

Reducing CO₂ Emissions From Fossil Fuel Power Plants



*EPGA's 3rd Annual Power
Generation Conference*

*October 16-17, 2002
Hershey, Pennsylvania*

Scott M. Klara - National Energy Technology Laboratory



National Energy Technology Laboratory



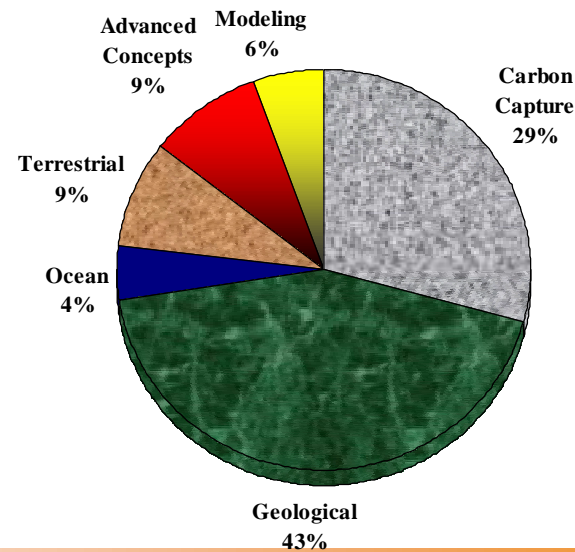
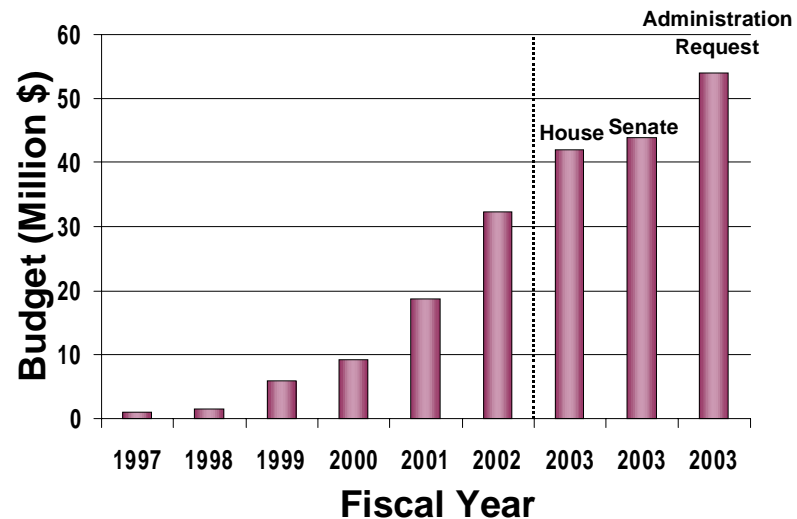
- One of DOE's 17 national labs
- Government owned/operated
- Sites in Pennsylvania, West Virginia, Oklahoma, Alaska
- More than 1,100 federal and support contractor employees
- FY 02 budget of \$750 million



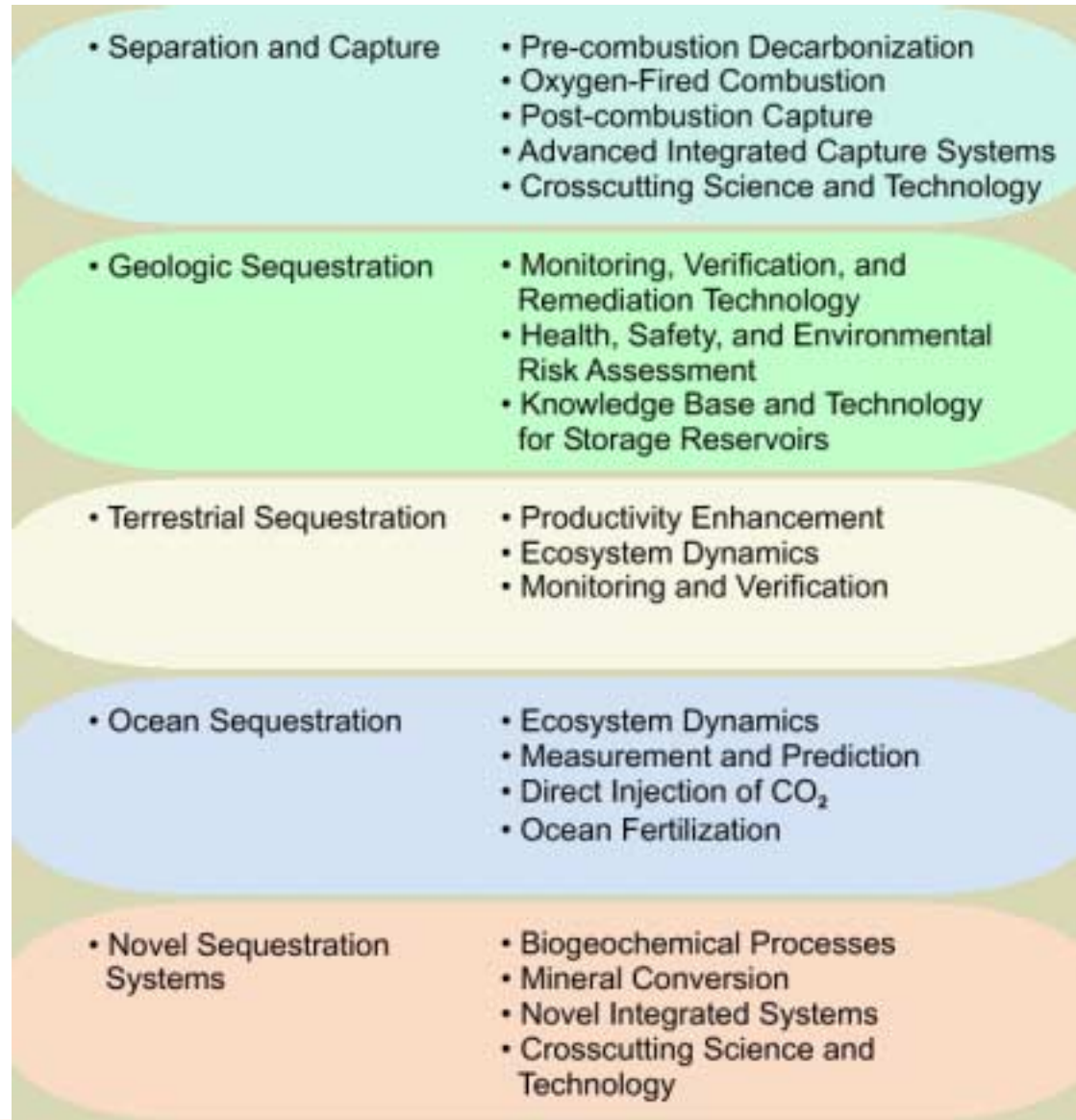
Carbon Sequestration: A Dynamic Program

Separation & Capture From Power Plants Plays Key Role

- **Diverse research portfolio**
 - 60 external projects
 - Onsite focus area
- **Strong industry support**
 - 40% cost share
- **Portfolio funding \$100M**



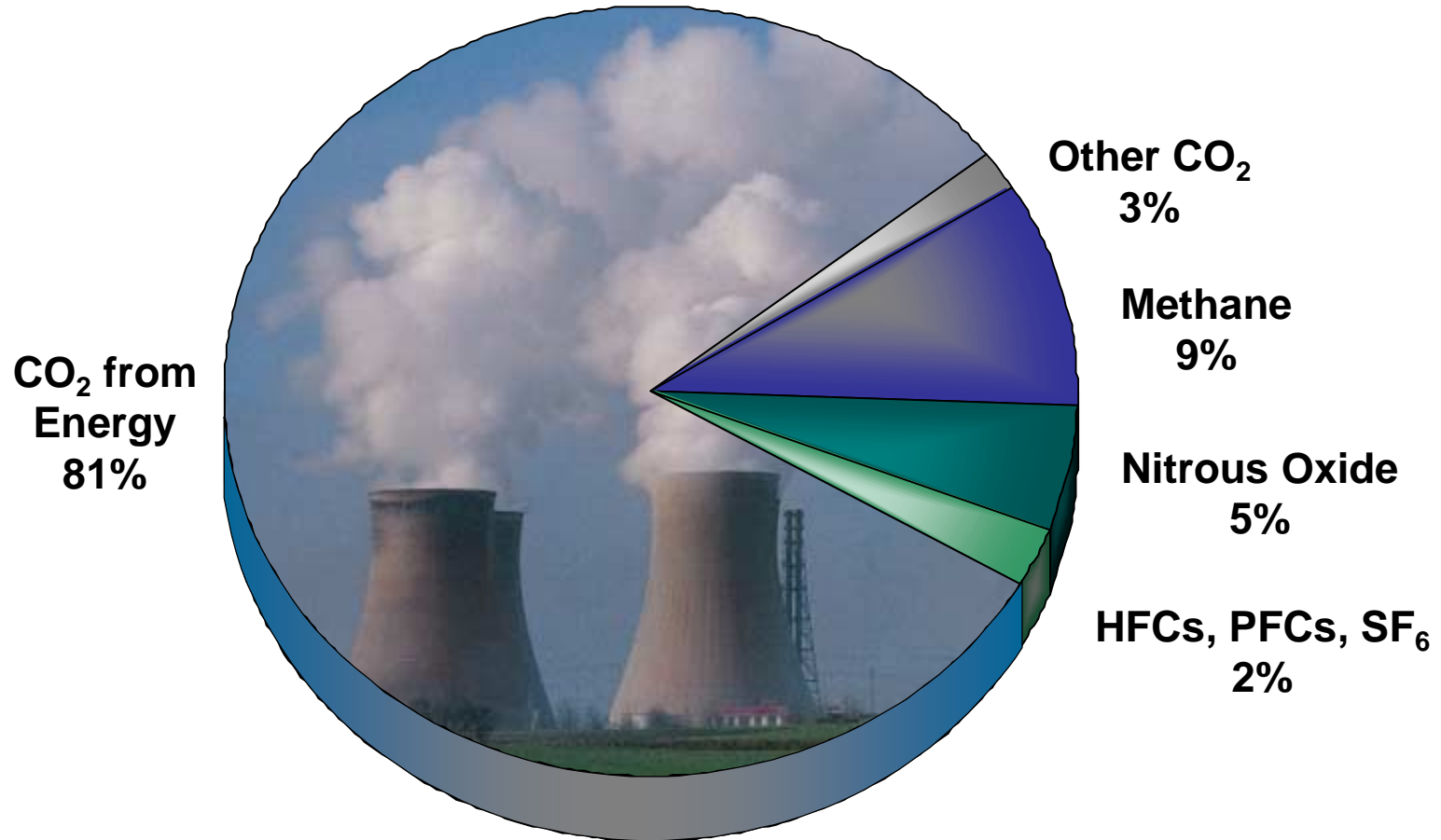
Technology R&D Pathways



Where Is The Problem?

CO₂ & CH₄ - The Primary GHG Contributors

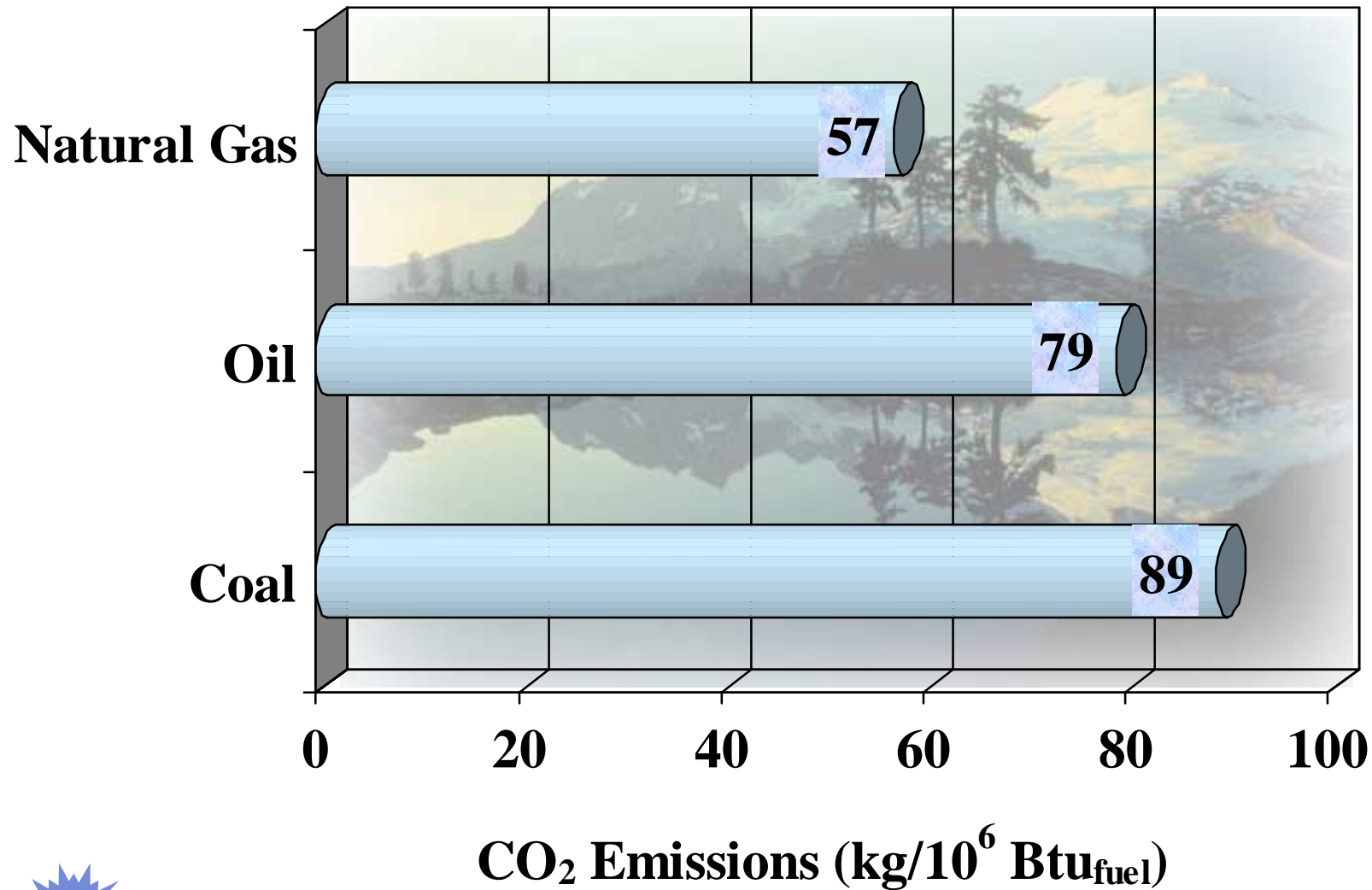
United States Greenhouse Gas Emissions (Equivalent Global Warming Basis)



"EIA Emissions of Greenhouse Gases in the U.S.: 2000"



Fossil Fuel's Inherent CO₂ Disadvantage



Source: NETL Combustion Calculations - HHV Basis

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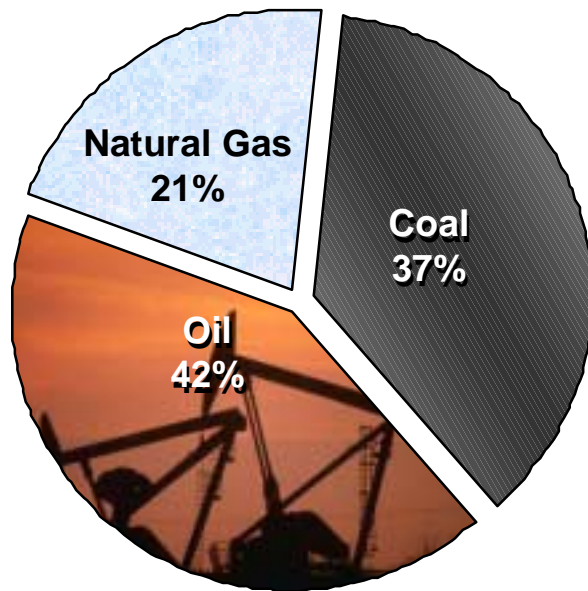
Coal & Electricity Are Major CO₂ Contributors

1998 United States CO₂ Emissions

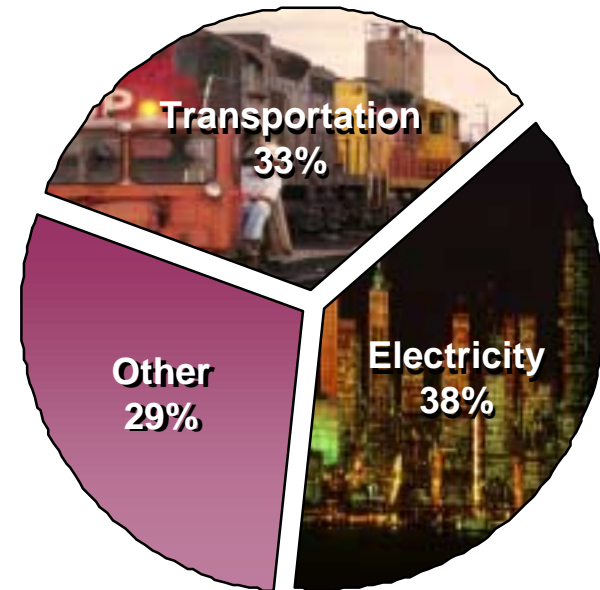
(Million Metric Tons Per Year Carbon Equivalent)

(Total Emissions = 1450)

By Fossil Fuel Type



By Sector

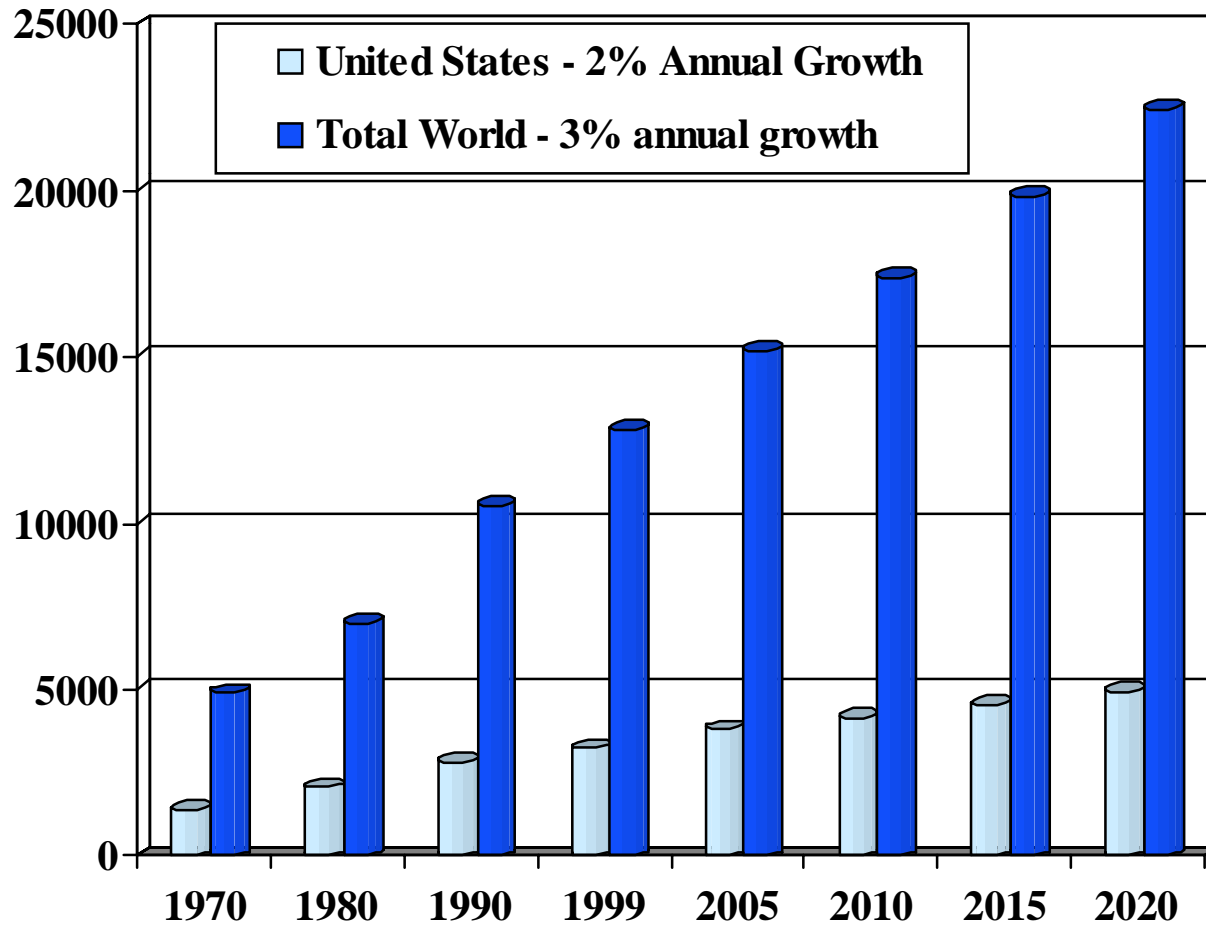


Source: EPA, Inventory of Greenhouse Gas Emissions, 2000

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Greenhouse Gas Emission Will Grow

World Electricity Demand (Billion kWh)



Source: EIA International Energy Outlook 2002



Technological Carbon Management Options

Reduce Carbon Intensity

- Renewables
- Nuclear
- Fuel Switching

Improve Efficiency

- Demand Side
- Supply Side

Sequester Carbon

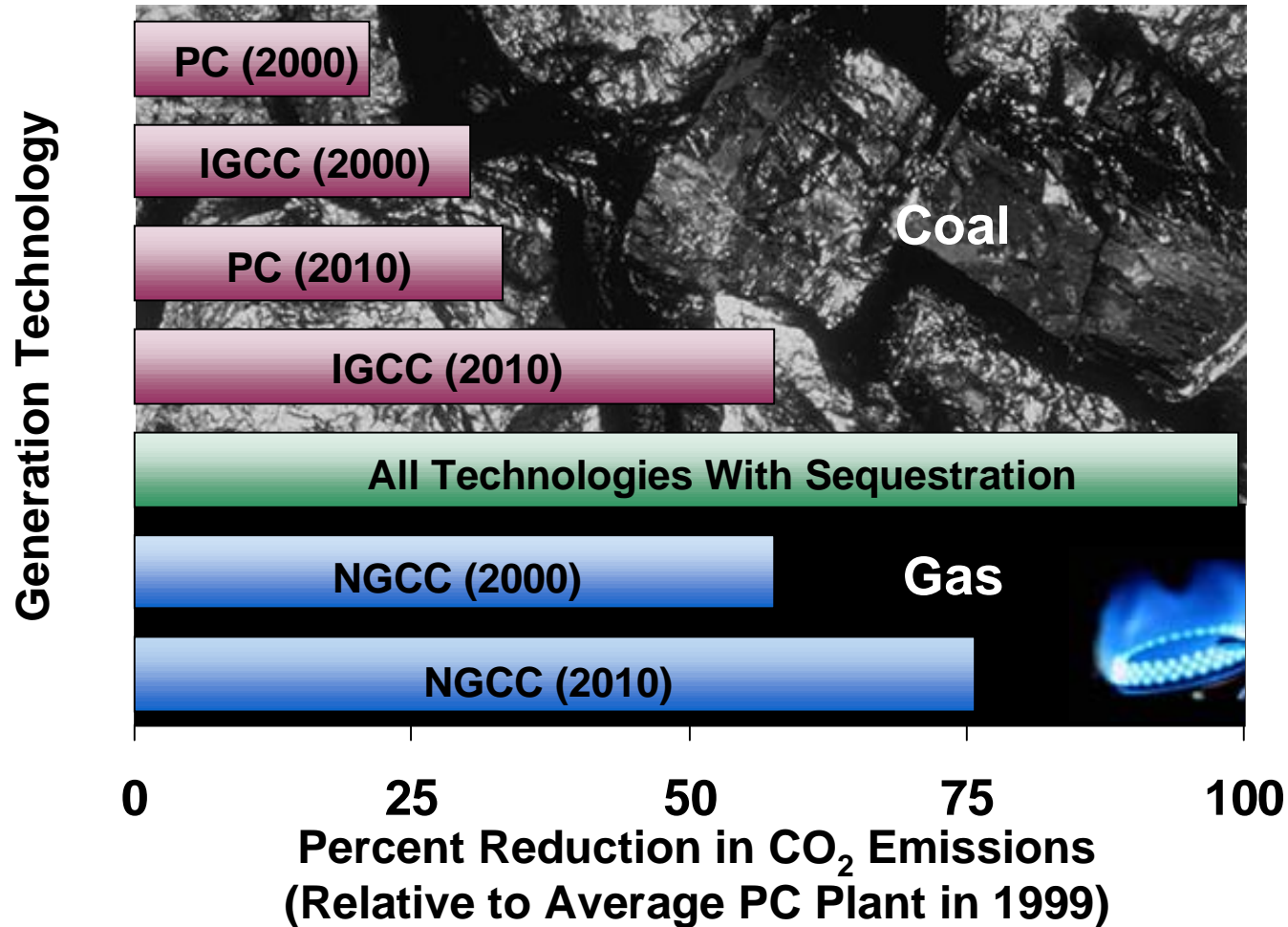
- Capture & Store
- Enhance Natural Sinks

All options needed to:

- Affordably meet energy demand
- Address environmental objectives

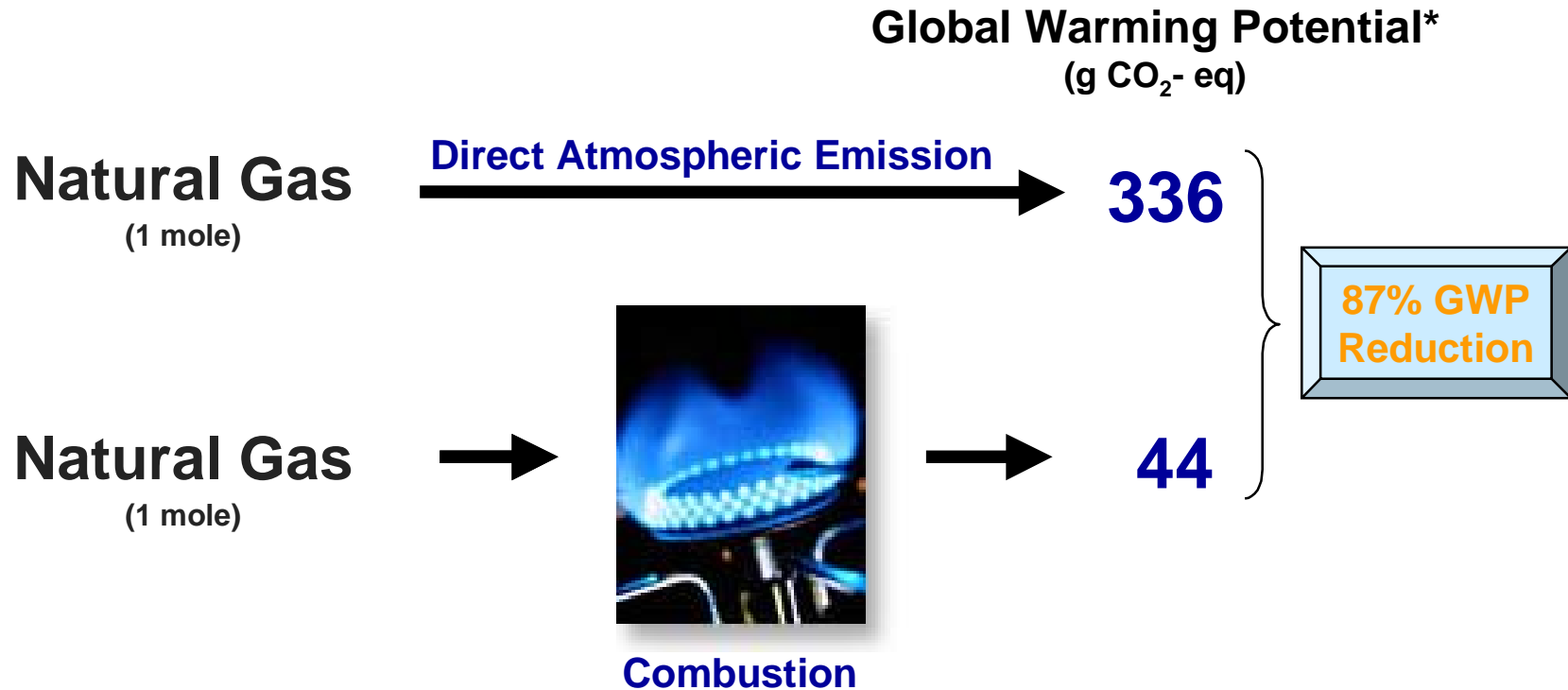


Increased Efficiency Reduces CO₂ Emissions > 25% Reduction With Current & Future Technology



Can Methane Combustion Reduce GWP?

87% Reduction in Global Warming Potential Versus Fugitive Release



*100-Year Time Horizon GWP for Methane = 21 g CO₂/g CH₄



Source: Energy Information Administration

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Separation and Capture Highlights

Many Advanced Integrated Schemes Emerging



Coal Gasification

**CO₂ Hydrates
Membranes
Advanced
Scrubbers Cheap
Oxygen**



Pathways to Zero Emissions



Pulverized Coal

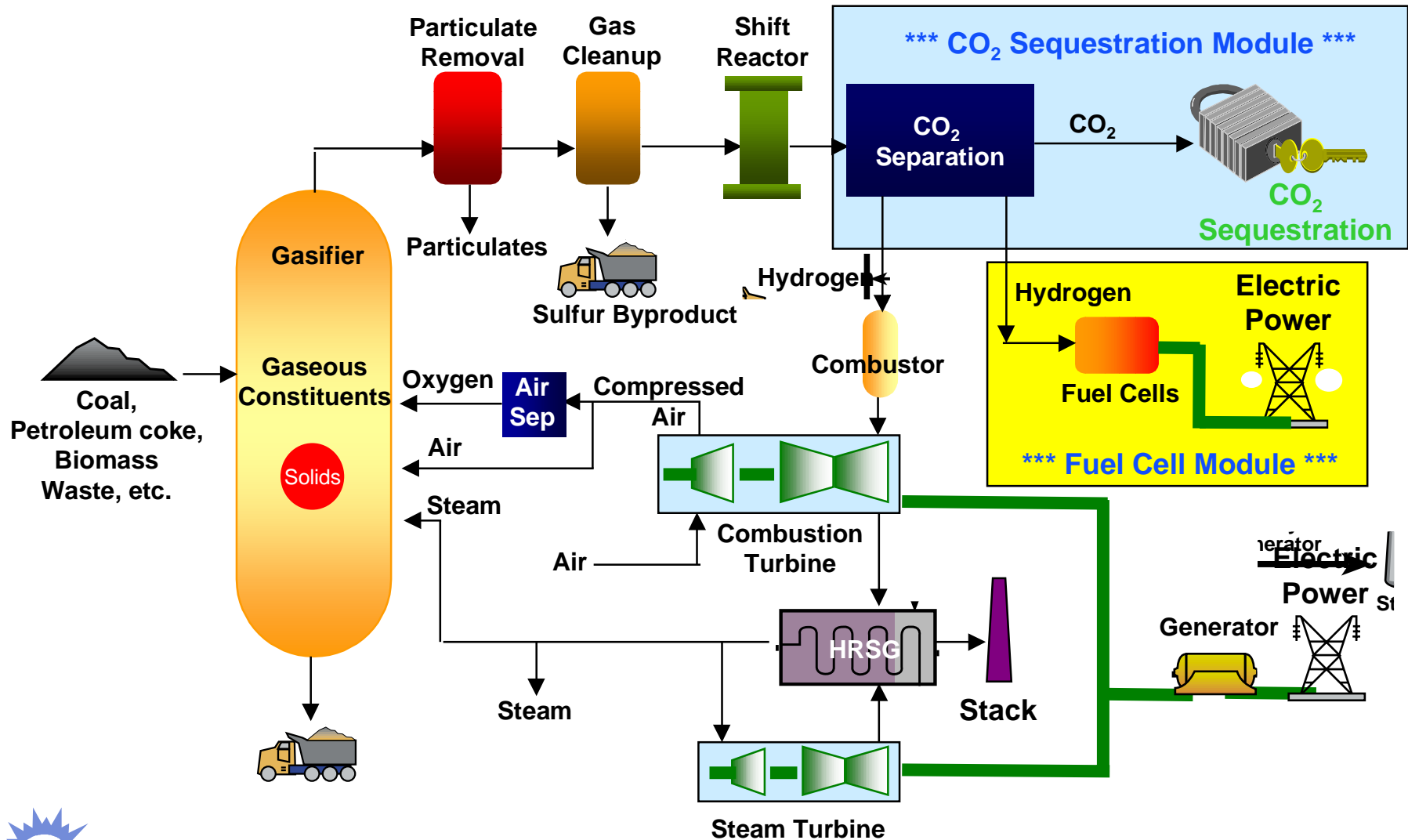
**Membranes
Advanced Scrubbers
New Sorbents
Mineral Carbonation**

Producing a Concentrated Stream of CO₂ at High Pressure

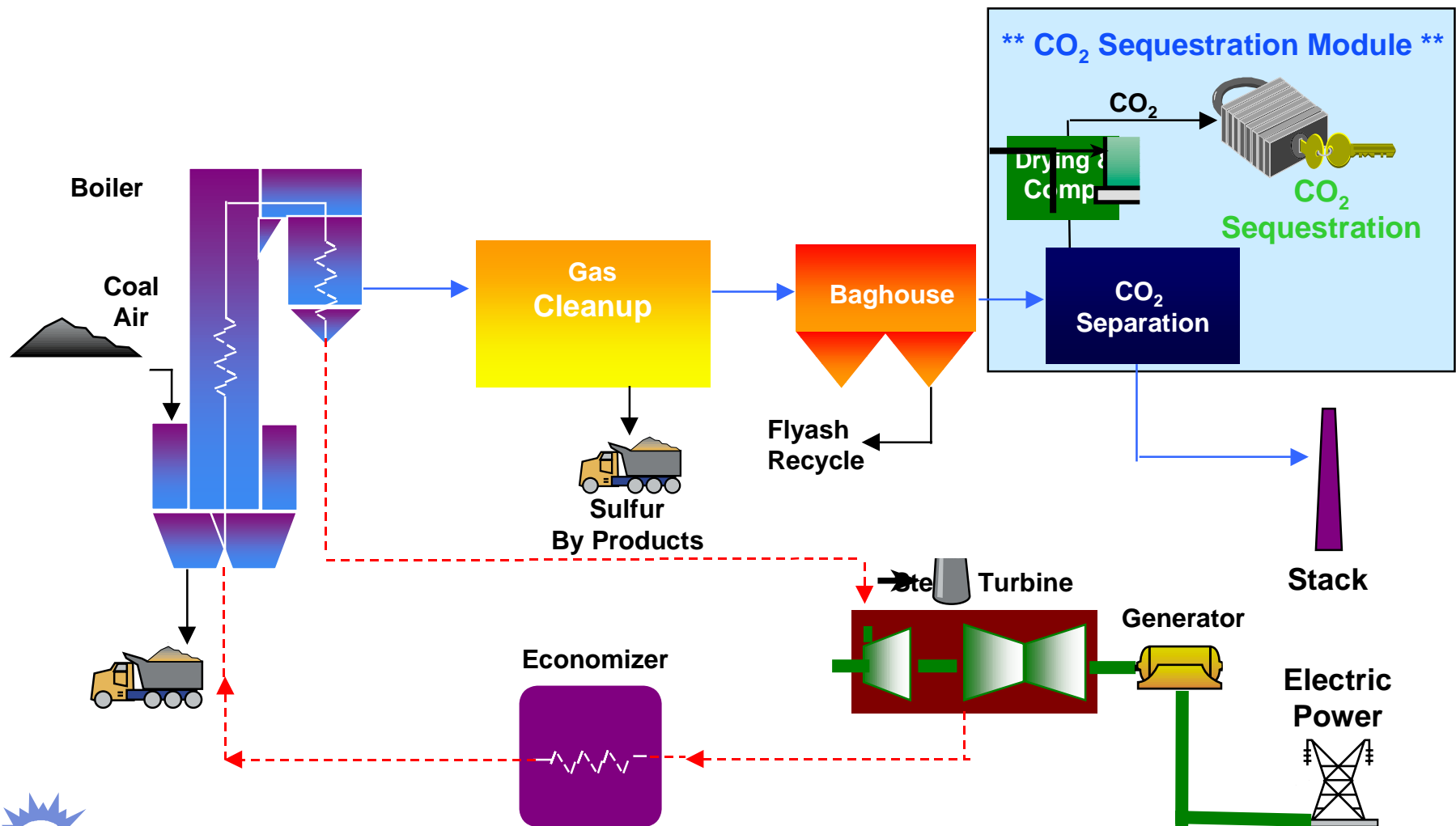
- Improves Sequestration Economics*
- Reduces Energy Penalty*



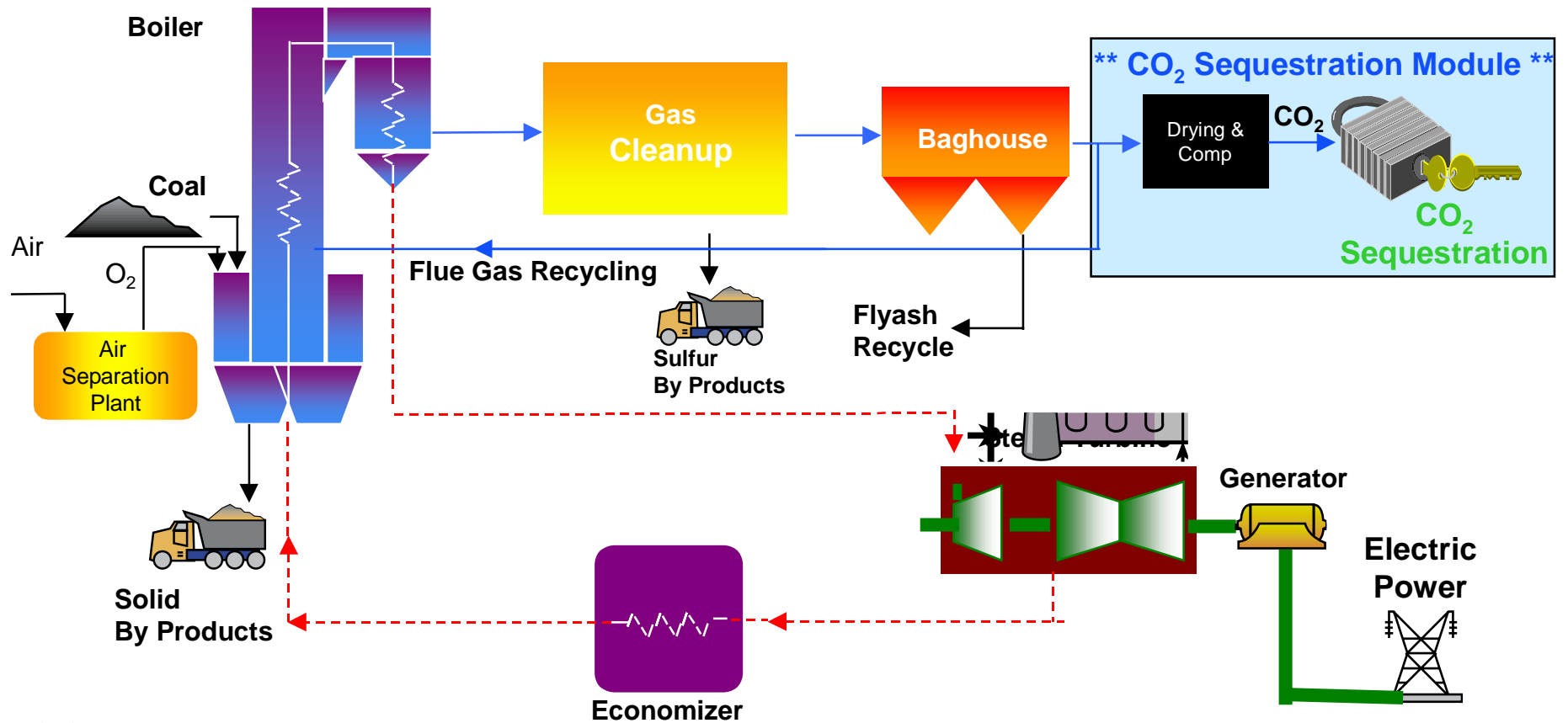
CO₂ Sequestered Gasification Plant (*Scrubbing, Membranes, Lower Cost O₂, Hydrates*)



CO₂ Sequestered PC Plant (*Scrubbing, Membranes*)



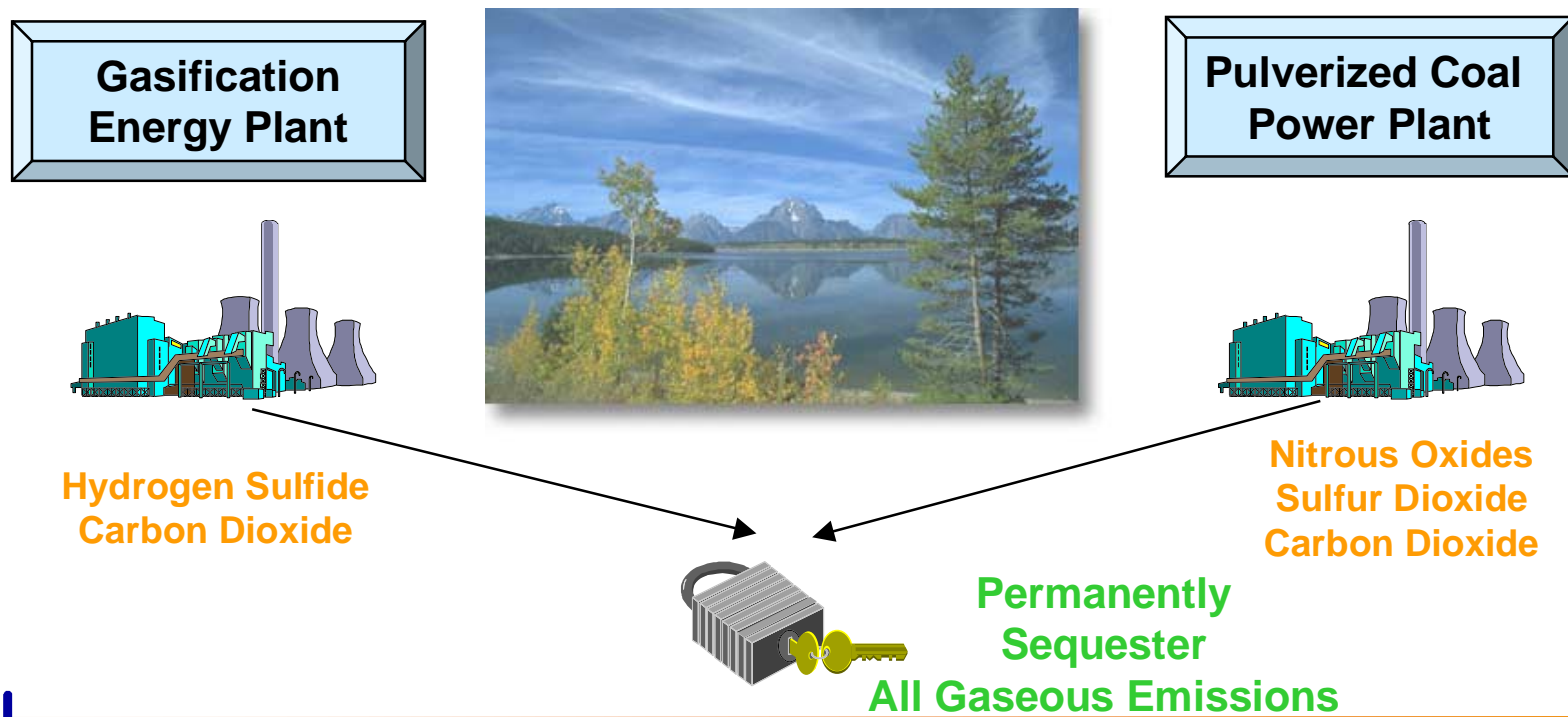
CO₂ Sequestered PC Plant (O₂ Combustion, Lower Cost O₂)



Sequestration - Not Just About CO₂

(Near Zero Emissions Concept)

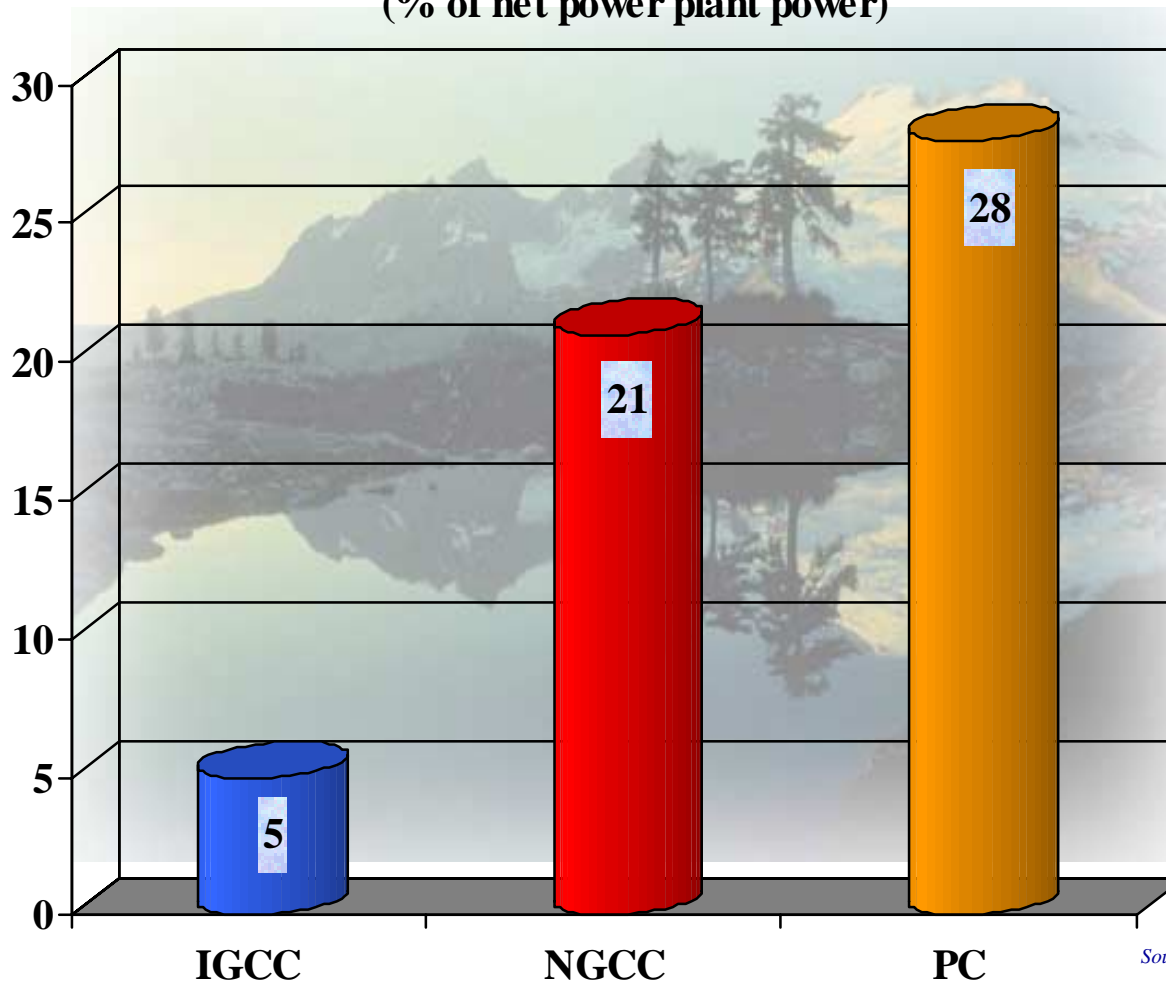
- Sequester traditional pollutants & CO₂
- Avoid costs, energy & complexity of controlling traditional pollutants
- Provide major cost & energy offsets for CO₂ capture & sequestration
- Substantially reduce footprint and complexity of plants



Substantial Energy Penalty of CO₂ Capture With State-of-Art Scrubbing Technologies

Parasitic Power Loss for CO₂ Capture

(% of net power plant power)

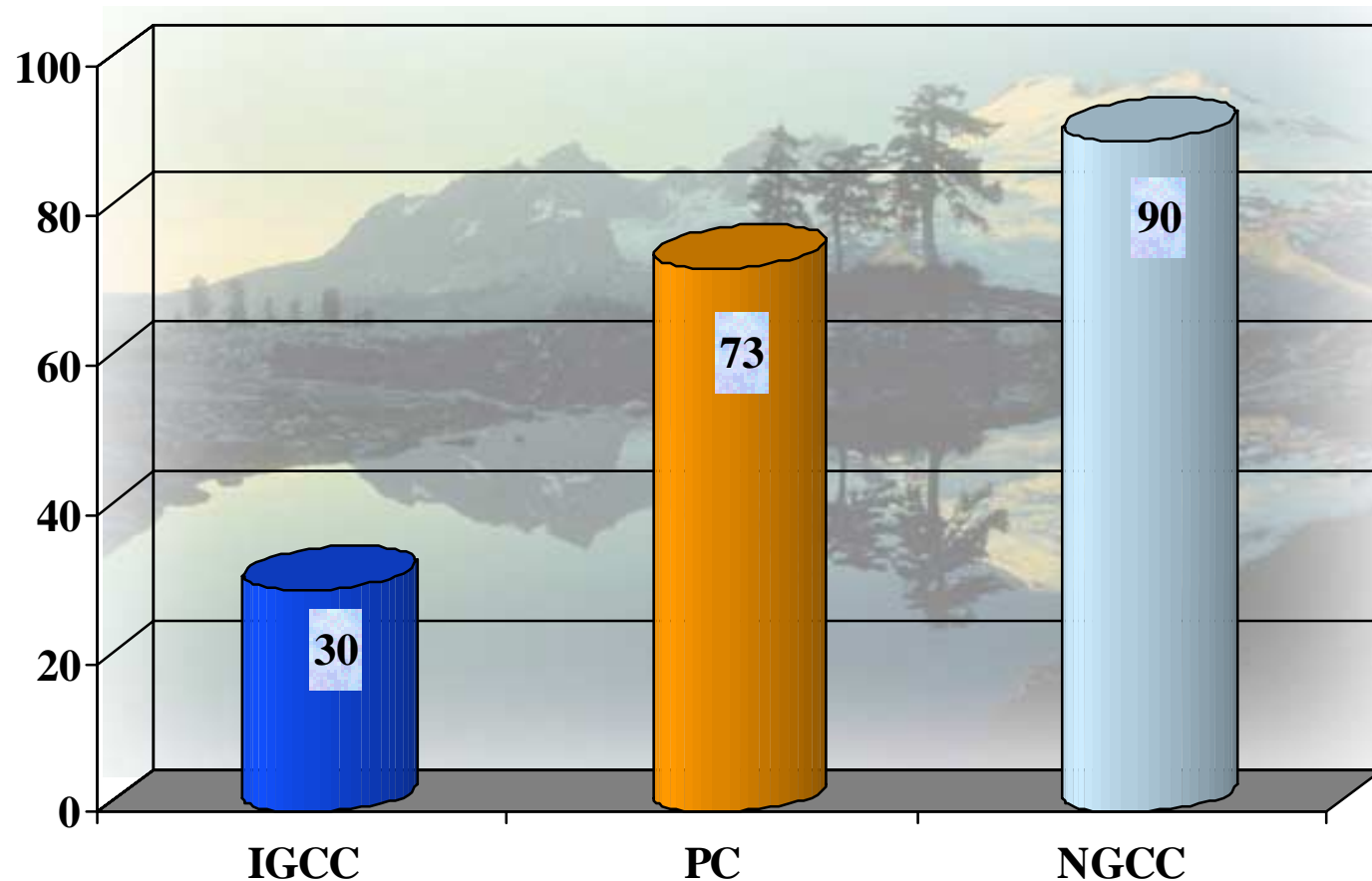


Source: DOE-EPRI Report 1000316, 12/2000



Substantial Capital Cost Impact of CO₂ Capture *With State-of-Art Scrubbing Technologies*

Effect of CO₂ Capture on Capital Cost
(% Increase Resulting From CO₂ Capture)

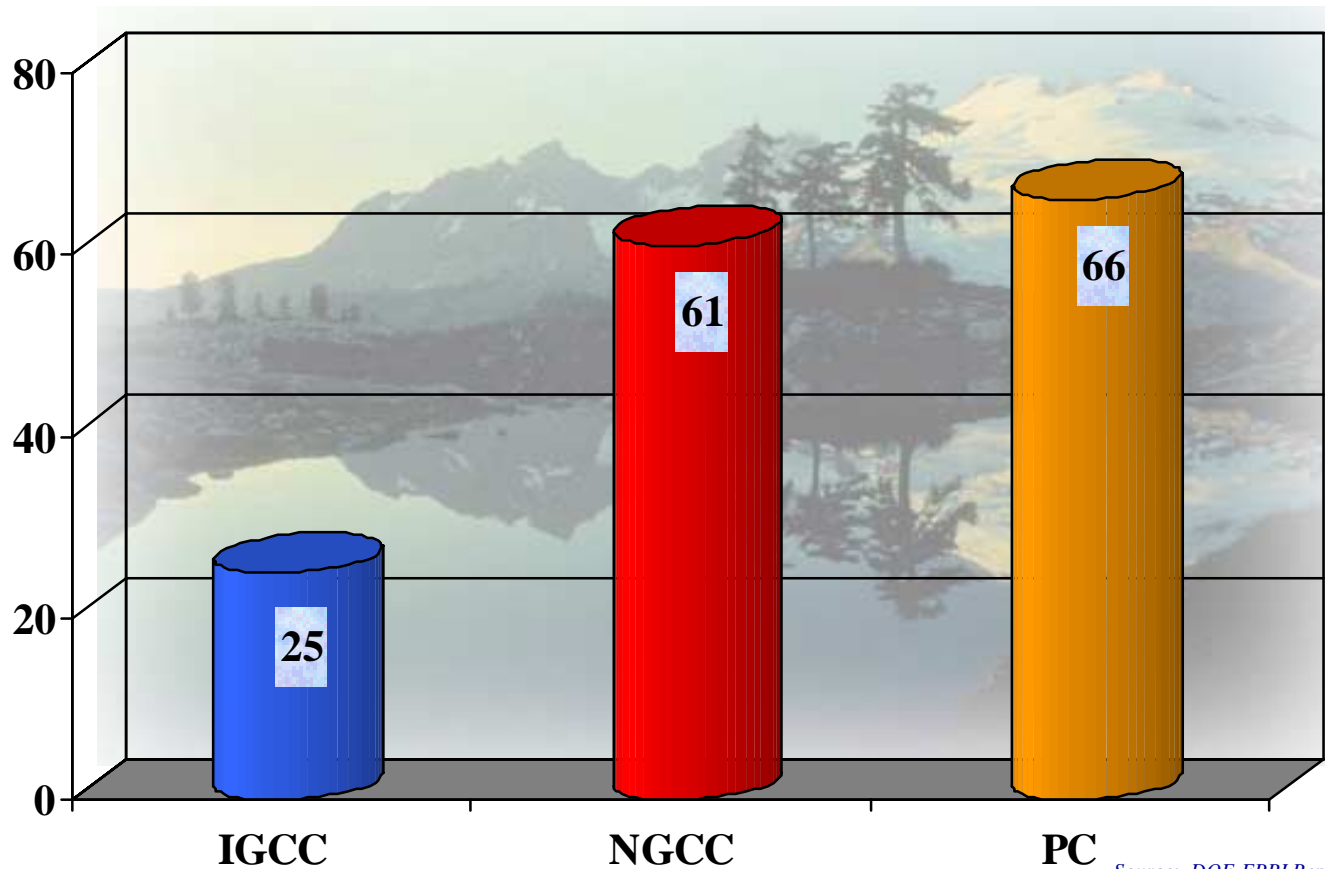


Source: DOE-EPRI Report 1000316, 12/2000

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Substantial COE Impact of CO₂ Capture *With State-of-Art Scrubbing Technologies*

Effect of CO₂ Capture on Cost of Electricity
(% Increase Resulting From CO₂ Capture)

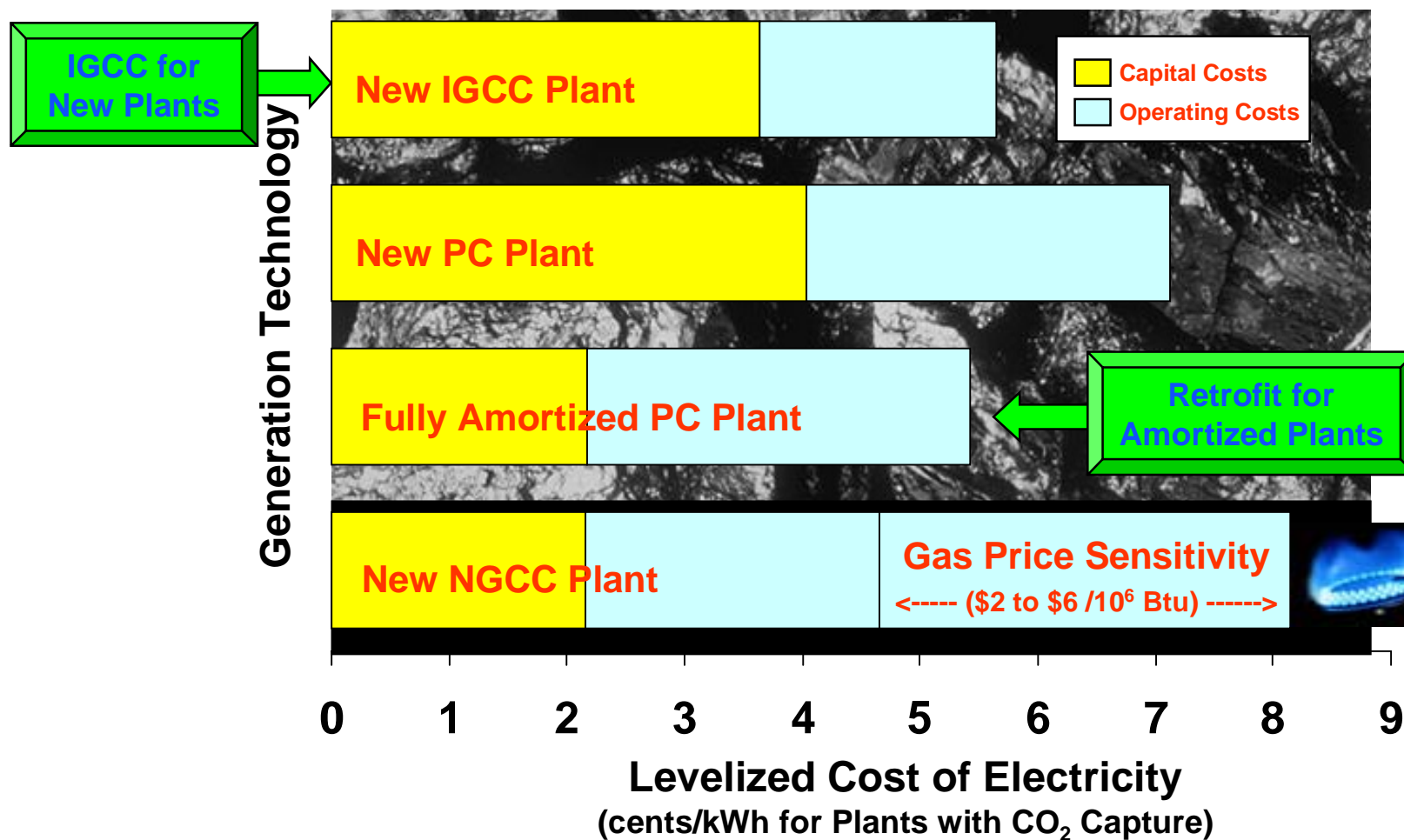


Source: DOE-EPRI Report 1000316, 12/2000



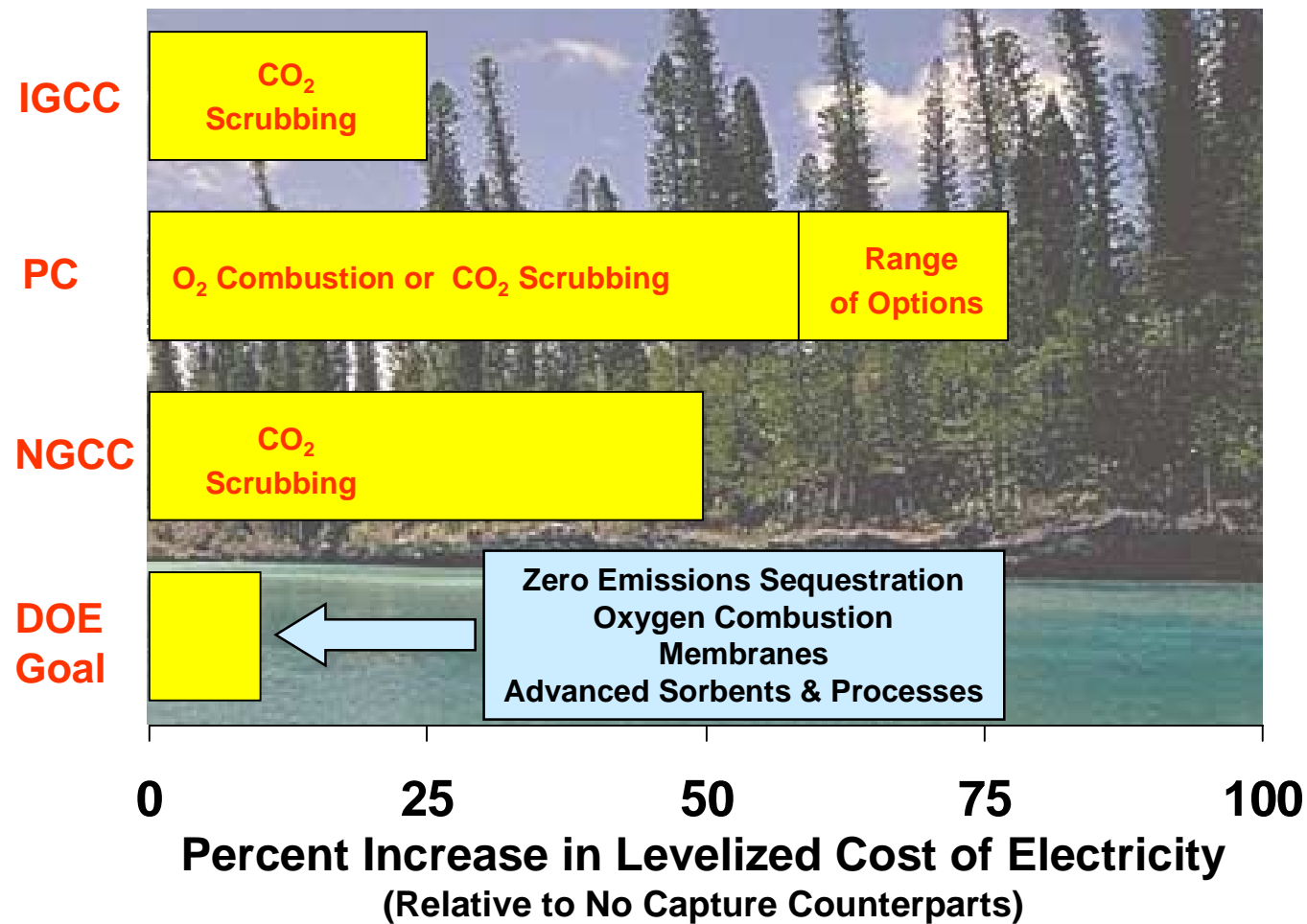
What About Existing Coal Fleet?

Existing Fleet Can Compete!



Sources: Derived From NETL, EPRI, Alstrom

A Challenging Road Ahead !!!!



Sources: Derived From NETL, EPRI, Alstom

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Visit Our NETL Sequestration Website

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

The screenshot shows the homepage of the National Energy Technology Laboratory's Carbon Sequestration Website. At the top, the NETL logo is on the left, and the text "NATIONAL ENERGY TECHNOLOGY LABORATORY CARBON SEQUESTRATION WEBSITE" is in the center. A navigation bar includes links for "Home", "Site Index", and "Feedback". The date "September 09, 2002" is displayed on the right. A vertical sidebar on the left lists various site sections: "What's New", "Events", "Overview", "Capture", "Geologic", "Ocean", "Terrestrial", "Conversion", "Modeling", "In-House R&D", "Ref. Shelf", "Kids Only!", "Links", and "Contacts". The main content area features a large circular graphic with a mountain landscape. The text "Carbon Sequestration" is prominently displayed. Below it, a welcome message introduces the "Carbon Sequestration Product" webpage and describes the lab's research goals. A list of research areas is shown within the circular graphic: "Capture & Storage", "Geologic Sequestration", "Ocean Sequestration", "Terrestrial Sequestration", "Adv. CO₂ Conversion & Reuse", and "Modeling & Analysis". A "MEDIA RELEASE" button and a "GET THE NEWS" icon are also visible. At the bottom, a box contains links to two PDF documents: "Carbon Sequestration Technology Roadmap [PDF-1025KB]" and "CO₂ Capture and Storage in Geologic Formations [PDF-226KB]".

NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY
CARBON SEQUESTRATION WEBSITE

Home | Site Index | Feedback

September 09, 2002

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—from the basics to specific technical information.

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

MEDIA RELEASE **GET THE NEWS**

Carbon Sequestration Technology Roadmap [PDF-1025KB]
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