



Compact GTL
The modular gas solution

Process Intensified GTL

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Compact GTL

The modular gas solution

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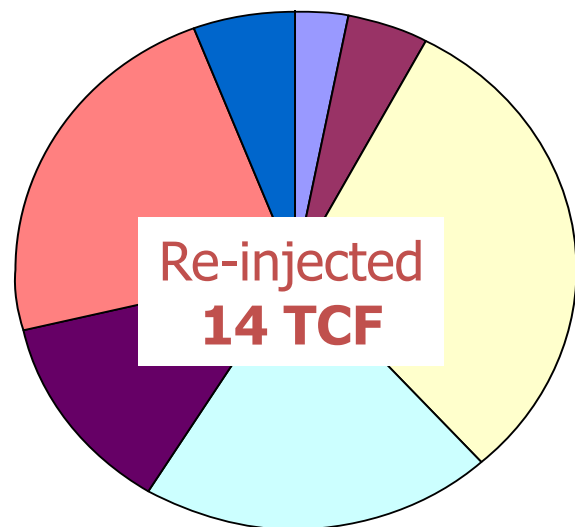
Stranded Oil!



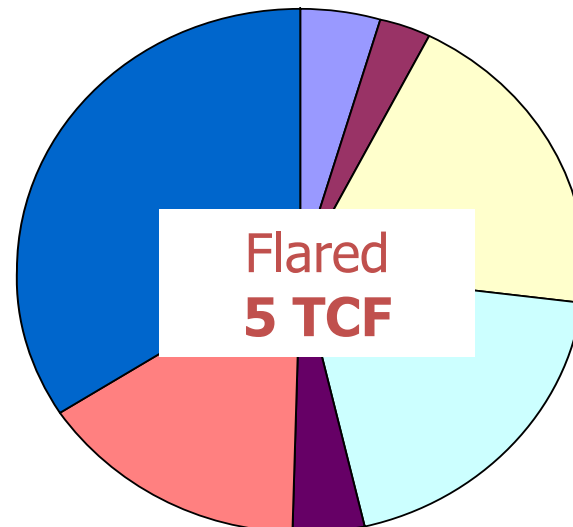
Satellite image of
gas flaring in Nigeria

250 km

Associated gas is a huge global problem



- Asia
- North America
- Africa
- Middle East
- Central & S America
- ROW
- Russia



~4 TCF
Not used to enhance
oil recovery

= 27%
of annual US gas
consumption !

> 9 TCF (= 4.2 mmbobe per day)

Current Offshore Gas Management Options



- Employ gas as FPSO fuel source



- Pipe gas to onshore infrastructure



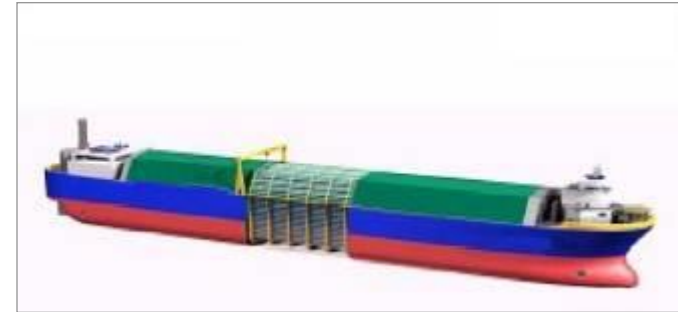
- Re-inject gas into reservoir



- Flare gas

- **CNG**

- High infrastructure cost
- Economics favourable at 200+ MMscfd
- **Limitations: High gas rate needed & sensitive to distance to market**



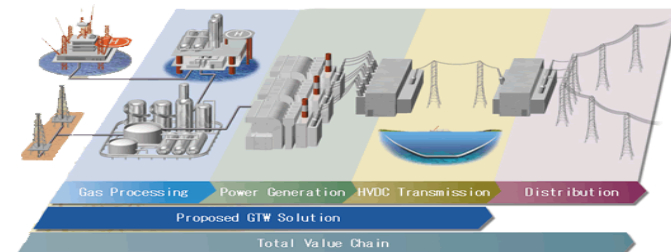
- **FLNG**

- High infrastructure cost
- Economics favourable at 400+ MMscfd
- **Limitations: High gas rate needed**



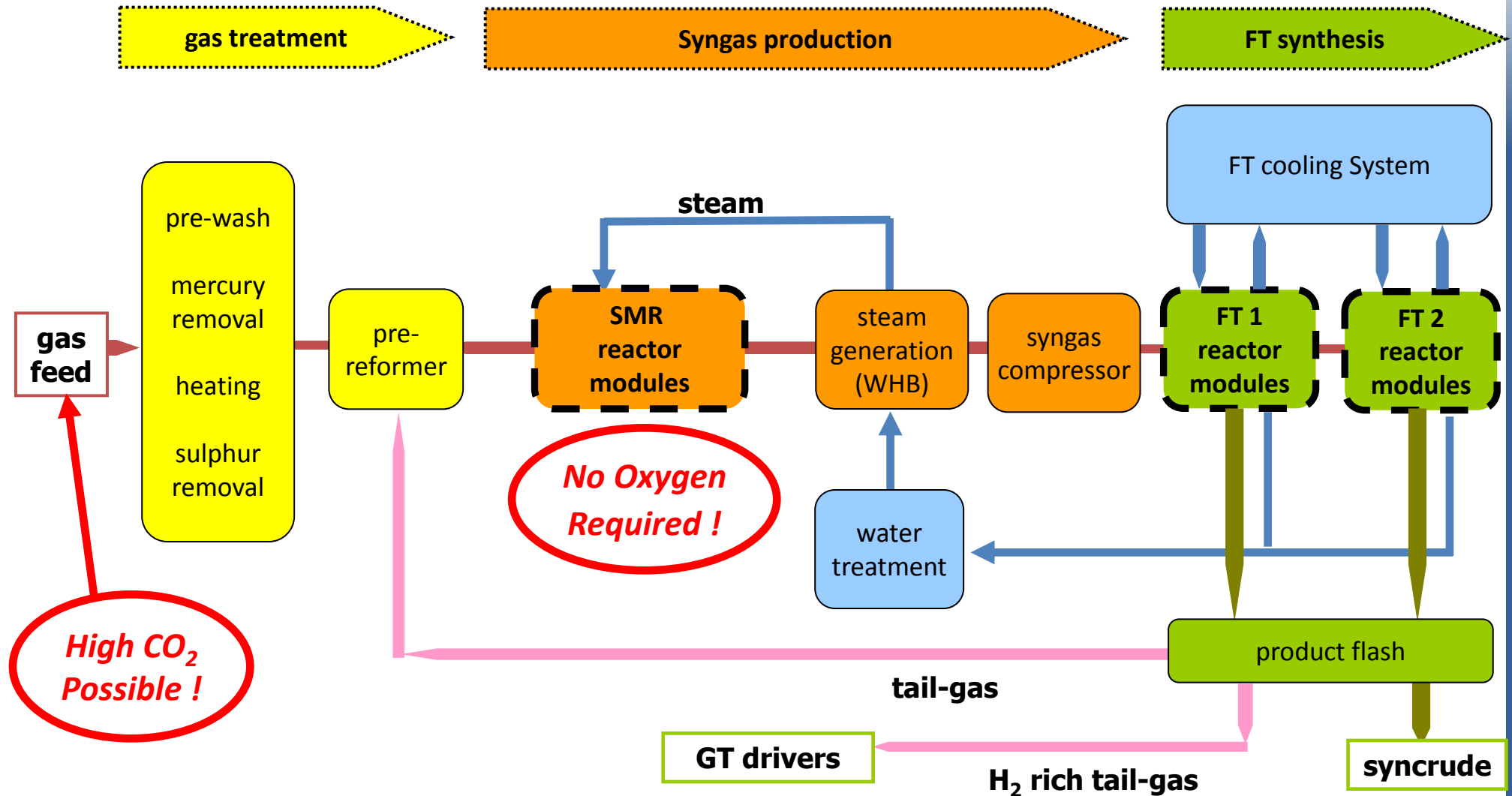
- **Gas to Wire**

- High cost for deep water and remote fields
- **Limitations: Low gas rate only & sensitive to distance to market**



What is a GTL process?

Process overview



CompactGTL Development Approach

Lab Reactors



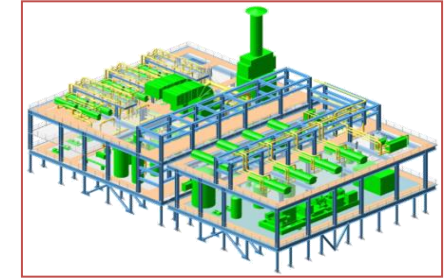
UK Pilot Plant



Brazil Plant



Commercial Plant



**Commercial
Plant Studies**

**Reactor &
Catalyst Supplier
Engagement**

**Prototype
Reactor &
Catalyst
Evaluation**

**Supplier
Selection**

**Pilot Reactor &
Catalyst
Manufacture**

Requirements

Requirements

Commercial Supply Chain Establishment

**Installation at
Wilton, NE
England**

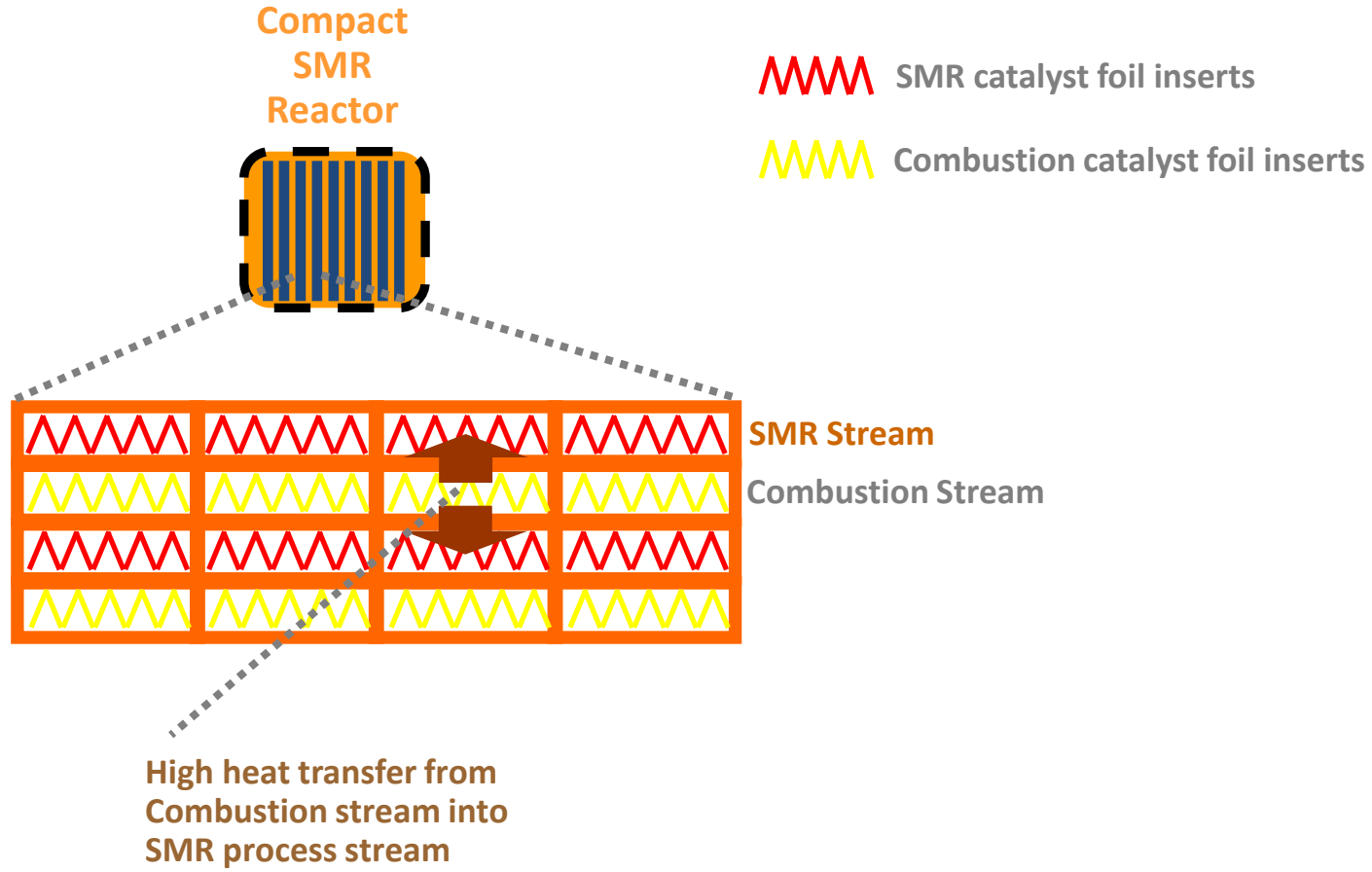


**Plant
commissioned
July 2008**

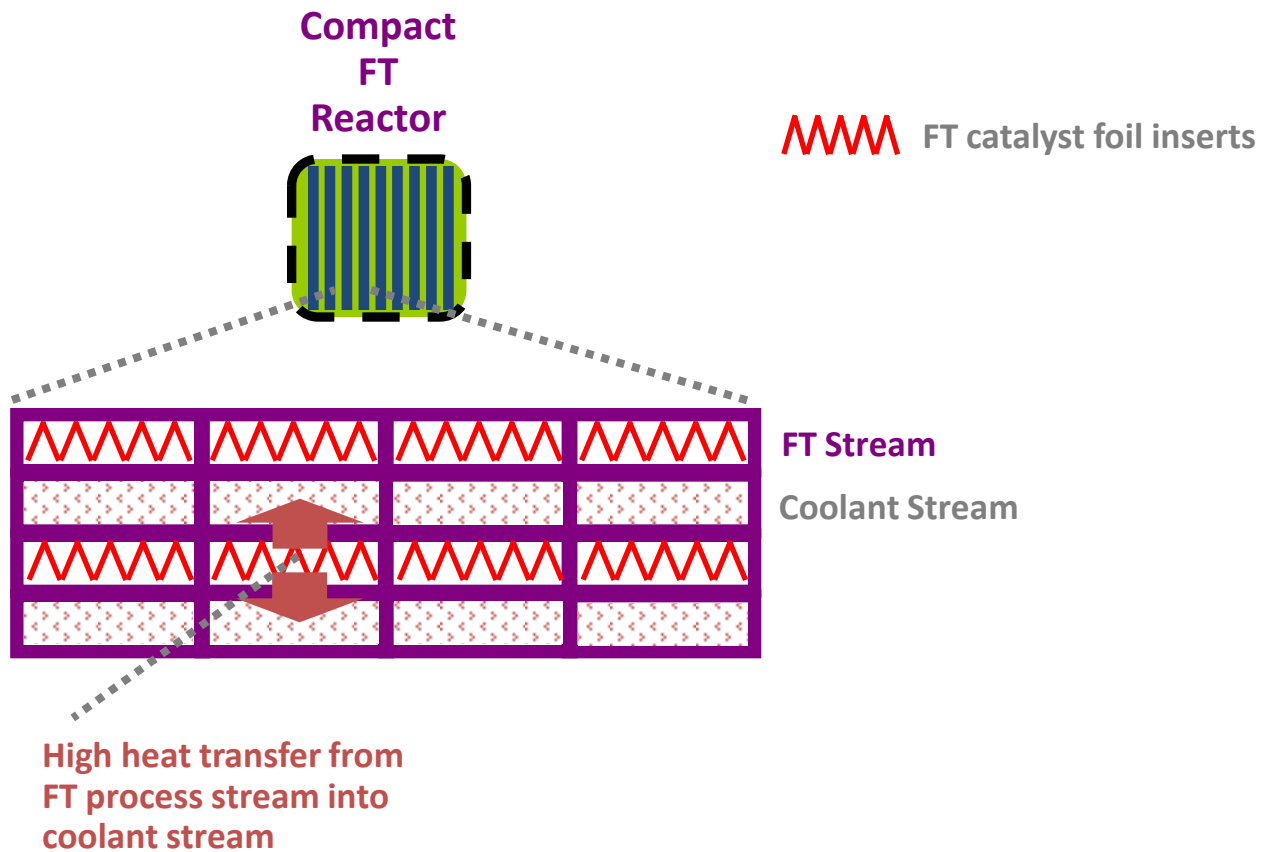


- Confirming catalyst & reactor performance from manufacturers
- Integrated operation – ‘gas in to liquids out’
- Operational stability, start-up & shut down procedures
- Variable feed gas composition & CO₂ content
- Operator training for larger plants

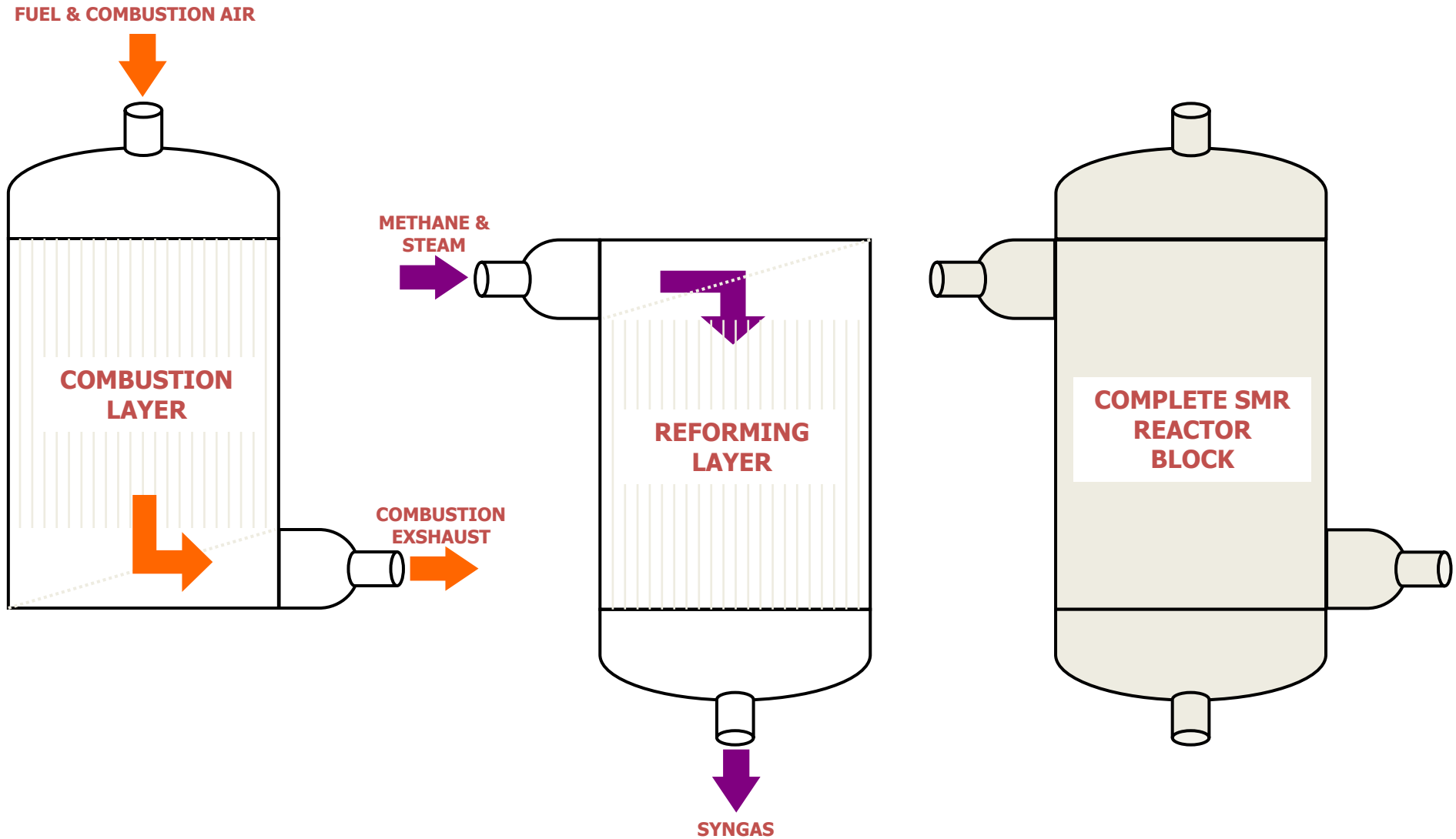
Process Intensified SMR



Process Intensified FT

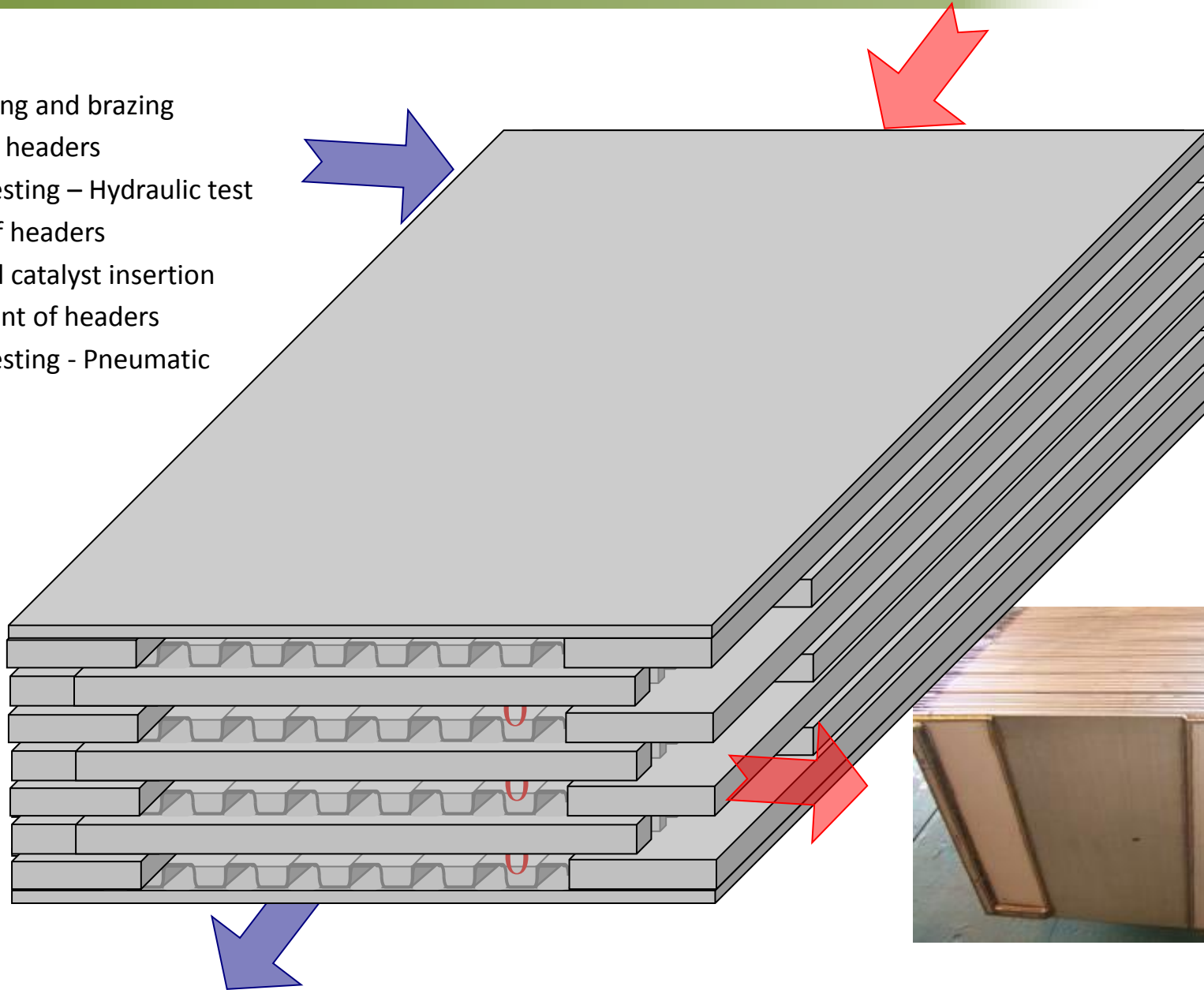


SMR Mini Channel Reactor Layout



SMR Reactor Core Fabrication

- Core stacking and brazing
- Welding of headers
- Pressure testing – Hydraulic test
- Removal of headers
- Automated catalyst insertion
- Replacement of headers
- Pressure testing - Pneumatic



**Automated catalyst insertion
& removal at point of
manufacture**



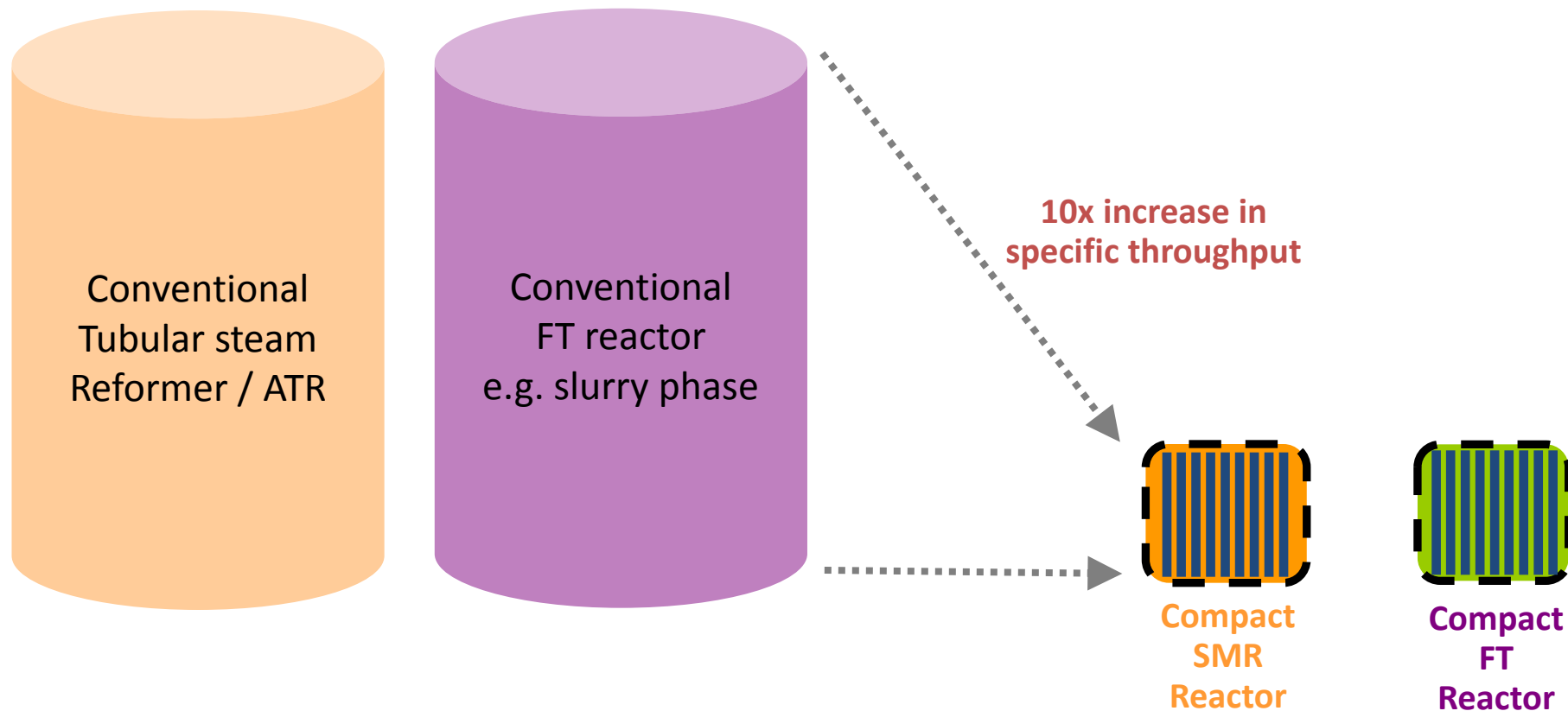
Catalysts :

- Removable metallic inserts
- Established automotive mass production techniques

Reactors :

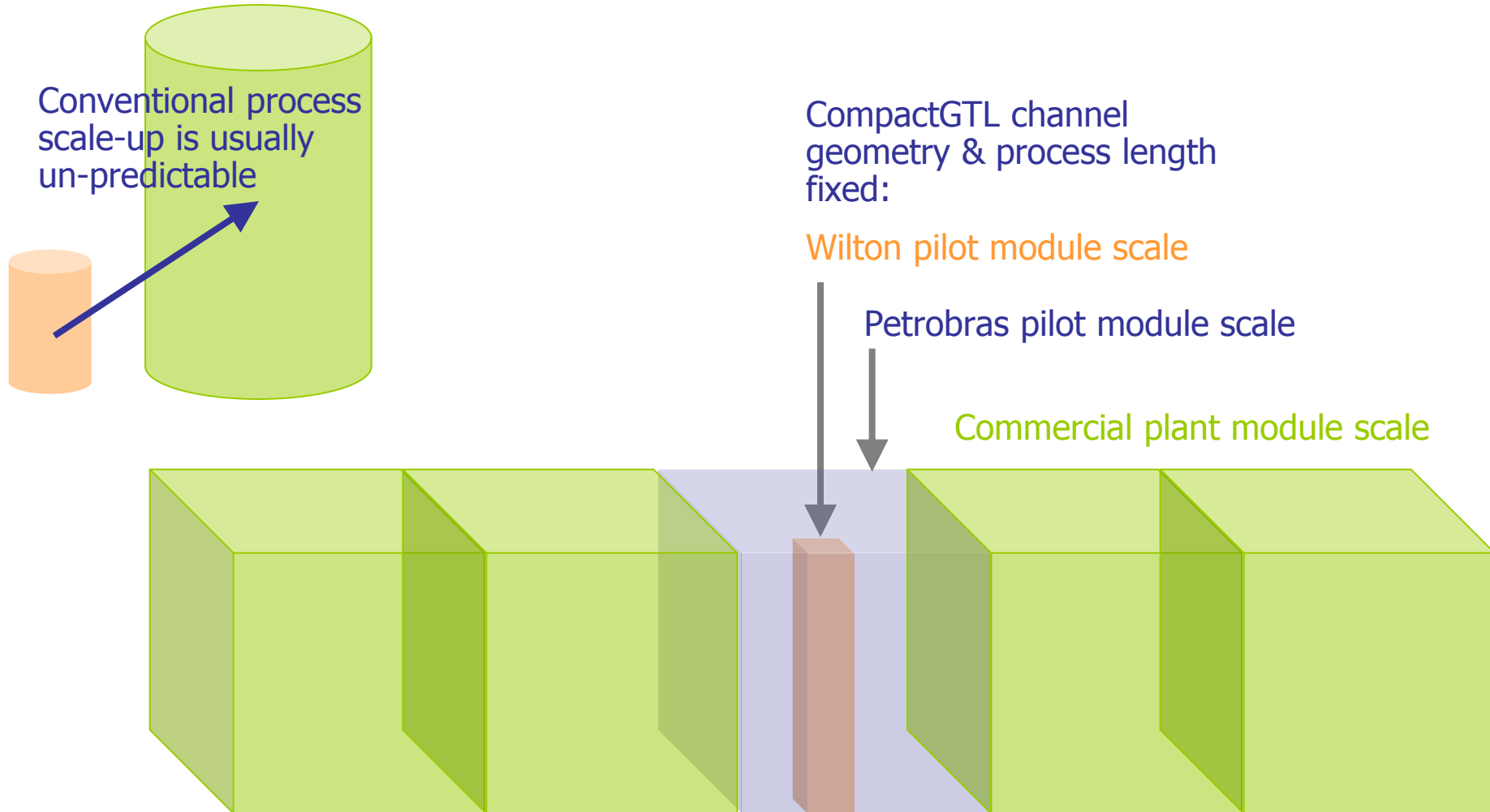
- High specific heat transfer
- Established heat exchanger mass production techniques
- High reactor 'voidage' using pressed fin plates, minimising metal content, cost & weight

Compact mini-channel reactors are key



- High heat transfer plate & fin reactor construction :
- High specific heat input to SMR reaction
- High specific heat removal from FT reaction

Scale Up



Construction of Commercial Demonstration Plant



**Construction in
Canada 2009/2010**

Complete Set Of GTL Reactors Sent By Air Freight To Brazil



World's first small scale fully integrated GTL facility

Commercial demonstration plant
Aracaju, Brazil 2010

Technology
approval by
Petrobras
2011

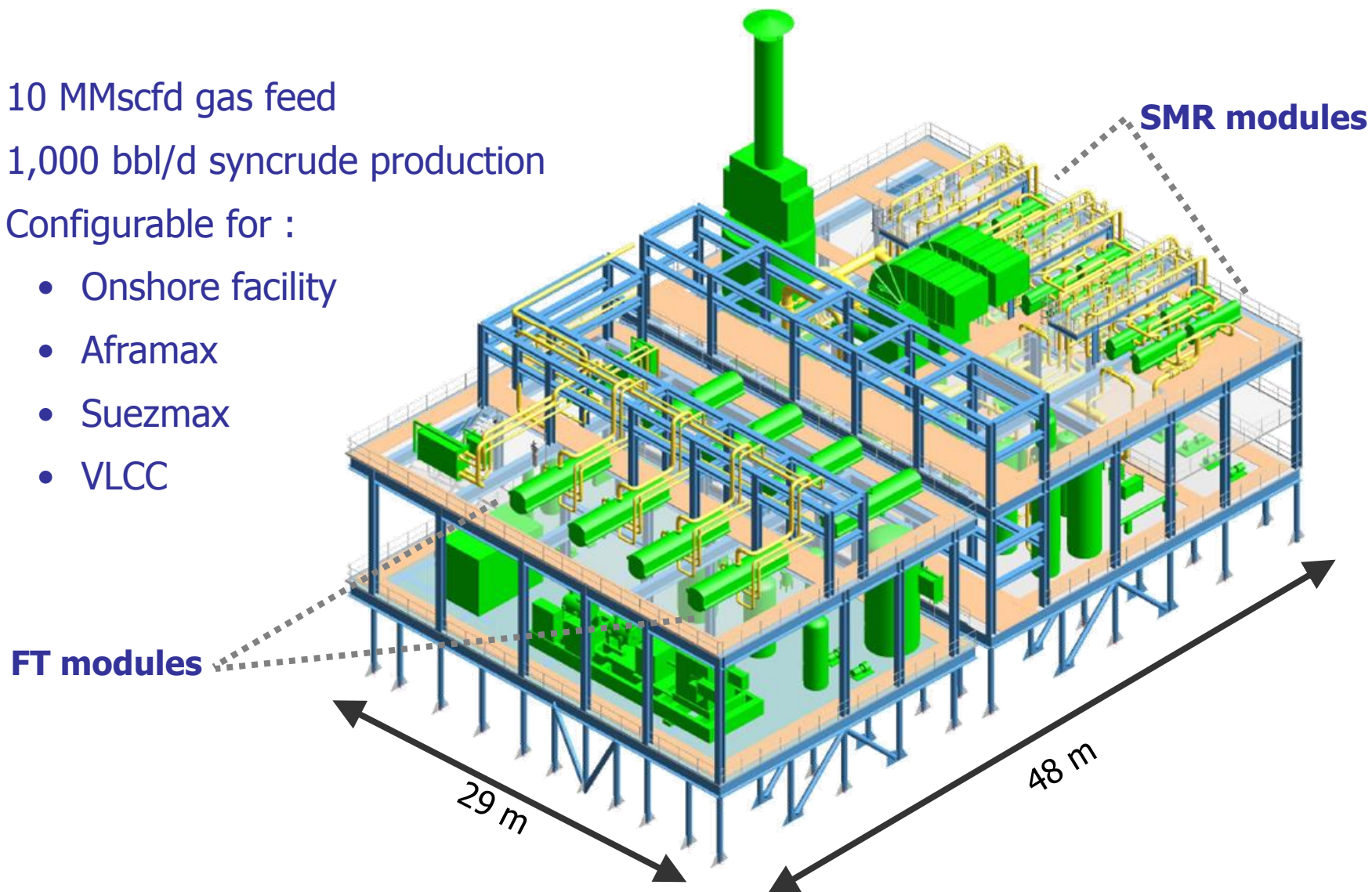
- Gas pre-treatment
- Pre-reforming
- Reforming
- Waste heat recovery
- Process steam generation
- Syngas compression
- Fischer Tropsch synthesis
- FT cooling water system
- Tail gas recycling

Challenges faced from Commissioning through to Performance Test Matrix

- Commissioning activities of Brazil CDP similar to Commercial GTL plants.
- Remote location challenge for spares.
- Language barrier.
- Inexperience of Operating personnel
- Extensive training program at Wilton UK as well as in Brazil.
- Fine tune complex Instrument control loops.
- Unreliable OSBL issues i.e. NG-, Instrument Air-, Power-, N₂ supply

The Commercial Demonstration Plant demonstrated it's robustness; considering volume of trips and restarts the plant had to withstand.

- 10 MMscfd gas feed
- 1,000 bbl/d syncrude production
- Configurable for :
 - Onshore facility
 - Aframax
 - Suezmax
 - VLCC



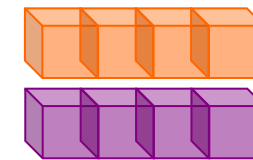
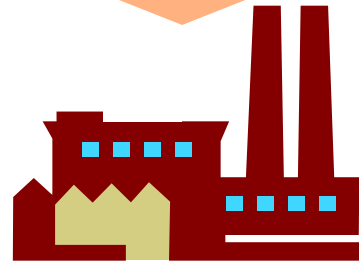
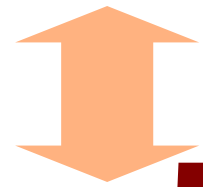
Standardised reactor module availability



Onshore plants



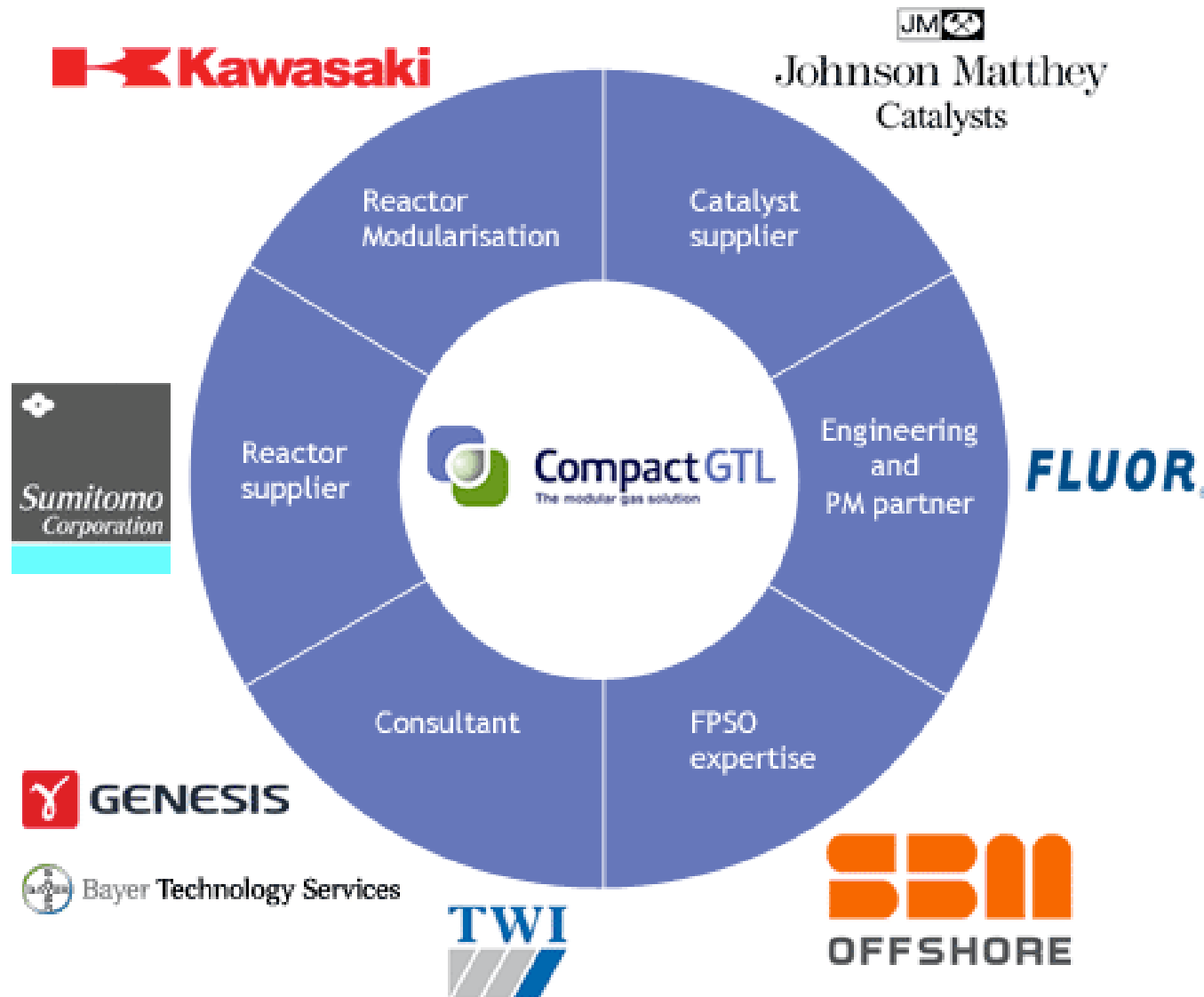
Offshore plants



Standard SMR & FT
reactor modules

- Standard, fully interchangeable reactor modules for all plants
- Modules returned to manufacturer for refurbishment
- No catalyst handling on plant sites

Partnership Approach Critical To Success



'Standalone' solution for oilfield development

Manufacturing route & partners established

CompactGTL is structured as a TURNKEY SOLUTION PROVIDER

UK pilot plant operational for 5 years

Technology approved by Petrobras for commercial deployment



Questions Answers