Introduction to Green Hydrogen Standards and Certification

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GH2 Green Hydrogen Organisation

Green Hydrogen Standard

Why do we need hydrogen standards?

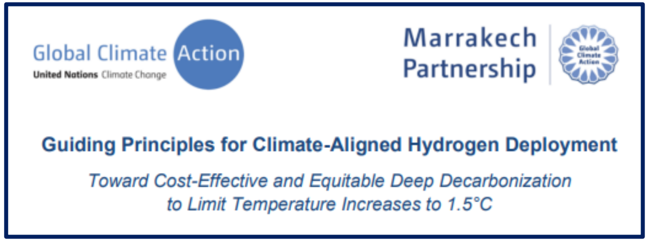
Any effort to create a standard for hydrogen must be aligned with the need to limit global warming to 1.5 degrees. It must also be flexible enough to cover a wide range of hydrogen products and applications.

Breakthrough Report (2022)

"While this report does not define a specific carbon intensity limit for low-carbon and renewable hydrogen, both of these production routes will need to achieve verifiable ***low carbon intensities that trend towards near zero by 2030****. This implies that fossil-based hydrogen production must operate with high carbon capture rates applied to all streams containing carbon dioxide, and that the captured carbon is permanently stored underground to prevent its release into the atmosphere. Additionally, it is critical that methane leakage is minimised to near zero, if not completely avoided. Rigorous measurement, reporting and verification of emissions will be necessary".*

Guiding Principles for Climate-Aligned Hydrogen Deployment (2021)

Renewable [Green] hydrogen is the only option strictly aligned with a 1.5-degree pathway. Fossilbased hydrogen intrinsically faces a high burden of proof it must meet through credible, independent monitoring and regulation of lifecycle emissions for inclusion in a 1.5C pathway.



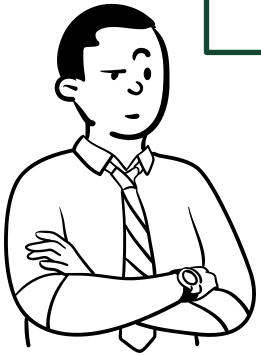
Why do we need a Green Hydrogen Standard?

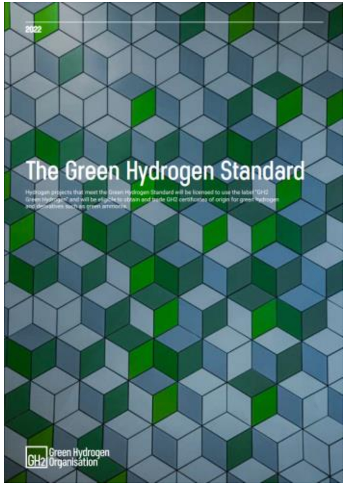
- Green hydrogen producers and customers need clarity and consistency in order to plan for the long term.
  - To secure government approvals and community support
  - To sign offtake agreements
  - To secure financing
- Customers and consumers want hydrogen that has close to zero-emissions and projects that contribute to sustainable development.
- Adherence to sustainability standards will strongly influence pricing and export opportunities.

The **Green Hydrogen Standard** has been developed to meet this need.

Projects that meet the Standard will be licensed to use the label GH2 Green Hydrogen and will be eligible to obtain and trade GH2 certificates of origin for green hydrogen and derivatives such as green ammonia.

“I need green hydrogen to decarbonise. If I can’t get a trusted green certificate, I won’t buy it”





Hydrogen policy summary

	EU	USA	Canada	UK	Germany	France	Spain	Portugal	Norway	Netherlands	Belgium	South Korea	Japan	India	China	Australia
2030 Production Target	40 Gwe / 10 Mtpa	10 Mtpa	✗	10GW	5 GWe	6.5 GWe	4 GWe	2 GWe	✗	3 – 4 Gwe	2 – 6 TWh	✓	3 Mtpa	5 Mtpa	0.2 Mtpa by 2025	✗
2030 Demand Target	20 Mtpa	10 Mtpa	✗	✗	✗	✗	25% of current demand	✗	✗	✗	✗	5.3 Mtpa by 2040	0.42[2]	–	✓	✗
Top 3 demand sectors	Industry Ammonia Refining	Other Refining Ammonia	Export Mobility Blending	Power Industry Mobility	Refining Ammonia Steel	Industry Mobility	Refining Ammonia Mobility	Blending Industry Mobility	✗	Industry Mobility	Industry Maritime	Power Mobility	Power Mobility Industry	Refining Fertiliser City Gas	Mobility	✗
Incentives (Tax or CfD)	Hydrogen auctions	Tax: up to $3/kgH$_2$	Tax	CfD	✗	✗	✗	✗	✗	✗	✗	✗	CfD	✓	✗	✗
H_2 project funding (US$ billions)	~167	8	✗	✓	~9.7	~8.3	~10.6	~8.8	✗	~0.4	~0.19	~3	~53[3]	~2.5	✗	1.6
Net-zero target legislated	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–
Emissions (Scope / $kgCO_2/kgH_2$)	Full life-cycle 3.38	well-to-gate 4.0	✗	well-to-gate 2.4	(EU flag)	(EU flag)	(EU flag)	(EU flag)	✗	(EU flag)	(EU flag)	well-to-gate 4.0	well-to-gate 3.4	✗	well-to-gate 14.5 / 4.9[1]	✗

Key	Targets	✓ Legislated	– Strategy or drafted/in progress	✗ Not in place

(1) China CI definition for Low Carbon Hydrogen is 14.51 $kgCO_2e/kgH_2$; and for Clean/Renewable hydrogen is 4.9 $kgCO_2e/kgH_2$

(2) Wood Mackenzie estimate equivalent to 1% of power generation in Japan in 2030.

(3) Japan plans to invest US$107 billion from both the private and public sector to develop hydrogen supply chains over 15 years. We've assumes a 50-50 split.

Methods

e.g., IPHE, GREET, I-REC ISO standards. Also some national standards (AUS)

"Non-discriminatory".
"how to measure?"
not "what is acceptable?"

Emerging global consensus. However:

- Measuring fugitive methane (grey and blue)
- Measuring fugitive hydrogen
- Embodied / embedded emissions
- Transportation, storage and distribution
- Coverage of derivatives and "energy carriers", ammonia, methanol, SAF.

Standards

e.g., GH2, CertifHy, TUV SUD, Also: National standards (EU RFNBO)

"Normative".
Addresses "what is good / acceptable"

Increasingly fragmented:

- Different scope (technology neutral vs Green / Renewable only)…
- System boundaries ("Well-to-gate", or "well to wheel").
- Different thresholds
- Additional criteria (labour, additionality, etc).

Project Testing

e.g., GH2

Focus on derisking, regulatory alignment, promoting best practice.

Needs greater attention:

- Start early
- Balance global standards // national regulation // local impact and benefits

Project Accreditation

Examples: GH2, CertifHy, TUV SUD, BV, SAP, SGS, etc. Also: National schemes

Some are hydrogen specific, other apply a generic GHG framework

Very few projects are ready for formal testing & certification

- Established players SGS, DNV, SAP, TUV-SUD have their own proprietary approaches
- Limited coordination and harmonisation.
- Development of data standards

Certification

Examples: GH2, CertifHy. National certification schemes?

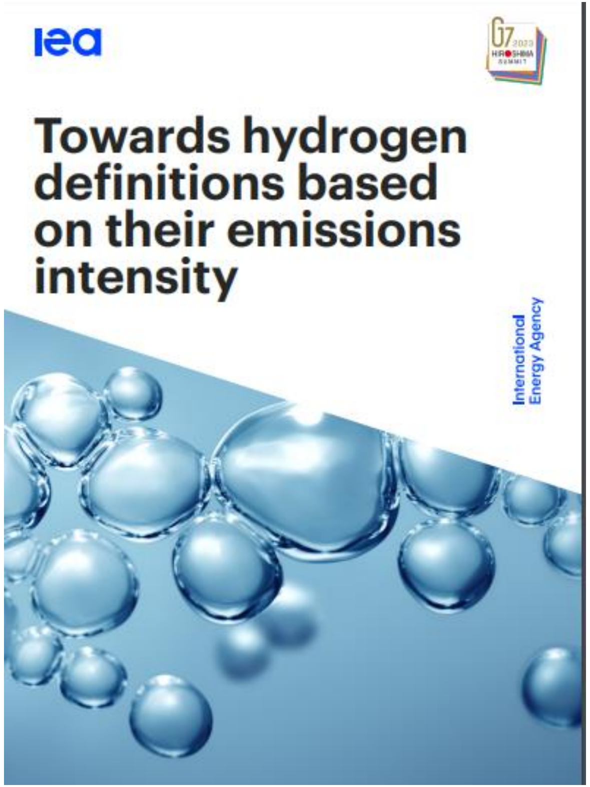
Various platforms under development, but almost zero trade.

Involves a significant upfront investment. (Thin markets for ≈ 3 - 5 years).

- A key challenge is accommodating different chain of custody models (identity preservation vs mass balance vs book and claim).

Overview of existing and planned certification systems and regulatory frameworks for hydrogen, ammonia and other hydrogen-based fuels

Purpose	Name	Market / jurisdiction	System boundary	Product	Demand sector	Status	Chain of custody	Production pathways	Emissions intensity level (kg CO_2-eq/kg H_2)
Voluntary	Standard and Evaluation of Low-Carbon Hydrogen, Clean Hydrogen and Renewable Hydrogen (China Hydrogen Alliance)	China	Well-to-gate	Hydrogen		Operational	Not specified	All	Low-carbon hydrogen: 14.5 Renewable hydrogen, clean hydrogen: 4.9
Voluntary	CertifHy	European Union	Well-to-gate	Hydrogen		Operational	Book-and-claim	Renewable electricity	Green hydrogen: 4.4
								Nuclear electricity, fossil fuels with CCUS	Low-carbon hydrogen: 4.4
Voluntary	Low-carbon hydrogen certification system (Aichi Prefecture)	Japan	Well-to-gate	Hydrogen		Operational	Book-and-claim	Renewable electricity, biogas	-
Voluntary	Green Hydrogen Standard (Green Hydrogen Organisation)	International	Well-to-gate	Hydrogen		Operational	Not specified	Renewable electricity	1
				Ammonia		Under development			0.3 kg CO_2-eq/kg NH_3
Voluntary	Climate Bonds Standard & Certification Scheme	International	Well-to-gate	Hydrogen		Operational		Electrolysis, natural gas and waste biomass	2022: 3.0 2030: 1.5 2040: 0.6 2050: 0.0



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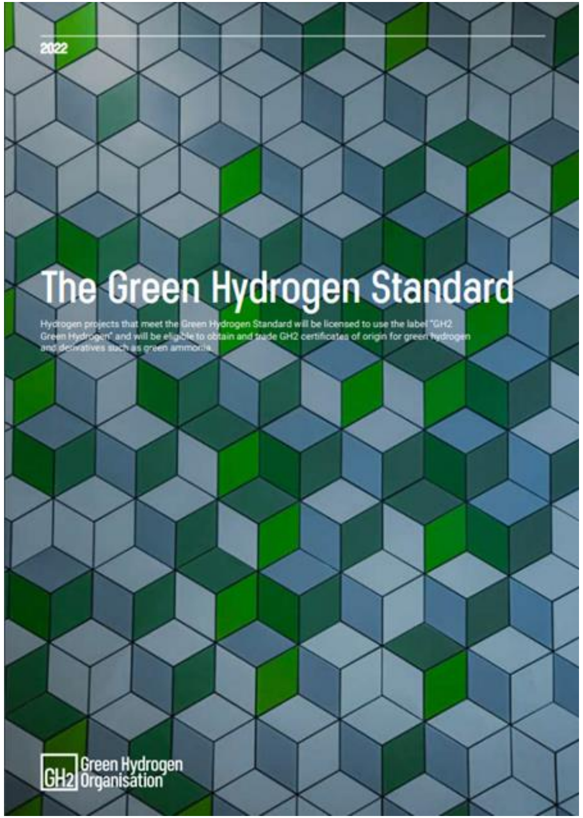
The Green Hydrogen Standard

A global definition of green hydrogen: "Green hydrogen is hydrogen produced through the electrolysis of water with 100% or near 100% renewable energy with close to zero greenhouse gas emissions".

Includes energy sourced from hydropower, wind, solar, geothermal, tide, wave and other ocean energy sources. Excludes nuclear. Excludes waste to energy, biomass*.

"Close to zero emissions" threshold of **< 1kg CO2e/Kg H2**. Includes "scope 1" emissions from production (including desalination), and "scope 2" emissions from on site or purchased renewable electricity.



Key Features

The Standard requires that the environmental, social and governance consequences of green hydrogen production are addressed. General principles to ensure a focus on the most significant impacts and avoid duplication with national standards.

- Alignment with international best practices, including the IFC safeguard policies.
- Green hydrogen producers may count electricity taken from the grid as fully renewable if they have concluded one or more power purchase agreements (PPAs) and make use of credible guarantee of origin certification schemes (or similar proofs) where available.
- On “additionality”. Requires an assessment of the impact of grid-connected projects on the grid + the identification of technically feasible and cost-effective measures.

The Standard requires that the development opportunities and impacts of green hydrogen production and use are fully considered.

Reviewing early-stage Green Hydrogen Projects

Objective: To accelerate high quality Green Hydrogen Project development

- GH2 provides support for scoping / pre-feasibility studies. Access to best practice / guidance notes
- "Derisking" + supports engagement with government, host communities, investors, lenders, customers

Green Hydrogen Project Accreditation

Objective: To accreditation projects that meet the Green Hydrogen Standard.

- Engagement of an Independent Assurance Provider (IAP)
- Stakeholder engagement & Public Comment
- Review by GH2's Accreditation Body

Projects licensed to use the label **GH2 Green Hydrogen**™

Green Hydrogen Production Certification

Objective: Globally recognised certification of green hydrogen production, trusted by producers and consumers.

- Compliant projects are eligible to obtain and trade GH2 certificates of origin for green hydrogen and derivatives such as green ammonia.
- Mass balance vs Book and Claim options

For discussion

1. The standards and certification landscape is **evolving quickly and is highly fragmented**.

2. **Developing and emerging economies have played a limited role** in developing these standards, even though they will play a big role in creating (and limiting) market opportunities. **Government, industry and civil society must play a greater role.**

3. We need a modular approach that accommodates different commodities, value chains, use cases and regulatory requirements.

4. Harmonisation of standards and certification schemes is a high priority, **but "mutual recognition" should not support lowest common denominator outcomes**.

5. We need to be clear on which standards are aligned with net zero targets (and which are avoiding the question!)

6. Sustainability and community development considerations **must** be incorporated.

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