

THE SUCCESS ENVELOPE OF GTL IN OUR NEW WORLD AND HOW TO STRETCH IT

SMI Gas to Liquids Conference, London

12th & 13th October 2016





Agenda

- ◆ **Historical Background**
- ◆ **How the World has Changed**
- ◆ **Technology, Scale and CAPEX**
- ◆ **Conclusions**



What are GTL's Natural Roles?

- ◆ When first invented the ruby laser was described as:

“ A Solution Looking For A Problem ”

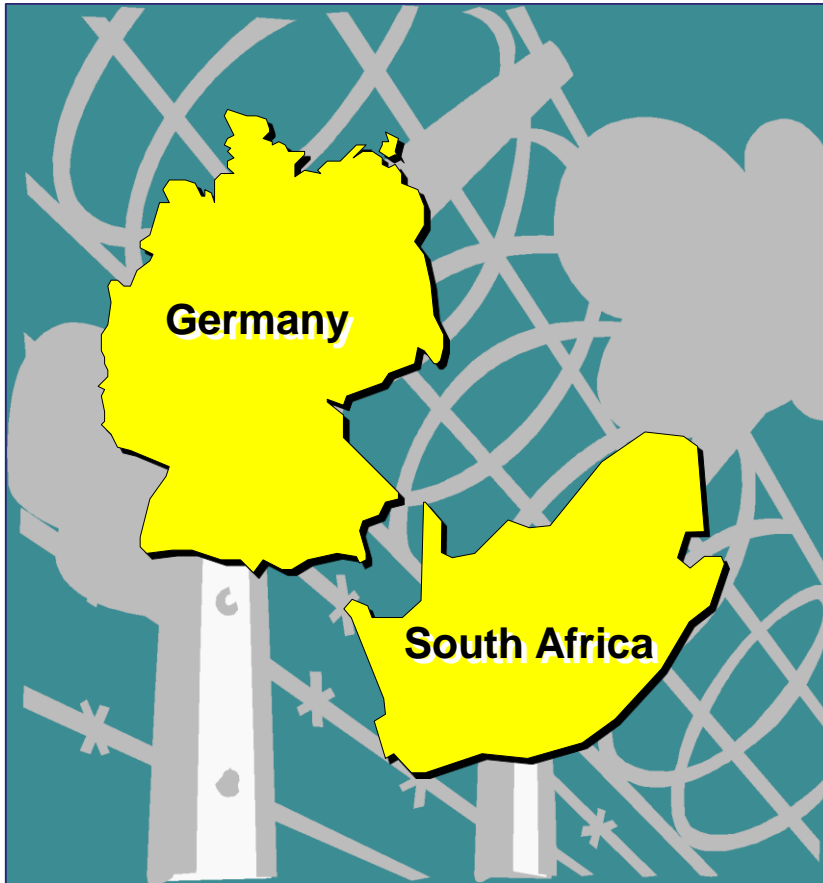
**Lasers are now ubiquitous – science, defence, industry,
medicine, entertainment**

**This paper will review the factors which shaped the
development of GTL, examine how these factors are
evolving and conclude on the implications for GTL**

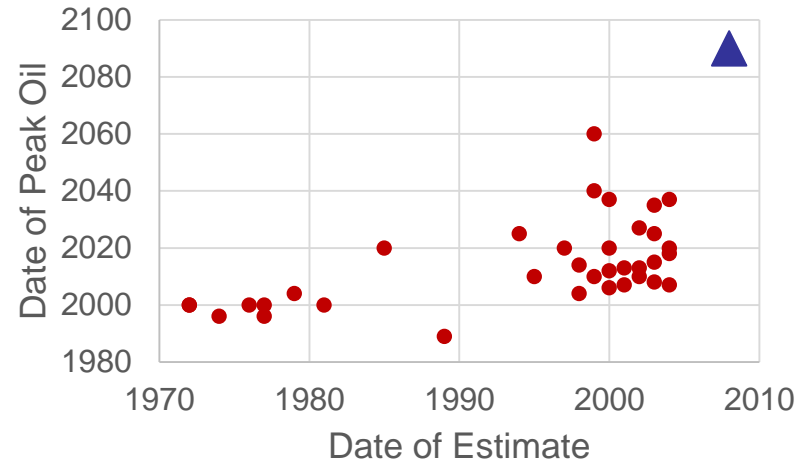
Three factors focused minds on GTL:

1 – Security of Supply

Politics



Industry Evolution



“The Stone Age did not end because we ran out of stones. The Oil Age will not end because we will run out of oil.”





Three factors focused minds on GTL: 2 – What do you do if you find “remote” gas?

A view from the 1980s



**Bad News –
Our well
didn't find oil**



**Good News –
We didn't find
gas either**



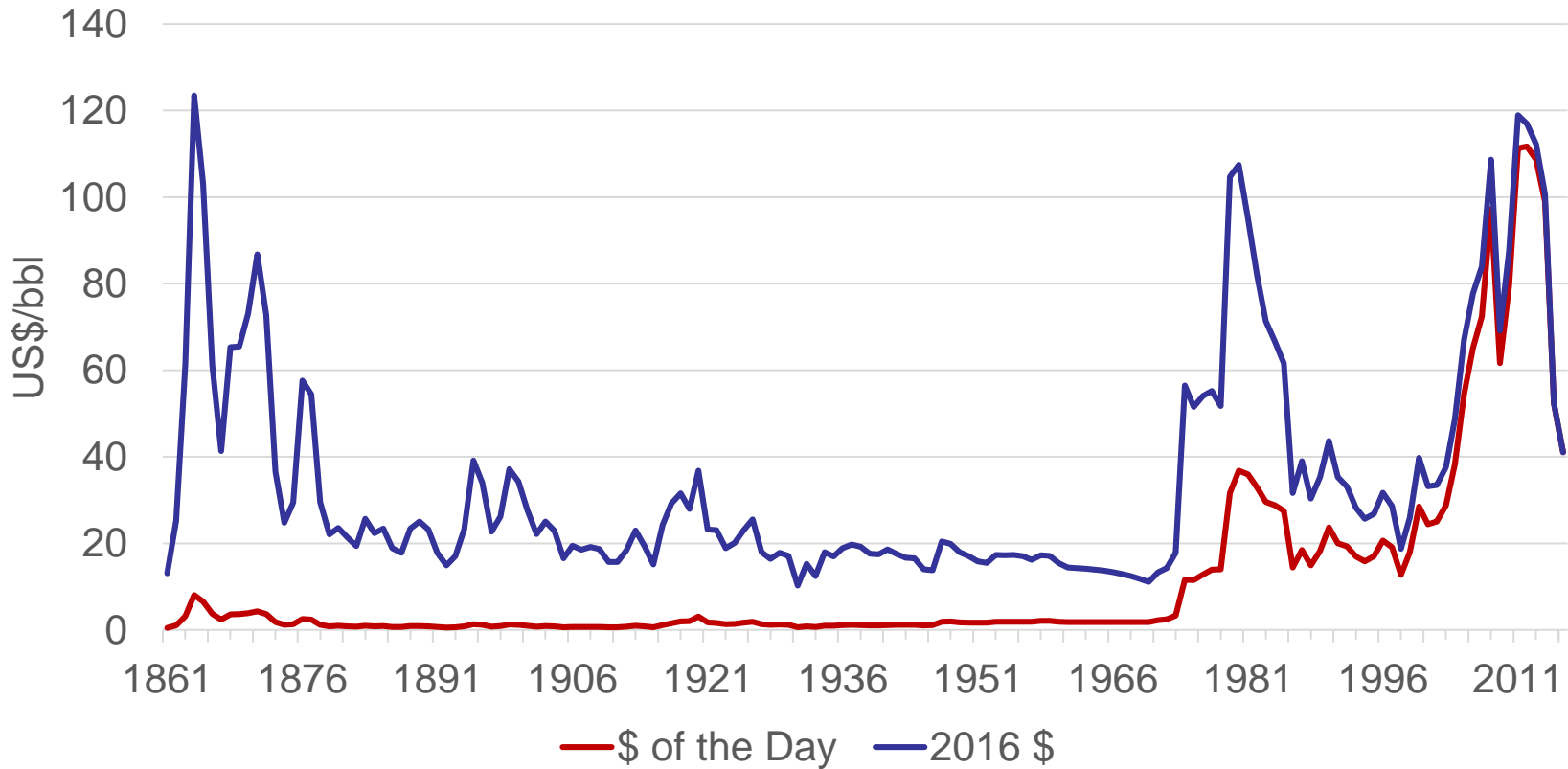
**Leads to a “Large-ist”
Thought Trap**

The only markets large enough to absorb large quantities of Gas-to-Something production are transportation fuels markets

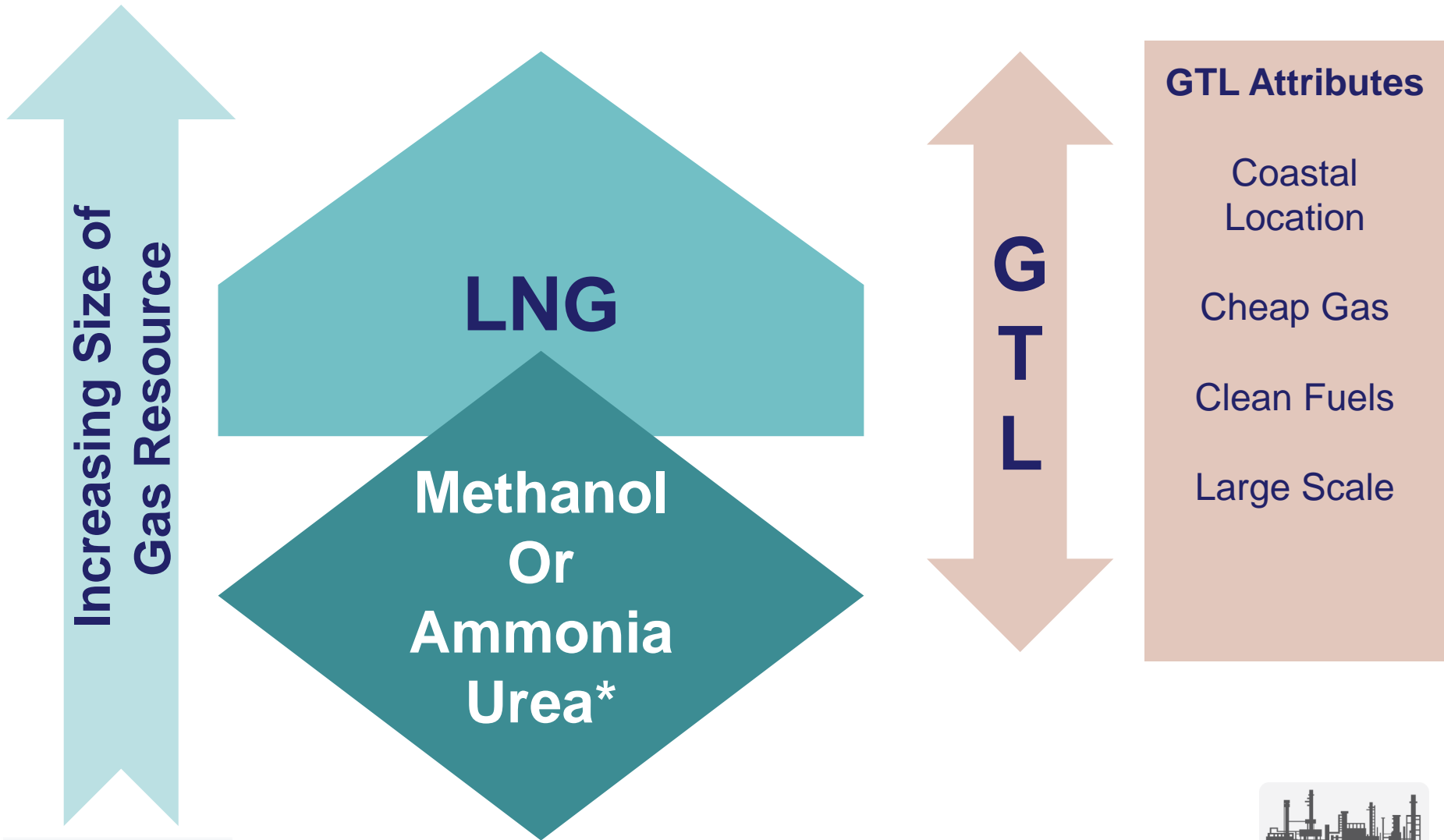
Further fuelled by “fuels - orientated” thinking in many of the E&P companies concerned about remote gas

Three factors focused minds on GTL: 3 – The dynamics of crude pricing

Crude Oil Price Development



Historically there have always been established alternatives to GTL



* But chemicals markets were small compared to fuel/energy markets



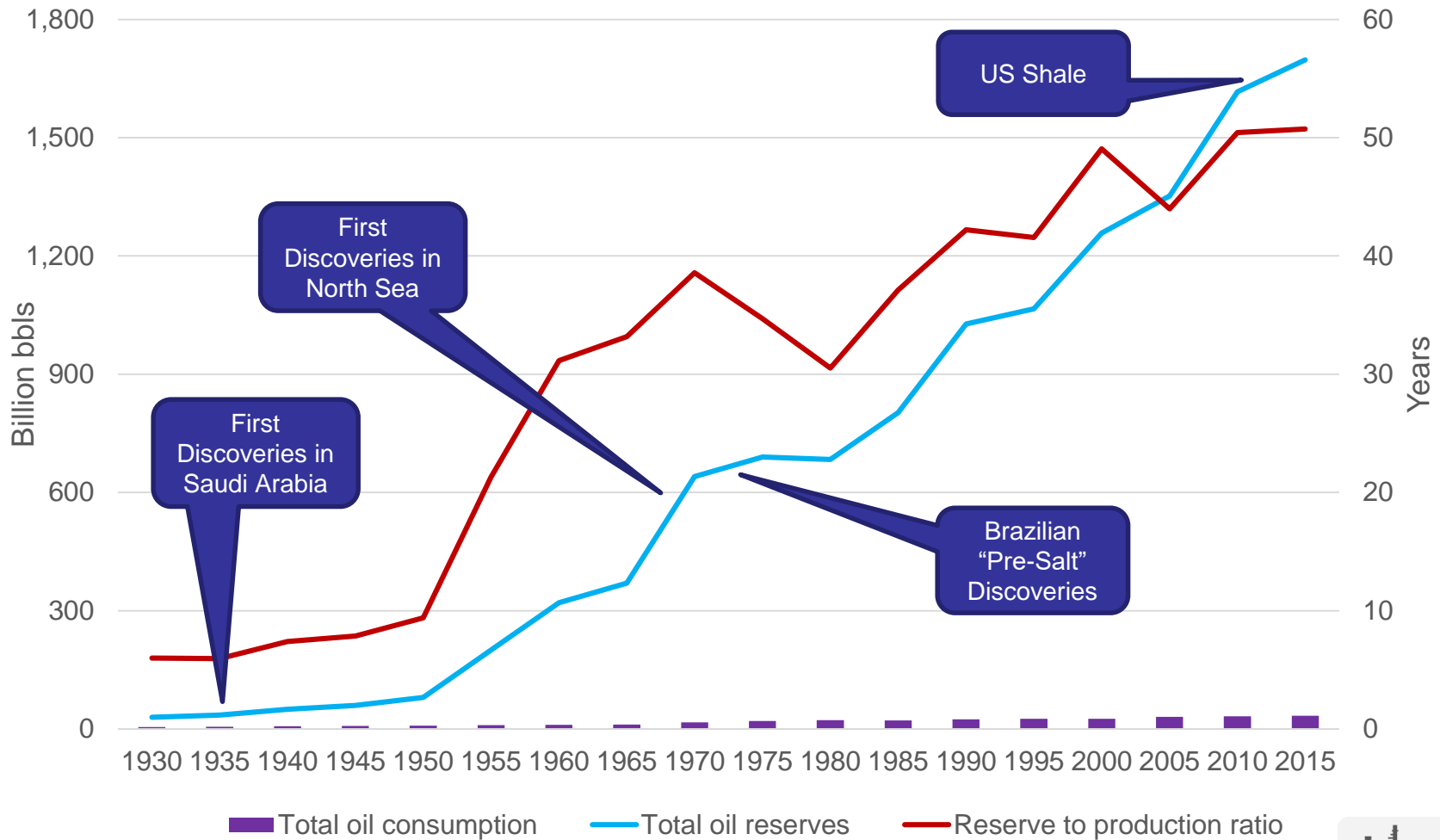
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The Oil Outlook Remains Positive

we are not running out of stones

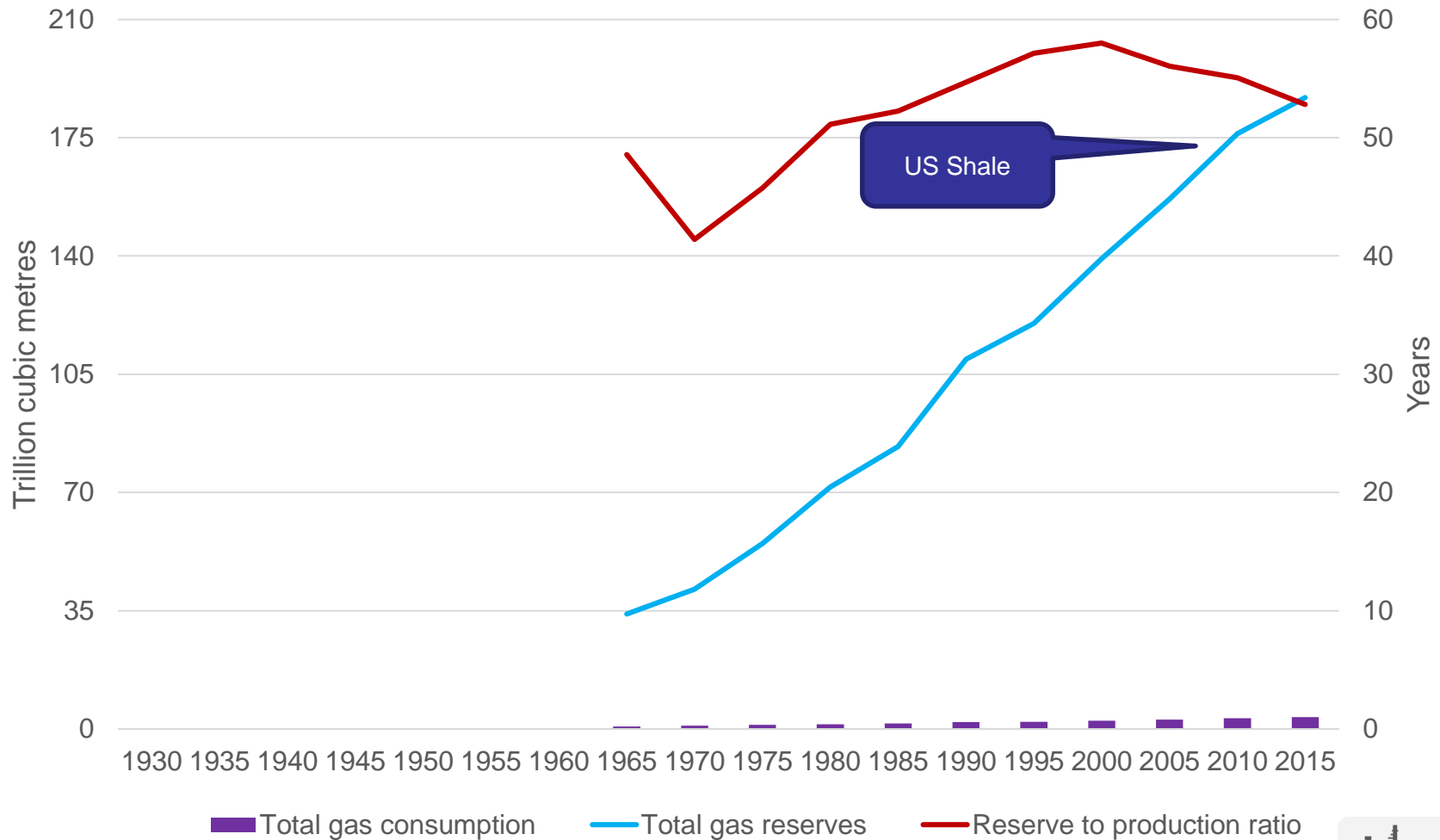
Comparison of Crude Oil Consumption versus Reserves



Source: BP Statistical Review of World Energy, 2016

The Gas Outlook is Positive Too

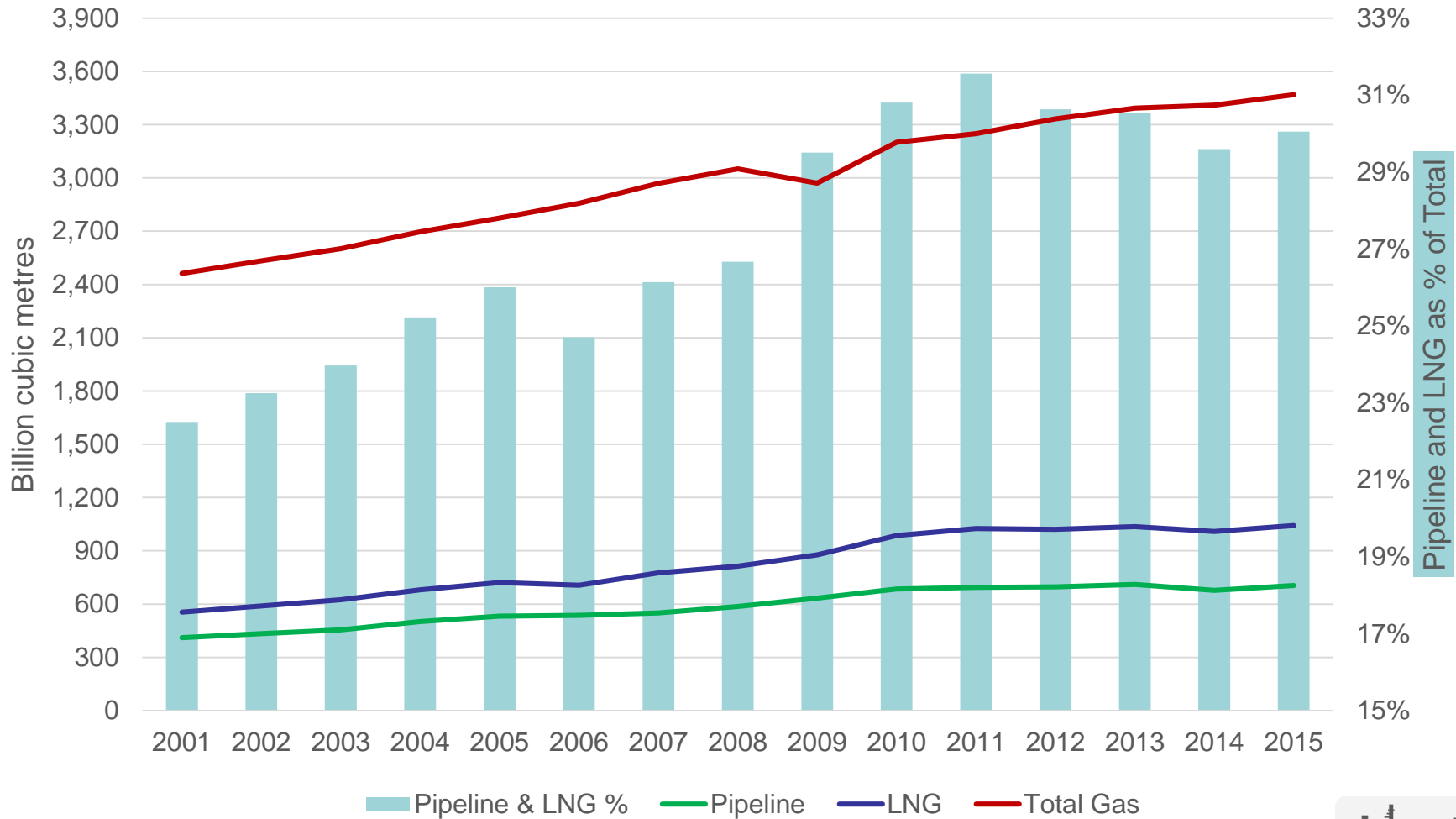
Comparison of Natural Gas Consumption versus Reserves



Source: BP Statistical Review of World Energy, 2016

The World though has Shrunk

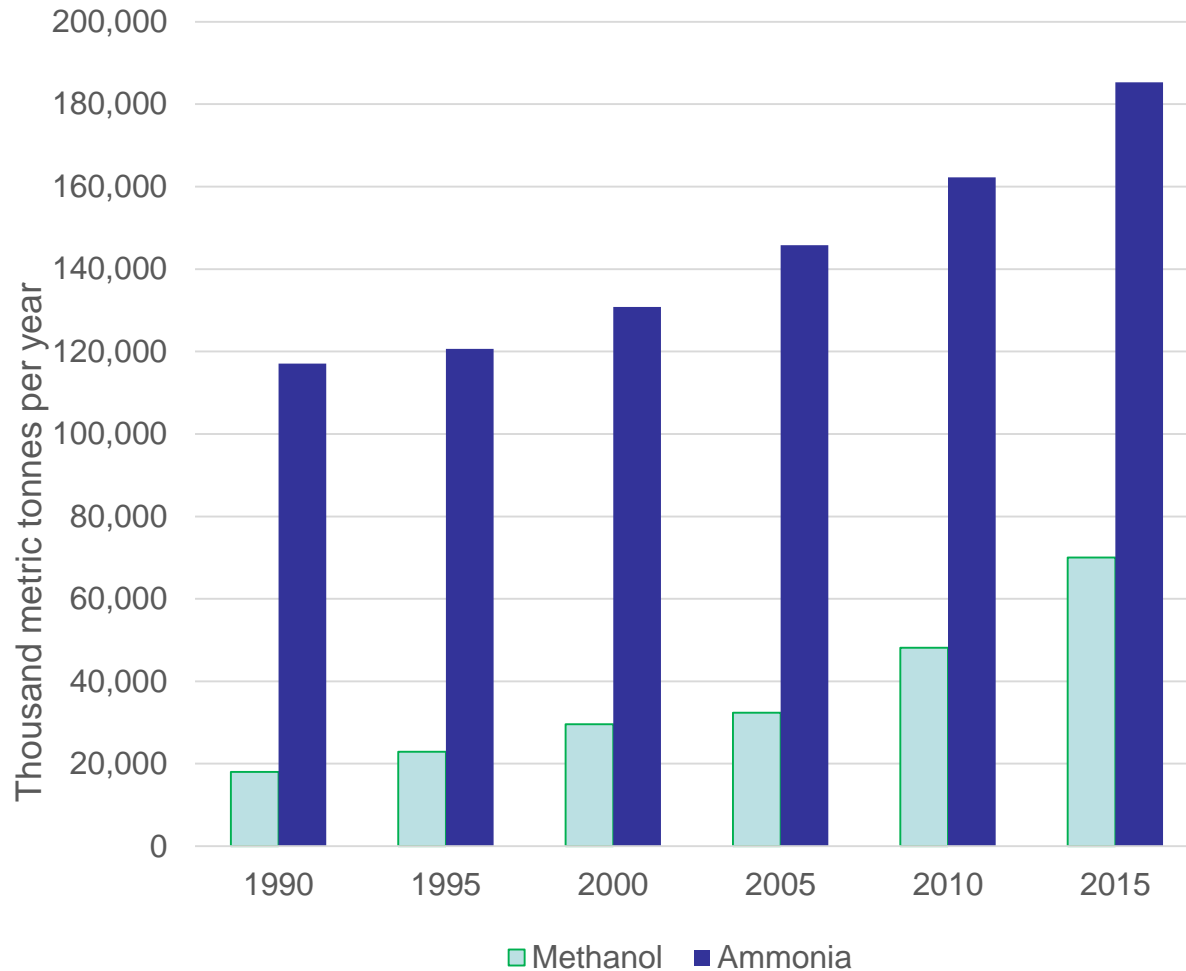
The Global Gas Market



Source: BP Statistical Review of World Energy, 2016

Whilst the World for the Alternatives has Grown

Global Methanol and Ammonia Demand



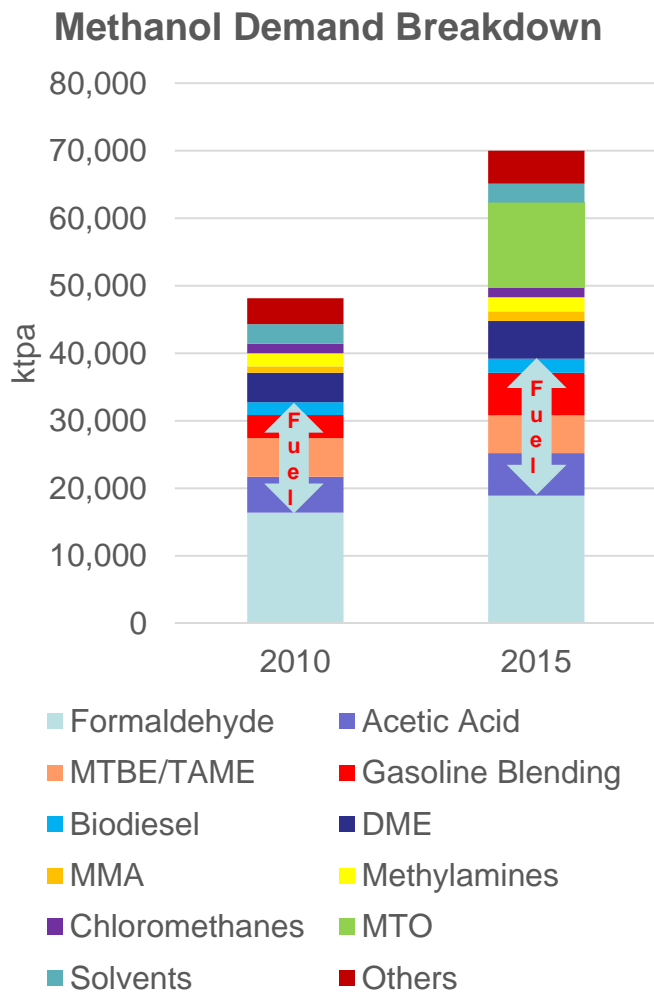
Source: NCSL Analysis

Assuming recent growth rates are sustained:

- For balance methanol requires 3 world-scale plants per year
- Ammonia requires 4-5 world-scale plant per year

Note: This sector has consumed around 6% (+/-1%) of global gas consumption

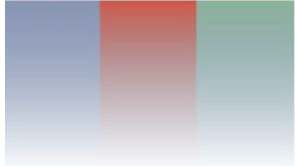
There are ever Increasing Options for Methanol



It is important to note that not all methanol is produced from natural gas (coal is significant in China). But,

- Direct and indirect fuel uses are growing strongly
- Novel uses are being developed and commercialised:
 - MTO – Methanol to Olefins – ethylene and propylene
 - Johnson Matthey Process Technologies offers methanol (or formaldehyde) to ethylene glycol

Source: American Methanol Institute, IHS



Olefins from Methanol Provides Options for Would-Be Producers

Route	Selectivity to C2= or Derivative	Commentary
Steam Cracking Ethane	High	Dependent on competitively priced ethane
Steam Cracking LPG	Moderate	Higher CAPEX than above, wider spectrum of intermediates
Steam Cracking Liquids	Low	Higher CAPEX than above, 2.5 tonnes of by-products to monetise per tonne of C2=
MTO/MTP	High/Moderate	Selective to C2=/C3=, but c. 3 +/- tonnes methanol/tonne of olefin
DAVY™ MEG	High	Selective to MEG – good option if ethane not available

Methanol chemistry offers an elegant route to olefins and derivatives which MAY be advantageous depending on both feedstock and market situations



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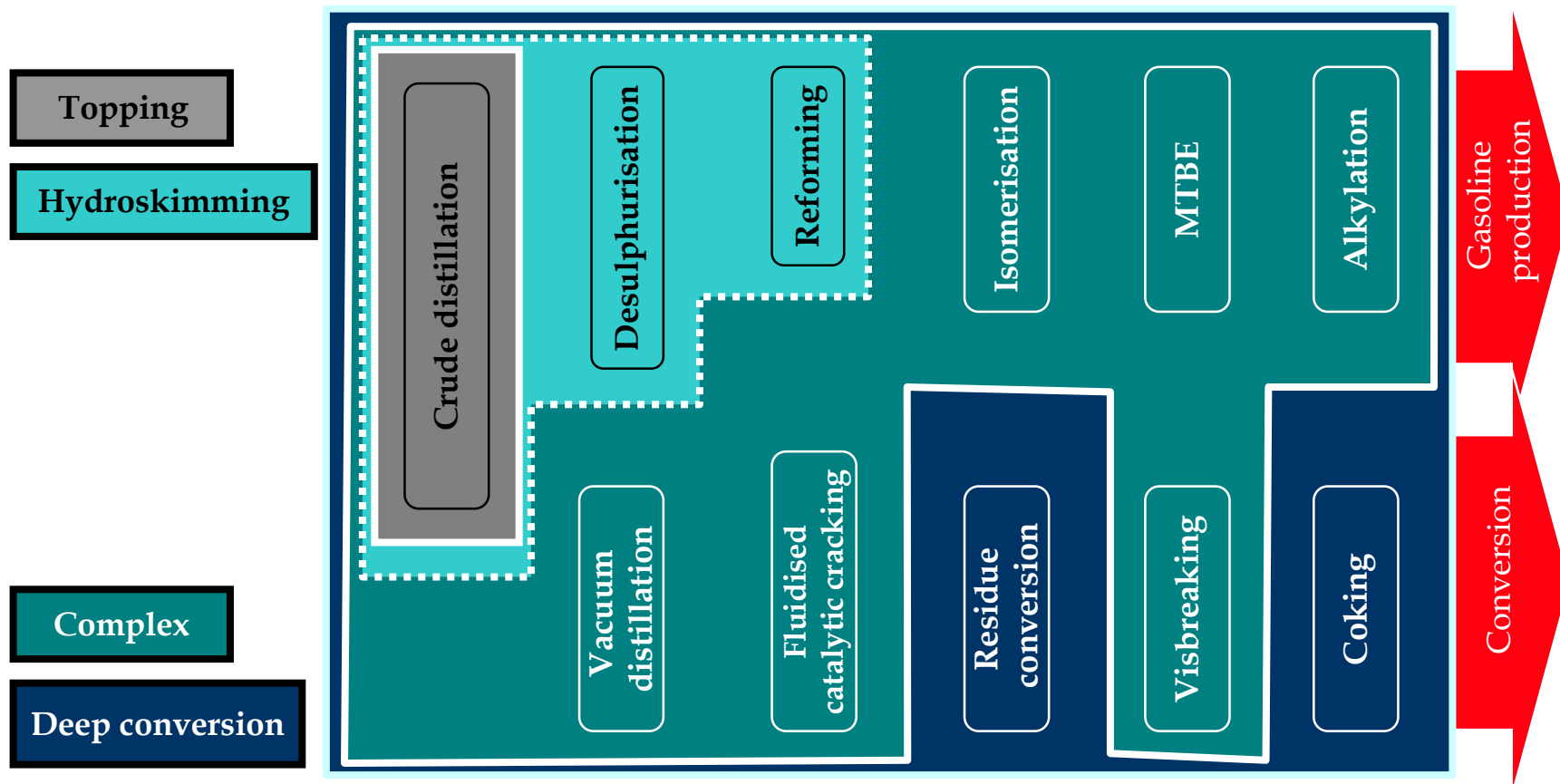
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Process Technologies for Refining, Petrochemicals and GTL

- ◆ **Refining technology provides a reference by virtue of aiming for similar products**
- ◆ **Methane based petrochemical technology provides a reference by virtue of having to overcome the same hurdle: the activation of methane**

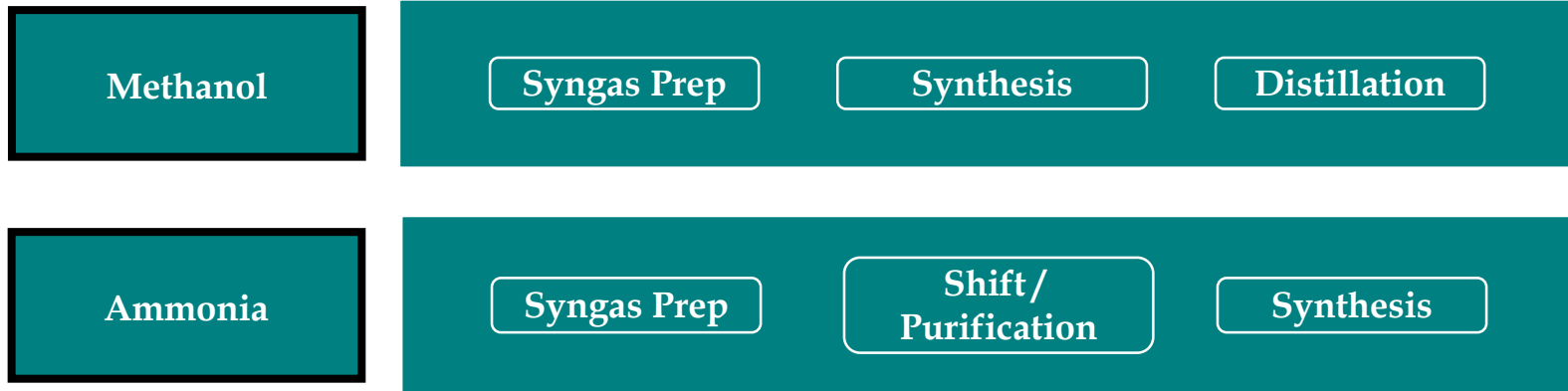
Refining Technology is Largely About Reducing the Size of Molecules



At a most simplistic level this can be seen as low CAPEX distillation, high CAPEX conversion, and low CAPEX finishing / blending



Methane Petrochemistry is all About Activating the Methane

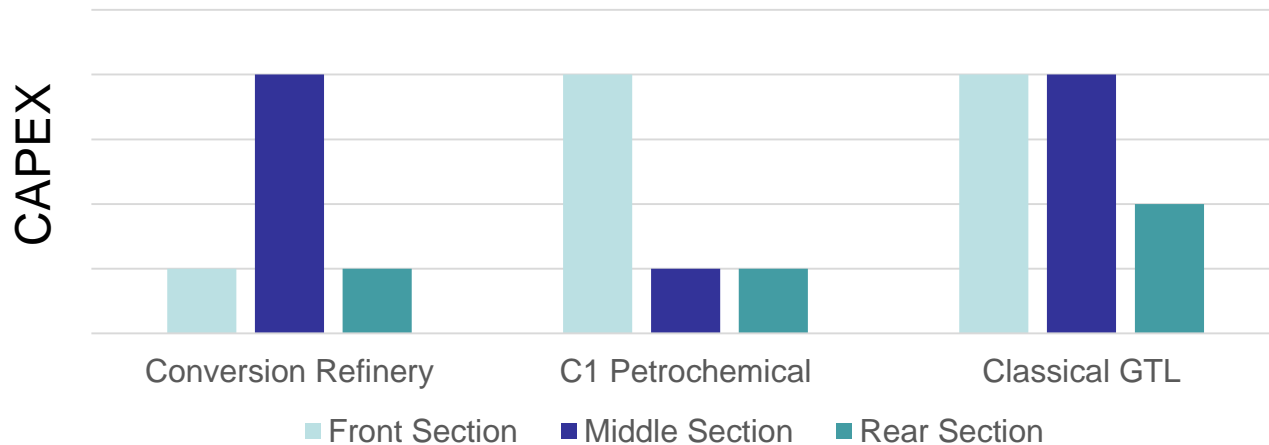


The key feature here is that the front end, the production of syngas, accounts for some 60-70 percent of the total ISBL CAPEX

Simply put the Classical GTL Plant is the Worst of Both Worlds



This can be seen as an expensive petrochemical front-end, followed by an expensive reactor and then a final product work-up section



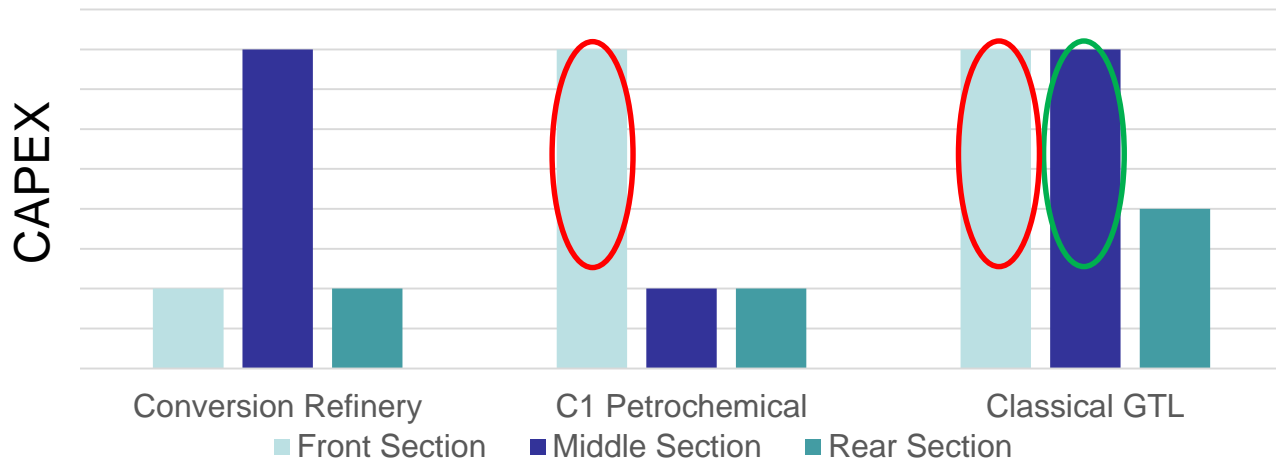
Pressures on GTL Technology

◆ Larger scale:

- Maximise gas consumption – assuming gas monetisation is the objective
- Maximises materiality versus refining industry
- Proportionately reduces impact of high cost units

◆ Technology Development:

- Larger/better front end – benefits “competition” (methanol and ammonia) too – and extensively researched
- Reactor area – largest “pay-off”





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Conclusions – The World is Trying to Eat GTL's Lunch

- ◆ **The world has become smaller - remote gas is no longer so remote from market – more is being shipped as gas or LNG**
- ◆ **We are not running out of oil - we don't need GTL fuels to “supplement” production from crude oil**
- ◆ **With gas monetisation in mind there are less CAPEX intensive and bankable options than GTL – with cheap gas and a coastal location then methanol or ammonia are “safe”**



Conclusions –Where Are The Opportunities?

- ◆ **GTL is “petrochemical” not “refining”**
- ◆ **Development drive on the conversion of syngas not the production of syngas – become more like ammonia or methanol in that respect**
- ◆ **Refinery-Petrochemical Integration can add value by “upgrading” molecules from fuels to commodity chemicals or specialities – i.e. in this case lubes, waxes, etc.,**
- ◆ **And there will always be logistic plays with cheap gas and high cost imports**

GTL is not a broad brush approach to gas monetisation but it will find tailored opportunities: it is a rapier – not a broadsword



Thank You



Roger Newenham

- ◆ A chemical engineer by training, Roger has 35 years' experience in the hydrocarbons and chemical industries. He has worked on a diverse range of strategy, feasibility study, M&A and techno-economic studies, many of them in the natural gas and gas-based chemicals areas. He has also worked extensively in the broader refining and petrochemicals areas. A particular interest has been the various options for gas monetisation and the dynamics of the factors influencing the choices made here: strategic; commercial; techno-economic; etc., against the volatile background of oil & product prices and escalating capital costs.
- ◆ As a consultant he has been involved with all aspects of the methanol and nitrogen fertilizer industries as well as performing many studies examining the pros and cons of GTL versus methanol to olefins versus methanol or ammonia. Whilst in industry Roger worked for BP, when it was researching gas to gasoline options and then more recently he worked for SABIC, one of the global leaders in both methanol and nitrogen fertilizers.
- ◆ Roger currently works for his own consultancy and is also a senior consultant at CEG Europe.

