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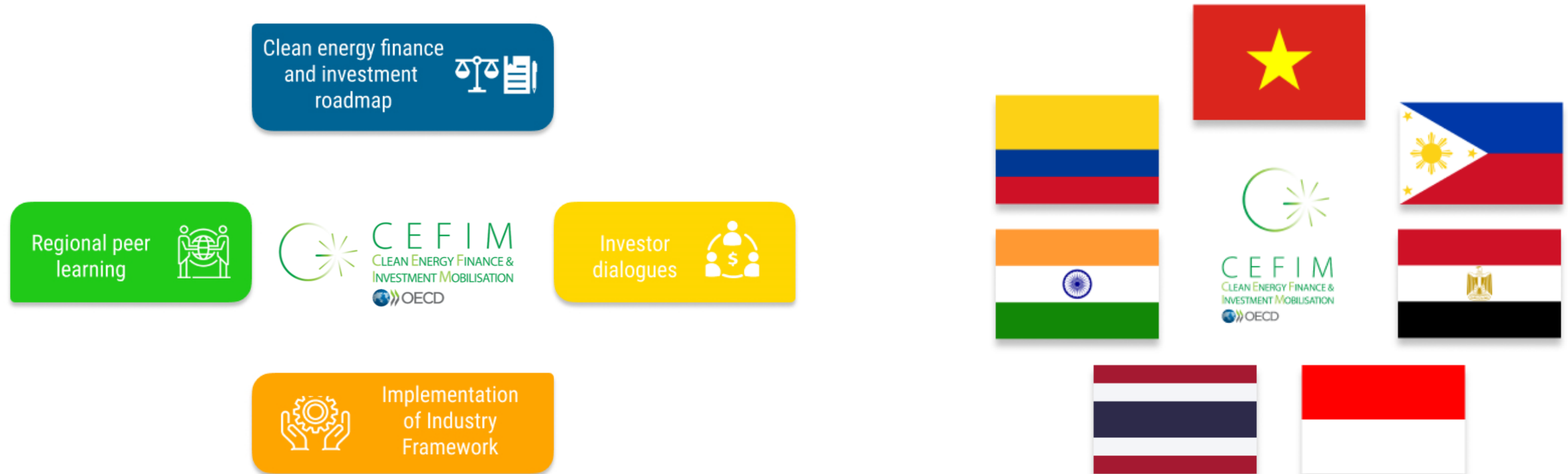
# Enabling conditions and success factors of green hydrogen projects in large-scale industry

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# The paper will provide insights to support CEFIM programme on green hydrogen in emerging and developing economies



- Build on the rich work and interest around green hydrogen to raise awareness on opportunities for emerging and developing economies
- First approach before engaging in Hydrogen / Finance roadmaps

Supporting activities in CEFIM country partners Colombia, Egypt, India, Indonesia, Philippines, Thailand and Viet Nam

## Timeline

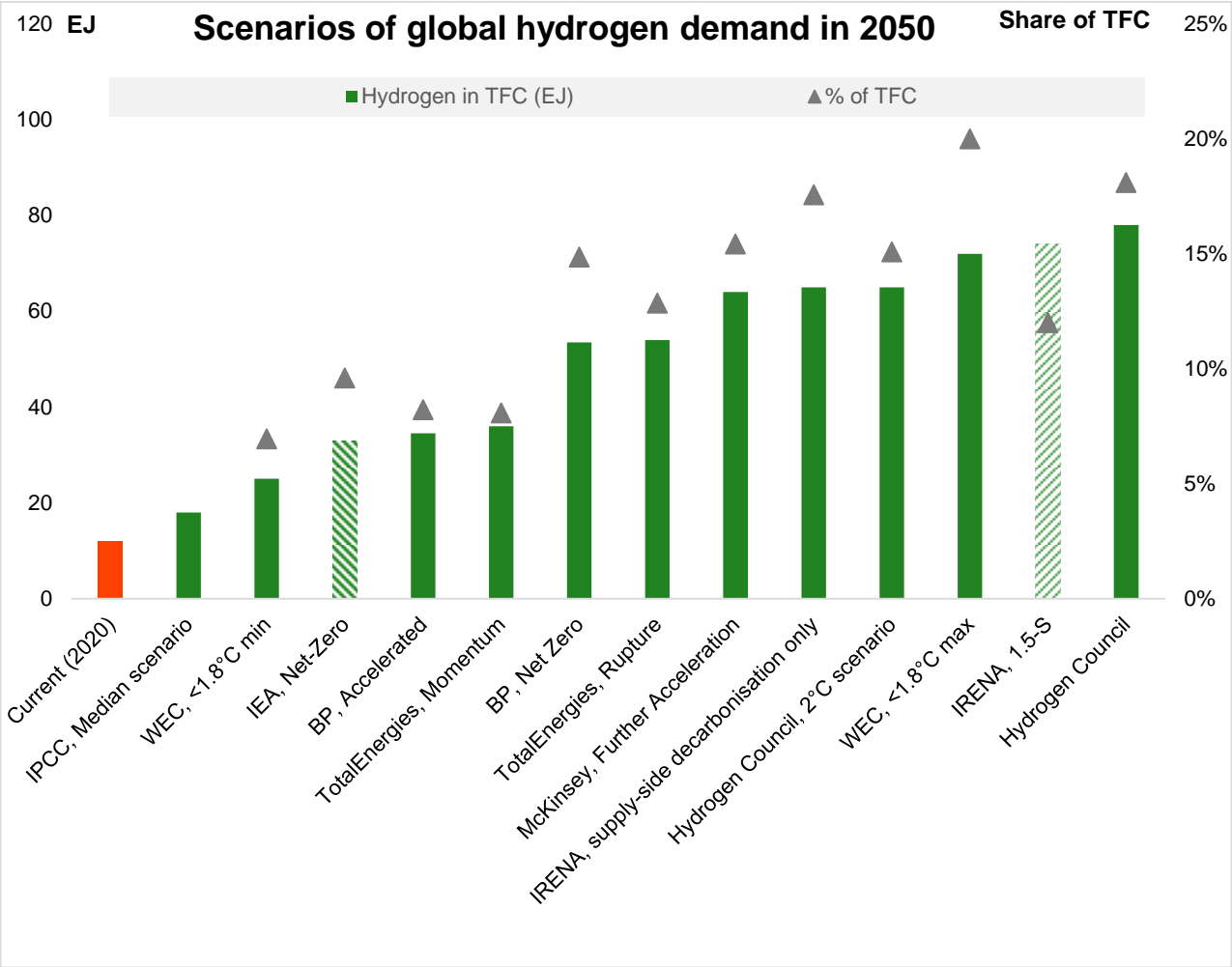
June 2022: Stakeholder webinar

November 2022: Working paper release

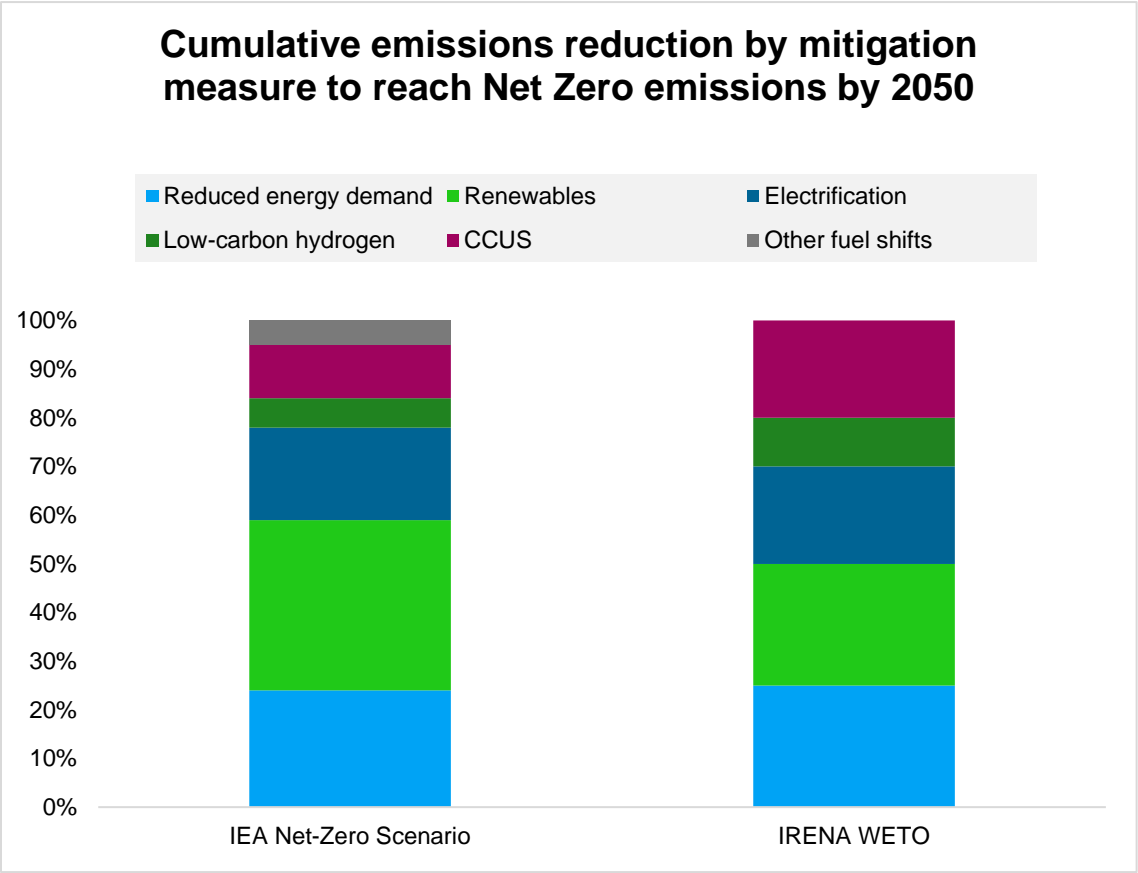
> Q4 2022: Integration with other CEFIM work



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



TFC: Total Final Energy Consumption

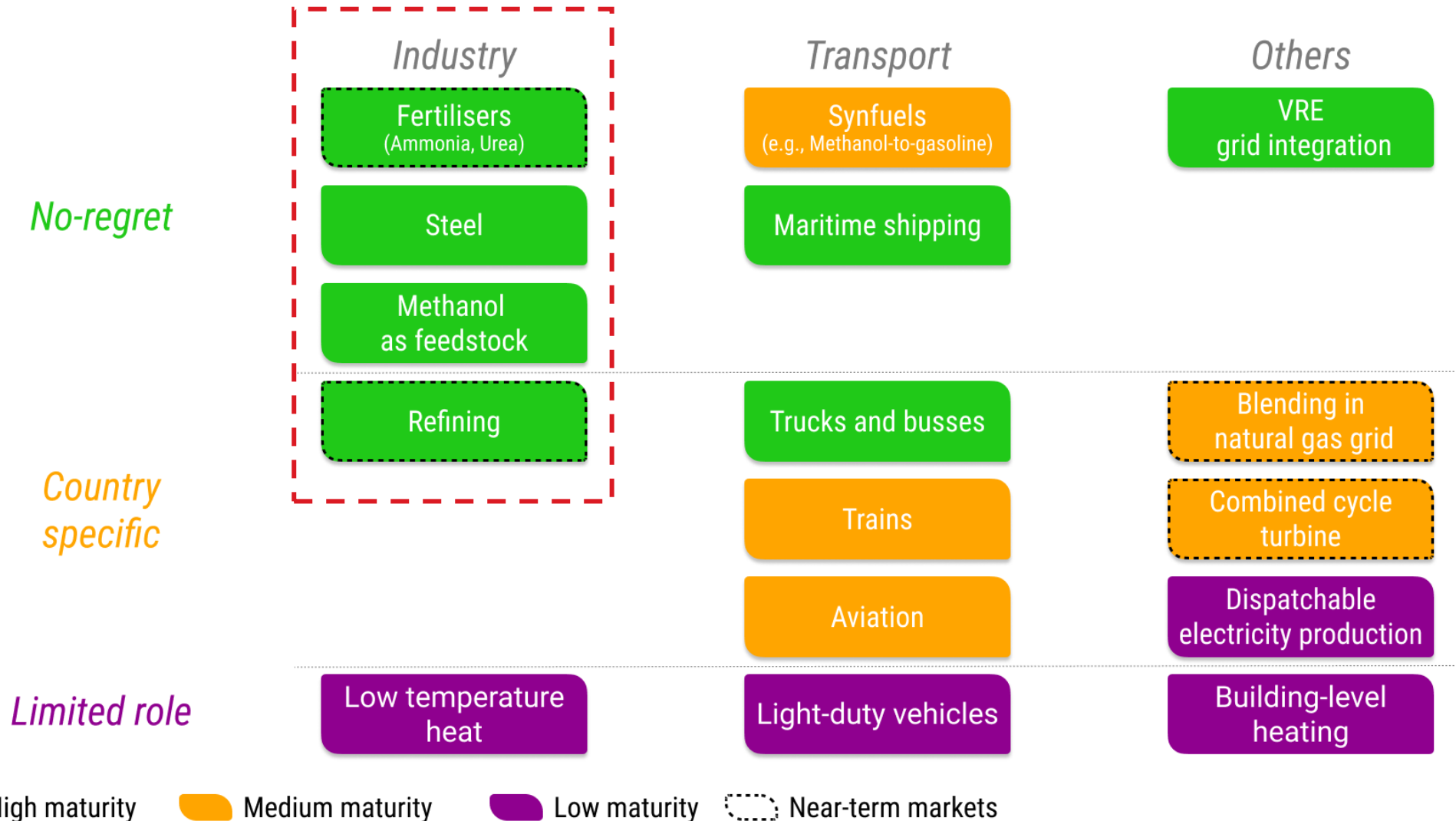


CCUS includes both Biomass-based and Fossil-Fuel based projects.  
Energy Efficiency includes Technology performance, Behaviour and avoided demand.  
*Sources: IEA (2021), Net Zero by 2050 & IRENA (2022), World Energy Transitions Outlook: 1.5°C Pathway*



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

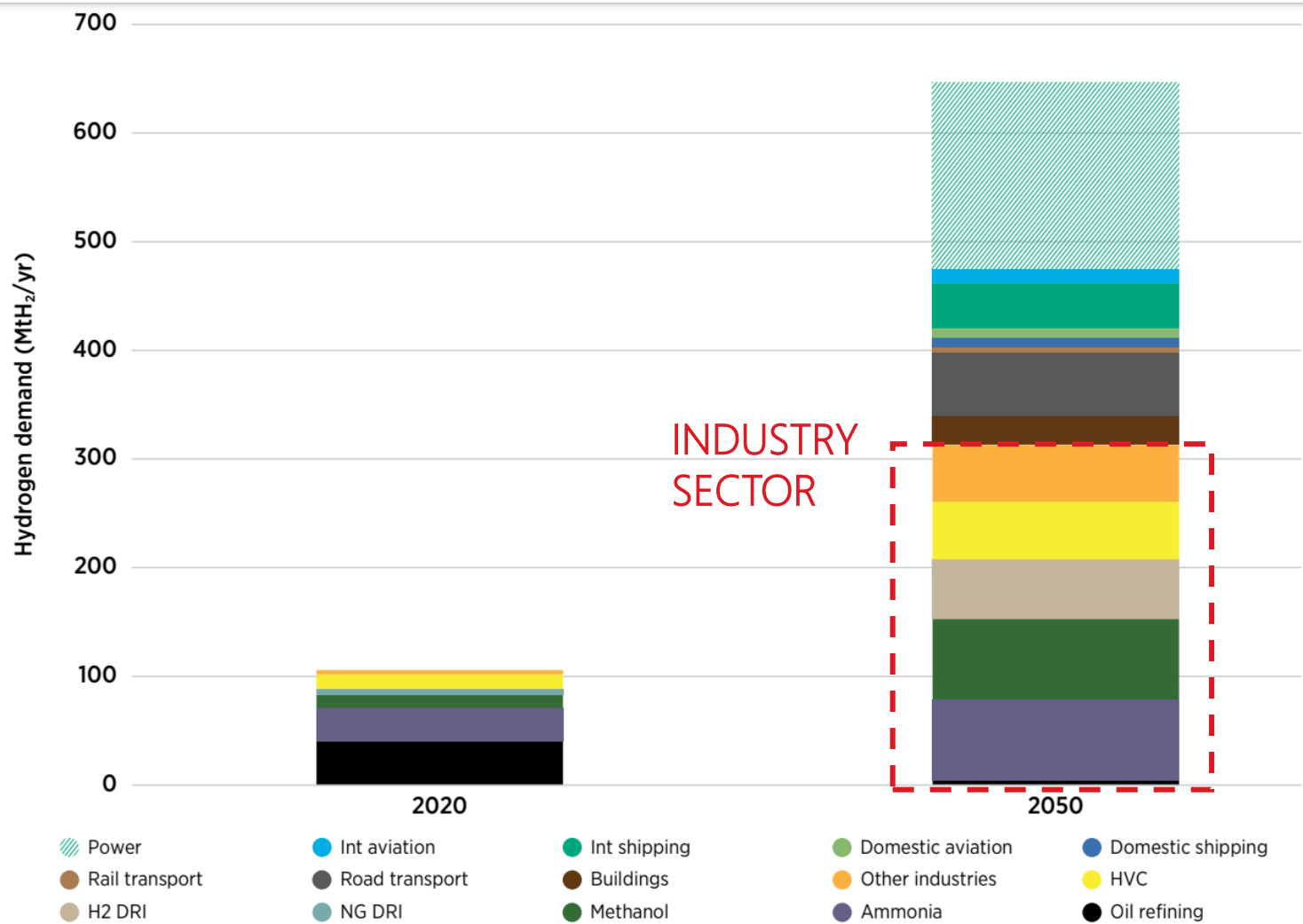
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Hydrogen is today consumed mainly by the manufacturing industry and the industry sector demand may triple by 2050

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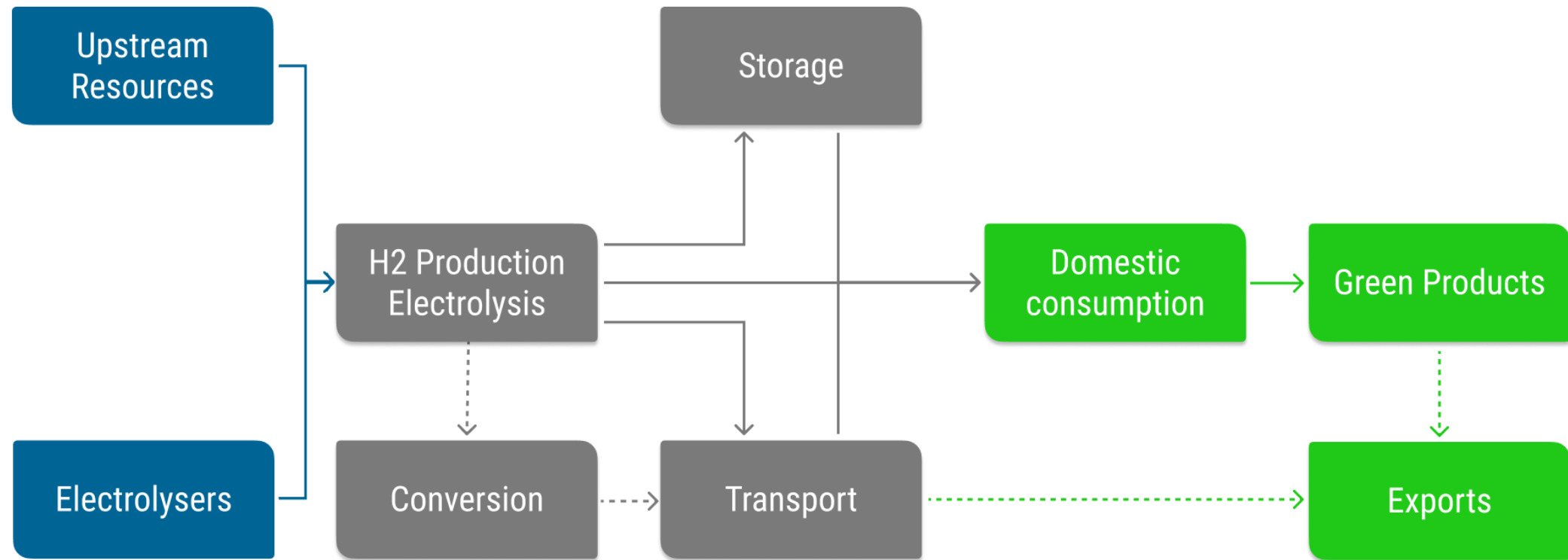


Hydrogen demand for 2020 excludes hydrogen as part of the mix of off-gases for steel production. DRI = direct reduced iron; HVC = high-value chemicals; Int = international; NG = natural gas

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



● Upstream    ● Midstream    ● Downstream    -----> Export route



# 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*

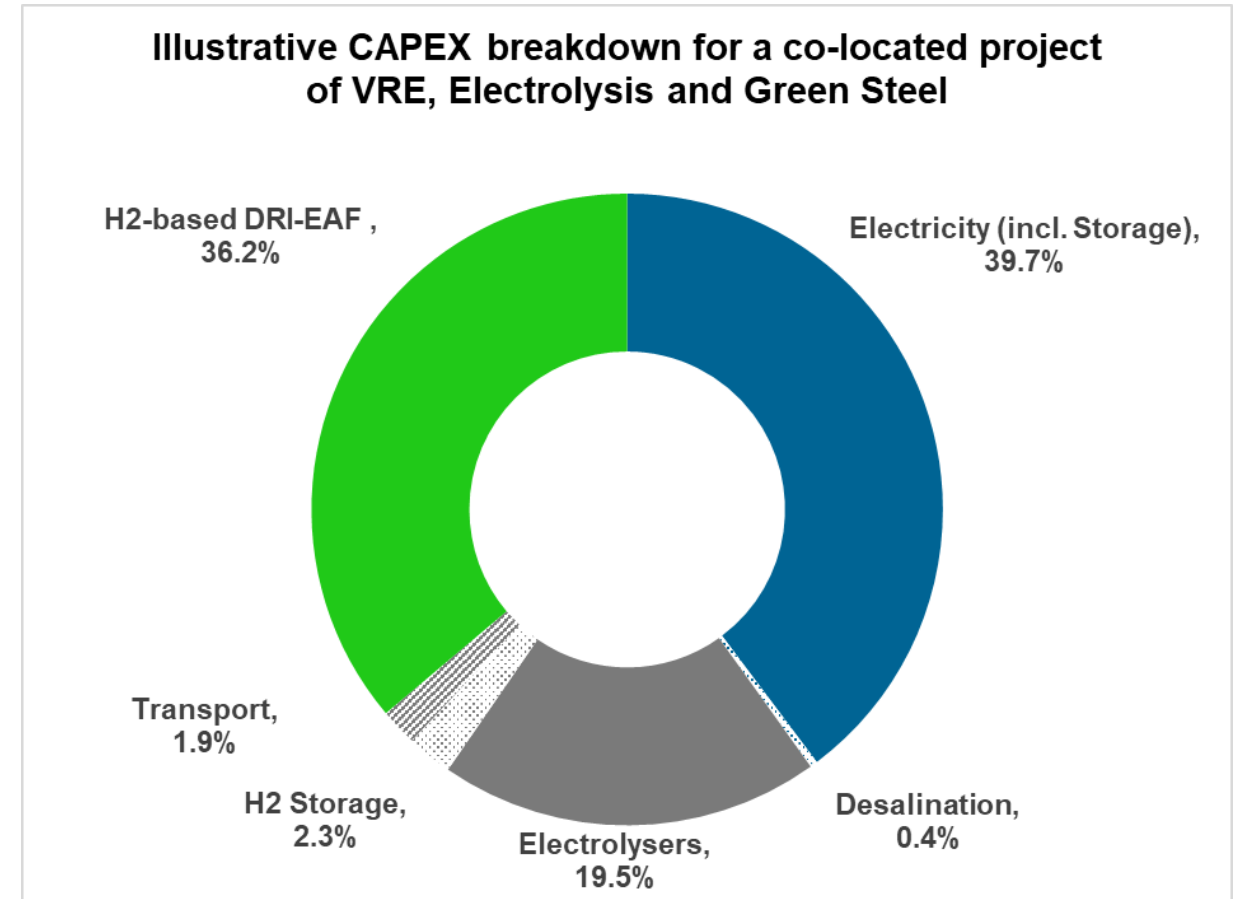
*Support policymakers in pinpointing potential barriers to the creation of an enabling environment*

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



# Illustrative green steel business case (CAPEX)

- **Illustrative business case** for a co-located project of a **greenfield steel plant of 1 Mtpa capacity**.
- The breakdown is sensitive to parameters such as:
  - *the access to renewable electricity sources*
  - *the electricity storage needs;*
  - *the availability of geological storage.*
- **High investment costs along the value chain require to share risks between stakeholders**, via policy instruments, enabling conditions, governance scheme and financing conditions.

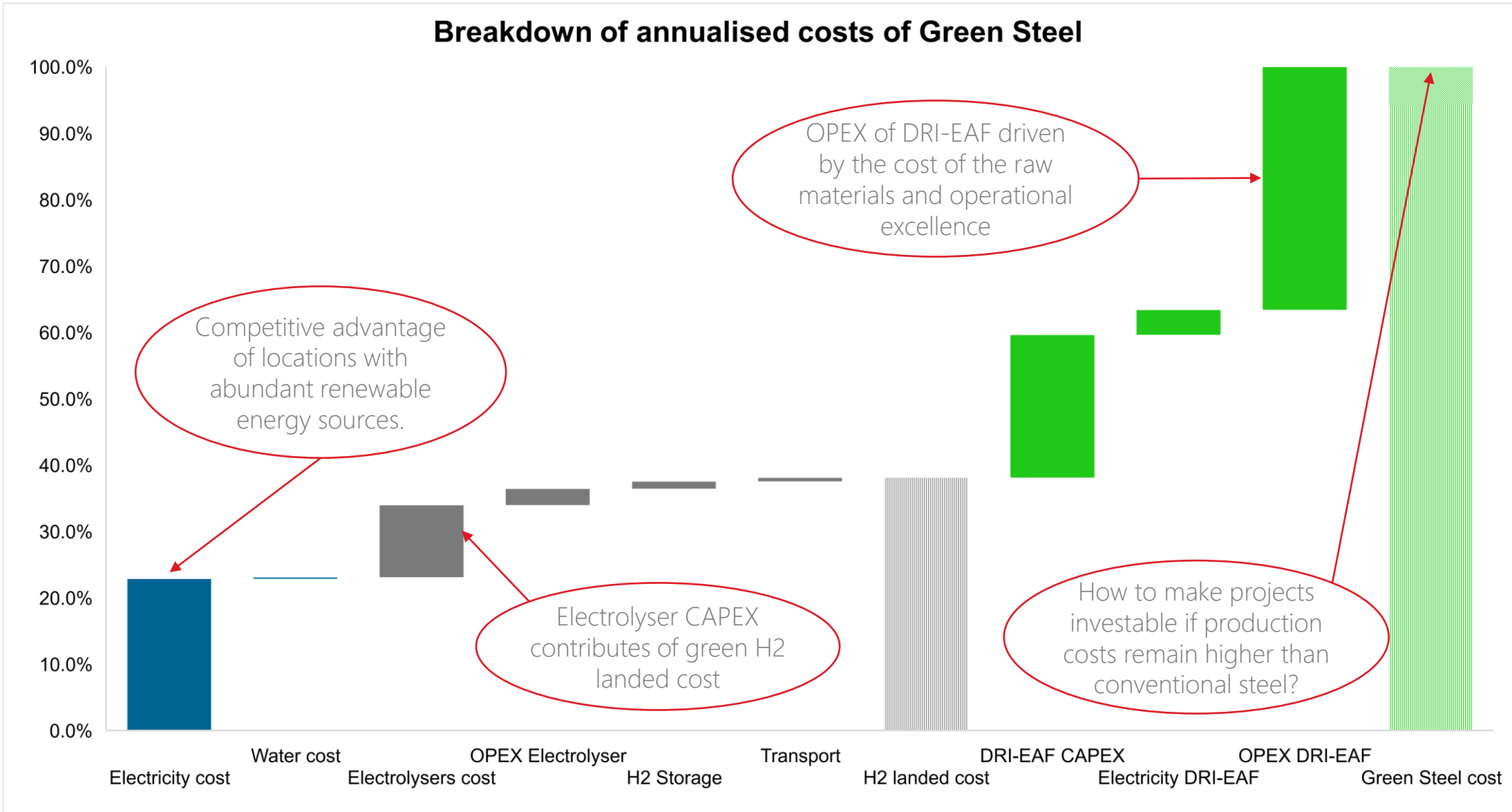


*Illustrative calculation based on 50% solar and 50% onshore wind in a favourable location (LCOE USD 30/MWh), USD 550/kW electrolyser costs, 50% capacity utilisation rate for the electrolyser, and availability of geological storage for H<sub>2</sub>.*



# Illustrative green steel business case (annualised costs).

Actions along the value chain can lower the final cost of green steel.





## 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.



# Possible measures for policy makers to facilitate market creation and market growth

Market creation						Market growth												
Strategy, Governance, Standards			Enabling market measures			De-risking instruments & Financing			Strategy, Governance, Standards			Enabling market measures			De-risking instruments & Financing			
Public sector (incl. DFIs)	Integrated energy roadmap including hydrogen targets and priority sectors			Land allocation			Feed-In tariffs / premiums			Large-scale green hydrogen demonstration projects or hydrogen valleys			Guarantees of origin and tracking system			Regulated Asset Base model / Minimum Revenue Guarantee		
	Infrastructures roadmap and investment planning (transport, storage, ...)			Duty relief on Renewable Energy Assets / Electrolysers			Carbon Contract for Difference			Auctions			Consumption quotas / mandates			Credit enhancement mechanism		
	Climate and renewable energy policies setting national targets			Fossil fuel subsidy reform			Grants/Viability Gap Fund						Tax relief for green products / Surcharge on end products			Subordinated debt		
	Simple licensing process			Public Procurement			Simple licensing process									Blended Finance		
							Subordinated debt											





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