Fischer-Tropsch Diesel – Meeting the California Supply Challenge

Alternative Diesel Fuels Symposium
Presented by CEC/CARB
Sacramento, California

By Dennis L. Yakobson
Rentech, Inc.
August 19, 2003
Agenda

- Quick Overview of Rentech Fischer-Tropsch Diesel (FTD)
- Viable FTD supply options
- Supplying California with Competitively Priced FTD
- Where Do We Go From Here?
Rentech Background

• Rentech was formed in 1981 specifically to develop Fischer-Tropsch technology
  – Patented/proprietary technology
  – Iron catalyst development
  – Slurry bubble column
  – Synhytech commercial demonstration

• Became a public company in 1991
  – Traded as RTK on the AMEX
“Hydrocarbons” to Liquids

Carbon-Bearing Feedstocks

• Natural gas

Synthesis Gas Generation

Fischer-Tropsch Synthesis

CO + H₂

Product Separation & Upgrading

Steam

Power

Tail gas

Water & Oxygenates

Hydrocarbons
“Hydrocarbons” to Liquids

Carbon-Bearing Feedstocks

- Natural gas
- Coal
- Refinery bottoms
- Orimulsion™
- Heavy oil
- Biomass/RDF

Synthesis Gas Generation

CO + H₂

Fischer-Tropsch Synthesis

Steam

Power

Tail gas

Product Separation & Upgrading

CO₂ & SOₓ

Water & Oxygenates

Hydrocarbons

Note: FTD quality is not dependent on the type of feed used to generate the syngas
Today’s Sources of FTD are not Domestic

**SASOL (S. Africa)**
- 44 years commercial
- 160,000 b/d+
- Feedstock Coal

**MossGas (S. Africa)**
- 10 years commercial
- 22,500 b/d+
- Feedstock Natural Gas

**Shell (Malaysia)**
- 7 years commercial
- 15,000 b/d+
- Feedstock Natural Gas
Examples of Viable Rentech GTL Projects

- Bolivia Stranded Gas: 10,000 B/D
- Indonesian Methane Complex: 16,500 B/D
- Flared Gas FPSO: 5,000-10,000 B/D
- IGCC / EECP Power Generation: 1,000 – 10,000 B/D
Supplying California
With Competitively Priced FTD
Domestic FTD Feedstock Alternatives

- Natural Gas
  (>$3.50/mmbtu)
- Coal
  (<$1.00/mmbtu)
- Refinery Bottoms
  (<$1.00/mmbtu)
- Refuse Derived Fuel & Biomass
  (?/mmbtu)

Wellhead Natural Gas Prices vs WY Coal Prices
(As reported by DOE)
Domestic FTD Feedstock Alternatives

- Natural Gas  
  (> $3.50/mmbtu)
- Coal  
  (< $1.00/mmbtu)
- Refinery Bottoms  
  (< $1.00/mmbtu)
- Refuse Derived Fuel & Biomass  
  (?)/mmbtu)
Why Not FTD from Coal?

- U.S. has over 275 billion tons of coal reserves
  - The world’s largest coal resource
  - Equivalent to over 20 trillion gallons of FTD
- U.S. coal is inexpensive, price stable and available for long-term contract supply
- New coal-fired power plants will be required to meet growing needs
- H₂ can be co-produced
- Carbon dioxide is extracted and can be sequestered
<table>
<thead>
<tr>
<th>Type of Feed</th>
<th>Natural Gas</th>
<th>Combined Cycle</th>
<th>FT</th>
<th>Conventional Pulverized Coal</th>
<th>IGCC w/o Sequestration</th>
<th>IGCC w/ Sequestration</th>
<th>FT w/o Sequestration</th>
<th>FT w/ Sequestration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ – pounds per Kwh (equivalent basis)</td>
<td>0.95</td>
<td>2.10</td>
<td>1.88</td>
<td>1.24</td>
<td>0.97</td>
<td>0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOₓ – parts per million</td>
<td>3</td>
<td>150</td>
<td>&lt;9</td>
<td>&lt;9</td>
<td>&lt;9</td>
<td>&lt;9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur Recovery - %</td>
<td>-</td>
<td>95</td>
<td>98</td>
<td>98</td>
<td>&gt;99.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Transportation to California market may range from $.08 to $.20/gal
The price of FTD from the CEC report is $0.10 per gallon above CARB Diesel
Where Do We Go from Here?
California Needs & Challenges

- Reduced air emissions
- Non-petroleum sources of transportation fuels
- Stable, competitive prices
- Reliable supplier
- Flexibility in supply
FTD Provider Needs & Challenges

- Reliable source of low-cost feedstock
  - Price, quality and quantity
- Long-term product sales contract (>5 years)
- Stable production off-takes
  - Steady growth from 350,000 gallons/day
  - Minimum disruption to existing markets
Proposed Wyoming Coal Project

Build a next generation FTD plant sourced on low-cost Wyoming coal

- Phase 1 facility at 350,000 gallons per day (gpd)
  - This represents less than 4% of CA’s diesel demand
  - Ultimate capacity could be over 1 million gpd
- Secure long-term coal supply <= $0.50 per mmbtu
- Optimize co-produced electrical generation, steam and other ancillary products including sequestered CO2
- Expedite construction to meet near-term California needs at current CARB diesel prices
Proposed Approach

- Public-private partnership between FTD provider and appropriate CA entity to expedite project development
  - Government support mechanism to enhance project attractiveness
  - Tax parity with other alternative fuels
  - State and local government support through promotion of FTD use by their own agencies
Proposed Approach

- Public-private partnership between FTD provider and appropriate CA entity to expedite project development

- Consortium of financially strong stakeholders capable of moving forward in a timely manner
  - Secure long-term agreements for feedstock supply and product off-takes
  - Develop an acceptable mechanism to allow for logical market introduction leading to steady sales growth and stable pricing
  - Obtain sufficient financial support to complete planning and construction steps quickly
Proposed Approach

• Potential stakeholders
  – Investors familiar with energy development projects
  – Fuel distributors and users willing to sign long-term agreements
  – Coal mine operators
  – Electric utilities
  – Railroads
  – Local and State Governments
  – Federal Government
  – FT technology partners
Summary

• FTD is Good!
  – FTD – either straight run or blended - is superior to CARB diesel

• FTD from coal is a viable low-cost alternative
  – The technology is proven
  – Domestic coal available at or below $0.50 per mmbtu
  – FTD from coal can be competitively priced with CARB diesel

• Public/private support needed to move any project forward
  – Long-term contracts needed for financing,
  – Financial commitment by interested parties critical for rapid implementation

• Rentech is ready to start a FTD project NOW!