

# **Gasification: The Enabling Technology**

**Sixth Goddard Forum  
The Opportunities & Challenges of the  
Pennsylvania Renewable Portfolio Standard:  
Emerging Technologies, Regulations & Institutions**

*January 31, 2006*

James Childress  
Executive Director  
Gasification Technologies Council

# GTC Mission

- Promote greater use of gasification technologies in environmentally superior manner.
- Priority Activities
  - **Industry** – customer education (national conference and participation in other events)
  - **Government** education with focus on state level officials – legislative, executive (PUC/PSC, DNR/DEQ, Economic Development)

# GTC Members

- Air Liquide America\*
- Air Products and Chemicals, Inc.\*
- Allied Syngas Corporation\*
- American Electric Power\*
- Aramco Services Company\*
- The Babcock & Wilcox Company
- Bechtel Corporation\*
- Black & Veatch Corporation\*
- BOC Gases\*
- Pratt & Whitney Rocketdyne Propulsion & Power\*
- Calpine Corporation\*
- Cinergy Corporation\*
- ConocoPhillips\*
- Constellation Energy\*
- The Dow Chemical Company\*
- Eastman Chemical Company\*
- Emery Energy Company
- Fluor Corporation\*
- Foster Wheeler Energy International Inc.\*
- Gas Technology Institute
- GE Energy\*
- Global Energy, Inc.\*
- Headwaters Inc.
- Kellogg, Brown & Root\*
- Kentucky Center for Applied Energy Research
- Lake Charles Cogeneration, LLC
- Linde AG
- CH2M Hill
- Lurgi
- Mitretek
- Nexant, Inc.
- Parsons Energy & Chemicals Group Inc.\*
- Peabody Energy\*
- Porvair PLC
- Praxair, Inc.\*
- Sasol Technology
- Sempra Generation
- Shell Global Solutions B.V.\*
- Siemens Power Generation, Inc.\*
- Snamprogetti S.p.A.
- Tennessee Valley Authority\*
- Uhde Corporation of America\*
- UOP
- URS Corporation
- Valvtechnologies, Inc
- Waste Management & Processors Pty., LLC\*

\* Denotes member of Board of Directors

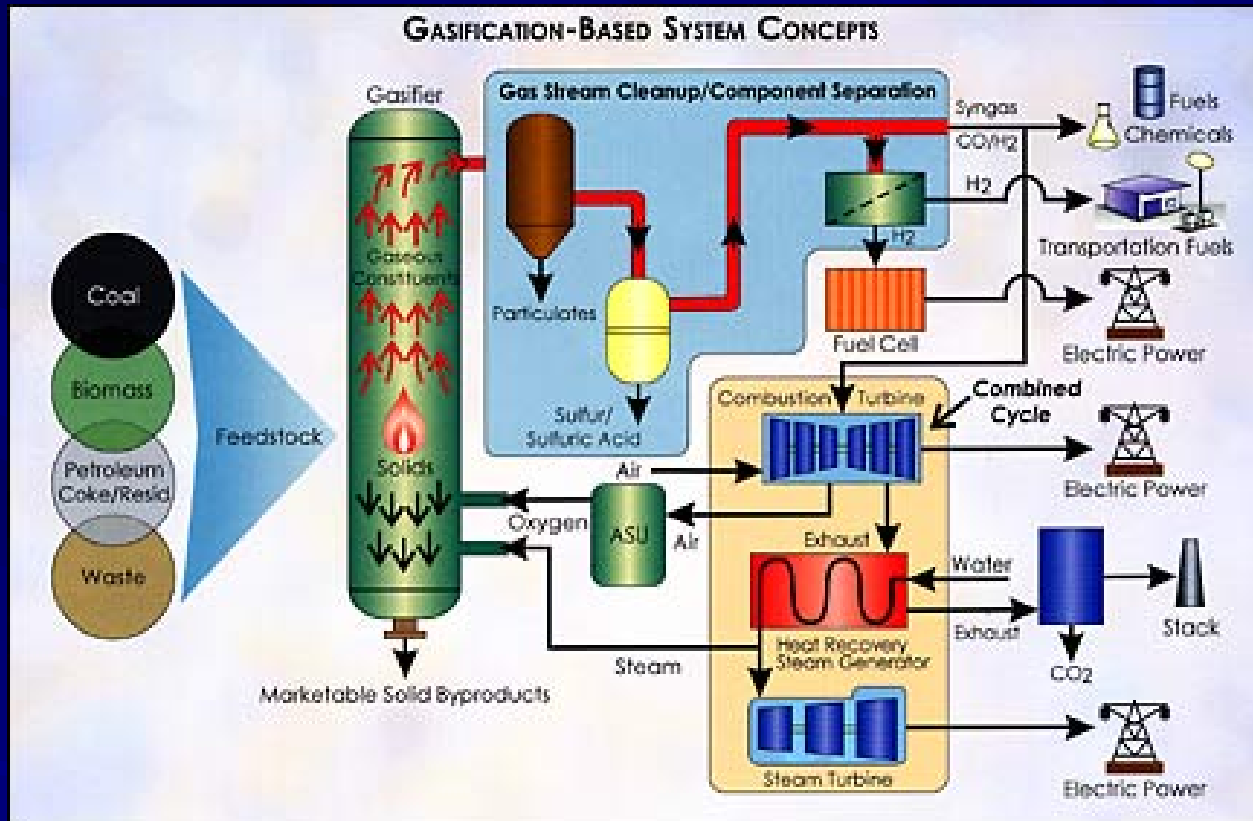
# The Message

- IGCC cleanest coal-based alternative for power generation, reducing natural gas dependency for electricity.
  
- Gasification also opens the way for coal to compete with natural gas and petroleum to produce value added products.
  - Chemicals
  - Fertilizers
  - Fuels (pipeline gas & F-T liquids)
  
- Implications for: National Security, Fuel Diversity, Geographical Conversion Diversity
  
- Gasification adds value to Nation's coal reserves and other "distressed" fuels/feedstocks.

# What is Gasification?

- A Process Technology
- Not Combustion
- Converts Feedstocks to H<sub>2</sub> & CO (Syngas)
- Cleans Gas as Integral Part of Process
- Syngas Can Be Used to Produce:
  - Power
  - Chemicals
  - Fuels

# What is Gasification?



Source: U.S. DOE

# World Gasification Survey: Summary Operating Plant Statistics 2004

**117** Operating Plants

**385** Gasifiers

Capacity ~ **45,000** MWth

## Feeds

Coal **49%**, Pet. Resid. **36%**

## Products

Chemicals **37%**, F-T **36%**, Power **19%**

Growth Forecast **5% annual**

# U.S. Gasification Experience

## 20 Plants Operating

### Feedstocks

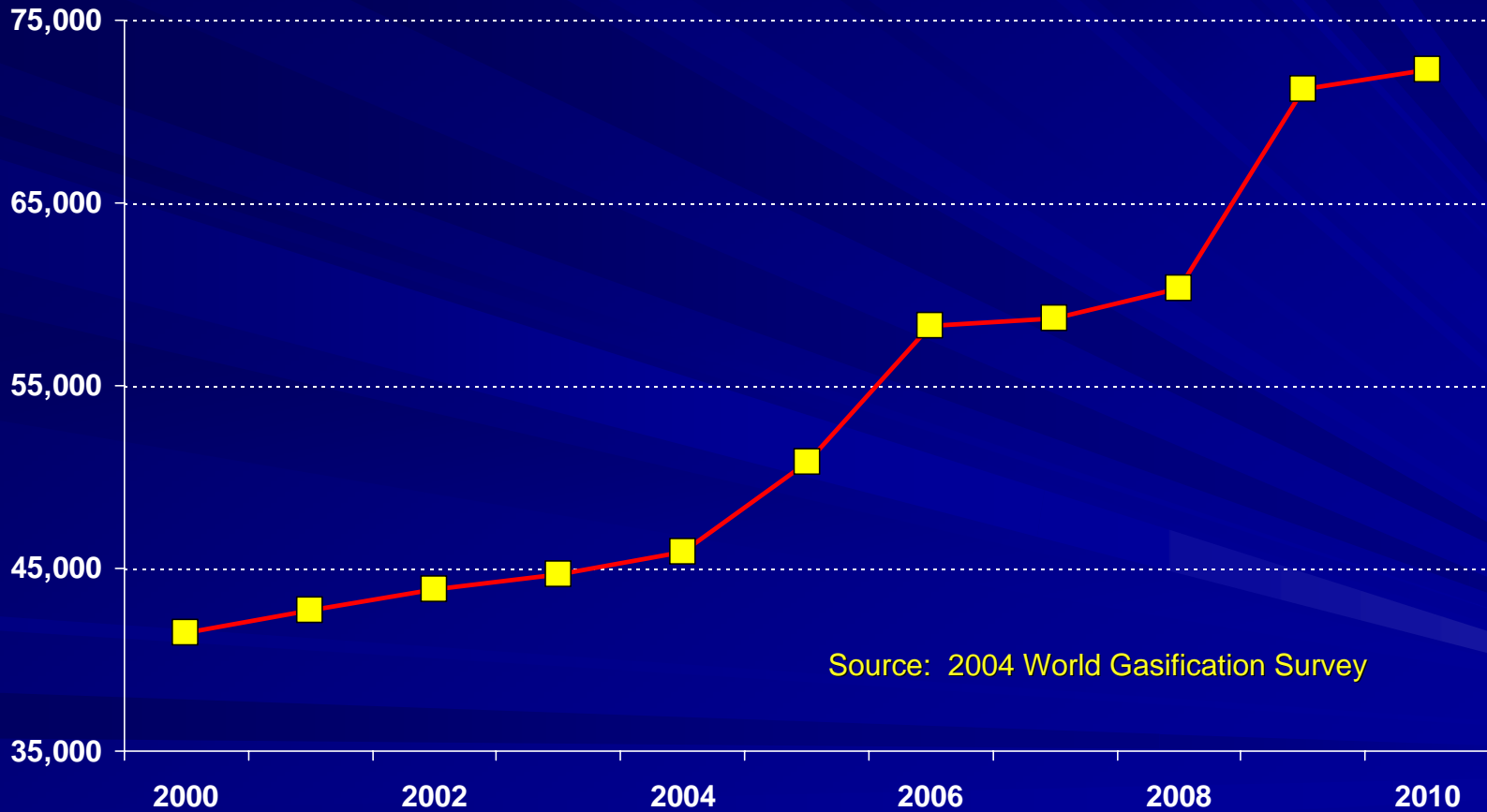
- Coal/Petcoke - 7
- Gas - 9
- Petroleum - 4

### Products

- Chemicals - 14
- Power - 4
- Gas - 2

# World Gasification Capacity Growth 2000-2010

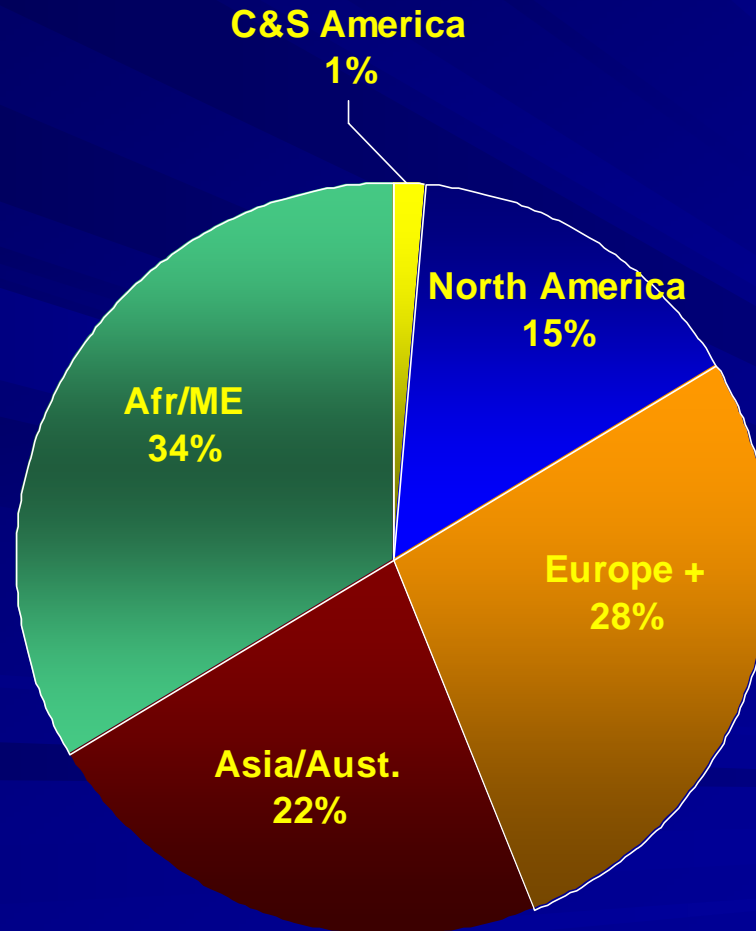
(MWth Equivalent)



Source: 2004 World Gasification Survey

# Geographical Distribution of World Gasification Capacity, 2004

(MW<sub>th</sub> Equivalent)



# Factors Driving Gasification Trends

## ■ Asia

- Fertilizers & Chemicals (China, poss. India)
- Fuels (China)
- Japan, Policy Shift Toward IGCC?

## ■ Europe

- Refinery Models – Environment Driven Toward Cleaner Fuels
  - Pernis (Hydrogen, Power)
  - Italian Plants (Power)
  - Gdansk
  - Netherlands
- Coal+Renewables – Nuon (Netherlands), Sanazarro (Italy)
- CO<sub>2</sub> Concerns

## ■ North America

- Natural Gas & Petroleum Prices
- U.S. Coal, Power, Environment
- U.S. Petcoke in Refineries (Hydrogen, Power)
- SNG
- Fischer-Tropsch Clean Diesel
- U.S. Public Sector Incentives (\$\$ + Regulations)
- Canada – Oil Sands, Coal

# **Going Forward: Why U.S. Coal-Based IGCC & Polygen?**

# U.S. Gasification Drivers

- Increasing demand for clean electricity from coal w/expectations of CO<sub>2</sub> Limits
- High natural gas & petroleum prices affecting power and manufacturing industries
- Drive for cleaner, non-petroleum fuels (refinery H<sub>2</sub>, F-T)
- Strong Technology Providers, Alliances & Guarantees (ConocoPhillips, GE Energy, Shell Global Solutions)
- Federal & State Financial Incentives

# Emissions Data Filed for Air Pollution Control Operation Permit

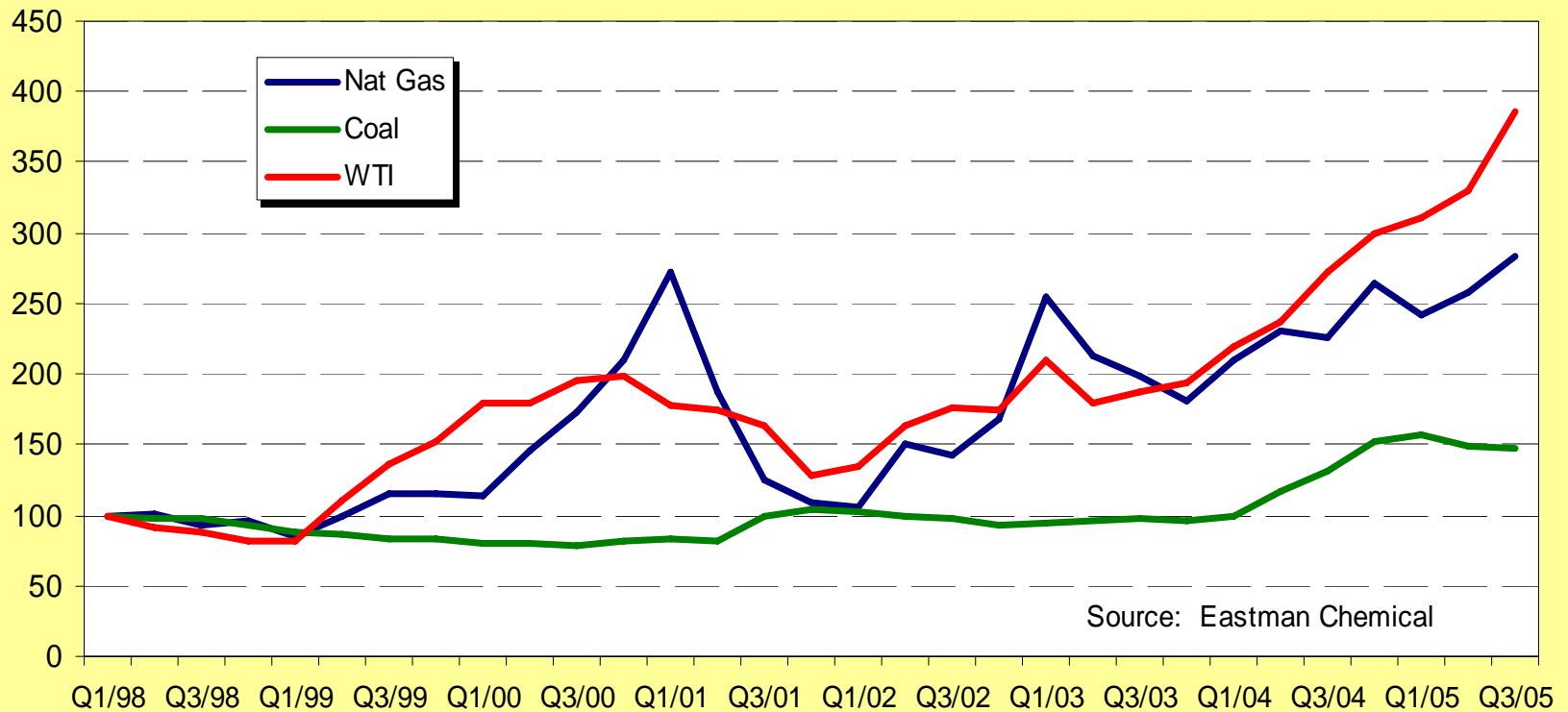
(600 mWe plant, tons per year)

	<b>SCPC</b>	<b>IGCC</b>	<b>IGCC Reduction</b>	<b>% Reduction</b>
<b>CO</b>	3,169	564	(2,605)	-82%
<b>NO<sub>x</sub></b>	1,859	1,396	(463)	-25%
<b>SO<sub>2</sub></b>	3,961	1,117	(2,844)	-72%
<b>Hg</b>	0.03	0.01	(0.02)	-67%
<b>PM<sub>10</sub></b>	475	199	(276)	-58%

Source: Wisconsin Department of Natural Resources, Permit 03-RV-166

# Energy Price Gasification Drivers

## Index of U.S. Energy Prices



# Gasification-Polygen

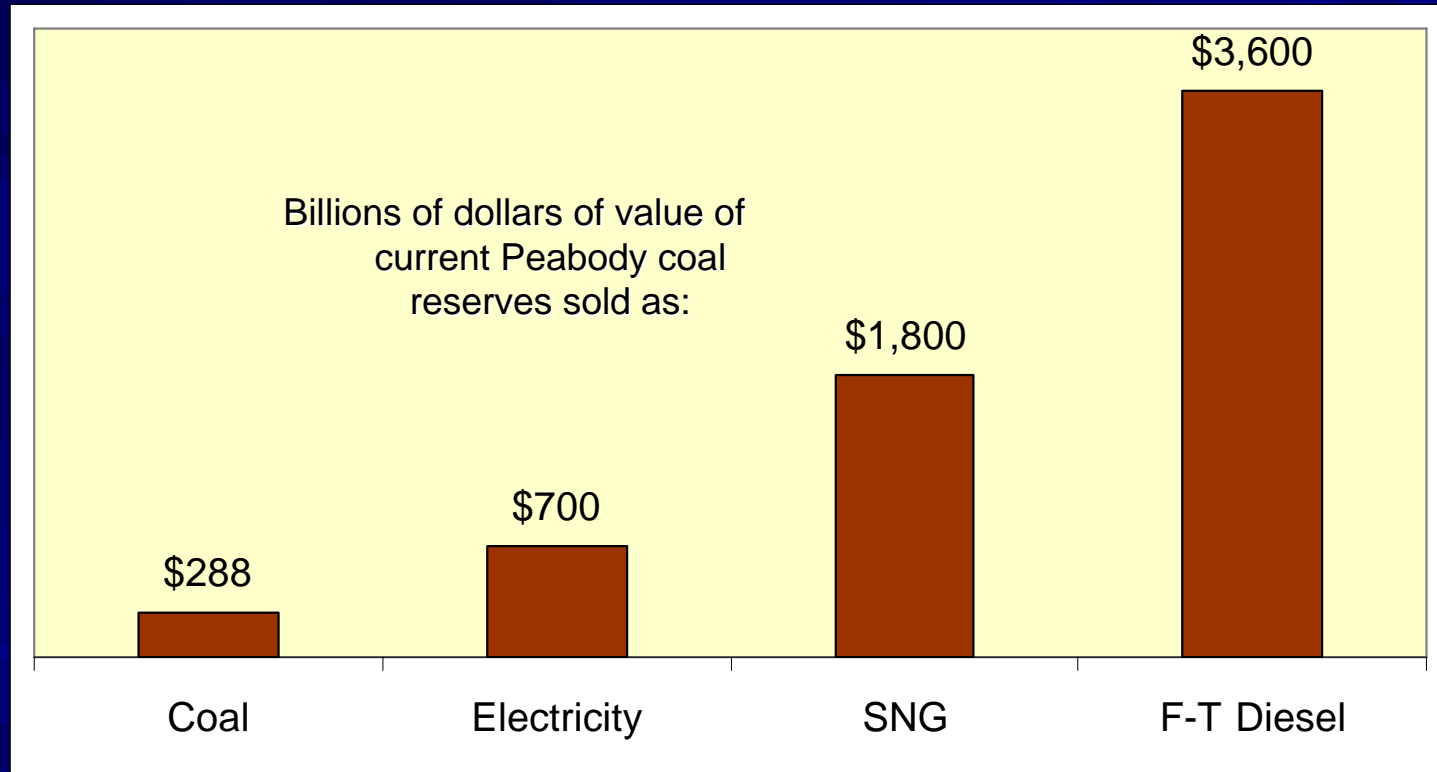
- Insulates manufacturing sector from natural gas cost & volatility for power
- Lower cost alternative feedstocks for fertilizers, chemicals
- Polygeneration has inherent flexibility
- Coal to F-T liquids an option to petroleum based fuels
- **A new market for coal in the U.S.**

# **“Btu Conversion” Technologies**

**“Coal to gas and coal to liquids are extremely powerful...The technologies are real, they are today’s technologies...Not emerging, not new...Coal gasification to pipeline gas at \$5-6 per mmBtu, diesel at \$35-40 per barrel...”**

**Greg Boyce, President & CEO Elect, Peabody Energy, September 2, 2005**

# Value-Add Potential of Btu Conversion Technologies to Peabody Coal Reserves



Source: Peabody Energy

# Significant Federal Incentives

- EPACT -- ~\$5.4 billion authorized for cost sharing, grants, investment tax credits
- +Loan Guarantees (scoring?)
- ~ 33 Projects from EPACT incentives?
- +50 cent/gallon tax credit – F-T diesel from coal
- F-T Off take agreements with DoD?

# Pre-EPACT Planned U.S. Gasification Plants

American Electric Power	OH	Madison Power	IL
Baard Generation	OH	Mohave Station	CA
Cash Creek Generation	KY	Mountain Energy	ID
Clean Coal Power	IL	Orlando Util./Southern	FL
DKRW	WY	Otter Creek	MT
Duke/Cinergy	IN	Power Holdings	IL
Energy Northwest	WA	Rentech	WY
Erora Group	IL	Royster Clark/Rentech	IL
Excelsior Energy	MN	Southeast Idaho Energy	ID
First Energy/Consol	OH	Steelhead Energy	IL
Florida Power & Light	FL	Synfuel	OK
Leucadia National	LA	Xcel Energy	CO

# Questions?

For further information: <http://www.gasification.org>

or

Google “gasification”

Mark your calendars

October 1-4

2006 Gasification Technologies Conference