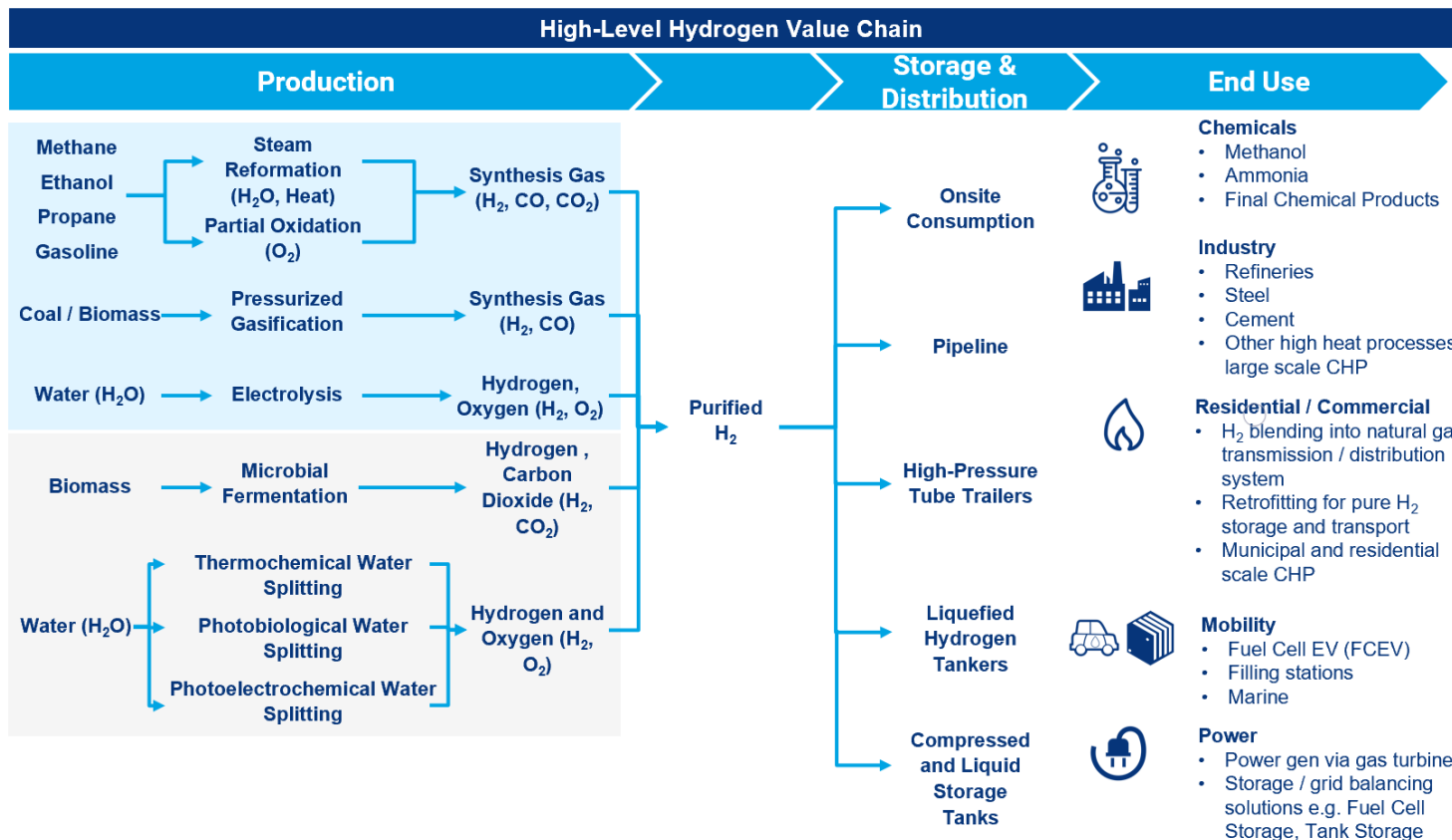# Hydrogen Forecast

23 June 2021

1   Forecast & Costs

Why is hydrogen capturing the zeitgeist?

Because it holds the promise to decarbonize so many "hard to abate" sectors

High-Level Hydrogen Value Chain

Production → **Storage & Distribution** → **End Use**

Production

Methane, Ethanol, Propane, Gasoline → Steam Reformation (H_2O, Heat), Partial Oxidation (O_2) → Synthesis Gas (H_2, CO, CO_2)

Coal / Biomass → Pressurized Gasification → Synthesis Gas (H_2, CO)

Water (H_2O) → Electrolysis → Hydrogen, Oxygen (H_2, O_2)

Biomass → Microbial Fermentation → Hydrogen, Carbon Dioxide (H_2, CO_2)

Water (H_2O) → Thermochemical Water Splitting, Photobiological Water Splitting, Photoelectrochemical Water Splitting → Hydrogen and Oxygen (H_2, O_2)

→ Purified H_2

Storage & Distribution

- Onsite Consumption
- Pipeline
- High-Pressure Tube Trailers
- Liquefied Hydrogen Tankers
- Compressed and Liquid Storage Tanks

End Use

Chemicals
- Methanol
- Ammonia
- Final Chemical Products

Industry
- Refineries
- Steel
- Cement
- Other high heat processes / large scale CHP

Residential / Commercial
- H_2 blending into natural gas transmission / distribution system
- Retrofitting for pure H_2 storage and transport
- Municipal and residential scale CHP

Mobility
- Fuel Cell EV (FCEV)
- Filling stations
- Marine

Power
- Power gen via gas turbine
- Storage / grid balancing solutions e.g. Fuel Cell Storage, Tank Storage

Source: Wood Mackenzie

Near term deployments are and will be driven by existing hydrogen markets

In order to use hydrogen as a vehicle for decarbonization, it first must be decarbonized. Outside of these markets and end use sectors, there is little to no certainty of near or medium term H2 adoption.

Countries with a _carbon regime_ that produce more than 0.5 MTPA of hydrogen

Countries with a _net zero target_ that produce more than 0.5 MTPA of hydrogen

2020 Global hydrogen production by source
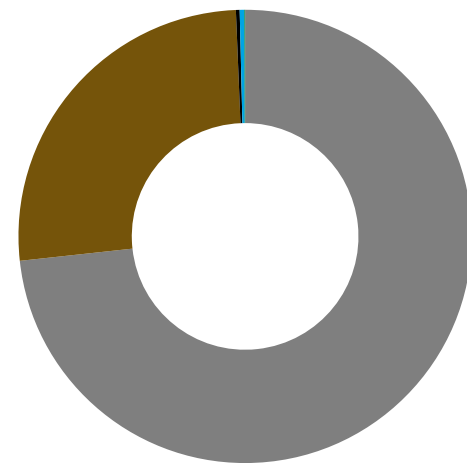
■ Grey ■ Brown ■ Black
■ Blue ■ Green

Source: Wood Mackenzie

If it feels like the hydrogen market has exploded recently, you are correct

Announcements since Q4 2019 constitute 87% of all projects with known announcement dates

Low-carbon hydrogen project announcements by quarter, Q1 2017 – Q1 2021 (mmtpa)

Quarterly Announcements ■   Cumulative Announcements ●
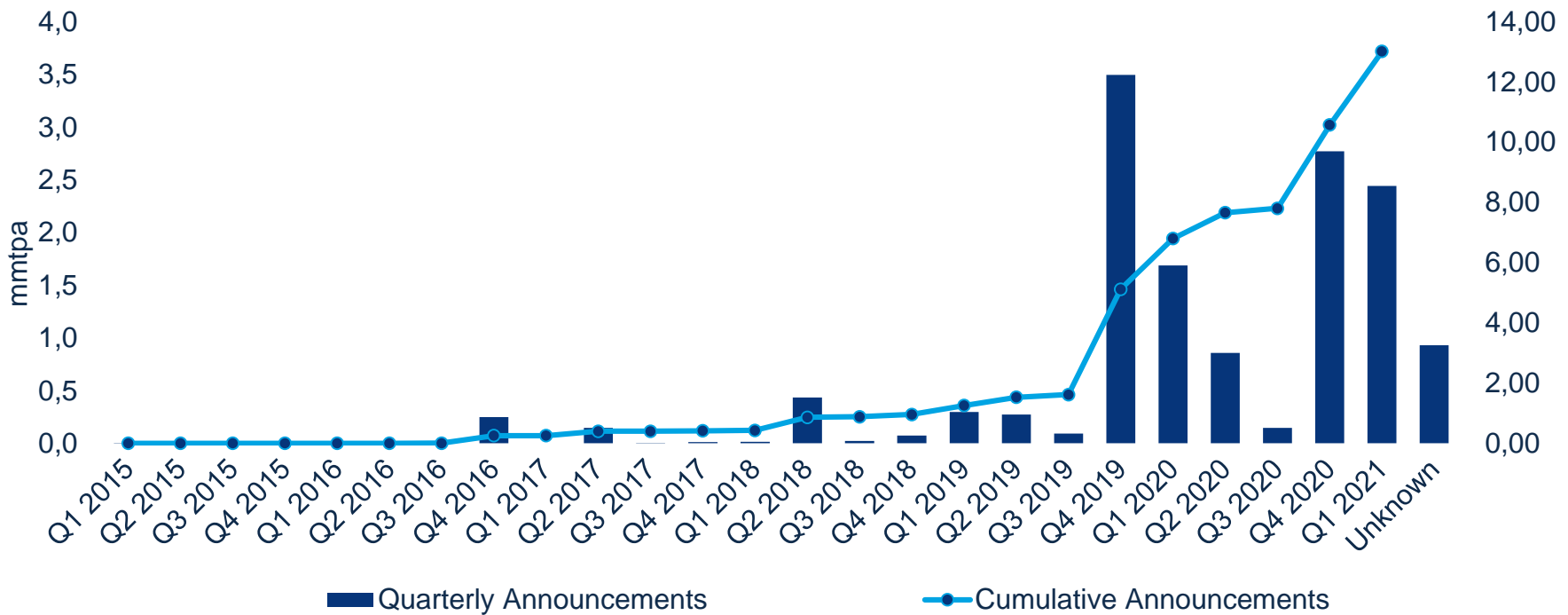
Where will low-carbon hydrogen be used? Existing hydrogen demand with low transport requirements move first, more exotic use cases arrive later

Global hydrogen demand by existing end use, 2030 – 2050

Global hydrogen demand by existing end use, 2030 – 2050

Source: Wood Mackenzie
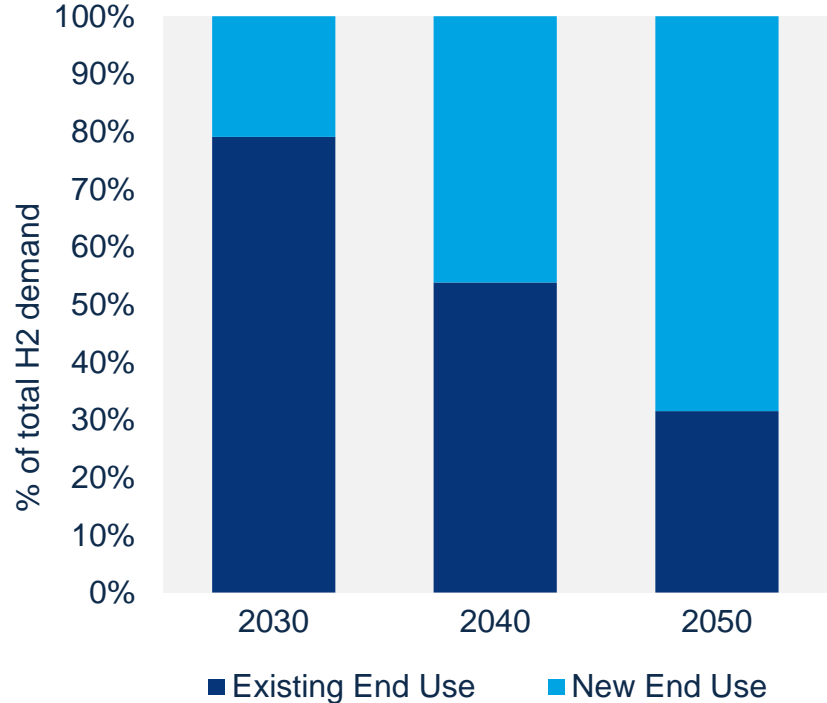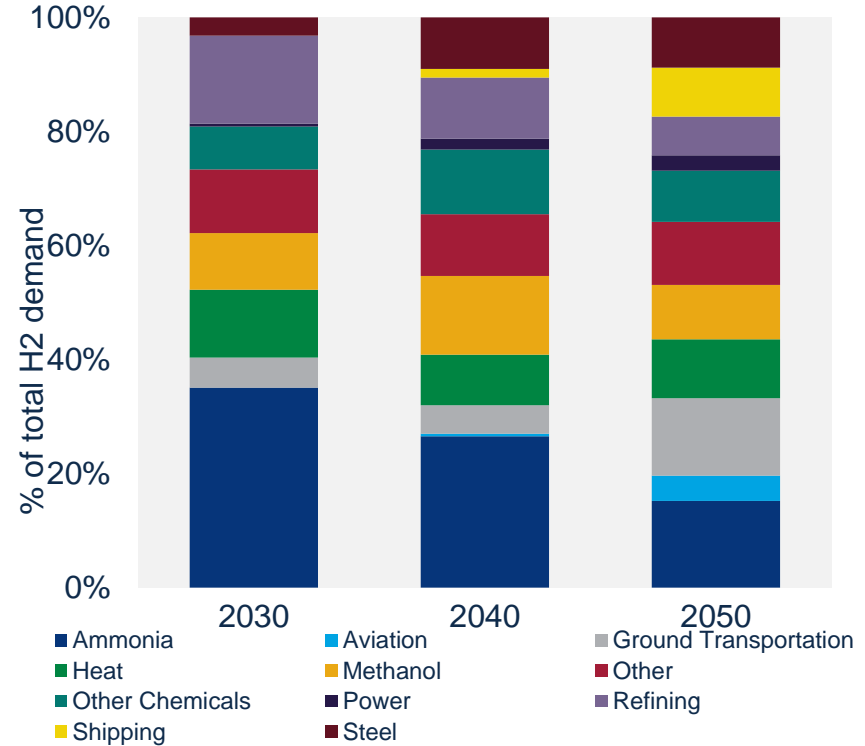
# How large can the market be? Over 200 mmtpa of low carbon hydrogen by 2050

2040 will be the last year where grey hydrogen holds the largest market share among other types

Global hydrogen production by colour 2020-50

We forecast 2040 will be the last year where grey hydrogen holds the largest market share among other types

Legend: Brown, Grey, Green, Blue, Other
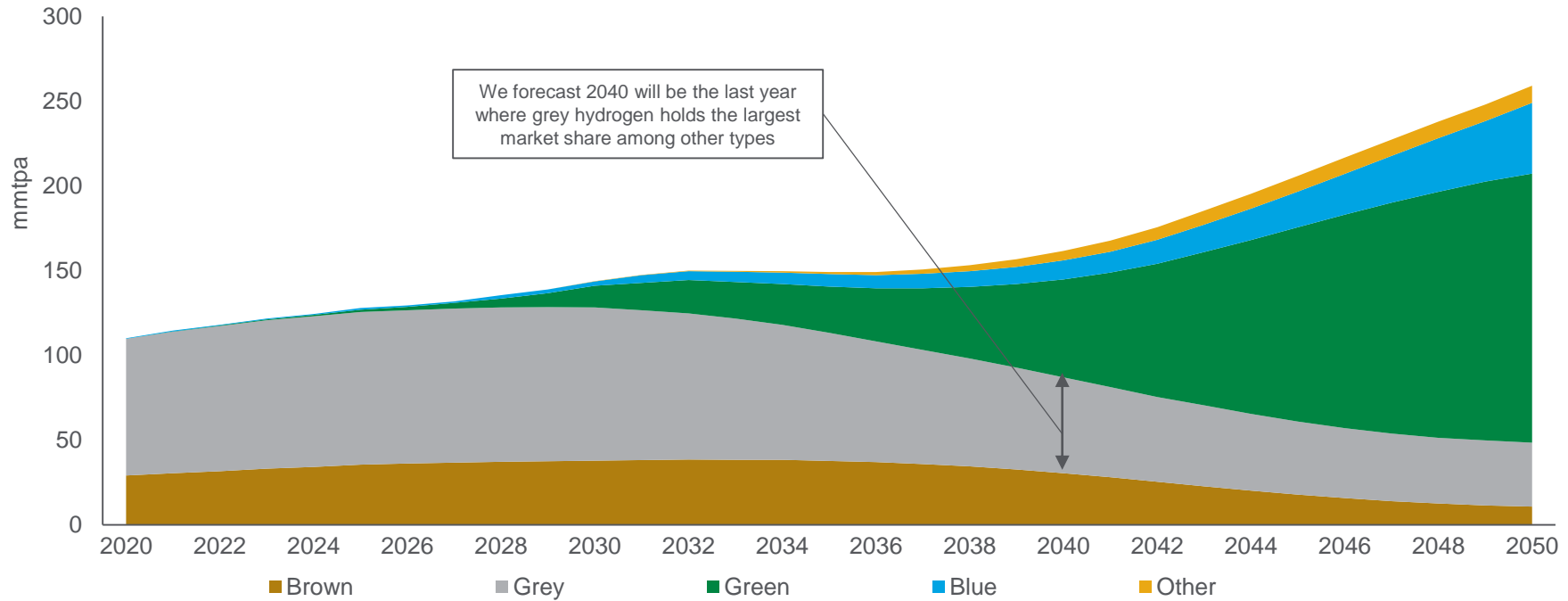
While green hydrogen will lead the way globally, the supply mix will vary by market

Global low-carbon hydrogen production by type and country/region, 2050
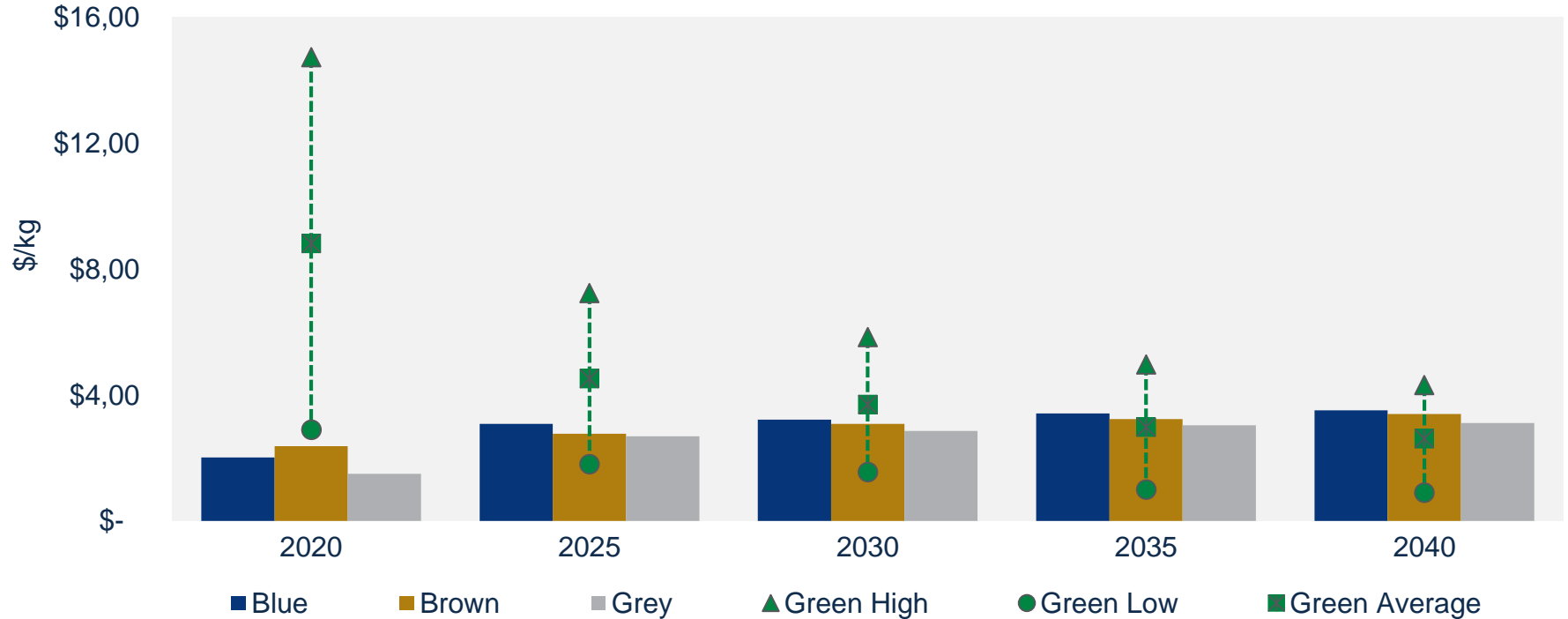

Legend: Blue, Green, Other
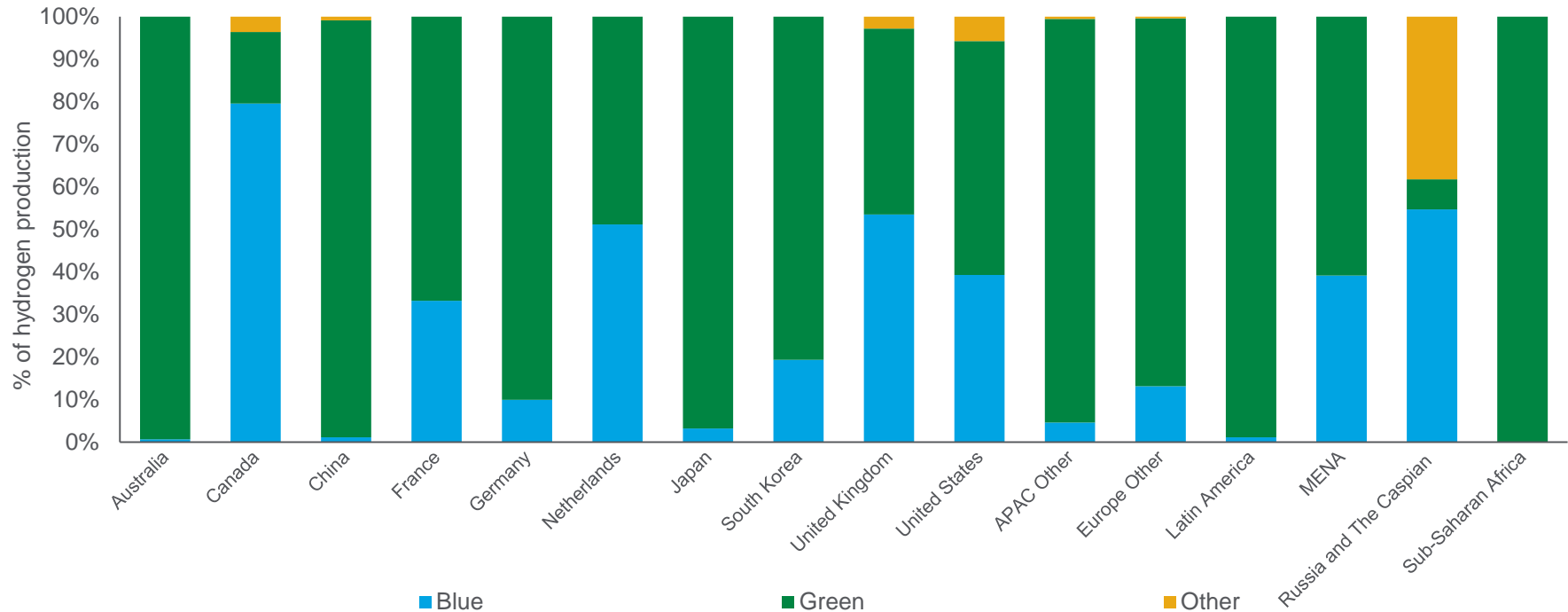
Germany: Green H2 cost will begin to outcompete other colours by 2025

By 2035 green H2 almost universally outcompetes fossil fuel based H2

LCOH of blue, brown, green and grey hydrogen production in Germany, 2020 – 2040

3   Conclusions

Risks to the hydrogen forecast remain, with cost and infrastructure the main potential bottlenecks to overcome

Powerfuel Hubs can help overcome some of these risks

SUPPLY

Cost competitiveness of green hydrogen

DEMAND

Demand pull to kickstart green hydrogen development

TRANSPORTATION

Transportation and storage is difficult

COMPETITION

Hydrogen will naturally compete with batteries and electrification