Quality Infrastructure for Green Hydrogen: technical standards and quality control for the production and trade of renewable hydrogen

Project funded by:

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Frist Workshop of Project Network

IRENA

21 June 2022

Francesco Pasimeni

Associate Progamme Officer

IRENA Innovation and Technology Center

The workshop

A virtual 'close-door' workshop to present IRENA's new project on **Quality Infrastructure (QI) for Green Hydrogen (GH2)**

> *QI covers technical standards, test methods, certification, accreditation and metrology services to mitigate technical risk and facilitate trade of technology and services.*

The project is funded by the **German Federal Ministry for Economic Cooperation and Development** (BMZ) via the **National Metrology Institute of Germany** (PTB)

The workshop is also part of a series of IRENA 'close-door' workshops on the *Use of the natural gas grid to deliver hydrogen*

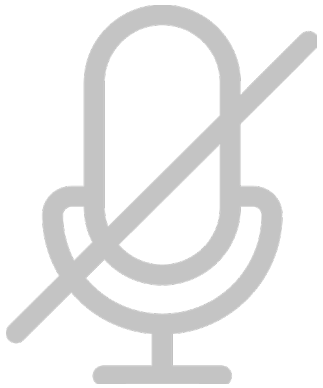
The goal of the workshop

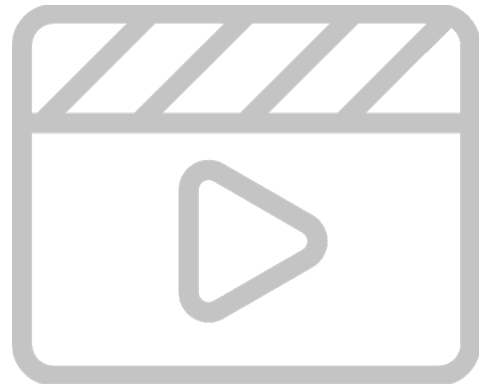
The goal is to facilitate a dialogue between the global stakeholders on the topic of QI for GH2

I. get advice from experts on the scope and implementation of the project
II. inform the stakeholders about the role of QI for GH2 and allow information sharing between participants
III. increase coordination among stakeholders
IV. involve stakeholders in supporting the development of QI for GH2

Agenda of the workshop

Openings **15 mins**	**Master of Ceremony** **Francesco Pasimeni**, Associate Programme Officer IITC - IRENA **Workshop Opening** **Andrea Ulbrich**, Senior Policy Officer – Trade Division - BMZ **Ulf Seiler**, Head of Section LAC - PTB **Roland Roesch**, Deputy Director IITC - IRENA **Project presentation from Project Manager** **Francisco Boshell**, Analyst IITC – IRENA
Discussion **100 mins**	**Moderator** **Francesco Pasimeni**, Associate Programme Officer IITC - IRENA ○ Panelists to present activities related to QI for GH2 + *Open discussion* ○ Poll questions (Part A) + *Open discussion* ○ Poll questions (Part B) + *Open discussion*
Closing **5 mins**	**Concluding remarks** **Roland Roesch**, Deputy Director IITC – IRENA





Andrea Ulbrich

Senior Policy Officer – Trade Division

German Federal Ministry for Economic Cooperation and Development (BMZ)

Ulf Seiler

Head of Section
Latin America and the Caribbean

Physikalisch-Technische Bundesanstalt (PTB)

Roland Roesch

Deputy Director

IRENA Innovation and Technology Center

Francisco Boshell

Analyst

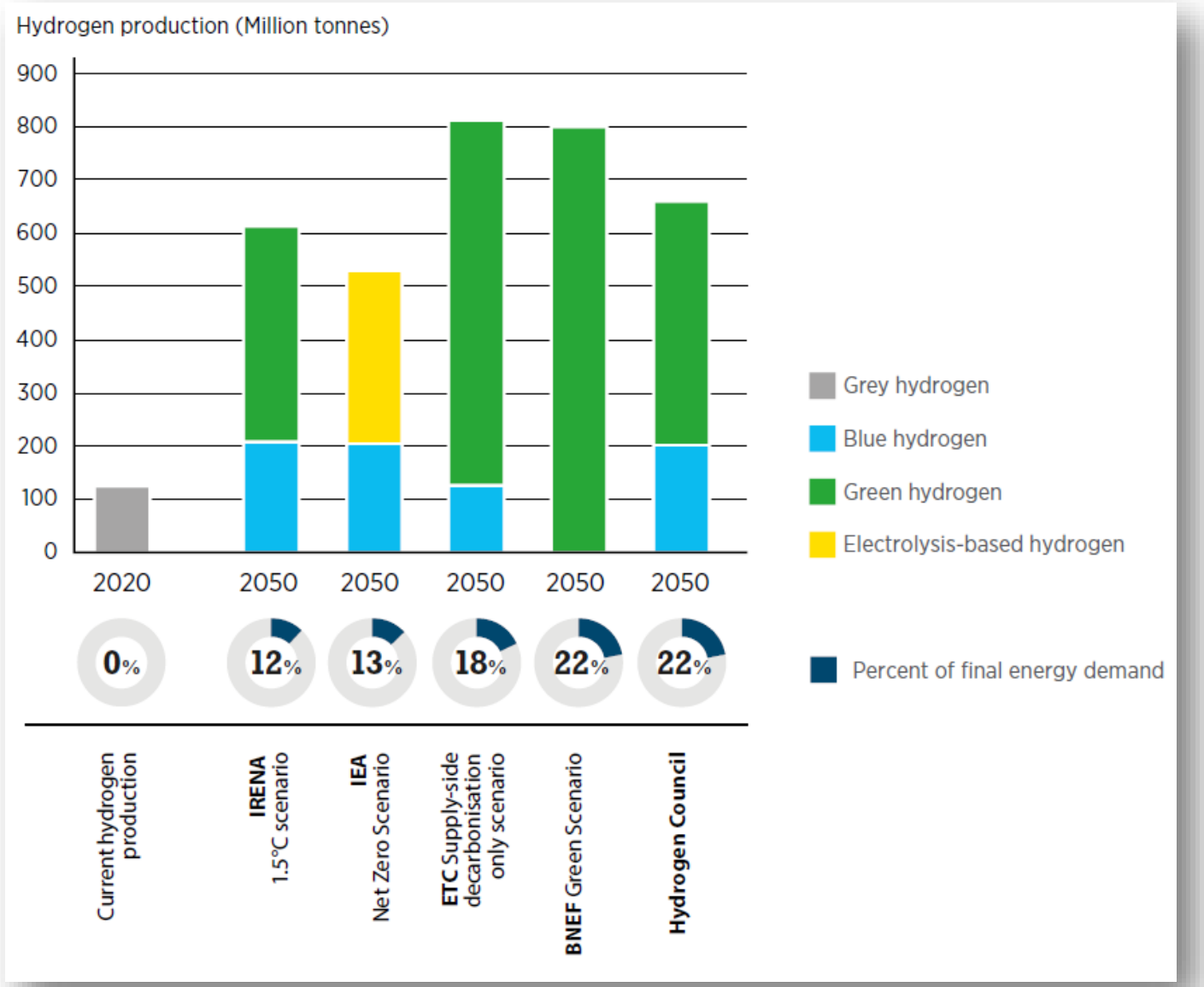
IRENA Innovation and Technology Center

1 Background: IRENA insights on Green Hydrogen

Countries with low-carbon H2 strategies as of end of 2021

Source:
https://www.irena.org/publications/2022/Jan/Geopolitics-of-the-Energy-Transformation-Hydrogen

Converging estimates for global hydrogen demand in 2050 - Green would dominate



Source: https://www.irena.org/publications/2022/Jan/Geopolitics-of-the-Energy-Transformation-Hydrogen

Need for a full value chain approach - IRENA's analysis

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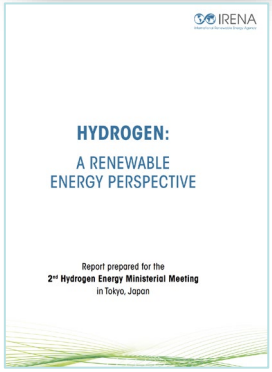
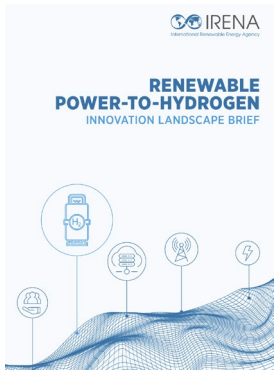
International Renewable Energy Agency

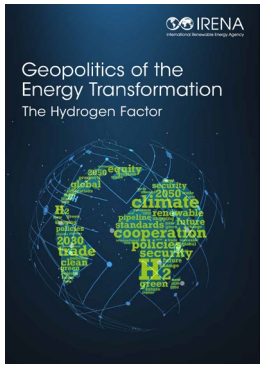
Supply

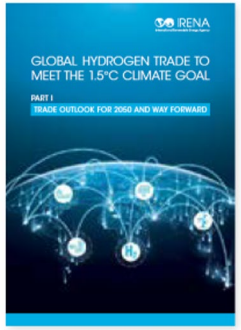
Sector coupling

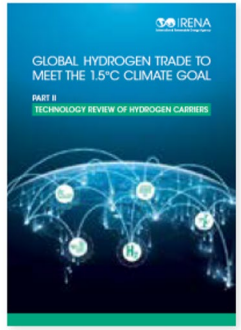


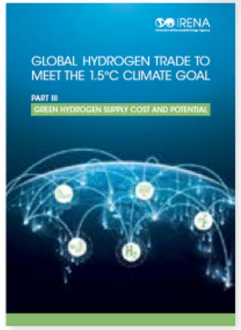


Trade

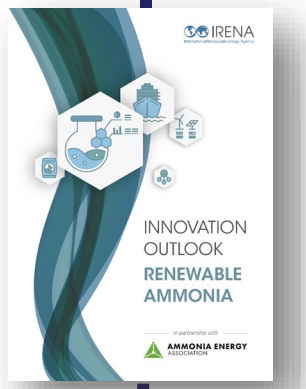


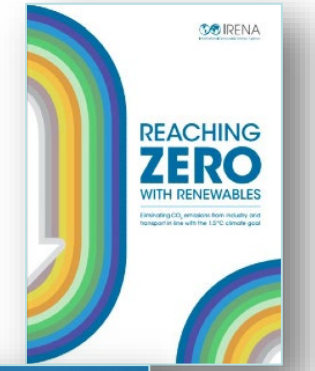


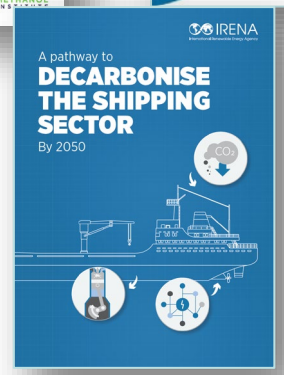




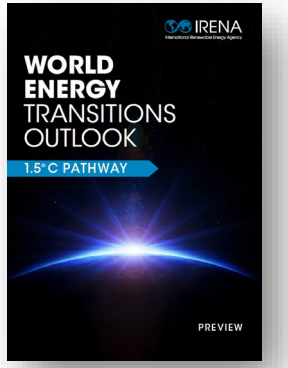
Demand

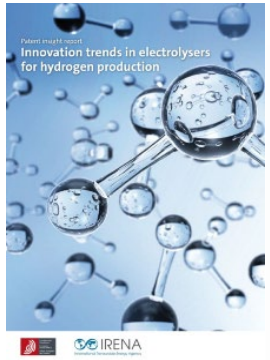


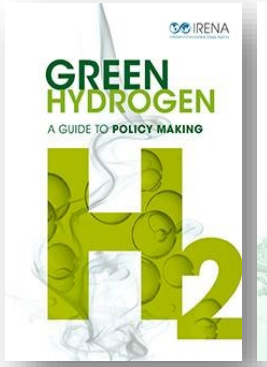


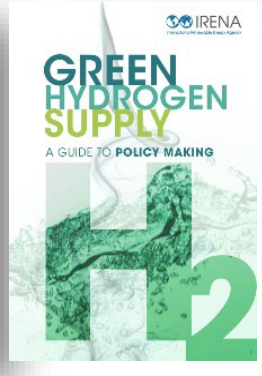


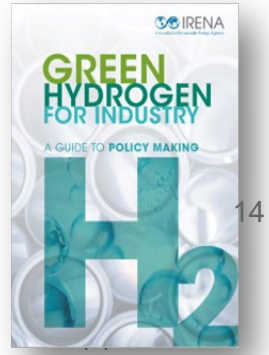
Cross cutting & Innovation Frameworks and Policies



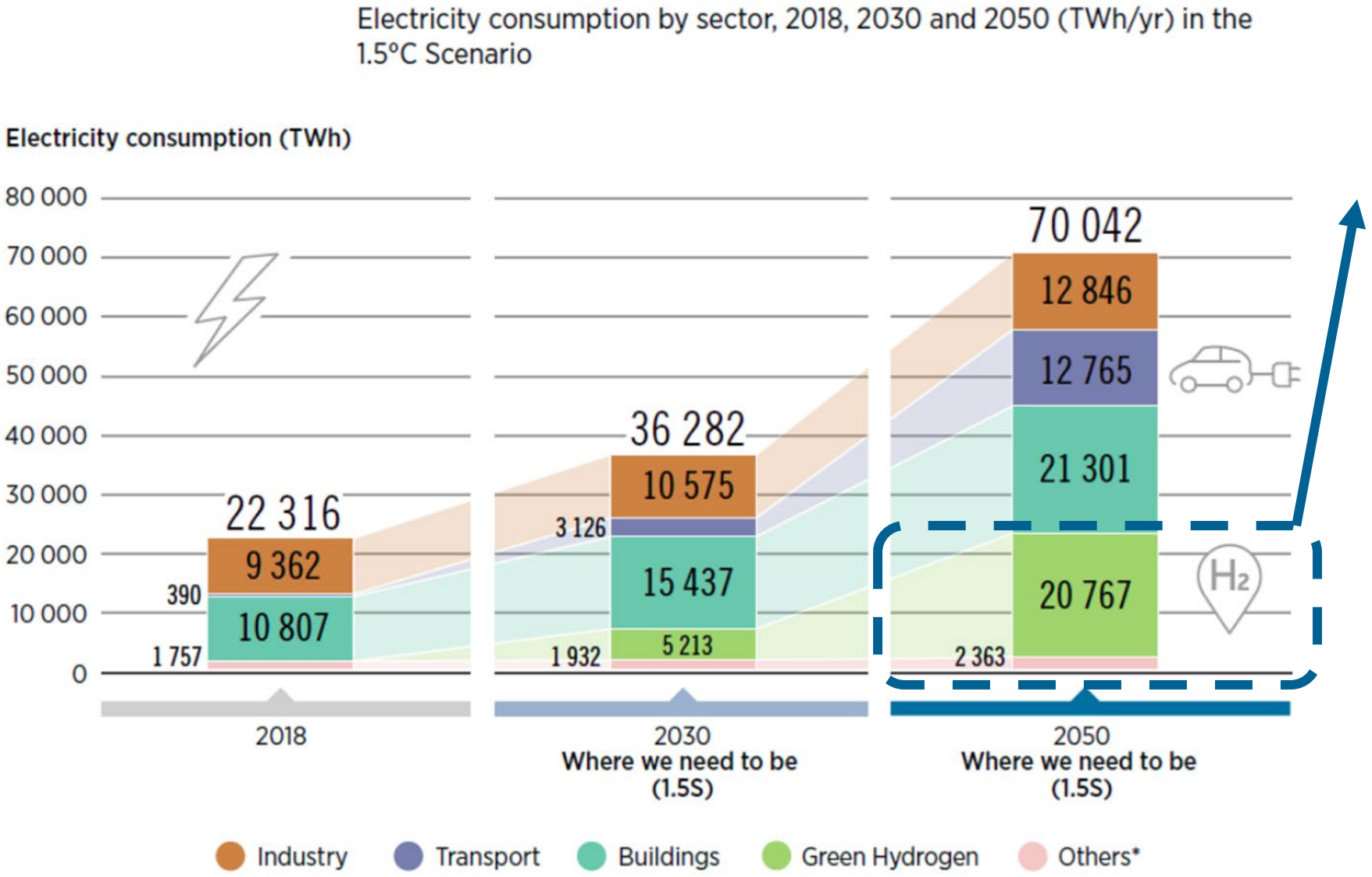








Needed supply of green hydrogen in a 1.5oC decarbonisation scenario



Key considerations

1- By 2050 more than 20,000 TWh of electricity demand for green hydrogen production – that is almost as much electricity as we consume globally today

2- We need a smart approach to integrate electrolysers in power systems, synergies with renewable generation

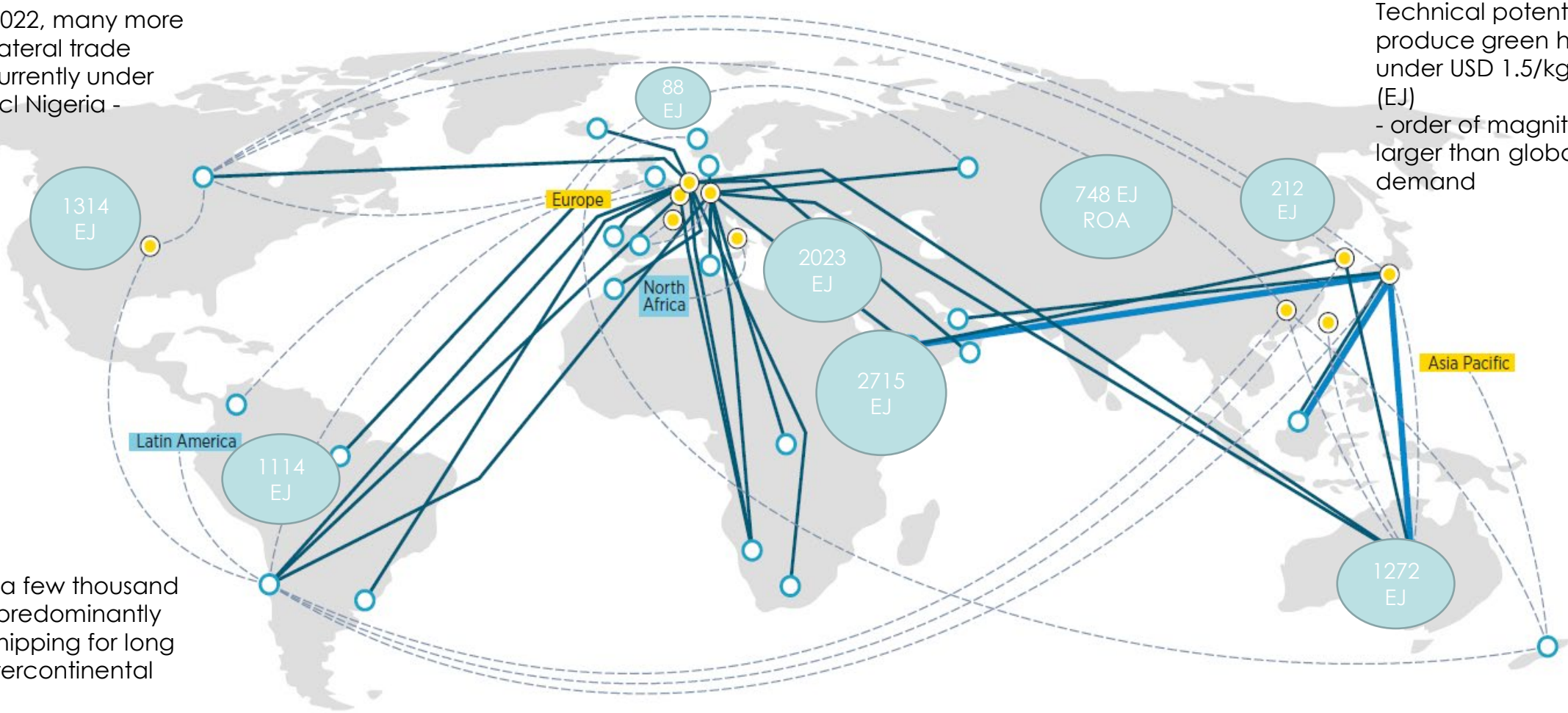
3- Key to **innovate to reduce the cost of electrolysers** – *standardisation supporting economy of scale and trade of technology to accelerate cost reduction trend*

Source: https://irena.org/publications/2022/Mar/World-Energy-Transitions-Outlook-2022

Hydrogen trade - 30% internationally traded H2, 50/50 pipeline and shipping

Status end 2022, many more potential bilateral trade routes are currently under discussion incl Nigeria - Germany

Technical potential to produce green hydrogen under USD 1.5/kg by 2050 (EJ)
- order of magnitude larger than global energy demand



Pipeline for a few thousand kilometres, predominantly ammonia shipping for long distance intercontinental trade

Technical potential 2050 at <1.5 USD/kg

Exporter

Importer

Exporting region

Importing region

New routes in place or under development

MoUs in place establishing trade routes

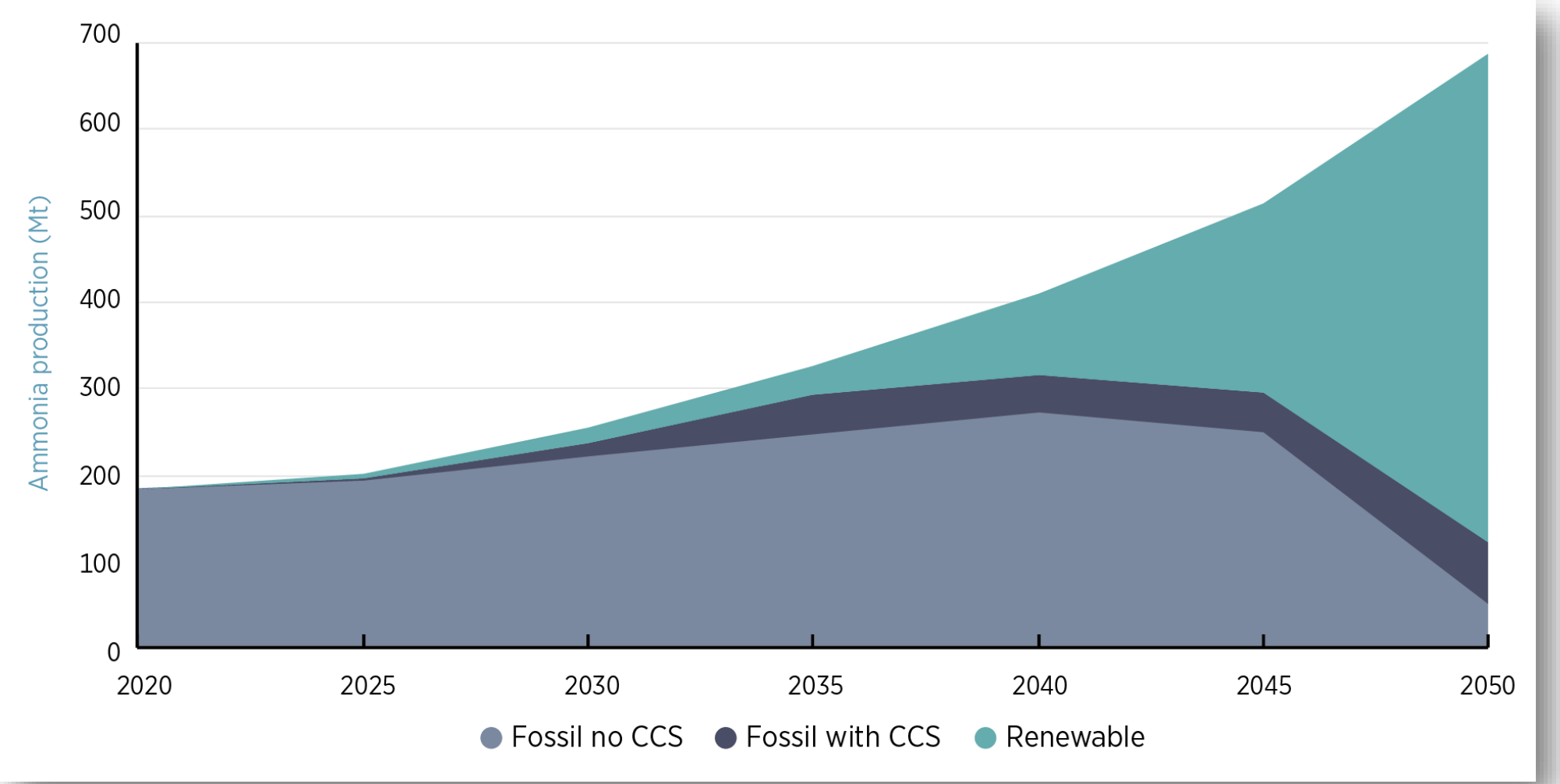
Potential trade route explicitly mentioned in published strategies

Source: IRENA

Source: https://www.irena.org/publications/2022/Apr/Global-hydrogen-trade-Part-II

Hydrogen derivatives- Ammonia as early market opportunity

Expected ammonia production capacity up to 2050 for the 1.5°C scenario.



- Shipping fuel
- Ammonia as hydrogen energy carrier
- Existing fertilizer market
- 70 Mt project pipeline

https://www.irena.org/publications/2022/May/Innovation-Outlook-Renewable-Ammonia

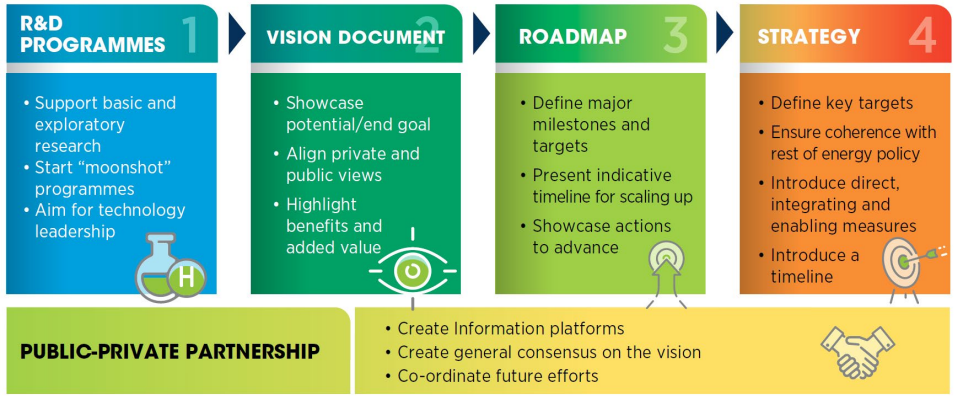
Demand for green hydrogen – some of the hard-to-abate sectors

	Energy-intensive industrial sectors				Energy-intensive freight & long-haul transport sectors		
	 Iron and steel	 Chemicals and petrochemicals	 Cement and lime	 Aluminium	 Road freight	 Aviation	 Shipping
Electrification	Small Prototype	Small Prototype	Small Prototype	Mature	Early adoption	Small Prototype	Demo
Hydrogen	Large prototype	Demo/mature	Prototype	N/A	Demo	Small prototype	Large prototype
CCUS	Large prototype	Demo/mature	Demo	N/A	N/A	N/A	N/A

- Direct electrification is challenging for most of these sectors, hydrogen and its derivatives represent a more feasible solution **– Chemicals, Iron & Steel and Shipping-**
- Not so clear a role in road transport (BEV) and residential/commercial heating (HPs)

Policies to enable cost competitiveness – QI will play a key role

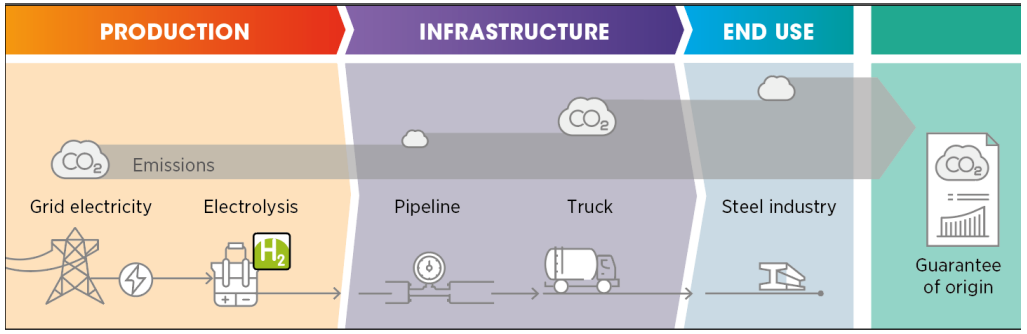
1. National hydrogen strategies



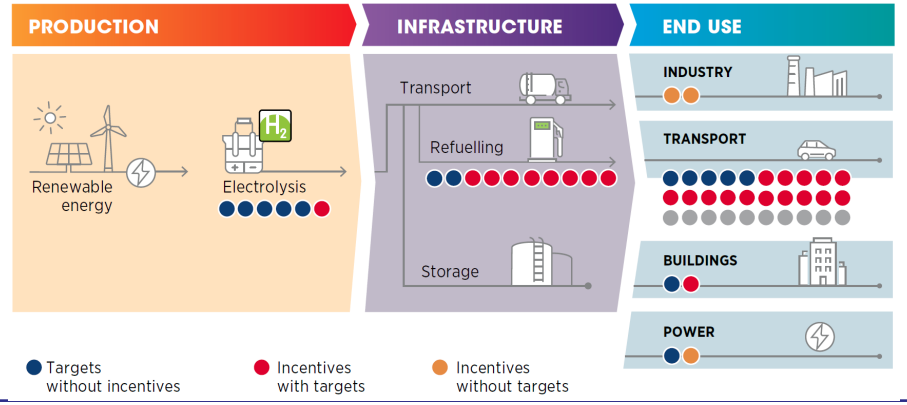
2. Governance system and enabling policies

- ✓ Advisory council and sectoral tables
- ✓ Workforce development
- ✓ **I. Codes, standards and regulations (performance, safety)**
- ✓ Level the playing field
- ✓ Research priorities

3. II. Certification (carbon content)



4. Establish policy priorities



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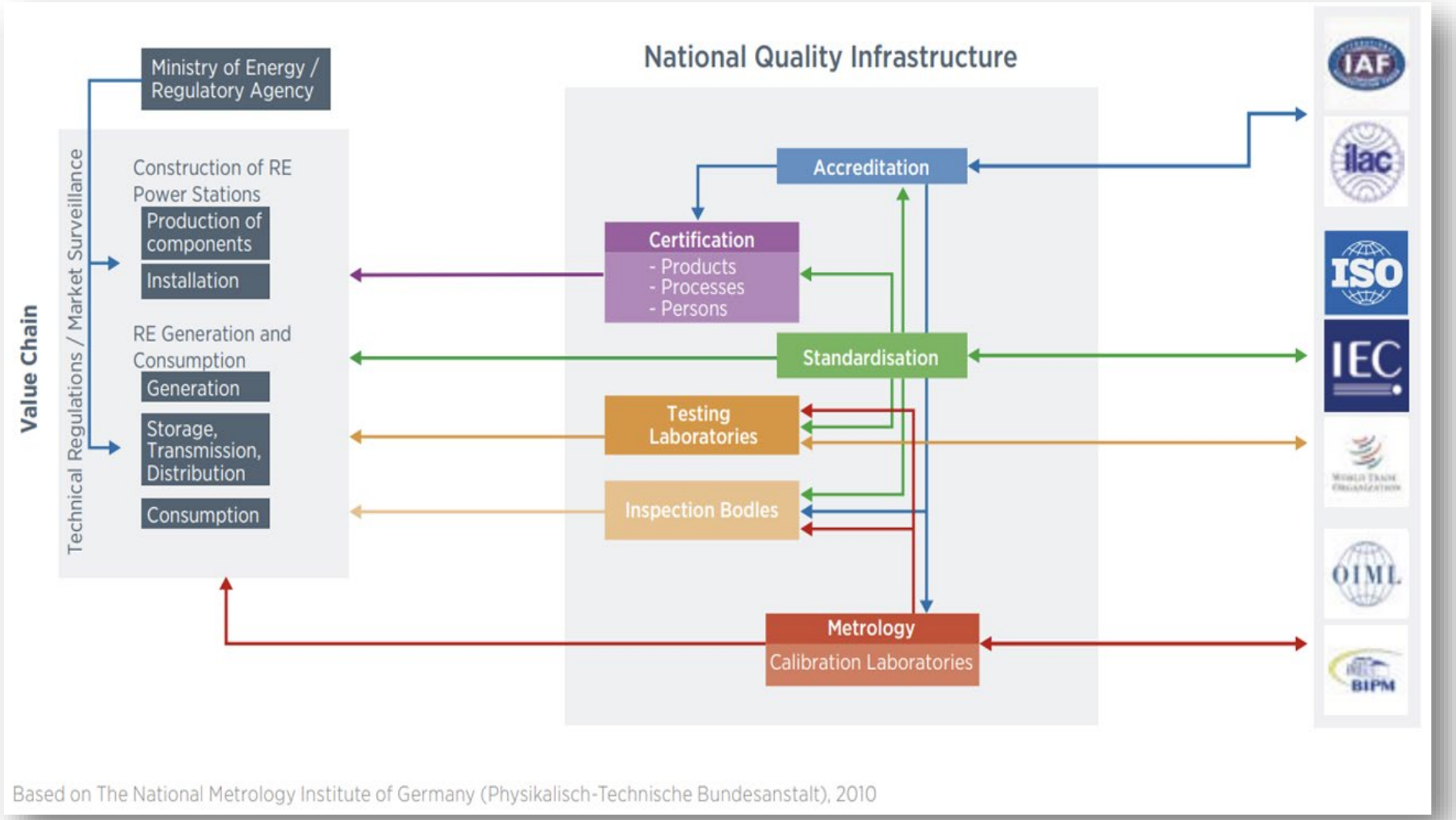
Project Overview

Objective of the Project

- Guide countries on how to develop a robust **quality infrastructure** (QI) for the production and trade of **green hydrogen** (GH2) in support of their national and multilateral strategies

- QI consists of all activities which provide confidence that a technology will meet the expectations of consumers, investors and other stakeholders



Project outputs

The primary outputs of the project are as follows:

- A **roadmap** on the development of the quality infrastructure to overcome existing quality, sustainability and safety challenges in green-hydrogen production and trade is defined and communicated.

- For **a selected country**, as result of a national stakeholder engagement process, recommendations are defined for **an action plan** to overcome existing quality, sustainability and safety challenges in green-hydrogen production and trade.

Link to other ongoing IRENA projects

This project

Quality Infrastructure for Green Hydrogen (2022 -2023)

Performance, reliability, safety, sustainability
What exists, what's for H2 in general and for GH2 in particular, who's doing what, what are the gaps

- **Standards:** available, challenges to adopt int standards, gaps, engagement in int processes
- **Testing:** test methods, laboratory equipment and competence, link to other industry sectors, key parameters, develop services locally or cooperation
- **Certification:** industry certification, international certification
- **Accreditation:** needed competencies
- **Metrology:** traceability, calibration equipment and competency, key parameters, develop services locally or cooperation

Other two related IRENA projects

Carbon accounting standards and certification for GH2 (2022)

Carbon content in hydrogen / GoO
Mapping who's doing what, different methods

- Standards
- Certification

Carbon accounting standards and certification for GH2 derivatives (2023)

Carbon content in Ammonia, Methanol and Steel
Mapping who's doing what, methods

- Standards
- Certification

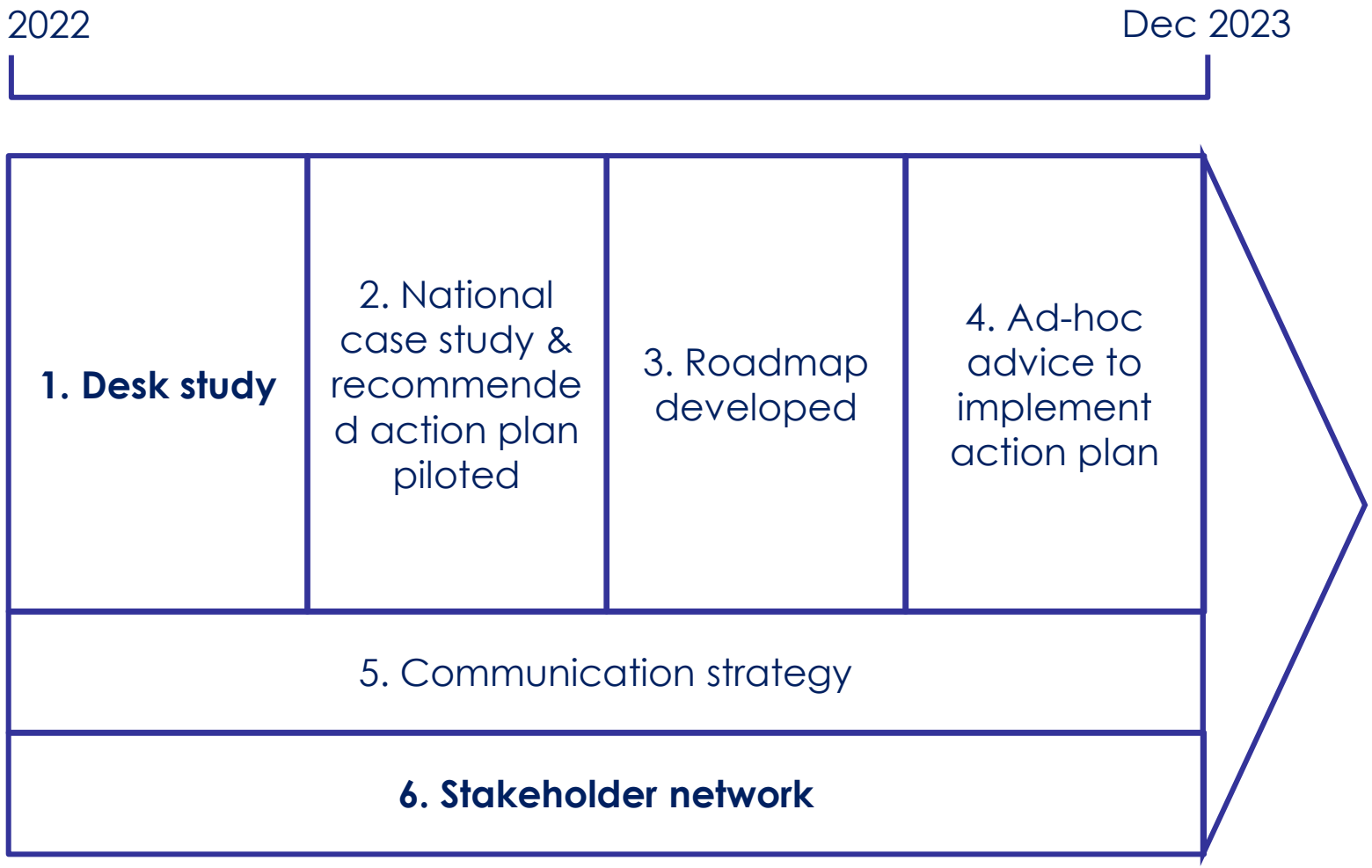
Workshop objective

- IRENA will facilitate the establishment of a **global stakeholder network**, including policy makers, green hydrogen industry, QI institutions and development community → **today's workshop is the first step focused on QI community and Industry. More to come.**

- Aim: The major stakeholder groups have sustainably increased the **coordination** amongst each other, are informed about the role of Quality Infrastructure (QI) and **support** the development of QI in line with identified priority areas for the sustainable production and trade of global green-hydrogen and selected derivatives.

Project team & plan of activities

Project Manager	Project Lead	Project Analyst
		
Francisco Boshell Senior Analyst	**Francesco Pasimeni** Associate Programme officer	**Jaidev Dhavle** Associate Programme officer



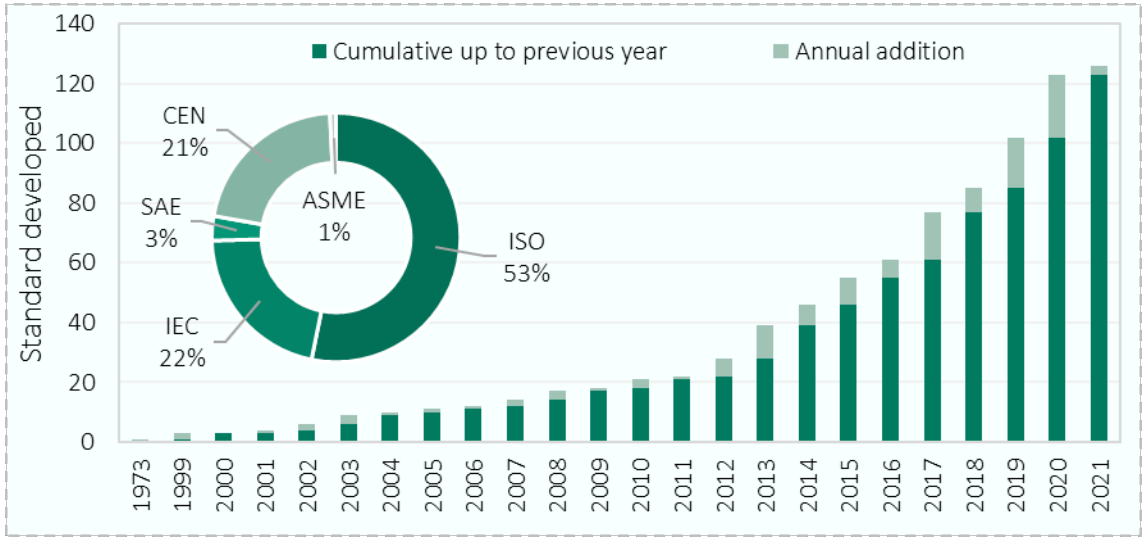
3 Preparatory Work

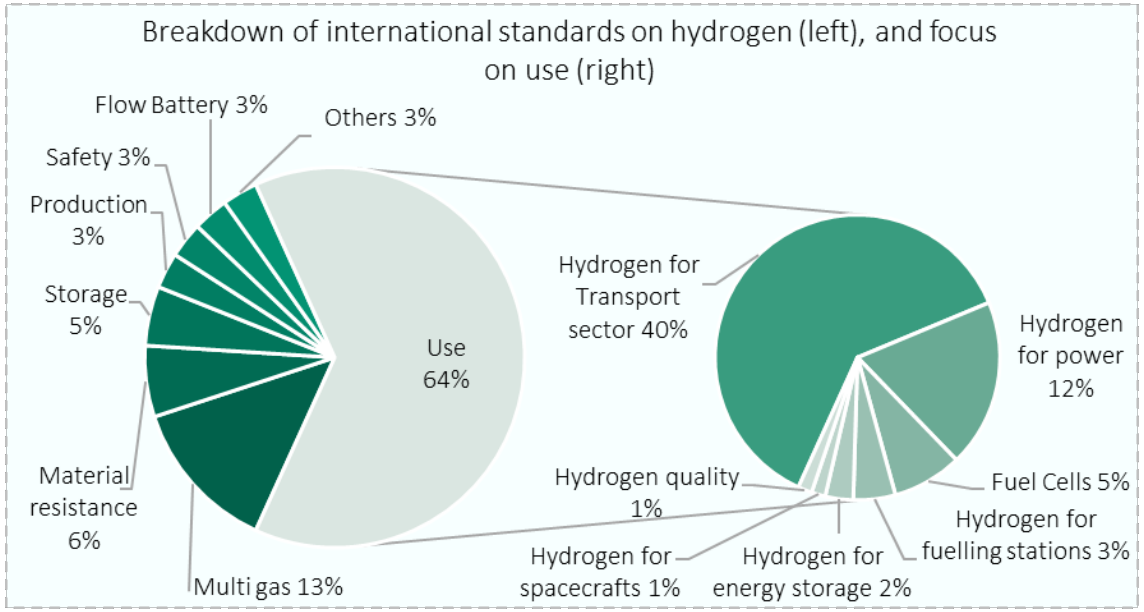
Number of international standards

>120 international standards by 2021: ISO (53%) IEC (22%)

Normative references: technologies and appliances in other sectors

- 48%: **safety** during installation, and the avoidance of explosions, fires and electrical shocks
- 20%: **design** requirements related to gas cylinders made from various materials
- 17%: **measurement and monitoring** related to gas and fluid flows in close conduits
- 15%: **testing** to environmental standards.



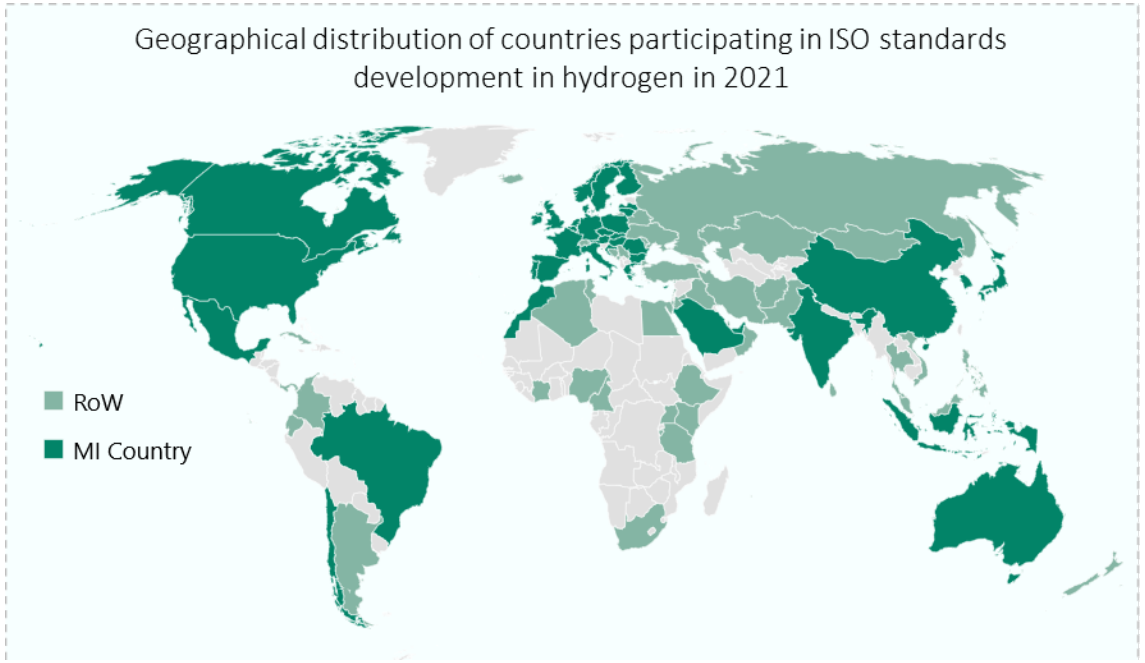


Countries Developing Standards

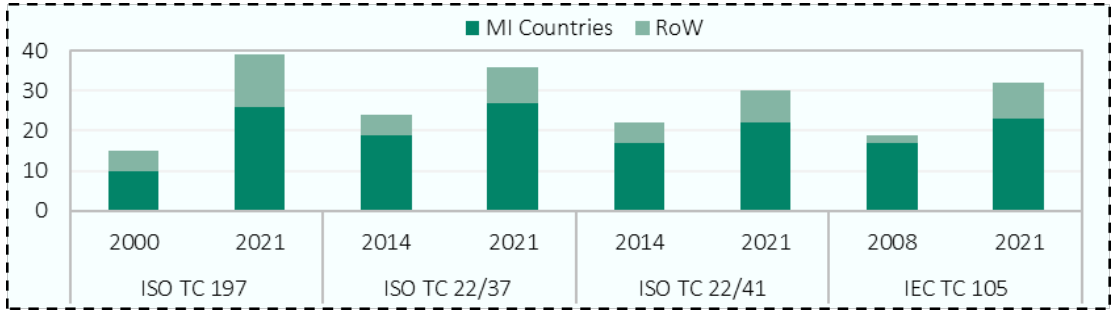
14 active **ISO committees** and sub-committees engaging **92 countries**, including all the Mission Innovation countries

- 22% participate **in 1** technical committee or sub-committee
- 11% participate **in all 14** committees or sub-committees

Canada, China, France, Germany, Italy, the Netherlands, the United Kingdom and the United States – chair one or more technical committees or sub-committees.



Country (MI highlighted)	ISO TC 197	ISO TC 22/37	ISO TC 22/41	IEC TC 105
Argentina	✓	✓	✓	✗
Australia	✓	✓	✗	✓
Austria	✓	✓	✓	✓
Belgium	✓	✓	✓	✓
Brazil	✓	✗	✗	✓
Canada	✓	✓	✓	✓
China	✓	✓	✓	✓
Croatia	✗	✓	✓	✗
Czech Republic	✓	✓	✓	✓
Denmark	✓	✓	✗	✓
Egypt	✓	✓	✓	✓
Ethiopia	✗	✗	✓	✗
Finland	✓	✓	✗	✓
France	✓	✓	✓	✓
Germany	✓	✓	✓	✓
Hong Kong	✓	✗	✗	✗
Hungary	✓	✓	✓	✗
India	✓	✓	✓	✗
Indonesia	✗	✓	✗	✗
Iran, Islamic Republic of	✓	✗	✓	✓
Ireland	✓	✓	✗	✗
Israel	✓	✓	✗	✓
Italy	✓	✓	✓	✓
Japan	✓	✓	✓	✓
Korea, Republic of	✓	✓	✓	✓
Netherlands	✓	✓	✓	✓
New Zealand	✓	✗	✓	✗
Norway	✓	✗	✗	✓
Poland	✓	✓	✓	✓
Portugal	✓	✓	✓	✓
Romania	✓	✓	✓	✓
Russian Federation	✓	✓	✗	✓
Saudi Arabia	✗	✓	✗	✗
Serbia	✓	✗	✗	✓
Singapore	✗	✓	✗	✗
Slovakia	✗	✓	✓	✗
South Africa	✗	✓	✓	✓
Spain	✓	✓	✓	✓
Sri Lanka	✓	✗	✗	✗
Sweden	✓	✓	✓	✓
Switzerland	✓	✓	✗	✓
Thailand	✓	✗	✗	✓
Turkey	✓	✗	✓	✓
Ukraine	✓	✓	✓	✗
United Kingdom	✓	✓	✓	✓
United States	✓	✓	✓	✓



Stakeholders mapping: a starting point

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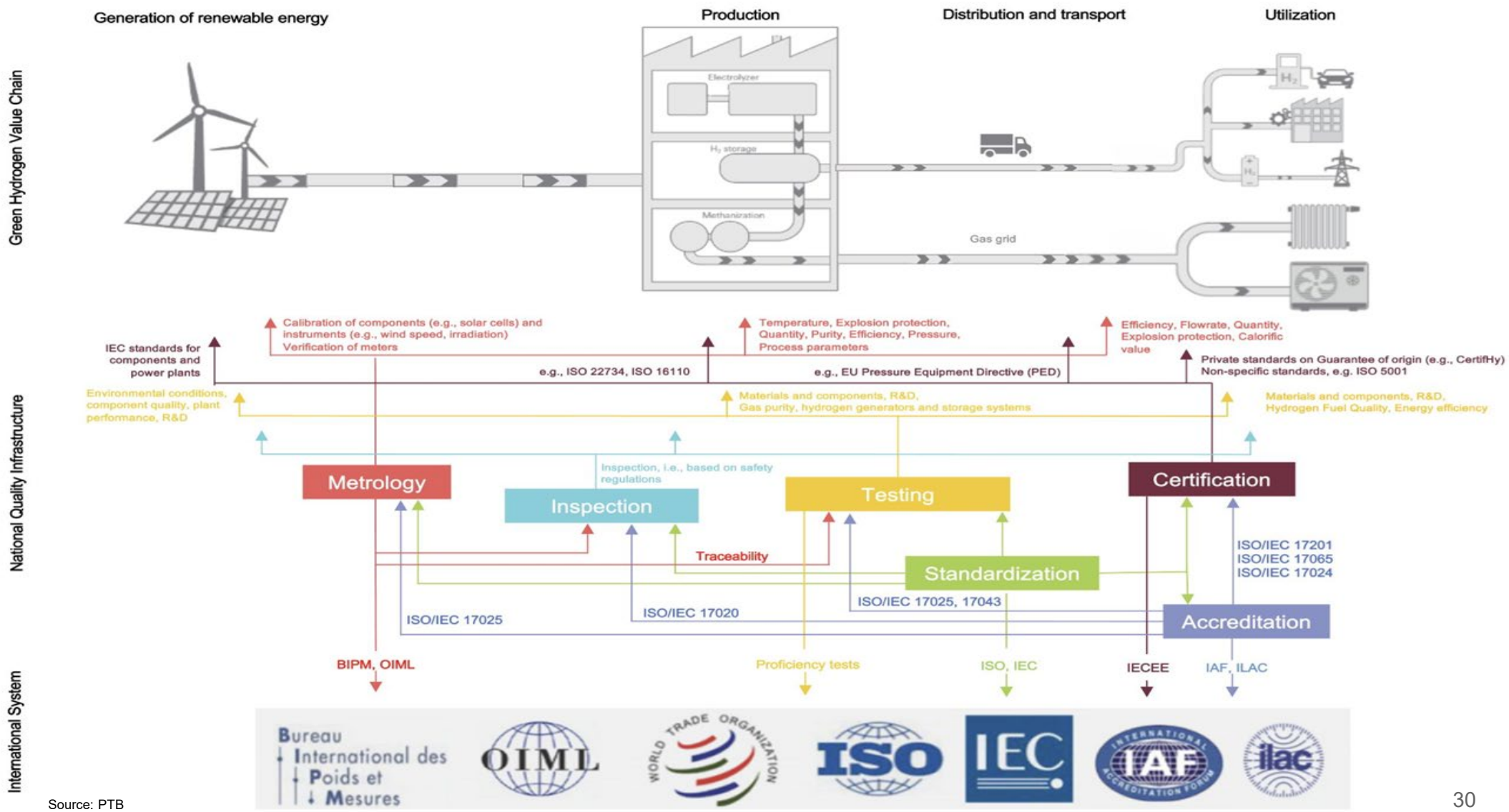
Standards	Certification	Metrology
IEC, ISO, DNV, CEN, Green Hydrogen Organisation, GOV.UK Guidance: UK Low Carbon Hydrogen Standard: emissions reporting and sustainability criteria	IECEx, Siemens Energy, CertifHy, TÜVRheinland Precisely Right., Ammonia Energy Association, DVGW	EURAMET, VSL National Metrology Institute, PTB Physikalisch-Technische Bundesanstalt National Metrology Institute

Knowledge repository

Mission Innovation Clean Hydrogen Mission; FCH Fuel Cells and Hydrogen Joint Undertaking; FCHO Fuel Cells and Hydrogen Observatory; HydrogenTools; dena Deutsche Energie-Agentur; IPHE; ENERGY.GOV Hydrogen Program » Annual Merit Review Presentation Database

Overview: QI along GH2 value chain (source: PTB)



Source: PTB

Water electrolysis taking the lead for hydrogen production

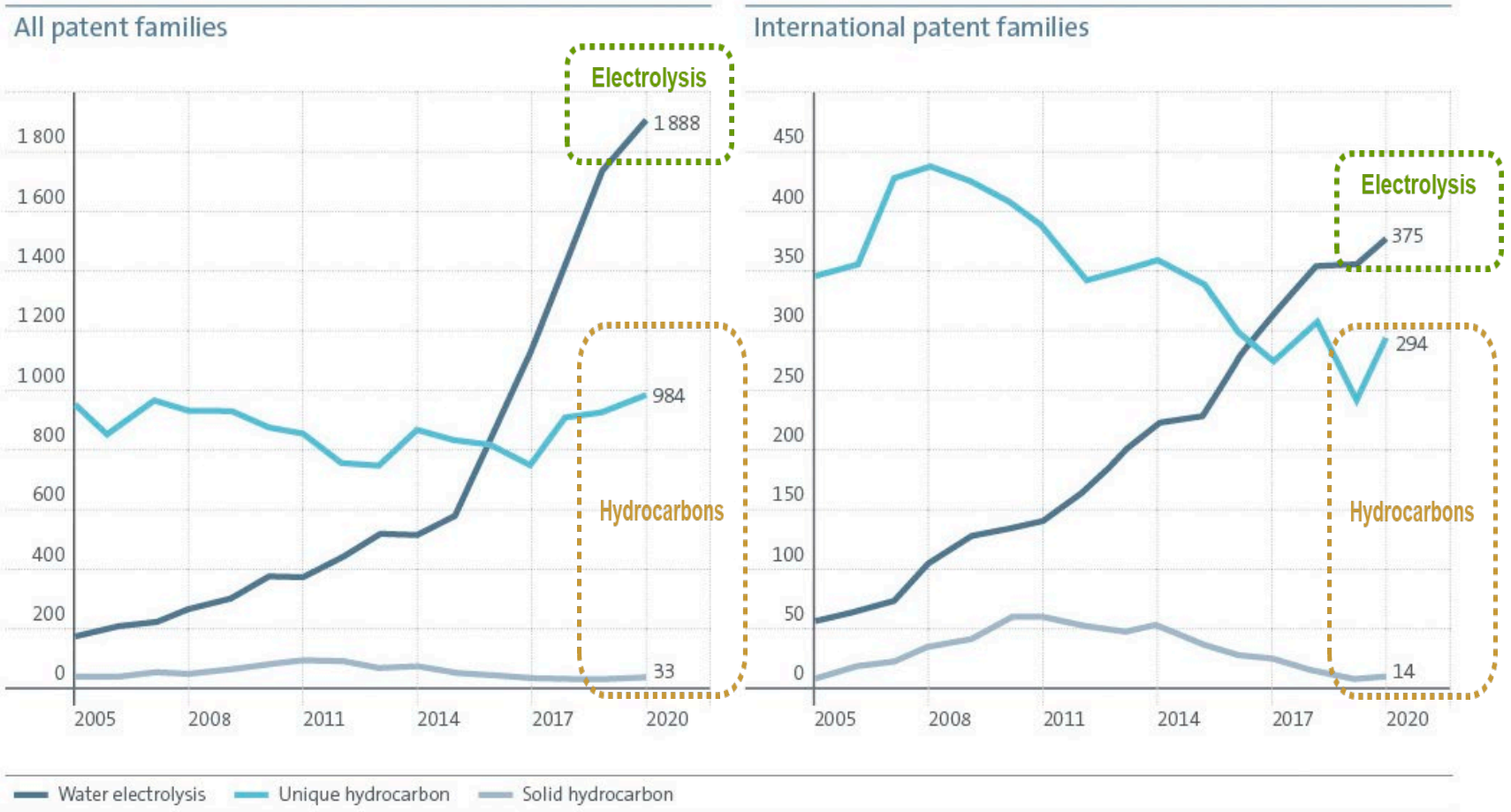


Figure 2: This figure shows the 2005-2020 trend of patent families (left-hand side) and international patent families (right-hand side), comparing hydrogen production processes based on water electrolysis with processes using liquid or solid hydrocarbon feedstock.

- From 2005, **+18% each year** for hydrogen production technologies
- In 2016, IPFs for **water electrolysis** > to IPFs for hydrogen from hydrocarbons

5 sub-technologies relevant for reducing the cost of electrolysis of water

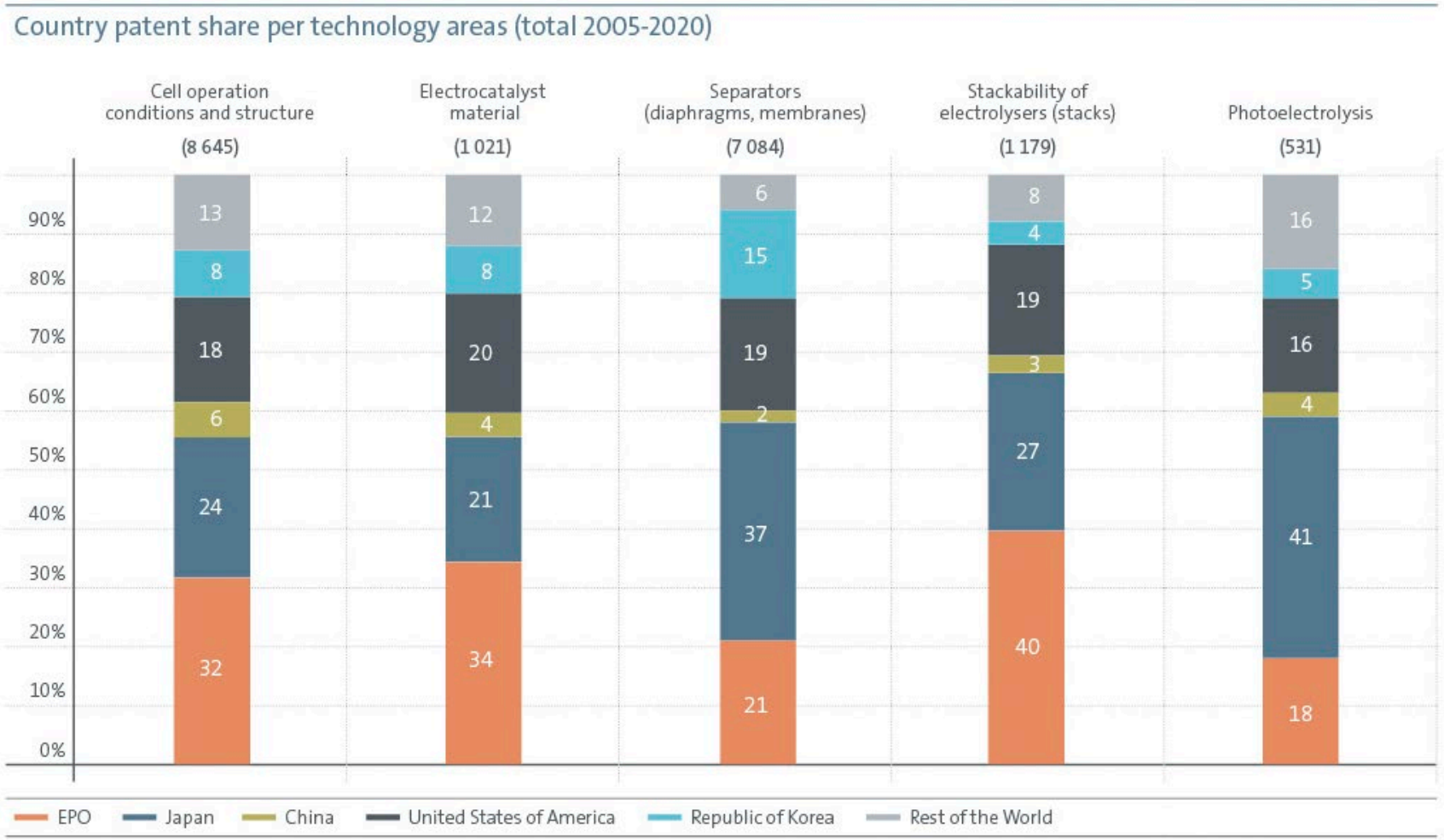


Figure 7: This is a summary chart of the country share of international patents in relation to the five subtechnology areas identified. The country refers to the country of the patent applicants. Europe groups together the 38 member states of the European Patent Organisation.[21] Numbers in bold and in parenthesis at the top of each column are the total number of international patent applications in that technology area.

- **Europe & JP: 50%** of the total IPFs filed in all areas
- **Europe** leads in the stackability of electrolysers (41%), electrocatalyst material (34%) and cell operation conditions and structure (32%)
- **Japan** first in photoelectrolysis (39%) and separators (diaphragms, membranes) (36%).
- **USA** averages 18% across all technology areas
- **Rep. of Korea** highest share in separators (diaphragms, membranes) (16%)
- **China** 4% international patents but dominates domestic filings.

Barrier Objectives

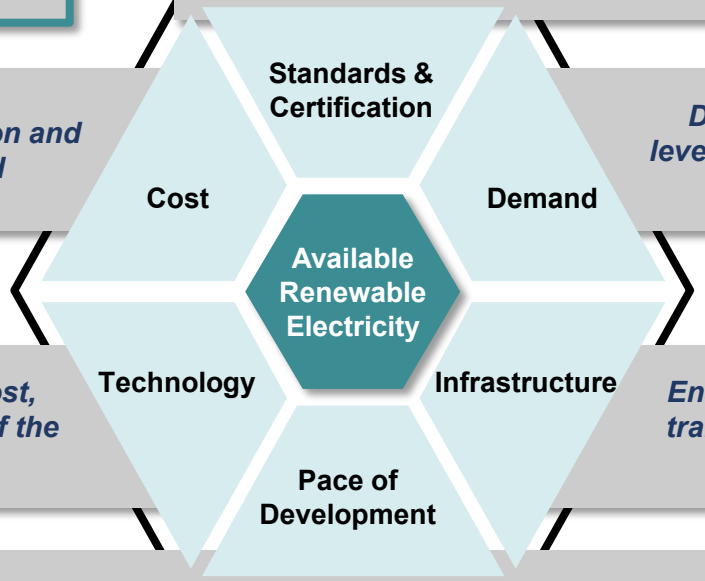
Enabling measures to overcome barriers to hydrogen market development

Significant ramp up and deployment of renewable generation through ambitious targets, incentives and energy system design

Ensure clarity on standards both through a certification scheme and for development of assets across the value chain

Remove critical cost and regulatory barriers for production and deploy mechanisms to accelerate hydrogen demand

Drive critical mass demand through major hydrogen projects leveraging efficient allocation of capital, long-term certainty and sectoral targets for uptake



Focus on innovation and R&D to enable improvement on cost, efficiency and durability of the electrolyser and de-risking of the technology steps for global hydrogen trade

Ensure early ramp up of infrastructure development, including transport, storage, conversion and re-conversion facilities and repurposing of the existing natural gas infrastructure

Accelerate scale-up of electrolyser manufacturing and electrolyser sizes driving economies of scale

Available renewable electricity is the fundamental enabler to the Green Hydrogen market

KEY:

Policy Required

- Technology Evolution & R&D
- Standards & Certification
- Markets & Financing
- Matching Supply & Demand

Responsible Policy Maker / Department

Responsible policy maker

Note: MS = Member State; EU = European Union; TSO Reg = TSO Regulator

IRENA International Renewable Energy Agency

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

Infrastructure:
Ensure early ramp up of infrastructure development

- 6a. Clarify governance of the hydrogen transmission network — TSO Reg (EU)
- 6b. Set up a flexible regulatory framework with quality standards and definitions — TSO Reg (EU)
- 6c. Plan hydrogen infrastructure consistent with the power and gas networks — TSO Reg (EU)
- 6d. Specify quality standards and definitions — TSO Reg (EU)
- 6e. Develop long-term view on supply chain funding and skills — Research (EU)

Standards & Certification:
Ensure clarity on standards to streamline megaproject development

- 7a. Define standards for new parts of the value chain beyond production (e.g. transportation & storage conversion) — Industry (EU)
- 7b. Define standards for hydrogen derivatives (e.g. ammonia, synthetic fuels) — Industry (EU)
- 7c. Develop safety standards for new hydrogen carriers — Industry (EU)

Standards & Certification:
Ensure clarity on standards through a Guarantee of origin scheme

- 8a. Set definitions, thresholds, boundaries to support green hydrogen — Environment (EU)
- 8b. Make sure member state, EU and exporter share the same standards — Environment (EU)
- 8c. Define standards for hydrogen derivatives (ammonia) and liquid hydrogen — Environment (EU)
- 8d. Introduce externalities (water, land, etc) in the certification process — Environment (EU)

Pace of Development:
Hyperscale electrolyser deployment

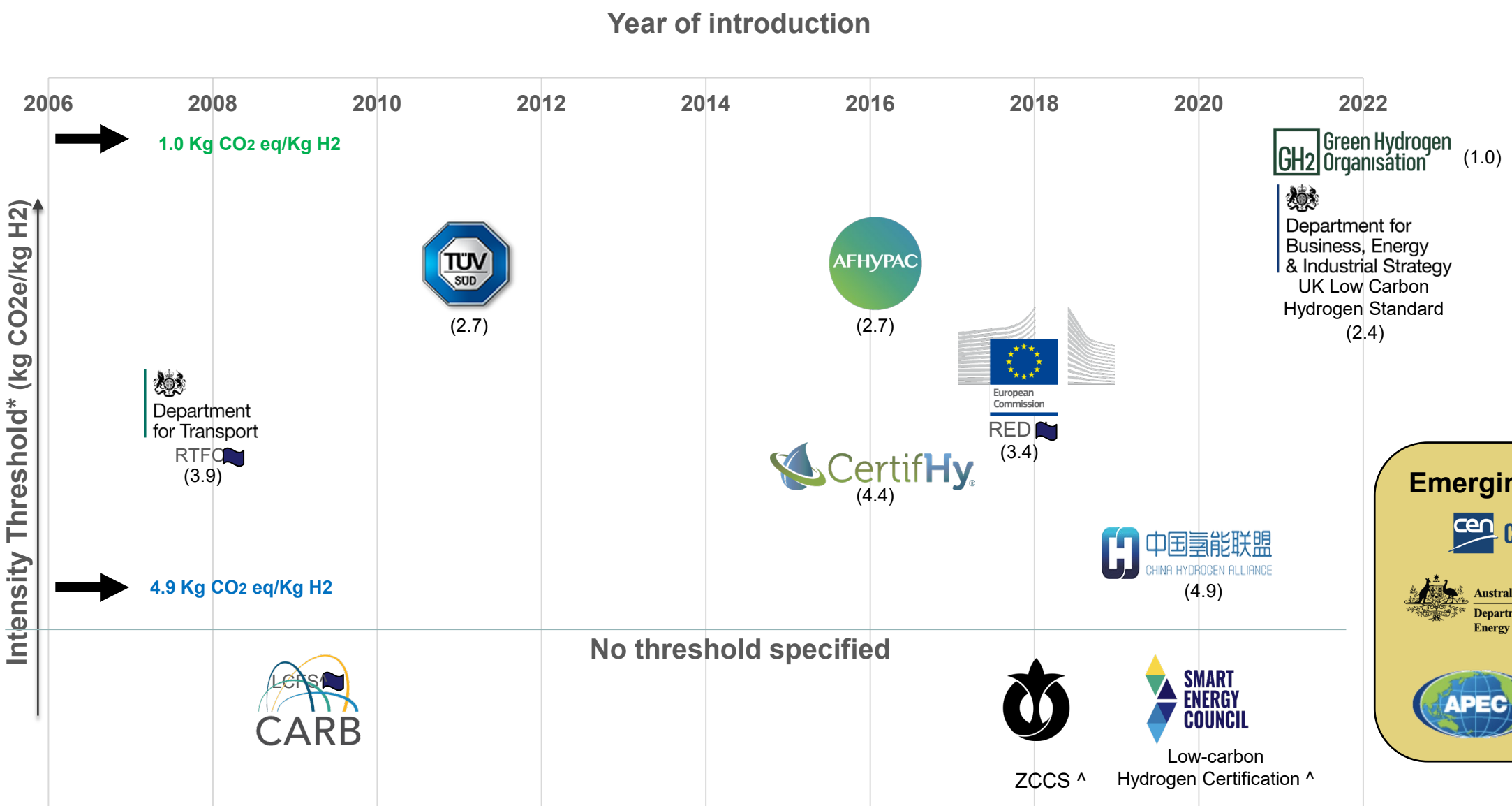
- 9a. Set electrolyser manufacturing capacity targets — Industry (EU)
- 9b. Set specific targets by part of the value chain — Industry (EU)
- 9c. Assess alternatives to automate production and decrease material need — Industry (EU)

Technology:
Focus innovation and R&D to enable technology scale up

- 10a. Focus R&D to improve technology performance including durability, cost and efficiency of the electrolysers — Research (EU)
- 10b. Scale and share pilot projects to build experience with commercial-size facilities — Research (EU)

DRAFT

Timeline of H2 cert schemes with carbon threshold



Source: IRENA – RMI study 2022

* Differences in boundary not considered
^ Intensity threshold not defined

IRENA role in hydrogen certification developments

Conduct analysis
- Trade report *due Mar 2022*
- Geopolitics *issued Jan 2022*
- G7 – gap analysis and HL conference by Jun 2022 *proposal to commence*
- Horizon – report on certification by 3Q22 *proposal*
- CfA report on certification launch 8 March
- *Global QI for Green Hydrogen* (BMZ/PTB)

Support developments
- **GH2** – developing a standard for GH by May 2022 *(on tech committee)*
- **IPHE** - methodology issued Dec 2021, next trade rules WG and ISO liaison *(review)*
- **Hydrogen Council** – roadmap for H2 certification due Nov 2022 (IPHE & ISO liaison) *Knowledge Partner & Advisory Board member*
- **IEA** – TCP H2 *(on tech committee)*
- H2 Europe - *in Hydrogen Council network*
- **CEM** – key advisor (*under discussion)*
- **Glasgow Breakthroughs** (*under discussion)*

Facilitate dialogue
- MENA workshops for EU
- World PTX Summit (Morocco)
- CFGH WG (proposal)
- CfA – paper on certification schemes
- KPFC geopolitics

Follow up
- Renew Energy Directive
  - 13 vol scheme expected adopted by end 1Q22
- CertifHy registry
- ERGAR registry
- DENA-WEC Report *Global Harmonisation of Hydrogen Certification*
- Certication system developments, such as
  - Acciona, Mallorca GreenH2Chain platform
  - **Australia H2GO** – labelling for GH and LCH (follows IPHE)
  - **UK** – RGGO scheme

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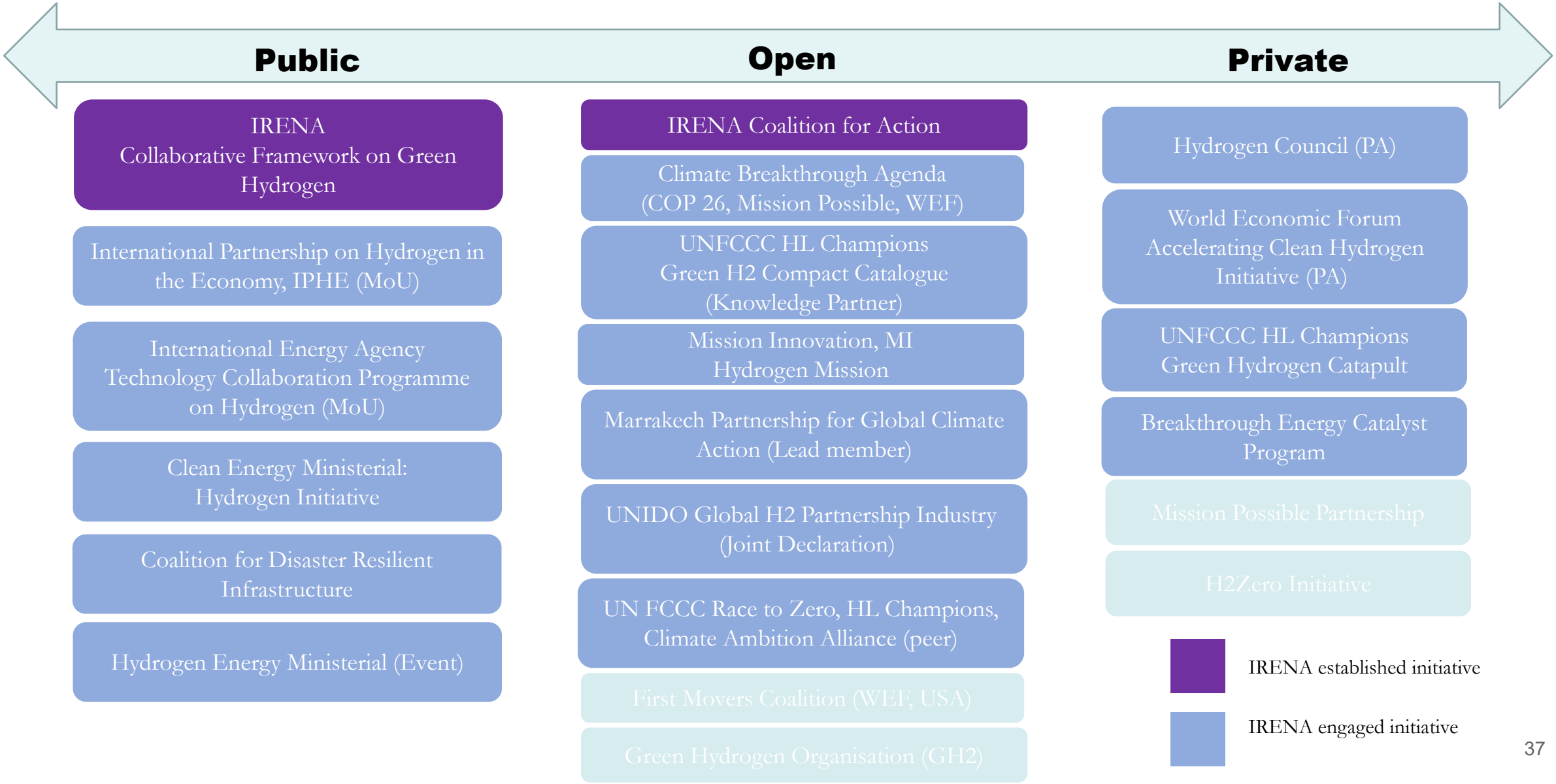
IRENA is engaged in all 21 global hydrogen initiatives across public and private sectors



IRENA's Collaborative Framework on Green Hydrogen

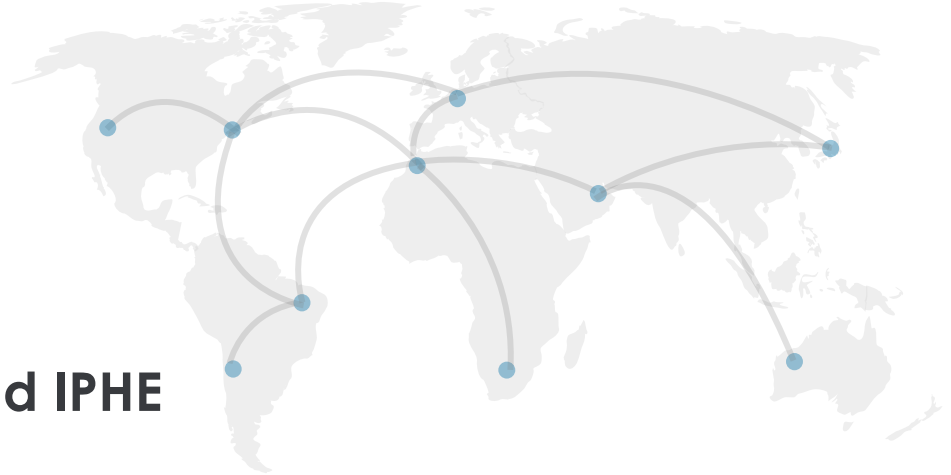
- **Green Hydrogen Ministerial Roundtable** at IRENA's 10th Assembly mandated IRENA to establish a **Collaborative Framework on Green Hydrogen**, **to foster dialogue between governments and private sector**

- **Established in June 2020**

- **Four plenary virtual meetings and one WG meeting**

- Participation to date: **65 countries, Hydrogen Council and IPHE**

- Currently **co-facilitated by the European Commission and Morocco**



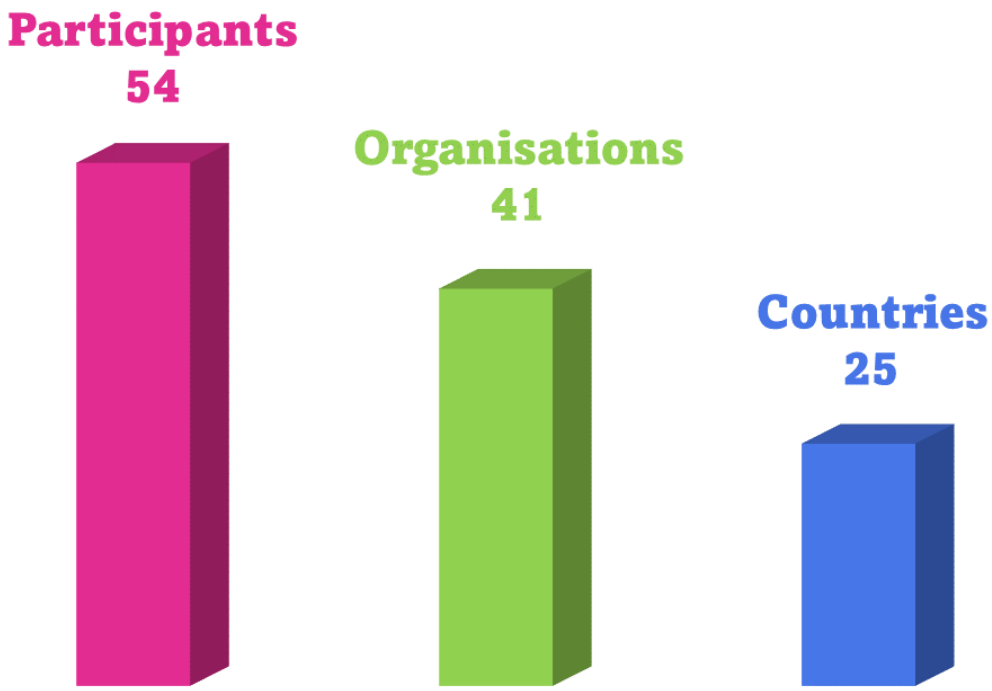
Benefits if you engage in this network

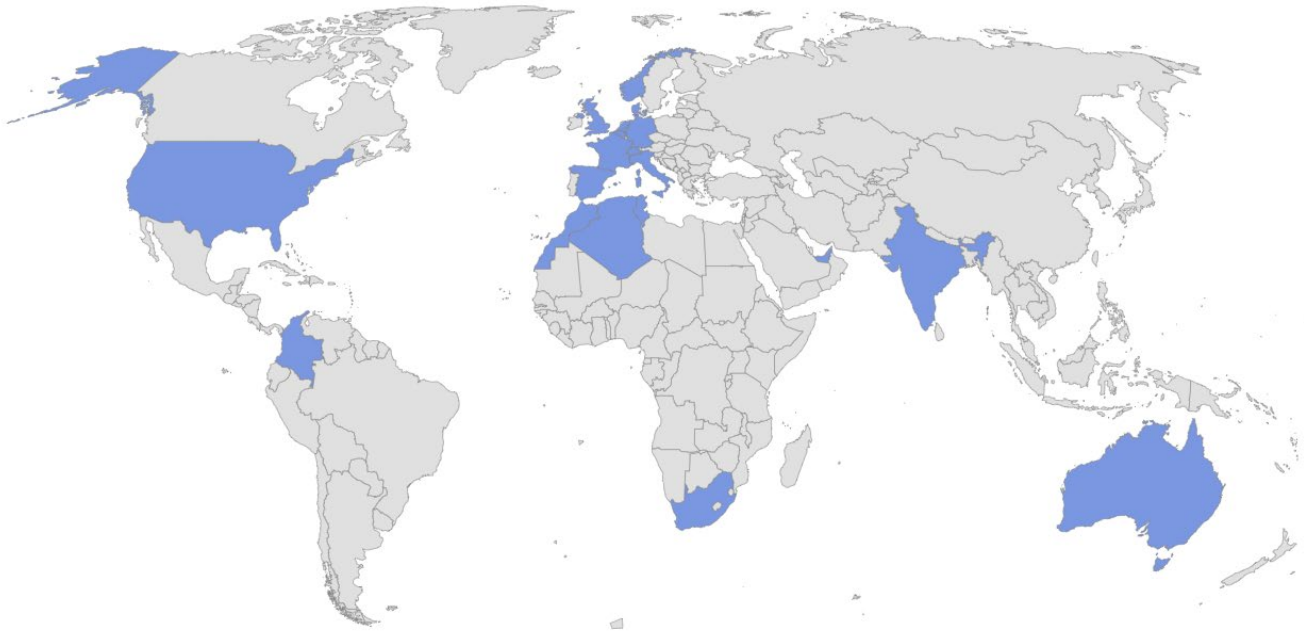
- Up-to-date information on **what others are doing** in similar areas of work
- Open discussions on **gaps, priority and different approaches to QI for GH2**
- **Access to ongoing analysis from IRENA** (peer-review) related to this project as well as to the GH2 carbon certification and GH2 derivatives certification
- Provide input to the project and leverage on IRENA's direct contact with 165 governments to **showcase your work** (IRENA's analysis are used in regulatory/policy documents, input to Ministerial discussions, input to G7 and G20, etc.)
- **Expand your networks** and knowledge base

Looking forward to working together on this project!

The stakeholder network on QI for GH2 !!!

Today's network:





Discussion plan

Panelists will present their views and activities related to the topic of the workshop (5 min).

a) What initiatives related to QI for GH2 are ongoing in your organisation?
b) Where are the priority gaps/needs related to QI for GH2?
c) With whom your organisation is cooperating/partnering on topic related to QI for GH2?

- *Where do you see the most added value coming from this project?*

Open discussion to follow

Niels Ferdinand

Director

Ferdinand Consultants

What initiatives related to QI for GH2 are ongoing in your organisation?

- PTB: Support content development of the PTB/IRENA cooperation on QI for green hydrogen.
- PTB: Research on QI services required and offered along the green H2 value chain, summary in a graphical overview.
- PTB: Presentation of the lessons learned in PV relevant for green H2, as part of the "Indo-German International Conference on Metrology for the Deployment of Green Hydrogen and Renewable Fuels in India".
- KfW: Development of TOR and realization of tender processes for consultancy projects on green H2 finance in South Africa.

Where are the priority gaps/needs related to QI for GH2?

Green H2-based economy requires:

- Strong increase of production
- Direct distribution via gas pipelines

Additional and new services of the QI are required to support a sustainable and safe development of the sector, e.g.:

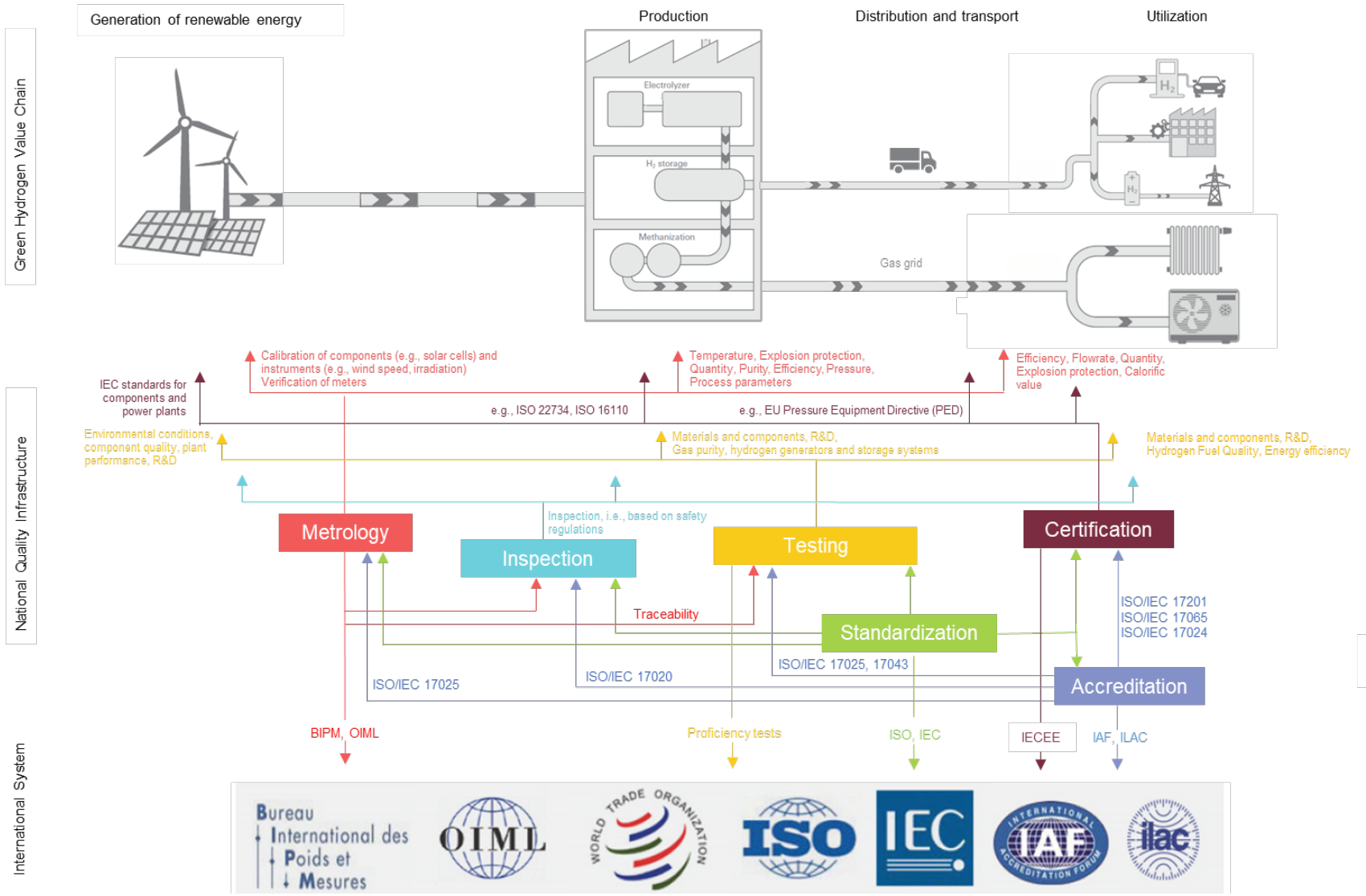
- **Metrology**: Metrological services to measure efficiency of the production (e.g. temperature, flowrate), purity of gas produced and to reduce risks of explosions (e.g. pressure).
- **Standardization**: Standards on equipment that tolerates high H2 levels. Internationally recognized standards on the guarantee of origin.

With whom your organisation is cooperating/partnering on topics related to QI for GH2?

- PTB
- KfW
- IRENA
- Relevant stakeholders India (e.g. NISE, NPL, TERI)

Quality Infrastructure requirements along the value chain

Overview: Quality Infrastructure along the Green H2 value chain



Chris Agius

Executive Secretary IECEx/IECQ

International Electrotechnical Commission (IEC)

IEC's Contribution to QI via Standards + Conformity Assessment Services

IECEx Value Proposition – 1 of the IEC CA Systems

Provides Assurance to Industry, Commerce, Regulators and Consumers that operations and activities involving flammable and combustible materials can continue safely and reliably, by providing an Internationally Standardized Approach to Testing and Certification, regardless which IECEx Approved Certification Body is used.

Currently **95** IECEx Certification Bodies offer IECEx Certification
>120,000 Certificates + Reports issued

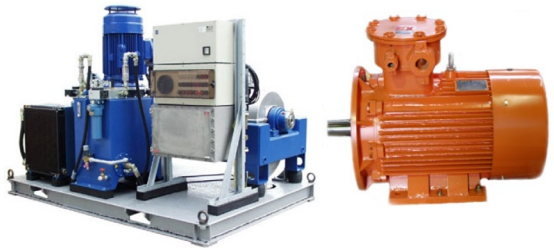
Industries that use flammable/combustible materials include:

- Production, Storage, Dispensing and use of flammable liquids and Gases, such as Hydrogen, including GH2
- Transport, eg cars / plans / ships / trucks (Passenger + Freight)
- Fueling stations and storage facilities
- Oil and gas exploration and processing
- Coal mining
- Food manufacture and processing
- Grain handling/storage/transportation
- Pharmaceutical manufacturing
- Textiles, fabrics and clothing
- Paint and surface coatings
- Medical applications, eg hospitals
- Furniture manufacturing
- Sewerage treatment plants
- Underground car parks
- Others

Overview of IECEx (3 separate International Certification Schemes) *Global Approach towards Quality Infrastructure*

IRENA
International Renewable Energy Agency

IEC System for Certification to Standards relating to Equipment used for Explosive Atmospheres, Ex

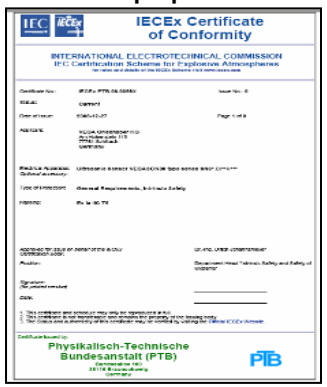


Equipment Scheme

Services Scheme

Persons Scheme

Equipment



Equipment, Components + Systems + Mechanical

Assemblies

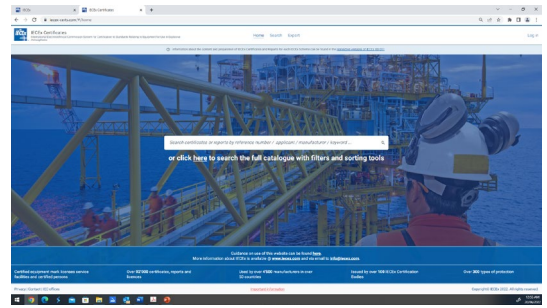
"Assemblies"

Services

Ex Services, eg Repair

Personnel

Competent Person, with Photo ID Card



All Certificates available for full public viewing in *real time* at www.iecex.com

IECEx – Applying proven solutions to GH2 QI

Traditional Areas – Areas where Flammable and Combustible materials may be present

IECEx provides a single global solution for assessment + Certification of Equipment/Services/Persons

- Key Role in the new Emerging Hydrogen and Fuel Cell Economy
- According to World Energy Council by **2025**, hydrogen strategies can be expected to cover countries representing over **80%** of global GDP
- Logical extension to IECEx past coverage of Ex Equipment in Hydrogen areas
- **IECEx Expert WG 19 "Hydrogen Technologies"** current focus:
  - Personnel Certification of Competence according to **ISO TC 197** and **IEC TC 105** Standards (eg ISO 15916 *Basic considerations for the safety of hydrogen systems*)
  - Certification of Equipment associated with Hydrogen dispensing systems
  - Certification of Stationary and Portable Fuel Cells (IEC 62282 series).

What initiatives related to QI for GH2 are ongoing in your organisation?

Initiatives related to QI for GH2 within IEC include:

- Standards development and maintenance via IEC TC 105 "Fuel Cells"
- Standards Development and maintenance via IEC TC 31 "Explosive Atmospheres" related to explosion protection, eg IEC 60079 and ISO 80079 series
- Standards dedicated to Management systems for production and trade, eg ISO/IEC 80079-34
- Testing, Production auditing, Certification, Accreditation, Inspection via the IECEx
- Equipment Certification / Certification of Services / Certification of Personnel Competence

Where are the priority gaps/needs related to QI for GH2?

Current Priorities to support QI for GH2:

- Support for a global approach to QI by use of long standing International IECEx Certification Schemes for Equipment / Services / Personal Competence
- Provide feedback and participate in the development / maintenance of International IEC and ISO Standards and IECEx certification procedures
- Communicate with all stakeholders on existing systems / solutions to prevent wasteful duplication of "re-inventing the wheel"

With whom your organization is cooperating/partnering on topic related to QI for GH2?

IEC and its IECEx are cooperating with various stakeholders via the National membership structure of the IEC organisation, however in addition, IEC and IECEx cooperate with the following International organisations, in addition to IRENA :

- ISO (International organisation for Standardization, in particular ISO TC 197
- ISO CASCO regarding the development and maintenance of Conformity Assessment Standards, eg Joint ISO/IEC 17XXX series
- United Nations UNECE, WTO, OECD
- Others

Annarita Baldan

Chair of European Network for Energy Gases

VSL / EURAMET – EMN for Energy Gases

What initiatives related to QI for GH2 are ongoing in your organisation?

- EMN for Energy Gases engages with stakeholders to address measurement needs with the goal to act as the European metrology knowledge center for energy gases including hydrogen

- EMPIR Metrology research projects to support (green) H2 measurement infrastructure: MetroHyVe I & II, NewGasMet, MetrHyInfra, MefHySto, Decarb

- EPM research project Met4H2 "*Metrology for the hydrogen supply chain*"(estimated start time 1 September 2022) where we envisage specific collaboration with IRENA

Where are the priority gaps/needs related to QI for GH2?

- Gap: Reliable and robust measurements that cover the GH2 supply chain from production, transport, storage and end-use.

- Need: traceable measurement methods and measurement standards are needed to ensure comparability of measurement results

- Examples: flow metering of green hydrogen for transport and distribution (custody transfer) and quality of hydrogen at HRS

With whom your organisation is cooperating/partnering on topic related to QI for GH2?

- EMN is a network of 19 NMI/DI in Europe experts in measurement of hydrogen
- EMN is part of EURAMET and backed up by the European Partnership on Metrology research programme
- Cooperation is under development with European organisations such as Clean Hydrogen Partnership and GERG
- Highly relevant: interaction between metrology and standardisation (e.g., ISO, IEC, CEN and CENELEC)

Trade and QI for GH2

Mateo Ferrero and Devin McDaniels

Trade and Environment Division

World Trade Organization

What initiatives related to QI for GH2 are ongoing in your organisation?

Addressed through different streams of work at the WTO

- Green hydrogen has a huge potential to decarbonize global trade (energy, production, transport)
- Technical Barriers to Trade (TBT) Agreement and Committee – **trade-facilitating QI**
- Trade and Environmental Sustainability Structured Discussions (TESSD) – environmental goods and services (**EGS**) and **trade-related climate measures** (regulatory coherence)
- Committee on Trade and Environment (CTE) – **trade and climate change nexus**

Where are the priority gaps/needs related to QI for GH2?

Trade and regulatory framework that enables global uptake of green hydrogen

- Relevant **international standards** for green hydrogen for use by governments and companies across the supply chain – overcoming regulatory bottlenecks (TBT Agreement)

- Reducing trade barriers from **certification** – recognition of conformity assessment

- **Challenges and opportunities for developing countries** in deploying green hydrogen to decarbonize their industries and participate in low-carbon markets – QI and technical assistance

With whom your organisation is cooperating/partnering on topic related to QI for GH2?

Cooperating on QI and renewable energy

- Positive IRENA/WTO collaboration on solar PV, QI and trade (2021)
- TESSD stakeholders
- INetQI – working closely with organizations including ISO, IEC, UNIDO, ILAC, IAF, BIPM, OIML
- Regional and firm-level dimensions of QI, trade and sustainability, e.g. ARSO and World Bank

Neha Rustagi

Technology Manager

U.S. Department of Energy (DOE)
International Partnership for Hydrogen in the Economy (IPHE)

What initiatives related to QI for Hydrogen are ongoing in your organisation?

The IPHE Hydrogen Production Analysis Task Force (H2PA) is developing mutually agreed upon methods of life cycle analysis for hydrogen production, conditioning, and transport, to inform global trade

- Working paper describing LCA methods for electrolysis, SMR with CCS, and coal with CCS published in October 2021

- Ongoing efforts covering additional H2 production pathways (e.g. biomass, autothermal reforming), hydrogen carriers, liquefaction, and hydrogen transport

Additionally, the US is a member of the IEA Hydrogen Technology Collaboration Programme (TCP). As part of this TCP, DOE's Argonne National Laboratory is developing a global version of the GREET model, to enable comprehensive LCA of global hydrogen pathways.

Where are the priority gaps/needs related to QI for Hydrogen?

- Best practices and consistent approaches to estimating upstream emissions, such as:
  - Fugitive emissions from natural gas drilling and transmission
  - Use of renewable energy certificates (RECs)/power purchase agreements (PPAs) to characterize electricity emissions intensity
  - CO_2 uptake and indirect effects (e.g. land use change) of biomass feedstock
- Emissions analysis methodologies of emerging methods of H_2 production such as:
  - Methane pyrolysis
  - Plastics to H_2 pathways
- Improved understanding of manufacturing emissions and climate impacts of hydrogen to inform future LCA

With whom your organisation is cooperating/partnering on topic related to QI for Hydrogen?

- IPHE includes government representatives from 22 countries and the European Commission

- The IPHE Draft Working Paper was disseminated among industry organizations (e.g. the Hydrogen Council) for stakeholder feedback prior to publication, and is currently being presented to standards development organizations.

- Member countries within IPHE are eliciting stakeholder feedback (e.g. from industry, non-profits) to inform national emissions accounting frameworks.

- Global GREET (IEA TCP) is being built leveraging the GREET platform, which has over 40,000 users worldwide (industry, government organizations, academia, etc.)

Björn Munko

Head of Gas Technologies and Energy Systems

DVGW German Technical and Scientific Association for Gas and Water

IRENA
International Renewable Energy Agency

Andrei Tchouvelev

ISO/TC 197 Co-Chair TAB (Technical Advisory Board)

Director Safety & Regulatory, Hydrogen Council

IRENA
International Renewable Energy Agency

Samuel Bartlett

Director

Green Hydrogen Organisation

Thomas Fuhrmann

Head Global Hydrogen Competence Center

TÜV Rheinland

Nick Cook

Senior EHS&Q Manager / AEA Certification Group Chair

CF Industries / Ammonia Energy Association (AEA)

What initiatives related to QI for GH2 are ongoing in your organisation?

- Update of DVGW Rules for H2
  - Two additional guidelines have been issued to make the rules H2 Ready
  - 224 Rules will be H2 ready be end 2022
  - 8 24 outstanding rules to make the complete rules applicable for H2
- Update of rules under the DIN NA Gas for H2
- Updates of EU rules under CEN TC 234

Where are the priority gaps/needs related to QI for GH2?

- Update DVGW Rules till 2024/25
- Update DIN Rules
- Identify gaps in H2 Readiness using the H2 Roadmap

With whom your organisation is cooperating/partnering on topic related to QI for GH2?

- DIN
- DKE
- ZVSHK
- NWB
- VDI
- VDK
- VDMA

Open discussion

a) What initiatives related to QI for GH2 are ongoing in your organisation?

b) Where are the priority gaps/needs related to QI for GH2?

c) With whom your organisation is cooperating/partnering on topic related to QI for GH2?

- *Where do you see the most added value coming from this project?*

PART A - Poll question 1

- Which segment of the **GH2 value chain lags behind in QI development**? (Select one option only)
  - ❑ RE electricity input to electrolyser
  - ❑ Water input to electrolyser
  - ❑ Electrolysis process (different electrolysis technologies)
  - ❑ Compression & Storage
  - ❑ Transmission & Distribution

PART A - Poll question 2

- Which one of the following **components of QI for GH2 deserve more attention**? (Select one option only)
  - ❑ Accreditation
  - ❑ Certification
  - ❑ Metrology
  - ❑ Standards
  - ❑ Testing

PART A – open discussion on priority needs in QI for GH2

- Which segment of the **GH2 value chain lags behind in QI development**?
- Which one of the following **components of QI for GH2 deserve more attention**?

PART B - Poll question 1

- Are you interested in providing **direct input to this project** (references, data sources, case studies)?
  - ❑ Yes
  - ❑ No

PART B - Poll question 2

- Are you interested in **co-hosting with IRENA virtual events/working groups** linked to specific areas of work in this project (standards, testing, certification, metrology)?
  - ❑ Yes
  - ❑ No

PART B – Open discussion on way to engage and contribute to this project

- Are you interested in providing **direct input to this project** (references, data sources, case studies)?
- Are you interested in **co-hosting with IRENA virtual events/working groups** linked to specific areas of work in this project (standards, testing, certification, metrology)?

Thanks for your active participation!

Next steps:

- Slides and summary notes from this workshop
- Sending a survey to start contributing to the project
- Bilateral contact to further engage in specific topic of QI for GH2

Roland Roesch

Deputy Director

IRENA Innovation and Technology Center

Thank you for your participation!

IRENA Innovation and Technology Center

Francisco Boshell **FBoshell@irena.org**
Francesco Pasimeni **FPasimeni@irena.org**

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