

# Green Hydrogen in the Energy Transition; prospects and opportunities

## Dialogue with GESEL, Brazil

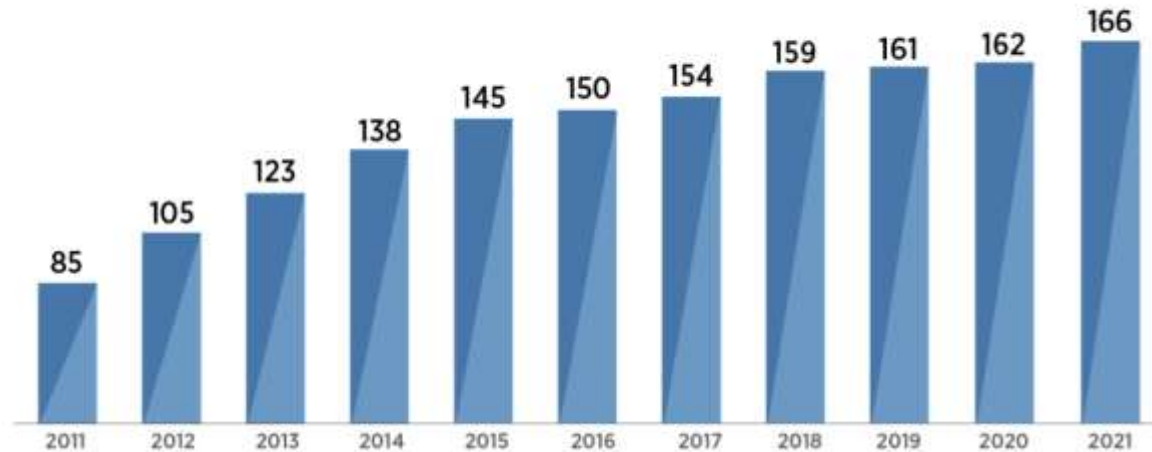


Barbara Jinks – Programme Officer, green gas delivery and use  
Pablo Ralon – Programme Officer, renewable energy cost status and outlook

Webinar, 16 December 2021

- 1. Overview of IRENA activities**
- 2. Role of hydrogen in the energy transition**
- 3. Electrolysis cost reduction**
- 4. Enabling Measures Roadmaps**
- 5. Conclusions**

Growth in IRENA Membership



Promote renewable energy (including gases).

Policy advice through scientific analysis, collaboration and dialogue.

Green gas team aims to increase awareness and dialogue on green gases (H<sub>2</sub>, biomethane, synthetic methane)

- Molecules essential for successful energy transition
- Gas business and infrastructure have key role in energy transition



# IRENA's work on green hydrogen since 2018

## Analysis/Reports

- 2018 Hydrogen from Renewable Power – technical outlook
- 2019 Hydrogen: A renewable energy perspective
- 2020 Reaching Zero with Renewables (Sep)  
Green hydrogen: a guide to policy making (Oct)  
Green hydrogen: electrolyser for cost reduction (Dec)
- 2021 Innovation Outlook: renewable methanol (Jan)  
Green hydrogen supply: a guide to policy making (May)  
Reaching Zero with renewables: Biojet Fuels (Jul)

## Outreach

- 2019 Ministerial Roundtable on Green Hydrogen at 10<sup>th</sup> Assembly (Jan)
- 2020 **Collaborative Framework on Green Hydrogen launch, meetings Jun & Sep**  
Biennial IRENA Innovation Week: green hydrogen session (Oct)  
Policy Talk - policies for green hydrogen (Nov)
- 2021 Policy Talk - Green Hydrogen Supply: policies & practical insights (May)  
**Collaborative Framework on Green Hydrogen, meetings May, Oct**  
**Launch Enabling measures Roadmap at COP 26 (Nov)**



# Collaborative Framework on Green Hydrogen

Established June 2020 to **foster dialogue between governments and private sector and consolidate voice of private industry to present to Members.**

**Co-facilitators are EC and Morocco**

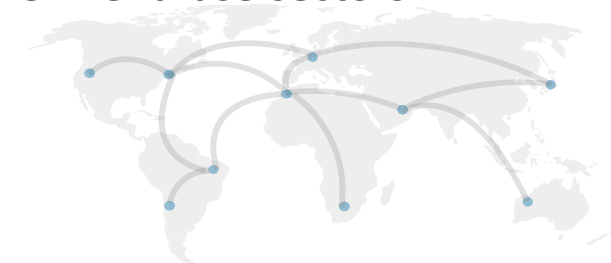
## Activities:

- 4 virtual meetings (with up to 70 Member countries)
- 4 additional panel discussions, workshops
- Collaboration with WEF, IPHE, Hydrogen Council
- Wider involvement from stakeholders; academia, private sector and associations
- Establishing Working Groups on priority issues
- Next meeting 1Q22

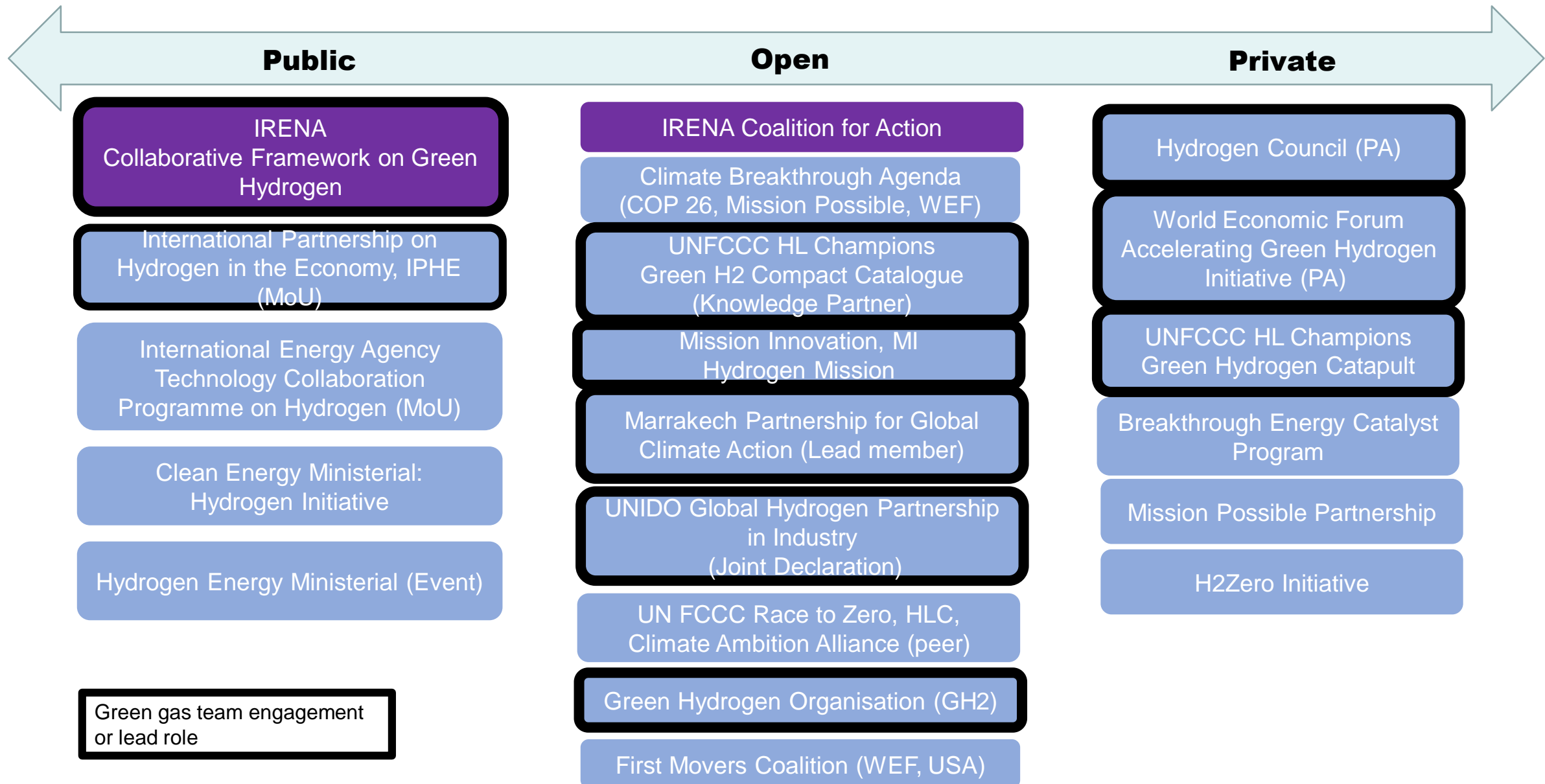


## Mandate and strategic direction from Members:

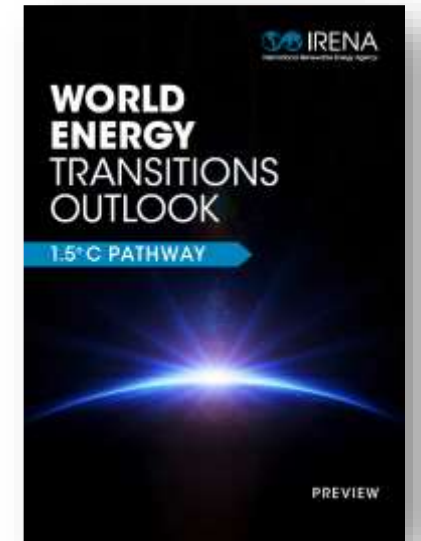
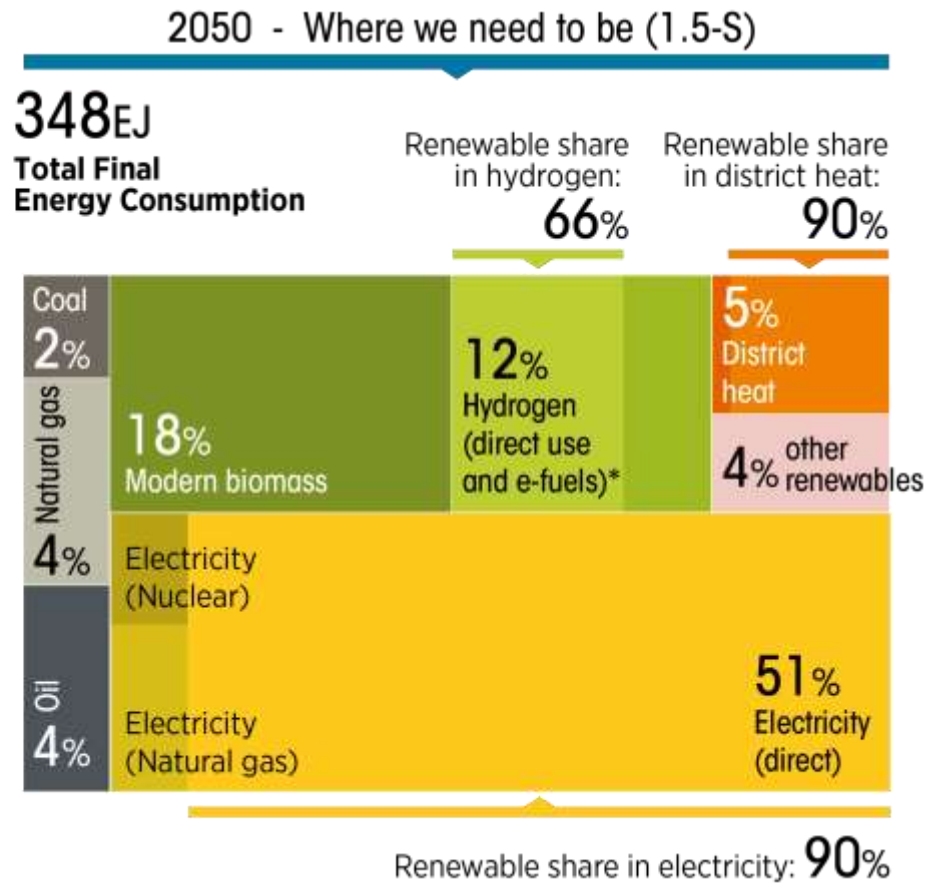
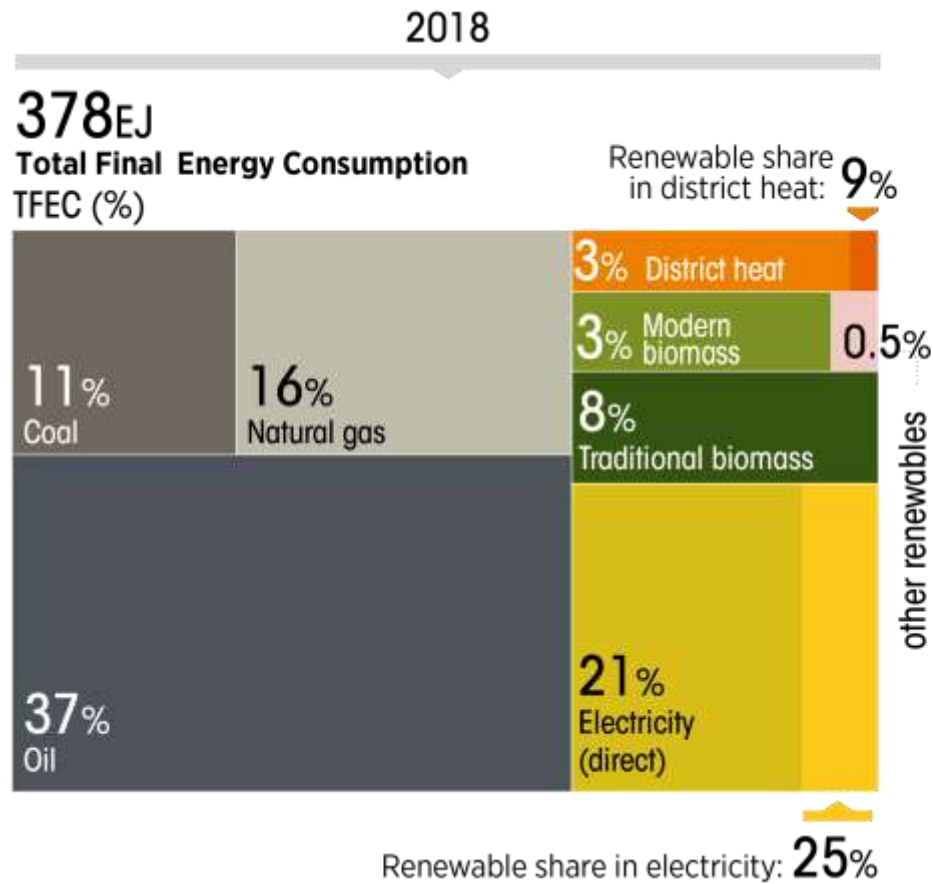
- Establish a global knowledge database for green hydrogen
- Strengthen collaboration with stakeholders and share knowledge incl finance, transportation, safety, applicability of hydrogen in small markets (such as SIDS)
- Evaluate nexus between hydrogen and renewables and flexibility from coupling power and hydrogen
- Coordinate standards and regulatory frameworks
- Stimulate early uptake in end-use sectors



# Green Gas Team engaged in all global hydrogen initiatives



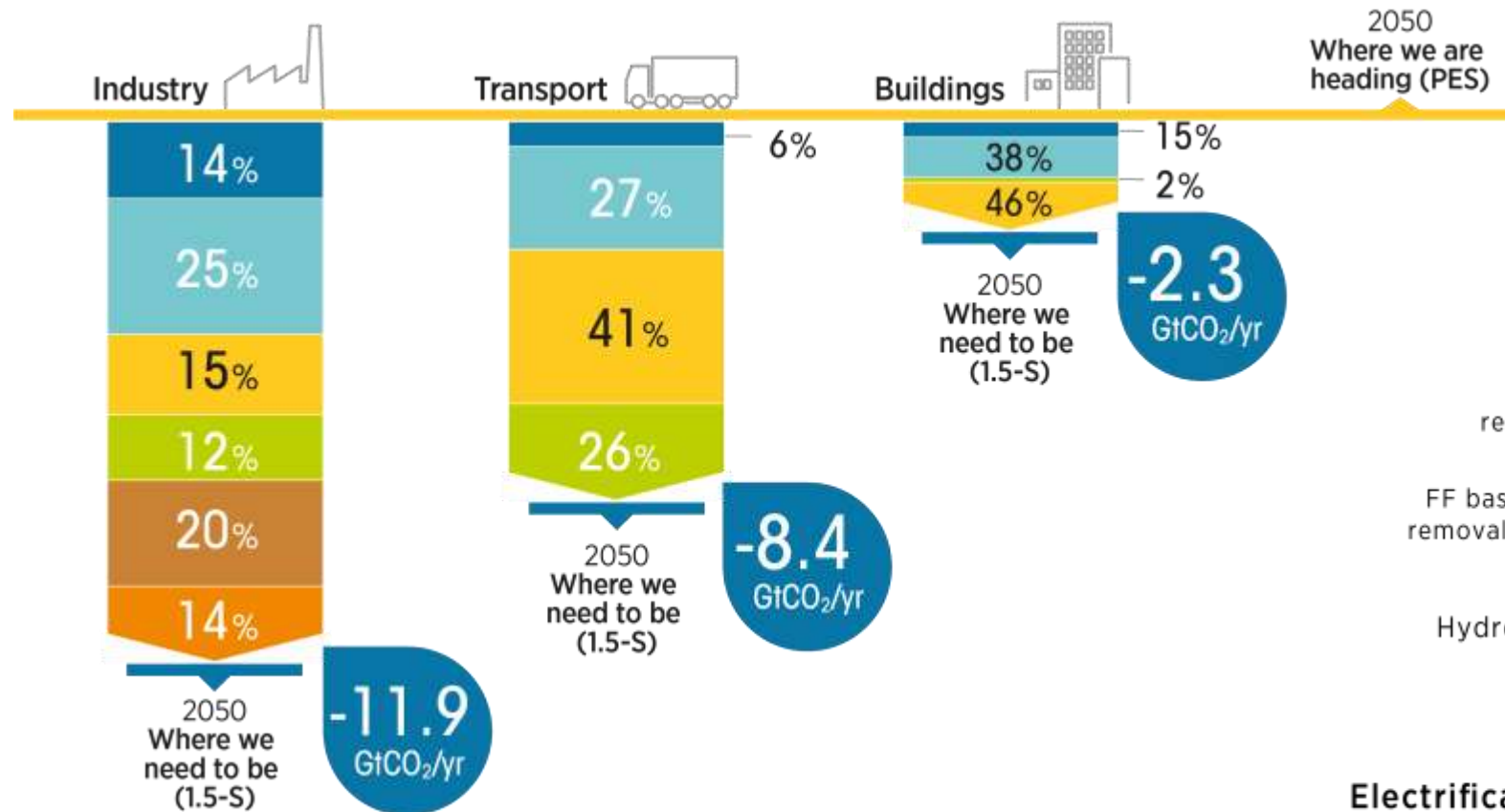
# World Energy Transitions Outlook (WETO) 2021



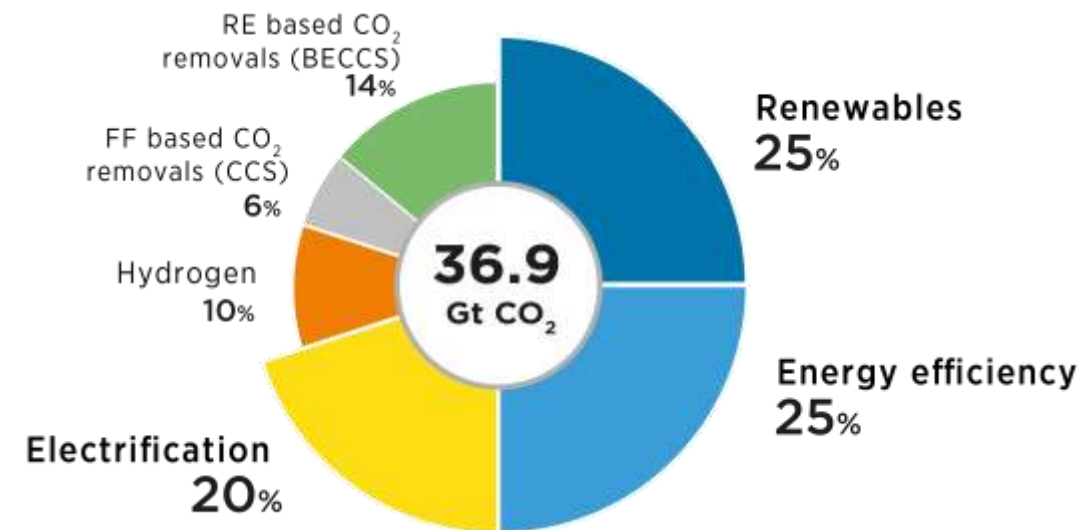
Electricity is main energy carrier in 2050 but nearly half of energy use cannot be electrified

Hydrogen has a role in reducing emissions from HTDS of aviation, heavy transport and heavy industry

## End-use CO<sub>2</sub> reduction by electrification and green H<sub>2</sub>



## Six components of the energy transition strategy



Hydrogen has a role in reducing emissions from HTDS of aviation, heavy transport and heavy industry

Nearly 70% hydrogen will be green hydrogen from renewable energy

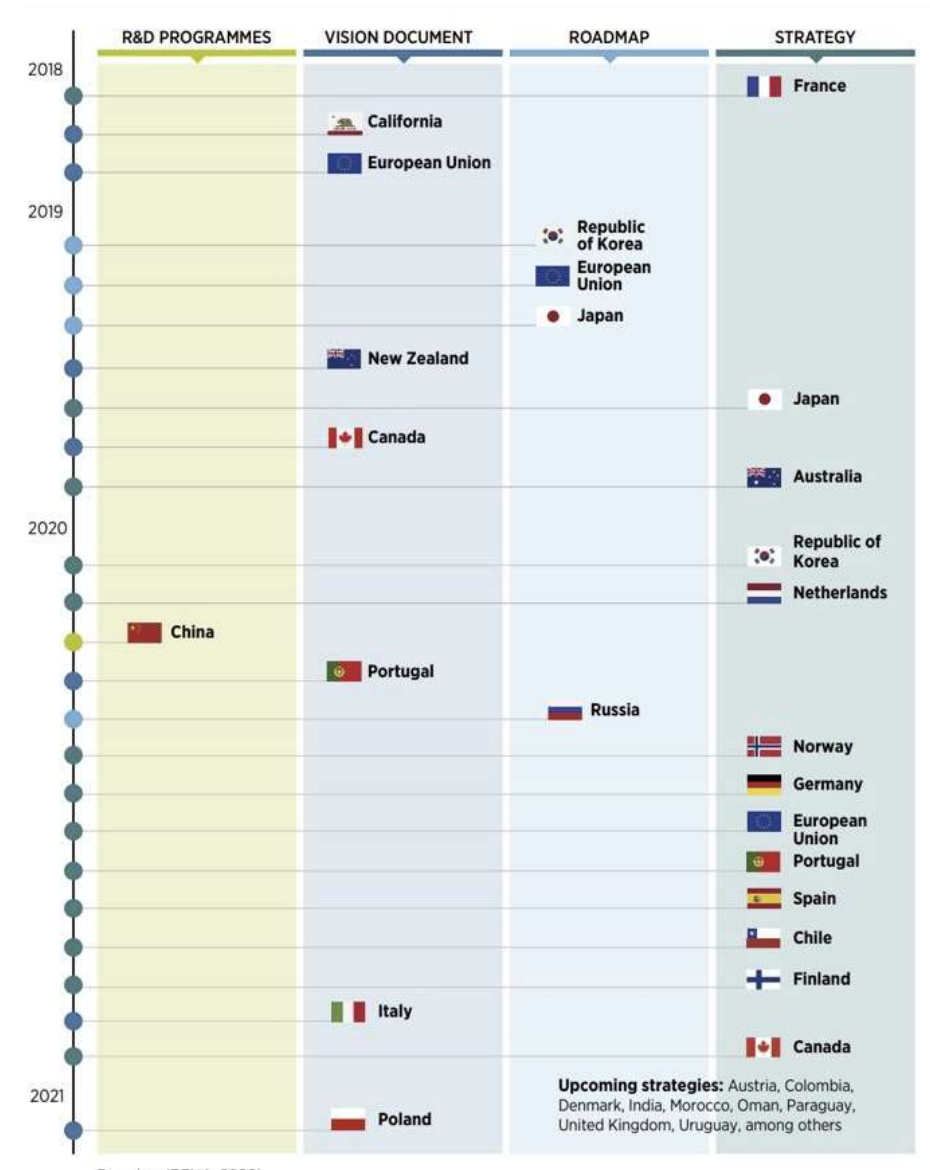


# Growing global commitment to develop green hydrogen

19 National Hydrogen Strategies issued to date

Over 30 UN Energy Compacts for green hydrogen

- 268 GW new renewable capacity by 2030
- 129 GW of new electrolyser capacity by 2030 (26MTpa)
- Brazil has submitted GHC – ambitions in R&D and knowledge and capacity building



# Hydrogen projects around the world

121 GW green hydrogen capacity under development.

85% projects in EU & Asia.

Forecast electrolysis scale up from sub-10 to 100-500 MW by 2026.

Over US\$300 Bn project investment. [Hydrogen Council](#)

Green H<sub>2</sub>; 136 projects in plan/devt phase. Largest cluster 136 projects in Australia. [Upstream](#)

Around the world hydrogen projects of unprecedented scale are being announced across the entire value chain, with 85% located in Europe, Asia and Australia



**228** announced projects

- 126** Europe (55%)
- 46** Asia and China (20%)
- 24** Oceania (11%)
- 19** North America (8%)
- 8** Middle East and Africa (4%)
- 5** Latin America (2%)

**17**  
**Giga-scale production**  
Renewable H<sub>2</sub> projects >1GW and low-carbon H<sub>2</sub> projects >200 kt p.a.

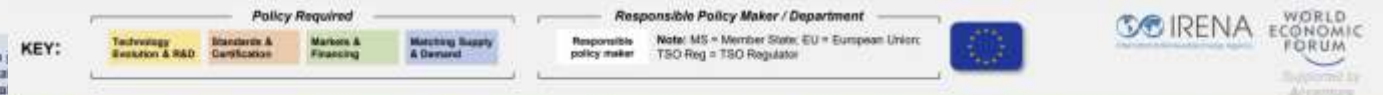
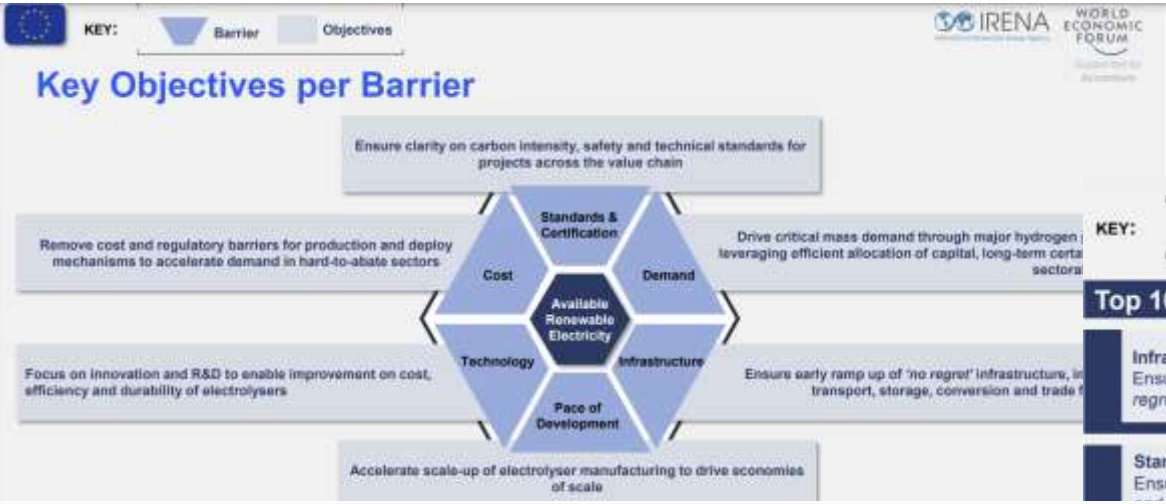
**90**  
**Large-scale industrial usage**  
Refinery, ammonia, methanol, steel, and industry feedstock

**53**  
**Transport**  
Trains, ships, trucks, cars and other hydrogen mobility applications

**45**  
**Integrated H<sub>2</sub> economy**  
cross-industry, and projects with different types of end-uses

**23**  
**Infrastructure projects**  
H<sub>2</sub> distribution, transportation, conversion, and storage

# Enabling Measures Roadmaps for Green Hydrogen



## Top 10 Objectives and supporting Enabling Measures to scale the green hydrogen market (2/2)

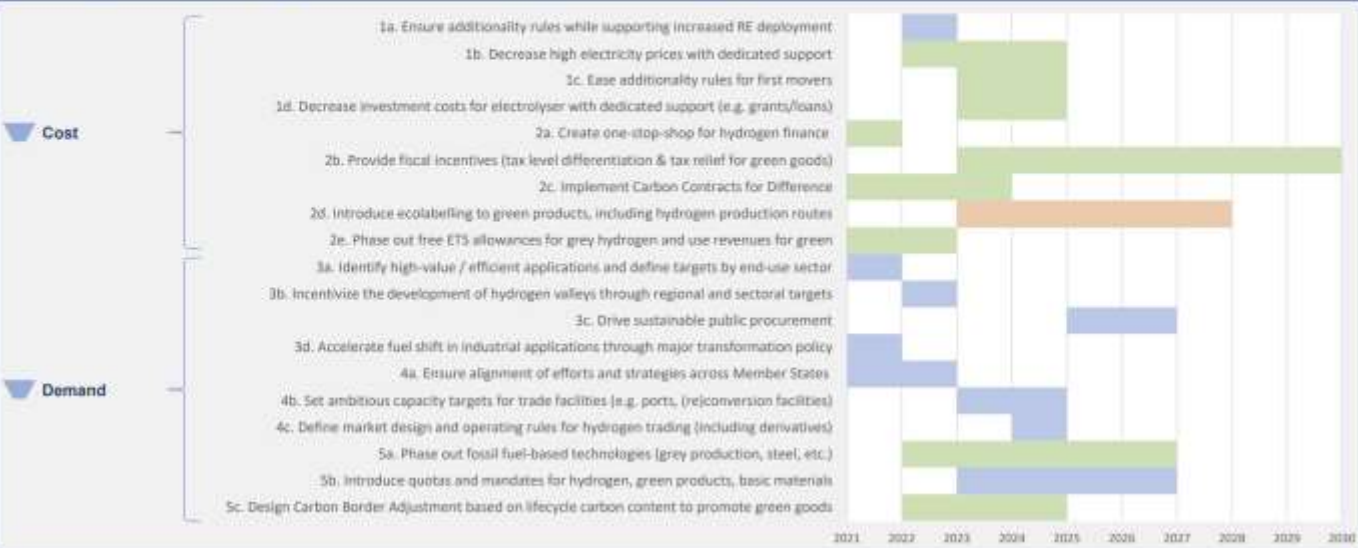
**Infrastructure:** Ensure early ramp up of 'no regret' infrastructure

- 6a. Clarify governance of the hydrogen transmission network (TSO Reg EU)
- 6b. Set up a flexible regulatory framework adjustable based on market developments (TSO Reg EU)
- 6c. Integrate long-term planning of hydrogen, power and gas infrastructure (TSO Reg EU)
- 6d. Specify interoperable quality standards and definitions (TSO Reg EU)
- 6e. Introduce capacity payments to support ramp-up of infrastructure (TSO Reg EU)

**Standards & Certification:** Ensure clarity on technical

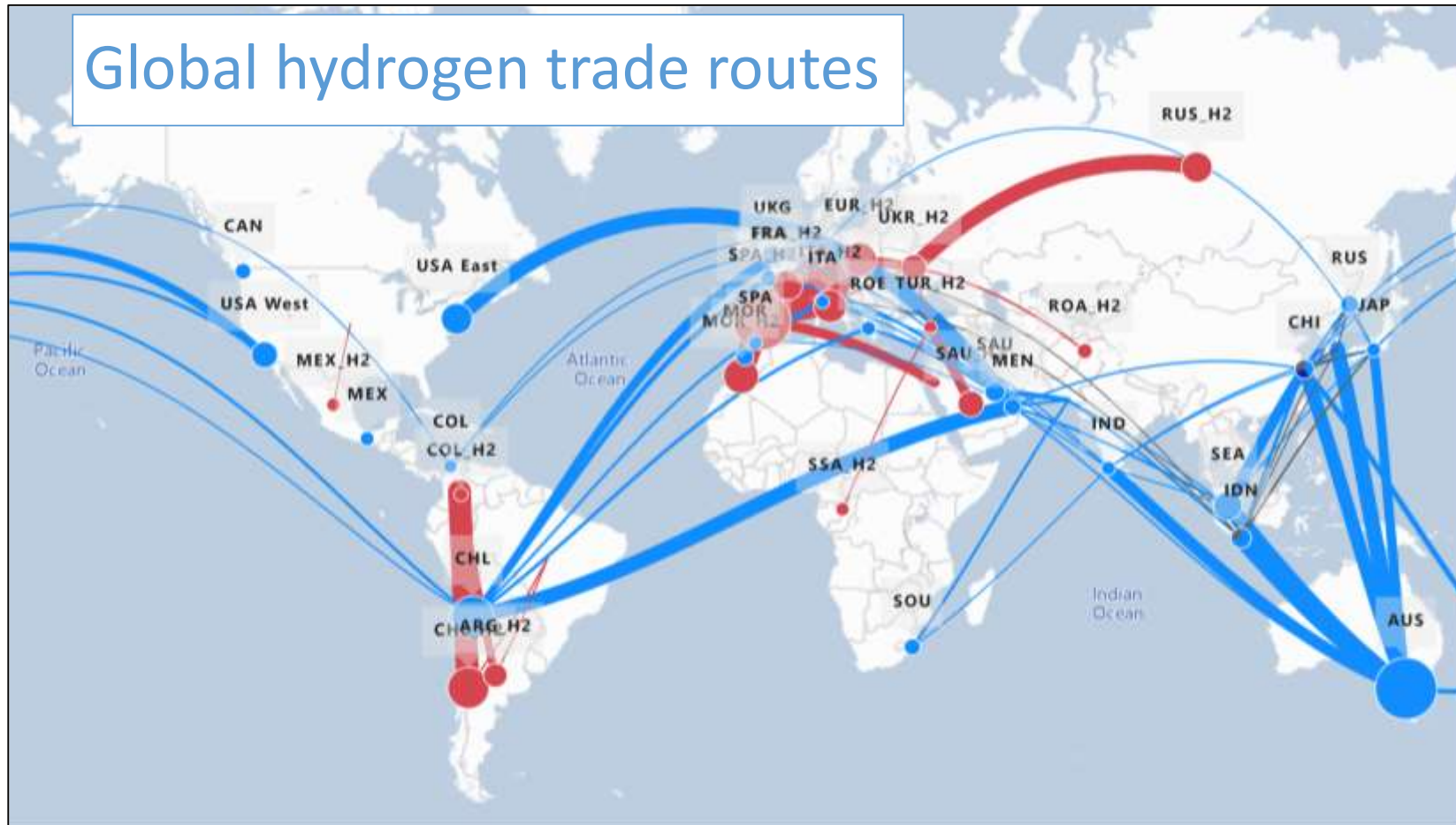
- 7a. Define technical standards for new parts of the value chain beyond production (transportation, storage, conversion)\* (Industry EU)
- 7b. Define technical standards for hydrogen derivatives (e.g. ammonia, synthetic fuels)\* (Industry EU)
- 7c. Develop safety standards for new hydrogen carriers\* (Industry EU)
- 8a. Set clear carbon intensity definitions, thresholds, boundaries for hydrogen production\* (Enforcement EU)
- 8b. Ensure Member States, EU and exporters use the same methodology and scope for carbon intensity (Enforcement EU)
- 8c. Define carbon intensity standards for hydrogen derivatives (ammonia) and liquid hydrogen\* (Enforcement EU)
- 8d. Introduce environmental externalities (water, land, etc) in the certification process (Enforcement EU)
- 9a. Set electrolyser manufacturing capacity targets (Industry EU)
- 9b. Set targets for electrolyser components to support supply chains (e.g. membranes, electrodes etc.) (Industry EU)
- 9c. Drive automation of electrolyser production and increase raw material efficiency (e.g. recycling) (Industry EU)
- 9d. Identify critical skills and develop strategy to ensure availability of qualified workforce\* (Research EU)
- 10a. Focus R&D to improve technology performance of electrolysers including, durability, cost and efficiency (Research EU)
- 10b. Scale and share pilot projects to build experience with commercial-size facilities (Research EU)
- 10c. Identify possible long term supply chain bottle necks by value chain component (Research EU)

## Enabling measures: target timeline for implementation (1/2)



# Policy needs to enable global hydrogen trade

## Preliminary results of IRENA trade analysis



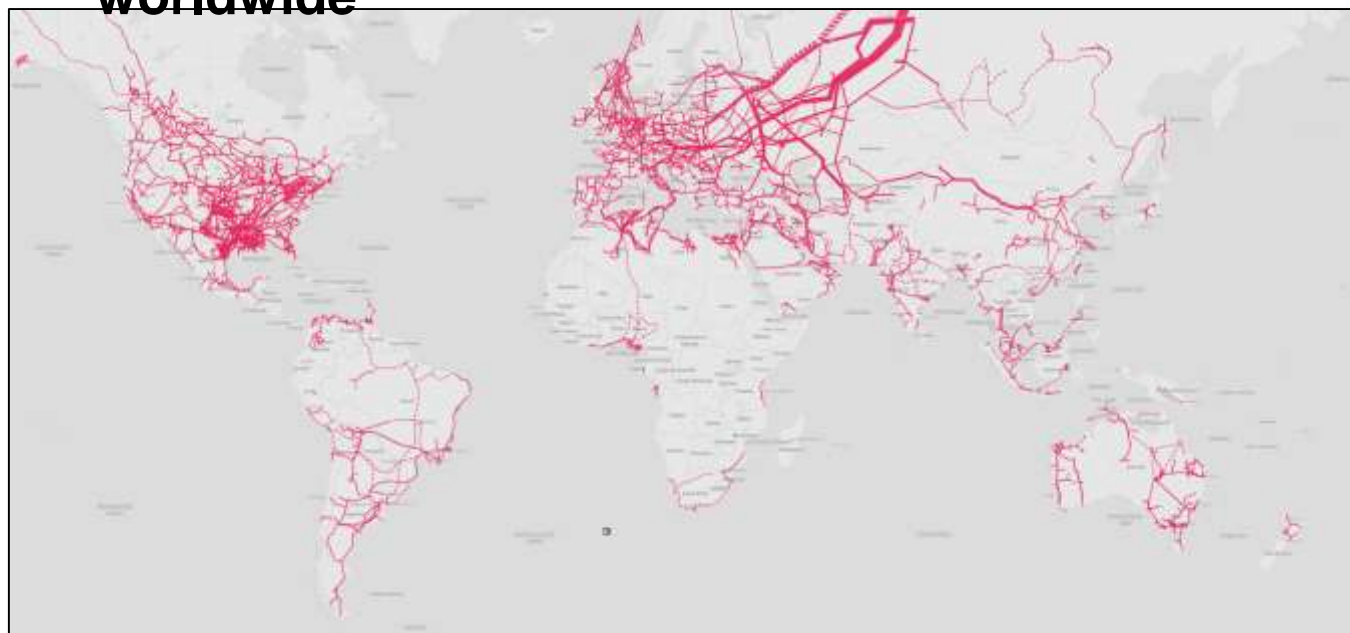
25-30% of hydrogen will be traded.

Half trade by ship as ammonia, other half pipeline.

Trade may be mostly regional.

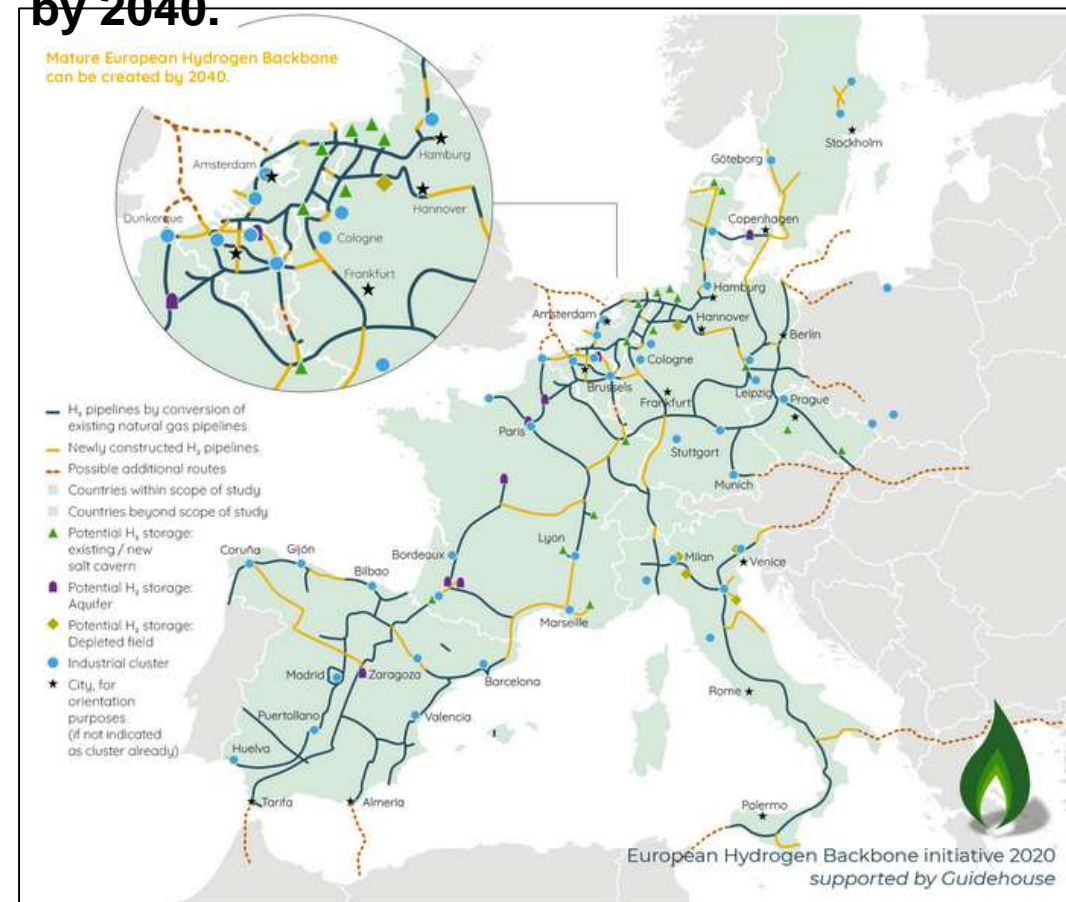
# Many opportunities from the gas grid

**2.5 billion km gas transmission pipelines worldwide**



<http://www.snamatlas.it/>

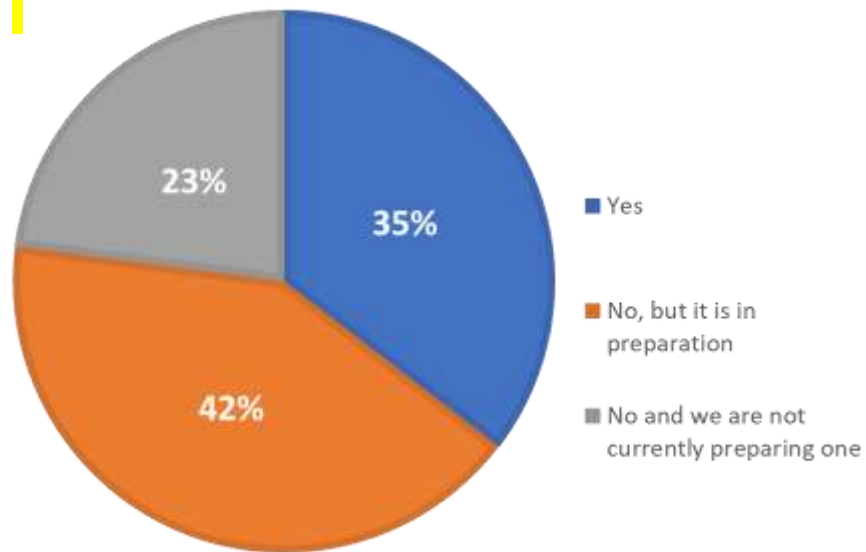
**EU Hydrogen Backbone – ~40,000 km pipelines in 21 countries can be repurposed by 2040.**



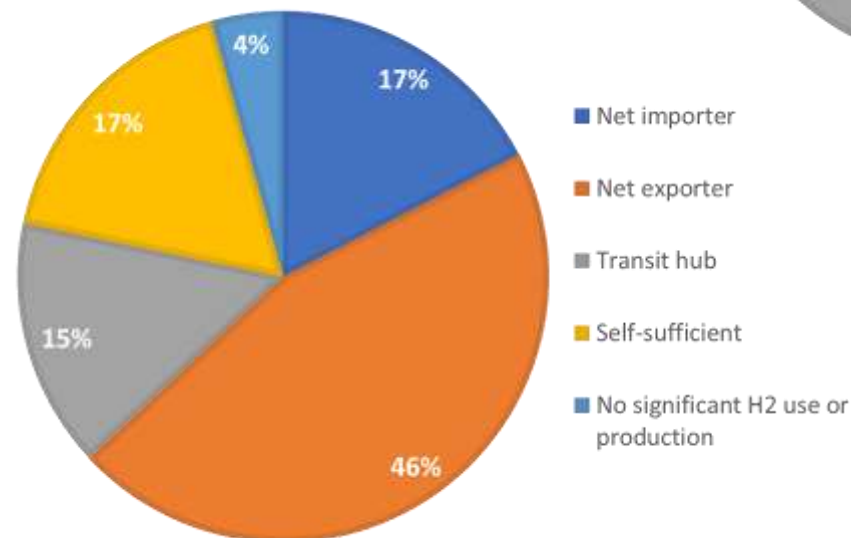
<https://gasforclimate2050.eu/ehb/>

# Geopolitics survey – need for collaboration and prioritisation

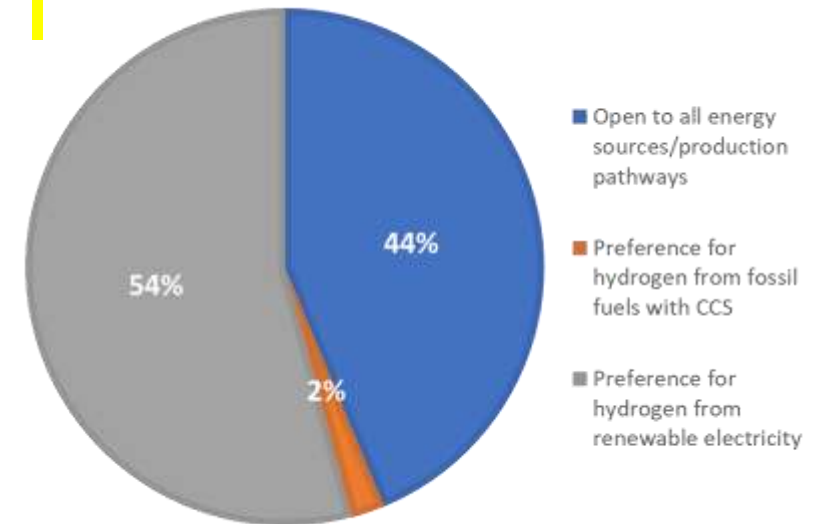
Majority of countries have or plan to have a hydrogen strategy



Significant role of hydrogen trade but 46% expect to be net exporter v 17% importer



Majority of respondents planning renewable hydrogen production



- 1. Role of green hydrogen is gaining recognition as part of energy transition**
- 2. Sands are shifting fast - growing commitment to developing and trading green hydrogen, disruptive in business**
- 3. IRENA plays an essential role as collaborator within the global network of initiatives.**
- 4. IRENA will continue to conduct essential techno-economic and policy work.**
- 5. Green hydrogen can become cost competitive**
- 6. Enabling Measures Roadmaps for Green hydrogen are an effective tool; the measures presented are common to all regions**
- 7. IRENA keen to work closer with Brazil to assist implement hydrogen strategy**