December 2023

Green Hydrogen Standard® 2.0

The Global Standard for Green Hydrogen and Green Hydrogen Derivatives

GH2 Green Hydrogen Organisation

Green Hydrogen Organisation (GH2)

The Green Hydrogen Organisation (GH2) is a not profit foundation under Swiss law. In addition to its office in Geneva it is present in London, Oslo, Perth, and Sydney.

The mission of GH2 is to dramatically accelerate the production and utilisation of green hydrogen across a range of sectors globally. It will push to rapidly decarbonise industries like steel, cement, fertilisers, shipping and aviation that have so far made limited progress reducing their emissions.

A global standard that defines green hydrogen is essential to promote confidence, raise and leverage investment, facilitate trade and unlock green hydrogen's vast potential.

Additional information regarding GH2 is available via **www.gh2.org.**

The latest updates on the Green Hydrogen Standard are available via **www.greenhydrogenstandard.org**.

The Green Hydrogen Standard 2.0

The Green Hydrogen Organisation

Version 2.0 December 2023

For more information, please contact
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Foreword

We are delighted to launch the Green Hydrogen Standard 2.0.

The Green Hydrogen Standard provides certainty and transparency to investors and other stakeholders that green hydrogen is exactly that: hydrogen made with renewable electricity which conforms to the highest standards on emissions, ESG and the sustainable development goals.

Drawing on the experience from testing and piloting the Standard since it was first launched in May 2022, this second edition includes some important refinements.

The Standard can now be applied to green hydrogen, green ammonia, green methanol, and synthetic methane production. This is important because many of the largest projects plan to produce green hydrogen derivatives that are more efficient to produce and easier to transport.

The Standard now addresses the use of biomass in renewable electricity production and in the production of green hydrogen derivatives, including safeguards that address impacts on the environment and food security.

The Standard is one of the first to require that hydrogen emissions are minimised and reported. This is important because hydrogen emissions can have a significant indirect impact on other greenhouse gases.

Finally, the Standard can now be used to "prequalify" early-stage green hydrogen projects. This is crucial, as our industry is still in its infancy. Prequalification helps to improve project design from an early stage and helps propel high quality projects towards final investment decision.

We greatly appreciate the work undertaken by the Standard Committee in overseeing and further developing the Standard. Many companies, research institutions, campaigning organisations and others have delved into the detail, scrutinised different pathways and contributed to the many working groups and to the work of the Committee. Above all, they have been prepared to compromise and land on genuine multistakeholder solutions, as reflected in the Standard. I cannot acknowledge them all here but you will find them listed in the next section.

The central importance of green hydrogen in the transition to net zero is clearer than ever. The Green Hydrogen Organisation is working to dramatically accelerate the uptake of green hydrogen to rapidly phase out fossil fuels in industries like steel, cement, power, fertilizers, shipping and aviation.

We have stopped debating whether green hydrogen is a solution. The question is how quickly we can make it happen.

Today we use nearly 100 million tonnes of hydrogen as a feedstock for chemicals and fertiliser production worldwide[1]. The problem is that this so-called black and grey hydrogen is produced from fossil fuels, with more than ten kilos of CO2 emissions for each kilo of hydrogen. Around a billion tonnes of carbon dioxide emissions each year are associated with this hydrogen production, equivalent to approximately 2% of global emissions[2]. With demand for hydrogen set to grow up to six-fold in the decades ahead, it is obvious that the production of unabated black and grey hydrogen must end.

The good news is that it is possible to produce hydrogen using little or no emissions. The bad news is that the vague concept of "clean" or "low carbon" hydrogen has become ubiquitous; a subtext for promoting fossil-fuel derived hydrogen with emissions which are still too high for our planet to cope with.

We support the efforts underway to develop a rigorous global standard for measuring greenhouse gas emissions and the mutual recognition of standards and certification schemes that adhere to these methods. However, we must define which hydrogen production pathways and projects are 1.5 degree aligned. Too many governments, industries and development organisations are avoiding this issue. Standards without thresholds legitimize hydrogen production pathways and projects that are not sustainable.

It is essential that we reach agreement on global standards that define green hydrogen. Everyone needs to know that "green" hydrogen means hydrogen produced with near zero associated greenhouse gas emissions. A standard is needed to build trust and confidence between investors, producers, customers and consumers.

We also need a social license to operate from the communities that will host renewable electricity and green hydrogen production. There are clear risks that, if not managed to a high standard, the green hydrogen revolution will stall. The Standard requires that the environmental, social and governance aspects of green hydrogen production are addressed. The utilisation of water is rightly attracting more attention, and our Standard is leading the way in establishing global best practice.

The Standard also requires that the development opportunities and impacts of green hydrogen production and use are considered. These are vital considerations for investors, customers, consumers and the communities that host green hydrogen projects.

Compliance with the Green Hydrogen Standard helps developers build confidence that their projects have been designed in compliance with national and regional schemes such as the EU's Renewable Fuels of Non-Biological Origin (RFNBO) requirements under the Renewable Energy Directive and forthcoming tax credit provisions under the US Inflation Reduction Act 2022.

GH2 is committed to championing global best practice and revising its approach to standards and certification as the green hydrogen industry develops. The GH2 Board, taking advice from the Standard Committee, will continue to review the Standard on an annual basis. The expectation is that the boundaries of the emissions assessment framework will be widened to cover a full life cycle assessment, and that the emissions thresholds will be lowered in accordance with emerging best practice.

GH2 was established to build the energy systems of the future. Green hydrogen is a vastly superior technology to fossil fuels and will inevitably replace them. The only question is when, and we are running out of time. If you are committed to the energy transition, reach out to us here at GH2. We have a planet to save and no time to waste.

Malcolm Turnbull
Chairman of the Green Hydrogen Organisation

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Acknowledgments

The Green Hydrogen Standard was proposed in 2021. GH2 subsequently formed a Technical Committee to advise the GH2 Board on the design of the Standard. When the Standard was adopted and launched in May 2022, the GH2 Board agreed to formalize this consultative process by establishing a Green Hydrogen Standard Committee. The Committee now advises the GH2 Board on the implementation and elaboration of the Green Hydrogen Standard. GH2 would like to thank the following Committee members for their expert advice and input:

- **Ahmed Hafez**, Ministry of Electricity and Renewable Energy, Egypt
- **Alain Kilajian**, Hydropower Sustainability Alliance
- **Anna Freeman**, Clean Energy Council Australia
- **Anuraag Nallapaneni**, WRI India
- **Claire Behar**, Hy Stor
- **Ernst Müller**, Herbert Smith Freehills South Africa LLP
- **Erwin Cornelis**, ECOS
- **Gagan Reddy**, ProClime
- **Geert Decock**, Transport & Environment
- **Hammad Masood**, ACWA Power
- **Heino von Meyer**, PtX Hub
- **Hemant Mallya**, Council on Energy, Environment and Water, India
- **Ilka-Rose Mitchell**, Fortescue Future Industries
- **Johanna Friese**, TES
- **Mahandra Rooplall**, Industrial Development Corporation
- **Matthew Tinari**, EverWind Fuels
- **Matthias Deutsch**, Agora Energiewende
- **Mohamed Hafez**, Egyptian Electricity Holding Company.
- **Paul Gleeson**, Aurecon
- **Paul Wambugu**, KenGen, Kenya
- **Prof. Liu Yunhui**, Tsinghua University
- **Rachel Fakhry**, Natural Resources Defense Council
- **Rajan Varshney**, NTPC
- **Ricardo Gedra**, Câmara de Comercialização de Energia Elétrica
- **Sachin Kulshreshtha**, Avina clean energy
- **Scott Hamilton**, Hydrogen Australia
- **Someshwer Dutt Sharma**, Avaada Group
- **Sonja Butzengeiger-Geyer**, Perspectives Climate Group GmbH
- **Subhash Kumar**, ACME
- **Tim Hard**, Argus Media
- **Ulrike Hinz**, WWF, Germany

We are also indebted to the many technical experts that have participated in working group meetings.

Stakeholders wishing to join the Committee are invited to contact GH2 via: **sam.bartlett@gh2.org.**

Version History

The first edition (version 1.0) of the Green Hydrogen Standard was published in May 2022. An updated version (1.1) was published in January 2023, including the Green Ammonia Protocol. The second version (2.0) was published in November 2023, including the Green Methanol and Synthetic Methane Protocol.

1. Introduction

Green hydrogen producers are invited to submit their projects for accreditation and certification by the Green Hydrogen Organisation (GH2). Green Hydrogen projects that meet the Green Hydrogen Standard (as set out below) will be licensed by GH2's accreditation and certification body to use the label "GH2 Green Hydrogen" and will be eligible to obtain and trade GH2 certificates of origin.

The Green Hydrogen Standard (hereafter "the Standard") establishes a global definition of green hydrogen. Green hydrogen is hydrogen produced through the electrolysis of water with 100% or near 100%[3] renewable energy with close to zero greenhouse gas emissions.[4] It requires that the environmental, social and governance consequences of green hydrogen production are thoroughly evaluated. It also requires that the development opportunities and impacts of green hydrogen production and use are fully considered.

The Standard is based on a project-level certification and accreditation. Chapter 2 outlines seven general and seven detailed requirements that projects must satisfy.

step 1	**Green Hydrogen Project Development**	The **project developer** ensures compliance with the GH2 Standard.
step 2	**Independent Assurance**	The project developer engages an **Independent Assurance Provider**.
step 3	**Consultation and public comment**	The Independent Assurance Provider consults stakeholders and prepares an assessment. A draft report is made available for public comment.
step 4	**Green Hydrogen Project Accreditation**	The final report is submitted to **GH2's Accreditation Body.** Projects that meet the Standard are licensed to use the label "GH2 Green Hydrogen" and will be eligible to obtain and trade GH2 certificates of origin.
step 5	**Green Hydrogen Production Certification**	**The GH2 Registry** issues, tracks and cancels GH2 Green Hydrogen Guarantee of Origin certificates.
step 6	**Review and Renewal**	Accreditation is reviewed annually. The Accreditation body undertakes spot checks and may recommend refinements to the Standard.

The Green Hydrogen Standard provides a clear global minimum standard, while also retaining the flexibility to accommodate local challenges and opportunities. The Standard places the onus on green hydrogen producers to demonstrate that they are addressing the environmental, social and governance performance of their projects in accordance with national laws and regulation and global best practice. The Standard seeks to ensure consistency and credibility, while also maintaining country ownership.

GH2 embraces the principle and practice of accountability by government and industry to all citizens for the stewardship of natural resources. Certification and accreditation by GH2 require that green hydrogen projects are subject to a credible, independent assessment, applying international assurance standards. The procedures emphasise openness and stakeholder consultation. Proactively engaging and building trust with key communities and stakeholders will also be its own reward outside of certification as it will build social licence to operate and improve the positive impacts of the investment and help mitigate any externalities.

1.1 Rigorous accounting of greenhouse gas emissions – guaranteeing close to zero emissions

The Green Hydrogen Standard sets a maximum threshold for greenhouse gas emissions of 1kg CO2e per kg H2 (see Requirement 5E, below). GH2 has worked with stakeholders to develop an emission measurement methodology that builds on international best practice and that enables comparisons with other hydrogen production pathways. GH2 also reviewed the academic literature and consulted green hydrogen producers on an appropriate threshold.[5] The GH2 Standard is rigorous, yet practical, with emission accounting procedures and thresholds that can be applied consistently to grid and off grid production.

The boundaries of the carbon accounting system and the thresholds at which hydrogen is considered "green" need to be clearly defined and trusted as credible by all stakeholders. With some modifications, GH2 applies the methodology for the electrolysis production pathway being developed by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) as outlined in the ***Working Paper Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen*** (see Annex 1).[6] The IPHE does not establish an emissions threshold. Building on IPHE's work, the Standard addresses the storage, conversion and delivery of H2 and its derivatives. Priority is given to green ammonia as a leading candidate for the transportation of green hydrogen.

1.2 Environmental, social and governance performance

While the emissions associated with hydrogen production have received significant attention, demonstrating that green hydrogen has been produced sustainably needs to be addressed in green hydrogen certification. The Standard tracks the overall social, environmental and governance performance of green hydrogen production.

GH2 focuses on the renewable energy technologies that are the leading candidates for scaling up green hydrogen production. GH2 accreditation and certification requires the project operator to demonstrate that hydrogen is produced through the electrolysis of water with 100% or near 100% renewable energy. GH2 accreditation and certification requires renewable energy sourced from hydropower, wind, solar (solar thermal and solar photovoltaic), geothermal energy, tide, wave and other ocean energy sources.

GH2 notes that some countries have determined that there is a role for nuclear energy to accelerate the shift from more polluting activities, such as coal generation. However, nuclear power raises some specific environmental and safety related issues, which this Standard is not designed to address. Similarly, there are sustainability issues related to biomass and waste to energy which this Standard is not designed to address. GH2 welcomes if the Green Hydrogen Standard inspires further rules and standards also for nuclear and other forms of energy production with close to zero emissions.

In exceptional circumstances, and in consultation with stakeholders, GH2 will consider opportunities to engage with project operators that are planning to produce hydrogen with other renewable non-fossil sources, but only where these projects meet the same emissions and sustainability standards.

Accelerating the production and utilisation of green hydrogen requires and supports a large increase in the production and utilisation of renewable energy. In order to be accredited and certified, the Standard requires that green hydrogen project operators prepare an evaluation of the project's utilisation of electricity and the impact on the energy market. The project operator must demonstrate that it has identified and implemented technically feasible and cost-effective measures that support energy efficiency or other decarbonisation options, addressing any impacts vis-à-vis access to affordable and reliable energy. The expectation is that green hydrogen projects contribute to the build-out of new renewable energy capacity and avoid leading to increased use of fossil-generated electricity elsewhere in the energy system.

The wider social and environmental impacts associated with additional renewable capacity need to be considered. Green hydrogen production facilities also need to be developed and operated responsibly and sustainably. Key questions include: ***Are the social and environmental impacts of new projects fully considered? Does the project comply with international human rights standards and are human rights promoted where the energy is produced? Has a good faith effort to engage key stakeholders and communities proactively been made? Have they been provided with the information and potential opportunities to engage that they see as most relevant and needed?***

The Green Hydrogen Standard incorporates best practice sustainability assessments into investment analysis and project decision-making processes through an inclusive process where stakeholder views are solicited, respected and addressed. The GH2 Standard incorporates the impact on affected communities, labour and working conditions, and the prohibition of all forms of slavery, child and forced labour. The use and management of water resources will also be considered during the certification process, together with adherence to best practice health and safety standards in green hydrogen production, storage and transportation.

1.3 The development impact – SDG performance

The Sustainable Development Goals (SDGs) call for the betterment of global populations, while preserving the environment and guarding against a climate disaster.[7] Green hydrogen is a unique technology and fuel that allows for scalable investment and dramatically decarbonised industry. As a system for energy production, it also promises to deliver greater energy independence for countries without natural endowments of fossil fuels as well as offering an alternative to fossil fuels. In order to achieve the SDGs and Paris Agreement targets, the energy transition must become a transformational global effort. An energy revolution is underway, but 759 million people still live without electricity and the development opportunities it provides.[8]

Green hydrogen has enormous potential to support the achievement of the SDGs. The most obvious contributions relate to SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth) and SDG 13 (climate action). In addition, there are direct and indirect contributions that contribute to almost all of the SDGs, including SDG 6 (clean water and sanitation) SDG 9 (industry, innovation and infrastructure), SDG 12 (responsible consumption and production), SDG 14 (life below water) and SDG 15 (life on land) that should also be considered. The Standard requires that green hydrogen project operators assess the project's development impact and contribution towards achievement of the SDGs. This work should be undertaken at an early stage, with a view to maximising the development potential to support energy sector development, increase energy security and development opportunities.

2. The GH2 Green Hydrogen Standard

The Green Hydrogen Standard is based on a project-level certification and accreditation. It is comprised of seven principles and seven requirements.

2.1 Principles of the Green Hydrogen Standard

The Green Hydrogen Standard provides a clear global minimum standard, while also retaining the flexibility to accommodate local challenges and opportunities. The following seven principles will be applied throughout the accreditation and certification process:

1. **Sovereignty and subsidiarity.** GH2 acknowledges that the development of natural resources and energy markets is in the domain of sovereign governments to be exercised in the interest of their citizens and national development. To avoid duplication, demonstrating adherence to credible and comprehensive national requirements[9] shall be deemed sufficient to meet GH2's accreditation and certification requirements. Similarly, any potential breaches of GH2's requirements by government agencies and/or other parties in relation to the project shall be fully considered. Science-based knowledge should be applied, referring to peer-reviewed literature and internationally accepted standards.

2. **Proportionality (materiality).** GH2 shall ensure proportionality in the accreditation and certification framework. The process should emphasise the most significant issues and impacts and allow for minor gaps/deviations in meeting the requirements where the broader objective of the requirement is met.

3. **Harmonisation.** To improve quality and efficiency, GH2 encourages alignment with international best practice and will work to ensure the interoperability of its work with organisations that are pursuing similar objectives.

4. **Consultation.** GH2 accreditation and certification requires clear evidence of proactive and broad-based stakeholder consultation. All stakeholders have important and relevant contributions to make - including governments and their agencies, companies and their suppliers, local communities who may be affected by the project, financial organisations, investors and non-governmental organisations. We support the principle of free, prior and informed consent.

5. **Transparency.** To contribute to informed public debate and building trust, the GH2 expects disclosures from project operators to be proactive, comprehensive, and publicly accessible. Project operators should find out what is of particular relevance and interest to specific stakeholders and seek the best ways to share that information. This information should be made freely available online and in other relevant formats to the community concerned[10]. Free access to, and subsequent re-use of, open data are of significant value to society.

6. **Independent verification, concerns and appeals.** GH2 relies on project operators to make a complete and compelling case of how they are meeting the Standard, which will be subject to independent review. GH2 will develop a review and appeal procedure but in the first instance, stakeholders with a concern regarding compliance with the Standard should raise it with the project operator and/or the appropriate national authorities. If this is not appropriate or if the concern remains, the stakeholder may petition GH2 to consider the matter.

7. **Further development of the Standard**. The Standard seeks to balance predictability and flexibility in a new and rapidly growing industry. Project proponents have emphasised the need for clear and stable standards to inform long term planning. Stakeholders are also in agreement that GH2 should take into account emerging best practices, particularly as projects are scaled up from pilots to large scale operation. GH2 will review the lessons learned from the accreditation and certification process in consultation with all stakeholders. Any subsequent refinements or modifications to the Standard will include transitional arrangements that will allow project operators to make the necessary adjustments within a reasonable timeframe before coming into force.

2.2 GH2 Requirements

The seven requirements below outline the specific requirements that must be met in order for projects to be accredited and certified by GH2. In some cases, the requirements reference policy notes. Policy notes provide additional detail and assessment criteria. Further refinements and interpretations are likely to occur and will be communicated through revised requirements and additional policy notes.

Terminology

The use of the terms '**required**' and '**must**' indicate that a provision is mandatory and will be taken into account in the accreditation and certification of the project.

The use of the terms '**expected**' and '**should**' indicate that the project operator should consider the issue and document their discussions and position. Certification will consider the progress made on these issues and any reasonable barriers to meeting the expectation.

The use of the terms '**recommended**', '**encouraged**', '**may wish**' and '**could**' indicate that a provision is optional, while adding to the balance of evidence for certification. However, these are not requirements for accreditation and certification of the project.

Acknowledgements

In developing these standards, the GH2 has drawn on a variety of international best practices, in particular the International Finance Corporation's (IFC) *Environmental and Social Performance Standards*[11], the Hydropower Sustainability Council's *Hydropower Sustainability Standard*[12] and the UN Sustainable Development Goals (SDGs).

Requirement 1

Project overview and outlook

The objective of this provision is to ensure that the project operator can demonstrate the project's strategic fit with relevant policies and plans of the host government, and that the project is a priority option to meet identified market needs.

GH2 accreditation and certification **requires** that the project operator publishes a publicly accessible and transparent overview of the project addressing expected outcomes and impact. This should include:

a. A simple but complete overview of the project (scope; technology used; capacities; timeframes; involved parties; how key decisions will be made and who will make them; local and regional impacts);

b. A summary of the project's contribution to local and national policies and plans objectives, and the project's contribution to the UN Sustainable Development Goals, where applicable;

c. A summary of the environmental, social and economic impact of the project and plans to mitigate them.

d. A summary of plans for ongoing consultation and community outreach and engagement;

e. A summary of how project operators intend to meet and sustain compliance with the requirements of the GH2 Green Hydrogen standard over the whole lifetime of the project.

Requirement 2

Stakeholder engagement and government approval

The objective of this provision is to demonstrate that the project has been a) subject to a proper approval process in accordance with national laws and regulations, b) that any concerns regarding the project can be addressed through the appropriate channels and with the relevant government authority and that c) the project has widely engaged relevant stakeholders to build trust and maximise its social licence to operate and local economic development opportunities.

GH2 accreditation and certification requires that the project operator publishes a publicly accessible summary of the government licences and approvals associated with the project. This should address property rights, land use, water rights (if applicable) environmental, public health and foreign investment approvals as appropriate, with links to the associated documentation where publicly available. The documentation should be made available to the Independent Assurance Providers, with appropriate caveats and safeguards to protect personal and commercially sensitive information.

Requirement 3

Project location and design

The objective of this provision is to demonstrate that the location and design of the project has been optimised as a result of an iterative and consultative process that addresses the most significant technical, economic, financial, environmental and social considerations.

GH2 accreditation and certification requires a publicly accessible evaluation of the project location and design options, including the renewable electricity and water sources, hydrogen production facilities, and associated storage and transportation infrastructure with appropriate attention to sensitive and protected areas.

Requirement 4

Social impact

International best practice highlights the importance of integrated assessments to identify: (1) the social impacts, risks, and opportunities of projects; (2) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (3) the project operator's management of environmental and social performance throughout the life of the project.[13]

The **expectation** is that the project has been subject to social impact assessment (SIA) or other similar assessment to help understand the potential impacts that a proposed project may have on a community. This should include a baseline study of the community's existing social environment. The baseline information is then used to help predict any social impacts the community may face, or changes that may occur to the existing social environment, by introducing the proposed project. The expectation is that these assessments have been carried out in accordance with applicable regulatory requirements, including appropriate stakeholder consultation and publication of the results. It is expected that the findings from this work have been incorporated into a community engagement plan (or similar) that addresses opportunities to create and contribute to social value in the communities that host the project.

The **expectation** is due consideration and planning can be demonstrated to maximise local development opportunities and to engage smaller businesses in the supply chain. This should include proactive engagement with smaller businesses as well as transparency about forthcoming contracting opportunities and procurement as demonstrates fair, transparent and competitive methods to award contracts to local vendors to foster economic inclusion.

Requirement 4A
Affected communities and livelihoods

The objective of this provision is that the livelihoods and living standards are improved for project-affected communities and that life, property and community assets and resources are protected from the consequences of the project.

GH2 accreditation and certification **requires** that issues relating to project affected communities have been identified through an assessment process utilising local knowledge and that these communities have been proactively engaged about the project and given support to understand and engage in project design and mitigation; and monitoring of project impacts and effectiveness of management measures is being undertaken during project implementation appropriate to the identified issues.

GH2 accreditation and certification **requires** that public health issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and monitoring is being undertaken during the project implementation stage appropriate to the identified issues.[14]

GH2 accreditation and certification **requires** that project operators are committed to identifying, assessing and mitigating human rights impacts, providing access to remedy through effective grievance mechanisms, and ensuring continuous improvement.

The Green Hydrogen Standard **requires** that green hydrogen project operators assess the project's development impact and contribution towards the SDGs. In the case that commitments to additional benefits or benefit sharing have been made, the expectation is that the project operator has established a system to monitor and report on the delivery of these commitments over the full lifetime of the project.

Requirement 4B
Resettlement

The objective of this provision is that the dignity and human rights of those physically displaced are respected; that these matters are dealt with in a fair and equitable manner; and livelihoods and standards of living for resettles and host communities are improved.

When project operators seek to acquire land for their business activities, it can lead to relocation and loss of shelter or livelihoods for communities or individual households. "Involuntary resettlement" refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. Resettlement is considered involuntary when affected persons or communities do not have the right to refuse land acquisition or restrictions on land use that result in physical or economic displacement.[15]

In accordance with IFC PS5[16], GH2 accreditation and certification **requires** that project operators avoid involuntary resettlement wherever possible and to minimise its impact on those displaced through mitigation measures such as fair compensation and improvements to and living conditions. Active community engagement throughout the process is essential.

Requirement 4C
Indigenous Peoples

The objective of this provision is to ensure that the project respects the dignity, human rights, aspirations, culture, lands, knowledge, practices and natural resource-based livelihoods of Indigenous Peoples in an ongoing manner throughout the project life.

Indigenous peoples may be particularly vulnerable to the adverse impacts associated with project development, including risk of impoverishment and loss of identity, culture, and natural resource-based livelihoods[17].

In accordance with IFC PS7[18], GH2 accreditation and certification **requires** that business activities minimise negative impacts, foster respect for human rights, dignity and culture of indigenous populations, and promote development benefits in culturally appropriate ways.

GH2 accreditation and certification **requires** informed consultation and participation with Indigenous peoples throughout the project process. The **expectation** is that project operators adhere to the principle of Free, Prior and Informed Consent

Requirement 4D
Labour and working conditions

The objective of this provision is to ensure that workers are treated fairly and are protected. GH2 accreditation and certification **requires** that project operators undertake an assessment of human resource and labour management requirements for the project, including recruitment, project occupational health and safety (OH&S) issues, risks, and management measures. Workers should be paid fairly and in accordance with all local laws, including those relating to minimum wage, leave entitlements and other benefits.

GH2 accreditation and certification **requires** project operators to respect the right of all workers to form and join trade unions of their own choosing, to bargain collectively and to engage in peaceful assembly as well as respect the right of workers to refrain from such activities. Project operators are **encouraged** to adhere to the IFC's performance standards relating to workers' organisations and collective bargaining.[19]

Requirement 4E
Modern slavery, child and forced labour

The objective of this provision is to ensure that the project protects workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.

GH2 accreditation and certification **requires** that the project operator does not employ children in any manner.

GH2 accreditation and certification **requires** that the project proponent does not employ forced labour, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labour, such as indentured labour, bonded labour, or similar labour-contracting arrangements. The project operator will ensure fair recruitment and employment practices are adopted and that workers are not charged recruitment fees.

GH2 accreditation and certification **expects** that project operators work in collaboration with their suppliers to eradicate modern slavery.

GH2 certification **expects** capacity building, the measurable improvement of skilled labour, payment of a living wage, job and education opportunities and transfer of knowledge for and to the local population.

Requirement 5

Environmental impact

International best practice highlights the importance of integrated assessments to identify: (1) the environmental, risks, and opportunities of projects; (2) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (3) the project operator's management of environmental and social performance throughout the life of the project.[20]

The **expectation** is that the project has been subject to an environmental impact assessment, i.e., a rigorous process identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of the project in accordance with applicable regulatory requirements, including appropriate stakeholder consultation and publication of the results. It is also expected that the project operator has established an environmental management plan to safeguard and improve environmental performance over the lifetime of the project.

Requirement 5A
Renewable energy sources

The objective of this provision is to demonstrate that green hydrogen is produced from renewable energy sources with close to zero emissions.

GH2 accreditation and certification requires the project operator to demonstrate that hydrogen is produced through the electrolysis of water with 100% or near 100% renewable energy. GH2 accreditation and certification requires renewable energy sourced from hydropower, wind, solar (solar thermal and solar photovoltaic), geothermal energy, tide, wave and other ocean energy sources.Where biomass[21] and/or biomass waste[22] is utilized for the production of renewable electricity and/or the production of green hydrogen derivatives (such as green methanol and synthetic methane) GH2 accreditation and certification requires the project operator to demonstrate that there is a low risk of indirect land use change, including verifying that production of feedstock does not take place on land with high biodiversity, that land with a high amount of carbon has not been converted for feedstock production. The use of biomass and biomass waste must be comprehensively addressed and incorporated into the assessment of requirements 3 and 4 (above)

The project operator should address any risks relating to the displacement of crops for food and feed. Adherence to the EU Commission Delegated Regulation 2019/807 or an equivalent national standard will satisfy this requirement. Where national regulatory bodies have imposed requirements for certifying low ILUC-risk biofuels, bioliquids and biomass fuels, GH2 certification requires that these requirements are met.

GH2 will monitor the implementation of this provision and will consider additional restrictions and safeguards relating to the utilization of biomass and biomass waste.

GH2 will consider proposals from project operators based on other renewable non-fossil sources on a case-by-case basis. The project operator must demonstrate that the project meets equivalent emissions and sustainability standards. GH2 will consider proposals from project operators based on other renewable non-fossil sources on a case-by-case basis. The project operator must demonstrate that the project meets equivalent emissions and sustainability standards.

GH2 accreditation and certification **requires** that the project operator undertakes an evaluation of the project's utilisation of electricity and the impact on the energy market including, where applicable, network congestion and the impact of their operations on the greenhouse gas emissions from the electricity grid. The project operator must demonstrate that it has identified and implemented technically feasible and cost-effective measures that support energy efficiency or other decarbonisation options, addressing any impacts vis-à-vis access to affordable and reliable energy. Where the evaluation concludes that the project may lead to a significant utilisation of renewable energy from the electricity grid and/or increased greenhouse gas emissions from the electricity grid, there is an **expectation** that the project operator has identified and implemented technically feasible and cost-effective measures to support the deployment of additional renewable energy capacity.

Green hydrogen producers may count electricity taken from the grid as fully renewable if they have concluded one or more power purchase agreements (PPAs) with operators producing renewable electricity in one or more installations, generating renewable electricity for an amount that is at least equivalent to the amount of electricity that is claimed as fully renewable and the electricity claimed is effectively produced in this or these installations. PPAs should make use of credible[23] Energy Attribute Certificates (EACs), Renewable Energy Certificates or other guarantee of origin certification schemes (or similar proofs) where available. There is an expectation that the project operator has addressed temporal correlation (ensuring that the electrolysers' demand matches the renewable power generation) as well as a geographical correlation (ensuring that the electrolyser and the renewable power generation covered by the PPA are located in the same power market). The granularity of the information in PPAs and guarantee of origin certificates should be aligned with the electricity market where the PPA and guarantee of origin certificates are issued. This data will incorporated into the certification of green hydrogen and green hydrogen derivatives issued by GH2. Where regulatory bodies have imposed requirements on temporal or geographical correlation between the consumption of electricity by the electrolysers and the generation of the additional renewables-based electricity, GH2 certification requires that these requirements are met. Adherence to these requirements will be included in the certification of green hydrogen and green hydrogen derivatives issued by GH2.

Up to 5% of electricity from any source may be consumed by electrolysers in a given year if it can be reasonably demonstrated that there have been technical or market constraints requiring such use. GHG emissions resulting from the use of this electricity consumption need to be calculated according to official grid emission factors published by host country governments or published as CDM standardised baseline approved by the CDM Executive Board.[24] The overall threshold for the GHG intensity of produced hydrogen (1kg CO_2 / kg H_2) must not be exceeded in a given calendar year.

Requirement 5B
Water use and quality

The objective of this provision is to ensure that green hydrogen projects address the availability and sustainable management of water and sanitation, particularly incorporating the need to address risks of reducing water access/exacerbating water stress[25], including desalination where applicable.

GH2 accreditation and certification **requires** a publicly accessible evaluation of the project's utilisation of water and the project's approach to wastewater treatment and water pollution[26], referencing, where appropriate, applicable national standards and global best practice. The project operator must demonstrate that it has identified and implemented technically and financially feasible and cost-effective measures for improving efficiency in its consumption of water, particularly in risks associated with water access and water stress. This could also include an assessment of opportunities to generate co-benefits for local communities through provision of drinking water, water for irrigation, and /or water treatment. Such measures will integrate the principles of cleaner production into product design and production processes with the objective of optimising water consumption and minimising water pollution.

Where desalination takes place, the GH2 accreditation and certification requires that project operators demonstrate that desalination plans do not have a negative effect on the water source.

The publicly accessible evaluation of the project's utilisation of water and the project's approach to wastewater treatment and water pollution should include:

- A description of how the project interacts with water, including how and where water is withdrawn, consumed, and discharged, and the water-related impacts caused or contributed to, or directly linked to the project;
- A description of total water consumption from all areas, with a focus on areas with water stress;
- A description of how water-related impacts are addressed, including how the project operator works with stakeholders to steward water as a shared resource;
- A description of any minimum standards set for the quality of effluent discharge, and how these minimum standards were determined.

Requirement 5C
Waste, Noise and Air Quality

The objective of this provision is to ensure that the negative environmental and social impacts associated with the project are managed; avoidance, minimisation, mitigation, compensation and enhancement measures are implemented; and environmental and social commitments are fulfilled.

GH2 accreditation and certification **requires** that waste, noise and air quality issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise and that monitoring is being undertaken during the project implementation stage appropriate to the identified issues.[27]

Requirement 5D
Biodiversity

The objective of this provision is to ensure that: (1) there are healthy, functional and viable aquatic and terrestrial ecosystems in the project-affected area that are sustainable over the long-term; (2) biodiversity impacts arising from project activities are managed responsibly; (3) that ongoing or emerging biodiversity issues are identified and addressed on an ongoing basis.

GH2 accreditation and certification **requires** that biodiversity issues relevant to project implementation and operation have been identified through an assessment process utilising appropriate expertise; and that monitoring is being undertaken during the project implementation stage appropriate to the identified issues.[28]

Requirement 5E
Climate change impact and mitigation

The objective of this provision is to demonstrate that green hydrogen is produced from renewable energy sources with close to zero emissions.

GH2 is committed to the full life cycle analysis (LCA) of greenhouse gas emissions associated with green hydrogen production and utilisation, including embedded emissions. Our emissions thresholds for green hydrogen and green ammonia are currently based on a "well to gate" methodology in line with the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE 2023). The GHS also expects project operators to calculate and report on the emissions associated with the storage, conversion and delivery of hydrogen and its derivatives and encourages project operators to calculate and report on embodied emissions.

The Green Hydrogen Standard **requires** independent verification (through the accreditation and certification process) that green hydrogen production facilities have robust systems to accurately and comprehensively measure the greenhouse gas emissions for production periods / shipments, including appropriate documentation for the purposes of certification. Project operators should align their approach with applicable national standards and global best practice including the GHG Protocol[29] and applicable ISO standards[30]. These reporting systems should clearly distinguish between assumptions and models for estimating emissions and empirical measurement of emissions. Reporting should focus on the degree of accuracy which has been achieved from production through different segments of the supply chain to end-use.

GH2 accreditation and certification **requires** that projects that operate at <=1 kg CO2e per kg H2 taken as an average over a 12-month period as per the electrolysis production pathway defined by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) as outlined in the Working Paper Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen noting the modifications as set out in Policy Note 1.

In addition, GH2 accreditation and certification **expects** project operators to calculate and report on the indirect GHG emissions associated with H2 production processes (e.g., relating to water use and waste disposal), and the emissions associated with the storage, conversion and delivery of H2 and its derivatives. The energy consumption associated with (re)conversion and the emissions linked to transport are an important consideration.

The IPHE methodology was recently revised to address GHG evaluation for transportation from production to consumption gate, including alignment with ISO 14083. Project operators and encouraged to consider applying the Global Logistics Emissions Council (GLEC) Framework for Logistics Emissions Accounting and Reporting the Smart Freight Centre & WBCSD (2023) Guidance on End-to-End GHG Reporting[31].

GH2 also **encourages** project operators to calculate and report on the embodied emissions associated with green hydrogen production, including embodied emissions associated with: (i) purchased energy (grid) and energy produced on site (off grid); (ii) construction of H2 production facilities, and (iii) construction of storage, conversion and delivery infrastructure. GH2 will collaborate with partner organizations to develop and apply methods consistently to all energy providers. GH2 accreditation and certification requires that the project operator: (i) has evaluated the risks associated with hydrogen emissions associated with the project; (2) has developed a plan to minimize hydrogen emissions; and (3) has established a system to monitor and measure hydrogen emissions. GH2 will review accredited projects on an annual basis and will establish a maximum threshold for hydrogen emissions within the boundaries of the emissions assessment framework in accordance with emerging best practice.

GH2 will review the performance of GH2 accredited projects on an annual basis, with the expectation that the boundaries of the emissions assessment framework can be widened, and that the emissions thresholds can be lowered in accordance with emerging best practice.

Requirement 6

Health and Safety

The objective of this provision is to demonstrate that the livelihoods and living standards impacted by the project are improved relative to pre-project conditions for project-affected communities; and that life, property and community assets and resources are protected from the consequences of any infrastructure and operational safety risks.

GH2 accreditation and certification **expects** project operators to have undertaken an assessment of human resource and labour management requirements for the project, including project occupational health and safety (OH&S) issues, risks, and management measures.[32]

Requirement 7

Governance, transparency and accountability

1. **General.** GH2 accreditation and certification **requires** that he project operator has sound corporate business structures, policies and practices; addresses transparency, integrity and accountability issues; can manage external governance issues (e.g., institutional capacity shortfalls, political risks including transboundary issues, public sector corruption risks); can ensure compliance; and procurement processes are equitable, transparent and accountable.

2. **Anti-corruption compliance.** Corruption deprives communities of the benefits that should flow from the development of natural resources and undermines decision making. GH2 accreditation and certification **requires** that the project operator establishes codes of conduct and anti-corruption standards that clearly prohibit bribery and corruption, including facilitation payments to government officials to obtain routine services. The standards should address the obligations for employees and contractors and include a risk-based system for due diligence. Project operators are **encouraged** to incorporate anti-corruption compliance into business key performance indicators that ultimately determine employee remuneration.

3. **Transparency**. The project operator is **expected** to publicly disclose key information of public interest about its corporate structure, contractual terms related to the project and financial transactions with the government. Disclosures are expected to be made proactively and in consultation with citizens and local communities to understand the information that they find more relevant and to furnish them with it.

    - **Beneficial ownership transparency.** Project operators are **encouraged** to disclose legal and beneficial ownership, including the identity(ies) of their beneficial owner(s), the level of ownership and details about how ownership or control is exerted. Where possible, this information should be incorporated in existing filings by companies to corporate regulators, stock exchanges or agencies regulating the project.

    - **Contract transparency.** Project operators are **expected** to disclose the full text of any contract, concession, production-sharing agreement or other agreement granted by, or entered into by, the project operators which provides the terms attached to the utilisation of electricity and water and the production of green hydrogen. We note that this is increasingly the norm even in previously opaque industries such as oil and mining and is important to establish trust and social licence to operate.

    - **Tax and subsidy transparency.** Project operators are **expected** to comprehensively disclose their payments they make to governments at both central and subnational level, and subsidies awarded to the project operator as individual subsidies or as part of a subsidy scheme. Types of payments to government include taxes levied on the income, production or profits of companies, royalties, dividends, licence fees, rental fees and other considerations for licences or concessions.

3. Accreditation and Certification

The Green Hydrogen Standard approach to accreditation and certification has three stages:

3.1 Early-stage commitment and support

Green hydrogen project operators are invited to work with GH2 from the earliest stages of project development. Project operators are invited to commit to the GH2 Principles and confirm their intention to seek GH2 accreditation and certification.

GH2 provides project developers with tools that can be used throughout early-stage concept and pre-feasibility work in consultation with stakeholders and host communities prior to final government approvals and final investment decision. Early commitment to the Green Hydrogen Standard can also be useful in marketing and negotiating offtake agreements, and in the early identification and amelioration of any environment, social and governance risks.

Project operators may seek prequalification under the Green Hydrogen Standard. Aimed at pre-Financial Investment Decision (pre-FID) projects, pre-qualification under the Green Hydrogen Standard allows project developers to demonstrate to investors, off-takers, government agencies and other stakeholders that projects will deliver green hydrogen (or its derivatives) produced with near-zero emissions and with world-class sustainable development impact. Projects that are on track to meet the Green Hydrogen Standard will be designated by GH2 as **Pre-qualified in accordance with the Green Hydrogen Standard™** and will then have an opportunity to undergo full certification once the project/s enter the production phase.

3.2 Independent appraisal of Green Hydrogen Projects

Project operators seeking GH2 accreditation should undertake the necessary preparatory work to demonstrate their project's adherence to the Green Hydrogen Standard as outlined in chapter 2.

Project operators engage an Independent Assurance Provider (at their own cost) to assess adherence to the Green Hydrogen Standard in accordance with standardised terms of reference available from GH2. The IAP should have access to the necessary documentation, with appropriate protocols to address confidentiality. GH2 should be notified at the commencement of the assessment.

IAPs are required to undertake assurance audits in accordance with the requirements of ISAE3000, ISO 14064-3 or an equivalent standard approved by GH2. IAPs are required to have appropriate assurance management systems in place to meet the requirements of ISQM 1 and ISQM 2, ISO 14065, or an equivalent standard approved by GH2. These requirements do not prevent GH2 establishing a Scheme in accordance with the requirements of ISO 17029 either directly or in partnership with an existing Accreditation Body.

The Independent Assurance Provider consults stakeholders and prepares an assessment. A draft report is made available for public comment. The final report from the Independent Assurance Provider is then submitted to GH2's **Accreditation Body**. 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 (see below). The decision from the Accreditation and Certification Body will indicate any issues that require close attention during the implementation of the project and specify a timeframe for a review of the project's accreditation (especially where the project involves staged development). Projects that do not meet the standard may be re-submitted.

The Accreditation and Certification Body will also conduct risk-based spot checks and thematic reviews of GH2 accredited projects.

Additional information about these procedures is available on the GHS website: **www.greenhydrogenstandard.org**.

3.3 Certification of Green Hydrogen Production

The final report from the Independent Assurance Provider is submitted to GH2's **Accreditation Body**. Projects that meet the Standard are licensed to use the label "GH2 Green Hydrogen" and will be eligible to obtain and trade GH2 certificates of origin. Projects that do not meet the standard may be re-submitted. The **GH2 Registry** will track the issuance, transfers and cancellation of GH2 Certificates.

Additional information on these procedures is available on the GHS website: **www.greenhydrogenstandard.org**.

step 1	**Green Hydrogen Project Development**	The project proponent / operator designs the project, conducts assessments and establishes internal processes. The project proponent prepares a self assessment and publishes information in accordance with the GH2 Standard.
step 2	**Independent Assurance**	The project operator engages an accredited Independent Assurance Provider to assess adherence to the GH2 Standard.
step 3	**Consultation and public comment**	The Independent Assurance Provider consults stakeholders and prepares an assessment. A draft report is made available for public comment.
step 4	**Green Hydrogen Project Accreditation**	The final report from the Independent Assurance Provider is submitted to GH2's Accreditation Body. Projects that meet the Standard are licensed to use the label "GH2 Green Hydrogen" and will be eligible to obtain and trade GH2 certificates of origin. Projects that do not meet the standard may be re-submitted.
step 5	**Green Hydrogen Production Certification**	The GH2 Registry issues, tracks and cancels GH2 Green Hydrogen Guarantee of Origin certificates.
step 6	**Review and Renewal**	The project proponent maintains adherence to the Standard (including disclosure requirements). Projects are reviewed annually. Material changes to the project require re-accreditation.

4. GH2 Policy Notes

Policy notes provide additional detail on issues covered in sections 2 and 3. The GH2 Board will refine and approve additional policy notes building on lessons learned from accreditation and certification, taking into account feedback from project operators and other stakeholders.

Policy Note 1
GH2 methodology for GHG emissions measurement

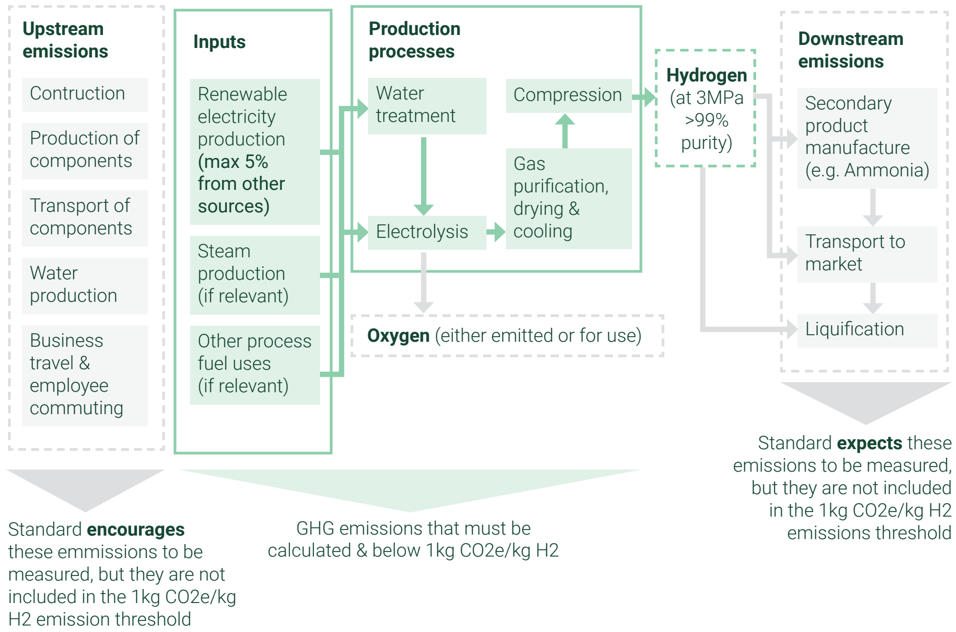
1. The Green Hydrogen Standard applies the methodology for the electrolysis production pathway being developed by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) as outlined in the Working Paper Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen.[33]
Based on discussions with stakeholders, some minor refinements have been adopted. This policy note will be reviewed on a regular basis, taking into account feedback from project operators and other stakeholders and subsequent refinements to the IPHE methodology. This will include a clarification of the methods to be followed for calculating GHG emissions for Green Hydrogen derivates, such as Green Ammonia.

2. **Technology Scope** (as per IPHE). There are currently three main electrolyser technologies, distinguished by the electrolyte (and associated production temperatures): alkaline electrolyser, polymer electrolyte membrane (PEM) electrolyser and solid oxide (SOEC) electrolyser. This methodology may be applied to any other electrolysis technologies.

3. **Electrolysis Process Description** (as per IPHE). A water electrolysis cell consists of an anode and a cathode separated by a membrane immerged in an electrolyte (a conductive solution). When connected to a direct current power supply, electricity flows through the electrolyte and causes the water to split into hydrogen and oxygen. Each electrolyser system consists of a stack of electrolysis units, a gas purifier and dryer and an apparatus for heat removal.

   Hydrogen and oxygen gas products must be purified, dried and cooled prior to storage and/or delivery to market, subject to required product specifications. The oxygen gas must be safely vented to the atmosphere. Alternatively, pending availability of appropriate markets, this oxygen may be sold as a co-product.

   Within this emissions accounting framework, electrolysers are assumed to have an outlet pressure of 3 MPa[34]. Depending on the design of the electrolyser, an electrolysis system may require compression to achieve 3 MPa pressure or drying. In that case, energy consumption for achieving this and the associated emission have to be calculated and included.



4. Emissions Sources in Electrolysis (as per IPHE). GHG emissions associated with electrolysis are subject to the nature of electricity supply for electrolysis as electricity can be sourced from the grid (noting that this may be impacted by contracting of renewable electricity supply and associated instruments), generated on-site via the combustion of liquid, gaseous and/or solid fuels (in this case, this would be the key emissions source) or supplied from an off-grid on-site system. Each process unit or stage in the electrolysis process contains emissions sources outlined below.

Process unit/stage	Key emissions sources	Other emissions sources
Water supply and treatment	Electricity for purification and filtration	
Hydrogen production	Electricity for electrolyser units	Steam (where purchased).[35] Liquid, solid and/or gaseous fuel combustion for steam generation.[36] Liquid, solid and/or gaseous fuel combustion for electricity generation.[37]
Hydrogen compression, purification, drying and cooling	Electricity for relevant units	Steam (where purchased) Solid, liquid and/or gaseous fuel combustion for relevant units and/or steam generation.

5. The process, methods and requirements of hydrogen life cycle impact assessment are as per IPHE §6.3 (and ISO 14044) with two modifications. Specifically:

   a. GHG impact of electricity used for H2 production. The IPHE methodology stipulates: "GHG impact of electricity used for H2 production shall be restricted to Scope 1 and 2 emissions, and partial Scope 3 assumptions (not including emissions associated with manufacturing of power generation facilities). As a result of this assumption, the GHG impact of electricity generation from wind, solar photovoltaic, hydropower and geothermal will be assumed to be zero" (§6.2.3 p32). GH2 notes that these emissions associated with renewable electricity may be > 0, and requires that these emissions are quantified as per requirement 5e.

   b. Fugitive hydrogen emissions. The IPHE methodology stipulates: "The impacts of hydrogen as an indirect GHG have not been considered … given [the] current focus on (direct) GHG emissions accounting". GH2 addresses hydrogen emissions as per requirement 5E.

6. **Information to be reported**. GH2 recommends alignment with the parameters specified by the IPHE (Table P1.5).

5. Protocol on Green Ammonia

1. **Summary**. This protocol provides guidance to green hydrogen project developers in measuring greenhouse gas emissions associated with green ammonia production in accordance with requirement 5E of the Green Hydrogen Standard. As per requirement 5e, GH2 will review the performance of GH2 accredited projects on an annual basis, with the expectation that the boundaries of the emissions assessment framework can be widened, and that the emissions thresholds can be lowered in accordance with emerging best practice.

2. **Background**. Requirement 5E of the Green Hydrogen Standard includes provisions focussed on demonstrating that green hydrogen is produced from renewable energy sources with close to zero emissions. The Green Hydrogen Standard applies the methodology for the electrolysis production pathway being developed by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) as outlined in the Working Paper Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen.[38] Requirement 5E **expects** project operators to calculate and report on the emissions associated with the storage, conversion and delivery of H_2 and its derivatives. Noting that the majority of export-oriented green hydrogen projects plan to ship green ammonia, GH2 has prioritised providing guidance on this topic. The IPHE working paper was recently revised to ammonia as a hydrogen carrier (Appendix C1). The current guidance focuses on ammonia production ("module 3" in the IPHE). GH2's guidance will be revised taking into account ongoing work by the IPHE and others. Additional guidance materials addressing ammonia transportation and storage is under consideration. Guidance will be prepared for other green hydrogen derivatives.

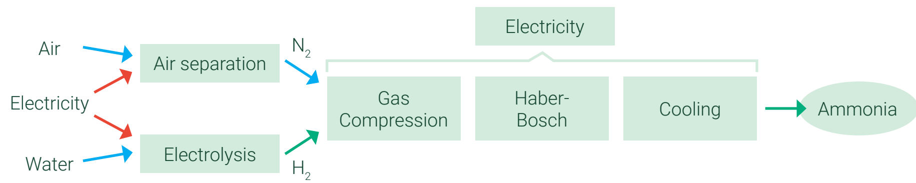
3. **GH2's Definition of Green Ammonia**. GH2 accreditation and certification requires that green hydrogen projects that operate at <=1 kg CO_2e per kg H_2 (taken as an average over a 12-month period) as per the electrolysis production pathway defined by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE). Noting the typical electricity requirements for ammonia production, GH2's definition of Green Ammonia is:

   Green ammonia is ammonia produced using green hydrogen (as defined above) with 100% or near 100% renewable energy with close to zero greenhouse gas emissions (<=.3kg CO_2e per kg NH_3 taken as an average over a 12-month period).

   The GH2 Board will review the performance of GH2 accredited projects on an annual basis, with the expectation that the boundaries of the emissions assessment framework can be widened, and that the emissions thresholds will be lowered in accordance with emerging best practice.

4. **Technology Scope**. The Haber Bosch (HB) process (also called Haber ammonia process, or synthetic ammonia process) for synthesizing ammonia from hydrogen and nitrogen (C1.5 in the IPHE).

5. **Process Description:**



   High purity nitrogen (N_2) is obtained by separating air. There are three main methods of separating N_2 from air: cryogenic distillation, pressure swing adsorption (PSA), and membrane separation. The electrolysis process is outlined in Policy Note 1 (above).

   The gas mixture containing N_2 and H_2 is compressed to the operating pressure of the HB reactor and enters the electricity-driven HB synthesis loop. There is a pressure drop around the HB synthesis loop. To overcome this, the recycled gas mixture needs to be recompressed to the operating pressure of the HB reactor. In the HB synthesis loop, the electricity is required almost exclusively for syngas/recycle gas compression. Energy is also required to circulate cooling water.

6. **Emissions Sources in Green Ammonia production**. The major component relates to the electricity supply as outlined below. GH2 is preparing guidance on the emission factors that should be applied for electrolysis, with the expectation that the same standards would be applied to green ammonia production.

   GHG emissions summary for green ammonia:

Process unit/stage	Key emissions sources	Other emissions sources
Air separation unit	Electricity consumption for relevant units	
Syngas compression	Electricity consumption for relevant units Fugitive emissions	
Haber-Bosch (HB)	Electricity consumption for relevant units Fugitive emissions	
Cooling	Electricity consumption for relevant units	HFC (or other refrigerant) emissions

7. **Co-products**. Where oxygen is a co-product, GH2 recommends alignment with the allocation factors specified in the Ecoinvent database, as further described in the IPHE "Methodology for determining the greenhouse gas emissions associated with the production of hydrogen".

8. **Embodied emissions**. GH2 encourages project operators to calculate and report on the embodied emissions associated with green ammonia production, including embodied emissions associated with: (i) purchased energy (grid) and energy produced on site (off grid); (ii) construction of green ammonia production facilities, and (iii) construction of storage, conversion and delivery infrastructure. These emissions are not included in the threshold as per §3 above. GH2 will collaborate with partner organizations to develop and apply methods consistently to all energy providers.

9. **Information to be reported**. GH2 recommends alignment with the parameters specified by the IPHE (Table C1.9).

6. Protocol on Green Methanol

1. **Summary**. This protocol sets out a procedure for project operators for measuring the greenhouse gas emissions associated with green methanol production in accordance with requirement 5e of the Green Hydrogen Standard. As per requirement 5e, GH2 will review the performance of GH2 accredited projects on an annual basis, with the expectation that the boundaries of the emissions assessment framework can be widened, and that the emissions thresholds can be lowered in accordance with emerging best practice.

2. **Background**. Requirement 5E of the Green Hydrogen Standard includes provisions focussed on demonstrating that green hydrogen is produced from renewable energy sources with close to zero emissions. The Green Hydrogen Standard applies the methodology for the electrolysis production pathway being developed by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) as outlined in the Working Paper Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen. Requirement 5E expects project operators to calculate and report on the emissions associated with the storage, conversion and delivery of H2 and its derivatives.

   Methanol is one of the most widely produced organic chemicals and one of the most important raw materials in the chemical industry. It is the world's most shipped chemical commodity. Whereas most of the methanol produced nowadays is produced from natural gas and coal, methanol can be also be produced from biomass and biomass waste (see Requirement 5A) and is expected to play a significant role in decarbonising hard to abate sectors, in particular shipping and in the production of sustainable aviation fuel (SAF).

   The Green Hydrogen Standard currently uses a "well to gate" system boundary, with the expectation that the system boundary will be extended to a full life cycle assessment. A comprehensive protocol for methanol requires a full life cycle boundary, including the emissions associated with methanol transportation, distribution and consumption. The majority of the lifecycle emissions reside in the consumption (combustion) stage. However, if the carbon feedstock carbon is supplied from a sustainable resource, the consumption emissions can be net climate neutral and reduce the lifecycle carbon footprint. Owners and operators of assets in the different segments of the supply chain will need to take responsibility for emission measurements from those assets. Reporting systems should clearly distinguish between assumptions and models for estimating emissions and empirical measurement of emissions.

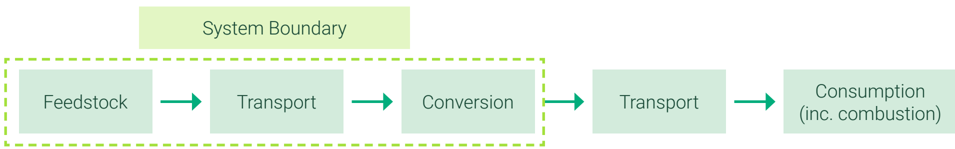
3. **GH2's Definition of Green Methanol**. GH2 accreditation and certification requires that green hydrogen projects operate at <=1 kg CO_2e per kg H_2 (taken as an average over a 12-month period) as per the well to gate electrolysis production pathway as defined by the IPHE. Based on modelled emissions for green methanol projects, GH2's definition of green methanol is:

   Green Methanol is methanol produced using green hydrogen (as defined in the green hydrogen standard) and an eligible source of CO_2 with well-to-gate greenhouse gas emissions of <=.3 kg CO_2e per kg CH_3OH taken as an average over a 12-month period. Eligible sources of CO_2 include CO_2 sourced from biomass, biomass waste and or bioenergy (as defined in the Green Hydrogen Standard), direct air capture, unavoidable industrial emissions[39] or emissions that have paid compensation through a credible carbon price mechanism.

   A key issue is the source of carbon. As per requirement 5A, where biomass and/or biomass waste is utilized for the production of renewable electricity and/or the production of green hydrogen derivatives (such as green methanol and synthetic methane) GH2 accreditation and certification requires the project operator to demonstrate that there is a low risk of indirect land use change, including verifying that production of feedstock does not take place on land with high biodiversity, that land with a high amount of carbon has not been converted for feedstock production.

4. **Technology Scope**. While several processes and technologies have been proposed for green methanol production, CO_2 hydrogenation – typically operated in fixed-bed catalytic reactor at 250–300 °C and 50–00 bar – is currently the technology with the largest development perspective at commercial scale.[40]

5. **Process Description**.



6. **Emissions Sources in Green Methanol production.**

Process unit/stage	Key emissions sources	Other emissions sources
Green Hydrogen Production	• As per the Green Hydrogen Standard	As per the Green Hydrogen Standard
Feedstock - CO_2 Capture and separation	• Electricity consumption for relevant units • Residual CO_2 which is not captured for permanent storage • Fugitive CO_2 emissions	Exhaust CO_2 due to sulphur removal of exhaust gases (where applicable) • Exhaust CO_2 due to sulphur removal of exhaust gases (where applicable) • Heat required for splitting CO_2 from other flue gases (needed depending on the CO_2 source)
Feedstock - Compression and transportation of CO_2	• Electricity for compression of CO_2 • Electricity and/or fuel combustion for pipeline transport • Liquid and/or fuel combustion for motive transport • Fugitive CO_2 emissions	
Hydrogenation	• Electricity consumption for relevant units • C, CO and CO_2 emissions	The calculation method allows for accounting for heat integration.
Disposal of waste products (where not valorized)	• Electricity and fuel combustion for transportation of waste products	

7. **Methanol transportation, storage and consumption.** GH2 is committed to the full life cycle analysis (LCA) of greenhouse gas emissions. Project operators are expected to quantify and report on the emissions associated with methanol transportation, storage and consumption. Project operators should align their approach with applicable national standards and global best practice. These reporting systems should clearly distinguish between assumptions and models for estimating emissions and empirical measurement of emissions. Reporting should focus on the degree of accuracy which has been achieved from production through different segments of the supply chain to end-use.

8. **Embodied emissions.** GH2 encourages project operators to calculate and report on the embodied emissions associated with methanol production, including embodied emissions associated with: (i) feedstock production and transportation; (ii) purchased energy (grid) and energy produced on site (off grid); (iii) construction of green methanol production facilities, and (iii) construction of storage, conversion and delivery infrastructure. These emissions are not included in the threshold as per §3 above. GH2 will collaborate with partner organizations to develop and apply methods consistently to all energy providers.

7. Protocol on Synthetic Methane

1. **Summary**. This protocol sets out a procedure for project operators for measuring the greenhouse gas emissions associated with synthetic methane production in accordance with requirement 5e of the Green Hydrogen Standard. As per requirement 5e, GH2 will review the performance of GH2 accredited projects on an annual basis, with the expectation that the boundaries of the emissions assessment framework can be widened, and that the emissions thresholds can be lowered in accordance with emerging best practice.

2. **Background**. Requirement 5E of the Green Hydrogen Standard includes provisions focussed on demonstrating that green hydrogen is produced from renewable energy sources with close to zero emissions. The Green Hydrogen Standard applies the methodology for the electrolysis production pathway being developed by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) as outlined in the Working Paper Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen. Requirement 5E expects project operators to calculate and report on the emissions associated with the storage, conversion and delivery of H2 and its derivatives.

   Synthetic methane (also known synthetic natural gas, e-NG and green methane) has been proposed as an energy carrier for hydrogen. The Green Hydrogen Standard currently uses a "well to gate" system boundary, with the expectation that the system boundary will be extended to a full life cycle assessment, including a closed carbon cycle. A comprehensive protocol for synthetic methane requires a full life cycle boundary, including the emissions associated with methane transportation, distribution and consumption. The majority of the lifecycle emissions reside in the consumption (combustion) stage. However, if the carbon feedstock carbon is sourced sustainably, as outlined in section 3, the consumption emissions can be net climate neutral and reduce the lifecycle carbon footprint, including by sourcing renewable and electricity for all steps of the capture process. Owners and operators of assets in the different segments of the supply chain will need to take responsibility for emission measurements from those assets. Reporting systems should clearly distinguish between assumptions and models for estimating emissions and empirical measurement of emissions.

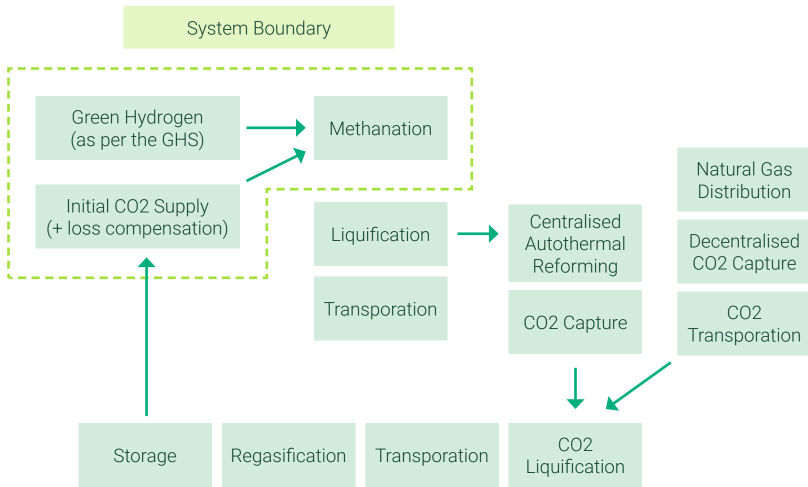
3. **GH2's Definition of Synthetic Methane**. GH2 accreditation and certification requires that green hydrogen projects operate at <=1 kg CO2e per kg H2 (taken as an average over a 12-month period) as per the well to gate electrolysis production pathway as defined by the IPHE. Based on modelled emissions for Synthetic Methane projects, GH2's definition of Synthetic Methane is:

   Synthetic Methane is methane produced using green hydrogen (as defined in the green hydrogen standard) and an eligible source of CO2 with well-to-gate greenhouse gas emissions of <=0.85 kg CO2e per kg CH4 taken as an average over a 12-month period. Eligible sources of CO2 include CO2 sourced from biomass, biomass waste and or bioenergy (as defined in the Green Hydrogen Standard), direct air capture, unavoidable industrial emissions[41] *or emissions that have paid comprehensive compensation through a credible carbon price mechanism.*

   A key issue is the source of carbon for converting green hydrogen into synthetic methane. As per requirement 5A, where biomass and/or biomass waste is utilized for the production of renewable electricity and/or the production of green hydrogen derivatives (such as green methanol and synthetic methane) GH2 accreditation and certification requires the project operator to demonstrate that there is a low risk of indirect land use change, including verifying that production of feedstock does not take place on land with high biodiversity, that land with a high amount of carbon has not been converted for feedstock production.

4. **Technology Scope**. The combination of electrolysis, driven by renewable energy, and the Sabatier reaction to enable methane synthesis and the subsequent distribution of synthetic methane. The Sabatier reaction or Sabatier process produces methane and water from a reaction of hydrogen with carbon dioxide at elevated temperatures (optimally 300–400 °C) and pressures in the presence of a nickel catalyst. GH2's initial work is based on thermal catalytic CO2 methanation, but also allows for other options, including biological methanation.

5. **Process Description**.



6. Emissions Sources in Synthetic Methane production.

Process unit/stage	Key emissions sources	Other emissions sources
Green Hydrogen Production	• As per the Green Hydrogen Standard	As per the Green Hydrogen Standard
CO_2 Capture and separation	• Electricity consumption for relevant units • Residual CO_2 which is not captured for permanent storage • Fugitive CO_2 emissions	• Exhaust CO_2 due to sulphur removal of exhaust gases (where applicable) • Heat required for splitting CO_2 from other flue gases (needed depending on the CO_2 source)
Compression and transportation of CO_2	• Electricity for compression of CO_2 • Electricity and/or fuel combustion for pipeline transport • Liquid and/or fuel combustion for motive transport • Fugitive CO_2 emissions	
Methanation	• Electricity consumption for relevant units • C, CO and CO_2 emissions	The calculation method allows for accounting for heat integration.
Disposal of waste products (where not valorized)	• Electricity and fuel combustion for transportation of waste products • Electricity and fuel for treatment and waste disposal	

7. **Methanol transportation, storage and consumption.** GH2 is committed to the full life cycle analysis (LCA) of greenhouse gas emissions. Project operators are expected to quantify and report on the emissions associated with methane transportation, storage and consumption. Project operators should align their approach with applicable national standards and global best practice, including applicable ISO standards[42]. These reporting systems should clearly distinguish between assumptions and models for estimating emissions and empirical measurement of emissions. Reporting should focus on the degree of accuracy which has been achieved from production through different segments of the supply chain to end-use.

8. **Embodied emissions.** GH2 encourages project operators to calculate and report on the embodied emissions associated with synthetic methane production, including embodied emissions associated with: (i) feedstock production and transportation; (ii) purchased energy (grid) and energy produced on site (off grid); (iii) construction of synthetic methane production facilities, and (iv) construction of storage, conversion and delivery infrastructure. These emissions are not included in the threshold as per §3 above. GH2 will collaborate with partner organizations to develop and apply methods consistently to all energy providers.

Endnotes

1 IEA (2023), Global Hydrogen Review 2023, IEA, Paris https://www.iea.org/reports/global-hydrogen-review-2023, License: CC BY 4.0

2 Longden T., Beck, F.J., Jotzo F., Andrews, R. and Prasad M. (2021), 'Clean' hydrogen? An analysis of the emissions and costs of fossil fuel based versus renewable electricity based hydrogen, CCEP Working Paper 21-03, ZCEAP Working Paper ZCWP02-21, March 2021, The Australian National University.

3 The Standard focusses on green hydrogen projects that aim to source 100% of their electricity from renewable sources. However, provision is made for <=5% electricity from other sources to cover exceptional circumstances. See requirement 5A, below.

4 Green hydrogen is sometimes characterised as having zero greenhouse gas emissions. However, the production of renewable electricity may involve some greenhouse gas emissions. In some circumstances, there may be some greenhouse gas emissions associated with electrolysis and associated processes. Accordingly, GH2 refers to "close to zero greenhouse gas emissions". GH2 requires that these emissions are quantified as part of the accreditation and certification process. See requirement 5A, below.

5 GH2 reviewed the recent academic literature (see for example here, here and here) and consulted green hydrogen project developers to establish an appropriate threshold. Some studies assume that 100% renewable energy equates to zero emissions. Others have argued that we should not assume zero, and that careful attention is needed to the source of electricity used for water electrolysis and any emissions from associated processes such as water treatment / desalination. The emerging consensus is that 1kg is a reasonable threshold, with the caveat that GH2 should review this threshold based on the early experience with green hydrogen project accreditation.

6 IPHE (2023) Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen. https://www.iphe.net/iphe-wp-methodology-doc-jul-2023

7 United Nations (2015) The 2030 Agenda for Sustainable Development. https://sdgs.un.org/goals

8 United Nations (2021) Department of Economic and Social Affairs. Sustainable Development. https://sdgs.un.org/news/proposed-global-roadmap-shows-how-universal-access-sustainable -energy-can-be-achieved-2030

9 It is important to emphasise that this is not a waiver of requirements. The onus is on the project operator to demonstrate their adherence to GH2's requirements. The credibility and comprehensiveness of national requirements will be considered as part of the independent appraisal process, including broad based consultation with project stakeholders.

10 GH2 recommends that the information is provided in a format which is accessible to the public (including hard copies as libraries or local government offices) and in a language which is spoken by the local communities.

11 IFC (2021) Performance Standards. https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-StandardsI

12 Hydropower Sustainability Council (2021) Hydropower Sustainability Standard https://static1.squarespace.com/static/5c1978d3ee1759dc44fbd8ba/t/613 79550f76c7d53f2b0f446/1631032662564/Hydropower+sustainabiity+standard+310821+01b.pdf

13 Project operators are encouraged to consult IFC (2012) Performance Standard 1. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps1 and the relevant requirements identified under the World Bank's ESS1: Assessment and Management of Environmental and Social Risks and Impacts Policy. https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=29&zoom=80

14 Project operators are encouraged to consult the World Bank's ESS4: Community Health and Safety policy https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=59&zoom=80 Project operators are encouraged to consult the IFC (2012)

15 Performance Standard 5: Land Acquisition and Involuntary Resettlement. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps5

16 Project operators are encouraged to consult the World Bank's ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement Policy https://www.worldbank.org/en/projects-operations/environmental-and-social-framework/brief/environmental-and-social-standards#ess5

17 Project operators are encouraged to consult the IFC (2012) Performance Standard 7: Indigenous Peoples. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps7

18 Project operators are encouraged to consult the World Bank's ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities Policy https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=89&zoom=80

19 Project operators are encouraged to consult the IFC (2012) Performance Standard 7: Labor and Working Conditions. https://www.ifc.org/wps/wcm/connect/88f1f09e-5fe4-4fad-9286-33ecb221ab23/PS2_English_2012.pdf?MOD=AJPERES&CVID=jiVQIns and the World Bank's ESS2: Labor and Working Conditions Policy https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=45&zoom=80

20 Project operators are encouraged to consult IFC (2012) Performance Standard 1. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps1 and the relevant requirements identified under the World Bank's ESS1: Assessment and Management of Environmental and Social Risks and Impacts Policy. https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=29&zoom=80

21 Replace with: "2023: P5.1. p107"

22 Replace with: "2023: P5.2. p107"

23 In accordance with the GHS General Principles the credibility and comprehensiveness of national requirements will be considered as part of the independent appraisal process, including broad based consultation with project stakeholders". In evaluating the credibility of national requirements, project operators and the Independent Assurance Provider should consider alignment with global best practice, such as the I-REC International Attribute Tracking Standard.

24 IThe Emission Factor Database (EFDB) is a project supported by the National Greenhouse Gas Inventories Programme (NGGIP), which is managed by the IPCC Task Force on National Greenhouse Gas Inventories (TFI). The EFDB is intended to be a recognized library, where users can find emission factors and other parameters with background documentation or technical references that can be used for estimating greenhouse gas emissions and removals. See: https://www.ipcc-nggip.iges.or.jp/EFDB/main.php In accordance with IFC (2012) Performance Standard 3: Resource Efficiency and Pollution Prevention, "the term 'pollution' includes: "both hazardous and non-hazardous chemical pollutants in the solid, liquid, or gaseous phases, and includes other components such as pests, pathogens, thermal discharge to water, GHG emissions, nuisance odors, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light". Project operators are encouraged to consult the World Bank's ESS3: Resource Efficiency and Pollution Prevention and Management policy https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=53&zoom=80

25 Project operators are encouraged to consult publicly accessible tools such as the WRI Aqueduct Water Risk Atlas https://www.wri.org/data/aqueduct-water-risk-atlas

26 In accordance with IFC (2012) Performance Standard 3: Resource Efficiency and Pollution Prevention, "the term 'pollution' includes: "both hazardous and non-hazardous chemical pollutants in the solid, liquid, or gaseous phases, and includes other components such as pests, pathogens, thermal discharge to water, GHG emissions, nuisance odors, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light". Project operators are encouraged to consult the World Bank's ESS3: Resource Efficiency and Pollution Prevention and Management policy https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-SocialFramework.pdf#page=53&zoom=80

27 Project operators are encouraged to consult the World Bank's ESS3: Resource Efficiency and Pollution Prevention and Management policy https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=53&zoom=80

28 Project operators are encouraged to consult the World Bank's ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources https://pubdocs.worldbank.org/en/837721522762050108/Environmental-and-Social-Framework.pdf#page=81&zoom=80

29 The GHG Protocol is a comprehensive and detailed standard and is aligned with a number of voluntary and mandatory reporting programs, in particular the Scope 2 guidance on measuring emissions from purchased or acquired electricity, steam, heat and cooling (called "scope 2 emissions"): https://ghgprotocol.org/scope-2-guidance

30 ISO 14040 and ISO 14044 define the principles, requirements and guidelines identified in existing International Standards on Life Cycle Assessment. The ISO 14060 family provides clarity and consistency for quantifying, monitoring, reporting and validating or verifying GHG emissions and removals. The ISO 14067 document is based on principles, requirements and guidelines identified in existing International Standards and establishes requirements for the quantification of a Carbon Foot Print (CFP).

31 https://www.feport.eu/images/downloads/glec-framework-20.pdf

32 https://www.smartfreightcentre.org/en/projects/c

33 IPHE (2021) Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen https://www.iphe.net/iphe-working-paper-methodology-doc-oct-2021

34 IPHE (2023) ib id

35 Where high temperature SOEC are utilised

36 Where high temperature SOEC are utilised

37 Where on-site electricity generation is non-renewable.

38 https://www.iphe.net/_files/ugd/45185a_48960ad9b26 045c7a082bceb3a192bc7.pdf

39 Industrial emissions remaining after the best available techniques and all demand-side emissions reduction measures have been demonstrably applied.

40 Sollai et al (2023) Renewable methanol production from green hydrogen and captured CO2: A techno-economic assessment. Journal of CO2 Utilization. Volume 68. https://doi.org/10.1016/j.jcou.2022.102345

41 Industrial emissions remaining after the best available techniques and all demand-side emissions reduction measures have been demonstrably applied.

42 See ISO 6338:2023 "Method to calculate GHG emissions at LNG plant" https://www.iso.org/standard/82214.html and "Calculations of GHG emissions throughout the LNG chain" under development by ISO/TC 67/SC 9/WG 10 https://www.iso.org/standard/87114.html and https://www.iso.org/committee/5749612.html

GH2 Green Hydrogen Organisation

gh2.org