Decarbonising today's methanol operations to meet tomorrow's demands

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Agenda

01 Drivers for methanol decarbonisation

02 **CLEANPACE™** Methanol

03 Decarbonising and debottlenecking

04 Key takeaways

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Drivers for methanol decarbonisation
- drivers are increasing with opportunities for industry leaders

Europe

- High CO_2 prices – forecast to exceed €100/te before 2030
- EU Innovation Fund: over €38bn to invest up to 2030
- Expansion of EU ETS to include maritime sector – demand for low carbon fuel

North America

- US – tax credits for carbon capture (45Q)
- Canada – ETS CO_2 price will be CAN$170/t in 2030
- US and Canada – government funding available for CCUS projects

MEA

- National strategies e.g.
  - Saudi Arabia and Bahrain net zero 2060
  - Oman and UAE net zero 2050
- EU Carbon Border Adjustment Mechanism (CBAM) - adds cost to exports to EU from 2026

Global

- ESG goals: desire to do the right thing and demonstrate corporate responsibility to stakeholders
- Price premium for low carbon products and market demand, e.g. maritime fuel

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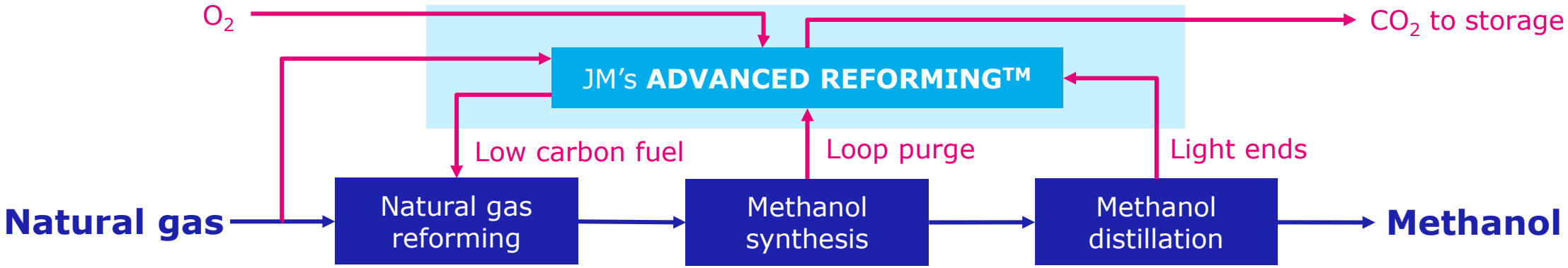
CLEANPACE Methanol
- a differentiated carbon capture solution for methanol plants

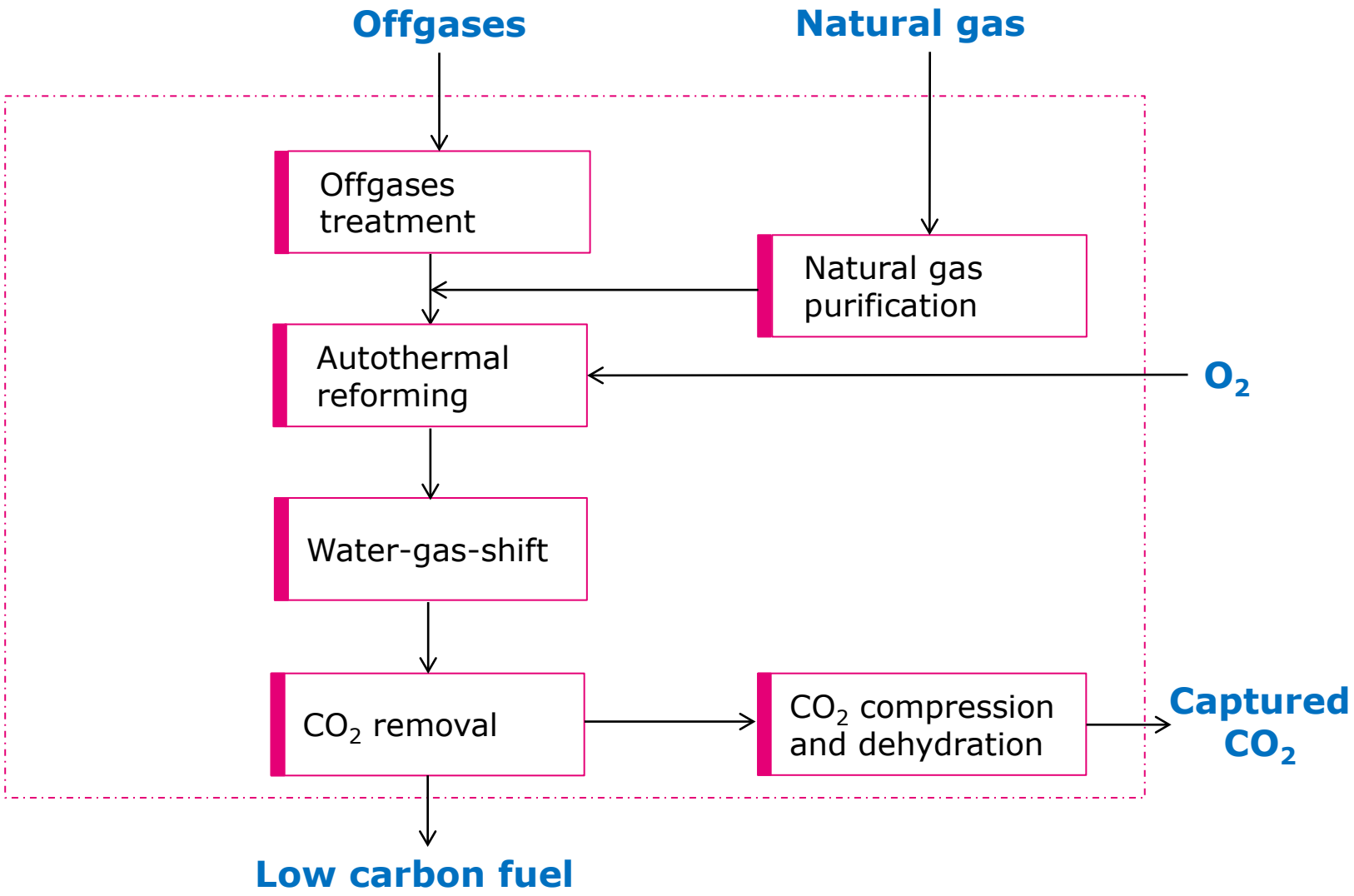


Key features of our solution:

A pre-combustion CO_2 capture solution, combining JM's **demonstrated ADVANCED REFORMING** experience with proven 3rd party CO_2 capture to **reduce cost** and technology **risk**

Optional:
- Steam export
- Syngas or H_2 export

JM's **ADVANCED REFORMING** unit



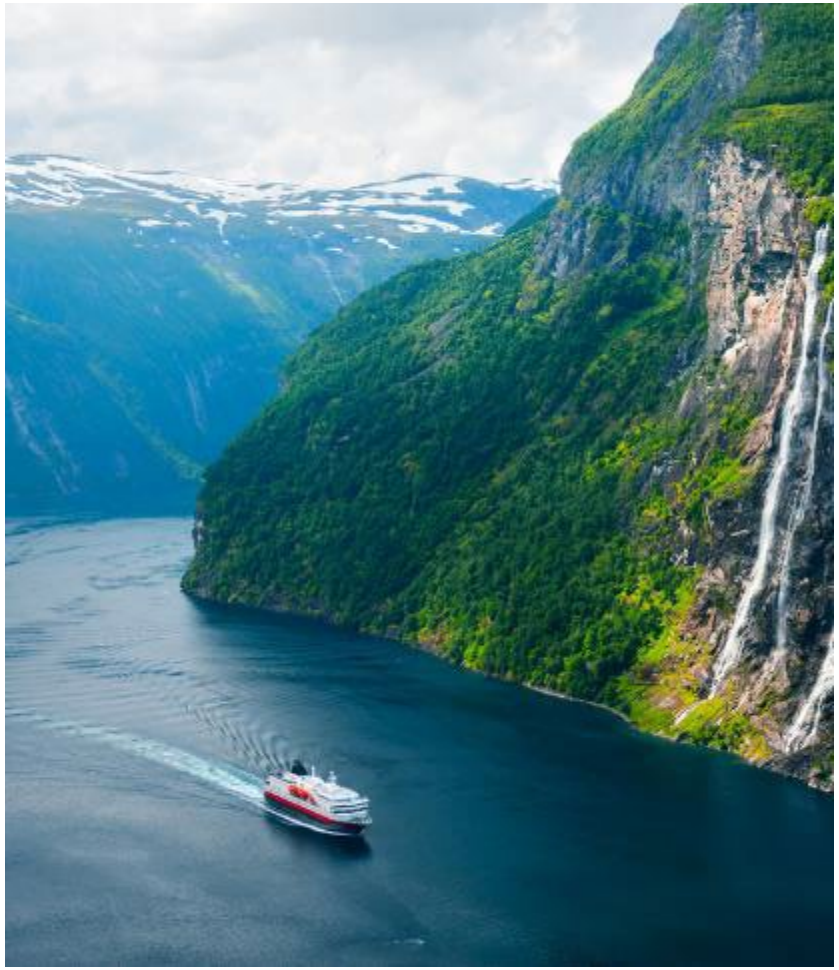
Concept

- Offgases and NG trim fuel converted to a high hydrogen content fuel and CO_2 captured
- The low carbon fuel is used for SMR firing (+ other FHRs)
- End of pipe solution
- Minimal changes to existing MeOH plant

Benefit of **CLEANPACE** Methanol is high performance at low CapEx - exceptional capture rate, for multiple plants, with low-risk

Lower CapEx and plot space requirement than post combustion capture

up to 95%
CO_2 emission reduction



Economy of scale
shared CapEx with a common unit serving multiple plants

Using only **well proven** technologies at scale

Flexible location
to ease implementation into an existing plant site

Can be combined with **capacity expansion** to support increased methanol demand

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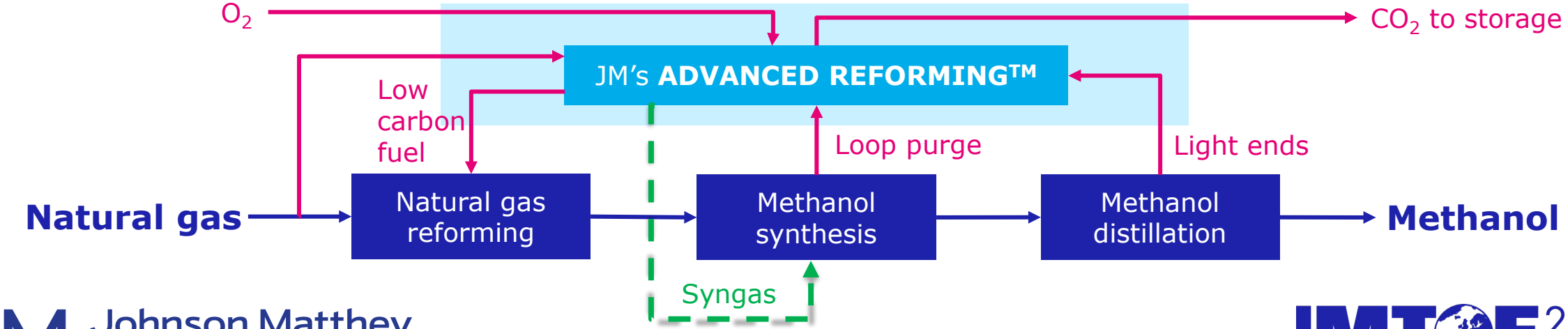
Decarbonising and debottlenecking - through **CLEANPACE** Methanol

- The SMR is often the restriction to capacity expansion
  - CO_2 co-feed could achieve up to ~20% expansion (using excess H_2 from SMR)
- Studies[1] show debottlenecking with extra syngas, could achieve 30% expansion
  - The extra syngas can be provided by the CLEANPACE unit
- ***Thus decarbonisation AND capacity expansion, can be achieved***



1. E.g. IMTOF 2019 - IMC's efficiency enhancement project exceeding the target

Case study
- using syngas from **CLEANPACE** unit to achieve 30% debottleneck

➢ TWO CASES ANALYSED

1) **CLEANPACE** only
2) **CLEANPACE** + 30% debottleneck

➢ For Case 2, the following modifications are assumed:

- Once through converter
- Parallel distillation

➢ BASIS

- 3000 MTPD (from natural gas)
- Middle East – no carbon tax
- Scope 1 = 0.8 teCO_2/teMeOH
- CLEANPACE CO_2 capture = 90%
- 50% export to EU => CBAM impact
- No premium for low carbon methanol
- Sales margin $200/teMeOH

Case study results

Basis: US $ / Natural gas 1.5 $/MMBTU / Power 0.05 $/kWh / CO_2 T&S $15/teCO2

	Case 1 Decarbonisation			Case 2 Decarbonisation + Debottleneck		
CO_2 tax – CBAM ($ /teCO_2)	**100**	**150**	**200**	**100**	**150**	**200**
CO_2 to storage (kte /year)	**720**			**720**		
Additional MeOH product (kte /year)	**0**			**300**		
Incremental OpEx - CLEANPACE ($m /year)	**-21**			**-27**		
CO_2 transport and storage cost ($m /year)	**-11**			**-11**		
Avoided CO_2 tax - CBAM ($m /year)	**36**	**54**	**72**	**36**	**54**	**72**
Incremental product margin ($m /year)	**0**			**60**		
Net annual cash flow ($m /year)	**4**	**22**	**40**	**58**	**76**	**94**
CapEx – ISBL + OSBL ($m)	**220**			**350**		
NPV (13 year @ 9% discount rate) ($m)	**-179**	**-82**	**15**	**-8**	**89**	**186**

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Key take aways
- for your decarbonisation journey

CLEANPACE Methanol is a new solution to decarbonise existing methanol plants, based on well proven technologies

Business case for decarbonisation improves with time, as emitting CO_2 becomes more expensive

There can be a positive business case ***today***, when decarbonisation is combined with capacity expansion

Thank you

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