



Deliverable 4: Advisory report on the development of a Green Hydrogen certification scheme in Chile

Consultancy Services for Technical Assistance Activity: Recommendations for a Green Hydrogen Certification Scheme in Chile that is compatible with national and international carbon markets



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Document prepared by:

HINICIO

Carrera 5 #70A-74, Oficina 301

Bogotá, Colombia

Point of Contact

Julian González

julian.gonzalez@hinicio.com

And

Ludwig-Bölkow-Systemtechnik (LBST)

Daimlerstrasse 15

85521 Ottobrunn, Germany

Point of Contact

Matthias Altmann

Matthias.Altmann@lbst.de

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List of Abbreviations

AIB	Association of Issuing Bodies
CA	Competent Authority
CEA	Commissariat à l'énergie atomique et aux énergies alternatives
CEM H2I	Clean Energy Ministerial Hydrogen initiative
CEN	European Committee for Standardization
CHBC	California Hydrogen Business Council
EATS	Energy Attribute Tracking System
EC	European Commission
EECS	European Energy Certificate System
ETS	Emissions Trading Scheme
EU	European Union
GHG	Greenhouse Gas
GO	Guarantee of Origin
H₂	Hydrogen
HC	Hydrogen Council
H2PA TF	Hydrogen Production Analysis Task Force
IB	Issuing Body
LBST	Ludwig-Bölkow-Systemtechnik
LCFS	Low Carbon Fuel Standard
RED II	Renewable Energy Directive recast (Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources; OJ L 328, 21.12.2018, p. 82–209)
RFNBO	Renewable Fuel of Non-Biological Origin
ToR	Terms of Reference

1. Executive Summary

This report represents the final deliverable of the consultancy “Recommendations for a Green Hydrogen Certification Scheme in Chile that is compatible with national and international carbon markets”. It is a synthetic advisory report with key recommendations that will allow the Government of Chile to define a path forward with regards to the selection, design, and implementation of a certification system for green molecules produced in Chile that increases the country’s competitiveness with regards to future exports of said products.

Chapter 3 provides a comprehensive review of what are the consultant’s recommendations with regards to the design or adoption of a scheme that is compatible both with international markets and with the existing Chilean Measurement, Reporting and Verification (MRV) system. In the chapter, the argument is made that market and regulatory signals from potential export markets indicate that **the adoption of an internationally recognized scheme that is already used in several target countries would be the best possible approach for a Chilean scheme**. An outside-in approach (where the regulation of the countries which will be importing the products and the cost competitiveness of those products) should define which type of Energy Attribute Tracking Systems (EATS) and scheme should be adopted by the country. Furthermore, we conclude that adopting a scheme such as CertifHy or a scheme that is compliant with existing and upcoming European Union (EU) regulation is the safest approach towards ensuring that the adopted scheme is not only future proof, but also will likely guarantee that Chilean exports will be compliant with upcoming sustainability criteria in other markets beyond the EU.

Chapter 4 includes recommendations of which baseline attributes should be tracked within a Chilean certification scheme. In line with existing schemes, we conclude that there are **two key attributes that need to be considered: renewable character of energy input and CO₂ emissions**. Nonetheless, we also identify additional sustainability criteria that could be tracked and traced via a future EATS that could add value to Chilean products in international trade markets, while still being compatible with import market regulation.

Chapter 5 lays out the preliminary elements to propose a governance structure for the Chilean certification system, considering all the types of stakeholders that normally intervene in the entire chain of custody of both the product and the tracking instruments themselves, using CertifHy as a blueprint. We conclude that adopting an existing scheme with international recognition and enduring mutual recognition of the tracking instruments between exporting and importing governments will result in a simpler governance scheme, as several roles within the chain of custody would be fulfilled by actors that are already embedded and recognized by the schemes to be adopted. Furthermore, we present a preliminary proposal of which national actors, both public and private, could potentially assume roles and responsibilities within this tentative governance structure.

Chapter 6 presents a strategy for the implementation of a certification system that fulfils all the requirements laid out by the mission Terms of Reference (ToR) as well as with the objectives by several Chilean stakeholders as expressed during the workshops carried out during the mission. **We conclude that the Chilean scheme should be designed and implemented by considering European standards at first: Guarantees of Origin (CEN / EECS) and Renewable Fuels of Non-Biological Origin (RFNBO).** Based on this, a strategy to put such a scheme in place is presented, along with considerations with regards to additional sustainability criteria specific to the country and recommendations to avoid embedding negative externalities or carbon leakage towards Chile.

Finally, chapter 7 contains a synthetic list of conclusions and recommendations, organized, and classified by type. These conclusions are organized in the form of insights, as follows:

Insight	Comments
Certification scheme design must follow the targeted market	There are no harmonized definitions on what a “green” or “sustainable” product, either hydrogen or a derivative is. These definitions are often set by the importing market based on priority sustainability criteria. Therefore, we recommend that efforts to define a certification scheme for Chile should begin by understanding the applicable definitions in the target markets and the regulation to comply with those product specifications.
Markets are demanding specific products based on their final use, and any scheme should adjust accordingly	Market forces have made it so that green molecules do not have a single criterion to adhere to, but rather, they have become highly specific products with environmental attributes for compliance based on what the final use of those molecules will be. This not only affects which kind of EATS should be developed for each specific product for export, but also, it is competitiveness (products with higher compliance criteria to clear will be more expensive to produce, but also, there will be a higher willingness to pay by the consumer, which should offset those investments). Thus, the recommendation is, in line with the previous insight, to begin by understanding the applicable definitions in the target markets and the regulation to comply with those product specifications.
Due to highly specific future export markets, an outside-in approach to adopt a scheme is the recommended path forward	Our recommendation, also supported by interactions with Chilean stakeholders, is that Chile would be best advised to pursue an outside-in approach (where external market signals shape the certification scheme definition), based on starting out by the identification of the quantitative competitiveness advantage of Chilean products and prioritization of high priority markets for export. Based on this preferred approach, four actions were identified as next steps for the Chilean government to continue working

	on the matter: (a) Identify and quantify the competitive advantage of specific products (molecules) that can be produced in Chile and exported overseas, (b) Select priority market and product pairs where efforts will be placed on developing trade agreements and mutual tracking instrument recognition, (c) Understand the regulatory framework for priority products in the markets where exports will be pursued, and the complementary nature of this emerging routes with existing International Trade Agreement, and (d) Select the appropriate EATS that will best support the product with regards to reaching the target markets
Regarding attributes to monitor and measure, there is no need to “reinvent the wheel”, but there is an opportunity to differentiate	Interviews with international stakeholders as well as our benchmark showed that two key criteria are must haves for an upcoming EATS for Chile: (a) the renewable character of energy input and (b) carbon footprint. Therefore, we advise that the Chilean scheme must include such attributes to add value both on the national and international level. This falls well in line with all the existing certification schemes used in international markets. However, this does not mean that Chile should restrict itself to only those two sustainability criteria, as we believe that adding additional criteria to the Chilean label could make exported products more attractive to certain types of off-takers and markets, and therefore, increase the willingness to pay. Also, it is likely that in the future regulation in certain markets (like the EU) could become more demanding with regards to penalizing carbon leakage or shifting of negative externalities to external countries, which could position Chilean products better. We recommend analyzing three additional criteria that could be added to the Chilean scheme, but the mechanisms in which such criteria will be measured, validated, and audited needs to be defined at a later stage. These criteria are additionality of the input energy, no conflict uses of water and no conflict uses of land.
Adopting CERTIFHY seems to be the best path forward for Chile, based on national stakeholder goals and future developments in the field of certifications in other markets	We have concluded that it would be a good recommendation for Chile to study the existing and upcoming EU regulation with regards to EATS, as developing products and installations that are compliant with European regulation is likely to be the safest way to ensure future compatibility with most, if not all, international markets. We advise that the Chilean scheme should be designed and implemented by considering European standards first: Guarantees of Origin (CEN / EECS) and RFNBO. This impression has been validated with key international stakeholders that are at the forefront of

	the development of a harmonized certification scheme worldwide, such as the Hydrogen Council Following on this logic, CertifHy has positioned itself as the world's most advanced GO scheme for hydrogen, and it is serving as a potential blueprint for this unified global scheme. Therefore, Chile would be well advised to pursue the adoption of CertifHy, which would require the mutual recognition of GO's between the EC and the Government of Chile.
If the recommendation to adopt a scheme rather than develop a new one is pursued, an eventual governance structure will be less demanding on the Government of Chile	An analysis based on the governance structure of a robust existing certification scheme allowed us to identify that several roles and responsibilities need to be assigned or extended to both public and private entities, so that the scheme will be credible, self-regulating, and sustainable. In a scenario where an operational scheme with international recognition is adopted, Chile would only need to appoint: a national competent authority, an issuing body or bodies, accredit certification bodies, and work with account holders with regards to understanding the process of instrument issuing and cancellation within the existing registry.

In short, we recommend that Chile pursues the adoption of an existing certification scheme for hydrogen and other “green” products derived from it, and the selection of which scheme is most suitable should follow **high-level discussions on defining which are the priority markets for export and which products will be the most attractive to potential off takers overseas**. Therefore, the next steps towards implementing the scheme will require **a further set of cost competitiveness studies (such as assessing the final cost of hydrogen in LCOH at different ports of destiny in Europe and Asia with respect to products sourced from competing countries), projection of market demands, and diplomatic considerations with regards to establishing cooperation agreements with other countries** (in particular with the EU via the European Commission) that will allow for the mutual certification of tracking instruments in the future.

2. Introduction

This report is aimed mainly at elaborating specific recommendations for the development or adoption of a green hydrogen certification scheme in Chile that is compatible with international markets as well as with the national MRV system.

Recommendations included in the report cover:

- ➔ A focus on which approach for deploying a hydrogen certification in Chile is the most reasonable, considering relevant export markets and opportunities to facilitate international recognition of products
- ➔ Identification of attributes to be monitored and measured by the scheme
- ➔ A qualitative analysis of challenges and opportunities to certify other green products derived from renewable or low carbon hydrogen
- ➔ Preliminary identification of relevant stakeholders within the scheme that could form the basis for the design of a governance structure
- ➔ A roadmap of actions to facilitate the implementation of the scheme
- ➔ A final set of high-level recommendations based on certification schemes that were internationally benchmarked, insights gathered from stakeholders within workshops and interviews, and the consultant's own advice

3. Recommendations on the compatibility of a scheme with international markets and the national MRV system

3.1. Compatibility with international markets

It is a paramount objective of this advisory report to provide sound recommendations to develop a certification scheme for Chile that ensure compatibility with international markets for which hydrogen and its derivatives will be shipped.

Based on the existing body of literature, known markets in which importing hydrogen is considered key to covering foreseen domestic demand, and the results of the workshops carried out in the context of the project, it is safe to say that Chile may have three markets of interest for future export:

- ➔ The **European market**, where hydrogen and its derivatives (notably, RFNBO's) are expected to be imported soon through ports in the Netherlands, Belgium, and Germany. Note that this market demands the highest logistical costs for Chile, due to geographical specificities that demand shipping go through either a route bordering the southern tip of South America or cross the Panama Canal.
- ➔ The **East Asian** market, where likely importers will be Japan, South Korea and Singapore, based on their existing hydrogen roadmaps and ongoing negotiations to establish trade routes with other countries.
- ➔ The **North American** market, where the focus for import in the medium term would be the US state of California and the western seaboard. However, unlike the EU and the Asian markets mentioned, there are no specific ongoing efforts from the US at a federal or state level to establish international import routes yet, as North America may provide competitive enough conditions to produce hydrogen locally.

A key piece of advice when designing or adopting a certification scheme that enables compatibility with international markets is given in Box 1.

BOX 1 – The logical process to define an EATS based on target markets

There is currently no single definition internationally recognized on what “green hydrogen” is. For instance, CertifHy, the GO scheme currently under development for EU-Wide recognitions, recognizes “green” and “low-carbon” hydrogen, based on production pathway and GHG emissions. The Aichi prefecture in Japan has a scheme in place to certify “CO₂ free hydrogen” based on the production pathway chosen. China defines “low-carbon”, “clean”, and “renewable”, categorizations for hydrogen. This reality also applies to derivatives, where there is no unified definition on what “green ammonia”, “green methanol”, or “low carbon urea” mean.

Insight 1: Rather than struggling to define what green products really are from a national (Chilean) point of view, efforts must be placed in understanding the applicable definitions in the target (export) markets and the regulation to comply with those product specifications. This goes to show also why developing a new certification scheme from

the ground up is not a recommended approach: it will require mutual understanding and recognition of WHAT both importer and exporter understand as a “green” product and HOW both parties use as EATS to demonstrate compliance with given sustainability criteria.

Based on the definitions of how each market understand what constitutes a product category, regulations are often put in place to further define the compliance and sustainability criteria that both the product and the facilities that produce it must align with for that specific product to be recognized as market compliant and thus eligible for import. The EU is often considered to be a pioneer in the development of regulation to define eligibility criteria for low carbon fuels and products, of which the EU Renewable Transport Fuel criteria, the Renewable Energy Directive, the EU Renewable Production target, and the EU Emissions Trading Scheme are prime examples.

Insight 2: After the markets have been prioritized, it will be necessary to delve into that market’s specific regulation to understand what compliance and sustainability criteria will be the minimum threshold that producers in Chile will need to clear. Only then will it make sense to define what kind of certification scheme will be needed; that is, one that covers all the compliance criteria demanded by the target market and that is likely recognized as regulation compliant by said market.

Insight 3: For domestic demand, Chile could pursue the definition of its own certification system that addresses the countries specific criteria to be quantified and specific industrial requirements, which could serve as an instrument to strengthen national demand for green molecules. However, adopting an existing scheme with international recognition and using the same scheme for national recognition could prove a more streamlined approach as a single system would serve all purposes, although costs of doing so are likely to be higher for producers due to relying on international bodies for certification.

Note that there are multiply pathways in which an appropriate set of actions to follow to design an internationally recognized certification scheme for Chile could be put in place; five pathways were outlined by Hinicio during the workshops with national stakeholders, which can be seen in Figure 1.

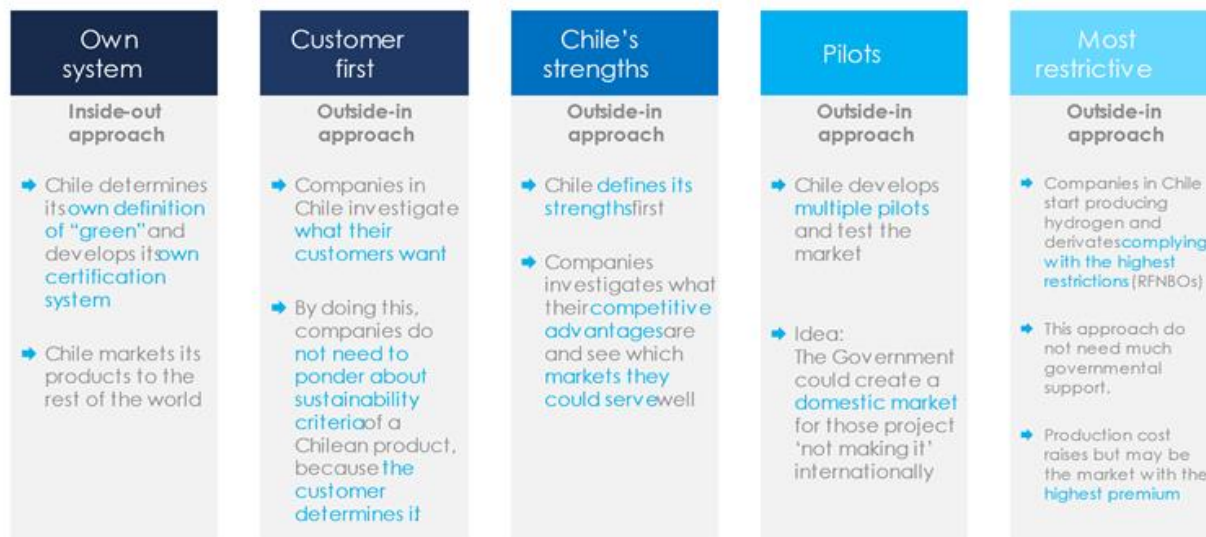


Figure 1. Five potential pathways to develop a Chilean certification scheme. Source: Hinicio-LBST, 2021.

For this advisory report, a recommended set of actions to follow in the short term for the design or adoption of a certification scheme that is compatible with international regulations is presented in Figure 2. This set of actions is based on recommendations gathered from workshops with national stakeholders in Chile, where an outside-in approach for designing a scheme based on Chile's strengths was widely preferred (the "Chile's Strengths" approach was the one most favored by participants in the workshops).

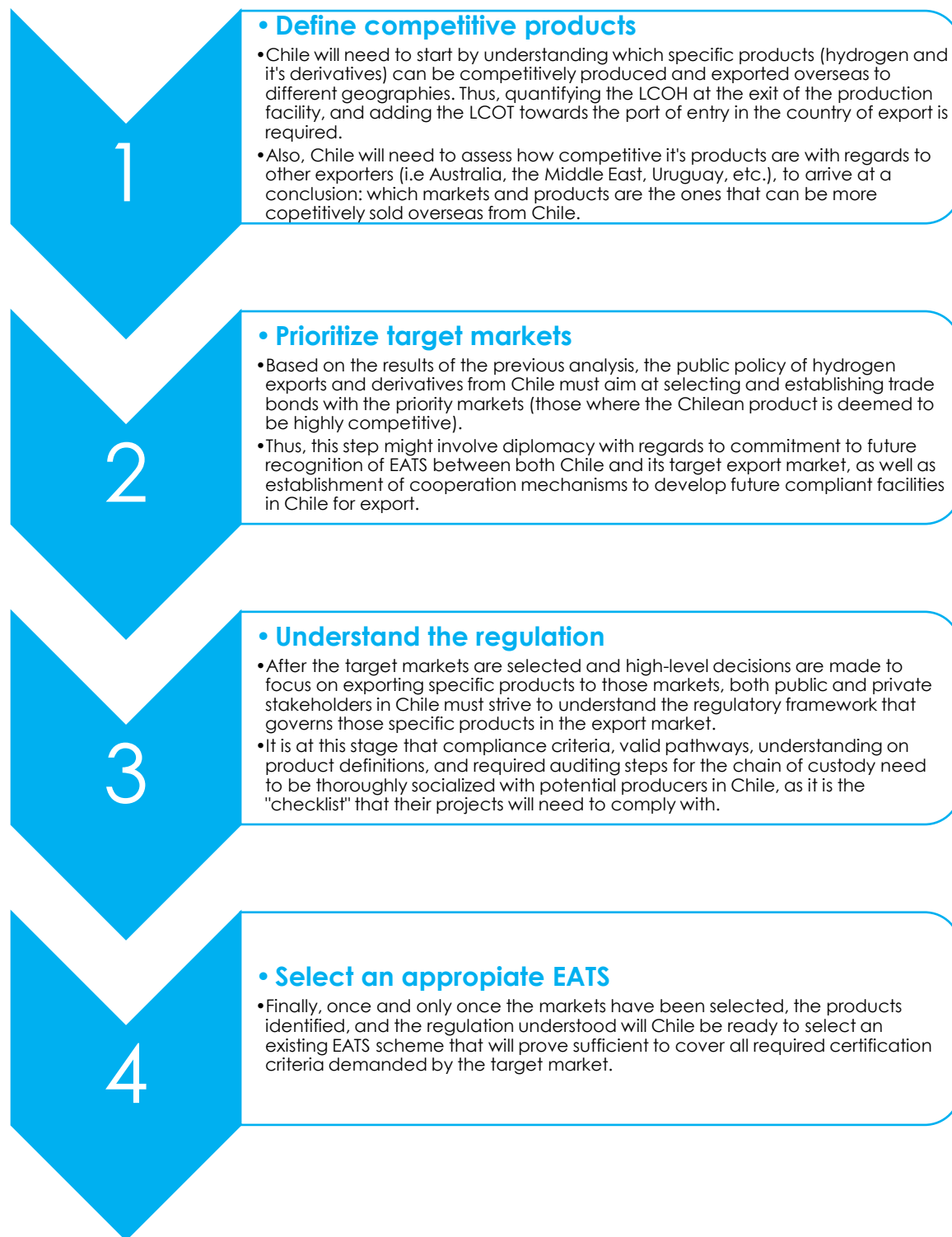


Figure 2. A simplified set of actions to support Chile in selecting an appropriate EATS scheme for international export of hydrogen and derivatives, based on an outside-in approach. Source: Hinicio-LBST, 2021.

It is worth noting however that the current state of existing certification schemes for hydrogen globally (outlined in depth in Deliverable 2) demonstrated that certain export

markets of high interest for Chile have yet to design definitions and regulation applicable to imported green and low carbon products and fuels.

Nonetheless, this does not mean that Chile needs to wait until said regulatory frameworks are put in place to design or adopt an EATS scheme, as Box 2 argues.

BOX 2 – Why understanding and adapting to existing and upcoming EU regulation would be the safest approach towards defining an appropriate EATS scheme for Chile, regardless of the priority markets finally chosen

The argument to be made here is that it would be a good recommendation for Chile to study the existing and upcoming EU regulation with regards to EATS, as developing products and installations that are compliant with European regulation is likely to be the safest way to ensure future compatibility with most, if not all, international markets.

This argument is built on the following observations, obtained from both Deliverable 2 and the interviews with international stakeholders:

- ✓ Europe is currently the global leader on the development of a hydrogen certification standard for disclosure (via the GO instrument) through the CEN, and its use as a transport fuel through the Directorate-General of Energy of the EC. It has been mentioned that European industry has been demanding that the EC develop policies to facilitate rapid scalation of the hydrogen economy, including the preparation of a CEN standard to be adopted worldwide and the rollout of a robust certification system (which will give an advantage to EU technology providers and potentially participating stakeholders in third countries an edge in worldwide export markets).
- ✓ Amongst stakeholders pushing for the development of this schemes in the EU, there is a strong consensus amongst stakeholders that there is a need for harmonization action now so that a fragmented H2 certification market is avoided.
- ✓ CertifHy, the scheme currently supported and promoted by the EC, is scheduled to provide input to the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) work group on hydrogen certification to ensure a harmonization between EU and the international methodology being shaped. Thus, it is extremely likely that CertifHy, built around EU policies and regulations, will be the referent model from which a global scheme could be developed with the support from the IPHE. It is worth noting that both CEM and IPHE promote the global development of harmonized standards for the certification of hydrogen.
- ✓ In October 2019, at the 32nd IPHE Steering Committee Meeting in Seoul, IPHE Partners agreed to the formation of a Hydrogen Production Analysis Task Force (H2PA TF) specifically to address challenges brought forth by governments and industry stakeholders on the need for a consistent framework and methodology in assessing hydrogen production technologies from diverse sources. On March 10, 2020, the Terms of Reference (ToR) for this Task Force were adopted. Countries confirming interest in working on the H2PA TF include France, European Commission, United States, Japan, Korea, Netherlands, United Kingdom, South Africa, Costa Rica, and

- Norway with a Co-lead being France, European Commission, and United States. Countries expressing interest in participating are Australia, Germany, and Canada. Other countries are welcome to join the H2PA TF, according to the ToR. Chile just joined the IPHE in November 2020, though on a mainly observer capacity for now
- ✓ While the current geographic scope for GOs is defined as the European Economic Area (EEA) including the European Union plus additional European countries, future plans include exploring the possibilities of imports and export of GOs with countries outside of the EEA. RED II Art 19(11) foresees this provided that direct import/export of energy takes place, and that the EU has made an agreement with the country regarding mutual recognition of the GOs. The agreement between the EU and a third country in practice will require the existence of a GO system like the one defined by RED II and the EU Energy Market Directive (specifically linked to “disclosure laws”) in that third country
 - ✓ According to the HC, based on a bilateral interview, **the EECS ruleset should be the basis for designing a future-proof certification system**, as it is the most advanced scheme worldwide and is gaining adopters beyond EU borders. This vision is shared by DENA as well.
 - ✓ Finally, both the CHBC (California reach) and HC (global reach) have confirmed that developing a country-specific scheme will only be important for disclosure purposes in local markets, but the adoption of an internationally recognized standard is likely the most future-proof decision with regards to using a scheme that will support export activities in the future.

In short, market and regulatory signals indicate that the adoption of an internationally recognized scheme that is already used in several target export markets would be the best possible choice.

In this regard, CertifHy will likely serve as a platform for developing a worldwide GO scheme for hydrogen, and thus, ensuring compatibility with its compliance criteria seems to yield the highest possibilities to be able to commercialize to other future markets which will either adopt EU and CEN standards and regulations, or develop market-specific criteria and regulations that are not foreseen to be as demanding as EU requirements.

Since CertifHy is focused on fostering international harmonization of a GO scheme for hydrogen, it would also be a sensible recommendation that the Government of Chile assesses the following specific actions (in this order):

- ➔ Strongly consider implementing a GO system that is compliant with RED II Art 19 ,the CE-EN 16325 standard, the EECS rules of AIB (the latter being more detailed than the former), as well as potentially implementing a disclosure law where RE-DISS recommendations can be taken as guidelines.
- ➔ Establish, via diplomatic means, a bilateral agreement between the EC and Chile for mutual recognition of GOs, Such bilateral agreements being hard processes,

it is preferable that this issue might be taken up in any larger Chile-EU bilateral agreement taken up¹.

- ➔ Designate an official body to become member of the AIB, facilitating the future transfer and cancellation of GOs from Chile to Europe via the AIB hub
- ➔ Assign the duties of Certification Body to a public or private entity in Chile that can take on accreditation duties with regards to EATS generated in Chile

These actions are framed within steps 3 and 4 detailed in Figure 2, as Box 2 arguments that while understanding competitive products and prioritizing target markets is key (steps 1 and 2), the EU framework is currently the most robust with regards to product certification and is likely a “fast-track” to achieving compliance with future global regulations.

3.2. Compatibility with Chile's MRV System

The countries that are part of the Paris Agreement (PA) have proposed Nationally Determined Contributions (NDCs) that represent their efforts to mitigate Greenhouse Gas (GHG) emissions. Article 4.13 of this agreement indicates the need for countries to account for their emissions. Thus, the Monitoring, Reporting and Verification (MRV) systems take on greater relevance, as they play a fundamental role in the follow-up of the measures adopted to mitigate the effects of climate change, their reporting to the competent bodies and their subsequent verification.²

MRV systems allow:

- track national plans and policies, both in their effectiveness and in the state of progress of their implementation.
- Handle and manage the information to be submitted to the UNFCCC
- Transparent reporting of information on financial support received internationally.
- Avoid double counting of reductions
- Prioritize sectoral efforts
- Identify and remedy methodological gaps
- Identify need for both technical and financial support.³

Compared to the 2015 NDC, which committed to annual absolute emission levels of about 123 MtCO₂eq by 2030 (equivalent to the unconditional intensity target of 30% reduction by 2030 of the c/r 2007 indicator), Chile in its 2020 NDC committed a maximum annual emissions level of up to 95 MtCO₂eq by 2030.⁴ For tracking NDC implementation,

¹ <https://www.energy-community.org/news/Energy-Community-News/2021/03/17.html>? Energy Community is calling upon the European Commission to have a bilateral agreement of mutual GO recognition.

² GIZ, Ministerio de Energía (2019).

³ Ministerio de Medio Ambiente (2017).

⁴ UNFCCC (2020a).

“developing countries are likely to have an MRV system for reporting on national greenhouse emissions (greenhouse gas inventory) for their Biennial Update Report.”⁵

In this context, the PA requires MRV Systems for different aspects: for the national GHG; for the progress made in implementing and achieving the NDC; for Climate Change impacts and adaptation; as well as for financial, technology transfer and capacity building support needed and received.⁶ Also, Article 6 of PA requires that adaptations to a National GHG Inventory shall be made in case of trading any carbon certificates.

Emissions in Chile are accounted for through the Chilean National Greenhouse Gas Inventory System (SNICHILE), administered by the Climate Change Office of the Chilean Ministry of the Environment and designed in accordance with the IPCC Guidelines. This system informs the public about GHG emissions and removals in the country. The SNI Chile platform serves to archive and document information related to the preparation of the National GHG Inventory (INGEI) of Chile to make the process transparent and available to users.

Thus, when thinking about a green hydrogen certification scheme, two aspects need to be considered:

1. Adaptations to the Chilean National Greenhouse Gas Inventory System (SNICHILE) according to Art. 6 of PA, when trading certificates
2. An integration with the relevant national MRV for emission reductions.

It is important to emphasize that two parallel mechanisms of accountability of emissions currently exist:

1. The abovementioned national accountability of emissions through the INGEI, as the tool to report and evidence the fulfilment of the national GHG reduction commitment.
2. Accountability of emission reductions, for which in Chile currently exist different mechanisms with different scopes and approaches, and which currently are not integrated/centralized. These different mechanisms are: the NCRE-MRV system of the Energy Ministry of Chile; the program *Huella Chile* run by the MMA, and a new, centralized emission reduction system under the Capacity-building Initiative for Transparency – CBIT, which is still under development.

Hereafter, three examples of relevant emission reduction MRV systems in Chile will be mentioned:

- The NCRE – MRV System of Energy Ministry of Chile⁷, whose scope is the quantification of GHG emission reductions generated by NCRE projects implemented in the country, and the measurement of GHG mitigation impacts

⁵ Climate and Development Knowledge Network (CDKN) online.

⁶ UNFCCC (2020b).

⁷ GIZ, Ministerio de Energía (2019).

of NCRE projects in Chile. Its target is to reflect the contribution made by local stakeholders and public institutions that promote renewable energy projects for self-consumption.

Its methodology is a bottom-up approach governed by the international standard ISO 14,064 (verification and accounting of greenhouse gases). It estimates emission reductions independently for each renewable energy project identified, covering renewable energy projects for self-consumption and renewable energy initiatives connected to the transmission grid. It quantifies the GHG emissions avoided during the lifetime of the projects, a period that corresponds to a minimum of 20 years. The NCRE technologies considered are solar PV, solar thermal, wind, hydro, geothermal by heat pumps, biogas, and biomass, including cogeneration. This methodology was developed based on international standards (Project Accounting Protocol of World Resources Institute (WRI); 2006 Guidelines of IPCC). System adapted to the Chilean reality using plant factors calculated by the Sustainable Energy Division through its Renewable Energy Explorers (<http://exploradores.minenergia.cl/>).

A relevant MRV developed by MMA within its voluntary program Huella Chile⁸ is a project-based system for the private sector, which quantifies emission reductions at the project level and aims to motivate the national private sector to account its emission reductions. Its methodology also follows a bottom-up approach and is governed by ISO 14,064 part two, which is the standard that provides guidelines for accounting for emissions and reductions, and part two is specific to accounting for reductions from project implementation. In difference to the abovementioned NCRE-MRV system, which quantifies GHG emissions avoided during the lifetime of the projects, a period that corresponds to a minimum of 20 years, Huella Chile quantifies emission reductions with a time span of 5 years (assuming a technological maturity of 5 years, with the previous level becoming the new baseline). Huella Chile provides a calculator on the official registration platform of the Ministry of the Environment (RET-C) which facilitates the calculation of emissions for organizations and events. Another difference between the NCRE-MRV and Huella Chile is, that Huella Chile addresses the private sector, while the first one includes also projects realized by the public sector. Although their basic methodology is similar, both systems use their own quantification tools and –platforms, which are not integrated.

- Currently, a centralized emission reduction system under the Capacity-building Initiative for Transparency - CBIT⁹ is being developed in Chile, managed by MMA, aiming to create a new, national MRV system, as "methodologies used for MRV

⁸ Ministerio del Medio Ambiente online.

⁹ Capacity-building Initiative for Transparency (CBIT), created at the request of IPCC Parties to help strengthen the institutional and technical capacities of non-Annex I countries to meet the enhanced transparency requirements defined in Article 13 of the Paris Agreement.

systems should be compatible across all sectors so as not to duplicate efforts".¹⁰ Its scope is transversal, including measures both of public and private sector. Its target is to strengthen national institutions for transparency-related activities in line with national priorities; provide relevant tools, training, and assistance for meeting the provisions stipulated in Article 13 of the PA and assist in the improvement of transparency over time. Its approach is top-down, and it is aimed to be finished until the end of 2021.

The two main approaches of emission counting and emission reduction counting, cannot be linked, but the different systems within the emission reduction, specifically the NCRE MRV-System as well as Huella Chile Program, should be integrated, as the interviewee of the MMA highlighted. The development of CBIT is a promising approach to realize this integration. The existence of a national, centralized MRV system for emission reductions, could serve as a methodological basis for a MRV of a hydrogen certification scheme.

Focusing on the needs of a hydrogen certification scheme, it is important to ensure that the H₂ produced is truly renewable, which is why it is necessary to have certainty of the origin of the electricity used in the electrolysis, through a nationally determined GO System.

The Ministry of Energy in 2020 carried out a public-private technical roundtable to discuss this topic and identify the first steps to define a national GO framework for NCRE¹¹. The Mining Council recommends this approach when thinking of an appropriate design of a green hydrogen certification scheme, including the proposals for the governance of such a system defined in the round-tables: *"The National Electric Coordinator (Spanish Coordinador Eléctrico Nacional, CEN) is already implementing such a system for free customers, free of charge, and it is the same system that future H₂ producers should operate under. The Ministry of Energy, based on the work of the green certificates roundtable, has published a good set of guidelines, which serves as a basis for the scheme that the CEN is about to implement."*(Morel, T., Chilean Mining Council, interview translated from Spanish).

Additionally, the interviewee S. Garin (MMA) emphasized the need of a NCRE certification in first place, before a green hydrogen label, in terms of the domestic market. At this moment it would be vital and crucial to have traceability and certificates for NCRE. This way, a producer that uses renewable electricity to produce H₂, can evidence the "renewable" attribute of that energy by showing the RECs associated with the energy used.

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¹¹ Ministerio de Energía, DIVISIÓN DE AMBIENTAL Y CAMBIO CLIMÁTICO (2020).

The recently launched National Registry of Renewable Energies (Spanish *Registro Nacional de Energías Renovables* - RENOVA) of the Chilean CEN, which is expected to start operation during March 2021, aims to be the unique registry of renewable energy production and -consumption in Chile, based on blockchain technology. As CEN informed in January 2021, the system is the outcome of the public-private expert round tables carried out in 2020, its design is based on Australian and US experiences and it considers avoiding double counting of the selling and the use of renewable energy and an issuance of certifications under international standards. Thus, a linkage of a Green Hydrogen Certification Scheme to this new RENOVA system seems to be appropriate, which is why the authors recommendation in this context, is an early coordination with Chile's CEN when starting to define a Green Hydrogen Certification Scheme.

Recommendations to avoid double-counting

To avoid double-counting of emission reductions and ensure traceability, the following aspects are to be considered, according to the expert recommendations identified during the bilateral interviews:

Institutional aspects:

- MRV by independent technical entities, in compliance with protocols developed by technical and political institutions (energy/environment), including the private sector, academy and civil society.
- International cooperation is key, especially between exporting and importing countries.
- The government must define clear guidelines for certification companies in Chile, and create a public framework that does not regulate, but allows public traceability in every sense.
- The government should establish rules for certifying agents, for example: the rule of reporting/reporting every day to a spreadsheet.

Technical aspects:

- Existence of a national registry where all relevant information is centralized (unified databases).
- Existence of a clearly defined feedstock classification
- Information about the GHG emission intensity of production process
- The database/registry must be non-hackable.
- Establish a centralized register with centralized reporting logics to avoid double counting and to have control.

Operational aspects:

- Projects must have a unique identifier, publicly registered.

- When a certificate is delivered to a final consumer, it is removed from the market, in order to avoid double-counting.
- Data transparency, a process design which is as simple as possible.
- Date of expire
- Name of the issuing body
- If there are several certification systems in parallel, make them talk to each other, designing a follow-up procedure to check that a kg of H₂ has not been counted twice.
- There should be a proof of eligibility for each awarded certification: in case of inquiry by third-party institutions or consumers, this should be retained.
- Transparent reporting systems with clear operational - and robust MRV record-keeping protocols, independent verification systems with agreed verification protocols.

4. Attributes to monitor and measure

4.1. Review of minimum attributes to include within scheme scope based on existing schemes

Most important attributes

Interviews with international stakeholders as well as our benchmark have shown that the **renewable character of energy input** and **CO2 emissions** are the two most important attributes for Chile's hydrogen certification scheme:

- Most studies schemes for hydrogen (LCFS, TÜV SÜD, Japan, China) are designed around the CO2 emission of the molecule, which is produced, either by disclosing the information or by introducing it as a threshold prior to the certification.
- CO2 emissions and energy content (i.e., the renewable character of the energy input) are also key attributes for stakeholders like Porsche who will target hydrogen certification as a renewable fuel of non-biological origin (RED II compliant transport fuel).

Therefore, **we advise that the Chilean scheme must include such attributes to add value both on the national and international level.**

Other important attributes

To ensure **clarify, trustworthiness and reliability**, a certification scheme should also include **baseline attributes** which serve as the “identity card” of the MWh produced. The CertifHy scheme includes the following attributes:

- Identification of the production plant: name, location, commissioning date, installed capacity
- Date and time of the hydrogen production
- Technology
- Financial support to hydrogen production or input fuel production

Additional attributes to facilitate international export routes

On top of those European standards, Chile should consider adding further criteria to proactively avoid sustainability and credibility issues such as the ones which took place with biofuels: land use and water scarcity, among others.

Finally, as Chile is targeting the export market, it is crucial that the future certification scheme shows that the domestic climate targets are not jeopardized by the export market. In practical terms, production and export of hydrogen should not be done at the expense of restarting coal fired plants for Chile's domestic power consumption.

Resulting attributes list

Table 1. Recommended attributes for Chilean certification system. Source: Hinicio-LBST, 2021

Important attributes	Comments
Identification of the production device	
Name	
Country	
Commissioning date	
Installed production capacity	MW
Date and time of the hydrogen production	Start date / End date
Energy input and Technology	Energy Input proven by Guarantees of Origin
Type of energy input	Wind, Solar, Fossil, ...
Technology	PEM, ALK, ...
Share of renewable energy	%
Financial support	
Support on investment	Yes / No
Support on production	Yes / No
Unsupported	Yes / No
GHG emissions intensity	gCO ₂ eq / MJ _{H2}
Additional, nice to have attributes	
Additionality of the input energy	Yes / No
No conflict uses of water	Yes / No
No conflict uses of land	Yes / No

4.2. Additional attributes to consider

It has been stated that each certification scheme has specific compliance and sustainability criteria, often defined by the regulatory framework of the region or country of applicability (for instance, RED II defines four sustainability criteria: renewability, Additionality, time - and geographical correlation). However, during the workshops and interviews carried out within the project, an additional environmental issue with the

potential to become a Chile-specific sustainability criterion was often mentioned by stakeholders: water scarcity.

Most large-scale electrolysis projects and carrier synthesis for export are being developed in Northern Chile, close to the Atacama Desert, famously known as one of the driest places on earth. This represents a sizable challenge for electrolysis, as the lack of surface water bodies in the region implies that water must be sourced by non-straightforward methods, implying that:

- ➔ Sourcing water to this region could have a carbon footprint, which could be quantified in the product. This is further accentuated if water needs to be desalinized first
- ➔ Competing uses for water (for instance, irrigation or consumption) could also represent a hurdle with regards to social impacts from large water draws in the North.

Water was identified by several stakeholders as an issue that could potentially be considered when designing a Chilean certification scheme, either as an attribute to be tracked, or as an additional variable to weigh by project developers when designing production facilities. Off-takers like Porsche informed that the company highly considers land-usage as well as water-consumption in their project investment decisions, to avoid any conflicts and thus, would like to know the water source and amount spent as an information on a certification, to know whether a production creates water scarcity in human consumption or agriculture. ProChile was also supportive on adding criteria related to water usage and scarcity, as they believe it could further add value to Chilean products and minimize negative impacts from projects deployed to communities and local resources.

On the other hand, DENA indicated that while the water scarcity issue should be balanced out, it should not be included in a certification scheme, which in their opinion should focus only on the sustainability criteria mandated by the RED II, related to renewable energy usage. This opinion is shared by the Consejo Minero and the Ministry of Environment as well.

Besides the water scarcity issue, it has identified that most of the interviewees would support adding additional attributes to a Chilean certification scheme for reporting and verification, although specific issues like local community involvement, for example, are difficult to verify.

Looking outside-in, it is worth noting that EU (as a key importer) has a history of incorporating externalities and impacts of products sourced from overseas as to avoid shifting negative environmental and social impacts to other regions, as demonstrated by:

- ➔ A proposal to impose a carbon tax to imported products to the EU based on their carbon footprint in their country of origin, determined by the production

pathway, as to avoid carbon leakage and provide incentives to cleaner production.

- ➡ EATS schemes approved by the EC often rely on avoiding double counting – that is, whereby an EU member state count renewable energy twice (or even 5 times) when measuring progress against national climate action goals, or when the “benefit” from RE usage is claimed by a Member State in the EU and the country where the actual RE was produced and consumed.
- ➡ In the context of biofuel production, in addition to production pathways, EU regulation considers indirect land use change impacts of biofuels (ILUC) as an additional criterion to be added to EC-approved schemes. This criterion is meant to verify that no negative consequences are generated by the expansion of farmland or crops for biofuel production due to changes in land usage that may eliminate any carbon offsets.

Thus, it is recommended that Chile does explore the possibility to propose additional country-specific sustainability criteria for future products exported to the EU and other international markets, via a cost-benefit analysis. While verifying such additional criteria may represent additional costs along the chain of custody (that will likely be transferred to the producer), the willingness to pay by end-customers overseas should be quantified and factored in when determining if such a cost will provide sizable returns to the Chilean market and strengthen its position with regards to competing producers.

5. Stakeholder analysis for a preliminary governance structure

5.1. A note on a robust governance structure as a model: CertifHy

While holding interviews with national stakeholders, several aspects were pointed out with regards to developing a solid governance structure for a Chilean certification scheme. These preliminary ideas for what a future governance structure could look like from the Chilean point of view are compiled in BOX 3.

BOX 3 – Preliminary ideas on building the governance structure from national stakeholders

Most stakeholders agreed that it should be the responsibility of the Government to provide general steering of the design and implementation of the scheme, as well as the definition of rulesets for the operation of each agent within the chain of custody. Furthermore, the public sector should be tasked with guaranteeing transparency in the generation of the specific EATS chosen.

Interviews also revealed a preference to involve the private sector in the governance structure, going as far as proposing a public-private-partnership when setting up a certification scheme, as private actors can adapt faster to technological innovation than public bodies, and can easily help cope with the financial requirements of developing and operating the scheme. In this partnership structure, guidelines should be set by government, as well as having the key responsibility to emit authorization for operation to the accreditation and verification bodies.

Specifically, stakeholders recommended that verifiers and auditors could be private third parties, under the requirement that the state determines that they comply with the relevant guidelines. The reputation of verifiers and accreditors of the certificates is seen as a key aspect for the credibility of a system. These external entities could be also validated by a public-private Steering Committee.

These observations are well aligned to how governance structures of advanced certification schemes are developed in other geographies. CertifHy, which has been used as a template for the development of arguments through this document, will once again be leveraged here, as it provides an excellent basis for which a governance structure for Chile could be developed upon. Furthermore, if Chile does decide to adopt a scheme such as CertifHy (which has been argued could provide a good choice regarding securing exports to future markets beyond the EU), developing a governance structure that closely matches or can be intertwined with CertifHy could prove appropriate.

Box 4 provides a brief note on the main stakeholders involved in the CertifHy governance structure, which is thoroughly detailed in Deliverable 2.

BOX 4 – Main actors involved in CertifHy governance

The CertifHy GO Scheme consists of six types of entities, with specific functions, as follows:

National Competent Authorities oversee matters related to compliance with national environmental goals, designate competent certification bodies to oversee the deployment of H2 GOs and appoint Issuing bodies.

The Stakeholder platform includes all relevant stakeholders that oversee the development and application of the certification scheme and its fit within existing national and international regulation.

Certification Bodies verify the eligibility of production devices through a 'production device audit and verify the attributes of production batches. Certification bodies thus carry out all audits necessary to verify all relevant aspects including the GHG reduction of the produced hydrogen.

Issuing Bodies are tasked with issuing, transferring, and cancelling GOs based on the compliance with minimum criteria set forth by the scheme's documents.

The CertifHy Registry is a database that centralizes all information of the GOs issued and cancelled. It is a digital platform that will be expanded to support Supply Certificates soon.

Account Holders at the CertifHy registry have in their accounts production devices and/or CertifHy Guarantees of Origin. It is the responsibility of the Account Holder to cancel a GO only against physical hydrogen consumption that he can ascertain as belonging to the specified GO system scope. They hold an account within the registry, which enables them to ask for product certification (via the Certification Bodies), and for issuing, transfer, or cancellation of GOs to the Issuing Body.

If Chile were to design a new, country specific certification scheme, it would be recommended that all these roles would be filled by a combination of national public and private entities, as detailed in Table 2.

Table 2. Roles and types of entities to fill them on a hypothetical scheme specifically designed within Chile. Source: Hinicio-LBST, 2021.

Certification Scheme Requirements for Chilean Adoption – Governance	
Role within governance	Type of Entities best suited to fill the role
National Competent Authorities	➡ Chilean Government authority that oversees the countries achievements towards environmental goals
Stakeholder platform	➡ Pool of public and private entities that will be directly affected by the scheme's existence and implementation across the entire value chain

Certification Bodies	➔ Private companies with a track record in providing technical verification and auditing services for the energy sector
Issuing Bodies	➔ A single, nationally appointed public or private entity that can issue, transfer, and cancel tracking instruments via the Registry, and review audit reports by the Certification Bodies
Registry	➔ A digital platform, that can either be developed and operated by a private entity or developed by a private and operated publicly, which centralizes the operations concerning the certificates or other instruments
Account holders	➔ Private green product producers that will request the issuing, transfer, and cancellation of certificates (i.e users)

However, if the country were to adopt an existing certification scheme, the need to appoint national entities to fulfill every role within the governance structure would be reduced, as several of these roles are already filled by appointed stakeholders based on the scheme that is to be adopted. This is further demonstrated in Table 3.

Table 3. Roles and types of entities to fill them on a hypothetical scheme in which an existing internationally recognized scheme is adopted. Source: Hinicio-LBST, 2021.

Certification Scheme Requirements for Chilean Adoption - Governance	
Role within governance	Type of Entities best suited to fill the role
National Competent Authorities	➔ Chilean Government authority that oversees the country's achievements towards environmental goals
Stakeholder platform	➔ Not required , as the country would join the existing platform of the scheme adopted, possibly via its National Competent Authority
Certification Bodies	➔ Not required, as often each certification scheme designates and approves Certification Bodies. ➔ A Chilean company could potentially apply to become a recognized IB to audit operators based on the scheme's specific criteria.
Issuing Bodies	➔ A single, nationally appointed public or private entity that can issue, transfer, and cancel tracking instruments via the Registry, and

	review audit reports by the Certification Bodies ¹²
Registry	➔ Not required , as the instruments would be tracked and traded via the existing registry used by the adopted scheme
Account holders	➔ Private green product producers that will request the issuing, transfer, and cancellation of certificates (i.e users) ➔ Would need to create accounts in the existing Registry

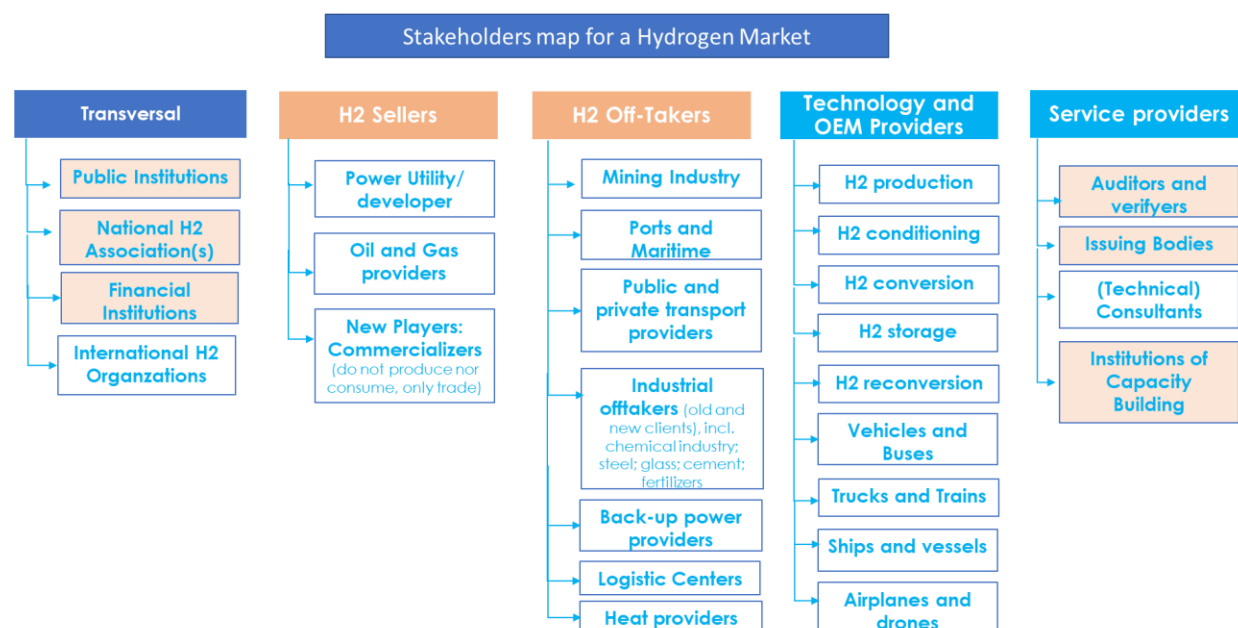
Considering that the consultant's recommendations imply pursuing an outside-in approach and adopt an existing scheme, it would be recommended to build a governance structure akin to that presented in Table 3, once the definitive scheme in question to adopt has been determined following the target market and product selection.

5.2. Identification of relevant stakeholders in Chile

The design and implementation of a certification scheme includes setting up a strong governance model, which requires having identified and -mapped all relevant stakeholders for this scheme ex-ante. A general stakeholder mapping can reach a very wide range; the focus in this context lays on the identification of stakeholders that are relevant for a hydrogen certification scheme by assuming the abovementioned roles within such a system; these actors are highlighted in the following image of stakeholder categories:

¹² If CertifHy is chosen as the scheme to be adopted, the Chilean IB could be well advised to join the AIB, in order to be able to trade GO's via the CertifHy registry and use the AIB Hub, once mutual recognition of GO's between the EU and Chile has been achieved

Figure 3 Categories of stakeholders within a hydrogen market. Source: Hinicio-LBST, 2021



The following tables show both national and international stakeholders that could have relevance in either setting up, operating, participation in the steering committee, or just using the certification scheme as sellers or off-takers and thus account holders.

The companies are categorized in “public institutions”, indicating those “national competent authorities” that could fulfil a relevant role as defined in table 3; “Associations and cooperation entities/Financial institutions” and “Private companies/potential account holders”, in accordance with the abovementioned relevant roles. The actors tagged with a “*” have participated in the workshops and thus, have already expressed their interest and gained basic knowledge about a hypothetical green hydrogen scheme.

Table 4 List of relevant **public institutions** with potential relevance in the governance of a hydrogen certification scheme in Chile

Public institution	National competent authorities best suited to fill the role	Specific potential roles within a H2 certification Scheme
CORFO*		Support in private sector engagement
Ministry of Energy of Chile*	x	Leading role in scheme design, in coordination with Ministry of Environment, aligned with NDC (national emission reduction targets) and CEN

		Authorization/accreditation of official verifiers and auditors of the scheme
ProChile*		Support in bilateral trade agreements and promotion of the certification scheme ("green label")
InvestChile* (part of Ministry of Foreign Affairs)		- Support in bilateral trade agreements - Attraction of international project finance - Promotion of the certification scheme ("green label")
Ministry of Environment, especially Department of Environmental Economy and experts of Program Huella Chile	x	- Support in designing the MRV, e.g. definition of guidelines for issuing bodies, verifiers and auditors, considering the national NDC accomplishment. Operation of a national integrated, centralized MRV registry of the scheme.
Agencia de Sostenibilidad Energética (Chilean Agency for Energy Sustainability)	x	- Selection of possible verifiers and auditors of the system; capacity building for these actors and their official authorization. Operation of a national integrated, centralized MRV registry of the scheme.
Coordinador Eléctrico Nacional CEN (National Electric Coordinator)	x	- Leading role in scheme design based on its expertise in setting up RENOVA (NCRE National GO scheme) - Inclusion/connection of both schemes to avoid double counting
National Energy Commission - CNE		Support in regulation aspects of the scheme design

*: actor participated in workshops.

*Table 5 List of relevant **associations and cooperation entities** with potential relevance in the design and operation of a hydrogen certification scheme in Chile*

Associations and cooperation entities/financial institutions		Specific potential roles within a H2 certification Scheme
International	World Bank*	- Technical advice and support - Initial co-finance

	GIZ*	• Technical advice and support • Initial co-finance
	IDB*	• Technical advice and support • Initial co-finance
	Green Climate Fund (GCF)	• Initial co-finance
	UN Environmental Programme (UNEP)	• Technical advice and support
National	ACERA*	• Support in company/user's engagement
	H2 Chile*	• Active participation in steering committee for scheme design • Support in company/user's engagement • Recommendation of potential verifiers and auditors as well as issuing body
	Generadoras*	• Active participation in steering committee for scheme design • Technical advice
	CEN*	• Active participation/lead in steering committee for scheme design
	Consejo Minero	• Participation in steering committee for scheme design • Support in company/users engagement

*: Participated in workshops.

The following table shows both national as well as international private companies which are potential account holders within a certification scheme, being producers/sellers or buyers. Some of these companies already demand hydrogen (although currently not produced based on renewable sources); others are potential future consumers. These hydrogen consumers are just a selection of stakeholders identified in Chile within the main application categories; as there are multiple possible applications for hydrogen, as well as multiple future demanding stakeholders, the list of potential consumers has a very wide, dynamic range.

*Table 6 List of relevant **private companies as potential account holders** within a hydrogen certification scheme in Chile*

Private Companies - potential account holders		
Utilities	Gas/fuel producers and suppliers	Energy Project Developers and Others:
Engie*	Abastible*	Austria Energy*
Statkraft*	Enagas*	TCI Gecomp*
AES Gener*	Gas Valpo*	Haura Energy*
Colbún*	Copec*	JTSA*
Enel Green Power	Air Liquid*	Prime Energía*

RWE*	Enex*	Enaex*
AME	Air Products	Mainstream RP*
Generadora Metropolitana	Linde	Atamostec*
Potencia Chile	Praxair	Consorcio Eólico*
Prime Energía	Shell	FRV
Interenergy	BP	Pronor
Acciona*	Petrobras	Andes Solar
Pacific Hydro	Enagás	Solek
H2 consumers (current and potential)		
Mining companies:		Refineries and chemical Industry
Codelco*	Collahuasi	ENAP
Anglo American*	Glencore	Ports and shipping industry
BHP	Teck	Maersk
Fortescue	Río Tinto	Ultramar
Barrick	KGHM	GNL Quintero
Antofagasta Minerals	Candelaria	Traders
Freeport-McMoRan	Escondida	Mitsui*

*: actor participated in workshops.

Issuing and Certification Bodies

When thinking of suitable issuing and certification bodies, these could be private third parties, specifically any entity that the state determines that complies with the relevant guidelines. A private actor under public surveillance is seen as a good model by the national interviewees, as the response time of private actors in processing information is much quicker than of public institutions. The issuing body should be defined and authorized by the lead national governing institution of the certification scheme; it needs to be officially accredited.

This issuing body could also be a public-private institution like the Chilean Energy Sustainability Agency (ASE), as it already has a register of verifiers in the field of energy efficiency that could be used as a basis for green H2 certification. In this case, specific training would have to be provided, maybe from an international entity which already has set up a hydrogen certification scheme. The national program Huella Chile also has a registry of climate change verifiers that could support this certification.

This issuing body would need to work close to the institution which administers the national, centralized certification registry, being always aligned to operational protocols defined by the respective national authority of the system. The state must ensure that the verifier has the basis to perform the service, otherwise everything would fall to the superintendence as auditors and would be an extra cost.

Verification is extremely important, therefore, an entity with recognition and experience is needed to have credibility.

6. Strategy for the implementation of the scheme

Interviews with international stakeholders as well as Hinicio's benchmark have shown that Europe is the most advanced market with regards to hydrogen certification. As such, it will be the standard to follow, which is backed by EU and non-EU companies, initiatives, and association. To name a few examples:

- With its NEOM project in Saudi Arabia, Air Products – a US company – is looking to export green ammonia worldwide and acknowledges that it should use European standard (renewable fuels of non-biological origin).
- CHBC in the US during its interview indicated CertifHy – a EU scheme – as a credible template for a global H2 certification standard.
- Hydrogen Council indicated that Europe is the most advanced region regarding guarantees of origin and that Japan is also considering CertifHy as a possible example for its own certification scheme.

Therefore, **we advise that the Chilean scheme should be designed and implemented by considering European standards** at first: Guarantees of Origin (CEN / EECs) and RFNBO.

On top of those European standards, Chile should consider adding further criteria to proactively avoid sustainability and credibility issues such as the ones which took place with biofuels: land use and water scarcity, among others.

Finally, as Chile is targeting the export market, it is crucial that the future certification scheme shows that the domestic climate targets are not jeopardized by the export market. In practical terms, production and export of hydrogen should not be done at the expense of restarting coal fired plants for Chile's domestic power consumption. A certification scheme serves as an instrument to control and facilitate the deployment of green H2 production facilities in spite of their potentially higher levelized costs of hydrogen production, as to avoid ramping up the production of grey hydrogen just due to cost drivers.

6.1. Strategy

Before building an operational roadmap for the implementation of the scheme, it is crucial for Chile to identify its target markets and then make political choices accordingly.

Therefore, we advise an outside-in approach by assessing:

- What are the requirements expressed by Chilean companies' customers and their expectation when it comes to sustainability criteria?
- What are Chilean companies' strengths / competitive advantages and are there synergies with customers' expectations?

These key answers will allow to identify:

- **Key target markets:** customers, products, criteria

- **export goals:** net income, volumes, investments, commercial roadmap

This will allow to steer Chile's political choices and outlining the future certification scheme for hydrogen.

Alternative strategies can be adopted but could limit Chile's ability to address actual market requirements or to foster the development of profitable projects in the future by taking a too restrictive approach (see Figure 1).

6.2. GO Scheme development roadmap

Guarantees of origin (or similar scheme) are a key entry point for any energy attribute tracking systems as they are the "identity card" of an electron or a molecule. GO provide information that will be used by i) end-consumers to choose their product and ii) by other certification schemes to get audited, certified information and avoid double valorization of a given molecule.

Whereas hydrogen GO schemes are still under development in Europe, many lessons were already learned through other energy carriers but also hydrogen as CertifHy has been working on building an EU Hydrogen GO scheme since 2014.

First step is creating momentum around the implementation of a hydrogen GO scheme in Chile. This can be achieved by setting up a stakeholder forum gathering all relevant actors in Chile and outside: industry, end consumers, policy makers, institutions, NGOs. Those stakeholders will assist the implementation of the GO scheme by providing relevant information with regards to their requirements and expectations.

An adapted governance must be put in place to ensure optimal stakeholder commitment and therefore improve the credibility and value of the resulting GO scheme.

Second step is taking actions on the development of the hydrogen GO scheme around three main axes:

- Data: the content of a GO.
- Procedures: for GO issuance, transfer, and cancellation.
- Governance: roles and responsibilities in the GO scheme.

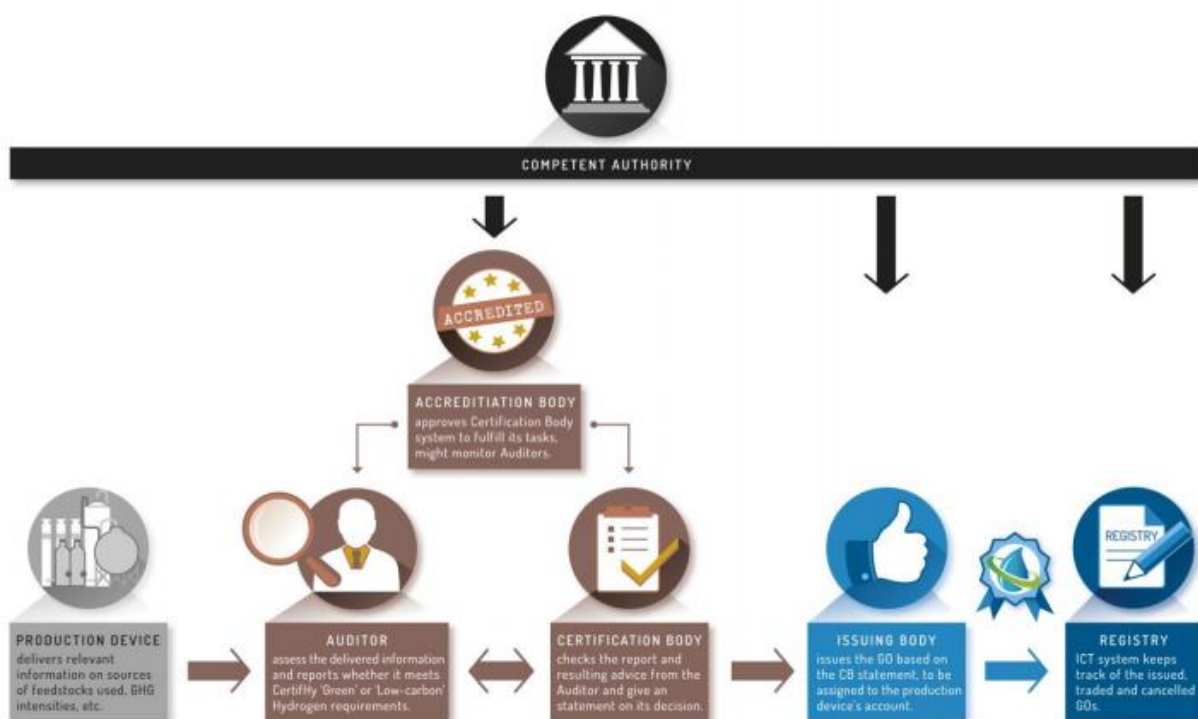


Figure 4 Example of GO scheme governance. Source: CertifHy, 2018

An adapted governance must be put in place to ensure optimal stakeholder commitment and therefore improve the credibility and value of the resulting GO scheme. Chilean specific requirements related to governance as well as a preliminary assessment of suitable stakeholders are developed in section 5.1 and 5.2.

As a third step in support of the development of a GO scheme for hydrogen in Chile, one or more pilots seem useful in which a limited number of producers and consumers participate. These pilots allow the various actors to gain experience and provide useful insights on the practical implications of the choices made in defining the premium labels and setting up the GO scheme. Pilots will essentially serve two purposes:

- The exploration of the value of premium hydrogen product labels. The uncertainty of the market value of GOs with a premium label is an important point on which practical experience will be useful. Therefore, the pilots are important to allow stakeholders to get a flavor of the potential market size and value of GOs, relevant for a business case.
- Gaining experience with the technical and administrative aspects of the GO scheme and the actual trade in GOs. The network that has by now been formed in the project provides a good basis for this and should be open for other entrants.

6.3. RFNBO Scheme development roadmap

The definition of RED II compliant renewable fuels of non-biological origin is not fully known yet, as GHG emissions benchmarks as well as definitions for additionality, geographical and temporal correlation are still pending by way of delegated acts from the European Commission.

Moreover, RFNBO certification will be addressed by EU Voluntary Schemes that do exist for biofuels, but not for RFNBOs yet.

Therefore, we advise to **monitor those above-mentioned delegated acts and voluntary schemes in Europe** before putting in place an implementation roadmap in Chile. It might be sufficient for Chile to ensure that accredited certification bodies are appointed within its geography to have the EU voluntary schemes being active in Chile (as was historically the case for biofuel certification with EU as a destination market).

7. Closing recommendations

This synthetic report has drafted a set of recommendations with regards to the adoption of a hydrogen certification scheme for Chile, based mainly on two previous activities carried out during the mission: (a) a review of existing certification schemes that are already established in other geographies and markets, and (b) insights gathered with both national and international stakeholders via interviews and workshops.

Below, we present a summary of the main insights and recommendations for Chile to move forwards with the adoption of a certification scheme.

INSIGHT 1 – SCHEME DESIGN MUST FOLLOW THE TARGET MARKET

The report has comprehensively explained that **there are no harmonized definitions on what a “green” or “sustainable” product, either hydrogen or a derivative is.** These definitions are often set by the importing market based on priority sustainability criteria. Therefore, **we recommend that efforts to define a certification scheme for Chile should begin by understanding the applicable definitions in the target markets and the regulation** to comply with those product specifications.

INSIGHT 2 – MARKETS ARE DEMANDING SPECIFIC PRODUCTS BASED ON THEIR FINAL USE, AND ANY SCHEME SHOULD ADJUST ACCORDINGLY

Based on existing regulation and interactions with stakeholders that are either planning to develop export facilities or become net importers, market forces have made it so that green molecules do not have a single criterion to adhere to (see insight 1), but rather, **they have become highly specific products with environmental attributes for compliance based on what the final use of those molecules will be.** This not only affects which kind of EATS should be developed for each specific product for export, but also, it is competitiveness (products with higher compliance criteria to clear will be more expensive to produce, but also, there will be a higher willingness to pay by the consumer, which should offset those investments).

INSIGHT 3 – DUE TO THIS HIGHLY SPECIFIC MARKET, AN OUTSIDE-IN APPROACH TO ADOPT A SCHEME IS OUR RECOMMENDED WAY TO GO

We developed five pathways that the country could pursue with regards to developing or adopting a certification scheme for hydrogen, all of which would yield the desired result: compatibility with international and national markets. Our recommendation, also supported by interactions with Chilean stakeholders, is that **Chile would be best advised to pursue an outside-in approach (where external market signals shape the certification scheme definition), based on starting out by the identification of the quantitative competitiveness advantage of Chilean products and prioritization of high priority markets for export.** Based on this preferred approach, four actions were identified as next steps for the Chilean government to continue working on the matter:

- ➔ Identify and quantify the competitive advantage of specific products (molecules) that can be produced in Chile and exported overseas
- ➔ Select priority market and product pairs where efforts will be placed on developing trade agreements and mutual tracking instrument recognition
- ➔ Understand the regulatory framework for priority products in the markets where exports will be pursued, and the complementary nature of this emerging routes with existing International Trade Agreements
- ➔ Select the appropriate EATS that will best support the product with regards to reaching the target markets

Participation of Chile in the IPHE H2PA Task Force to follow up on how this government to government body is elaborating a standard on hydrogen certification (taking CertifHy as a basis) is also recommended.

INSIGHT 4 – REGARDING ATTRIBUTES TO MONITOR AND MEASURE, THERE IS NO NEED TO REINVENT THE WHEEL, BUT THERE IS AN OPPORTUNITY TO DIFFERENTIATE

Interviews with international stakeholders as well as our benchmark showed that **two key criteria are must haves for an upcoming EATS for Chile: (a) the renewable character of energy input and (b) carbon footprint**. Therefore, we advise that the Chilean scheme must include such attributes to add value both on the national and international level. This falls well in line with all the existing certification schemes used in international markets. However, **this does not mean that Chile should restrict itself to only those two sustainability criteria**, as we believe that adding additional criteria to the Chilean label could make exported products more attractive to certain types of off-takers and markets, and therefore, increase the willingness to pay. Also, it is likely that in the future regulation in certain markets (like the EU) could become more demanding with regards to penalizing carbon leakage or shifting of negative externalities to external countries, which could position Chilean products better. **We recommend analyzing three additional criteria that could be added to the Chilean scheme, but the mechanisms in which such criteria will be measured, validated, and audited needs to be defined at a later stage**. These criteria are **additionality of the input energy, no conflict uses of water and no conflict uses of land**.

INSIGHT 5 – ADOPTING CERTIFHY SEEMS TO BE THE BEST PATH FORWARD FOR CHILE, BASED ON NATIONAL STAKEHOLDER GOALS AND FUTURE DEVELOPMENTS IN THE FIELD OF CERTIFICATION IN OTHER MARKETS

Based on an extensive review of the state-of-the-art of regulations in several key markets in Europe, Asia, and North America for importing green molecules, we have concluded that **it would be a good recommendation for Chile to study the existing and upcoming EU regulation with regards to EATS, as developing products and installations that are compliant with European regulation is likely to be the safest way to ensure future compatibility with most, if not all, international markets**. We advise that the Chilean scheme should be designed and implemented by considering European standards first:

Guarantees of Origin (CEN / EECs) and RFNBO. This impression has been validated with key international stakeholders that are at the forefront of the development of a harmonized certification scheme worldwide, such as the Hydrogen Council. Following on this logic, CertifHy has positioned itself as the world's most advanced GO scheme for hydrogen, and it is serving as a potential blueprint for this unified global scheme. Therefore, **Chile would be well advised to pursue the adoption of CertifHy, which would require the mutual recognition of GO's between the EC and the Government of Chile.**

INSIGHT 6 – IF THE RECOMMENDATION TO ADOPT A SCHEME RATHER THAN DEVELOP A NEW ONE IS PURSUED, AN EVENTUAL GOVERNANCE STRUCTURE WILL BE LESS DEMANDING ON THE GOVERNMENT OF CHILE

An analysis based on the governance structure of a robust existing certification scheme allowed us to identify that several roles and responsibilities need to be assigned or extended to both public and private entities, so that the scheme will be credible, self-regulating, and sustainable. In a scenario where an operational scheme with international recognition is adopted, Chile would only need to appoint: a national competent authority, an issuing body or bodies, accredit certification bodies, and work with account holders with regards to understanding the process of instrument issuing and cancellation within the existing registry.

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Contact

Hinicio Chile

Av. Eliodoro Yáñez N°2979, 6th floor.

Santiago, Chile

www.hinicio.com

<https://www.linkedin.com/company/hinicio>

<https://twitter.com/HinicioSA>