



Johnson Matthey
Inspiring science, enhancing life

HSBC hydrogen week

The future with Fuel Cells and Hydrogen

25th February 2021

Maurits van Tol, Chief Technology Officer, Johnson Matthey

Cautionary statement

This presentation contains forward looking statements that are subject to risk factors associated with, amongst other things, the economic and business circumstances occurring from time to time in the countries and sectors in which Johnson Matthey operates. It is believed that the expectations reflected in these statements are reasonable but they may be affected by a wide range of variables which could cause actual results to differ materially from those currently anticipated and you should therefore not place reliance on any forward-looking statements made. Johnson Matthey will not update forward-looking statements contained in this document or any other forward-looking statement it may make.

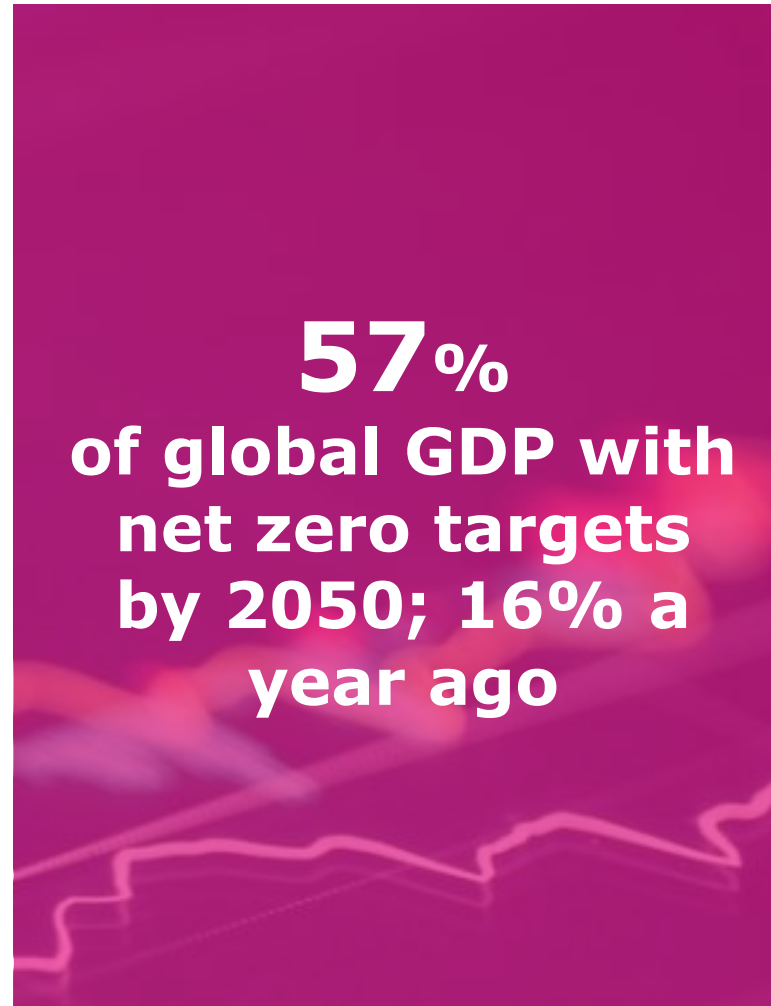
The information in this presentation should not be reproduced without prior agreement of Johnson Matthey.

**A world that's
cleaner and
healthier;

today and
for future
generations**



The move to net zero is accelerating: “building back greener”



Let's look at some of JM's technologies for the hydrogen transition



Blue
hydrogen production

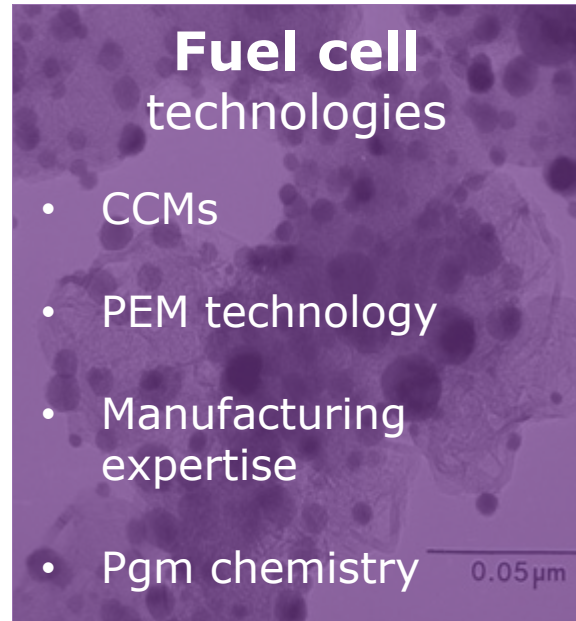
ICHEME Global Awards 2020
Winner
Johnson Matthey, UK
Low Carbon Hydrogen –
Clean Energy Transition

- Leading technology
- Commercialisation
- Building on our expertise



Green
hydrogen production

- CCMs
- PEM technology
- Electrochemistry



Fuel cell
technologies

- CCMs
- PEM technology
- Manufacturing expertise
- Pgm chemistry 0.05 μm



Chemical
building blocks

- Existing technology
- Syngas conversion, Fischer Tropsch
- Jet fuel, ammonia, methanol, formaldehyde

Hydrogen production technologies

Use of hydrogen

JM continues to support an integrated hydrogen economy...

-from hydrogen to base chemical building blocks to specialty chemicals and fuels

Research



- R&D investment
- Sample and small series production
- Partnering for pilot scale demonstration

Commercialisation



- Accelerated growth
- Blue Hydrogen, commercial launch
- Appointment of MD in green hydrogen
- JM Hydrogen Council

Strategy



- Hydrogen and fuel cells sales already c.£100 million
- Fit with portfolio of small chemical building blocks
- JM is a Global Hydrogen Council Board member and on UK Govt Hydrogen Advisory Council

...and our stakeholders are recognising it

JM receives
London Stock Exchange's Green
Economy Mark

16th July 2020

JM recognised as a constituent of the
FTSE4Good Index Series

13th August 2020

JM's leading Low Carbon Hydrogen
technology scoops IChemE award

11th November 2020

JM recognised by
Dow Jones
Sustainability Index

24th November 2020

JM recognised as #1 B2B brightest
brand

3rd February 2021

JM joins UK All-Party Parliamentary
Group on Hydrogen

15th February

Market is accelerating and we are delivering for our customers

JM and SFC Energy
AG sign multi-million
pound deal and
joint development
agreement for
supply of fuel cell
components

11th January 2021

HyNet North West

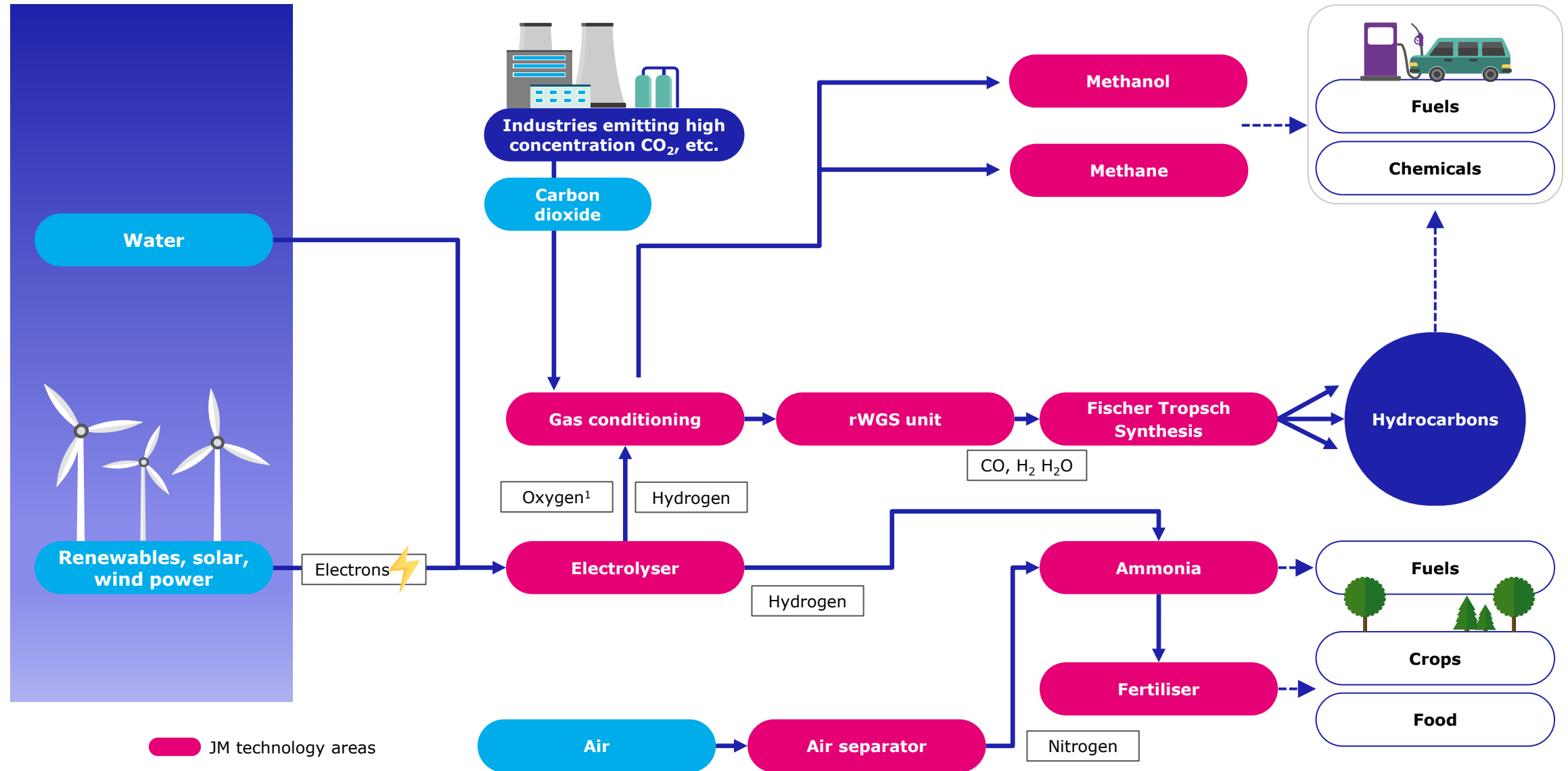
HyNet:
A step closer to the
UK's first hydrogen
hub which will use
JM's low carbon
hydrogen technology

15th January 2021

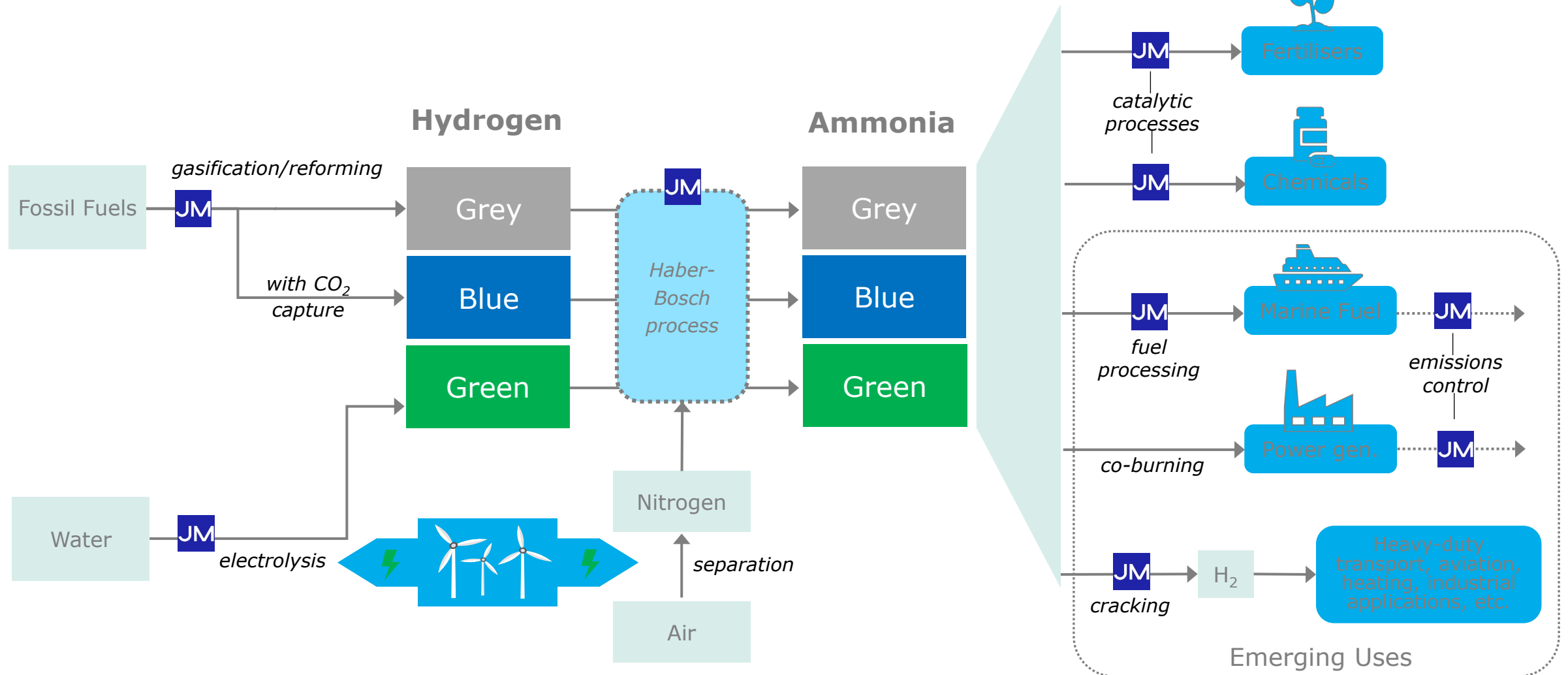
JM announces
manufacturing
capacity for products
enabling 10s of MWs
of green hydrogen;
ability to scale up to
multi-GW

20th January 2021

Turning green hydrogen into chemical building blocks: a vision



Grey, blue and green ammonia: existing and new uses emerging from global decarbonisation





Johnson Matthey
Inspiring science, enhancing life

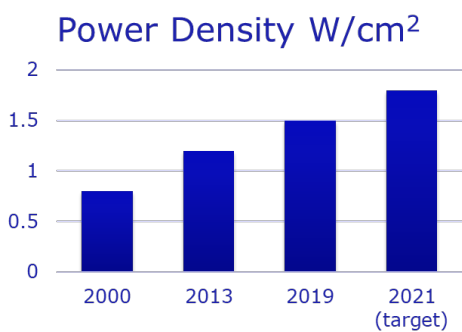
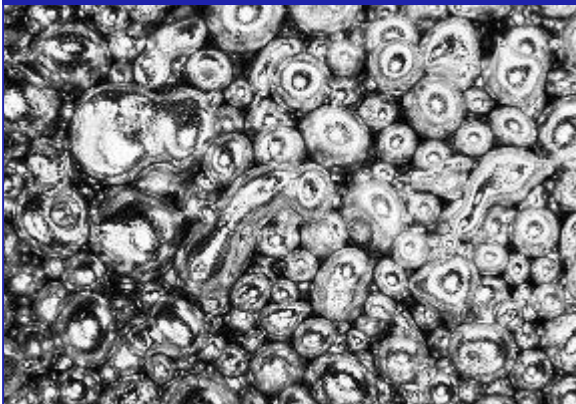


Q&A



Johnson Matthey
Inspiring science, enhancing life

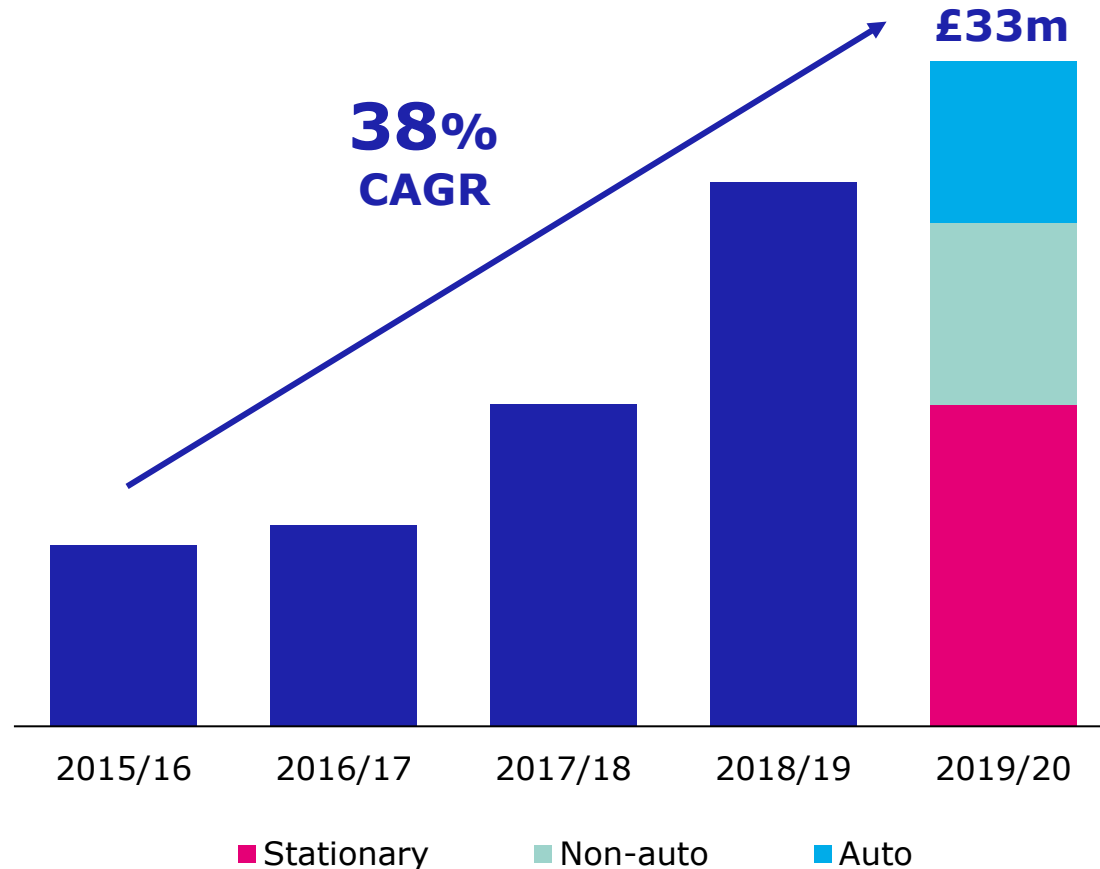
Appendix

Fuel Cells: JM has a strong competitive advantage...

Science	Pgm expertise	Trusted partner	Established manufacturing										
 <table><caption>Power Density W/cm²</caption><tr><th>Year</th><th>Power Density W/cm²</th></tr><tr><td>2000</td><td>0.8</td></tr><tr><td>2013</td><td>1.2</td></tr><tr><td>2019</td><td>1.5</td></tr><tr><td>2021 (target)</td><td>1.8</td></tr></table>	Year	Power Density W/cm²	2000	0.8	2013	1.2	2019	1.5	2021 (target)	1.8			
Year	Power Density W/cm²												
2000	0.8												
2013	1.2												
2019	1.5												
2021 (target)	1.8												
Catalyst and membrane expertise	Potential closed loop offering	Stationary, auto and non-auto markets	Well along experience curve										
Optimisation for high performance	Lower carbon intensity	Existing customers	Doubling capacity 2020/2021										
	Ability to reduce cost	Over 20 years' experience	Further expansion										

...JM has an established, profitable and growing business

Fuel cell sales (£m)



Note: Sales excluding precious metals.

1. Based on LMC, KGP and JM assumptions which equate to i) c.0.4 million trucks.

2. Source: McKinsey cost estimations and OEM targets.

3. Based on LMC, KGP and JM assumptions which equate to i) c.3 million trucks and ii) c.14.5 million autos, of which c.60% is assumed to be non-captive in 2040. Estimated CCM value per auto vehicle is c.£800.

Customers include major global truck and auto OEMs

Estimated addressable truck market of
c.£1bn p.a. in 2030^{1,2}
>£10bn p.a. in 2040^{2,3}

JM has a strong presence across hydrogen production technologies

JM's technologies

Grey

Natural gas

Leading catalyst supplier
40% segment share¹

Steam methane reforming
No CCS

High GHG emissions
(11 tCO₂/tH₂)

\$1 – \$2.1 per kg H₂

Blue

Natural gas

Differentiated technology
and catalyst supplier

Advanced gas reforming
CCS

Low GHG emissions
(0.2 tCO₂/tH₂)

\$1.5 – \$2.9 per kg H₂

Green

Renewable electricity

Expect to supply catalyst
coated membrane

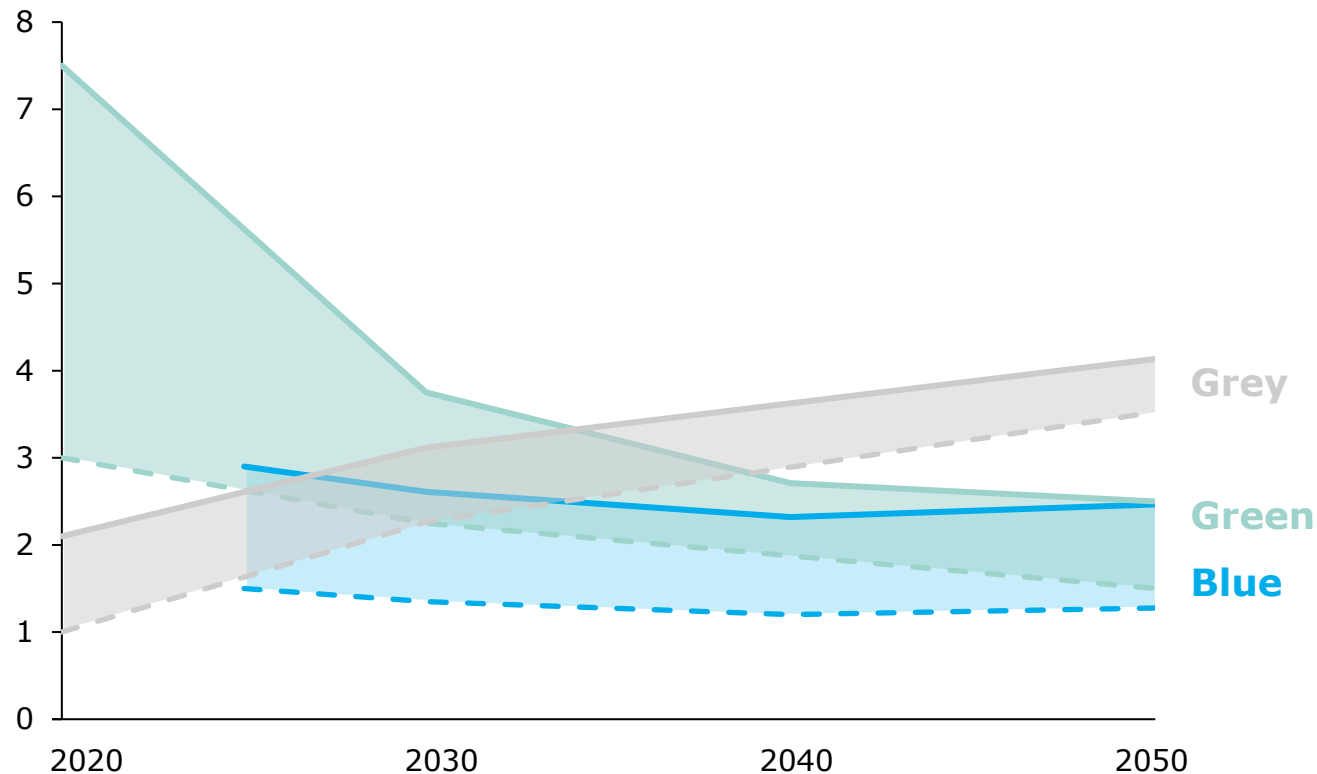
Electrolysis

Potential for zero GHG
emissions

\$3 – \$7.5 per kg H₂

Green hydrogen becomes more competitive over the medium term

Estimated hydrogen cost (\$ per kg H₂)

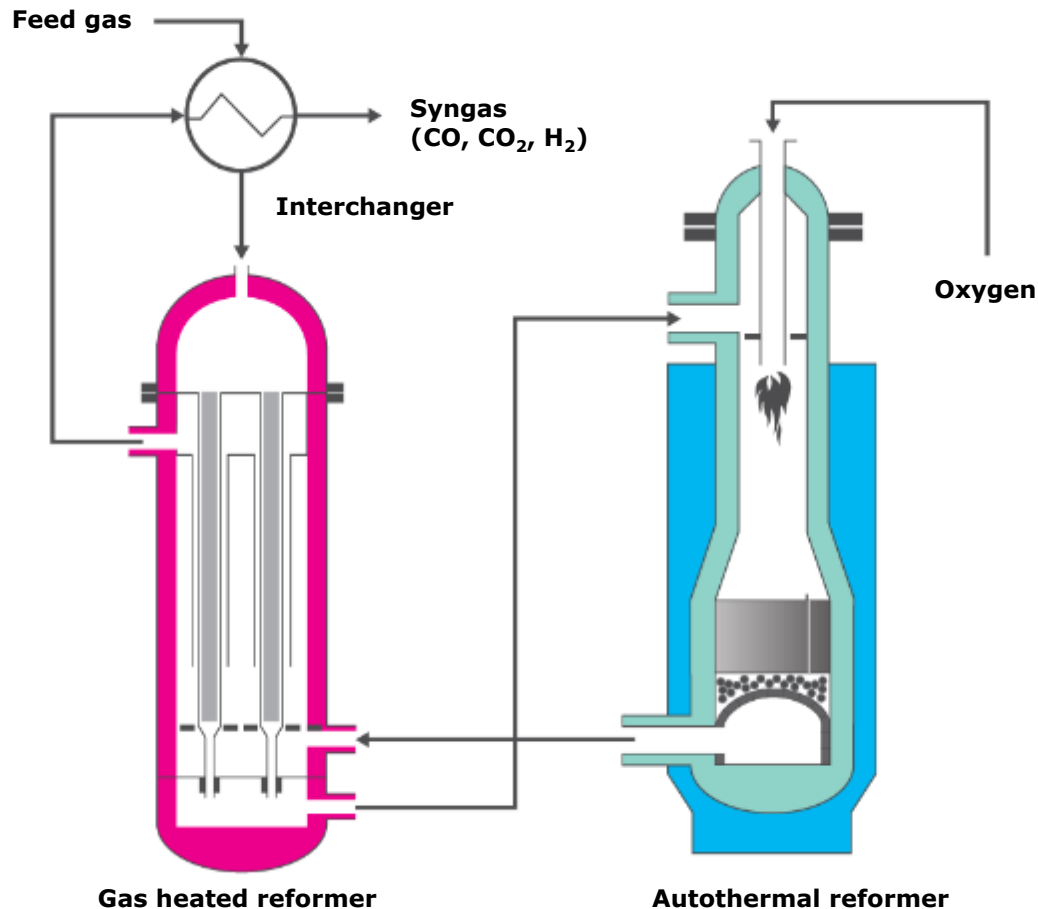


Blue hydrogen advantaged in certain regions and likely to be a long term solution in places with the right geology and infrastructure e.g. US and UK

Green hydrogen will be a solution in some regions as both renewable energy and capital costs decline

JM's award winning blue hydrogen technology builds on our expertise in grey hydrogen and methanol

Johnson Matthey's blue hydrogen technology



Methane (CH₄) from natural gas is reacted with steam to produce **hydrogen** (H₂) and **carbon dioxide** (CO₂)

Most efficient process – 9% less natural gas usage¹

Lowest capex – 40% lower capital cost¹

98% of produced CO₂ captured: single stream at high pressure and purity enabling easier transport or storage

World's most progressed low carbon hydrogen projects have JM's LCH™ technology at their heart

HyNet Phase 1 North West England

Trialling decarbonised hydrogen
as a fuel and feedstock

Phase 1: 80kt of hydrogen p.a.
Equivalent to world scale hydrogen plant

Used in industry, homes
and transport

Acorn Phase 1 North East Scotland

North Sea natural gas reformed
into clean hydrogen and CCS

Phase 1: 55kt of hydrogen p.a.

Used in transport and the gas grid
to decarbonise heating

Engaged with a
growing global
pipeline of
over 15 projects

Estimated
addressable market
of c.£1.5bn to c.£2bn
p.a. in 2030^{1,2}

JM is a trusted partner in the rapid scale up of green hydrogen

Comparable technology to fuel cells

- CCM is heart of system and key for performance and cost reduction
- Competitive advantage in pgm catalysis and thrifting
- Ability to scale quickly

Potential closed loop offering

- End of life options designed in from R&D stage
- Pgm recycling expertise

Experience in enabling new technologies

- Fuel cells
- Fischer Tropsch
- Technology for waste to aviation fuel

90GW of
electrolyser
capacity by 2030

Hydrogen Council
(February 2021)

Testing
with leading
electrolyser
players



Johnson Matthey
Inspiring science, enhancing life

www.matthey.com/investors
