

26th World Gas Conference

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WOC1-4: Technologies for the monetisation of gas reserves

From Gas to Liquids:
history and opportunities

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Reserves: Our use of the term “reserves” in this presentation means SEC proved oil and gas reserves.

Resources: Our use of the term “resources” in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.

Organic: Our use of the term Organic includes SEC proved oil and gas reserves excluding changes resulting from acquisitions, divestments and year-average pricing impact.

Resources plays: Our use of the term ‘resources plays’ refers to tight, shale and coal bed methane oil and gas acreage.

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THE NEW ENERGY FUTURE BY 2050

RISING ENERGY DEMAND, SUPPLY PRESSURE, CLIMATE CHANGE



9 BILLION people, **75%** living in cities

(2 BILLION more than today)



2 BILLION vehicles

(800 MILLION at the moment)



Many **MILLIONS** of people will rise out of energy poverty; with higher living standards energy use rises



Energy demand could **DOUBLE** from its level in 2000... while CO₂ emissions must be half today's to avoid serious climate change

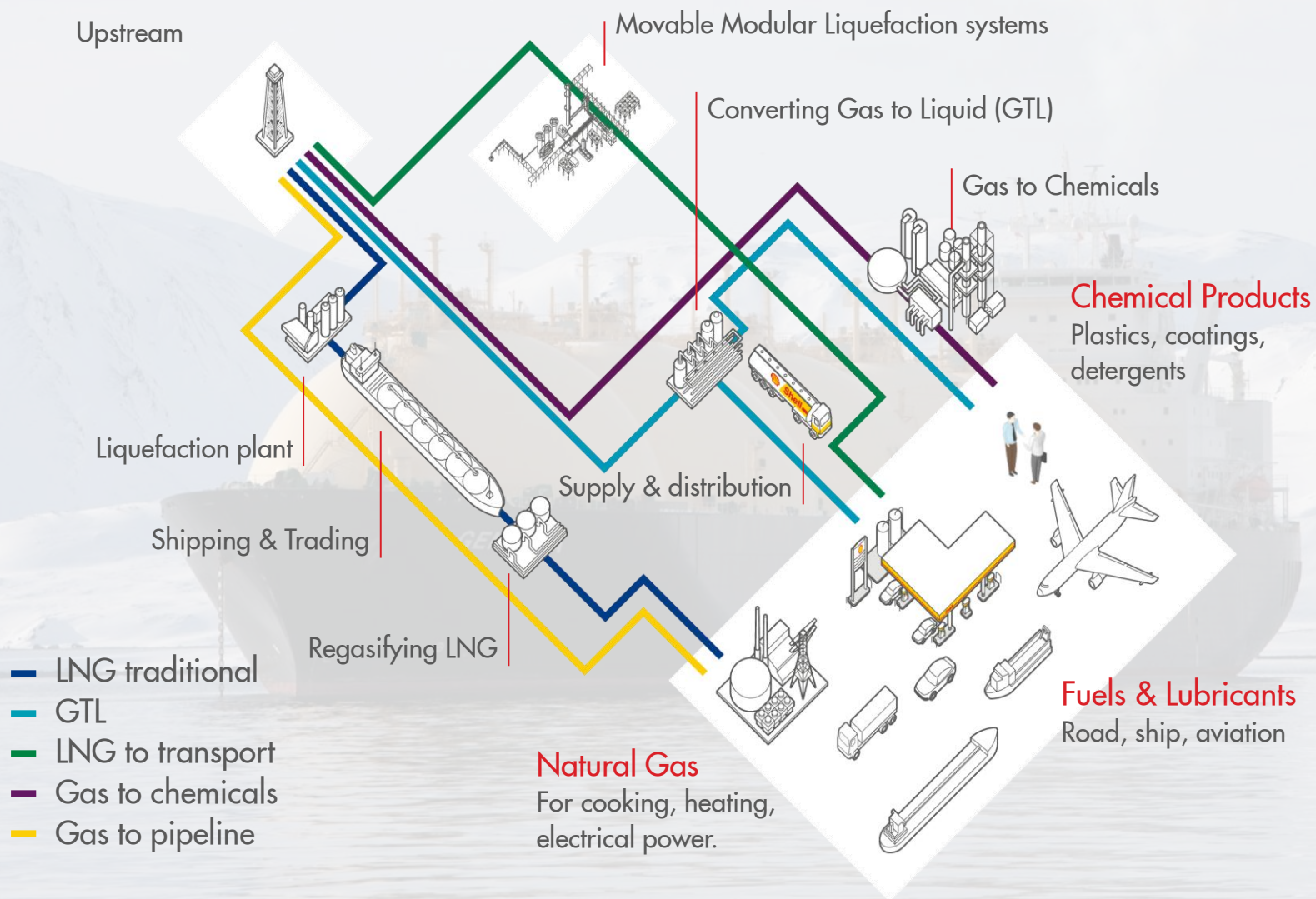


Twice as efficient, using **HALF** the energy to produce each dollar of wealth



3 times more energy from renewable sources

GAS VALUE CHAIN



WHAT IS GAS TO LIQUIDS?

Breaking through the paradox that gas needs to be sold as gas
GTL CONVERTS GAS INTO HIGH QUALITY LIQUID PRODUCTS

Natural gas

GTL plants process natural gas
using Fischer-Tropsch process

Products include transport fuels,
lubricants, waxes and chemicals



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GAS-TO-LIQUIDS

A 40-YEAR JOURNEY OF TECHNOLOGY AND PRODUCT INNOVATION



1973

LABORATORY
AMSTERDAM



1983

PILOT PLANT
AMSTERDAM



1993

SHELL MDS
BINTULU MALAYSIA

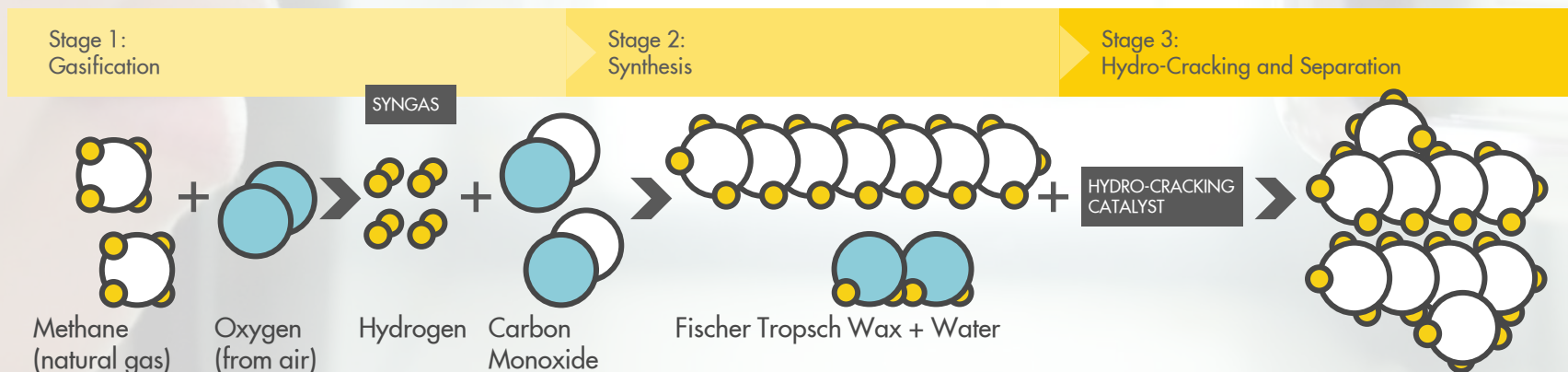
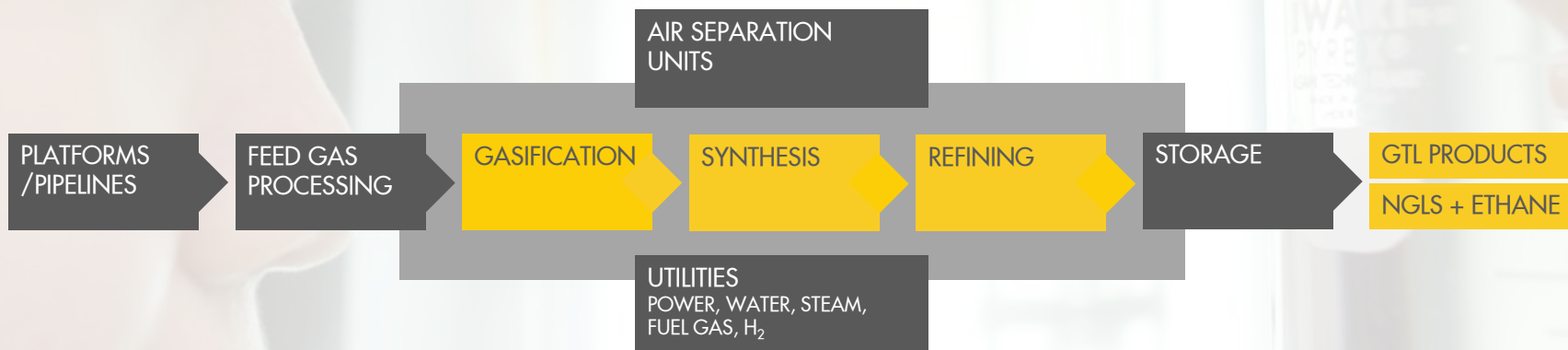


TODAY

PEARL GTL QATAR

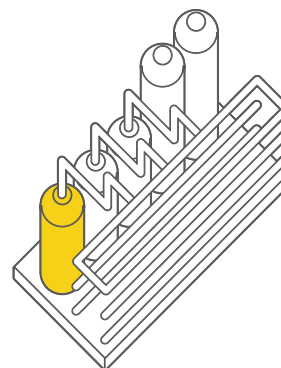
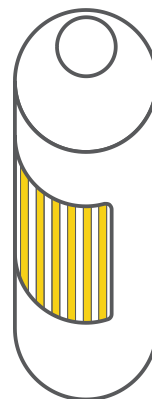
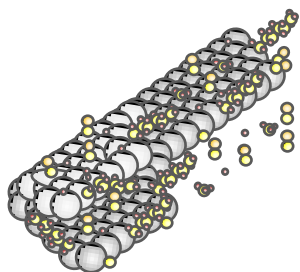
GAS-TO-LIQUIDS TECHNOLOGY

CATALYTIC PROCESS TO CONVERT GAS TO OIL PRODUCTS



INNOVATION

MASTERING TECHNOLOGY AT ALL SCALES



NM SCALE

Catalytic
Active Site

MM SCALE

Catalyst
Particle

CM SCALE

Reactor
Tube

M SCALE

Multitubular
Reactor

KM SCALE

Integrated
Complex

GLOBAL SCALE

GTL
products

MALAYSIA



SHELL MDS

FIRST COMMERCIAL FACILITY IN THE WORLD

- Location: Bintulu, Malaysia
- Plant capacity 14,700 b/d of liquid products & waxes
- More than 400 staff
- Customers in more than 50 countries
- More than 2200 shipments
- More than 90% Malaysian staff

PEARL GTL

A MAJOR ENGINEERING FEAT

IMPORTED MATERIAL:
2 MLN+
FREIGHT TONNES

CONCRETE:
750,000 M³
8 WEMBLEY STADIUMS OR 2 BURJ KHALIFAS

STEEL: ERECTED
2.5 EIFFEL TOWERS / MONTH
IN PIPE & STRUCTURAL STEEL AT PEAK

GTL SYNTHESIS REACTOR TUBES:
END TO END WOULD STRETCH
FROM **DOHA** TO **TOKYO**

CABLES:
13,000 KM
FROM DOHA TO HOUSTON

EQUIPMENT:
1.2 GIGAWATT
OF ROTATING EQUIPMENT

WATER CLEANED:
45,000 M³
PER DAY
EQUAL TO A TOWN
OF 140,000 PEOPLE

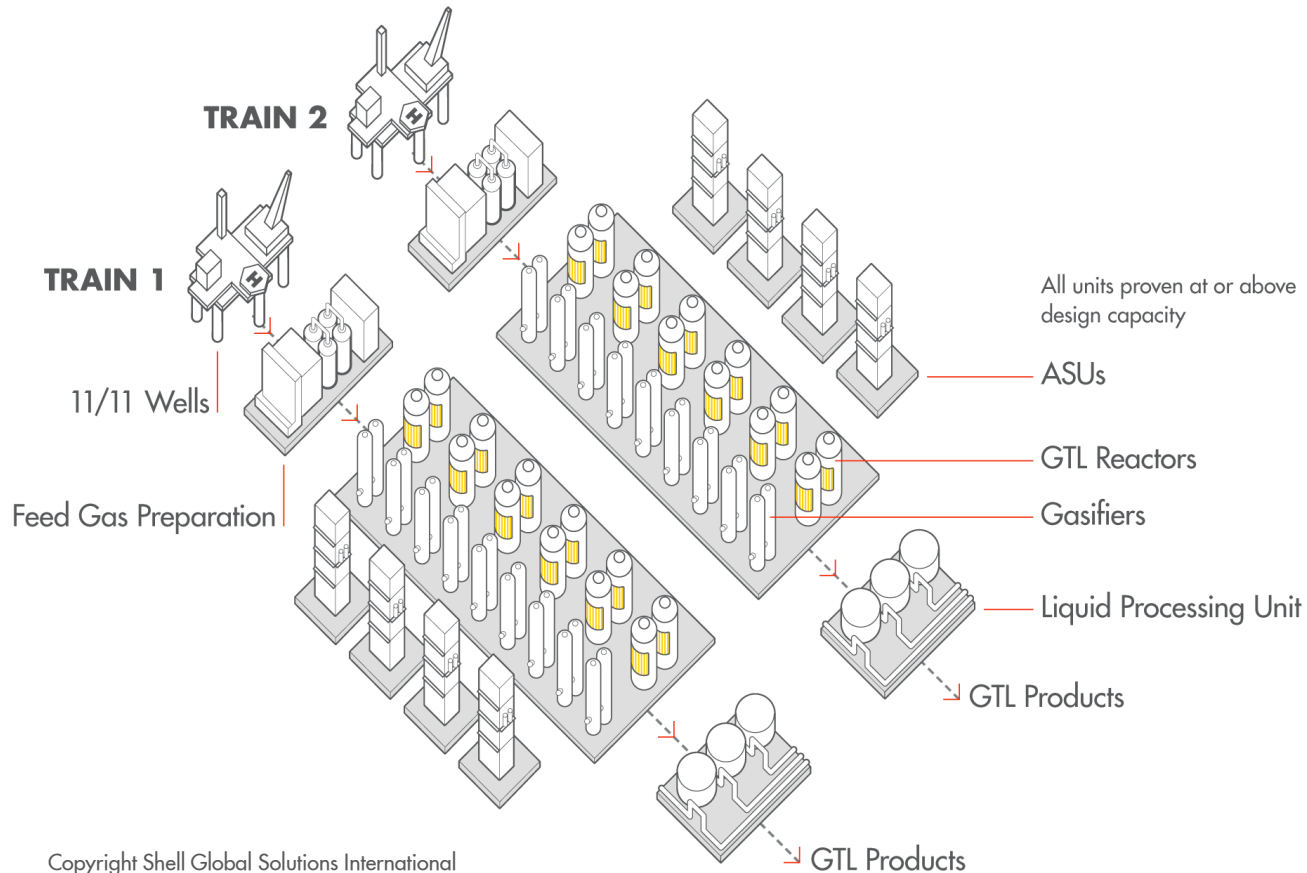
STEAM FOR POWERGEN:
8,000 TONNES
PER HOUR
3 OLYMPIC SIZE / HOUR
SWIMMING POOLS

OXYGEN FOR GTL:
28,000
TONNES PER DAY PRODUCED

CATALYSTS:
SURFACE AREA EQUIVALENT
>10X SURFACE
AREA OF
QATAR

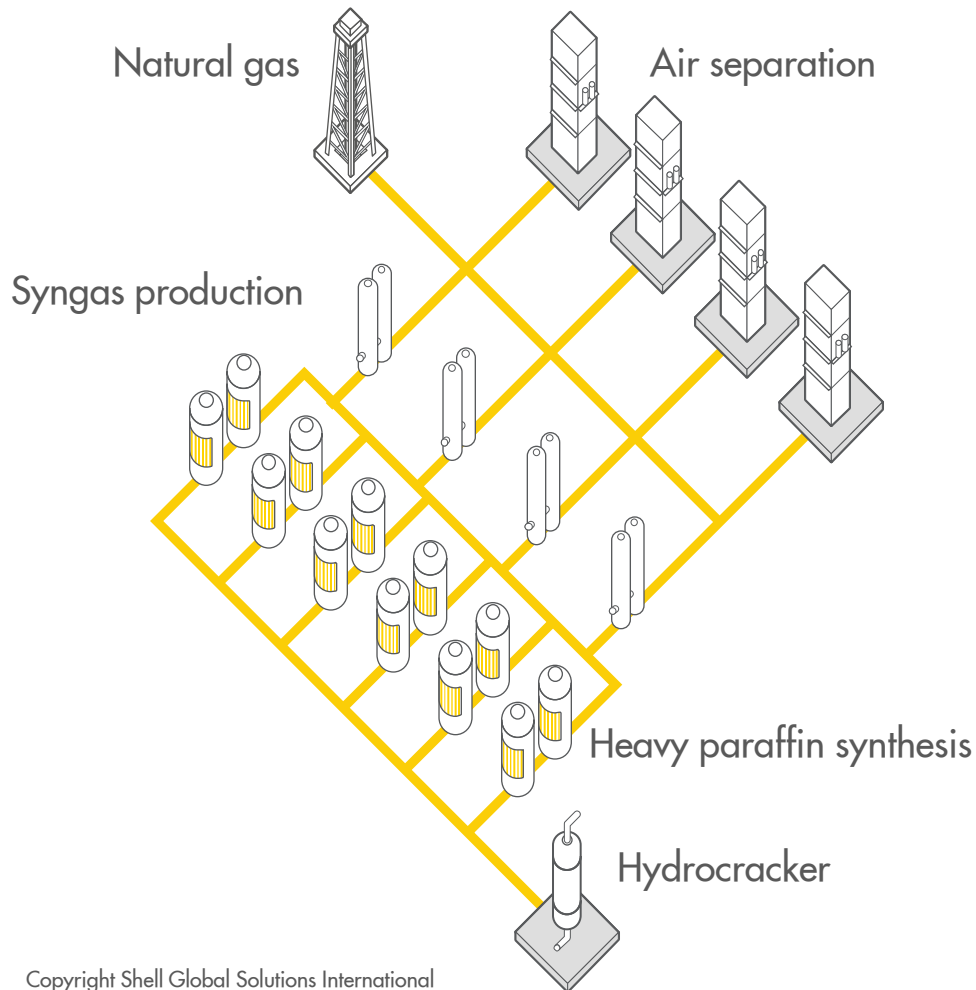
PEARL GTL

INTEGRATED GAS-TO-LIQUIDS FACILITY

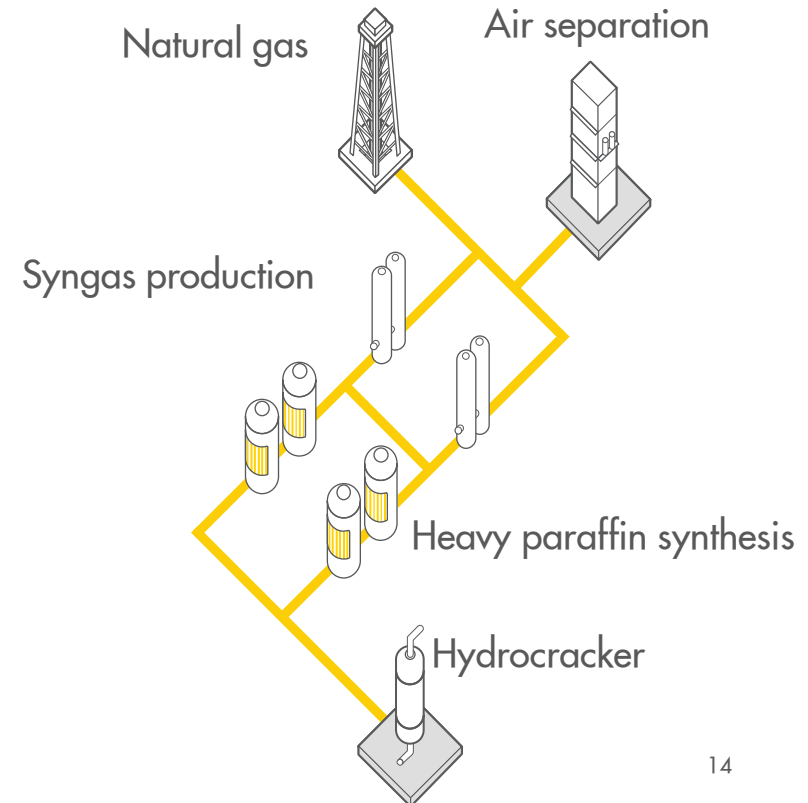


- 1.6 Bcf/d of Wet Gas
- 140 kbbl/d GTL products
- 120 kbbl/d NGLs/Ethane
- Full integration from offshore to refined products
- In production since 2011

A SMALLER TRAIN FROM THE LARGEST BLOCKS



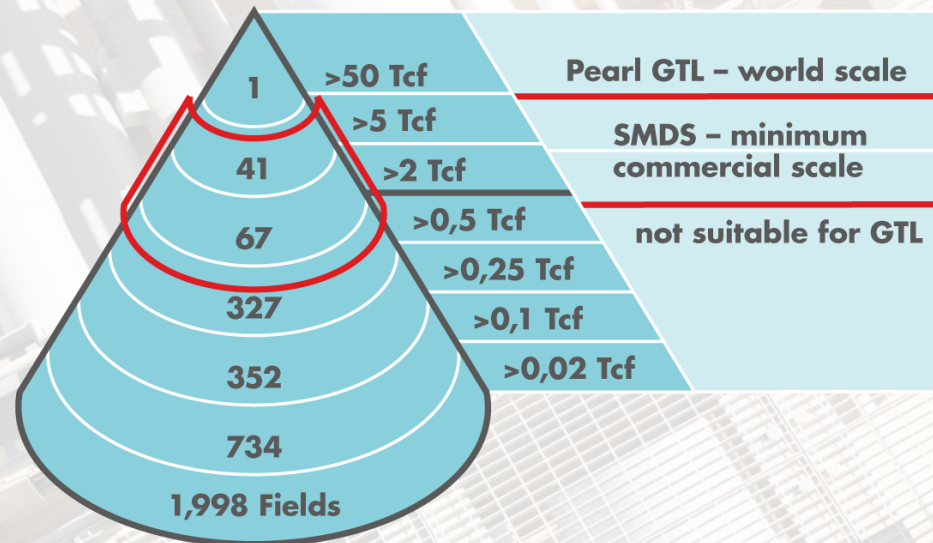
- Now developed a mid scale option
- Competitive, scaled for local market
 - Expandable
 - => options



GOING SMALLER UNLOCKS NEW OPPORTUNITIES

Number of undeveloped gas fields

IHS International E&P Database



A Flexible size opens up a new opportunity set:

- Possibility to develop more plentiful and diverse, smaller gas resources
- **Standardised** GTL unit, **faster** to implement with sufficient **flexibility** to tailor to project needs
- Better potential to utilize existing infrastructure

SHELL GTL PRODUCTS



- Reduced environmental impact
- High-purity, clear & water white
- Low odor
- Synthetic, stable & consistent composition

GTL PRODUCTS



Base Oils



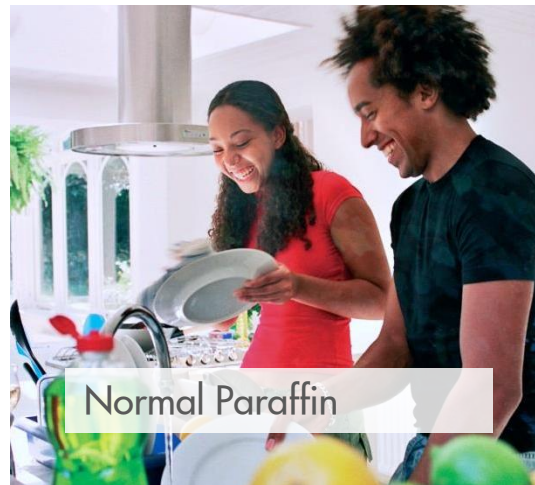
GTL Fuel - Gasoil



Kerosene



Naphtha



Normal Paraffin



Waxes

SECTORS WHERE SHELL GTL FUEL IS SUCCESSFULLY APPLIED

Shell
GTL Fuel



CANAL BOATS



WASTE COLLECTION



BUSSES



RAIL



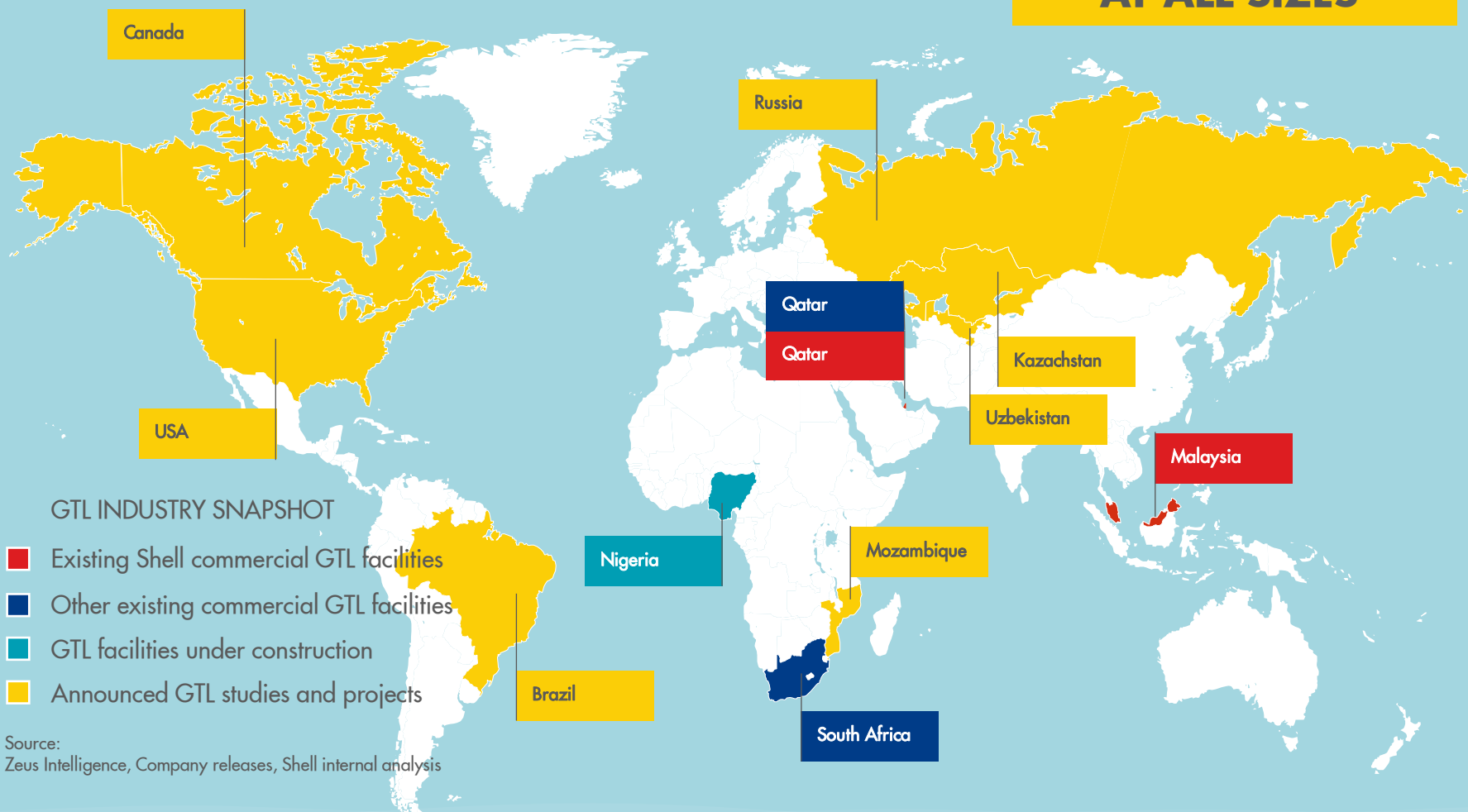
LAST MILE DELIVERY



STATIONARY POWER

GTL INDUSTRY CONTINUES TO EVOLVE

AT ALL SIZES



UNIQUE CVP CONTINUES TO CREATE OPPORTUNITIES

IN SUMMARY



- GTL provides a good opportunity for gas rich countries to use local resources to reduce dependence on imports
- GTL is a key component of Shell's suite of integrated gas solutions
- GTL plants can be designed at a variety of scales to suit the local gas resource and market

