Modular GTL
global solutions and projects
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History and achievements

**Year 2000**
- Lab Scale Development
  - 12 years test rig operations
  - Reactor & catalyst development
  - Independent verification

**2008**
- UK Pilot Plant
  - 4 years operations
  - Reactor & catalyst manufacturer selection
  - Now an operator training centre

**2010**
- Brazil Commercial Demonstration Plant
  - 24 months’ operations
  - Process approval by BR Dec 2011

**2012**
- Client funded project studies
- Brazil Commercial Demonstration Plant
- 2 years operations
- Process approval by BR Dec 2011

- Hybrid Plant study completed for NOC client
- Hybrid Plants @ 3,000 to 15,000 bpd
- Stated by World Bank as No. 1 for small scale GTL

- IOC’s, NOC’s & Majors under NDA
- Plants @ 200 bpd to 10,000 bpd
- Commercial Agreement with SBM Offshore

**Present**
- Client funded project studies
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An ISO 9001 company – established 2006

Abingdon, UK Head Office
Rio De Janeiro Office
Wilton, UK Operations
Aracaju, Brazil Operations

> 100 man-years commercial GTL plant design & operational experience
Strong functional organisation for project delivery & continuous improvement
Onshore & Offshore plants are custom engineered for each project via engineering partners, but CompactGTL reactor modules are standardised and mass produced.

- Each partnership represents a well established, long term relationship
- Certain exclusivity rights have enabled pre-investment & joint development funding by the supply chain, ensuring early capacity to deliver
- Reactor manufacturing by Sumitomo in Japan, and catalyst manufacture by Johnson Matthey in Europe, utilise established mass production techniques
- CGTL & Sumitomo jointly developed automated catalyst insertion & removal systems for the reactors
World’s first modular fully integrated GTL facility!

Plant commissioned in December 2010.
CompactGTL technology now approved by Petrobras for deployment

- Gas pre-treatment
- Pre-reforming
- Reforming
- Waste heat recovery
- Process steam generation
- Syngas compression
- Fischer Tropsch synthesis
- FT cooling water system
- Tail gas recycling

Image shown courtesy of Petrobras
Independent verification of our process

More than 6 independent companies have verified our technology, process, engineering and plant cost basis

Public endorsement by Petrobras in January 2012. World’s 1st and only small scale GTL process approved for commercial deployment
3 proven and operational GTL processes today

World scale GTL
Gas monetization
300MMscf/d ++

Compact GTL
Oilfield access
<= 150MMscf/d
Conventional GTL vs. CompactGTL

Shell Pearl Plant - Qatar
140,000 bbl/d GTL products
350 football fields

CompactGTL Modular Plant
1,000bbl/d plant,
1 Football field
Why is this now possible?

Conventional Tubular steam Reformer / ATR

Conventional FT reactor e.g. slurry phase

CompactGTL reactors using brazed plate & fin construction

10x increase in specific throughput
Wide ranging applications

Onshore
5 - 150 MMscf/d
≈ 500 – 15,000 bopd syncrude or diesel
- Monetise stranded & shale gas
- Convert associated gas
- Avoid flaring restrictions & penalties
- Unconventional gas – UCG, CBM

Offshore
5 – 50 MMscf/d
≈ 400 – 4,000 bopd syncrude
FPSO production ≈ 30 – 60 mbopd crude
- Avoid costly gas export or re-injection
- Avoid flaring restrictions & penalties
- Extended Well Test Facilities
- Early Production Systems
- Full Field Development FPSO

Feed Gas Quality
- Wide range of gas compositions and variability during operation
- Up to 50% CO2 accommodated and utilised by the process – no need for removal
- Contaminants (H2S, Cl, Hg ..) addressed by project specific gas treatment packages
Our products

Onshore modular plants
CompactGTL has a standalone modular gas solution offering strong incremental economics for enabling oilfield development. This solution is suitable for low, variable gas flow rates, where flaring, gas infrastructure and reinjection are avoided.

Onshore hybrid plants
The CompactGTL hybrid plant employs conventional reforming technology and integrates this with our own FT modules. This solution is suited to higher, more sustained gas feed rates.

Offshore plants
From the outset the CompactGTL technology was designed for onshore and offshore application. The exclusive, strategic partnership between CompactGTL and SBM Offshore has enabled the integration of the modular GTL plant into a FPSO.
Technology overview
Modular Plant – critical for oilfield projects

- Inherent Reliability
- Scaleability
- Operability
- High Turn Down
- Access to Site
- Reactor Changeout

The number of active reactor modules can be adjusted to match the associated gas production profile over time.
Mini-channel CompactGTL reactors

- Brazed plate-fin reactor construction minimises metal content and weight
- Complete set of GTL reactors despatched by air-freight to Brazil
- Corrugated metallic catalyst inserts maximise active surface area per channel
- Automated catalyst insertion and removal
Complete reactor module
Onshore projects – plant options

Modular Plants

- 200 – 5,000 bpd [2 – 50 MMscf/d]
- Using CompactGTL modular reformers
- Accessible to sites with severe logistical constraints
- High Turn-Down and flexibility as field production declines

Hybrid Plants

- 3,000 – 15,000 bpd [30 – 150 MMscf/d]
- Using conventional reforming suppliers
- Suitable for reasonably accessible sites
- Suitable for more sustained gas flow rates
- Lower capital & operating costs

Multiple CGTL modular reformers

Single large scale conventional reformer
Modular plant - process overview

Gas treatment
- Pre-wash
- Mercury removal
- Heating
- Sulphur removal

Syngas production
- SMR 1 reactor modules
- SMR 2 reactor modules
- Steam generation (WHB)
- Syngas compressor

FT synthesis
- FT cooling system
- FT 1 reactor modules
- FT 2 reactor modules

Gas feed
- Pre-reformer
- Steam
- Water treatment

No Oxygen Required!

High CO₂ Possible!

HC rich tail-gas
- GT drivers
- H₂ rich tail-gas

Syncrude

High CO₂ Possible!
Typical 1000bpd modular plant

- Standardised mass produced SMR & FT modules
- Road / rail transportable reactor modules
- Bespoke balance of plant to suit client project

Blend Syncrude with the Crude Oil Export
50MMscfd onshore modular GTL plant

- Plant layout from completed Feasibility Study for Middle East location
- 275 x 175m footprint
Hybrid plant – process overview

**Gas Treatment**
- Pre-wash
- Mercury removal
- Heating
- Sulphur removal

**Syngas Production**
- Conventional ATR
- Oxygen separation unit
- Steam generation (WHB)

**FT Synthesis**
- FT 1 reactors
- FT 2 reactors

**Fuel Gas**

**Tail-gas**

**Product Flash**

**Syncrude**
100MMscf/d onshore hybrid GTL plant

- Plant layout from completed Feasibility Study for NOC client
- 335 x 290m footprint
Offshore solutions
Introduction of SBM Offshore

The Company
- 4 Project Execution Centres
- 9 Shore bases
- 4 Representative offices
- 7,000 Employees

Lease Fleet
- 15 FPSOs
- 2 FSOs
- 1 Semi Sub

Financials FY 2011 in US$
- Turnover: 3.2 billion
- Backlog: 16.9 billion
- Market Cap: 3.53 billion

Performance
- 211 years of operations
- 99.1% Uptime
- 4,734 Tanker Offloads
SBM & CompactGTL have worked closely together for 6 years
> 2,000 engineering man-days invested

- Full commercial agreement signed in Oct 2012
- Commercial Heads of Terms signed in Aug 2011
- Generic Study: Suezmax DP EWT
- Developed a fully integrated GTL design basis
- Early generic GTL FPSO conceptual engineering
- SBM Review of Aframax study for Petrobras
- 1st MOU signed in Nov 2008
Offshore project delivery - exclusive partners

Client

CGTL SUB-CONTRACT

CGTL & SBM Integrated Project Team

GTL Reactors
Gas Treatment Package
Pre-Reformers
Engineering Process Package

Commissioning, Operations & Support – Integrated Solution

CGTL Supply Chain

SBM Supply Chain
25MMscf/d GTL integrated FPSO

- Fully integrated design
- 32,000 bbl/d crude production
- 2,000 bbl/d GTL liquids production
- Approval in principle from certifying authority

Image courtesy of SBM Offshore
FPSO with GTL

GTL is excellent Gas Disposal Alternative in an Offshore Application

Flaring Restrictions
- New fields not allowed to flare
- Existing fields risk shut-in or financial penalties

Gas Re-injection
- High cost – wells in deepwater can cost $200 to $250 million
- Gas breakthrough risks, limits production, threat to reserves

Gas Infrastructure Issues
- High cost of pipelines in remote or deepwater areas
- Multi-party, complex infrastructure projects take time
Summary

- Exclusive, long term co-operation
- Oil Company approved GTL technology
- Approval in principle by DNV
- 24 months operational experience onshore plant Brazil
- World class GTL component supply chain established
- EWT Concept study complete, ready for FEED
- Extendable to Full Field Developments
Market opportunity
## Project examples

<table>
<thead>
<tr>
<th>Client</th>
<th>Region</th>
<th>Feed gas rate</th>
<th>Project driver</th>
<th>Project Status</th>
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<tbody>
<tr>
<td>IOC</td>
<td>MENA</td>
<td>50 MMscf/d</td>
<td>Liberate crude production</td>
<td>Completed</td>
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<tr>
<td>NOC</td>
<td>Americas</td>
<td>25 MMscf/d</td>
<td>Extended Well Test Vessel</td>
<td>Ongoing</td>
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<tr>
<td>NOC</td>
<td>Russia-CIS</td>
<td>10 MMscf/d</td>
<td>Remote location</td>
<td>Ongoing</td>
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<tr>
<td>NOC</td>
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<td>20 MMscf/d</td>
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<td>Russia-CIS</td>
<td>100 MMscf/d</td>
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<tr>
<td>IOC</td>
<td>Asia-Pacific</td>
<td>30 MMscf/d</td>
<td>Eliminate flaring</td>
<td>Completed</td>
</tr>
</tbody>
</table>
≈ 800 Oilfields with problematic associated gas @ <50MMscf/d

800 oilfields with reserves of 73 billion barrels of oil

Analysis carried out by Wood Mackenzie and Fugro Robertson
Options for associated gas

- **Reinjection & Flaring**
- **FLNG**
- **CNG**
- **Pipeline**

Distance to market for converted product [km]

- 500
- 500
- 500
- 500

Associated Gas MMscf/d

- 50
- 200
- 400
- 500

- **Gas to Wire**
- **CNG**
- **FLNG**
- **Pipeline**

Energy solutions provided by CompactGTL.
A ‘Win-Win’ for IOCs, NOCs and governments

**IOCs**
- Enhance production
- Unlock new discoveries
- Add gas reserves to balance sheet
- Conversion of low value commodity into a high value commodity

**NOCs**
- Increase in PSC profit oil
- Greater tax revenues
- Environmental “Kudos”

**Governments**
- Preserve and utilise National natural resources
- Reduced dependency on fuel imports
- Gain access to World Bank finance
CompactGTL: Partner of choice

**Demonstrated, proven and independently verified**
- 24 months integrated GTL operations demonstrated
- Approved by PETROBRAS
- 48 months UK GTL pilot plant operations
- Robust, verified process, designed for oilfield conditions

**Committed world class alliances**
- Johnson Matthey
- Sumitomo
- Kawasaki Heavy Industries
- SBM Offshore
- Fluor

**In house GTL experience**
- World scale GTL facility design, commissioning & operations
- Operation AND integration of large scale GTL facilities and reformer systems

**Execution strategies**
- FEED
- EPC / local content
- Operations support to meet client requirements
- Lease financing options to reduce CAPEX

Reference visit available with PETROBRAS