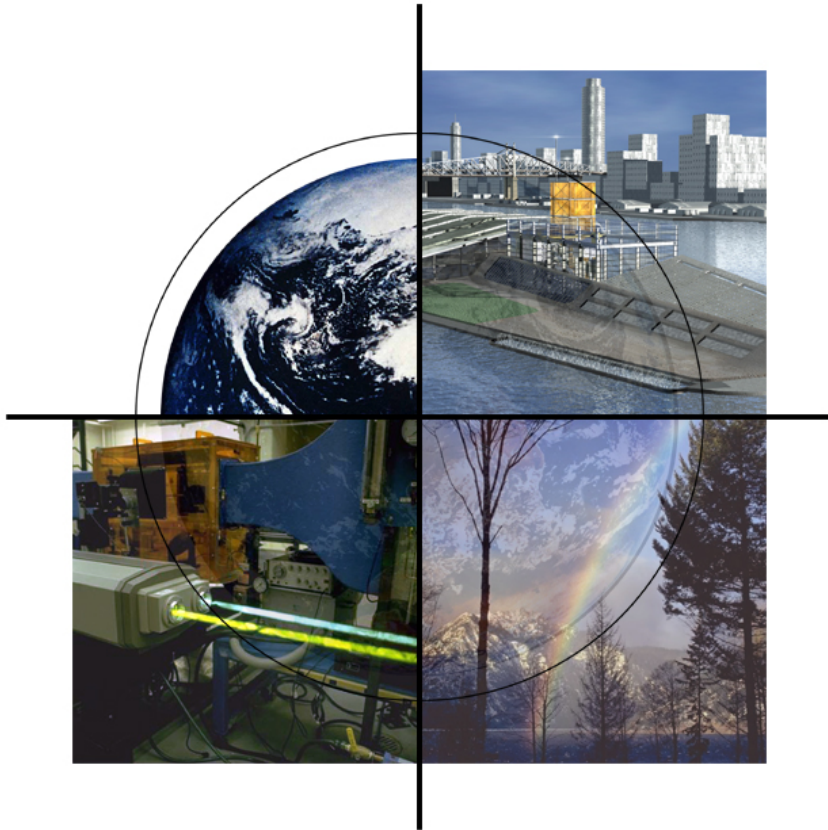


DOE Office of Fossil Energy Carbon Sequestration Program



*Fourth Annual Conference
on Carbon Sequestration*

May 2-5, 2005

*Scott M. Klara,
Deputy Director,
Office of Coal & Power R&D*

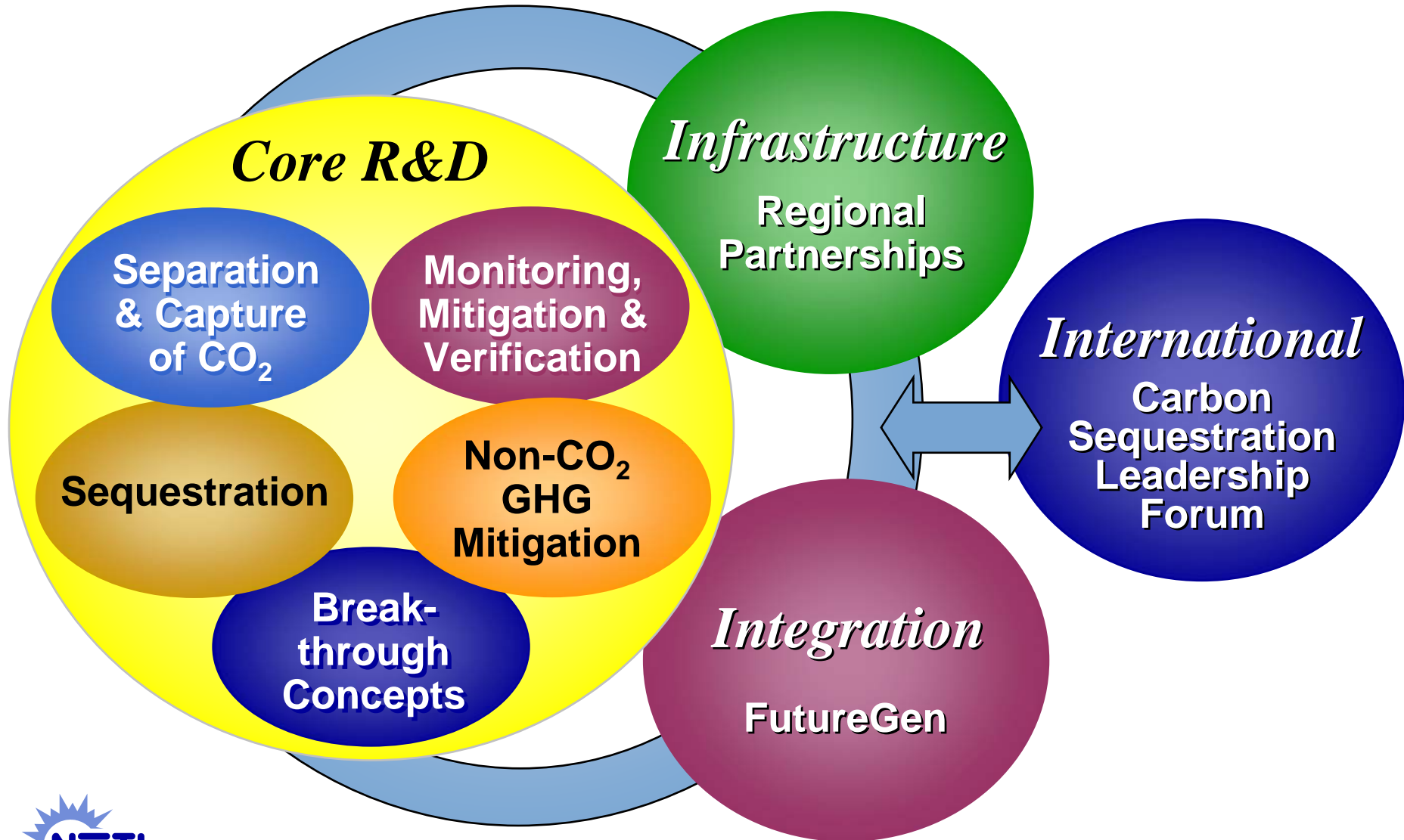
National Energy Technology Laboratory



Office of Fossil Energy

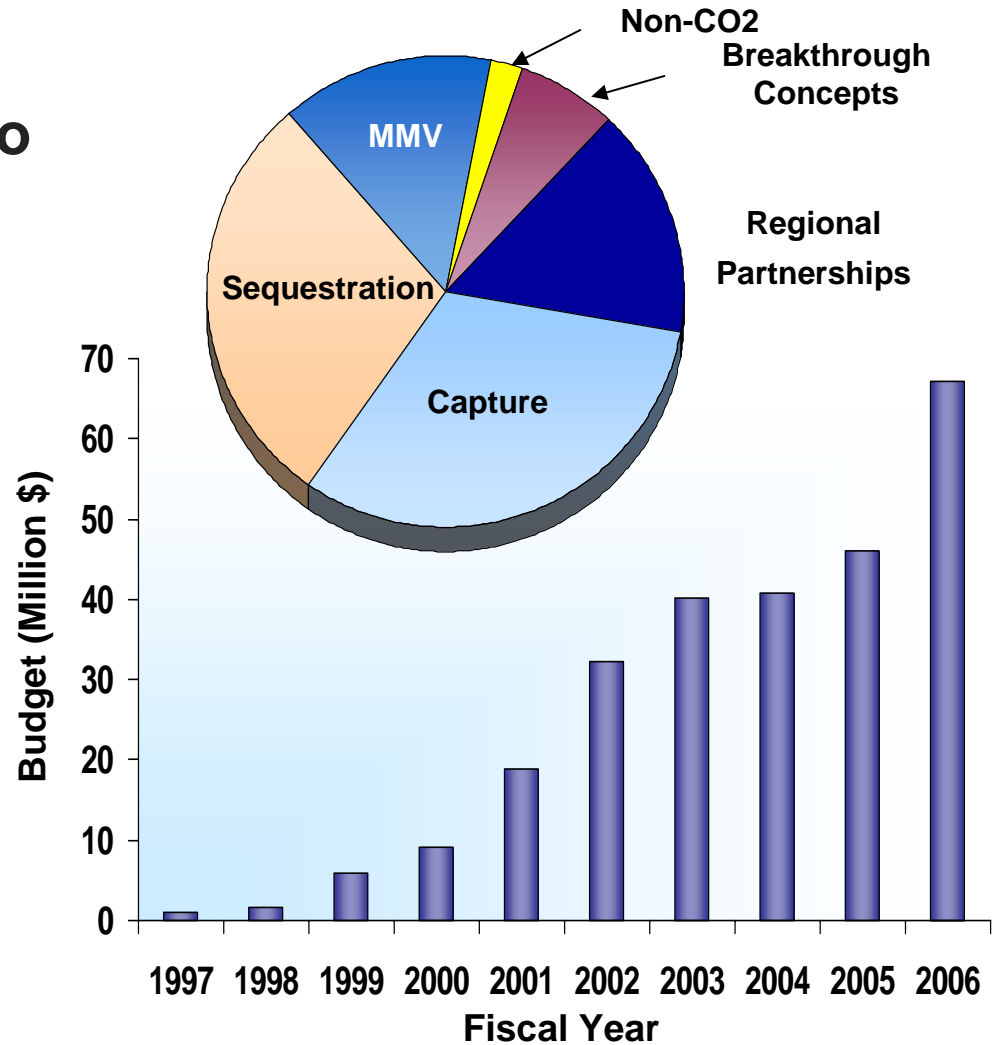


U.S. DOE/ Fossil Energy Program Organization

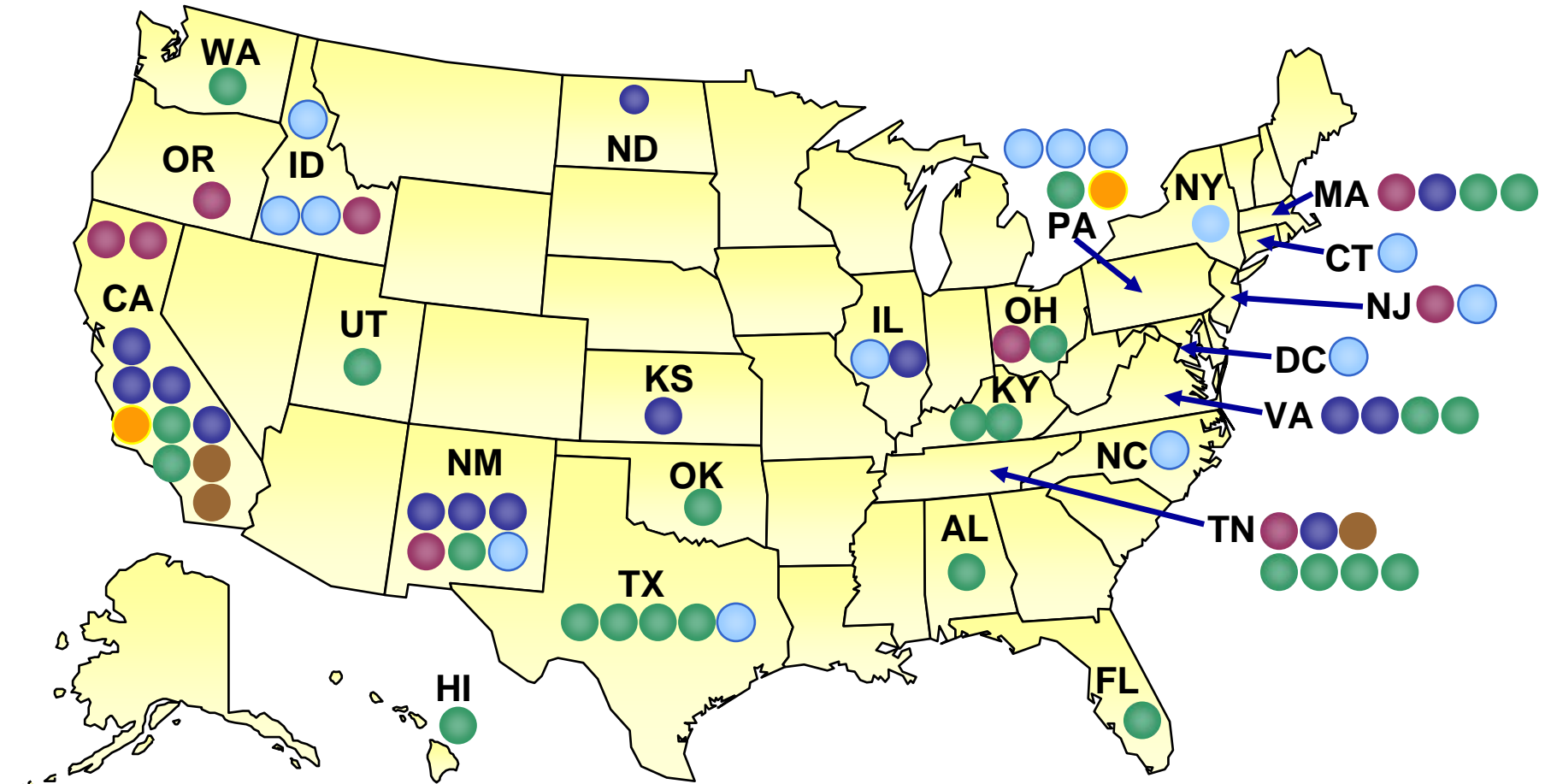


Portfolio Overview – FY2005

- **Diverse research portfolio**
 - ~ 60 R&D Projects
 - IEA & CCP consortia
- **Strong industry support**
 - ~ 36% cost share
- **Portfolio ~ \$200 Mil**
- **Administration Priority**
 - ~ 50% increase in 2006 budget request



Sequestration Projects Span Nation



- Capture
- MMV
- Sequestration
- Breakthrough Concepts
- Non-CO₂ GHGs
- Sequestration / MMV



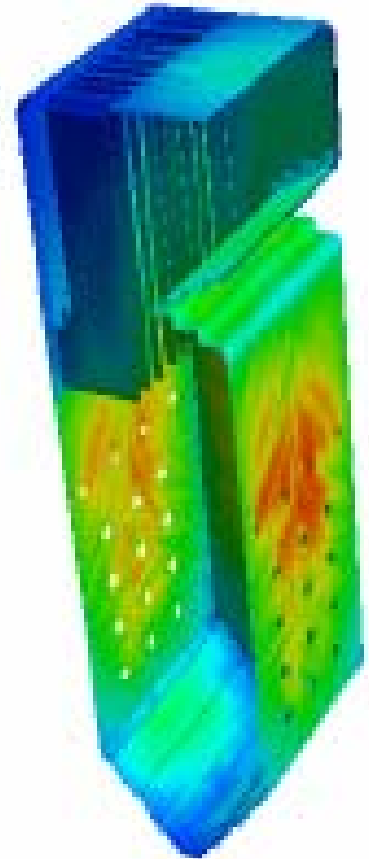
2005 Programmatic Highlights

- **2005 Sequestration Roadmap and Project Portfolio Available**
- **Programmatic Environmental Impact Statement**
 - Draft EIS to be released Summer FY05
 - Second round of public hearings to be held
- **Sequestration Educational Curriculum**
 - Middle school curriculum developed
 - High school curriculum under development
 - Teacher training sessions offered



Capture and Separation Solicitation Recently Announced

- **Validation Tests of Separation Technologies**
 - Slip-stream
- **Areas of interest**
 - Oxyfuel Combustion
 - Post-combustion Capture
- **Anticipate \$13.5M Total Federal funding**
 - 20% minimum non-Federal cost share



Separation & Capture of CO₂

Technology Goals

- 2007 have two technologies < 20% increase in COE
- 2012 developed two technologies < 10% increase COE

Pathways

- Pre-combustion capture
- Post-combustion capture
- Oxygen-fired combustion
 - Chemical looping
- Optimized engineering



2005 Highlights

Capture

- **Post-combustion:**
25% reduction in net steam use for amine-based CO₂ capture
- **Pre-combustion:**
New technologies offer a cost of CO₂ capture 33-38% below conventional selexol/amine
- **Oxy-fuels:**
Pilot-scale experiment demonstrated a 70% reduction in CO₂ recycle



Sequestration/Storage R&D

Technology Goals

- 2012 – predict CO₂ storage capacity with +/- 30% accuracy
- Develop best practice reservoir management strategies that maximize CO₂ trapping

Pathways

- Field experiments / demos
- Protocols for identifying amenable storage sites
- Capacity evaluation studies
- Underlying science



2005 Highlights

Storage

- **Geologic:**

- Successful injection of 1,600 tons of CO₂ in a domestic saline formation
- Increased understanding of CO₂ trapping mechanisms

- **Terrestrial:**

80% survival rate for tree plantings on abandoned mine lands

- **Ocean:**

Dense CO₂/water hydrate formed in laboratory tests at MBARI



Carbon Sequestration Field Projects

Geologic

AEP – Mountaineer

ARI – Natural Analogs

Burlington Resources & ARI – Sequestration of CO₂ in Coalbeds

CONSOL- Slant Hole ECBM

North Dakota Gasification – Weyburn

Strata – West Pearl Queen

Texas BEG - Frio



Carbon Sequestration Field Projects

Terrestrial

Nature Conservancy –
Carbon Accounting

TVA - CCWESTRS

Univ. of KY – Surface Mine
Lands

VA Tech – Restoring Forests
on Mined Lands



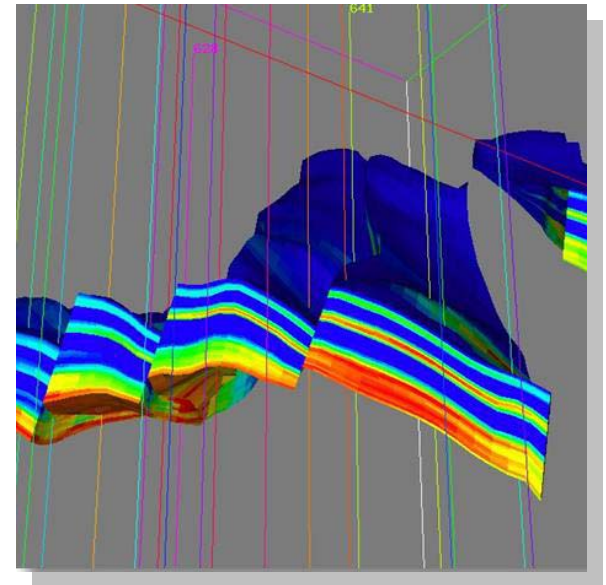
Monitoring, Mitigation & Verification

Technology Goals

- 2012 – ability to verify 95% of stored CO₂ for credits (1605b)
- CO₂ material balance to >99%

Pathways

- Surface and subsurface CO₂ leak detection and mitigation tools
- Atmospheric detection systems
- CO₂ fate and transport studies
- Protocols for accounting and permanence



Source. Myers, et al

2005 Highlights

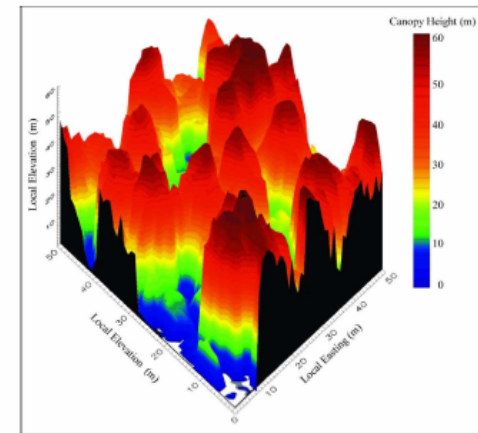
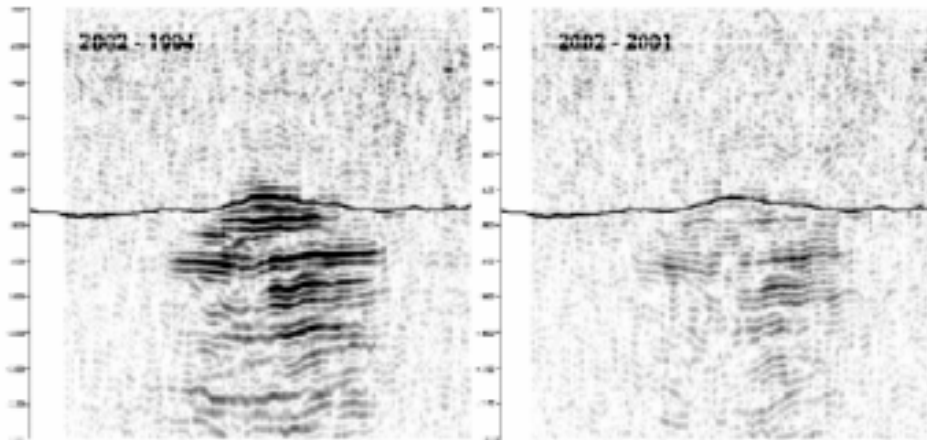
Monitoring, Mitigation, & Verification

- **Geologic:**

Time lapse seismic able to detect volumes of CO₂ as small 2,500 metric tons

- **Terrestrial:**

Initiated work to explore the next generation terrestrial MM&V technologies



Non-CO₂ Greenhouse Gas Mitigation

Technology Goals

- Develop two technologies to mitigate Methane from mines or landfills

Pathways

- Technologies to mitigate large fugitive releases
 - Coalbeds
 - Landfill gas
- Collaboration with EPA on best-practice mitigation options



2005 Highlights

Non-CO₂ GHG Mitigation

- **Expanded project portfolio to from 2 to 5 field projects**
 - Kansas landfill capture followed by ECBM recovery
 - Landfill microbial methane reduction
 - Landfill cover
 - Intelligent Bioreactor Management System for Landfill
 - Coalmine methane capture and reuse



Carbon Sequestration Field Projects

Non-CO₂

CONSOL- Mine
Ventilation
Air Methane

Univ. of Kansas -
Landfill Gas
Sequestration

Univ. Michigan –
Microbe-Mediation
Mitigation Landfill

UNC – Bio-Tarp

Velocys – Upgrading
Methane

Yolo – Bioreactor
Landfill



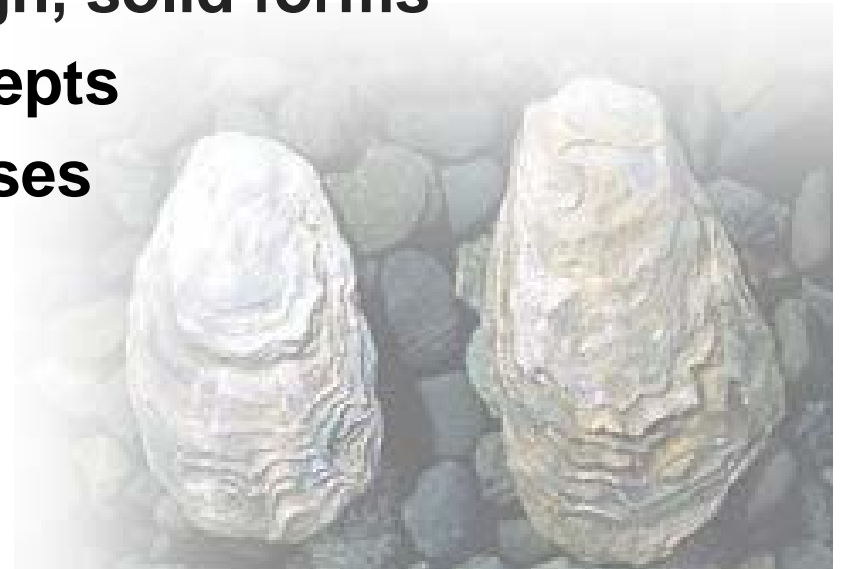
Breakthrough Concepts

Technology Goal

- 2007 - Identify lab scale technologies capable of meeting 10% increase COE 2012 goal

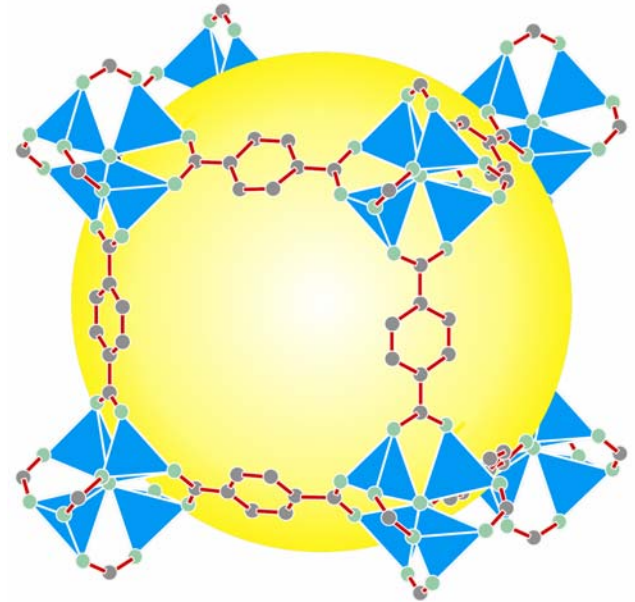
Pathways

- CO₂ conversion to benign, solid forms
- Advanced capture concepts
- Biogeochemical processes



Metal Organic Frameworks for CO₂ Capture

- Hybrid organic/inorganic structures that are highly porous and thermally stable
- Proven storage capacity for methane
- Will Screen potential MOFs
- Preliminary economics promising

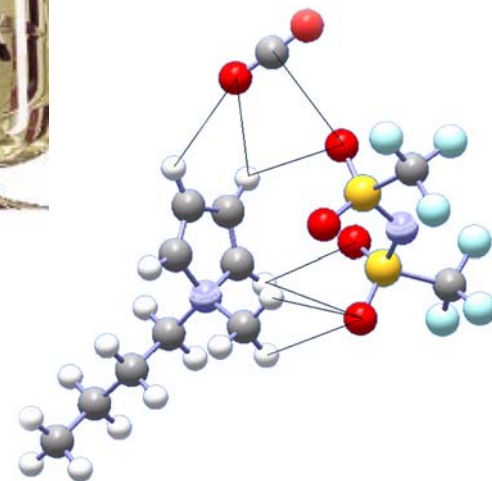


MOF - 5

*Participants: UOP LLC, University of Michigan,
Northwestern University*

Ionic Liquids as Novel Absorbents

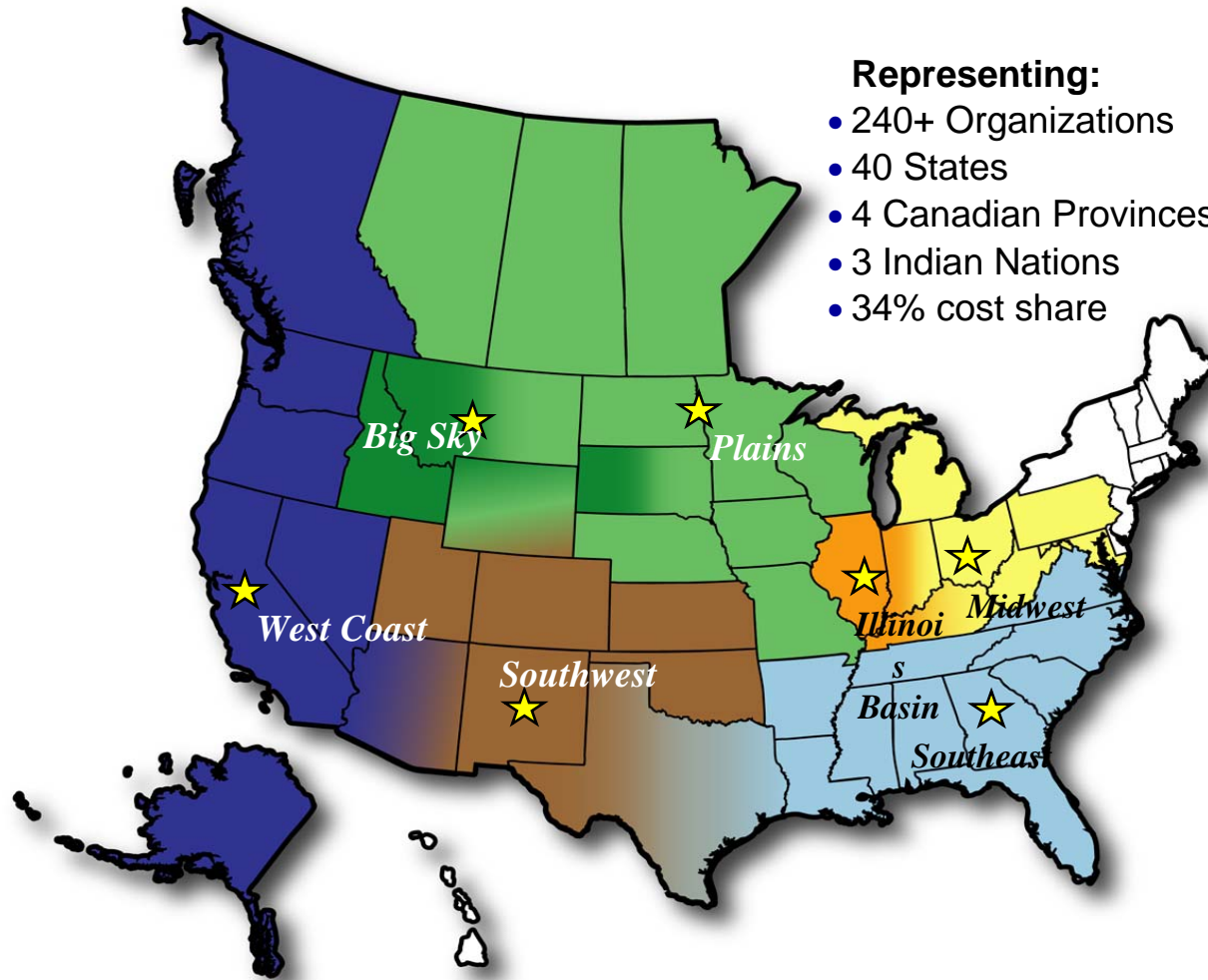
- **Ionic liquids (ILs): salts that are liquid at room temperature**
 - Discovered ~ 12 years ago
 - Will *never* evaporate
 - Can absorb large amounts of CO₂
- **Basic research stage**
 - Select best compounds
 - Feasibility of use for CO₂ capture from post combustion plants
- **Possible uses**
 - Liquid absorbents to replace amines
 - Supported liquid membranes (with NETL)



Participants: University of Notre Dame

Regional Carbon Sequestration Partnerships

Infrastructure Required for Wide Scale Deployment



Celebrate Success of Phase I Partnerships by Moving to Phase II

- **Proposals receive March, 15 2005**
 - currently under review
- **Announcements in Summer 2005**
- **Award made before October 2005**
- **Expect to award approximately 7 partnerships**
 - 20 - 30 sequestration field tests anticipated



FutureGen

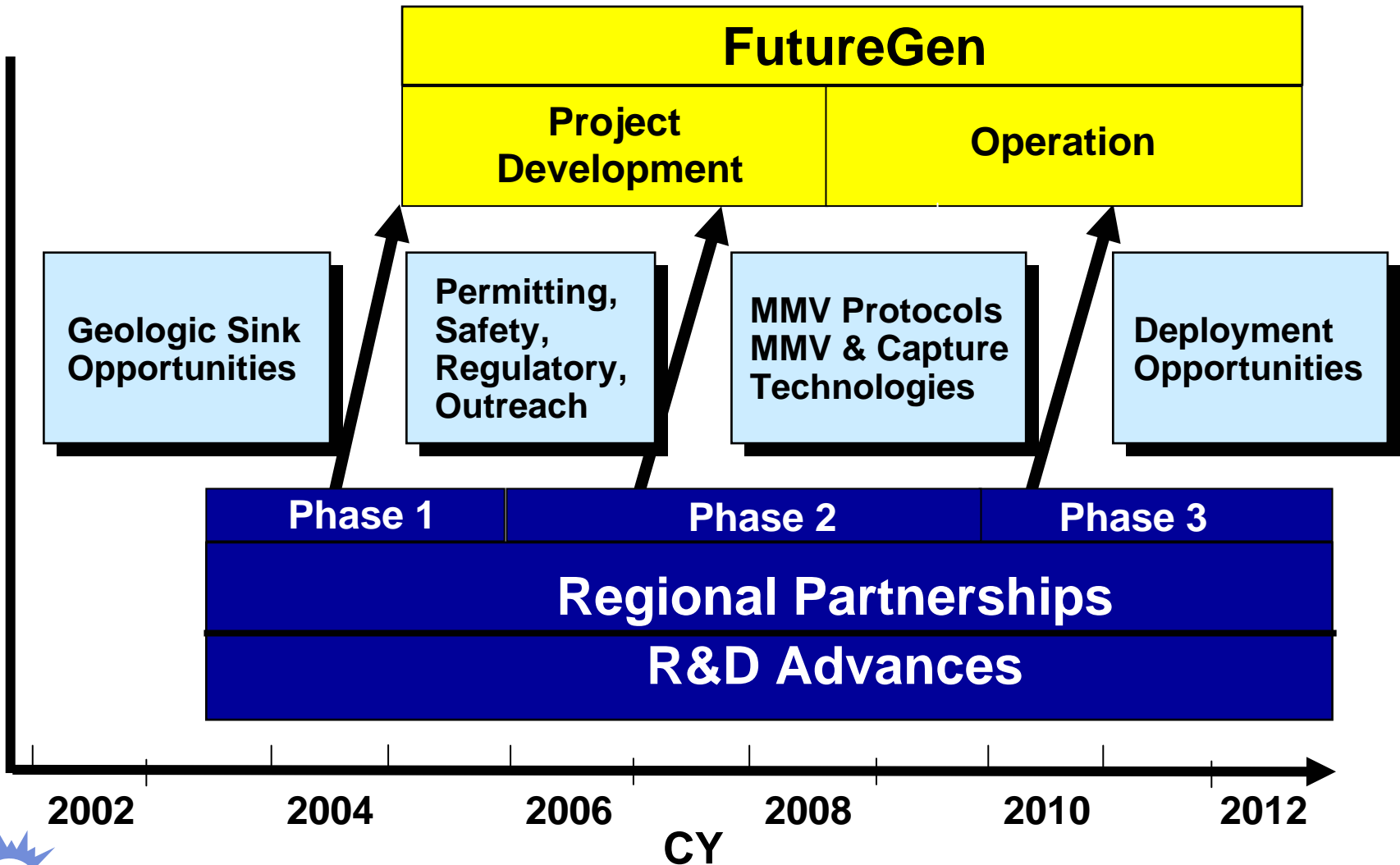
Sequestration & Hydrogen Research Plant

“ . . . the United States will sponsor a \$1 billion, 10-year demonstration project to create the world's first coal-based, zero-emissions electricity and hydrogen power plant . . . ”

February 27, 2003



Critical FutureGen Connection



Questions ?

