

Midwest Regional Carbon Sequestration Partnership (MRCSP) Michigan Basin Test Site

Press Briefing

Introduction and Overview: Abed Houssari, DTE Energy

DOE's Sequestration Program: Lynn Brickett, US DOE/NETL

The MRCSP: Dave Ball, Battelle

Geology of the Michigan Site: Dr. David Barnes, WMU

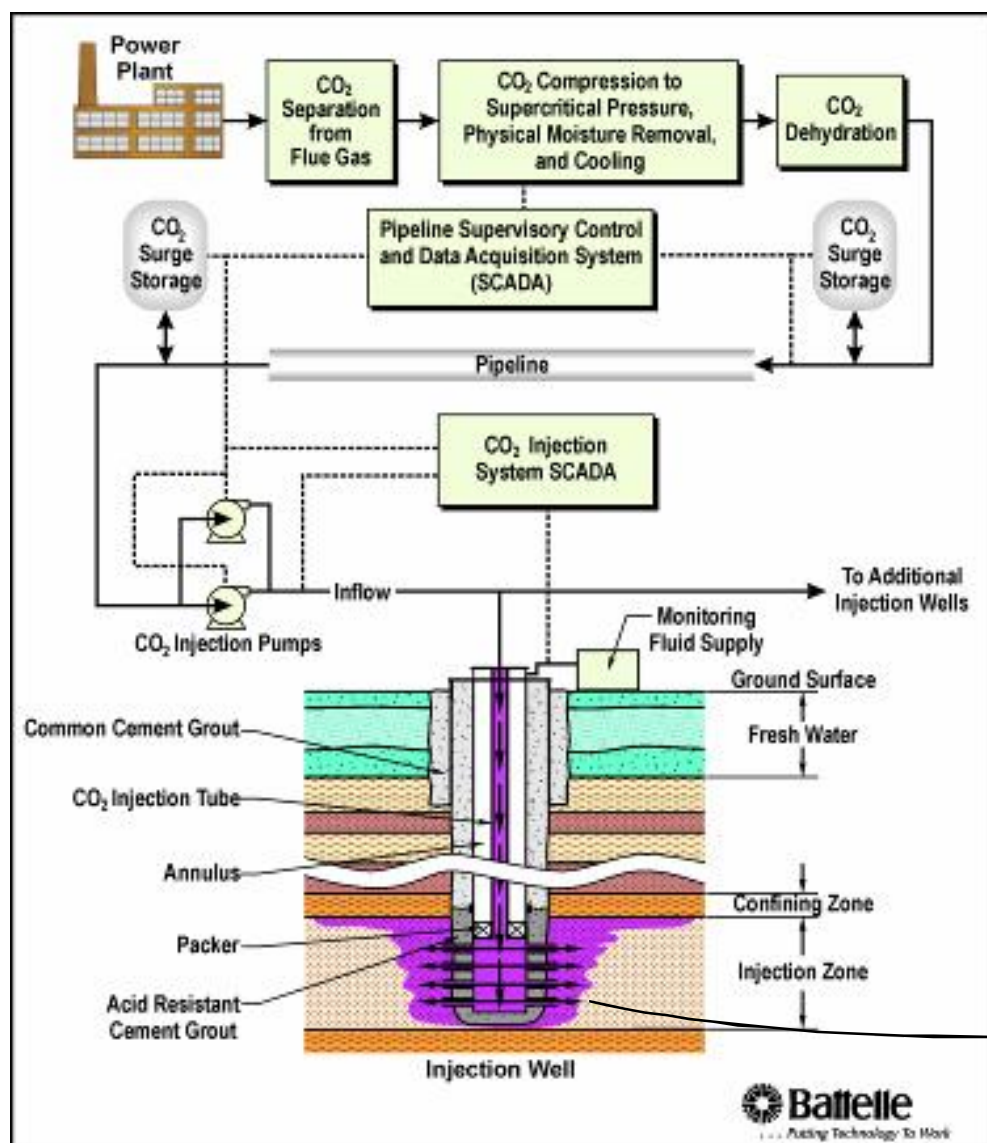
What we will see today: Bob Mannes, Core Energy

What we will learn from this test: Dr. Neeraj Gupta, Battelle

Site Tour: Phil Jagucki, Battelle

February 21, 2008

At Gaylord we are testing a technology called Carbon Capture and Geologic Storage (CCS)



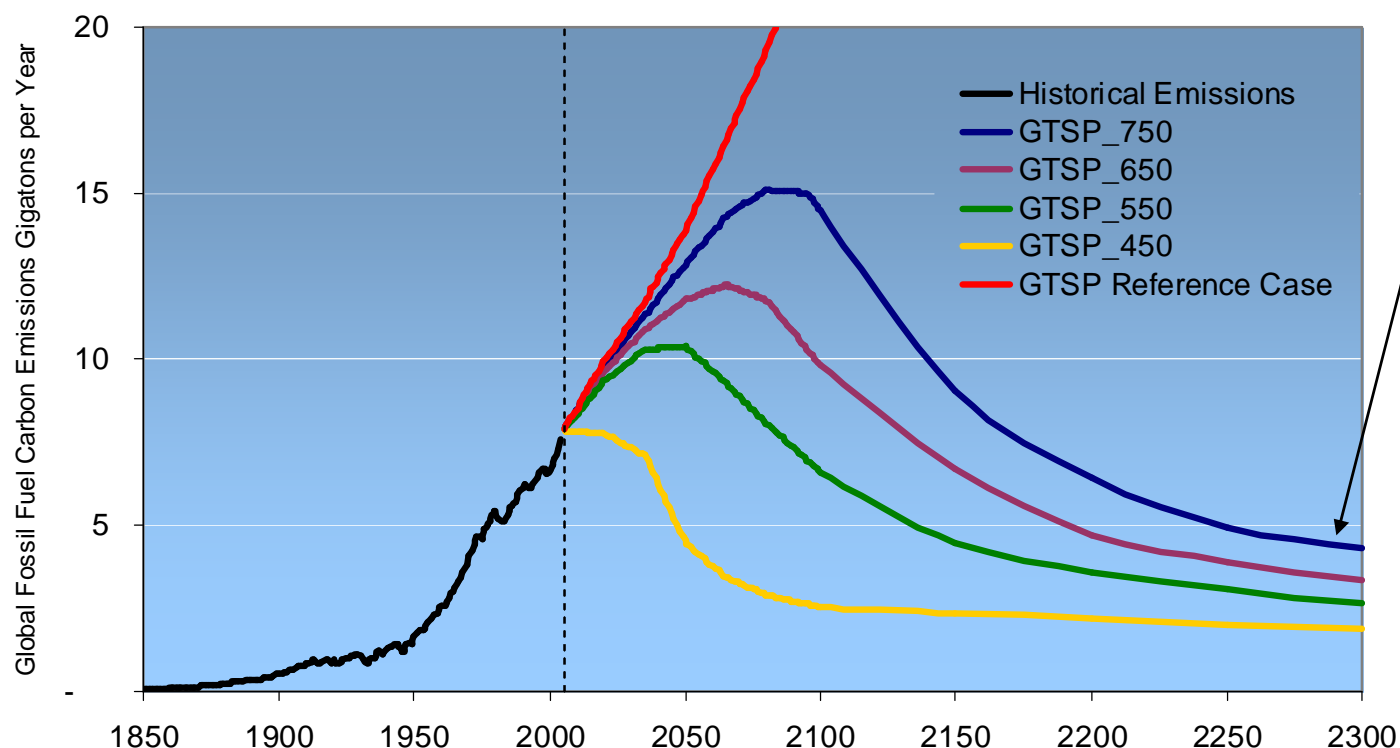
CO₂ Capture

CO₂ Transport

CO₂ Injection into deep geologic formation (permanent storage)

> 2500 ft deep

Stabilizing atmospheric CO₂ concentrations ultimately means reducing CO₂ emissions -- forever



Although costly, geologic storage of CO₂ (CCS) is seen by many as the most cost effective way to achieve that goal because it will allow us to continue to use economical fossil fuels

DOE's Regional Partnership Program

Lynn A. Brickett,

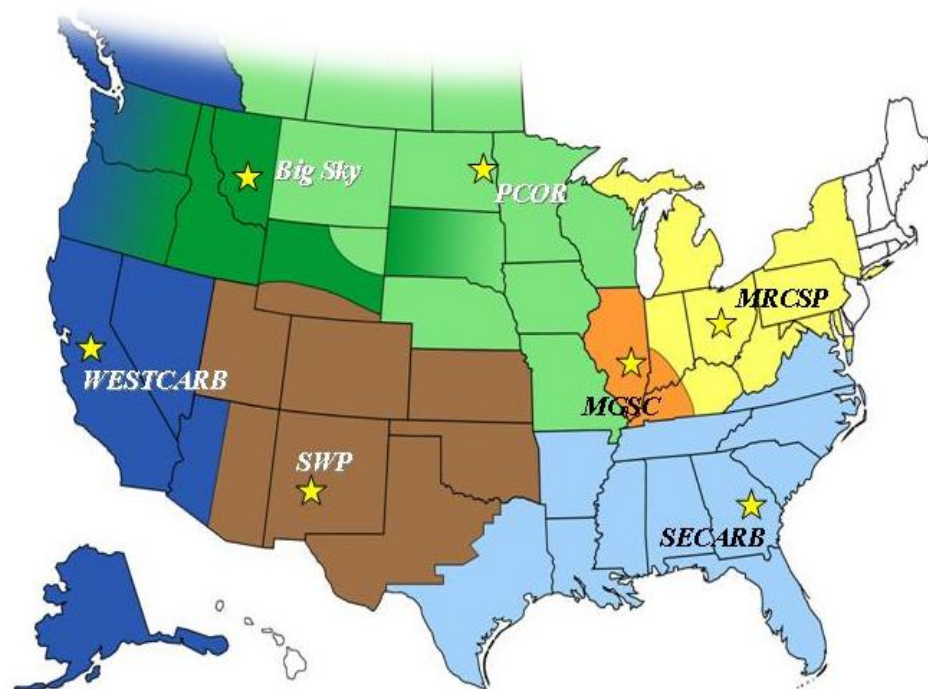
- DOE's National Energy Technology Laboratory (NETL)



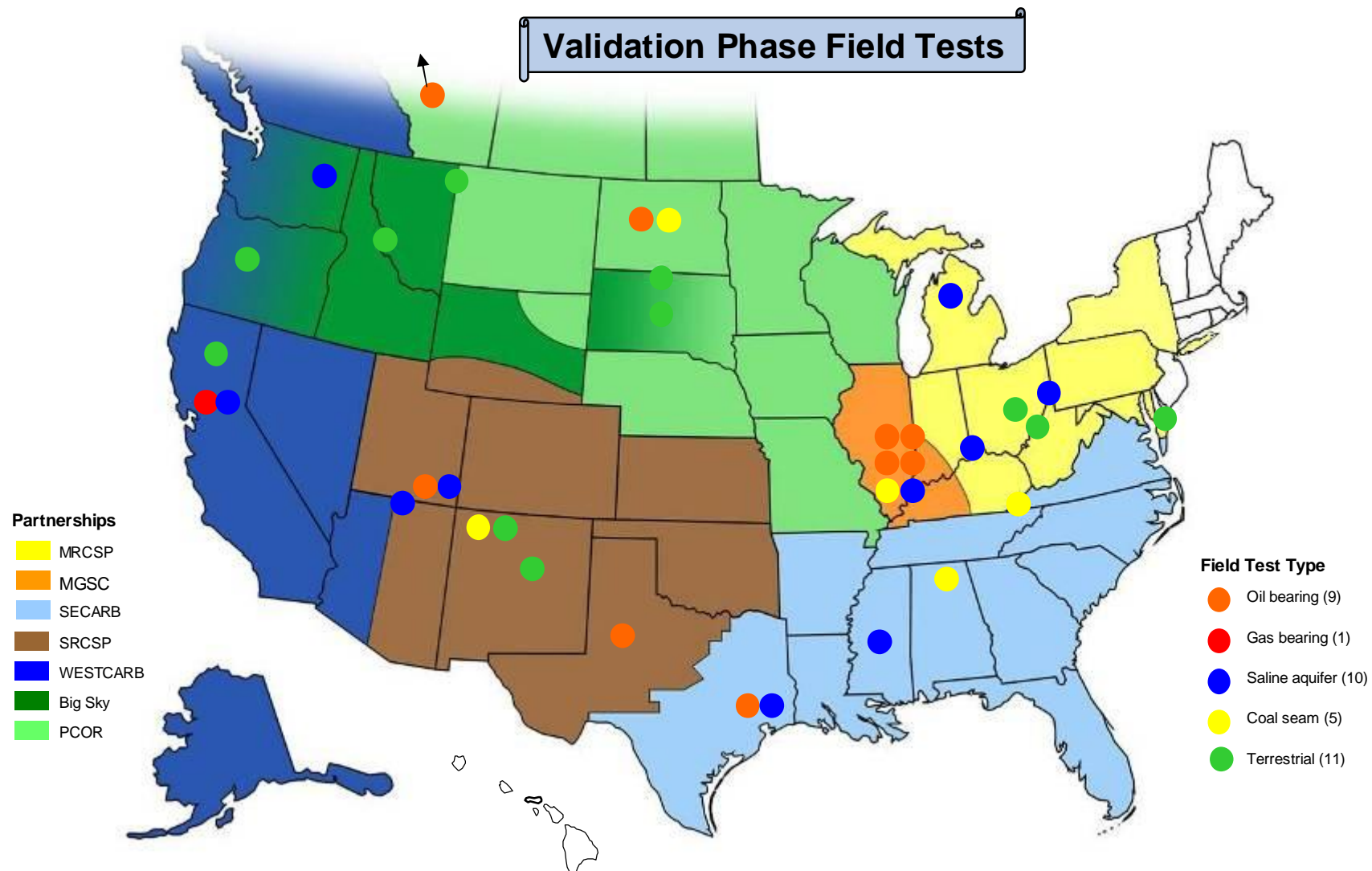
Regional Carbon Sequestration Partnerships

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



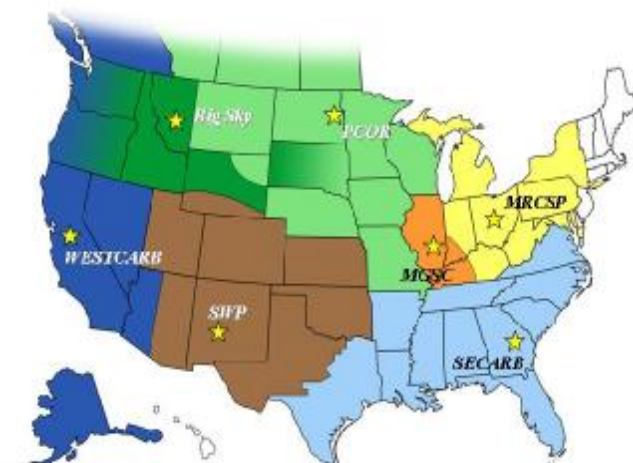
Regional Carbon Sequestration Partnerships



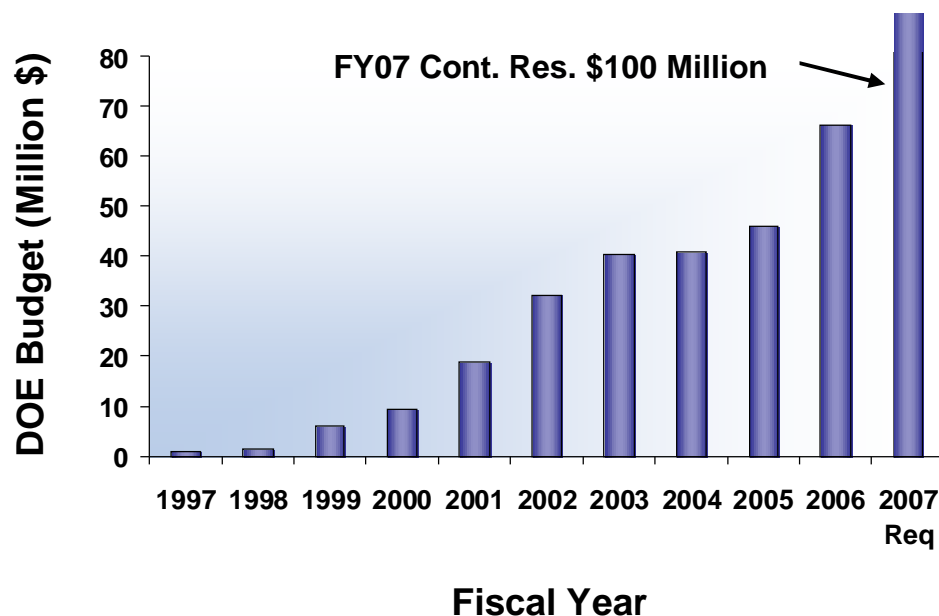
Regional Carbon Sequestration Partnerships

Deployment Phase

- Plan
 - 10 years (2007-2016)
 - 7 large volume injection tests
- Injection rates up to 1M tons/yr
- Status
 - 4 awarded
 - 3 pending
- Scale up is required to provide insight into several operational and technical issues in different formations



Sequestration Program Statistics FY2007



Strong industry support

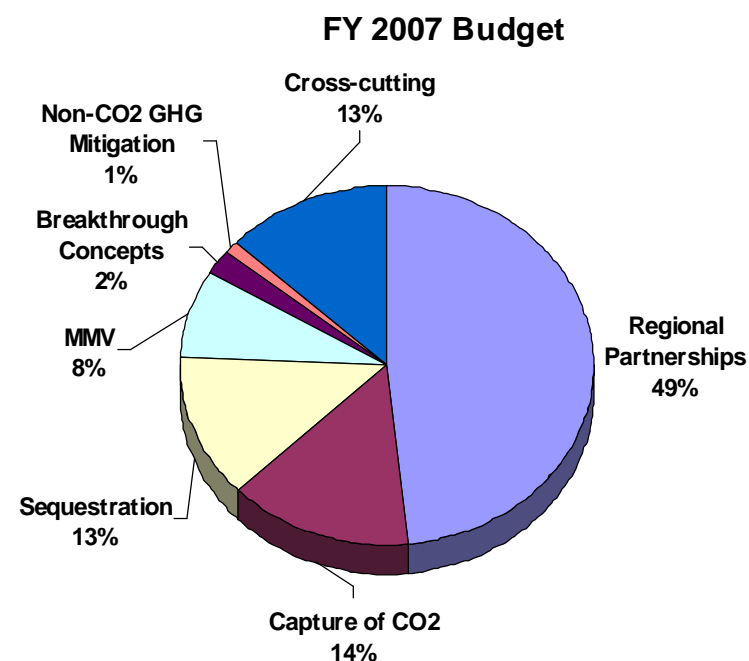
~ 39% cost share on projects

Federal Investment to Date

~ \$360 Million

**Diverse research
portfolio**

~ 70 Active R&D Projects



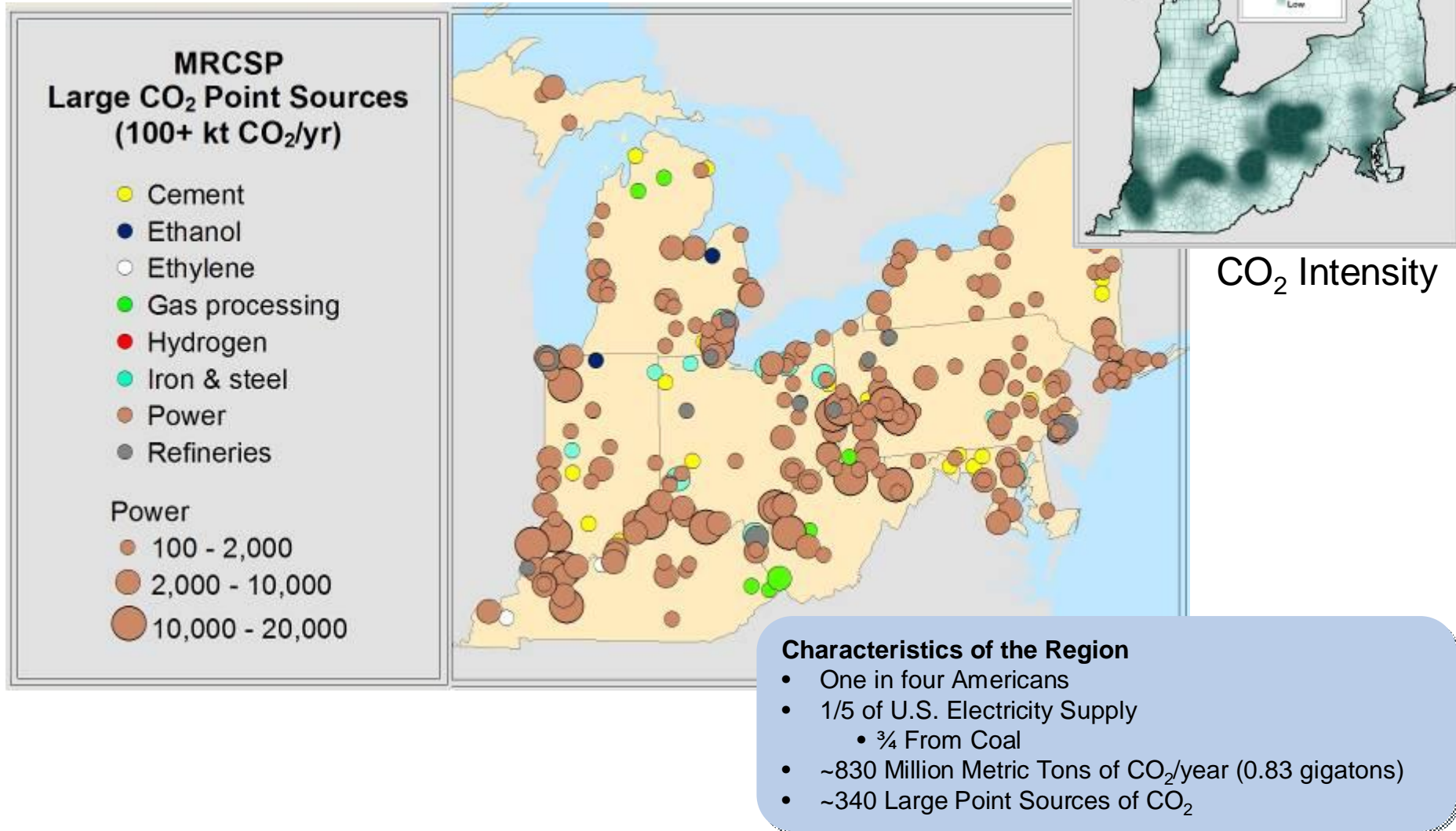
The Midwest Regional Carbon Sequestration Partnership (MRCSP)

Dave Ball, Battelle

- MRCSP Project Manager

The MRCSP Region

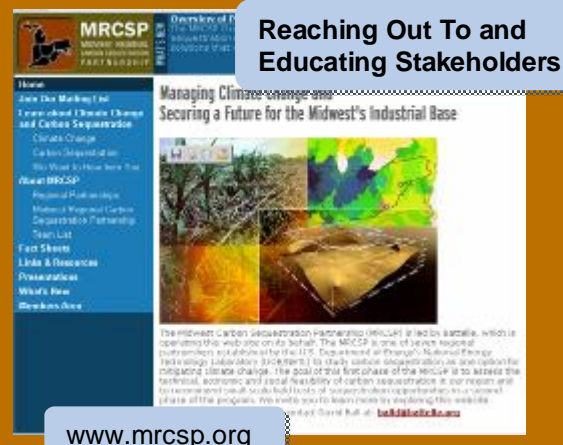
The Nation's Engine Room



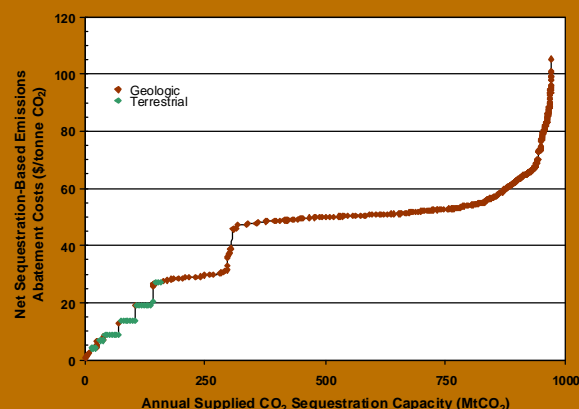
MRCSP membership



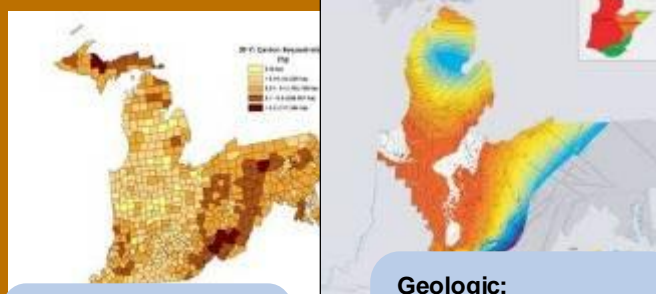
Quantifying CO2 sources, demographics and economics in the region



Developing a Regional Model of the Economics of Sequestration



Quantifying CO₂ 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's Phase II tests involve small-scale injection into key geologic reservoirs

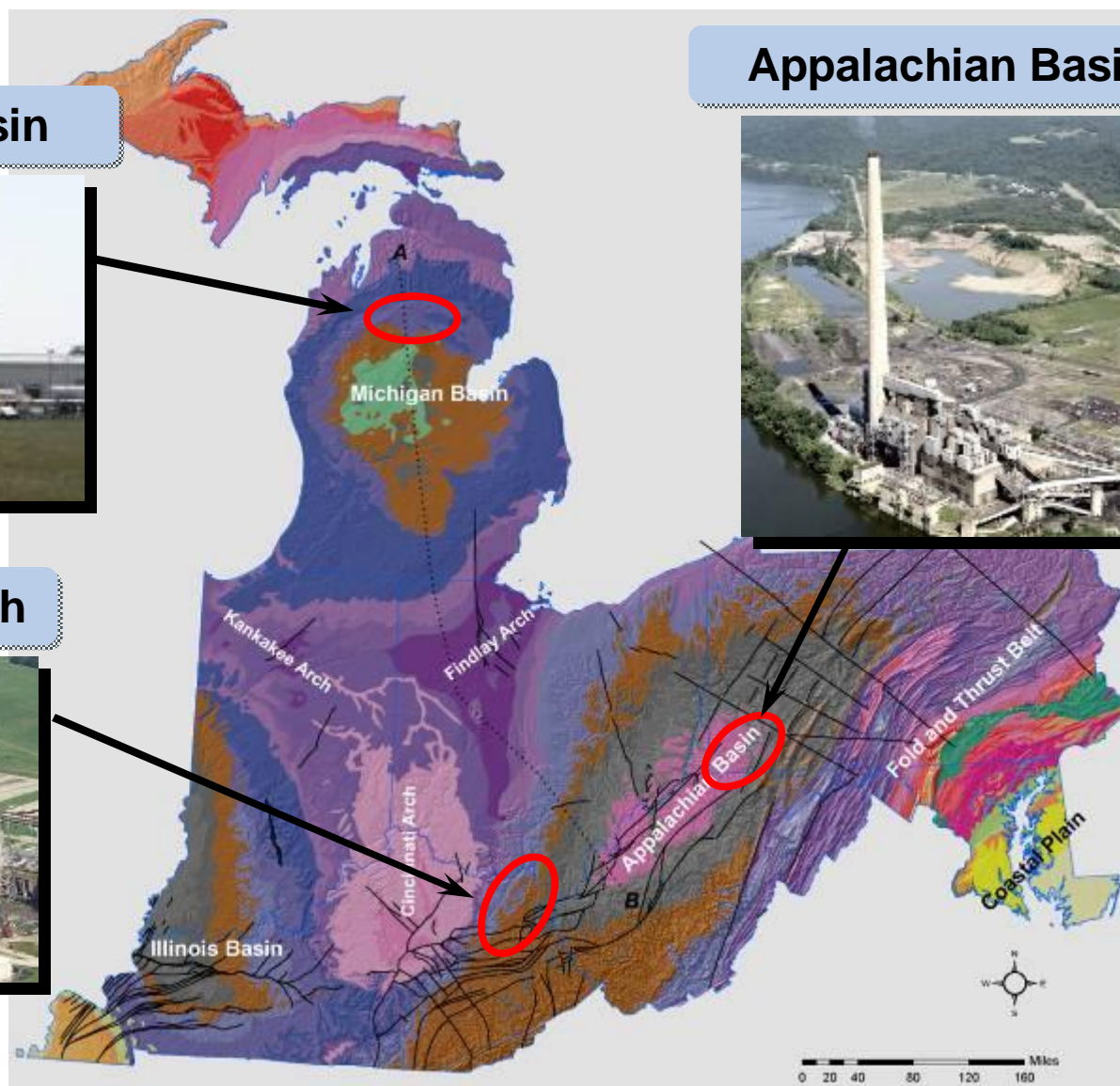
Michigan Basin



Appalachian Basin



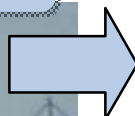
Cincinnati Arch



The MRCSP's focus is geological but we are also addressing terrestrial sequestration

Sequestration Friendly Agriculture

Replace this

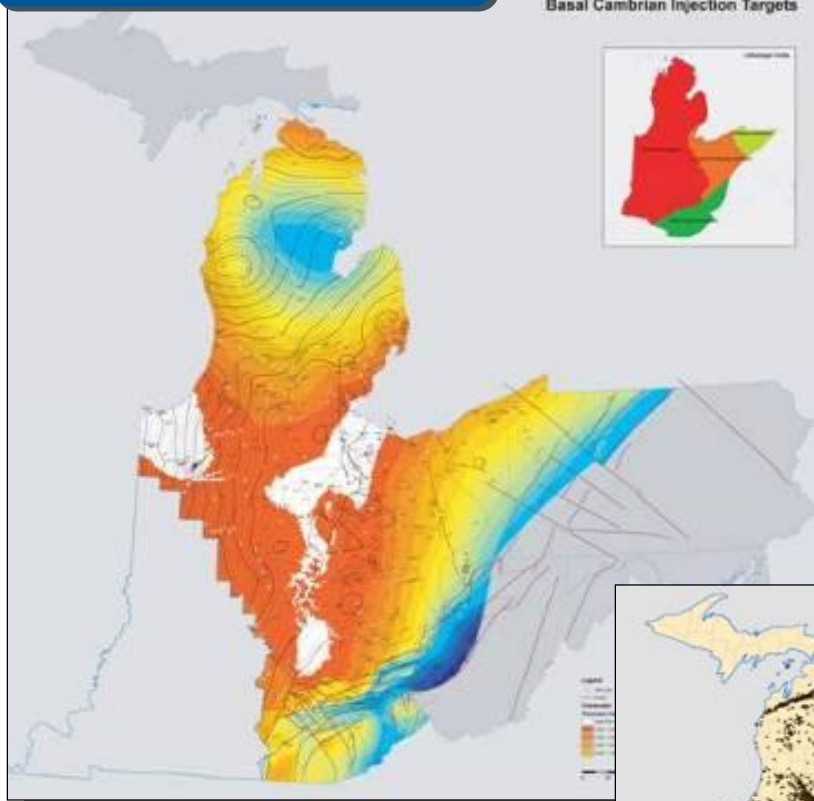


With this

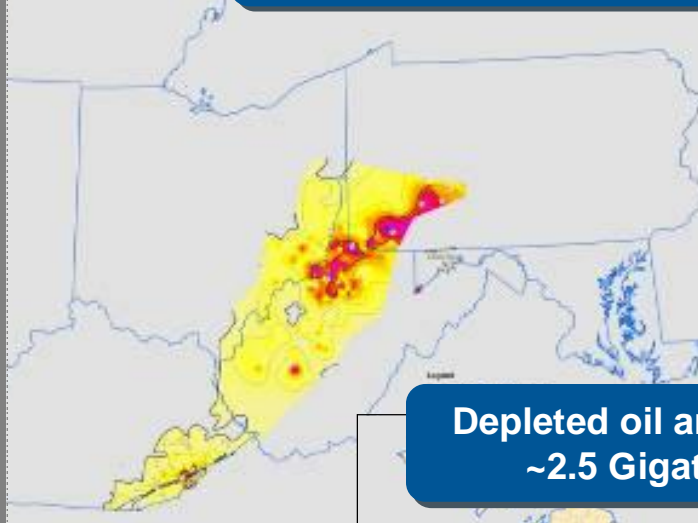


An important part of MRCSP's mission is to characterize our potential CO₂ sinks as a region

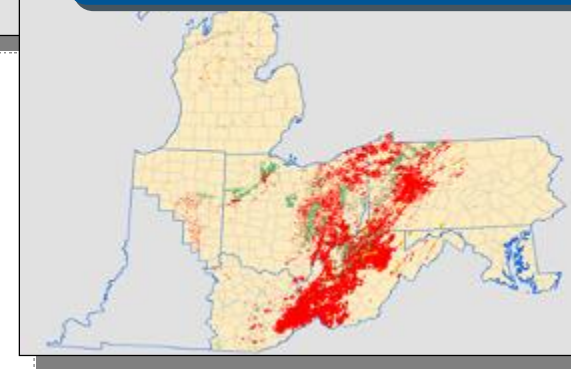
**Deep saline formations:
>189 Gigatons CO₂**



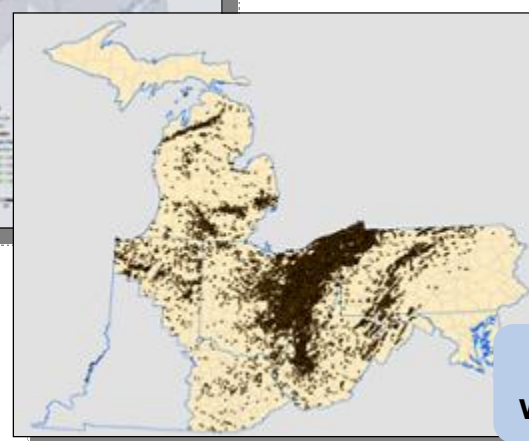
**Unmineable coal and shale
~46 Gigatons CO₂**



**Depleted oil and gas fields
~2.5 Gigatons CO₂**



**Our geological resources are
vast – over 100 years of capacity
for all our large sources**



**Data from over 80,000
wells have been analyzed**

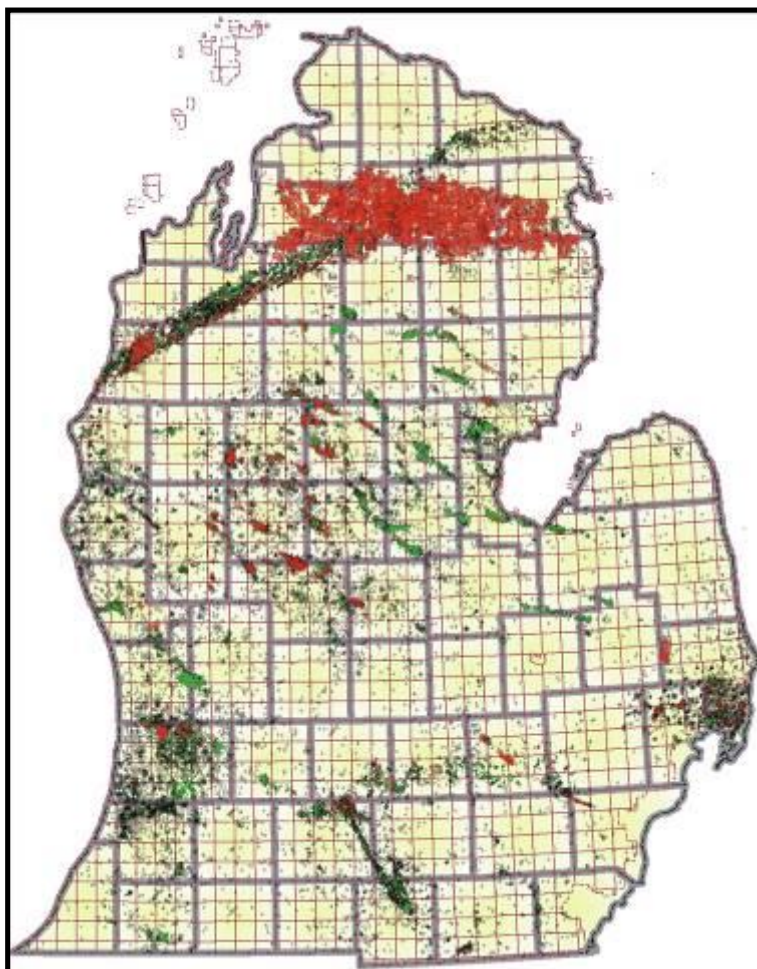
Geology of the Michigan Basin Site

Dr. David Barnes, Western Michigan University

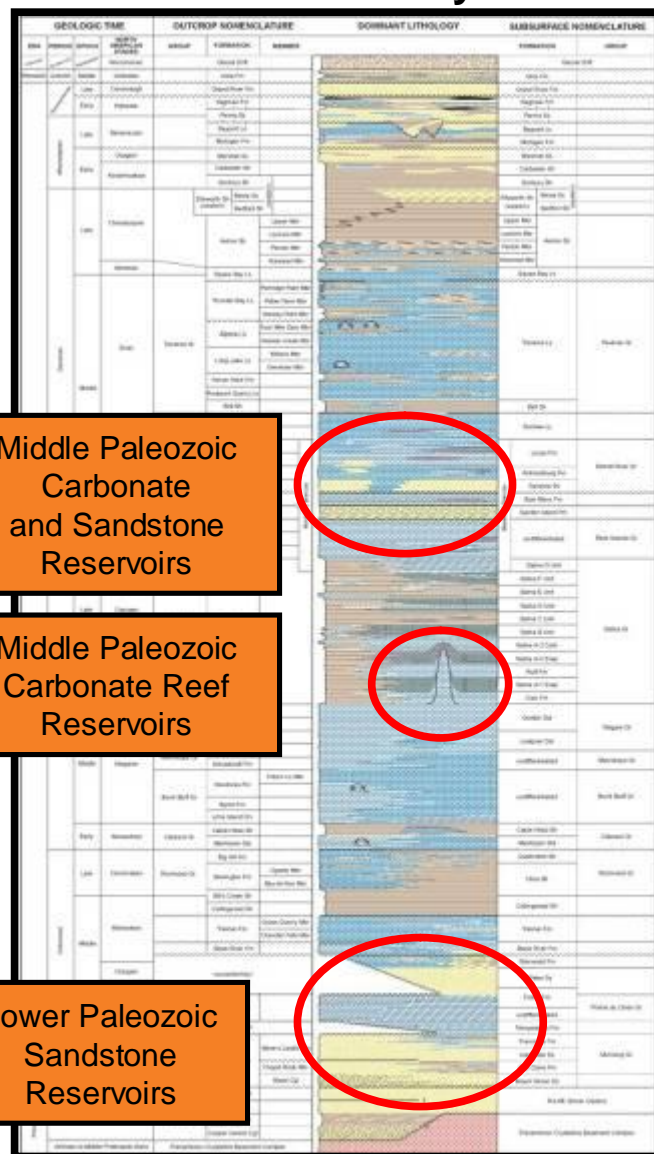
- Lead for MRCSP Michigan characterization effort

Subsurface CO₂ Reservoir Rocks in Michigan

As much as 16,000ft of
Paleozoic sedimentary rock strata



**Permitted Oil and Gas
Well Penetrations ~ 55,000**

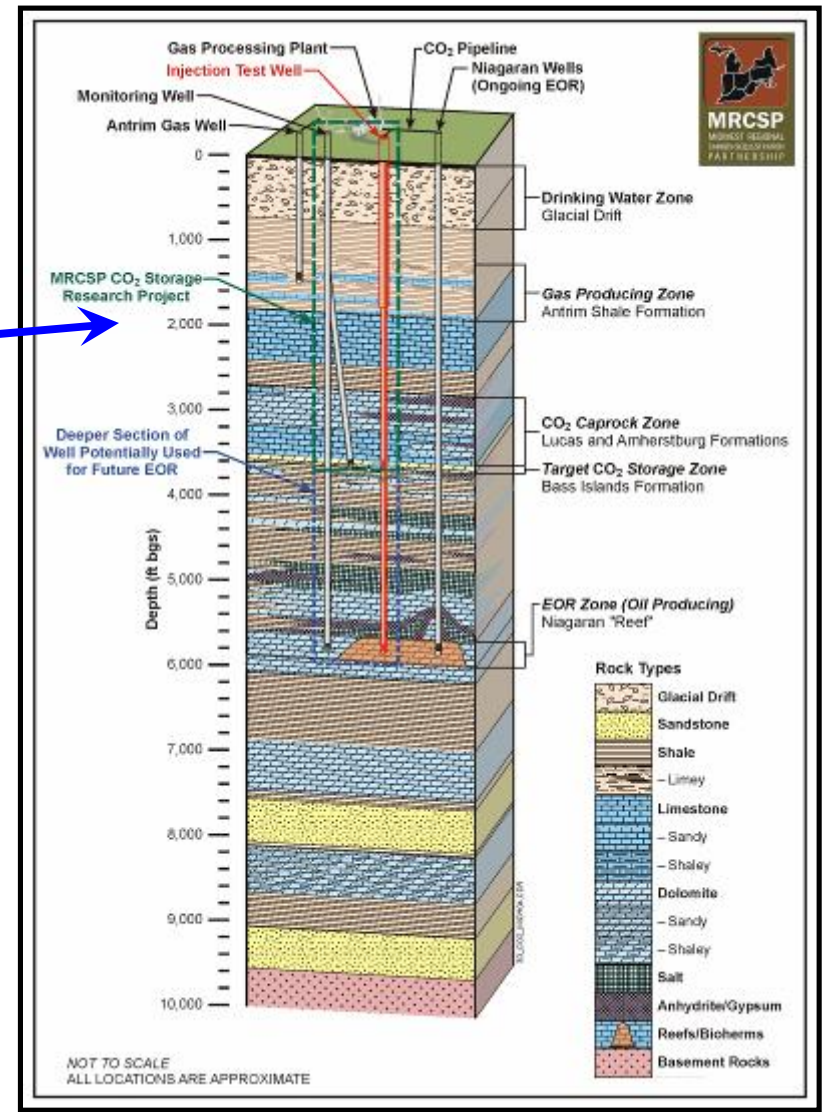
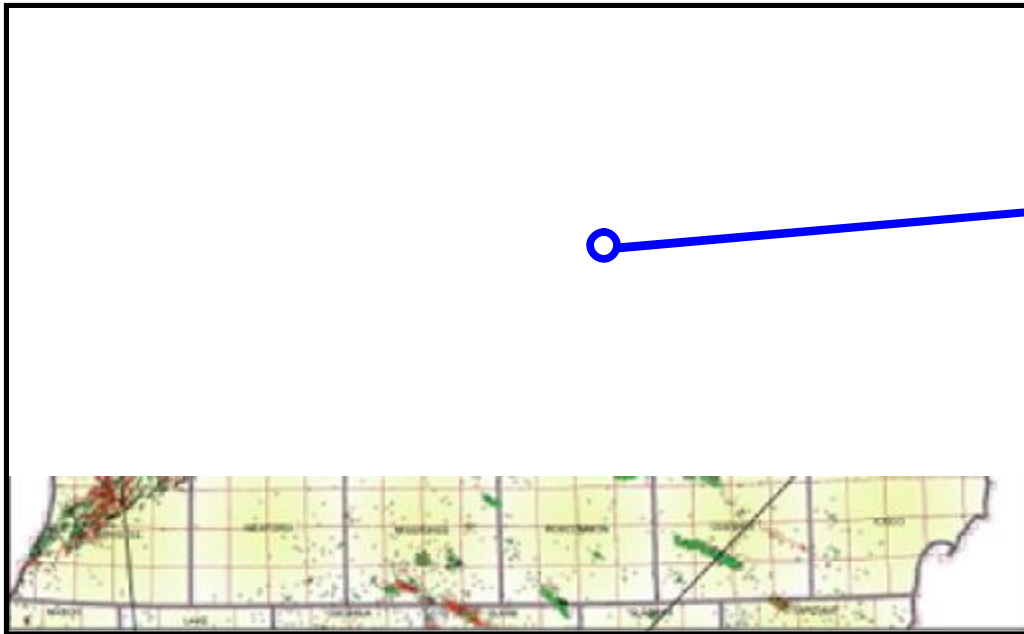


**Middle Paleozoic
Carbonate
and Sandstone
Reservoirs**

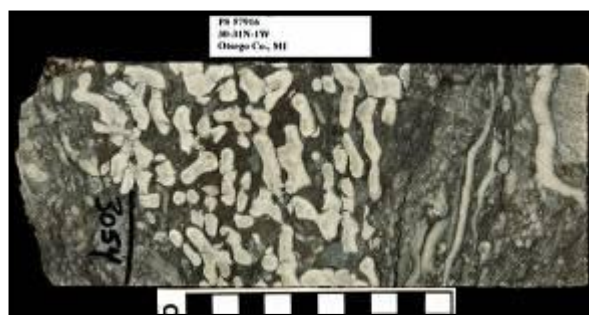
**Middle Paleozoic
Carbonate Reef
Reservoirs**

**Lower Paleozoic
Sandstone
Reservoirs**

Northern Michigan CO2 Pilot Injection Test Well, Otsego Co., MI



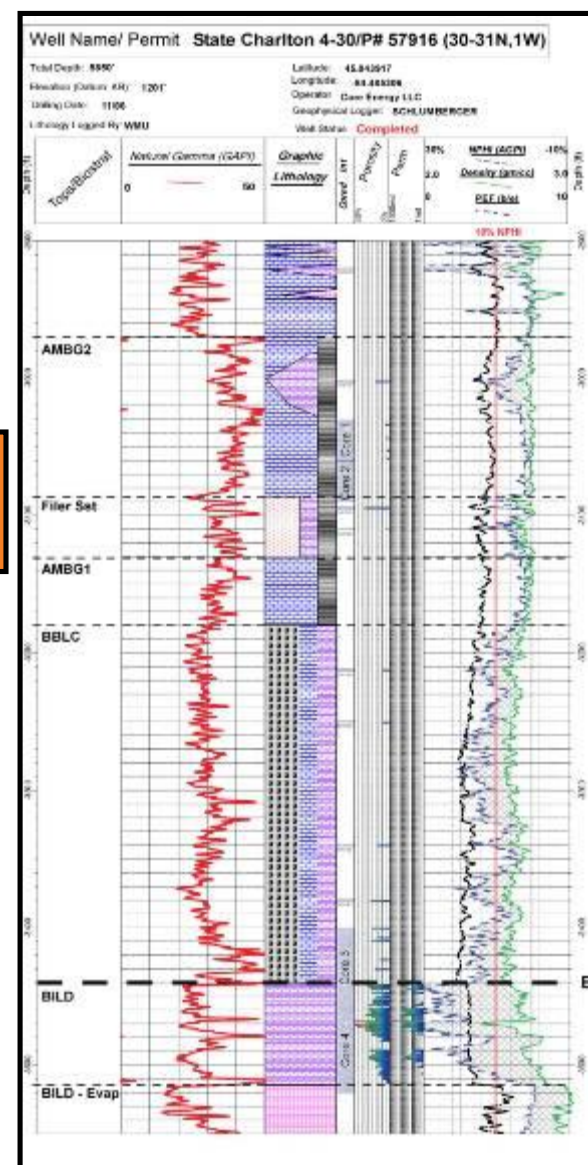
Rock Properties of Reservoir and Caprock Formations



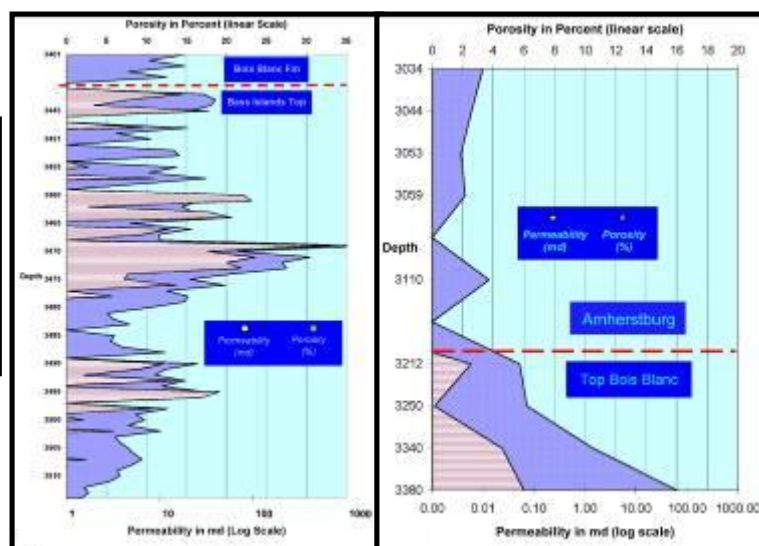
Amherstberg Formation
Caprock



Bass Islands Formation
Injection Target



Porosity and
Permeability
In Rock Core



What we will see today

Bob Mannes, President, Core Energy

- Operator for Michigan Basin Site

This site has key infrastructure needed to support a CO₂ injection test

DTE's Turtle Lake Gas Processing Plant



Core Energy's Compression Plant and CO₂ Pipeline



6" Diameter CO₂ pipeline leaving compression plant



The test site then and now

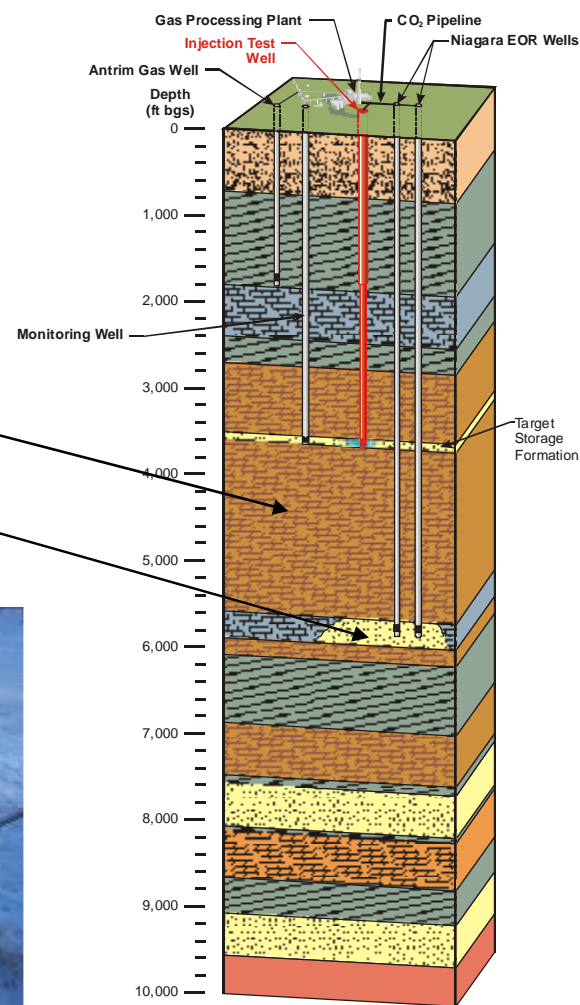
5000 Foot Deep Test Well Drilled in November 2006



180 feet of core taken

Confining Layer:
Amherstburg Limestone

Injection Target:
Bass Islands Dolomite



Well Site Today



Starting Injection

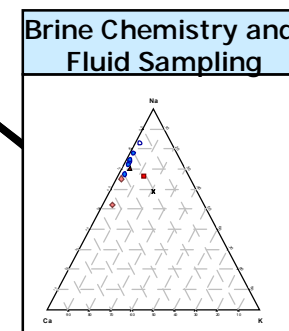
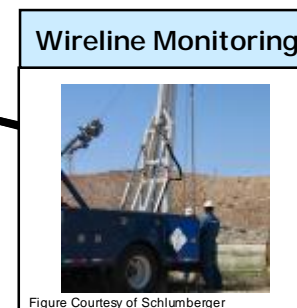
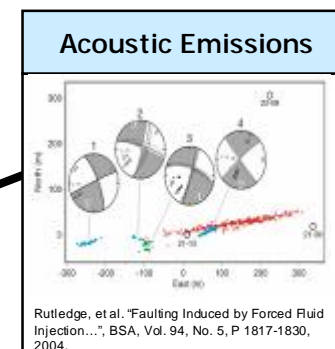
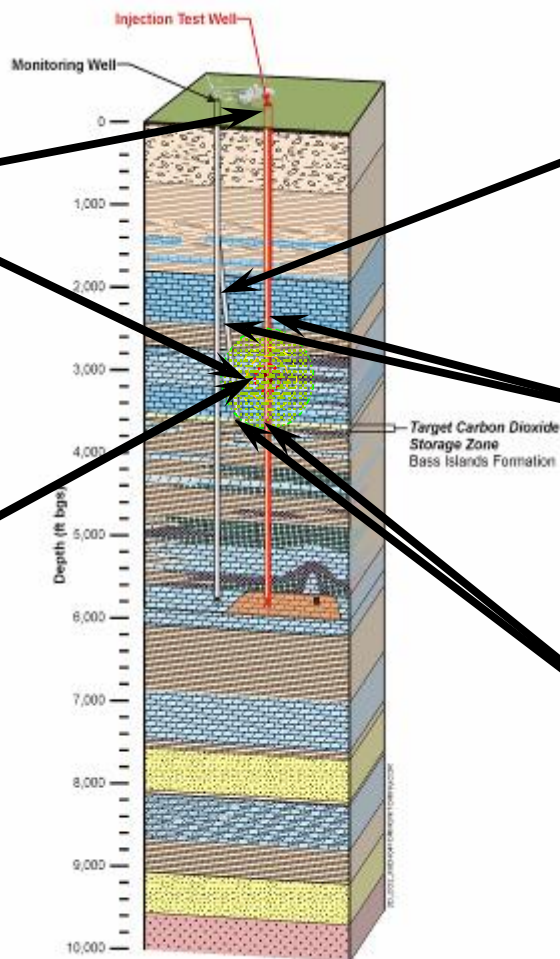
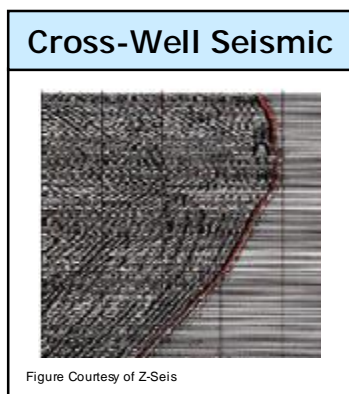
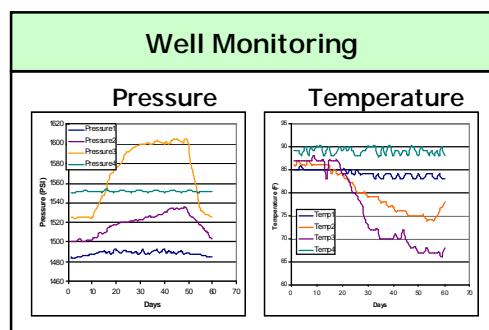
Well Column

What do we hope to learn from these tests

Dr. Neeraj Gupta, Battelle

- MRCSP, Lead for Geological Sequestration

Our monitoring suite includes a wide variety of technologies for this site



- Government Required Monitoring
- Research Monitoring

NOT TO SCALE
ALL LOCATIONS ARE APPROXIMATE

Monitoring technology is an important part of our testing



Monitoring Well

(about 500 feet from injection well)



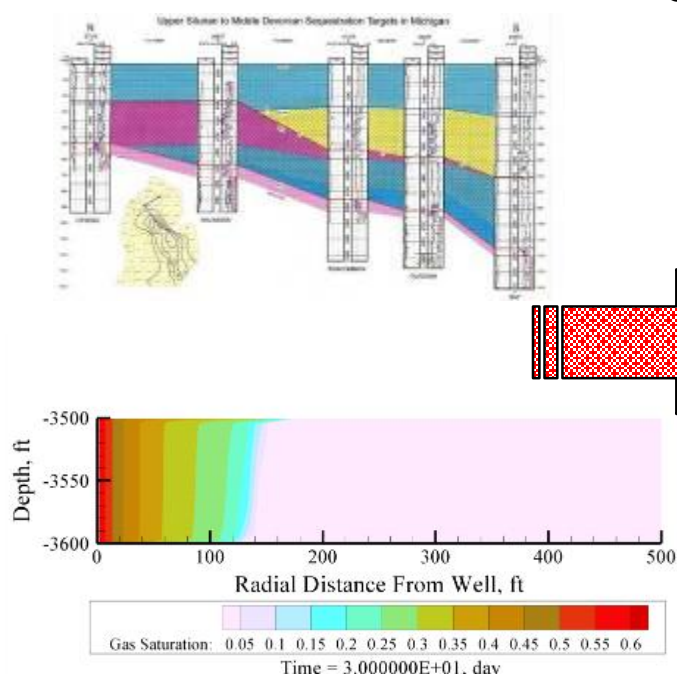
Acoustic Array



Cross Well Seismic Analysis

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

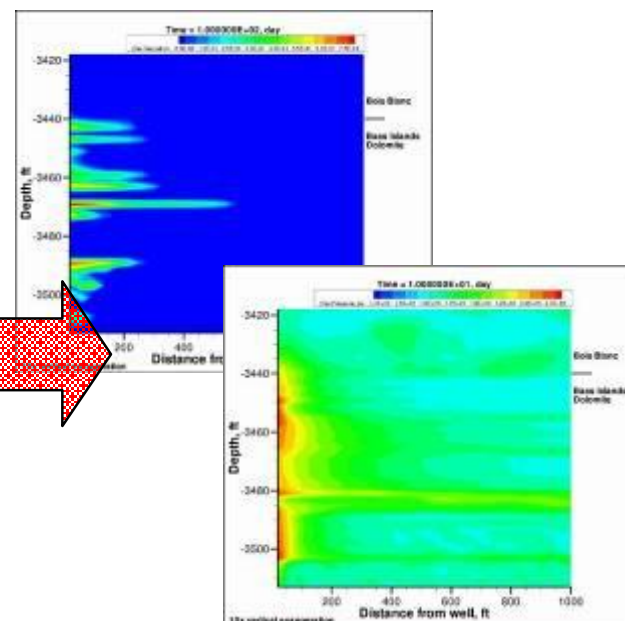
Preliminary Modeling Based on Regional Data



Site Drilling and Testing



Site Specific Modeling



Conceptualize



Design



Calibrate



Characterize



Monitor



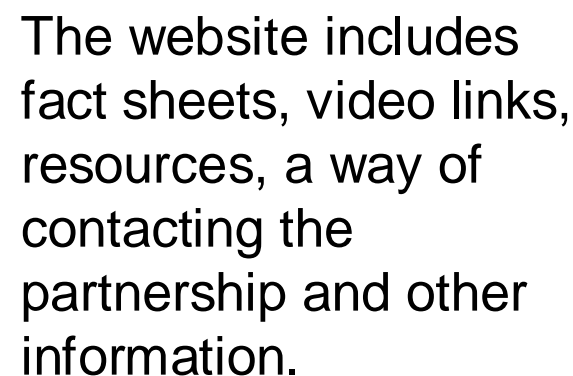
Validate

-----Communicate-----

Public outreach is a key component of our research



An informational meeting was held at the Johannesburg-Lewiston Area School, July 2007, to inform the local public about the project



29