U.S. DEPARTMENT OF ENERGY

FutureGen: The Energy Plant of the Future

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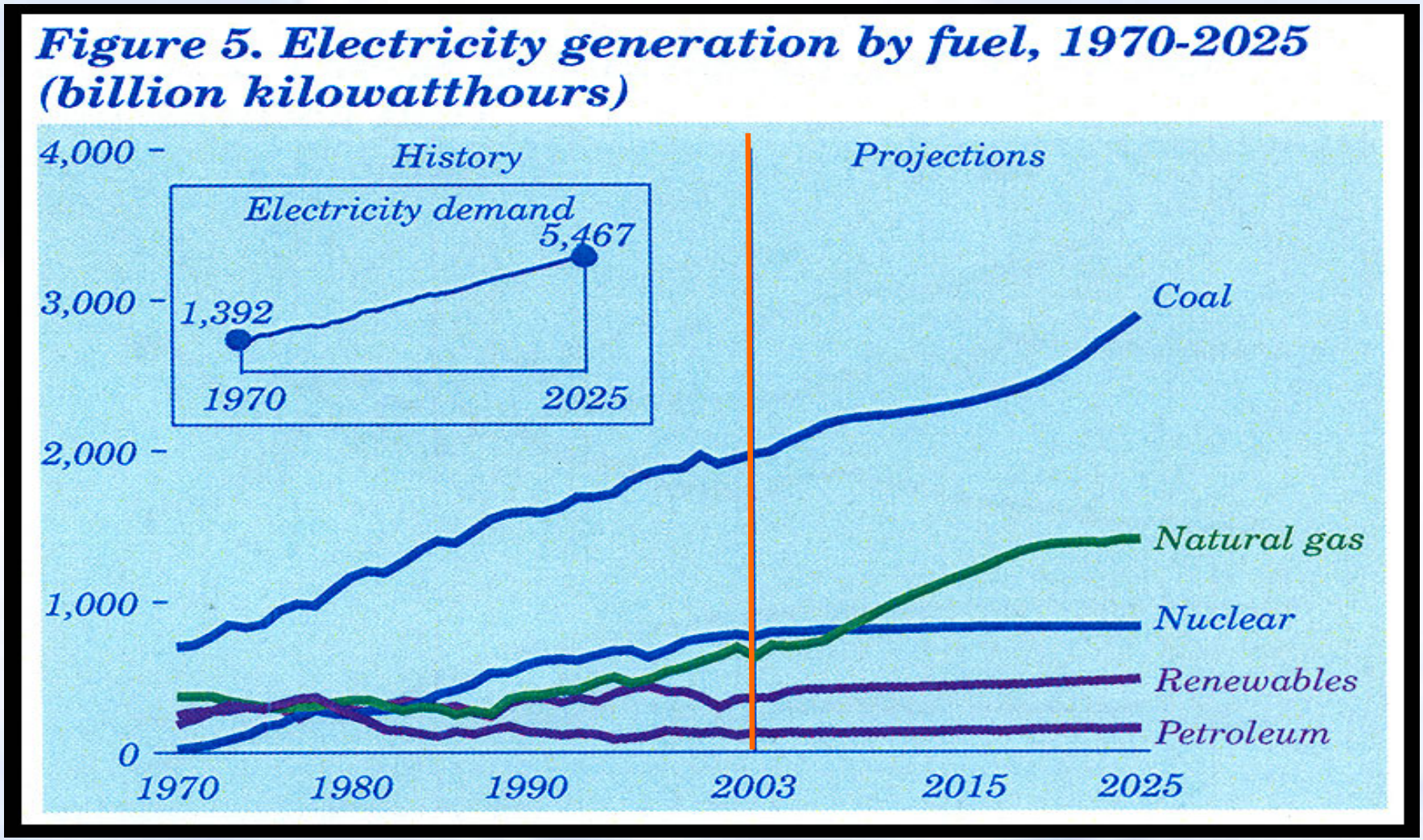
Presentation Overview

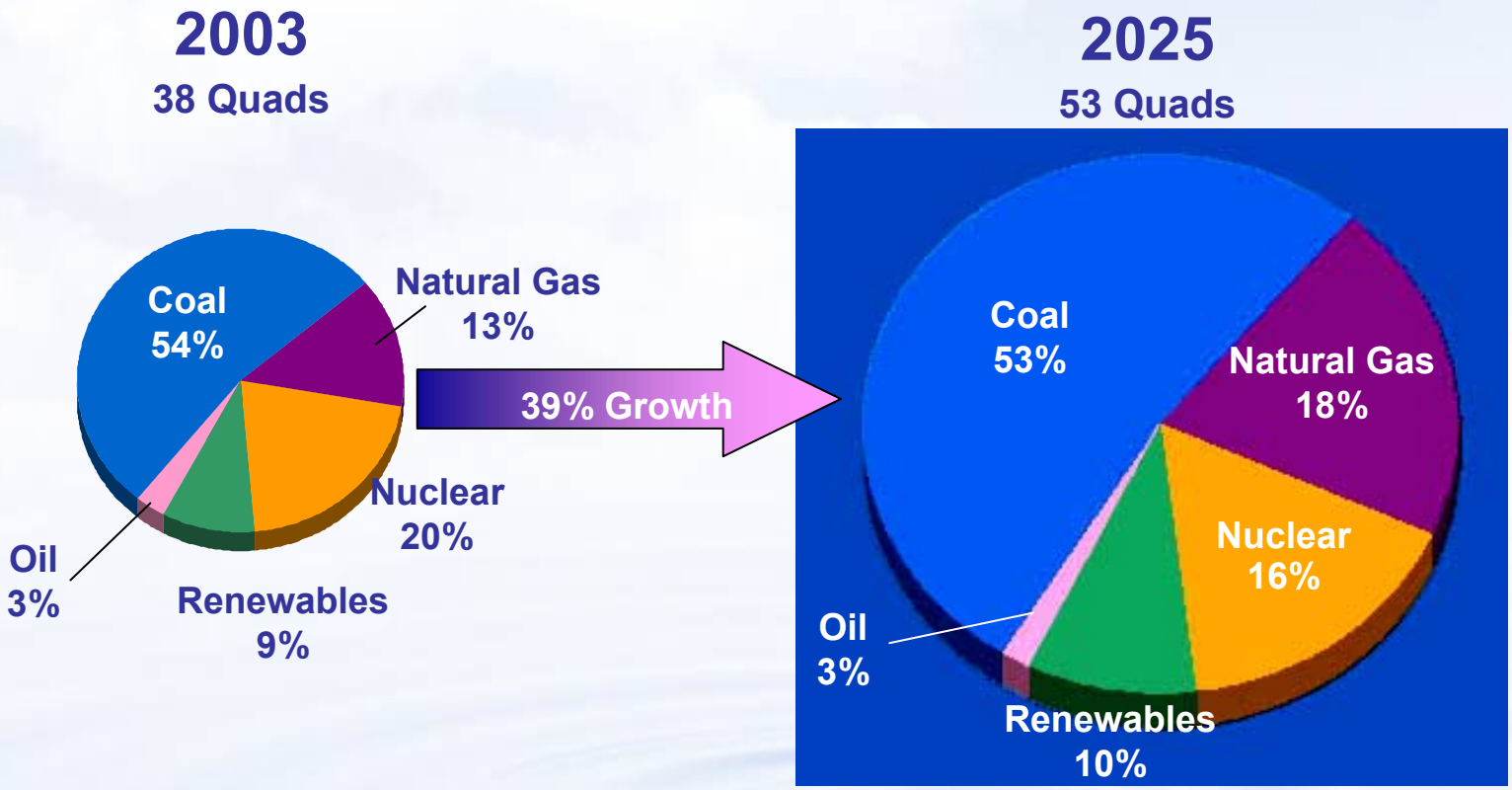
- Background / Future U.S. Energy Outlook
- What is FutureGen and why is it important?
- Supporting RD&D for FutureGen
- Schedule
- Progress to date
- Next Steps
- Summary

U.S. Electricity Outlook



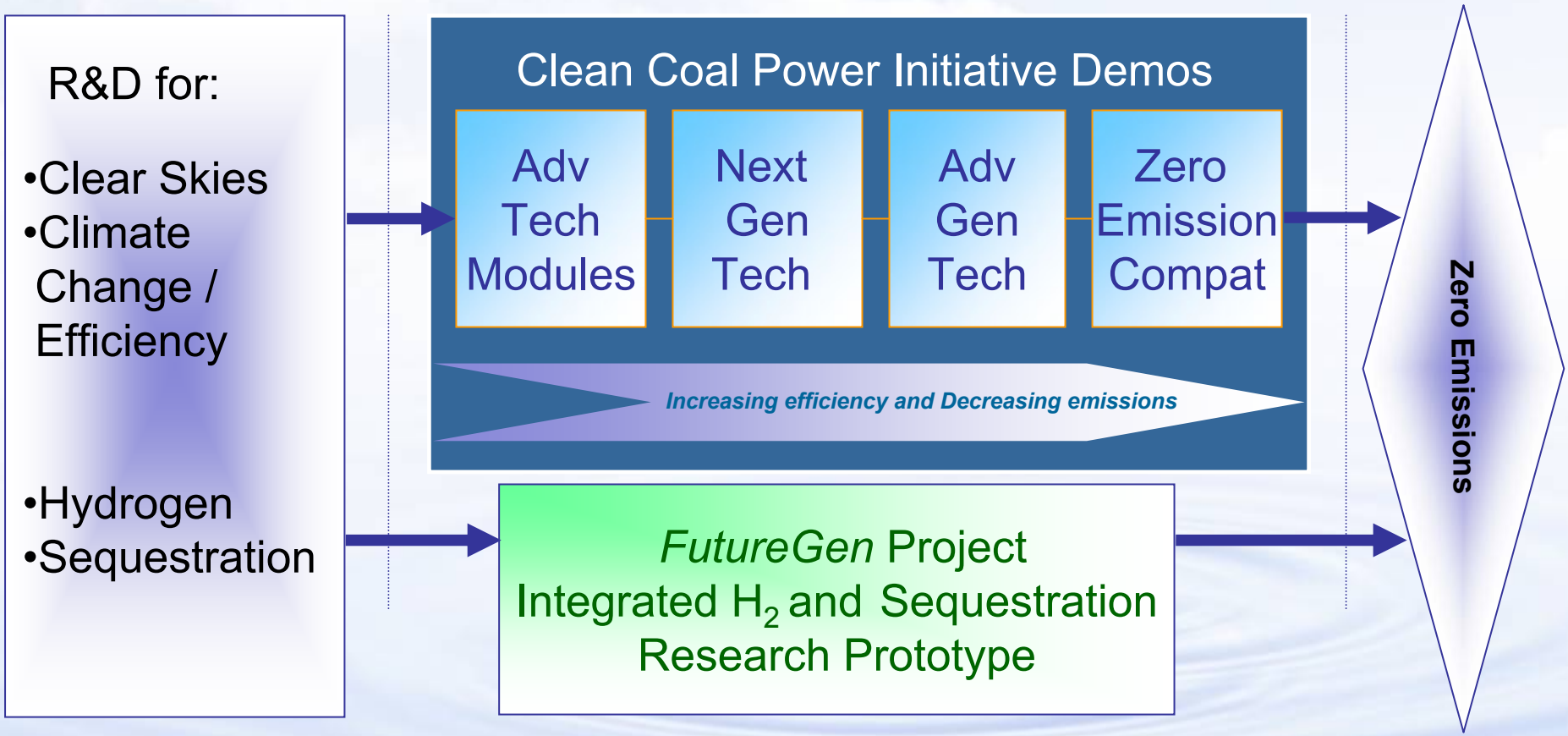
Source: Energy Information Administration (EIA), Annual Energy Outlook (2005)

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

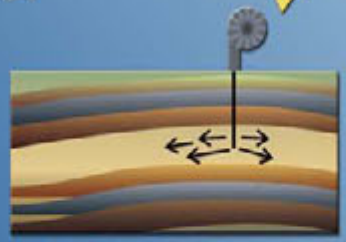
Energy Independence through Carbon Sequestration and Hydrogen

Coal Gasification-Based Power

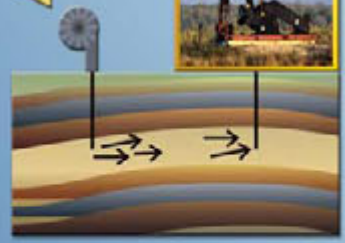
Electricity

Hydrogen Pipeline

CO_2 Pipeline



Geological Sequestration



Enhanced Oil Recovery

Oil Pipeline

Refinery

Confluence of Presidential Initiatives

Hydrogen Fuel Initiative

Clear Skies Initiative

Global Climate Change Initiative

- 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

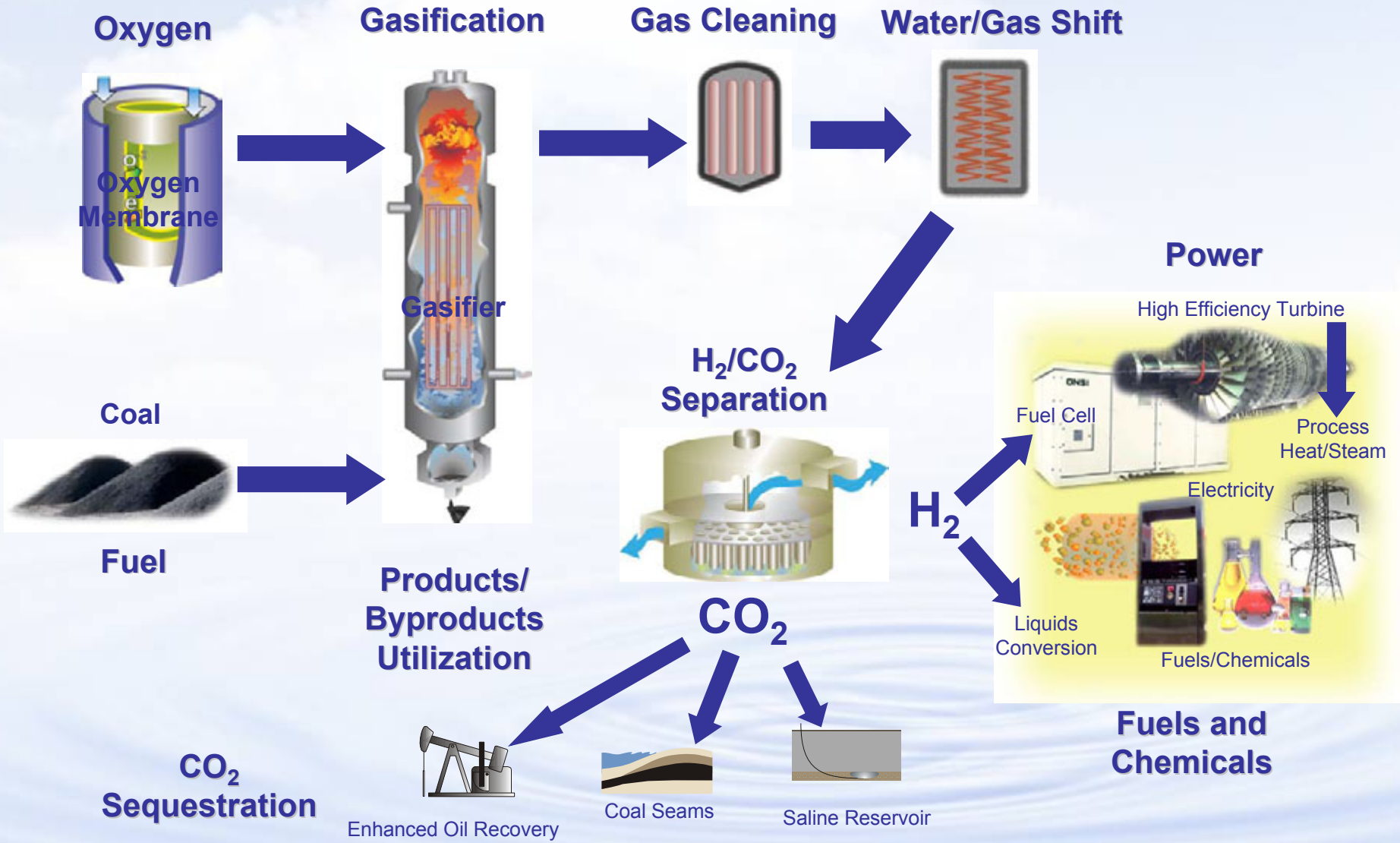
FutureGen Goals

- Design, construct and operate a 275 MW prototype plant that produces electricity and hydrogen fuel while sequestering CO_2 at an annual rate of 1-2 million metric tons.
- Sequester at least 90 percent of CO_2 initially and up to 100 percent sequestered eventually
- Prove the effectiveness, safety, and permanence of CO_2 sequestration through validating the technology at large scale under real world conditions.
- Establish technology standards and protocols for CO_2 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

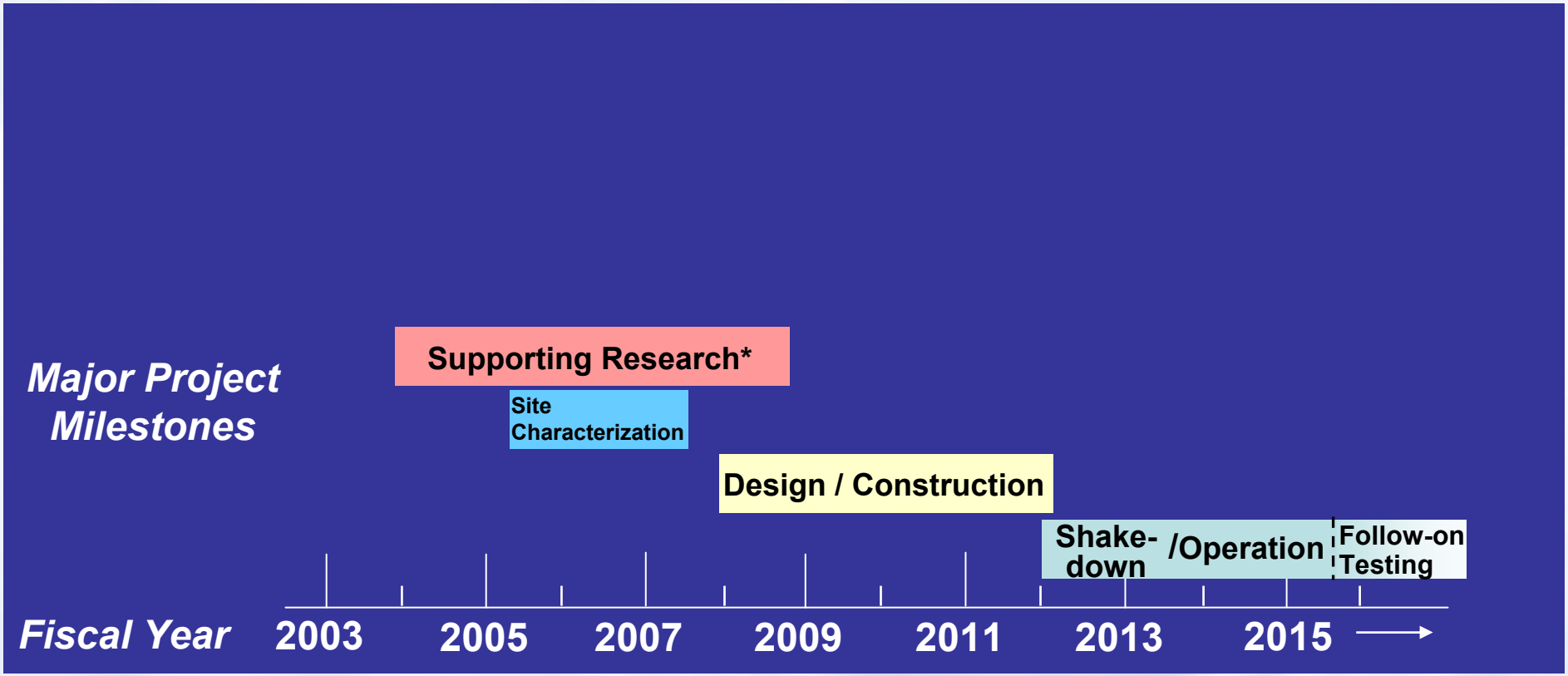
FutureGen Systems



RD&D to Meet Technology Challenge

Traditional Advanced Technology		Research Inventions
Cryogenic Separation	→	O_2 Membranes
Amine Scrubbers	→	H_2 Membranes, "Clathrate" CO_2 Separation or Advanced Selexol
Gas Stream Clean-Up	→	Raw Gas Shift Reactor
Syngas Turbine	→	Ultra-low NO_x Hydrogen Turbine
Fuel Cell ($4,000/kW)	→	SECA Fuel Cell ($400/kW design)
EOR based	→	Sequestration Technology (including in-situ CO_2 monitoring)
Existing Gasifier	→	Advanced Transport Reactor
System Integration	→	"First of a Kind" System Integration
Plant Controls	→	"Smart" Dynamic Plant Controls & CO_2 Management Systems

Project Schedule - Key Events



* 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.

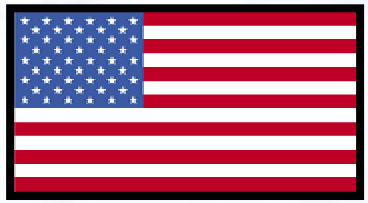
The FutureGen "Alliance"

- **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 initiative 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.climatescience.gov