

Carbon Sequestration – Public Meeting

*Programmatic Environmental
Impact Statement
Public Meeting
May 18, 2004*

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National Energy Technology Laboratory



Office of Fossil Energy



Carbon Sequestration Program Overview

- **What is Carbon Sequestration**
- **The Fossil Energy Situation**
- **Greenhouse Gas Implications**
- **Pathways to Greenhouse Gas Stabilization**
- **Sequestration Program Overview**
- **Program Requirements & Structure**
- **Regional Partnerships**
- **FutureGen**
- **Sources of Information**



What is Carbon Sequestration?

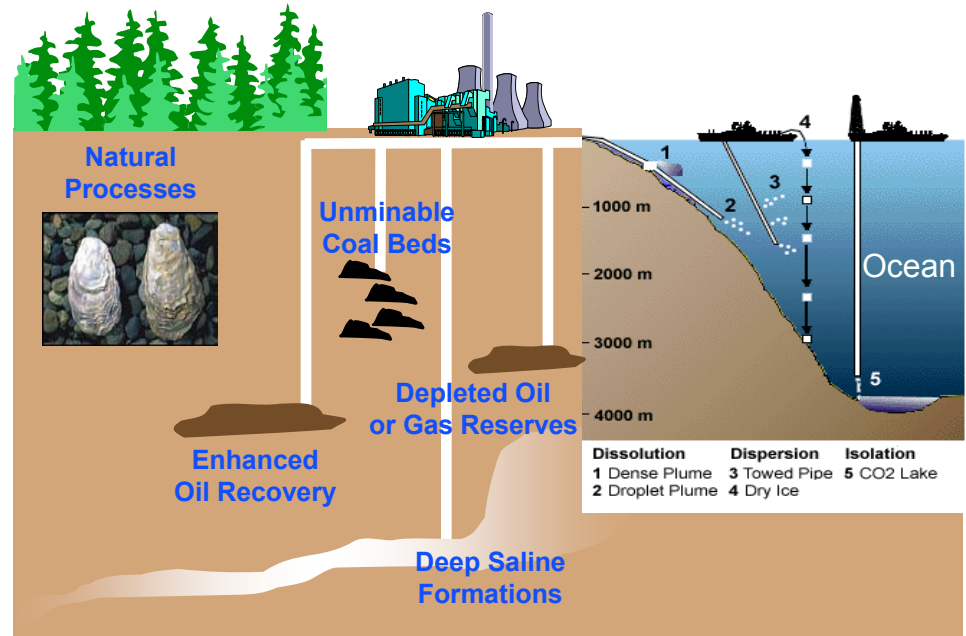
Capture and storage of CO₂ and other Greenhouse Gases that would otherwise be emitted to the atmosphere

Capture can occur:

- at the point of emission
- when absorbed from air

Storage locations include:

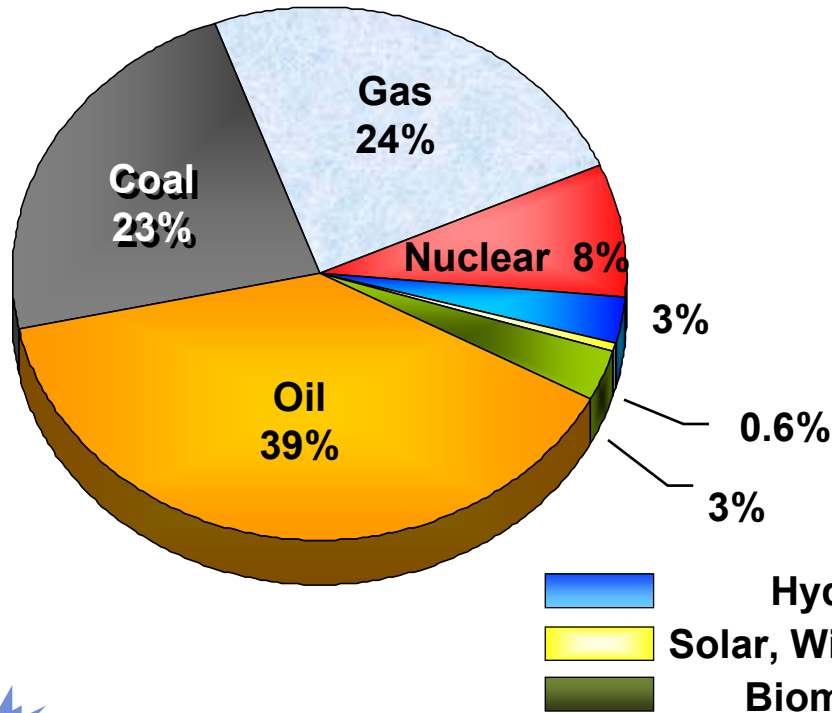
- underground reservoirs
- dissolved in deep oceans
- converted to solid materials
- trees, grasses, soils, or algae



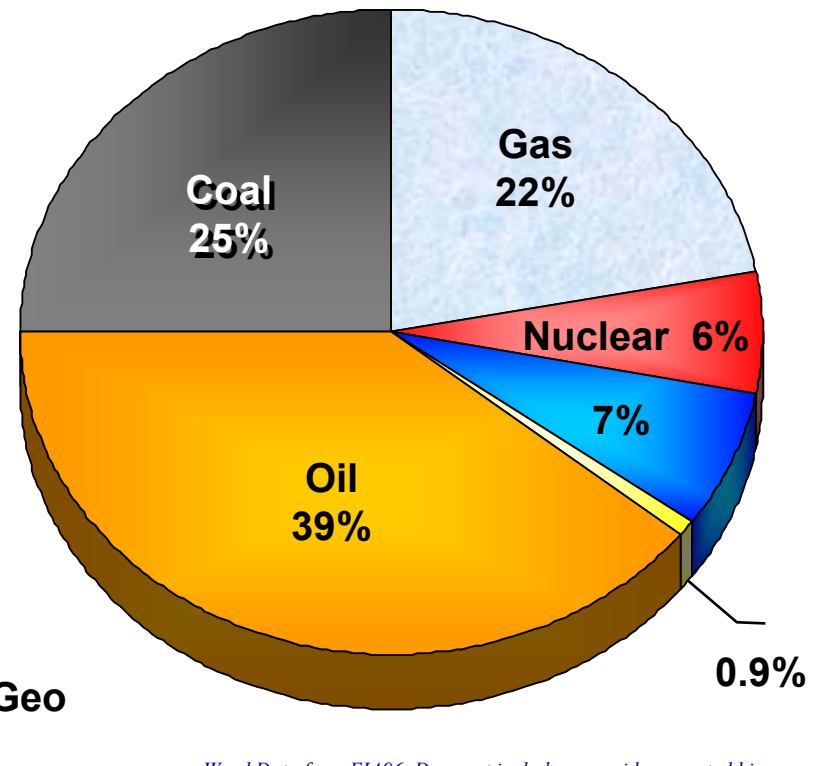
Fossil Fuels

World's Dominant Energy Source

United States
98 QBTU/yr; 86% Fossil Energy



World
382 Quads/yr; 86% Fossil Energy



■ Hydro
■ Solar, Wind, Geo
■ Biomass

*World Data from EIA96. Does not include non-grid-connected biomass.
U.S. Data from Table 2 of EIA REA 97 & AEO 2004*

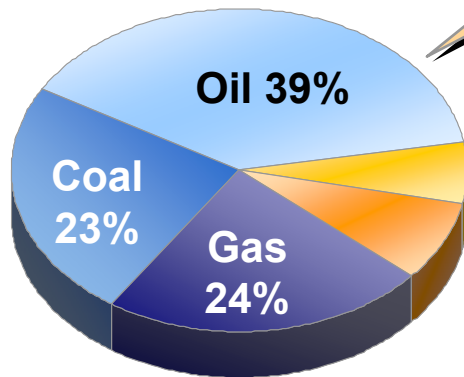


Fossil Energy - America's Energy Foundation

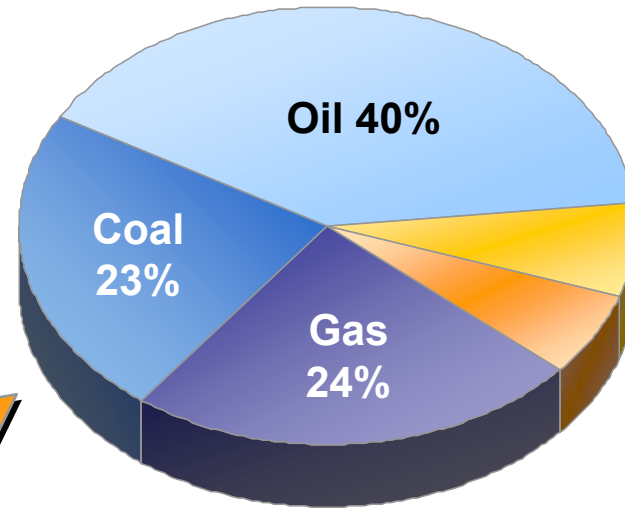
2002

98 Quads

**Fossil fuels provide
86% of energy**



+ 40%



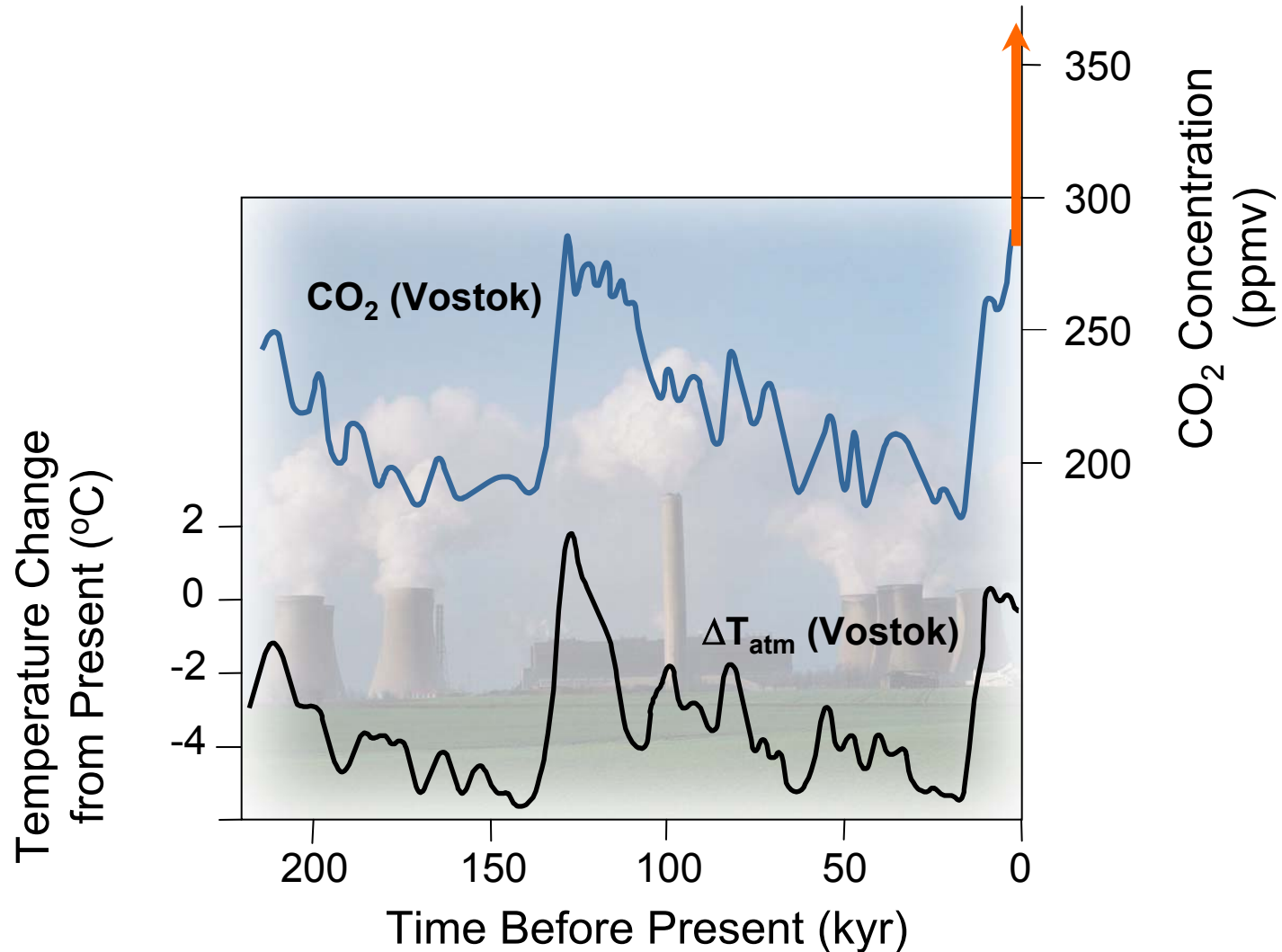
2025

136 Quads

**By 2020, reliance on
fossil fuels remains
stable at 87%**

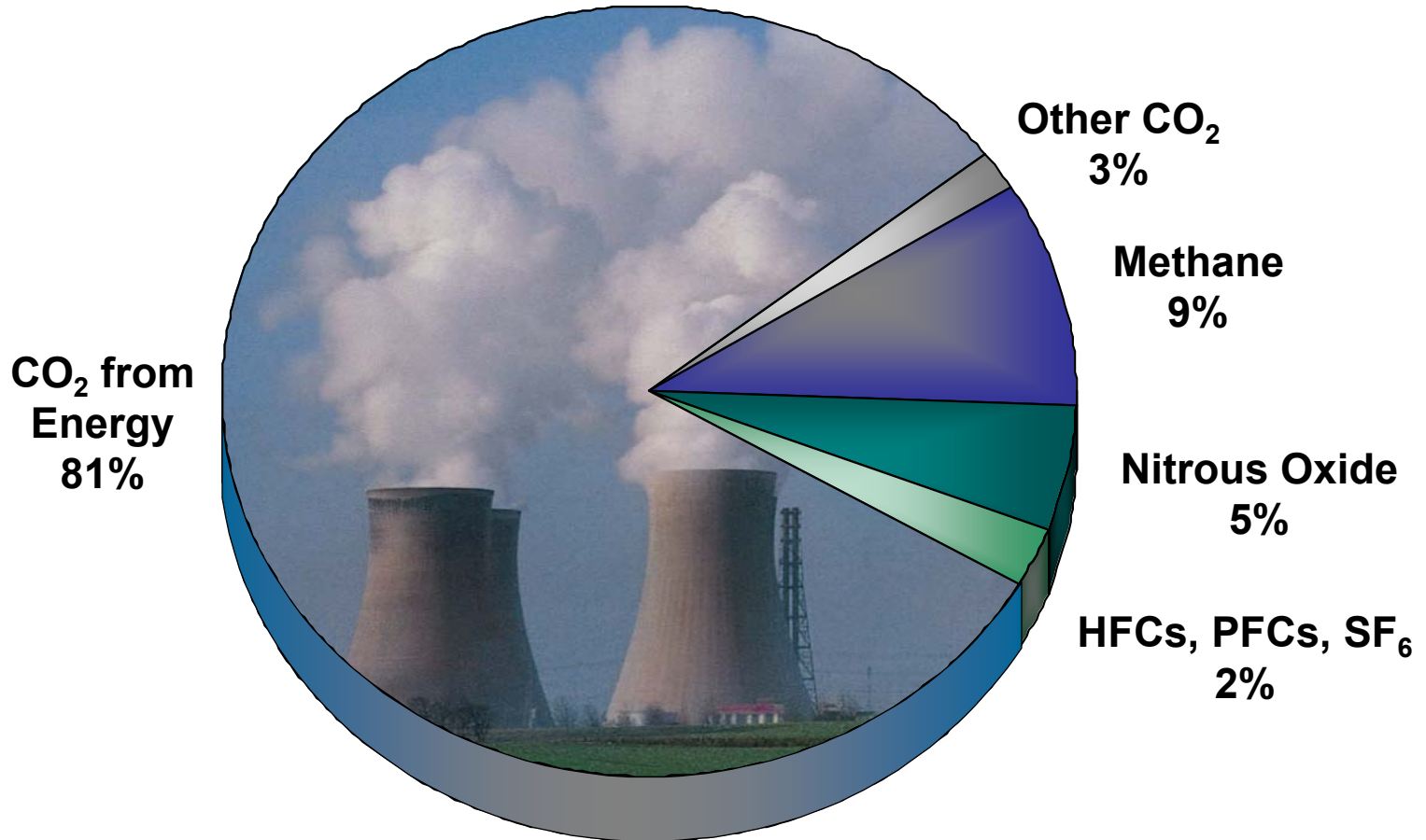


CO₂ Concentrations On The Rise (~280 ppm to 370 ppm over last 100 years)



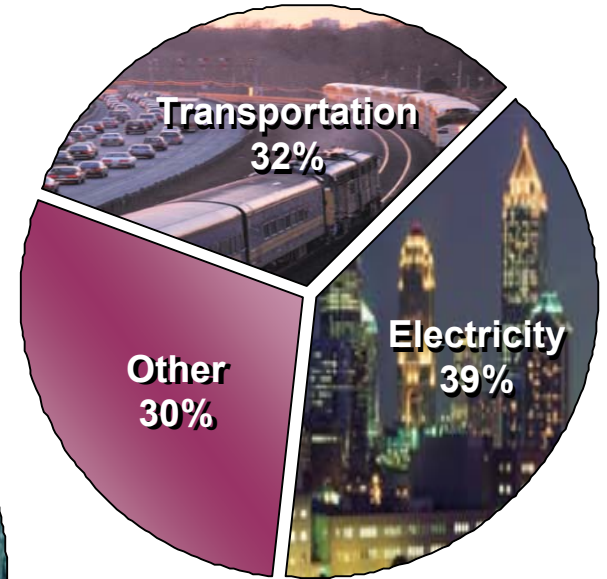
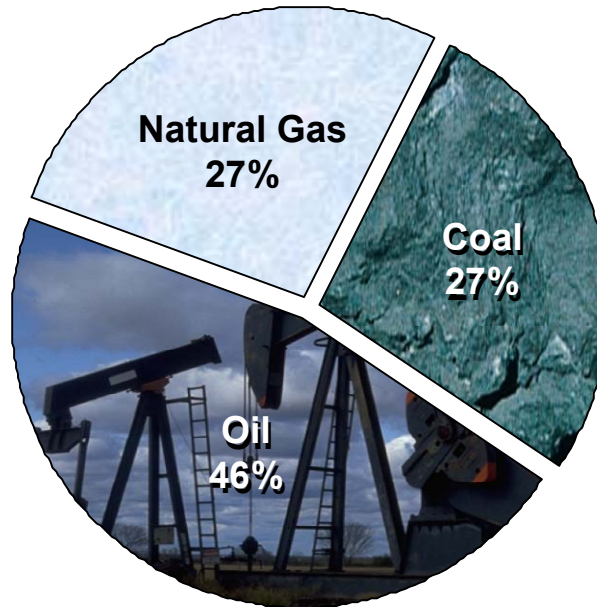
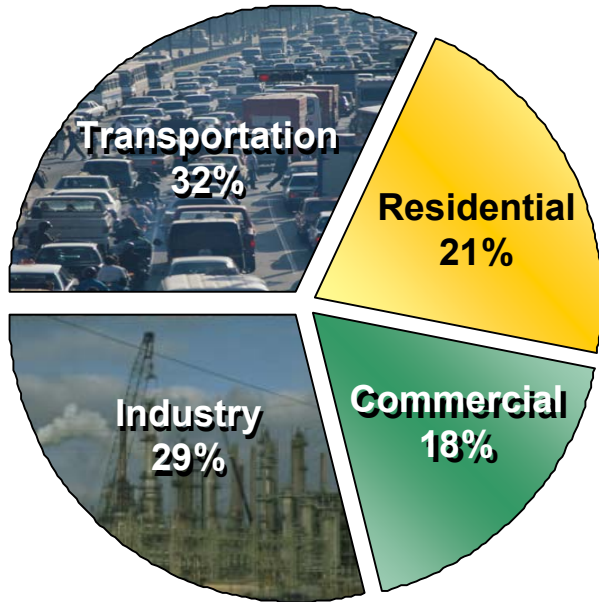
CO₂ & CH₄ - The Primary GHG Contributors

United States Greenhouse Gas Emissions
(Equivalent Global Warming Basis)



All Fossil Fuels & Energy Sectors Contribute CO₂ Emissions

United States Carbon Dioxide Emissions
(By Source & Sector)



Technological Carbon Management Options

Reduce Carbon Intensity

- Renewables
- Nuclear
- Fuel Switching

Improve Efficiency

- Demand Side
- Supply Side

Sequester Carbon

- Capture & Store
- Enhance Natural Sinks

All options needed to:

- Affordably meet energy demand
- Address environmental objectives



Presidential Direction

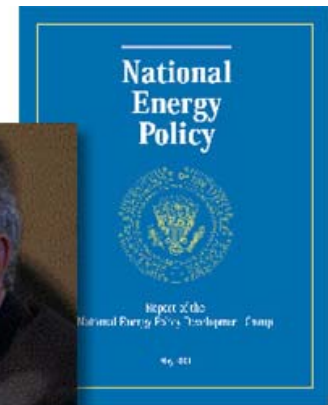
Current Drivers for Carbon Sequestration

National Climate Change Technology Initiative June 11, 2001

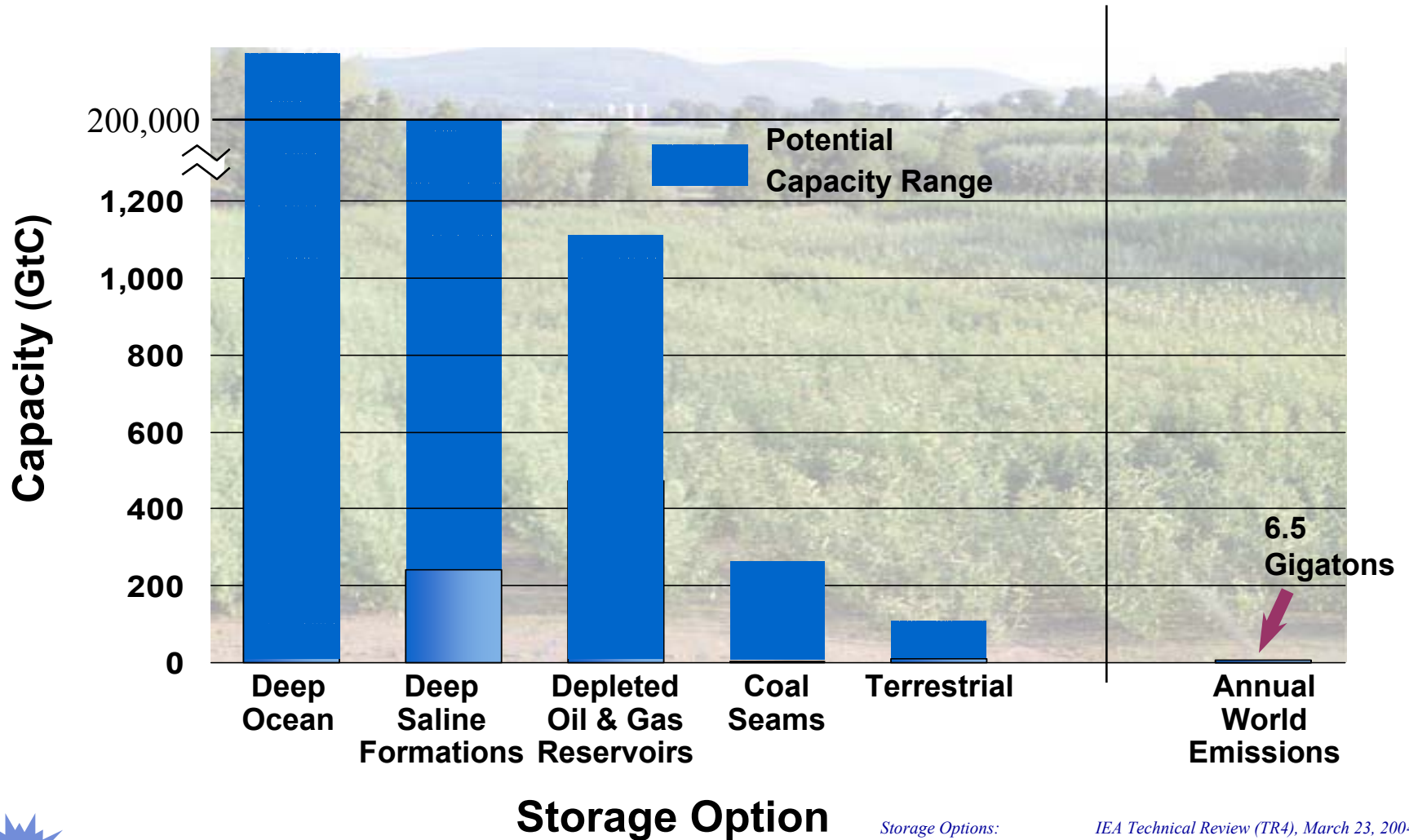
- Third option for global climate change
- Enables continued use of domestic energy resources and infrastructure
- Geologic formations have potential for essentially unlimited storage capacity
- Demonstrated industry interest, participation, and cost-sharing in public/private partnerships
- “We all believe technology offers great promise to significantly reduce emissions -- especially carbon capture, storage and sequestration technologies.”

Global Climate Change Initiative February 14, 2002

- Sustain economic growth
- Reduce GHG intensity by 18% in next 10 years
- Reevaluate science & path in 2012



Large Potential Worldwide Storage Capacity



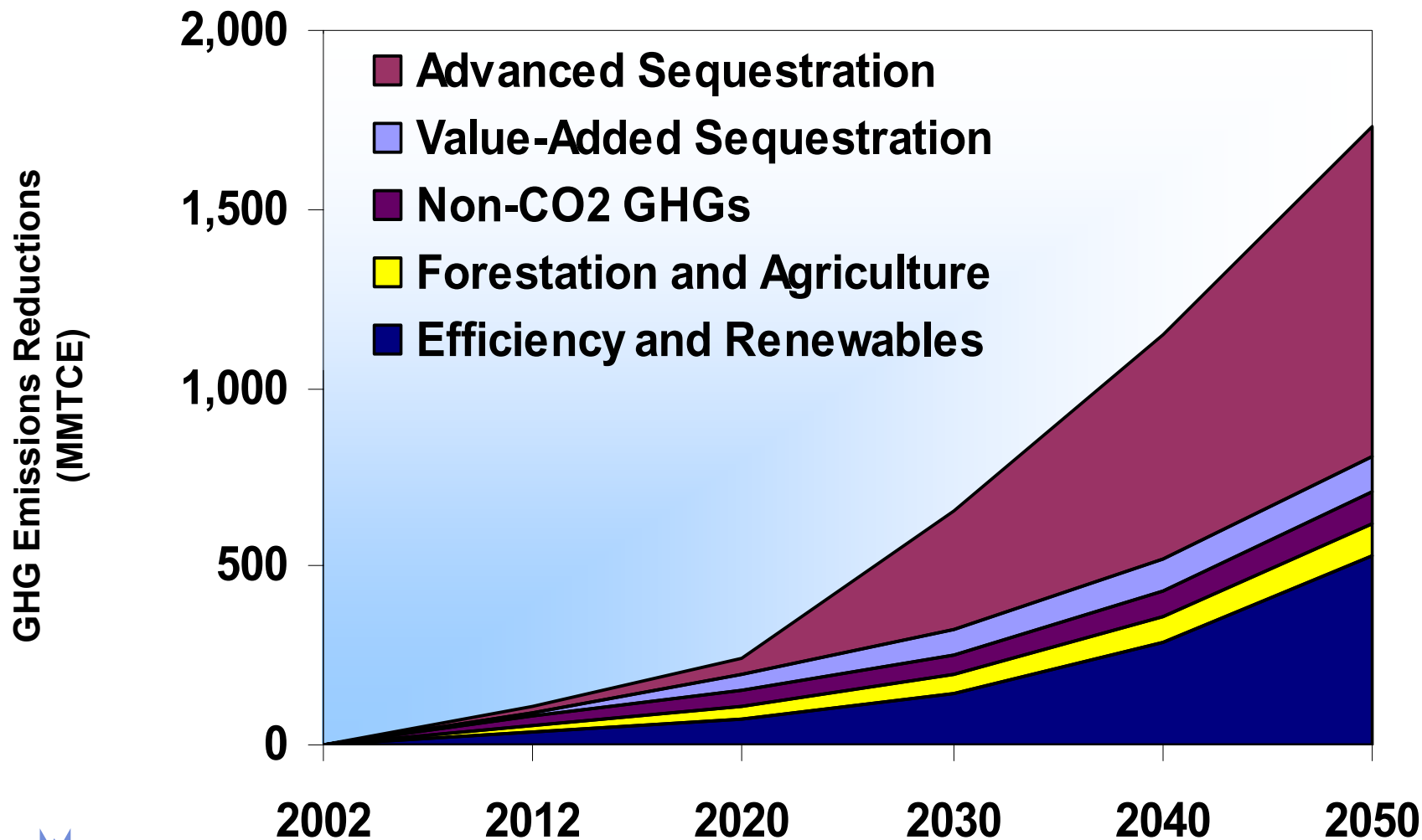
Storage Options:

IEA Technical Review (TR4), March 23, 2004
Carbon Capture & Sequestration Program @MIT

World Emissions: DOE/EIA, International Energy Outlook 2003, Table A10

Sequestration = Stabilization

Plausible Scenario to Stop GHG Emissions Growth



Requirements for Sequestration

- **Environmentally acceptable**
 - No legacy for future generations
 - Respect existing ecosystems
- **Safe**
 - No sudden large-scale CO₂ discharges
- **Verifiable**
 - Ability to verify amount of CO₂ sequestered
- **Economically viable**



Sequestration at DOE

**Climate Change
Technology
Program
*Coordination***



**Office of Fossil
Energy
*Applied R&D***

**Office of
Science
*Basic Science***



Agencies Conducting Sequestration-Related Research

USGS

Geologic sequestration research

NASA

Space-based studies of earth as integrated system

EPA

Non-CO₂ Greenhouse Gas mitigation

OSM

Carbon sequestration on abandoned mine sites



USAID

Tropical reforestation in developing countries

NOAA

Atmospheric and oceanic global observations

NSF

Science of CO₂ and N₂ cycles in oceans

USDA

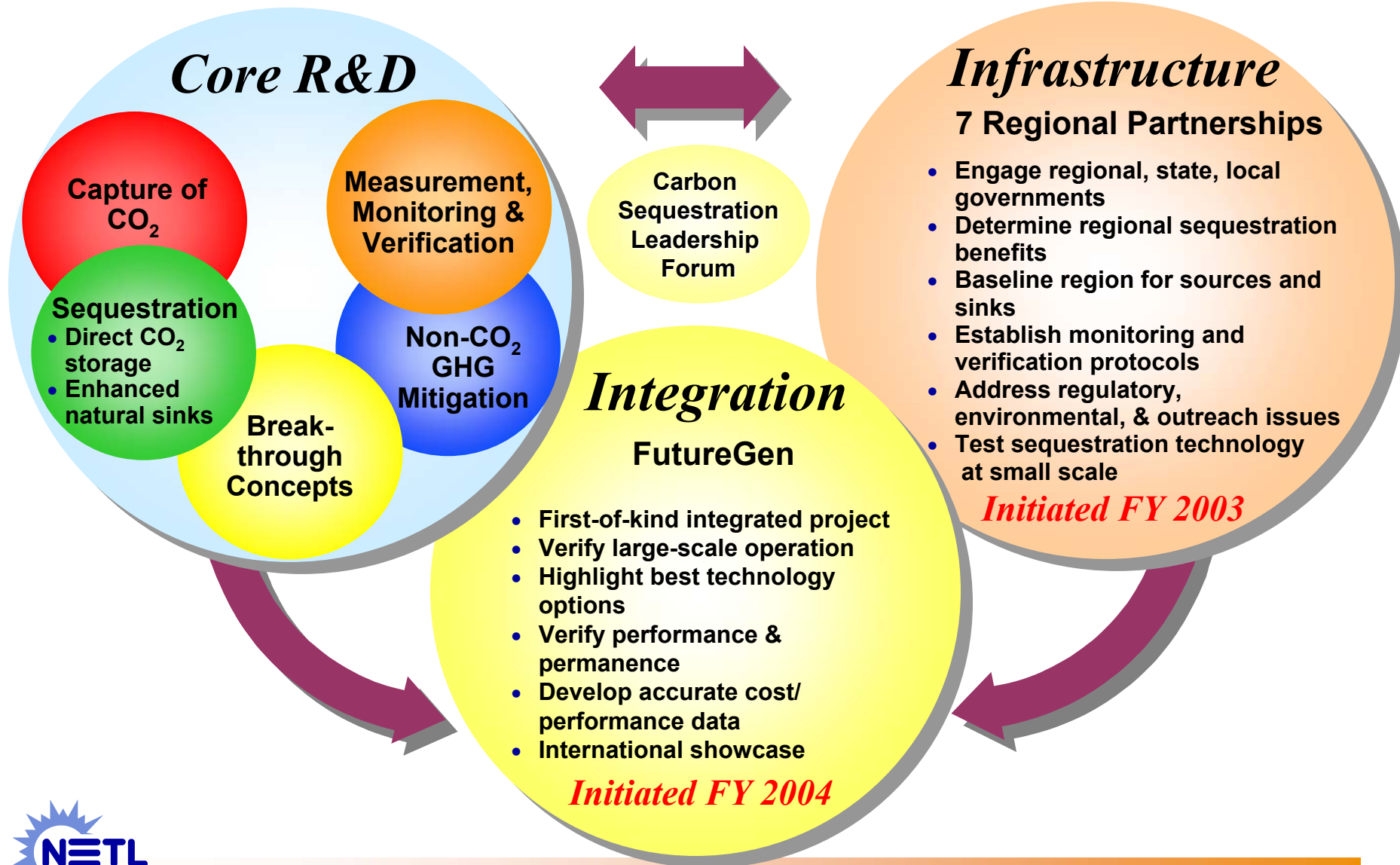
Terrestrial sequestration, soil carbon database, sequestration models

U.S. Dept. of State

Facilitate International collaboration and activities

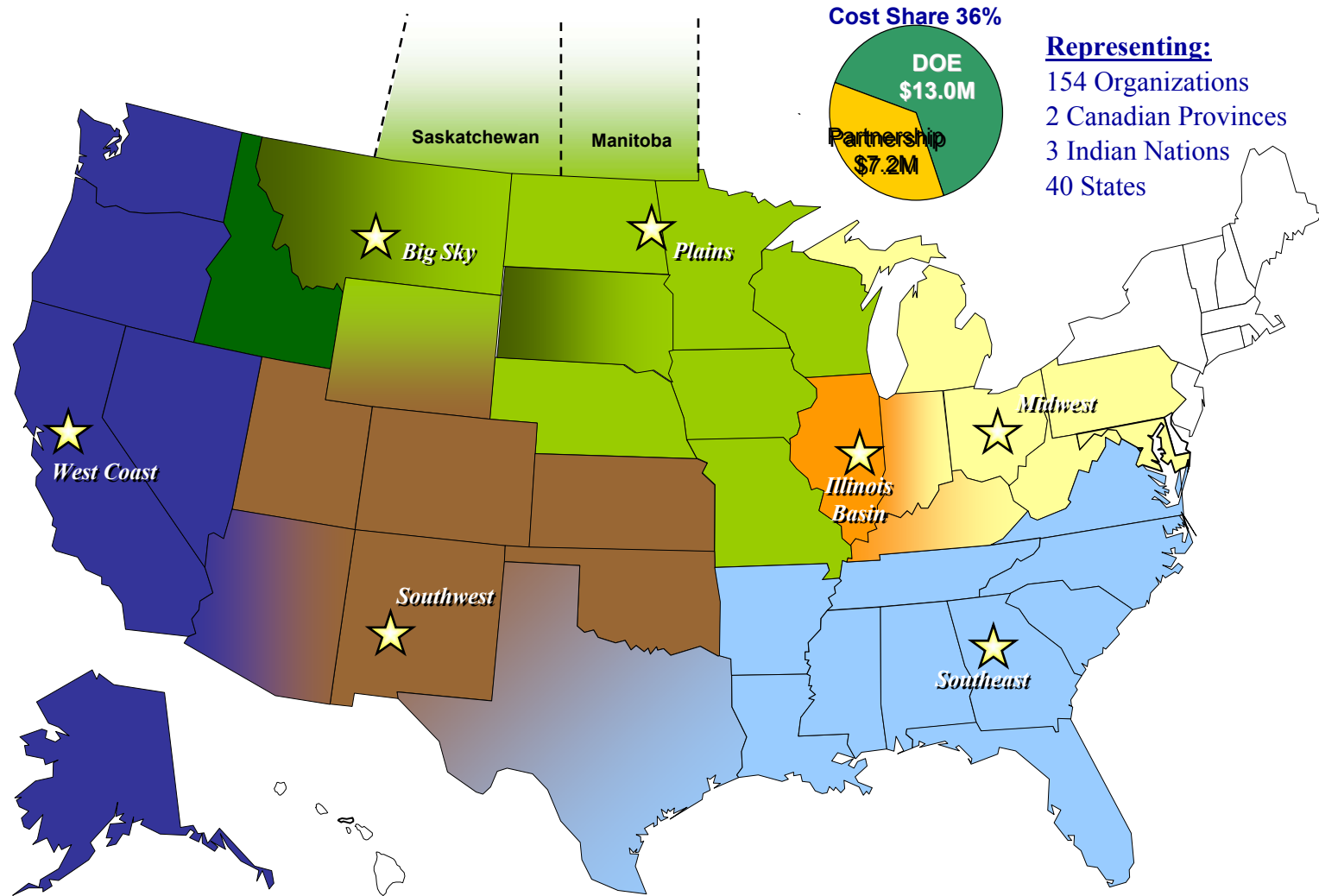


Carbon Sequestration Program Structure



Regional Carbon Sequestration Partnerships

Seven Partnerships Established in Five Geographic Regions



Regional Carbon Sequestration Partnerships

Developing Infrastructure for Wide Scale Deployment

- **Baseline region for sources and sinks**
- **Address regulatory, environmental, outreach issues**
- **Establish monitoring and verification protocols**
- **Validating sequestration technology & infrastructure**
 - Phase 1 - design
 - Phase 2 - testing
- **Determine benefits of sequestration to region**

These partnerships - 4 to 10 across the country, each made up of private industry, universities, and state and local governments - will become the centerpiece of our sequestration program. They will help us determine the technologies, regulations, and infrastructure that are best suited for specific regions of the country.

Energy Secretary Spencer Abraham
November 21, 2002



FutureGen . . .

- Produce electricity and hydrogen from coal using advanced technology
- Emit virtually no air pollutants
- Capture and permanently sequester CO₂

Address three Presidential initiatives:

- FreedomCar
- Clear Skies
- Climate Change



Visit the NETL Sequestration Website

www.netl.doe.gov/coalpower/sequestration/

NATIONAL ENERGY TECHNOLOGY LABORATORY
CARBON SEQUESTRATION WEBSITE

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January 13, 2003

Carbon Sequestration

*Pathways to Sustainable Use of Fossil Fuels--
enabling the removal and permanent storage
of carbon dioxide from fossil-energy systems*

Welcome to NETL's **Carbon Sequestration Product** webpage. We seek to define carbon sequestration's role in stabilizing atmospheric carbon dioxide levels by developing a scientific understanding and environmentally acceptable technologies. Our research areas include capture & storage, geologic, ocean, and terrestrial sequestration, advanced CO₂ conversion & reuse, and modeling & analysis.

Our site is designed to answer your questions about carbon sequestration—

- Regional Partnerships
- Capture & Storage
- Geologic Sequestration
- Ocean Sequestration
- Terrestrial Sequestration
- Adv. CO₂ Conversion & Reuse
- Modeling & Analysis

What's New
Events
Overview
Capture
Geologic
Ocean
Terrestrial
Conversion
Modeling
In-House R&D
Ref. Shelf
Kids Only!
Links
Contacts
GHG Facts



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.



The Carbon Sequestration Newsletter

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

Sequestration in the News

Congress Shifts Focus Due to the terrorist attacks of September 11, the agenda in congress has been radically simplified to focus on national

A Greener Greenhouse NASA Satellites show plant growth in northern regions has been more vigorous over the past two decades. The

