

ASIA CLEAN ENERGY FORUM 2023
Navigating toward
a Carbon-Neutral Future
through Clean Energy Solutions
13-16 June



Spotlight Session

Green Hydrogen: Its Development, Status and Prospects

Thursday, 15 June | 2:00 – 5:30 p.m. (GMT+8)





GREEN HYDROGEN INNOVATION CENTER

Potential and Opportunities

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ISA ADB Technical Assistance Programme



ISA PROGRAMME FOR GREEN HYDROGEN

Objective: To accelerate solar hydrogen production, utilization and trade in ISA member countries



Role of INTERNATIONAL SOLAR ALLIANCE (ISA)

Support in assessment and facilitate solar H2 readiness level in member countries related to-

01.

Enabling policy and regulatory framework

02.

Identifying technological gaps; 'go-to' resources

03.

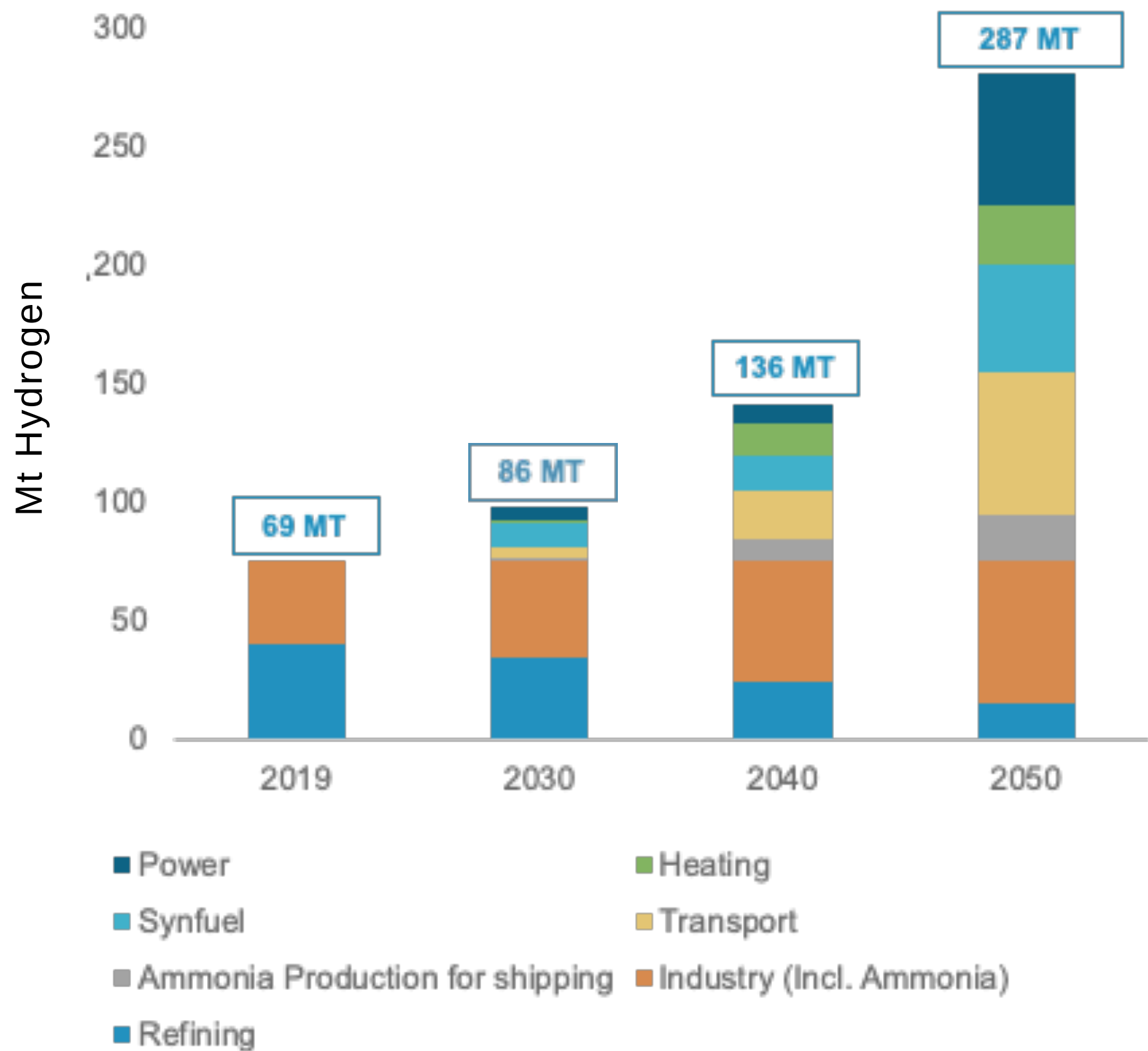
Facilitating investment environment for commercially viable solar H2 projects

04.

Identification of viable projects pipeline across solar hydrogen value chain

05.

Creating global synergies & leveraging partnerships with public and private sector



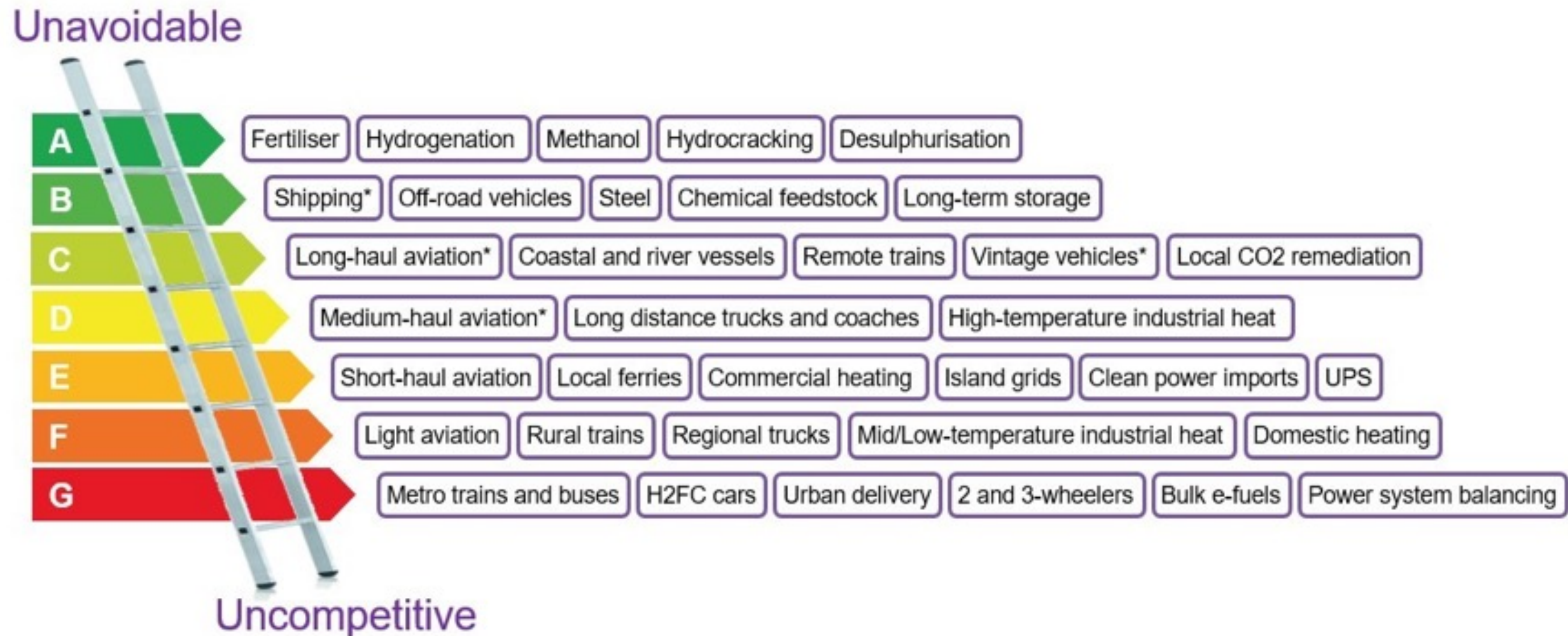
Source: IEA 2022

Green Hydrogen will play a key role in decarbonisation of hard-to-abate sector

- Global H2 demand stood at **94 MT in 2021** - mainly from petroleum refining and production of **chemicals and fertilizers**
- **H2 demand has potential to grow more than 300% by 2050**
- GH currently accounts for **less than 1%** of total hydrogen produced, is expected to **increase exponentially in future**
- With increasing capacity of GH, the **cost of electrolyser is expected to reduce sharply**

Green hydrogen is not a “silver bullet”

GH has inherent value for long-term time-shifting and location-shifting of variable RE. There is a merit order of applications, starting with replacement of grey / black hydrogen in petroleum refining and chemical manufacturing.

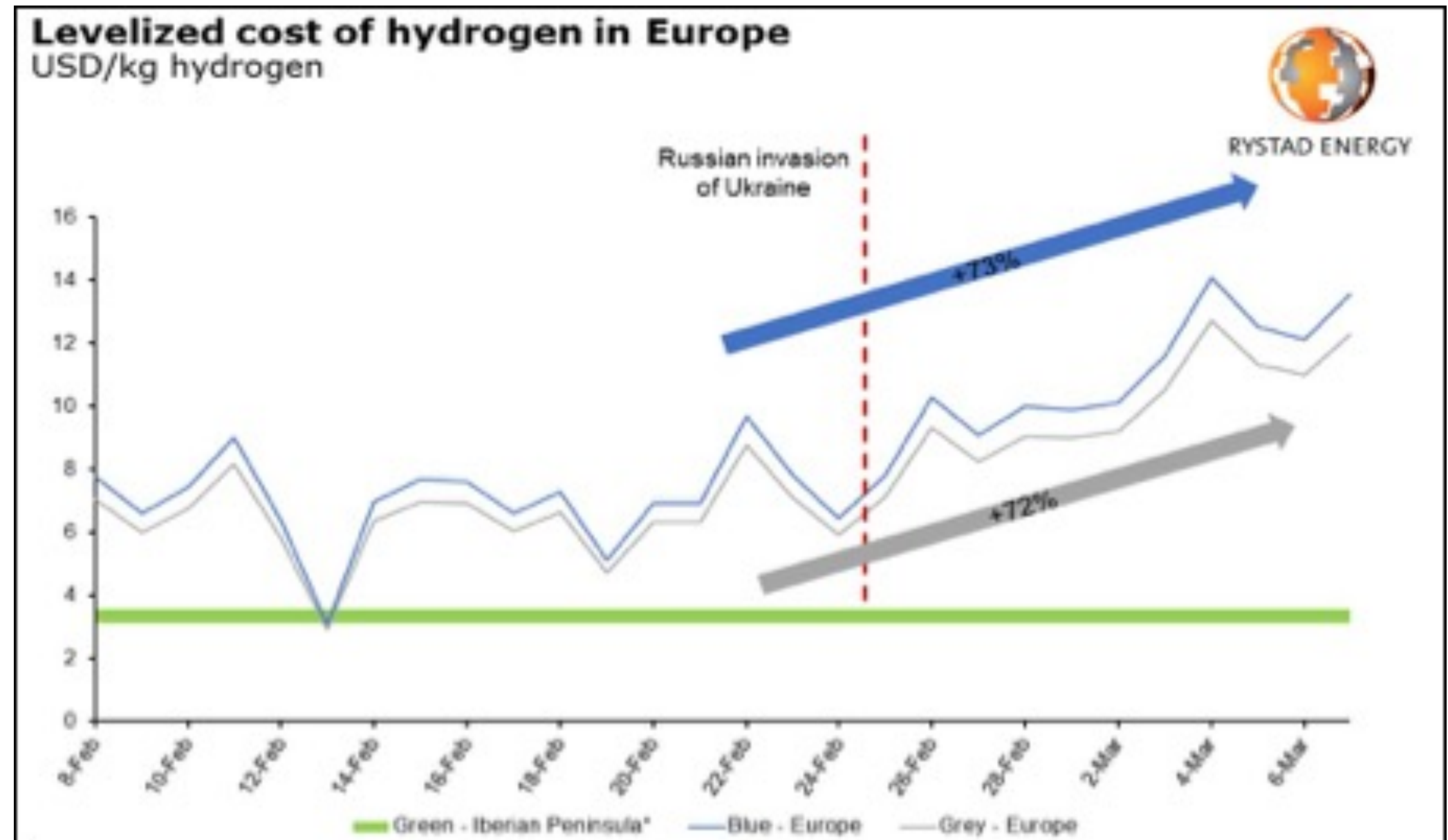


* Via ammonia or e-fuel rather than H2 gas or liquid

Source: Liebreich Associates (concept credit: Adrian Hiel/Energy Cities)

GH was cheaper than grey H2 in Europe last year

- The cost of blue and grey hydrogen in Europe was at USD 8/kg to USD 14/kg a year ago.
- Cost of GH vs. grey / black hydrogen is location-specific
- GH can be as low as USD 3.5/kg today



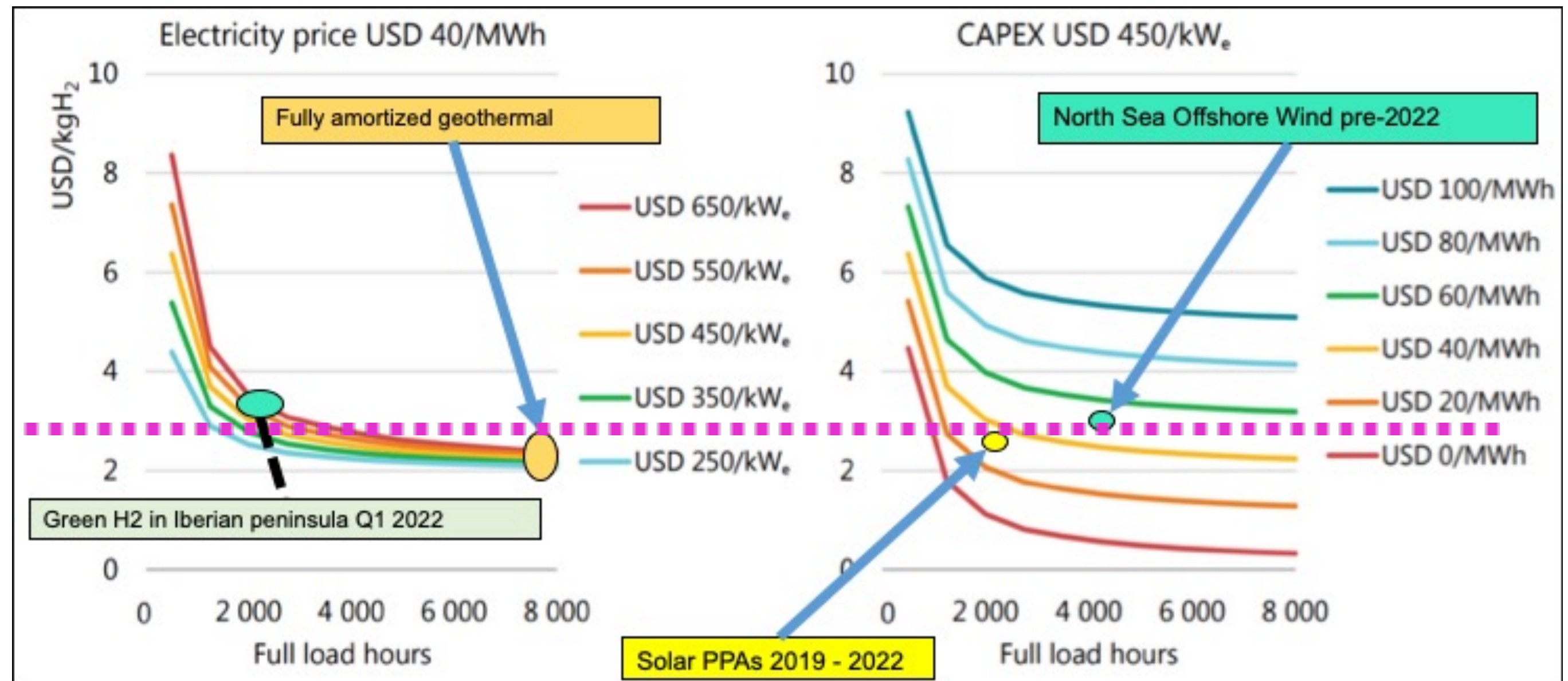
Decreases in fossil fuel prices will directly reduce costs for blue and grey hydrogen, but price volatility should be expected.

GH is inherently modular like solar, wind, and battery storage. Increased deployment will drive down GH production costs!

Costs as low as USD 1.3/kg by 2030 can be expected in regions with excellent RE

GH cost is a function of electricity & electrolyzer costs & load factors

LCOH of \$3 – 3.5/kg appears feasible today: if buyers will pay \$4/kg there is no cost barrier



Difference in CAPEX does not have significant impact on cost competitiveness when utilization is high

Cost competitiveness diverges with higher utilization due to differences in electricity prices

Government leadership and decision-making is critical in GH project development

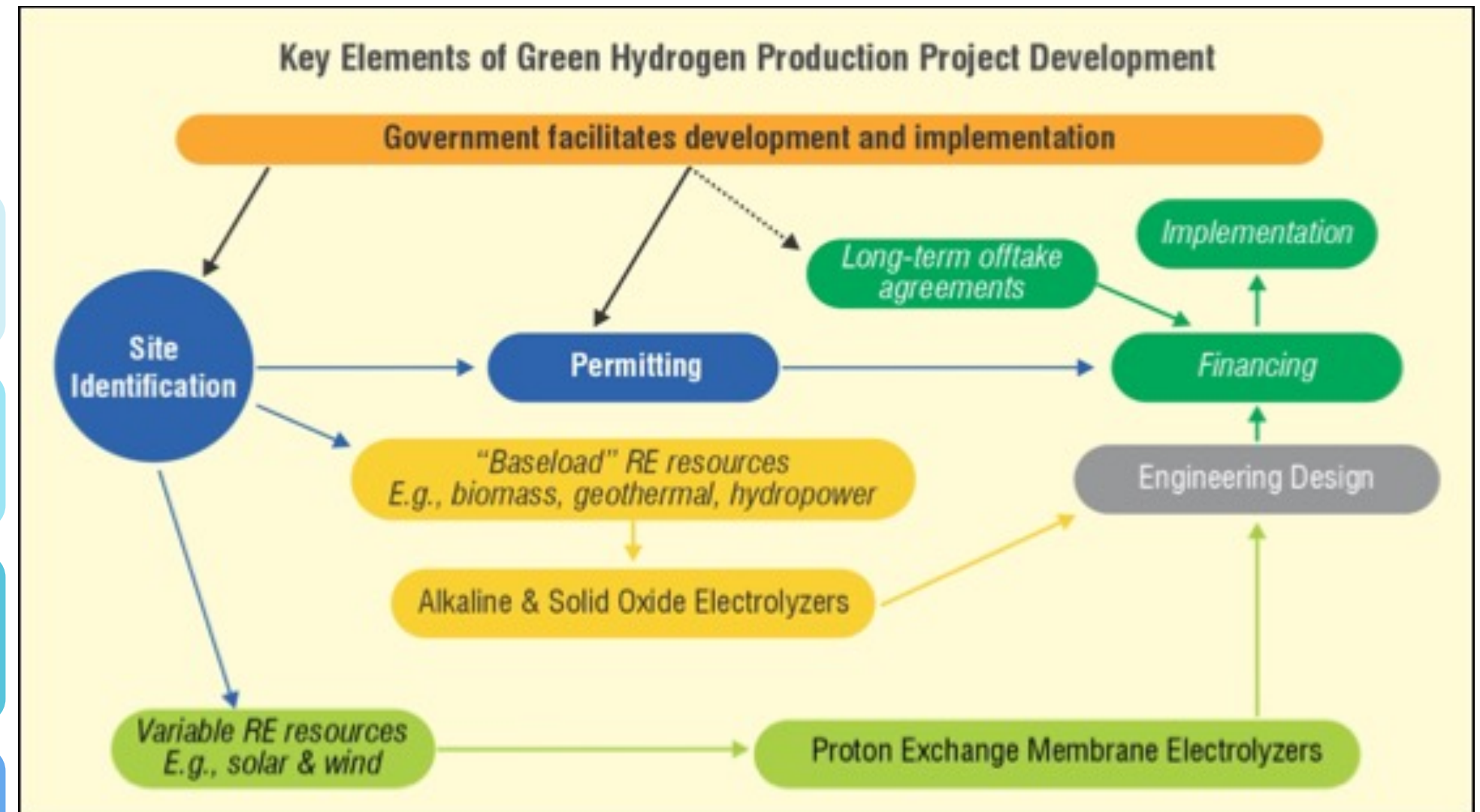
Identify **sites** with good RE sources (solar, wind, hydro etc.)

Choosing appropriate **technology** for electrolysers

Strong government support is needed in **site allocation, permitting and control**

Governments should assist in securing **long-term offtake agreements** for early projects to enable **project financing**

Multilateral agencies such as ISA and ADB can assist in project development through technical assistance and knowledge sharing



ADB can assist governments in RE resource evaluation for site selection, conceptual design, tendering to bring in commercial partners, and financing the major physical components of the project via sovereign and non-sovereign channels, employing blended finance, as necessary.



GREEN HYDROGEN PROGRAMME

Initiatives and Updates

ISA ADB Technical Assistance Programme

Country Level Analysis for Green Hydrogen (ISA- ADB Collaboration)

Key Parameters for readiness level assessment



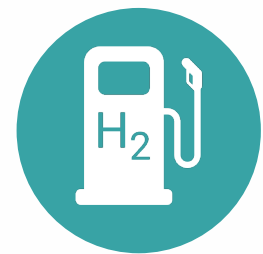
Market Overview

Holistic overview of demand and supply status and projections for GH



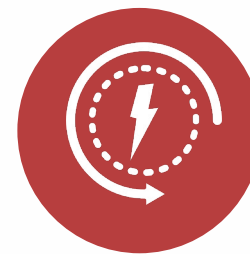
Renewable Energy Assessment

Installed Capacity of Renewable Energy.
Solar and Wind Energy Potential



Green Hydrogen Pipeline

Number of projects in pipeline within the country



Hydrogen Consumption

Analysis of current hydrogen consumption
Potential of replacing H2/other fossil fuels with green hydrogen



Strategic Intent

Net-zero commitments
Monetary commitments
Regulations and Standards
Mandates and Targets
Strategy or Roadmaps

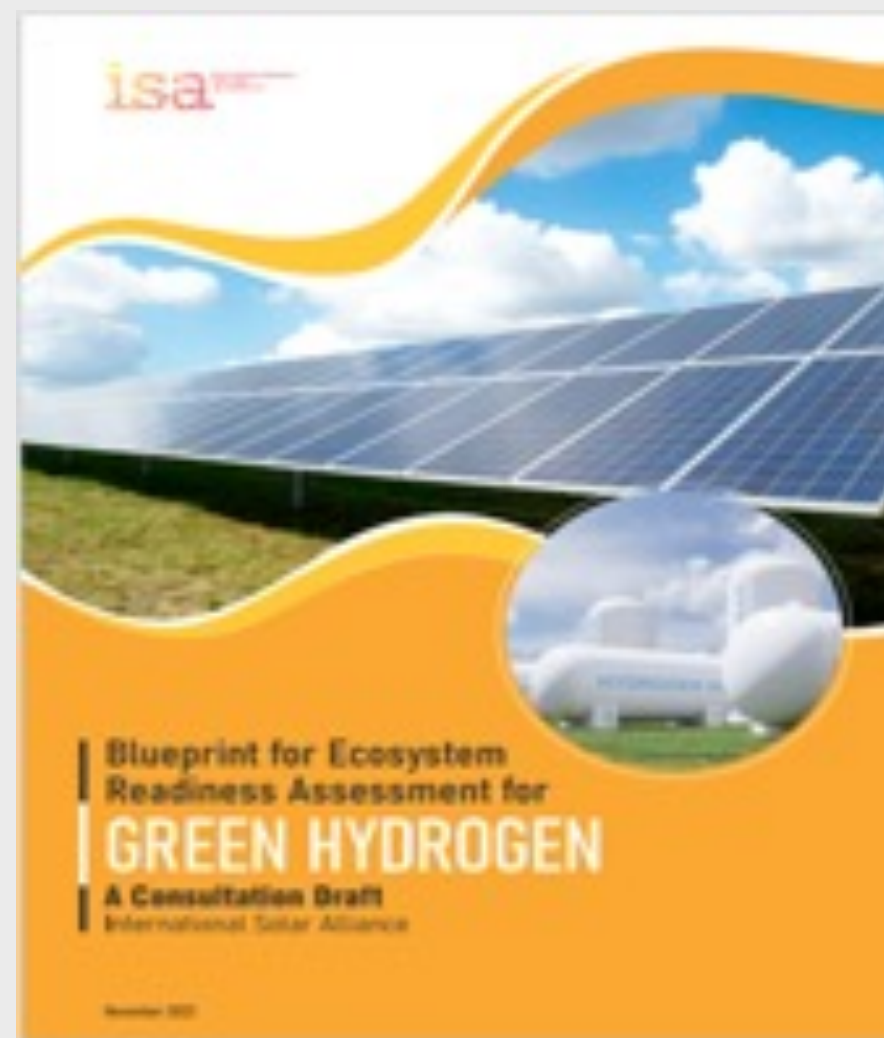


Experience with Infrastructure

Fuel Handling Infrastructure: Existing
Infrastructure of pipeline, storage, liquefaction, gasification and transportation within the country and its ports

REPORTS

Report on framework to self assess ecosystem readiness in countries to adopt GH2



Report launch at COP27, Sharm El-Sheikh, Egypt

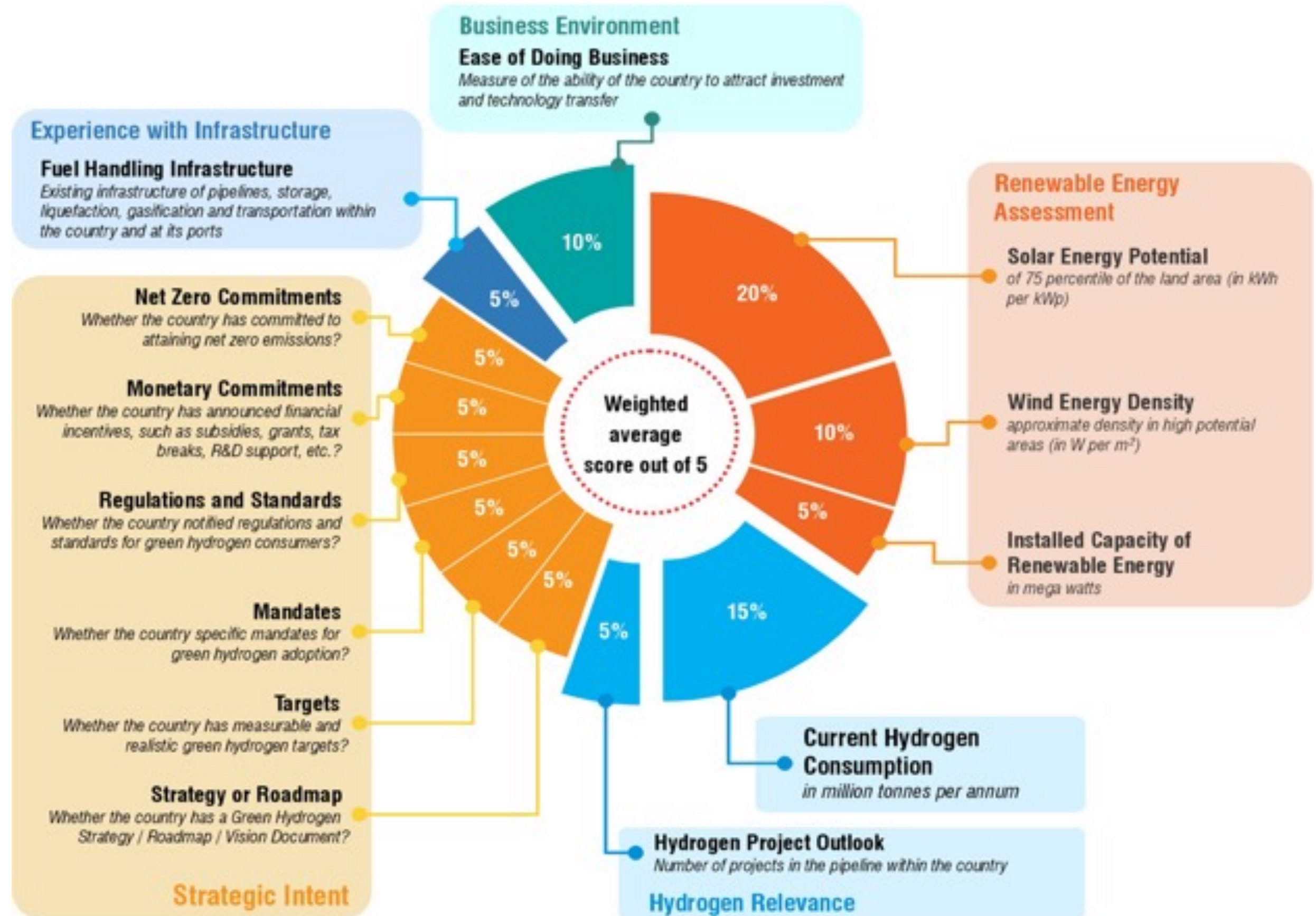
Africa's Extraordinary Green Hydrogen Potential (ISA-EIB-Africa Union)



Report launch at COP27, Sharm El-Sheikh, Egypt

Mauritania, Morocco, southern Africa and Egypt show high potential

**ISA -ADB
framework to
assess
ecosystem
readiness in
countries to
adopt GH2**



ISA –ADB framework to assess ecosystem readiness in countries to adopt GH2

Frontrunners

- Announced structured policy for GH, with clear roadmaps, realistic targets
- Strong alignment for GH among stakeholders
- Moderate-to-strong installed RE solutions
- Strong experience with relevant infrastructure

Progressives

- RE rich countries and proximity to ports
- Some countries have strategies with targets, timelines, and monetary commitments
- Lack of standards and certifications
- Moderate experience with relevant infrastructure

Prospectives

- Excellent RE generation potential
- Exhibit some strategic intent – nascent strategy / roadmap
- Low levels of RE deployment
- Announced Net – zero targets

Potentials

- Early movers with lack of strategic intent fairly
- Favorable environment for business
- Availability of infrastructure
- Need to strengthen their RE base



ISA SUPPORT TO G20

2023

As countries develop green hydrogen ecosystems, there is a necessity for a knowledge repository that tracks global progress and provides up-to-date information, and learning.

Global Center of Excellence for Green Hydrogen: A one-stop platform with country-level insights and knowledge repository

Creation of GCoE for GH can help countries in various aspects, the three main pillars of support are detailed below

Knowledge dissemination

Green Hydrogen – GCoE to serve as a one-stop knowledge repository on various topics of Green Hydrogen like:

- Global projects
- Case Studies
- Reports
- Research publications

Best Practices & Learnings

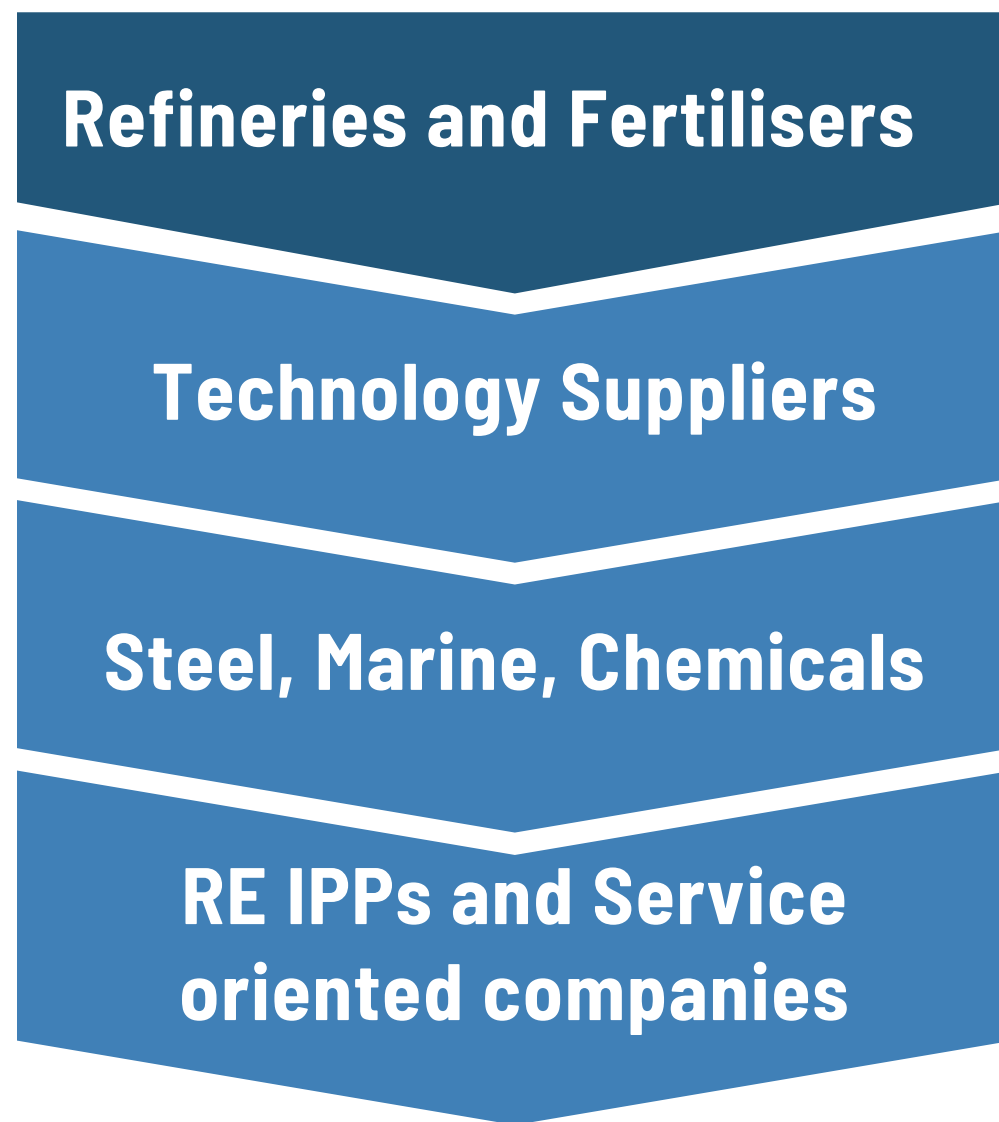
- Access country policies, regulations, standards and code through the portal
- Outreach to stakeholders
- Portal to provide country-level insights for green hydrogen along with potential and demand of the green hydrogen

Knowledge dissemination

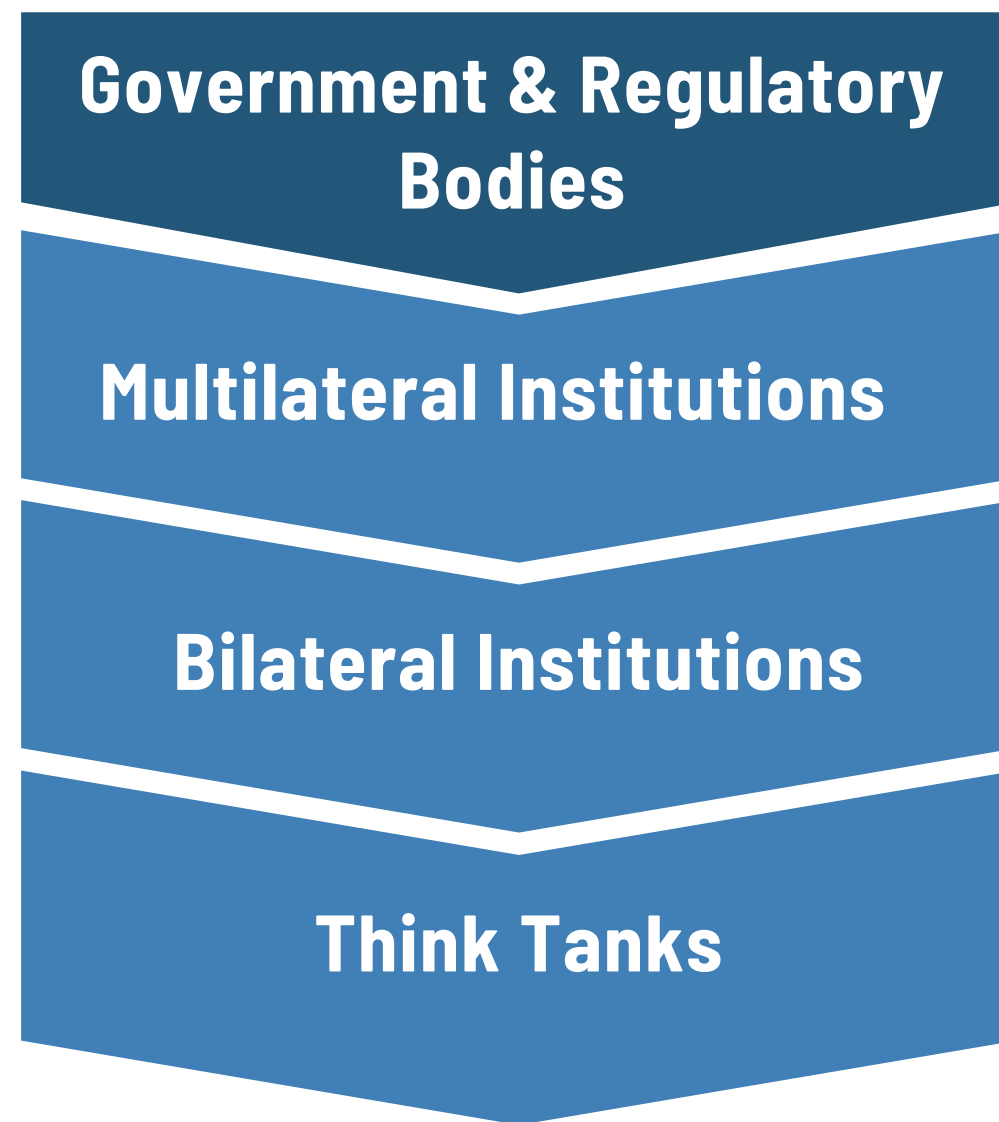
Green Hydrogen – GCoE will aid developers in providing details about OEMs for Electrolyzers, Fuel Cells, Storage providers, and their products, along with EPC/system integrators, and later identifying possible financing partners

Entire energy community to benefit from Global Center of Excellence for Green Hydrogen

Demand and Supply Actors



Policy Makers and Financiers



Research and Trainings



How GCoE for Green Hydrogen will be different?

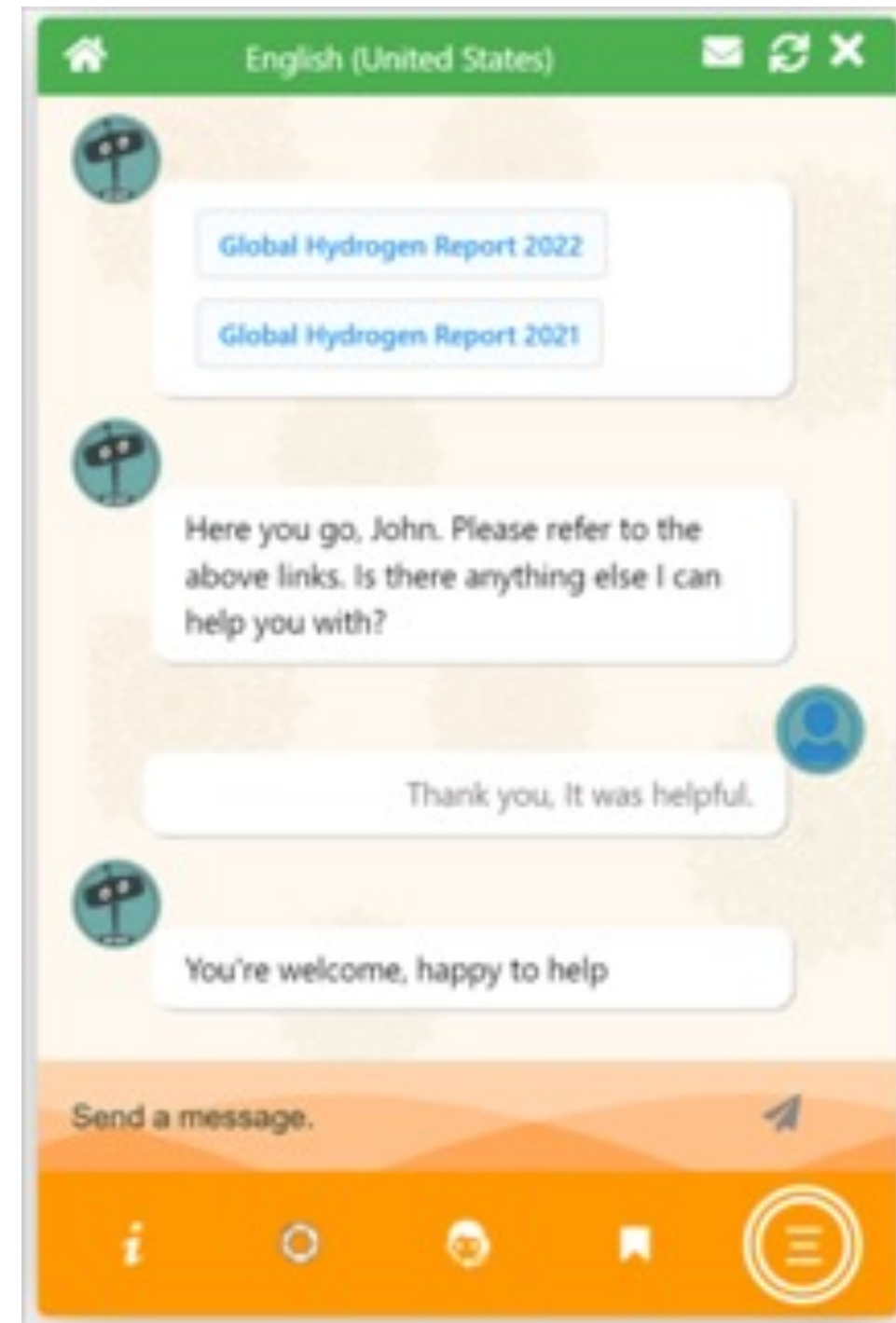
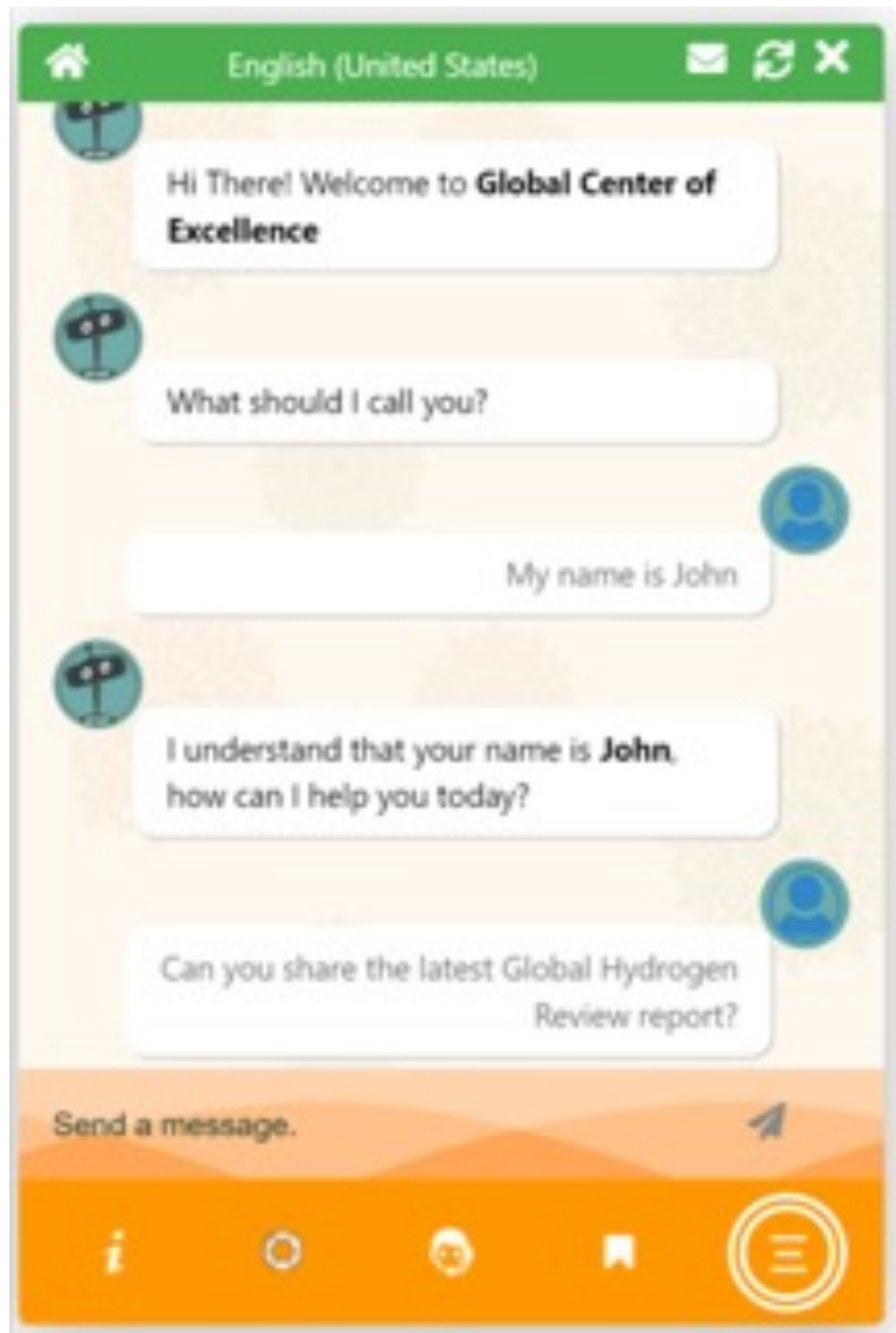
GH portals	Knowledge hub	Resources & Initiatives	Country Studies (Deep- dive analysis)	Trainings	Events	AI & ML Chatbot	Community	Country Insights & Datasets
H2 council	●	●	●	●	●	●	●	●
European commission	●	●	●	●	●	●	●	●
IRENA	●	●	●	●	●	●	●	●
IEA	●	●	●	●	●	●	●	●
HAI	●	●	●	●	●	●	●	●
GBEP	●	●	●	●	●	●	●	●
GH association	●	●	●	●	●	●	●	●
GHIndia	●	●	●	●	●	●	●	●
IPHE	●	●	●	●	●	●	●	●
GCoE- GH	●	●	●	●	●	●	●	●

● Available

● Not Available

Progress update- GCoE for Green Hydrogen

Phase 2- Web Development/ Screen Shot



- **AI-Chatbot:** This portal will be fully integrated with an Artificial Intelligence (AI) chatbot. The chatbot will answer all clarifications and queries of the user.
- The AI will direct the question, when required, to the host organization for a suitable solution.
- The machine learning algorithm used in this understands the user behavior and enhances the result accordingly.

Progress update- GCoE for Green Hydrogen

Phase 3- Content Development/ Screen Shot

Home Knowledge Center Country Insights GCoE Initiatives Outreach Events Skill Development Financing Newsroom Tools

Hydrogen Overview

GENERAL INFORMATION

The Paris Agreement under the UNFCCC has renewed the global commitment to limit temperature rise to 1.5°C and atmospheric carbon dioxide (CO₂) concentrations to 400.2 parts per million (ppm). The Agreement calls for concerted global efforts for rapid economy-wide decarbonization, if the Paris goal is to be fulfilled, actions that are immediate and tangible need to be taken globally. Growing number of countries are pledging Net Zero emissions by mid-century, which is a positive development for climate change mitigation.

Energy transformation in electricity generation has accelerated significantly since the turn of the century, and growth in renewable energy, particularly solar PV, in the electricity sector is consistently displacing traditional fossil fuels in nearly all the mature electricity markets. The International Energy Agency (IEA) estimates that renewable energy is set to account for almost 95 percent of the increase in global power capacity through 2026. The amount of renewable capacity added over the period of 2023 to 2026 is expected to be 30 percent higher than from 2015 to 2020, driven by stronger support from government policies and more ambitious clean energy goals. Rapid scale of renewable energy deployment has been a critical enabler for economies of scale and consequent precipitous drop in the levelized cost of electricity of the associate technologies. Solar PV, without energy storage, is now amongst the cheapest source of electricity in large markets where government policy and regulatory frameworks support renewable energy development in general, and solar in particular (e.g., India).

Overview

In 2021, however, the share of electricity in global final 2 consumption of energy was only 20.4 percent. It is expected to increase to around 50 percent by 2050. Thus, there is clearly a need to decarbonize other forms of energy usage in hard-to-abate sectors to keep the goal of 1.5°C alive, which was reiterated at COP 26. Hard-to-abate sectors encompass steel, cement, chemicals (including fertilizer), long-haul road transport, maritime shipping, and aviation.

Key Role

Usage

Home Knowledge Center Country Insights GCoE Initiatives Outreach Events Skill Development Financing Newsroom Tools

Global supply and demand

Global Center of Excellence for Green Hydrogen

Global demand for hydrogen has increased since the 1980s, and as of 2021, demand is more than 94 MTPA and is growing currently at ~five percent. Most of the hydrogen currently being consumed is produced from fossil fuels (more than 90 percent) and the cost of production is based on local market costs of coal and natural gas. China is the world's largest consumer of hydrogen, with demand of around 28 Mt in 2021, followed by the United States and the Middle East, both at 12 Mt of hydrogen demand in 2021. Europe and India trail with a demand close to 8 Mt each.

The future growth of GH is expected to be led by the increased usage in current as well as emerging applications. Global hydrogen demand has potential to grow more than threefold by 2050.

Global Hydrogen Demand (Mt)

Year	China	United States	Middle East	Europe	India	Rest
2019	28	12	12	8	8	10
2020	28	12	12	8	8	10
2021	28	12	12	8	8	10

Global Hydrogen Supply (Mt)

Year	Power	Synthetic	Industry Production for shipping	Transport	Heating	Industry (incl. Ammonia)
2019	50	0	0	0	0	0
2020	50	0	0	0	0	0
2040	50	50	50	50	50	50
2050	50	100	100	100	100	100

ROLE OF HYDROGEN

Way forward

Holistic overview of the green hydrogen sector and its development

01**Stakeholder discussions on Ecosystem Readiness Framework****02****Deep dive country level consultations to assess GH readiness for accelerated deployment****03****Assess viability of current global solar/green hydrogen sector in ISA member countries, including India****04****Develop roadmap for production/deployment of solar/green hydrogen across identified ISA member countries through 2030, 2040, and 2050****05****Identify ready-to-invest opportunities across various end-use sectors across identified ISA member countries and provide recommendations****06****Identify stakeholders - across ISA membership, peer organizations, industry associations**

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