SINGAPORE

STREBL ENERGY™

RENEWABLE ADVANCED TECHNOLOGIES

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RENEWABLE ENERGY - WASTE-TO-ENERGY
ENERGY RECOVERY - ADVANCED TECHNOLOGY SOLUTIONS

www.streblenergy.com

COAL-TO-DIESEL PRESENTATION

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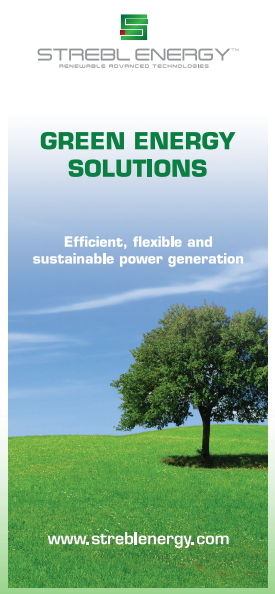
ABOUT STREBL ENERGY PTE LTD

STREBL Energy Pte Ltd is in the business of providing thermal treatment technologies for the safe disposal of Waste to Energy.

The senior management of STREBL Energy waste Management have been closely involved in the design and upgrading of the thermal processes in Europe, Asia and Africa. World renowned facility specializing in the safe treatment of waste to Energy Plants.

Mr. Peter Strebl is an adviser on waste treatment technologies in 8 countries



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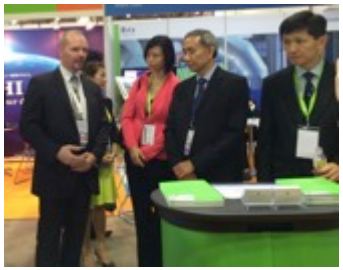
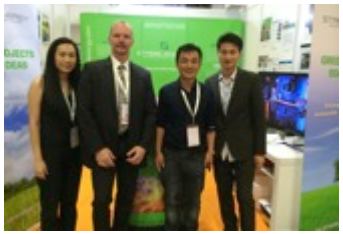
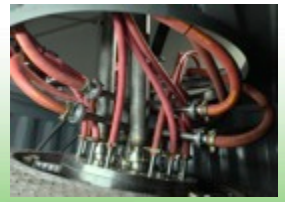
STREBL ENERGY PTE LTD SINGAPORE

The company offers proven technologies to the international Waste to Energy communities to replace traditional thermal methods that are posing severe challenges to our living environment





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Advanced Technology Centre in Czech Republic, EU








STREBL Energy has broad international experience in the design, engineering, procurement and construction of waste-to-alternative fuel plants, municipal solid waste, used tires and waste plastic treatment facilities, providing all the technical and management skills needed to complete a project successfully.

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MISSION STATEMENT

Our mission is to become a valued partner to our clients and to make significant contribution to preserving a sustainable environment and striving for a cleaner future, through use of advanced technology solutions and leveraging on our wide engineering experience and global network.

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COMPANY ACTIVITIES

STREBL Energy has broad international experience in the design, engineering, procurement and construction of waste-to-alternative fuel plants, municipal solid waste, used tires and waste plastic treatment facilities, providing all the technical and management skills needed to complete a project successfully.

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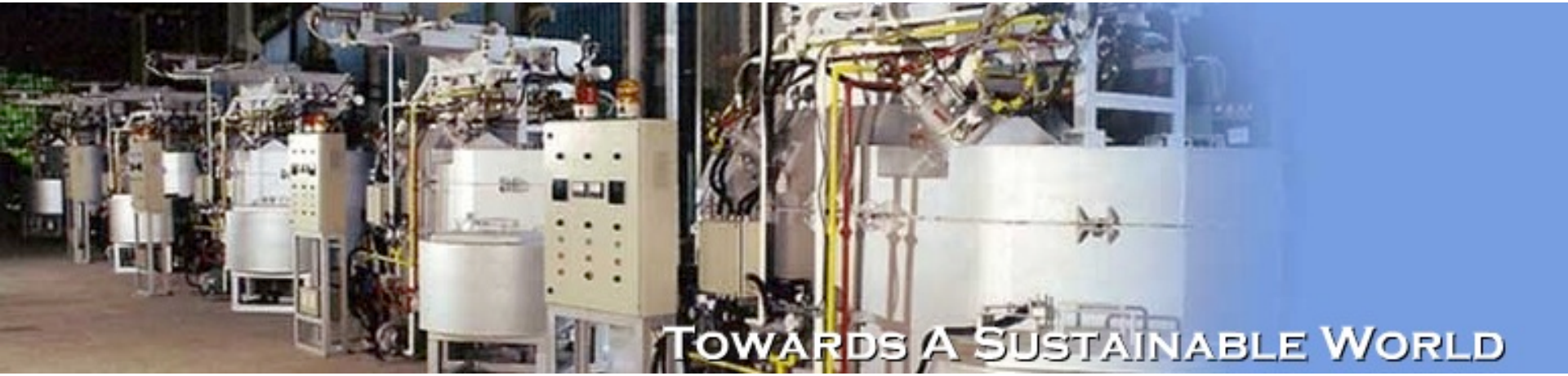
OUR COMMITMENT

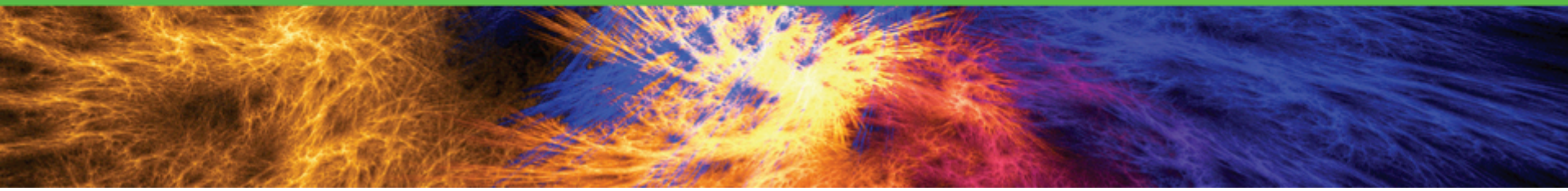


- Maximize plant availability
- Achieve better plant performances
- Compliance with environmental and safety requirements
- Maximize throughput of the plant
- Maximize energy output
- Minimize maintenance costs
- Minimize consumption of chemicals & utilities
- Organize or assist with major overhauls or plant upgrades

CORPORATE RESPONSIBILITY

- **The growing global consumption and waste creation is a stress on landfill, water and energy. STREBL Energy aims to create a sustainable future and a cleaner world.**
- **STREBL Energy is committed to providing a service to the community around the globe. Our green business model powers the community while providing job opportunities. "Eco-friendly" and "sustainability" are some of the words we live by in our business.**
- **We feel responsible in making a difference in the lives of the people in the communities we work in by managing their wastes, reducing the environment impact and providing a better standard of living.**

ENVIRONMENT



- **The technology we use meets the highest environmental standards. The use of innovative and high quality technology means smell and toxic pollutants are not the by-products of our process.**
- **The high yield conversion of the waste product and biomass into energy reduces the need for landfills and creates rural jobs. The gasification process cleans and recycles ash properties that would otherwise require disposal.**
- **STREBL Energy are committed to contributing to a cleaner environment.**

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PRODUCTION FACILITY In Czech Republic

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DELIVER PROFESSIONAL SERVICES

- Project Management
- Basic Engineering
- Detailed Engineering
- Construction Management
- Contract Management, cost control and time scheduling
- Worldwide sourcing of quality equipment and materials
- Supervision and control of construction and erection
- Quality inspections in the factory or on site
- Commissioning and start-up of installations
- Operator training

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OUR REFERENCES

REFERENCE PLANT

Integrated Hospital Waste Incineration Plant

REFERENCE PLANT
Industrial Furnaces

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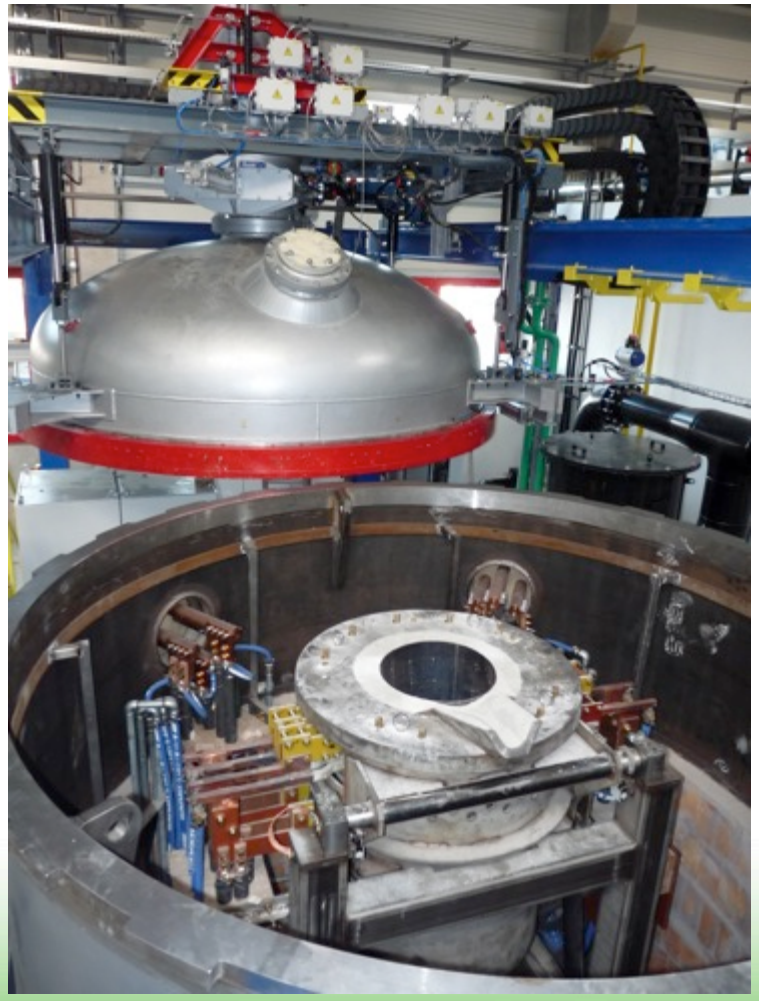

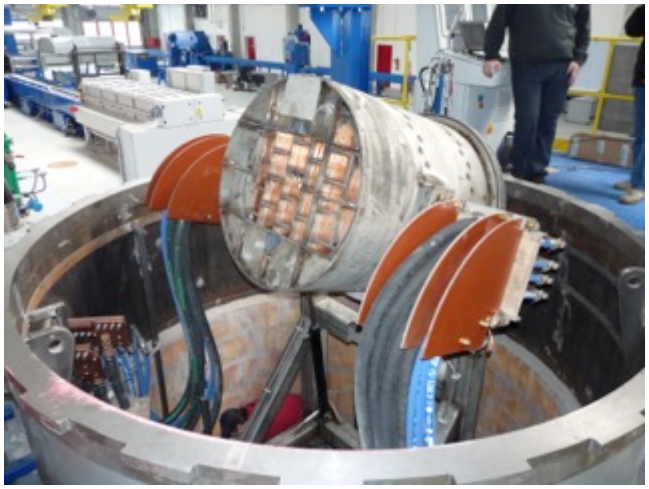

REFERENCE PLANT
Tunnel Composting

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(to produce soil amendments from MSW organics)

REFERENCE PLANT
Material Recovery Facility

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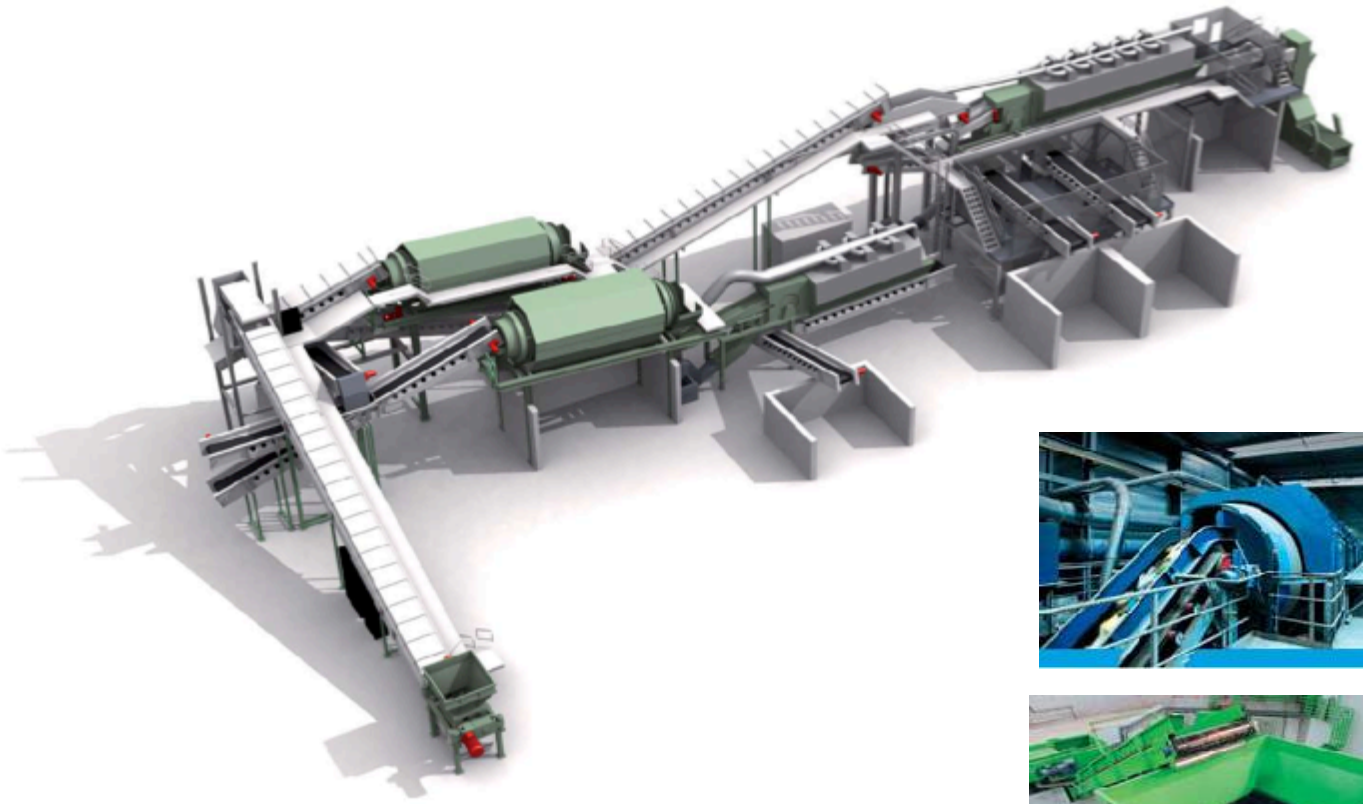

(Recycling MSW)

REFERENCE PLANT
Gasification of MSW

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REFERENCE PLANT

Gas/Oil Generator Installations

REFERENCE PLANT

LTDT Plastic Waste Facility

INTRODUCTION
Coal-To-Liquid (Diesel) Technology

4th GENERATION FISCHER – TROPSCH TECHNOLOGY

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CTL - Coal-To-Liquid (Diesel) Technology

Gasification has been used to commercially produce liquid fuels for decades. CTL was used during World War II by the Germans, when they had limited access to petroleum but desperately needed fuel for their military. At peak production, the Germans were producing over 5 million gallons of synthetic fuel a day.

South Africa during Apartheid had a similar experience. With sanctions restricting its petroleum supplies. South Africa followed Germany's example and turned to CTL using its large coal reserves to produce liquid fuel. Sasol (South African Coal, Oil and Gas Corporation) operates a number of gasification facilities, including the 160,000 barrels per day (bpd) Secunda CTL in South Africa. In total, about 25% of South Africa's liquid fuel is produced synthetically from coal.

Shell is also a major developer of GTL technology. Shell has operated a GTL plant in Bintulu, Malaysia, since 1993, with current capacity of nearly 15,000 bpd. In 2011 Shell commissioned the 140,000 bpd Pearl GTL plant in Ras Laffan, Quatar – by far the largest GTL plant in the world.

Coal-To-Liquid Technology (CTL)

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Strebl Energy uses modular design refinery, a small scale, low pressure gasification to convert coal into any synthesis gas or fluid using plasma and catalytic commercial grade systems that are extremely cost effective. Most developers are planning to build more capacity CTL barrels 10000-15000 per day with the use of expensive gasification systems are designed for high pressure and cost-effective only for large volumes of coal gasification.

We have to offer savings in both stages and equipment in connection with the process of coal gasification and do not require large initial investments in synthesis gas compressor stations. Our flexible low pressure coal gasifier allows a wide range of almost any type of coal including coal dust to be in cash on both large and small scale. Our system allows the production of high-quality synthetic fuels using the most proven and new technologies.

The main product of Strebl Energy coal gasification high grade diesel fuel. In the world view of the adoption of morevand more countries tightening of environmental demand for diesel fuel with a low sulfur content less than 15 ppm of sulfur. CTL Diesel ultrapure high cetane diesel fuel with very low emissions due to the presence of only trace amounts of sulfur.

CTL diesel fuel can be used in conventional engines with compression either in pure form or as an effective component of the mixture to upgrade marginal middle distillate streams to supply road diesel fuel. Diesel engine emissions affects primarily through its cetane number, aromatics and sulfur. In all these aspects, CTL diesel the best quality.

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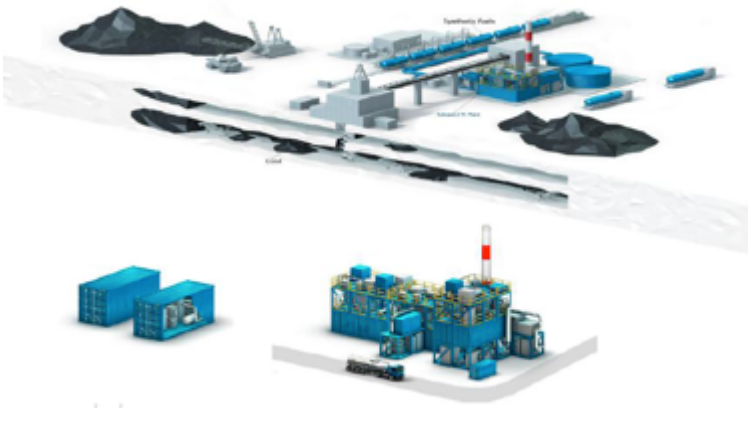
Coal-To-Diesel Technology

1. Aim-Project

Construction of the high-tech plant for production of diesel fuel from coal based on green technologies.



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Coal-To-Diesel Technology

2. Product

GTL diesel is positioned as a pure, high-quality product, or as a blend to improve the quality of conventional diesel engines. Offering a cleaner, more efficient diesel GTL diesel much higher quality than diesel derived from crude oil. GTL diesel has a high cetane number (at least 70, compared with 45 to 55 list of the most diesels), low sulfur (less than five parts per million), low aromatics (Less than 1%), and good cold flow properties, which can be optimized according to specific applications. GTL diesel is positioned as a pure, high-quality product, or as a mixture action to improve the quality of conventional diesel engines. Best of all, GTL diesel can be used in all modern diesel engines. High-quality properties lead to a reduction of noise and other productivity. High cetane number and very low sulfur and aromatic hydrocarbons more effectively and cleaner burning combustion environment. This leads to significant reduction in engine wear and emissions. It is noteworthy, too, that GTL diesel fuel compatible with the established Distribution infrastructure. Therefore, it can be spread on the ship, Tanker trucks or rail tankers without operators having to make new investments to change their equipment. It can can be used with current and future engine provided technology and exhaust gas. Compression ignition vehicles using GTL diesel is not necessary to pass any engine or exhaust system modifications.

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Coal-To-Diesel Technology

3. Market

According to experts, in the period from 2013 to 2017 the production of diesel fuel in the world will grow by 4,4-4,9% per year. Market prospects for diesel vehicle fleet associated with growth, is used as diesel fuel. Use a mixture of diesel fuel and special "green supplements" (GTL-diesel) provides ample opportunity to use this product in the markets of developed countries, where environmental problems associated with emissions of road transport is a serious problem. The leading manufacturers of diesel fuel in the world are the U.S. and China. The share of these countries in 2010 accounted for 16.3% and 12.7% of the total production of diesel fuel in the world. Besides the U.S. and China, large amounts of diesel fuel produced in Russia, Japan and India.

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Coal-To-Diesel Technology

Indonesia has more 161milliardami tons of coal. In 2012 the main domestic consumers of coal are power plants. The basic amount mined in Indonesia coal is exported. In view of this for products with higher added Indonesian Government adopted the decision on the strengthening of controls over exports of coal country. Government decided to favorable policy for coal-to-country and export of processed products with higher added value, which is a favorable factor for the project.

Not expressly competitor is Sasol South Africa also used Fischer-Tropsch. However, we use a more progressive and developed the 4th generation Fischer-Tropsch technology allows cost-effective to produce in small and medium-sized plants. Place the plant as close to the place of production by reducing transportation costs.

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Beginnings of the FT process

The process was invented in petroleum-poor but coal-rich **Germany in the 1920s**, to produce liquid fuels. The invention of the original process was developed by the German researchers **Franz Fischer and Hans Tropsch** at the Kaiser Wilhelm Institute. It was used by Germany and Japan during World War II to produce alternative fuels. Germany's annual synthetic fuel production reached more than **124,000 barrels per day in 1944** (from 25 plants, 6.5 million tons)

Professor Franz Fischer (left) and Dr Hans Tropsch, the inventors of a process to create liquid hydrocarbons from carbon monoxide gas and hydrogen using metal catalysts. Image: Max Planck Institute of Coal Research.

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FT process basics

The Fischer-Tropsch process uses **hydrogen (H_2) and carbon-monoxide (CO)** to make different types of hydrocarbons with various H_2:CO ratios

In a CTL facility the H_2 and CO can be **supplied from the coal gasifier**

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FT process basics

The original Fischer-Tropsch process is described by the following chemical equation:

$$(2n+1)H_2 + nCO \rightarrow CnH_{(2n+2)} + nH_2O$$

The **initial FT reactants in the above reaction** (i.e. **CO & H_2**) **can be produced by** other reactions such as the partial combustion of a hydrocarbon or by the **gasification of coal** or biomass: $C + H_2O \rightarrow H_2 + CO$

FT reactants can also be produced from methane in the **gas to liquids** process: $CH_4 + \frac{1}{2}O_2 \rightarrow 2H_2 + CO$

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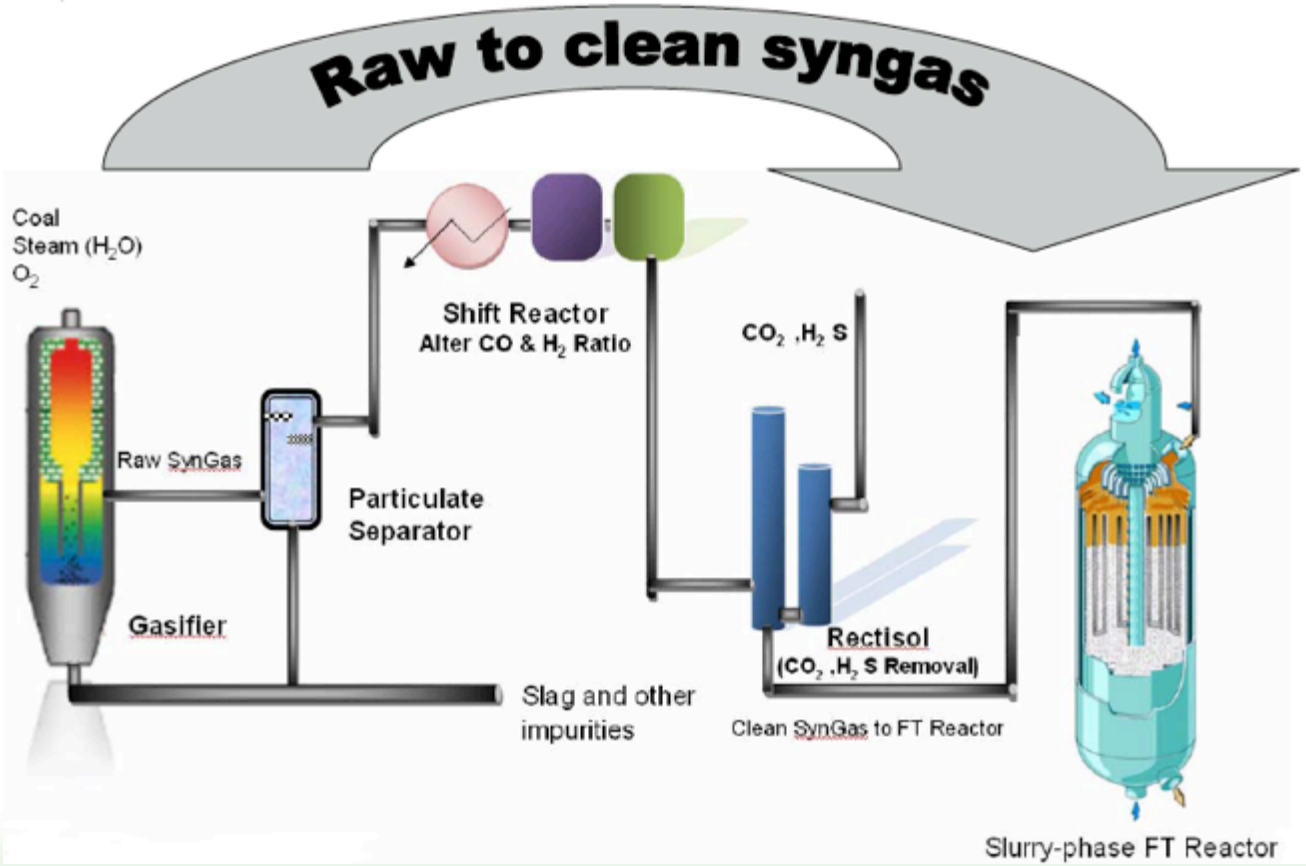
Syngas to FT reactor



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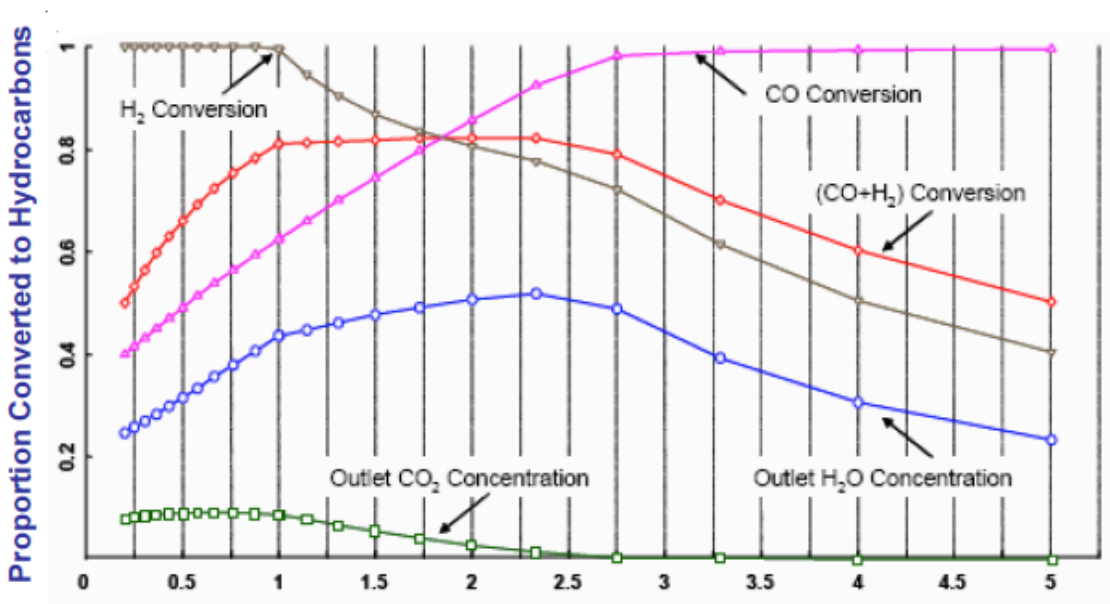
H2:CO ratio



SynGas H_2:CO Molar Ratio Input {(Moles of converted CO &H2)/Total Moles of CO & H2)} to Synthesis Reactor, Fixed Volume of (CO+H_2)

The FT process still produces CO_2 although substantially smaller amounts compared with the gasification process

The products of FT synthesis include hydrocarbon chains, oxygenates, water & carbon-dioxide among others at varying proportions depending on the catalyst used & reactor conditions. The efficiency of the FT reaction is commonly measured by the conversion ratio, also known as the rate of FT reaction

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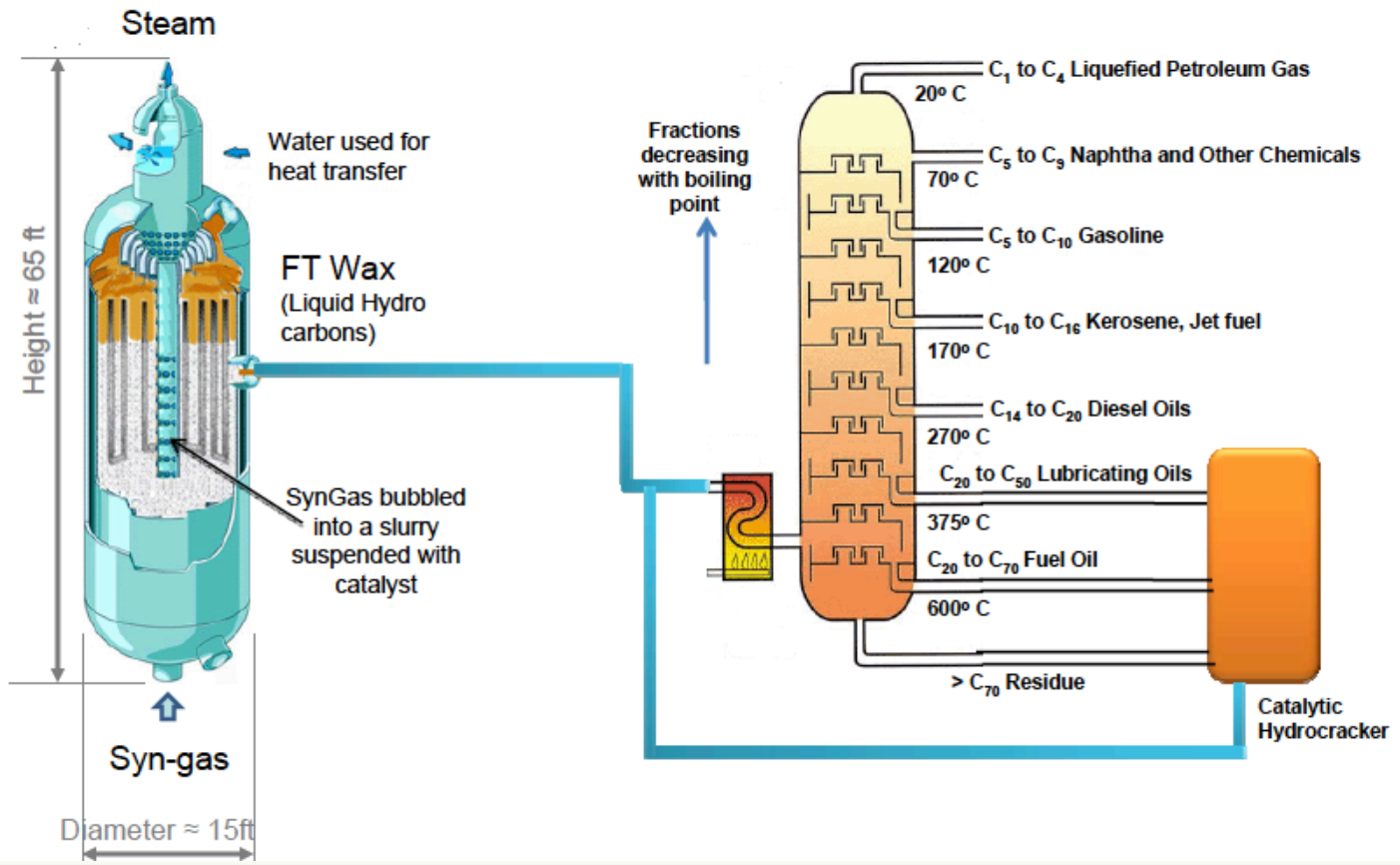
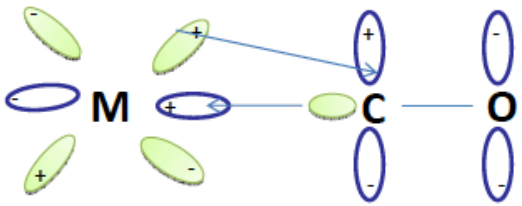
Slurry – phase FT reactor



FT & Catalysis

The **FT Process** is a catalyzed chemical reaction in which carbon **monoxide and hydrogen are converted** into liquid hydrocarbons of various forms

The catalyst used *(often based on iron or cobalt)* is a chemical compound that **increases the rate of a chemical reaction without altering the final equilibrium** *(catalysis is purely a kinetic phenomenon).* Catalysts reduce the free activation energy which then quickens the speed of the reaction



M = Metal
CO = Carbon Monoxide
The ligand CO *(propensity to bonding)* exchanges electrons with the Metal

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Catalysts & Products

CATALYST	PRODUCT
Iron	Linear alkenes and oxygenates
Cobalt	Alkanes
Nickel	Methane
Ruthenium	High molecular weight hydrocarbons
Rhodium	Large amounts of hydrocarbons & little oxygenates

Note: Alkanes are hydrocarbons containing only single covalent bonds. Alkenes are hydrocarbons containing a double covalent bond between two carbon atoms. Oxygenated substances have been infused with oxygen. Oxygenates are usually employed as gasoline additives to reduce CO that is created during the burning of the fuel

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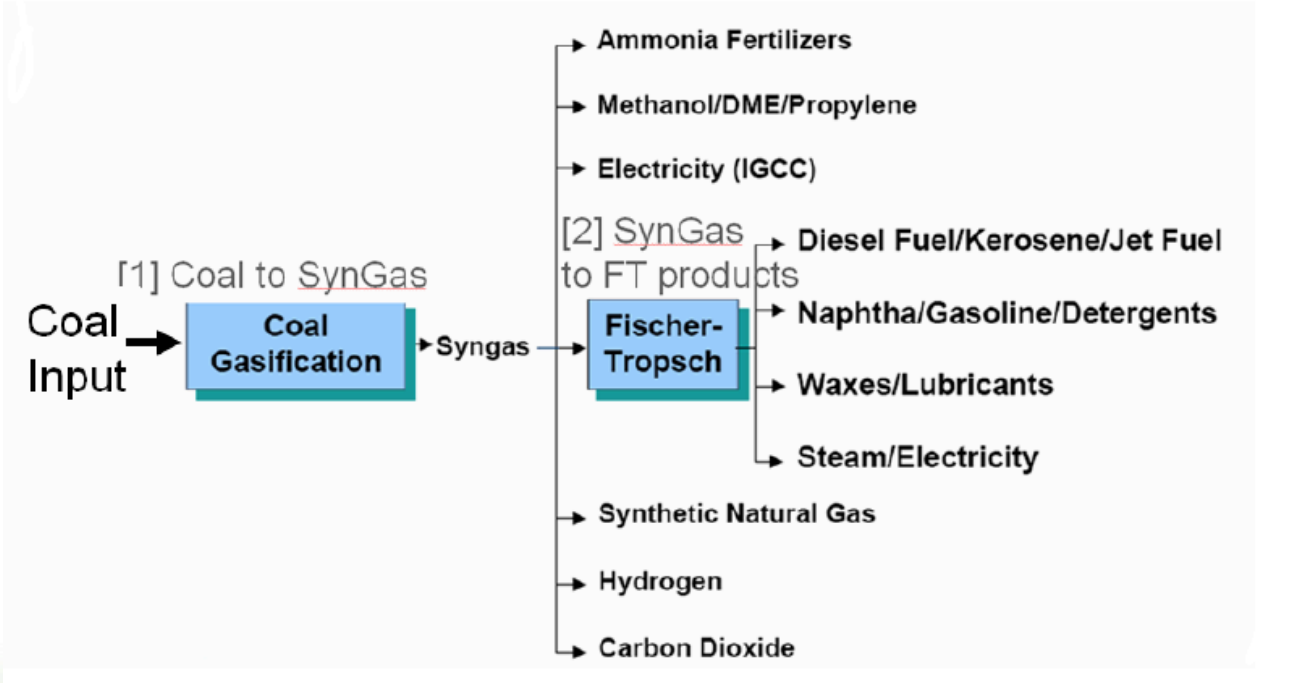
What can be produced From a CTL facility?

The final products coming from a CTL facility are decided upon during the initial stages of plant design



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A list of studies on the coal and mining regimes and processes for the production of diesel fuel from coal

1. Analysis of coal.

1.1. General information about the chemical composition and structure of coal.

1.2. Main results of thermal and processing properties .

1.3. Results of the study on thermal effects on the coal.

1.4. Brief conclusions and recommendations for the adjustment process and the catalysts

2. An analysis of the scientific and practical components of the mineral part of the study in relation to coal - as raw material for the production of diesel fuel

2.1. Information on the effect of the mineral component of coal output of finished products - diesel.

2.2. The requirements for the catalysts used to stimulate chemical decomposition processes of the mineral part of the gasification of coal

2.3. The studies on the mineral composition of the inorganic carbon.

2.4. Statement of the research problem and determine the optimal temperature conditions at each stage of the process

3. Definition of the methodology and characterization of the conditions for research.

3.1. The main provisions of research methodologies.

3.2. Physical conditions prior fractionation of coal for optimal loading and processing.

3.3. Testing of the process of decomposition of the mineral composition of coal in view of ensuring the provision of Sulphur and get it in powder form.

A list of studies on the coal and mining regimes and processes for the production of diesel fuel from coal

3.4. Ensuring reliability and error estimation results of the coal processing at each stage of the process

4. Investigation of mineral components in coal.

4.1. Chemical composition of fly ash .

4.2. The distribution of mineral matter on coal fractions having different densities.

4.3. Major groups of minerals in the coal.

4.4. Discussion of the results and a brief conclusion with recommendations for correcting the technologists operating practices and the inclusion of the catalysts of additional items.

5. Prediction of the behavior of the mineral part of coal in the production technology of diesel fuel when the initial quality of the different batches of raw coal.

5.1. Basic laws of transformation of the mineral components under the influence of factors in the gasification stage .

5.2. The estimated parameters for predicting the properties of the chemical composition of diesel fuel. Testing modes of technological processes to guarantee the stability of the chemical composition of diesel fuel during transportation and storage for a long period of time , according to the fuel quality requirements category EURO5

5.3. Development (including the recommendations of the studies) alloy for metal catalysts and the organization of their production.

5.4. Testing of the entire process in a laboratory with the preparation of routing.

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Kindly, see attached file Historical_Review_of_F-T.pdf

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OUR PROJECTS IN 2014

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Commissioned Plastic Waste-To-Energy LTDT 20TPD Plant

Location – Czech Republic







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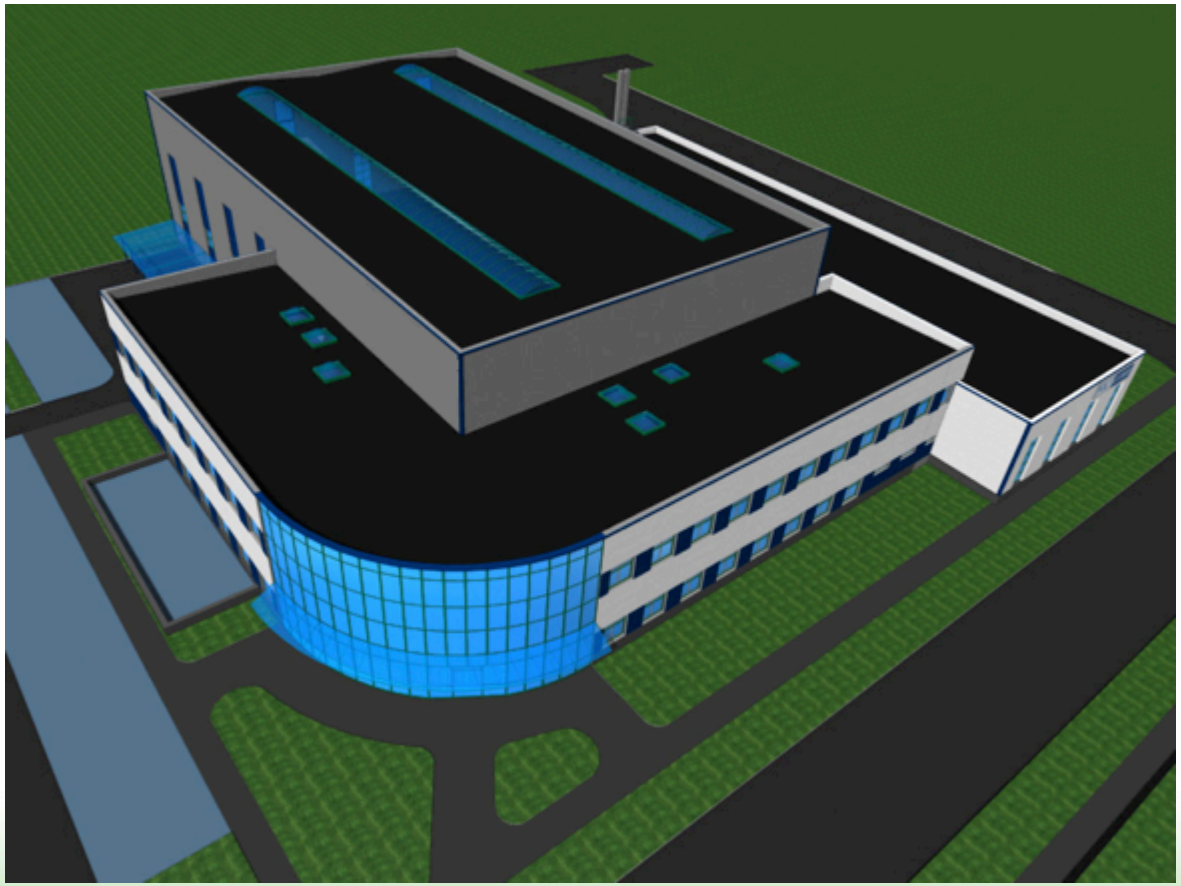
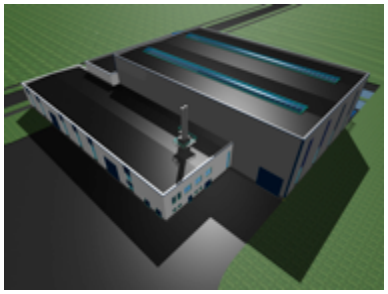
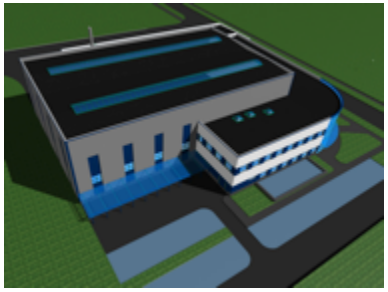
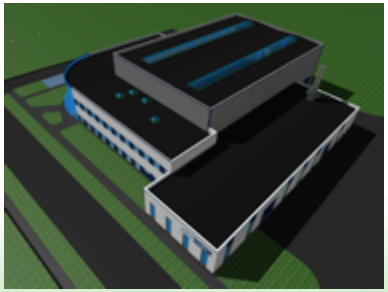
Designed Tires-To-Energy UTDT 18MW Plant

Location - Singapore









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Designed MSW-to-Energy 15MW Plant

Location – Bamako, Mali

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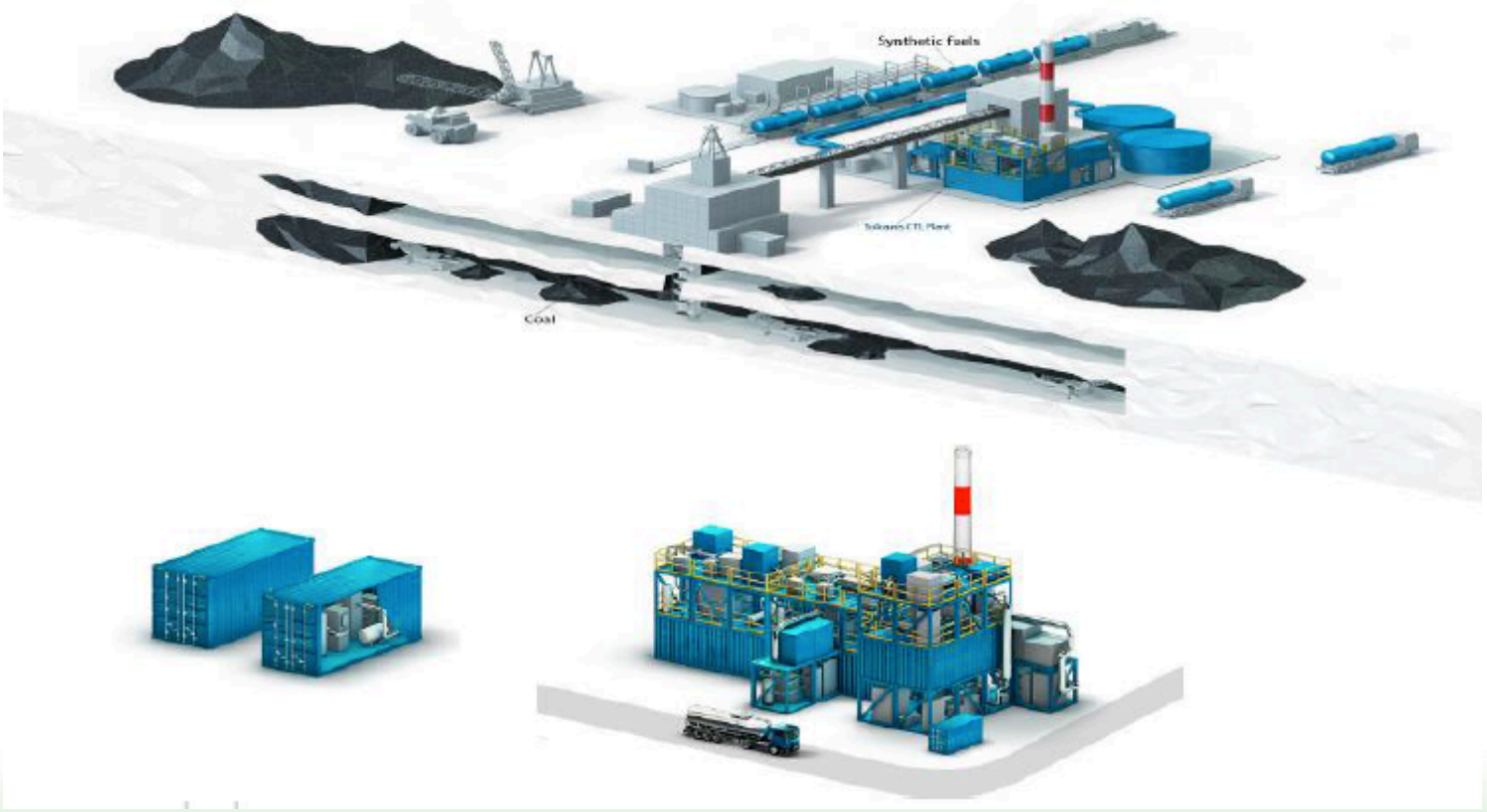
Designed Coal-to-Diesel 6,000 tons/Month Plant

Location – Indonesia



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Thank you for your attention