Coal to Liquids: Shell Coal Gasification with Fischer-Tropsch Synthesis

A Private Developers Perspective

John A. Baardson
CEO
Baard Energy, L.L.C.

2005 Gasification Technologies Conference
October 11, 2005
Baard Energy, L.L.C. – Business Synergies
Baard Company Credentials

- Baard Generation LLC had 20 years experience in the development of power plants in the USA & Canada:
  - Three 16 MW wood-fired QF projects, Michigan and Pennsylvania
  - Windsor Power – 440 MW Natural Gas
  - South Point AZ – 500 MW Natural Gas
  - Wyandotte MI – 572 Natural Gas
- Baard Renewables LLC develops ethanol facilities in the USA
  - Ravenna, NE – 88 million gallons/yr
  - Coshocton, OH – 55 million gallons/yr
- Baard Clean Fuels: FT Project Developer
  - Four 35,000 b/d CTL projects under development
Gasification of coal is the BACT for coal-based power generation, but is this the best use of these hydrocarbons?

Our country is highly dependent on energy from hydrocarbons, including petroleum & natural gas. Over 55% comes from unstable countries and the trend is worsening:

- Production of electricity
- Production of transportation fuels
- Production of Chemicals
- Production of food (Fertilizers)
USA Energy Constraints
Capacity & Transmission

• Increasing demand for energy in localized markets (concentration of refinery assets, transmission constraints) changes the equation for natural gas, diesel, heating oil, and electricity; thus straining the existing energy infrastructure.

• Strategic location of baseload generation must view existing ISO transmission constraints and load sinks.

• Oil Refineries are running at 96% capacity. No new refineries are being built.

• Natural threats negatively affecting the highly concentrated refining capacity in the USA.

• The majority of our crude supply is concentrated in unstable regions of the world.
**Boston News**

ChevronTexaco Warns of Global Bidding War

By Deepa Babington | February 15, 2005

HOUSTON (Reuters) - Asia's insatiable appetite for oil coupled with tight supplies has triggered the start of a global bidding war for oil from the Middle East, the head of ChevronTexaco Corp. said on Tuesday.

**Resource Investor**

Famed Oil Tycoon Sounds Off on Peak Oil

By Michael J. DesLauriers

TORONTO

In recent months, legendary oil baron, T. Boone Pickens has become increasingly vocal about his view that peak oil is upon us and high prices are here to stay.

**Mexico Daily**

Pemex: Reserves overestimated

BY NOÉ CRUZ SERRANO/EL UNIVERSAL

April 18, 2005

The national petroleum giant reports that deepwater deposits in the Gulf of Mexico may be half of what was initially predicted.

**The Daily Telegraph**

Unrest 'could double' oil price

By Ambrose Evans-Pritchard

Filed: 27/06/2005

A warning of a possible near doubling in the cost of oil was issued yesterday as UK prices rose to more than £4 a gallon and the AA Motoring Trust said the price of diesel was approaching £5 a gallon.

**Boston Herald**

Taking a peak:

Concern over world's oil supply fuels discussion over alternatives, technology

By Jay Fitzgerald

Sunday, January 2, 2005

Enjoy the ride up "Hubbert's peak." The descent might not be so fun. After a 34 percent spike in the price of crude oil this past year, many industry experts and economists are wondering whether something larger was at play during 2004.
USA Coal and Oil Shale Deposits
Domestic Reserves total 1.9 Trillion Barrels

1 trillion barrels (shale crude)
800 billion barrels of FT (coal)
0.15 billion barrels of pet coke
22.7 billion barrels oil reserves
32+ billion barrels of oil (EOR)

< 0.7 trillion barrels remain in the Middle East
Optimal Process Description
IGCC and Polygeneration for Strategic Fuels

Coal → Gasification → CO - Shift → Acid Gas Removal → PSA → Combined Cycle
Hydrogen

Oxygen → Internal Recycle

Fischer Tropsch → Heavy Ends Recovery → Water Treatment

Product Upgrading

Power → Steam

Effluent Water → Diesel Naphtha
FT Diesel is an Ultra Clean Transport Fuel

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<tr>
<td><strong>Cetane Index</strong></td>
<td>&gt;40</td>
<td>&gt;48</td>
<td>72</td>
<td>&gt;50</td>
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<tr>
<td><strong>Aromatics (vol %)</strong></td>
<td>&lt;35</td>
<td>&lt;10</td>
<td>&lt;4</td>
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<td><strong>Sulfur (ppm)</strong></td>
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<td>&lt;500†</td>
<td>&lt;1</td>
<td>&lt;10</td>
<td>&lt;15</td>
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<tr>
<td><strong>Biodegradable</strong></td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
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† Note: In 2006, US regulations will require <15 ppm sulfur
Baard Developments in Ohio
Ashtabula, Ohio

35,000 bpd FT Liquids
Coal/Biomass for Power

Shell Coal Gasification IGCC (253 MWe)
Buggenum, The Netherlands
IGCC Puertollano, 318 MW (Coal, Pet Coke)
Target: Carbon Sequestration Deployment
Ashtabula Strategically Located for CO$_2$ Sequestration

![Map of carbon sequestration areas]

All CO$_2$ sources $>100$ kt/y

**Annual Emissions**
- $100 - 1,000$ ktCO$_2$/y
- $1,001 - 5,000$ ktCO$_2$/y
- $5,001 - 10,000$ ktCO$_2$/y
- $10,001 - 20,000$ ktCO$_2$/y
- $20,001 - 30,000$ ktCO$_2$/y

**Source Type**
- Cement
- Gas processing
- Hydrogen
- Iron & steel
- Power
- Refineries

*Courtesy of Dave Ball, Project Manager, Midwest Region Carbon Sequestration Partnership, Battelle-Columbus*
Project Enablers

✓ Markets
  • Need for Regional Baseload Generation
  • Need for Alternative Transportation fuels
  • Carbon Sequestration plays

✓ Raw Materials – Ohio Coal
  • Ohio has abundant coal and shale resources

✓ Ohio Support:
  • Ohio Power Siting procedures are clearly established and time-sensitive.
  • Ohio Air Quality Development Authority provides funding, guidance and assistance in project financing.
  • Ohio Department of Development assists in siting evaluations, community involvement.
  • Enthusiastic community support and experienced labor force.
Catalyzing a New Industry in Ohio

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<th>Product</th>
<th>Daily</th>
<th>Annually</th>
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<tr>
<td>FT Liquids Barrels</td>
<td>35,000</td>
<td>11 million</td>
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<tr>
<td>Baseload Generation</td>
<td>250 - 300 MW</td>
<td>~ 2000 GWhr</td>
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<tr>
<td>Plant Employment</td>
<td>200 Direct Full Time Employees</td>
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</table>
What’s at Stake for Ohio

• Deployment of advanced clean-coal technology
• Dynamic growth for Ohio coal
• Jobs Creation
  – Over 200 full time plant employees
  – Over 400 coal mining employees
  – Over 1500 construction jobs over four-year period
• Add baseload power generation to address grid stability and aging coal fleet
• Creation of a new industry: Ultra-clean Manufactured Transportation Fuels
• CO2 Sequestration for products as well as Enhanced Oil Recovery and Methane extraction
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