Are Small Scale GTL Plants Economic or Do They Just Require Less Capital

Many new F-T technology providers are touting small scale F-T plants as the answer. In general all they really do is require less capital to build but the actual cost per barrel of installed capacity is typically much larger. But you need gas reserves and gas deliverability to support the GTL plant. If you have little of each you can only build a small scale plant. In addition the operating costs of small scale plants are typically much higher. The obvious reason is that 10 people can run a 2,000 bbl/d plant or a 10,000 bbl/d plant or even a 15,000 bbl/d. The same holds true for utility and gas conditioning modules.

The real economic advantages or break throughs will occur with the commercial introduction of ceramic membrane to make syn-gas and catalyst technology that makes the finished F-T product in the reactor eliminating the costly third step, hydrocracking.
GTL Cost Breakdown

- Syn-Gas: 30%
- F-T synthesis: 20%
- Product work-up: 15%
- Other process units: 15%
- Utilities: 15%
- Offsites: 10%
Scale of F-T Reactors

The next 3 charts show the size of a Sasol design 15,000 bbl/d slurry bubble column F-T reactor, a Shell 7,500 bbl/d fixed bed (tube) F-T reactor and a Velocys 125 bbl/d microchannel F-T reactor.

The Sasol 35,000 bbl/d Oryx plant has two F-T reactors costing well over $150 million each.

The Shell tube reactors in the 140,000 bbl/d Pearl GTL plant are smaller but will have 24 reactors.

The Velocys 1,400 bbl/d GTL Calumet plant has 8 175 bbl/d reactors costing about $1.3 million each.
33’ Diameter, 196’ Tall, 2,200 tons can only be delivered via ship/barge at a tide water location

15,000 BBL/D Sasol F-T Reactor
Shell F-T Reactors at Pearl
3-core FT reactor 125 bbl/d
SMALL SCALE GTL PLANTS
INDUSTRY LEADERS

The economic advantages or break through’s in small scale GTL plants have occurred with the advances in 4 areas:

1. Commercial introduction of micro-channel F-T technology;
2. High reactive cobalt catalysts;
3. Mass production of F-T reactors; and
4. Modular construction of the plants.

Two companies that are leading the way in this revolution:

• Velocys PLC based in Houston, Texas
• Ventech Engineering based in Pasadena, Texas
Modular Fabrication

Crude Topping Units ♦ Catalytic Reformers ♦ Naphtha Hydrotreaters
♦ Vacuum Units ♦ Gas Plants ♦ Diesel Production

As a pioneer in defining and utilizing modularization, Ventech employs modularization in the majority of our refinery units.

Ventech’s 32-acre fabrication facility is ideal for the assembly and integration of piping, equipment, instrumentation, and electrical components necessary for quick, easy field installations.

• Competitive schedules, the world’s fastest
• Capabilities engineered to your business needs
• Mechanical warranties
• Services available for erection, commissioning, and startup

Benefits:
Optimally shorten project schedules, enhanced quality control, fieldwork reduction, elimination of weather delays, improved safety, reduced need for onsite skilled labor and specialized equipment, simplified logistics, and time and cost savings
Modularisation Partner: Ventech Engineers

- Full service EPC firm
- Proven world leader in modularisation of process units for the oil and gas industries
- Financial strength allows partnering and co-investing in projects

- Velocys is Ventech’s preferred FT partner
- $2 million equity investment in OCG in November 2012
- Ordered reactors for 1,400 bpd plant
The Fischer-Tropsch Process (F-T) has three main processing steps shown here, all of which are commercially proven.

**STEP 1: SynGas Generation** represents ~50% of the total cost.

**STEP 2: F-T Conversion** - 25% of the total cost.

**STEP 3: Product Upgrading** - 15% to 25% of the total cost.

The type of SynGas Generation, gas reforming or gasification of solids, depends upon the raw material or feedstock available. Around the world stranded Natural Gas is the choice; however, in the US with the exception of North Slope Natural Gas, coal, bio-mass (garbage), bio-renewables (trees and plants) represent the majority of available feedstock for a US based F-T program.

**COAL** → **SOLIDS GASIFICATION** → **H₂ & CO**

**BIO-MASS** → **H₂ & CO**

**BIO-RENEWABLES** → **H₂ & CO**

**Natural Gas Reforming** → **H₂ & CO**

**METHANE** → **H₂ & CO**

**STEAM** → **H₂ & CO**

**OXGEN** → **H₂ & CO**

**FISCHER-TROPSCH REACTOR** → **GASEOUS PRODUCTS**

**H₂ & CO** → **SYNTHESIS GAS** (H₂ & CO)

**CHOOREN**, a German company, has been operating a bio-mass gasifier to produce syngas for methanol and electric production since 1998. This plant is considered the world's first bio-renewable gasifier and has the distinction of producing fuels and electricity with a net zero impact on the world's CO₂ production as the CO₂ absorbed by the plants and trees is equal or greater than the CO₂ produced from generating the electricity and burning the fuels.

**Step two**, the Fischer-Tropsch conversion, discovered by the Germans in the early 1900s, upgrades the syngas into a waxy hydrocarbon.

**CO + 2H₂ → CH₄ + H₂O**

**STEP 3: HYDROCRACKING - PRODUCT WORKUP**

- **KEROSENE**
- **DIESEL**
- **NAPHTHA**

**PRODUCT UPGRADE**

Upgrading can produce a wide range of commercial products from gasoline to diesel to candle wax. For a US based F-T program, we would recommend middle distillate fuels: kerosene, diesel, and naphtha.

This process makes use of standard hydrocracking and hydrosasturization processes commonly found in the refinery world. As with the First Step of syngas production, suitable technology is widely available from several licensors around the world. The F-T process produces fuels that contain essentially no sulfur, no aromatics or ring chain hydrocarbons that are so toxic and harmful to the environment. The F-T process does produce CO₂, but it is in a pure stream and is easily contained for sale to third parties or can be sequestered for injection into underground wells.

**F-T Fuels**, clean fuels for our future that will reduce our dependence on foreign crude oil and products.
WHAT IS “SYN-GAS”? 
In the F-T world syn-gas is carbon monoxide & hydrogen
SYНTHЕΤIC DИЄSEL

F-T DИЄSEL BURNS
AS CLEAN AS CNG

U.S. EPA*
APPROVED
NON-TOXIC

ZERO SULFUR
ZERO AROMATICS
>70 CETANE
PM$_{10}$ ≤ CNG