GE
Energy Financial Services

Coal: A fuel for all seasons

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GE Is Delivering Gasification Solutions Worldwide

Licensing to Turnkey IGCC Plants

Coal to Chemicals - Coal to Liquids

Electricity (IGCC)

Polygeneration
Gasification–Multiple Cleaner Coal Solutions

- **Electricity (IGCC)**
  - Greenfield
  - Polygen
  - Refueling
  - Site Repowering

- **Refineries**
  - Hydrotreating
  - Hydrocracking
  - Hydrodesulfurization
  - Hydrodenitrogenation

- **Chemicals**
  - Formaldehyde
  - MTBE
  - Acetic acid
  - Amine
  - DME
  - Urea
  - Ammonia nitrate/sulfate
  - Oxochemicals: Butanol, Ethylhexanol

- **Coal to Liquids**
  - Clean Diesel
Coal-to-Liquids Process

Coal + Oxygen \rightarrow\text{Steam}

Gasification Process → Sour Syngas → Syngas Cleanup Process

\[ \text{CO}_2 \text{ Stream} \rightarrow \text{Sulfur} \rightarrow \text{Clean Fuels} \]

Sweet Syngas → Common FT Technology → Clean Fuels

CTL Technology
- Coal gasification produces syngas: \( \text{CO} + 2\text{H}_2 \)
- Common FT Technology converts syngas to liquids
- Tail gas opportunity fuel for power generation

Steam Power Applications
CTL Environment Risk Assessment

PRB Minemouth 80,000 bbl/d Coal-to-Liquids Plant

22MM TPY of CO\textsubscript{2} emissions
- Sasol CTL in South Africa is the largest single point source of CO\textsubscript{2} in the world
- Carbon capture will be a requirement

6 B gal/y of makeup water used
- Western US is water scarce
- Zero liquid discharge is possible requirement

20MM TPY of coal consumed
- Must have dedicated mines

Source: Northern Plains Resource Council, 2005
Coal Reserves

Stranded Lignite

Infrastructure Limited

Poor Quality Coal

US Reserves (MMTons)

- Demonstrated Reserve Base
- Estimated Recoverable Reserves
- Producing Mine Reserves

Western Bituminous

Dakota Lignite

Gulf Coast Lignite
CTL Economics

Capital Cost

k$/bpsd

FT+Upgr ASU+Syngas

7 MBD/Gfr Trn

17 MBD/Gfr Trn

$2-3B CTL Plant Equivalent to 3 600MW IGCC Plants breakeven oil price - $35-40/bbl

Diesel Cost

NYMEX Diesel Price

Breakeven FT Liq Price

Profit
Taxes
Trans
Capex
OSIM
Coal/Gas

* Based on 10% premium for FT diesel over NYMEX diesel
** Based on host country laws/agreement for GTL – (potential gas price increase).
(Source: GTL - E-Metaventure Inc., 2003, Sasol UBS Global Oil & Gas Conf, Sep 2005)
What would it take to replace 8 MMbbl/d of crude imports with coal?

James Roberts of Foundation coal recently estimated:

- 1.9 billion ton increase in coal production
- 217 new coal mines (net)
- 62,557 new coal miners
- $59 billion in new supply side investment
- $545 billion capital cost for CTL facilities

What is the lead time required to develop 100 new 80,000 bbl/d CTL facilities?

How many projects per year is realistic?
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