

Hydrogen Study: International H₂ Strategies

A study commissioned by and in cooperation with the
World Energy Council – Germany

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Ludwig-Bölkow-Systemtechnik GmbH (LBST)

World Energy Council – Germany (WEC)





World Energy Council

- Largest international energy organization since 1923
- About 90 country committees
- Independent, no lobbying organisation
- Includes private and public sector, science and NGOs
- Includes all energy sources
- Represents over 90 % of the world's energy production
- Develops important analysis and tools for leaders in the energy sphere
- Unique platform for exchange



Mission since 1923: „To promote the sustainable supply and use of energy for the greatest benefit of all people.“

Study objective: analyse and learn from H₂ strategies

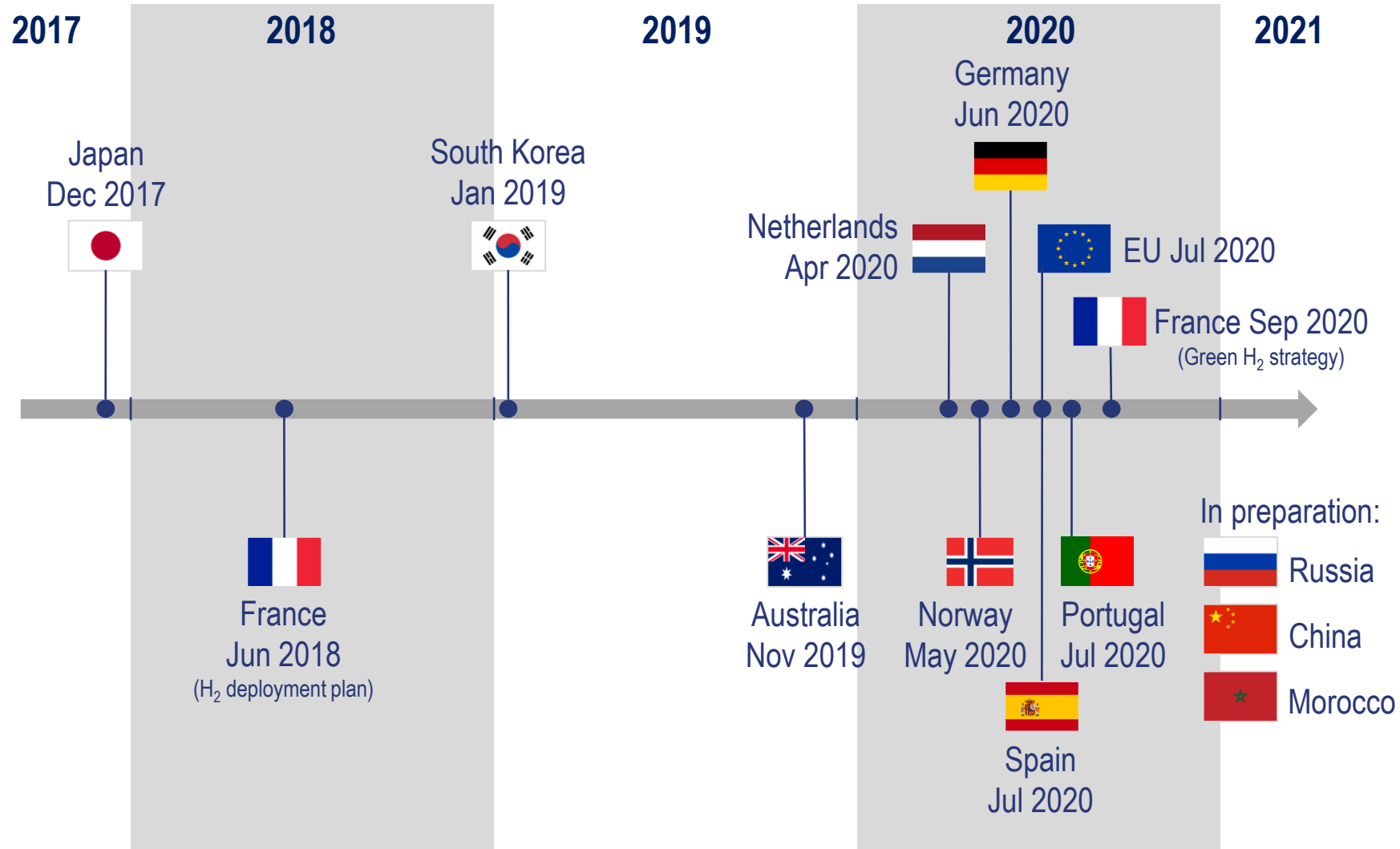
What is the national governmental support for H₂ technologies and applications?

How can current experience benefit discussions of the European and German strategy?



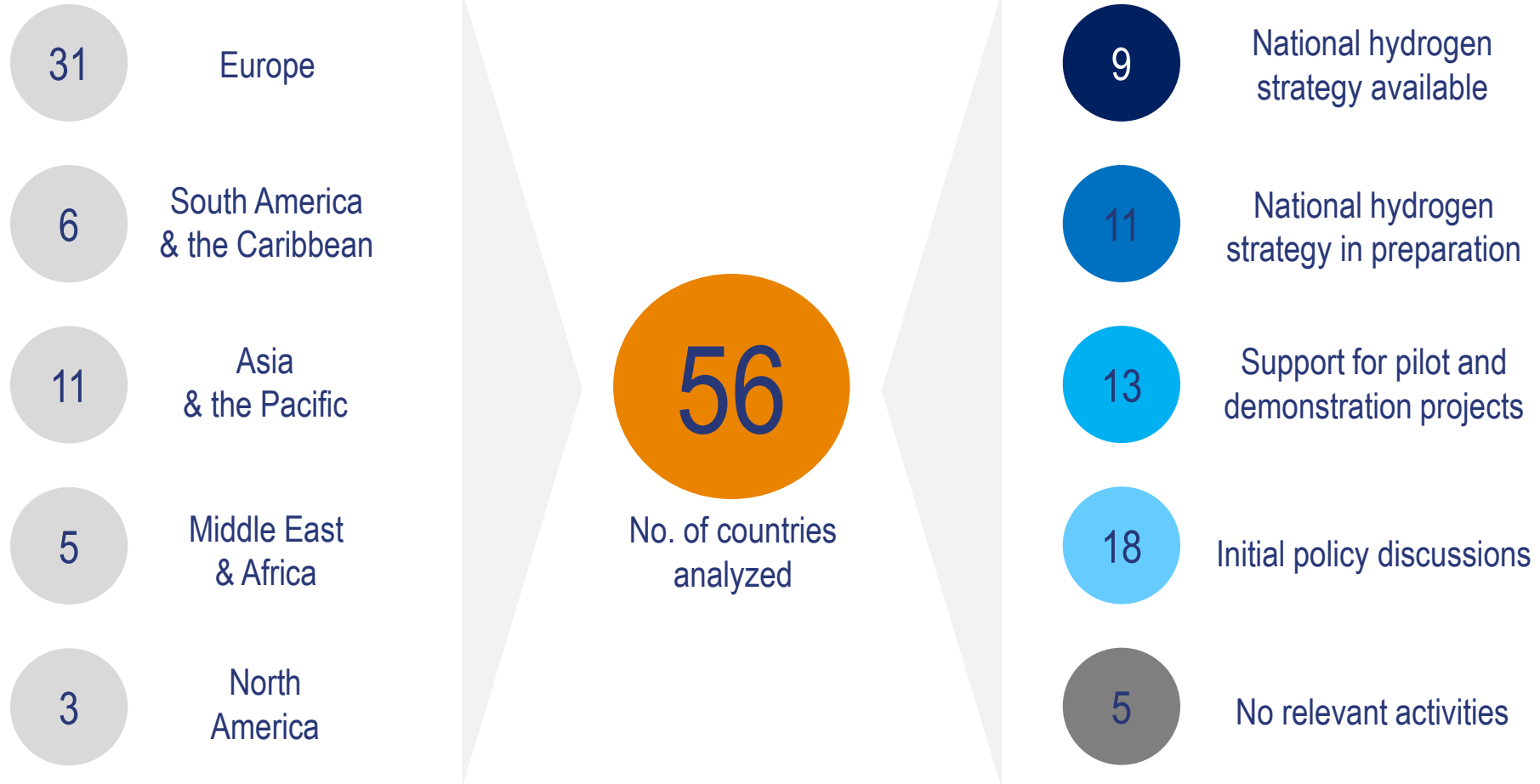


“Hot” strategic hydrogen summer 2020





Overview H₂-strategies and activities (Status: August 2020)



August 2020, World Energy Council, LBST

Overview H₂ strategies and activities (Status: August 2020)

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**National H₂ strategies in place or in preparation
in at least 20 countries**

By 2025 H₂ strategies are expected to cover > 80% of global GDP

National hydrogen strategy available

National hydrogen strategy in preparation

Support for pilot and demonstration projects

Initial policy discussions

No relevant activities

Not assessed



Main goals of current H₂ strategies per country

Strategic goals	EU	DE	NL	FR	ES	IT	UK	NO	CH	UA	RU	JP	KR	CN	AU	CA	MO
Reduce emissions	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	(✓)	(✓)	✓	(✓)	✓	(✓)	✓	✓
Diversify energy supply	✓	✓	✗	(✓)	✓	(✓)	✗	(✓)	✗	✓	(✓)	✓	(✓)	✓	(✓)	(✓)	✗
Foster economic growth	✓	✓	✓	✓	(✓)	✗	(✓)	✓	(✓)	(✓)	(✓)	✓	✓	✓	✓	✓	✓
Support national technology develop.	✓	✓	✓	✓	(✓)	✗	✓	✓	(✓)	(✓)	✓	✓	✓	✓	✓	✓	✓
Integration of renewables	✓	✓	✓	✓	✓	(✓)	✓	(✓)	(✓)	✓	✓	✓	(✓)	✓	(✓)	✓	✓
Develop hydrogen for export	✗	✗	✗ ¹⁾	✗	✓	✗	✗	✗ ²⁾	✗	✓	✓	✗	✗	✗	✓	✗	✓

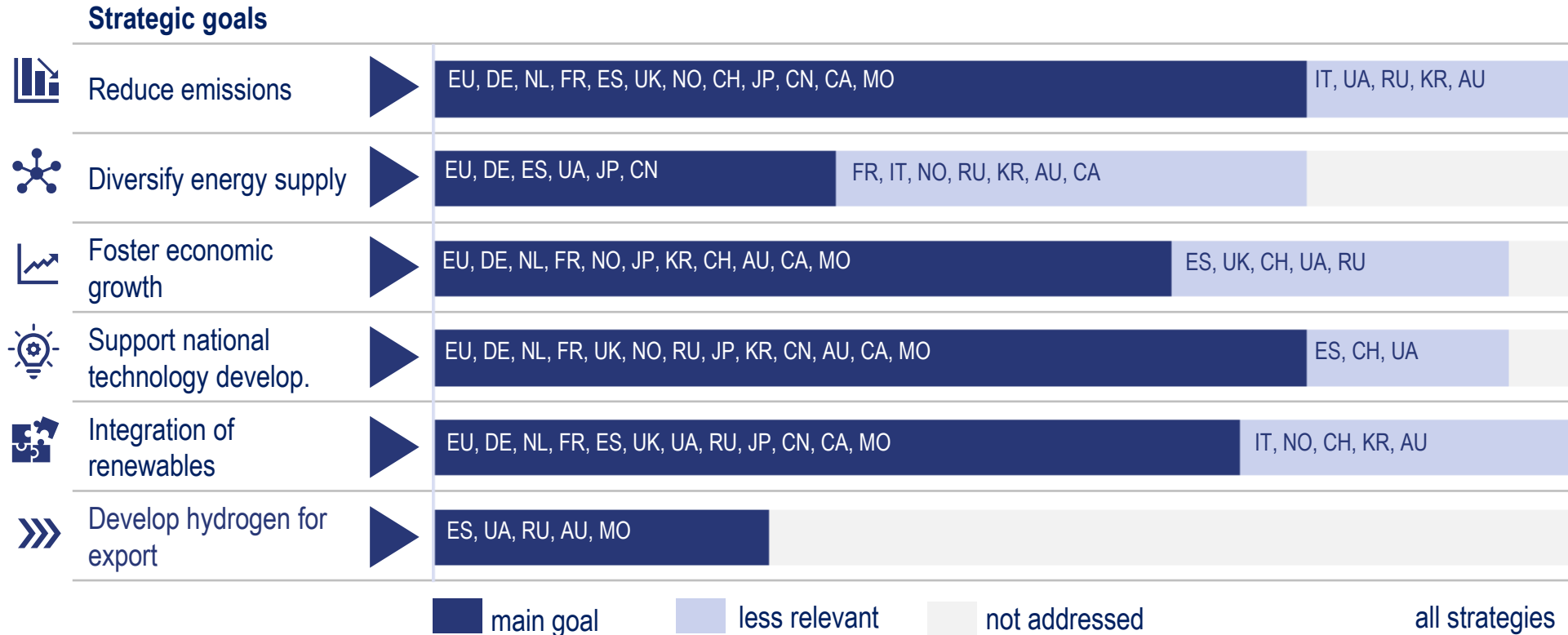
✓ main goal (✓) less relevant ✗ not addressed

1) Hydrogen imports transit to other counties (e.g. Germany) considered.

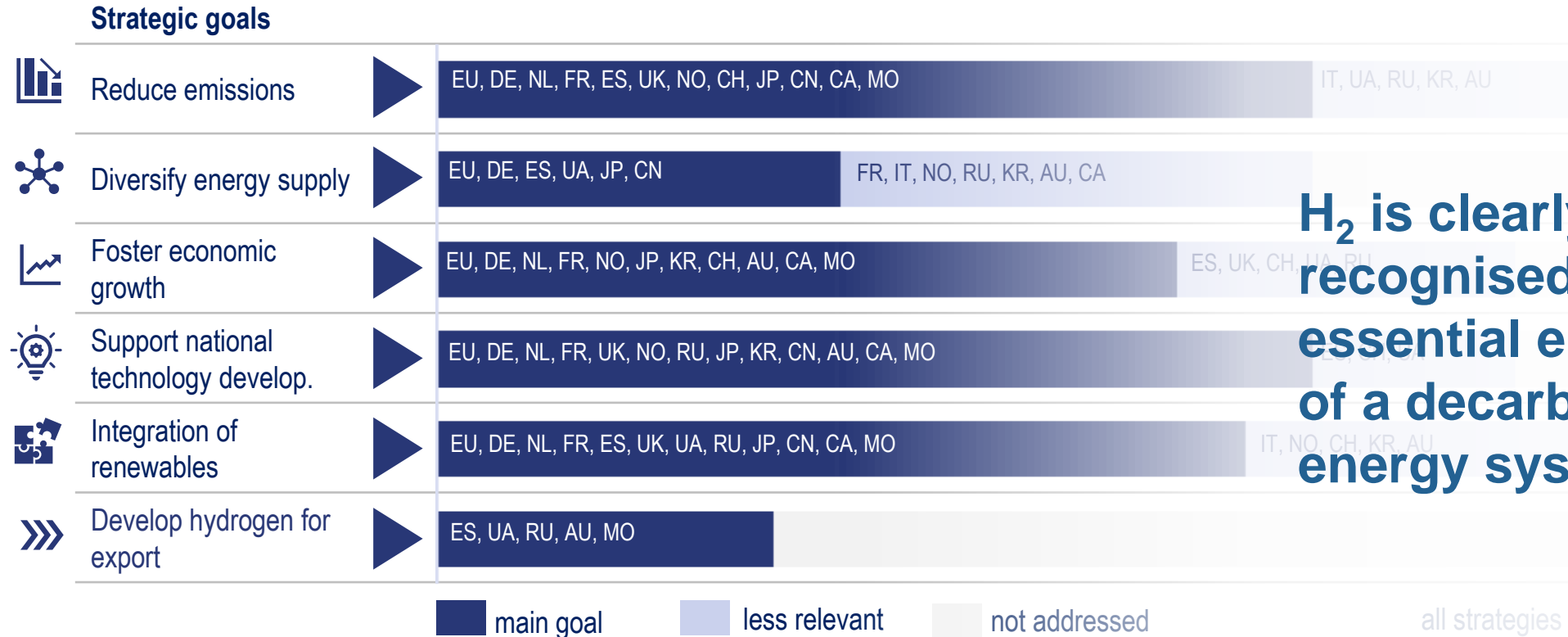
2) For Norway, hydrogen is not targeted for direct export, but indirectly through the export of NG with local CCS.



Main goals of current H₂ strategies per country



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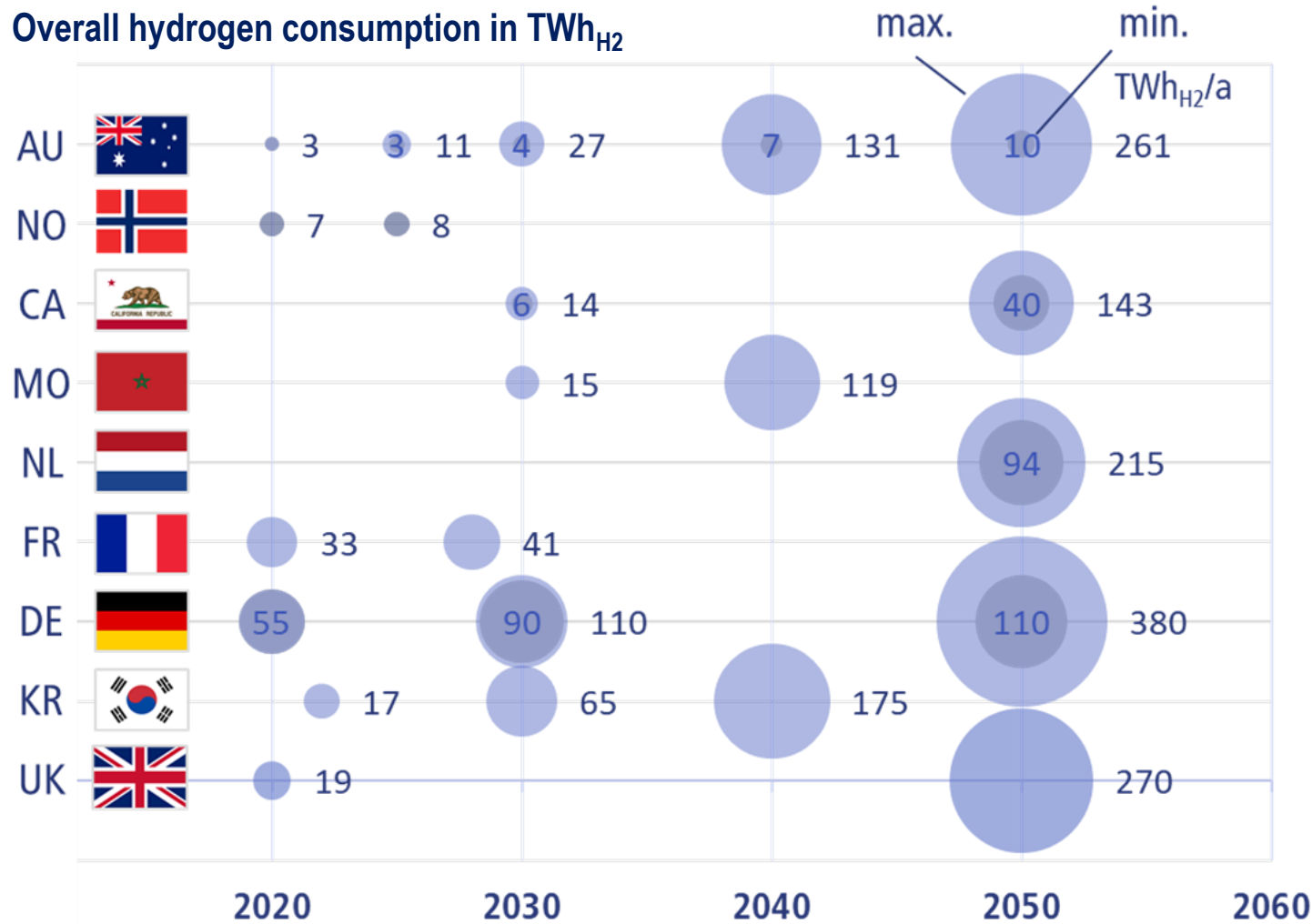


H₂ is clearly recognised as an essential element of a decarbonised energy system



Expected hydrogen consumption

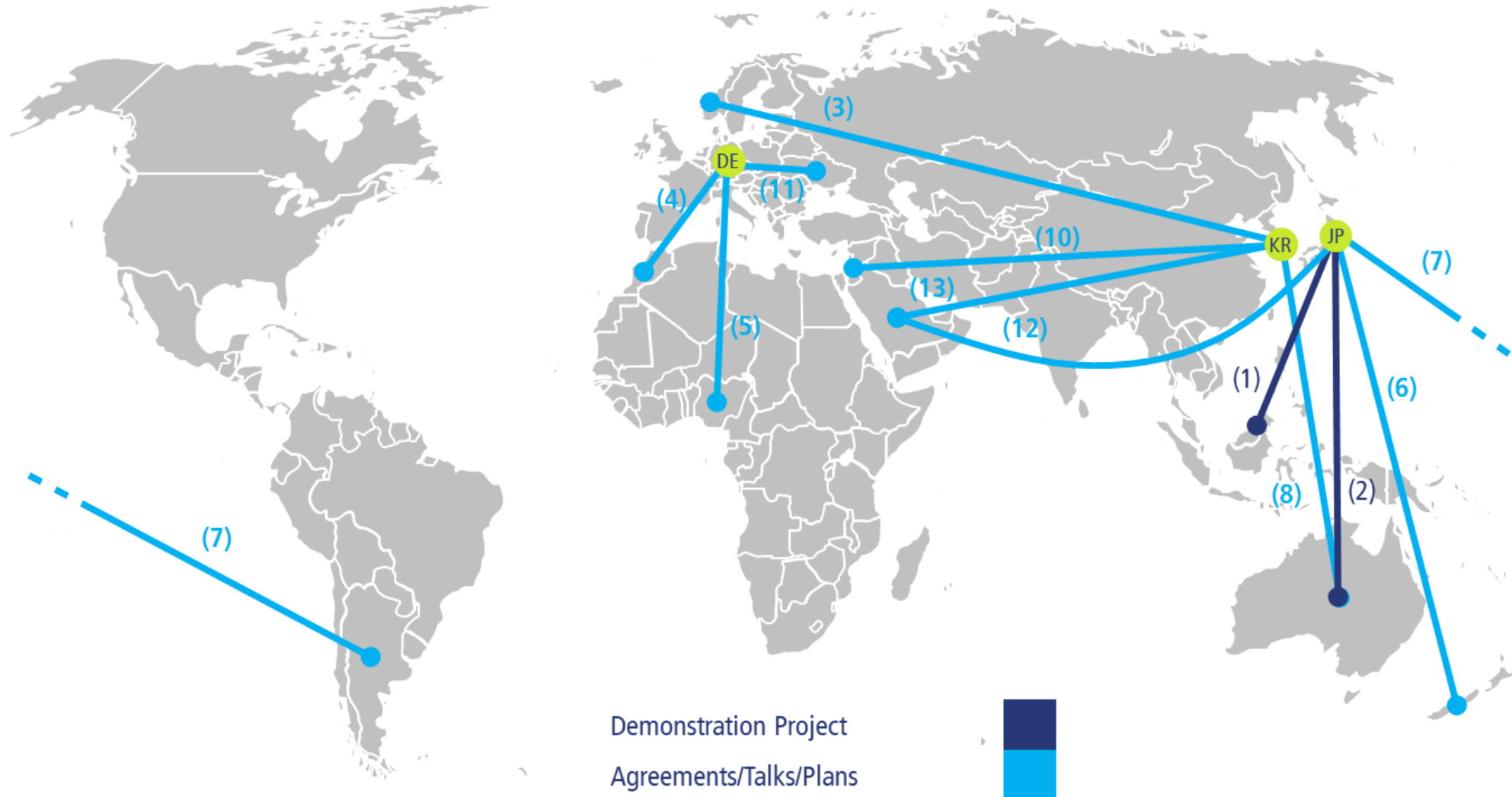
Overall hydrogen consumption in TWh_{H2}



Scaling upper H₂ demand expected for 2050 in national strategies to global level indicates a potential of up to 9000 TWh
 (an amount almost as large as half the primary energy consumption of the EU-28)

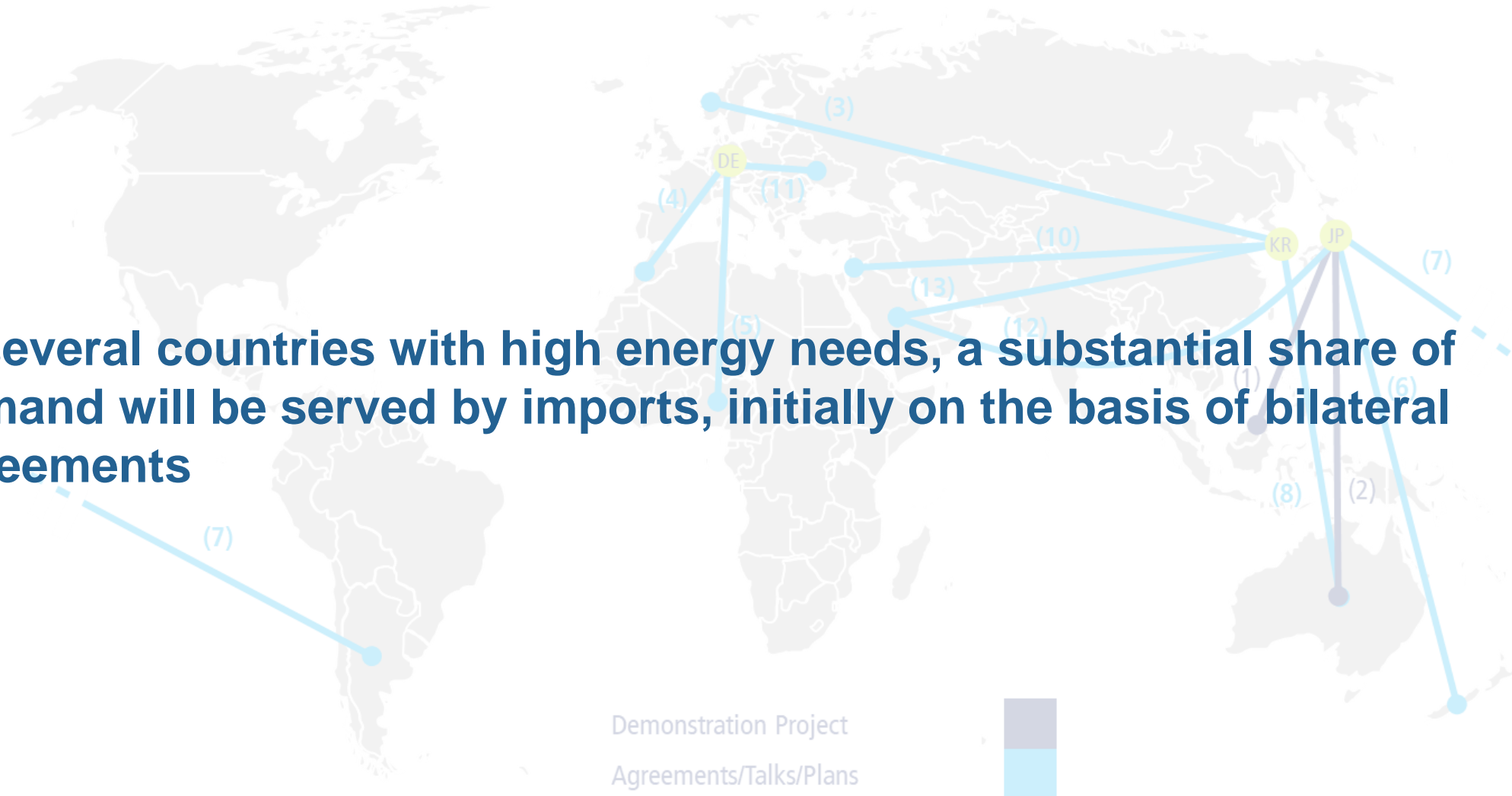


Hydrogen as an energy vector: International cooperation



Hydrogen as an energy vector: International cooperation

In several countries with high energy needs, a substantial share of demand will be served by imports, initially on the basis of bilateral agreements





Main target sectors of current H₂ strategies per country

Hydrogen use sectors		EU	DE	NL	FR	ES	IT	UK	NO	CH	UA	RU	JP	KR	CN	AU	CA	MO
	Industry	✓	✓	✓	✓	✓	(✓)	✓	✓	✗	✗	✓	(✓)	✗	✗	✓	(✓)	✓
	Power	(✓)	(✓)	(✓)	✓	(✓)	✗	✓	✗	✗	✓	✓	✓	✓	✓	✓	(✓)	(✓)
	Transport	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	✓	(✓)	✓	✓	✓	✓	✓	(✓)
	Buildings	(✓)	(✓)	(✓)	(✓)	✗	✗	(✓)	✗	✗	(✓)	(✓)	✓	✓	✗	(✓)	(✓)	(✓)
	Export	✗	✗	✗ ¹⁾	✗	✓	✗	✗	✗ ²⁾	✗	✓	✓	✗	✗	✗	✓	✗	✓

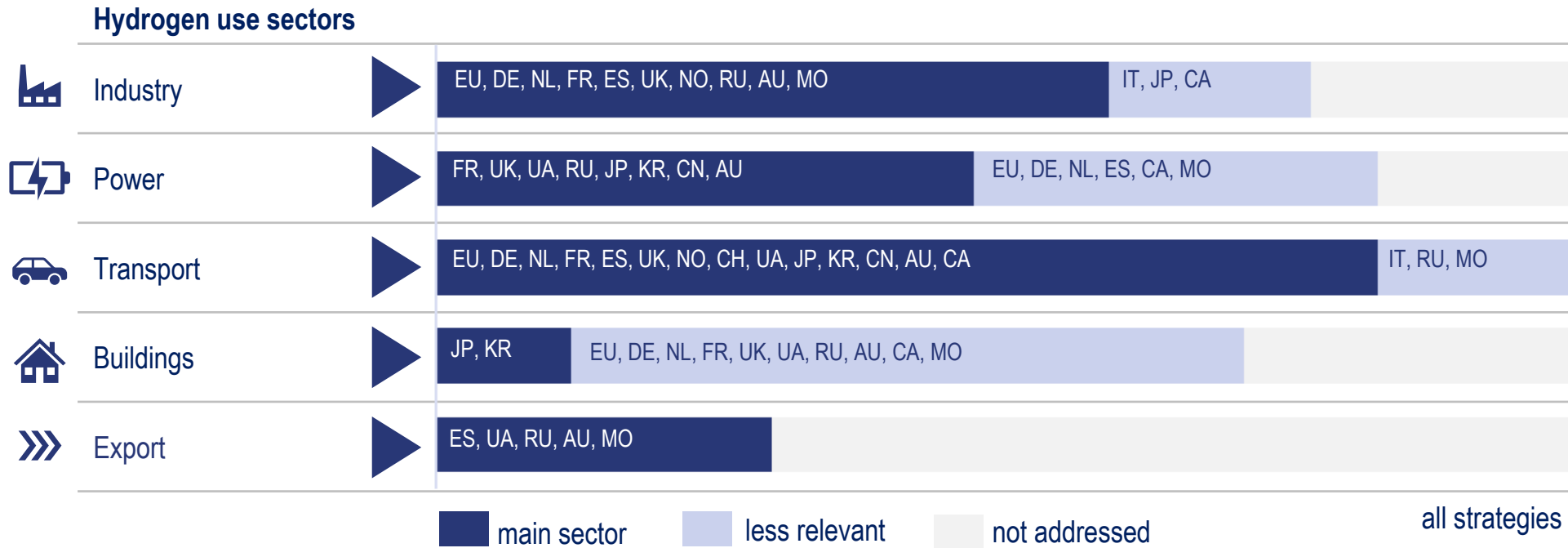
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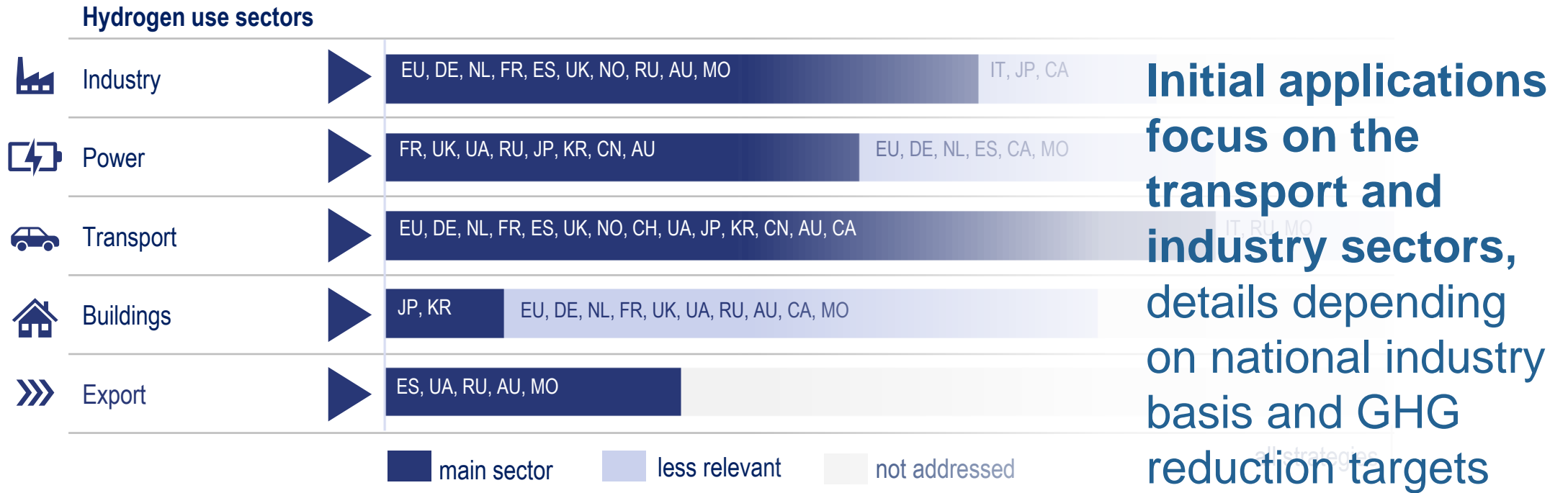


Main target sectors of current H₂ strategies per country





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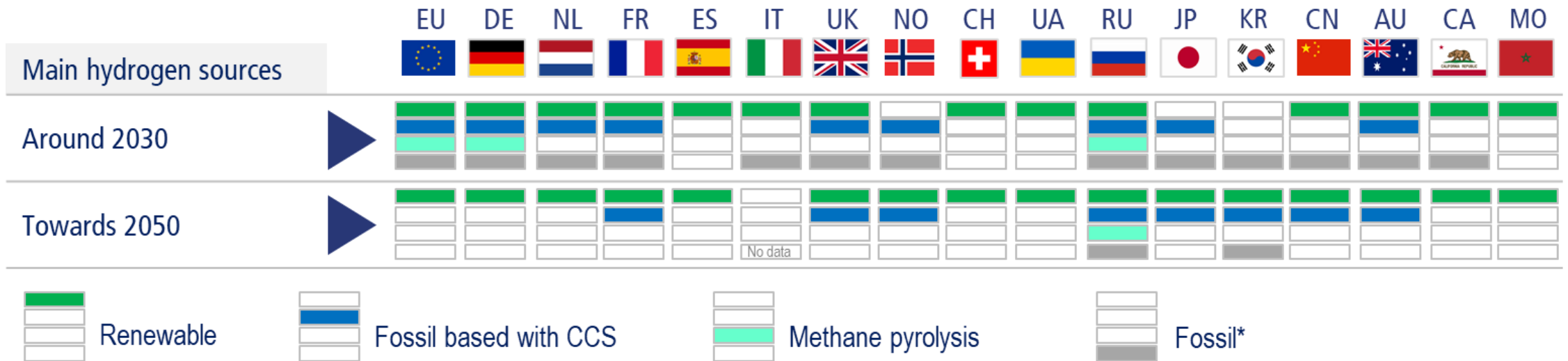
H₂-related requirements: the color of hydrogen

Around
2030

- Renewable and fossil-based hydrogen (with and without CCS) are generally considered viable medium-term sources.
- Methane pyrolysis for hydrogen production is mainly discussed as option in the German and Russian strategies.

Towards
2050

- Renewable hydrogen is the most favorable hydrogen quality in the long-term. Various countries considering it the only viable long-term option.
- Fossil based hydrogen with CCS is regarded a feasible hydrogen source in the long-term in a range of countries.



* In Russia in 2050 mainly based on nuclear power

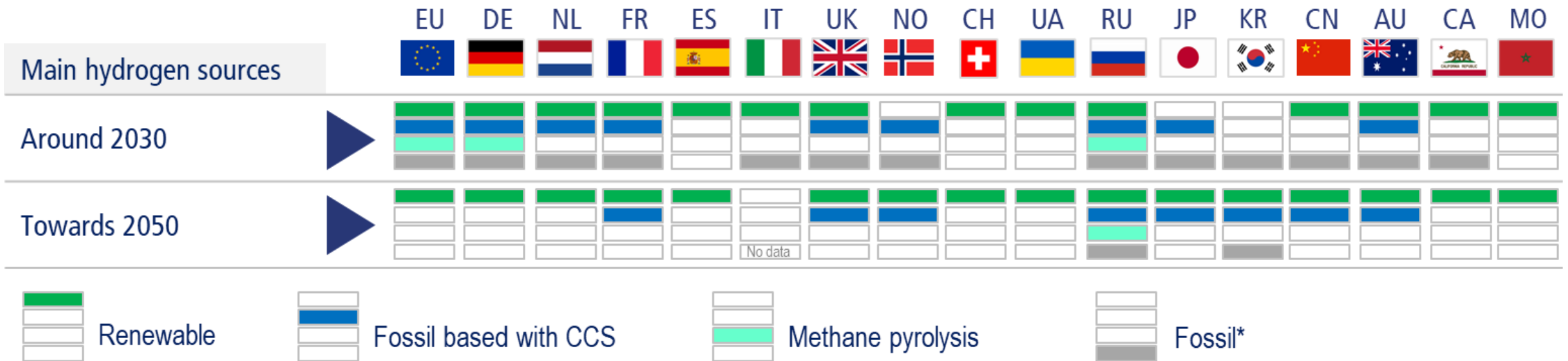
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Around 2030
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**Green H₂ is central to all strategies;
blue H₂ mainly plays a role in a transition period before 2050**

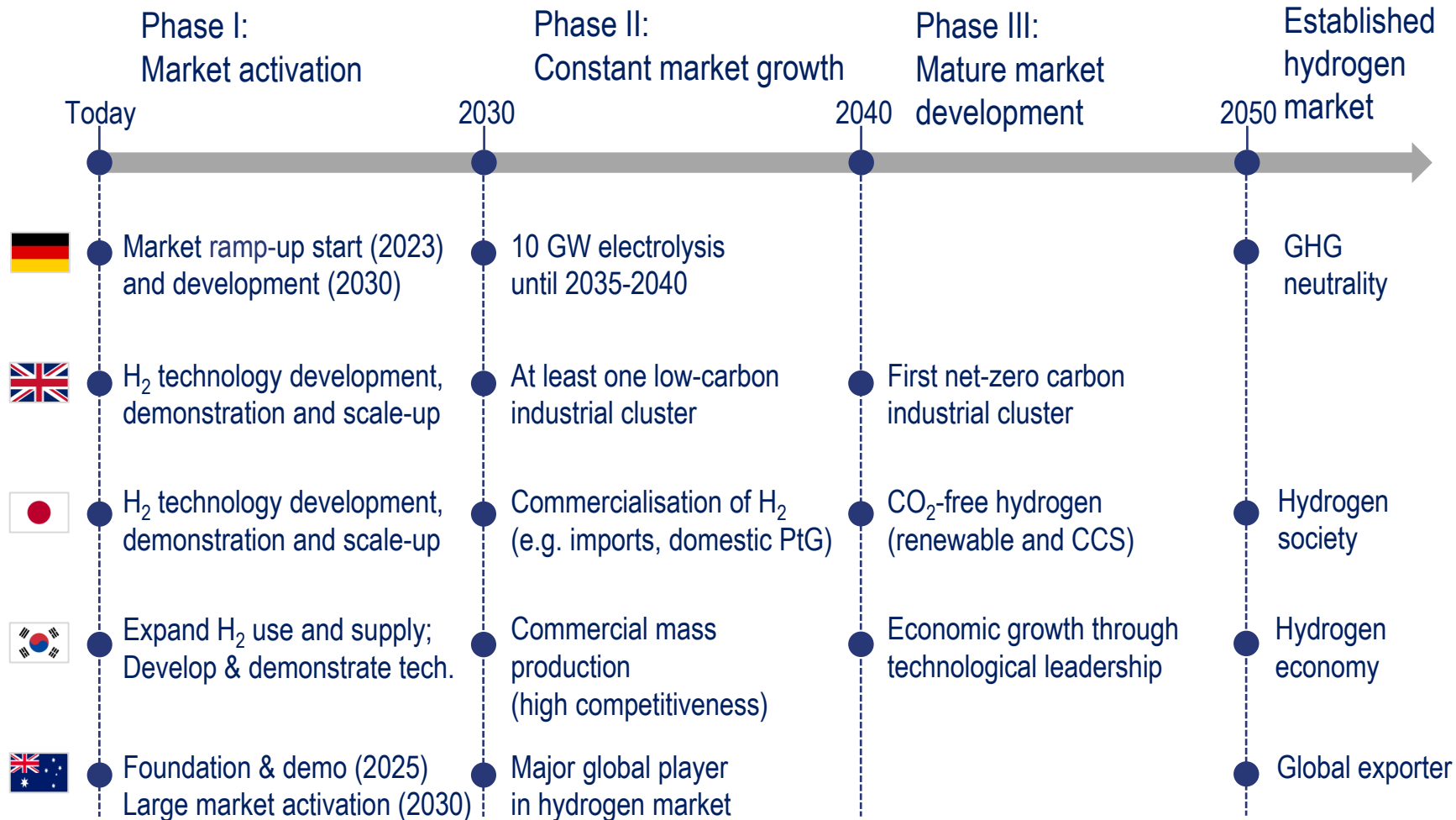
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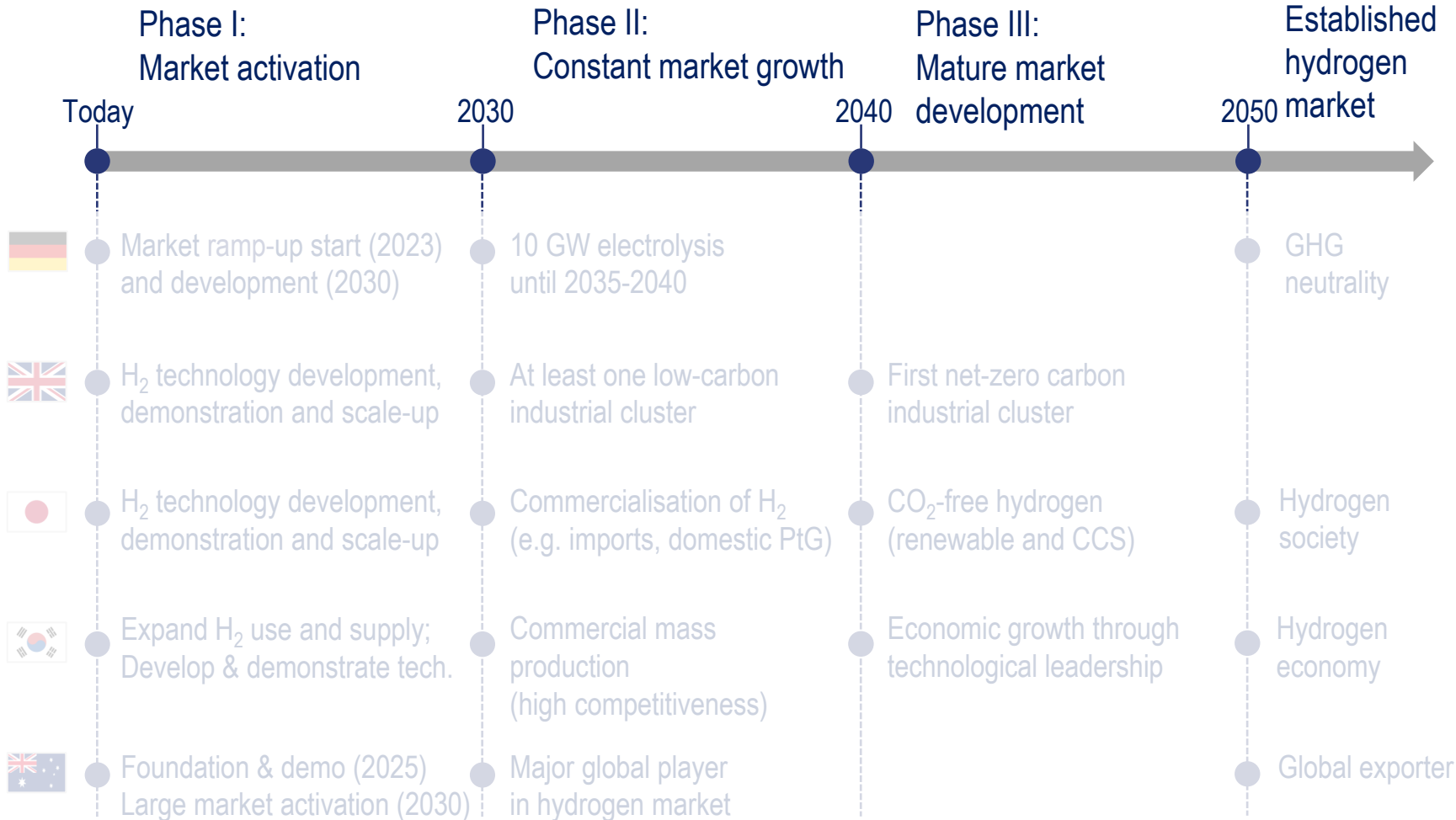


H₂ market development in 3 major phases (examples from selected countries)





H₂ market development in 3 major phases (examples from selected countries)



Market ramp-up in 3 phases:

activation
(<2030)



growth
(>2030)



established
(2050)

A dynamically growing market for hydrogen



**National
H₂ strategies in place
or in preparation in
at least 20 countries**

By 2025 H₂ strategies
are expected in countries
representing > 80% of
global GDP

- Scaling upper H₂ demand expected for 2050 in national strategies to global level indicates a **potential of up to 9000 TWh**
- In several countries with high energy needs, a **substantial share of this demand will be served by imports**, initially on the basis of **bilateral agreements**
- **Initial applications focus on the transport and industry sectors**
- **Green H₂ central to all strategies**;
blue H₂ mainly plays a role in a transition period before 2050
- **Market ramp-up in 3 phases**:
activation (<2030) ⇒ growth (>2030) ⇒ established (2050)

Emerging opportunities for commercial actors



Large H₂ production capacities required

A > 40 B€ market
alone in the EU
until 2030

- Large **industrial partnerships** will be formed for production and export/import
- **Refineries and chemical industry** to become the first important large-scale green H₂ markets in the mid-term
- **Road transport market** (vehicles and trucks) currently stronger in Asia than in Europe
- **Green synthetic liquid e-fuels (PtL)** can grow into an interesting opportunity with large potential quantities particularly in the aviation and/or maritime sector

New policies needed to achieve strategic aims



**Most strategies focus
on targets rather than
measures**

Policy development
is lagging behind
strategic aims

Current measures
insufficient to catalyse
envisaged strong
growth

- Building on earlier successes, policies should focus on commercialisation:
 - **Sectoral quota** stimulate large scale demand
 - Targeted support for **establishing comprehensive value chains**, providing nuclei for sustainable business
 - Move from CAPEX to **OPEX support**
 - Globally **high CO₂ prices** help further reduce cost gap
 - Provide **long-term perspective and security of investment**
- A broadly agreed **green or low carbon hydrogen certification** mechanism is crucial
- **Infrastructure development** requires public financing and central coordination for planning and harmonisation
- Complement all activities with measures supporting **public acceptance**

Danke!
Thank you!



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