Coal-to-Liquids / Questions

- What?
- Why?
- When?
- How Much?
- Where?
- How Many?
Simplified CTL Block Flow Diagram

*Feedstocks could also include heavy resid and/or pet coke*
Coal-to-Liquids / Questions

- What?
- Why?
- When?
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- Where?
- How Many?
The U.S. Has Been Called the “Middle East” of Coal

Total World Proven Reserves: 910 Billion Tons

- USA
- Russian Federation
- China
- India
- Australia
- South Africa
- Ukraine
- Kazakhstan
- Other

NOTE: World Proved Reserves at end of 2005
SOURCE: EIA for U.S.; BP 2006 World Statistics for rest of world
U.S. Coal Production Converted to Liquids

**Annual Coal Production**

1.1 Billion short tons/year

**Distillate Fuels**

5.3 Million B/D

NOTE: One short ton of sub-bituminous coal can be converted to approximately 1.75 barrels of CTL distillate fuels.

Total U.S. Distillate Fuels Demand (5.9 Million B/D)
Coal-to-Liquids / Questions

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Lower sulfur requirements for on-road diesel fuel are here

- Allows a maximum of 15 ppm sulfur at the pump

NRLM diesel fuel produced by refiners and imported must meet 500 ppm standard by June 1, 2007

- Schedule in place for achieving further sulfur reductions by 2010 - 2014
Fischer-Tropsch (FT) Distillate Fuel Quality

- Meets ASTM Specifications
- Meets or Exceeds CARB Diesel Specifications
- Superior Product
  - Virtually free of sulfur and aromatics
  - 70+ cetane
- Compatible with Existing Infrastructure
Coal-to-Liquids / Questions

- What?
- Why?
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- How Much?
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- How Many?
Plants (>40MB/D) are expected to cost $70K – $100K per B/D of liquids

Total investment also depends on remoteness of site, availability of water resources, existing infrastructure, and proximity to end-user fuel markets.
Distillate Prices Have Averaged 120% - 130% of WTI

SOURCE: Platt's Oilgram Price Report
What Will $55 Buy?

**Crude Oil Refined**
- LPG & Fuel Gases
- Conventional & Reformulated Gasoline
- Distillate Fuels
- Petcoke

**Coal-to-Liquids**
- LPG & Fuel Gases
- FT Naphtha
- Distillate Fuels & Blending Stocks

### CTL Feedstock Advantage

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Liquid Product Yield</th>
<th>Product Revenue</th>
<th>Gross Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td>~1 bbl</td>
<td>$72</td>
<td>$17</td>
</tr>
<tr>
<td>U.S. Coal</td>
<td>~5.5 ton</td>
<td>$637</td>
<td>$582</td>
</tr>
<tr>
<td>Western Coal</td>
<td>0.90 – 0.95 bbl</td>
<td>10.5 bbl</td>
<td>$17</td>
</tr>
</tbody>
</table>

**SOURCE:** Baker & O’Brien analysis; EIA; Platt’s

1 Based on 3 year average pricing (2004 - 2006)

2 Baker & O’Brien analysis – full conversion refinery

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Base Case Economic Analysis

- **Capex**  $85k per B/D
- **Operating Costs**  $15/B
- **Coal Feedstock Cost**  $10/Short Ton
- **Distillate Price**  122% of WTI
- **Total Liquid Yield**  1.9B/Short Ton Coal
Crude Oil Breakeven Sensitivity Analysis

Breakeven Crude Oil Price (WTI) to Generate 12% After-tax IRR

Dollars per BPD of Liquids:
- 70K Capital Investment
- 100K

Dollars per Barrel:
- $10 Operating Costs
- $20

Dollars per Ton:
- $5 Feedstock Cost
- $15

Percent of Crude:
- 125% Diesel Price
- 115%

Yield:
- 2.1

Barrel Liquid per Ton Coal:
- 48

Increase in Variable
Decrease in Variable

NOTE: Economics based on 100% equity and do not assume any favorable tax incentives or other subsidies

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Coal-to-Liquids / Questions

- What?
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- How Much?
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- How Many?
54% of U.S. Reserves
144 Billion Tons

U.S. Coal Reserves

SOURCE: American Coal Foundation; www.teachcoal.org
Coal Classification

Percent of U.S. Coal Production 2005

- Hard Coal: 50.6%
- Bituminous: 50.4%
- Anthracite: 0.2%
- Sub-Bituminous: 42%
- Lignite: 7.4%

Carbon / Energy Content of Coal
- 7,000Btu/Lb. High
- 13,500Btu/Lb. High

Moisture Content of Coal
- Low Rank: 1.5 – 3.5
- High Rank: 49%

Largely Power Generation
- Lignite: 7.4%
- Sub-Bituminous: 42%

Cement Manufacture
- Hard Coal: 50.6%
- Bituminous: 50.4%

Industrial Uses
- Lignite: 7.4%
- Sub-Bituminous: 42%
- Hard Coal: 50.6%
- Bituminous: 50.4%
- Anthracite: 0.2%

Power Generation
- Lignite: 7.4%
- Sub-Bituminous: 42%
- Hard Coal: 50.6%
- Bituminous: 50.4%
- Anthracite: 0.2%

SOURCE: World Coal Institute; EIA; National Coal Council

NOTE: Average Sulfur Content Reported as Lb.SO2 / MMBtu

7,000Btu/Lb. 13,500Btu/Lb.
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Potential CTL Plants Based on Coal Reserves – PADD 4

- 1.75 barrels of CTL distillate fuels per short ton of available proved reserves in each state.
- 60MB/D plants
- 30 year plant life

If only 10 CTL plants are built, 667,000 B/D would result.
Larger scale CTL plants are likely to be built mainly in PADD IV where most of the coal resources are.
Summary

- Proven Technologies
- U.S. is M.E. of Coal
- High Quality Product Slate
- Introduced at Time of Strong Demand
- Economical at 45 – 55 $/B WTI
- Plants Most Likely in U.S. West (PADD IV)
- Distillate Movements to PADDs II & V
Proven Technologies

U.S. is M.E. of Coal

High Quality Product Slate

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Plants Most Likely in U.S. West (PADD IV)

Distillate Movements to PADDs II & V
Key Take-A-Ways

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