



Midwest Regional Carbon Sequestration Partnership (MRCSP)

*Managing Climate Change and Securing a Future for the
Midwest's Industrial Base – Phase II*

MRCSP Briefing, December 2005

Briefing Overview

- Background
 - Carbon dioxide (CO₂) emissions and climate change
 - Carbon sequestration
- The U.S. Department of Energy (DOE) Carbon Sequestration Program
- The MRCSP:
 - Partners and project organization
 - Phase I and Phase II timelines
 - Phase I activities and findings
 - Phase II objectives, activities and work plan
- Public Outreach
- Contacts

Carbon Dioxide (CO₂) Emissions and Climate Change

- 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 negative impacts
- Efforts are underway to develop the means to reduce CO₂ emissions and to stabilize concentrations of CO₂ in the atmosphere
- A variety of solutions will be needed as world industrial development increases fossil fuel use
- As part of a broad portfolio of technologies, carbon sequestration can play an important role in stabilizing atmospheric CO₂ concentrations

Carbon Sequestration

- Sequestration is the controlled, permanent storage of CO₂
- 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 injection of CO₂ into rock formations such as depleted oil wells, unmineable coal seams and very deep saline reservoirs to permanently store CO₂ in the earth
- Known methods for monitoring and verifying to ensure that the CO₂ remains in storage can be applied; new methods are being be developed and tested

The DOE Carbon Sequestration Program

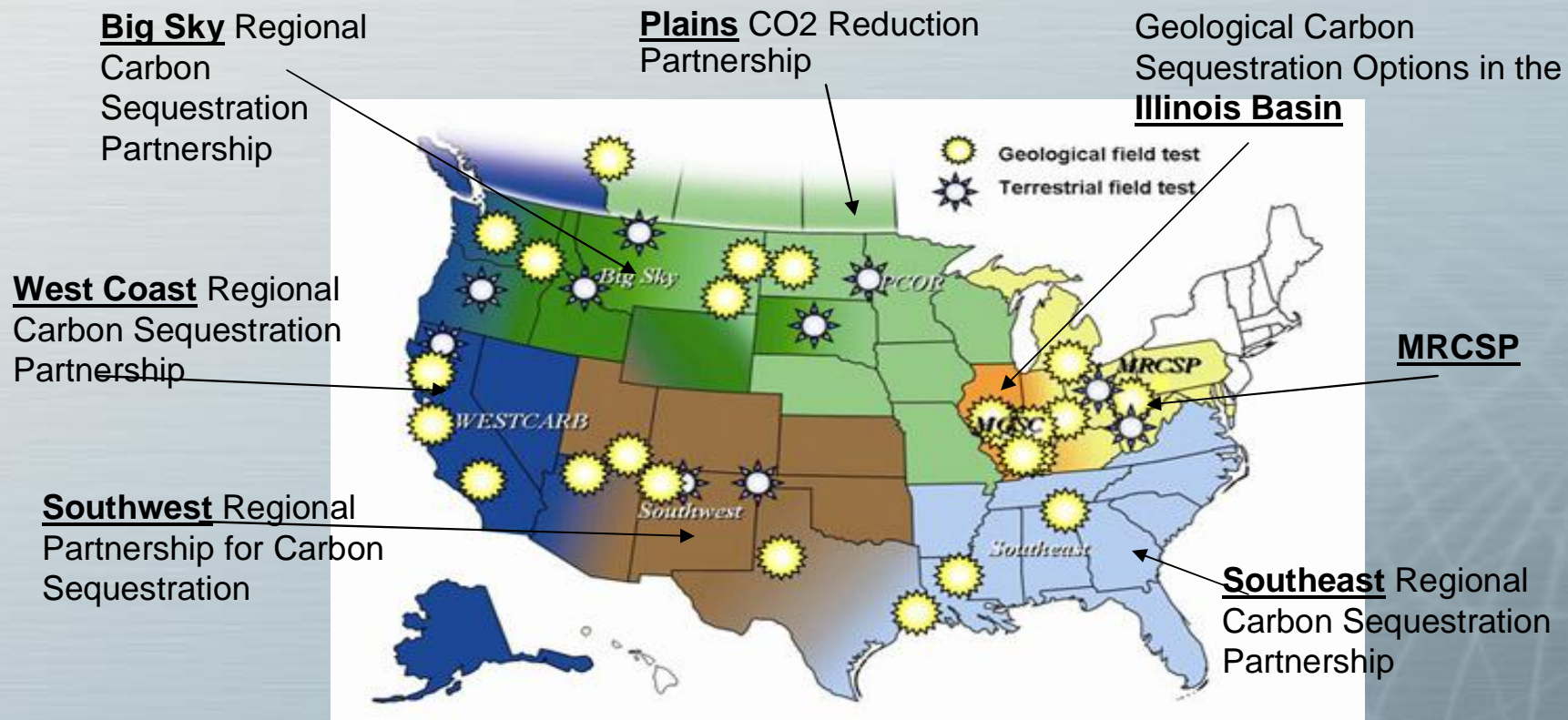
- The Carbon Sequestration Program is run by the National Energy Technology Laboratory (NETL), a part of the U.S. Department of Energy (DOE)
- The program includes research and development to support sequestration technologies that hold promise to significantly reduce CO₂ emissions and their impact on the atmosphere
- The program also includes seven regional partnerships to help develop the best approaches to sequestration across the country. The MRCSP is one of these partnerships.
- DOE is preparing a programmatic Environmental Impact Statement (EIS) covering the entire sequestration program. Public scoping meetings were held in the summer of 2004. The draft is expected to be released for public comment in the winter of 2006. For more information on this, see: <http://www.netl.doe.gov.coalpower/sequestration/eis/index.html>

DOE's Regional Carbon Sequestration Partnerships

- Public/private partnerships in a nationwide effort to determine regionally-appropriate sequestration options and opportunities
- Regional approaches make sense because of differences in fossil fuel use and characteristics of sequestration sinks
- Seven Partnerships established in 2003
- They include 154 organizations spanning more than 40 states, three Indian nations, two Canadian provinces
- MRCSP is one of the seven partnerships. See:
<http://www.netl.doe.gov/coalpower/sequestration/partnerships/index.html>

The MRCSP is One of Seven DOE/NETL Regional Partnerships

Public/private partnerships in a nationwide effort to determine regionally-appropriate sequestration options and opportunities



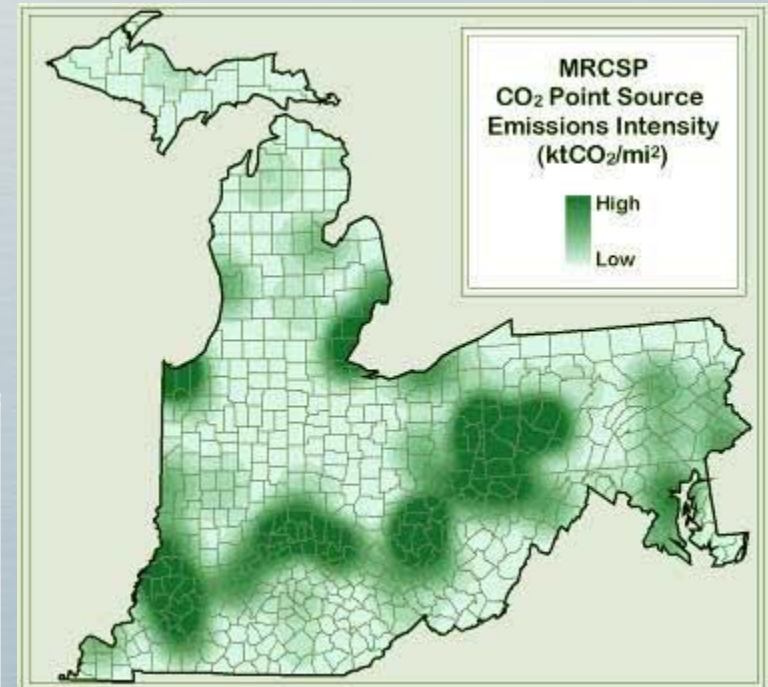
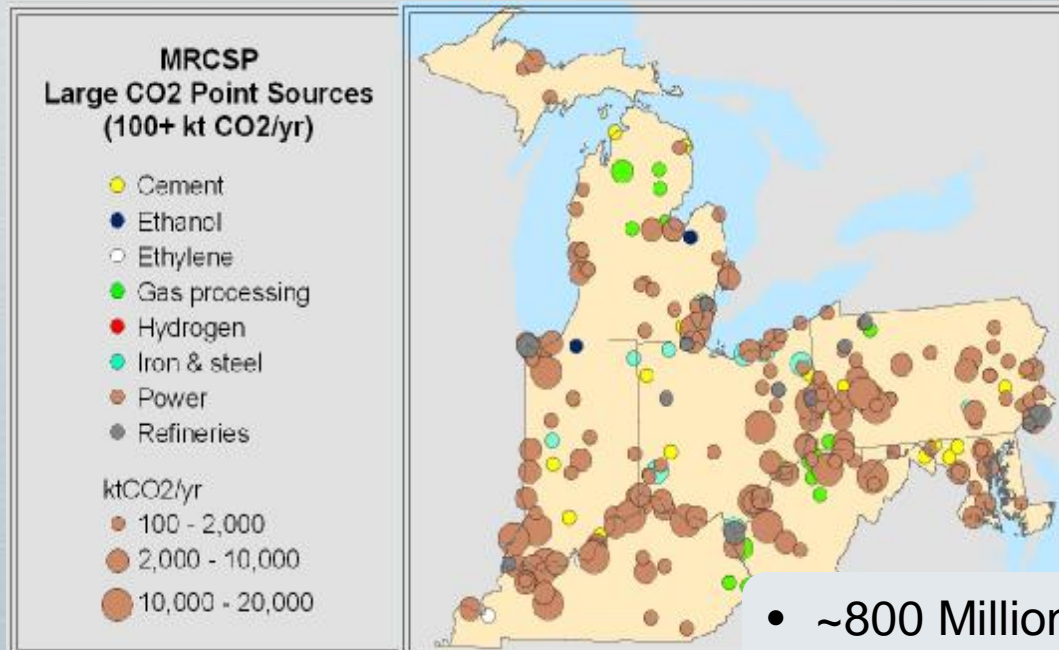
See <http://www.netl.doe.gov/coal/Carbon%20Sequestration/partnerships/index.htm> for more information from NETL on the seven partnerships.

Snapshot of the MRCSP

- **Who:** 30+ member team from the research community, energy industry, non-government organizations, and government led by Battelle
- **What:** Demonstrate the safety and effectiveness of carbon sequestration and further add to our understanding of the best approaches to carbon sequestration in the region
- **When:** Phase I Launched, fall 2003; final report available, winter 2005/6; Phase II commenced October 2005
- **Where:** Seven-state region of IN, KY, MD, MI, OH, PA, WV
- **Why:** Part of a national effort to develop robust, potentially large-scale and cost-effective options for mitigating CO₂ emissions that contribute to climate change

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



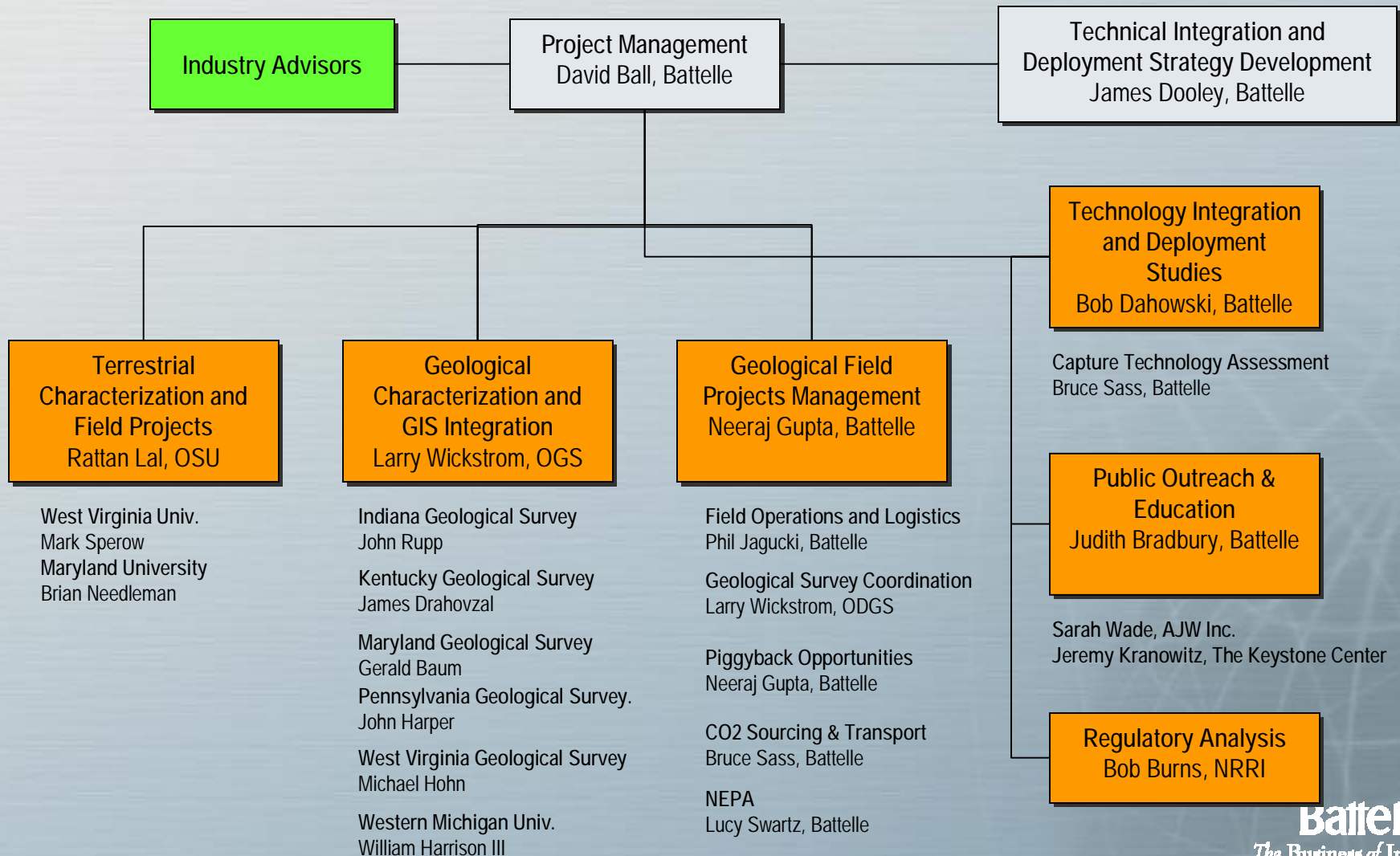
- ~800 Million Metric Tons (MMT) CO₂/year
- ~300 Large Point Sources

Our partner team is a strategic asset as well as a source of funding

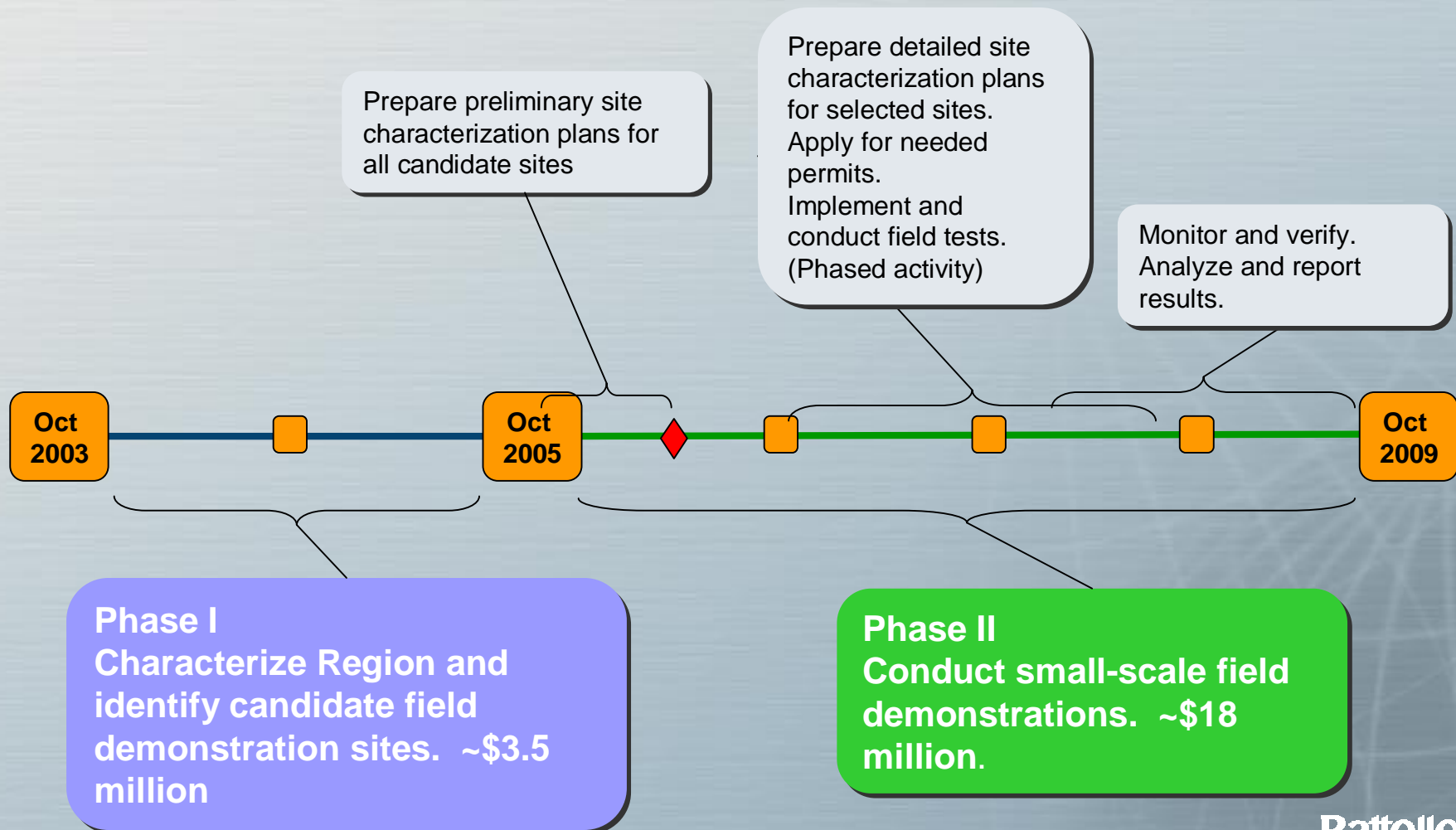


U.S. Department of Energy/NETL

Phase II Project Organization



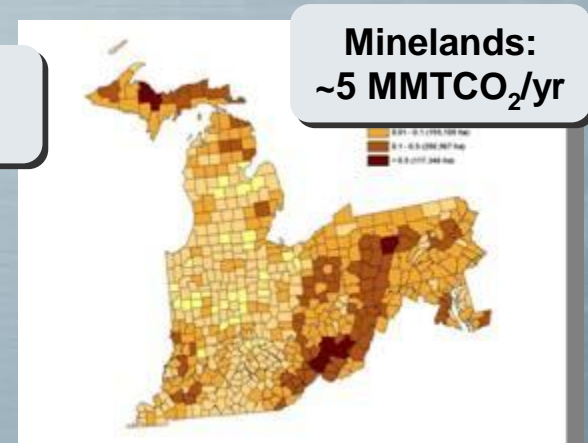
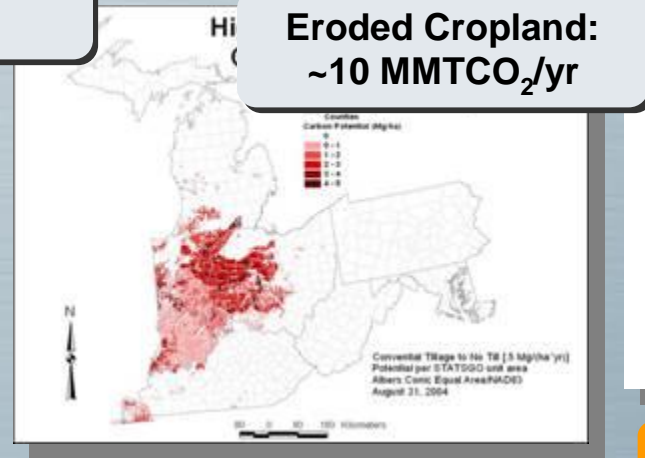
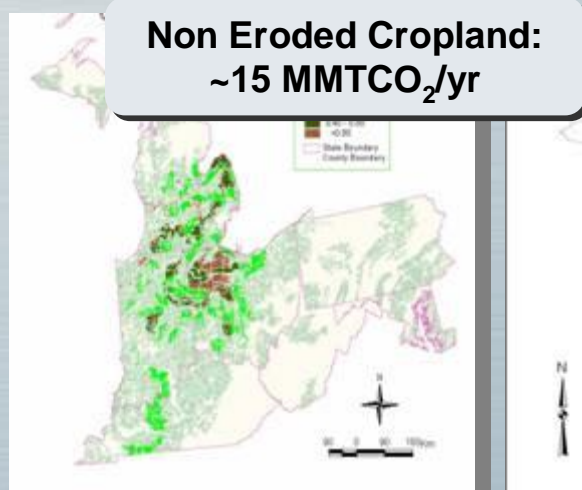
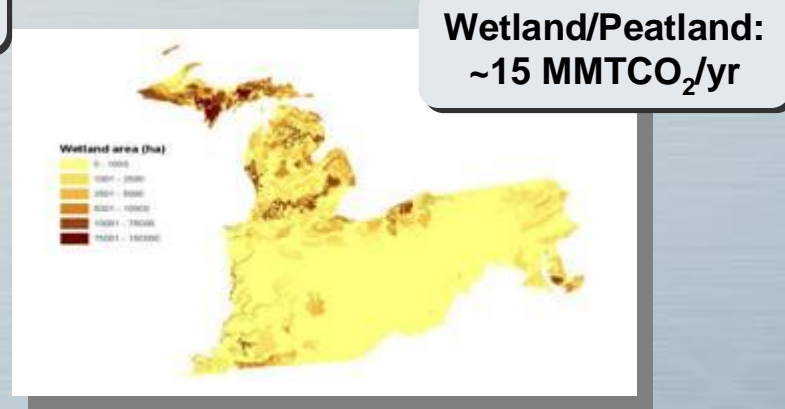
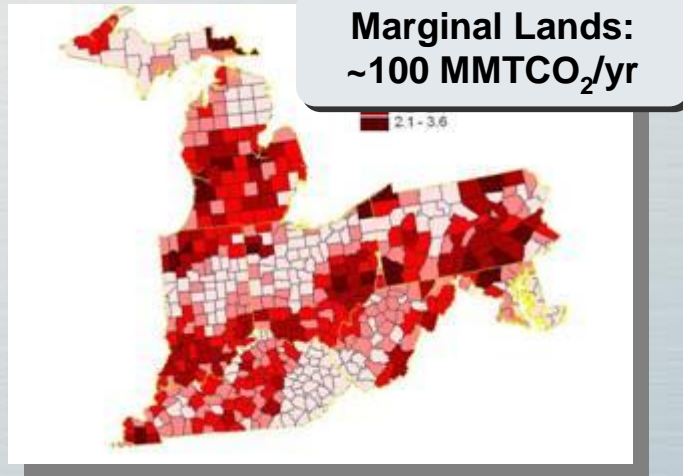
Timeline for MRCSP Phase I and Phase II Activities



MRCSP Activities in Phase I

- Identified CO₂ sources in the MRCSP Region
- Assessed the cost of capturing CO₂ from these sources
- Assessed the region's deep geologic formations, forests, agricultural and degraded land systems for their potential to sequester CO₂
- 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
- Identified promising options and strategies for addressing potential deployment issues
- Developed recommendations for potential small-scale validation testing during a second phase of DOE/NETL's partnership program

Terrestrial Sequestration Potential in the Region*



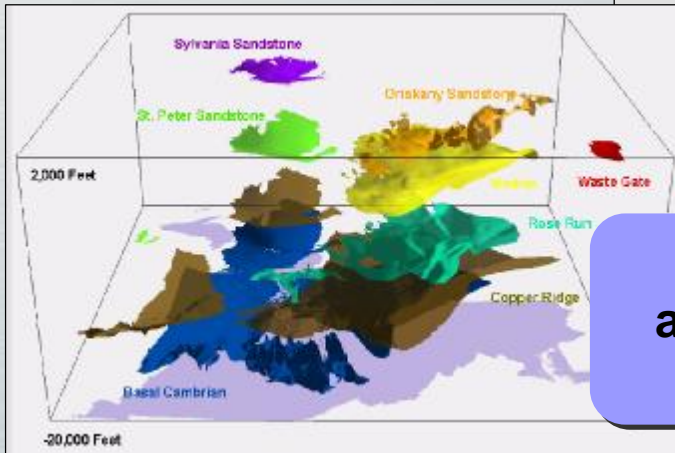
(*) These are preliminary estimates that will be further refined

Vast Geological Potential of the Region*

Deep saline formations:
~ 500,000 MMTCO₂

Depleted oil and gas fields
~ 2,000 MMTCO₂

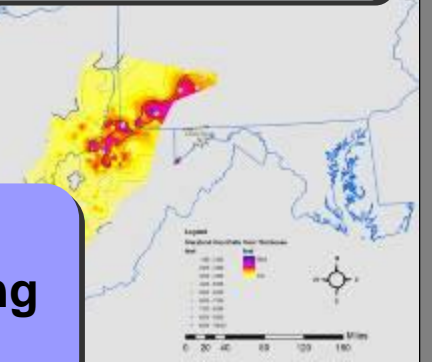
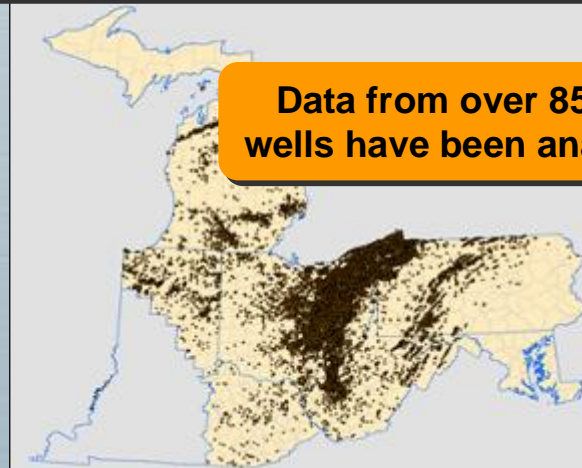
Unmineable coal and shale
~ 25,000 MMTCO₂



Phase II efforts are designed to address all of these sinks at varying levels of detail

Data from over 85,000 wells have been analyzed

(*) These are preliminary estimates



Emissions and Storage Capacity by Individual State*

Terrestrial

State	Total Terrestrial Capacity* (MMTCO ₂ /yr)	Emissions from Large Sources (MMTCO ₂ /yr)	% of Emissions from Large Sources
Eastern Indiana	33	162	20%
Eastern Kentucky	21	102	20%
Maryland	6	38	16%
Michigan	23	94	25%
Ohio	28	148	19%
Pennsylvania	21	127	17%
West Virginia	11	96	12%
MRCSP Total	143	767	19%
(*) Numbers are based on a twenty-year horizon			

(*) These are preliminary estimates

Geologic

State	Total Geologic Capacity (MMT CO ₂)	Emissions from Large Sources (MMTCO ₂ /yr)	Years of Storage Capacity
Eastern Indiana	80,700	162	498
Eastern Kentucky	13,200	102	129
Maryland	9,500	38	250
Michigan	220,300	94	2344
Ohio	46,300	148	313
Pennsylvania	88,500	127	697
West Virginia	60,800	96	633
MRCSP Total	519,300	767	677

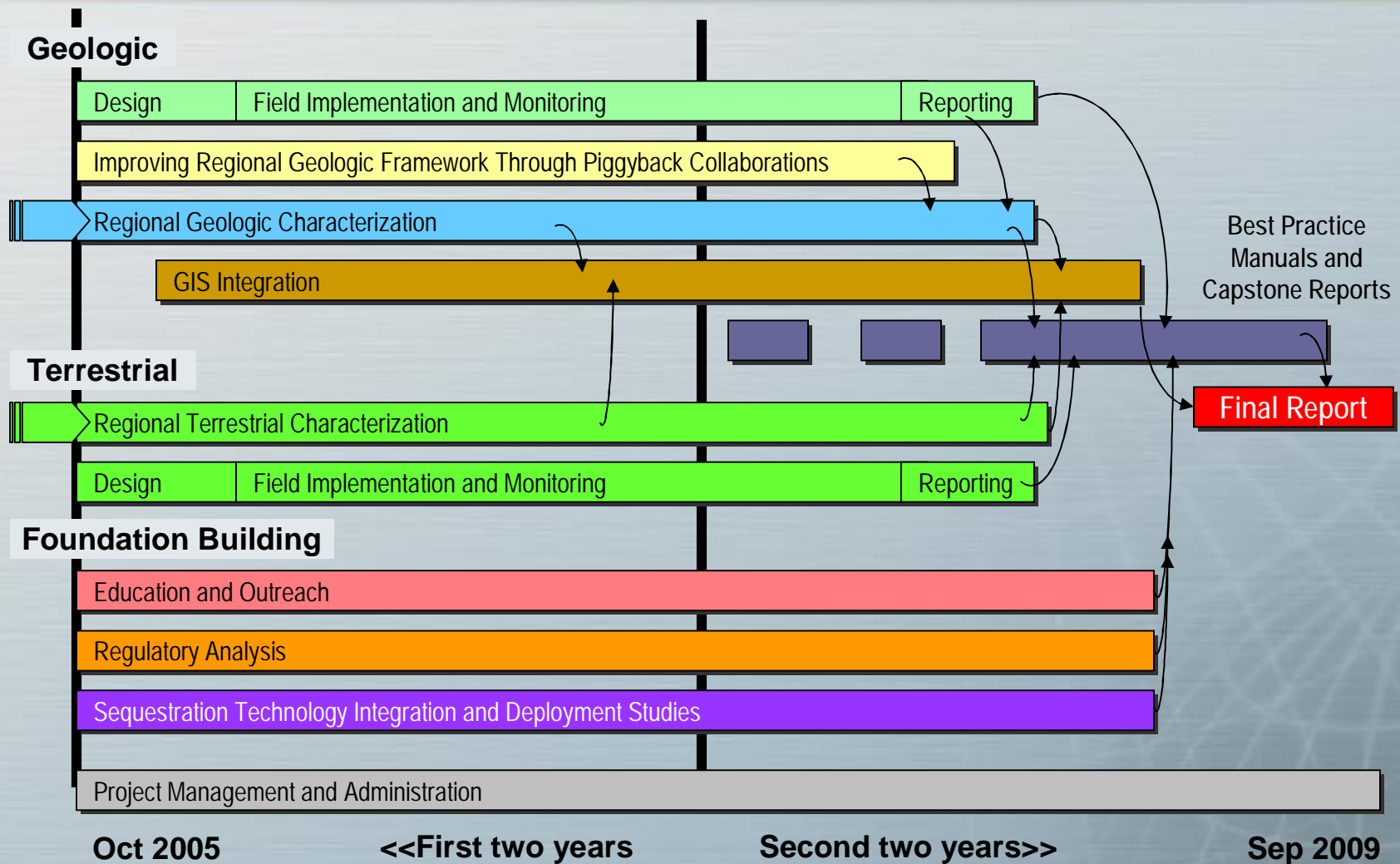
Phase II Objectives

- 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 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
- Identification of readily-available or near-commercial sequestration technologies
- Articulation of the full system necessary to support carbon sequestration at a large scale in the region
- Proactive stakeholder engagement and public outreach
- Integration of MRCSP activities with the other DOE regional partnerships

When: Phase II Work Plan



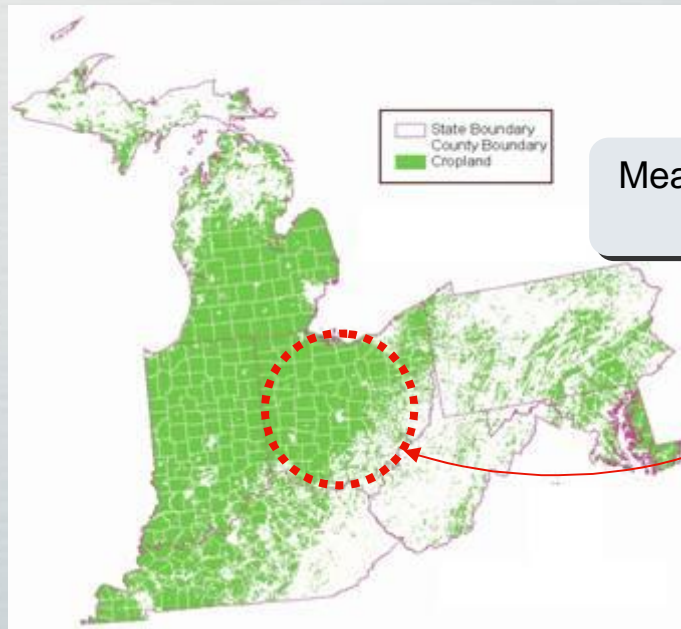
Phase II Field Demonstration Projects

- MRCSP has identified and is further assessing several candidate locations representing geographic, land-use and geologic diversity in the region
- Once selected, the projects will be carried out with rigorous monitoring methods and safeguards
- MRCSP will work with officials and stakeholders to gain any necessary approvals to proceed and complete the project design

Framework for Evaluating Candidate Phase II Field Projects

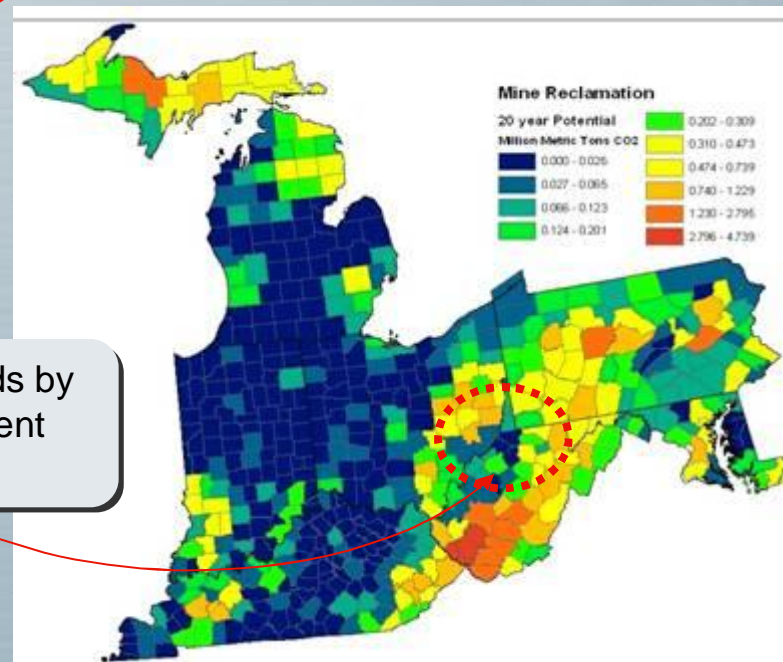
- Cost/benefit
- Cost share support available
- Innovativeness of research (is it helping to define the state of the art)
- Applicability to region (capability to address multiple reservoirs)
- Public/stakeholder acceptance
- Degree of support from state and federal regulators
- Safety and risk assessment
- Contribution to the region:
 - Potential for sequestration deployment in the region
 - Cost of commercial implementation
 - Time to commercial implementation
 - Degree to which the project will help attract and retain business or research to the region
 - Degree to which the project would help define new science-based regulations

Phase II Terrestrial Field Demonstration Tests



Measure sequestration on croplands under different conditions.

Characterize sequestration for minelands by comparing carbon uptake under different reclamation practices.

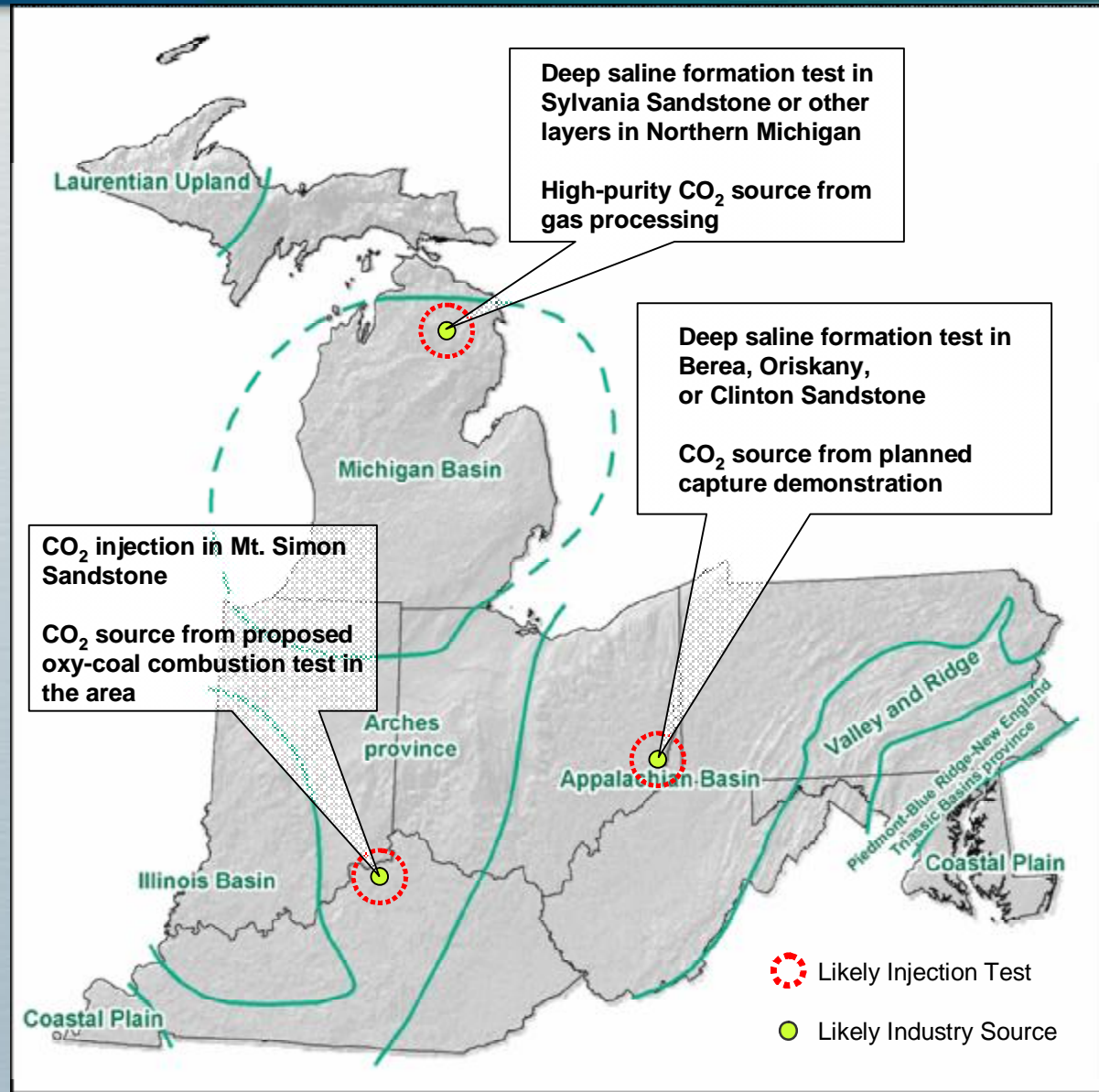


Recommended Management Practices for Soil Carbon Sequestration

1. No-till farming
2. Residue retention
3. Cover crops
4. Fertility management
5. Drainage

Phase II Candidate Geologic Field Demonstrations and CO₂ Sources

- The primary CO₂ injection sites are shown on the map
- Additional locations may be characterized for injection feasibility in saline formations, oil/gas fields, coal seams, and organic shales
- Additional possible sources of CO₂ include ethanol plants, gas processing, and commercial suppliers



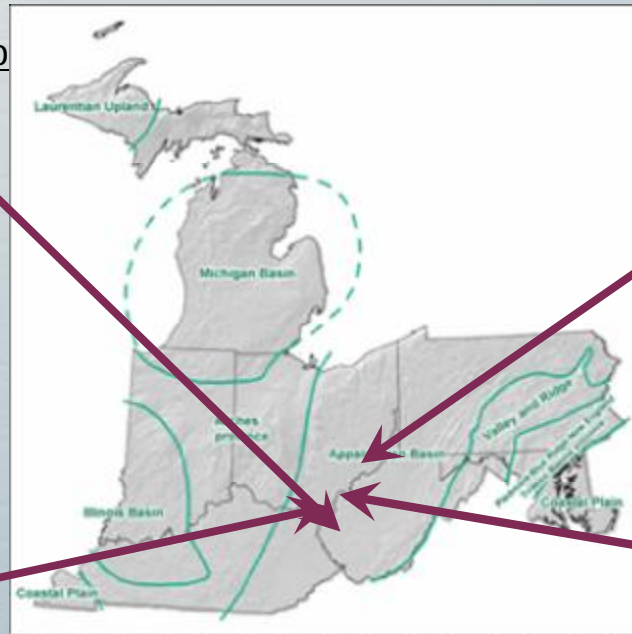
Collaborating to Build a Regional Geologic Framework

Examples of Projects Being Conducted at other Ohio Locations, in Collaboration with the Oil and Gas Industry



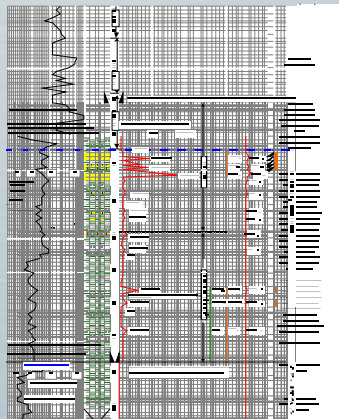
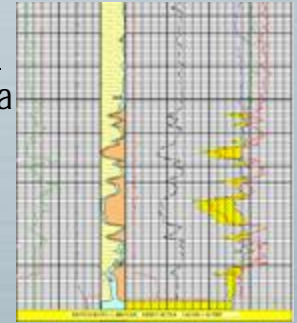
Gallia County, Ohio

- Drill, log, and core borehole to risk assessment
- Collaborative project with Japanese electric power institute



Noble County, Ohio

- Collect wireline data
- Collect rock core samples



Gallia County, Ohio

- Extend borehole depth
- Collect wireline data
- Collect rock cores
- Establish regional continuity

Mountaineer Plant

- Drill 9200 ft. test well
- Collect wireline data
- Collect brine and rock core samples



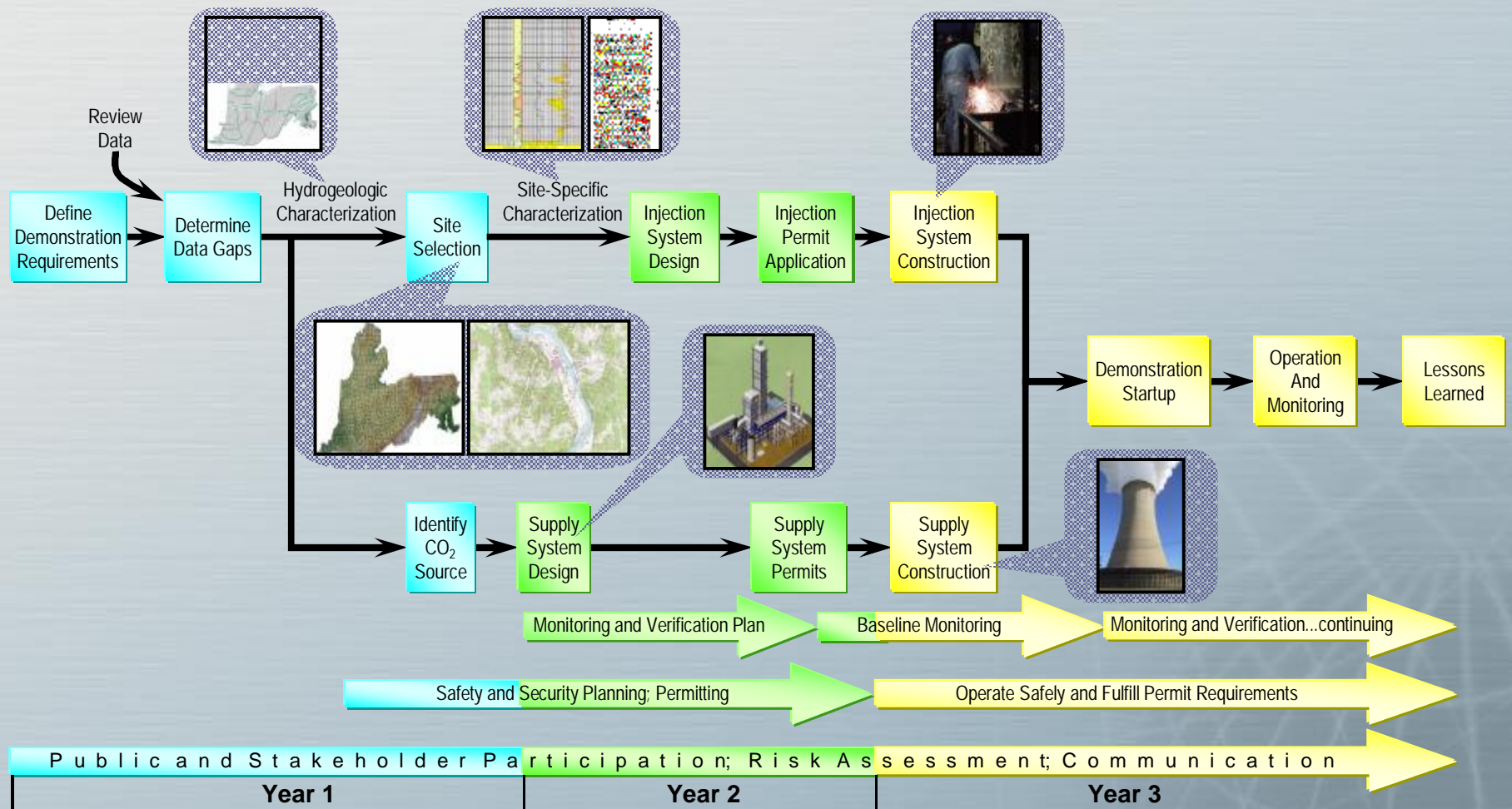
Likely Steps in Conducting a Geologic Storage Demonstration

- Preliminary site screening
 - Geologic data compilation and mapping based on current information
 - Regulatory review
 - Review monitoring, measurement & verification feasibility
 - Develop research plan and safety plan
- Permitting
 - Federal
 - State
 - Facility-specific issues

Likely Steps in Conducting a Geologic Storage Demonstration (Continued)

- Well construction
 - Approval to begin injection
 - Continued monitoring, mitigation & verification
 - Injection of small amounts of CO₂
 - Obtain final approval to inject
 - CO₂ acquisition and handling
 - Well completion and injection tests
- Post injection
 - Data analysis and review
 - Well closure or plugging
- Post closure monitoring, mitigation and verification

Developing CO₂ Geologic Storage Demonstrations



Monitoring Plan Guiding Principles

- Monitoring for any injection test phase will need to address
 - Regulatory monitoring requirements for injection wells
 - Performance assessment – scientific monitoring to understand fate and transport of injected CO₂
- Avoid setting unnecessary precedents for future full-scale sites
- Site features/constraints for industrial settings
 - Active high-value asset – no interruptions to operations allowed
 - Surface features such as plant, power lines, ash ponds, railway lines affect monitoring
 - Local public/stakeholders must be kept informed
- Monitoring, mitigation & verification (MMV) techniques should be sensitive enough to detect injected CO₂
- Effort will be made to evaluate/demonstrate a range of MMV options but only a selected subset will be used for any site

Public Outreach

- Two-way effort includes sharing of information and solicitation of public input on all stages of project including:
 - Development of general information materials
 - Use of interactive website as a means of informing the public and seeking input
 - Use of focus groups and interviews to obtain detailed feedback
 - With Research Partners, conduct briefings and meetings to update stakeholders

Feedback is Welcome

- MRCSP Website:
www.mrcsp.org
- MRCSP contacts:
 - Dave Ball, Project Manager: 614-424-4901;
balld@battelle.org
 - Judith Bradbury, Outreach Coordinator: 703-519-4955;
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- NETL Carbon Sequestration Website:
www.netl.doe.gov/coalpower/sequestration/partnerships/index.html



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