FutureGen Status

7th Annual SECA WORKSHOP & PEER REVIEW

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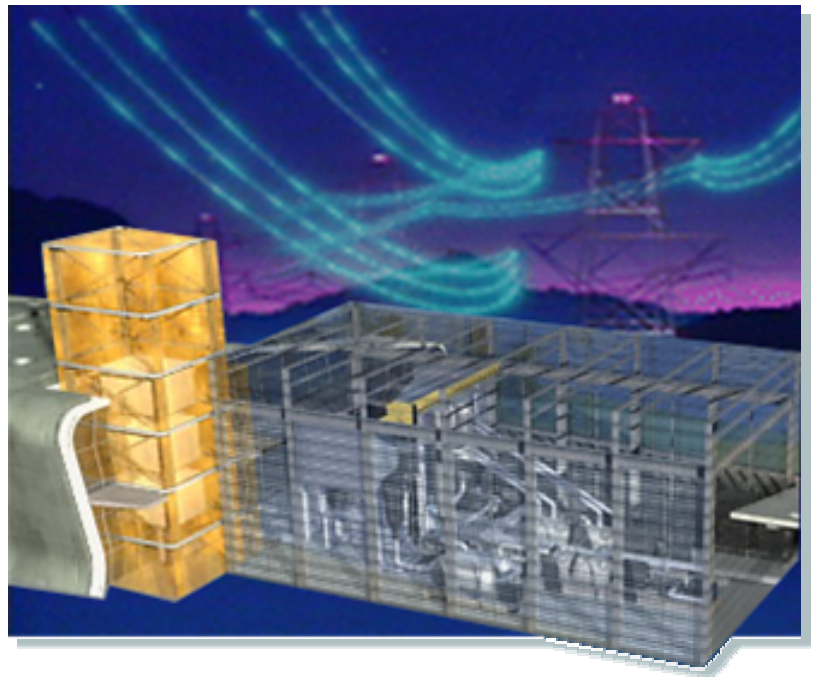
U. S. Department of Energy

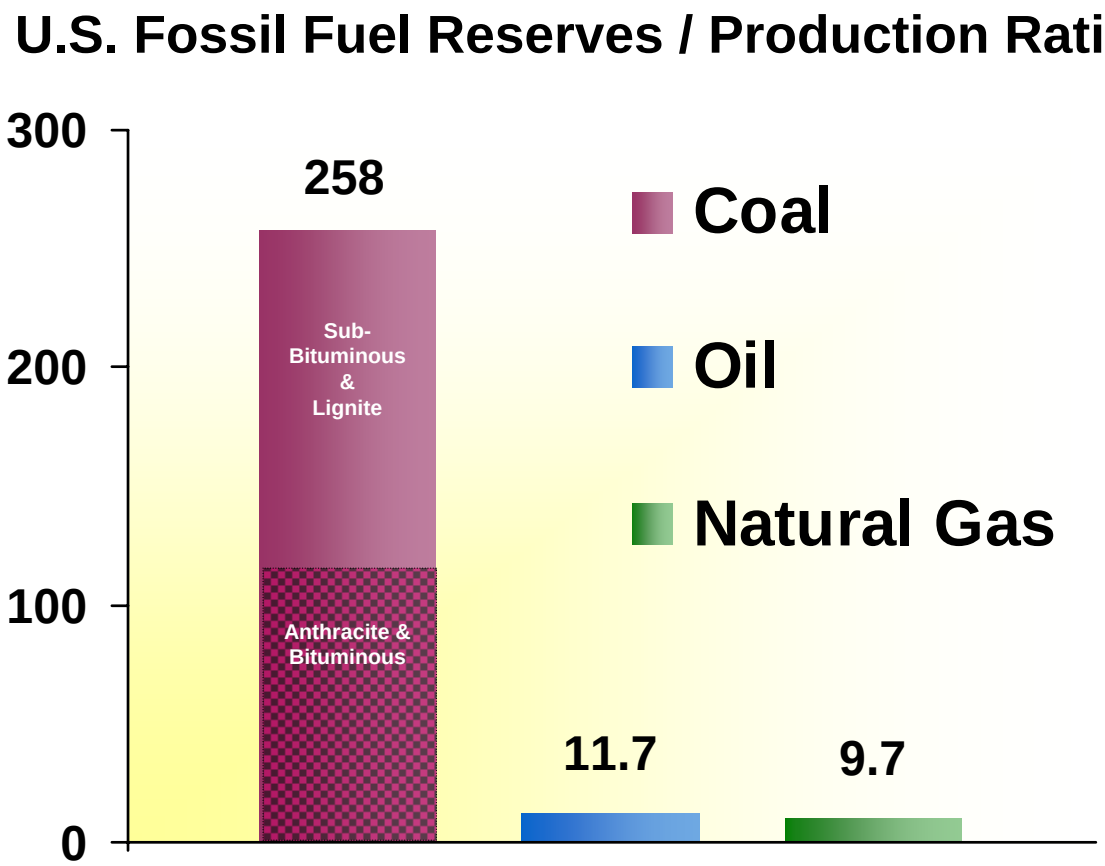
FutureGen

World's first near zero-emission, coal-based power plant to:

- **Pioneer advanced hydrogen production from coal**
- **Emit virtually no air pollutants**
- **Capture and permanently sequester carbon dioxide**
- **Integrate operations at full-scale – a key step to proving feasibility**

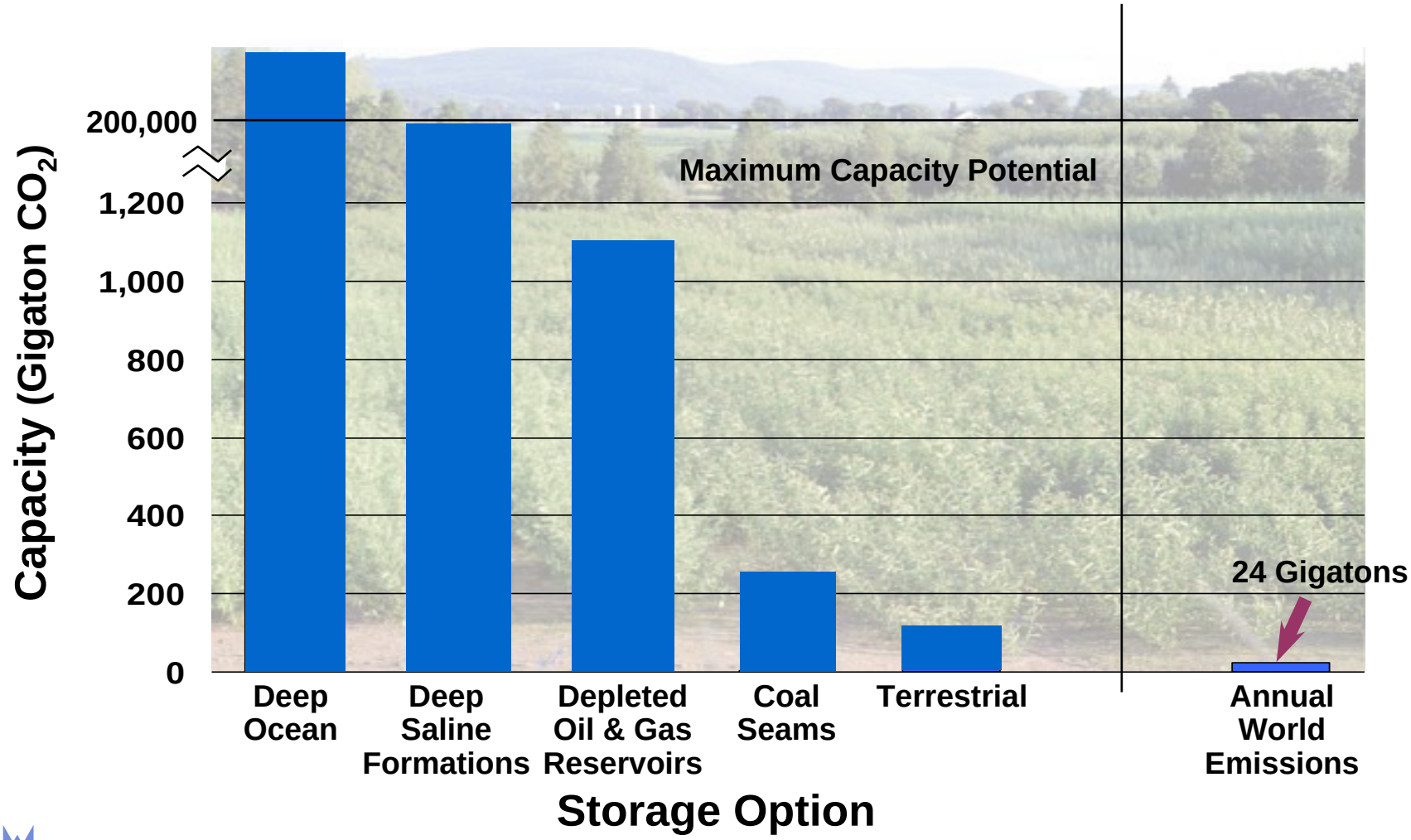


250 Year Supply of Coal at Current Demand Levels



Sources: BP Statistical Review, June 2004, - for coal reserves data - World Energy Council;
EIA, Advance Summary U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 2003 Annual Report, September 22, 2004 - for oil and gas reserves data

Large Potential Worldwide CO_2 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*

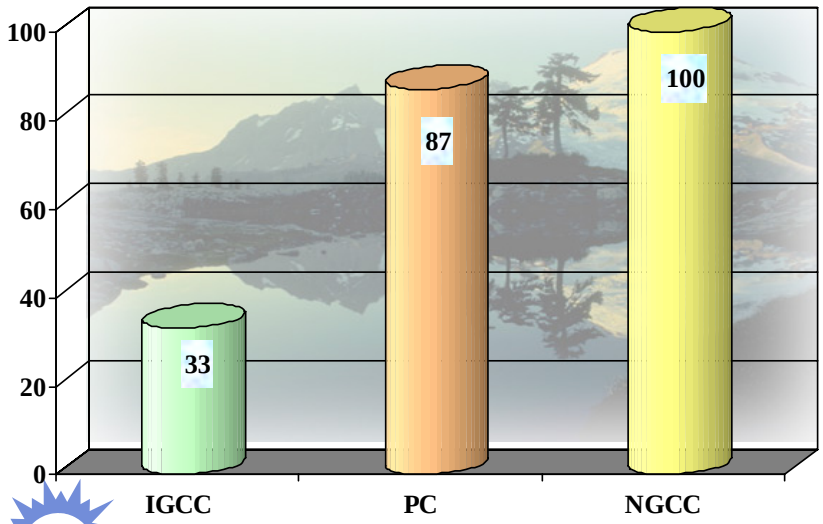
Current "Best Case" Technologies Costly

Using State-of-the-Art Scrubbing Technologies

- 5 to 30% Parasitic energy loss
- 30 to 100% Increase in capital cost
- ***25 to 100% Increase in cost of electricity***

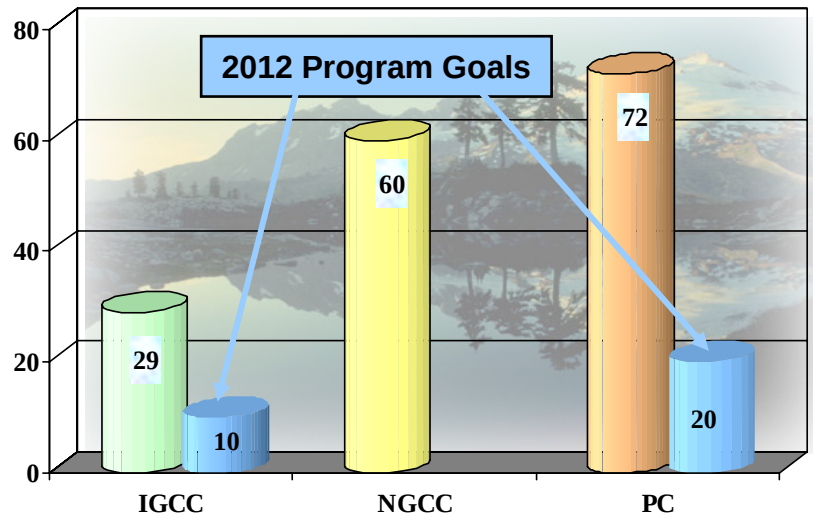
Effect of CO_2 Capture on Capital Cost

(% Increase Resulting From CO_2 Capture)



Effect of CO_2 Capture on Cost of Electricity

(% Increase Resulting From CO_2 Capture)



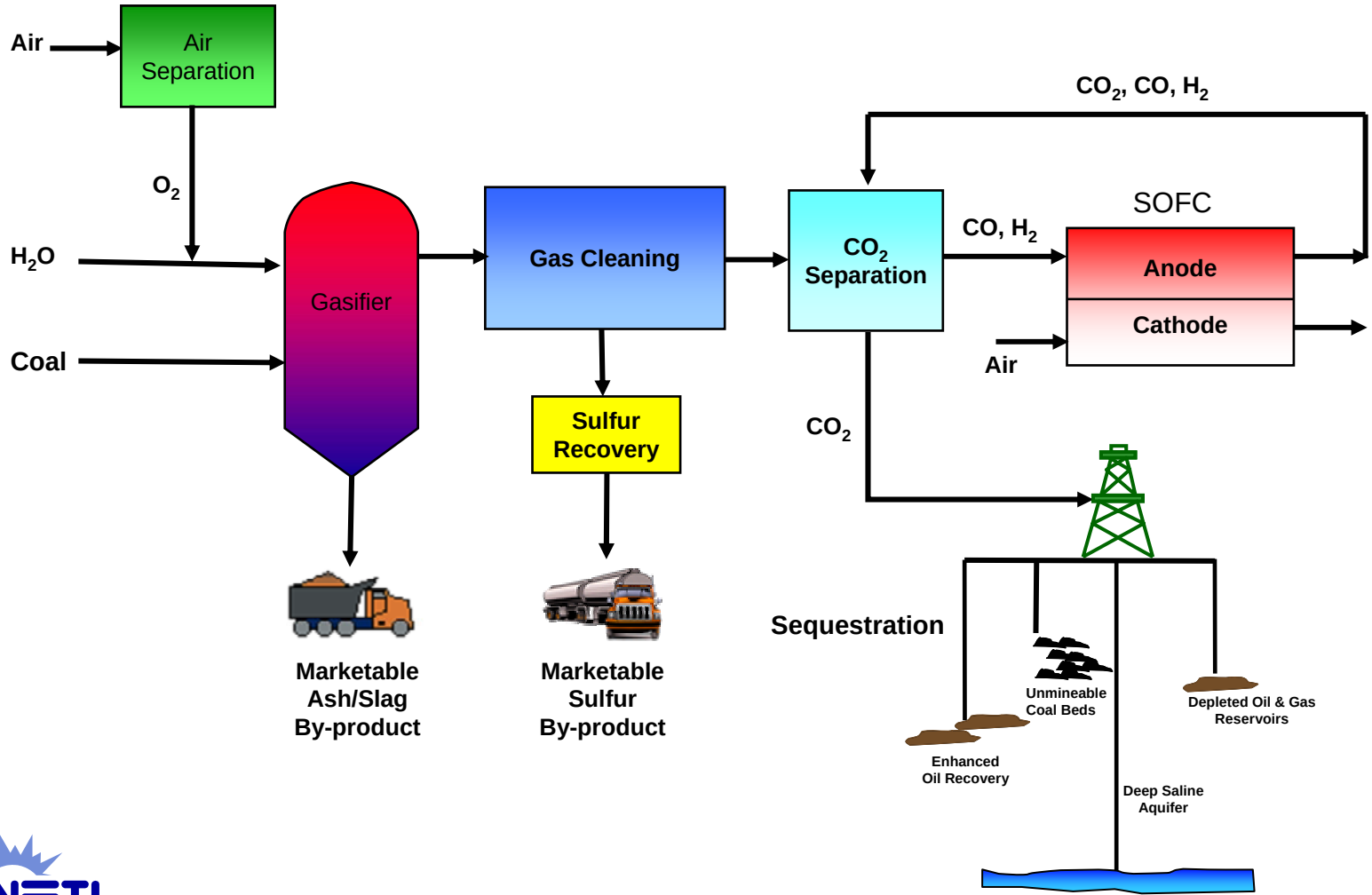
Why IGCC/IGFC?

R&D in the pipeline is reducing cost & improving efficiency

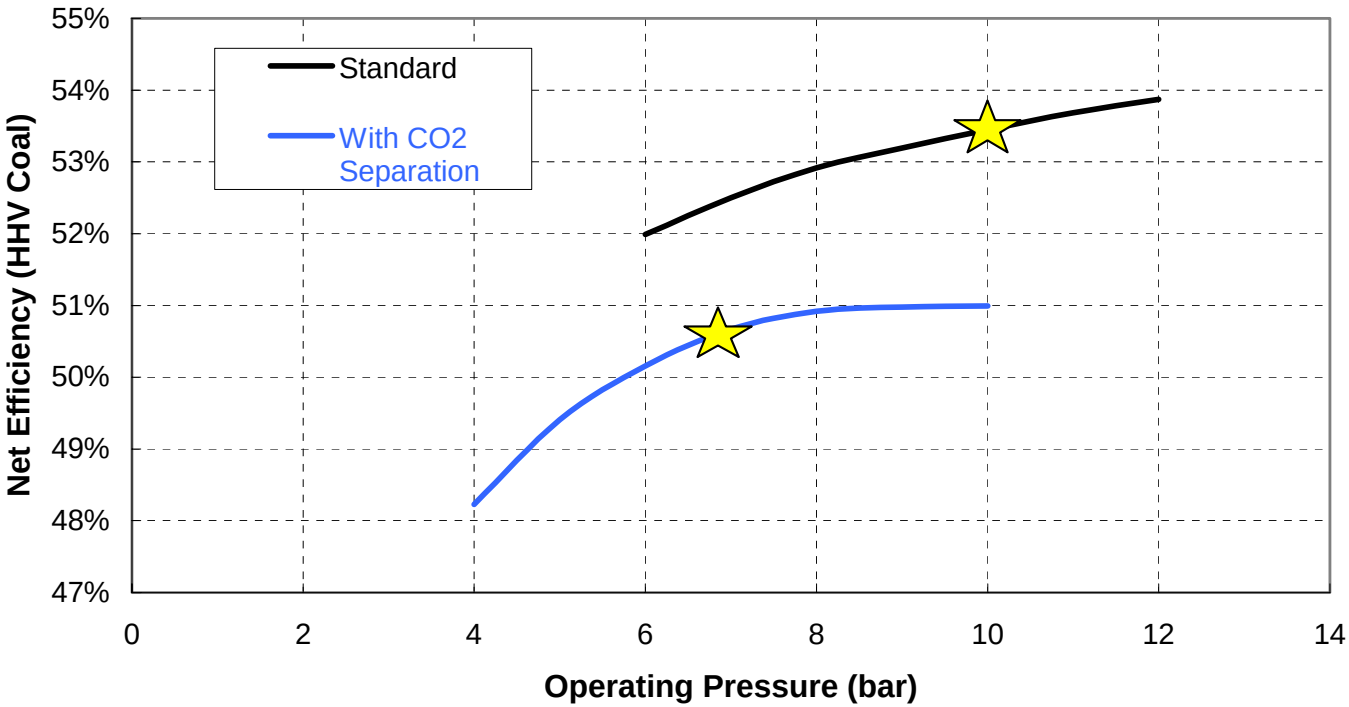
- **Gasifier/refractory material**
- **Low-cost oxygen**
- **Gas separation membranes**
- **Fuel cell power**

- **Environmentally superior coal-based power**
- **Easily adapted for CO_2 sequestration**
- **High efficiency**
- **Fuel & product flexibility**
- **Promising "coal-to-hydrogen" option**

FutureGen
IGFC with Sequestration



GE IGFC Study
Performance Summary



- 53.4% (HHV) Possible with IGFC
- CO_2 Separation penalty 2.7 points

FutureGen Will Build Upon Experience from Commercial-Scale Coal-Based IGCC Power Plants

Wabash River

- **W. Terre Haute, IN**
- **296 MWe (gross); 262 MWe (net)**
- **Operations began 11/95**

Tampa Electric

- **Mulberry, FL**
- **315 MWe (gross); 250 MWe (net)**
- **Operations began 9/96**

FutureGen Will Build on Two Non-Integrated One Million TPY CO_2 Sequestration Projects

Weyburn CO_2 EOR Project

- Pan Canadian Resources
- 200-mile CO_2 pipeline from Dakota Gasification Plant
- Enhanced Oil Recovery in Canada

Sleipner North Sea Project

- Statoil
- CO_2 sequestered - Utsira Formation
- Currently monitoring CO_2 migration
- Separates CO_2 from natural gas
- $36–50 / tonne CO_2 tax

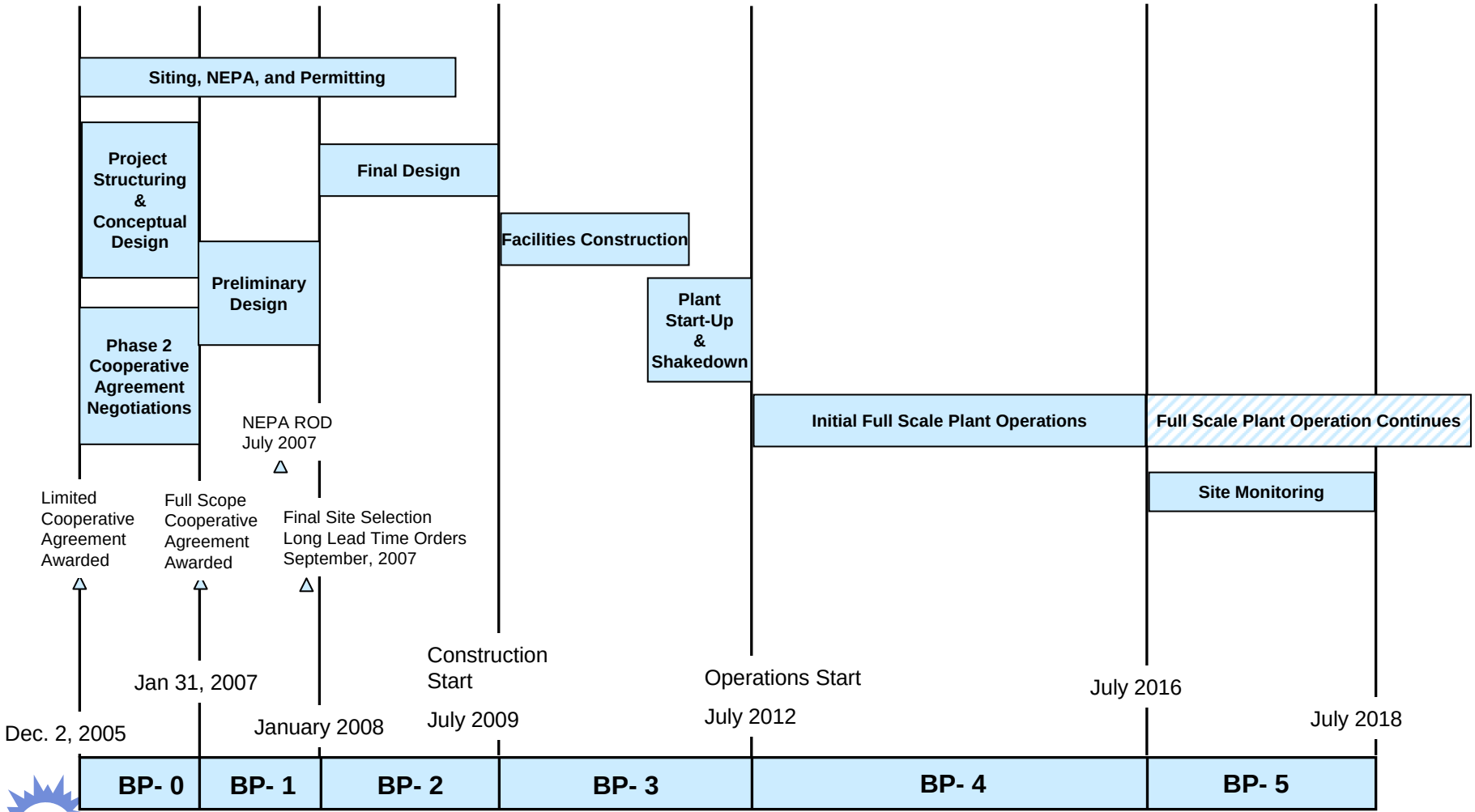
Cutting-Edge Candidate R&D Technologies for *FutureGen*

Traditional Technology	Research Invention Examples
Commercial Gasifier → → → → → →	Advanced Transport Reactor
Cryogenic Air Separation → → → → → →	O_2 Membranes
Gas Stream Clean-Up → → → → → →	Warm Gas Cleanup - Transport Desulfurizer
Amine Scrubbers → → → → → → →	H_2 Membranes, "Clathrate" CO_2
Syngas Turbine → → → → → → →	Ultra-Low NO_x Hydrogen Turbine
Fuel Cell ($4,000/kW) → → → → → →	SECA Fuel Cell ($400/kW Design)
EOR Based → → → → → → → →	Sequestration Technology
Plant Controls → → → → → → →	"Smart" Dynamic Plant Controls & CO_2 Management Systems
System Integration → → → → → →	"First of a Kind" System Integration

FutureGen Industrial Alliance, Inc.
Signed Cooperative Agreement with DOE on Dec. 2, 2005

- American Electric Power
- AngloAmerican
- BHP Billiton
- China Huaneng Group
- CONSOL Energy
- Foundation Coal
- Peabody Energy
- PPL
- Rio Tinto Energy America
- Southern Company

FutureGen Project Schedule



FutureGen Funds / Estimated Costs

Cost Elements	$ Million
Plant Definition, Baselining & NEPA	81
Plant Procurement & Construction	480
Shakedown & Full-Scale Operation	188
Sequestration (Design & Construction)	191
Site Monitoring	10
TOTAL	$950

DOE	620
Industry	250
International	80

FutureGen Status

- Industry-led cooperative project with government oversight & international participation
- Industry will choose project site, backbone technologies, etc.
- DOE has invited other nations to join *FutureGen*
- Gov’ts of India & South Korea have each pledged $10 Million

FutureGen Public Scoping Meetings

Jewett, TX – Aug. 22, 2006

Odessa, TX – Aug. 24, 2006

Tuscola, IL – Aug. 29, 2006

Mattoon, IL – Aug. 31, 2006

Visit the *FutureGen* Websites

- **NETL website:**
  - www.netl.doe.gov
- **Office of Fossil Energy website:**
  - ww.fe.doe.gov
- **FutureGen Alliance website:**
  - www.futuregenalliance.org