



CEFIM
CLEAN ENERGY FINANCE &
INVESTMENT MOBILISATION
 OECD



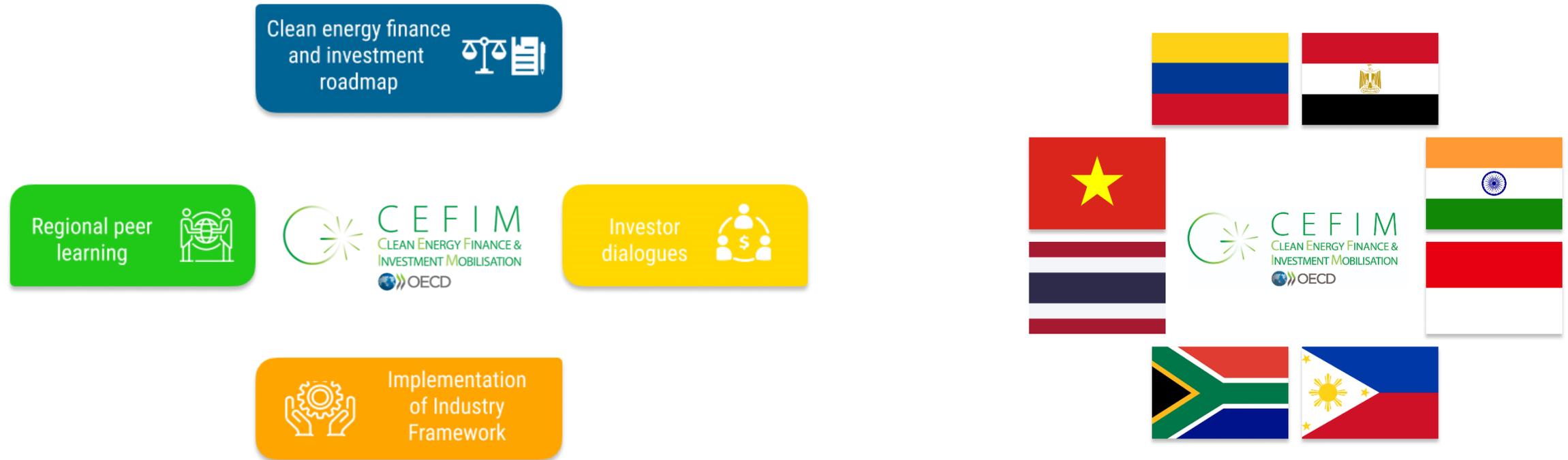
Low-carbon hydrogen opportunities for emerging and developing economies

Identifying success factors for market development and building enabling conditions

Joseph Cordonnier
Industry Programme Analyst

February 2023

The paper provides insights to green hydrogen development in emerging & developing economies



➤ Build on the rich work and interest around green hydrogen to raise awareness on opportunities for emerging and developing economies

Supporting activities in CEFIM country partners

Timeline

June 2022
Stakeholder webinar

November 2022
Working paper release

Throughout 2023
Series of webinars on priority issues



Framework for industry's net-zero transition

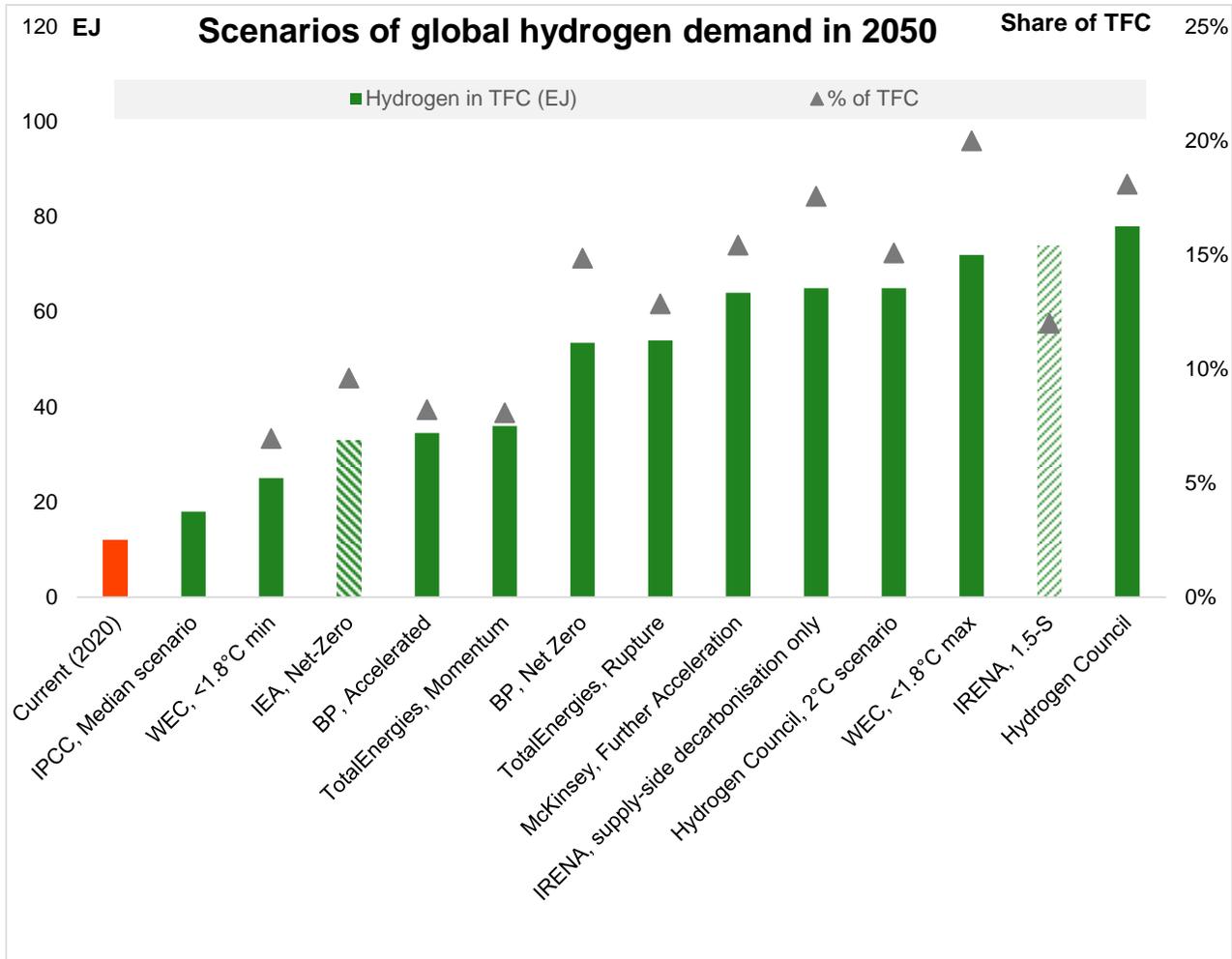


- Country level for an industry sub-sector or a low-carbon technology
- Pipeline of bankable projects
- Solutions for enabling conditions and financing

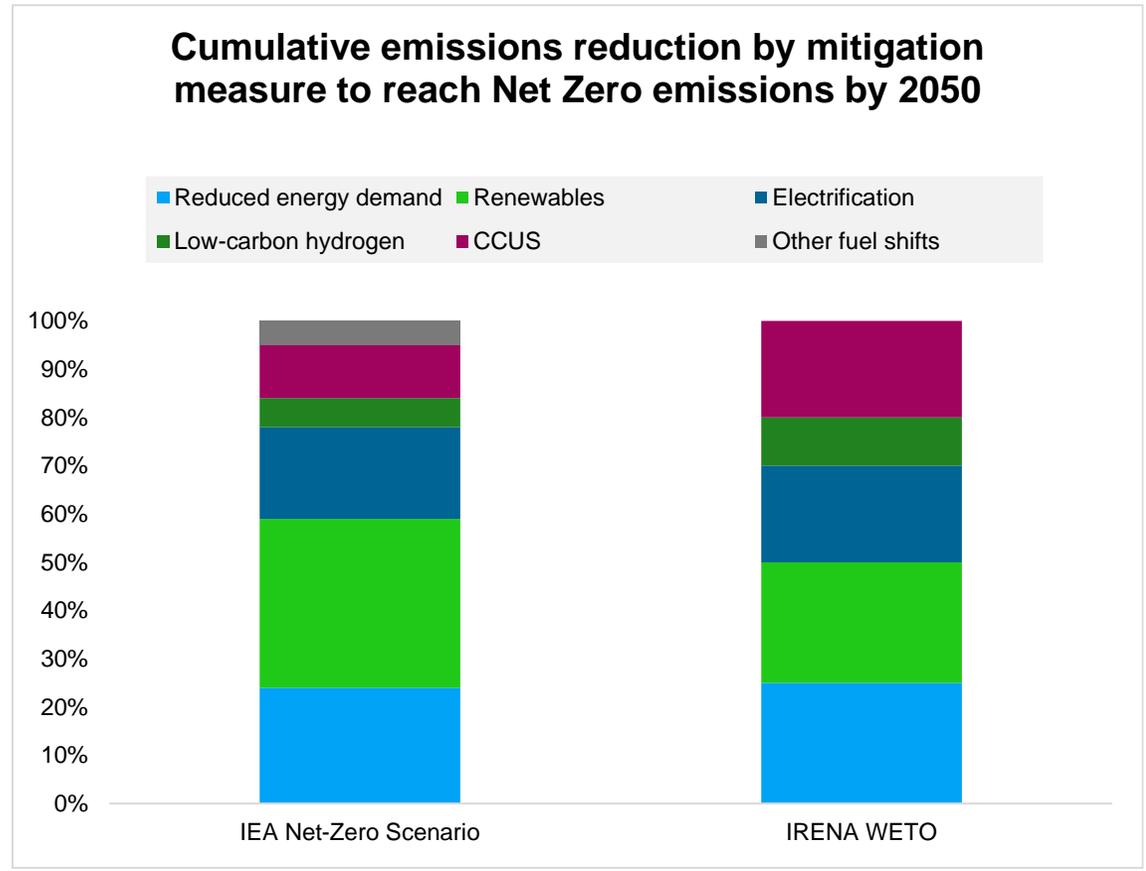
Low-carbon Hydrogen

- Value chain, financing and enabling conditions
- National hydrogen strategies
- International collaboration

Growing Hydrogen contribution to the global energy mix to achieve net zero emissions by 2050

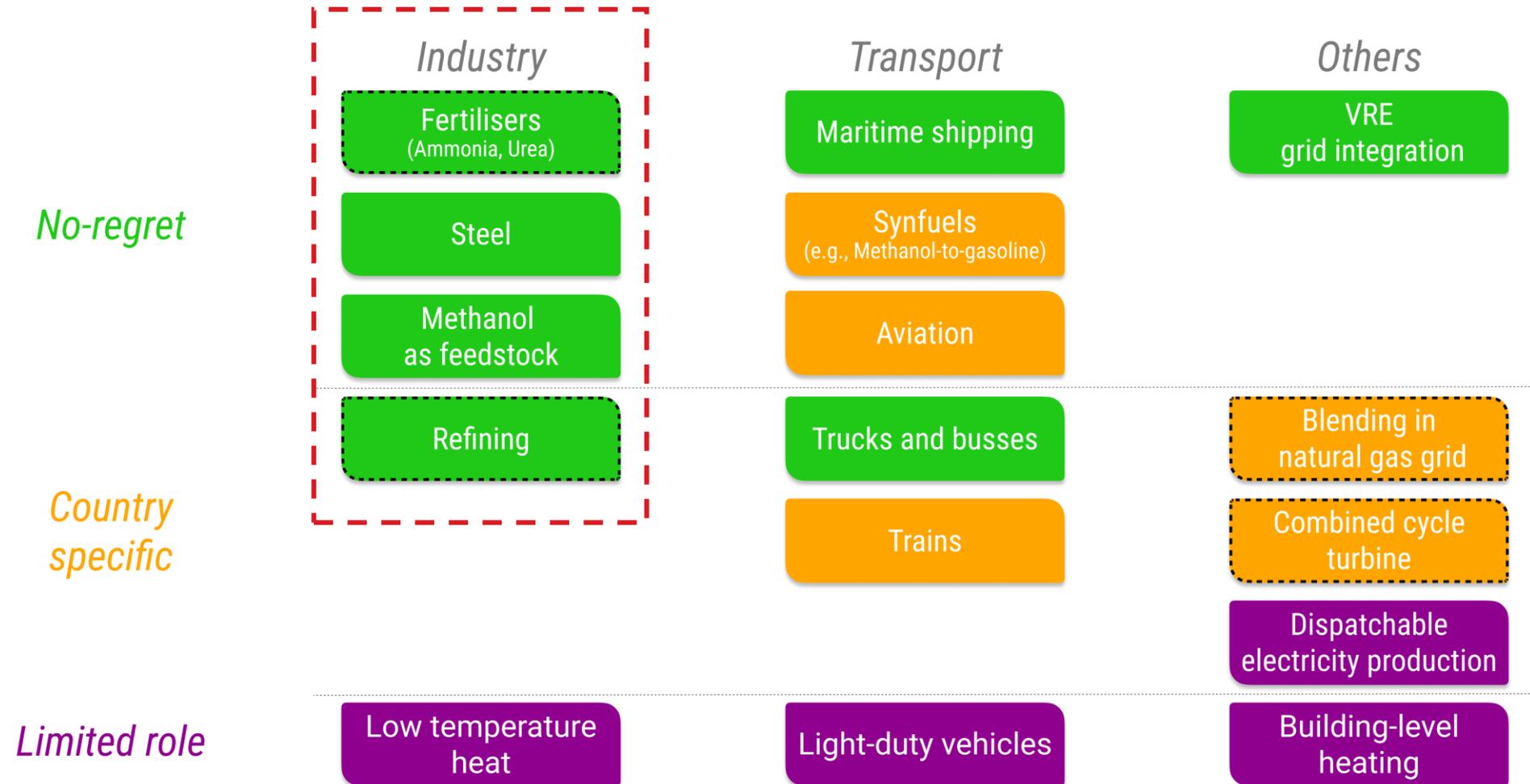


TFC: Total Final Energy Consumption



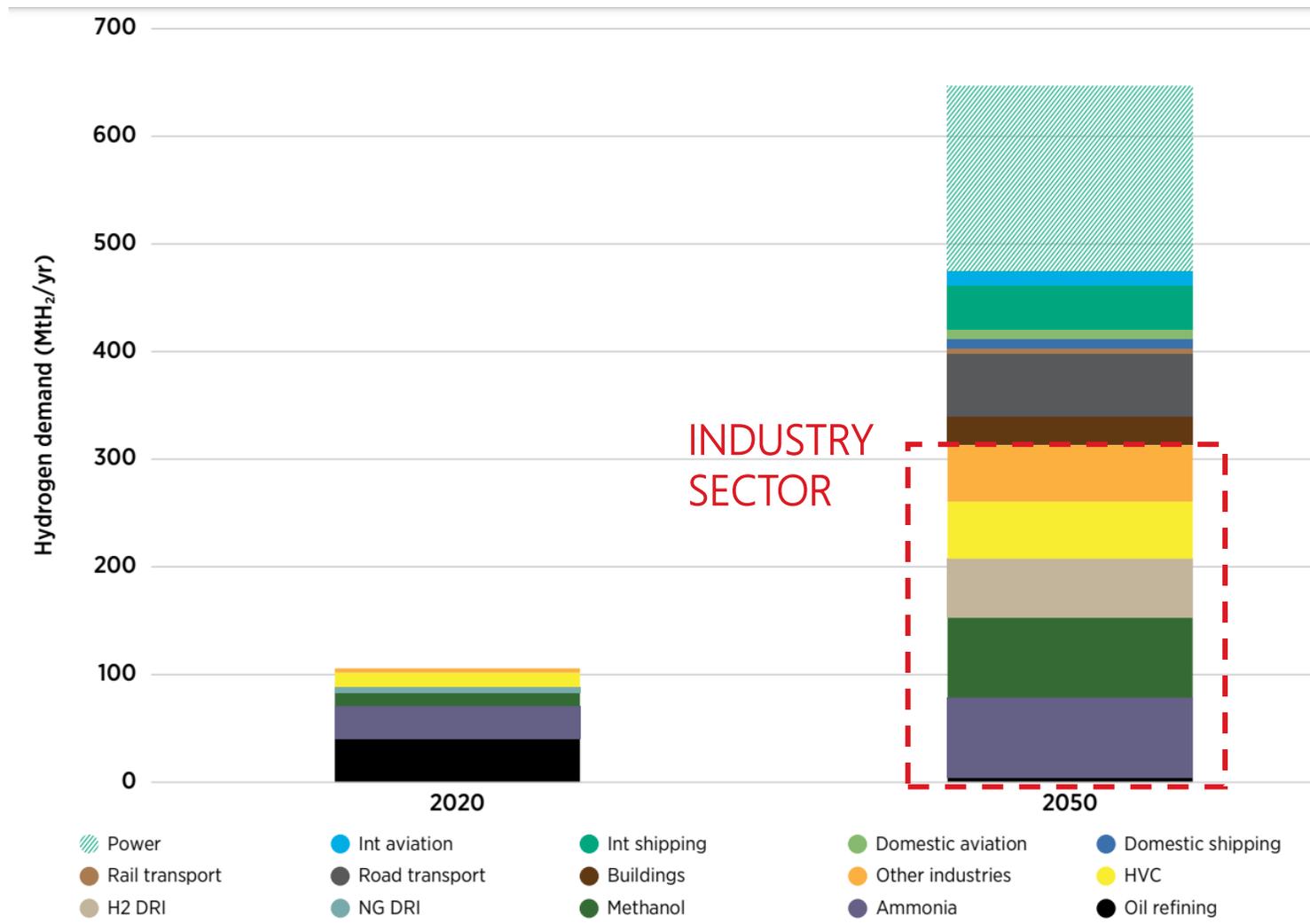
CCUS includes both Biomass-based and Fossil-Fuel based projects.
 Energy Efficiency includes Technology performance, Behaviour and avoided demand.
 Sources: IEA (2021), Net Zero by 2050 & IRENA (2022), World Energy Transitions Outlook: 1.5°C Pathway

Several industrial subsectors are often considered as “no-regret” when prioritizing potential usages of green hydrogen



■ High maturity
 ■ Medium maturity
 ■ Low maturity
 Near-term markets

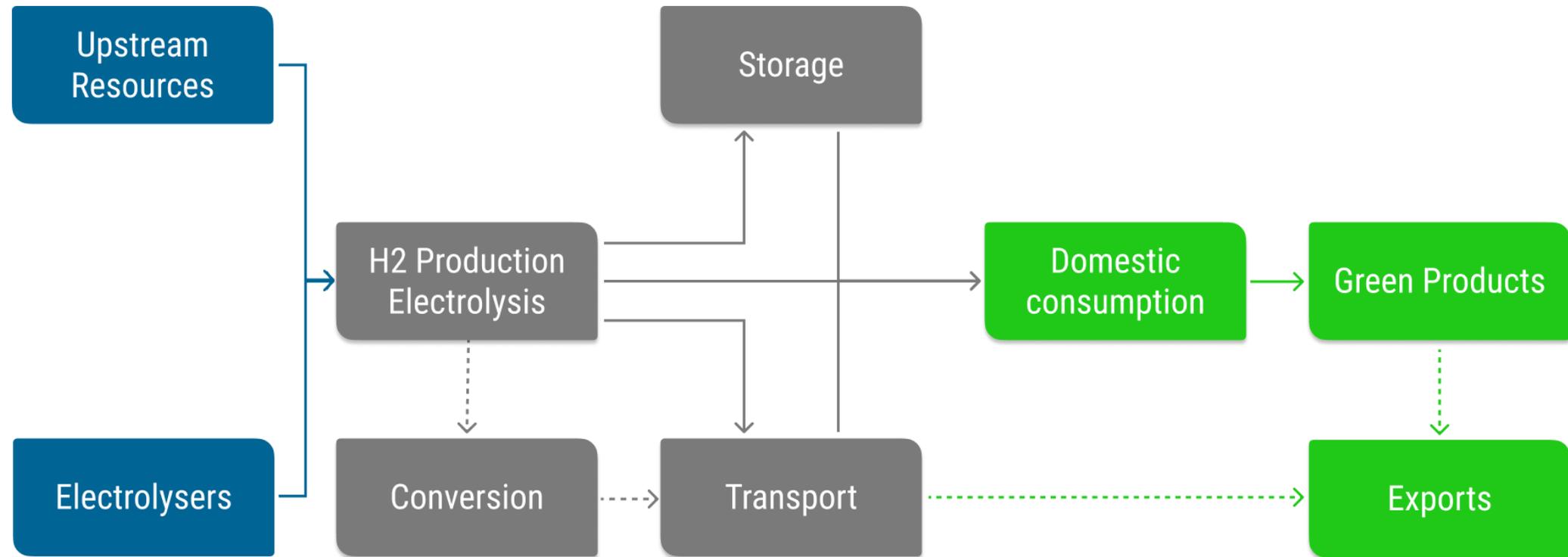
Hydrogen is today consumed mainly by the manufacturing industry and the industry sector demand may triple by 2050



Hydrogen demand for 2020 excludes hydrogen as part of the mix of off-gases for steel production. DRI = direct reduced iron; HVC = high-value chemicals; Int = international; NG = natural gas

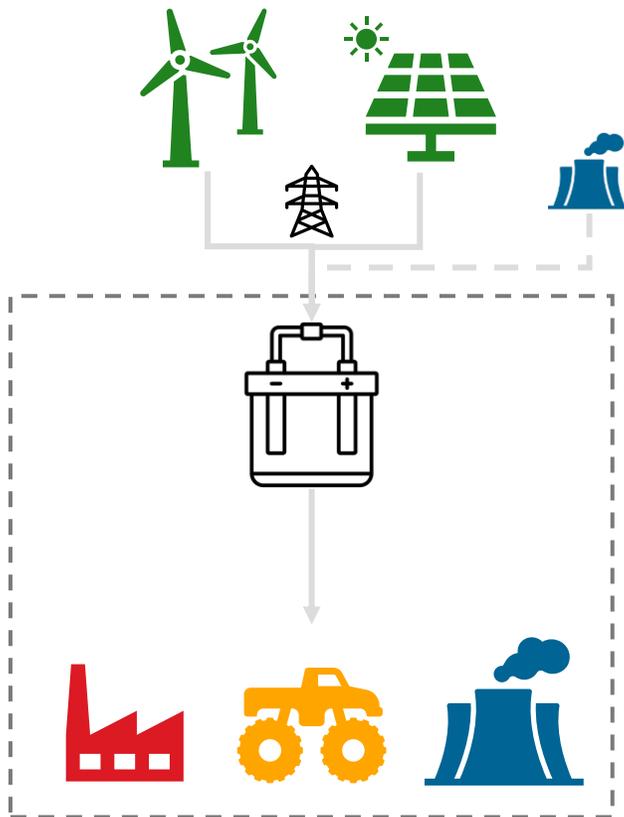
Source: IRENA (2022), Global hydrogen trade to meet the 1.5°C climate goal: Part I – Trade outlook for 2050 and way forward

Addressing the value chain of green hydrogen is crucial in developing national strategies

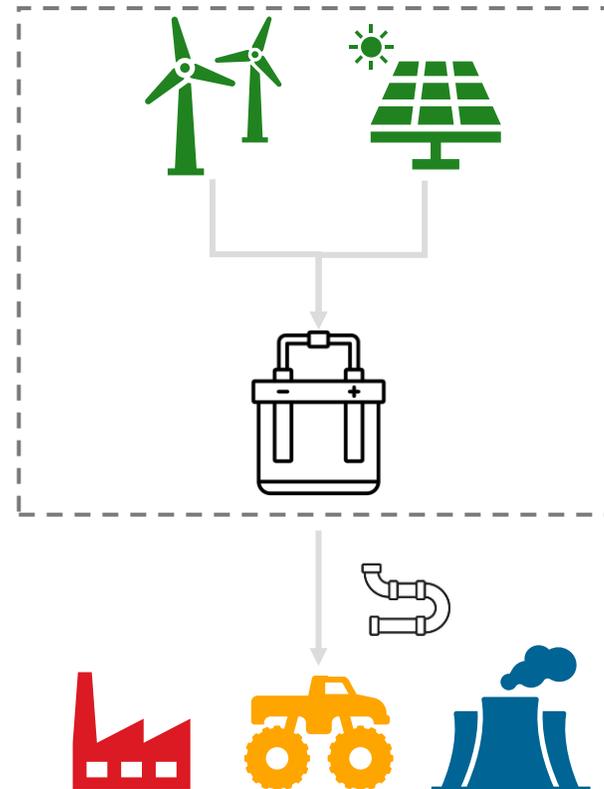


Renewable energy potential and infrastructure are critical to select a project design

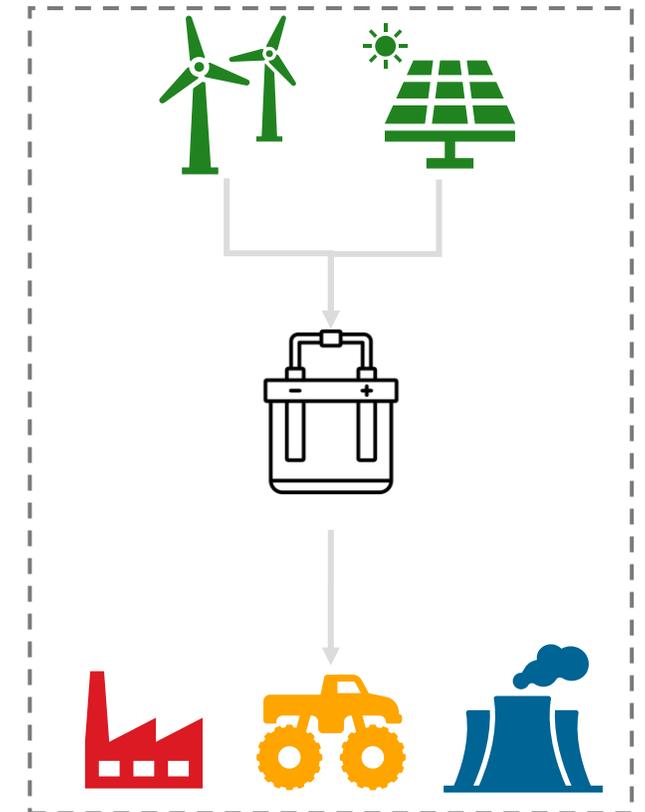
Low-cost renewables
Co-located electrolyser and
end-use



Co-located low-cost
renewables & electrolyser
H₂ transport to end-use



Co-located low-cost
renewables, electrolyser
and end-use



- Electrolyser capacity factor and low-carbon hydrogen cost highly depends on renewable electricity production
- Optimal project design may vary depending on availability or possibility to build/extend power grid and pipelines

Upcoming OECD study provides a toolbox comprising of 3 elements to help countries build an enabling environment

List of statements to carry out a country self-assessment

Checklist of 45 questions along the value chain

8 case studies of green hydrogen projects
(5 in the industry sector)

- | | | |
|--------------------------|----------|--------------------------|
| • H2 Green Steel | Sweden | Steel |
| • HIF Global | Chile | E-fuels |
| • Hyphen Hydrogen Energy | Namibia | Ammonia |
| • Port of SOHAR | Oman | Hydrogen, Ammonia, Steel |
| • The Green Solutions | Viet Nam | Ammonia |

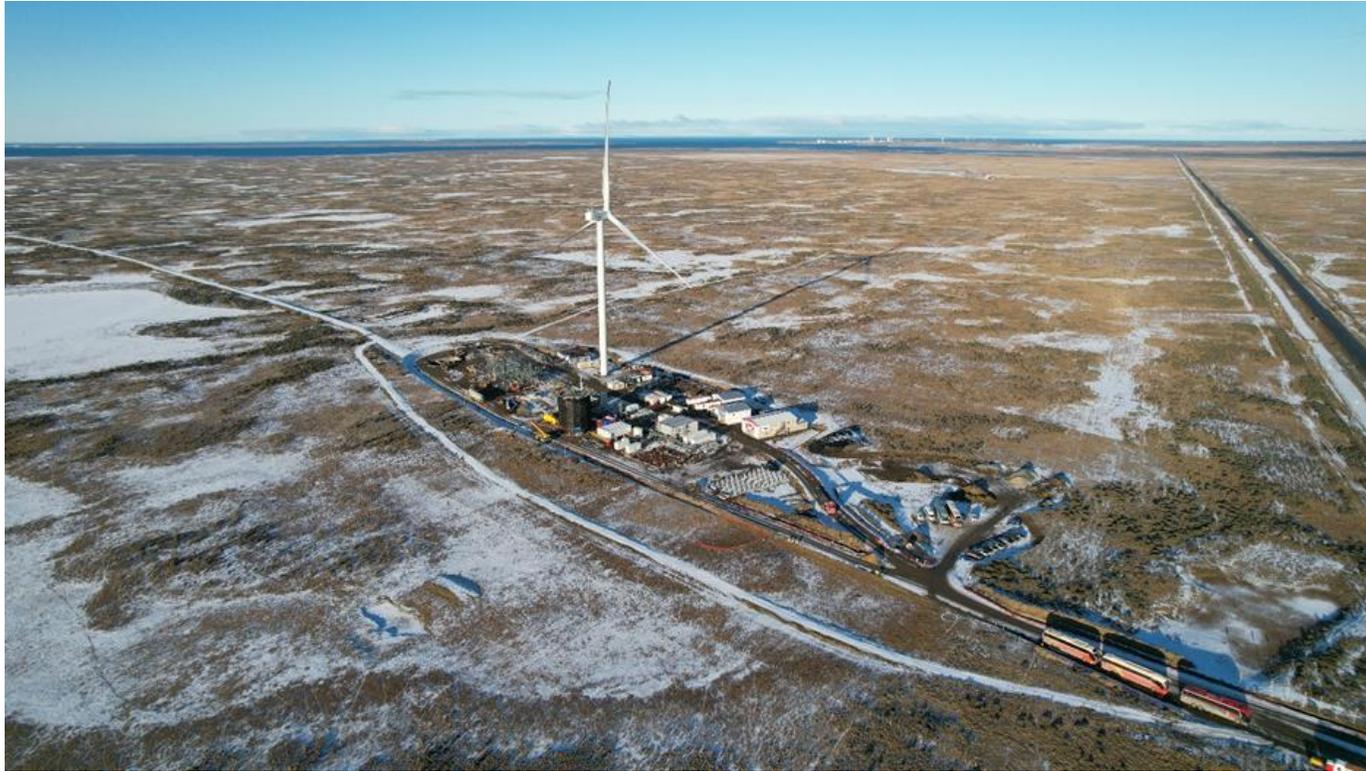
Identify country's potential to develop green hydrogen and where to position in the value chain

Support policymakers in pinpointing potential barriers to the creation of an enabling environment

Highlight commonalities and specificities of enabling market conditions and financing mechanisms that can foster the development of green hydrogen

Example of case study (Industry)

HIF Global – e-fuels – Chile



Demonstration plant (FID 2021)

- 3.4 MW onshore wind turbine
- 1.2 MW electrolyser
- 143 tonnes of green hydrogen annually
- Direct Air Capture of CO₂
- 130 000 litres of e-gasoline annually

HIF Cabo Negro (construction from 2023)

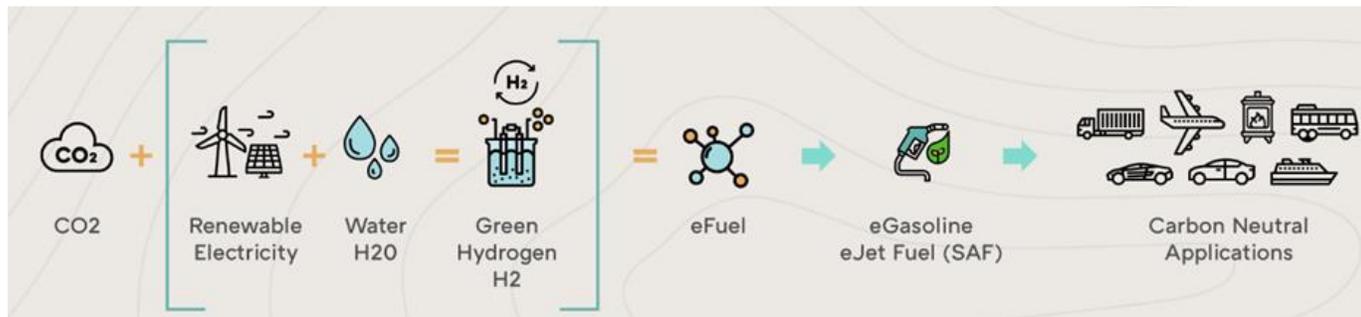
- 325 MW onshore wind turbine
- 240 MW electrolyser
- 66 000 000 litres of e-gasoline annually

Business rationale

- Green electricity below USD 2 cents/kWh
- Synthetic fuels can be sold at a premium

Financing

- The demonstration project HIF Haru Oni has raised over USD 60 million in total
- USD 260 million capital increase in April 2022



Example of case study (Industry)

H2 Green Steel – steel - Sweden



Basic Description

- Company founded in 2020; production from 2025
- Hydrogen-based steel production facility in northern Sweden
- 700 MW electrolyser
- 2.5 million tonnes of steel

Business Model

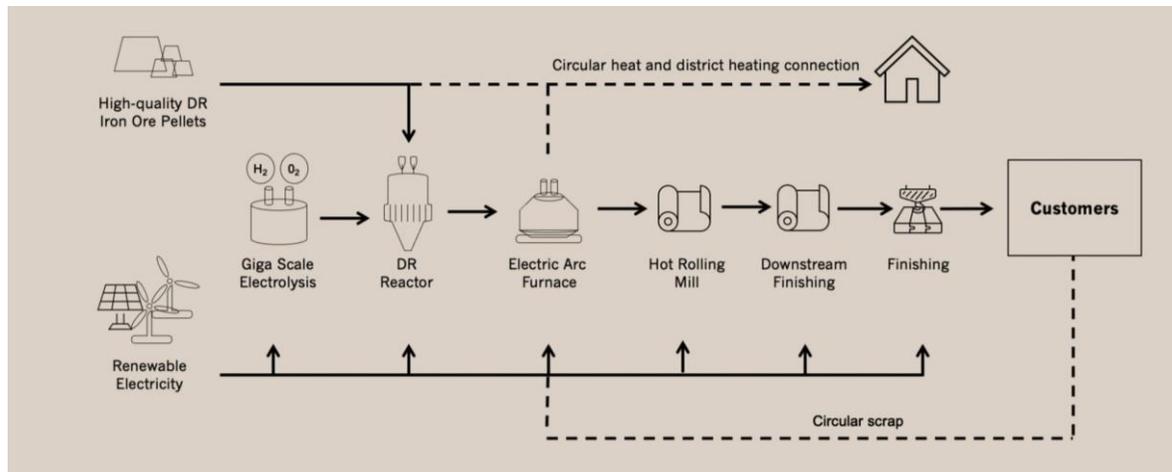
- First-mover customers willing to pay a premium
- 1.5 million tonnes pre-sales in 2022
- Hydrogen cost minimization thanks to cheap hydropower

Investment de-risking

- Location next to large hydropower resources
- Connection to infrastructures (ongoing)
- Lean permitting process
- Local buy-in from local community

Financing

- The demonstration project HIF Haru Oni has raised over USD 60 million in total
- USD 105 million equity financing in 2021 (Series A)
- USD 260 million equity financing in October 2022 (Series B)



Business Models

- Main challenges are the **high overall capital requirements** and the **uncertainty on volumes and revenues**
- The first large-scale projects for green hydrogen derivatives or goods rely on a mature value chain and existing markets

Projects' governance

- Importance of **public-private partnerships**, particularly to develop hydrogen hubs / common user infrastructures
- Several project developers rely on **vertically integrated partnerships**

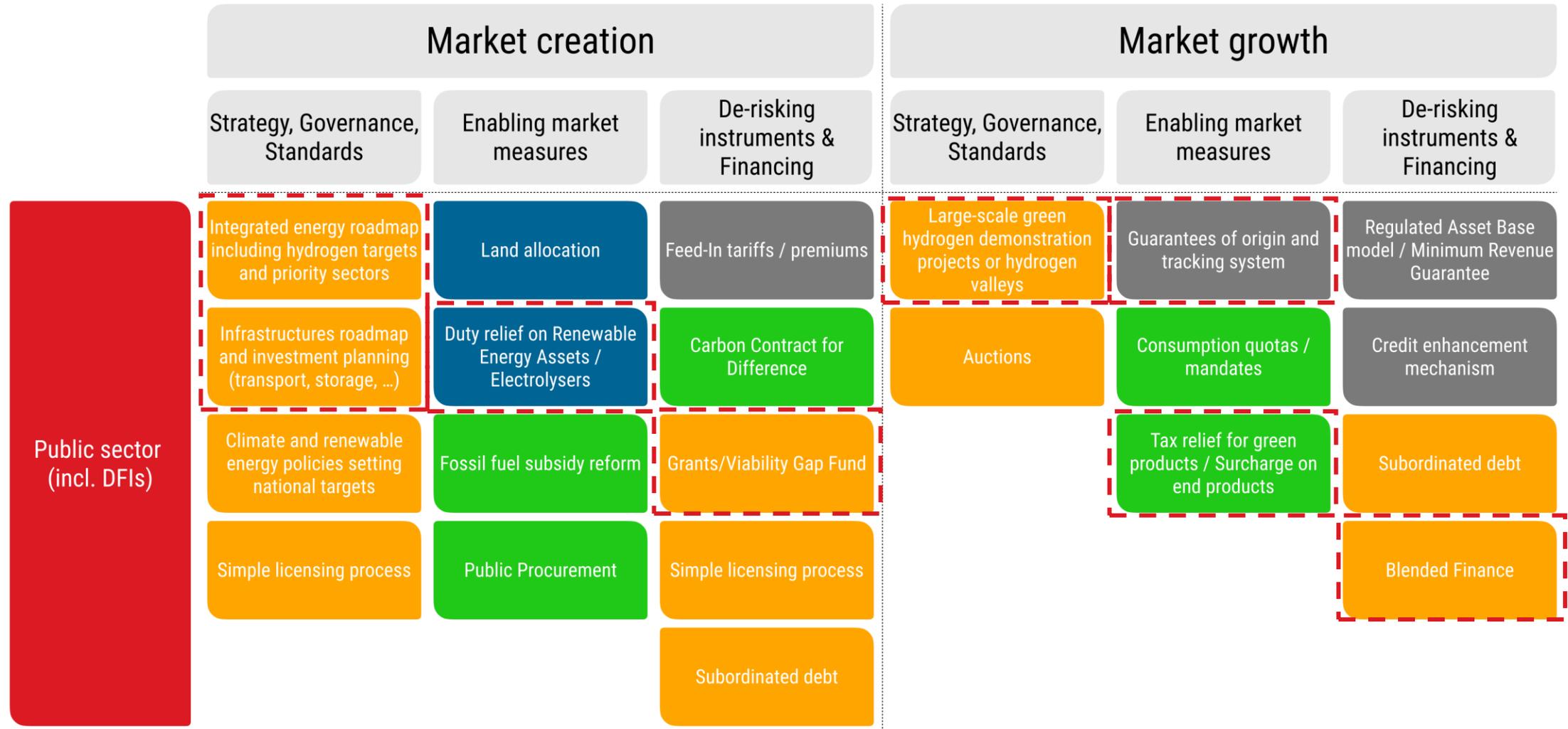
Enabling market conditions and de-risking investment

- Access to **low-cost and stable renewable electricity, land, water and infrastructures** (power transmission lines, railways, deep-sea harbours)
- **Green mandates or blending obligations** to address offtake risk. Effective **carbon pricing** to define a level playing field.

Financing

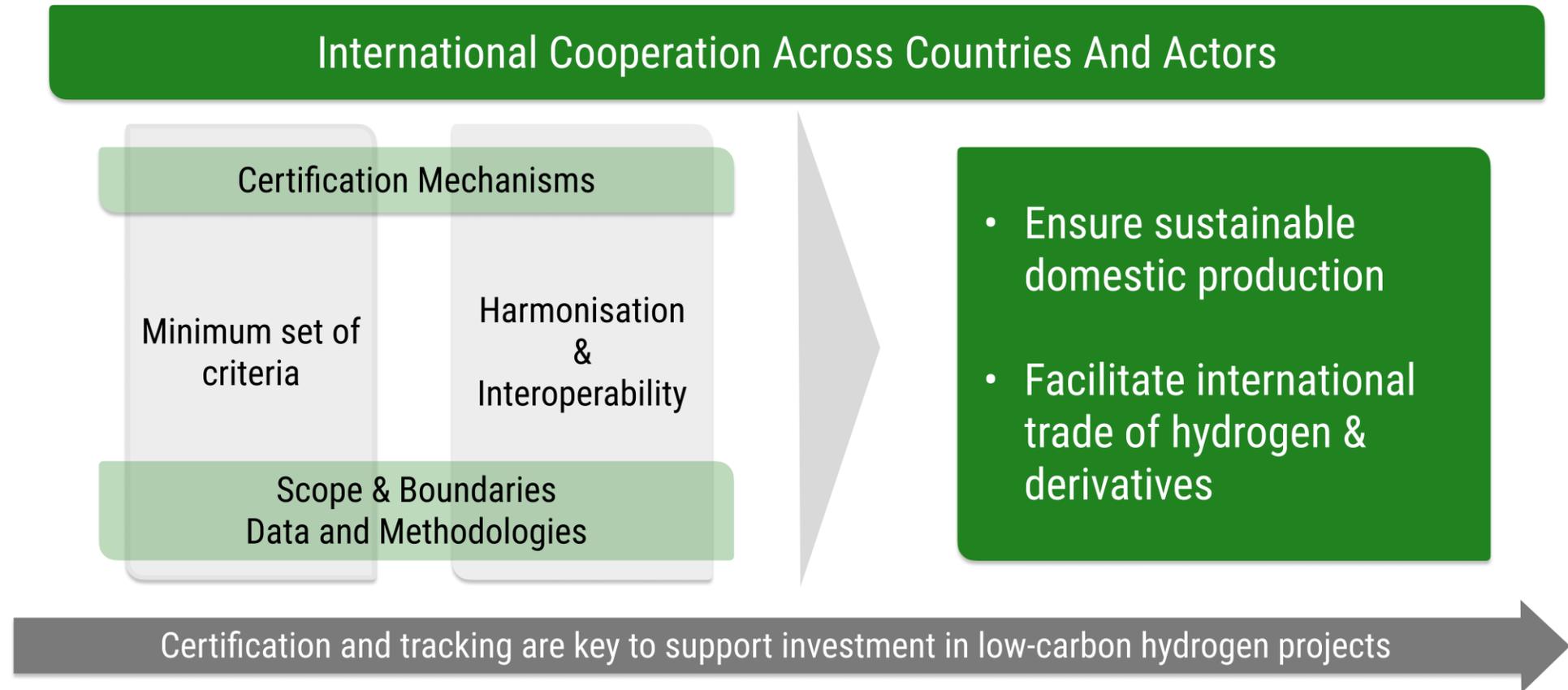
- Large ticket size often requires **sharing risks among actors**, notably with **blended finance**.
- **Project finance** seems to be the preferred option for developers.

There are a suite of measures available to facilitate hydrogen market creation and growth



● Upstream
 ● Midstream
 ● Downstream
 ● Cross-cutting

- Webinar took place on 31 January 2023 with participation of speakers from OECD member countries (e.g. Australia, Republic of Korea, and France), international organisations (e.g. IEA, IPHE) and private sector (e.g. Hydrogen Council, DNV).



Possible activities for OECD's future work on green hydrogen





CEFIM
CLEAN ENERGY FINANCE &
INVESTMENT MOBILISATION
 OECD



Thank you

Joseph Cordonnier
Industry Programme Analyst

February 2023