Unlocking Green and Just Hydrogen in Latin America and the Caribbean

IDB

Authors:

Christiaan Gischler
Eric Daza
Paola Galeano
Michelle Ramirez
Julian Gonzalez
Fernando Cubillos
Nuria Hartmann
Valentina Pradelli
Juan Sebastián Márquez
Juan Antonio Gutiérrez
Juan Gerardo Juarez Hermosillo
Carolina Alonso Rodriguez
Laura Souilla
Julieta Rabinovich

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1. Introduction

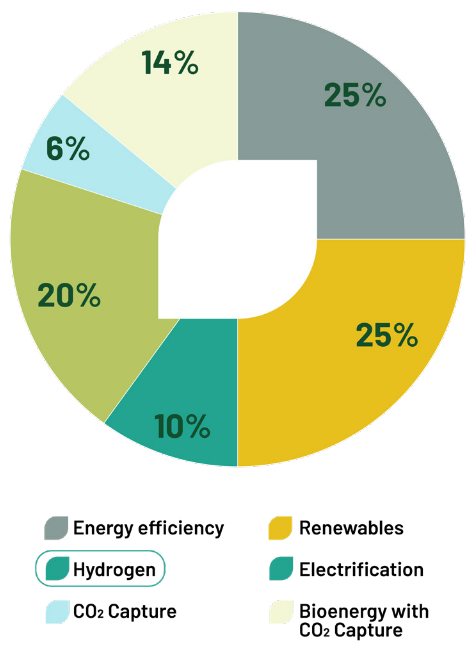
The world has experienced significant changes during the last few years, that have highlighted the increasingly evident negative impacts of climate change. These effects have disproportionately affected socially vulnerable populations, underscoring the urgent need to substantially reduce greenhouse gas (GHG) emissions. Additionally, the global energy crisis resulting from the conflict in Eastern Europe has accelerated the drive to reduce dependence on fossil fuels and enhance energy security. Consequently, there has been a heightened focus on aligning with the goals outlined in the Paris Agreement and prioritizing actions aimed at decarbonizing hard-to-abate sectors.

Countries must continue their efforts to develop nationally determined contributions (NDCs) and work towards limiting global warming to 1.5ºC. This can be achieved by swiftly adopting decarbonization solutions and policies to fulfill the commitments of achieving net-zero emissions. After an abrupt decline in GHG emissions from 2019 to 2020 due to the COVID-19 Pandemic, emissions rebounded to 2019 levels in 2021 (United Nations Environment Programme, 2022) and are without prompt and effective measures, they are expected to rise further. Large-scale and systemic transformation is necessary across all sectors, requiring a combination of actions.

To reach net-zero emissions by 2050, six decarbonization pathways have been identified, as depicted in **Figure 1.** These pathways can be categorized into four key measures:

(I) enhancing energy efficiency;
(II) electrifying processes through the use of renewable energy sources;
(III) implementing carbon capture, utilization, and storage (CCUS), including bioenergy capture; and
(IV) leveraging green and low-carbon hydrogen (GLCH).

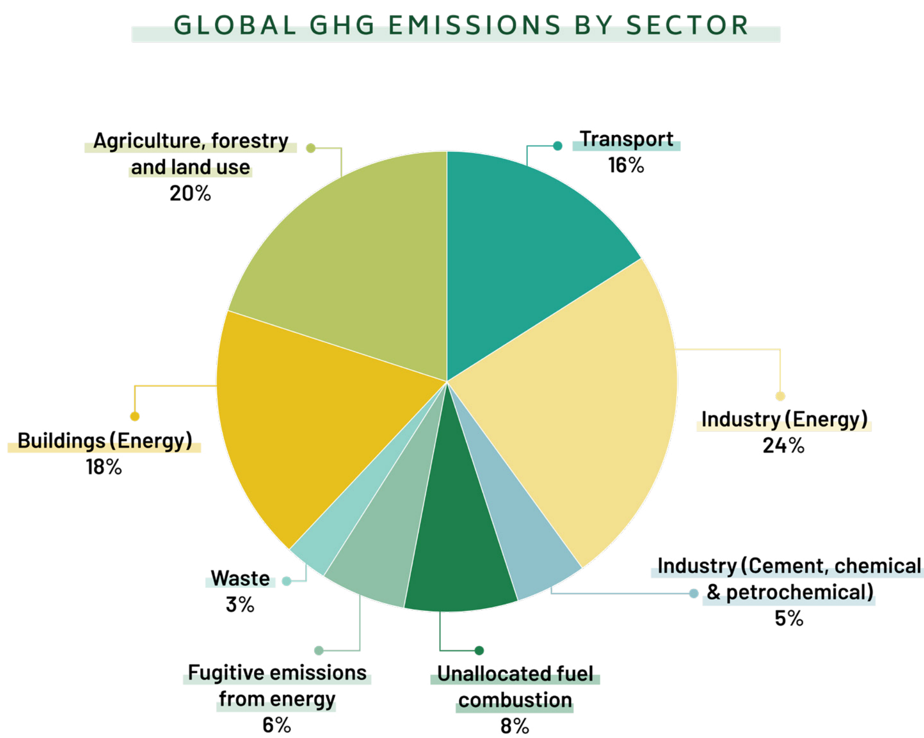
Figure 1. Six Technology Pathways to reduce GHG emissions



Source: Own elaboration based on information from IRENA (IRENA, 2022a).

Extensive implementation of the first two measures is currently underway, resulting in a significant reduction in the costs of solar and wind energy. On the other hand, the deployment of CCUS and GLCH is still in its early stages. In sectors that are relatively easier to electrify, interventions can be carried out utilizing renewable energy sources such as solar, wind, geothermal, biomass, and hydro power. However, addressing the hard-to-abate sectors like industry and transport will require more complex interventions, along with prioritizing the electrification of processes whenever feasible. It is worth noting that industry and transport together contribute to nearly 50% of the total GHG emissions, as depicted in **Figure 2**.[1] Therefore, the successful implementation of GLCH will play a critical role in reducing emissions within these two sectors.

Figure 2. World GHG by Sectors



Source: Prepared by authors based on the information from The World Resources Institute (Ritchie & Roser, 2020).

Besides their role in reducing emissions, these measures present an unprecedented opportunity to enhance energy access, generate new green jobs, foster the participation of marginalized communities, promote gender equality, bolster energy security, and shield consumers from the volatility of fossil fuel prices. When properly implemented, these measures can ensure a just energy transition, one that places people at the heart of the transition considering the technological transformation required to combat climate change. This approach takes into account the impact of climate change on the world's most vulnerable communities.

[1] Transport accounts for 16% of GHG emissions and industry for 29% (Ritchie, H. & Roser, M., 2020).

A human-centered transition towards renewable energy and GLCH entails addressing the needs of communities where these projects are developed. It recognizes the importance of ensuring access to energy and clean drinking water for these communities. Moreover, it aims to create job opportunities in the renewable energy sector and provide alternative sources of income for workers and local communities affected by the decommissioning of coal and power plants. Central to a just energy transition is the protection of indigenous territories, adherence to f prior and informed consent processes, and the active participation of affected communities and minorities in the implementation of policies and projects. It goes beyond the objective of solely reducing GHG emissions and integrates principles of justice and human rights.

This report primarily focuses on deploying green hydrogen (GH_2) in Latin America and the Caribbean (LAC) as a crucial component of their just energy transition. It underscores the significant role that LAC can play in the global supply of GH_2 while simultaneously decarbonizing its own transportation and industrial sectors.

LAC boasts immense potential for GH_2 production, both for export and domestic use. The region possesses exceptional wind, solar, geothermal, and hydric resources, ranking among the world's best. More than 60% of the energy generated in LAC is derived from renewable sources, and many countries in the region can develop an excess of clean energy beyond their own requirements (Paredes, 2017). Additionally, LAC's strategic geographical location provides it with access to markets in Europe, Asia, and North America.

To date, six countries in LAC have published hydrogen strategies or roadmaps, while six others are in the process of preparing theirs. Many countries in the region are also drafting specific public policies, incentives, and regulations related to GH_2. As a result, numerous projects are being planned and developed across LAC, with over 85 pilot and commercial-scale GH_2, green ammonia, and green methanol initiatives currently in progress. These projects will benefit from the existing oil and gas infrastructure in LAC.

However, LAC may require assistance in accessing public funds compared to other countries. Innovative structures and blended finance, as proposed in this report by the Inter-American Development Bank (IDB), will be necessary to mobilize private sector capital. Furthermore, additional studies are needed to fully exploit LAC's potential for adequate GH_2 production.

As a prominent source of development financing in LAC, the IDB plays an active role in promoting renewable energy generation and supporting the deployment of GLCH in the region. Over the past years, the IDB has worked closely with governments and private stakeholders in LAC to establish an industry for GH_2 production, local adoption, and export, along with its derivatives like green ammonia and methanol. The IDB also promotes regional cooperation to enhance competitiveness, identify synergies and opportunities, and strengthen negotiation positions with off-takers.

The IDB currently has GLCH initiatives in most LAC countries, offering technical and financial assistance, pilot projects, grants, loans, as well as conducting evaluations of regional market potential and providing guidelines for GH_2 certification and safety standards. Eleven out of twelve national hydrogen strategies are financed and technically supported by the IDB. Additionally, the IDB has provided consulting services for prefeasibility studies in seven countries, value chain analyses in four countries, and legal framework drafting in four countries. Throughout its assistance, the IDB places a priority on environmental sustainability and the participation of local and indigenous communities in developing GLCH policies and projects, ensuring a just energy transition.

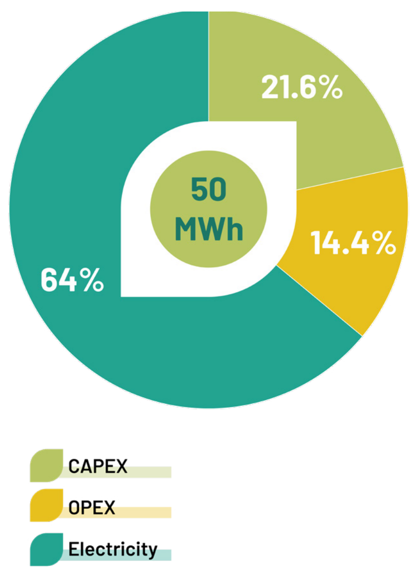
This report presents an overview of the status of GH_2 in the region, aiming to provide guidance to decision-makers and investors regarding its deployment. The first section focuses on GH_2 production and applications, while the second section provides insights into the state of GH_2 in LAC, including hydrogen strategies, regulations, production costs for GH_2 and green ammonia, available renewable energy, hydrogen projects, hubs, and off-takers. The third section elaborates on the IDB's work in promoting GLCH in LAC, detailing the technical and financial assistance provided at both the country and regional levels. It also highlights alternative finance structures and additional studies that should be considered for GH_2 deployment in LAC. The final section emphasizes key considerations for decision-makers to attract investment to the region through regional and national strategies, integrating green hydrogen into a just energy transition.

2. Green Hydrogen: Production and Uses

Hydrogen, as an energy carrier, has traditionally been produced primarily from fossil fuels, especially natural gas, resulting in what is known as grey hydrogen. However, hydrogen itself is the most abundant element on Earth and needs to be separated from other compounds, such as oxygen (O_2) in water (H_2O), using an electrolyzer powered by renewable energy sources or extracted from methane (CH4), the main component of natural gas. In the case of GH_2, the electrolysis process splits the H_2O molecule into hydrogen (H_2) and oxygen (O_2) molecules when exposed to an electric current from a renewable source.

Currently, the cost of producing GH_2 represents its main obstacle. Electricity and electrolyzers constitute the major cost components. In fact, electricity alone can account for up to 75% of the GH_2 production cost (IEA, 2021b), while the electrolyzer stack makes up 50-60% of the capital expenditure (CAPEX) (IEA, 2019a). Nevertheless, over the past decade, the cost of solar energy has decreased by 85%, while offshore and onshore wind costs have dropped by 48% and 56%, respectively (IRENA, 2022a), with further reductions anticipated. This decline will help mitigate the impact of electricity on the overall cost of GH_2, as depicted in **Figure 3.** However, additional efforts are still necessary to further decrease electricity costs for GH_2 production.

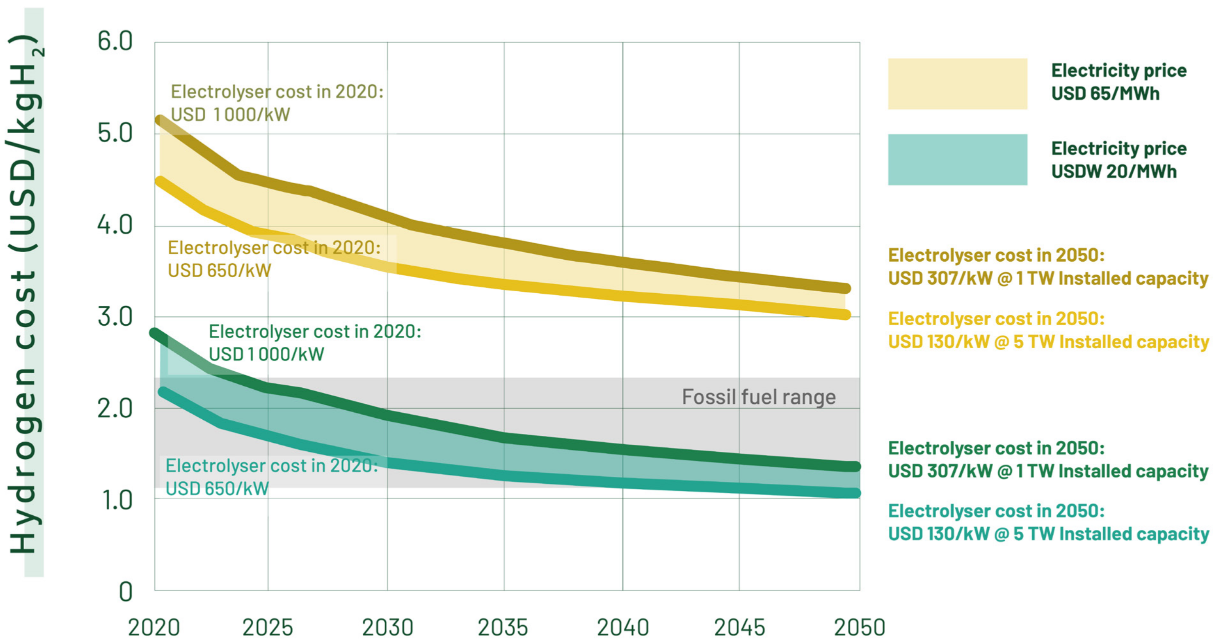
Figure 3. GH_2 Cost Structure by 2030



Source: Prepared by authors.

As shown in **Figure 4,** three-fold reductions in the cost of electrolyzers are also expected in terms of the current cost. As prices of renewables and electrolyzers continue to decline, the costs for GH_2 production will drop significantly by 2050.

Figure 4. Reduction of green hydrogen cost, electricity, and electrolyzers



Note: Efficiency at nominal capacity is 65%, with a LHV of 51.2 kilowatt hour/kilogramme of hydrogen (kWh/kg H2) in 2020 at 76% (a an LHV of 43.8 kWh/kg H2) in 2050, a discount rate of 8% and a stack lifetime of 80 000 hours. The electrolyser investment cost fo 2020 is USD 650-1000/kW. Electrolyser costs reach USD 130-307/kW as a result of 1-5 TW of capacity deployed by 2050.

Source: IRENA (2020a).[2]

The production of GH_2 is just the initial step overall. While existing transport and storage infrastructure can be utilized, the entire value chain will require innovation and adaptation to meet the projected volumes of GH_2 production and demand.

The hydrogen value chain can be divided into three stages, as depicted in **Figure 5**:

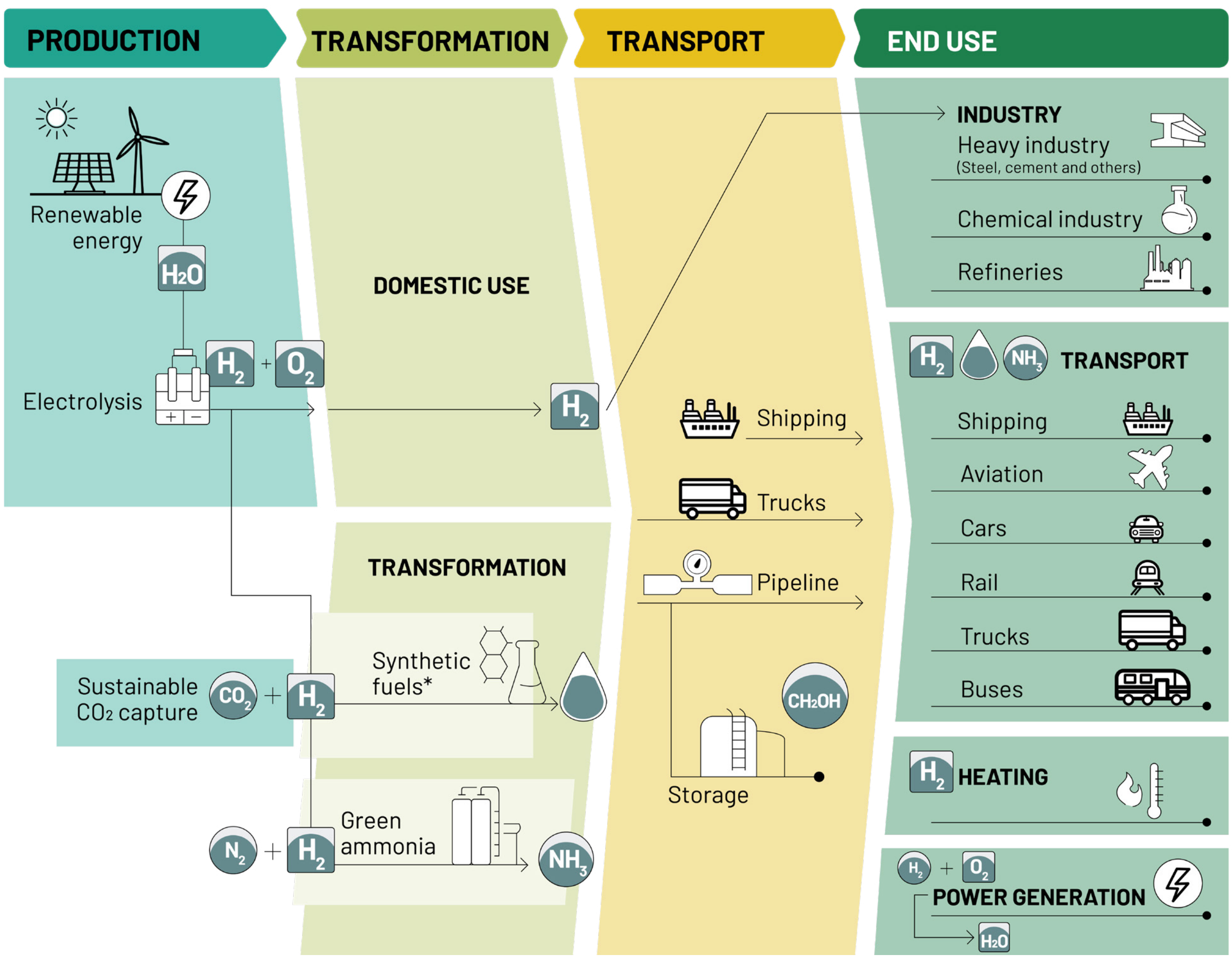
1. **Production and transformation:** GH_2 production involves the electrolysis process. Following this process, hydrogen is obtained in a gaseous form. However, it can be further processed by compression, liquefaction, or synthesis into other energy carriers such as ammonia, which facilitates its transportation. Alternatively, GH_2 can be converted into green ammonia to be used in the production of fertilizers or synthetic fuels, with sustainable CO_2 added to the GH_2.

2. **Transport and storage:** Gaseous hydrogen can be transported via dedicated pipelines or existing natural gas pipelines. It can also be compressed and transported in containers using trucks, trains, or ships. Derivatives of hydrogen, such as synthetic fuels, methanol, and ammonia, which are in liquid form at room temperature, can be transported using existing oil and fossil fuel pipelines and associated infrastructure. Hydrogen can be stored in various forms, including underground geological formations like salt caverns, high-pressure cylinders, or steel and composite tanks.

[2] The graph was calculated using an average (US$65/MWh) and a low (US$20/MWh) electricity price, constant over the 2020-2050 period

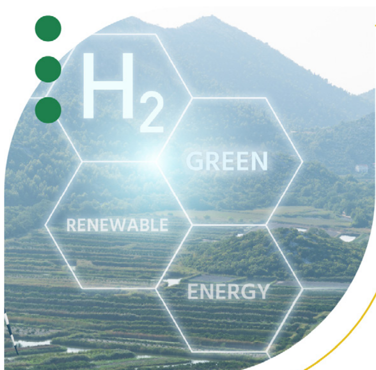
3 **End-use:** Hydrogen serves multiple purposes as a raw material, fuel, or energy storage medium. It can be directly employed in industrial applications, for power generation and heating, or as a fuel for various modes of transportation, including road, sea, air, and rail. Additionally, hydrogen can be blended with natural gas for certain applications or utilized in the production of green ammonia, green methanol, fertilizers, and synthetic fuels.

Figure 5. Hydrogen Value Chain



Source: Adapted from IRENA (2020), Green Hydrogen A Guide to Policy Making.

3. Status of Green Hydrogen in Latin America and the Caribbean



As previously mentioned, the LAC region recognizes its significant potential for GH_2 production, both for domestic use and export purposes. Consequently, numerous countries in the region are making progress on various fronts, including production, utilization, and export of GH_2.

Hydrogen Strategies, Public Policy and Regulations

GH_2 is a critical component of just energy transition plans in LAC. Recognizing that a one-size-fits-all approach is not applicable, individual countries must design their strategies based on factors such as available resources, existing infrastructure, industrial value chain, domestic hydrogen demand, export opportunities, and geographical location. Currently, 12 countries in the region have either adopted or are in the process of developing GH_2 strategies, as illustrated in **Figure 6**.

Chile, Colombia, Uruguay, Costa Rica, Trinidad and Tobago, and Panama have published their strategies in the past three years. Chile and Colombia are already working on updating their strategies despite their recent publication. Paraguay and Argentina have laid out initial hydrogen roadmaps, while Bolivia, Brazil, Ecuador, and Peru are in the process of developing their strategies.

These strategies share the common objective of gradually substituting grey hydrogen with GLCH, while also identifying new applications, particularly in the transport and industrial sectors. Some countries, such as Chile, Uruguay, and Colombia, have ambitious plans to produce and export GH_2 and its derivatives. Argentina has positioned itself as an aspiring hydrogen exporting nation. Other countries, like Panama and Paraguay, aim to become transportation and logistical hubs, capitalizing on their strategic geographic locations. Trinidad and Tobago, leveraging its existing petrochemical facilities, operational experience, industry expertise, and associated infrastructure, is planning to develop a GLCH economy.

Figure 6. Hydrogen National Strategies, Laws, and Regulations

Source: Prepared by authors based on hydrogen strategies, roadmaps, laws, regulations, and public information

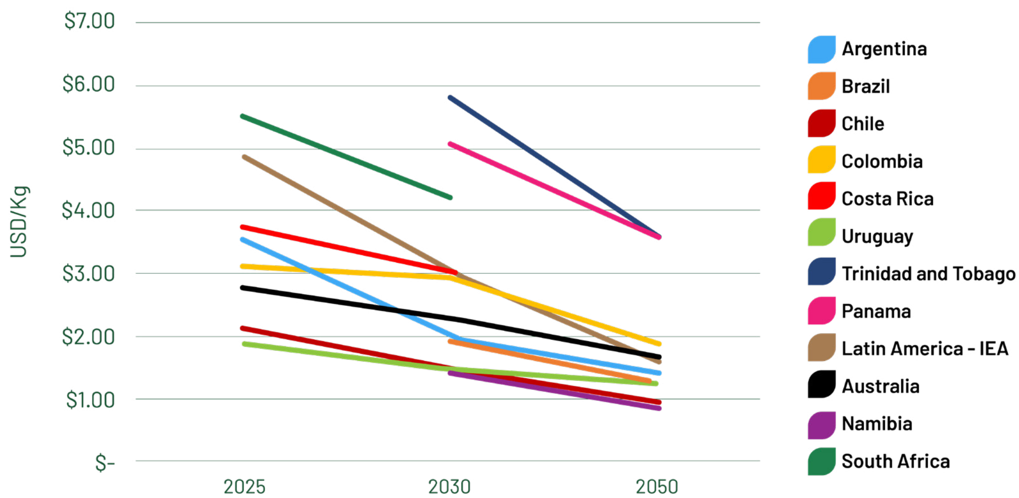
Countries in the LAC region are not only formulating hydrogen strategies but also actively working on developing laws, public policies, regulations, and funding programs to support the growth of GH_2 (**Figure 6**). Colombia stands out with its recently enacted law that provides tax incentives and establishes a general framework for GH_2 projects. Argentina, although having a national hydrogen law issued in 2006, is currently updating it to align with current developments. Other countries, including Panama, Brazil, Paraguay, El Salvador, Peru, Costa Rica, and Mexico, are in the process of preparing specific hydrogen laws.

Significant advancements are observed in public policies, regulations, and funding opportunities for GH_2 across the region. Chile has taken multiple initiatives, such as establishing a guide for authorizing hydrogen projects and offering various financing schemes through the Corporation for Production Promotion (CORFO). The Chilean government also plans to grant land use concessions in fiscal lands to hydrogen project investors for up to 40 years. Uruguay has established the Green Hydrogen Sectorial Fund to finance projects and has assigned hydrogen-related responsibilities to the Energy and Water Services Regulatory Unit. In Colombia, government funding is being directed through the Nonconventional Energy Fund (FENOGE), while regulations pertaining to hydrogen blending, transport, industry, and environmental matters are being developed. Costa Rica has made progress in formulating a policy that utilizes the additional capacity of its national electrical system for GH_2.

The Levelized Cost of Green Hydrogen and Ammonia Will Fall as Global Demand for GH_2 Rises

Most national hydrogen strategies have conducted calculations on the Levelized Cost of Hydrogen (LCOH) to assess competitiveness and opportunities. Overall, the production costs in the LAC region position it as a major contender in the global hydrogen export market, as depicted in **Figure 7**.

Figure 7. Average Levelized Cost of Green Hydrogen between 2025-2050



Source: Prepared by authors based on national hydrogen strategies, roadmaps, and reports.

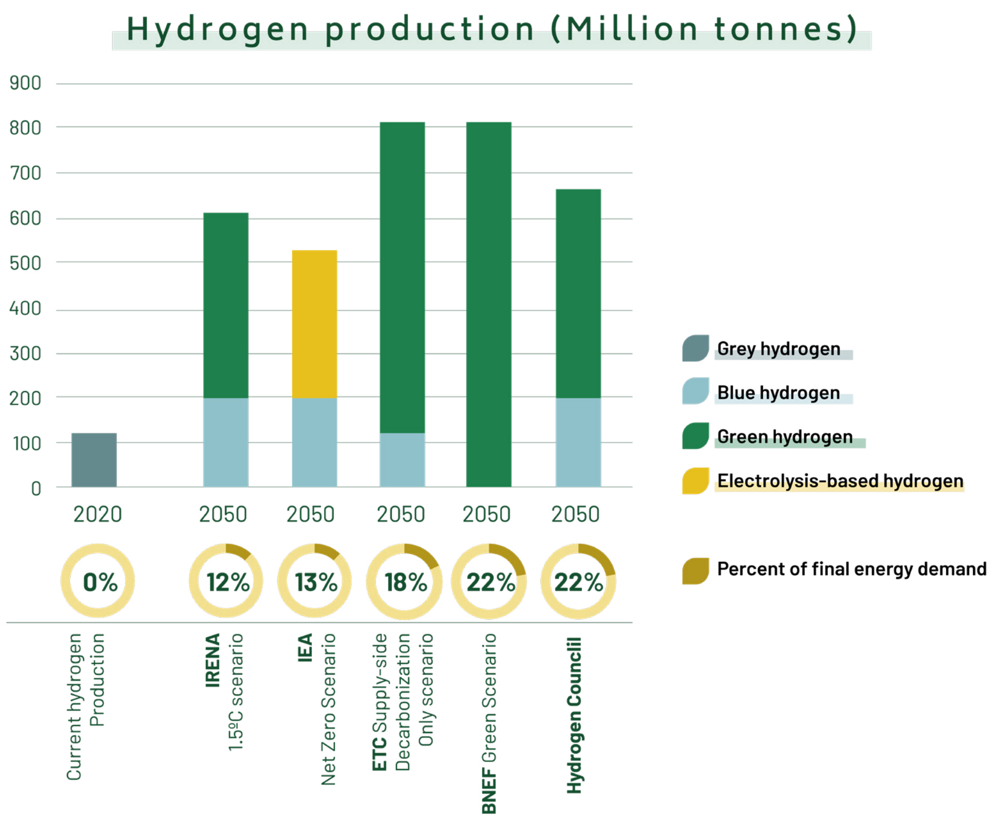
Indeed, the LCOH is not uniform across the LAC region or even within each country. The LCOH is influenced by factors such as the type and quality of renewable energy sources used for GH_2 production and the specific region where production takes place.[3] Considering the different LCOHs for each country, **Figure 7** provides an average estimation of the LCOH for selected LAC countries, potential export competitors, including all regions and renewable energy sources[4]. The data indicates that the LCOH is projected to decrease in most countries by 2030 and 2050. By 2050, the prices are expected to be below US$2/kg in many countries, aligning with other countries aspiring to become hydrogen exporters, such as Namibia and Australia.

While costs decrease, global demand for hydrogen is expected to rise, as shown in **Figure 8**. By 2050, GH_2 and GH_2 fuels, along with other low-carbon hydrogen variants, are projected to completely replace grey hydrogen and establish a robust market presence as hydrogen finds new applications.

[3] For example, in Colombia's Northern Caribbean Region, which has abundant wind and solar resources, the LCOH for hydrogen was estimated to be around US$2.80/kg in 2020. The country expects this cost to decrease to US$2.20/kg by 2030 and further drop to US$1.50/kg by 2050 (Ministry of Mines and Energy of Colombia et al., 2021). In Costa Rica, the LCOH will depend on the technology employed. By 2025, solar-based hydrogen production is estimated to be the most expensive, ranging between US$4.90/kg and US$5.80/kg. However, it is expected to drop to US$1.60/kg by 2050. By 2030, the LCOH produced with wind energy is calculated between US$2 - 2,50 /kg (Government of Costa Rica, 2022).

4 The LCOH for Argentina, Costa Rica, Colombia, Chile, Uruguay, Trinidad, and Tobago, and Panama was derived from their respective hydrogen strategies or roadmaps. The LCOH for Brazil was obtained from a McKinsey & Company report for 2025 and 2040. The data for Argentina was sourced from the document "Towards a National Strategy - Hydrogen 2030," although it was not specified if it referred to Argentina specifically.

Figure 8. Estimates for global hydrogen demand in 2050



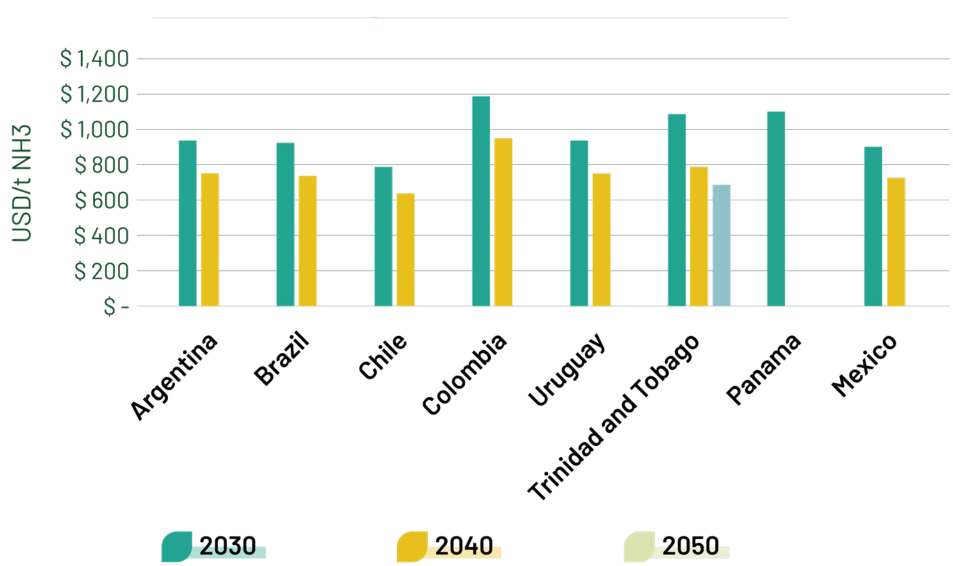
Source: IRENA (2022). Geopolitics of the Energy Transformation: The Hydrogen Factor.

It is expected that the demand for hydrogen in Latin America and the Caribbean (LAC) will increase, driven by both existing and new applications. In 2019, the total hydrogen demand in the region was 4.1 million tonnes (Mt), and this is projected to rise to nearly 7 Mt by 2030 (IEA, 2021b). The main concentration of demand is seen in countries such as Argentina, Brazil, Chile, Colombia, Mexico, Trinidad and Tobago, and Venezuela, primarily for the production of ammonia, methanol, and oil-refined products. These traditional uses will continue, while new applications will emerge in industries like cement, steel, and transportation, across most countries in the region, and not only as hydrogen but through its derivates, like green ammonia and green methanol.

When considering the production costs of GH_2 derivatives, it's important to note that any reduction in GH_2 production will directly impact the cost of its derivatives. This is because it accounts for a significant portion of the production costs of these derivatives, approximately 60% for green ammonia and 75% for green methanol.

While cost analyses for hydrogen derivatives may not have been included in many strategies, a recent study financed by the IDB indicates that by 2030, the average Levelized Cost of Ammonia (LCOA) could be around US$990/t, as shown in **Figure 9.** By 2040, the LCOA is projected to drop below US$800/t in most countries in the region. This study also highlights that countries with existing infrastructure for ammonia and methanol production, such as Trinidad and Tobago, have the potential to be competitive in the long run. However, to support the production of hydrogen derivatives, it is crucial to develop additional renewable energy capacity in the region.

Figure 9. Average Levelized Cost of Green Ammonia between 2030-2050



Source: Prepared by authors based on hydrogen strategies, roadmaps, and studies.

Available and additional renewable energy

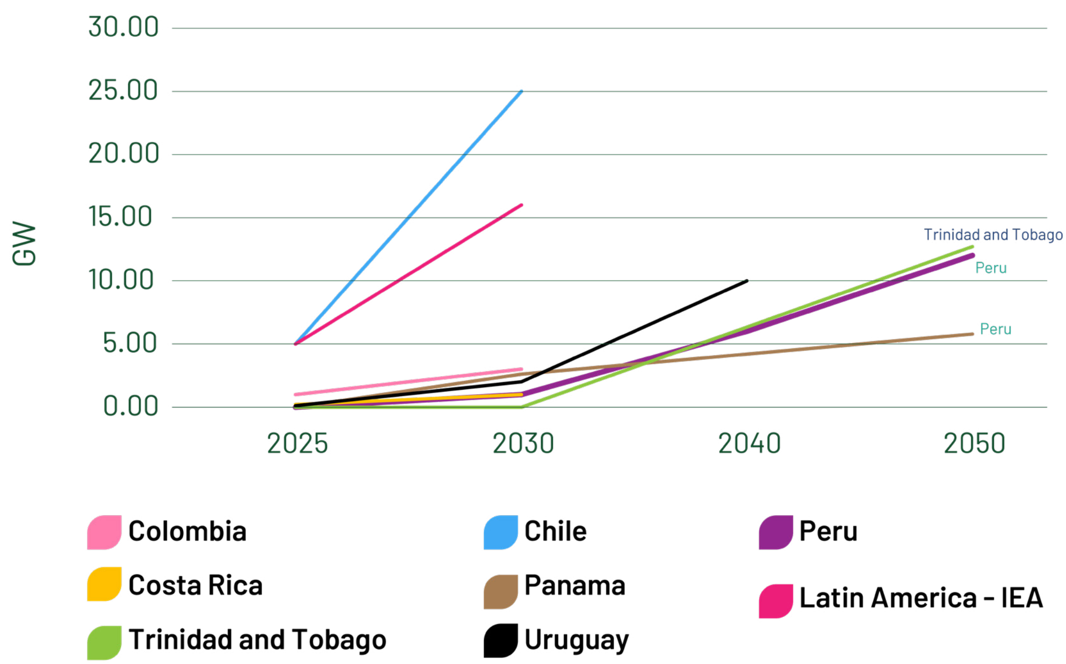
To achieve the target costs for GH_2 and green ammonia production in LAC, countries in the region will need to increase their renewable energy capacity. This is because the cost of electricity accounts for up to 75% of GH_2 production costs (IEA, 2021b). Fortunately, many countries in LAC already have a significant portion of their energy matrix coming from renewable sources but others must progress in decarbonizing their energy matrix. Costa Rica, Paraguay, and Uruguay already generate almost 100% of their energy from renewables, while Brazil, Ecuador, Peru, Panama, El Salvador, and Colombia generate over 60% of their energy from renewables, with a substantial contribution from hydroelectric power (Paredes, J., 2017).

Although the exact amount of additional renewable capacity required for GH_2 production is still being calculated by most countries[5], recent studies have provided estimates for the region in the next decades. Even if the significant part is destined for direct electricity consumption, there will be additional capacity for GH_2 production. In a business-as-usual scenario, LAC is projected to add 85 GW of renewable energy capacity by 2030 and 373 GW by 2050 (OLADE, 2022). However, if there is a faster deployment of renewable energy and battery storage, these numbers could increase to 183 GW by 2030 and 918 GW by 2050 (OLADE, 2022).

[5] However, some countries, like Uruguay, have calculated that the required installed capacity (20 GW) will reach its 10 GW goal of electrolyzer capacity by 2040 (Ferragut P. et al., 2022).

The commitment of LAC countries to installing additional renewable capacity for GH_2 production is evident in their installed electrolyzer objectives. While the International Energy Agency (IEA) estimated 16 GW of installed electrolyzer capacity for Latin America by 2030(IEA, 2022b), the combined objectives of the analyzed countries already amount to at least 34 GW. Chile has set the most ambitious goal, aiming for 25 GW of installed electrolyzer capacity by 2030. Considering that many countries, even without establishing electrolyzer objectives, have projects in the pipeline and that the global electrolyzer capacity by 2030 is projected to be between 134-240 GW, with over 10% of that attributed to Latin America (IEA, 2022a), it is likely that the installed electrolyzer capacity in the region will exceed 20 GW by 2030, as shown in **Figure 10**.

Figure 10. Projected Electrolyzer Capacity in LAC between 2025-2050



Source: Prepared by authors based on hydrogen roadmap, strategies, and reports.

Hydrogen Projects, Hubs and Off-takers

Although long terms objectives, such as the electrolyzer capacity described above, will attract investment, it is crucial to consider factors beyond renewable energy capacity. Port infrastructure, additional production, transformation, storage infrastructure, and logistics for trade and commerce, play a vital role in the development and operation of GH_2 projects. Currently, there are over 60 pilot and commercial-scale GH_2 projects in various stages of development or production in LAC. Additionally, there are plans for at least 20 ammonia projects and 15 methanol projects, highlighting the potential for GH_2 derivatives.

To enhance competitiveness and efficiency, regional strategies should be adopted to establish GH_2 hubs and clusters. These hubs would serve as connections between hydrogen consumers, producers, and exporters, leveraging shared infrastructure and renewable energy sources to reduce costs. IDB has been evaluating the region's market potential and has identified 11 potential hubs for GH_2 and various clusters for demand and export, production and export, and demand-supply dynamics (**Figure 11**). This analysis, based on examination of 33 countries, considers factors such as current renewable energy potential, logistics competitiveness, renewable energy regulations, existing GH_2 and derivative projects, port infrastructure, and opportunities for specialization in key sectors. Figure 11 also presents the projected LCOH, LCOA, and Levelized Cost of Methanol (LCHM) for the different hubs in 2030 and 2040.[6]

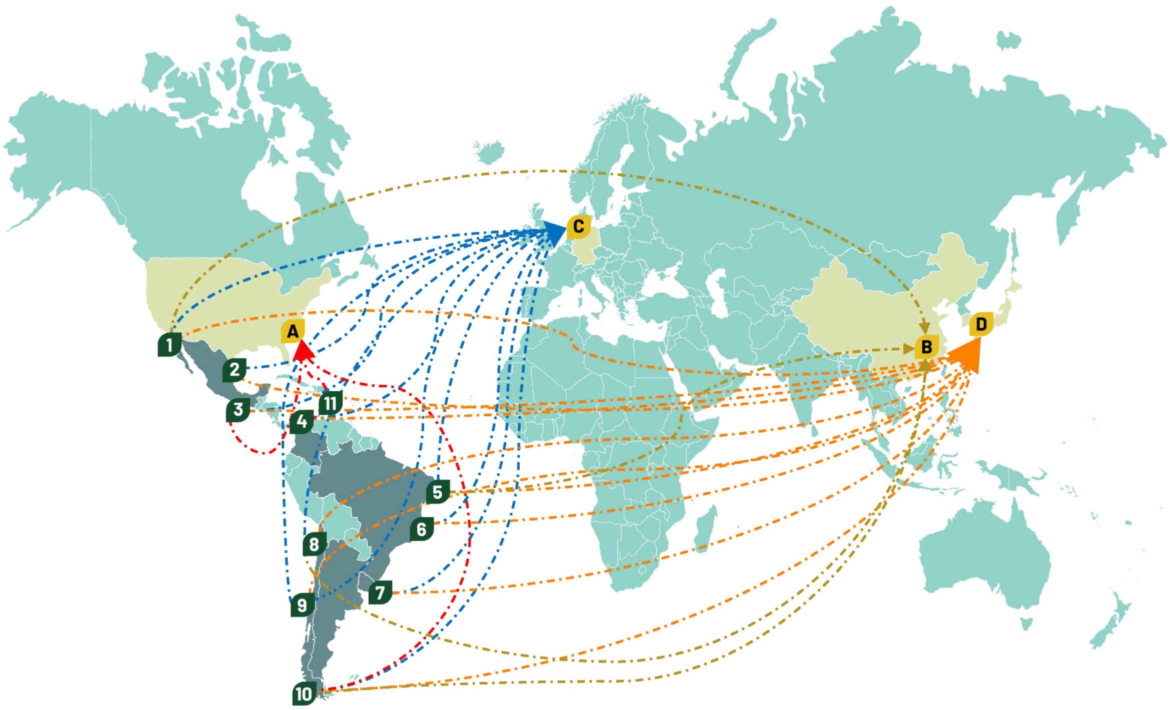
The analysis primarily focuses on countries in a more advanced phase of becoming GH_2 exporters, including Mexico, Colombia, Trinidad and Tobago, and the Southern Cone countries. Countries like Peru, Ecuador, Costa Rica, and Bolivia are in earlier stages of GH_2 development and are expected to contribute to the next wave of GH_2 projects in the region.

Figure 11. GH_2 Projects, Hubs, and Clusters in LAC

Source: Prepared by authors based on Oxford (2022), Afif et al. (2022), Jain et al. (2022), IRENA (2021), IRENA (2020b), Christensen (2020), Caparrós Mancera et al. (2020), IEA (2019b), Rivarolo et al. (2019), Noh et al. (2019), COSIA (2018) and CSIRO (2016)

Figure 12 identifies potential export partners for the LAC region in the GH_2 industry. The countries mentioned include Germany, the Netherlands, Japan, South Korea, and China. It is worth noting that the United States, despite its inclusion in the list, is expected to primarily supply its own GH_2 needs. This is due to the incentives established for clean hydrogen in the Inflation Reduction Act (IRA) and the country's aim to position itself as a global exporter of GH_2 and derivatives.

Figure 12. Production, Transport, and Main Destination of GH_2 and Derivates from LAC



- **A** USA
- **B** China
- **C** Germany & The Netherlands
- **D** South Korea & Japan

#	HUB	NAME
1	MSS	Mexico-Sonora-Sinaloa
2	MTNL	Mexico-Tampico-Nuevo Leon
3	ICS	Istmo de Mexico-Coatzacoalcos-Salina Cruz
4	CBP	Cartagena-Barranquilla-Panama
5	CAS	Brazil-Ceara-Alagoas-Sergipe
6	SPRJ	Brazil-Sao Paulo-Rio de Janeiro
7	CPBAM	Central Paraguay-Buenos Aires-Montevideo
8	CA	Chile-Antofagasta
9	CVB	Chile-Valparaiso-Biobio
10	CM	Chile-Magallanes
11	T&T	Trinidad and Tobago

Source: Prepared by authors.

Despite being relatively further from importing markets, such as Europe, the countries in the region offer highly competitive destination costs when compared to major competitors like Saudi Arabia, the United Arab Emirates, and Morocco. **Table 1** presents the potential destination prices for the European market from selected hubs in 2030 and 2040, along with a comparison to prices from competing countries.

Table 1. Analysis of the Destination Cost of Green H2 and its Derivatives from LAC's Competitors to Europe.

2030

	Conversion (USD/KgH_2)			Final use (no cracking) (USD/ton)	
	LH_2	NH_2	MeOH	NH_3	MeOH
Mexico-Sonora-Sinaloa	$ 6.09	$ 10.63	$ 10.52	$ 887.06	$ 1,113.66
Mexico-Tampico-Nuevo-Leon	$ 5.95	$ 10.68	$ 10.48	$ 896.45	$ 1,109.11
Mexico-Coatzacoalcos-Salina Cruz	$ 5.93	$ 10.67	$ 10.45	$ 893.56	$ 1,105.27
Colombia-Cartagena-Barranquilla-Panama	$ 7.25	$ 12.08	$ 12.18	$ 1,141.63	$ 1,321.12
Brazil-Ceara-Algoas-Sergipe	$ 5.75	$ 10.59	$ 10.30	$ 879.96	$ 1,085.97
Brazil-Sao Paolo-Rio de Janeiro	$ 6.11	$ 10.84	$ 10.68	$ 924.84	$ 1,133.76
Central Paraguay-Buenos Aires-Montevideo	$ 6.20	$ 10.85	$ 10.71	$ 925.57	$ 1,137.24
Chile-Antofagasta	$ 5.45	$ 10.00	$ 9.71	$ 775.53	$ 1,012.16
Chile-Valparaiso-Biobio	$ 5.98	$ 10.52	$ 10.37	$ 867.29	$ 1,095.03
Chile-Magallanes	$ 5.42	$ 9.95	$ 9.75	$ 768.12	$ 1,017.74
Saudi Arabia	$ 5.47	$ 6.89	$ 10.58	$ 876.28	$ 1,121.84
Arab Emirates	$ 5.79	$ 7.06	$ 10.88	$ 906.30	$ 1,159.51
Moroco	$ 5.18	$ 6.74	$ 10.31	$ 850.72	$ 1,089.17

2040

	Conversion (USD/KgH_2)			Final use (no cracking) (USD/ton)	
	LH_2	NH_2	MeOH	NH_3	MeOH
Mexico-Sonora-Sinaloa	$ 4.98	$ 5.95	$ 8.92	$ 710.56	$ 913.86
Mexico-Tampico-Nuevo-Leon	$ 4.81	$ 5.98	$ 8.87	$ 715.35	$ 908.37
Mexico-Coatzacoalcos-Salina Cruz	$ 4.78	$ 5.95	$ 8.84	$ 711.66	$ 904.88
Colombia-Cartagena-Barranquilla-Panama	$ 5.73	$ 7.00	$ 10.22	$ 896.53	$ 1,077.15
Brazil-Ceara-Algoas-Sergipe	$ 4.62	$ 5.89	$ 8.70	$ 700.86	$ 886.83
Brazil-Sao Paolo-Rio de Janeiro	$ 4.93	$ 6.10	$ 9.02	$ 736.54	$ 927.37
Central Paraguay-Buenos Aires-Montevideo	$ 4.97	$ 6.05	$ 9.00	$ 729.27	$ 923.60
Chile-Antofagasta	$ 4.46	$ 5.42	$ 8.20	$ 617.43	$ 823.78
Chile-Valparaiso-Biobio	$ 4.87	$ 5.84	$ 8.78	$ 691.49	$ 896.53
Chile-Magallanes	$ 4.60	$ 5.57	$ 8.34	$ 644.92	$ 841.83
Saudi Arabia	$ 4.60	$ 5.88	$ 8.67	$ 697.88	$ 882.74
Arab Emirates	$ 4.91	$ 6.03	$ 8.95	$ 725.10	$ 917.61
Moroco	$ 4.32	$ 5.74	$ 8.41	$ 673.32	$ 851.27

Source: Prepared by authors based on Oxford (2022), Afif et al. (2022), Jain et al. (2022), IRENA (2021), IRENA (2020b), Christensen (2020), Caparrós Mancera et al. (2020), IEA (2019b), Rivarolo et al. (2019), Noh et al. (2019), COSIA (2018) and CSIRO (2016).

4. The Inter-American Development Bank's Technical and Financial Assistance for a Green Hydrogen Economy in Latin America and the Caribbean

The IDB has been actively supporting governments and private actors in the LAC region to develop and establish an industry for the production, local adoption, and export of GH_2 and its primary derivatives, including ammonia and methanol. The bank's efforts encompass both technical assistance and financial support, showcasing its commitment to the region.

The IDB's Green Hydrogen Technical Assistance

The IDB is engaged in promoting GLCH initiatives across the majority of countries in the LAC region. In terms of technical assistance, the bank is involved in various initiatives, including pilot projects, the development of national GLCH strategies, conducting prefeasibility studies, and evaluating the regional market potential. Additionally, the IDB has taken the lead in establishing guidelines for GH_2 certification and safety standards. Among the twelve LAC countries with national hydrogen strategies, the IDB is providing financial and technical support to eleven of them. Furthermore, the bank has offered its consulting services for prefeasibility studies in seven countries, conducted value chain analyses in four countries, and contributed to the drafting of legal frameworks in four countries.

Figure 13. The IDB action for developing green hydrogen capabilities in Latin America and the Caribbean

Potential hydrogen exporters analysed in this study.

Potential hydrogen exporters in earlier stages of GH_2 development.

#	HUB	NAME
1	MSS	Mexico-Sonora-Sinaloa
2	MTNL	Mexico-Tampico-Nuevo Leon
3	ICS	Istmo de Mexico-Coatzacoalcos-Salina Cruz
4	CBP	Cartagena-Barranquilla-Panama
5	CAS	Brazil-Ceara-Alagoas-Sergipe
6	SPRJ	Brazil-Sao Paulo-Rio de Janeiro
7	CPBAM	Central Paraguay-Buenos Aires-Montevideo
8	CA	Chile-Antofagasta
9	CVB	Chile-Valparaiso-Biobio
10	CM	Chile-Magallanes
11	T&T	Trinidad and Tobago

Feasibility **studies for the potential of producing and exporting** GH2 and its derivatives.

Support for the development of **market studies** (2019 and 2021), the **National Green Hydrogen Strategy** (2022) and a pilot project.

Support for the development of **National Strategy for Green Hydrogen and Derivatives of Panama** (2022) and prefeasibility studies.

Support for the development of the **Hydrogen Roadmap of Colombia** (2021), regulatory sandbox (2022) and continuity studies (2022 and 2023).

Support for de creation of a **National Green Hydrogen Strategy of Ecuador** (2022 - 2023).

Development of the **Peruvian National Green Hydrogen Strategy** (2023, under development).

Development of the **National Green Hydrogen Strategy of Bolivia** (2023, under development).

Feasibility studies to **evaluate GH2 exporting potential** and a **$400 million loan** to Chile to expedite a fair, **clean and sustainable energy transition** in the country and multiple collaborations with **private and public** sectors for **hydrogen projects** execution.

Support for the development of T**he roadmap for a green hydrogen economy in Trinidad and Tobago** (2022) and other **techno-economic studies** (2023).

Support to achieving the objectives **Brazilian National Hydrogen Program** and feasibility studies to **evaluate GH2 exporting potential.**

Development of the **national strategy for the economy of green H2 in Paraguay** (2023, under development), creation of the **Preliminary law** about the legal regime for the hydrogen value chain, and prefeasibility studies.

Support for the creation of **the Green Hydrogen Roadmap in Uruguay** (2022), a pilot project and setting favorable conditions for successful green hydrogen investments.

Support for the **construction of an inter-ministerial working team for hydrogen issues,** in conjunction with the Latin America Program (International Energy Agency).

Source: Prepared by authors.

In addition to the market potential evaluation mentioned in the previous section, the IDB is involved in a regional study that encompasses GH_2 certification and safety guidelines, as well as the establishment of a knowledge-sharing network among several countries in LAC. The countries involved in this initiative are Mexico, Panama, Trinidad and Tobago, El Salvador, Honduras, Colombia, Ecuador, Paraguay, Uruguay, and Bolivia.

> **The primary objective of the project "Guidelines on Harmonized Green Hydrogen Certification" is to develop a proposal for a renewable and low-carbon hydrogen certification system that takes into account the requirements of global certification systems while considering the specific characteristics of the LAC region. The ultimate aim is to achieve regional harmonization in the certification approach. As a subsequent step, the project seeks to deliver a practical guide for the implementation of the proposed certification system.**

Product certification plays a vital role in the commercialization and off-take of hydrogen and its derivatives. It provides consumers with specific information about the product, including details about its place and time of production, the technology utilized, its carbon footprint, and other attributes defined within the certification scheme, such as sustainable water use and compliance with labor and environmental standards. By transparently conveying this information, certification ensures consumer confidence, willingness to pay, and product differentiation.

The proposal for a regional hydrogen certification system was developed through a comprehensive review of the state-of-the-art in hydrogen certification systems worldwide, encompassing 17 existing or under-development systems featured in **Figure 14**. The proposal also incorporates feedback from stakeholders in countries within the region that have made notable progress in developing their hydrogen ecosystems. Importantly, it takes into account the social, environmental, economic, and regulatory context specific to the region.

Figure 14. Certification systems in operation or under development worldwide

Certification System	Status	Administrative Body	Country-Region of Origin	Geographical Scope	Objective of the certification scheme
Blockchain-based clean Energy Certificate	Finalized	Siemens Energy, TÜV SÜD, and German Energy Agency (DENA)		Global	Voluntary
TYMLEZ – Green Hydrogen Guarantee of Origin	Finalized	TYMLEZ		Australia	Voluntary
Standard and Assessment for Low carbon Hydrogen, Clean Hydrogen, and Renewable Hydrogen Energy	Finalized	China Hydrogen Alliance		China	Voluntary
UK Low Carbon Hydrogen Standard	Finalized	UK Department for Business, Energy, and Industrial Strategy		United Kingdom	Voluntary

Certification System	Status	Administrative Body	Country-Region of Origin	Geographical Scope	Objective of the certification scheme
Certificado de Hidrogenio - CCEE	Finalized	Brazilian Electric Energy Commercialization Chamber (CCEE)		Brazil	Voluntary
I-REC for Hydrogen Certification System	Under development	The International REC Standard (I-REC)		Global	Voluntary
South Korea's Hydrogen Certificat System	Under development	Ministry of Trade, Industry and Energy of South Korea (MOTIE)		South Korea	To be defined
CertifHy ® Supply Certificates	Under development	CertifHy		European Union	Compliance
US Clean Hydrogen Production Standard	Under development	To be defined		United States	Compliance
CEN – CENELEC JTC 6	Under development	Joint Technical Committee 6		European Union	To be defined
TÜV SÜD CMS 70 Standard	Finalized	TÜV SÜD		Global	Voluntary & Compliance (RED II label)
CertifHy ® GO	Finalized	CertifHy		European Union	Voluntary
Zero Carbon Certificate Scheme	Finalized	Smart Energy Council		Australia	Voluntary
TÜV Rheinland	Finalized	TÜV Rheinland		Global	Voluntary
Green Hydrogen Standard (GH2)	Finalized	Green Hydrogen Organization		Global	Voluntary
Low-carbon hydrogen certification system	Finalized	Aichi Hydrogen Supply Chain Promotion Association		Aichi Prefecture	Voluntary
Hydrogen Guarantee of Origin scheme	Under development	Department of Industry, (Australia)		Australia	Voluntary

Source: Prepared by authors.

Drawing from the benchmarking and analysis of hydrogen certification systems worldwide, as well as country-level examinations, the proposed regional certification scheme for LAC adopts a voluntary approach. The primary objective is to facilitate the intraregional market and prevent potential duplication of efforts that may arise if individual countries develop their own certification systems simultaneously, which can create difficulties at the moment with a greater degree of convergence and regional trade.

The envisioned LAC GH_2 Certification should encompass key attributes already considered in other certification systems that are relevant for the region. One crucial aspect is efficiency, ensuring that the production process of green hydrogen is optimized, minimizing energy waste. Sustainability is another focal point, with a strong emphasis on verifying that hydrogen production exclusively relies on renewable energy sources, such as solar or wind power, to achieve a carbon-neutral outcome. The certification system also emphasizes the importance of adhering to stringent standards regarding the quality and purity of the hydrogen product. This ensures its suitability for various applications and end-users. Two vital aspects are addressed within this framework: water management, including the utilization of desalination and wastewater for GH_2 production, and respect and inclusion of the native inhabitants and communities along the GH_2 value chain. These elements underscore the concept of "just" GH_2. In its entirety, the proposed certification scheme encompasses a comprehensive evaluation of critical aspects that promote the growth of a sustainable green hydrogen industry in the LAC region, as explained in **Figure 15**. It also incorporates features specific to the region that will be reflected in LAC certifications. This can serve as a differentiating factor for LAC-produced H_2 and derivatives, facilitating their off-take and improving access to financing. Key considerations include sustainable consumption practices, the positive impact of projects on local communities and indigenous peoples, and responsible management of water resources (see **Figure 15**).

Figure 15. Attributes for a LAC Region Hydrogen Certification

Attributes	Justification	Certification Category
Primary energy source and power production plant information.	**Present in all hydrogen certification systems worldwide.**	**LAC Region H2 Certification**
H2 Production Plant Information.		
Intensity and scope of GHG measurement.		
Positive social impact of the project in surrounding communities / indigenous peoples.	Highly relevant for the LAC Region.	
Sustainable sources of water.		
Measures to minimize the environmental impact of the project.		
Wastewater treatment (brines, when applicable).		
Compliance with international labor standards.		
Location and sustainable use of land, that is socially and environmentally harmonious (excluding land conflicts).		
Production time of H2 with respect to the energy.	Necessary to meet the temporal correlation criteria required by European regulations*.	**Certification of H2 exportable to Europe**

Source: Prepared by authors

As a second key outcome of the "Guidelines on Harmonized Green Hydrogen Certification" project, a practical implementation guide is being developed to provide a navigation map for establishing a regional certification system in LAC. The following key steps have been identified and are recommended for the realization of such a certification scheme:

1. Stakeholder mapping and **assessment of countries' interest** in establishing and implementing a regional certification scheme.

2. **Awareness program** addressed to decision makers to align knowledge on H_2 certification between the countries interested in participating.

3. Appointment/designation of **a coordinating body at the regional level** to lead the process of **establishing the governance structure:**

   - Establishment of the Scheme Owner, composed of a representative from each country participating in the initiative.

   - Joint definition of the governance of **interaction** for establishing the scheme.

   - Formation of a Stakeholder Group and Technical Committees, a heterogeneous group of actors representing both public and private sector interests, including renewable energy certifiers, national accreditation bodies, and allied institutions.

4. **Agreement on the system design:** validation of the scheme attributes and its management, based on the proposal; emission calculation methodology; and designation of the governance scheme of the other necessary actors.

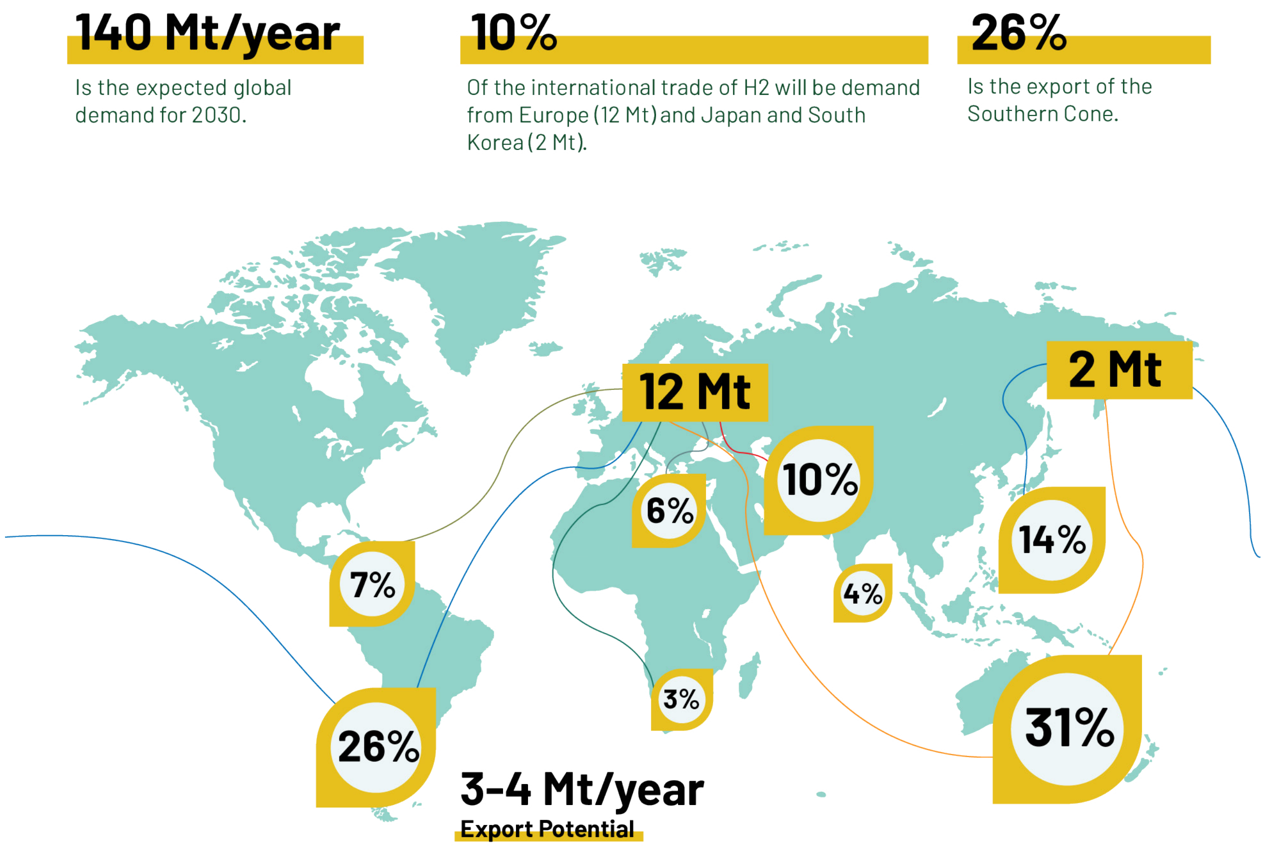
5. Determination of the potential costs associated with developing and operating the regional certification system (CAPEX and OPEX).

6. Methodology for monitoring and verifying the implementation progress.

These guidelines aspire to support the materialization of a certification scheme within the LAC region, and the IDB intends to provide further assistance in this initiative.

At a regional level, IDB is also conducting an analysis of the **potential and positioning of the Southern Cone** (Argentina, Brazil, Chile, Uruguay, and Paraguay) as a global exporter of GH_2 and its derivatives. This study takes into account the region's abundant renewable energy resources and available land for GH_2 projects. It also identifies various critical factors necessary for the development of export projects, including energy policy prioritization, legal and regulatory frameworks, establishment of global market creation and framework agreements between exporting and importing countries, certification systems, project inventory, regional integration, and demand hubs. **Figure 16** illustrates the export potential of the Southern Cone countries, as indicated by the International Energy Agency (IEA, 2022b).

Figure 16. Export Potential from the Southern Cone



Source: Prepared by authors based on IEA information.

Additionally, the IDB is in the final stages of a s**coping study on the environmental, health, safety, and social management of GH_2** in LAC. This study focuses on eight countries in the region and intends to analyze the main risks, impacts, and mitigation measures associated with the GH_2 value chain and its derivatives. It also compares international best practices for environmental, health, safety, and social management in the hydrogen sector.

Furthermore, to ensure a reliable supply of hydrogen from LAC, it is necessary to conduct various studies (Figure 17) to understand the region's renewable potential, the temporal distribution of renewable resources, and the maturity and planning of infrastructure needed.

Figure 17. Studies to Ensure Reliable Green Hydrogen & Derivates from LAC Production

Renewable energy production	• Renewable resources quantification (potential and land extension) • Resource consistency (production over the time)	• Technical capabilities and regulatory framework for the renewable projects deployment
Energy transmission	• Capacity analysis and transmission grid planification considering potential energy demand by hydrogen projects • Business models for the energy transport in hydrogen business	• Investment quantification and planification • Regulatory framework assessment for energy transmission in hydrogen business
Hydrogen production	• Levelized costs of hydrogen • Hydrogen production volumes considering renewable production profiles	• Technological capabilities for the local manufacturing of electrolysers and balance of plant equipment
Conditioning and derivates synthesis	• Levelized cost of hydrogen derivates (ammonia, methanol, e fuels, etc) or conditioning processes • Convenient sites identification and safety analysis	• Technological capabilities for equipment production, installation, operation and maintenance
Hydrogen and/or derivates transport	• Techno-economic evaluation of transport technologies for the identification of best suitable methods • Infrastructure diagnostic: retrofittable & new needed infrastructure	• Investment quantifications and planification for its deployment
Storage terminals	• Volumes estimation and technology selection for hydrogen and/or its derivates storage • Sites identification and safety analysis	• Infrastructure diagnostic: retrofittable (if any) & new needed infrastructure
Port infrastructure	• Infrastructure diagnostic, including ships traffic and both, land and sea sides technical characteristics	• Medium and long term planification to ports infrastructure and new developments to guarantee hydrogen and its derivates mobilization
Social and environmental	• Social and environmental baselines and impact analyses	• Adequate environmental assessment studies framework

Source: Prepared by authors.

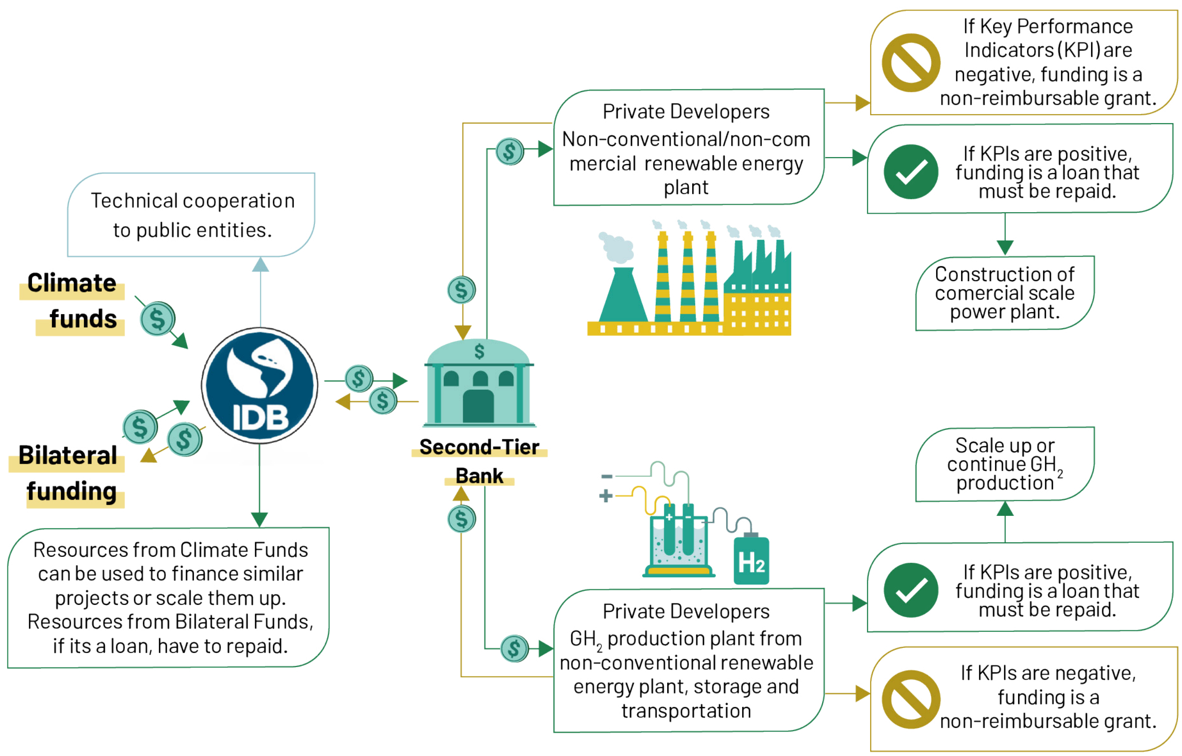
The IDB's Green Hydrogen Financial Assistance

The IDB recognizes the cost and financing challenges faced by GH_2 projects in LAC and is providing financial assistance through innovative financing structures. Unlike countries such as the United States, with IRA, and those in Europe, with the Hydrogen Bank, LAC may require support to access public funds and subsidize GH_2 projects. Financing structures for GH_2 projects in the region will require a combination of public sector grants, government guarantees, tax benefits, long-term fixed-price off-take contracts, project finance, equity, and concessional funds. It is important that subsidies and tax benefits cover the entire GH_2 value chain, including renewable energy plants, GH_2 and derivatives production plants, and transportation and storage infrastructure.

LAC can leverage its competitive advantage of lower renewable energy costs compared to its competitors and utilize existing oil and gas infrastructure that can be repurposed for GH2 production and its derivatives. The region can also tap into blended finance from climate funds and bilateral funding sources. To mobilize private sector capital, innovative financing structures and blended finance approaches through development banks are necessary, as depicted in **Figures 18-20.** These funding schemes involve second-tier local development banks or government entities that channel funding towards the private sector, thereby attracting private sector investment.

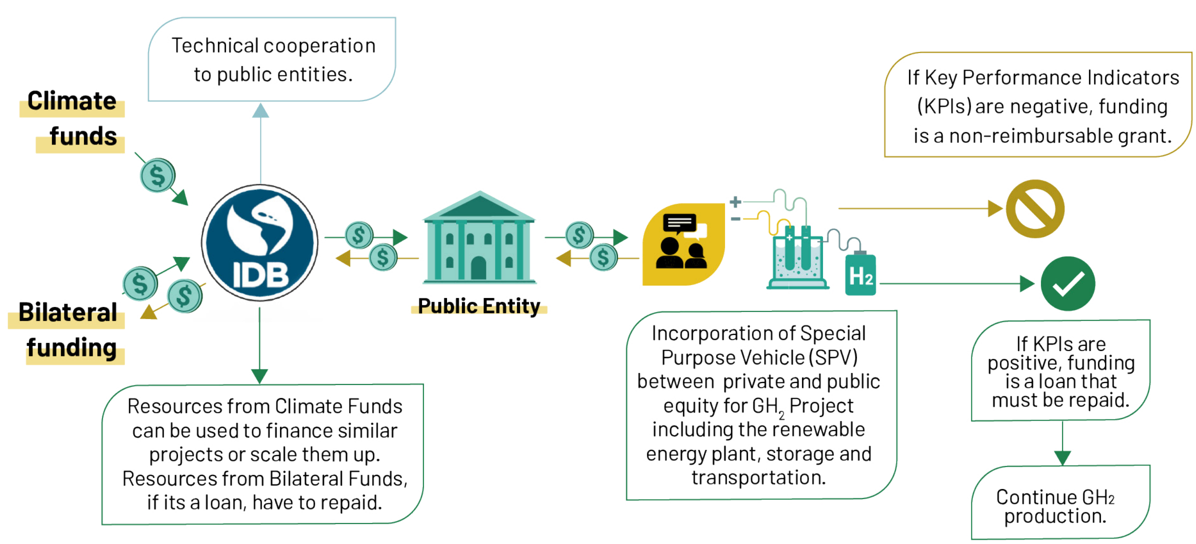
Raising capital for projects involving GH2 production through non-conventional and non-commercial renewable energy sources may require additional effort. **Figure 18** presents an alternative approach to mitigate risks in sectors where private sector investment is limited. It involves a contingent recovery grant for a demonstration project that combines, for example, a geothermal plant and a GH2 production plant with storage and transportation. Developers repay the funds to the second-tier bank under the IDB's supervision if the project achieves positive results based on predefined Key Performance Indicators (KPIs). Conversely, if the project's KPI results deviate from expectations, the funding is considered a non-reimbursable grant. **Figure 19** offers another alternative, where a contingent recovery grant is provided as a loan to a public entity that establishes a Special Purpose Vehicle (SPV) with a mix of public and private capital.

Figure 18. Contingent Recovery Grant for a Demonstration Project



Source: Prepared by authors.

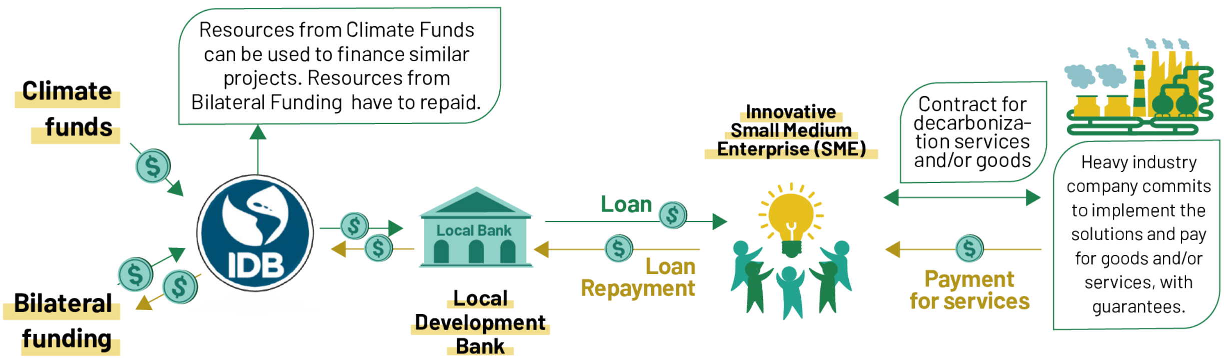
Figure 19. Contingent Recovery Grants for GH_2 projects where public-private investors are Special Purpose Vehicles



Source: Prepared by authors.

Finally, **Figure 20** presents an alternative to decarbonize heavy industry and boost innovative Small and Medium Enterprises (SMEs) that provide decarbonization services or goods.

Figure 20. Decarbonizing Heavy Industry through Small and Medium Enterprises



Source: Prepared by authors.

First Green Hydrogen Facility in LAC financed by the IDB

The Chilean government's achievement of securing a $400 million loan from the IDB to advance the development of green hydrogen in the country stands as a significant milestone. This successful funding arrangement, facilitated through a second-tier financing institution, serves as an exemplary model that other countries in the region can emulate. The collaboration between the IDB and the *Corporación de Fomento de la Producción de Chile* (CORFO) aims to strengthen the GH2 value chain and expedite decarbonization initiatives. Chile's attainment of this loan underscores the crucial factors that contribute to its success, such as public support, the establishment of enabling conditions, investment in human capital, fostering public-private collaboration, and nurturing support for innovative enterprises in the realm of green hydrogen. By showcasing this effective financing model, Chile sets a precedent for other countries in the region to explore similar avenues for propelling sustainable and clean energy transitions.

5. Final Considerations for Green and Just Hydrogen Deployment in Latin America and the Caribbean

Regional cooperation to strengthen LAC's position in the global GH_2 market

Regional cooperation is crucial to complement national strategies and enhance the competitiveness of LAC in the global GH_2 market. By working together, countries can identify synergies, explore opportunities, and strengthen their negotiation position with off-takers. This requires the establishment of institutional and infrastructure agreements to develop a robust GH_2 market and ensure the seamless functioning of the entire value chain.

The implementation of a regional certification scheme, as discussed earlier, is a significant step towards positioning LAC as a competitive player, while facilitating negotiations with major off-takers such as the European Union. As the EU establishes common certification schemes and negotiation strategies, it is imperative for LAC countries with GH_2 export aspirations to form regional agreements with Europe and Asia, enabling collective negotiations rather than individual country-level discussions.

National strategies are essential but not enough

While national strategies are vital, investment decisions in the GH_2 sector depend on various factors such as legal stability, long-term government signals, regulatory clarity, financing options, and the availability of infrastructure.

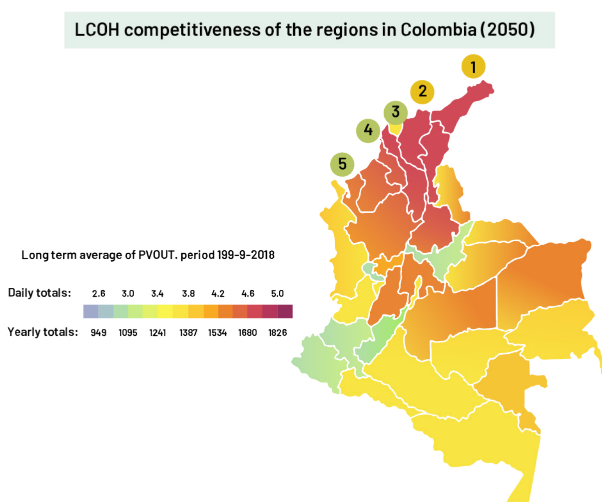
Green and just hydrogen

In the pursuit of a just energy transition, LAC combines the principles of green and just hydrogen. This means that all GH_2 transactions should consider the perspectives of native inhabitants, civil society, and the communities that may befit, hopefully not be affected, by GH_2 and derivatives projects.

Socioeconomic impacts vary depending on the region and project size. It is crucial to ensure that GH_2 production adheres to just principles, addressing environmental measures and concerns of local communities, native inhabitants, indigenous peoples, with particular attention to disadvantaged groups. Issues related to land acquisition, land use fragmentation, and socioeconomic implications should be carefully assessed during the early planning phase, with appropriate mitigation measures put in place.

The active engagement of local communities is essential for the development of new infrastructure elements that enable the reduction of costs associated with GH_2 production. The case of Colombia's La Guajira region exemplifies how addressing its social challenges can contribute to reducing production costs and enhancing the competitiveness of GH_2 projects. Since la Guajira has a high renewable potential over Cartagena and Barranquilla, it achieves better production costs on green hydrogen, methanol, and ammonia at costs up to 33% lower than in other regions as shown in figure 21. By involving local communities in the planning and implementation processes, their valuable knowledge and insights can be harnessed to identify suitable sites, favorable environmental conditions, and efficient production techniques. This collaborative approach not only enhances the economic viability of GH_2 projects but also takes into account the social and environmental considerations and aspirations of the communities, fostering a just and sustainable energy transition. Moreover, incorporating local perspectives enables a thorough assessment of potential environmental impacts and facilitates the implementation of measures to mitigate any adverse effects, ensuring the preservation of ecological balance and the well-being of both communities and natural ecosystems.

Figure 21. Local Community Participation Could Be a Key Driver for the Competitiveness of the GH2

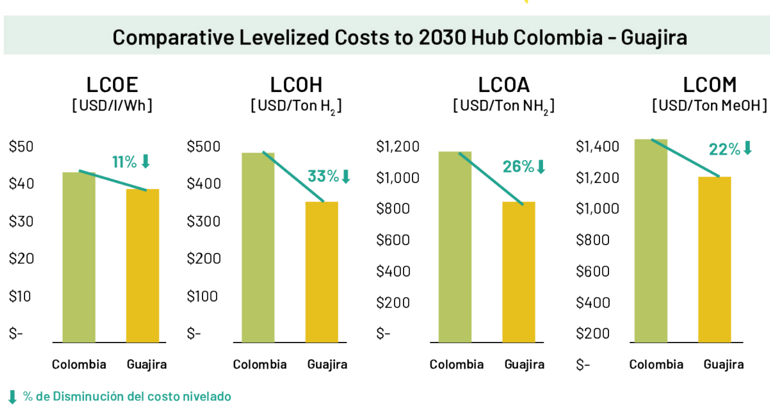


Infraestructure available in La Guajira

1. Bolivar Port
2. Brisa Multipurpose Port

Infraestructure available at the CBP Hub (not including La Guajira)

3. Barranquilla Port
4. Cartagena Port
5. Coveñas Port



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	Minimums	Maximums	Units
LCOH	$258	$349	USD/Ton H_2
LCOA	$688	$858	USD/Ton NH_3
LCOM	$911	$1,086	USD/Ton MeOH

Source: Prepared by authors based on Oxford (2022), Afif et al. (2022), Jain et al. (2022), IRENA (2021), IRENA (2020b), Christensen (2020), Caparrós Mancera et al. (2020), IEA (2019b), Rivarolo et al. (2019), Noh et al. (2019), COSIA (2018) and CSIRO (2016)

Additional and low-cost renewable energy

Latin America possesses abundant wind, solar, and hydropower resources and it generates excess clean energy, which position the region as one of the most competitive in the world for GH_2 production. However, to fully capitalize on this potential, electricity costs need to decrease as they constitute a significant portion of the LCOH (IEA, 2021b). Increasing renewable energy capacity is also crucial.

One approach to reducing electricity costs is to establish off-grid renewable energy plants dedicated to GH_2 production. By avoiding grid fees and taxes, these plants can operate at a lower cost. Another option is the development of hybrid plants that combine various renewable energy sources such as solar, wind, batteries, geothermal, and surplus hydropower. Harnessing economies of scale is also vital for renewable energy projects, as larger plants can generate cheaper power with the same level of sunlight or wind.

Environmental Permitting

To streamline the environmental permitting process for GH_2 projects in some countries, it is recommended to adopt a single permitting procedure that covers all project components, from the renewable energy plant to the facilities for GH_2 derivatives conversion. Environmental impact assessments should include social impacts, water usage, wastewater discharge, biodiversity conservation measures, efficient resource utilization, and pollution prevention measures.

Given the potential concentration of multiple GH_2 projects in specific regions, it is crucial for countries to assess and monitor the cumulative environmental and social impacts. Promoting the construction of shared infrastructure, such as ports, transmission lines, and pipelines, can help mitigate these impacts.

GH_2 Derivates

GH_2 and its derivatives, particularly ammonia, methanol, and synthetic fuels, should be prioritized for hard-to-decarbonize sectors where energy efficiency and direct electrification are not feasible. This includes sectors such as maritime, road and air transport, industry, mining, and agriculture. Additionally, using ammonia as a carrier for transporting GH_2 can be a more cost-effective and practical solution than transporting hydrogen directly.

Partnerships across the GH_2 value chain

Partnerships between private entities at different stages of the value chain have emerged globally as a means to share risks and investment costs. In Latin America, it is crucial to leverage the expertise of the oil and gas and petrochemical industries to create synergies with renewable energy companies and end-users. Public-private partnerships are also essential for attracting significant investments from the private sector.

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