Midwest Regional Carbon Sequestration Partnership (MRCSP)

Appalachian Basin Test Site at FirstEnergy's R.E. Burger Plant

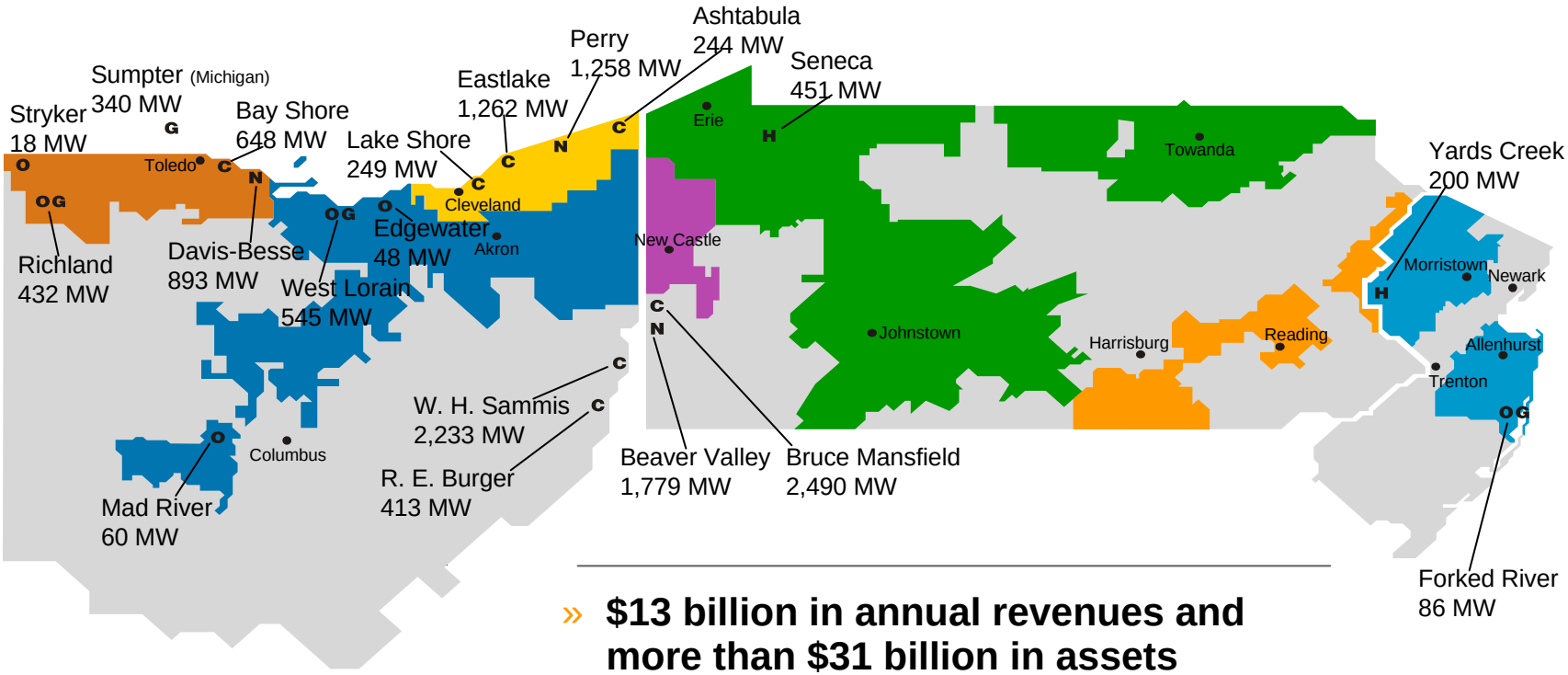
Public Meeting, March 6, 2008

Shadyside, Ohio

Introduction:	Chris Eck, FirstEnergy
DOE's Sequestration Program:	Lynn Brickett, US DOE/NETL
MRCSP Overview and Purpose of Test:	Dave Ball, Battelle
Site History and Plans for the Test:	Phil Jagucki, Battelle
What Will We Learn from the Test:	Neeraj Gupta, Battelle

The MRCSP is being conducted under DOE/NETL Contract DE-FC26-05NT42589

Who We Are - FirstEnergy System



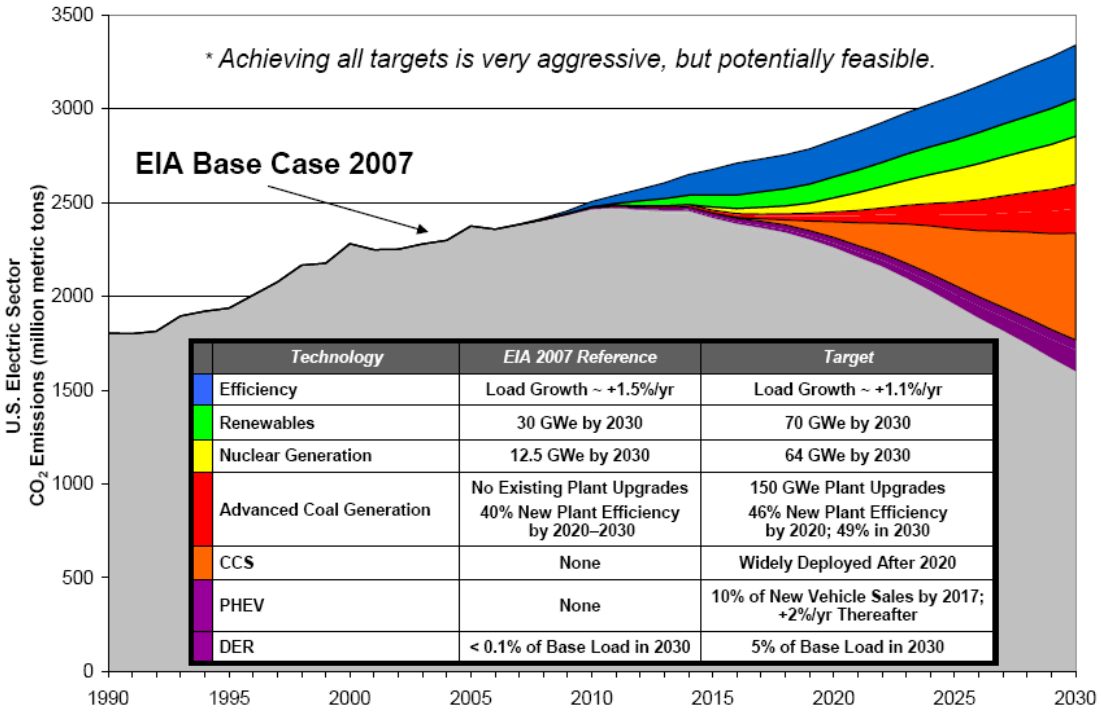
Assets	8
Customers	5
Revenues	5
Market Cap	10

- **$13 billion in annual revenues and more than $31 billion in assets**
- **4.5 million customers**
- **20 generating plants**
- **128,000 transmission & distribution miles**
- **Approx. 13,100 employees in electric utility operations and 2,100 employees in oil, natural gas and mechanical contracting operations**

Why is this project important

Unlike other environmental issues there currently are no near-term solutions

- *Supports the use of coal in electricity generation*
- *Supports technology development*
- *Economic benefit by saving jobs*
- *Assists in stabilizing/reducing atmospheric CO_2*

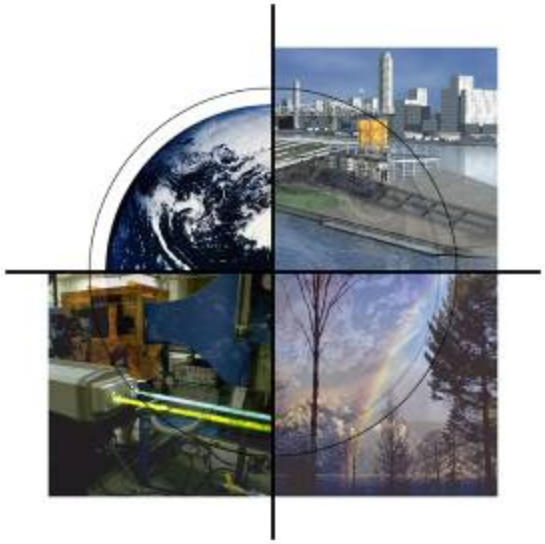


Technology	EIA 2007 Reference	Target
Efficiency	Load Growth ~ +1.5%/yr	Load Growth ~ +1.1%/yr
Renewables	30 GWe by 2030	70 GWe by 2030
Nuclear Generation	12.5 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Existing Plant Upgrades 40% New Plant Efficiency by 2020–2030	150 GWe Plant Upgrades 46% New Plant Efficiency by 2020; 49% in 2030
CCS	None	Widely Deployed After 2020
PHEV	None	10% of New Vehicle Sales by 2017; +2%/yr Thereafter
DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

DOE's Regional Partnership Program

Lynn A. Brickett,

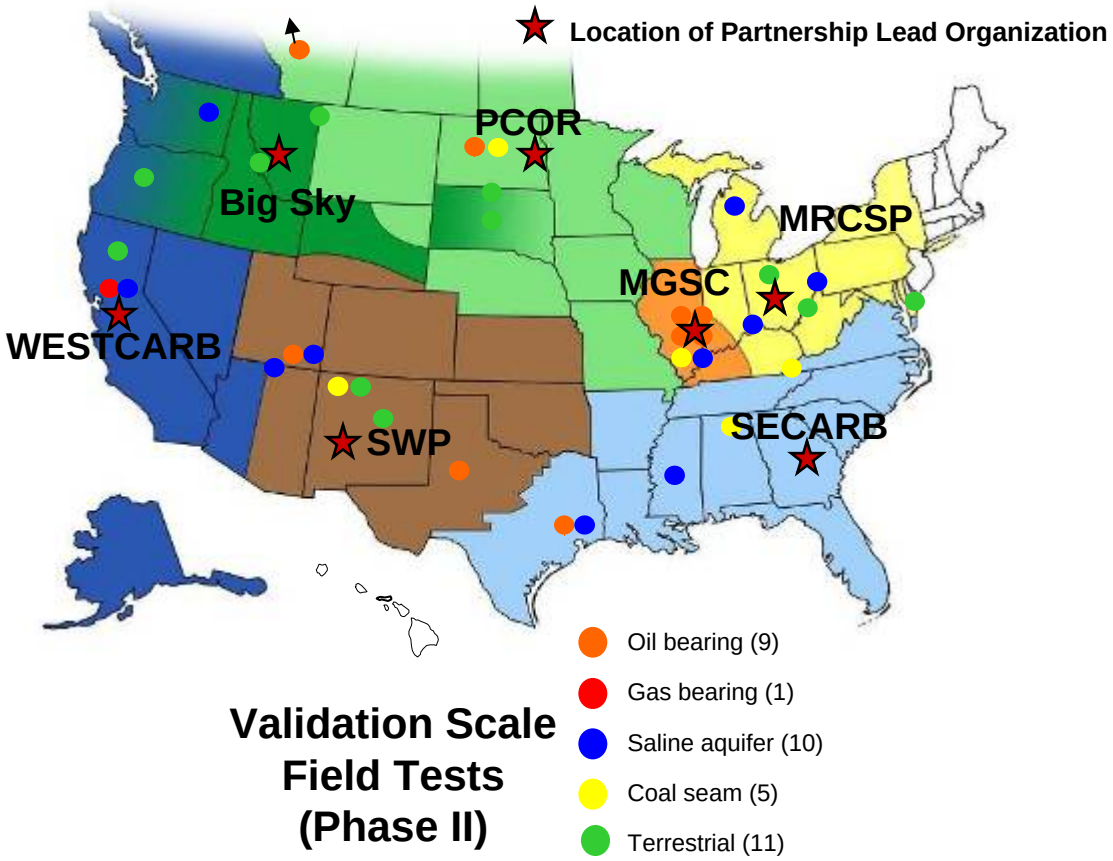
- DOE's National Energy Technology Laboratory (NETL)



Regional Carbon Sequestration Partnerships

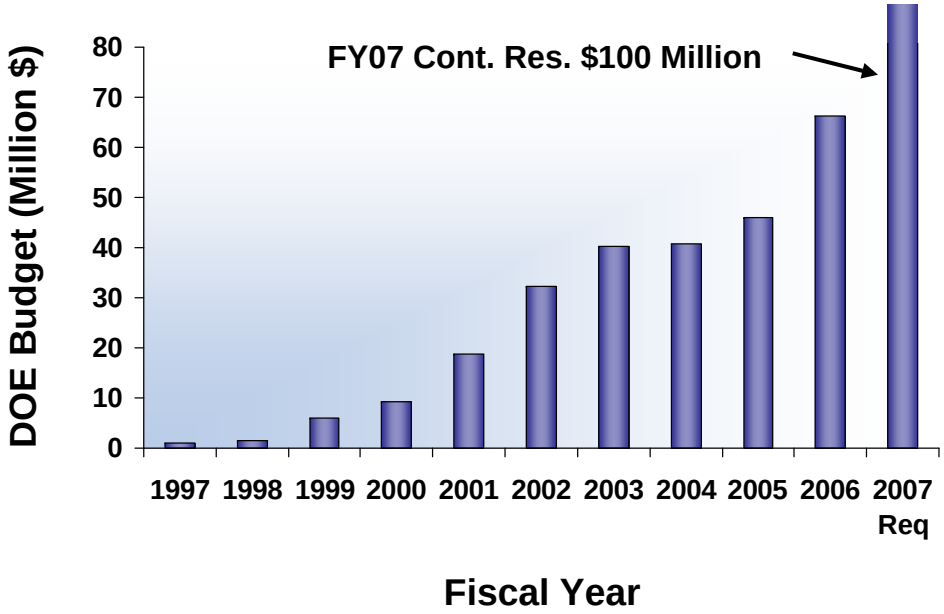
Creating Infrastructure for Wide Scale Deployment

- Three Phases:
  - Characterization Phase
    - 24 months (2003-2005)
  - Validation Phase
  - Deployment Phase
- Representing:
  - >350 Organizations
  - 41 States
  - 4 Canadian Provinces
  - 3 Indian Nations
- Addressing:
  - Permitting
  - Regulatory framework
  - Public Acceptance
  - Liability
  - Best Practices



Validation Scale Field Tests (Phase II)

Sequestration Program Statistics FY2007

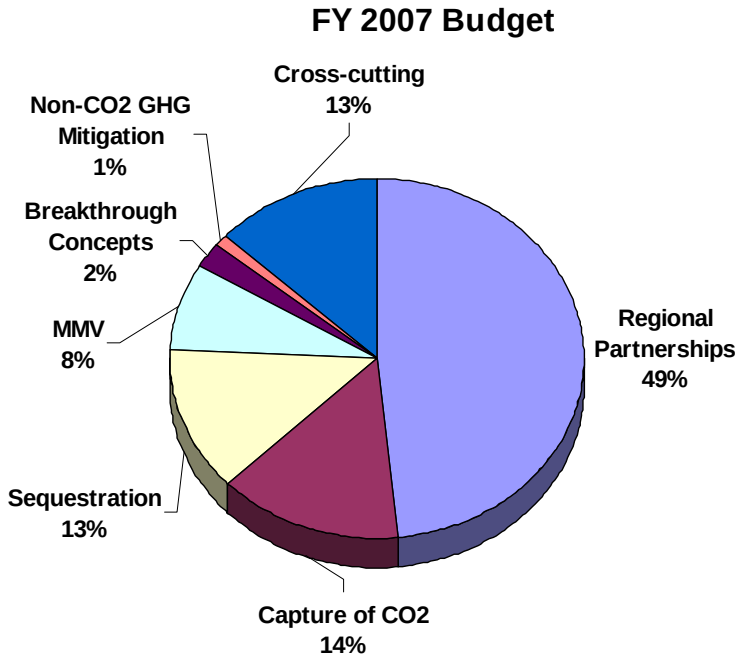


Strong industry support

~ 39% cost share on projects

Federal Investment to Date

~ $360 Million



Diverse research portfolio

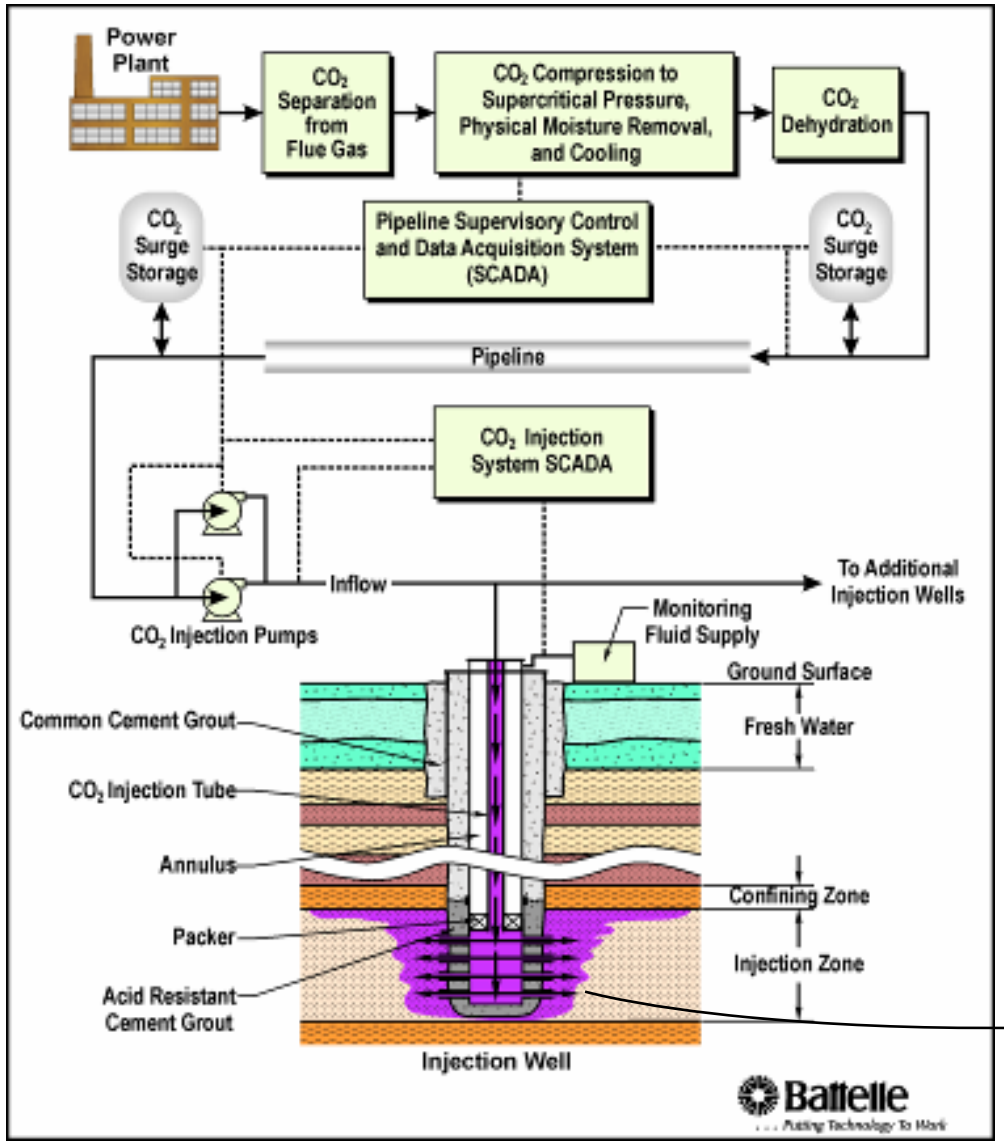
~ 70 Active R&D Projects

The Midwest Regional Carbon Sequestration Partnership (MRCSP)

Dave Ball, Battelle

- MRCSP Project Manager

In this test we are evaluating a technology called Carbon Capture and Geologic Storage (CCS)



CO_2 Capture

CO_2 Transport

CO_2 Injection into deep geologic formation (permanent storage)

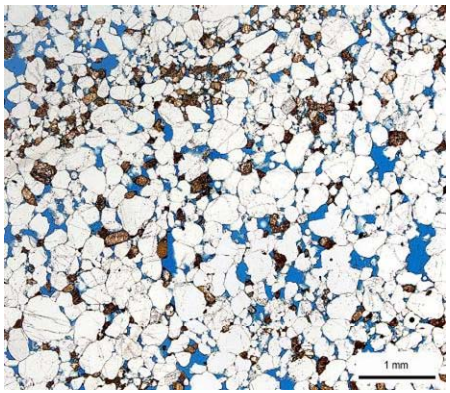
>2500 ft deep (the test at the Burger site will be at ~7500 ft)

How does carbon dioxide storage in geologic formations actually work?

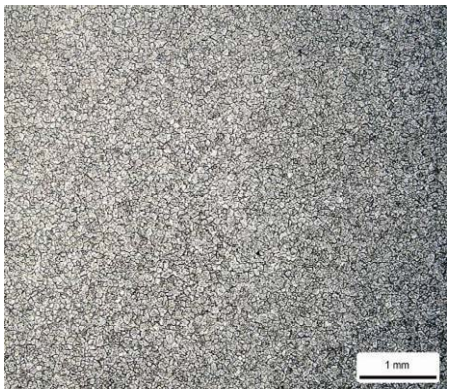
- Porosity is the amount of space between grains of rock; permeability is the connectedness of the pore spaces.
- A good storage reservoir has a lot of porosity and permeability which are combined in a term called “injectivity”
- A good cap rock has low porosity and permeability and acts as a barrier to prevent carbon dioxide from rising to the surface

Both images show a slice of rock that has been magnified 100 times and treated with blue dye to show the pore spaces. The image on the left is sandstone, a good storage reservoir. The image on the right is a shale, which forms a good cap rock or seal.

Storage Reservoir

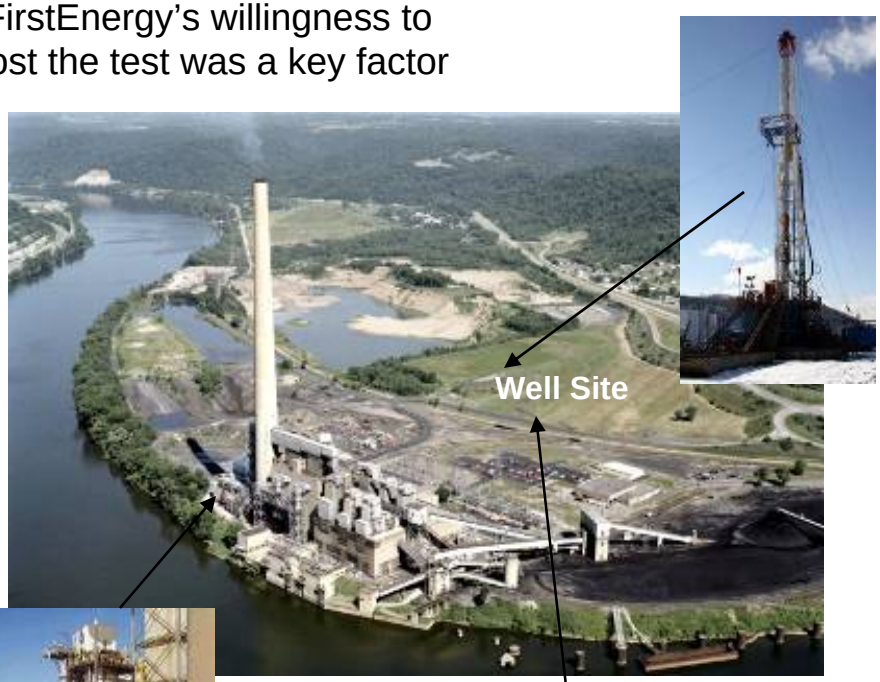


Cap Rock



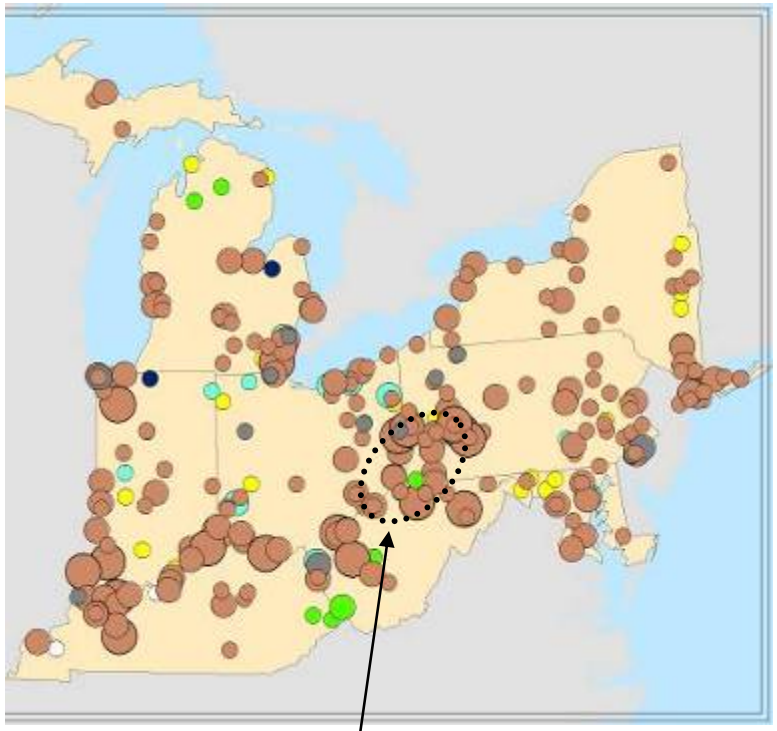
Why did we choose the R.E. Burger site?

FirstEnergy's willingness to host the test was a key factor



Accessibility for the injection well site is good

This site is also host to a test of Powerspan's emissions control technology

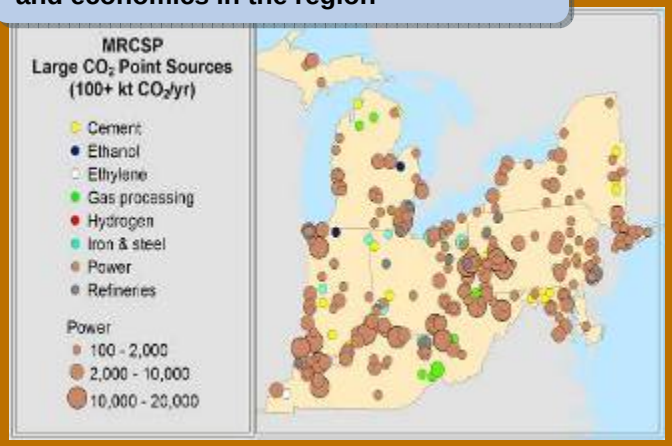


Located in the heart of a key power generating region

MRCSP's mission: be the premier resource for sequestration knowledge in its region

Characterization, Phase I, 2003 - 2005

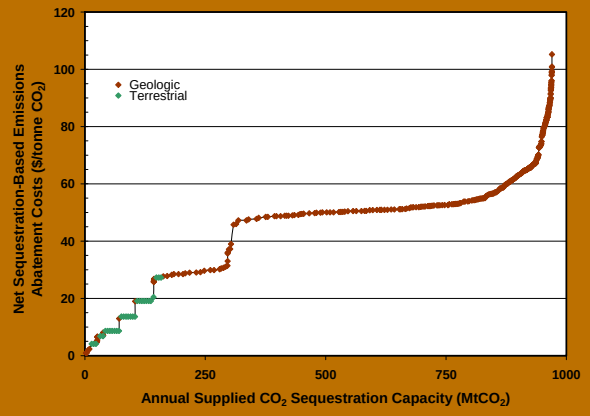
Quantifying CO2 sources, demographics and economics in the region



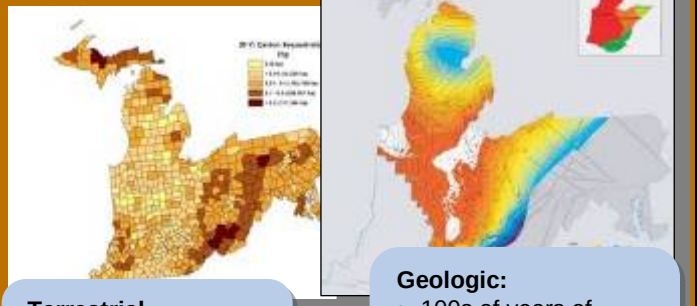
Reaching Out To and Educating Stakeholders

www.mrcsp.org

Developing a Regional Model of the Economics of Sequestration



Quantifying CO_2 Sinks in the Region



Terrestrial:
- Potential for 20% annual offset for large point sources

Geologic:
- 100s of years of capacity for large point sources in deep saline alone

Validation, Phase II, 2005 - 2009

Implementation

Geological

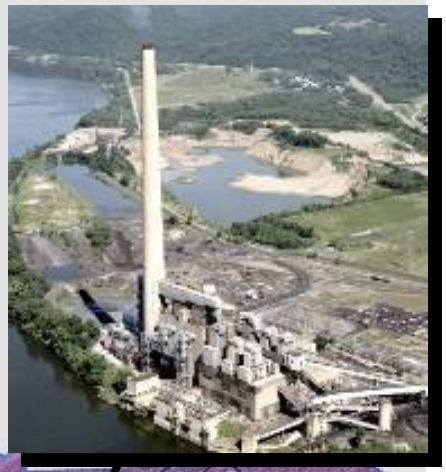
Terrestrial

MRCSP membership

MRCSP's Phase II tests involve small-scale injection into key geologic reservoirs

Michigan Basin

Appalachian Basin



Cincinnati Arch

History at the Burger Site and Plans for Future Testing

Phil Jagucki, Battelle

- Manager, MRCSP Site Operations

Key Steps in MRCSP Geologic Carbon Storage Field Test

Conduct a preliminary analysis of the geology based on existing data

Prepare a preliminary analytical model of the injection zone

Initiate permitting process with appropriate authorities

Conduct a seismic survey. Drill and log a test well

Refine model based on actual data

Complete permitting process

Inject carbon dioxide under carefully controlled test conditions

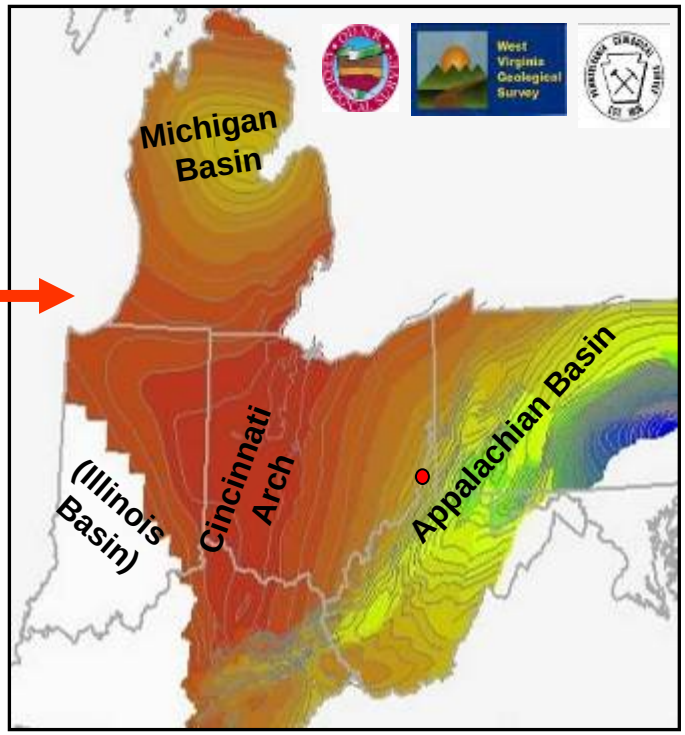
Monitor results to validate and refine the model.

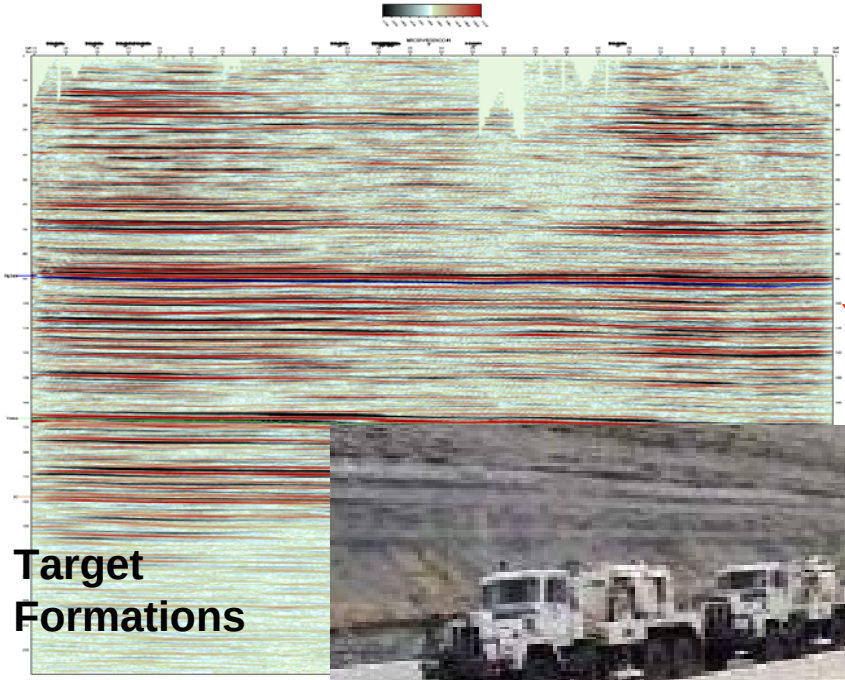
Report results

The Goal: demonstrate the feasibility of carbon dioxide storage in the real world as a step towards commercial deployment

Assessing the Regional Geology

1. Location in a major sedimentary basin--these are thought to be good storages sites.





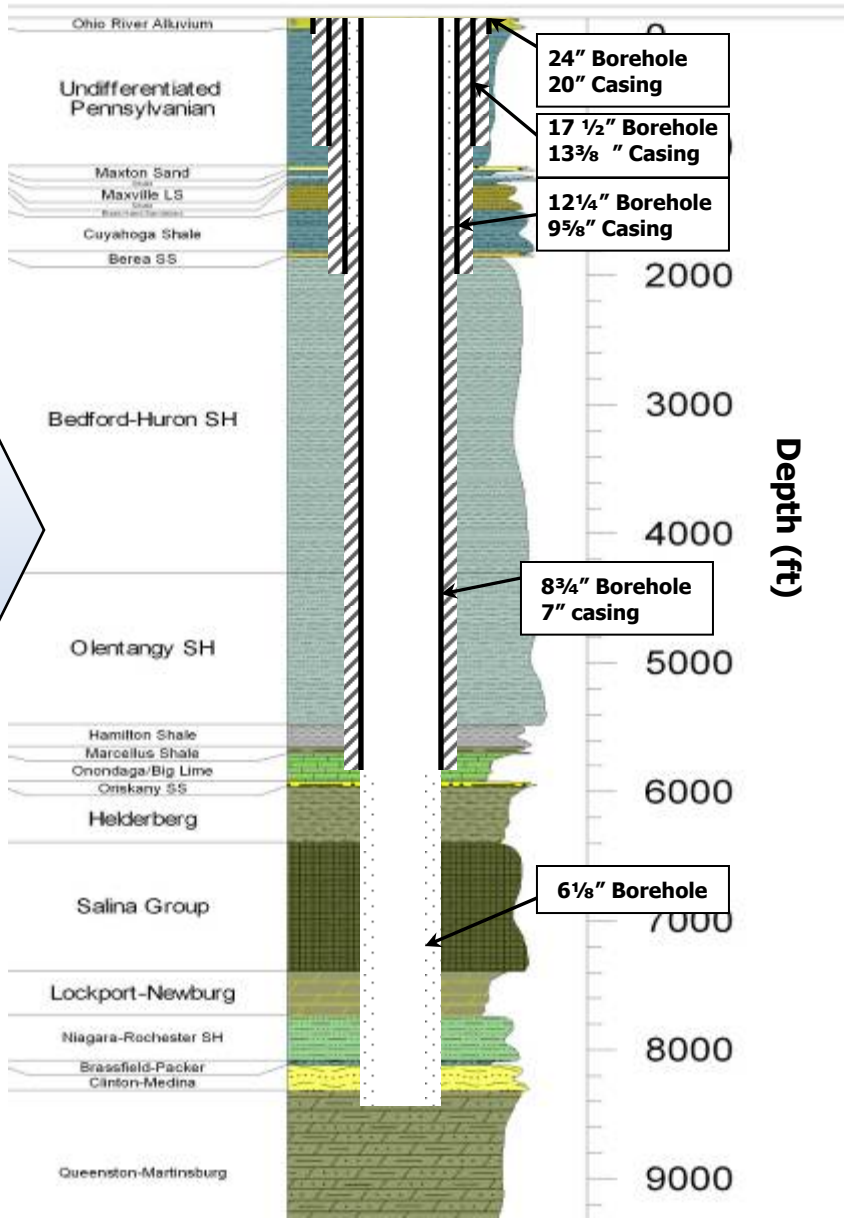
2. Seismic survey conducted in August 2006 showed favorable geologic conditions

Site Characterization- Test Well Drilling

Test Well Drilled in Jan/Feb 2007.
Total Depth = 8,384’

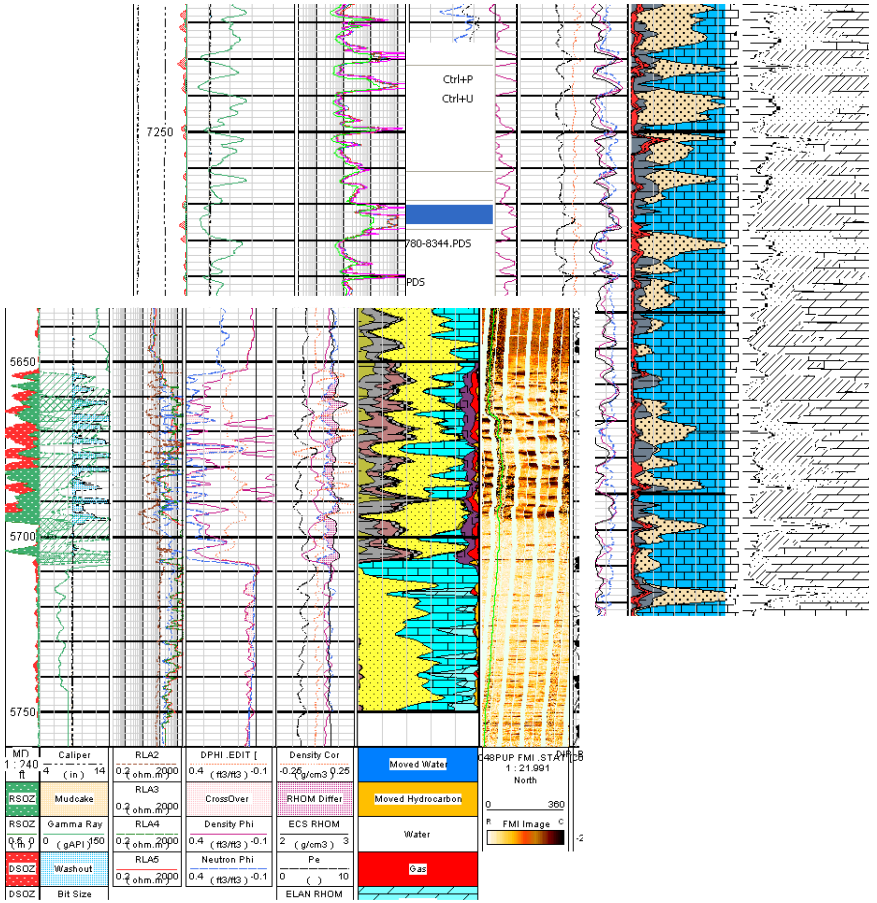
Drill rig on site (Jan 2007)

Well Diagram



Site Characterization- Test Well Drilling

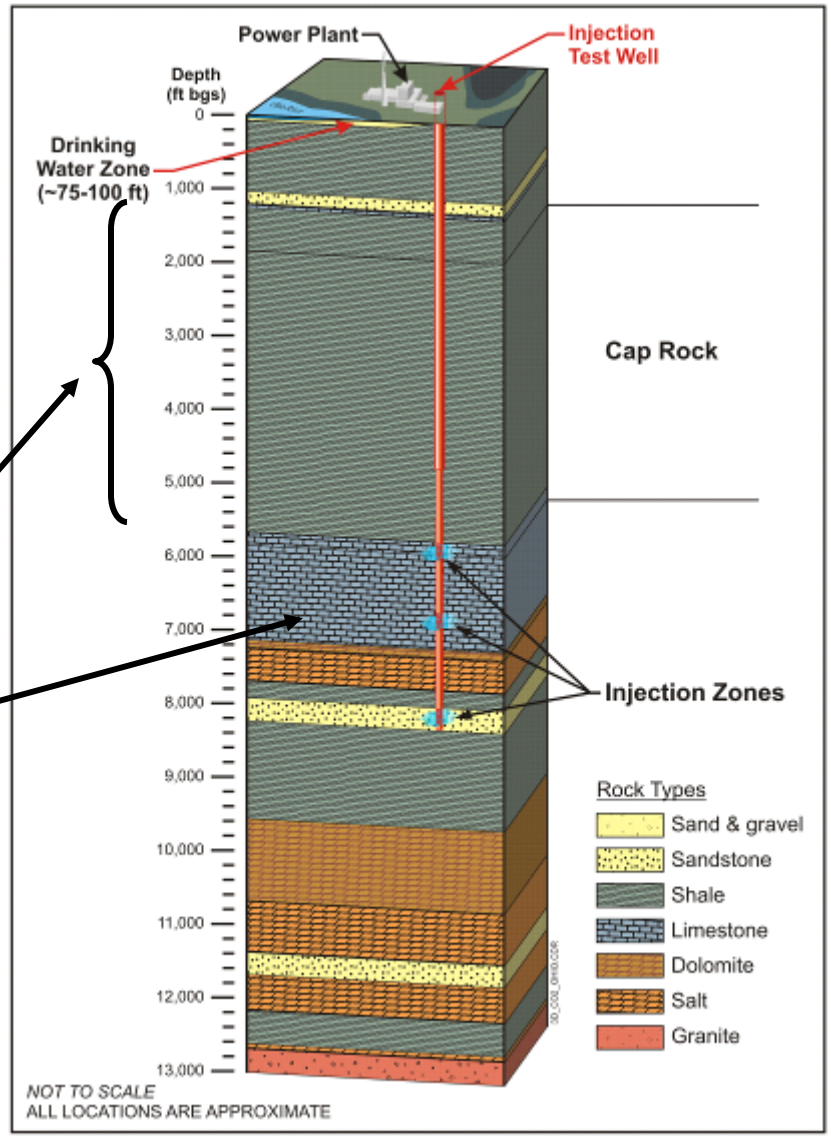
Mud logging and Wireline logging were used to characterize well.



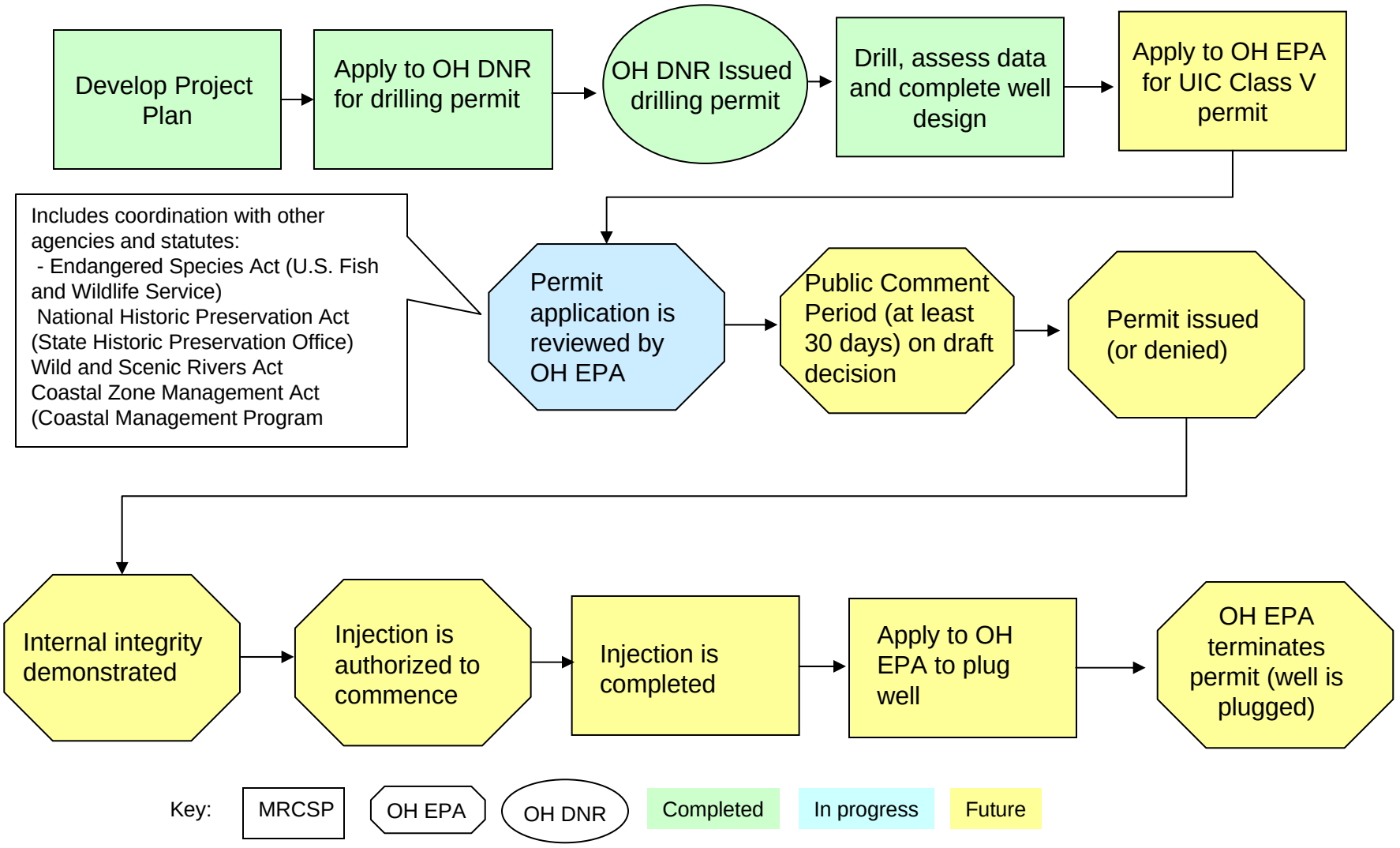
Planned Injection Test

- Drinking water table located less than 100 feet deep in this area.
- Extensive shale and carbonate layers serve as a seal or cap rock.
- Primary injection targets: deep saline formations about 6,000 to 8,000 feet underground.

- Target CO_2 injection: 3,000 metric tonnes.
- Target injection rate: Up to about 50 to 100 tonnes per day. ~30 to 60 day injection period.



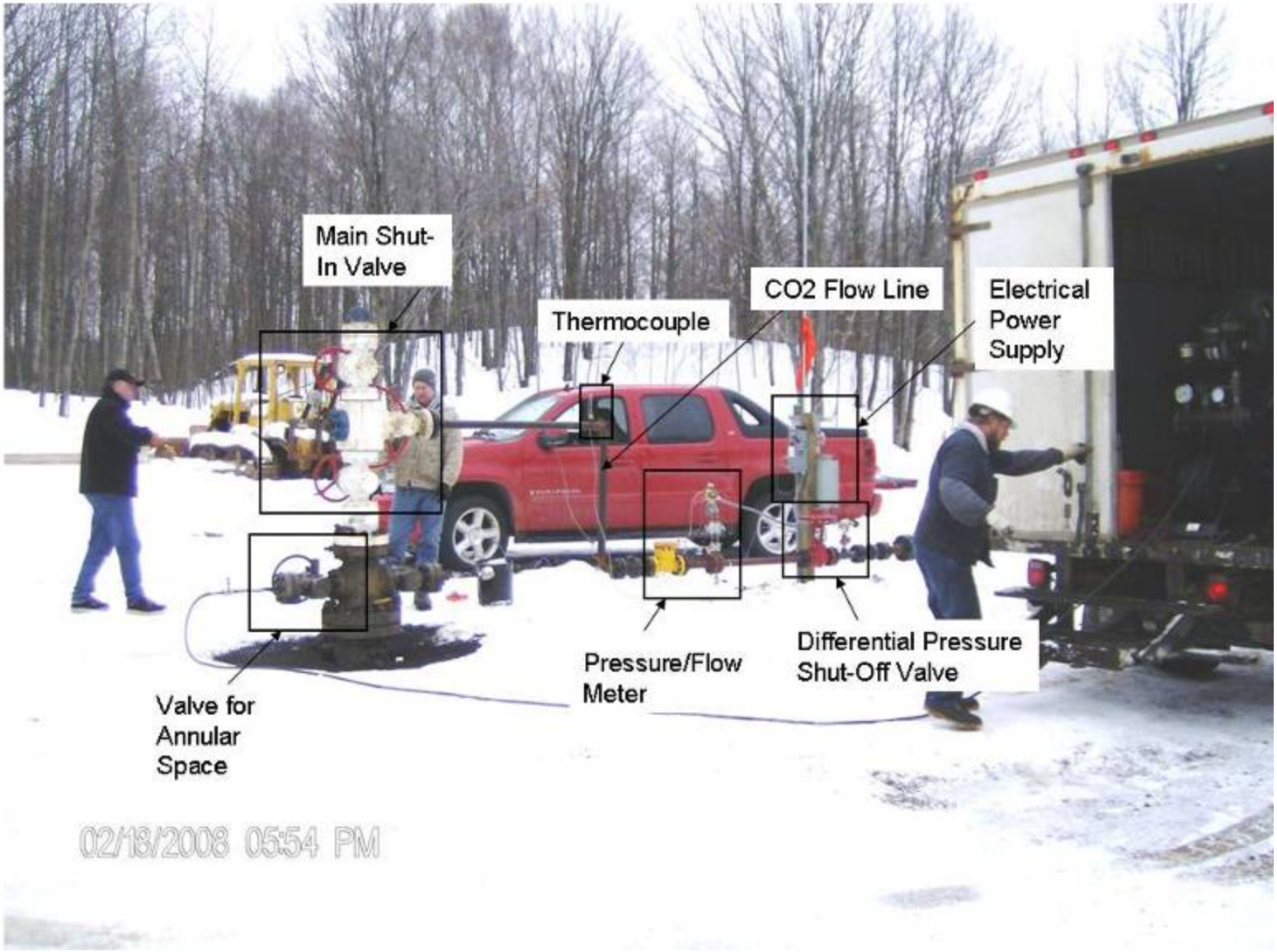
Key Regulatory Steps for the R.E. Burger Field Test



What To Expect Next

- Proceed through regulatory process
  - Permit review and issue for public comment
  - Address comments and, if needed, revise permit
  - OEPA issues permit
- Prepare well for injection
- Mobilize for injection test
- Injection testing, monitoring, reporting

Example of Well Completion



Equipment for Injection Test

Temporary CO_2 Storage

Pump and flow control equipment

Photos Courtesy of Praxair and BOC

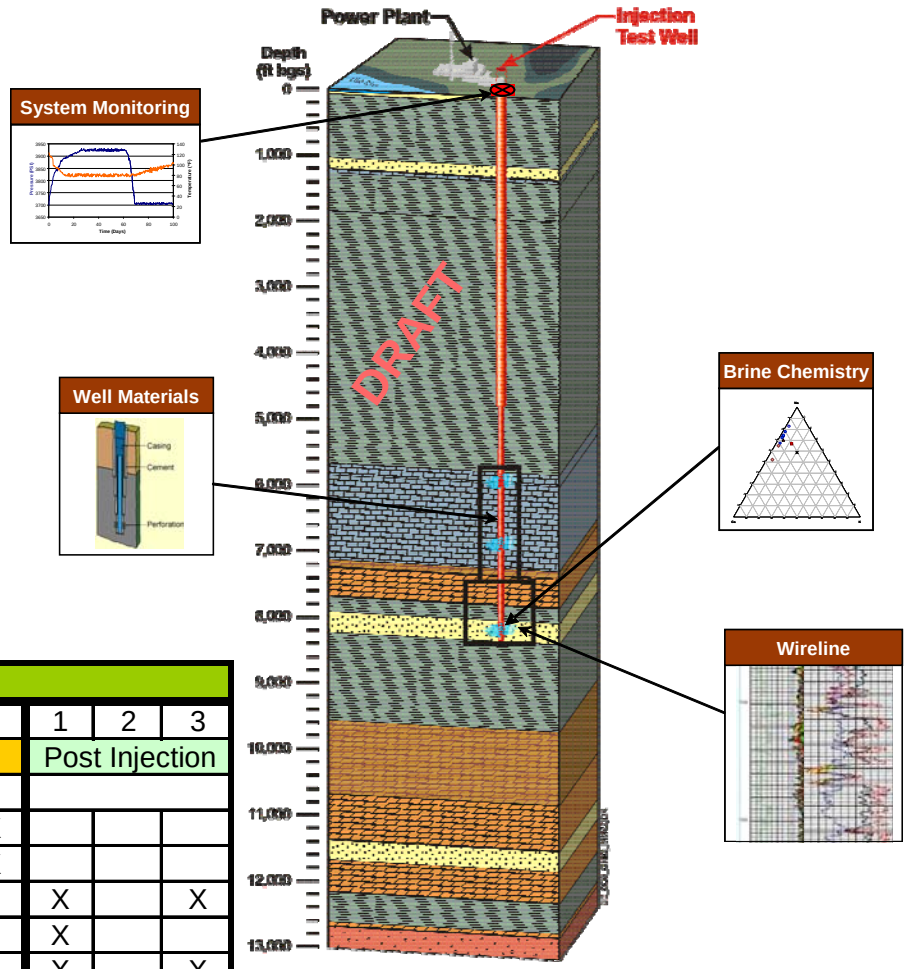
What do we hope to learn from these tests?

Dr. Neeraj Gupta, Battelle

- MRCSP Geological Technology Leader

Monitoring Program

There are a number of techniques available to monitor the injection process, the movement of the carbon dioxide and the changes in the well. We have selected a set of these techniques based on the specific features of this location.



Appalachian Basin											
Time (Months)	-3	-2	-1	1	2	3	4	5	1	2	3
Phase	Pre Demo			Active Injection					Post Injection		
Injection System (PVT)				X	X	X	X	X			
Health and Safety				X	X	X	X	X			
Repeat Wireline (RST, PEX)			X			X			X		X
Reservoir Sampling			X						X		
Short-Lived Tracers					X		X		X		X

Monitoring technology is an important part of our testing

Acoustic Array

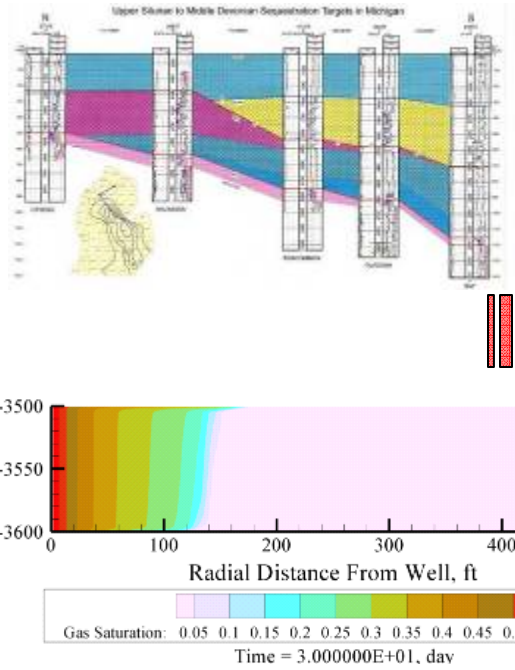
Monitoring Well
(about 500 feet from injection well)

Cross Well Seismic Analysis

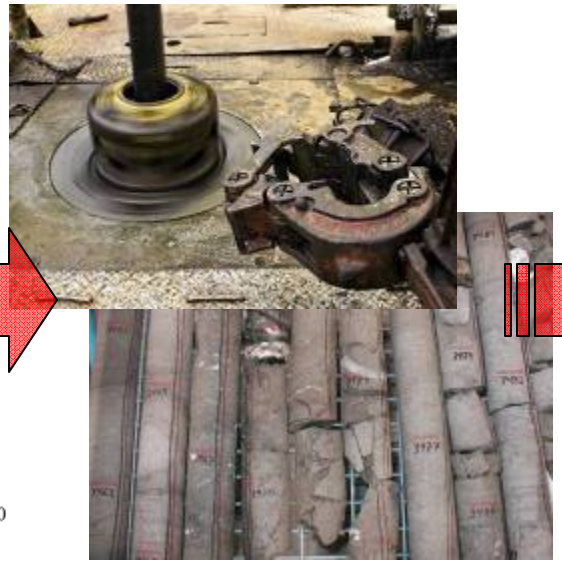
Examples from MRCSP Michigan Basin test site

Ultimately tests like this help us understand how to implement this technology

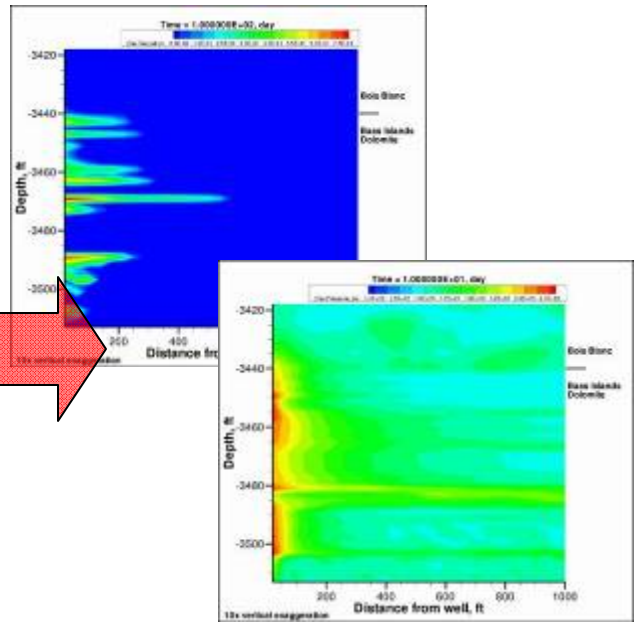
Preliminary Modeling Based on Regional Data



Site Drilling and Testing



Site Specific Modeling



Conceptualize → Design → Calibrate

Characterize → Monitor → Validate

----------Communicate----------

Examples from MRCSP Michigan Basin project

SUMMING UP

- This test is part of an important national program to address climate change concerns
- Many in-built safeguards:
  - Thorough site characterization studies show good cap rock or seals for permanent storage of CO_2
  - Ohio EPA regulatory/permitting process is specifically designed to protect groundwater
  - Underground Injection Control permit controls well construction and injection operations
  - The monitoring program provides a check on what happens to the CO_2 after injection
  - It is also a key component of our scientific learning process.
  - Field tests like this allow us to improve our models if needed

Thank You

For more information on the MRCSP

see: **www.mrcsp.org**

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