Hydrogen Certification 101

BREAKTHROUGH AGENDA

IPHE

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International PtX Hub

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01 – Purpose of this 101 paper[1]

This document is designed to:

1. Provide clarity and precision on terminology and concepts used in hydrogen certification;
2. Describe the purposes and functionalities of hydrogen certification schemes;
3. Offer basic information on certification scheme design; and
4. Lay out the concept of mutual recognition of certification schemes for hydrogen and derivatives.

02 – Background

In the emerging global hydrogen economy, robust tradeable certification schemes for hydrogen and derivatives are due to play a key role to:

- **Enable the implementation of government policies** as certification can constitute an integral element of policy measures such as targets, quotas and tax credits;
- Evidence their **sustainability attributes**, such as carbon footprint (CFP) - meaning greenhouse gases (GHG) – as well as the use of land and water, and social impacts – in a reliable **and consistent manner** internationally;
- Create **transparency for consumers** and enable **consumer choice**;
- Allow consumers to **signal demand** for hydrogen based on its sustainability credentials;
- Create trust between prospective importers and exporters, fostering global, **cross-border trade in hydrogen and derivatives** based on their sustainability credentials.

Certification allows evidencing that a unit of hydrogen or a derivative product has been produced, transported, and delivered with specific sustainability attributes. This commonly results in the issuance of electronic certificates, which may then be transferred either with or separately from the underlying physical hydrogen or a derivative product.

The need for and types of attributes evidenced by certification schemes, as well as design features of schemes are largely driven by demands of the end-consumer, in line with mandatory (imposed by a regulatory obligation) or voluntary requirements (imposed by the consumer itself or its peers, driven by ESG reporting and disclosure requirements).

Certification schemes are currently largely regional or national, which may constitute a barrier to global, cross-border trade in hydrogen and derivatives between regions or countries. Mutual recognition of certification schemes is instrumental to overcoming this barrier, ensuring that an end-consumer in a given import country can trust in the veracity of the production and certification process in the given export country. Mutual recognition of schemes requires first and foremost a political commitment by first mover countries championing hydrogen economy development, followed by an agreement on a minimum set of fundamental design principles ensuring reliability and interoperability between schemes. However, to begin the process of accelerating mutual recognition of certification schemes, it is critical to create a common language on certification and the associated components and processes.

[1]The title "101" implies that this document offers information on the basics of certification of hydrogen and derivatives.

03 – What is certification?

Certification is defined as the process undertaken to evaluate if a product complies with a given set of requirements. In the world of energy, the term certification refers to the issuance of a statement by an independent entity to confirm that a unit of a given energy carrier had a set of (sustainability) attributes upon its production and or/along the entire value chain.

This statement is often issued in a form of an electronic record, which may be transferred and therefore bought and sold on a market. Certification can involve multiple actors including regulators/authorities imposing relevant regulatory requirements, certification scheme owners, certification bodies, issuing bodies and independent auditors (the roles of different actors are described in sub-section 0.4 below).

Certification of hydrogen sustainability attributes can provide reliable information about the way hydrogen is produced and delivered to the consumption gate. These sustainability attributes may cover environmental aspects (GHG emissions of hydrogen production and transport; use of land and water; impact on air quality), as well as social aspects (such as rights of Indigenous peoples, labour rights, local value creation, increase in energy access, competence gains, as well as diversity, equity and inclusion) of the relevant segment of the value chain covered by the certificate.

Certification therefore allows the end-consumer to make an informed choice about the type of hydrogen they procure, as well as evidence purchase and consumption of the certified quantity of hydrogen. This, in turn, allows the consumer to show their contribution to climate mitigation and/or the fulfilment of other sustainability goals such as mitigating resource depletion and improving air quality, land use, water consumption and social aspects associated with hydrogen production in a given jurisdiction.

The term “certification” is used in this report as a generic term in relation to issuing certificates attributed to hydrogen, in relation to certification schemes, and in relation to the verification of information provided by a certificate. This is done in order to facilitate reading without compromising on the explanation above.

04 – Purpose of hydrogen certification: disclosure, corporate reporting and regulatory compliance

There are different drivers for the need to demonstrate sustainability attributes of hydrogen by way of using certification. Information contained in a certificate evidences the sustainability attributes of a given unit of hydrogen or derivative. Market participants subject to either mandatory or voluntary compliance requirements will need to procure a number of certificates with certain attributes within the relevant reporting time period.

Policymakers may choose to use certification as a design feature of the regulatory frameworks and incentives for hydrogen and its derivatives in their respective jurisdictions. A number of emerging national or regional legislative frameworks across geographies already include incentives, which can be accessed by procuring and, in the case of Guarantees of Origin - GOs, cancelling (see definition below) certificates evidencing that a unit of hydrogen complies with sustainability attributes set by the given support scheme or public policy framework (e.g. CFP and/or renewable content). Such policies include targets, quotas, tax credits and other incentives.

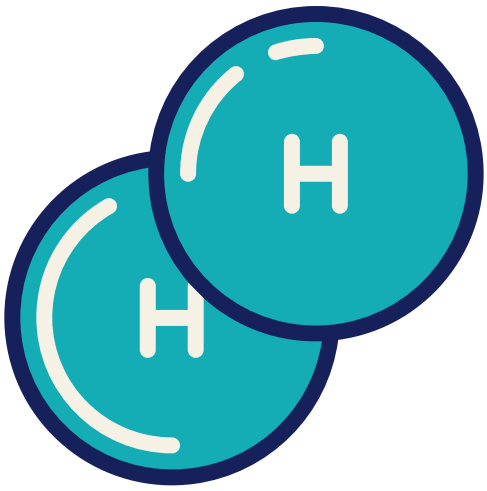
Market participants would in turn be required to use certificates for **compliance with regulatory requirements and/or access incentives** designed as part of national or regional legislative frameworks for hydrogen and its derivatives. Compliance frameworks are expected to be the key driver for cross-border trade in hydrogen as they incentivise fuel switching to hydrogen and derivatives in the end use sectors.

Companies may also use certificates for voluntary disclosure purposes to inform consumers and enable consumer choices. This allows consumers to signal their demand for hydrogen based on their sustainability attributes. Certificates used for voluntary disclosure can also support project bankability by way of evidencing not only the sustainability attributes of hydrogen produced and its eligibility for government support but also the social impact of the project in the given jurisdiction. The use of such voluntary schemes for the purpose of compliance with national legislation and access to government support is subject to the recognition of the given voluntary certification scheme by the government.

The two most prominent purposes for which certification can be used by market participants are therefore to either (i) demonstrate **compliance with regulatory requirements and/or access incentives** designed as part of national or regional legislative frameworks for hydrogen and derivatives, or (ii) demonstrate compliance with **voluntarily reporting and disclosure requirements**, notably Corporate Social Responsibility (CSR)/Environmental, Social, and Governance (ESG) reporting.

In the subsequent sections, the paper refers to two types of markets for certificates for hydrogen and derivatives – **compliance/mandatory markets** (referring to markets for certificates used for compliance with policy and regulatory requirements or enabling access to support schemes) and **voluntary/reporting markets** (referring to markets for certificates used for voluntary reporting and disclosure purposes).

05 – Key terms and concepts in hydrogen certification



Certificate – a document evidencing that a given product has certain attributes and that the product and the scheme user meet specific requirements. In the world of energy, the term certification refers to the issuance of a statement by a certification body to confirm that a unit of a given energy product has a set of attributes upon its production and/or that certificate holders along the entire chain of custody provide correct information about the attributes of the given energy product. This statement is often issued in the form of an electronic record which may be transferred and therefore bought and sold on a market, either separately from the physical product (with the book and claim model) or with the physical product (with the mass balance model).

- **Energy Attribute Certificates** (e.g. GO – Guarantee of Origin, REC – Renewable Energy Certificate, I-REC – International Renewable Energy Certificate) provide information about the origin of the energy, its renewable source as well as the related information including date and location of production. The term is often used in certification schemes underpinned by the book and claim model. The certificates issued under such schemes underpinned by the book and claim model (e.g. renewable power GOs) are currently used by market participants only for supporting product and corporate reporting purposes.
- **Sustainability certificates**, as a distinct type of certificates, can evidence the sustainability attributes of a given product and traceability of these attributes along the supply chain from production to consumption gate. The term ‘sustainability certificate’ is often used in certification schemes with mass balancing tracking and tracing model. Such certificates have been used for compliance purposes in some jurisdictions, for example, for biofuels in the European Union (EU).

A certification scheme (or mechanism) is a set of governance, assessment and verification processes used to ensure that the considered product (e.g. hydrogen) produced and consumed meets a given set of requirements or criteria. It is an instrument that provides for evidencing attributes (such as sustainability attributes) of production, transport and delivery of hydrogen and/or derivative products. The attributes evidenced by a given scheme can be aligned to match the requirements of national legislation applying specifically to hydrogen, e.g. benefits afforded to renewable hydrogen in a tax credit or a quota scheme. In some cases, a scheme may cover additional attributes beyond those mandated by national legislation.

Certification schemes are informed by and refer to regulatory frameworks and/or standards, including standard defining methodologies for assessing the attributes evidenced by the schemes. Certification schemes provide for relevant administrative procedures, governance as well as certification and verification processes in order to ensure trustworthy and reliable outcomes.

Figure 1 illustrates the different elements that need to be defined in a certification scheme. In practice, in some cases these roles have been integrated for efficiency purposes. For legal compliance purposes, governments may also operate a national database that stores a specific subset of information; this is notably the case in countries where more than one schemes operate.

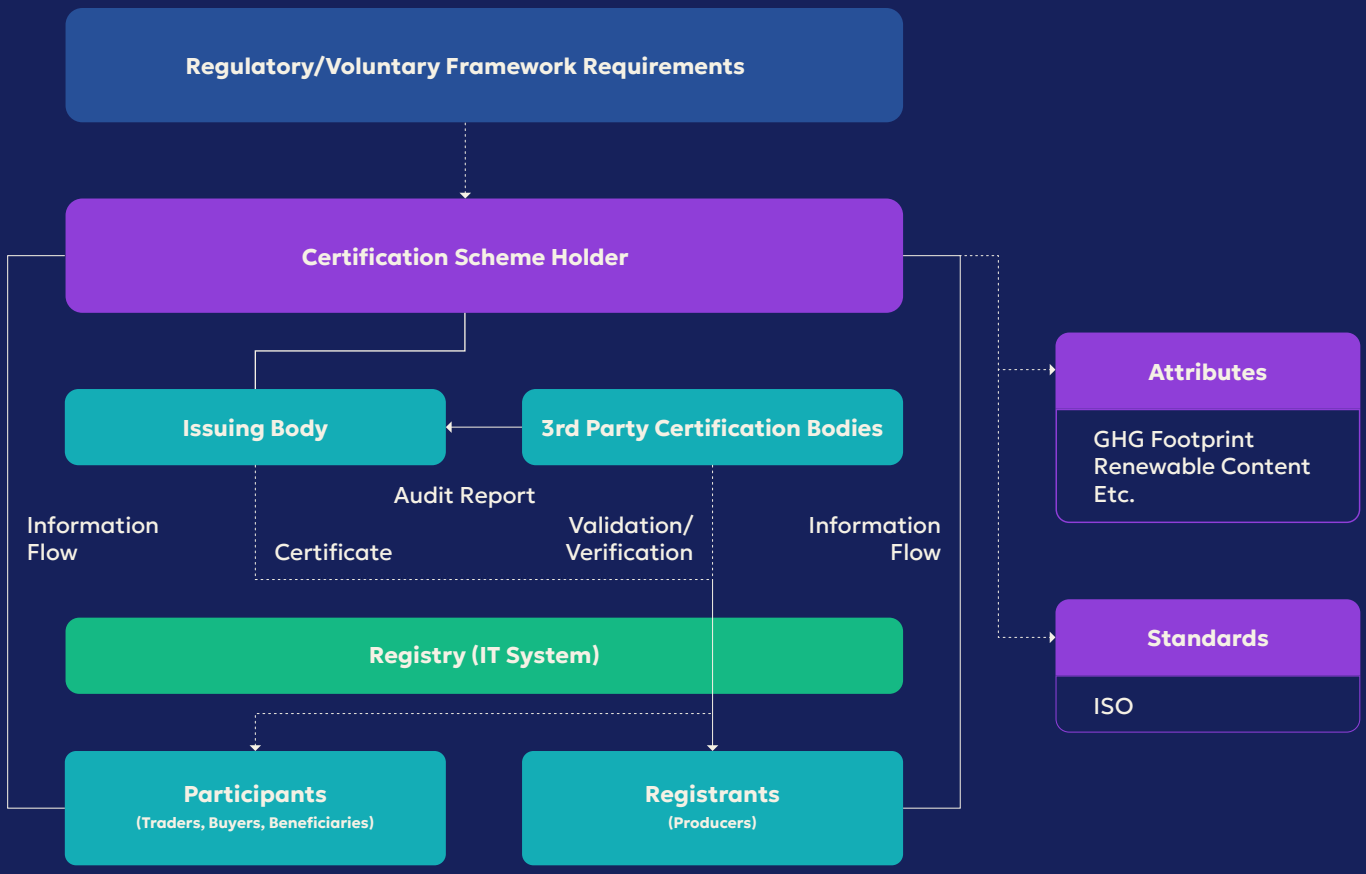


Figure 1: Schematic representation of a certification process – user information flow (solid lines indicate information or document flows between stakeholders, dotted lines indicate external documents that may inform a given scheme).

Certification scheme owners/holders are responsible for designing and operating certification schemes. Trustworthiness of schemes is ensured through suitable scheme design including governance, reliable and accurate operation, as well as by way of insuring impartiality based on independent third-party verification by certification bodies through audits. Scheme owners may be public or private entities. When it comes to national certification schemes, governments can play a key as supervision of scheme owners by government authorities is important to ensure their credibility.

Certification bodies are independent third parties that validate or verify both the conformity of a methodology applied by a given production facility with the standard requested by the certification scheme and the actual determination of the attributes according to the methodology. A certification body may also assume the role of an issuing body and issue certificates.

Certification bodies play a key role in independent monitoring, by conducting third-party assessments to provide independent confirmation that scheme users are in line with certification scheme requirements. Certification schemes define the qualifications required from certification bodies. In order to be able to work on behalf of a certification scheme a certification body and its auditors must be recognized by the scheme owner and approved to certify on behalf of the certification scheme (based on specifications and requirements defined by the scheme). A prominent example are the requirements for certification bodies to be accredited according to certain ISO standards, like ISO 17065.[2]

Figure 2: Interaction between scheme owners, certification bodies & accreditation bodies

Once all requirements defined by the scheme are fulfilled—including, for example, any accreditation requirements—, the certification scheme owner can recognize the certification body to certify products in accordance with the scheme on its behalf . As soon as a certification body is recognized by the certification scheme owner/holder, it can conduct audits according to the specifications in the scheme. The interactions between scheme owners/holders, certification bodies and accreditation bodies are shown schematically in Figure 2.

To assess whether a user complies with the certification scheme, a certification body employs auditors who conduct in-depth assessments. These assessments can use a variety of methods. For example: (1) testing and review of data can be used to certify operations; (2) competency/skills testing can be used to certify personnel; and (3) on-site inspection can be used to certify production facilities.

In the case of reporting markets, a positive audit by the certification body is the basis for the issuance of corresponding certificates by the designated issuing body. For compliance markets, certification bodies to which governments have delegated a specific power of inquiry can be used in order to demonstrate compliance with legislative requirements and regulations. In this case, however, it is the certification body itself issuing the certificate, thereby certifying the scheme user and the facility (rather than the energy quantities) to fulfil the requirements set by the corresponding certification scheme. In both cases, the certificates are valid for a fixed period. In case of reporting markets based on a book and claim system (see definition below), certificates have an expiration date, after which they expire and no longer can be traded. In the case of compliance markets, scheme users themselves need a recertification (generally this must be done annually).

Issuing bodies ensure, taking into account the validation or verification processes established by the certification bodies, that the information evidenced by the certificate is correct and complies with the requirements of the scheme. Where the judgement of the issuing body is positive, it issues the related certificates. The issuing body may be a separate body, or the certification body may additionally take that role.

Accreditation bodies assess and regularly monitor the technical competence, reliability, independence, and integrity of certification bodies in the public interest. National accreditation bodies act as a regulatory authority on behalf of a state. As the worldwide system of accreditation is based on common international standards, accredited certification bodies are comparable and can enhance mutual trust and therefore mutual recognition of certification schemes (see also section 8). In this context, International Accreditation Forum (IAF), plays an important role as a worldwide association of accreditation bodies as its primary function is to develop a single worldwide approach of conformity assessment, which reduces risk for businesses and their customers by assuring them that accredited certificates and validation and verification statements may be relied upon.

Certification scheme registry is an IT tool that allows storing all certificates issued under a given scheme digitally, as well as tracking and tracing[3] product movements along the chain of custody as required.

Chain of custody model within a scheme determines the process associated with the change of ownership of a certificate and/or the underlying physical product for tracking and tracing of product attributes along the supply chain. In the world of energy,[4] there are two types of chain of custody models commonly used in certification of energy products:

- Mass Balancing model that allows tracking and tracing sustainability attributes from production to consumption gate applied on a consignment basis, linking sustainability attributes evidenced by the certificate to physical product consignments. Mass balancing is commonly used in biofuels certification. This chain of custody model requires an underlying physical link between producers and consumers, or

- Book and Claim model that allows tracking the electronic certificates, containing the information of attributes of the physical product, from their issuing to their cancelling for disclosure (see definition below).
  It allows for complete separation between the certified product and the certificate. In other words, product can be traded separately from the certificate. Book and claim model is widely used in so called “Guarantee of Origin” schemes for renewable power.

In the case of certification schemes using book and claim model, scheme users include producers of the given unit of energy, and the scheme is used to certify a given unit of energy. Whereas in the case of certification schemes with mass balancing model, scheme users include all stakeholders involved in the certificate and product transaction along the supply chain (producers, traders and suppliers), and the scheme is used to certify that scheme users along the chain of custody provide correct information about product attributes.

Cancellation (widely used in certification of renewable power based on the book-and claim model) is the physical 'use' of a GO certificate and is the method for allocating the attributes of the electricity to a single end-user. In case of renewable power GOs, cancelling a GO is the only way to redeem its benefits while ensuring that the certificate will not be traded, sold, or used by another end-user – in other words, to avoid double counting.

Supervision of certification schemes describes the continuous monitoring of certification schemes with regard to the requirements imposed on them. It represents a fundamental principle of certification. Supervision is made up of various components and is intended to ensure that schemes, once they have been recognized, adhere to the specifications throughout their entire operation and do not subsequently deviate from them. The primary goal of supervision is to create trust in the respective certification schemes, as well as in the system as a whole. Supervision is required at different levels of management and is carried out regularly.

Standard – the International Organization for Standardization (ISO) defines a standard as "a document, established by a consensus of subject matter experts and approved by a recognized body that provides guidance on the design, use or performance of materials, products, processes, services, systems or persons." Standard Development Organisations (see definition below) produce global voluntary standards, which can be used as reference across regulatory and voluntary frameworks internationally. In the context of hydrogen certification, a standard can define a methodology for identifying or calculating a certain sustainability attribute, e.g. for calculating the CFP or partial CFP of hydrogen production and transportation or for establishing its renewable content (i..e. establishing the amount or share of renewable energy used in its production and transport). An international standard should not be confused with national laws and regulations. However, national or regional laws, regulations and guidelines may refer to standards (for example, the EU Taxonomy for Sustainable Finance refers to the use of ISO standards for the assessment of the GHG footprint of hydrogen production to be qualified as a sustainable economic activity).

A **Label** or certification mark signals that certain defined requirements are fulfilled. For example, a label may define hydrogen as "renewable" hydrogen when it has been produced from renewable sources and has a carbon footprint below a threshold defined by the label.

[2] Conformity assessment, requirements for bodies certifying products, processes and services.
[3] ISO/TS 24533:2012 defines tracing as „function of retrieving information concerning goods, goods items, consignments or equipment", while it defines tracking as „function of maintaining status information of goods, goods items, consignments or equipment". In other words, tracing relates to information on the origin of the product/certificate (where it comes from), while tracking relates to the destination of the product/certificate containing the relevant information (where/whom it is passed on to).
[4] While the present 101 document focuses on learnings from certification of energy products, certification is used across a wide range of products and commodities, including agriculture products. In food and agriculture industries common chain of custody models include identity preservation (if identity preservation is applied, the certified product and its certificate cannot be separated across the supply chain, and the product cannot be mixed with any other identical products, even if they have also been certified and have a certificate under the same certification mechanism) and segregation model (largely the same as identity preservation, except that mixing of identical products, which have been certified under the same certification mechanism, is allowed). The segregation model is commonly used in, but not restricted to, certified organic or fair trade products, or materials such as organic or fair trade cotton.

06 – Main actors

Alongside the key actors involved in certification processes as described above, this section provides a snapshot of the main actors involved in standardisation, regulation and use of certification schemes.

These include:

- Governments, legislators, policy makers set rules and requirements for the functioning and use of certification schemes, in particular those that can be used to access incentives (e.g. targets, quotas and tax credits), and have the responsibility to ensure consumer protection and to put in place safeguards against double counting and fraud. They are the only authority with power of inquiry. In other words, they are the only authority of control/inspection and inflicting fines or other penalties.

- Producers use certification schemes to have their products certified for mandatory or voluntary compliance purposes.

- Traders/suppliers/end-consumers can use certificates to (i) buy certified products and resell them or to declare for voluntary reporting and disclosure purposes, (ii) use them as input for production of derivative products supplied to customers, or (iii) qualify for subsidies/comply with mandatory compliance regimes, such as quotas and targets, or to benefit of tax exemptions (e.g., CO2 taxes or costs of GHG emissions under carbon pricing mechanisms). An example of the latter case is fuel suppliers buying renewable hydrogen to comply with fuel mix requirements under the Renewable Energy Directive II of the EU.

- Standards Development Organisations (SDOs), such as the International Organisation for Standardisation (ISO), are organizations focused on developing, publishing, or disseminating technical standards to meet the needs of an industry or field. In hydrogen specifically, ISO/TC197 Hydrogen Technologies leads international standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen. ISO/TC 197/Sub-committee 1 Hydrogen at scale and horizontal energy systems focuses in particular on standardization of large-scale hydrogen energy systems and applications including aspects of testing, certification, sustainability and placement, and coordination with other relevant standardization bodies[5] and stakeholders.

  Notably, there is an agreement for technical co-operation between ISO and CEN, the Vienna Agreement, signed in 1991. It was drawn up with the aim of preventing duplication of effort and reducing time when preparing standards. As a result, new standards projects are jointly planned between CEN and ISO. Wherever appropriate priority is given to cooperation with ISO provided that international standards meet European legislative and market requirements and that non-European global players also implement these standards. The Vienna Agreement allows expertise to be focused and used in an efficient way to the benefit of international standardization.

- Conformity Assessment Bodies (CABs) are bodies that undertake conformity assessment activities. CABs range from multinational companies that undertake all types of conformity assessment activity (e.g. testing, inspection and certification), to CABs offering national services within one specific country, or small localised entities that work in a specific sector and region. In most cases, CABs can act as a first, second or third party that is making the claim of conformity. Where bodies act in a third party capacity, an important feature is that they have to act in an impartial way so that the results of their work can be objective and maintain the highest degree of confidence. CABs issue certificates of conformity. The International Electrotechnical Commission System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres (IECEx) is an example of a CAB. The IECEx is the conformity assessment arm of the International Electrotechnical Commission (IEC), a global international standardization body established in 1904. IECEx is a global organization with 95 certification bodies worldwide. In 2021 IECEx has established a Working Group on Hydrogen Economy for the purposes of certification of hydrogen equipment based on ISO/TC 197 standards.

[5] Examples of relevant SDOs active at regional level include the European Committee for Standardization (CEN) - an association that brings together the National Standardization Bodies of 34 European countries, as well as the European Committee for Electrotechnical Standardization (CENELEC), which prepares voluntary standards in the electrotechnical field, which help facilitate trade between countries, create new markets, cut compliance costs and support the development of a Single European Market

07 – Main design elements of a certification scheme

A snapshot of the key design elements of a certification scheme is provided by Figure 3 below. These elements include:

A. Fundamental design principles of schemes: robustness - ensuring safeguards against fraud (and double counting) of certificates are in place, transparency and impartiality, oversight and accuracy as well as harmonization and future-proof design (see section 9 for more details);

B. Attributes covered by the scheme, including carbon footprint, use of land/water and socio-economic impacts;

C. Governance of the scheme laying out the rules and responsibilities of certification bodies;

D. Certification issuing, oversight and supervision rules, including independent audit and reporting;

E. Scope and boundary conditions of the certification scheme, which are informed by the underlying methodologies used for assessing the sustainability attributes covered by the scheme;

F. Chain of custody used for tracing of product attributes along the supply chain according to the scope of the given certification scheme.

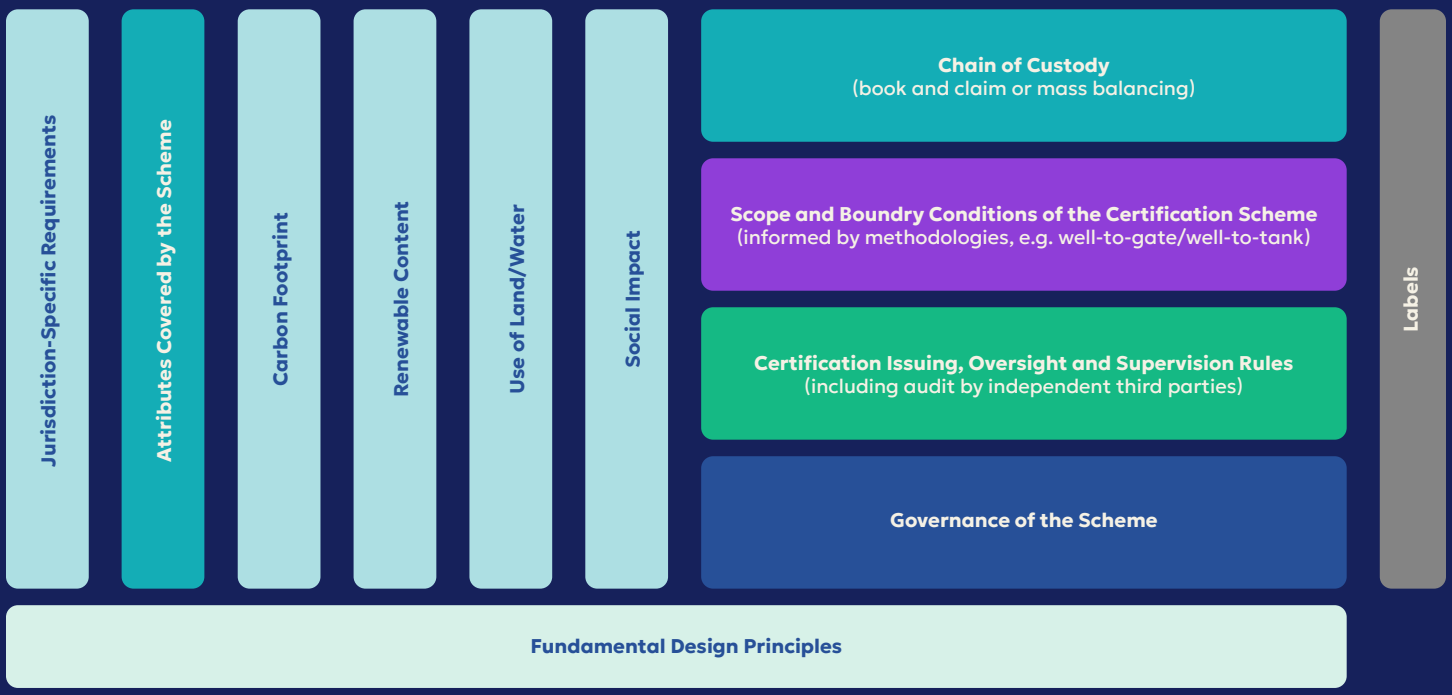
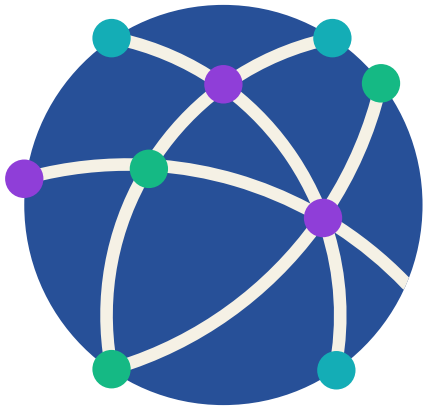


Figure 3: Main design elements of a certification scheme

08 – Mutual recognition of certification schemes



Today, a number of countries and regions including some of the European Union Member States, Japan and Korea, seek to secure imports of hydrogen and derivatives.

Hydrogen producers may need to have their products certified for each importing country/region individually according to the respective requirements and certification schemes. Incompatibility between requirements or lack of recognition between one country's requirements and another's leads to additional administrative burden and delays in the development of trade corridors, creating barriers to international trade of the certified products on the global market. In case of fragmented compliance markets with different certification schemes, only bilateral trades between a hydrogen producer and an importing country would be possible. This would effectively preclude the development of a global hydrogen market.

Global harmonization of certification and/or, ideally, adoption of a single new global scheme could be ideal for international trade of hydrogen, but it appears to only be attainable in the longer run due to existing differences in hydrogen policies and regulations around the world. The approach of developing mutual recognition of certification schemes rather than to aim at full harmonization or a single new global scheme in the short-to-medium term is both pragmatic and sound, as it builds on existing experiences from other certification processes and examples that could guide the development of mutual recognition of certification schemes. International government-to-government platforms, such as IPHE, alongside expert groups can be instrumental in advancing mutual recognition.

Mutual recognition of certification schemes is a crucial prerequisite for the development of a global hydrogen market, as it provides for a commonly agreed approach to evidencing, tracking and tracing, and recognising attributes of hydrogen and its derivatives. Pursuing mutual recognition of certification schemes is a promising way forward as it enables convergence on the fundamentals of certification scheme design, while factoring in specific policy objectives and choices of different countries and, as a consequence, compliance requirements impacting certification schemes.

Implementation of mutual recognition will require collaboration between actors in the certification ecosystem, including governments, accreditation bodies, as well as conformity assessment bodies.

09 – Fundamental design principles for certification schemes

Robustness, transparency and impartiality, oversight and accuracy as well as harmonization constitute a vital common basis of certification schemes globally. The analysis of these principles in this report is based on the relevant ISO definitions, namely:

- **Transparency:** All relevant issues are addressed and documented in an open, comprehensive and understandable presentation of information (ISO 14067)
- **Impartiality:** Decisions are based on objective evidence obtained through the validation and verification process and are not influenced by other interests or parties (ISO 17029)
- **Accuracy:** Quantification is accurate, verifiable, relevant and not misleading, and bias and uncertainties are reduced as far as practical (ISO 14067)
- **Harmonization:** Methodologies, standards and guidance documents that are already recognized internationally and adopted for product categories are applied, to enhance compatibility (ISO 14067).

Adapting those concepts to hydrogen certification and considering lessons learned from certification of biofuels and renewable power, the report identifies the following five fundamental principles (see Figure 4 and the list below).

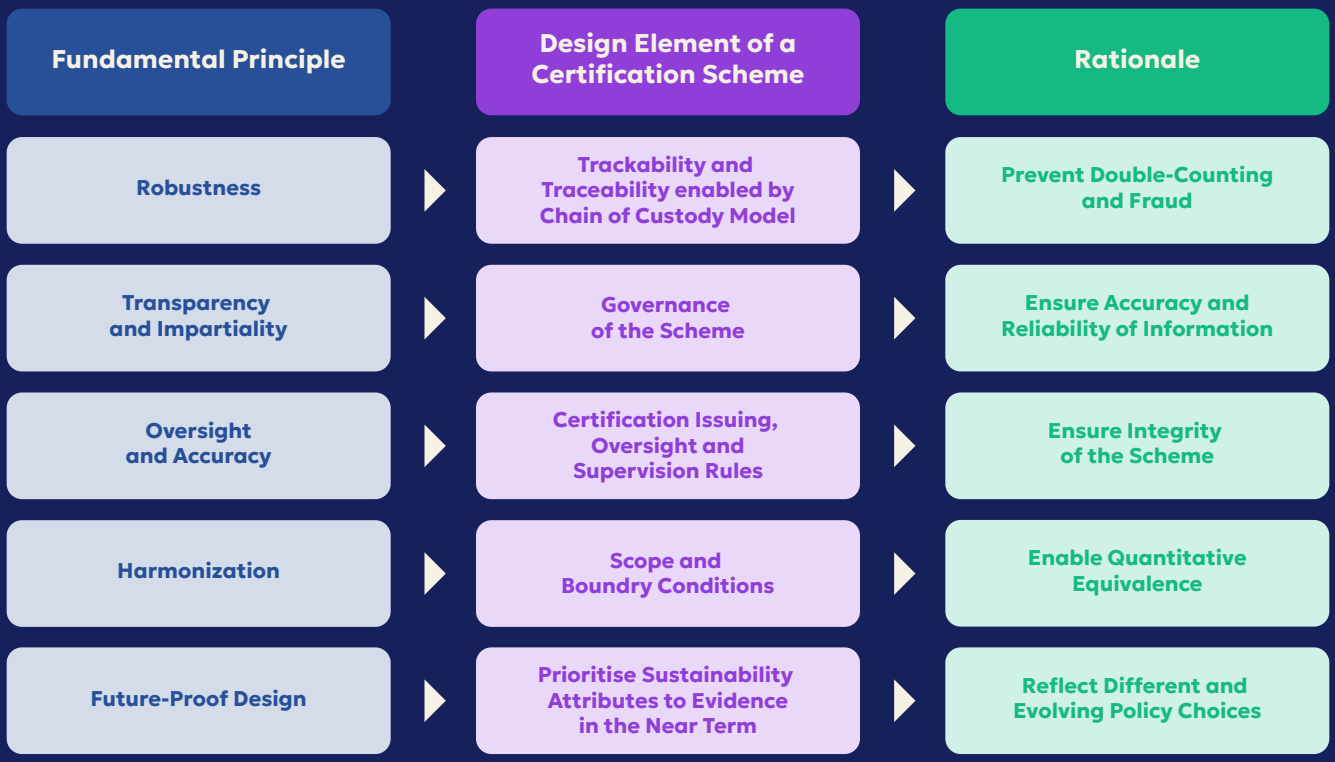


Figure 4: Aligning fundamental principles with design elements of certification schemes for hydrogen and derivatives

1. **Robustness: traceability of sustainability attributes and safeguards against double counting of certificates**

   - Safeguards against double counting, i.e. ensuring that the (sustainability) attributes are disclosed and that the benefit of a single unit of hydrogen production/ consumption and/or the associated greenhouse gas emission reduction or removal is not counted more than once towards achieving climate change mitigation targets or pledges, for regulatory or voluntary purposes; and

   - Reliable tracing of sustainability attributes along the supply chain.

2. **Transparency and impartiality** of the scheme: transparent rules, stakeholder engagement, procedures for complaints, appeals and grievances

   - Stakeholder engagement and consultation on the development of underlying methodologies and design of the scheme;

   - Clear and transparent rules on the use of methodologies and the functioning of traceability solutions (including title transfer and cancellation rules where applicable);

   - Impartiality and consistency in the implementation and the operations of the certification scheme;

   - Independence and impartiality of third-party Certification Bodies accredited by Accreditation Bodies;

   - Regular publication and maintenance of up-to-date information and data for transparency and public awareness; and

   - Complaints, appeals and grievances procedures; right to appeal of scheme users and commitment to non-discriminatory and fair treatment and decision-making.

3. **Oversight of the scheme and accuracy of information provided by the scheme**

   - Independent Supervision by public authorities or by independent third parties entrusted with power of inquiry;

   - Balanced internal governance structure of schemes;

   - Independence of judgment and integrity in the implementation of the certification scheme;

   - Certificaiton schemes should be open for recognition of any Certification Body demonstrating the required competencies and capacities; and

   - Record keeping and register of certificates and audit reports.

4. **Harmonization:** While full harmonisation presents unattainable in short-to-medium term, pursuing a degree of convergence on some design elements of certification schemes can play an important role. Use of global standards and frameworks as a technical basis for the scheme can facilitate that convergence, while fully recognizing and enabling compliance with national/regional regulatory frameworks.

   - ISO standards form a solid and consistent basis for methodologies that inform the scheme (in particular, ISO standard methodologies for assessment of sustainability attributes, such as GHG emissions footprint); and

   - Modular approach to certification design allows plugging in country/jurisdiction-specific compliance requirements for sustainability attributes;

   - Build on existing good practices and global frameworks (e.g. International Accreditation Forum) to facilitate quick uptake of the scheme by relevant stakeholders.

   - Cooperation between governments will play a key role in enhancing harmonization.

5. **Ensure the scheme is future-proof** and can adapt to changes and evolution in the sustainability methodologies or assessment frameworks, while retaining immutable fundamental principles. Global standard methodologies to assess the full range of sustainability attributes are evolving. Currently, the most mature standard methodology being developed at global level by an SDO is the ISO TC197/SC1 methodology for GHG emissions assessment of hydrogen production, conditioning and transport (ISO TS19870).

10 – Acronyms and Abbreviations

AIB	Association of Issuing Bodies
CCS	Carbon Capture and Storage
CFP	Carbon Footprint
CO2	Carbon Dioxide
CSR	Corporate Social Responsibility
EAC	Environmental Attribute Certificate
ESG	Environmental, Social and Governance
EU	European Union
GHG	Greenhouse Gas
GO	Guarantee of Origin
H2	Hydrogen
H2PA	Hydrogen Production Analysis
IAF	International Accreditation Forum
IEA	International Energy Agency
I-REC	International Renewable Energy Certificate
IPHE	International Partnership for Hydrogen and Fuel Cells in the Economy
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
LCA	Life Cycle Analysis
SDGs	Sustainable Development Goals