

Overview of Gas to Liquids

01 GTL series



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GTL SERIES

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This information sheet provides a general overview of the Gas to Liquids (GTL) process.



What is Gas to Liquids?

GTL is the term used to describe the chemical conversion of a gas into synthetic crude (syncrude) by the Fischer-Tropsch (FT) synthesis process. The syncrude is then refined by traditional methods to produce ultra-clean liquid transport fuels.

As a feedstock, the process uses synthesis gas (syngas) generated from the gasification of solid, liquid or gaseous carbon rich materials, such as coal or natural gas. Linc Energy is planning to use syngas from Underground Coal Gasification (UCG) to commercially produce liquids using GTL.

The following three main steps comprise Linc Energy's GTL process:

1. Gas treatment: Removes impurities from the UCG syngas.
2. Fischer-Tropsch synthesis: Produces syncrude through catalytic reactions.
3. Product work-up and refining: Separates liquids and waxes and refines into final products.

Gas treatment

Coal derived syngas (such as UCG syngas) contains various impurities that must be removed to meet specifications to run an efficient GTL plant.

Some impurities act as poisons to catalytic reactions in the GTL process, reducing the efficiency of the process. Such impurities include condensed oils, solid particles, arsenic, mercury, oxygen, sulphur compounds and carbon dioxide. These originate from the coal itself or its gasification. Impurities are removed from the gas and their absence enables high conversion to liquid fuels over a prolonged period.

On the completion of gas treatment, the syngas is free of impurities and is rich in hydrogen and carbon monoxide, which are the basic elements needed to manufacture syncrude.

Fischer-Tropsch synthesis

All saturated liquid fossil fuels are a chain of carbon molecules with single bond hydrogen molecules attached. The longer the carbon chain, the heavier the product. The hydrocarbons with the shortest carbon chains are gases like propane, ethane and methane, and the heaviest hydrocarbons are solids like tars and pitch.

FT synthesis combines carbon and hydrogen molecules into chains by reacting carbon monoxide with hydrogen in the presence of a metal catalyst, heat and pressure.

Product work-up and refining

The syncrude product from the FT synthesis is refined or upgraded into higher value end products through traditional and syncrude specific refining processes. The product range depends on the FT technology, process conditions and the refinery scheme or setup. New generation GTL plants are aimed primarily at producing middle distillates for transportation fuels, e.g. diesel, kerosene and naphtha.

GTL products

Due to the removal of impurities before the gas is converted to liquid, GTL products have superior properties in terms of combustion efficiency and pollutants. GTL fuels are compatible with old, existing and future diesel engine technologies. This means that FT fuels can be directly substituted for traditional fuels, negating the need for large scale vehicle and infrastructure fleet modifications.

Naphtha

GTL naphtha could be used in ethylene and propylene manufacturing as well as blendstock for lighter fuels, such as petrol and kerosene. The highly paraffinic nature of the naphtha from the GTL process is an excellent

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refining feedstock that provides a higher ethylene and propylene yield than naphtha from petroleum refining.

Jet Fuel

Kerosene produced from GTL can be used as jet fuel to power jet engine aircrafts. Special International Air Transport Association approval is required to get synthetic jet fuel certified for this application.

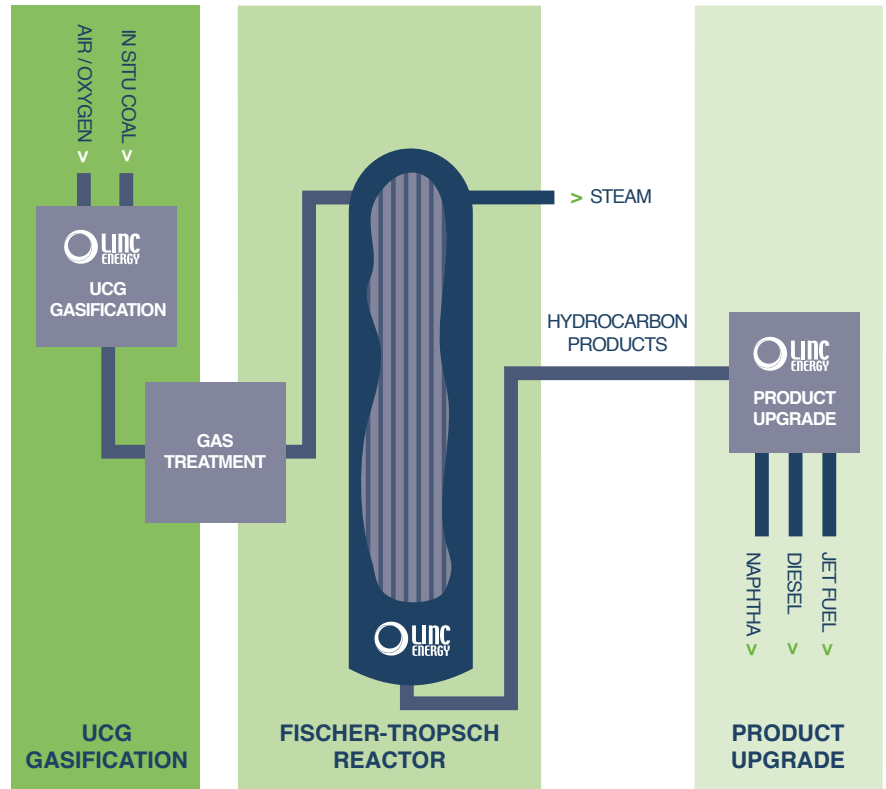
Diesel

FT diesel is considered superior to conventional diesel as it has no sulphur content, near zero aromatics and a high cetane number, providing excellent combustion properties. FT diesel has superior environmental performance compared to conventional crude oil refinery diesel, providing significant reductions in emissions of particulates, NO_x, SO_x, carbon monoxide and light hydrocarbons.

Base oils and waxes

Base oils are the starting material for lubricants production. GTL lubricants and paraffinic waxes are of very high quality, fitting into niche markets with high standard requirements.

1. Beer et al, undated. Comparison of Transport Fuels. CSIRO Final Report to the Australian Greenhouse Office on the Stage 2 Study of Life Cycle Analysis of Alternative Fuels for Heavy Vehicles.
2. In the absence of any published works on the life cycle emissions of FT fuels where UCG syngas is the feedstock, tailpipe emissions only have been presented.



Emission reductions from FT diesel

Compared to conventional diesel, FT Diesel results in reduction of tailpipe emissions by:^{1,2}

- 6%: greenhouse gases
- 13%: oxides of nitrogen
- 19%: carbon monoxide
- 35%: fine particulates (PM-10)
- 43%: hydrocarbon gases

About Linc Energy

Linc Energy is an Australian energy company which listed on the Australian Securities Exchange (ASX) in May 2006 and the OTCQX in December 2007. Through the unique combination of Underground Coal Gasification (UCG) and conventional Fischer-Tropsch technology to produce Gas to Liquids (GTL), Linc Energy is developing a significant energy business based on the production of cleaner energy solutions for the future.

Related information sheets

- Overview of Underground Coal Gasification
- GTL Explained
- UCG, GTL and the Environment

AUSTRALIAN HEAD OFFICE

32 Edward Street
GPO Box 1315
Brisbane QLD 4000
AUSTRALIA

p +61 7 3229 0800
f +61 7 3229 6800

UNITED STATES HEAD OFFICE

1200 17th Street
Suite 2100
Denver CO 80202
UNITED STATES

p +11 303 623 0510
f +11 303 623 0547

linc@lincenergy.com.au

www.lincenergy.com.au

