CHAPTER SIX

# INTERNATIONAL CONVENTIONS AND REGIONAL TREATIES SHAPING THE HYDROGEN ECONOMY

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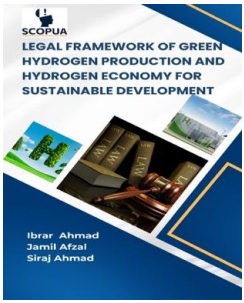


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## Abstract

This chapter focused on international conventions for H2 and how regional treaties are shaping the hydrogen economy. This chapter critically examines the role of the United Nations Economic Commission for Europe, the WTO Framework, the International Hydrogen Trade Forum (IHTF), the International Partnership for Hydrogen and Fuel Cells in the Economy, and the Green Hydrogen Legal Capacity Unit (GH2L). To meet their full potential, however, many regulatory, standardisation, and jurisdictional issues will need to be resolved to open up the entire market for hydrogen. Strengthening measures for enforcement, promoting greater international collaboration, and improving legislative frameworks are among the measures needed to overcome these obstacles and to ensure the role of hydrogen as a cornerstone of the worldwide energy transition.

**Keywords:** *Green Hydrogen; Hydrogen Economy; International Conventions for H2; International Conventions and Hydrogen Production; Regional Treaties and Hydrogen Economy*

## 6.1. Introduction

International legal regimes, such as treaties, conventions, and agreements, designed to facilitate the production, trade, and investment in hydrogen infrastructure as a clean energy carrier, are essential [1]. Green hydrogen, generated with renewable electricity from wind and solar sources in particular, is emerging as a cornerstone of the global shift towards renewable energy systems [2]. As such, there is a need for coherent international legal frameworks. These frameworks will bring the legal predictability, standardisation, and global cooperation needed to mobilise investment, facilitate cross-border movement of hydrogen, and secure the environmental sustainability of hydrogen production. The international trade law that applies to hydrogen is mainly the United Nations Convention on Contracts for the International Sale of Goods (CISG) [3]. This convention provides a single legal regime for contracts for the sale of goods, including hydrogen, between parties located in different contracting states. By providing uniform rules for the formation of contracts and their

interpretation and enforcement, the CISG serves to cut out transaction costs and legal wrangling associated with international trade [3],[4]. However, the CSA does not cover any hydrogen-specific issues like certification or transport standards, which would lead to delays or disputes between the trading partners, while these issues can be negotiated later. The hydrogen trade is also underpinned by the World Trade Organisation (WTO) framework, within the broad principles of trade. WTO pacts GATT and the Agreement on Technical Barriers to Trade (TBT) guarantee non-preferential trade and promote standard harmonisation. Such rules are essential to counteract protectionism that can potentially distort the hydrogen market. Current WTO law, however, does not definitively tackle the comparatively complex legal issues presented by green hydrogen, i.e., how to achieve compliance with environmentally driven standards without generating a discriminatory effect under wealthier challenges (whether relating to subsidies or local content) [5],[6].

International cooperation platforms, such as the Hydrogen Implementing Agreement of the International Energy Agency and the International Hydrogen Trade Forum (IHTF) hosted by UNIDO, also control the governance of the hydrogen economy [7],[8]. These round table discussions promote the exchange between hydrogen buyers and sellers, establish common certification criteria, and align sustainability criteria to form fair and functioning global markets for hydrogen. Especially, the IHTF is preparing to enable nondiscriminatory market access and to develop new hydrogen trade corridors by aligning regulatory approaches and handling socio-economic aspects. On a regional level, the European Union is taking strong measures to create legal instruments that will facilitate the production and trade of green hydrogen. EU legislation RED III and its delegated acts lay down specific criteria for renewable fuels, such as hydrogen, e.g., GHG savings and sustainability [9]. It is these standards that not only apply to domestic production but also

to hydrogen imports and that form the basis of shaping global supply chains. Yet the lack of a level playing field in the law, combined with more fragmented rules across the EU and within member states, is holding back the rollout of hydrogen infrastructure at speed. Efforts such as Germany's Hydrogen Acceleration Act are designed to simplify permitting and planning and show how regional approaches can provide examples on the global stage, championing a consistent, hydrogen-supporting legal framework [10],[11]. Environmental law is present in the governance of hydrogen. Certification programs like Green Hydrogen Standard ($GH_2$) extend well beyond production emissions to encompass social impact, health & safety, governance, and transparency.

However, such efforts have not been enough to knock down real legal barrier walls. The absence of a common framework at the global level is a source of uncertainty for investors and market players. Differences in national regulation, bureaucratic permitting regimes, and varying definitions of green hydrogen are preventing cross-border trade and investment in infrastructure [12]. The fast pace of technological change and the realignment of geopolitical forces only muddle the effort to harmonise law. Closing these legal gaps and aligning legislation is an important task that requires immediate action so that hydrogen can deliver on its full potential to support the global energy transition as well as the climate targets.

## 6.2. United Nations Economic Commission for Europe: Hydrogen Chapter

The United Nations Economic Commission for Europe (UNECE) is leading the way with hydrogen governance to facilitate the scaling up of hydrogen production, trade, and infrastructure across Europe and potentially other regions [13]. The main objective of UNECE is to promote regional economic integration

and sustainable development [14]. As part of its wider work, UNECE is helping to integrate hydrogen into Europe's green transition, which is in line with the efforts of the European Green Deal and global climate goals, contributing to low-carbon hydrogen production and infrastructure. UNECE has a global impact through partnership work with the World Trade Organisation and the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) [15],[16]. In enabling cross-border trade in hydrogen and global cooperation, UNECE has broadened its reach to non-EU members, as well as emerging hydrogen markets in Asia and Africa. One example of such cooperation is in the harmonisation of hydrogen safety standards, where UNECE has assisted countries in Africa to bring their regulatory regimes into line with global best practices. UNECE now joins the likes of the International Renewable Energy Agency (IRENA) and the International Energy Agency (IEA), adding to their focus on technical regulations and infrastructure standards critical to hydrogen's integration in the market [17],[18]. The UNECE Hydrogen Chapter creates ground rules for hydrogen governance. The UNECE Hydrogen Chapter serves as the starting point of hydrogen governance by establishing precise rules for production, trade, infrastructure, and deployment. UN Global Technical Regulation No. 13 (Draft GTR 13) is one of these main provisions: It covers the safety and performance aspects of hydrogen fuel cell vehicles [19],[20]. This legislation is important to advancing cross-border trades because it establishes consistent criteria for certifying hydrogen vehicles.

As for sustainability, UNECE supports hydrogen certification schemes in line with the EU taxonomy for sustainable activities [21]. These systems are intended to demonstrate that hydrogen production is environmentally compliant and meets greenhouse gas emission reduction requirements. At least the certification systems are voluntary in some cases; UNECE will start

to promote their implementation through mutual recognition agreements. For instance, UNECE's hydrogen certification mechanisms have been taken up in Switzerland and Norway, enabling the cross-border trading of clean fuel without compromising the environment [21],[22]. UNECE works with countries in Asia to assist them in integrating such systems into their regulatory regimes, helping to extend the impact of its standards. UNECE has a key role in advancing the cross-border trade of hydrogen, as well as the development of infrastructure, by working to ensure that technical and safety standards are mutually recognised in different regions. Regulatory fragmentation has been a major obstacle to trade; many countries have different safety regulations and certification schemes for hydrogen. UNECE's work to standardise these regulations is contributing to the lowering of these technical barriers and facilitating the transport of hydrogen across borders. For instance, when Germany accepted UN Global Technical Regulation No. 13, over 50 hydrogen vehicles were certified in a two-year period, which then led to increased hydrogen trade with neighbouring markets such as France and the Netherlands [23],[24]. As for infrastructure, UNECE offers technical and legal frameworks for developing places for hydrogen filling stations, pipelines, and reservoir facilities. Safety and interoperability are supported directly from top management downwards, guaranteeing that infrastructure work complies with international standards. Nevertheless, uncertainties remain, notably in Germany, where the federal states are still drawing up their own rules on safety and inspections. These differences impede the rapid deployment of hydrogen infrastructure and thus trade across borders. Looking ahead, in Norway and other regions, the construction of hydrogen refuelling stations has been quickly ramped up, with regional integration of hydrogen markets in which UNECE has been actively involved in streamlining permitting.

The Hydrogen Chapter of UNECE provides a comprehensive regulatory structure, but it encounters several legal and institutional challenges. A key problem is in relation to the market design and aspects such as tariff adjustment and conflict resolution. The lack of an integrated market structure creates opportunities for conflicting tariffs or non-tariff barriers to be applied, which could disturb hydrogen trade. National sovereignty is yet another obstacle. Governments frequently facilitate their national energy policies, which conflict with UNECE's harmonised structure. One example is the Facturation by France's Hydrogen Decree, which creates trade barriers as it diverges from UNECE's common rules [25]. It is difficult to implement UNECE's recommendations, as no enforcement instruments are available. The UNECE framework is based heavily on voluntary adherence to it, and there is no clear way to address the gap between national policies and UNECE standards as a matter of law. In order to overcome these gaps, UNECE may want to consider upgrading the legal instruments by cooperating with international trade institutions such as the WTO and by associating its regulations with global trade agreements that carry clearer enforcement mechanisms. Compared to more comprehensive frameworks, such as WTO agreements or IPHE, the UNECE's Hydrogen Chapter is very technical and region-specific. Although the WTO establishes general ideas and principles applicable to international trade, it does not contain rules tailored to the peculiarities of hydrogen's features, including safety and certification standards. Similarly, IPHE supports research and cooperation but lacks the regulatory depth for trade and infrastructure that UNECE can bring. UNECE's framework has echoes in EU legislation such as RED III, which introduces binding sustainability requirements for hydrogen production and use. Whereas EU RED III addresses sustainability standards, UNECE is committed to harmonising technical regulations and infrastructure. UNECE also works with IRENA and

IEA, integrating its base in the feasibility assumptions to global environmental objectives (like the Paris Agreement). With its support for low-carbon hydrogen production, UNECE is contributing to climate change mitigation and the global energy transition. Real-life cases such as in Germany, France, and Norway illustrate the concrete UNECE-related impact on hydrogen deployment. In Germany, UNECE's incorporation of UN Global Technical Regulation No. 13 has facilitated the certification of more than 50 hydrogen vehicles in 2022, greatly promoting cross-border trade [26]. Also, Norway's infrastructure has already embraced UN Economic Commission for Europe standards, with 20 hydrogen refuelling stations in place to enhance regional connectivity and trade with countries neighbouring the nation [27]. However, there are challenges, especially in non-EU countries and in regions with immature hydrogen markets. Furthermore, a slow rollout in a few EU states makes it more difficult to scale up the hydrogen infrastructure and the market. UNECE's Hydrogen Chapter is critical in the development of the legal and technical environment for the hydrogen economy. Its work facilitating the normalisation of hydrogen regulations, sound environmental practices, and cross-border trade is priceless.

## 6.3. WTO Framework and Its Influence on Global Green Hydrogen Trade

The World Trade Organisation (WTO) is the main legal framework for regulating international trade, which includes the emergent green hydrogen sector [28],[29]. Two main agreements under the ambit of the WTO are of importance: the General Agreement on Tariffs and Trade (GATT) and the Agreement on Technical Barriers to Trade (TBT). GATT codifies basic trade principles, including non-discrimination, most-favoured-nation (MFN) treatment, and the ban on quantitative restrictions. These

same truths can be directly applied to green hydrogen and its derivative products (green ammonia and methanol) and enabling technologies (such as electrolysers and fuel cells). GATT has urged the participants to gradually decrease their tariffs on these products in order to facilitate their free trade across borders and to avoid the implementation of any protectionist policy that might hamper the development of the hydrogen market. However, tariffs on hydrogen-related appliances are quite different between the countries. For instance, even though most developed economies have minimal or no tariffs on electrolysers, emerging markets like India and Brazil still have tariffs upwards of 5% on hydrogen-related technologies. These differences could act as major obstacles to market access, especially in the case of developing countries where tariff protection may restrict the supply of vital technology. In Brazil, high duties for electrolyser imports make it difficult for local hydrogen producers to expand their activities and hamper the rollout of green hydrogen infrastructure and the creation of a competitive hydrogen market. The TBT Agreement is a natural extension of GATT: it addresses technical standards, conformity assessment, and certification. Considering the difficulty of these technologies from a technical perspective, but also from a safety standpoint, the TBT is very important to avoid national regulations turning into hidden barriers to trade. It also calls for WTO members to align their technical standards with widely accepted international standards and use science-based, transparent certification processes. In routine, hydrogen production and transport have been somewhat approached with international standards established by the fighting community of the International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC) [30],[31]. For example, both the ISO 14687, on hydrogen fuel quality, and the IEC 62282, for hydrogen refuelling station safety protocols, create the requisite international technical commonality to support interoperability and cross-border trade [32],[33].

However, the technical barriers of trade are being replaced by concerns over intellectual property (IP) and patent protection.

Subsidies are a particularly thorny aspect of green hydrogen trade within WTO rules [34]. Such subsidies, which could distort trade and trigger disputes, are not allowed under the Agreement on Subsidies and Countervailing Measures (ASCM), which prohibits subsidies contingent upon export performance and local content requirements. However, the WTO has acknowledged that "green" subsidies that promote clean energy, such as green hydrogen, are necessary for meeting climate objectives and could be allowed if designed in a non-discriminatory way [35],[36]. Multiple nations, from Germany and Japan to the United States, have begun offering large subsidies to jump-start green hydrogen production and infrastructure. For its part, Germany has set aside billions of euros for green hydrogen infrastructure, with subsidies for electrolyser manufacturing and refuelling stations. However, there have been concerns about these subsidies being biased in favour of the produce in the domestic market. For example, subsidies that stimulate local content could potentially breach WTO rules of non-discrimination if, at the expense of foreign suppliers, the subsidies go in favor of the country where they have been implemented. Real-world cases, such as the EU–US trade row on renewable energy subsidies or China's electric vehicle subsidies, demonstrate the precedence of scrutiny of subsidy structures under WTO rules, and the same could happen with green hydrogen subsidies. Local content requirements could pose a major challenge in some developing countries as they try to spur local industry. Countries such as India, China, and South Africa have introduced local content requirements in their renewable energy and green hydrogen industries, but these can be inconsistent with the WTO's non-discrimination regulations. The WTO's system for resolving disputes is a linchpin for enforcing trade rules and settling conflicts. No disputes have so far arisen with regard to green hydrogen, but

lessons can be drawn from other clean energy industries. In DS456, United States–Solar Panels, the WTO found against specific U.S. subsidies that discriminated against foreign producers by giving preference to domestically produced goods and called for policy reform [37]. So too did Canada–Renewable Energy (DS412), centred upon Ontario's local content requirements, which were deemed to be discriminatory [38]. These cases serve as examples of how the WTO examines subsidies and trade limitations that distort markets and will set a blueprint for future disputes over the trade in green hydrogen. If countries like the U.S. or China give subsidies to their national green hydrogen producers, such WTO challenges may come about, underscoring the importance of respecting international trade obligations.

## 6.4. United Nations Industrial Development Organisation (UNIDO): International Hydrogen Trade Forum (IHTF)

Various key international entities, including the United Nations Industrial Development Organisation (UNIDO) and the International Hydrogen Trade Forum, are actively facilitating the acceleration of the global hydrogen economy [39],[40]. UNIDO is contributing significantly to supporting the use of hydrogen technologies in developing countries [41],[42]. Mainly via capacity development, policy advisory, and technical support, it supports countries in the integration of hydrogen technologies into the energy system. This involved, for instance, initiatives in Morocco and South Africa, where UNIDO supported the creation of the hydrogen infrastructure through the generation of power from locally available renewable sources [43],[44]. But there are also a number of obstacles that the organisation faces. The explanation is financial, a lack of technical expertise in most developing countries and a lack of existing infrastructure. While the levels of UNIDO's contributions were current, the majority of programs were driven to

deliver quick wins. Nor do they provide the level of sufficiency necessary to enable locally driven hydrogen industries to stand on their right. In order to enforce such a mechanism, there is a requirement for financial restructuring that could be accomplished by new financial programs. Potential sources of finance are multilateral development banks and private sector investment. Besides the market, IHTF is crucially engaged in regulating the international hydrogen market development by standardisation of regulation and implementation of certification and certification processes, as well as in governance of environmental issues throughout the hydrogen value chain. The measures have also been introduced in order to prevent market fragmentation and to support the trade in hydrogen among producers, consumers, and traders. But, as of now, the biggest impediment to trade in hydrogen across borders is the fragmentation of regulatory regimes. There are different national regulations on the safety, transport, and environmental effects of hydrogen. For example, the legal system of Europe is distinct from that of Asia or Africa.

Regional hydrogen hubs are essential to maximising the use of local, renewable resources to produce hydrogen for domestic and overseas markets [45]. In areas such as Southern Africa and Latin America, with vast renewable energy potential, hydrogen production could have a central role in delivering on both energy and economic objectives [46],[47]. The promotion of these regional hydrogen hubs by IHTF, by standardising technical standards and reducing regional agreements, is very important. Fleshing out specific cases, specifically in resource-abundant regions, will enable us to comprehend the factors involved in regional hydrogen development and the policy measures needed to address local impediments to market integration. MDBs like the World Bank and the Asian Infrastructure Investment Bank (AIIB) play a crucial role in funding $H_2$ projects in emerging economies [48],[49]. These banks offer loans at attractive terms, grants, and risk-sharing

facilities that reduce financial uncertainties and support hydrogen infrastructure investments. While the section on MDBs briefly describes MDBs' roles, an analysis of how MDBs de-risk projects in capital-scarce areas would add value to the discussion. Concrete examples of MDB-financed hydrogen infrastructure projects, such as AIIB's assistance in Asia or the World Bank's blended finance efforts in Africa, will illustrate the real added value of MDBs in promoting green hydrogen projects in developing countries.

UNIDO and IHTF are essential parts of the emerging hydrogen economy in the world. UNIDO's capacity-building activities and those of the IHTF have built momentum for a more connected and sustainable hydrogen market. Yet, major challenges persist chiefly in financial viability, regulatory fragmentation, and market power. To overcome these challenges, UNIDO needs to prioritise the establishment of sustainable funding mechanisms that lessen dependence on external assistance. Moreover, more needs to be done to converge regulatory frameworks across geographies and to mobilise $H_2$ activities in the private sector. Leveraging MDBs as sources of finance for hydrogen infrastructure and developing regional hydrogen hubs will also be key to realising the full potential of the global hydrogen economy.

## 6.5. International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)

The International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) was launched in 2003 and is a significant global collaboration to accelerate progress in the development and deployment of hydrogen and fuel cell technologies [50]. The IPHE works to foster the transition to clean energy systems and the use of hydrogen as a sustainable, clean energy solution for a variety of sectors, including those such as transportation, energy storage, and heavy industry [51]. IPHE facilitates worldwide collaboration and

information sharing for the purpose of promoting the transition to clean and efficient hydrogen systems within the framework of sustainable development. IPHE coordinates and promotes research and development in hydrogen technologies. IPHE has been a leading force in developing the international hydrogen community by promoting RD&D, international collaboration, and the commercialisation of hydrogen technologies. One of the greatest advantages of IPHE is its addressing the standardisation of hydrogen technologies. By collaborating with global entities, including ISO and IEC, the IPHE has promoted the creation and implementation of worldwide standards for hydrogen production, storage, delivery, and safety. Such standards are important in lowering technical trade barriers and promoting cross-border interoperability, key to the creation of a global hydrogen economy.

IPHE is also promoting the use of renewable (green) hydrogen, including via collaboration with partners like the International Renewable Energy Agency (IRENA) [18]. The work of IPHE to align hydrogen efforts with the objectives of the Paris Agreement and other global sustainability regimes advances the deployment of low-emission alternatives. Specifically, IPHE contributes to a sustainable energy transition because of its commitment to the promotion of green hydrogen production and to the decarbonization targets of a wide variety of industry sectors. Legal and regulatory harmonisation is central to IPHE's efforts to enable international hydrogen trade [28],[52]. The association aggressively seeks to align legislation, making sure that member countries' national laws are consistent with those of the international community. Taking action to help unify such policy activities, IPHE aims to develop and harmonise safety codes, certification procedures, and environmental standards, one of the key obstacles on the road to hydrogen trade. IMTA is in favor of the development of international standards that become accepted worldwide, aligning regulatory governments and adding an element of predictability for

market participants. For instance, by also working together with ISO and IEC, the IPHE ensures that technologies for producing hydrogen, storing it, and transporting it are covered by similar safety and performance standards, which helps to increase the proliferation of hydrogen infrastructure across borders. This alignment creates confidence for investors and market participants, supporting the development and expansion of hydrogen markets globally.

IPHE has played a key role in promoting hydrogen development in different parts of the world by supporting strategic partnerships. In particular, IPHE's partnership with the United Nations Industrial Development Organisation (UNIDO) is designed to support hydrogen implementation in regions with developing economies. The IPHE has had a visible effect on the worldwide hydrogen market by stimulating international cooperation and market visibility. Through converging regulation and encouraging standardisation, IPHE has stimulated investor confidence in hydrogen. The partnership's work to develop global safety standards and promote interoperability has lowered risk and uncertainty, making the market more likely to attract private-sector capital investments. IPHE plays a key role in the transition to a global hydrogen economy as a forum for the coordination of international policies, sharing of best practices, and promotion of the internationalisation of new hydrogen codes, standards, and safety practices. Through its activities promoting green hydrogen infrastructure and regulatory alignment, IPHE supports the development of a sustainable and connected global hydrogen economy.

## 6.6. The Green Hydrogen Legal Capacity Unit (GH2L): Advancing Legal Frameworks and Market Integration for Green Hydrogen

The Green Hydrogen Legal Capacity Unit (GH2L) has been created to fill the crucial lacuna in legal and regulatory expertise and framework that is vital to expedite and support large-scale renewable energy and green hydrogen projects, especially in the developing world. GH2L forms part of the wider GH2 project and aims to deliver high-quality, affordable legal advice and support to governments and stakeholders, supporting them to create strong and transparent legal and regulatory structures, which can help unlock the potential for development set out in the green hydrogen scenario. GH2L's main aim is to support sustainable energy transitions in line with global climate conventions, including the Paris Agreement and SDG 7, to ensure access to affordable, reliable, sustainable, and modern energy for all. This strategic focus ensures that GH2L initiatives will advance global decarbonization through the adoption of green hydrogen in national energy systems around the world. GH2L has a key role in addressing legal and regulatory barriers that hinder investment in green hydrogen infrastructure or delay it. By helping governments develop clear regulations, policies, licensing, and regulatory oversight approaches for hydrogen use in their national and international energy systems, GH2L works to ensure that the integration of hydrogen as an energy carrier is legally robust and supports sustainable development. This is especially important for LDCs and EMDEs, which often do not have the institutional capacity to quickly develop the complex legal framework that is essential for hosting large-scale green hydrogen projects. In their work, GH2L is legislating and implementing laws that support and meet the specific needs of green hydrogen technologies and markets. This could include advice to governments on creating regulatory regimes for hydrogen

production, distribution, and storage, for example, by introducing licensing regimes to achieve a balance between state control and market flexibility. This will require, among others, independent regulators with specific mandates to oversee market activity, enforce compliance, and verify "green" hydrogen claims via guarantee of origin (GO) systems, which are critical for ensuring market transparency and boosting investor confidence.

Even though these frameworks have worked reasonably well, there are considerable challenges to harmonising them across such diverse jurisdictions with differently developed legal systems. GH2L, therefore, provides the needed navigational power in these disparities by providing tailor-made advice such that the frameworks are practical and implementable. Moreover, GH2L has been instrumental in the creation of legal frameworks that support project development and financing, a vital aspect that goes beyond legislation. Please contact us to help with managing and negotiating offtake agreements, PPAs, equipment supply, and financing that are based on best practices and risk allocation. GH2L, for instance, has counselled on offtake agreements for Morocco projects, as well as "take-or-pay" agreements to protect the interests of investors while closely attuned to state-sponsored incentives that would jive with national energy policies. Capacity-building activities involve legal training, model clauses for contracts, and policy development tools for the public and private sectors to structure complex green hydrogen project agreements. GH2L engages as an active partner with a variety of international organisations, governments, and private industries to clarify global legal standards and market environments. It also collaborates with the European Union, the International Renewable Energy Agency (IRENA), and the International Organisation for Standardisation (ISO) to spread and adopt the development of harmonised legal protocol and certification systems. They do so by helping interconnect green hydrogen markets through regulatory cooperation and achieving

mutual recognition of sustainability certificates. For instance, the work GH2L has performed with IRENA has resulted in the development of a scalable regulatory regime for hydrogen production, which has been instituted in a number of African nations. These partnerships are actively assisting in the build-up of hydrogen infrastructure, cross-border trade, and efforts to enhance foreign investment inflows.

## 6.7. Regional Treaties Supporting Green Hydrogen Production and Market Integration

### 6.7.1. Regional Treaties Promoting Green Hydrogen Production

Regional treaties and strategic alliances are emerging as key factors for advancing green hydrogen production by setting clear objectives, establishing cooperative frameworks, and mobilising required financial and political resources. Within Europe, the EU Hydrogen Strategy, which was unveiled as part of the European Green Deal last year, has developed into a solid regional framework [53]. It is hoping to deliver 10 million tonnes of renewable hydrogen per year by 2030 and to deploy 40 gigawatts (GW) of electrolyser capacity in the EU countries [54]. The EU Hydrogen Backbone initiative has so far identified more than 3,000 km of hydrogen pipelines and is expanding up to 6,800 km by 2030, to enable the transport of hydrogen across borders at a large scale [55]. A cornerstone of this is the European Clean Hydrogen Alliance, which has brought together more than 750 hydrogen projects across the EU to develop a cross-border value chain and ensure that investment is channelled towards the EU's renewable hydrogen objectives [56]. These initiatives receive EU financing through the European Structural and Investment Funds, the Connecting Europe Facility, and the Innovation Fund. The

commitment to green hydrogen of the EU has not only further galvanised the internal market, but has also carved out an increased demonstration space for the EU gas industry as a global model and a place to develop and innovate hydrogen technologies. In the Asia-Pacific (APAC) region, the APAC Green Hydrogen Alliance, which was established by the Green Hydrogen Organisation (GH2) in collaboration with Breakthrough Energy, comprises countries such as Australia, Japan, South Korea, Indonesia, and Singapore [57],[58]. The alliance is committed to promoting facilitative policies, harmonising regulatory standards, and enabling financing measures that should help ensure the scalability of hydrogen production at industrial clusters. It further seeks to establish APAC as a hydrogen export corridor within the region and to global markets so that APAC can not only become the foremost hydrogen producer but also a major player in the global hydrogen marketplace. The Middle East and North Africa (MENA) region is no less ambitious, as Saudi Arabia, Egypt, and Morocco have all targeted 10 million tonnes per year of green hydrogen output by 2030 [59]. Saudi Arabia has its own NEOM project, funded by the Public Investment Fund, which perfectly illustrates a move in this direction, leveraging the region's plentiful renewable resources, particularly the abundant solar and wind available [60]. Moreover, the Africa Green Hydrogen Alliance (AGHA), including Egypt, Kenya, Morocco, Namibia, and South Africa, aims to position Africa as a major global player in green hydrogen by aligning policy, certification systems, and regional cooperation, making it easier to export hydrogen to Europe and Asia.

### 6.7.2. Legal and Regulatory Frameworks under Regional Treaties

It is important to develop legal and regulatory regimes based on such regional treaties to foster green hydrogen production and guarantee the stability of the emerging market. The Renewable

Energy Directive II (RED II) of the EU specifies specific sustainability requirements as well as the requirement to use Guarantees of Origin (GO) for renewable hydrogen [30],[61]. This method of certification ensures transparent accounting and eliminates double-counting, instilling confidence in both investors and consumers. Meanwhile, the Alternative Fuels Infrastructure Regulation (AFIR) requires the rollout of refuelling stations with hydrogen every 200 km on the continent's core network for road transport by the decade's end, integrating hydrogen into the European transport landscape [62],[63]. The APAC Green Hydrogen Alliance supports the convergence of regulations, the development of consistent licensing regimes, and environmental protocols in hydrogen production across Asia-Pacific. Such a harmonised regulation method enables member states not only to achieve the highest hydrogen production and trade but also to counteract the legal (uncertain regulatory environment) and market (distorted competitive environment) challenges that different regulatory structures create. Cross-border Hydrogen Trade: APAC's alignment of national policies paves the way for the establishment of robust legal frameworks to support the trade of hydrogen between countries and further investment. Also in Africa, AGHA has played a leading role in stimulating regulatory harmonization within member states. The harmonization of policies and regulatory frameworks helps to lower investment hurdles and allows African countries to ramp up their hydrogen production. In addition, adhering to global sustainability metrics allows Africa's hydrogen to satisfy worldwide certification, thereby allowing the region to export to global markets.

### 6.7.3. Infrastructure Development Supported by Regional Treaties

Creating hydrogen infrastructure is key for the expansion of green hydrogen, and regional agreements are important drivers.

Among the most ambitious is the vision of the EU Hydrogen Backbone project, which aims to establish a continent-wide network of hydrogen pipelines. In 2030, more than 6,800 km of hydrogen pipeline will be in operation, connecting hydrogen production and consumption sites and enabling the cost-effectiveness of transport between countries [64],[65]. With distances exceeding 3,300 km, the South Corridor (a cross-border project connecting North African renewable hydrogen to Europe) from Africa to Europe will supply 5 GW of renewable hydrogen to Europe securely in 2030 [66],[67]. These facilities are examples of how regional agreements are critical for the large-scale production and transport of hydrogen. For Africa, AGHA is working on the creation of hydrogen production units together with the transportation system needed to allow the export of massive quantities of hydrogen. AGHA is involved in obtaining regulatory approval, financing, and exploiting the continent's considerable renewable energy resources for use in the projects.

### 6.7.4. Regional Collaboration and Knowledge Sharing

Regional pacts foster cooperation and sharing of knowledge, essential to expedite the growth of hydrogen technology. In the EU, there is Horizon Europe, which supports research and innovation in projects devoted to improving the efficiency of the electrolyser and technologies for hydrogen storage and fuel cells [68],[69]. These projects frequently include international consortia, resulting in the transnational sharing of knowledge and the development of technology. The APAC Green Hydrogen Alliance supports governments, academia, and industry working together towards the establishment of best practice legislation, contracting, and sustainability standards. These projects help make sure that hydrogen projects are developed efficiently and in compliance with environmental requirements. It also enables new markets to apply the best practices implemented in proven markets.

In Africa, AGHA's capacity-building initiatives offer technical support and knowledge-sharing to support local governments, states, and non-state actors in the challenges of producing hydrogen and coupling to the markets and regulatory systems.

### 6.7.5. Financing Mechanisms and Investment

Financing is a critical enabler for green hydrogen projects, and regional accords serve as a major catalyst for capital provision. The EU also has financial instruments such as the Innovation Fund, InvestEU, and Next Generation EU to back hydrogen projects. These financial resources offer grants, loans, and guarantees to backstop hydrogen projects as they secure the needed capital. For example, the Innovation Fund has set aside more than €2.8 billion for hydrogen across its projects, enough to help create a new industry and infrastructure [70],[71]. In APAC, the APAC Green Hydrogen Alliance targets both public and private sector actors to activate capital. The coalition encourages enabling policies required for the large-scale investments necessary to scale hydrogen production. Private investors, including big energy companies, have also been key to funding hydrogen in the region. The partnership collaborates closely with multilateral development banks and donor collaboration to deliver concessional finance and risk mitigation tools. These actions contribute to unlocking investments in hydrogen infrastructure projects, in particular in areas with reduced access to traditional forms of investment.

## 6.8. Conclusion

To conclude, we can say that International Conventions and Regional Treaties are playing a positive role in shaping the dynamic of the hydrogen economy. Regional agreements have helped to scale green hydrogen production, though these come with their challenges. In Europe, the EU Hydrogen Strategy has initiated more

than 750 investment projects and is fuelling the rapid expansion of hydrogen infrastructure through projects such as the hydrogen backbone. The South2 Corridor will be operational by 2030, with which the large-scale export of renewable hydrogen from Africa to Europe will become a fact. Africa (via AGHA) has made strides towards policy alignment and pilot establishment. However, problems such as financing shortfalls, fragmented regulations, and infrastructure constraints remain. They can be tackled to an extent using regional agreements, which feature harmonised policy frameworks and stimulate investment in hydrogen infrastructure, but implementation schedules can be pushed back by geopolitics and economics. Regional agreements in Europe, Asia-Pacific, MENA, and Africa have helped to catalyse green hydrogen production through the creation of a legal framework and related infrastructure build-out and financing. Although these efforts are propelling the global green hydrogen economy, challenges, including the high level of regulatory fragmentation, funding shortfalls, and geopolitical tensions, persist. Engagement of the private sector is necessary to address these barriers and to scale hydrogen production. The further fortification of these regional agreements is going to be crucial if we are to scale green hydrogen production to meet global decarbonization ambitions.

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