Benchmark on Low-Carbon Hydrogen

Policy and Infrastructure

Countries covered: Austria, Argentina, the Caribbean Region, Chile, Italy, Peru, and Spain

June 2026

This report has been prepared within the framework of the Hydrogen Working Group of the International Confederation of Energy Regulators (ICER). A benchmark questionnaire on low-carbon hydrogen policy, markets, infrastructure, regulation, and institutional arrangements was circulated to ICER member jurisdictions, and the analysis presented in this report is based exclusively on the responses received. The findings therefore reflect the information provided directly by participating members at the time of completion and do not include external assessments or interpretations beyond those submissions.

Executive Summary

This benchmark report synthesizes responses to a comparative questionnaire on low-carbon hydrogen policy, markets, infrastructure, regulation, and institutional arrangements. The findings provide an overview of how hydrogen is being positioned within national energy transitions and highlight the implications for regulators operating in an environment of technological uncertainty and evolving policy priorities.

Overall, hydrogen strategies are either in place or under development, but they vary widely in maturity, scope, and level of specificity. Some strategies articulate clear quantitative targets for electrolyser deployment, infrastructure expansion, or fuel substitution, sending strong near-term signals to market actors and regulators. Others adopt a more exploratory or enabling approach, emphasizing long-term demand scenarios, pilot projects, or legislative frameworks without binding milestones. In several cases, policy ambition has advanced faster than the supporting regulatory architecture.

Current hydrogen markets remain largely concentrated in traditional industrial uses, with production still predominantly fossil-based. Low-carbon hydrogen deployment is generally confined to demonstration projects or early commercial applications, reflecting both cost gaps and limited demand certainty. While expectations for future growth are significant, particularly in industry, transport, and export-oriented applications, the transition from pilots to large-scale deployment has not yet occurred in most jurisdictions.

Infrastructure planning emerges as a key differentiator. Some strategies envision extensive new networks or the repurposing of existing gas assets, while others link infrastructure development closely to specific projects or export corridors. In less mature markets, infrastructure considerations remain largely conceptual, with limited concrete planning or investment signals. Storage, in particular, is often identified as strategically important but insufficiently developed.

Regulatory and institutional frameworks are uneven and, in many cases, still evolving. Safety regulation is generally the first area of regulatory focus, while market design, network access, cost allocation, and certification schemes are at earlier stages. Institutional responsibilities are not always clearly defined, and the interaction between hydrogen regulation and existing electricity and gas frameworks remains a central open question.

In conclusion, the benchmark highlights low-carbon hydrogen as a policy priority with strong long-term potential but significant near-term regulatory uncertainty. For regulators, the main challenge lies in enabling early development without locking in inefficient solutions, while ensuring safety, system integrity, and consumer protection. A phased, adaptive regulatory approach, aligned with broader energy system planning and responsive to market signals, emerges as a common and necessary pathway to support the gradual maturation of low-carbon hydrogen markets.

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1. Introduction

Hydrogen is increasingly considered a key energy carrier for supporting decarbonisation in sectors that are difficult to electrify, such as heavy industry, long-distance transport, and certain energy system balancing applications. In response, many jurisdictions are developing national hydrogen strategies, investment programs, and regulatory frameworks to enable the production, transport, and use of low-carbon and renewable hydrogen.

The development of hydrogen markets presents new challenges for energy regulators, including the oversight of emerging infrastructure, the interaction between hydrogen and existing gas and electricity systems, the management of safety risks, and the design of market rules under conditions of high uncertainty. Regulatory responses are evolving alongside policy ambitions, investment activity, and technological progress.

This report presents the results of a questionnaire-based benchmark on low-carbon hydrogen policy and infrastructure, covering seven jurisdictions: Austria, Argentina, the Caribbean Region, Chile, Italy, Peru, and Spain. The questionnaire collected information on national strategies, hydrogen technologies promoted, market size and outlook, infrastructure development, regulatory and institutional frameworks, and financing and incentive mechanisms.

The objective of the report is to provide a structured, comparative overview of how different jurisdictions are approaching hydrogen development from a policy and regulatory standpoint. The analysis is descriptive, reflecting only the information provided by respondents. It is intended to support regulators by highlighting similarities and differences in national approaches, identifying common challenges, and documenting emerging practices relevant to regulatory design and implementation.

2. National Hydrogen Strategy

Across the responding jurisdictions, national hydrogen strategies are in place or emerging, but they differ substantially in their level of maturity, the type of targets adopted, and the regulatory signals they send. Some countries rely on explicit capacity and production targets that imply near-term regulatory action, while others frame hydrogen development through long-term demand scenarios or enabling legislative and investment frameworks, with regulatory implications that are longer term or less clearly defined.

Austria, Spain, Chile, and Argentina adopted strategies that include explicit quantitative objectives, though with different time horizons and market orientations. Austria’s national hydrogen strategy, published in June 2022, focuses on industrial decarbonisation and energy system integration, with a target of 1 GW of electrolyser capacity by 2030 and an objective to

replace 80% of fossil-based hydrogen with climate-neutral hydrogen in energy-intensive industries by 2030. Priority sectors include chemicals and steel, aviation and shipping, and system services such as storage and peak load balancing. Spain's strategy, updated in September 2024, sets an ambitious target of 12 GW of electrolyser capacity by 2030. While it does not specify hydrogen production volumes, it establishes a consumption-oriented objective for industry, with renewable fuels of non-biological origin (RFNBOs) expected to account for 74% of hydrogen use by 2030. Chile's National Green Hydrogen Strategy, published in November 2020, is the most explicitly phased, with targets of 5 GW of electrolysis operating or under development by the end of 2025 and 25 GW by 2030. It defines a sequenced rollout of priority sectors, starting with road transport, followed by mining transport and ammonia exports, and moving toward large-scale hydrogen exports after 2030. An updated version of Chile's National Hydrogen Strategy was published in March 2026, representing a key step in consolidating the country's leadership in the energy transition and industrial decarbonisation.

Argentina's national hydrogen strategy, published in September 2023, combines long-term quantitative targets with a strong export-oriented vision. The strategy sets objectives of 55 GW of renewable energy capacity and 30 GW of electrolyser capacity by 2050, alongside an annual production target of 5 million tonnes of low-carbon hydrogen. Approximately 80% of this production is intended for export, primarily in the form of green ammonia, sustainable aviation fuels, and maritime fuels, with the remaining 20% allocated to domestic uses in sectors such as chemicals, mining, and steel. The strategy also emphasizes broader economic objectives, including large-scale investment mobilisation and job creation, signaling a development-led approach in which regulatory frameworks are expected to evolve in parallel with project deployment rather than preceding it.

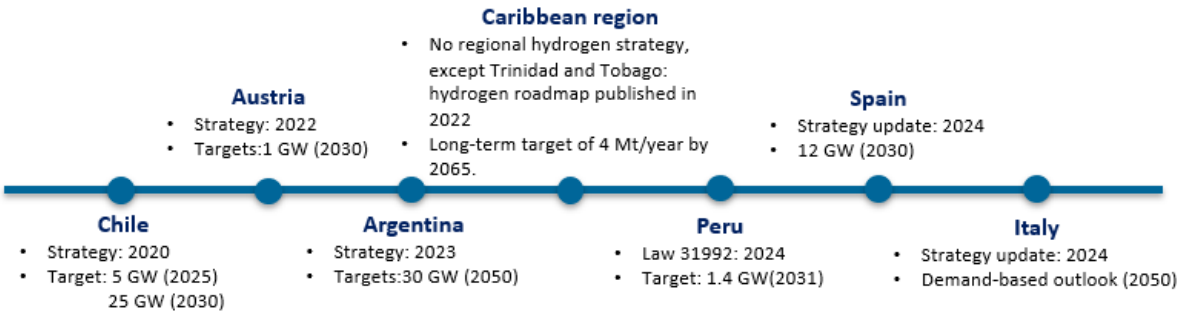

Figure 1: Timeline of National Hydrogen Strategies and Electrolyser Capacity Targets

Italy follows a different approach, relying primarily on long-term demand scenarios rather than production or capacity targets. Its national strategy, published in November 2024, estimates hydrogen demand in 2050 at between 2.23 and 4.16 million tonnes, with expected use concentrated in transport, particularly aviation, and in industry, notably steel and feedstock applications, as well as e-fuel production. The strategy explores alternative supply balances, with domestic production covering either 70% or 20% of demand, implicitly raising regulatory

questions related to imports, infrastructure designation, and cross-border coordination rather than near-term deployment oversight.

hydrogen strategies vary significantly in their level of maturity, ambition, and design. Capacity-driven strategies send strong near-term signals for deployment, while demand-based and enabling frameworks point to longer-term development pathways, highlighting the need for flexible regulatory approaches aligned with each strategic model.

Peru and the Caribbean region reflect more enabling or project-driven approaches. Peru's strategy framework is grounded in Law No. 31992, published in March 2024, which aims to promote the full green hydrogen value chain, including research and development, production, transport, use, and exports. Priority sectors are broad, spanning vehicular, agricultural, industrial, aviation, maritime, and public transport, while detailed targets and secondary regulation remain under development. In the Caribbean region, a comprehensive regional hydrogen strategy is generally absent. Trinidad and Tobago stands out with a roadmap published in 2022 that includes offshore wind and renewable hydrogen production, with a long-term indicative objective of 4 million tonnes per year of green hydrogen by 2065, primarily to support the transition of the petrochemical sector from grey to green hydrogen. Other jurisdictions in the region, such as Barbados and Dominica, are pursuing project-level initiatives, focused respectively on power applications and geothermal-based hydrogen, without an overarching national strategy.

From a comparative and regulatory perspective, these different strategic choices carry distinct implications. Capacity and production-based strategies, as seen in Austria, Spain, Chile, and Argentina, tend to require earlier regulatory engagement on permitting, grid connection, network planning, and safety oversight, although the timing and scope of regulatory intervention vary across jurisdictions. In Austria, for example, ambitious production targets and support schemes were established before a comprehensive hydrogen regulatory framework was fully developed, with the national regulator only receiving hydrogen-related competencies in late 2025 and further sector-specific legislation still under development. Export-oriented models such as those of Chile and Argentina place additional emphasis on international coordination and infrastructure development. Demand-scenario approaches, such as Italy's, shift the regulatory focus toward long-term system integration, infrastructure planning, and import governance. Framework-based and project-driven strategies, evident in Peru and much of the Caribbean region, signal a preparatory phase in which regulatory development is ongoing and institutional roles may still be evolving. Export orientation is a defining feature in Chile and Argentina and is also referenced in Peru, particularly for green ammonia, while Italy explicitly anticipates imports depending on domestic supply outcomes.

By contrast, Spain and Austria place greater emphasis on domestic market development and alignment with the broader European regulatory and market framework.

3. Promoted Hydrogen Technologies

Before presenting the hydrogen technologies promoted in each jurisdiction, it is important to clarify the main hydrogen production pathways and their respective implications. Hydrogen is commonly classified according to the energy source and production process used, which directly affects its carbon intensity, environmental performance, infrastructure requirements, and regulatory treatment. These distinctions are particularly relevant from a policy and regulatory perspective, as they influence eligibility for public support, alignment with decarbonisation objectives, and long-term system planning. The table below summarises the main hydrogen types: grey, blue, pink, and green, and highlights their key characteristics and implications.

Hydrogen Type	Energy Source	Production Process	Emissions Profile	Key Characteristics	Typical Policy Treatment
Grey Hydrogen	Fossil fuels (Coal and natural gas)	Steam Methane Reforming (SMR) or Autothermal Reforming (ATR)	High – CO_2 released directly into the atmosphere	Mature, lowest-production cost; dominant source of current hydrogen supply; heavily used in refineries and ammonia production	Generally not supported under decarbonisation policies; targeted for phase-out or replacement
Blue Hydrogen	Fossil fuels (Coal and natural gas)	SMR or ATR with Carbon Capture and Storage (CCS)	Medium – emissions reduced but not eliminated	Transitional option; dependent on CCS efficiency and methane leakage; infrastructure-intensive	Conditionally supported in some jurisdictions as a bridge technology
Pink Hydrogen	Nuclear energy	Electrolysis powered by nuclear electricity	Low – near-zero operational emissions	Provides stable, baseload hydrogen production	Supported primarily in countries with nuclear generation

Green Hydrogen	Renewable electricity	Water electrolysis using renewable power	**Very low / near-zero**	Fully aligned with long-term decarbonisation goals; higher costs today; scalability depends on renewable deployment	**Strongly promoted** in most national strategies and regulatory frameworks

Table 1: Overview of hydrogen production pathways

Across the seven jurisdictions, the policy direction is toward renewable or green hydrogen, but the degree of explicitness and the starting point for transition differ. In Austria, the promoted pathway is renewable (climate-neutral) hydrogen aligned with EU RFNBO definitions and delegated acts, with currently no indication of policy promotion for grey or blue hydrogen. In Spain, the position is explicit and restrictive: green hydrogen is promoted, while grey and blue hydrogen are not supported. Peru adopts a similarly explicit green-only stance, promoting green hydrogen and excluding grey and blue hydrogen from policy support.

Chile's national priorities also centre on green hydrogen; however, the market context reflects a more mixed early-stage reality in which both green and grey hydrogen may appear in pilot or testing activities. In the Caribbean region, the transition narrative is particularly clear: Trinidad and Tobago currently relies on grey hydrogen, mainly for the petrochemical sector, while policy direction and project-level initiatives point toward a gradual shift to green hydrogen, including activities in Dominica and Barbados.

Italy and Argentina present distinct transitional profiles. In Italy, hydrogen use remains predominantly grey, supplied through steam methane reforming and gasification routes, while strategic planning focuses on long-term demand scenarios rather than immediate technology substitution. In Argentina, current hydrogen consumption is also dominated by grey hydrogen, but the national strategy explicitly promotes a broader technological mix, including green hydrogen, blue hydrogen, and pink hydrogen, with a strong long-term orientation toward large-scale production and exports.

4. Installed and Target Electrolyser Capacity

Electrolysis deployment remains limited in absolute terms across most jurisdictions, a pattern that is not specific to the benchmarked countries but reflects a broader international trend. As shown in the table below comparing installed electrolyser capacity and projected targets, current deployment levels are significantly lower than stated ambitions. This divergence highlights a widespread structural gap between strategic planning and on-the-ground implementation in the early stages of hydrogen market development.

Jurisdiction	Installed Capacity (MW)	Target Capacity (MW)	Target Year
Argentina	Not reported / negligible	30,000	2050
Austria	~35,2	1,000	2030
Caribbean Region	Not reported	No regional target	–
Chile	~1–2	5,000 / 25,000	2025 / 2030
Italy	Not reported	No capacity target	–
Peru	~6	1,400	2031
Spain	~36	12,000	2030

Table 2: Installed vs Target Electrolyser Capacity

This gap is largely driven by uncertainty on both the supply and demand sides. Future hydrogen demand remains uncertain in terms of volume, timing, and end-use sectors, which weakens investment signals for large-scale electrolyser deployment. In parallel, high production costs, limited availability of long-term offtake agreements, infrastructure constraints, and the absence or limited maturity of certification and market rules further delay final investment decisions. Together, these factors contribute to a cautious, phased approach by project developers, with many projects remaining at the planning or pre-FID stage.

Bridging this gap will require stronger and more predictable support mechanisms and long-term market instruments, such as contracts for difference, hydrogen auctions, guaranteed offtake schemes, or cap-and-floor mechanisms for infrastructure. In parallel, regulatory and policy actions should focus on streamlining permitting procedures, clarifying grid access and connection rules, ensuring robust safety and technical standards, and aligning hydrogen regulation with existing gas and electricity market frameworks. Clear institutional roles, coordinated infrastructure planning, and stable policy signals will be critical to translating ambitious capacity targets into actual electrolyser deployment.

5. Hydrogen Market Overview: Current Demand and End-Users

Hydrogen demand is presently dominated by industrial end-uses where quantified data is available, with refineries and ammonia production consistently leading, and clean hydrogen

still representing a marginal share. In Austria, total consumption was 116,000 tonnes in 2022, with most hydrogen produced from natural gas and only 0.7% derived from renewable electrolysis; end-use is concentrated in ammonia production (61%) and refinery hydrotreating (31%). In Spain, demand reached 570,410 tonnes in 2023, dominated by refining (466,880 tonnes) and ammonia (72,450 tonnes), with smaller volumes in chemicals, industrial heat, and mobility; clean hydrogen use is reported at 3.77 kt within the total. In Italy, current demand is around 0.5 Mt H_2, mainly serving refineries and chemical industries and supplied predominantly through grey production routes.

Argentina exhibits a similar industrial demand profile. Current hydrogen consumption is estimated at approximately 400,000 tonnes per year, almost entirely supplied by grey hydrogen produced through steam methane reforming. End-use is concentrated in refineries and ammonia production, reflecting a mature but carbon-intensive hydrogen market. No quantified demand growth forecasts are currently reported, underscoring the early stage of transition planning despite the country's long-term export-oriented ambitions.

Chile presents a different demand profile reflecting an earlier market phase, with quantified figures linked to operational and authorised energy uses and approximately 1,139 kg H_2/day referenced for in-operation and authorised projects. End-uses are oriented toward pilots and demonstrations, including transport refuelling, e-fuels, blending demonstrations, and electricity-related applications, rather than established large-scale industrial substitution.

In Peru and the Caribbean region, quantified demand volumes are not provided, but the qualitative description points to grey hydrogen use in existing industrial settings. In Trinidad and Tobago, the petrochemical sector is the key end-user, while in Peru grey hydrogen use is associated primarily with refineries and oil production.

Across jurisdictions, the dominance of industrial hydrogen demand in Austria, Italy, Spain, and Argentina places regulatory emphasis on certification and traceability, industrial safety oversight, and the design of access and blending rules as hydrogen begins to interact with existing gas and electricity systems. In Europe, this is driven by the European legislative framework. Chile's pilot-led profile instead prioritises learning-oriented regulation that enables demonstrations under controlled conditions while building monitoring systems capable of scaling with market maturity. Persistent data gaps in Peru and the Caribbean region limit comparability and reinforce the importance of regulator-led reporting requirements covering demand volumes, end-users, and supply pathways.

6. Forecast Demand Growth

Demand forecasting ranges from quantified long-horizon projections to limited or absent forecasts, shaping the degree to which regulators can anticipate infrastructure and market design needs. In Spain, forecast demand reaches 2.2 Mt by 2040, signalling material future

network and storage requirements. In Italy, long-term scenarios place 2050 demand between 2.23 and 4.16 Mt H_2 with sectoral breakdowns, but intermediate-year forecasts are not included, implying a strategic horizon that is clear in magnitude but less detailed in timing.

Chile combines pipeline and macroeconomic signals, referencing a project pipeline estimate of 26.4 GW alongside central bank forecasts for internal demand of around 790 kton by 2035 and 1,816 kton by 2050. This combination supports a staged regulatory approach, where early pilots and corridors evolve toward larger domestic and potentially export-oriented systems. In Austria, a moderate near-term outlook is provided, expecting a demand of 0.15 Mt H_2 (5 TWh) by 2030, consistent with a smaller-scale transition and EU integration.

In Argentina, no quantified hydrogen demand growth forecasts are reported. While the national strategy defines ambitious long-term production and export objectives—particularly 5 million tonnes per year by 2050—these are not accompanied by domestic demand projections or intermediate milestones. As a result, demand-side visibility remains limited, constraining the ability to anticipate infrastructure needs and regulatory requirements beyond high-level strategic intent.

In the Caribbean region, quantified demand forecasts are not provided, but Trinidad and Tobago's roadmap includes a long-term production ambition of 4 Mt/year of green hydrogen by 2065, indicating strategic intent rather than near-term quantified domestic demand. In Peru, no demand growth forecasts are provided.

Overall, Spain and Italy signal large long-horizon growth with significant implications for network planning, storage, and market rules. Austria signals moderate near-term growth consistent with incremental deployment. Chile provides both market pipeline and macro projections supporting phased regulation. Argentina, like Peru and the Caribbean region, exhibits a gap between strategic ambition and quantified demand forecasting, suggesting that infrastructure planning and market design may remain project-led until more robust national demand outlooks are developed.

7. Import and Export Strategies

Trade positioning divides broadly between export-oriented jurisdictions, import-dependent or balance-driven systems, and jurisdictions with no explicit trade positioning.

Austria and Italy fall into the import-dependent or balance-driven category. In Austria, an import strategy is not yet formalised, but by 2040 hydrogen use is expected to reach around 70 TWh, with approximately 70% supplied through imports; an import strategy is currently under preparation, and a potential transit role is implied. In Italy, imports are embedded within long-term supply–demand scenarios for 2050, ranging from 0.7–1.2 Mt in a higher domestic

production case to 1.8–3.3 Mt in a lower domestic production case, indicating structural reliance on external supply under certain pathways.

Chile, Peru, Argentina, and the Caribbean region are primarily export-oriented, though with differing degrees of specificity. Chile's strategy is framed around international export partnerships, with memoranda of understanding in place with Europe, Japan, and South Korea, but without quantified export volumes. Peru's export orientation is more project-specific, centred on the "Horizonte de Verano" project, which targets exports of 3.6 million tonnes per year of green ammonia by 2031 to global markets.

Argentina adopts a clearly export-driven strategy, with an explicit objective to export approximately 4 million tonnes per year of hydrogen derivatives by 2050, mainly to EU countries, Japan, and Korea, while reserving a smaller share for domestic industrial use. In the Caribbean region, no import strategies are indicated, and export orientation is referenced through Trinidad and Tobago's long-term roadmap, as well as project-level visions in Barbados and Dominica, though without quantified export targets.

Spain stands apart as a trade-neutral jurisdiction, with neither import nor export objectives explicitly defined. Its approach appears primarily oriented toward domestic market development and integration within the broader EU framework, rather than a distinct trade positioning.

Across jurisdictions, a recurring issue is that export-oriented strategies frequently rely on MoUs, roadmaps, or flagship projects without firm volume commitments, increasing uncertainty for infrastructure sizing and investment sequencing. Import-dependent systems such as Austria and Italy face distinct regulatory challenges related to security of supply, cross-border infrastructure risk-sharing, and mutual recognition of certification schemes. Jurisdictions without explicit international trade targets, such as Spain, offer reduced visibility on future cross-border flows despite likely participation in regional hydrogen corridors.

8. Legislation and Regulation

Regulatory maturity varies significantly, ranging from hydrogen-specific safety rules and evolving network governance arrangements to the absence of dedicated hydrogen legislation. Austria is primarily anchored in EU frameworks: Regulation (EU) 2024/1789, Directive (EU) 2024/1788, and RED III, without yet a hydrogen-specific national law. National measures focus on investment and production support, notably through the Renewable Energy Expansion Act and the Hydrogen Promotion Act (June 2024), which provides up to €820 million in RFNBO-compliant production support. E-Control was designated as the competent authority for hydrogen-related matters in December 2025; however, its operational mandate remains limited pending the amendment of the Austrian Gas Act, which will bring further scope for action (expected in 2026).

Regulatory maturity for hydrogen remains highly uneven. Frameworks range from jurisdictions with hydrogen-specific safety and permitting rules and progressively evolving governance arrangements, to contexts where no dedicated hydrogen legislation yet exists and regulation relies on general energy or environmental law. In most cases, safety oversight is the first regulatory layer to be established, while market design, infrastructure governance, certification, and cost allocation mechanisms are still under development or absent. Overall, hydrogen regulation is in a transitional phase, characterised by preparatory legal frameworks, partial integration into existing energy regulation, and ongoing efforts to align policy ambition with regulatory certainty.

Chile represents the most advanced case in terms of hydrogen-specific regulation, having integrated hydrogen into existing legal instruments and adopted a dedicated safety regulation (DS 13/2024). Hydrogen is formally recognised as an energy source, and a broader programme of regulatory updates across mining, gas, transport, and electricity reflects a safety- and permitting-centred approach.

Spain has no standalone hydrogen law but is developing a structured framework aligned with EU market integration. This includes the provisional designation of a Hydrogen Network Operator, specific arrangements for projects of common interest under an unbundling regime, and detailed provisions for natural gas network access, blending, and certification of renewable electricity generation, largely administered and overseen by the national energy regulator CNMC.

Peru stands out among non-EU jurisdictions for adopting a hydrogen-specific legal basis through Law No. 31992, which defines green hydrogen, establishes incentives, and creates a multisectoral governance structure led by the Ministry of Energy and Mines. However, key secondary regulations—covering safety, certification, and quality—remain under development.

Argentina currently lacks hydrogen-specific legislation, with its regulatory framework still at a preparatory stage. While draft bills are under consideration by the National Congress, hydrogen regulation continues to rely on general energy and gas sector rules, particularly for pipeline safety and blending standards. This creates regulatory uncertainty for project developers, especially in relation to permitting, certification, and long-term infrastructure governance.

In Italy, no dedicated hydrogen regulatory framework is yet in place, and the EU decarbonisation package has not been transposed. Similarly, in the Caribbean region, no hydrogen-specific legislation is reported, with governance remaining project-driven and ministry-led.

Overall, four broad regulatory patterns emerge: hydrogen-specific safety and permitting regimes (Chile), infrastructure governance aligned with EU market integration (Spain), funding and eligibility frameworks anchored in EU sustainability rules (Austria), and enabling or preparatory legal frameworks (Peru and Argentina).

9. Infrastructure for Transportation: Pipelines, Refuelling, Storage

Infrastructure readiness is uneven. Spain and Italy outline substantial pipeline expansion plans: Spain references a 2,844 km hydrogen backbone plus cross-border H2Med segments and planned seasonal storage in salt caverns, while Italy reports ~2,500 km of planned pipelines and repurposing of ~60% of existing gas infrastructure. Austria has no existing hydrogen pipelines but intends to build 380 km of new pipelines and convert 730 km of existing natural gas pipelines by 2030. Chile reports no current hydrogen pipelines but expects project-linked pipelines under environmental assessment; refuelling stations exist mainly around Santiago with mixed operational status, and storage is project-specific. Argentina reports a small pilot hydrogen pipeline (2.5 km) and a pilot underground storage facility, but no broader pipeline forecast. Peru reports no pipelines, refuelling stations, or storage facilities. The Caribbean region similarly reports no pipelines and no refuelling stations, with one planned storage project (128 MWh).

Overall, the benchmark highlights a clear divide between jurisdictions moving toward integrated hydrogen networks and those where infrastructure development is still exploratory, suggesting that regulatory focus in early-stage systems will remain centered on project-level permitting and safety, while more advanced systems will need to address network governance, access regimes, and long-term system planning.

10. Institutional Framework and Roles

Across the benchmarked jurisdictions, institutional arrangements for hydrogen governance reflect differing levels of market maturity and regulatory development. While ministries typically lead strategy and policy formulation, the roles of regulators, promotion bodies, and infrastructure operators vary significantly, ranging from clearly defined multi-agency frameworks to more centralised or evolving arrangements.

- **Policy and Strategy Authorities:**

In all jurisdictions, central government ministries lead hydrogen policy and strategy formulation (Austria, Spain, Italy, Chile, Argentina, Peru, Caribbean region).

- In more mature systems, ministries also oversee funding mechanisms, international cooperation, and integration with broader climate and energy strategies (Austria, Spain, Italy).
- In emerging systems, ministries additionally coordinate pilot projects, international finance, and institutional capacity building (Peru, Chile, Caribbean region, Argentina).

➢ **Hydrogen Promotion and Market Development:**

Dedicated hydrogen promotion agencies are not universal.

- Some jurisdictions rely on industry associations, clusters, or public agencies to promote hydrogen development and stakeholder coordination (Chile: H2 Chile and regional hydrogen associations; Spain: AeH2, IDAE, CNH2, SHYNE; Austria: Hydrogen Partnership Austria).
- Others adopt a market-led approach, where no formal hydrogen promotion agency exists and private actors are expected to drive investment decisions (Argentina, Italy, Trinidad and Tobago).
- In early-stage systems, promotion functions are often assumed de facto by ministries or project-specific entities (Peru, Barbados and Dominica within the Caribbean region).

➢ **Energy Regulators:**

The role of energy regulators differs substantially across countries:

- In jurisdictions aligned with EU frameworks, regulators are expected to assume responsibilities similar to those in gas and electricity markets, including network oversight, access rules, unbundling, tariffs, and market monitoring, although formal mandates are still evolving (Spain: CNMC; Austria: E-Control; Italy: ARERA – mandate pending).
- In other jurisdictions, regulators currently have limited or no formal competence over hydrogen, intervening mainly through existing mandates such as gas pipeline regulation or technical standards (Argentina: pipeline regulator for blending standards; Chile: CNE advisory role).
- Where hydrogen markets remain nascent, regulators focus on monitoring developments and advising policymakers rather than active market regulation (Peru, Caribbean region).

➢ **Safety and Environmental Authorities:**

Safety oversight is generally entrusted to specialised safety regulators or inspectorates, often distinct from economic regulators.

- These authorities approve technical standards, register installations, and conduct inspections (Chile: SEC under DS 13/2024; Spain and Austria through general energy and safety legislation).
- Environmental agencies conduct environmental impact assessments and public consultations (Chile: SEA; Argentina: provincial environmental authorities; Peru: Produce; Spain and Italy: national/regional environmental bodies; Caribbean jurisdictions through ESIA frameworks).

➢ **Grid and Infrastructure Operators:**

Infrastructure operation is typically assigned to existing gas and electricity network operators, whether public or private.

- In advanced jurisdictions, operators are actively planning hydrogen backbones, repurposing gas networks, and developing storage solutions (Spain: Enagás Infraestructuras de Hidrógeno; Italy: Snam and SGI; Austria: gas TSOs under ÖNIP).
- In early-stage systems, operators report no current hydrogen projects or requests, but are expected to play a future role in blending authorisation and dispatch (Argentina, Peru, Caribbean region).

➢ **Research, Certification, and Supporting Institutions:**

Several jurisdictions involve research institutions, standardisation bodies, and certification entities to support hydrogen development.

- Research organisations contribute to pilot projects and technology development (Italy: ENEA, CNR, RSE; Spain: CNH2; Chile: universities and energy clusters).
- Standardisation bodies are expected to adopt international technical and safety standards (Argentina: IRAM; Chile and Austria through adoption of ISO and EU standards).
- Certification roles are emerging or anticipated (Spain: CNMC guarantees of origin of renewable electricity generation; Argentina: CAMMESA potential role; Peru: certification framework under development, Austria: E-Control guarantees of origin of green hydrogen).

11. Financing and Incentives

Based on the benchmark, financing and incentive approaches can be grouped into a limited number of recurring models. Each model reflects a different level of market maturity, fiscal capacity, and policy objective, and is adopted by several jurisdictions with similar strategic orientations.

Financing & Incentive Model	Key Characteristics / Instruments	Countries / Regions
Structured public funding and rule-based support schemes	Competitive auctions, fixed production premiums, investment grants, IPCEI participation, recovery and resilience funding, RFNBO-aligned eligibility criteria, PCI/PMI (CEF)	Austria, Spain, Italy
State-backed investment leverage and export-oriented financing	Dedicated hydrogen development funds, blended finance with multilateral development banks, state guarantees, allocation of public land, advisory and project support	Chile
Investment-enabling fiscal and tax incentive frameworks	Tax incentives, fiscal stability regimes, large-investment promotion laws, market-led project development with limited direct subsidies	Argentina
Enabling legal frameworks with incentives under development	Hydrogen-specific framework laws, future tax and economic incentives under secondary regulation, reliance on international financing in early stages	Peru
Project-based and blended finance approaches	Grants, concessional loans, guarantees, bilateral and multilateral funding, PPAs and offtake agreements, no comprehensive national subsidy schemes	Caribbean Region (Trinidad and Tobago, Barbados, Dominica)

Table 3: Overview of Financing and Incentive Models for Low-Carbon Hydrogen Development

12. Conclusion

This benchmark highlights that low-carbon hydrogen has become a clear strategic priority across jurisdictions, yet its practical deployment remains at an early and uneven stage. While national strategies are widely established, their design, maturity, and regulatory implications differ markedly. Some jurisdictions articulate clear quantitative targets for electrolyser deployment, production, and infrastructure, whereas others rely on long-term scenarios, enabling legislation, or project-driven approaches. As a result, policy ambition often outpaces regulatory and market readiness.

Across all jurisdictions, current hydrogen markets remain dominated by conventional industrial uses supplied largely by fossil-based hydrogen. Clean and renewable hydrogen deployment is still marginal, with installed electrolyser capacity far below stated targets. This gap reflects structural challenges, including uncertain demand trajectories, high production costs, limited offtake certainty, infrastructure constraints, and incomplete regulatory frameworks. Export-

oriented strategies further amplify these challenges by introducing dependencies on international coordination, cross-border infrastructure, and mutual recognition of certification schemes.

Infrastructure readiness is a key differentiator. A limited number of jurisdictions are moving toward corridor-scale hydrogen networks and storage systems, while others remain focused on pilot-level or project-specific infrastructure. Storage development, although widely recognised as critical, remains one of the least mature elements of hydrogen systems. Institutional arrangements also vary widely, with clear multi-agency governance in some cases and evolving or fragmented responsibilities in others.

Overall, the benchmark confirms that hydrogen policy has entered a transition phase: moving from vision-setting and pilots toward questions of scale, system integration, and cost allocation. For regulators, the central challenge is to support early development and learning while avoiding premature lock-in, ensuring safety, protecting consumers, and maintaining coherence with existing electricity and gas market frameworks.

13. Recommendations for Regulators and Policymakers

1. **Adopt a phased and adaptive regulatory approach**

Regulation should evolve in step with market maturity, prioritising safety and transparency in early stages while allowing flexibility to adjust market rules, access regimes, and tariff structures as demand and infrastructure scale.

2. **Strengthen demand visibility and data transparency**

Improved reporting requirements for hydrogen production, consumption, end-uses, and project pipelines would reduce uncertainty, support infrastructure planning, and enhance regulatory foresight, particularly in jurisdictions with limited demand forecasts.

3. **Bridge the gap between targets and deployment**

Long-term support mechanisms, such as contracts for difference, hydrogen auctions, guaranteed offtake schemes, or cap-and-floor models for infrastructure, are essential to translate strategic ambitions into bankable investment decisions.

4. **Clarify institutional roles and regulatory mandates**

Clear allocation of responsibilities among ministries, regulators, safety authorities, and infrastructure operators is critical to reduce uncertainty, streamline permitting, and ensure consistent oversight as hydrogen systems expand.

5. **Ensure alignment with existing energy system regulation**

Hydrogen regulation should be designed coherently with electricity and gas frameworks, particularly for network access, blending, storage, and cross-sector interactions, to avoid fragmentation and inefficiencies.

6. **Prioritise safety and technical standardization**

Early and robust safety regulation, aligned with international standards, is a prerequisite for public acceptance, investor confidence, and scalable deployment across production, transport, storage, and end-use applications.

7. **Prepare for cross-border and trade implications**

Export-oriented and import-dependent strategies require early regulatory attention to certification, interoperability, infrastructure governance, and international coordination to manage future cross-border hydrogen flows effectively.

By addressing these areas, regulators can play a central role in enabling hydrogen's transition from a policy aspiration to a reliable, cost-effective, and integrated component of decarbonised energy systems.