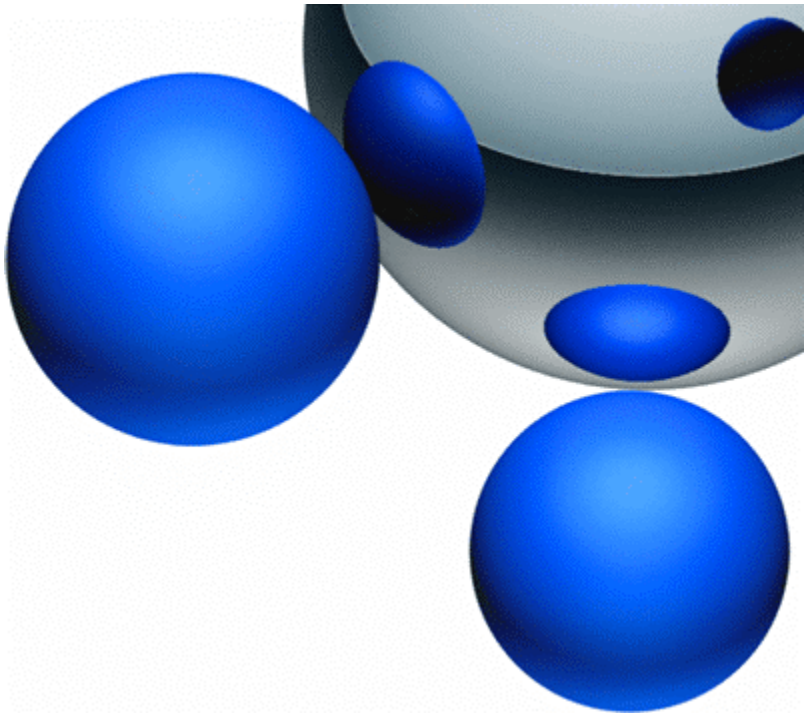

Overview of Sasol CTL Technologies & Recent Activities

Presentation by André Steynberg

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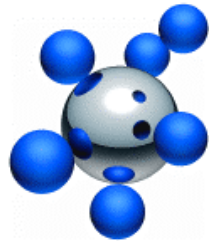
Fischer-Tropsch Technology - The Foundation For CTL:



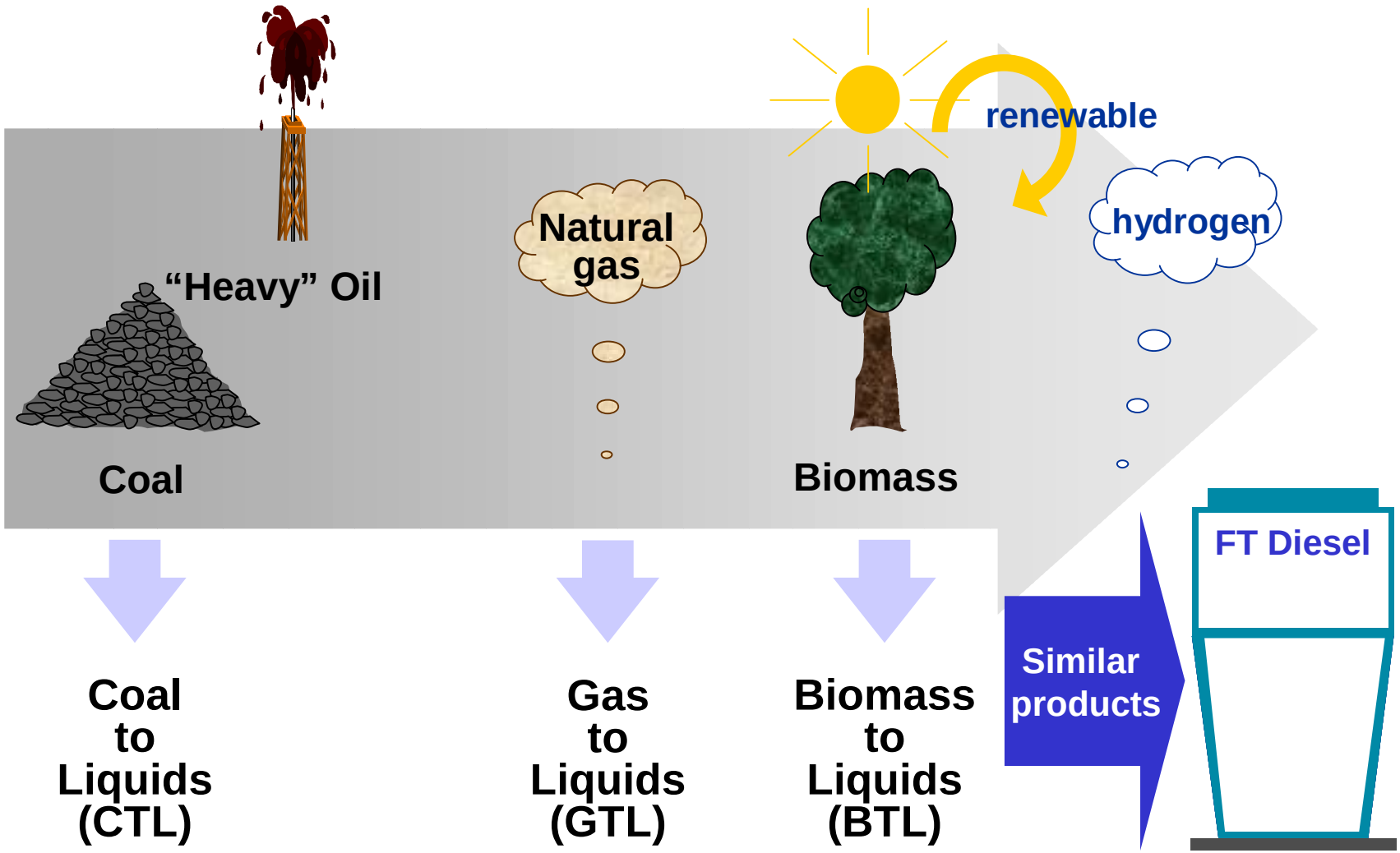
Mainly used to provide cleaner, more useful forms of energy

Enables access to diversified energy markets

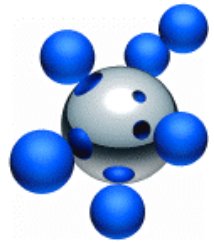
Also (potentially) produces higher value co-products

ECONOMY OF SCALE IS ESSENTIAL FOR SUCCESS

Sasol's FT Technology can be applied to multiple feedstocks



Fischer-Tropsch Enablers



Common Drivers

Abundant, inexpensive hydrocarbon reserves (coal, natural gas, biomass)

+

Global drive for cleaner transportation fuels

\+ **FT** +

Additional CTL Drivers

Diversity of energy supply

+

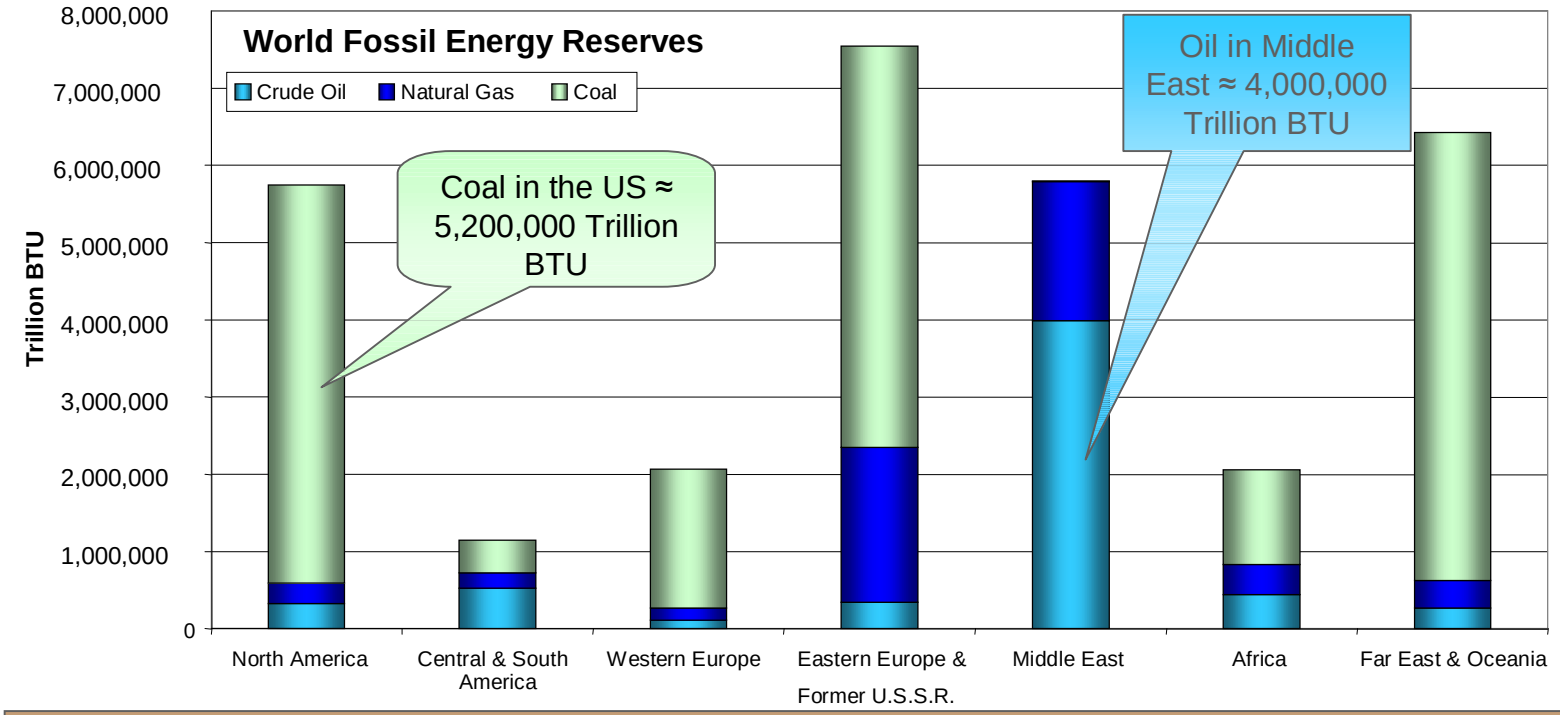
Reduced dependence on crude oil

Global Energy Dynamics….

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

• Crude Oil	42 years
• Natural gas	62 years
• **Coal**	**224 years**

Source : Chiyoda



Energy content of coal in US more than oil in Middle East.

Drivers for CTL….

- *Countries with access to:*
  - *large reserves of low cost gasifiable coal (a minimum of approximately 2 – 4 billion tons) at proposed location*
    - *Reserves to support further expansions*
  - *Adequate water resources close to proposed site*
- *Suitable partners – Coal supplier, product marketer, power utility & other technology providers*
- *Low construction cost countries*
- *with good infrastructure (roads, railway, etc.)*
- *Countries where suitable sites are close to large attractive markets*
- *Countries with the ability and will to provide enabling support*

CTL Challenges & Benefits

Challenges:

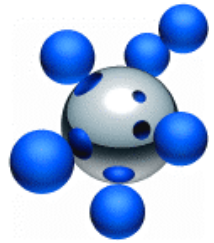
- *Critical mass of key industry players*
- *Capital intensive process*
- *Environmental issues:*
- *"Dirty coal" - public perception*
- *Permitting –*

  no new refineries in the US since 1984

Benefits:

- ***Relatively low operating cost***
  - *Low feedstock cost: Price of coal = USD 10/t equivalent to ~ USD 0.50/MMBtu*
- *Technologies facing dual challenges of capture and storage of CO_2 – capture not major concern for CTL due to concentration of CO_2 which allows for* ***simple CO_2 sequestration.***
- ***Polygeneration***
  - *Might improve plant efficiency*

Combined Production of Transportation Fuels and Electricity



Transportation fuels & electricity are the main conversion products for fossil fuels

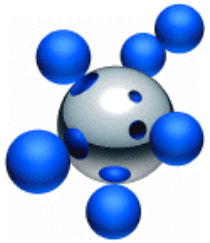
There is no good reason why they should not be produced in the same facility

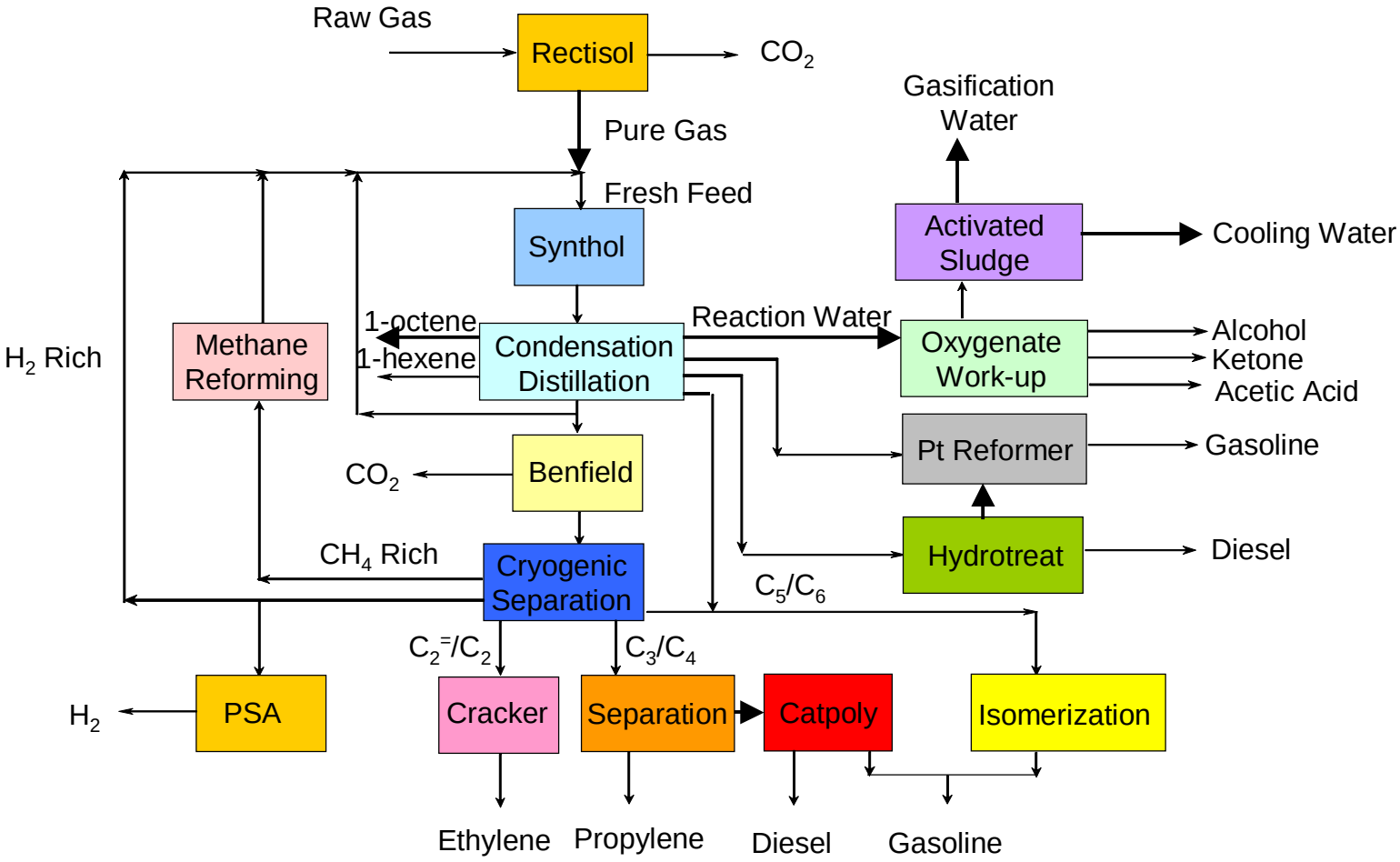
In the USA this concept is known as co-production

Polygeneration = POWER, FUELS & CHEMICALS

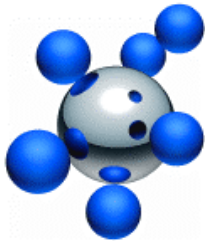
CAN PRODUCE SYNERGIES THAT IMPROVES THE CONVERSION EFFICIENCY TO THESE PRODUCTS

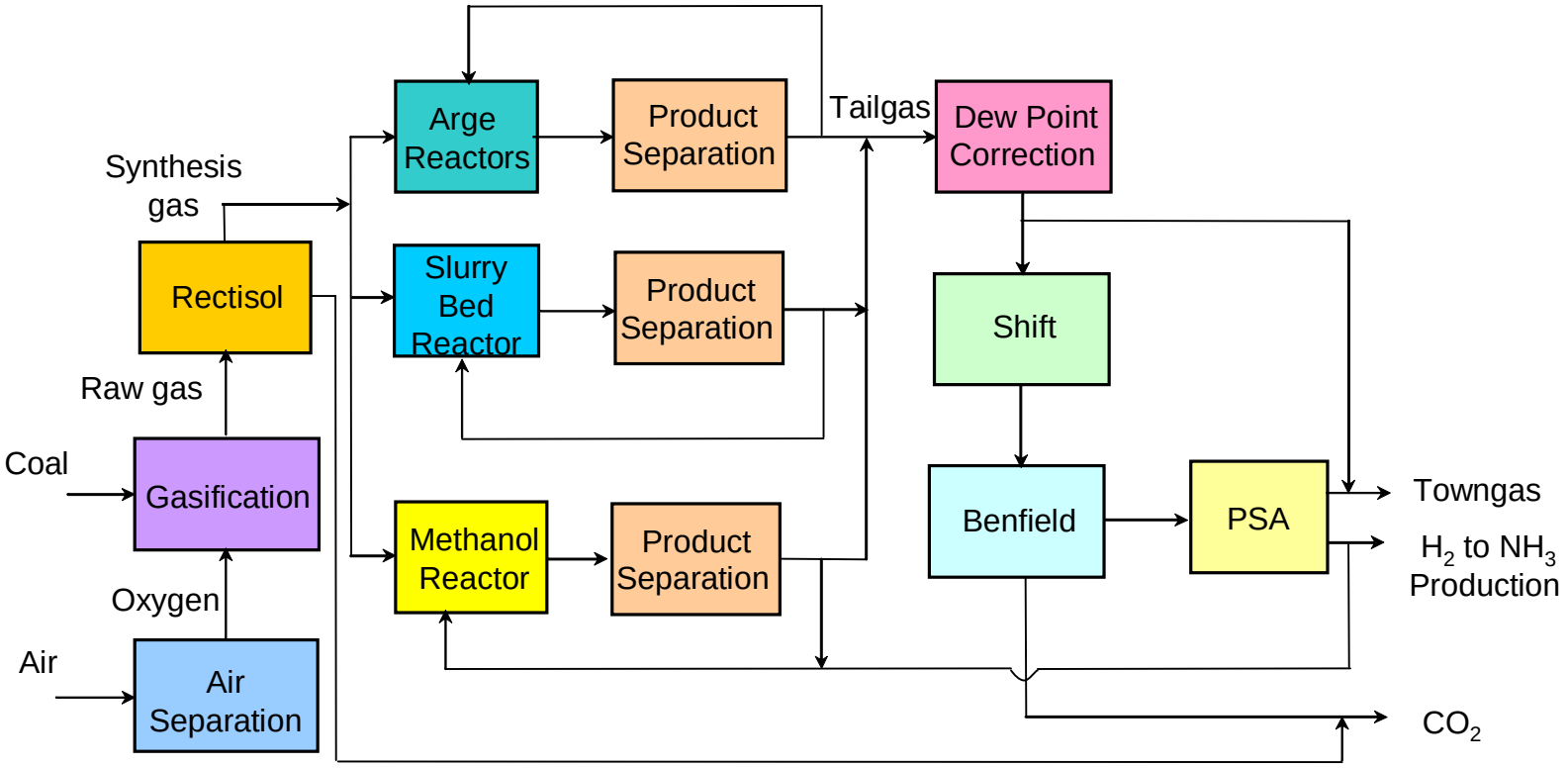
Secunda



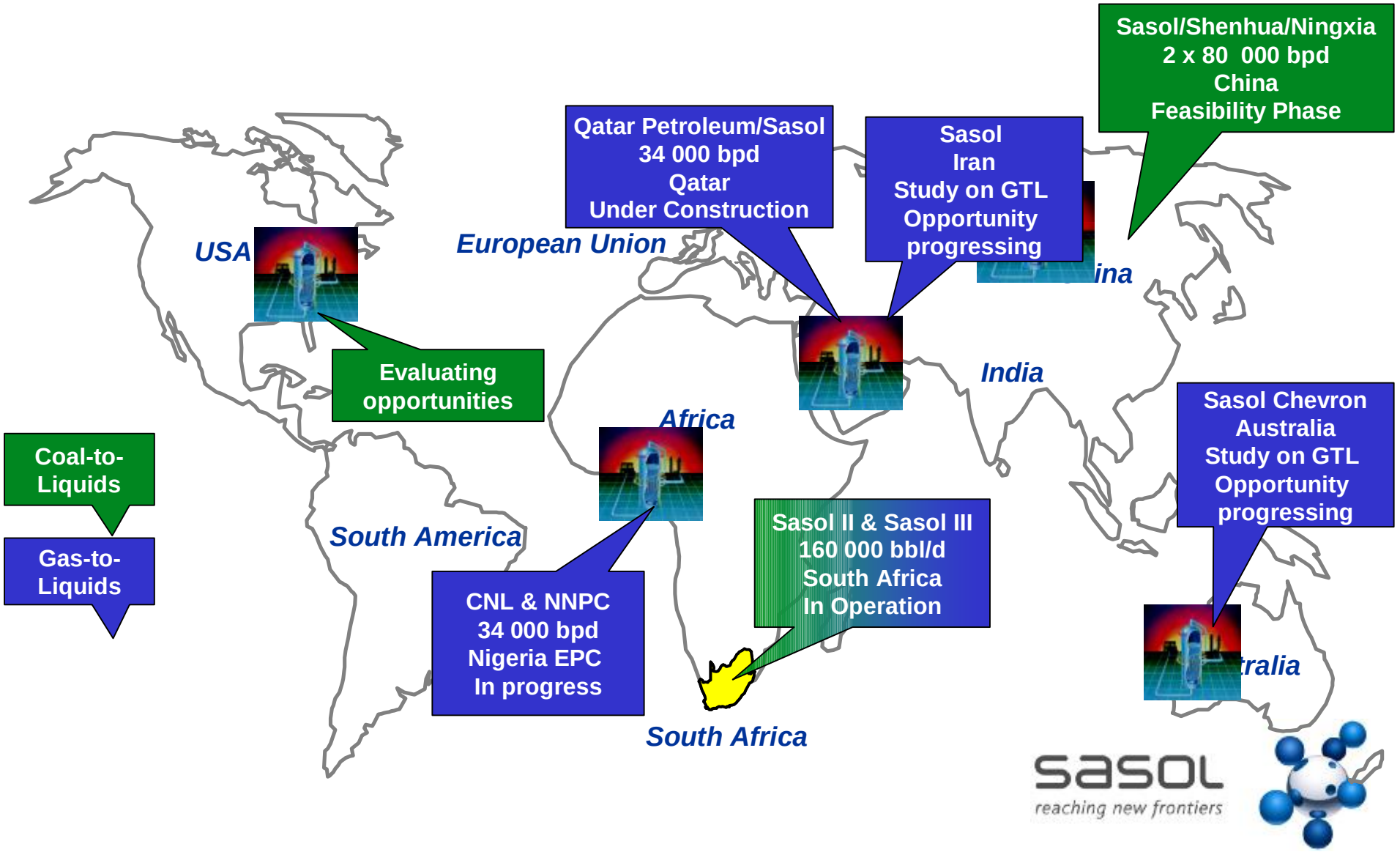

Raw Gas
Rectisol
CO_2
Pure Gas
Gasification Water
Fresh Feed
Synthol
Activated Sludge
Cooling Water
H_2 Rich
Methane Reforming
1-octene
1-hexene
Condensation Distillation
Reaction Water
Oxygenate Work-up
Alcohol
Ketone
Acetic Acid
Pt Reformer
Gasoline
CO_2
Benfield
CH_4 Rich
Cryogenic Separation
Hydrotreat
Diesel
C_5/C_6
$C_2^=/C_2$
C_3/C_4
H_2
PSA
Cracker
Separation
Catpoly
Isomerization
Ethylene
Propylene
Diesel
Gasoline

Sasolburg




Arge Reactors
Product Separation
Tailgas
Dew Point Correction
Synthesis gas
Rectisol
Slurry Bed Reactor
Product Separation
Shift
Raw gas
Coal
Gasification
Methanol Reactor
Product Separation
Benfield
PSA
Towngas
H_2 to NH_3 Production
Oxygen
Air
Air Separation
CO_2

Sasol's current global FT activities



China CTL project status

- *Identified 2 sites in coal rich western part of China:*
  - *Ningxia Autonomous region*
  - *Shaanxi province*
- *Plant capacity ~ 85 000 barrels per day per site*
- *Capital cost*
  US$ 60 000 to 80 000/daily bbl
- *Due to enter full feasibility study in 2nd quarter 2006*

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Sasol's future FT approach…..

- *Sasol wants to remain the leading producer of clean fuels from non-petroleum sources*
  - *Main focus is on natural gas feedstock (GTL)*
  - *Considering coal feedstock (CTL) where strategic drivers exist (e.g. China, USA)*
  - *Will develop biomass options (renewable) with time (BTL)*

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Variety of Industrial Processes

- ***Gas/Coal processing***
- ***Syngas production akin to MeOH and ammonia plants***
- ***Hydrocarbon synthesis***

  - gas, liquid and solid mixtures

  - recycles and solids separation

  - large volumes flammable materials at high pressure that auto-ignite
- ***Refinery operations***
- ***Specialty chemical processing***
- ***Integrated utility systems***
- ***Power generation***
- ***Catalyst manufacture has elements of mineral processing combined with the precision found in the pharmaceutical industry***

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Get by with a little help from our friends…

- ***Gas processing – Chevron/ Foster Wheeler***
- ***Gas conversion – Haldor-Topsoe/ Lurgi/ Linde/…***
- ***Hydrocarbon synthesis – In-house/ Stone & Webster/ IHI and others***
- ***Refinery operations – Chevron/ UOP/ IFP***
- ***Integrated utility systems – Foster Wheeler***
- ***Power generation – Foster Wheeler and others***
- ***Catalyst manufacture – Engelhard (Co)/ SudChemie (Fe)***
- ***EPC – most competitive bid***
- ***ASU – most competitive bid/ Air Liquide***

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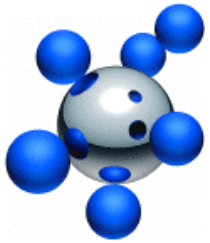
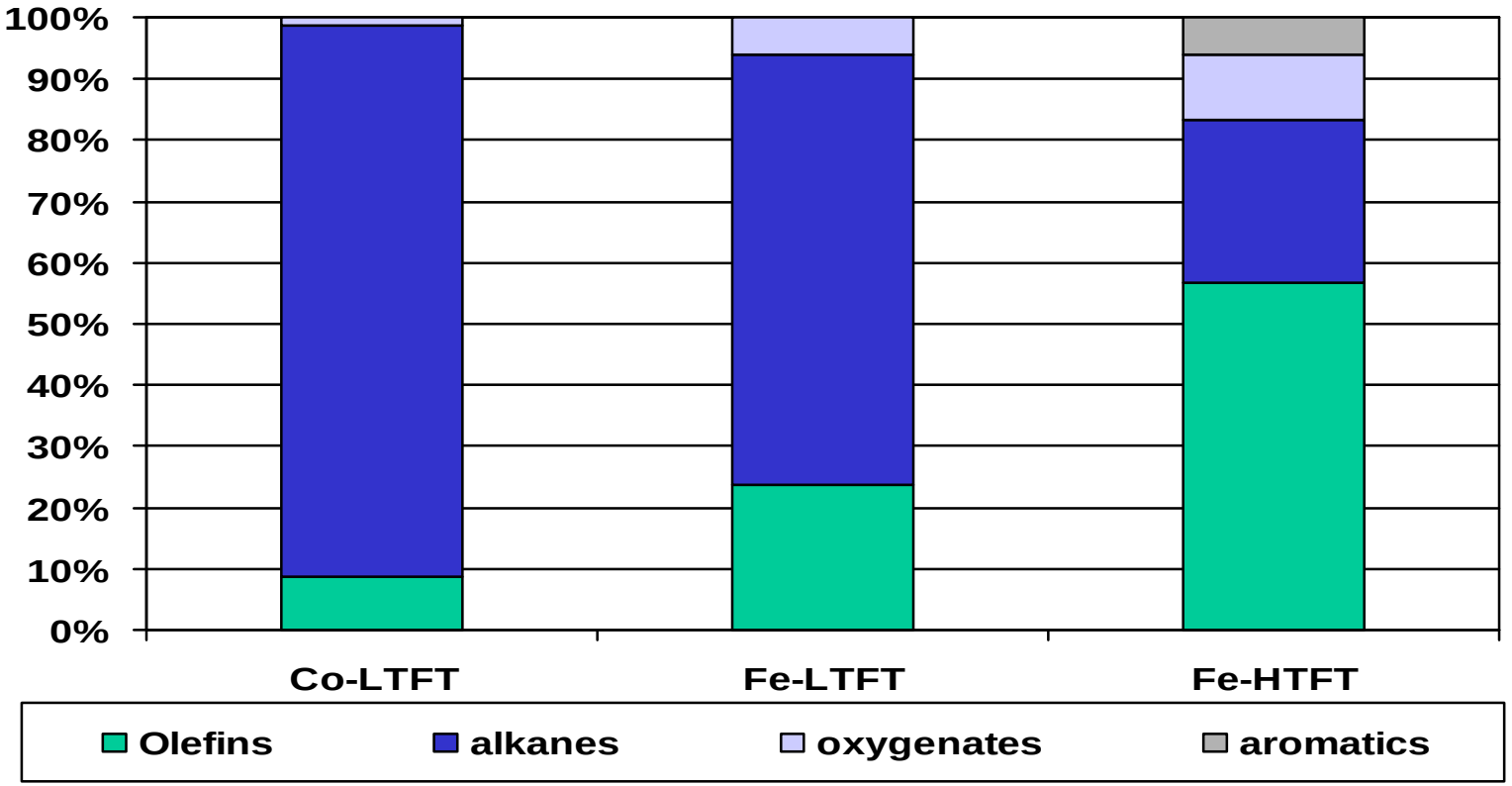
The 3 different Sasol Fischer-Tropsch technologies

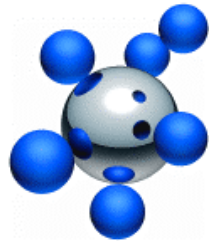


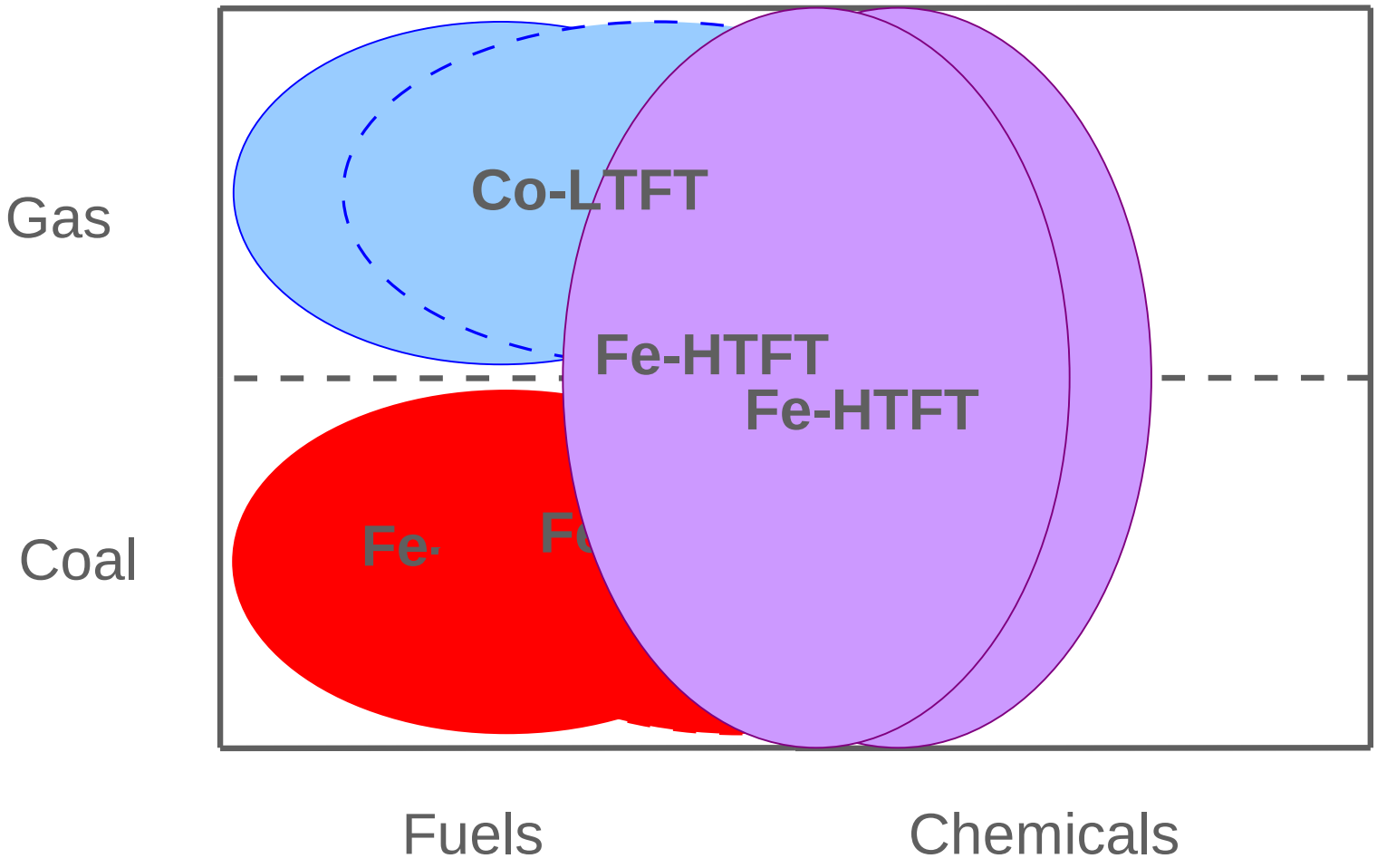
- *Cobalt low temperature Fischer -Tropsch (Co-LTFT)*
- *Iron low temperature Fischer-Tropsch (Fe-LTFT)*
- *Iron high temperature Fischer-Tropsch (Fe-HTFT)*

The 3 technologies produce fundamentally different types of hydrocarbons and thus ultimately have the potential to produce different chemical products

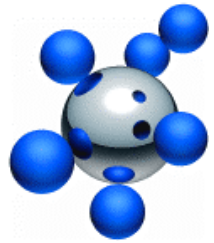


Sasol's three different Fischer-Tropsch technologies



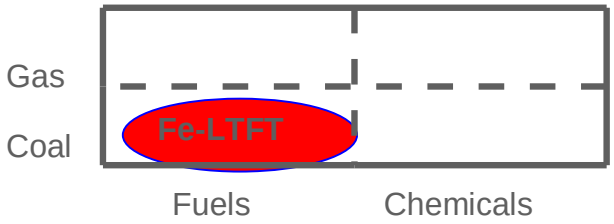


Recommendations for CTL Applications:

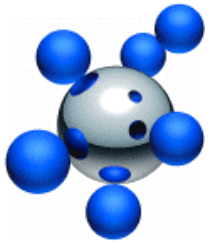


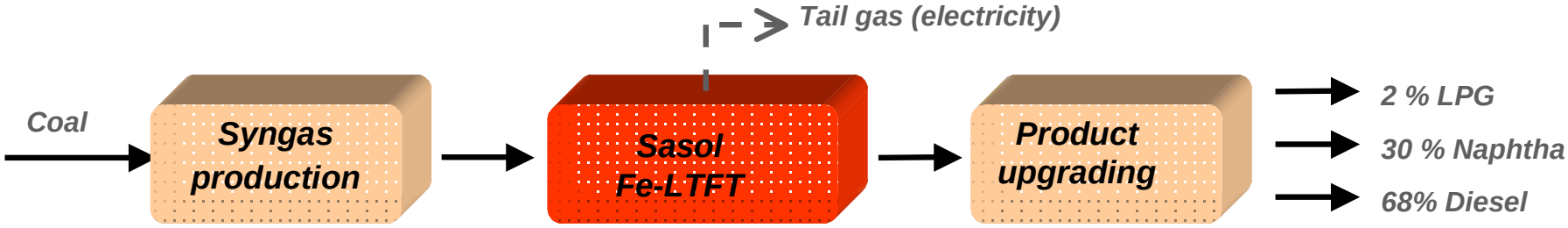
- *Power export (co-production) should be a feature from the outset*
- *Each potential site should consider the business case for a footprint plant and the eventual targeted product spectrum*
- *Starting with fuel value products and gradually phasing in the high value products is a successfully proven business model*
- *Alternative approaches only making high value products from the outset will be complex leading to start-up delays and difficulties in placing products in the market*

- *Message: look for a simple starting scheme that allows the ultimate business objective to be achieved with a phased approach*



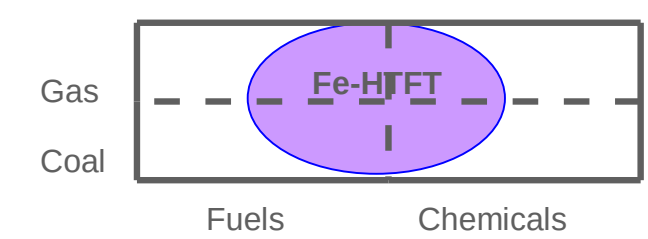
Sasol's Fe-LTFT technology – the footprint plant

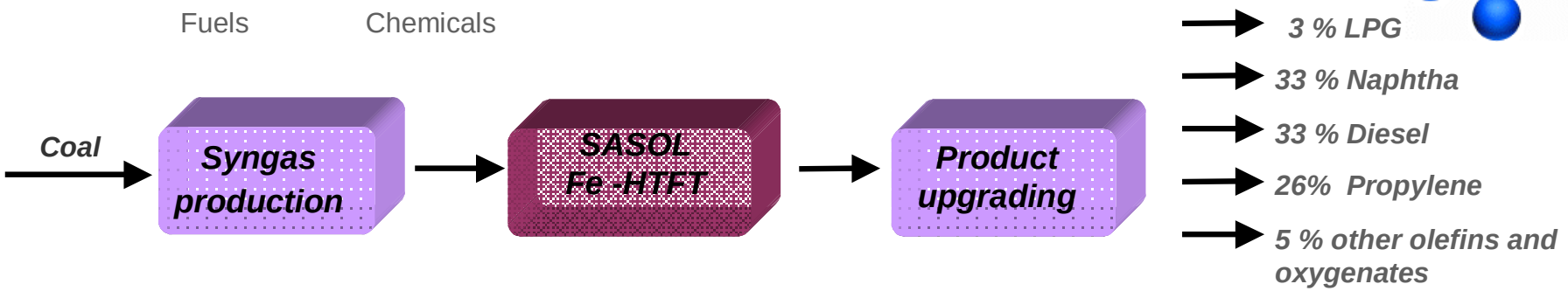


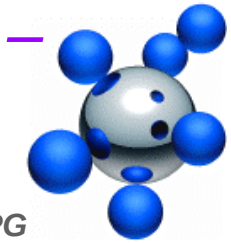


- *Sasol's Iron low-temperature technology is ideally suited for the production of diesel from Coal (CTL technology).*
- *Very high quality Naphtha is produced -- ideal for steam crackers.*
- *Best option for a simple footprint plant.*
- *Need a use for the FT tail gas.*

Sasol's Fe-HTFT technology – footprint plants

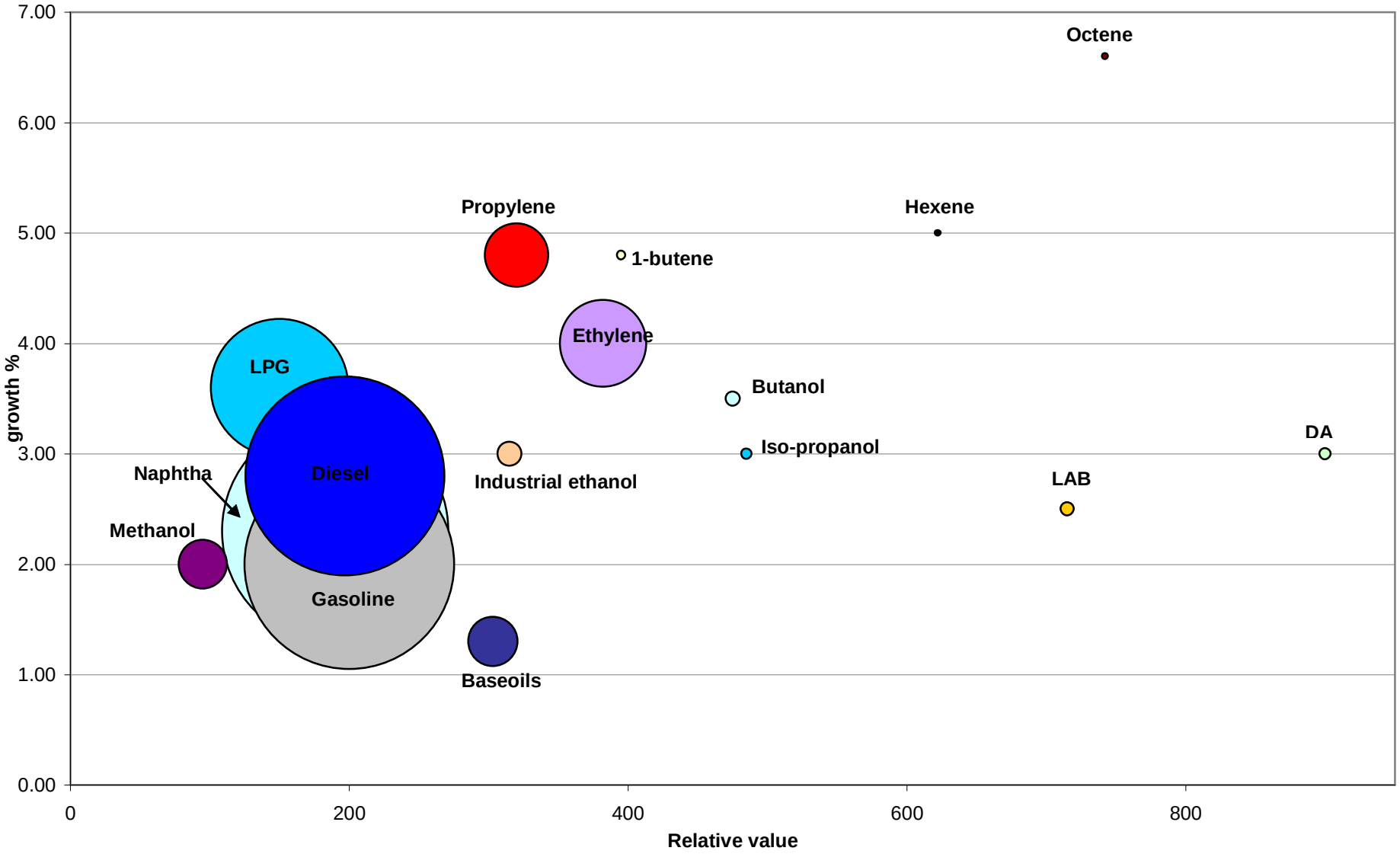




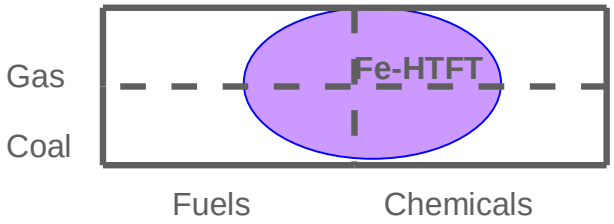


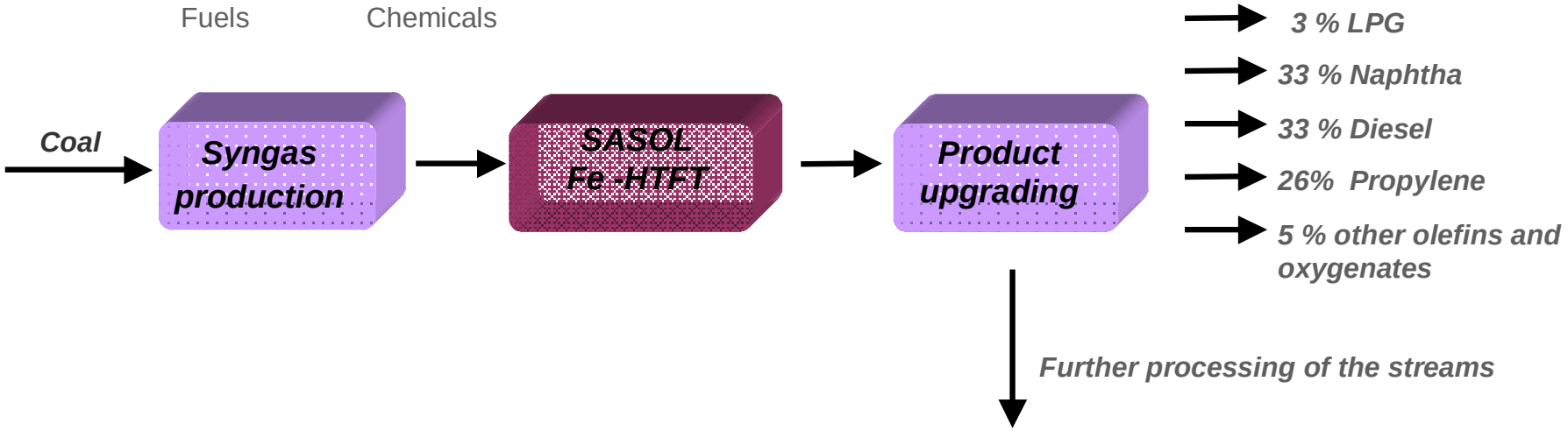
- *HTFT products are highly olefinic and these olefins are ideal building blocks for producing high value products.*
- *A simple initial product offering is possible. Various options exist and an example here illustrates a propylene, diesel and naphtha footprint plant.*
- *Propylene volumes that accompany a reasonable scale diesel plant match well with a world scale polypropylene plant.*
- *Major products are aimed at large markets (fuels, propylene & ethylene), to obtain economy of scale with syngas preparation and FT synthesis.*
- *Most capital intensive product upgrading processes but some progress has been made to decrease these costs.*

Target propylene and ethylene -- these are large chemicals markets



Sasol's Fe-HTFT technology with additional chemicals





Complex due to many different products with differed market drivers. Therefore a phased approach has proven to be successful

Ethylene
Butene and butylenes
Hexene
Octene
Nonene
Detergent alcohols
Ethanol
N and iso-propanol
N and iso-butanol
Acetone
MEK