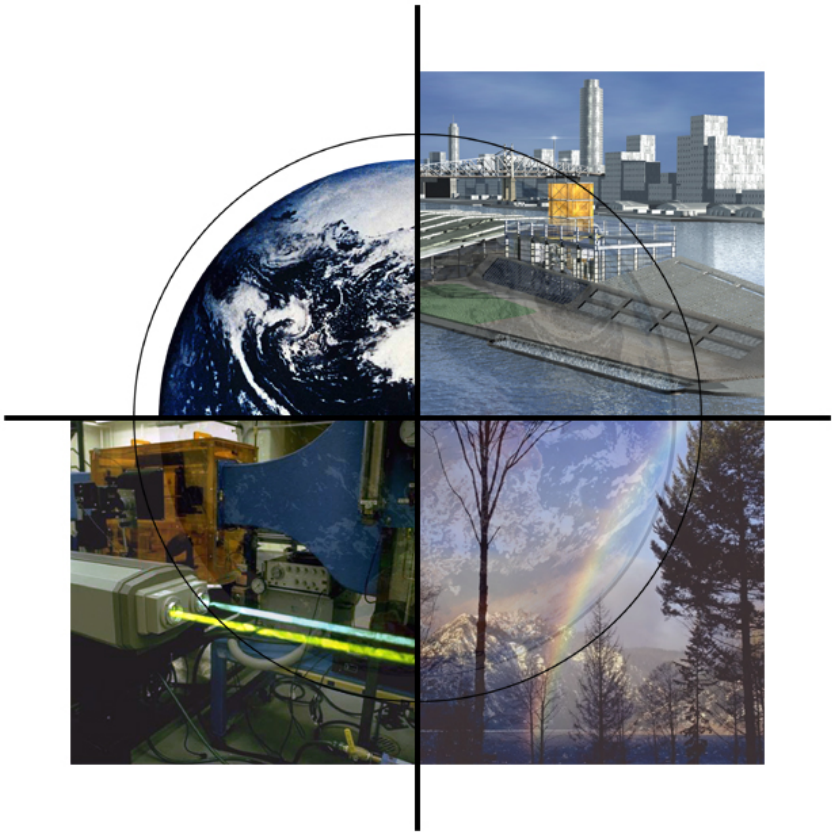
DOE Office of Fossil Energy
Carbon Sequestration Program



Fourth Annual Conference on Carbon Sequestration

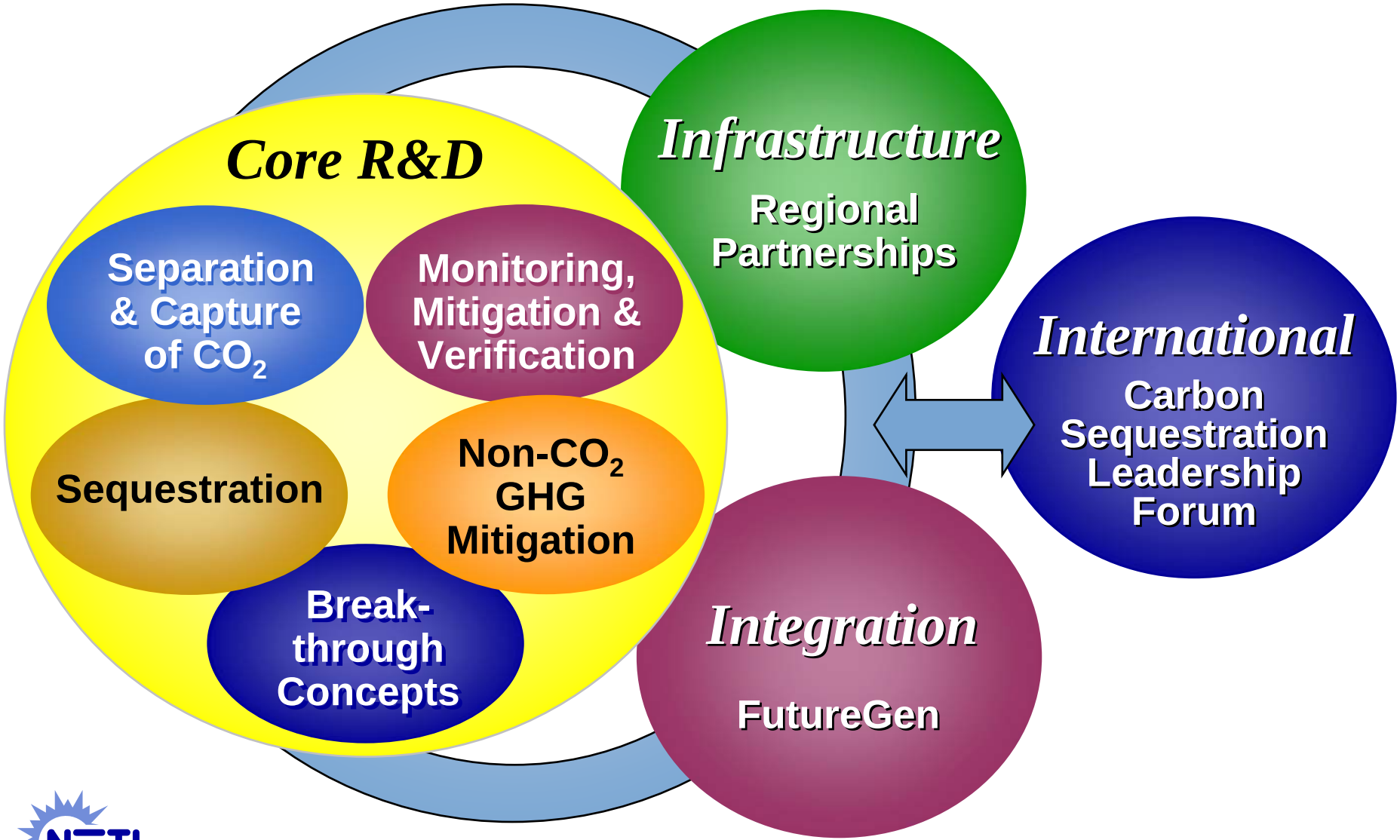
May 2-5, 2005

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

National Energy Technology Laboratory

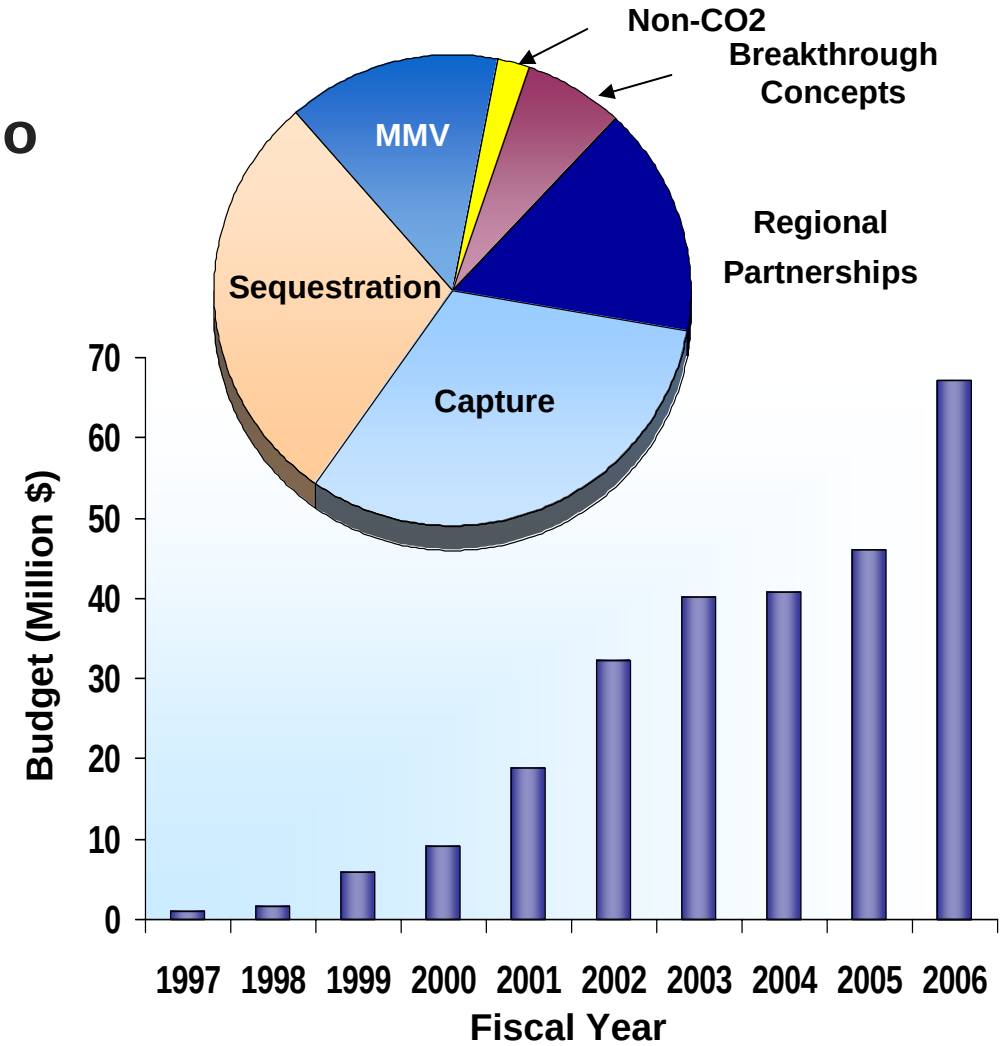
Office of Fossil Energy

U.S. DOE/ Fossil Energy Program Organization

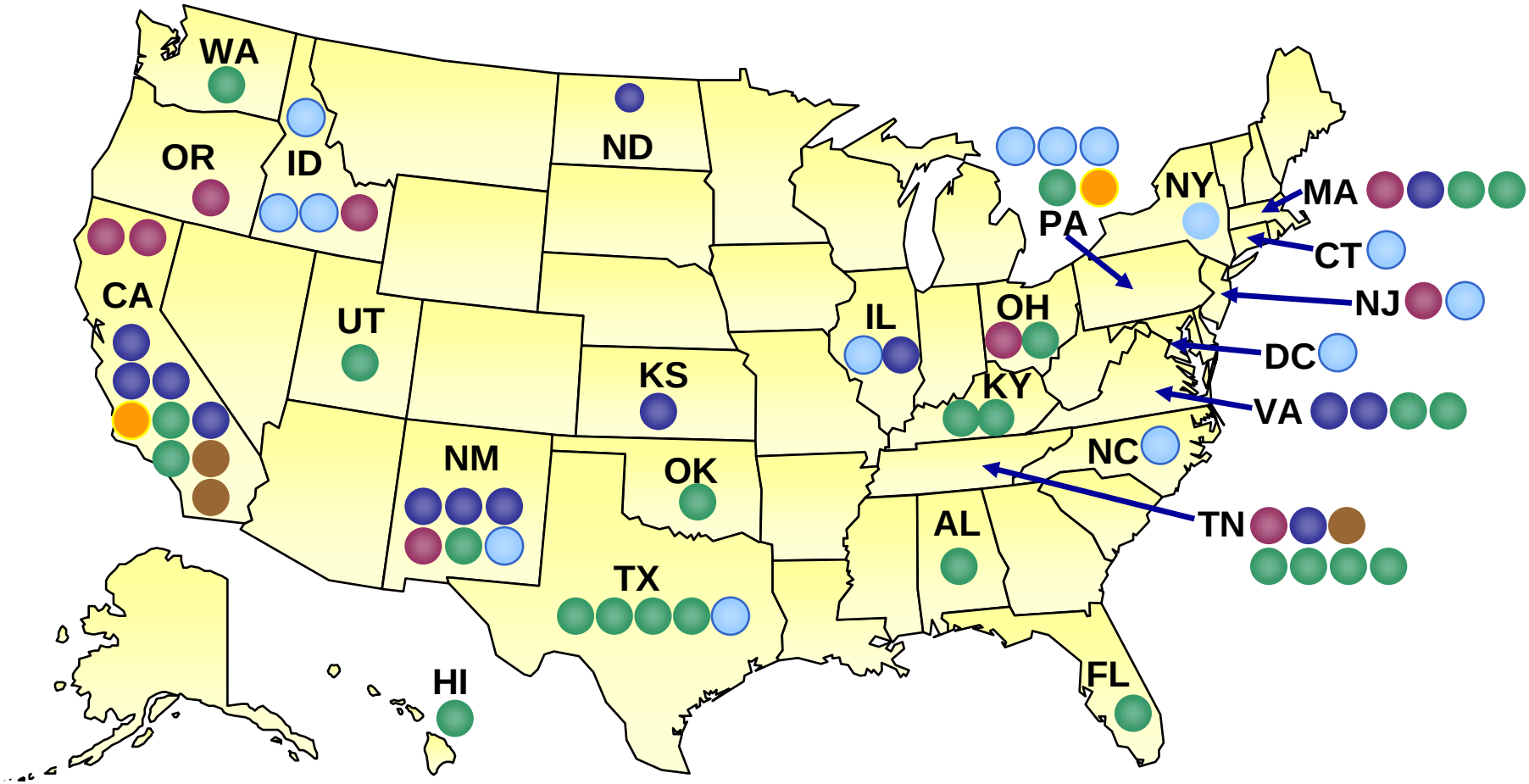


Portfolio Overview – FY2005

- **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-CO_2 GHGs
- Sequestration / MMV

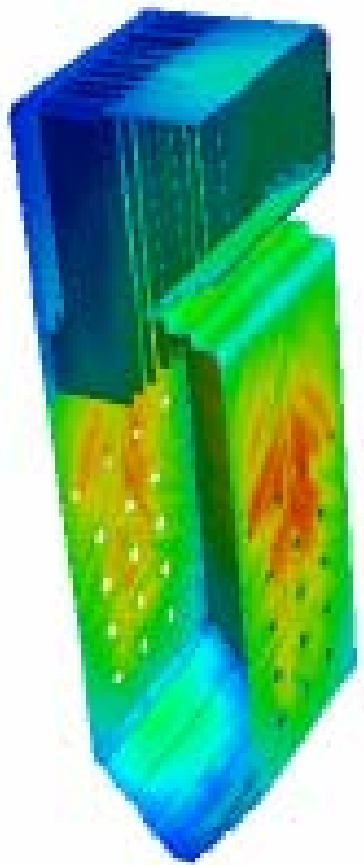
NETL

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 CO_2

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 CO_2 capture
- **Pre-combustion:**
  New technologies offer a cost of CO_2 capture 33-38% below conventional selexol/amine
- **Oxy-fuels:**
  Pilot-scale experiment demonstrated a 70% reduction in CO_2 recycle

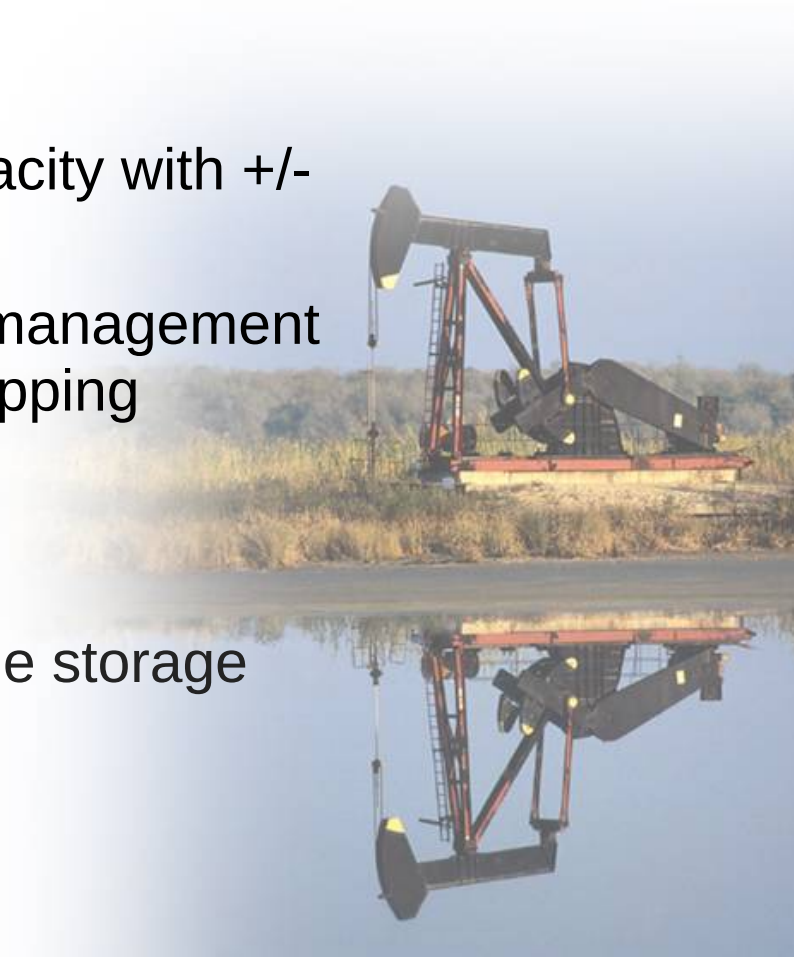
Sequestration/Storage R&D

Technology Goals

- 2012 – predict CO2 storage capacity with +/- 30% accuracy
- Develop best practice reservoir management strategies that maximize CO_2 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 CO_2 in a domestic saline formation
  - Increased understanding of CO_2 trapping mechanisms
- **Terrestrial:**
  80% survival rate for tree plantings on abandoned mine lands
- **Ocean:**
  Dense CO_2/water hydrate formed in laboratory tests at MBARI

Carbon Sequestration Field Projects
Geologic

AEP – Mountaineer

ARI – Natural Analogs

Burlington Resources & ARI – Sequestration of CO_2 in Coalbeds

CONSOL- Slant Hole ECBM

North Dakota Gasification – Weyburn

Strata – West Pearl Queen

Texas BEG - Frio

Carbon Sequestration Field Projects

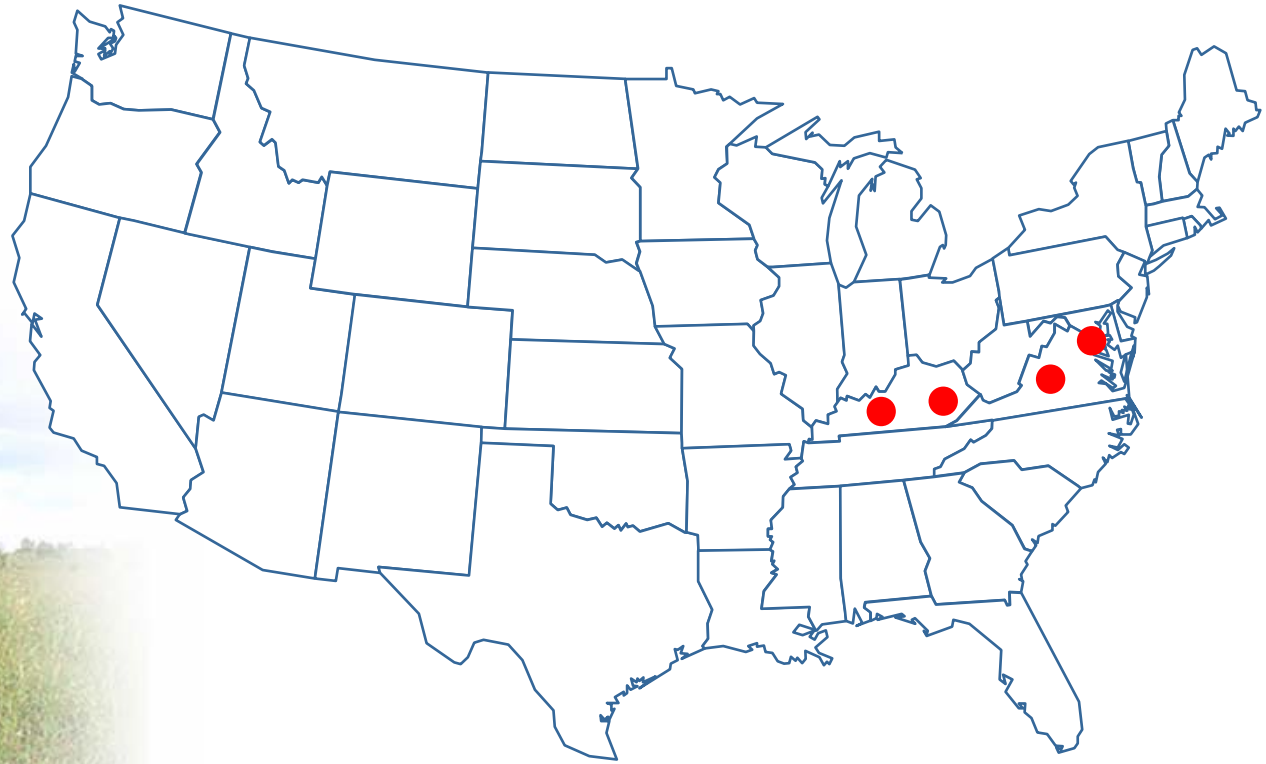
Terrestrial

Nature Conservancy – Carbon Accounting

TVA - CCWESTRS

Univ. of KY – Surface Mine Lands

VA Tech – Restoring Forests on Mined Lands



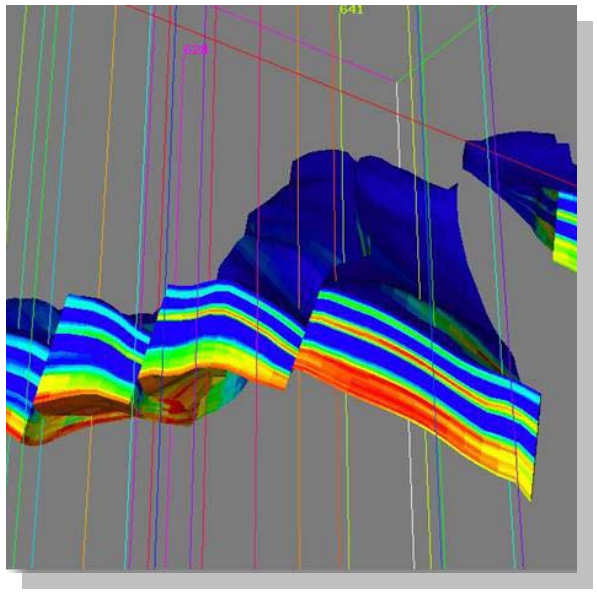
Monitoring, Mitigation & Verification

Technology Goals

- 2012 – ability to verify 95% of stored CO_2 for credits (1605b)
- CO2 material balance to >99%

Pathways

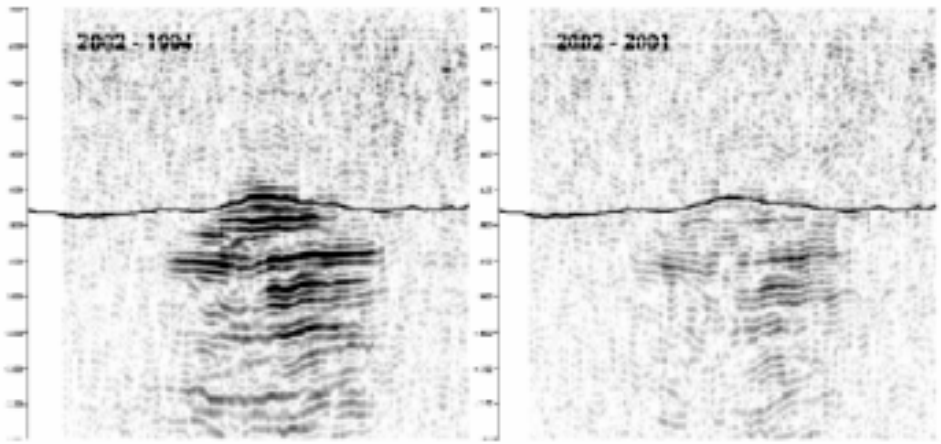
- Surface and subsurface CO_2 leak detection and mitigation tools
- Atmospheric detection systems
- CO_2 fate and transport studies
- Protocols for accounting and permanence

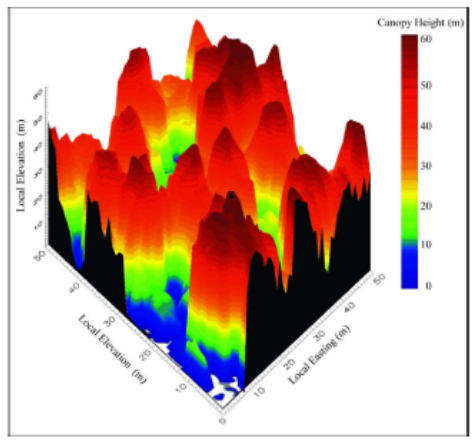


Source. Myers, et al

2005 Highlights
Monitoring, Mitigation, & Verification

- **Geologic:**
  Time lapse seismic able to detect volumes of CO_2 as small 2,500 metric tons
- **Terrestrial:**
  Initiated work to explore the next generation terrestrial MM&V technologies





Non-CO_2 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-CO_2 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-CO_2

CONSOL- Mine Ventilation Air Methane

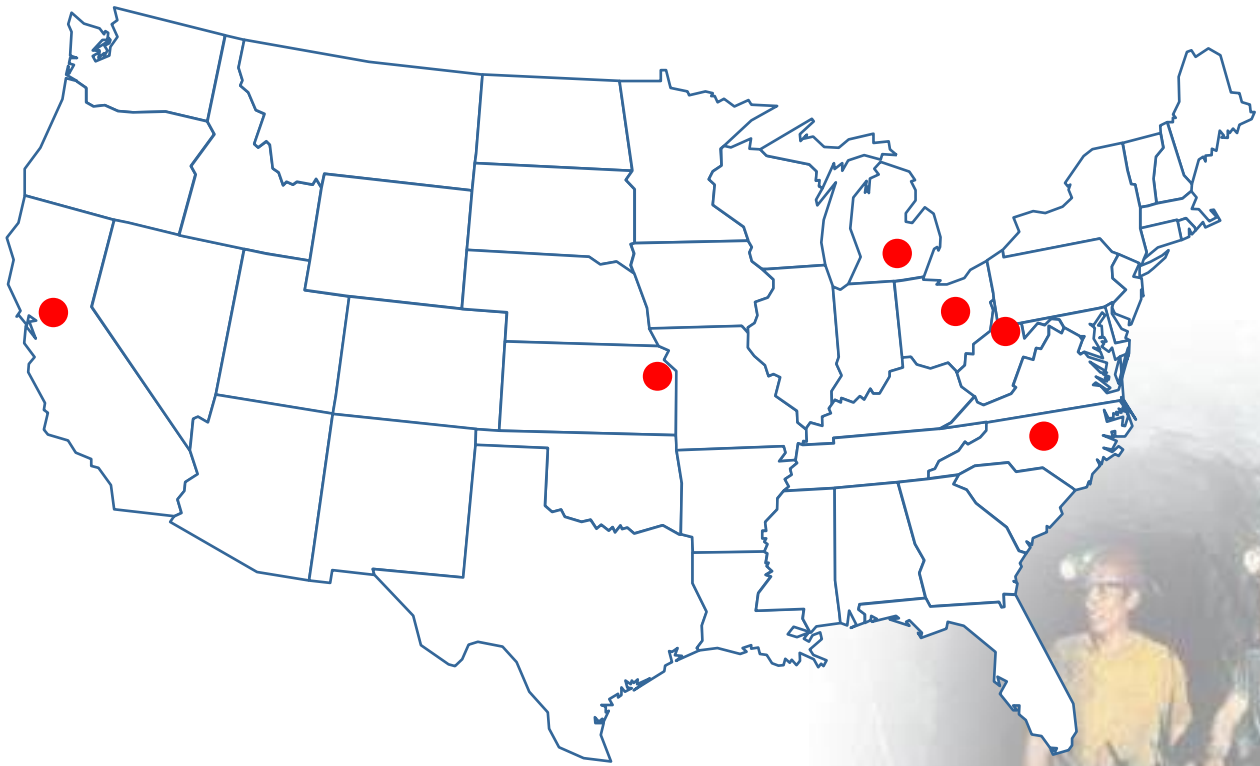
Univ. of Kansas - Landfill Gas Sequestration

Univ. Michigan – Microbe-Mediation Mitigation Landfill

UNC – Bio-Tarp

Velocys – Upgrading Methane

Yolo – Bioreactor Landfill



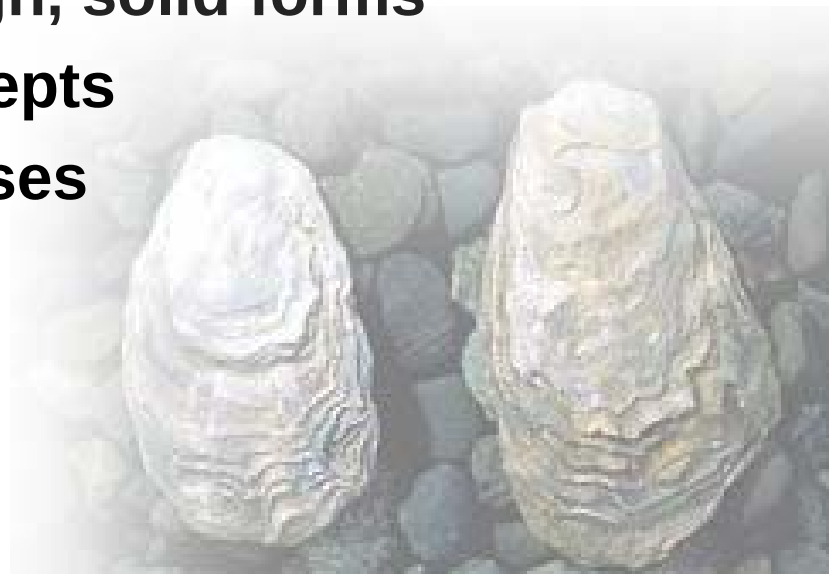
Breakthrough Concepts

Technology Goal

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

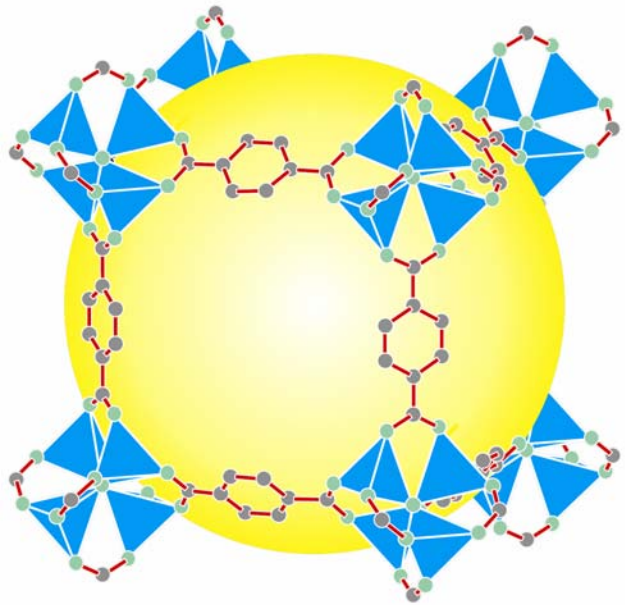
Pathways

- CO_2 conversion to benign, solid forms
- Advanced capture concepts
- Biogeochemical processes



Metal Organic Frameworks for CO_2 Capture

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

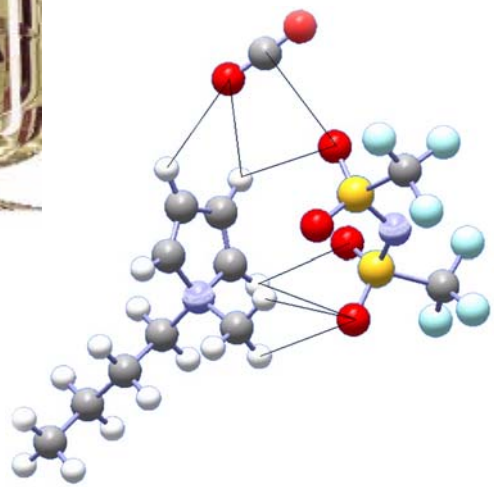


MOF - 5

Participants: UOP LLC, University of Michigan, Northwestern University

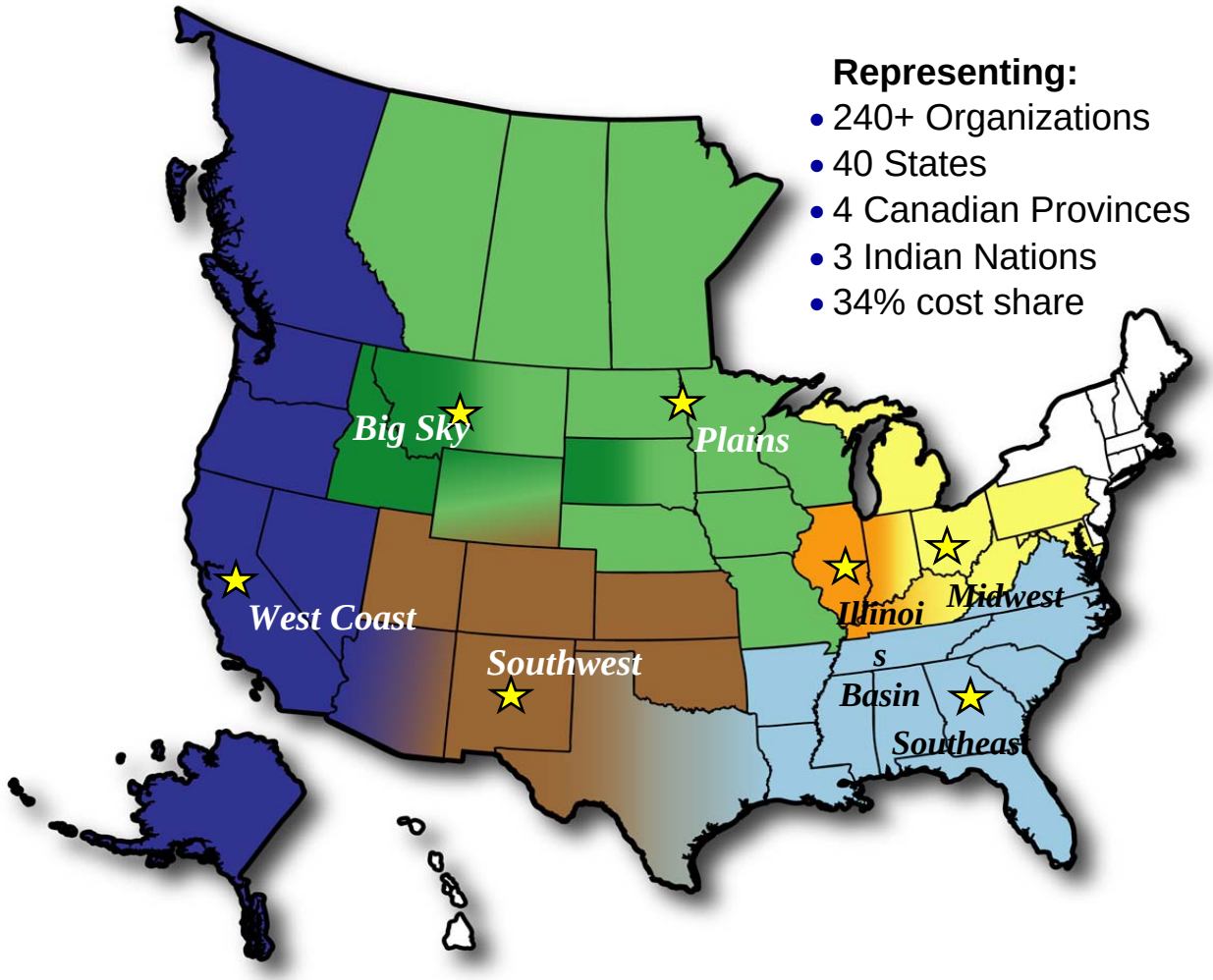
Ionic Liquids as Novel Absorbents

- **Ionic liquids (ILs): salts that are liquid at room temperature**
  - Discovered ~ 12 years ago
  - Will *never* evaporate
  - Can absorb large amounts of CO_2
- **Basic research stage**
  - Select best compounds
  - Feasibility of use for CO_2 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

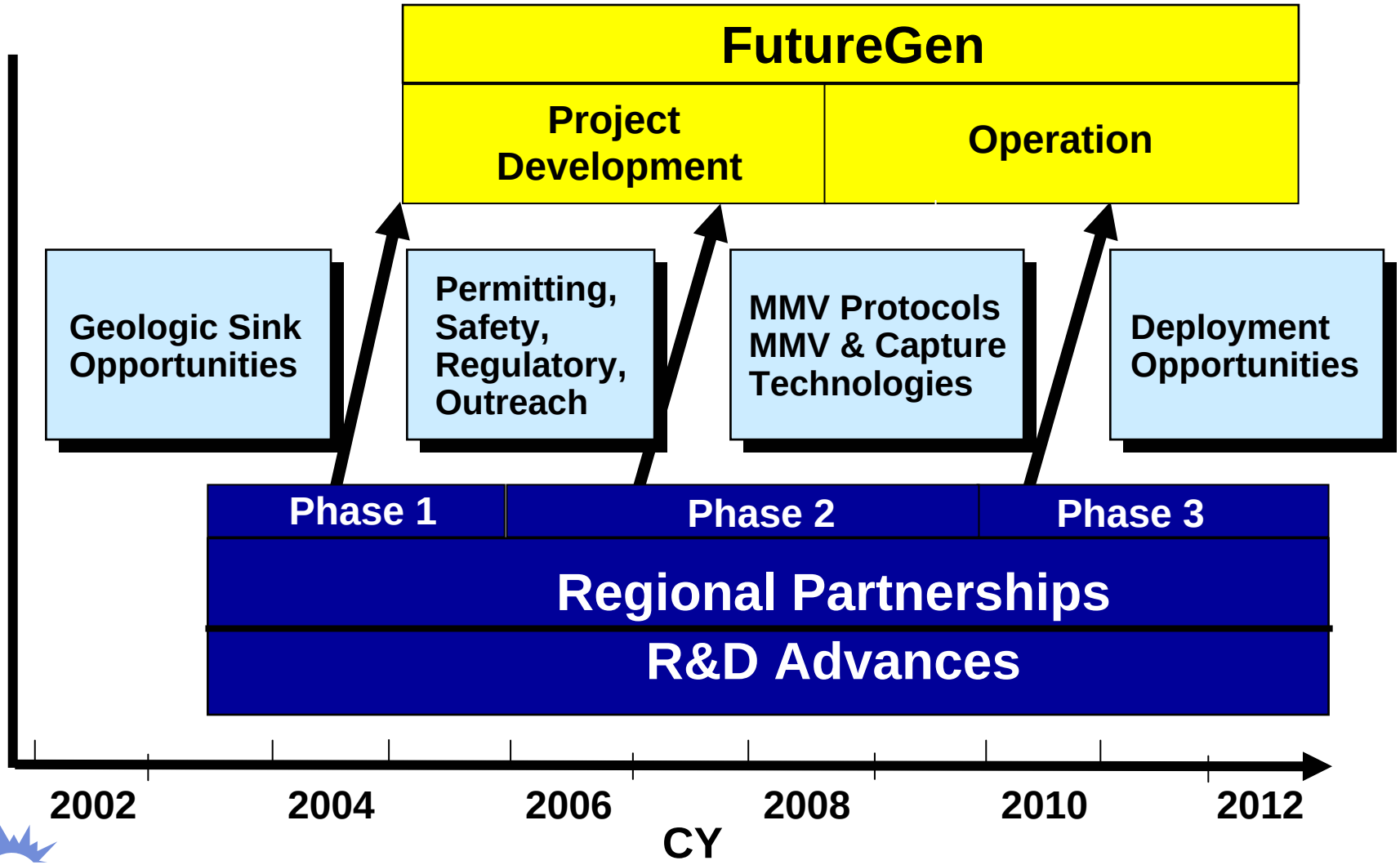
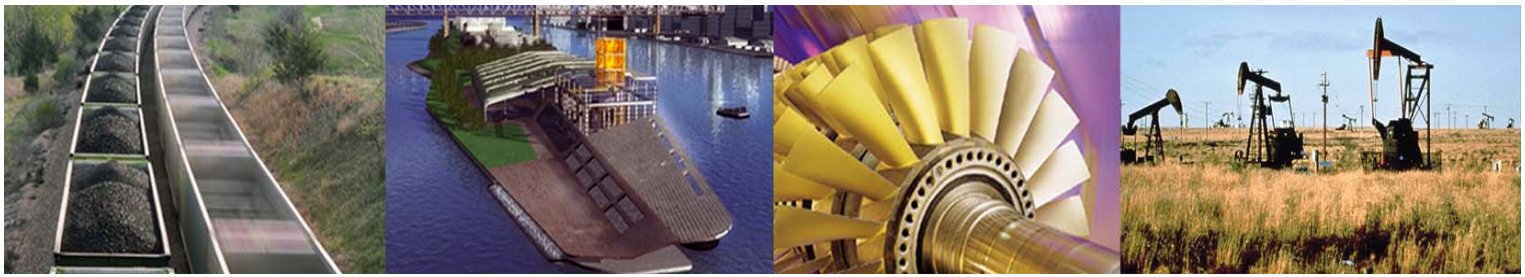
- **Proposals receive March, 15 2005**
  - currently under review
- **Announcements in Summer 2005**
- **Award made before October 2005**
- **Expect to award approximately 7 partnerships**
  - 20 - 30 sequestration field tests anticipated

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 ?