

# The Top Ten Most-Asked Questions and How to Answer Them



*2005 Annual Carbon  
Sequestration Conference*

*Sarah Forbes, Scott Klara, and  
Bob Kane*

*May 3, 2005*

**National Energy Technology Laboratory**

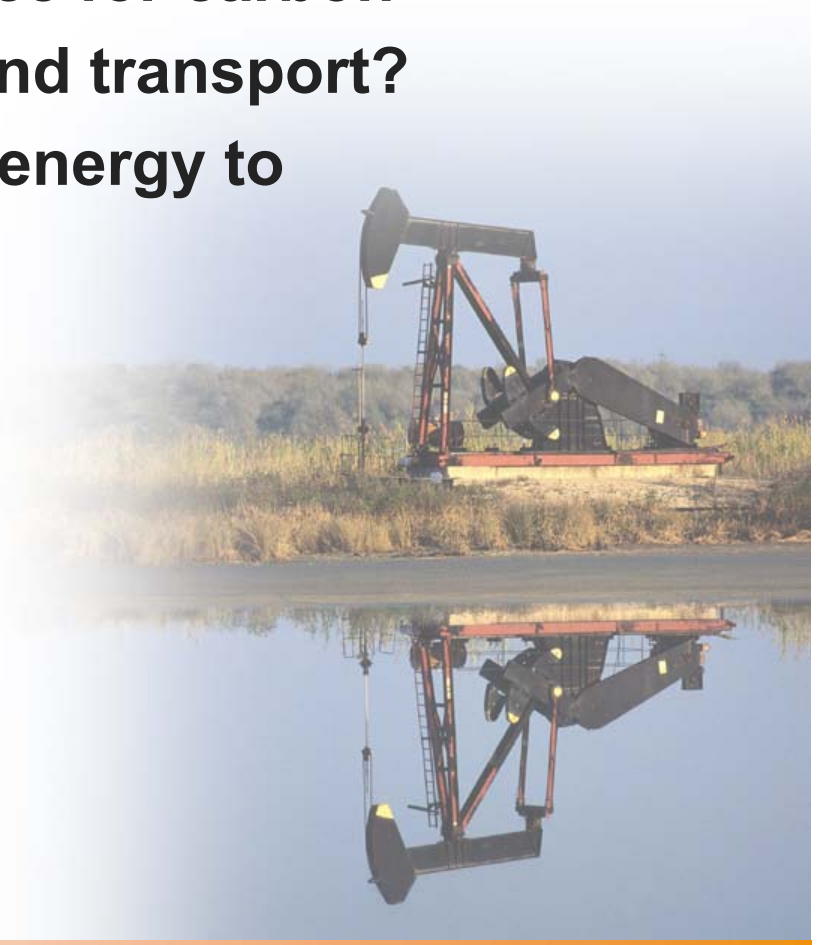


**Office of Fossil Energy**

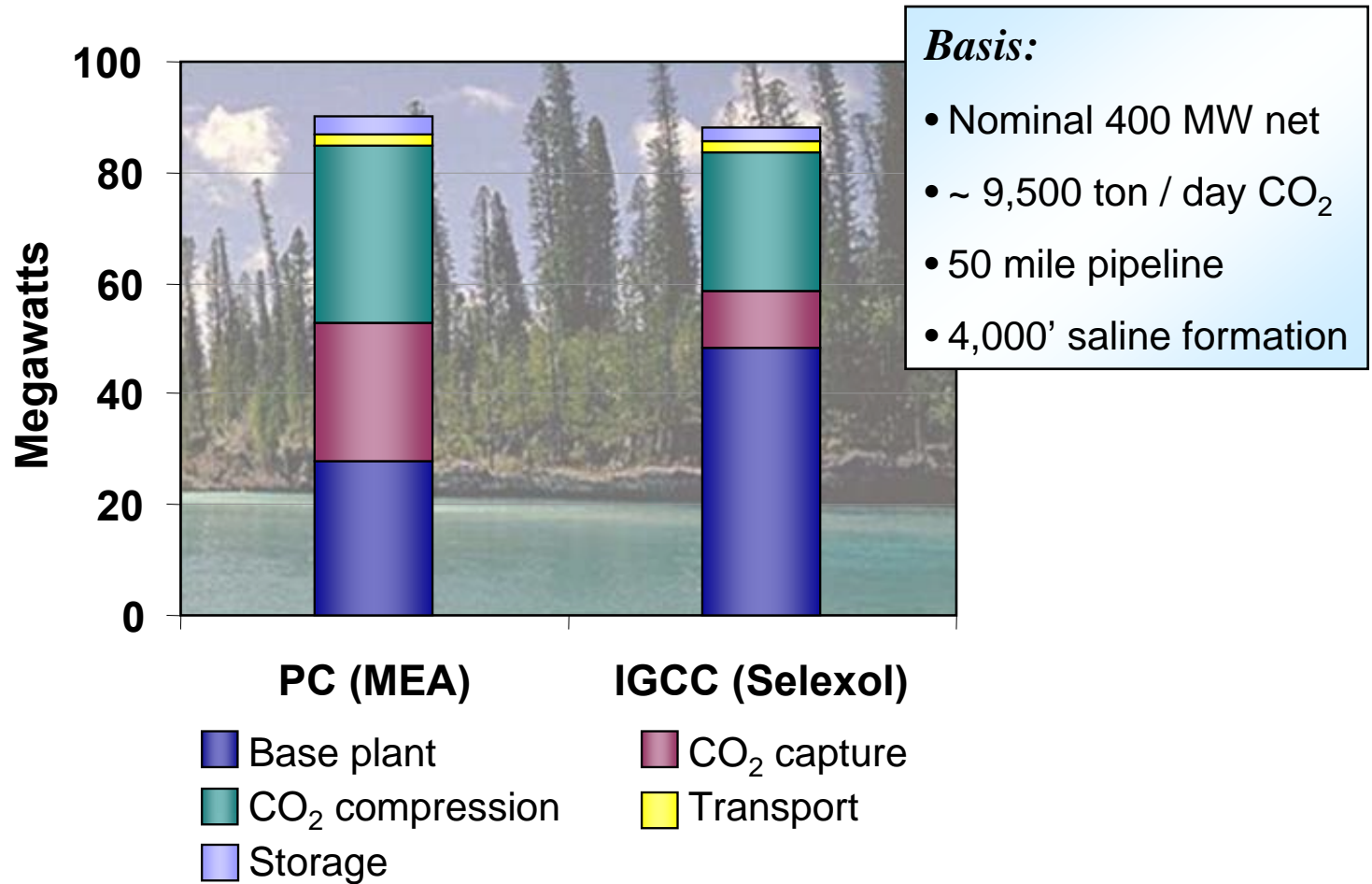


# Question #1

- **What is the energy balance for carbon capture, sequestration, and transport? Doesn't it take too much energy to pump it underground?**



# CO<sub>2</sub> Sequestration Auxiliary Power Loads



## Question #2

- Is this even technically possible? Do we have technologies that can capture CO<sub>2</sub> from power plants?



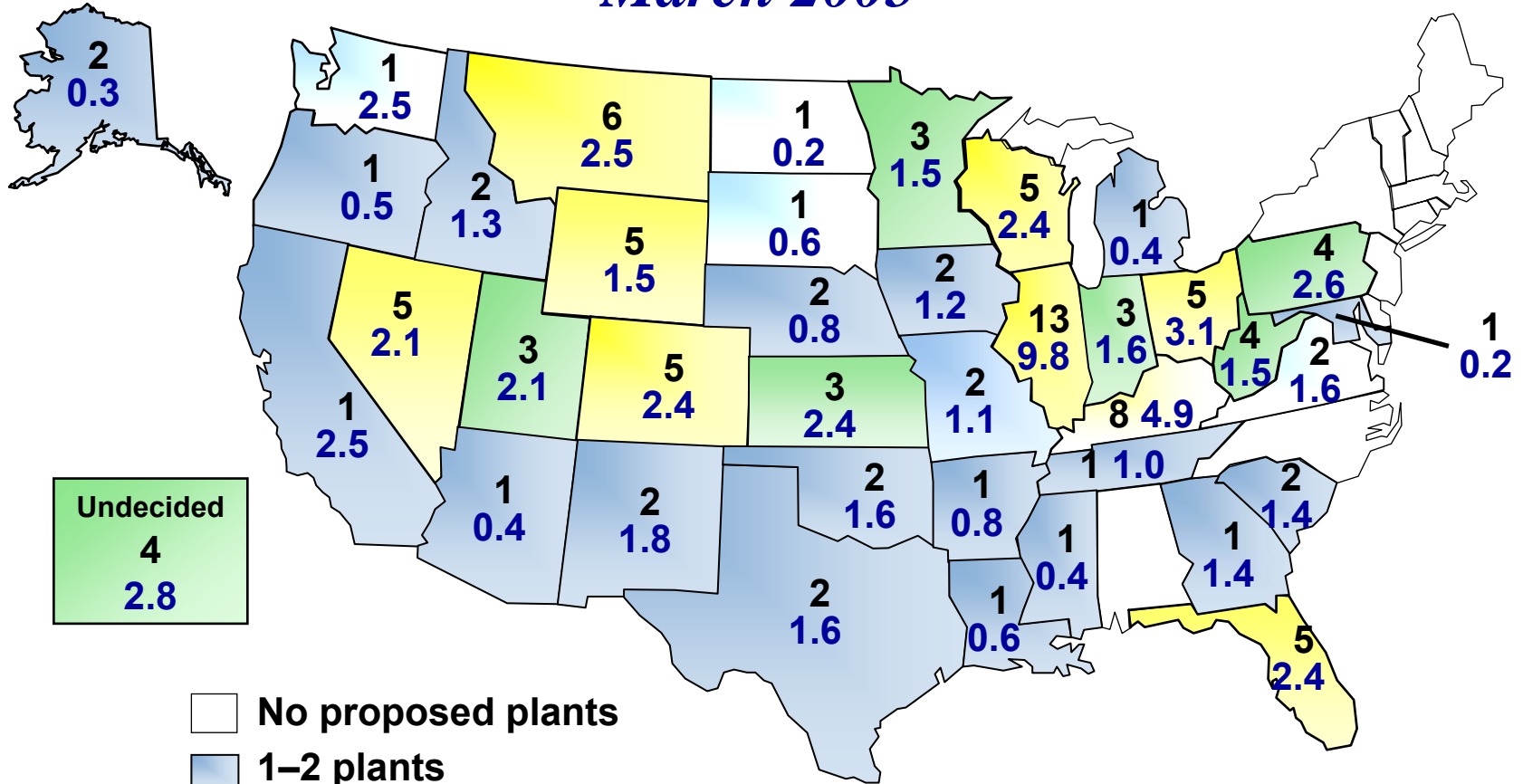
# Warrior Run Plant

- **Warrior Run plant in Cumberland, MD captures food-grade CO<sub>2</sub> and sells it to the beverage industry**



# Proposed New Coal Power Plants

## March 2005



**114 Proposed new plants**  
**70 Gigawatts capacity**



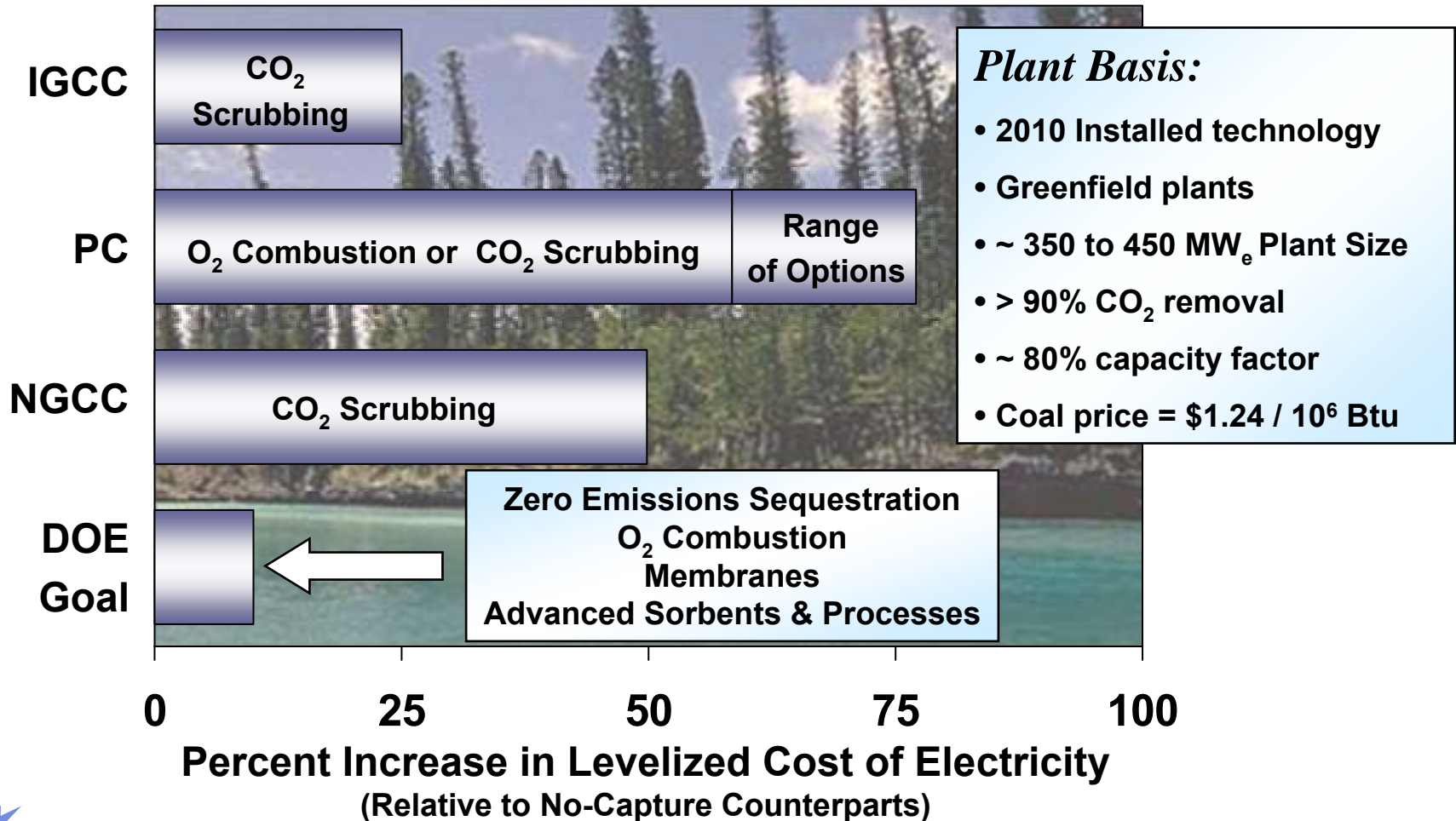
## Question #3

- If it doesn't cost that much, why aren't people doing it?



# Separation and Capture

## *A Challenging Task Ahead*





## Question #4

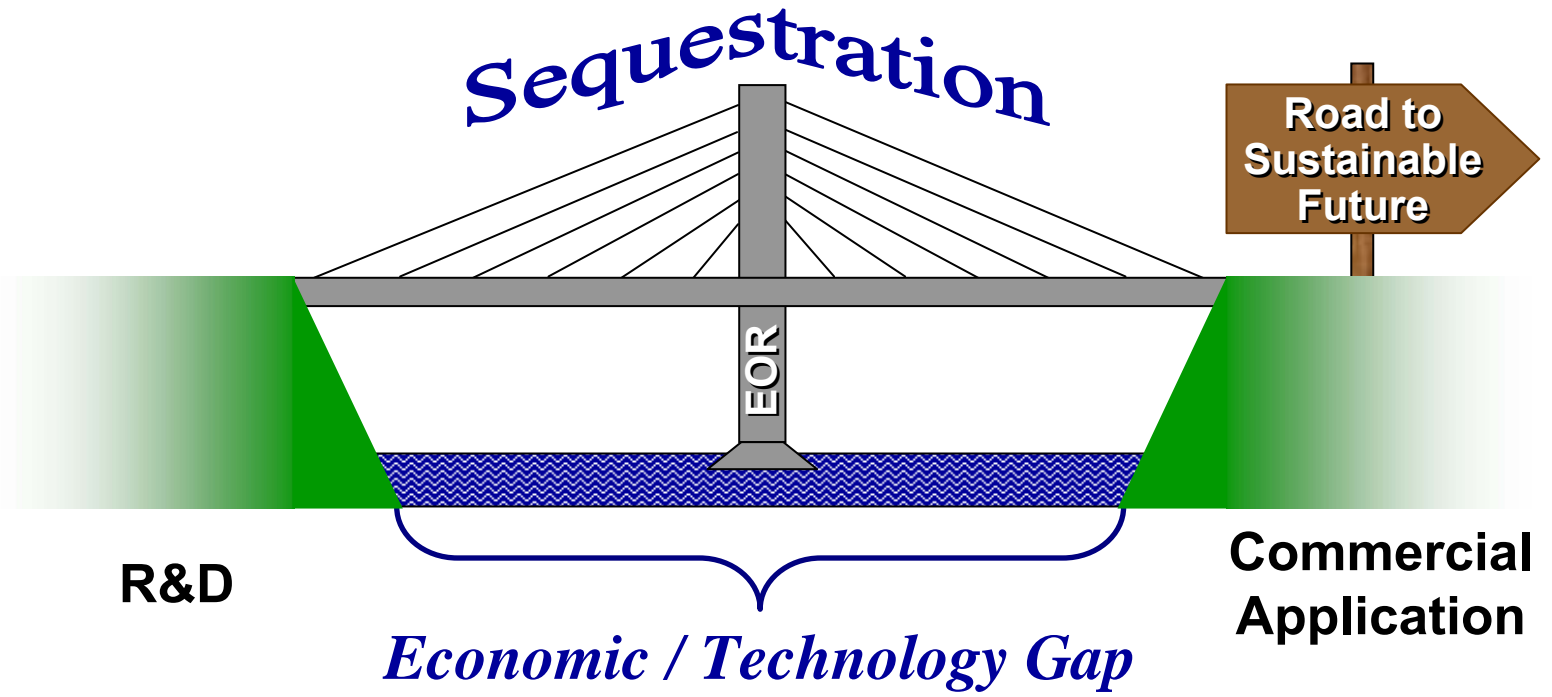
- Is enhanced oil recovery (EOR) really sequestration?



# Sequestration is a Bridge to Hydrogen Economy

Fossil Fuel Economy

Hydrogen Economy



## Question #5

- Is the United States the only nation funding sequestration research?



# Sequestration Projects Worldwide

Project	Year Begun	Size (MM tons CO <sub>2</sub> / yr)	Summary
Sleipner	1996	1.0	<ul style="list-style-type: none"> <li>CO<sub>2</sub> captured from off-shore natural-gas-processing platform, injected into saline formation.</li> <li>Project motivated by net tax on CO<sub>2</sub> emissions.</li> </ul>
Weyburn	2000	1.5	<ul style="list-style-type: none"> <li>CO<sub>2</sub> captured in ND, piped to Saskatchewan.</li> <li>Significant modeling and field testing of CO<sub>2</sub> monitoring equipment.</li> </ul>
In Salah	2004	1.2	<ul style="list-style-type: none"> <li>CO<sub>2</sub> captured from natural gas processing and reinjected to enhance gas recovery.</li> </ul>
Snow White (Snohvit)	2006	0.75	<ul style="list-style-type: none"> <li>Need to purify gas before liquefaction (raw gas 5–8% CO<sub>2</sub>).</li> </ul>
CCPC			<ul style="list-style-type: none"> <li>Project in planning stages, leaning toward EOR combined with post-combustion or oxyfuel.</li> </ul>
Gorgon	2007	4.0	<ul style="list-style-type: none"> <li>Need to purify gas before liquefaction (raw gas 12% CO<sub>2</sub>).</li> </ul>
Alaska gas pipeline project	2009	12	<ul style="list-style-type: none"> <li>Need to purify gas to meet pipeline standards (Prudhoe Bay raw gas 12% CO<sub>2</sub>).</li> <li>CO<sub>2</sub> capture qualifies for 15% EOR tax credit.</li> </ul>
Stanwell			<ul style="list-style-type: none"> <li>Part of Australia's clean coal program.</li> </ul>
Hypogen			<ul style="list-style-type: none"> <li>Pre-feasibility study completed January 2005.</li> <li>EU version of FutureGen.</li> </ul>
Innovation Center Initiative (North Sea EOR)			<ul style="list-style-type: none"> <li>Large-scale proposed project to help Europe meet Kyoto limits and extend productive life of North Sea fields.</li> <li>CO<sub>2</sub> source unspecified.</li> </ul>

Projects in orange are developing technology for CO<sub>2</sub> capture from coal



# Sequestration Field Tests Worldwide

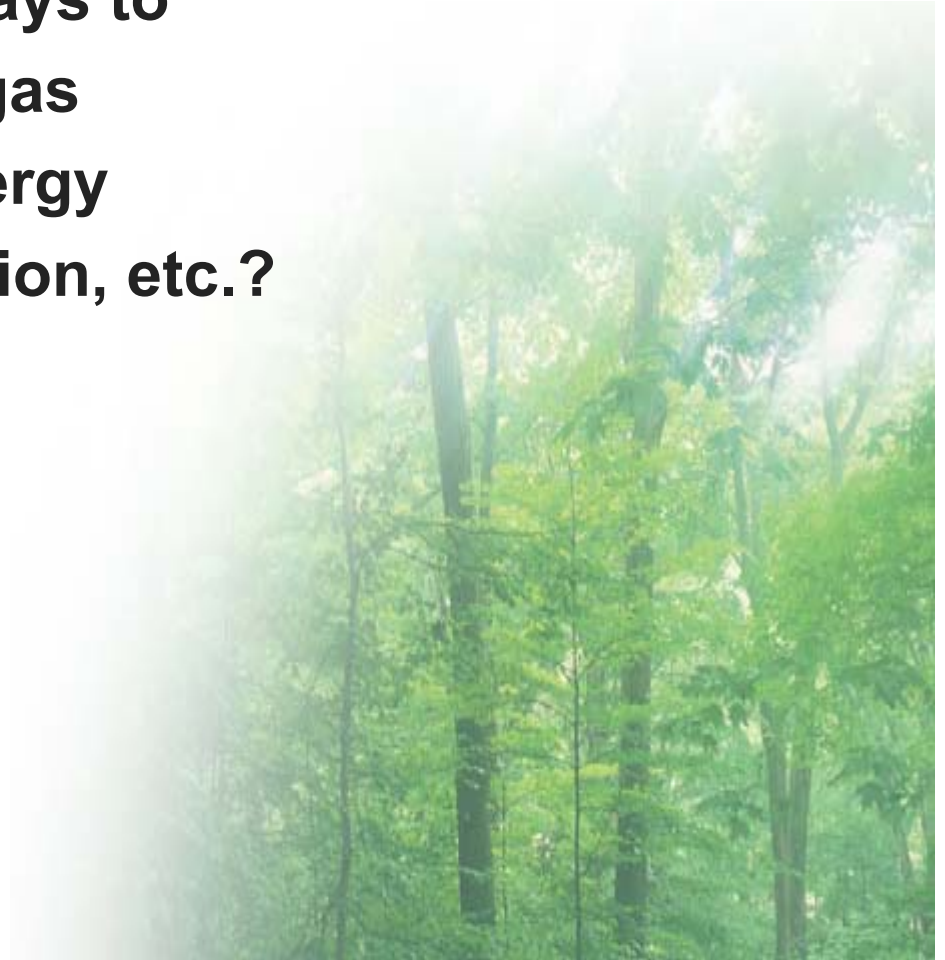
Project	Year Begun	Size	Summary
K12B	2004	<ul style="list-style-type: none"> <li>• Initial inj.: 30 kt / yr</li> <li>• 2006+: 0.4 MMt / yr</li> <li>• Total: 8 MMt</li> </ul>	<ul style="list-style-type: none"> <li>• Enhanced gas recovery demo project.</li> </ul>
RECOPOL	2004	<ul style="list-style-type: none"> <li>• Designed: 20 t / d</li> <li>• Achieved: 1–1.3 t / d</li> <li>• Total: 3 Mt</li> </ul>	<ul style="list-style-type: none"> <li>• Injection into coal seam has been more difficult than expected.</li> <li>• Horizontal wells have been drilled.</li> </ul>
Hokkaido	2004	<ul style="list-style-type: none"> <li>• Injection rate: 2 t / d</li> <li>• Total injected: 24 t</li> </ul>	<ul style="list-style-type: none"> <li>• CO<sub>2</sub>-ECBM test project.</li> <li>• Spring 2005 wells will be refurbished (original cementing not satisfactory) and new more extensive CO<sub>2</sub> injection test planned.</li> </ul>
CASTOR	2004	<ul style="list-style-type: none"> <li>• Rate: 10 kt / yr</li> </ul>	<ul style="list-style-type: none"> <li>• Conducting pilot-scale tests of post combustion capture and case studies of four potential geologic storage sites.</li> </ul>
Quinshi	2005	<ul style="list-style-type: none"> <li>• Total injected: 200 t</li> <li>• Duration: 22 d</li> </ul>	<ul style="list-style-type: none"> <li>• Next phase of the project will involve multi-well test, design of which will be complete in 2005.</li> </ul>
Otway	Late 2005	<ul style="list-style-type: none"> <li>• Rate: 160 t / d</li> <li>• Duration: 2 yrs</li> <li>• Total: 0.1 MMt</li> </ul>	<ul style="list-style-type: none"> <li>• Planned pilot-scale project.</li> <li>• Saline formation and depleted gas field.</li> </ul>
CO <sub>2</sub> SINK	2006	<ul style="list-style-type: none"> <li>• Rate: 30 kt / yr</li> <li>• Duration: ≥ 2 yr</li> </ul>	<ul style="list-style-type: none"> <li>• Project to test and evaluate CO<sub>2</sub> capture and storage at an existing natural gas storage facility and in a deeper land-based saline formation.</li> </ul>
ARC ECBM Recovery Project			<ul style="list-style-type: none"> <li>• Pilot-scale project (3 test wells).</li> </ul>

Projects in orange are developing technology for CO<sub>2</sub> capture from coal

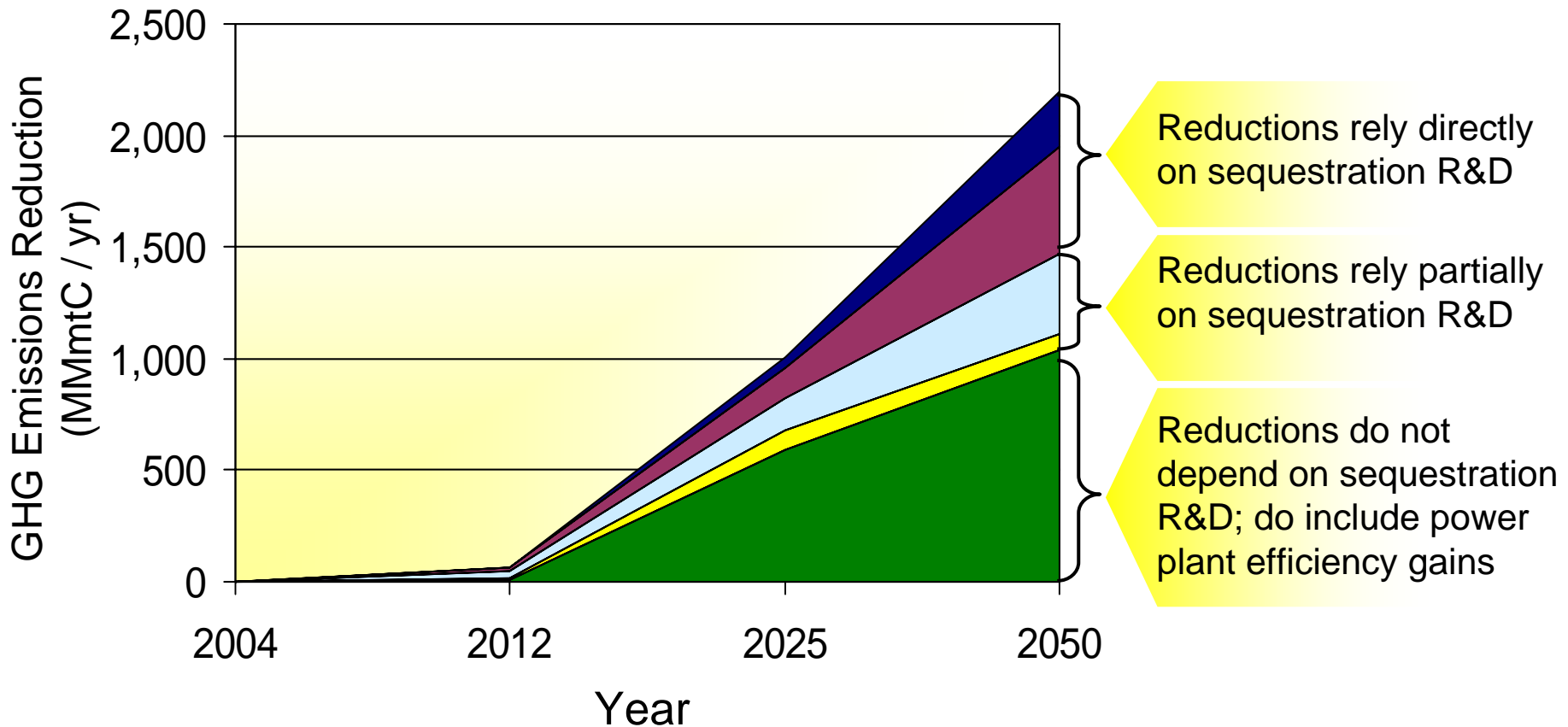


## Question #6

- **Aren't there better ways to reduce greenhouse gas emissions — like energy efficiency, conservation, etc.?**

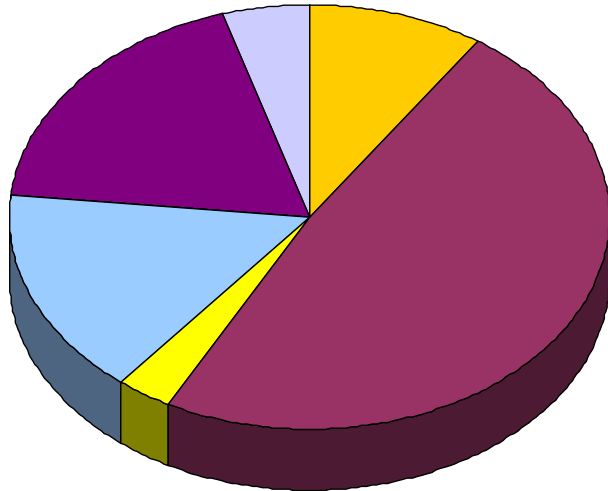


# Sources of GHG Emissions Reduction in U.S. *Under Atmospheric Stabilization Scenario*



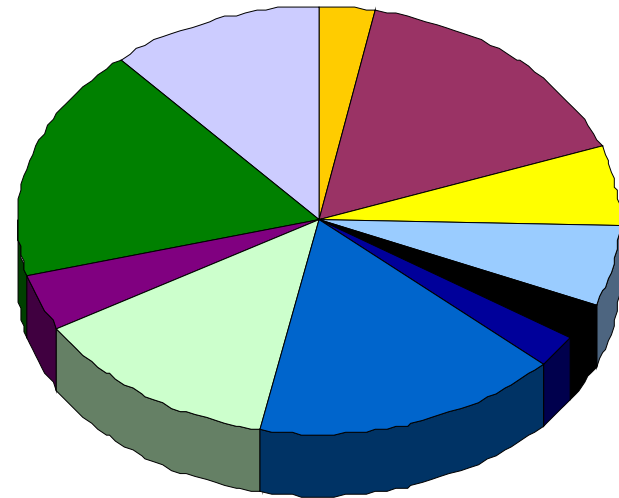
# As GHG Emissions Reduction Becomes Large, More Sources Needed, Sequestration Plays Bigger Role

**2012**  
(65 MMmtC / yr)



- Terrestrial offsets
- Non-CO<sub>2</sub> GHG emissions reduction
- Increased use of renewable power
- Improved power plant efficiency
- Reduced electricity cons. per GDP
- Reduced travel per GDP

**2050**  
(2,200 MMmtC / yr)



- Improved vehicle efficiency
- GHG red. in residential, commercial, and industrial
- Sequestration applied to CO<sub>2</sub> vents
- Sequestration from power plants
- Hydrogen with sequestration



## Question #7

- Is this just a government program, or are you working with others?



# Portfolio Overview — FY 2005

- **Diverse research portfolio**

- 44 external projects
- 16 focus area projects
- BP & IEA consortia

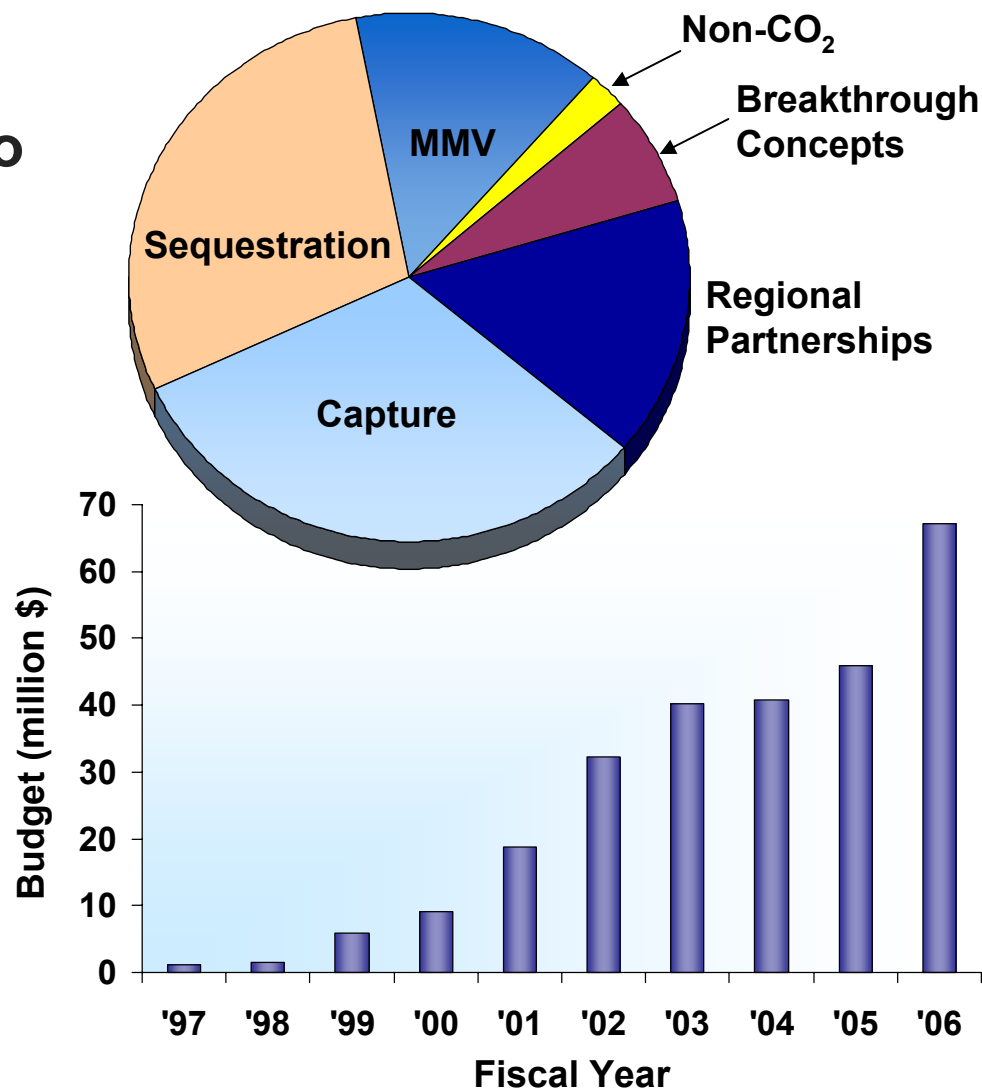
- **Strong industry support**

- ~ **36% cost share**

- **Portfolio ~ \$205 million**

- **Administration priority**

- ~ 50% increase in 2006 budget request



## Question #8

- What are the goals of the DOE program?

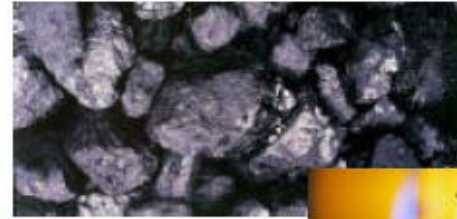


NETL



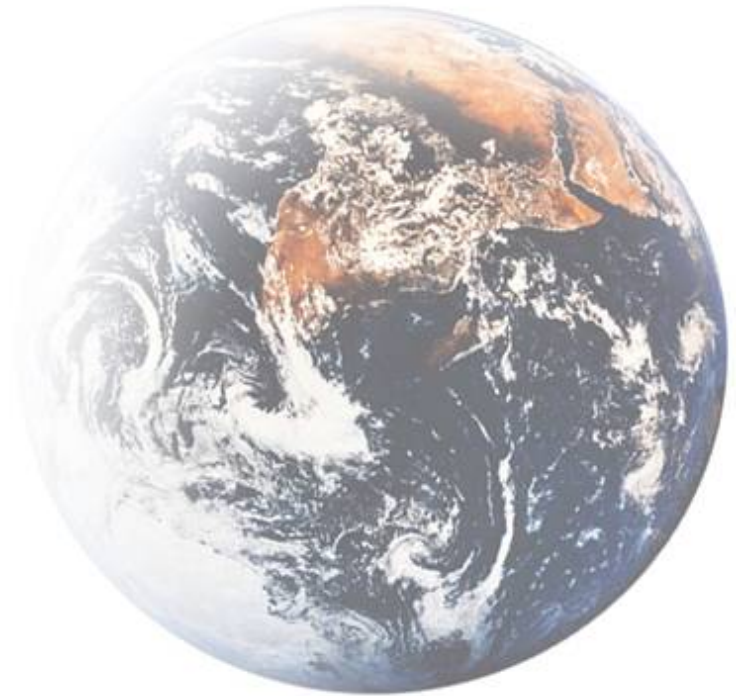
# 2005 Carbon Sequestration Roadmap

- 90% CO<sub>2</sub> capture  
*with*
- 99% storage  
permanence  
*at*
- < 10% increase in cost  
of energy services  
*by*
- 2012

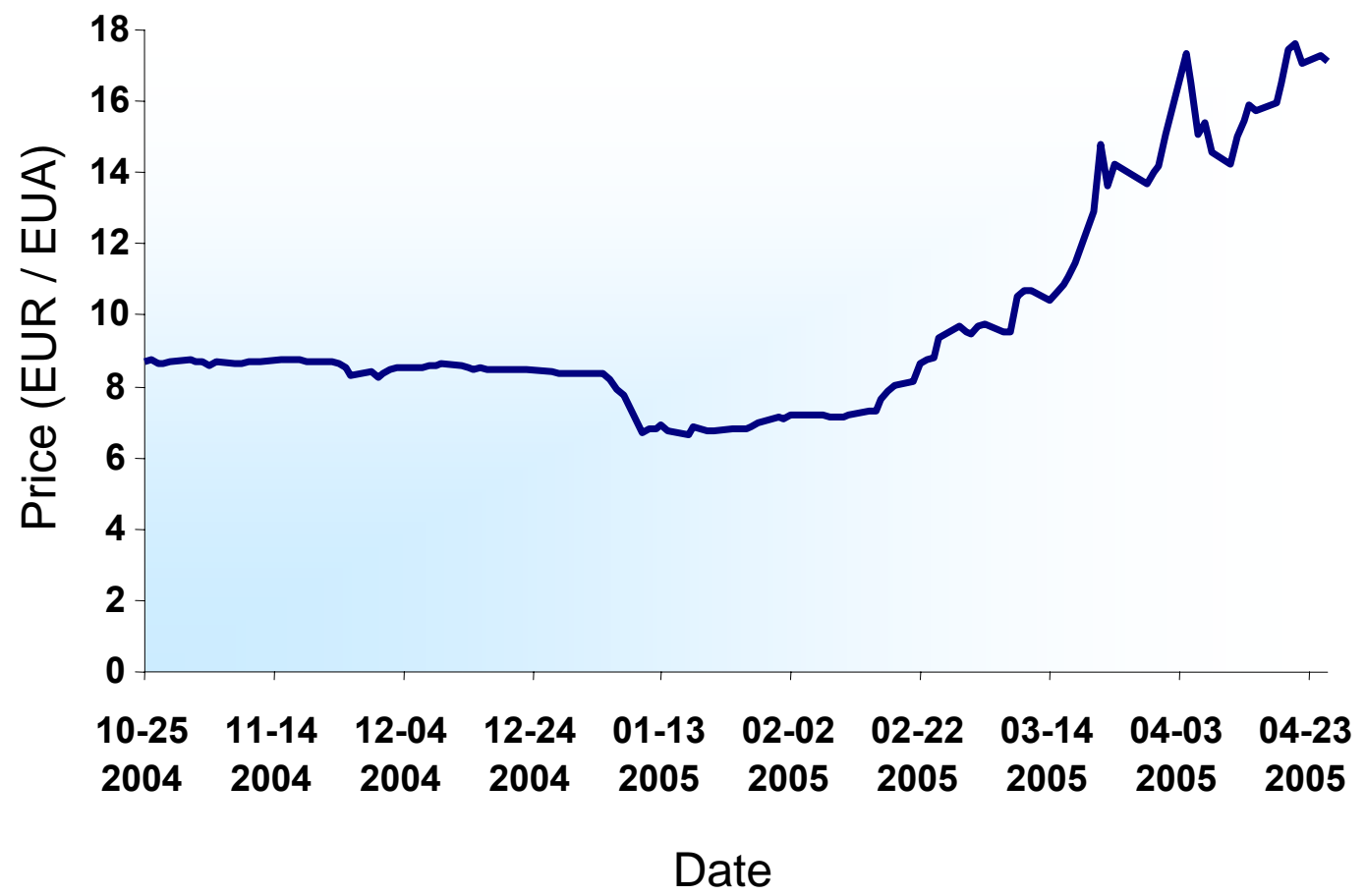


## Question #9

- **What is a carbon credit and how much is it worth?**

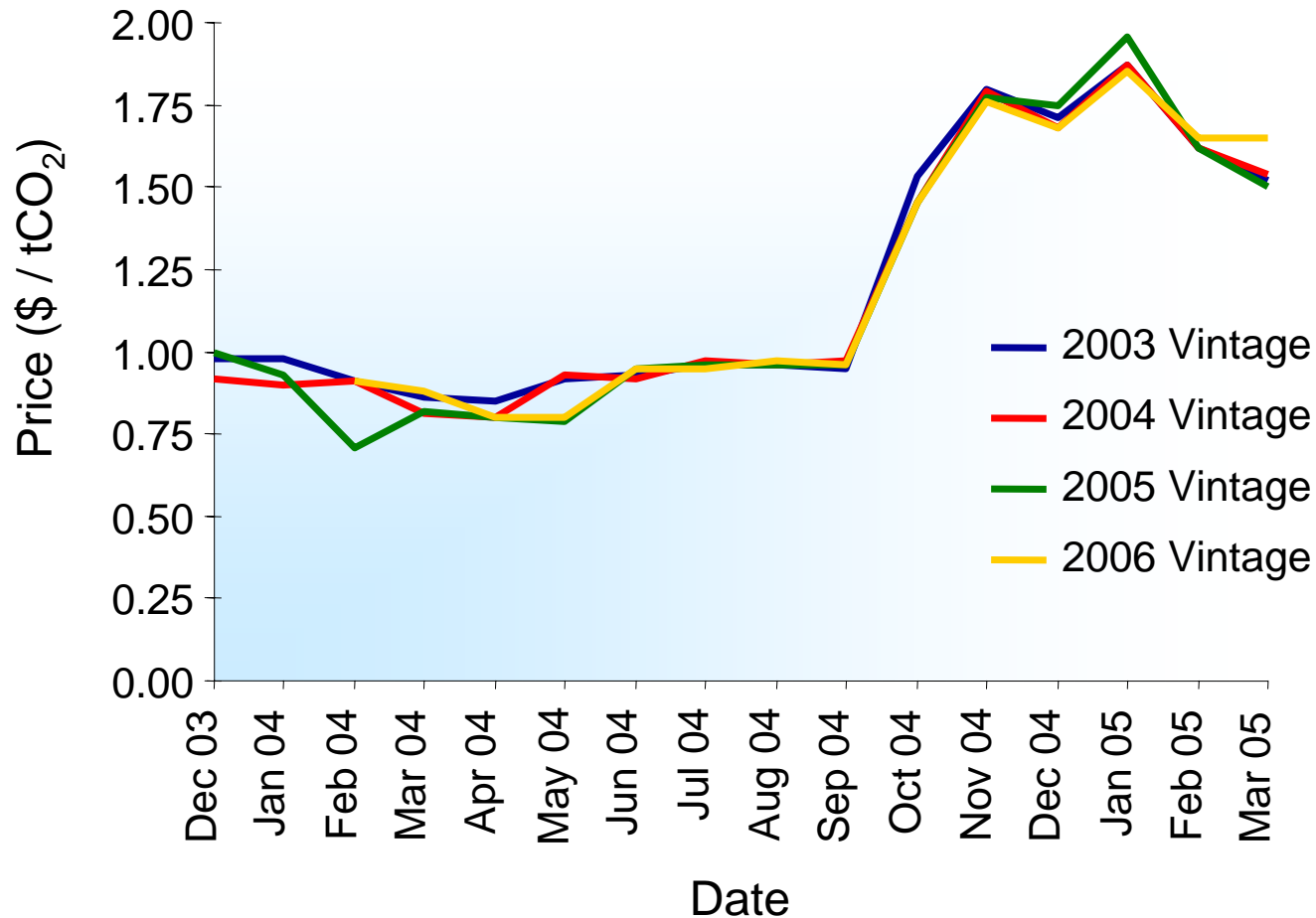


# European Energy Exchange (EEX) — EU Emissions Allowance (EUA)



Source: EEX

# Chicago Climate Exchange (CXX) — Carbon Finance Instrument (CFI)



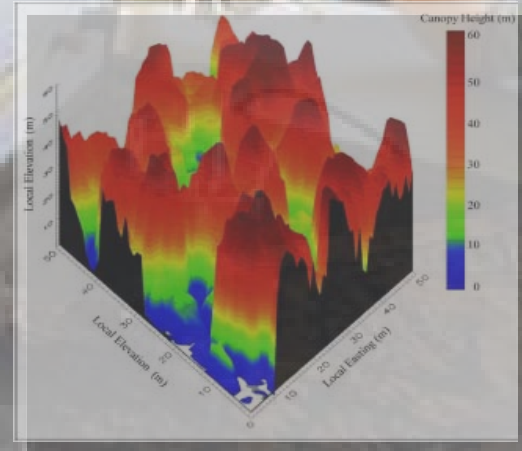
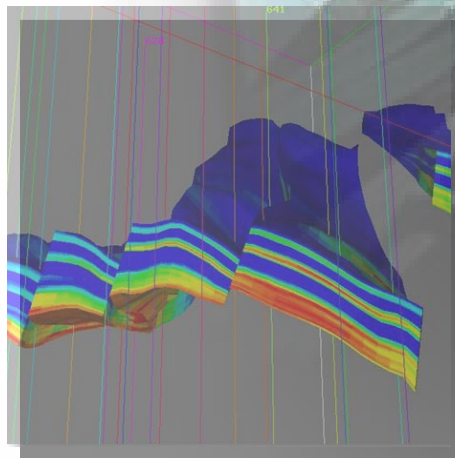
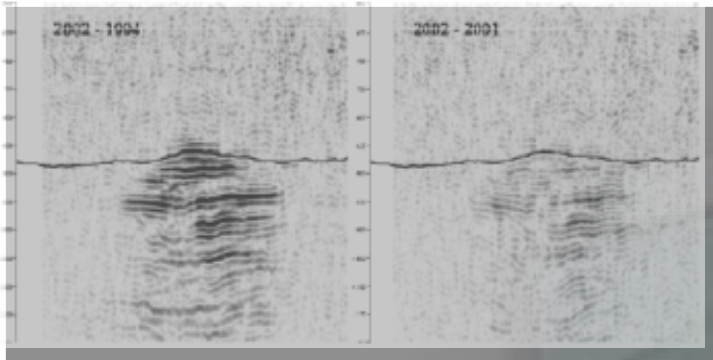
## Question #10

- Who is responsible for the stored CO<sub>2</sub> over the long term?





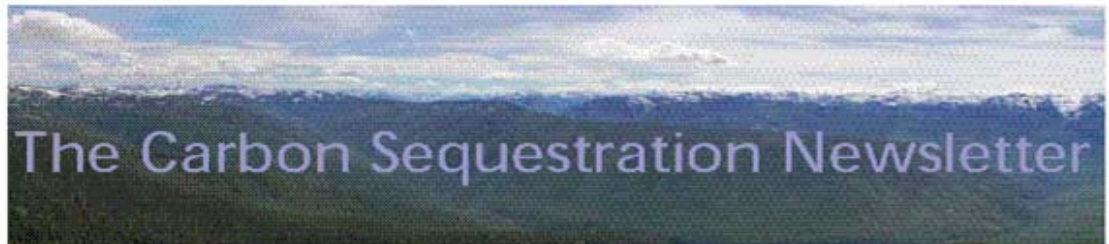
# R&D Will Ensure Safe, Permanent Storage



# Carbon Sequestration E-mail Newsletter

## Subscribe for The Carbon Sequestration Newsletter

Each month, NETL publishes a short newsletter describing significant events related to carbon sequestration that have taken place over the past month. This newsletter is posted here on our website's [Reference Shelf](#) and distributed by e-mail. If you'd like to join the e-mail distribution list, please refer to the [Subscription Directions](#) page for more information as to "Subscribing" and "Unsubscribing" to our mailing list.



### TABLE OF CONTENTS

OCTOBER 2001

- Sequestration in the News
- Events/ Announcements from NETL's Carbon Sequestration Program
- Publications
- Legislative Activity

[www.netl.doe.gov/products/sequestration/refshelf.html](http://www.netl.doe.gov/products/sequestration/refshelf.html)

### Sequestration in the News

**Congress Shifts Focus** Due to the terrorist attacks of September 11, the agenda in congress

**A Greener Greenhouse** NASA Satellites show plant growth in northern regions has been more

