

The background of the slide is a photograph of an industrial gasification plant at night. The scene is filled with large cylindrical vessels, complex piping, and scaffolding, all illuminated by warm yellow lights against a dark blue twilight sky. The text is overlaid on this image.

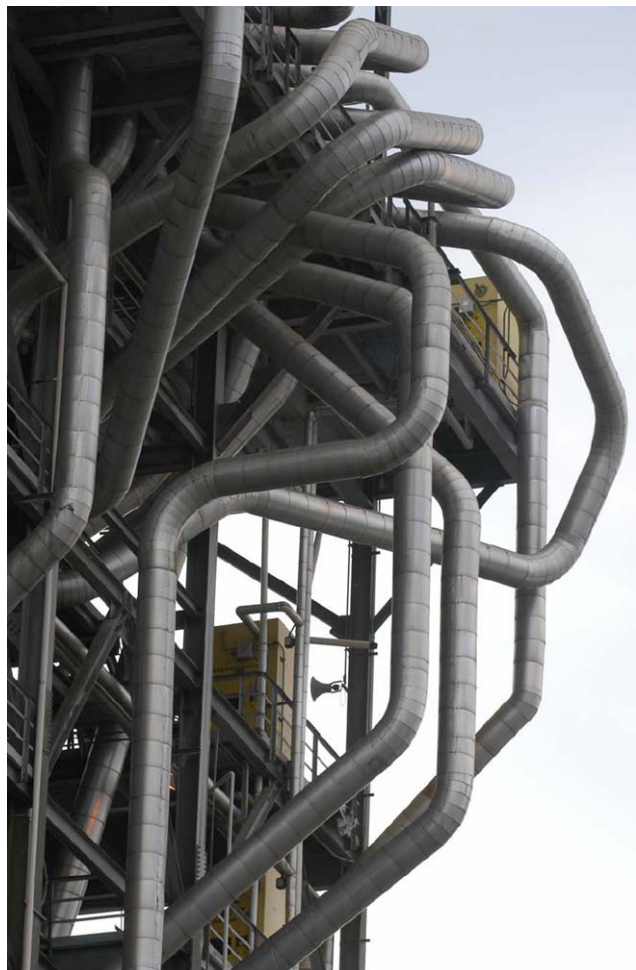
# Market Opportunities for Substitute Natural Gas (SNG) via Gasification

*Gasification Technology Council Workshop  
March 14, 2008  
Tampa, Florida*

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# Outline

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1. E-Gas™ Technology
2. SNG Drivers
3. Plant Design & Performance
4. Projects and Enablers

# E-Gas™ Gasification Technology Commercial Feedstock Offerings and Gasifier Scale-up

Single-Train Commercial Operation

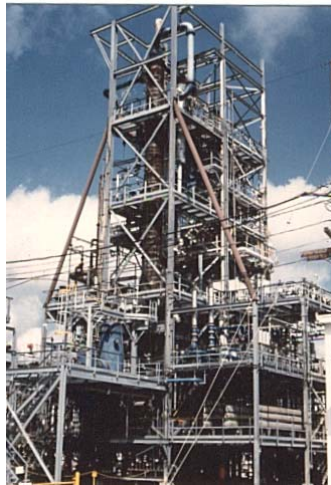
Large Demonstration

Basic R&D

Bench-Scale,  
Mini Plant,  
Pilot Plant  
1975 - 1982  
36 TPD



Proto 1  
1979 - 1983  
400 TPD



Lignite

Proto 2  
1983 - 1987  
1600 TPD



Sub-Bituminous Coal  
(Rochelle Mine)

LGTI  
1987 - 1995  
2,400 TPD



Bituminous Coal  
(Illinois No. 6)

Wabash River  
1995 - 2000  
2,500 TPD

Wabash River  
2000 - Present  
2,000 TPD



Petroleum Coke  
(Multiple Refineries)

30+ Years of Continuous Improvement

# WABASH RIVER IGCC PLANT

*One of the Cleanest  
Solid Fuel Power Plants  
in the World*



- Fuel flexibility
  - ✓ 1.7 million tons of bituminous coal
  - ✓ Over 2 million tons of petcoke
- 2500 ton/day bituminous coal feed
- Operational since 1995 at Duke Energy's Wabash River Station
- 262 MWe net output by repowering 1953-vintage PC 100MW STG (+ GTG)
- SG Solutions, LLC owns Syngas Plant
- Wabash Valley Power owns Power Block
- ConocoPhillips provides technical and professional services on site

# Wabash River IGCC

Gas  
Turbine

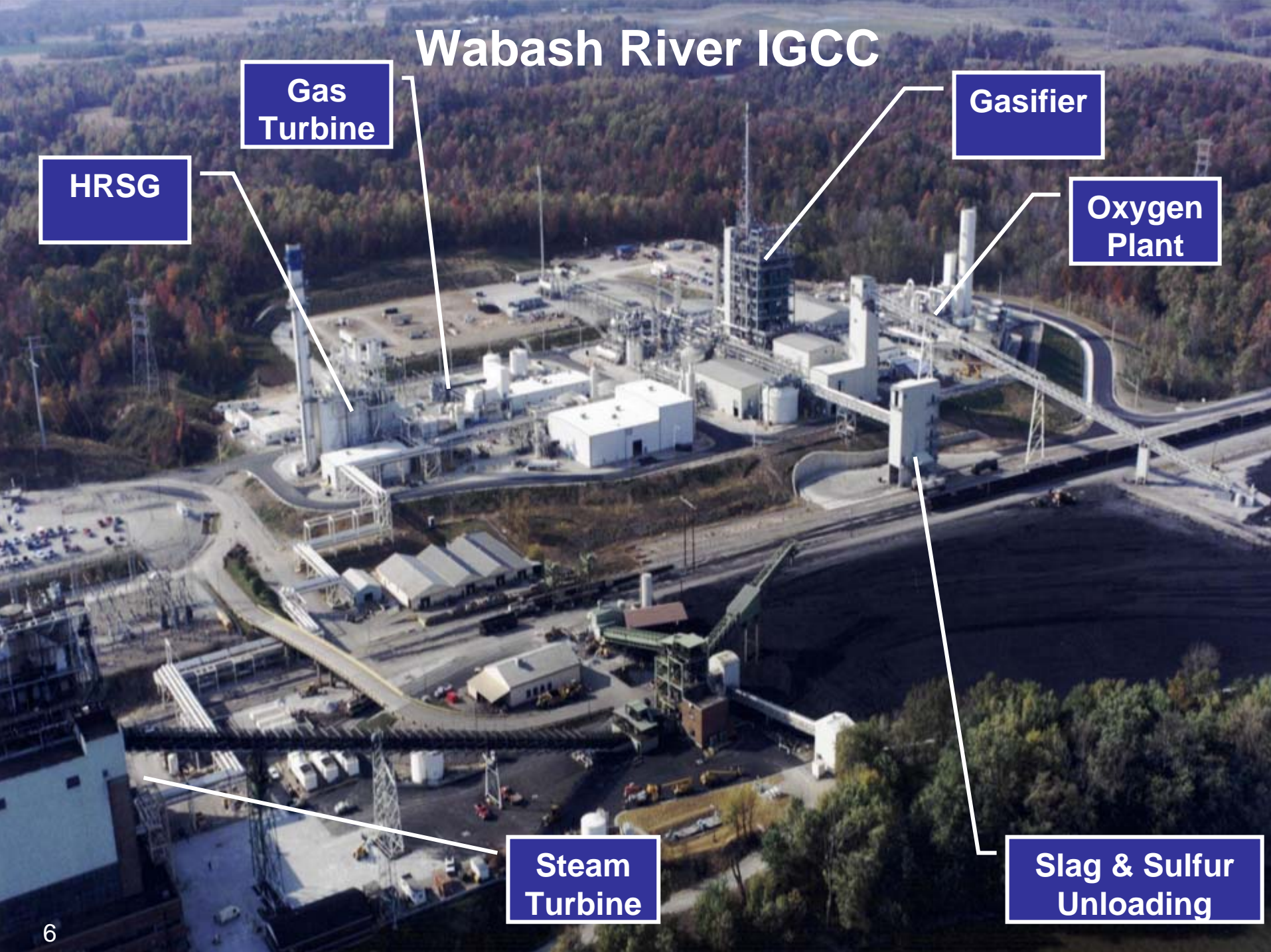
Gasifier

Oxygen  
Plant

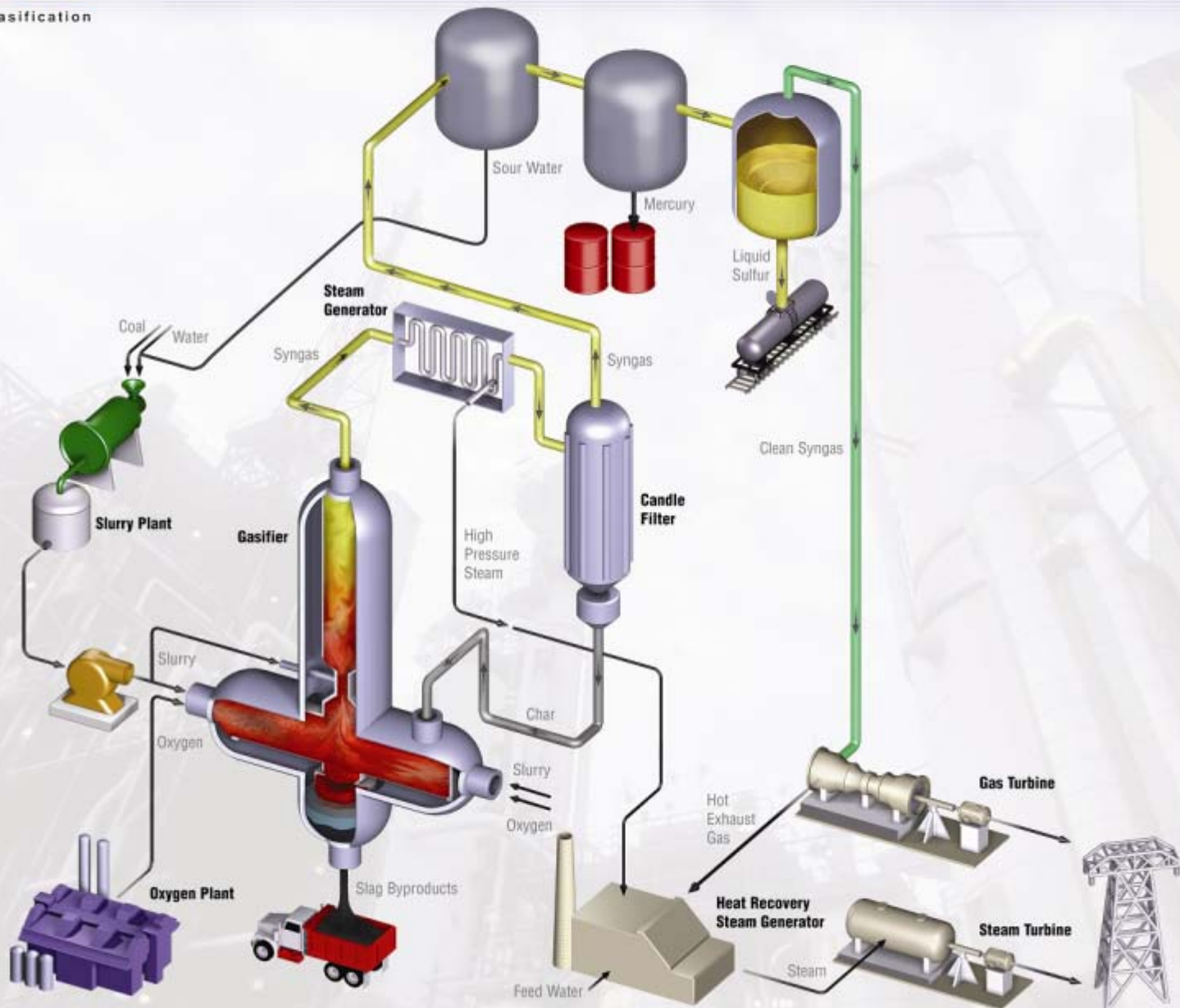
HRSG

Steam  
Turbine

Slag & Sulfur  
Unloading



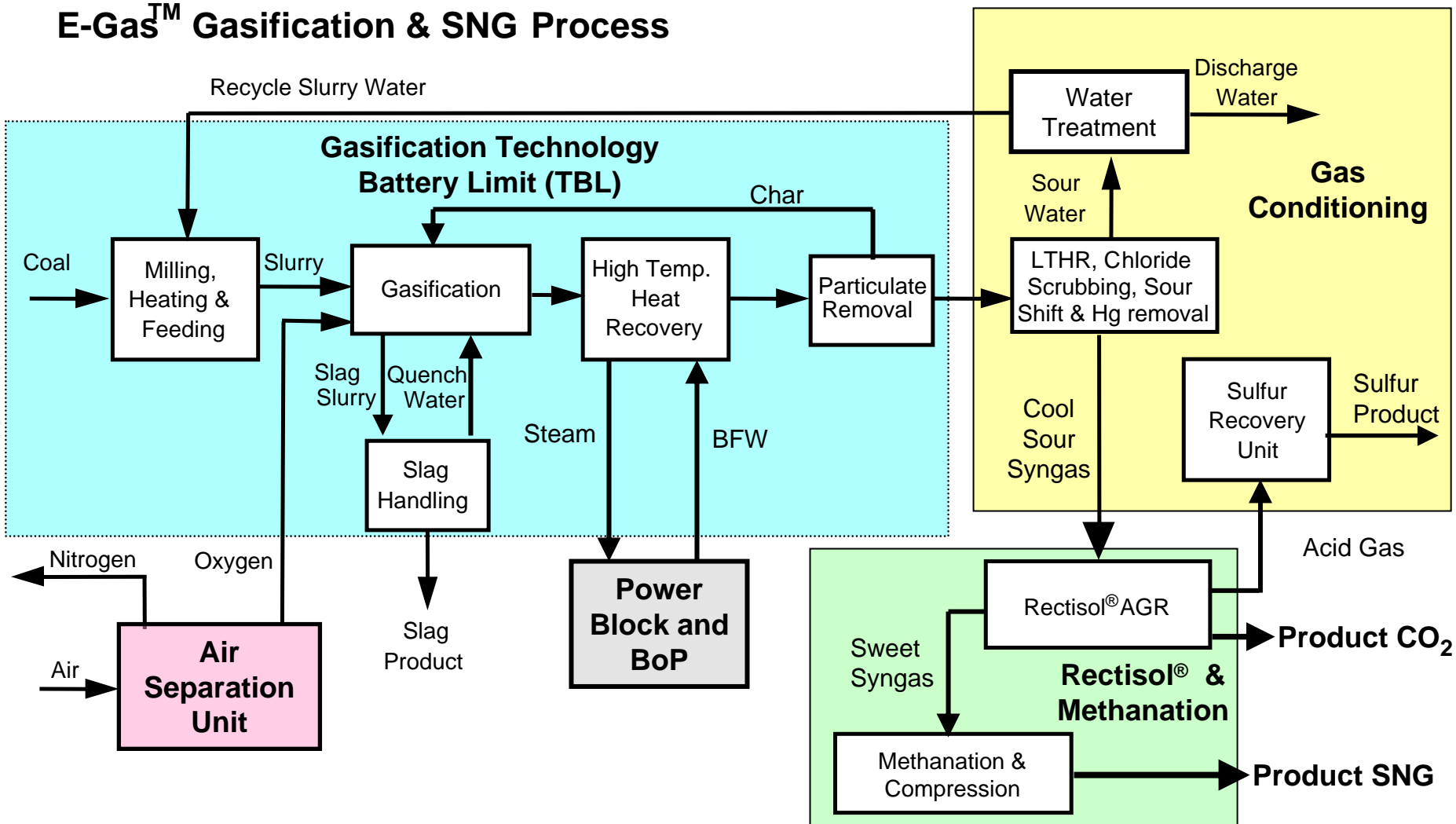
## A Look Inside the Process



# Simplified Block Flow Diagram

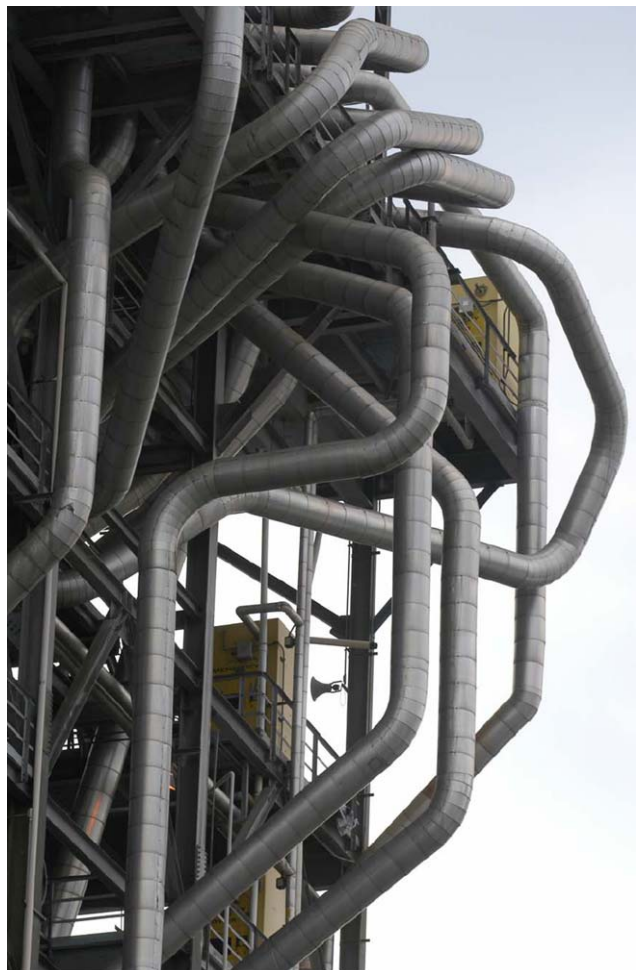
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## E-Gas™ Gasification & SNG Process



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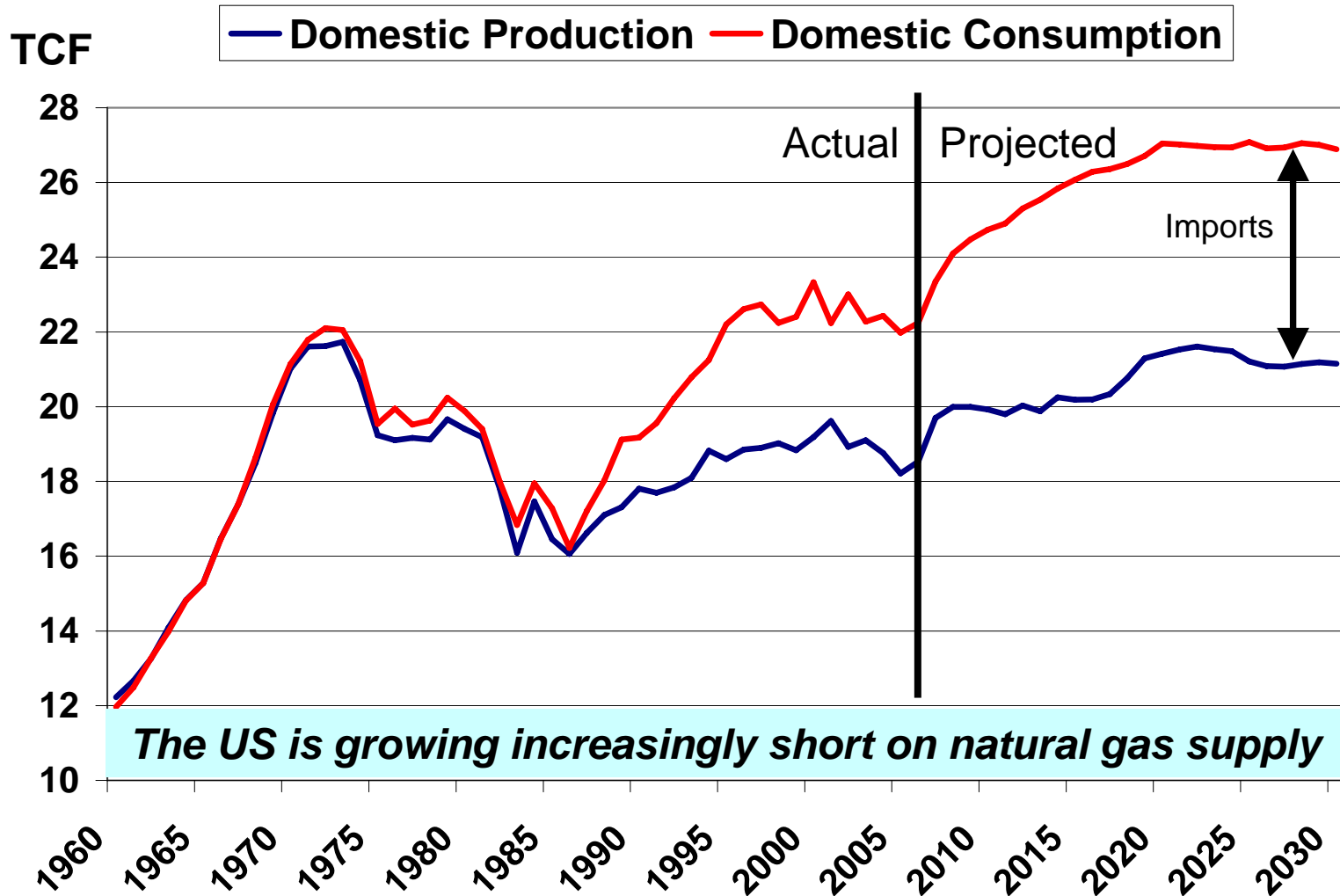
# US Drivers for Substitute Natural Gas

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- ✓ USA is short on natural gas and very long on coal
- ✓ Gasification technology can augment North American natural gas supplies and LNG imports
- ✓ Adds value to US coal reserves
- ✓ Increased energy diversity
- ✓ National energy security implications
- ✓ Existing Infrastructure of pipelines and combustion turbines
- ✓ Method to reduce carbon penalty associated with coal

# Domestic Natural Gas Production Falling Short of Demand

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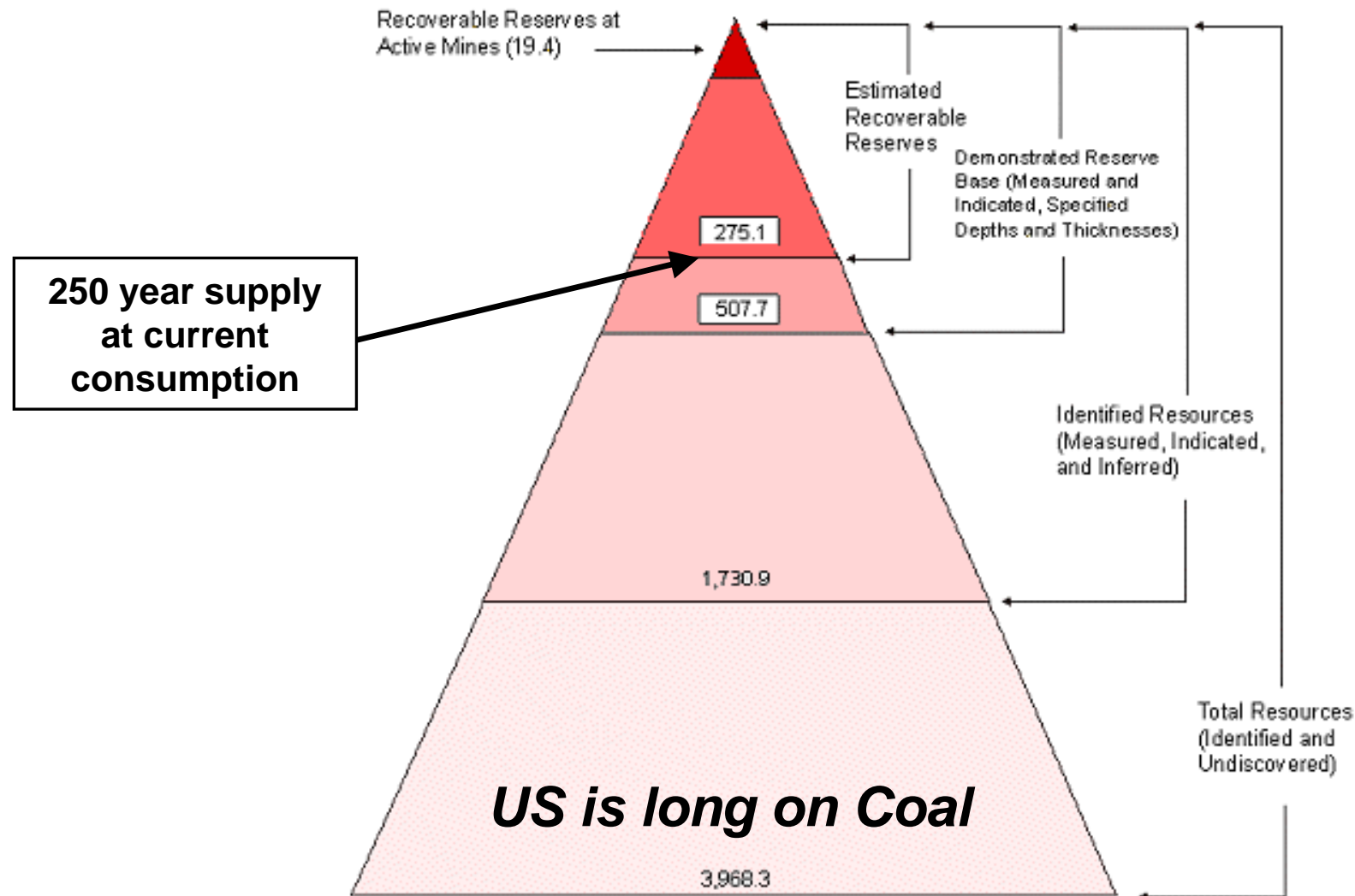


Source: DOE/EIA-Report#0383 (2007) & EIA Annual Energy Review (2007)

# Delineation of U.S. Coal Resources and Reserves

(In Billions of Tons)

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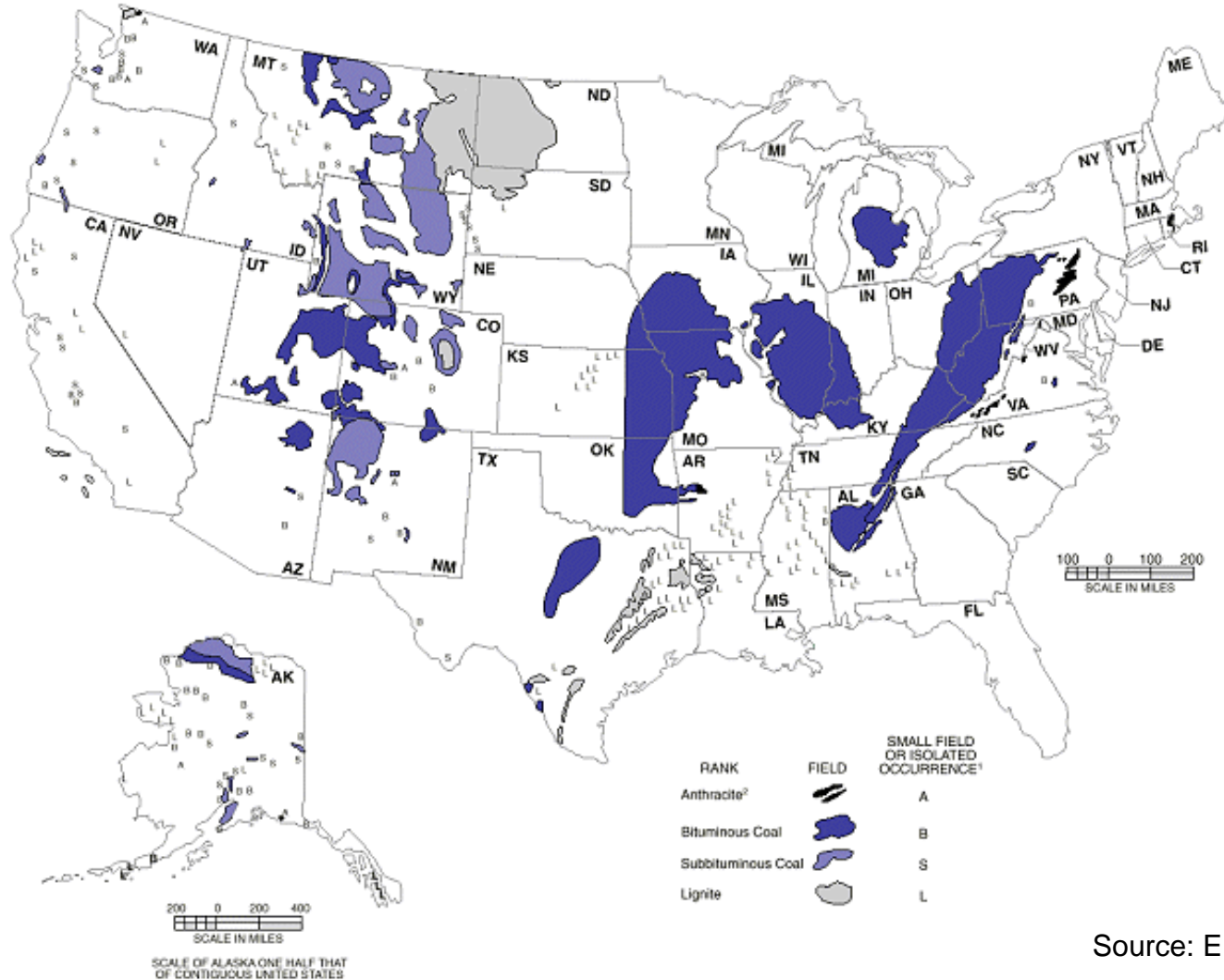
Source: EIA Coal Reserves Data, 1997



Technology for Gasification

# Coal Bearing Areas of the US

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Source: EIA

***“Illinois coal resources hold more BTUs than all of Saudi Arabia's and Kuwait's oil reserves combined.” - ISGS***

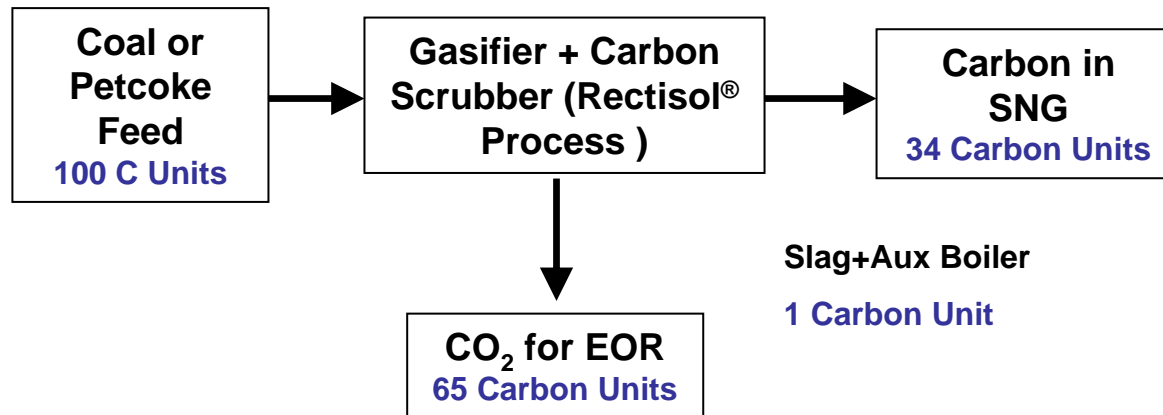
# SNG Process Scrubs Carbon from Coal

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Carbon capture for enhanced oil recovery is a “potential” application

- Reasonable proximity to oil fields required
- Improves project economics
- Increases life of existing oil fields
- Scrubs approximately 65% of the carbon from the feedstock
- Increases environmental attractiveness

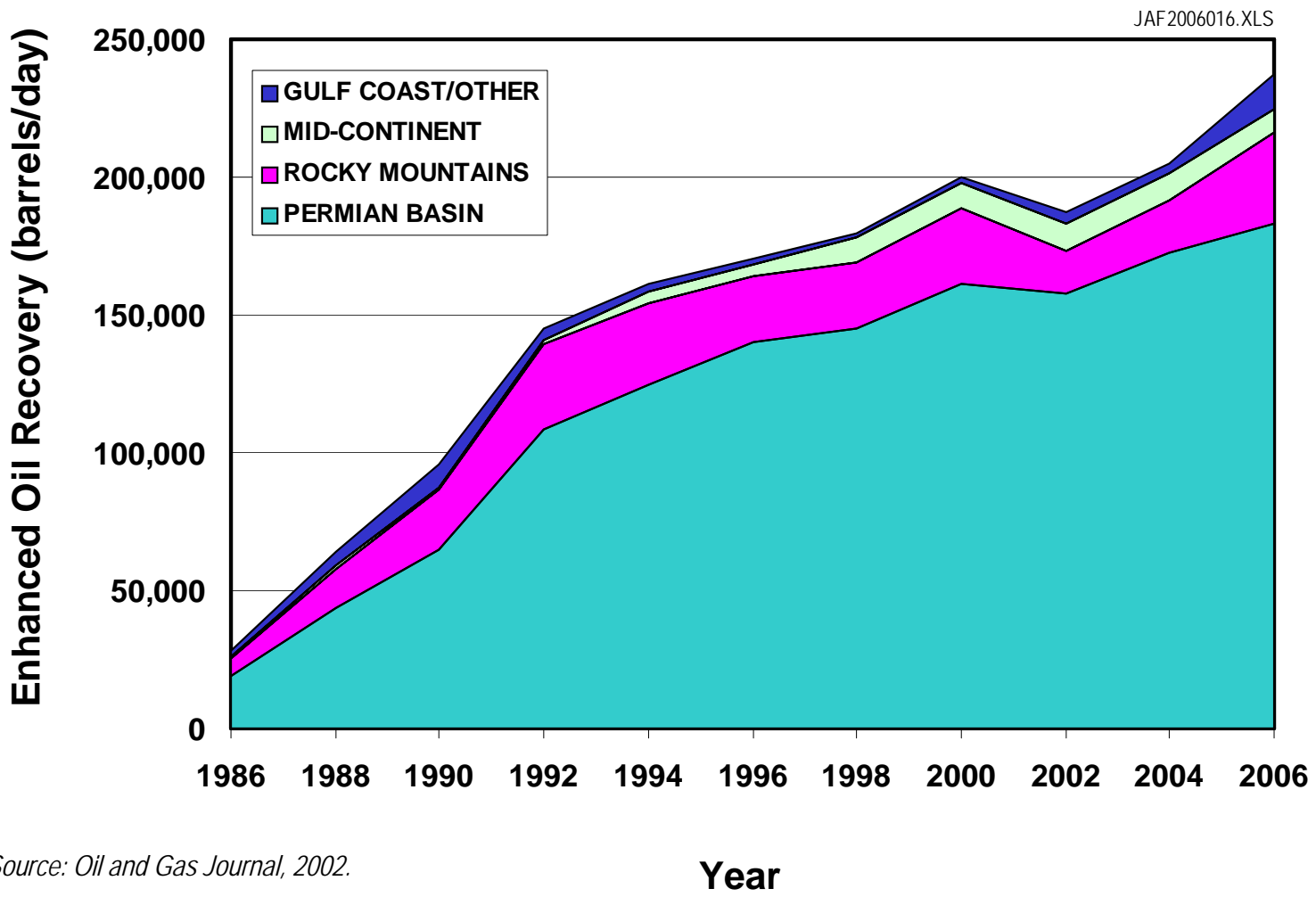
## Carbon Balance



**65% of carbon in feedstock can be captured with SNG**

# Enhanced Oil Recovery in U.S. is Growing Again

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Source: Oil and Gas Journal, 2002.



# US Market Potential - Purchased CO<sub>2</sub> for EOR

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Technically Recoverable with “State-of-the-Art” CO<sub>2</sub>-EOR Technology

Basin/Area	Technically Recoverable (Billion Barrels)	Purchased CO <sub>2</sub> (Tcf)
1. Alaska	12.4	51.4
2. California	5.2	23.9
3. Gulf Coast	6.9	33.3
4. Mid-Continent	11.8	36.3
5. Illinois/Michigan	1.5	5.7
6. Permian	20.8	95.1
7. Rockies	4.2	27.5
8. Texas, East/Central	17.3	62.0
9. Williston	2.7	10.8
10. Louisiana Offshore (Shelf)	5.9	31.0
Total	88.7	377.1*

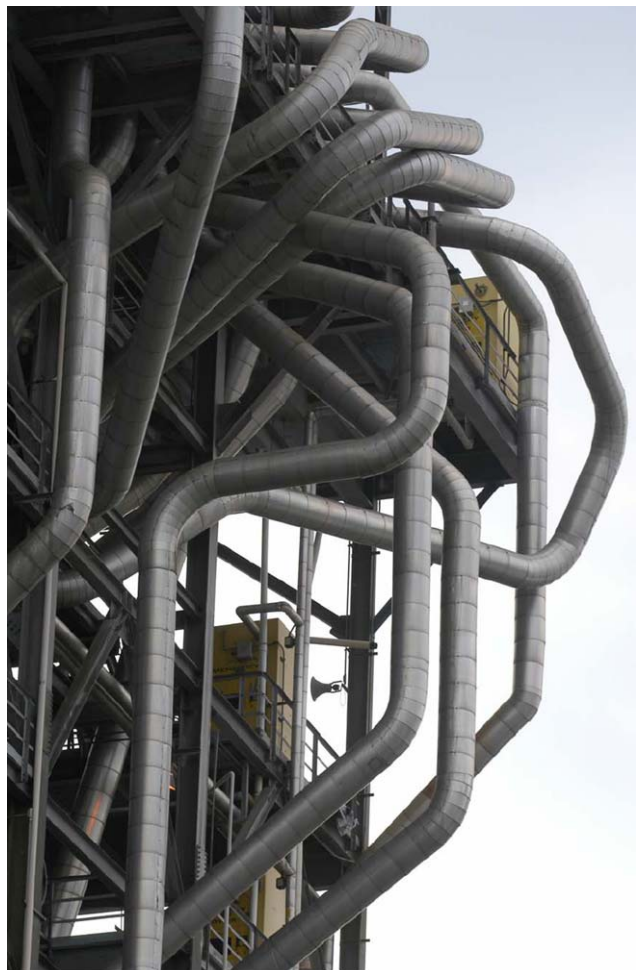
\*Equal to 20 billion metric tons.

Source: Advanced Resources Int'l, 2006.



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# SNG Design Basis

Fixed gasifier size for all cases

3 x 50% gasification train plant

12 hours of LOX storage

High reliability

High purity oxygen (99.5%)

CO shift

Hg removal

Rectisol® acid gas recovery

Claus sulfur recovery unit

Commercial methanation

SNG delivery pressure 900 psi

CO<sub>2</sub> compression to 2000 psi

Case	Feedstock	Location
1	Petcoke	Gulf Coast
2	IL#6 Coal	Midwest
3	PRB	Wyoming
CO <sub>2</sub> capture option evaluated		

# Feedstock Parameters

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<b>Feedstock</b>	<b>Petcoke</b>	<b>IL #6</b>	<b>PRB</b>
<b>Location</b>	Gulf Coast	Midwest Minemouth	Wyoming Minemouth
<b>HHV, Btu/lb (As Rec'd)</b>	13,699	11,053	8,800
<b>Composition:</b>			
<b>Carbon (dry basis), wt%</b>	87.3	70.1	70.2
<b>Hydrogen (dry basis), wt%</b>	3.7	4.7	5.3
<b>Sulfur (dry basis), wt%</b>	6.3	2.7	1.2
<b>Nitrogen (dry basis), wt%</b>	1.3	0.3	1.1
<b>Ash (As Rec'd), wt%</b>	0.63	11.08	6.8
<b>Moisture (As Rec'd), wt%</b>	9.9	13.7	26.9

# Expected Performance Results

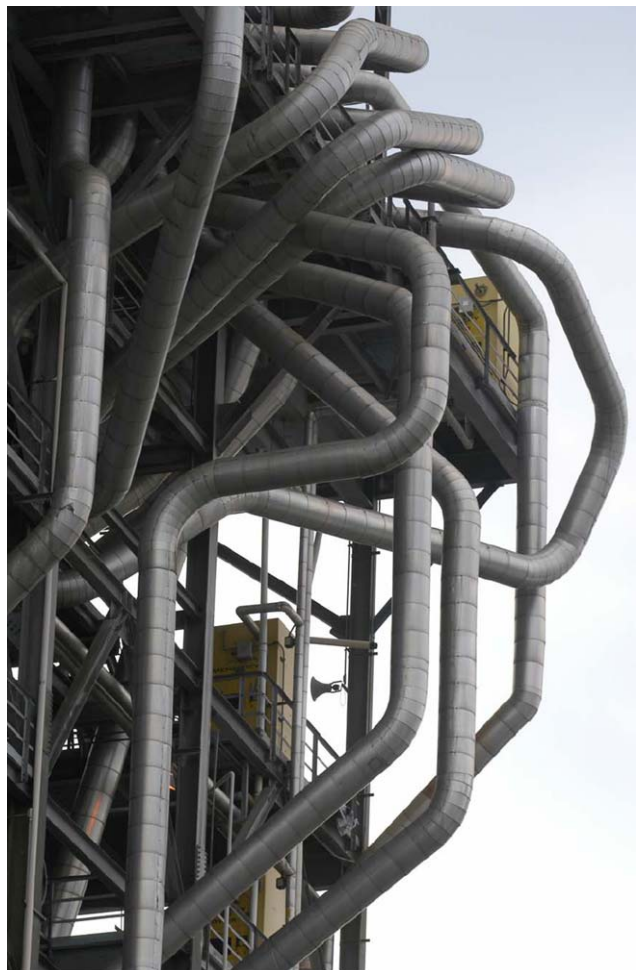
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	<b>Petcoke</b>	<b>IL#6</b>	<b>PRB</b>
Feedrate (TPD)	6,300	7,000	8,300
Gross Power	160	155	165
Net Power* (MW)	20	35	30
SNG Product (MMSCFD)	115	100	90
Product Yield (MCF/ton)	18	14	11
CO <sub>2</sub> product (MMSCFD)	190	160	170

\* Net power reduced by approximately 15MW in CO<sub>2</sub> capture case

# Outline

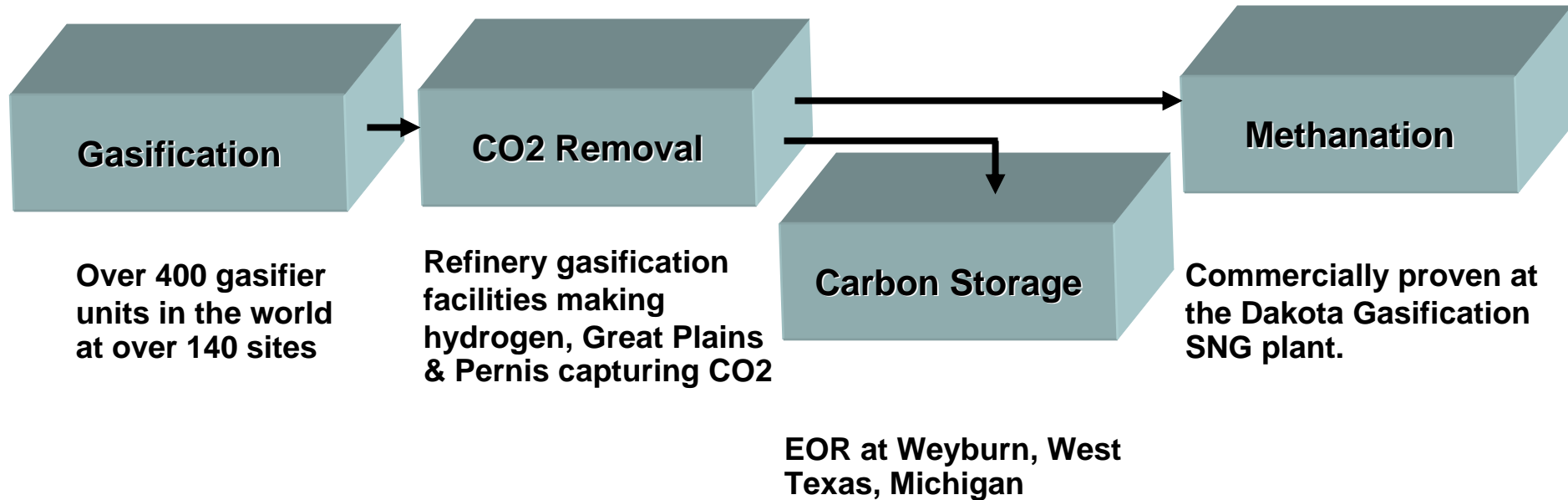
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# The Technology is Available

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# Dakota Gasification Company



- Largest commercial SNG plant in the world
- Operational since 1984
- Approximately 45 BCF of annual SNG production
- Approximately 2 MMtpy of CO<sub>2</sub> capture for EOR
  - 205 mile CO<sub>2</sub> pipeline to the Weyburn oil field in Canada

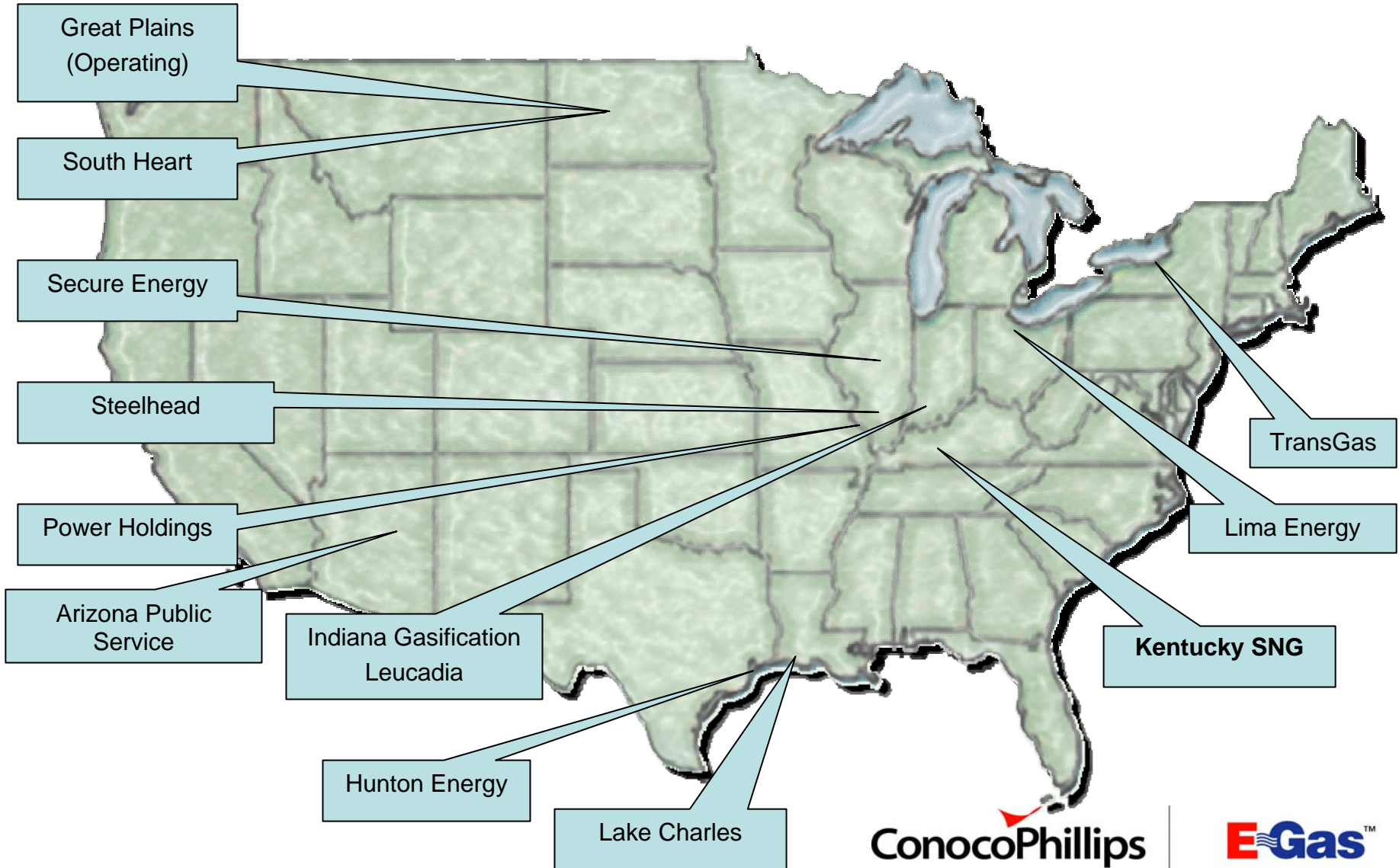
Source: Dakota Gasification Company

**All components of the SNG plant and CCS commercially demonstrated in an integrated facility**

# SNG Project Development

Public Announcements

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PRESS RELEASE  
July 23, 2007

**Peabody and ConocoPhillips Enter into Agreement to Explore  
Development of Midwest Coal-to-Substitute Natural Gas Facility**

ST. LOUIS and HOUSTON, July 23, 2007 -- Peabody Energy (NYSE: BTU) and ConocoPhillips (NYSE: COP) today announced they have entered into an agreement to explore development of a commercial scale coal-to-substitute natural gas (SNG) facility using proprietary ConocoPhillips E-GAS™ technology.

“Our agreement with ConocoPhillips combines the strength of global industry leaders and proven technology that further demonstrates coal’s ability to build energy reliability, security and price stability,” said Gregory H. Boyce, Peabody president and chief executive officer. “The energy value in Peabody’s vast coal reserve base exceeds the energy in the oil or gas reserves in the continental United States, offering strategic advantages for coal-to-gas projects and other Btu conversion projects.”

“ConocoPhillips believes the key to a secure energy future is the development and efficient use of diverse energy sources,” said Jim Mulva, ConocoPhillips chairman and chief executive officer. “This project, as currently envisioned, would be designed to deliver over 1.5 trillion cubic feet of SNG in its first 30 years of operation from proven, domestic coal reserves. It also offers an excellent opportunity to use our company’s project management capabilities, manufacturing expertise, and advanced technology to help increase the supply of alternative fuels.”

# Enablers for Successful Projects

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- Favorable forward gas price
- Location, location, location
  - Construction cost (labor, rail and deep water access)
  - Feedstock pricing
  - EOR or other market for CO<sub>2</sub>
  - Other product markets (Liquid air products, sulfuric acid, etc.)
- Governmental supports (both state and federal)
- Regulatory Framework for CO<sub>2</sub> Transportation and Storage
- Reduction in capital cost – all technologies
  - ASU, Rectisol<sup>®</sup> process, methanation and gasification

# Summary

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- SNG integrates proven technologies
- SNG has favorable economics in certain applications
- Scrubbing carbon from coal – puts coal on an comparable footing with natural gas
- Deployment of SNG augments North American supplies
  - Broadens energy diversity
  - Reduces foreign dependence on natural gas
  - Significant deployment requires governmental supports

# E-Gas Technology for Gasification

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**“Common Sense  
For Energy And The  
Environment”**

ConocoPhillips

**E-Gas™**  
Technology for Gasification