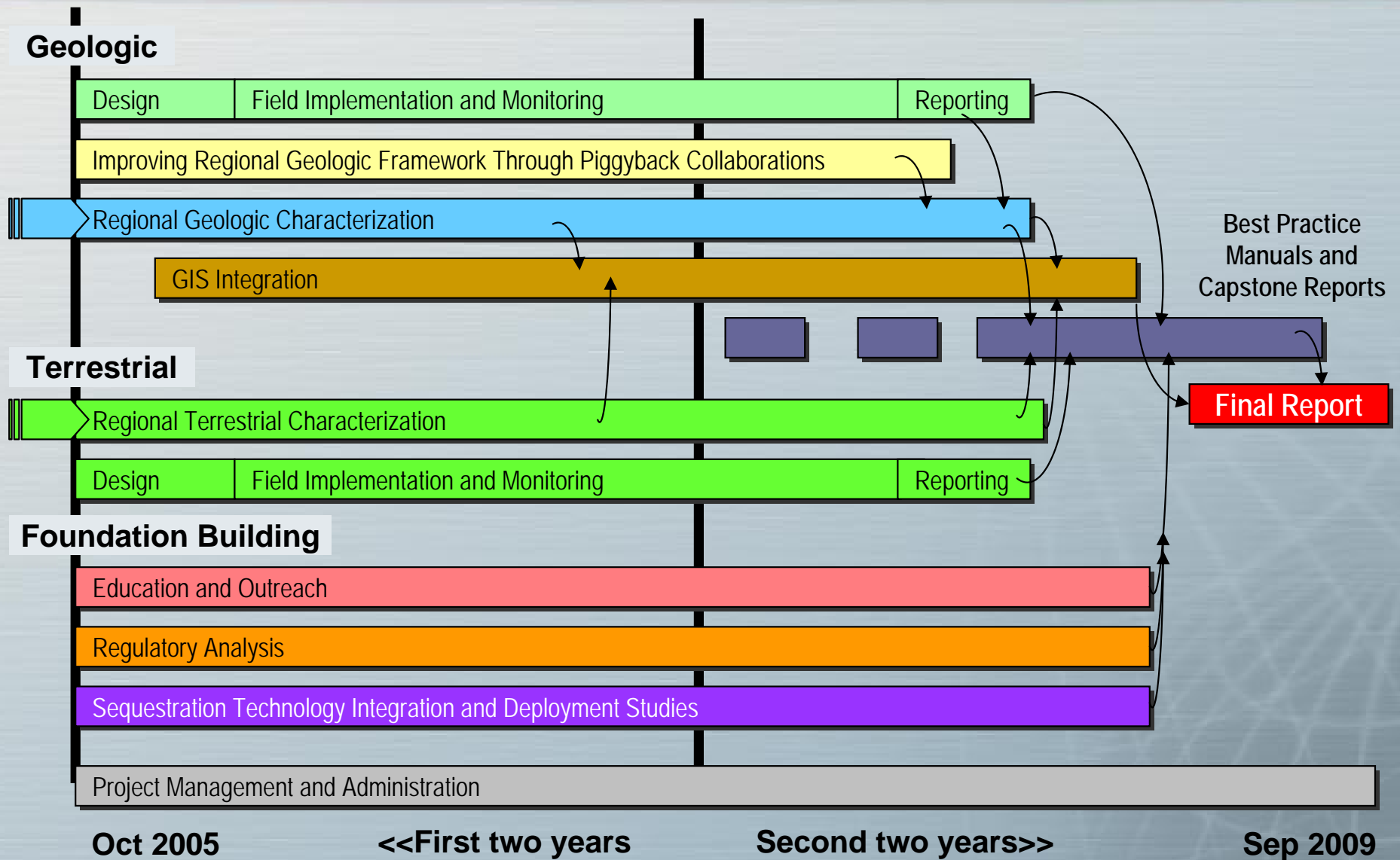
Phase II Objectives

- Translate the theoretical potential for carbon sequestration defined in Phase I into tangible measures and approaches for the region
- Continue to develop the best approaches to carbon sequestration in the region by:
 - Using mapping, surveying and modeling to develop a unified conceptual framework of the region to serve as the foundation for a regional sequestration plan
 - Conducting multiple geological and terrestrial sequestration field demonstration projects in a variety of land and geology types
 - Developing innovative methods such as “piggyback” drilling to use activities already underway to generate additional geologic information about the region
 - Engaging stakeholders, including officials, industry, interest groups and ordinary citizens to inform them about the project and to obtain feedback

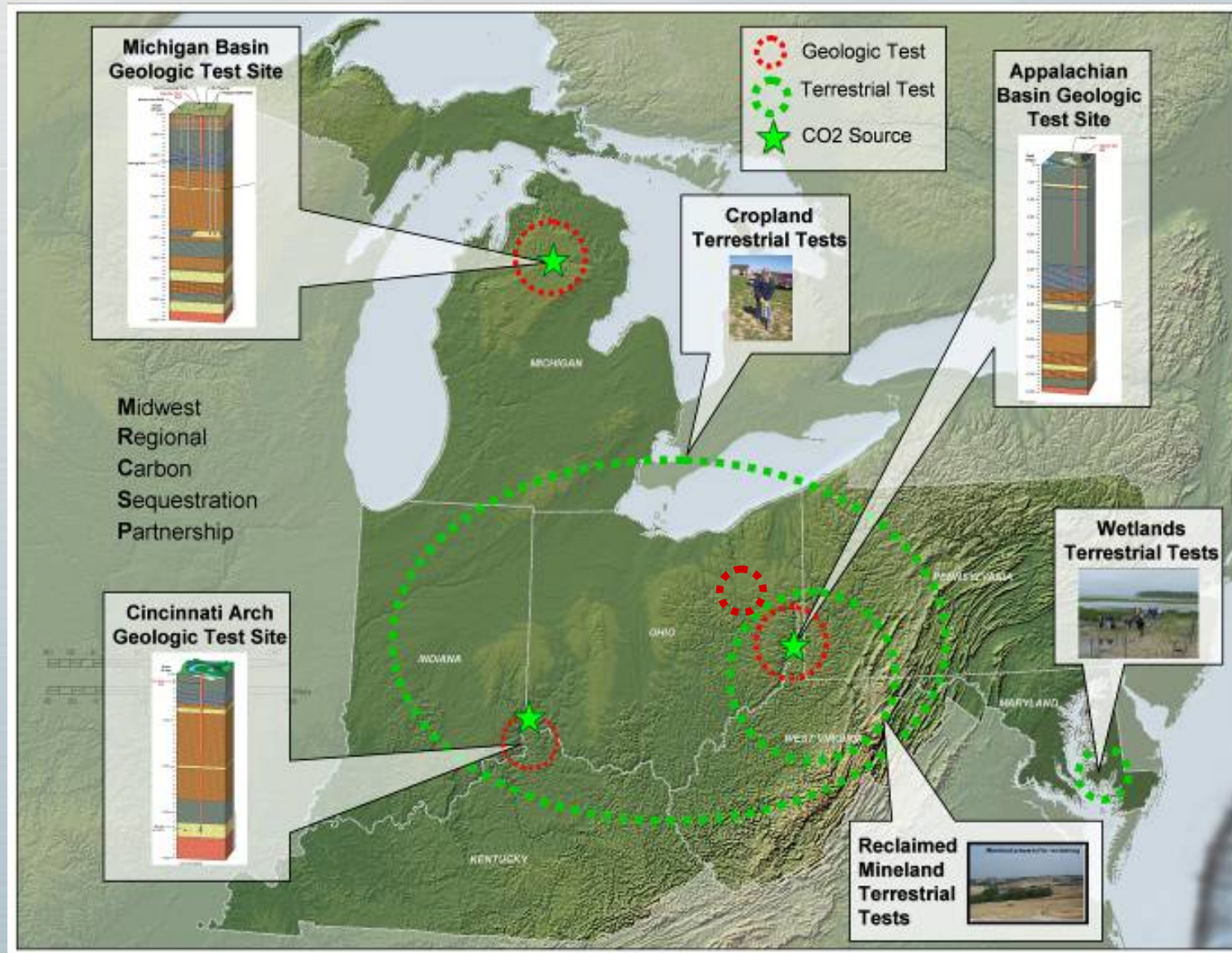
Phase II General Activities

- Field validation of geologic sequestration
- Field validation of terrestrial sequestration
- Regulatory compliance
- Development of appropriate protocols for monitoring, mitigation and verification
- Refinement of regional characterization of sinks and sources
- Proactive stakeholder engagement and public outreach
- Integration of MRCSP activities with the other DOE regional partnerships

When: Phase II Work Plan

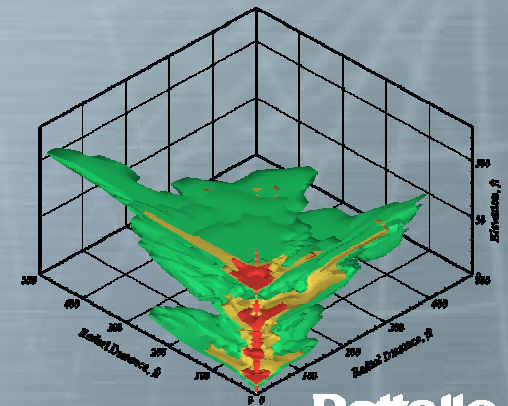
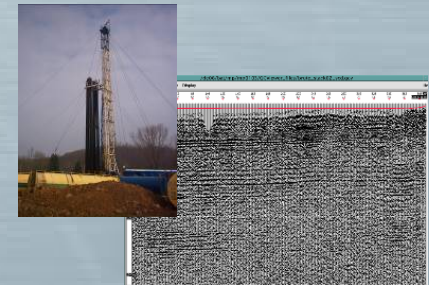
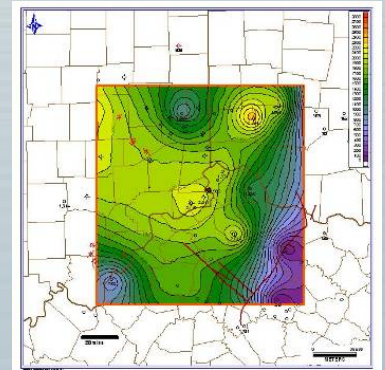


MRCSP Geologic and Terrestrial Field Tests



Phase II: Geologic Field Test Activities

- Preliminary Geologic Assessment
 - Site specific assessment of target storage reservoirs and geologic setting performed jointly with state Geologic Surveys
- Site Characterization and Design
 - Conduct seismic surveys, test-well drilling, reservoir tests, brine sampling, other site-specific field work
 - Use site data to design injection and monitoring programs
- CO₂ Injection Tests and Monitoring
 - Finalize CO₂ source and delivery
 - Conduct CO₂ injection testing and monitoring/verification
 - Meet site field test objectives addressing different storage targets, CO₂ sources, and system design

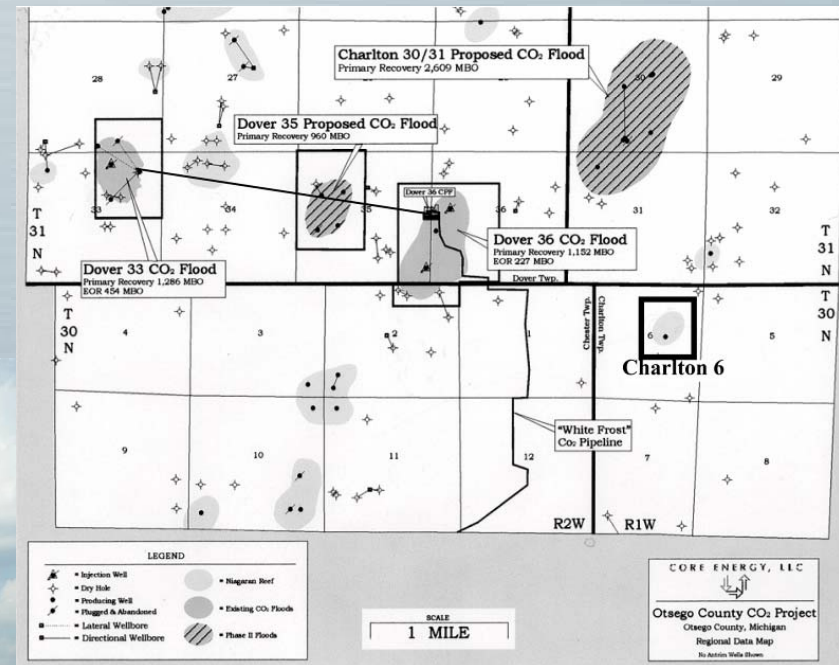


The Michigan Basin Field Demonstration

- DTE Energy is working with MRCSP contractors to conduct a geologic storage demonstration test in Northern Michigan.
- The site is being assessed by MRCSP to confirm suitability for injection
- Several sandstone formations underlie this region. These formations represent significant potential injection and regional storage opportunities.
- The formations appear to be well contained with extensive, low-permeability cap rock.
- Planned tests would assess the continuity and injectivity of the sandstone formation and the integrity of the caprock, operational approaches, and monitoring mechanisms

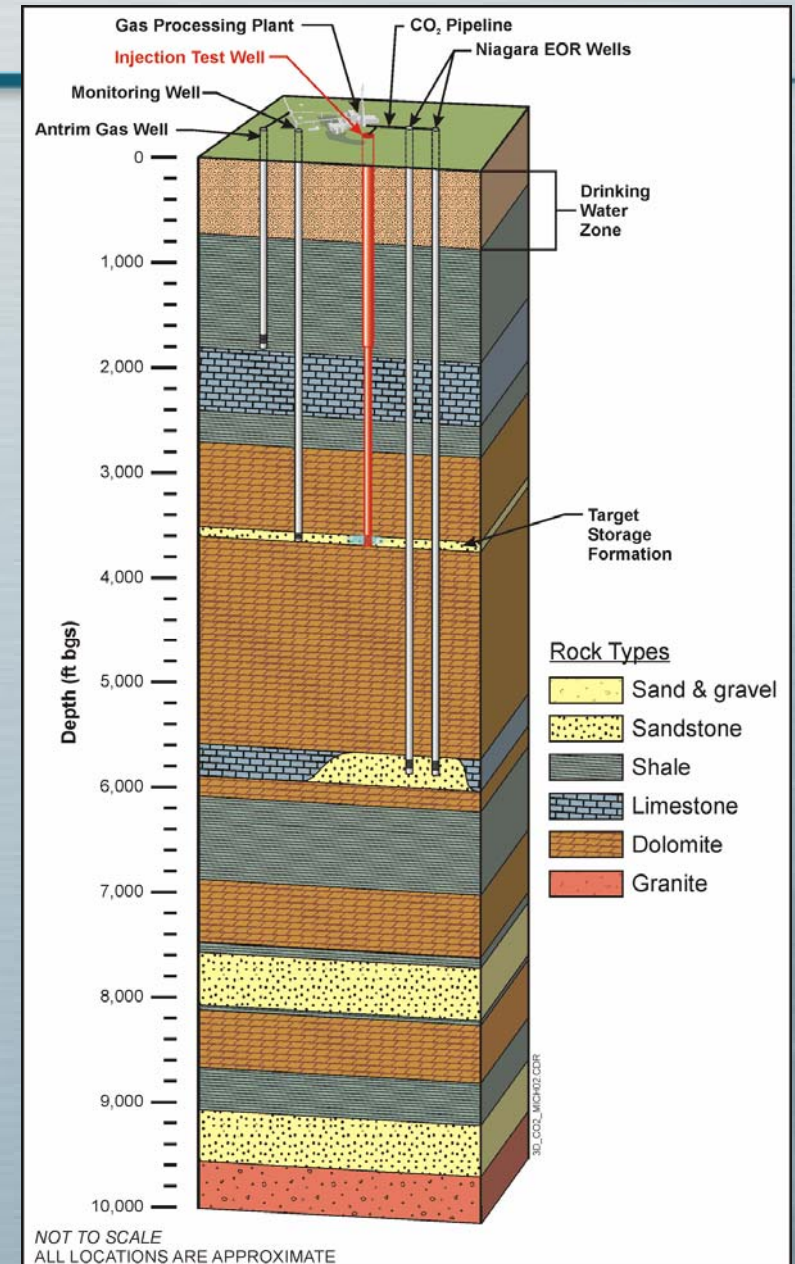
Michigan Basin- Otsego County Test Site

- The plant is a rural setting, with minor development.
- Antrim gas fields, currently 10th most prolific gas play in continental U.S.
- 8-mile long CO₂ pipeline already in place for enhanced oil recovery



Preliminary Conceptual Injection System

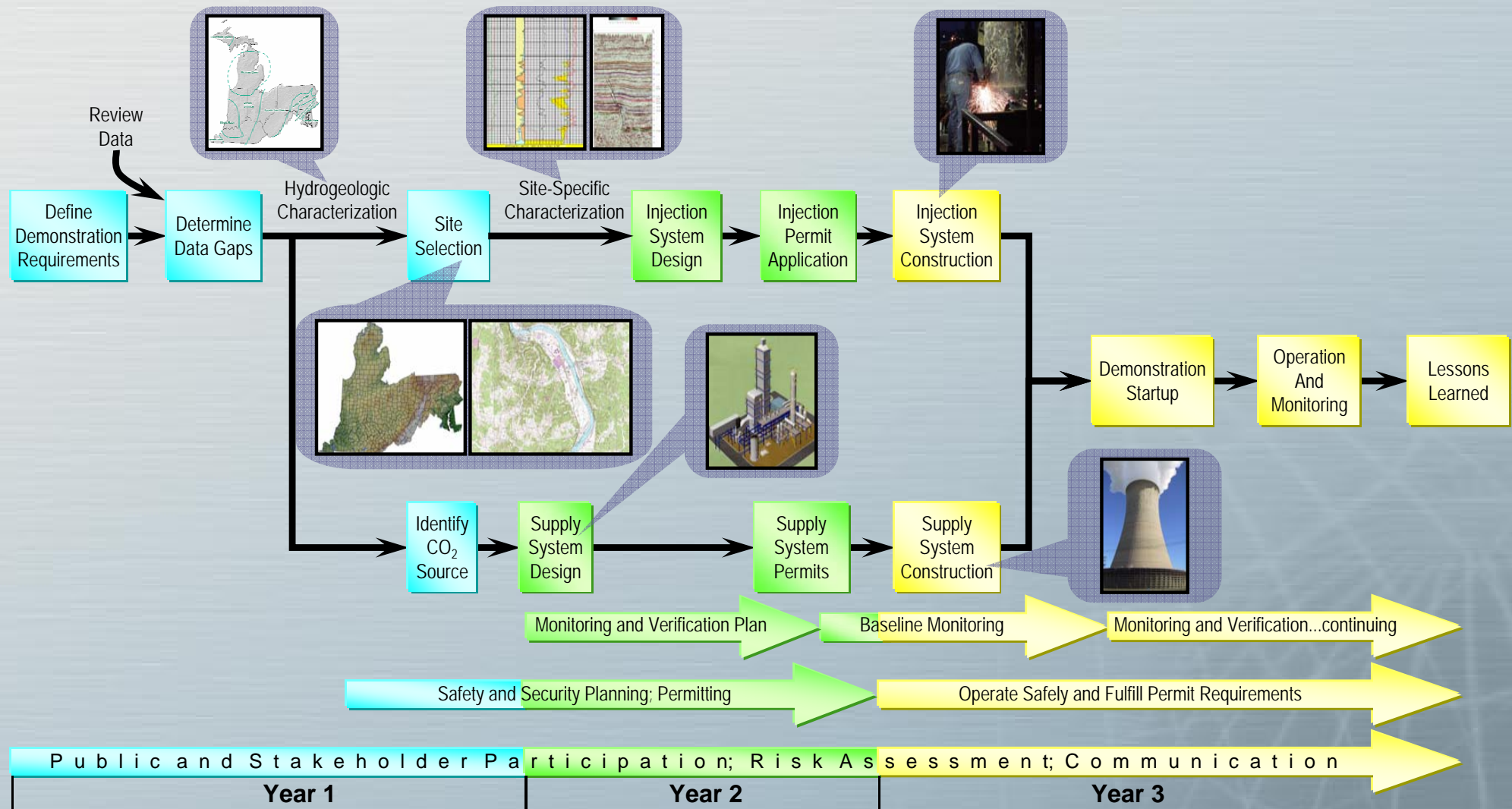
- Bois Blanc and Bass Islands deep saline formations primary target
- Detroit Group shale and salt layers provide containment
- Injection well and monitoring wells completed



Advantages of the Northern Michigan Site

- The site is located among a series of active oil and gas fields. As a result, much of the underlying geology is well documented
- Given the history of oil and gas development in the local area, MRCSP researchers will be able to leverage available data to develop a site-specific monitoring approach and build a detailed conceptual understanding of the site
- This analysis can be used to develop a computer model of the test injection and aid in describing injection and post-injection conditions

Key Steps in Developing CO₂ Storage Demonstrations



Timeline and Next Steps for the Michigan Basin Field Demonstration

- Preliminary site screening: Completed
 - Geologic data compilation and mapping based on current information
 - Regulatory review
 - Review monitoring, measurement & verification (MMV) feasibility
 - Development of research plan and safety plan
- Permitting: Initiated in Stages
 - State: Drilling permit obtained from MI Department of Environmental Quality, Fall 2006
 - Federal: Injection permit to be submitted to EPA Region 5, spring/summer 2007

Timeline and Next Steps for the Michigan Basin Field Demonstration (Continued)

- Site characterization: Underway
 - Well drilling and testing of candidate formations
 - Baseline monitoring, measurement & verification
 - Well completion and injection tests
- Operations
 - CO₂ acquisition and handling
 - Injection following EPA Region 5 approval
 - Continued monitoring, measurement & verification
- Post injection
 - Data analysis and review
 - Well closure or plugging
 - Post closure monitoring, measurement & verification

Contacts

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- MRCSP web site: www.mrcsp.org



For more information on
the MRCSP see
www.mrcsp.org