An Upstream Success Story in a $50 Oil World
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6th International Gas Technology Conference
Dubai

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Chief Operating Officer

19th & 20th February 2015
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Associated gas flared – no available market

5 TCF

Source: World Bank GGFR
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Crude reserves stranded in 800 oilfields with associated gas problems

73 Bn bbls

Source: Wood Mackenzie & Fugro Roberson analysis of oilfields with associated gas potential flow rate <500 MMCM/YR
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Much of this opportunity lies in CIS / Central Asia

Associated gas and stranded oil
Gas handling alternatives

Gas volume, distance to market and infrastructure constraints are the key factors dictating gas solution selection

**Reinjection & Flaring**
Smaller volumes at remote locations, generating no value

**Gas Pipeline**
Moderate to large volumes at moderate distance to a gas market

**Gas to Wire**
Smaller volumes with nearby market for electricity

**CNG - Compressed Natural Gas**
Moderate volumes at moderate distance to gas market

**LNG - Liquefied Natural Gas**
Large volumes at remote locations
Small scale GTL is the only viable monetisation option where flaring and reinjection occurs.

Source: World Bank GGFR

<table>
<thead>
<tr>
<th>Resource size TCF</th>
<th>Distance to market for converted product (km)</th>
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<tbody>
<tr>
<td>1</td>
<td>75</td>
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<tr>
<td>2</td>
<td>150</td>
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<tr>
<td>5+</td>
<td>500</td>
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- **Small Scale GTL**: Flaring and Reinjection
- **LNG**: Gas to Wire
- **CNG**: Pipeline
Conventional GTL vs CompactGTL

Conventional GTL (Sasol / Shell)

- Shell Pearl Project: 140,000 bpd
- Capex: >$20bn
- Construction: 7 years

Sasol FT reactor: 60m x 10m
≈ 17,000 bpd capacity
30,000 – 140,000 bpd diesel + speciality synthetic products

Modular, CompactGTL

- CompactGTL Kazakhstan: 2,500 bpd
- Capex: $275m
- Construction: 2 years

CompactGTL FT reactors (Containerised modules)
≈ 200 bpd capacity each
1,000 – 15,000 bpd syncrude or diesel
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CompactGTL process: Clean diesel from flare gas

- Gas Feed Flexibility
  - Wide range of gas compositions
  - Up to 50% CO2 accommodated
  - Contaminants (H2S, Cl, Hg...) removed by gas treatment package

- Feed Gas Flexibility
  - Up to 50% CO2 accommodated

- NGL Recovery
  - C5+ hydrocarbons in feed gas
  - Recovered prior to gas treatment and pre-reforming
  - Can be blended with Naphtha

- CGTL SMR
  - Modules or Conventional SMR or ATR

- CGTL FT1
- CGTL FT2

- Synthetic Diesel Product
  - Premium, ultra-clean
  - High Cetane, zero Sulphur
  - Winter & Summer Grades

- Hydro-Processing (optional)
  - Can be blended with Naphtha
  - Available for sale and market @ Premium
Pilot plant UK 2008 - Present

- Over 6 years’ operations
- Operator training centre
- Full GTL process from gas to syncrude
- Continuous improvement
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Fully integrated demonstration plant with Petrobras

- Project funded by Petrobras (US$45 million); built in 2010
- Plant demonstrates fully integrated small scale GTL facility with gas pre-treatment, syngas production, process steam generation, 2 stage Fischer Tropsch process, single phase FT cooling water system and tail gas recycling
- Operated under representative field conditions, using associated gas
- Extensive testing proven the facility to be operable and robust
Commercial Projects and Supply Chain
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Projects are partnerships

- **Dedicated Supply Chain**
  - SPP
  - Kawasaki
  - Johnson Matthey
  - FLUOR
  - Sumitomo Corporation

- **Competitively Tendered**
  - EPC Contractor

**Compact GTL**
Contributes technology, project execution and possible investment

- **Oil Company / Gas Resource Holder**
- **Project SPV / Joint Operating Company**
- **Liquids Offtaker**
A major milestone in 2014….

7th March 2014: MOU between Kazakhstan Oil Ministry & CompactGTL
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CompactGTL plant design for Kazakhstan project #1

Fully integrated plant – remote location
Turnkey project by CompactGTL
Engineering support partner – Fluor
Operational by the end of 2017
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Kazakhstan opportunities

Kazakhstan – Main E&P and Population Areas

Zone 1 21%
Zone 2 37%
Zone 3 29%
Zone 4 10%

Major population areas
1,000 km

Source: World Bank GGFR
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World class supply chain

- Kawasaki
- Johnson Matthey
- Compact GTL
- Sumitomo Corporation
- SPP
- Fluor
- Bayer

Reactors Modularisation
Catalyst suppliers
Engineering and project management partner
Consultants
CompactGTL reactor mass production facility

New dedicated factory for CompactGTL reactor manufacturing at Sumitomo Precision Products in Osaka, Japan
CompactGTL provides a complete Turn-Key capability

**Planning & FEED**
- Economic Appraisal
- Design Concept Selection
- FEED
- Local Permitting
- EPC Contractor Qualification
- Supported by Fluor

**Execution**
- EPC Contractor Tendering
- High Local Content
- Detailed Engineering
- Procurement
- Construction
- Commissioning
- Fluor Supervisory Support

**Operations & Maintenance**
- CGTL Turnkey Plant Operations
- Or: Operator Training – UK & Local
- CGTL Reactor Maintenance - Local Facilities
- Local Employment & Investment
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The Technology
A working solution is not just an “FT Island”

Operational impacts must be fully understood for whole plant:
• FT tail gas recycle
• Multiple system interactions
• Utility variability & failure
• Feed gas variability
Modular reactors

- CompactGTL technology is inherently modular
- CompactGTL reactors are simple steel plate/fin heat exchangers
- Modular technology is flexible, mass producable & deployable in remote sites
- Fixed bed particulate catalyst for FT
Long FT catalyst life is essential for remote locations

**Single Stage Fixed**

- Conventional & Modular
- Short catalyst life, frequent re-generation
- Low availability, high opex
- Unsuitable for remote site deployment
- Duty + standby reactors just adds cost

**Slurry Bubble Column**

- Catalyst continuously “replaced”
- High availability
- Large, tall reactors
- Unsuitable for remote site deployment

**Two Stage Fixed**

- 3-5 year catalyst life, no re-generation
- High availability, low opex
- Modular reactors
- Perfect for remote site deployment
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Proprietary 2-stage FT process

Two Stage Process
- High overall conversion achieved whilst preserving catalyst life
- Water partial pressure is reduced in each stage

Benefits
- Increased plant availability
- Suitable for remote locations
- Low OPEX

CompactGTL has granted Shell a global license which covers the two-stage Fischer Tropsch synthesis
FT Catalyst replacement without plant shutdown

- CompactGTL reactor modules exchanged in pairs for spares
- Plant continues to operate
- No catalyst handling and safety issues on the operational site
- High availability = low opex

12m FT Reactor Modules
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- Zero cost gas is abundant in remote locations
- There, liquid fuel is often at premium prices
- This combination makes high returns available
- But remoteness dictates robust, low opex plants
- Uniquely, CompactGTL proprietary 2-stage FT process provides this
- Commercial project underway in Kazakhstan
- Operational by the end 2017
- Other projects in development in the CIS and globally
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