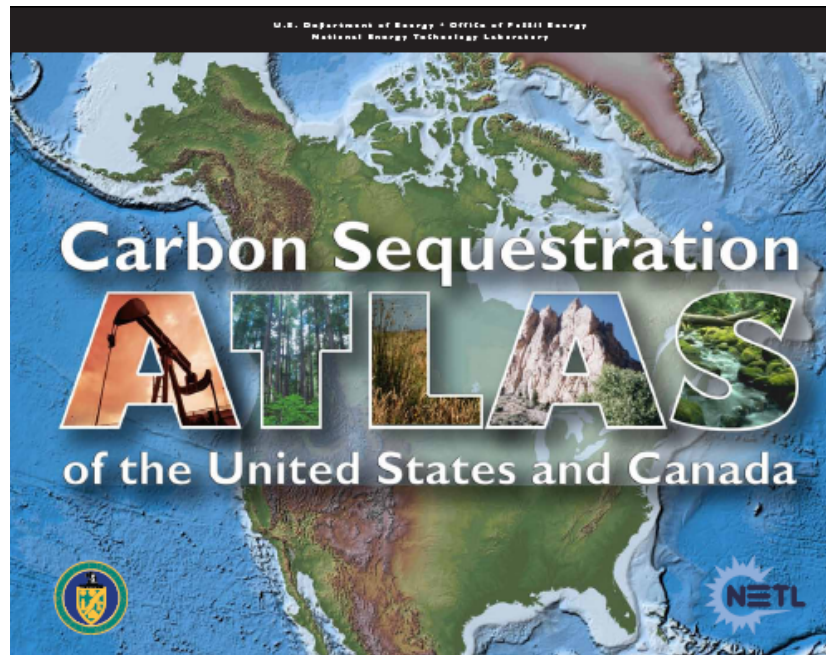




NATIONAL ENERGY TECHNOLOGY LABORATORY



Carbon Sequestration Program – 2008 Annual Regional Carbon Sequestration Partnership Meeting

Sean Plasynski, PhD

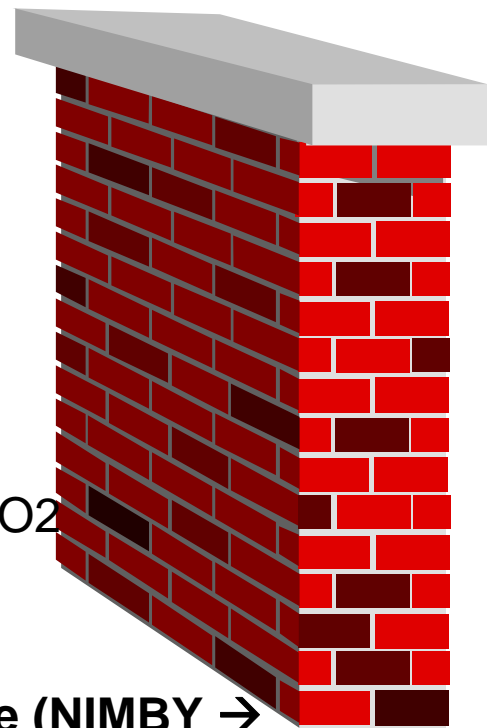
Sequestration Technology Manager
U.S. Department of Energy
National Energy Technology Laboratory



Key Challenges to CCS

- Cost of CCS
- Sufficient Storage Capacity
- Permanence
- Best Practices
- Regulatory Framework and Permitting

- Liability
- Ownership
 - pore space/CO₂
- Infrastructure
- Public Acceptance (NIMBY → NUMBY and BANANA)
- Human Capital Resources



BANANA= Build
Absolutely Nothing
Anywhere Near
Anything (or
Anyone)

DOE Program helping to address challenges – either specific project, participation in working groups, or through Regional Partnerships

Carbon Sequestration Program Goals

Develop Technology Options for GHG Management

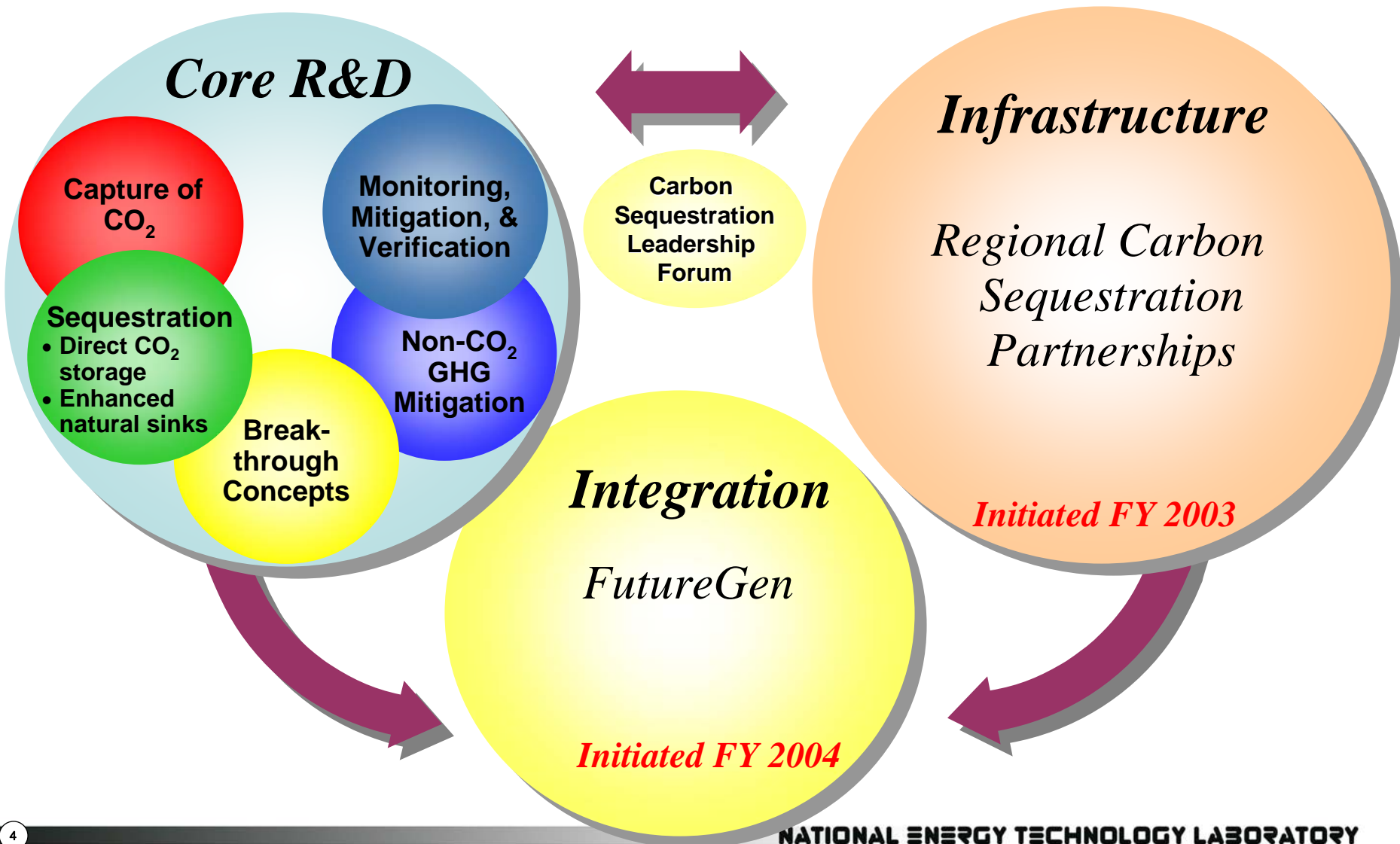
That...

- **Deliver technologies & best practices that validate Carbon Capture and Safe Storage (CCSS):**
 - 90% CO₂ capture
 - 99% storage permanence
 - < 10% increase in COE (pre-combustion capture)
 - +/- 30% storage capacity



Carbon Sequestration Program Structure

Previous Structure



2008/2009 - Transition Year.....Capture

FY07

SEQ

Pre-Combustion

Post-Combustion

Oxy-Combustion

IEP

FY08

SEQ

Pre-Combustion

Post-Combustion

Oxy-Combustion

IEP

Existing Plants

- Post-Combustion

- Oxy-Combustion

FY09

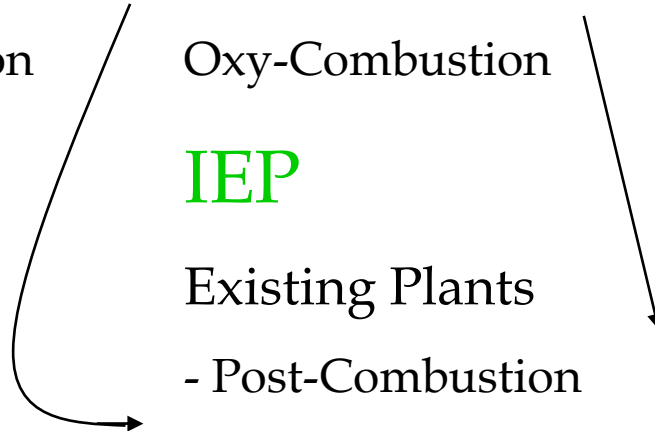
SEQ

Pre-Combustion

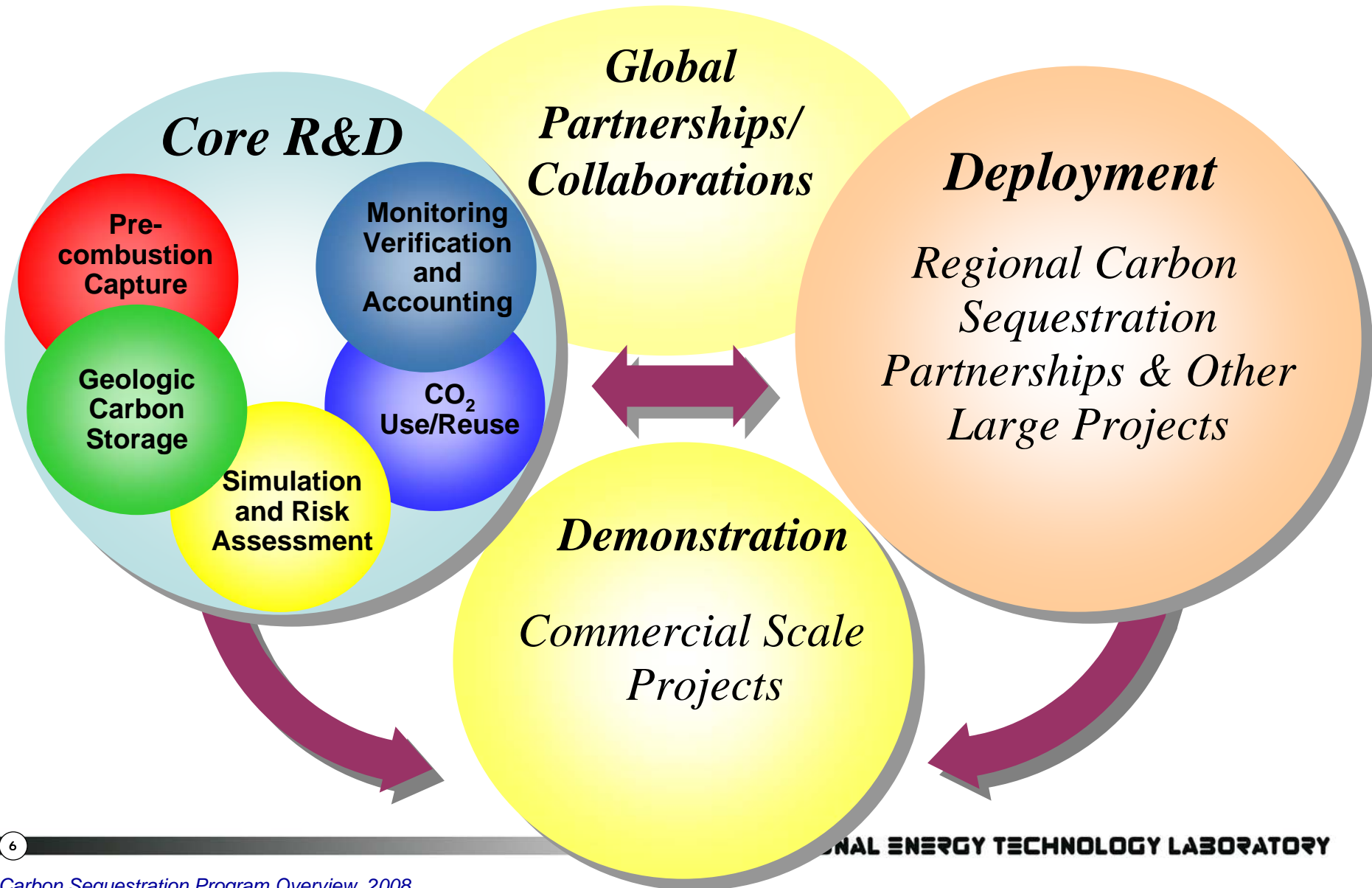
IEP

Post-Combustion

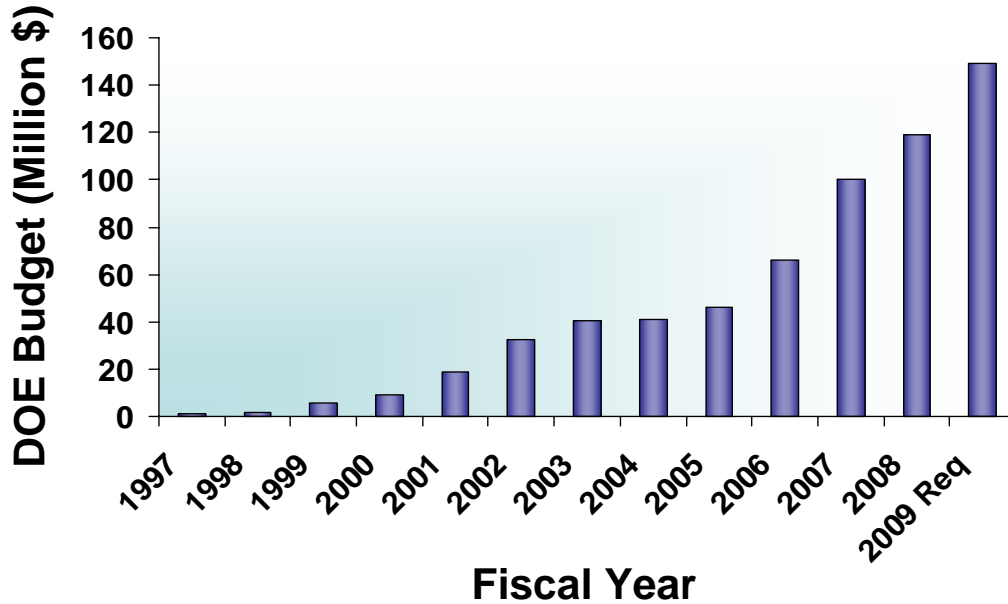
Oxy-Combustion



Sequestration Program Structure - FY2009



Sequestration Program Statistics

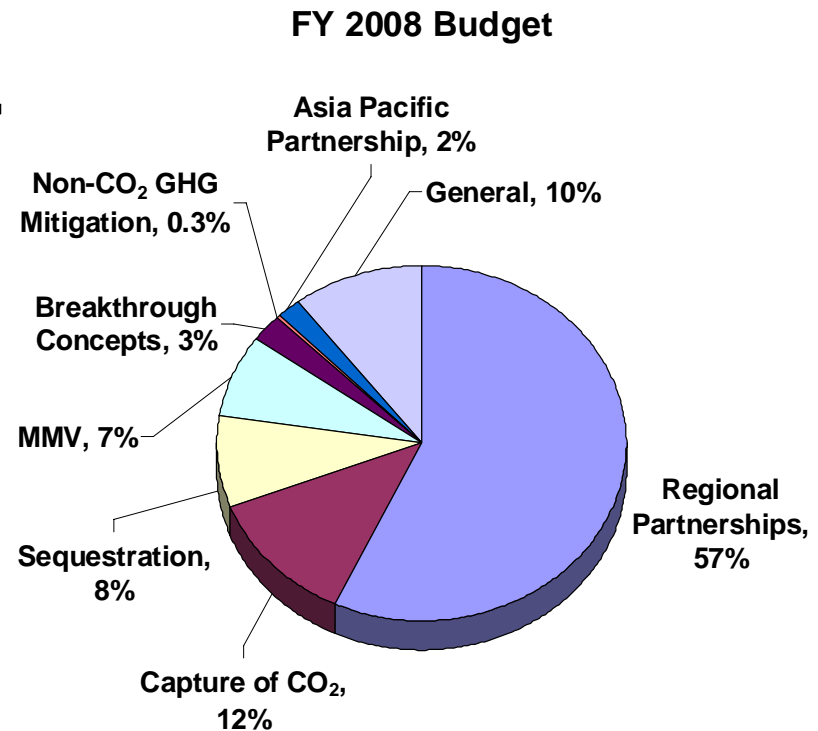


Strong industry support
 ~ 39% cost share on projects

Federal Investment to Date
 ~ \$481 Million

Diverse research portfolio

~ 70 Active R&D Projects



Regional Carbon Sequestration Partnerships

Creating Infrastructure for Wide Scale Deployment

- 350+ organizations
- 42 states
- 4 Canadian provinces
- 3 Indian nations
- Total of 34% cost share



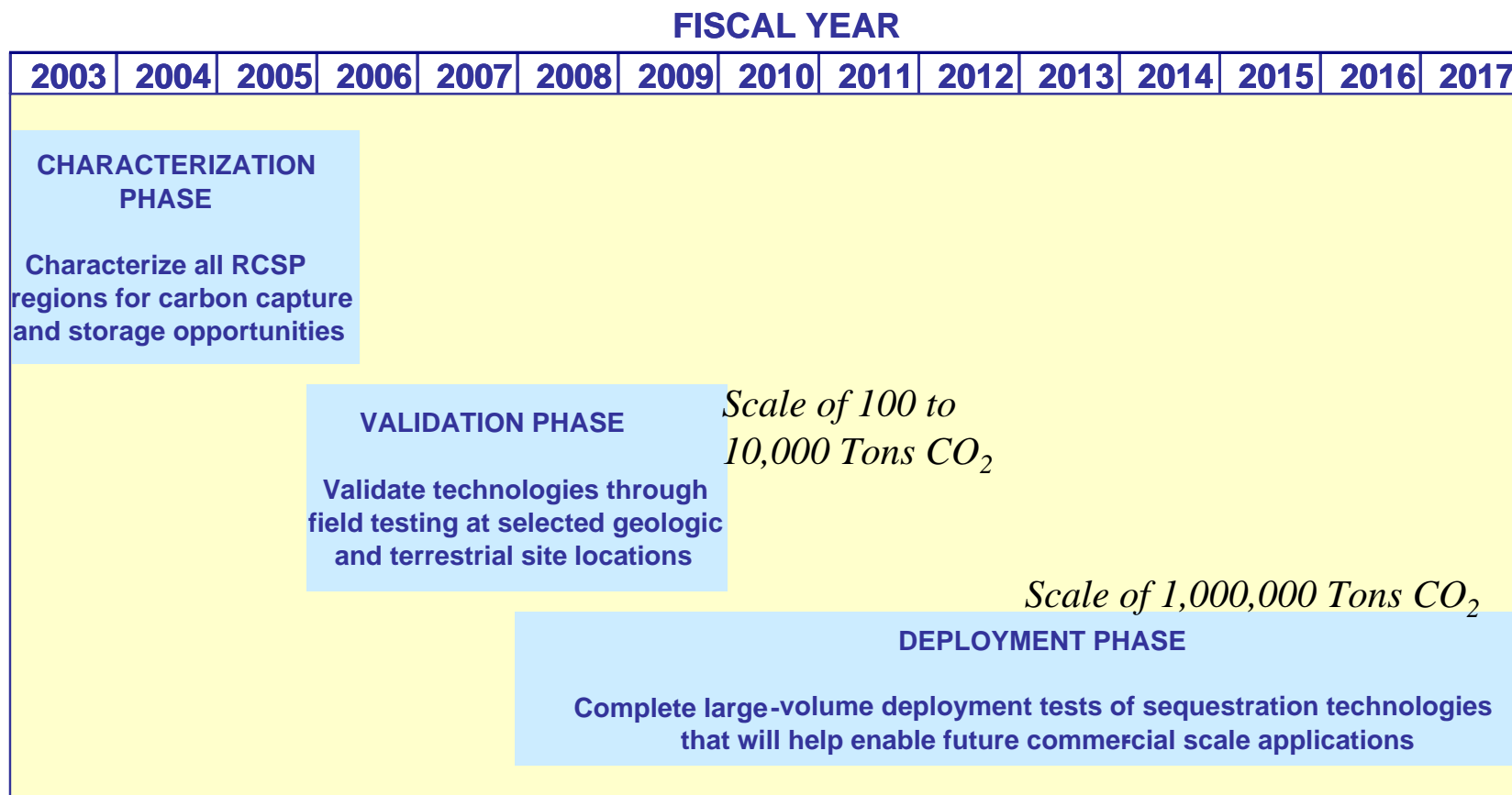
Growing Participation

160 organization in Phase I

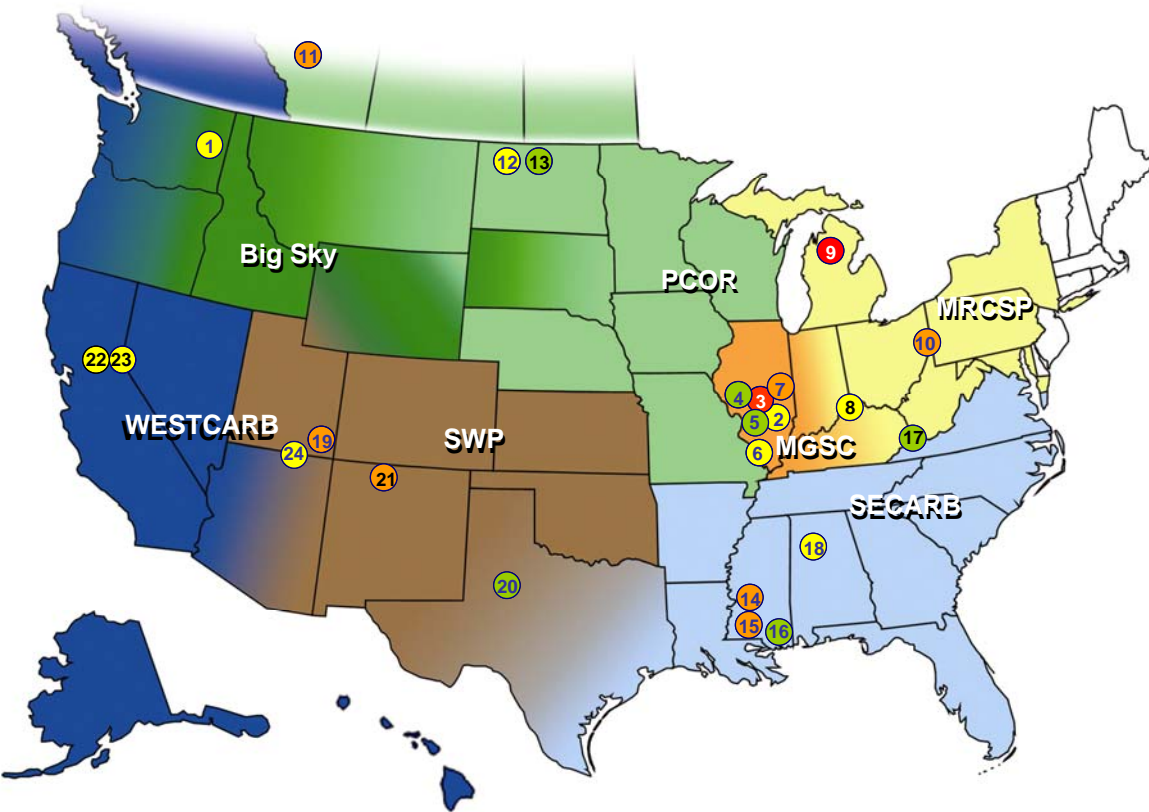
349+ organizations in Phases II and III

Organizations	Number	Organizations	Number
Chemical Companies	5	Land Management/Development Company	2
CO ₂ Trading Organizations	3	Law Firm	2
Coal Companies	8	Local Agencies	4
Electric Utilities	1	Media/Outreach	6
Electric Utilities	52	National Laboratories	10
Engineering and Research Firms	44	Oil & Gas Companies	36
Environmental NGOs	11	Other State Agencies	51
Foreign Government Agencies	10	Pipeline Company	1
Forest Products Companies	4	State Geologic Surveys	18
Governmental Advisory Groups	2	U.S. Federal Agencies	6
Indian Nations	4	University and Academic Institutions	47
Industry Trade Groups	22	Total	349

Regional Carbon Sequestration Partnerships Program Phases



Validation Phase – Geologic Field Tests Injection Schedule



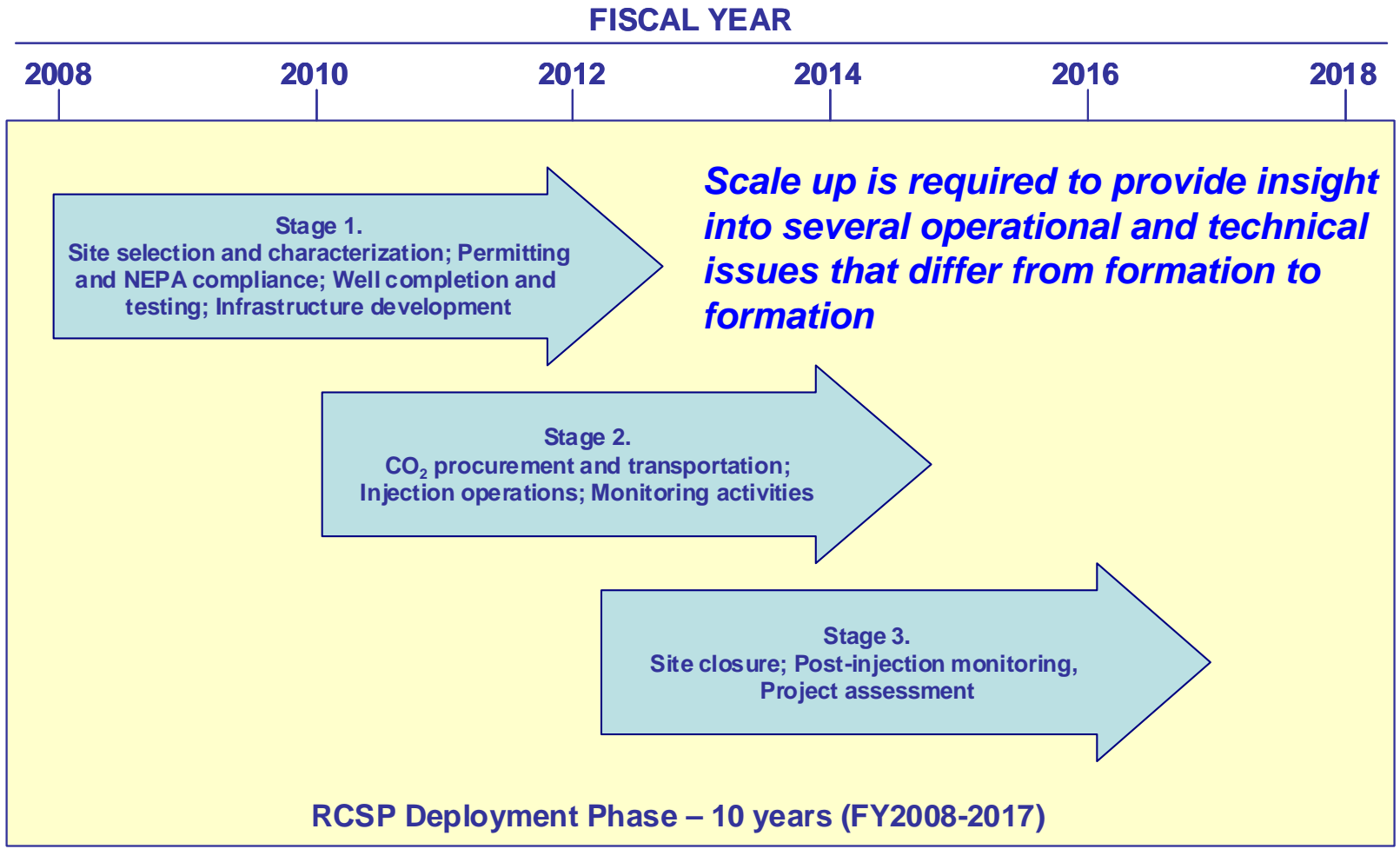
Injection Schedule

- Injection Complete
- Injection Ongoing
- 2008 Injection Scheduled
- 2009 Injection Scheduled

Partnership	Geologic Province	Formation Type
1	Columbia Basin	Saline
2	Illinois Basin	Saline
3	Illinois Basin	Oil Bearing Heavy
4	Illinois Basin	Oil Bearing Well Conversion
5	Illinois Basin	Oil Bearing Pattern Flood I
6	Illinois Basin	Oil Bearing Pattern Flood II
7	Illinois Basin	Coal Seam
8	Cincinnati Arch	Saline
9	Michigan Basin	Saline
10	Appalachian Basin	Saline
11	Keokuk Formation	Oil Bearing
12	Duperow Formation	Oil Bearing
13	Williston Basin	Coal Seam
14	Gulf Coast	Oil-Bearing
15	Gulf Coast	Saline
16	Mississippi Salt Basin	Saline
17	Central Appalachian	Coal Seam
18	Black Warrior Basin	Coal Seam
19	Paradox Basin, Aneth Field	Oil Bearing
20	Permian Basin	Oil Bearing
21	San Juan Basin	Coal Seam
22	Thornton Gas Field	Saline
23	Thornton Gas Field	Gas Bearing
24	Colorado Plateau	Saline

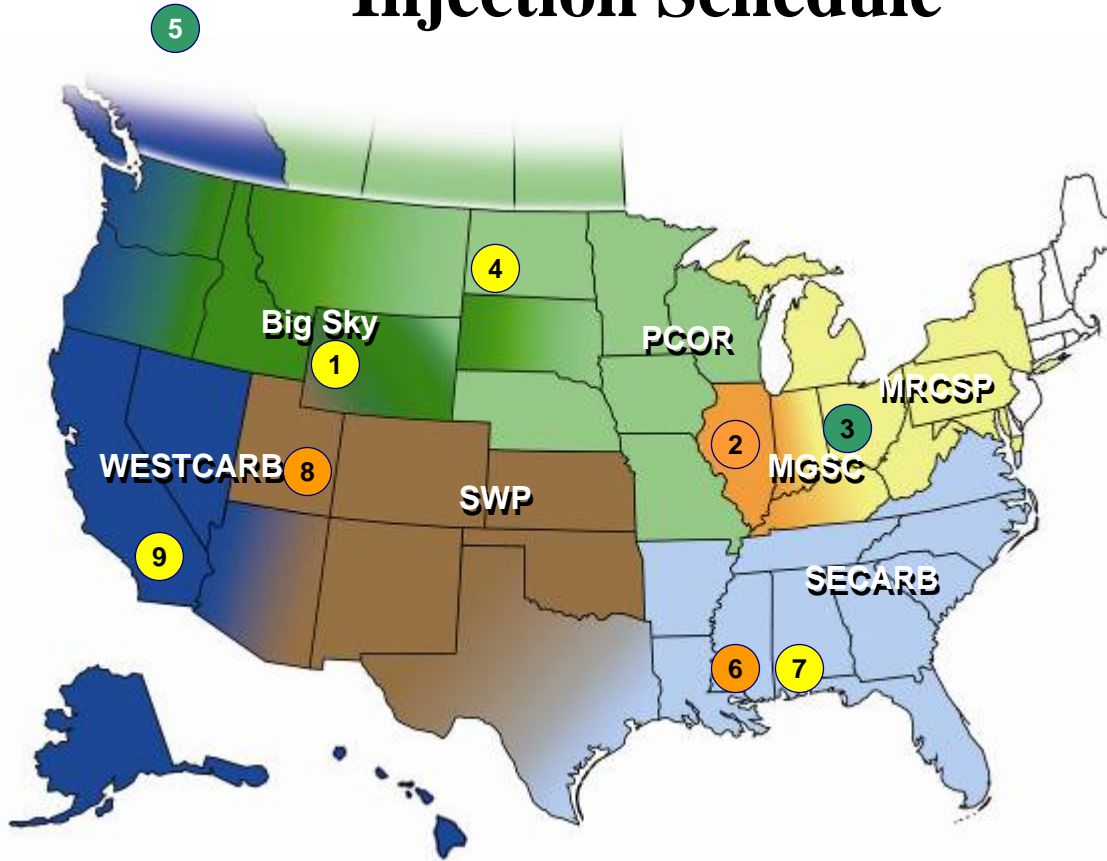
Deployment Phase

Scaling Up Towards Commercialization



\$470 million DOE - over \$200 million cost share

Large Scale Field Tests Injection Schedule



Injection Schedule

- 2009 Injection Scheduled
- 2010 Injection Scheduled
- 2011 Injection Scheduled

	Partnership	Geologic Province	Formation Type
1		Triassic Nugget Sandstone/ Moxa Arch	Saline
2		Mt. Simon Sandstone	Saline
3		Mt. Simon Sandstone	Saline
4		Williston Basin	Saline/Oil Bearing
5		Devonian Age Carbonate Rock	Oil Bearing
6		Lower Tuscaloosa Formation	Saline
7		Massive Sand Unit	
8		Regional Jurassic and Older Formations	Saline
9		San Joaquin Basin	Saline

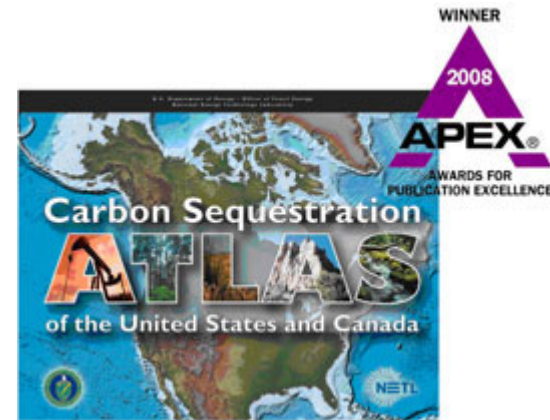
Program Highlights

- **IEA GHG International Review of the Regional Partnership large scale field tests – March 2008**

- *RCSP was recognized as most significant program in the world today*
- *Excellent program that will achieve significant results*

- **APEX Awards recognizing publication excellence**

- ***Carbon Sequestration Atlas of the United States and Canada***



- *ASME Review*

- *GAO Review Program*
 - *Oct 07-Sept 08*



2009 DOE Initiatives

- **Carbon Sequestration Roadmap**
- **National Atlas – Version 2**
- **National Pipeline Study**
- **Science Protocol**
- **Best Practice Manuals – Phase II**
 - Monitoring Verification and Accounting
 - Risk Assessment
 - Well construction and closure
 - Site characterization
 - Public Education



CO₂ Pre-Combustion Capture Solicitation

- *Funding Opportunity Announcement* [DE-PS26-08NT00699](#)

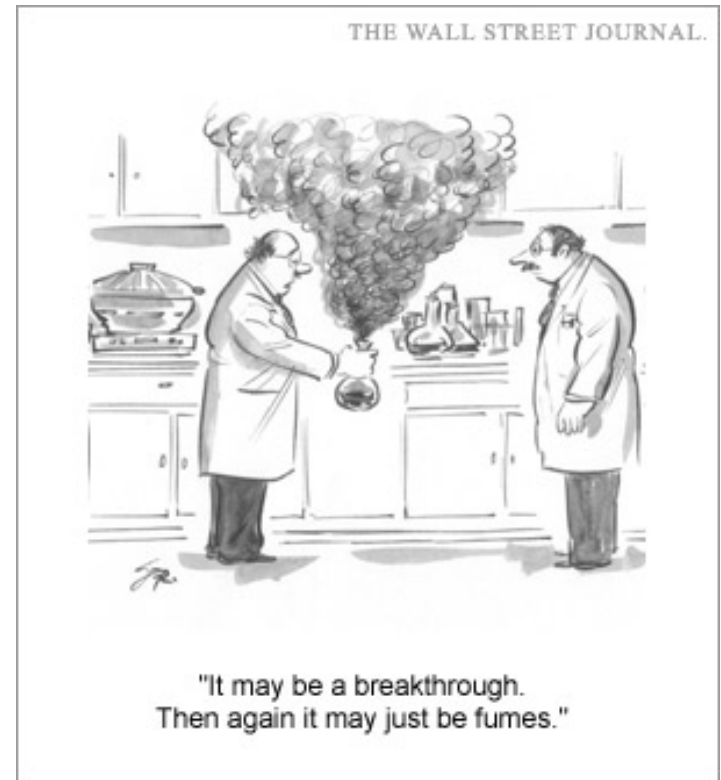
- *"Pre-Combustion Carbon Capture Technologies for Coal-Based Gasification Plants."*

- ~ \$24 million total DOE funding available
 - 14 to 26 projects @ \$200k to \$2M each (up to 4-yrs duration)

- *FOA issued on Aug 15, 2008*

- *Applications due Oct 14, 2008*

- *Project awards in 3rd Quarter FY09*



Global Partnerships



DOE Participating in CCS Demonstration on Four Continents

DOE Participation in International CO₂ Storage Projects

Location	Period (U.S.)	Operations	Reservoir	Operator /Lead Org.	Int'l Recognition
North America, Canada Saskatchewan Weyburn-Midale	2000-2009	1.8 mT CO ₂ /yr commercial 2000	oilfield carbonate EOR	Encana, Apache	IEA GHG R&D Programme, CSLF
North America, Canada, Alberta Zama oilfield	2005-2009	230,000 tons CO ₂ , 80,000 tons H ₂ S demo	oilfield EOR	Apache (Reg. Part.)	CSLF
North America, Canada, BC Fort Nelson	2009-2015	1.8 mT acid gas/yr (> 1mT CO ₂ /yr)	Saline	Spectra Energy	
Europe, North Sea Sleipner	2002-2006	1 mT CO ₂ /yr commercial 1996	marine sandstone	Statoil	IEA GHG Prog, EC
Europe, Germany CO ₂ SINK, Ketzin	2007-2010	60,000-90,000 tonnes CO ₂ demo 2008	gas field sandstone	GeoForsch- ungsZentrum, Potsdam	CSLF, European Commission
Australia, Victoria Otway Basin	2005-2010	100,000 tonnes CO ₂ demo 2008	gas field sandstone	CO ₂ CRC	CSLF
Africa, Algeria In Salah gas	2005-2010	1 mT CO ₂ /yr commercial 2004	gas field sandstone	BP, Sonatrach, Statoil	CSLF, European Commission
Asia, China, Ordos Basin	2008-TBD	assessment phase CCS	Ordos Basin	Shenhua Coal	

Questions ?

