Sasol Coal-to-Liquids Developments

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Eric van de Venter on behalf of Sasol Synfuels International and Sasol Technology (Pty) Ltd
Johannesburg, Rep. of South Africa
Email: enc.vandeveanter@sasol.com

Authors: John Sichinga, Nici Jordaan, Maggie Govender, Eric van de Venter
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1. A Sasol view: Drivers Supporting the Establishment of a Global CTL Industry
Why CTL could work….abundance of supply

Proven reserves of fossil fuels will sustain the world for just over 300 years at current production rates

- Crude Oil 41 years
- Natural gas 67 years
- Coal 192 years

Source: BP World Energy Review

Coal will last twice as long as the combined crude oil and natural gas reserves at current usage rates
Energy dynamics impacting competitive landscape

- Escalating oil price, caused by supply constraints and increased demand resulting in:
  - Increased emphasis on alternatives
  - Renewed interest in coal use

CTL likely to be viable at crude oil prices > USD 35/bbl
Coal usage projected to increase….

...a reversal in the downward trend...

- Coal meets approximately 30% of world’s primary energy needs
- Coal used to produce approximately 40% of world’s electricity
- Price of coal relatively stable compared to other fossil fuels due to its abundance
Speculation about peaking oil production … "Hubbert's Curve"

"Our ignorance is not so vast as our failure to use what we know." - M.King Hubbert

Dr. M. King Hubbert's prediction in 1956 that U.S. oil production would peak in about 1970 and decline thereafter was scoffed at then but his analysis has since proved to be remarkably accurate.

When, not if, global oil production will peak, is now becoming increasingly accepted
Resurgence of coal use due to current energy dynamics…

- Upward step change in crude oil and natural gas prices
  - Drives the search for crude oil alternatives
- Declining domestic oil and natural gas production in high energy consuming economies
- Concern about peaking oil production and refinery capacity
- Unstable political situation in Middle East
  - Energy security and diversification of energy supply features as strategic drivers on the agenda of many nations
- Latest technology developments – clean coal technology becoming a reality
Where could CTL work….

- **Countries with access to:**
  - Large reserves of low cost and grade gasifiable coal (a minimum of approximately 1 – 4 billion tons) at proposed location
    - Minimum plant capacity: ≈ 40 000 – 80 000 barrels per day to realise economy of scale benefits
    - Reserves to support further expansions
  - “Stranded coal” (e.g. due to quality or location) which can not be easily monetised in other ways
  - Adequate water resources close to proposed site

- **Major energy consuming countries that are energy short**

- **Low construction cost countries**

- **Countries where suitable sites are close to large attractive markets**

- **Countries with the ability and will to provide enabling support**

- **Geological formations for storage of CO₂ in sequestration**

Remember: Country Total Fuel Energy Demand

- Domestic Production
  - Reduce imports
  - Increase capacity, efficiency, co-production

- Oil/Petroleum/Gas Imports
  - Reduce imports
  - Non-conventional production
    - Oil sands, CTL, biofuels and shale oil
    - CTL opportunity in the World: upside 2* million bpd by 2025 compared to 1.2 million bpd for GTL

*Based on - Annual Energy Outlook 2005, [www.eia.doe.gov](http://www.eia.doe.gov) plus estimated 1 million barrels per day for China
Regions with very large coal reserves (Billion Short tons)
Countries with an enabling energy mix…

Sustainable conditions for CTL supported by energy short countries that have a need for energy self-sufficiency
But CTL faces significant challenges...

- Capital intensive process
  - Technology breakthrough required – involvement of critical mass of key industry players
  - CTL is not economically viable without some form of government intervention
  - Need a new generation CTL project to build on Sasol’s successful model

- Environmental issues
  - “Dirty coal” - public perception
  - The cost effective handling of CO₂ still needs to be demonstrated
  - Permission – e.g. no new refineries built in the US since 1970’s

The first 2nd generation CTL project offers Sasol a unique opportunity to highlight new generation process – “a clean coal energy solution”
**CTL could offer significant upside if..**

- Crude oil prices persist above $40 per barrel
- Project has relatively lower operating cost
  - *Low feedstock cost: Price of coal = USD 10/t equivalent to ~ USD 0.50/MMBtu vs. NG price of around > USD 7/MMBtu in the US*
- Targeting large fast growing domestic markets minimises logistic costs
- Countries willing to have a first mover advantage maybe willing to provide enabling environment
- Supports drive to increase energy security in energy short, high energy consuming countries that offer opportunity with large coal reserves
- Alternative technologies facing dual challenges of capture and storage of CO₂
  - *CTL process concentrates pure CO₂ which allows for simple CO₂ sequestration*
- Polygeneration opportunities
  - *Could improve plant efficiency*
2. CTL in SA – Lessons Learnt
Vision of the SA government - a Synfuels Industry

Realization by the South African government
SA had to be protected from adverse effect of crude oil imports and volatile prices

1927

1947

1949

Anglovaal obtained licence for CTL plant.
Unable to secure loan from World Bank and lost interest in project

South Africa has very little crude oil reserves but large coal reserves

Liquid Fuel and Oil Act - support CTL plants.

Private sector funding did not support the establishment of the capital intensive oil from coal process
Birth of Sasol

South African Government investigated the production of oil from coal.

Decided to form a state-owned company

South African Coal Oil and Gas Corporation (SASOL) incorporated as a state owned company in 1950

1950

Government support was essential for the establishment of a Synfuels Industry
Construction of the first Sasol plant in Sasolburg completed at a cost of USD 132 million of the day.

First petrol delivered to the market.

Sasol became cash positive.

First profit.

1954 1955 1958 1960

Initial Facility Profitable within 5 years of start-up.
**Sasol II & III**

- **1974:** Sasol Two announced
- **1973:** October War
  - Crude oil prices peaked at > USD40/bbl in today’s money
- **1979:** Iranian Revolution
  - Crude oil prices peaked at about USD80/bbl in today’s money
- **1979:** Sasol Three announced

High oil prices precipitated the establishment of a Large Scale Synfuels Industry.
Sasol II & III completed & construction of PetroSA Gas-to-Liquids facility

1980: Completed construction of Sasol II at a cost of USD 3200 million of the day

1984: Completed construction of Sasol III at a cost of USD 2520 million of the day

1989: PetroSA GTL facility (Mossgas) using Sasol technology
Synfuels Industry in South Africa today

- **Sasol II & III (CTL)**
  - Capacity: 150,000 bbl/d crude oil equivalent

- **Mossgas (GTL)**
  - Capacity: 45,000 bbl/d crude oil equivalent

**Total Capacity:**
195,000 bbl/d crude oil equivalent

*Synfuels Industry supplies 30% of total current SA consumption*
In Conclusion……

- Sasol was created with government support for strategic reasons, but…
  - The South African government’s investment in Sasol was well rewarded
  - Sasol is now a profitable publicly listed company
- Sasol’s technology is a significant contributor to the country’s fuel requirement and…
Social and Economic Benefits to RSA

- Direct and indirect employment for about 170,000 people, about 2% of the formal employment sector

- Directly and indirectly, almost US $7 billion or 4% to national gross domestic product

- US $5.1 billion in foreign exchange savings

- Supplies 40% of RSA’s liquid fuel requirements (28% from coal)

- 18% of the country’s saleable coal produced

- About US $1 billion to the South African Government in taxes and levies

- Capital investment US $10.6 billion between 2003-7
3. Sasol’s FT Approach
**Fischer Tropsch (FT) Enablers**

**Main GTL Drivers**
- Abundant, inexpensive hydrocarbon reserves (coal, natural gas, biomass)
- Global drive for cleaner transportation fuels

**Main CTL Drivers**
- Diversity of energy supply
- Reduced dependence on crude oil

**FT**
Sasol’s FT Processes Convert “Locked-in” resources to easily transportable liquid fuels
Sasol’s FT Technology can be applied to multiple feedstocks.
Sasol’s FT Approach…..

- Sasol wants to remain the leading producer of clean fuels from non-petroleum sources utilising its proprietary FT technologies:
  - Main focus is on natural gas feedstock (GTL)
  - Pursuing coal feedstock (CTL) where strategic drivers exist (e.g. China, USA, India)
  - Will develop biomass options (renewable) with time (BTL)
Sasol offers…

- 50+ years of commercial experience in indirect coal liquefaction.
- Expertise enabling a “running plant” project approach
- Expertise in marketing of FT derived fuels.
- Quickest way to develop a viable commercial CTL project.
4. Sasol’s Position in Gasification
Application of Gasification in Sasol: Secunda, RSA

Sasol has demonstrated technologies for indirect coal liquefaction

Combination of Sasol-Lurgi fixed bed gasification and Sasol Fischer-Tropsch requires serious consideration in future indirect coal liquefaction projects
Application of S-L FBDB Gasification in Sasol

Successful deployment and operation of 97 Sasol-Lurgi FBDB Gasifiers over 50 years, >20 million gasifier operating hours
Selection of Gasification Technology - key factors to consider

- Compatibility with coal feedstock
- Compatibility of process with downstream process and final product requirements
- Reliability, availability, maintainability, stability (RAMS)
- Process characteristics:
  - oxygen
  - steam requirement
  - carbon conversion
  - thermal efficiency, byproducts
- Economics will govern: Capex, Opex, maint and owner’s cost

Ref. M Keyser, Sasol
Sasol’s approach to Gasification wrt CTL

Sasol will continue to **deployment the most appropriate and cost effective gasification technologies** together with its propriety FT technology in the deployment of CTL.

- Sasol-Lurgi FBDB GG
- HT GG Technologies

Syngas → Sasol Fischer-Tropsch Conversion
- LTFT
- HTFT

FT Products
5. Sasol’s International Activities and Projects
The Sasol CTL Offering

- Sasol is the only company that has operated large scale, commercial, integrated CTL plants successfully
- Complete suit of supporting business processes – Sasol has a “blue print” of the total CTL business
- Ability and knowledge to do research and development across the full value chain – from coal characteristics to fuel and chemical products
- Competent pool of resources, including alliances with engineering contractors, that know how to operate, maintain and construct CTL related plants and technologies
Sasol’s current global FT activities

Sasol operates the world’s only commercial scale CTL Facility and is currently constructing a commercial scale GTL facility.
China CTL - Significant Number of Coal Conversion Projects Planned in the Same Region in China

Co-operating on two pre-feasibility studies with consortium of Chinese companies
- One project led by Luneng power and Ningxia Coal and the other led by Shenhua Coal
- Plant capacities ~ 80,000 barrels per day, per site
- Awarded pre-feasibility study contract to Foster Wheeler in February 2005
- Pre-feasibility Study completed
- Indications are that projects are viable with appropriate government support
Importance of the US.

- A CTL venture in the US would be a strategic fit for Sasol
- The US has the largest coal reserves and large petcoke supplies, is energy short and is a large chemicals and fuels market

The Energy Policy is a significant milestone and could enable a CTL industry
**Potential CTL Sites in US**

- **Powder River Basin**
  - Low cost coal
  - High Hg content – lowers value of coal
  - Water and skills challenges
  - Relatively far from markets

- **Dakota Lignite**
  - Low BTU content – lowers value of coal
  - Water shortages

- **Illinois Basin**
  - High sulphur content – lowers value of coal
  - Close to market

- **Pittsburgh Basin**
  - Good quality coal
  - Difficult to mine

- **Gulf of Mexico**
  - **Petcoke**
    - Low value by-product of Refinery Industry
    - Close to market

Source: EIA-7A Coal Production Report, file data R Bonskowski April 2004
6. Conclusion
Conditions today similar to when Sasol was established….

Sasol II was justified at current oil price levels

Crude oil prices higher than 1973 levels
A Coal-to-Liquids Industry…

- CTL proven at commercial scale in RSA
- Requires initial government support & involvement:
  - Enabling
  - Protection
- Sasol provides low risk route to a domestic deployment

Coal to Liquids Industry requires a country specific package of enablers