



U.S. DEPARTMENT OF
ENERGY

FutureGen: The Energy Plant of the Future

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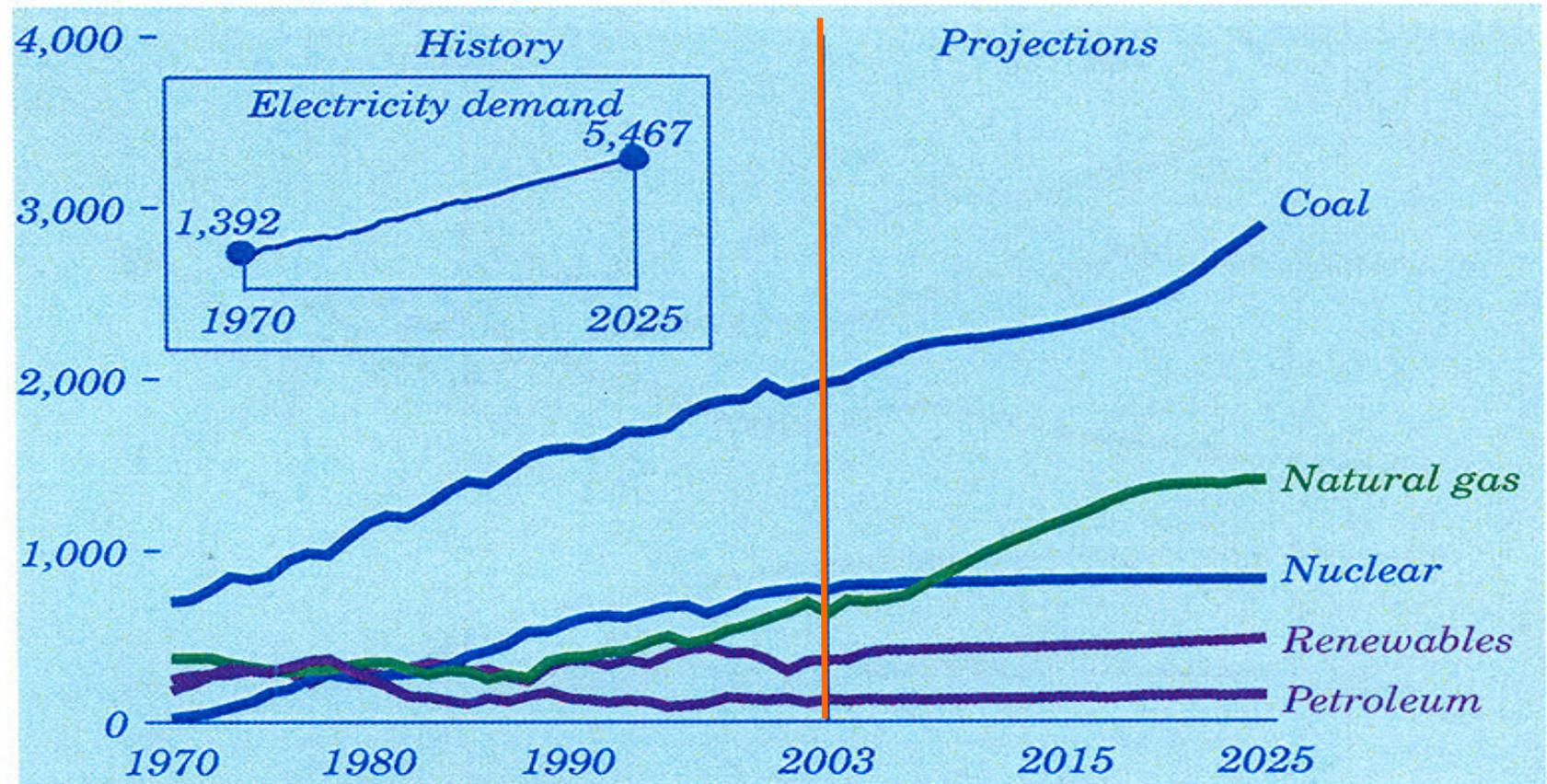
**2006 DOE Hydrogen Program
Merit Review and Peer Evaluation Meeting
May 16, 2006**

Presentation Overview

- **Background / Future U.S. Energy Outlook**
- **What is FutureGen and why is it important?**
- **Supporting RD&D for FutureGen**
- **Schedule**
- **Progress to date**
- **Next Steps**
- **Summary**

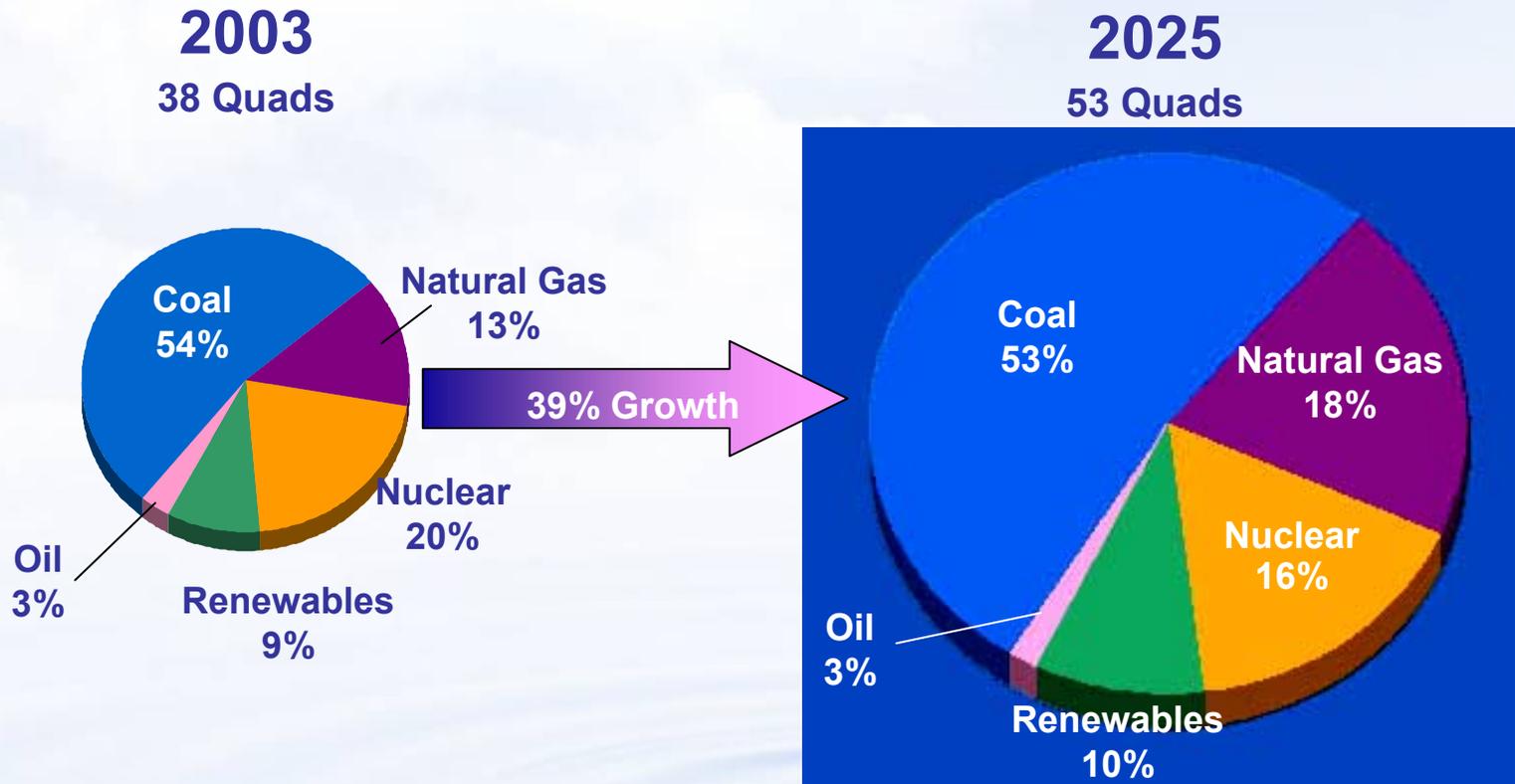
U.S. Electricity Outlook

Figure 5. Electricity generation by fuel, 1970-2025 (billion kilowatthours)



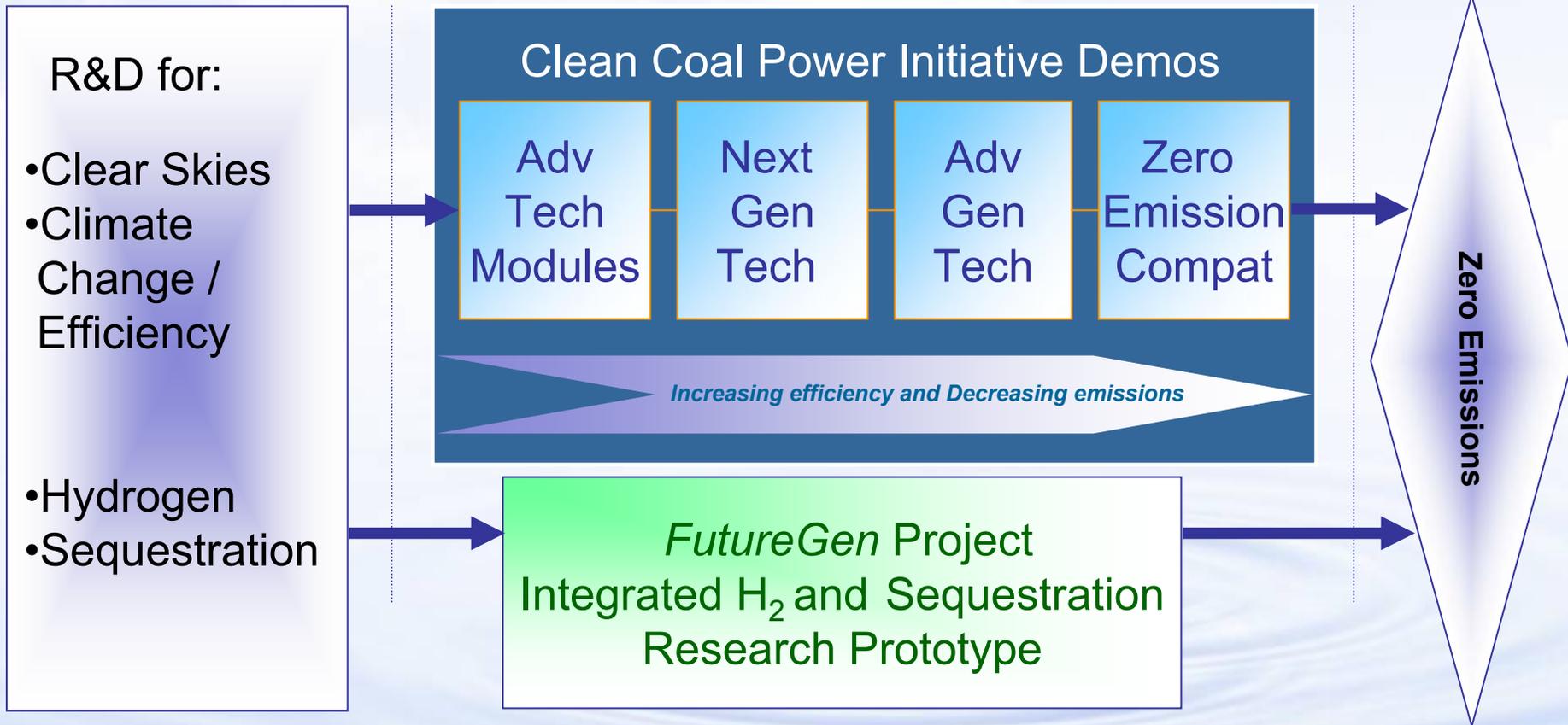
Source: Energy Information Administration (EIA), Annual Energy Outlook (2005)

U.S. Electricity Outlook



Source: Energy Information Administration (EIA), Annual Energy Outlook (2005) – Table A-2

FE's Coal Research Program



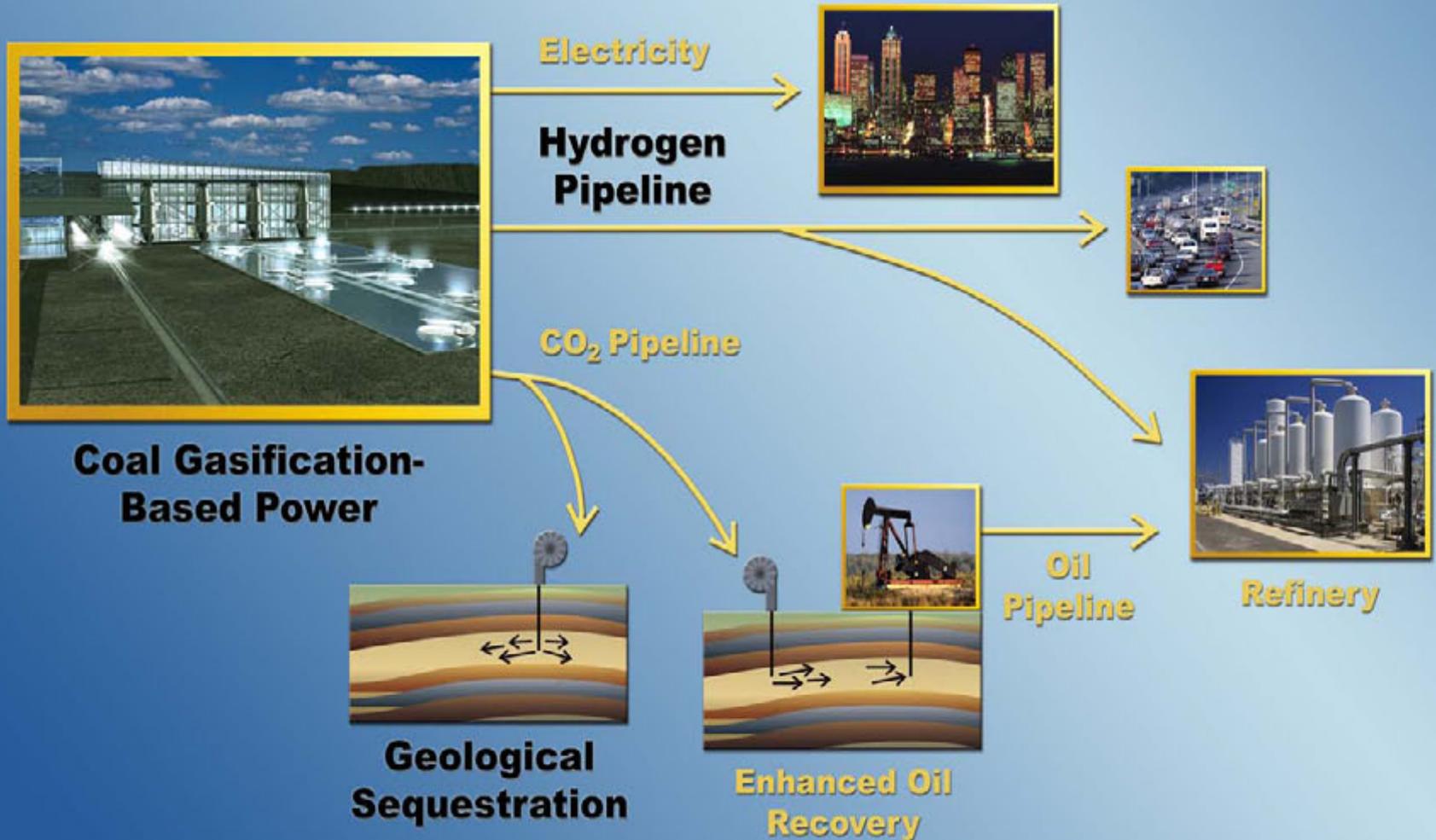
Tomorrow's Energy Plant



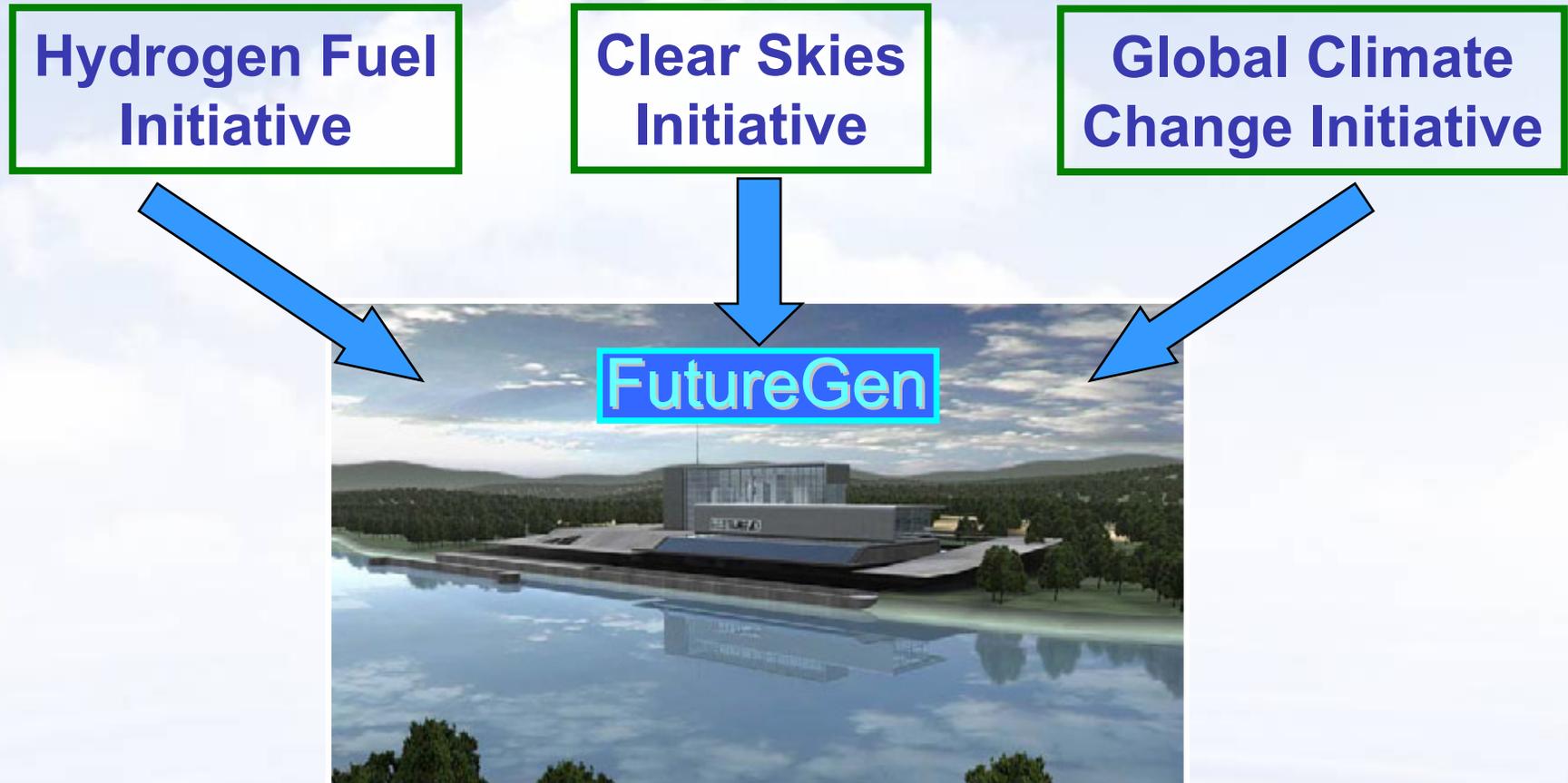
The goal of the FutureGen research project is to establish the technical feasibility, economic viability and broad acceptance of co-producing electricity and hydrogen from coal with essentially zero emissions, including carbon (sequestration).

FutureGen

Energy Independence through Carbon Sequestration and Hydrogen



Confluence of Presidential Initiatives



- President Bush announced the FutureGen Initiative on February 27, 2003
- FutureGen will be an international test facility for breakthrough technologies that addresses three key Presidential initiatives: (1) Hydrogen, (2) Clear Skies, (3) Climate Change Technology

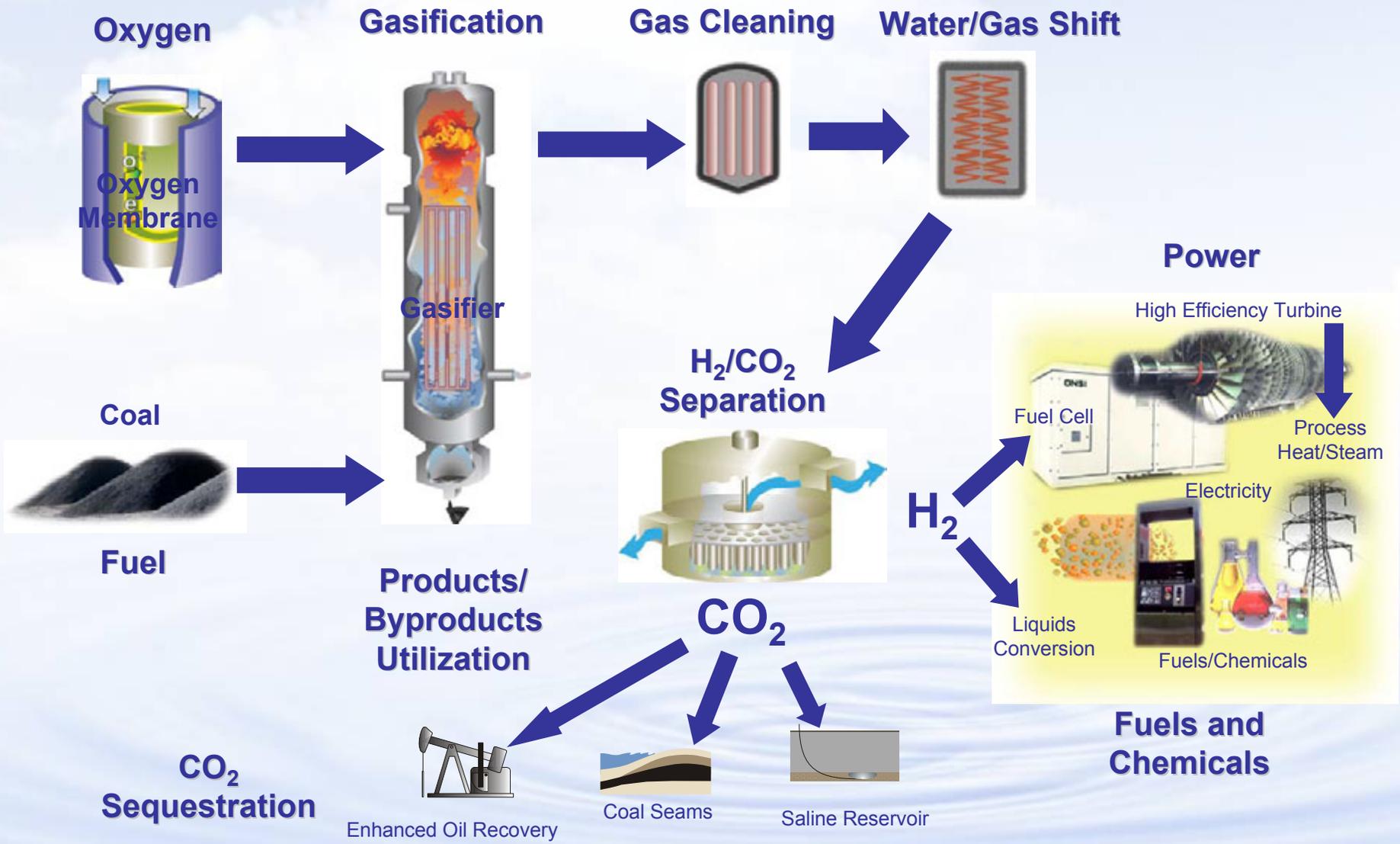
FutureGen Goals

- Design, construct and operate a 275 MW prototype plant that produces electricity and hydrogen fuel while sequestering CO₂ at an annual rate of 1-2 million metric tons.
- Sequester at least 90 percent of CO₂ initially and up to 100 percent sequestered eventually
- Prove the effectiveness, safety, and permanence of CO₂ sequestration through validating the technology at large scale under real world conditions.
- Establish technology standards and protocols for CO₂ measuring, monitoring, and verification
- Validate the engineering, economic, and environmental viability of advanced coal-based, zero emission technologies for commercial readiness in 2020

Why FutureGen Is Needed

- FutureGen is a key step to creating a zero emission coal energy option
- Zero Emission Coal will enable:
 - Countries to meet their growing energy needs
 - Secure an economic and energy future through the clean use of coal, an abundant, strategic energy resource
 - Remove all environmental concerns over coal's use including climate change concerns by sequestering carbon dioxide emissions from coal power plants, and
 - Produce clean low-cost hydrogen with zero emissions for power generation or for transportation.
- Integration of concepts and components is the key to proving the technical and operational viability as well as gaining acceptance of the zero emission coal concept

FutureGen Systems



RD&D to Meet Technology Challenge

Traditional Advanced Technology

Cryogenic Separation



Amine Scrubbers



Gas Stream Clean-Up



Syngas Turbine



Fuel Cell (\$4,000/kW)



EOR based



Existing Gasifier



System Integration



Plant Controls



Research Inventions

O₂ Membranes

H₂ Membranes, “Clathrate” CO₂
Separation or Advanced Selexol

Raw Gas Shift Reactor

Ultra-low NO_x Hydrogen Turbine

SECA Fuel Cell (\$400/kW design)

Sequestration Technology

(including in-situ CO₂ monitoring)

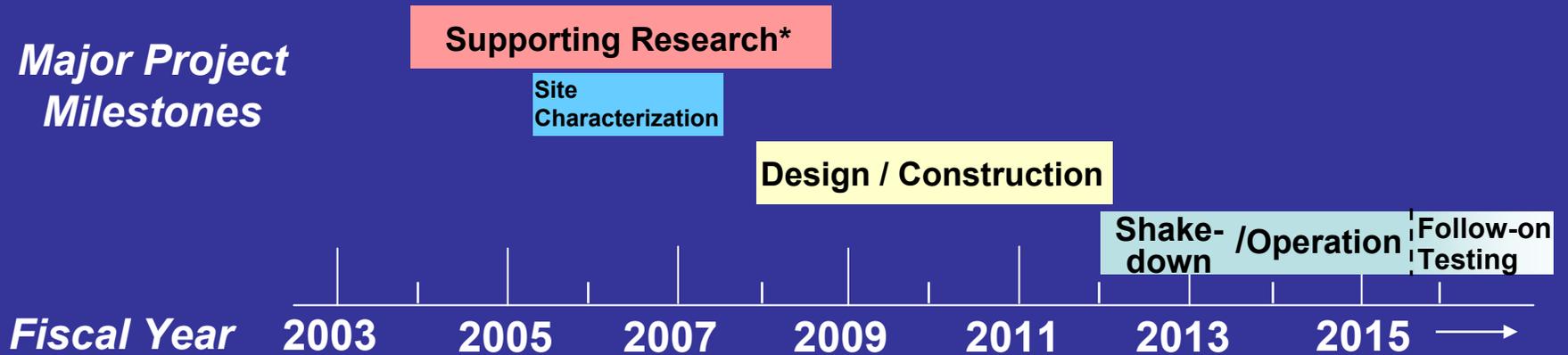
Advanced Transport Reactor

“First of a Kind” System Integration

“Smart” Dynamic Plant Controls &
CO₂ Management Systems

Project Schedule - Key Events

Major Project Milestones



* Supporting research includes research embedded in the FutureGen project and additional research in FE's carbon sequestration, IGCC, turbines, and fuel cell R&D programs.

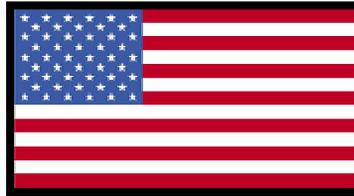
The FutureGen “Alliance”



- The Alliance presently consists of nine organizations representing over 15% of the U.S. coal-fired electricity generation and over 40% of the U.S. coal production, plus a coal-based utility in China.
- As an open consortium (both domestically and internationally) the Alliance is geographically diverse, currently including both eastern and western domestic coal producers and coal-fueled electricity generators, as well as a utility in China. It includes producers and users of a full range of coal types.

- American Electric Power
- CONSOL Energy Inc.
- Kennecott Energy Company, a member of the Rio Tinto group
- BHP Billiton
- Anglo American
- Peabody Energy
- Foundation Coal Holdings (Formerly RAG)
- Southern Company
- China Huaneng Group

Government Steering Committee (GSC)



- **April 3, 2006** - India became the first member of the FutureGen GSC
- South Korea have responded positively to join the GSC
- Negotiations with other countries have been promising and are ongoing
- Participation in FutureGen promotes a government's capability to be a leader on Climate Change and coal sustainability.
- Participating countries will also have the opportunity to provide technical advice by sitting on technical sub-committees under the GSC in several specific areas

- Outreach Strategy
- Test Planning
- Data Analysis & Validation
- Technology Inclusion
- MMV & Sequestration Subsystem
- Plant Design
- Construction
- Operations
- Cost & Scheduling Analysis
- Risk Analysis & Assessment

Progress to Date

- **A cooperative agreement was signed in December 2005 with the FutureGen Industrial Alliance Inc. to initiate the first phase of the project.**
- **The Alliance issued a competitive Site Solicitation on March 7, 2006 with proposal responses due back May 4, 2006. So far, 22 potential offerors in nine states have indicated intent to bid.**
- **The DOE issued an Advanced Notice of Intent for an Environmental Impact Statement for FutureGen on February 16, 2006**
- **Identification of potential cutting-edge technology and readiness for inclusion for further evaluation by FutureGen Alliance.**
- **Conceptual designs on several plant configurations and associated preliminary cost estimations completed.**
- **Initiated preliminary planning activities for permitting process**
- **Developed NEPA (environmental compliance) strategy and milestones including plans for public scoping meetings.**
- **Invited other countries to join in FutureGen; Government of India first to join; South Korea indicated it will soon join.**

Next Steps

- **Start the evaluation process of proposed sites from competitive solicitation and identify best qualified sites for consideration.**
- **Base-line the plant design configuration and start preliminary design for FutureGen.**
- **Assess cutting-edge technology readiness for inclusion.**
- **Develop test scope for validating FutureGen**
- **Conduct planning activities for permitting process (some preliminary work has already begun)**
- **Start formal NEPA (environmental compliance) process with issuance of Notice of Intent for an EIS; begin work on environmental information data gathering; develop plans for public scoping.**
- **Establish the Government Steering Committee operations involving international governmental participation.**
- **Continue outreach to garner public acceptance and to bring additional participants into the project both domestically and internationally (coordinated team effort of DOE/Alliance)**

Summary Remarks



- **FutureGen is a key research step towards proving the feasibility of a zero-emission coal option.**
- **Project is currently on track in terms of progress and funding for initial phase, and evaluation of proposed sites will be underway to identify a set of best qualified sites for further consideration.**
- **Expect site selection by Alliance upon completion of NEPA process**
- **The cooperation and support of all international stakeholders (government, industry, environmental) will be needed for FutureGen to be successful and accepted. Therefore, global participation is invited.**
- **The potential benefits of a zero-emission coal option are enormous with respect to energy, environmental and economic security.**

Additional Information

- **MAIN FUTUREGEN WEBSITES**

<http://fossil.energy.gov/programs/powersystems/futuregen/>

<http://www.netl.doe.gov/technologies/coalpower/futuregen/index.html>

<http://www.futuregenalliance.org/>

- **GENERAL**

www.netl.doe.gov

www.eia.doe.gov

www.epa.gov

www.climate-science.gov

