OHI COUNTRY MARKET & POLICY DOSSIER

COLOMBIA

POSITIONING HYDROGEN IN A HYBRID STRATEGY ECONOMY

OPEN HYDROGEN INITIATIVE

GTI ENERGY

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The Open Hydrogen Initiative includes a broad range of stakeholders who are collaborating to develop open-source protocols that will unlock hydrogen's potential to decarbonize energy-intensive sectors. It was developed by GTI Energy and S&P Global Commodity Insights.

GTI Energy is focused on developing, scaling, and deploying energy transition solutions that improve lives, economies, and the environment.

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Executive Summary

Colombia enters 2026 as one of Latin America's more credible hydrogen actors, with strong renewable resources, a functioning legal framework, and a state champion in Ecopetrol that is commissioning the region's largest green hydrogen plant. Yet ambition and execution remain distinct. Progress has been uneven, with delays in transmission infrastructure, suspended pilot projects, social license challenges in La Guajira (Colombia's highest-potential hydrogen production zone located in the northeast region of the country), and a domestic demand base that has yet to scale meaningfully.

The country's 2021 Hydrogen Roadmap set targets of 1-3 GW of electrolysis capacity by 2030 at a production cost of USD 1.7/kg, which is technically achievable given La Guajira's wind and solar potential, but contingent on infrastructure investments and permitting timelines that have consistently slipped. A 2025 review by the Colombian Hydrogen Association reflects this mixed progress, noting both advancement and remaining gaps.

In the OHI Global Hydrogen Market Landscape Report (March 2026), Colombia is classified as a Hybrid Strategy country, combining strong resource potential and policy intent with constraints around financing and domestic demand [1]. This dossier expands that assessment by drawing on news articles, official government reports, IEA and World Bank data, industry publications, and the most recent peer-reviewed academic literature on Colombia's hydrogen pathways.

System-level analyses suggest that realizing Colombia's longer-term hydrogen potential would require significantly greater scale – on the order of 2-6.4 Mt/year of production, 8–27 GW of capacity, and USD 50–80 billion in investment through 2050 – placing current targets within a broader development trajectory [2].

Colombia's climate ambition has meaningfully deepened since the roadmap's 2021 publication. In September 2025, Colombia submitted an updated nationally determined contribution (NDC) committing to an absolute emissions ceiling of 155–161 $MtCO_2e$ by 2035, a value lower than its 2030 target under the previous NDC. However, the Climate Action Tracker rates Colombia's policies as 'Insufficient' to meet its own targets, with a projected implementation gap of 36–38% above the fair-share pathway. Hydrogen will need to scale substantially to help close that gap, particularly in hard-to-abate industrial sectors [3], [4].

Current policies remain insufficient to meet these targets, implying a need for hydrogen to scale, particularly in hard-to-abate sectors. Regionally, Colombia is well-positioned in terms of resources and policy coherence but continues to lag in execution and market development. Its limited domestic industrial demand base and partial reliance on blue hydrogen pathways introduce additional complexity, particularly in the context of evolving international certification requirements [5].

While Colombia has established a domestic emissions threshold (<4.13 kg CO_2e/kg H_2), alignment with export markets – particularly the EU – will require meeting stricter standards around additionality, temporal matching, and full chain-of-custody verification [6].

Overview and Key Takeaways

Overview

Policy & Regulatory Support	Offtake & Demand Development	Technology & Innovation Capacity
■■■■□	■■□□□	■■■□□
Geographic Strategic Location	**Economic Viability**	**Social License & Stakeholder Alignment**
■■■□□	■□□□□	■■■□□

Key Takeaways

Investors	Policy & Government	General Audience
Globally competitive costs: Colombia is projected to be one of the lowest-cost hydrogen producers in the world by 2050. In La Guajira, production costs could reach around **USD 1.70/kg**, [7], [8]. **Strong project economics (in the right conditions):** A December 2025 World Bank analysis found that most modeled port-based hydrogen export configurations are economically viable, with **returns in the range of 14–24%** under base-case assumptions [9]. **Large-scale investment opportunity:** Building out a full hydrogen economy in Colombia will require **USD 50–80 billion in investment through 2050**, underscoring the scale of the opportunity and the level of commitment needed [7]. **Key risks:** Lengthy permitting processes policy uncertainty beyond the 2026 election, and emissions-related risks for blue hydrogen, particularly around upstream methane leakage.	**Dual-pathway strategy:** Colombia's green + blue approach is **among the most pragmatic in Latin America**, but blue H_2 viability depends on stringent carbon capture and methane controls [5]. **Climate alignment:** Colombia's September 2025 NDC sets a stricter 2035 emissions ceiling (155-161 $MtCO_2e$), increasing the **importance of scaling industrial hydrogen** to help close the implementation gap [3]. **Derivatives-first pathway:** Near-term commercialization is expected to center on hydrogen derivatives – including ammonia, methanol, and synthetic fuels – rather than pure hydrogen, which faces **infrastructure and demand constraints** [5]. **Social license risk:** Project development in La Guajira is contingent on establishing binding water-sharing and community co-ownership frameworks prior to construction, not after.	**Early deployment milestone:** Colombia is commissioning its first large green hydrogen plant in Cartagena in 2026, making a significant first step toward broader system development. **High potential, constrained by execution:** The country has world-class wind and solar resources, but faces infrastructure, water access, and social challenges that will determine whether that potential translates into commercial projects. Realizing Colombia's long-term hydrogen vision could require USD 50-80 billion in total investment. **Economic transformation potential:** Colombia's hydrogen story is also about economic transformation: replacing fossil fuel revenues with clean energy exports, creating new industries, and building long-term energy sovereignty.

Contents

National Strategy & Regional Positioning

The Hydrogen Roadmap and Policy Architecture

Colombia's National Hydrogen Strategy and Roadmap, published in September 2021, establishes a long-term framework for hydrogen development through 2050. Developed with support from the Inter-American Development Bank (IDB) and the UK Sustainable Infrastructure Program, the roadmap is structured around four core components: production pathway analysis, demand and emissions scenarios, regulatory gap assessment, and stakeholder engagement. It remains one of the more comprehensive hydrogen policy frameworks in Latin America [10].

The roadmap sets quantified 2030 targets across supply, demand, and economic development. These include 1-3 GW of installed electrolyzer capacity, production costs of approximately USD 1.7/kg, and 50 ktpa of low-carbon hydrogen output. On the demand side, targets include 120 ktpa of domestic consumption, replacement of 40% of existing industrial hydrogen use with low-carbon supply, and early deployment of hydrogen mobility infrastructure (1,500-2,000 fuel cell vehicles, 1,000-1,500 trucks, and 50–100 refueling stations). The roadmap also targets USD 2.5-5.5 billion in investment and the creation of 7,000-15,000 jobs [5], [10], [11].

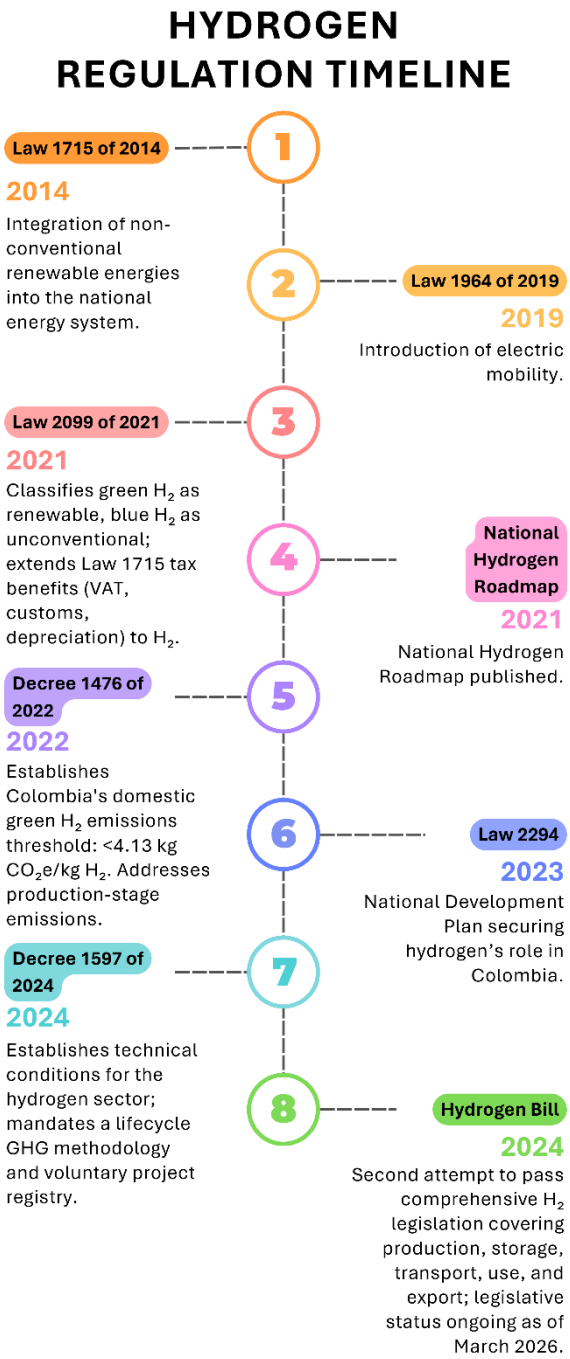

Figure 1. Hydrogen law, regulations and strategy timeline in Colombia. [5],[10],[14]

Colombia's policy framework adopts a dual-pathway approach, supporting both green hydrogen (renewable-powered electrolysis) and blue hydrogen (natural gas with CCUS). Subsequent regulatory developments have expanded and operationalized this framework. Decree

1476 of 2022 defines a domestic emissions threshold for hydrogen production (<4.13 kg CO_2e/kg H_2), while the National Development Plan 2022–2026 (Law 2294 of 2023) establishes the broader CCUS policy context. Decree 1597 of 2024 introduces technical guidelines for the sector, including the development of a lifecycle GHG methodology and a centralized project registry (Ecosistema H2 Colombia, ECOH2) [12]–[14].

In parallel, Colombia has introduced enabling mechanisms to support early-stage deployment. Under Law 2069 of 2020, a cross-sector regulatory sandbox allows temporary relaxation of regulatory requirements to facilitate testing of innovative technologies, including hydrogen applications. This mechanism is identified as an important tool for advancing project development in an evolving regulatory environment [5].

Despite this policy progress, implementation remains at an early stage. A 2025 review by the Colombian Hydrogen Association (AHC) identifies continued gaps in demand formation, grid connectivity, and certification alignment with international markets. As of early 2026, approximately 37 hydrogen-related projects have been announced in Colombia, with the majority (86.5%) in development and a limited share (13.5%) operational, indicating that the sector remains in a pre-commercial phase [5]. Other estimates have operational projects closer to 20%, which is a more positive outcome, but still represents a minority of projects [15].

Colombia's Climate Commitment and the Role of Hydrogen

Colombia's hydrogen strategy is closely linked to its broader climate commitments. The country submitted its updated NDC 3.0 in September 2025, committing to an absolute emissions ceiling of 155-161 $MtCO_2e$ by 2035 – lower than its previous 2030 target – and aligned with a 2050 carbon neutrality goal. The energy sector accounts for 31.5% of total emissions, and Colombia became a net importer of natural gas in 2024 as domestic production declined [3], [4]

Current policy implementation remains insufficient to meet these targets. The Climate Action Tracker projects Colombia's 2030 emissions at 36-38% above its fair-share 1.5°C pathway under existing measures. Closing this gap will require hydrogen to scale in hard-to-abate sectors, particularly refining, cement, fertilizers, and heavy transport. System-level modeling suggests that under an ambitious decarbonization scenario, hydrogen could grow from a negligible share today to approximately 15% of Colombia's energy mix by 2050, with the strongest uptake in industry, transport, and export markets [4], [7].

Colombia's current hydrogen demand is concentrated in industrial applications. In 2021, consumption was estimated at 150-155 ktpa, primarily supplied via steam methane reforming (76%), with smaller shares from SMR with CCUS (20%) and electrolysis (4%) [7]. As of 2024, demand continues to grow, led by Ecopetrol's refinery operations, which produce approximately 130 ktpa of hydrogen for internal use. This positions refinery decarbonization as the most immediate commercial application for low-carbon hydrogen.

Industrial clusters reinforce this pathway. The Mamonal Industrial Zone near Cartagena - including the Reficar refinery, Esenttia plastics complex, Argos cement operations, and Yara fertilizer production - represents a concentrated demand center aligned with hydrogen hub models seen in

North America and Europe [16]. Consistent with the national roadmap, early hydrogen adoption is expected to be driven by industrial demand, with transportation applications scaling more gradually over time.

Colombia's Just Energy Transition Roadmap further reinforces this trajectory, outlining an end to new oil and gas exploration and a coal phase-out by 2036. This creates both policy pressure and economic incentives to accelerate hydrogen deployment as a transition fuel and long-term substitute for fossil-based feedstocks [4].

Positioning Colombia in the Regional Context

Structural Positioning: What the Evidence Shows

Colombia occupies a middle position in Latin America's hydrogen landscape. It is neither an export-first system like Chile or Argentina nor a large-scale domestic industrial anchor like Brazil. Instead, it is best characterized as a domestic decarbonizer with an emerging export pathway, with early deployment focused on industrial applications before scaling toward international markets.

This positioning is consistent across multiple classifications. The World Economic Forum, IRENA, and OLACDE describe Colombia as a "local decarbonizer," while the Open Hydrogen Initiative Global Hydrogen Market Landscape Report places it in the lower-left quadrant of the domestic demand versus export orientation matrix, alongside countries such as the United States, India, Spain, Portugal, and Norway [1], [17].

Cost Competitiveness and the Measurement Problem

Widely cited cost comparisons between Colombia and Chile are not directly comparable. Colombia and Brazil use 20-year project lifetimes in their LCOH calculations; Chile uses 25 years. Colombia uses the weighted average cost of renewable energy for OPEX; Brazil uses LCOE; Chile uses hourly cost. These differences compound over long-term projections and distort relative cost positioning [5].

When evaluated under consistent assumptions, the cost gap narrows considerably. Wind-powered hydrogen in La Guajira is estimated at ~USD 1.6/kg by 2030, with delivered costs to Europe around USD 3.10/kg, broadly competitive with leading Chilean sites. Colombia's Caribbean location also provides a relative advantage for U.S. East Coast markets. Reported cost disadvantages are therefore partly methodological rather than structural [18].

Scale Gap Between Near-Term Targets and System-Level Requirements

Colombia's 2030 roadmap targets (1-3 GW of electrolyzer capacity, 50 ktpa of production) represent an initial deployment phase rather than a full system buildout. System-level modeling indicates that achieving long-term decarbonization and export potential would require 8-27 GW of capacity and USD 50-80 billion in investment through 2050 [7].

This highlights a structural gap between near-term policy framing and long-term system requirements. While current targets are appropriate as first-phase milestones, a clear pathway to second-phase scale-up has not yet been defined.

Commercial Pathway: Derivatives Over Pure Hydrogen

Across both system-level modeling and project-level evidence, direct commercialization of pure hydrogen is unlikely in the near to medium term. The more viable economic pathways run through hydrogen derivatives – particularly ammonia, methanol, and synthetic fuels – which align with existing infrastructure and global demand channels [5], [7].

This distinction has direct implications for how Colombia's project pipeline should be evaluated. Projects configured for derivative markets – green ammonia for maritime bunkering and fertilizers, green methanol for the Cartagena/Barranquilla industrial corridor – have a clearer path to bankability than those premised on pure hydrogen export infrastructure that does not yet exist.

Demand Constraints vs. Export Potential

Colombia's domestic demand base is relatively limited. It is concentrated in refining and fertilizer production, and lacks the diversified industrial anchor seen in Brazil, where steel and large-scale petrochemicals generate substantial hydrogen demand. At the same time, Colombia benefits from strong renewable resource potential and a geographically concentrated export corridor in La Guajira, offering a more focused development pathway than Brazil's distributed approach [7], [18].

This creates a structural tension: the country is well-positioned for export-oriented production but must simultaneously address domestic demand formation and market access challenges. Absent meaningful demand signals – whether from carbon pricing, procurement mandates, or industrial cluster development – project timelines are likely to continue lagging announced targets.

KPI Comparison: Colombia vs. Regional Peers

The table below presents key hydrogen economy indicators across the principal Latin American hydrogen markets. These figures should be interpreted directionally rather than as precise comparisons; underlying methodologies differ significantly across countries, particularly in LCOH calculation. They are most useful when read alongside the structural analysis above [1], [5].

Table 1. Key hydrogen economy indicators across Latin America's principal markets. Sources: [1], [5], [7], [10], [18]

KPI	Colombia	Chile	Brazil	Notes
Electrolyzer Capacity Target (GW)	1-3 GW (2030)	25 GW (2030)	1 GW (2030, post-2024 law)	Chile target reflects different ambition stage and strategy
LCOH Target (USD/kg, 2030)	USD 1.7/kg	USD 1.2-1.5/kg	Not specified	Not directly comparable (different modeling assumptions) [26]
Best-Region LCOH (wind, 2030)	USD ~2.25/kg (La Guajira)	USD ~1.50/kg (Magallanes)	—	Gap narrower than roadmap targets imply when consistent methods used [27]
H_2 Production Goal (Mt, 2050)	~3.5 Mt (roadmap); 2-6.4 Mt (modelled)	~3.5 Mt (roadmap)	—	System-level modelling suggests roadmap is undersized [25]
GHG Reduction Target	51% by 2030; 155-161 $MtCO_2e$ by 2035	Net zero by 2050	Net zero by 2050	Colombia has among region's most ambitious near-term targets

Projects (operational / total)	~5 / 37 (13.5% operational)	~31+ (several commercial)	20+ large-scale	Colombia has smallest operational share of the three [26]
Domestic H_2 Demand Base	Refining, fertilizers (~155 ktpa gray)	Mining, industrial	Steel, chemicals, refining	Brazil has most diversified industrial demand base
Primary Near-Term Export Vector	Green ammonia; green methanol	Green ammonia; e-fuels	Green ammonia	All three converging on derivatives over pure H_2
Total Investment Needed (to 2050)	USD 50-80 billion (modelled)	USD 81 billion (announced)	USD 26 billion (committed)	Scale of long-term commitment required

The Regional Competitive Landscape

Colombia's four primary regional comparators each represent a different hydrogen development model. Understanding how Colombia differs from each, and where those differences create both competitive pressure and potential for regional collaboration, is essential context for assessing Colombia's strategic position.

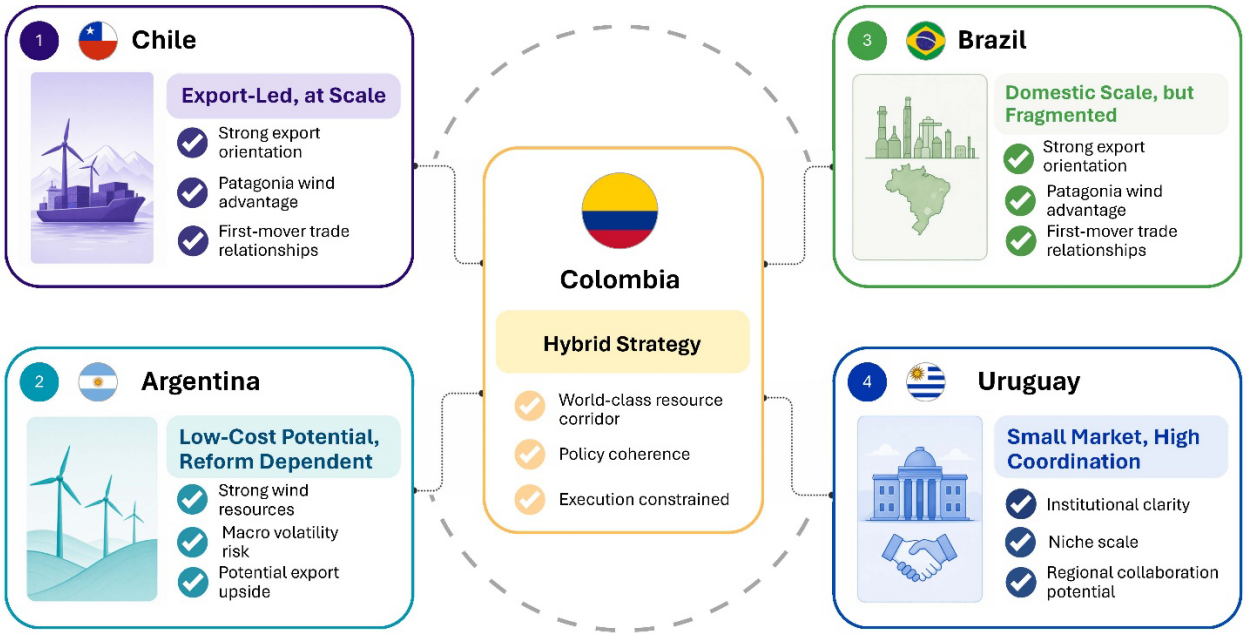

Figure 2. Competitive landscape showing key hydrogen economies in Colombia's vicinity.

Chile: Export-Led, at Scale

Chile is the regional benchmark on cost, scale, and international alignment. Its 25 GW electrolyzer target and early bilateral offtake discussions with Germany, Japan, and South Korea reflect a fundamentally different strategic posture than Colombia's. Chile leads primarily through Patagonia's extraordinary wind resource and the Magallanes corridor, and has a more mature export infrastructure conversation. Colombia's comparison disadvantage on cost targets is partly a modeling artifact, but Chile's depth of project execution and bilateral trade relationships is a genuine first-mover advantage that will take years to close [1], [5]. The assessment is shared by practitioners in Colombia's energy sector. Diego L. Franco J. of the Centro de Desarrollo

Tecnológico del Gas put it plainly: "Chile is ahead of every other country in Latin America. They are most advanced in contracts, agreements, and further along in infrastructure installation."

Brazil: Domestic Scale, but Fragmented

Brazil's strength lies in its large domestic demand base, anchored in steel, petrochemicals, and refining, alongside a growing pipeline of large-scale projects. Its regulatory framework accelerated after 2024, positioning Brazil as a demand-led system with long-term export potential.

However, development is geographically dispersed, particularly across northeastern hub regions, creating infrastructure and coordination challenges. In contrast, Colombia's La Guajira corridor is more geographically concentrated, though smaller in scale [5].

Argentina: Resource-Rich, Execution-Constrained

Argentina's Patagonia region offers some of the world's strongest wind resources for hydrogen production, supporting credible long-term export ambitions. However, project development has been constrained by macroeconomic instability, including high financing costs and currency risk.

Recent policy reforms have reduced some barriers, but long-term regulatory certainty remains uncertain. Argentina is therefore best understood as a resource-competitive but execution-constrained player, with implications for future competition in export markets [19]–[21].

> I do not view hydrogen development in Latin America as a zero-sum competition. As the first commercial-scale hydrogen and derivative projects begin operating and demonstrate technical and economic viability, other countries in the region will be able to learn from these pioneering experiences. In that sense, successful projects in Chile, Brazil, Uruguay, or elsewhere may ultimately accelerate, rather than hinder, the development of projects in Colombia.
>
> MARTHA ISABEL COBO ÁNGEL
> *Dean of Engineering at the Universidad de La Sabana, Colombia*

Uruguay: First-Mover on Derivatives

Uruguay is the most significant recent development in the regional landscape. In December 2025, Uruguay signed an MoU with HIF Global for a USD 6 billion e-methanol facility at Paysandú, one of the region's first genuinely large-scale derivative production project. Simultaneously, Uruguay secured IFC's first-ever global green hydrogen investment in the Kahirós project [22]–[24]. With over 99% of its electricity from renewables and a stable, investment-friendly regulatory environment, Uruguay is rapidly establishing itself as the region's most credible focused player on e-fuels and derivatives. It represents a different competitive axis from Chile or Brazil: not large-scale ammonia export, but early-mover advantage in synthetic fuels that will be in high demand for maritime decarbonization. Cartagena's position near the Panama Canal gives Colombia a geographic counter-advantage Uruguay cannot replicate, but Colombia has yet to move with Uruguay's speed on commercial agreements.

That gap in commercial speed does not necessarily mean Colombia loses ground permanently. As Dr. Cobo Ángel suggests — and as the pull-quote alongside this section elaborates — early movers

like Uruguay may ultimately serve as proof points that accelerate, rather than foreclose, Colombia's own path to market.

Colombia's Distinctive Position

Colombia occupies an intermediate position within this competitive landscape. It is not the most advanced on scale or deployment, but it is among the more policy-coherent and geographically focused systems.

Its primary advantage lies in the La Guajira corridor, combining strong renewable resources with proximity to Caribbean shipping routes. This is reinforced by the Mamonal industrial cluster near Cartagena, providing a near-term demand base. Few regional peers combine resource quality, industrial demand, and export access within a single, concentrated geography.

However, this advantage remains largely latent. While Colombia ranks highly on readiness, progress in execution has lagged peers that are already securing financing and commercial agreements. As the regional market evolves, competitive positioning will increasingly depend on infrastructure readiness, certification alignment, and speed of commercial deployment, rather than resource potential alone.

Qualification & Compliance Environment

Domestic Regulatory Framework

Colombia has built one of the more comprehensive hydrogen regulatory frameworks in Latin America in a short period of time. The architecture is largely incentive-based, including tax exemptions, accelerated depreciation, and government financing, rather than mandates or penalties. The critical gap on the demand side is the absence of a carbon price that would make low-carbon hydrogen competitive with gray hydrogen in domestic markets without explicit policy support. The table below summarizes key regulatory instruments in the Colombian hydrogen space.

Table 2. Colombia's regulatory framework development [5],[14].

Regulatory Instrument	Key Provision and Status
Law 2099 - Energy Transition Law (2021)	Classifies green H_2 as renewable, blue H_2 as unconventional; extends Law 1715 tax benefits (VAT, customs, depreciation) to H_2; mandates FENOGE to finance H_2 projects
Decree 1476 (2022)	Establishes Colombia's domestic green H_2 emissions threshold: <4.13 kg CO_2e/kg H_2. Addresses production-stage emissions but lacks the additionality and chain-of-custody requirements needed for EU export markets
Decree 1536 (2022)	Expands public utility and social interest declarations to include green H_2 production, storage, and energy infrastructure
Colombia Green Taxonomy (2022)	Channels investment toward environmental objectives; green and blue H_2 explicitly included as eligible activities
Decree 2235 (2023)	Classifies naturally occurring 'white' hydrogen as renewable; enables exploration and development projects

Law 2294 - National Development Plan (2023)	Expands CCUS legal framework; defines white H_2; extends CO_2-as-raw-material concept
Decree 1597 (2024)	Establishes technical conditions for the hydrogen sector; mandates a lifecycle GHG methodology and voluntary project registry (both still in development as of March 2026)
Regulatory Sandbox (Law 2069, 2020)	Allows temporary relaxation of regulations for testing innovative H_2 projects; a useful mechanism that has not yet been formally extended to the hydrogen sector
Decree 852 (July 2024)	Centralizes environmental licensing for projects >50 MW at ANLA; intended to reduce 8-year permitting timelines (impact on timelines still being assessed)
Domestic Carbon Tax / ETS	Under development; not yet enacted. Blue H_2 parity with gray H_2 requires a CO_2 price above ~USD 20/tCO_2; Colombia's current trajectory peaks at USD 6.2-11.2/tCO_2 by 2030
Hydrogen Bill (filed 2024)	Second attempt to pass comprehensive H_2 legislation covering production, storage, transport, use, and export; legislative status ongoing as of March 2026

GHG Accounting: Colombia's Domestic Standard vs. International Requirements

Colombia's domestic standard and what export markets actually require are not the same thing. Decree 1476 sets a domestic green hydrogen threshold of <4.13 kg CO_2e/kg H_2 - a figure derived from lifecycle assessment work calibrated to Colombian production conditions. For a wind-powered, off-grid electrolyzer in La Guajira, production-stage emissions approach zero; embedded lifecycle emissions from equipment manufacturing add an estimated 0.4-2.7 kg CO_2e/kg H_2. On this measure, Colombian green hydrogen easily meets its own standard [25].

However, export markets – particularly the EU – impose stricter requirements. The RFNBO framework and CertifHy certification require additionality (dedicated new renewables), temporal and geographic correlation, and verified chain-of-custody systems. These elements are not addressed under Colombia's current standard. As a result, compliance with domestic thresholds does not ensure eligibility for EU market mechanisms, requiring additional certification investment [6].

For blue hydrogen, the challenge is more fundamental. Achieving emissions below 4 kg CO_2e/kg H_2 requires capture rates above 90% and upstream methane leakage below 1%. Colombia does not yet have verified, system-wide methane emissions data, limiting the credibility of certification claims. Higher capture rates also significantly increase costs, with CCUS rising from USD 60-85/tCO_2 at moderate capture levels to USD 85-110/tCO_2 above 90%, reducing the competitiveness of certified blue hydrogen relative to roadmap assumptions [26].

Colombia has initiated efforts to address these gaps, including collaboration with Germany's PtX Hub to develop a certification framework. Independent analysis indicates that La Guajira's wind-based hydrogen could meet EU requirements at competitive cost – but only if certification systems are developed in parallel with production capacity, rather than retrofitted later [1], [18].

Demand Landscape

The Starting Point: Captive Industrial Demand

Colombia's hydrogen demand is currently concentrated in industrial applications, estimated at approximately 130,000-155,000 tpa and supplied almost entirely by gray hydrogen via steam methane reforming. Refining accounts for roughly 76% of consumption, primarily through Ecopetrol's operations at Cartagena and Barrancabermeja [7]. This represents the most immediate market for low-carbon hydrogen: substitution rather than demand creation. Known volumes, locations, and buyers reduce early-stage commercial risk.

Initial deployment reflects this dynamic. The Coral plant at Reficar, commissioning in 2026, will produce ~800 tpa of green hydrogen for refinery use. Additional projects are planned, including a 60 MW facility at Barrancabermeja and a 186 MW green methanol and biofuels project [5], [27]. While these indicate credible progress, current volumes remain small relative to full sector decarbonization requirements.

Policy-Created vs. Market-Driven Demand

One of the structural challenges Colombia faces is that the near-term demand signals for low-carbon hydrogen are almost entirely market-driven rather than policy-mandated. This means, they depend on corporate voluntary commitments and the economics of substitution; this distinction matters for forecasting.

Policy-created demand would come from instruments that make low-carbon hydrogen economically necessary regardless of corporate preference: a carbon price above the gray hydrogen parity threshold (approximately USD 20/tCO_2 for blue hydrogen; higher for green), a blending mandate requiring a minimum proportion of low-carbon hydrogen in gas networks, or a green procurement standard for public-sector or regulated industrial buyers. Colombia currently has none of these in force. The domestic carbon tax is under development and projected to reach only USD 6.2-11.2/tCO_2 by 2030, a figure that is well below parity. At the same time, the regulatory sandbox mechanism under Law 2069 exists but has not been formally extended to hydrogen [12].

Market-driven demand from companies choosing low-carbon hydrogen voluntarily is real but fragile. It is typically tied to export market access (buyers in Europe or Japan demanding certified low-carbon inputs), corporate sustainability commitments, or first-mover positioning. Ecopetrol's hydrogen investment is the clearest example: it is driven partly by its long-term strategy and partly by the export market access, not by a current price signal. This is a credible near-term demand anchor, but it does not scale without either a carbon price or a blending mandate activating the broader industrial market.

The practical implication is that Colombia's demand trajectory is currently tied to a handful of major corporate actors (such as Ecopetrol, Yara, and Argos) rather than to a policy-driven market. Until a carbon price or mandate is in place, the demand ceiling is effectively set by those actors'

own capital allocation decisions, which are subject to change across political and commodity cycles.

Downstream Sectors Most Likely to Drive Consumption

Across both the domestic and export demand picture, four downstream sectors stand out as the most likely near-to-medium-term drivers of hydrogen consumption in Colombia.

Petroleum Refining

Petroleum refining is the highest-probability near-term market because it represents captive demand, known volumes, and has Ecopetrol as a motivated buyer. Ecopetrol uses approximately 130,000 tpa of gray hydrogen today. Full decarbonization of refinery hydrogen supply would be the single largest demand signal available in the Colombian economy over the next decade. The constraint is carbon pricing: without a price on gray hydrogen emissions, the economics of substitution depend entirely on Ecopetrol's internal transfer pricing and strategic priorities.

Fertilizers and Chemicals

Yara's Colombian operations and the broader chemicals cluster in Mamonal are the second-highest-probability demand segment. Fertilizer-grade ammonia is already a global commodity with established trade channels; green ammonia for fertilizer production is one of the most commercially mature hydrogen derivative pathways globally, and Colombia's proximity to agricultural export markets in the Americas gives it a natural customer base. Hevolución's Protium plant, which converts green hydrogen to ammonia in Antioquia, is the first operational example of this pathway in Colombia [28].

Maritime Bunkering

IMO's GHG reduction targets (a 40% intensity reduction by 2030 and net-zero by 2050) are creating growing demand for zero-carbon maritime fuels. Colombia's position adjacent to the Panama Canal, one of the world's busiest shipping corridors, makes green methanol and green ammonia bunkering an export demand opportunity unlike anything available to landlocked or single-ocean producers. This is not yet a firm demand market, but the infrastructure investment decisions being made now (port upgrades, LNG terminal expansions at Cartagena) will determine which ports can serve it [9].

Heavy-Duty and Long-Haul Transport

Hydrogen's transport role in Colombia will be concentrated in segments where battery electrification is uneconomical: long-haul trucking, mining logistics, and eventually aviation fuels. Light-duty transport has effectively been captured by EVs; nearly 10,000 were sold in Colombia in 2024, with low-emission vehicles at 38% of monthly new registrations by April 2025 [20]. The Bogotá hydrogen bus pilot and Hevolución's mobility applications represent early demonstrations in this category, but the market is still nascent and will depend on the cost trajectory of fuel cell technology rather than on policy mandates in the near term.

Supply Potential & Project Pipeline

The Resource Base

Colombia's renewable resource potential is among the strongest in the world. La Guajira's wind resource is the defining asset: average capacity factors of 46-63%, measured wind speeds of 9 m/s at 80m (roughly twice the global average), at least 25 GW of onshore wind potential and 50 GW of offshore[5], [29], [30]. Solar capacity factors of 19-21% across the northern coast complement wind with a distinct generation profile. Independent modeling using ERA-5 weather data confirms performance factors above 60% for La Guajira wind, making it equal to or better than the Magallanes corridor in southern Chile [5], [28]. By 2050, IRENA projects Colombia as the fourth-lowest hydrogen production cost location in the world, behind only China, Chile, and Morocco [31].

La Guajira is not the only viable production zone. Colombia has an estimated bioenergy potential of 500,000 TJ/year, offering a biomass gasification pathway that avoids La Guajira's infrastructure and social complexity [7], [18], [32]. Valle del Cauca adds significant hydroelectric resources and access to the country's largest Pacific port at Buenaventura. Colombia's three-hub structure (La Guajira for wind-powered export; Cartagena/Barranquilla for industrial methanol; Valle del Cauca for biomass and Pacific trade routes) gives it more geographic flexibility than any single-resource producer in the region [33].

Projected LCOH by region tells a clear story. La Guajira leads: USD 3.37/kg today, declining to USD 1.59/kg by 2050. The Cartagena/Barranquilla corridor runs USD 4.66-6.46/kg today, declining to USD 2.17-2.92/kg by 2050. Valle del Cauca sits at USD 6.54/kg today, declining to USD 2.80/kg. The cost gap between La Guajira and other regions is significant now but converges substantially by 2050 – near-term project prioritization should concentrate on La Guajira, while longer-term supply diversification becomes increasingly viable [7].

Colombia's Competitive Position

Colombia's supply-side position is strong on resources, mixed on infrastructure, and constrained by execution track record. A concise assessment of where Colombia sits relative to its regional peers:

Advantages vs. Regional Competitors

La Guajira's wind resource is Colombia's clearest advantage – capacity factors of 46–63% are equal to or better than anything in the region except Patagonia, and La Guajira benefits from a far shorter shipping distance to both Atlantic export markets and the Panama Canal. Colombia's dual-ocean coastline gives it export route optionality that single-coast producers lack. The Mamonal industrial cluster near Cartagena combines collocated demand (Ecopetrol, Yara, Argos) with Caribbean port access in a way that reduces the infrastructure gap between production and offtake. Colombia also benefits from a more developed regulatory framework than Brazil at a comparable stage, and a more geographically concentrated development corridor than Brazil's diffuse northeast hub structure.

Structural Disadvantages

Colombia's most significant structural disadvantage relative to Chile is execution: Chile has a larger operational project base, more advanced bilateral trade agreements, and a longer track record of renewable energy auction delivery. Relative to Brazil, Colombia lacks a diversified heavy industrial demand base (steel, large-scale petrochemicals) that would provide multiple demand anchors for hydrogen substitution. Colombia also faces a WACC of approximately 13.75% in project financial modeling, roughly 4-6 percentage points above comparable European or East Asian projects, which systematically compresses IRR and extends payback periods [9]. The social license challenge in La Guajira – the highest-resource zone – is a structural constraint with no equivalent in Chile's Magallanes or Uruguay's Paysandú development contexts.

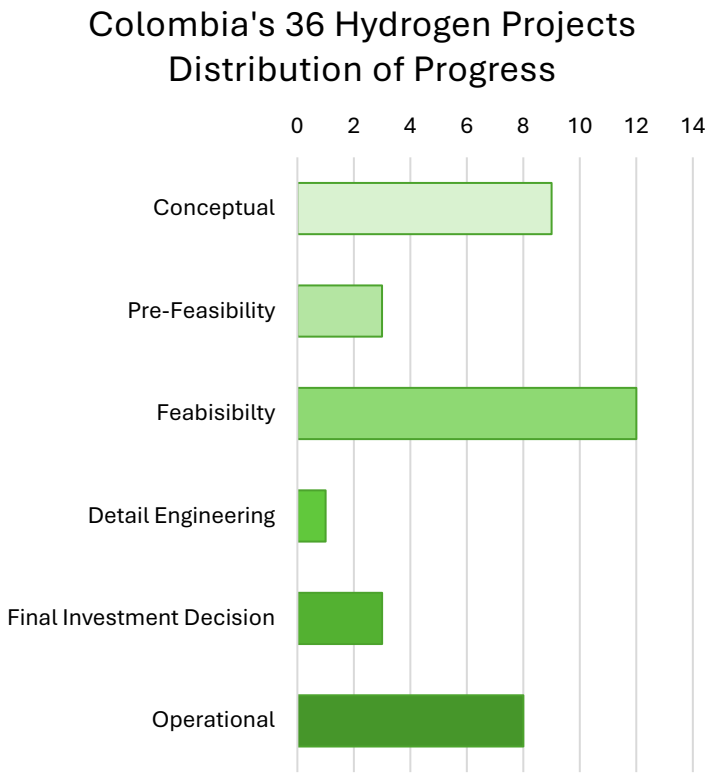

Figure 3. Distribution of progress across 36 hydrogen initiatives in Colombia, based on a recent national project survey, as presented in a Fuel Cells Works Industry Report, April 2025.

Expected Premium / Discount Drivers

For buyers evaluating Colombia as a supply source, the key pricing variables are: (1) wind capacity factor premium – La Guajira's >60% factor drives a meaningful LCOH discount versus solar-only or lower-capacity-factor wind sites; (2) shipping cost discount to U.S. East Coast – Colombia's Caribbean location offers a freight advantage over Pacific-coast competitors estimated at USD 0.30-0.50/kg delivered; (3) certification cost premium – until Colombia's domestic framework aligns with EU RFNBO requirements, third-party certification adds cost that Chilean producers with more developed certification infrastructure do not face; (4) political risk premium – Colombia's credit rating sensitivity to its fossil fuel exit trajectory and upcoming electoral transition adds a WACC premium that buyers and financiers may price into offtake terms. Net of these factors, Colombian wind-based hydrogen is competitively positioned at USD 3.10/kg delivered to Europe by 2030 – within the range of Chile but with a larger political risk component [18].

The Project Pipeline by Stage

Of Colombia's approximately 36 hydrogen-related projects as of early 2026, about 15-20% are operational, based on various reports. Total operational capacity is 0.36 MW producing 2.08 ktpa – roughly 4,000 times smaller than the 2030 electrolyzer target. The table below sorts a subset of the project pipeline by stage rather than by size, which gives a more accurate picture of near-term commercial substance [5], [15].

Table 3. Colombia hydrogen project pipeline by stage (sample projects selected for this table).

Stage	Project / Company	Scale	Product	Location
OPERATIONAL	Ecopetrol 50 kW electrolyzer (Reficar pilot)	50 kW; 0.0075 ktpa [26]	Green H_2	Cartagena
OPERATIONAL	Promigas Grid Blending	22 kW PEM; since 2022 [10]	H_2 grid injection	Cartagena
OPERATIONAL	Hevolución 'Protium'	2.3 MW ALK; 0.4 ktpa (2025) [9]	Green ammonia	Antioquia
OPERATIONAL	Estación Andes (mobility)	8.4 kW; 0.0015 ktpa [26]	H_2 mobility	Bogotá
OPERATIONAL	EPM Aguas Claras	50 kW; blending trial [26]	H_2 blending	Antioquia
COMMISSIONING	Ecopetrol 'Coral' Reficar	5 MW PEM; 800 tpa; H1 2026; USD 28.5M [7]	Green H_2 (refinery)	Cartagena
PLANNING	Ecopetrol: Barrancabermeja	60 MW; ~9 ktpa [26]	Green H_2 (refinery)	Barrancabermeja
PLANNING	Ecopetrol Green Methanol Project	186 MW; 32 ktpa [26]	Green methanol	National
PLANNING	HUB Hidrógeno Verde Barranquilla	40 MW PEM; 6 ktpa [26]	Derivatives	Barranquilla
PLANNING	AES Colombia: La Guajira	Target 800 ktpa; 2028 [26]	Green H_2	La Guajira
PLANNING	Green Urea Production	30 MW ALK; 5.1 ktpa [26]	Green ammonia	National
CONCEPTUAL	HUB Hidrógeno Atlántico II	1,106 MW PEM; 165.9 ktpa [26]	Derivatives	Atlántico
CONCEPTUAL	TW Solar Sucre	3 GW; 449.8 ktpa [26]	Green H_2 / derivatives	Sucre
CONCEPTUAL	Puerto Bolívar Conversion	Coal concession expires 2033 [2]	Green ammonia export	La Guajira
SUSPENDED	TGI Pilot: La Guajira	No public explanation (2025) [9]	Green H_2	La Guajira
EXPLORATION	Ecopetrol White H_2 Studies	Llanos Basin; early stage [13]	Natural H_2	National

Colombian experts confirm the pattern. "The main challenge is not simply access to financing," said Martha Isabel Cobo Ángel, Dean of Engineering at Universidad de la Sabana, "but rather the ability to create attractive and stable investment conditions. Colombia must strengthen ecosystem coordination, reduce investment uncertainty, and create the conditions that allow international capital to view the country as a reliable destination for long-term energy investments."

Trade Position & Infrastructure

Port Infrastructure: Four Candidates, Different Roles

Colombia's geography is a structural export advantage that tends to be underappreciated in global trade modeling. Over 3,200 km of coastline across two oceans, with Caribbean ports handling approximately 95% of national exports, gives Colombia a logistics profile that no single-coast producer can replicate. The December 2025 World Bank study "Winds, Waters, and Watts" shortlists four candidates: Puerto Brisa, Puerto Bolívar, Barranquilla, and Cartagena. Five of seven assessed project configurations are NPV-positive at base-case pricing, with IRRs of 14-24% and payback periods of 6-11 years [9].

Each port has a distinct role. Puerto Bolívar is the most strategically significant: it is Latin America's largest coal export terminal, sits in La Guajira's best wind-solar corridor, has existing heavy logistics infrastructure, and faces a coal concession expiry in 2033. The conversion opportunity – from coal export to green ammonia export – is one of the most clearly defined hydrogen infrastructure pivots available in the entire region. Puerto Brisa offers deep-draft capability and a Special Economic Zone of approximately 354 hectares. Barranquilla and Cartagena are better suited for green methanol given proximity to industrial CO_2 sources, and Cartagena additionally benefits from LNG infrastructure, a canal-adjacent location ideal for maritime bunkering, and an existing industrial cluster ready for hydrogen demand.

The Grid Constraint

La Guajira's resource potential and its infrastructure reality are in sharp tension. The Colectora transmission line – 475 km connecting 1 GW of renewable capacity – took over eight years and more than 235 prior consultation agreements to secure its environmental license, finally granted in June 2024 [34]. Full-scale La Guajira wind development would require an estimated many more kilometers of new transmission lines at costs that the private sector cannot finance alone and that could take the better part of a decade to build.

Colombia's 7,500+ km natural gas pipeline network offers a partial workaround for near-term blue hydrogen distribution and grid injection blending; Promigas has been injecting green hydrogen at small volume concentrations at Cartagena since 2022, and a new Barranquilla-Ballena gas field pipeline is approved for 2027. But the grid constraint in La Guajira will not be solved by gas infrastructure. It requires transmission investment that is tied to the prior consultation process, and that process is tied to the Wayuu social license challenge discussed in the Market Access Constraints section, below.

Trade Relationships and Delivered Cost

Colombia has signed MoUs with Germany, Chile, and Japan for hydrogen trade and technology cooperation. None of these have matured into binding offtake agreements as of March 2026. The international partnership signaling is positive but currently aspirational [1].

The delivered cost picture is more encouraging. Independent analysis confirms that Colombian green hydrogen delivered to Europe via ammonia carrier costs approximately USD 3.10/kg by 2030 and USD 2.55/kg by 2050, making it competitive with Chile and Australia. More distinctively, Colombia's Caribbean location gives it a delivered cost advantage to U.S. East Coast markets that no Pacific-facing competitor can match. The Section 45V clean hydrogen tax credit under the U.S. Inflation Reduction Act creates an emerging market that Colombia's geography positions it well to serve, but which has received almost no attention in Colombia's current trade strategy [18].

Import Carbon Policies and CBAM Compliance

Colombia does not impose any import restriction or carbon border tax on hydrogen or hydrogen derivatives, nor does it have a domestic policy equivalent to the EU's CBAM [35]. Its existing carbon tax – currently USD 6.90/tCO_2 in 2025, with a proposed increase to USD 10.62/tCO_2 in 2026 under President Petro's September 2025 financial reform bill – applies to domestic fossil fuel producers, importers, and distributors, but sits well below the threshold at which it would meaningfully close the competitiveness gap between gray and low-carbon hydrogen [36], [37]. Colombia is now advancing the design of a national Emissions Trading System (PNCTE), legally mandated to be fully operational by 2030. For Colombian hydrogen exporters, the relevant carbon border policy is the EU's CBAM, which entered its definitive phase on 1 January 2026, requiring EU importers of hydrogen and ammonia to surrender certificates corresponding to embedded emissions at a price linked to the EU ETS carbon price [38],

Figure 4. Potential export ports and associated export demand routes, based on port analyses results from the 2025 World Bank study "Winds, Waters, and Watts." Demand estimates are based on a 2040 timeline.

[39]. This is a direct commercial pressure point: Colombian green hydrogen exported to Europe must be able to demonstrate certified low embedded emissions to avoid the CBAM charge – Colombia's fiscal framework for hydrogen projects, including tariff exemptions, VAT exclusion, and a 50% income tax deduction on investments under Laws 1715 and 2099, reduces project development costs but does not resolve the certification gap that CBAM compliance requires[12], [14].

Uruguay and Argentina: The Regional Picture Is Moving

Two recent developments illustrate how quickly the regional competitive landscape is shifting, and what Colombia risks if export market relationships are not formalized soon.

Uruguay, a country of 3.5 million people with a far smaller economy than Colombia, has done more to advance commercial-stage hydrogen agreements in the past 12 months than Colombia has in the past four years. In December 2025, Uruguay signed an MoU with HIF Global for a USD 6 billion e-methanol plant at Paysandú – 700,000 tons of e-methanol annually, 1 GW renewable capacity – and secured IFC's first-ever global green hydrogen investment in the Kahirós project at the same time [23], [24]. Uruguay already generates over 99% of its electricity from renewables and has a stable regulatory environment that international investors trust [40]. It is not competing with Colombia for the same resource base, but it is competing for the same international financing relationships and the same European and Asian offtake agreements.

Argentina's position is longer-horizon but potentially larger in scale. Patagonia's wind resource is among the strongest in the world, with measured wind speeds up to 185 km/h, and capacity factors comparable to Magallanes; at the same time, Argentina's National Strategy for the Development of the Hydrogen Economy (ENH, 2023) targets 5 Mt/year of low-emission hydrogen production by 2050 (80% for export), requiring 30 GW of electrolysis capacity and 55 GW of renewable electricity generation [21]. The Ministry of Production estimates this could generate approximately USD 15 billion annually in export revenues by 2050, comparable to Argentina's current soybean export earnings [41]. The binding constraint has historically been macroeconomic: the 'Argentine cost' of high financing rates, currency instability, and tax burden has negated resource advantages repeatedly. The Milei administration's liberalization program and the RIGI investment incentive framework have improved conditions somewhat, but as Climate Action Tracker notes, long-run climate policy continuity under the current administration remains an open question [19], [42].

The common thread is that preferred-supplier relationships for long-term offtake are being established now, not when production scales up. Colombia's window to position itself as a favored trade partner for Germany, Japan, and South Korea is open but not permanently so.

Market Access Constraints

The Barrier Stack

Colombia's hydrogen potential is real. The barriers to realizing it are equally real, and perhaps more importantly, they are interdependent in many cases. Grid constraints slow La Guajira development of green hydrogen; the prior consultation process is embedded in the grid constraints; water access is embedded in the prior consultation dynamic; and the absence of domestic demand signals means projects that navigate all of the above still face uncertain offtake. No single barrier is insurmountable in isolation. The challenge is that they compound.

Table 4. Market access constraints in Colombian hydrogen market.

Constraint	Assessment
Grid & Transmission in La Guajira	The single largest near-term bottleneck. Colectora's 8-year licensing process is not an anomaly; it reflects systemic consultation complexity in Wayuu territory. SEVERITY: HIGH
Prior Consultation & Environmental Licensing	235+ consultation agreements for one 114 km line illustrates the scale of engagement required. Decree 852 (2024) centralizes licensing for projects >50 MW at ANLA, which is intended to reduce timelines, but impact still being assessed. SEVERITY: HIGH
Water Access in La Guajira	PEM electrolysis requires 9–10 liters of water per kg H_2. Less than 50% of rural La Guajira households had reliable drinking water access in 2023. Water demand at gigawatt scale requires desalination, which itself requires permitting and community agreement. SEVERITY: HIGH
Certification Gap	Decree 1476 meets Colombia's own standard. It does not meet EU RFNBO additionality and temporal correlation requirements. Projects targeting export markets need additional third-party certification investment. Solvable, but not automatic. SEVERITY: MEDIUM
No Demand-Side Policy	No carbon price, blending mandate, or green H_2 procurement requirement exists. Without a price signal, domestic offtake depends on voluntary corporate commitment. Blue H_2 parity with gray H_2 requires CO_2 above USD 20/tCO_2; Colombia's trajectory reaches USD 6-11/tCO_2 by 2030. SEVERITY: MEDIUM-HIGH
Cost of Capital	WACC of ~13.75% in World Bank port modeling. Colombia's credit rating is sensitive to its fossil fuel exit trajectory, which introduces a structural tension between climate ambition and fiscal stability. SEVERITY: MEDIUM-HIGH
Electrolysis Capacity Gap	0.36 MW operational vs. 1-3 GW by 2030. That is a 4,000-fold increase required in four years. SEVERITY: HIGH [26]
Skills and Supply Chain	No domestic electrolyzer manufacturing; limited trained H_2 workforce. Both Fraunhofer ISE and Gómez et al. (2025) flag this as a medium-term constraint. SEVERITY: MEDIUM
Political Continuity	President Petro's term ends in 2026. The Just Energy Transition Roadmap is closely tied to his administration. Successor policy alignment is the key monitor variable. SEVERITY: MEDIUM

La Guajira: The Social License Is Not a Procedural Problem

> Social licensing remains an important topic, especially in regions where there is water stress. Many big infrastructure projects are facing this kind of challenge; it is not exclusive to La Guajira.
>
> MARÍA I. JARAMILLO G. AND CARLOS E. GARCÍA S.
> *Centro de Desarrollo Tecnológico del Gas*

La Guajira is Colombia's highest-potential hydrogen production zone and one of its most challenging social environments. The Wayuu people, with a population of approximately 790,000 across a binational territory straddling Colombia and Venezuela, are the original inhabitants of the peninsula [43]. The department is one of the poorest in Colombia, with over 50% of the population in poverty. Less than 50% of rural households have reliable drinking water access. Between 2008 and 2015, nearly 5,000 Wayuu children died from malnutrition and thirst – a situation that Colombia's Constitutional Court ruled a rights violation in 2017 [44], [45]. Years later, the structural conditions persist [46].

The history of extractive industry in La Guajira, particularly via coal mining, has created a context in which new energy projects, regardless of their climate credentials, are read through the lens of dispossession. In 2024, Wayuu leaders blocked roadways not just to protest the Cerrejón coal mine, but also to block government water supply deliveries, as an act of resistance against the broader pattern of extraction without benefit [47]. As Dr. Cobo Ángel has noted: "Foreign companies cannot expect to successfully implement projects in La Guajira without first achieving meaningful consultation and alignment among all relevant stakeholders. Social license must be built over time through trust, transparency, and demonstrated commitments to local development." In December 2025, a Wayuu writer published a first-person account noting that hydrogen and renewable energy projects 'do not seek to bring energy to local communities, but rather to produce green hydrogen and its derivatives for export [2].' A 2023 legal challenge by Wayuu communities before the Inter-American Commission on Human Rights is still pending [2].

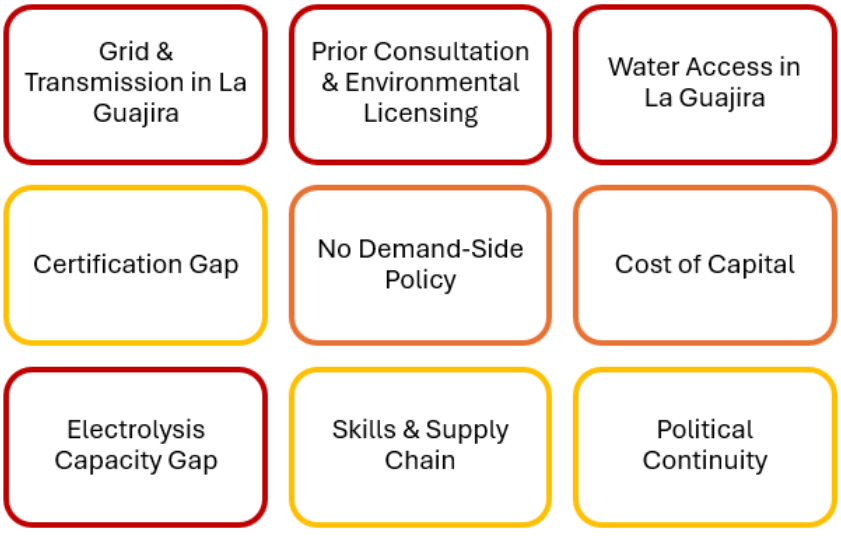

Figure 5. Current barrier stack in Colombia, showing range of political, social, financial, technical, environmental, and legal challenges.

Water is where the hydrogen-Wayuu conflict is most direct. Gigawatt-scale electrolysis at La Guajira would require desalination infrastructure given the peninsula's water scarcity. Green hydrogen

production that requires water in a region where children have died from lack of water is not a framing problem; rather, it is a substantive one. The Colectora transmission line's eight years and 235 prior consultations illustrates what engagement at this scale actually requires. Developers who treat prior consultation as a box-checking exercise will face what Cerrejón faced: legal challenges, physical disruption, and reputational costs that make the project unbankable regardless of its resource economics.

The path forward is not to avoid La Guajira. The region remains the most competitive production site in Latin America. The path forward is pre-competitive public investment in water infrastructure, legally binding community benefit and co-ownership frameworks designed before project approval rather than after, and a genuine renegotiation of what the energy transition means for communities that have experienced extraction without benefit for generations.

Development Pathway & Strategic Role

Colombia's hydrogen trajectory breaks into three phases. The first is underway. The second is conditional on decisions made in the next two years. The third is plausible but not inevitable.

Phase 1 (2021–2028): Proof of Concept

The defining action of this phase is the Coral plant commissioning at Reficar in 2026, representative of Colombia's first industrial-scale green hydrogen deployment. The rest of Phase 1 is about building the enabling conditions for Phase 2: grid infrastructure in La Guajira, permitting reform, early certification frameworks, and industrial cluster demand development. Success is not measured in export volumes but in whether the prerequisites for scale-up are credibly in place by 2028.

The most consequential variable in Phase 1 is the 2026 presidential election. As outlined in the OHI Global Landscape Report, policy durability – not policy ambition – is what investor confidence depends on. The next administration's stance on the Just Energy Transition Roadmap, FENOGE's hydrogen financing mandate, and La Guajira infrastructure investment will set the trajectory for everything that follows.

Phase 2 (2028–2035): Scale-Up and Export Entry

If Phase 1 delivers on its prerequisites, Phase 2 is centered on La Guajira and the Caribbean port corridor. The commercial framework must be built around derivatives – green ammonia for maritime bunkering and fertilizer markets, green methanol for Cartagena's industrial cluster – not pure hydrogen, for which the distribution infrastructure does not exist and will not exist within this window. Puerto Bolívar's 2033 concession renewal is the single most important strategic decision point of the decade: converting Latin America's largest coal export terminal to green ammonia export would be transformational for Colombia's trade profile.

Phase 2 is also when Colombia must lock in bilateral trade relationships. The window for securing preferred-supplier status with Germany, Japan, and South Korea is not open indefinitely. Chile,

Uruguay, and potentially Argentina are all moving to establish those relationships now. Colombia needs commercial agreements – not MoUs – before Phase 2 scale-up begins.

Phase 3 (2035–2050): Major Export Player (Conditional)

The long-run scenario – 2-6.4 Mt/year of production, USD 50-80 billion in investment, hydrogen rising to 15% of total energy mix – is technically achievable given Colombia's resource base [7], [10]. Under this scenario, carbon intensity falls by 93% and fossil fuel import dependency drops by 90% [48]. The most likely export partners are Germany, Japan, South Korea, and potentially the United States for SAF precursors. This scenario is contingent on sustained policy support across multiple administrations, a global hydrogen market that develops faster than current volumes suggest, and successful resolution of the La Guajira social license question. None of those are guaranteed, but none are implausible.

Implications for Global Trade

Colombia's hydrogen development matters beyond its own borders in four distinct ways.

A Template for Fossil-Fuel Transition

Colombia is one of the clearest cases of a fossil-fuel-dependent emerging economy attempting to use hydrogen as the commercial bridge to a post-fossil future. It exports approximately 45% of fossil fuels, which represents 10% of GDP [49]. Dr. Martha Isabel Cobo Ángel, Dean of Engineering at Universidad de la Sabana, offers a grounded view of how that transition is likely to unfold: "I do not see the future as a choice between hydrocarbons and hydrogen. Rather, the transition is likely to require an ambidextrous approach, in which the oil and gas industry continues to operate and generate value while simultaneously investing in and developing low-carbon energy businesses, including hydrogen, synthetic fuels, and other emerging technologies."

Colombia is simultaneously committed to halt new oil and gas exploration and phase out coal by 2036 [4]. If Colombia can demonstrate that a country in that position can develop credible hydrogen export infrastructure without fiscal collapse, it provides a genuinely replicable model for similar economies in Africa, Southeast Asia, and the Middle East. If it cannot, the lesson is equally instructive.

An Underappreciated Trade Route

Colombia's Caribbean location gives it delivered-cost advantages that are not reflected in most global hydrogen trade modeling, which has historically centered on Pacific exporters. With delivered cost to Europe via ammonia projected at USD 3.10/kg by 2030 and delivered cost to U.S. East Coast in a favorable geographic location, Colombia has a real opportunity [18]. As IMO decarbonization mandates drive demand for zero-carbon maritime fuels, Cartagena's position adjacent to the Panama Canal makes it a natural bunkering hub for transoceanic shipping, presenting a role that is not currently occupied by any producer [9].

A Regional Convener Role

OLACDE projects that coordinated Latin American action could supply 25-33% of global clean hydrogen demand. Colombia's combination of policy maturity, geographic centrality, and resource depth makes it a natural convener of that regional coordination, particularly alongside Chile's cost leadership and Brazil's industrial base. That convener role has not yet been claimed. The region currently lacks shared certification standards, harmonized KPI frameworks, and joint infrastructure agreements. Colombia is positioned to lead on all three if it chooses to.

The Blue Hydrogen Test Case

Colombia's dual-pathway approach – green and blue hydrogen in parallel – will serve as a real-world test of whether blue hydrogen can meet international certification standards under realistic emerging-market conditions. The conditions under which this is possible (very high CCUS capture rates, verified low upstream methane leakage, transparent emissions accounting) are demanding. If Colombia can meet them, it expands the feasible transition pathways available to other fossil-fuel-dependent countries. If it cannot, whether it is because the methane data is unavailable, or the capture rates too low, or the certification costs are prohibitive, it is an important signal about the limits of the blue hydrogen pathway for the global south.

Strategic Conclusions & Outlook

Colombia’s hydrogen strategy sits at an inflection point between ambition and execution. The country has key elements for long-term competitiveness – strong renewable resources, a favorable export position, and a coherent policy framework – but its pathway to scale remains uncertain.

The primary challenge is not a single constraint, but the interaction of several: limited domestic demand, dependence on infrastructure not yet built, evolving export market requirements, and the need for policy durability across political cycles. These factors do not prevent development, but they will determine its pace and trajectory.

The phased development pathway underscores the importance of the next two to three years. Phase 1 is defined by credibility, which in turn serves to establish enabling conditions for scale. Phase 2 depends on translating that foundation into commercial agreements and infrastructure deployment, particularly in La Guajira and the Caribbean corridor. Phase 3 remains plausible, but contingent on sustained domestic follow-through and global market growth.

Regionally, Colombia is unlikely to lead on cost (Chile) or domestic demand scale (Brazil). Its competitive position lies between these models: a concentrated development corridor, proximity to major shipping routes, and the ability to link domestic decarbonization with export markets. Realizing this position will require alignment across policy, infrastructure, and commercial strategy.

More broadly, Colombia represents a test case for hydrogen-led transition in fossil-fuel-dependent economies. Its ability to shift from hydrocarbon exports toward low-carbon energy without a large domestic demand anchor will be instructive for similar markets.

Overall, Colombia's trajectory is less a question of technical feasibility than of coordination and timing. The resources and strategic rationale are in place; outcomes will depend on whether policy certainty, infrastructure buildout, demand formation, and international alignment develop in parallel.

Sources

[1] I. Iacob, E. Goita, A. Reilly, Z. McDonald, and van Wagener, "Global Hydrogen Market Landscape Report: Assessing Strategic Economies," Open Hydrogen Initiative, Mar. 2026.

[2] L. Monterrosa Atencio, "On Colombia's coast, the Wayuu struggle to save their territory and culture," *Dialogue Earth*, Dec. 17, 2025. Available: https://dialogue.earth/en/ocean/on-colombias-coast-the-wayuu-struggle-to-save-their-territory-and-culture/. [Accessed: May 11, 2026]

[3] H. M. Donado, "Inside Colombia's New 2035 Climate Plan: What You Need to Know," Feb. 2026, Available: https://www.wri.org/technical-perspectives/inside-colombia-climate-plan-2025-nationally-determined-contribution. [Accessed: May 11, 2026]

[4] "Colombia," *Climate Action Tracker*. Available: https://climateactiontracker.org/countries/colombia/. [Accessed: May 11, 2026]

[5] J. S. Gómez *et al.*, "Fueling the transition: A comprehensive analysis of hydrogen roadmaps in Chile, Brazil and Colombia," *Renew. Sustain. Energy Rev.*, vol. 222, p. 115885, Oct. 2025, doi: 10.1016/j.rser.2025.115885

[6] "European Commission Finalizes Regulatory Framework for Low-Carbon Hydrogen with New Delegated Act," *CERTIFHY*. Available: https://www.certifhy.eu/eu-low-carbon-hydrogen-delegated-act/. [Accessed: May 11, 2026]

[7] F. A. Plazas-Niño, R. Yeganyan, C. Cannone, M. Howells, B. Borba, and J. Quirós-Tortós, "Open energy system modelling for low-emission hydrogen roadmap planning: The case of Colombia," *Energy Strategy Rev.*, vol. 53, p. 101401, May 2024, doi: 10.1016/j.esr.2024.101401

[8] C. Kumar, H. Fekete, and I. Outlaw, "The Landscape of Green Hydrogen in Colombia," New Climate Institute - Institute for Climate Policy and Global Sustainability gGmbH, Berlin, Germany, Nov. 2023. Available: https://newclimate.org/sites/default/files/2023-11/The%20landscape%20of%20green%20hydrogen%20in%20Colombia_nov2023.pdf

[9] World Bank Group, "Winds, Waters, and Watts: How Colombia's Ports can Fuel a Green Hydrogen Economy," World Bank, Washington, DC, Dec. 2025.

[10] "Colombia's hydrogen roadmap," Sept. 2021. Available: https://www.minenergia.gov.co/documents/5862/Colombias_Hydrogen_Roadmap_2810.pdf. [Accessed: Jan. 10, 2024]

[11] "Colombian Hydrogen Roadmap – Policies," *IEA*. Available: https://www.iea.org/policies/14596-hydrogen-roadmap. [Accessed: May 11, 2026]

[12] "Hydrogen law, regulations & strategy in Colombia." Available: https://cms.law/en/int/expert-guides/cms-expert-guide-to-hydrogen/colombia. [Accessed: May 11, 2026]

[13] “Decree 1597 of 2024 on the Promotion and Management of Low-Emission Hydrogen – Policies,” *IEA*. Available: https://www.iea.org/policies/28798-decree-1597-of-2024-on-the-promotion-and-management-of-low-emission-hydrogen. [Accessed: May 11, 2026]
[14] “Regulations | Ecosistema H2 Colombia.” Available: https://www.minenergia.gov.co/es/ecosistema-hidrogeno-colombia-english/h2-in-colombia/regulations/. [Accessed: May 11, 2026]
[15] “Colombia Consolidates 36 Hydrogen Projects, Strengthens Ecosystem - Fuelcellsworks,” *Fuel Cell Works*, Apr. 30, 2025. Available: https://fuelcellsworks.com/2025/04/30/news/colombia-consolidates-36-hydrogen-projects-and-strengthens-its-national-ecosystem-according-to-a-survey-by-the-andi-naturgas-hydrogen-chamber. [Accessed: May 11, 2026]
[16] G. E. Azuela and C. Govindarajalu, “As Colombia leads on renewables, boosting its clean hydrogen industry is the next step. The World Bank is ready to help.,” *World Bank Blogs*, Apr. 2024. Available: https://blogs.worldbank.org/en/energy/as-colombia-leads-on-renewables--boosting-its-clean-hydrogen-ind. [Accessed: May 11, 2026]
[17] A. T. Andersen, M. A. de Barillas, R. Bocca, and D. Bustamente, “Accelerating the Clean Hydrogen Economy in Latin America,” World Economic Forum, Aug. 2024. Available: https://www3.weforum.org/docs/WEF_Accelerating_the_Clean_Hydrogen_Economy_in_Latin_America_2024.pdf. [Accessed: May 11, 2026]
[18] A. Burdack, L. Duarte-Herrera, G. Lopez-Jimenez, T. Polklas, and O. Vasco-Echeverri, “Techno-economic calculation of green hydrogen production and export from Colombia,” *Int. J. Hydrog. Energy*, vol. 48, no. 5, Jan. 2023, Available: https://doi.org/10.1016/j.ijhydene.2022.10.064
[19] “Argentina,” *Climate Action Tracker*. Available: https://climateactiontracker.org/countries/argentina/. [Accessed: May 11, 2026]
[20] B. Santori, “Hydrogen in Argentina and South America: a national and regional strategy for development,” *PAGBAM Abogados*, Nov. 28, 2023. Available: https://pagbam.com/articles/hydrogen-in-argentina-and-south-america-a-national-and-regional-strategy-for-development/. [Accessed: May 11, 2026]
[21] “Estrategia Nacional para el Desarrollo de la Economia del Hidrogeno,” Government of Argentina - Ministry of Economy of the Nation, Sept. 2023. Available: https://www.argentina.gob.ar/sites/default/files/2023/07/estrategia_nacional_de_hidrogeno_-_sae.pdf. [Accessed: Jan. 09, 2024]
[22] “Green Hydrogen Roadmap for Uruguay,” Government of Uruguay - Ministry of Industry, Energy, and Mining, 2022. Available: https://www.gub.uy/ministerio-industria-energia-mineria/sites/ministerio-industria-energia-mineria/files/documentos/noticias/Green%20Hydrogen%20Roadmap%20in%20Uruguay_0.pdf. [Accessed: Jan. 10, 2024]
[23] “IFC selects Uruguay for its first-ever global green hydrogen investment,” *International Finance Corporation: World Bank Group*. Available: https://www.ifc.org/en/pressroom/2025/ifc-selects-uruguay-for-its-first-ever-global-green-hydrogen-investment. [Accessed: May 11, 2026]
[24] “HIF Global and Government of Uruguay Sign Agreement to Accelerate e-Fuels Project in Paysandú,” *HIF Global*, Dec. 19, 2025. Available: https://hifglobal.com/media/news-description/2025/12/19/hif-global-and-government-of-uruguay-sign-agreement-to-accelerate-e-fuels-project-in-paysandú. [Accessed: May 11, 2026]
[25] J. Moreno, M. Cobo, C. Barraza-Botet, and N. Sanchez, “Role of low carbon emission H2 in the energy transition of Colombia: Environmental assessment of H2 production pathways for a

certification scheme," *Energy Convers. Manag. X*, vol. 16, p. 100312, Dec. 2022, doi: 10.1016/j.ecmx.2022.100312
[26] "Global Hydrogen Review 2024," International Energy Agency, Paris, Oct. 2024. Available: https://www.iea.org/reports/global-hydrogen-review-2024
[27] R. Brelsford, "Ecopetrol advances green hydrogen plant at Cartagena refinery," *Oil & Gas Journal*, Jan. 02, 2026. Available: https://www.ogj.com/energy-transition/news/55341146/ecopetrol-advances-green-hydrogen-plant-at-cartagena-refinery. [Accessed: May 11, 2026]
[28] R. Rodríguez, "Colombia's green hydrogen ambitions face challenges," *Dialogue Earth*, Feb. 13, 2026. Available: https://dialogue.earth/en/energy/colombias-green-hydrogen-ambitions-challenges/. [Accessed: May 11, 2026]
[29] "La Guajira: Colombia's prospective renewables powerhouse - The Energy Year," Jan. 22, 2025. Available: https://theenergyyear.com/articles/la-guajira-colombias-prospective-renewables-powerhouse/. [Accessed: May 11, 2026]
[30] "Colombia's Offshore Wind Roadmap," Ministry of Mines and Energy, Apr. 2022. Available: https://www.minenergia.gov.co/documents/5859/Colombia_Offshore_Wind_Roadmap_VE_compressed.pdf
[31] "Global Hydrogen Trade to Meet the 1.5*C Climate Goal - Part III: Green Hydrogen Cost and Potential," IRENA, 2022. Available: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/May/IRENA_Global_Hydrogen_Trade_Costs_2022.pdf
[32] "Invest in biomass energy in Colombia | Invest in Colombia," Apr. 11, 2025. Available: https://investincolombia.com.co/en/resources/energy-biomass-investment-colombia. [Accessed: May 12, 2026]
[33] C. Hank, "New Fraunhofer ISE Study: Exploring Colombia's Potential for Large-Scale Green Hydrogen Production - Fraunhofer ISE," *Fraunhofer Institute for Solar Energy Systems ISE*, Oct. 01, 2024. Available: https://www.ise.fraunhofer.de/en/press-media/press-releases/2024/new-fraunhofer-ise-study-exploring-colombias-potential-for-large-scale-green-hydrogen-production.html. [Accessed: May 12, 2026]
[34] "La Guajira: Colombia's prospective renewables powerhouse - The Energy Year," Jan. 22, 2025. Available: https://theenergyyear.com/articles/la-guajira-colombias-prospective-renewables-powerhouse/. [Accessed: May 11, 2026]
[35] "Colombia | Green Hydrogen Organisation." Available: http://gh2.org/countries/colombia. [Accessed: May 11, 2026]
[36] M. Maradan, "Colombian Government Proposes Changes to Carbon Tax Mechanism," Sept. 2025. Available: https://www.clearbluemarkets.com/knowledge-base/colombian-government-proposes-changes-to-carbon-tax-mechanism. [Accessed: May 11, 2026]
[37] "Colombia's Executive Branch submits 2026 tax reform bill to Congress." Available: https://www.ey.com/en_gl/technical/tax-alerts/colombias-executive-branch-submits-2026-tax-reform-bill-to-congress. [Accessed: May 11, 2026]
[38] "EU Carbon Border Adjustment Mechanism (CBAM) Tracker," *Carbon Gap - Policy Tracker*. Available: https://tracker.carbongap.org/policy/carbon-border-adjustment-mechanism/. [Accessed: May 11, 2026]
[39] "Colombia | PMI." Available: https://www.pmiclimate.org/country/colombia. [Accessed: May 11, 2026]
[40] "Uruguay - Energy," Aug. 15, 2025. Available: https://www.trade.gov/country-commercial-guides/uruguay-energy. [Accessed: May 11, 2026]

[41] J. Reingold, “Argentina’s Troubled Road Towards Green Hydrogen,” *Energy Monitor*, Sept. 13, 2022. Available: https://www.energymonitor.ai/tech/hydrogen/argentinas-troubled-road-towards-green-hydrogen. [Accessed: May 12, 2026]
[42] P. Videla and A. Caldart, “What every investor should know about Milei’s Argentina,” *IESE Insight*. Available: https://www.iese.edu/insight/articles/invest-argentina-milei-reforms/. [Accessed: May 12, 2026]
[43] “Wayuu people,” *Wikipedia*. May 10, 2026. Available: https://en.wikipedia.org/w/index.php?title=Wayuu_people&oldid=1353441372. [Accessed: May 12, 2026]
[44] “Colombia: Thousands of indigenous Wayúu children dead from malnutrition - IWGIA - International Work Group for Indigenous Affairs.” Available: https://iwgia.org/en/colombia/2235-colombia-thousands-of-indigenous-wayuu-children-de. [Accessed: May 12, 2026]
[45] T. N. Thompson, “Natural Resource Extractivism: Deepening Poverty in La Guajira | ReVista.” Available: https://revista.drclas.harvard.edu/natural-resource-extractivism-deepening-poverty-in-la-guajira/. [Accessed: May 12, 2026]
[46] “Visit to Colombia: REDESCA observes serious challenges for the guarantee of ESCER in La Guajira,” *Inter-American Commission on Human Rights (IACHR)*. Available: https://www.oas.org/en/IACHR/jsForm/?File=/en/iachr/media_center/PReleases/2022/265.asp&utm_content=country-col&utm_term=class-mon. [Accessed: May 12, 2026]
[47] A. Lippi, “Water and Wayuu: The crisis in La Guajira, Colombia by Ariana Lippi,” *American University: Journal of International Service*, Dec. 16, 2024. Available: https://ausisjournal.com/2024/12/16/water-and-wayuu-the-crisis-in-la-guajira-colombia/. [Accessed: May 12, 2026]
[48] F. A. Plazas-Niño, R. Yeganyan, C. Cannone, M. Howells, and J. Quirós-Tortós, “Informing sustainable energy policy in developing countries: An assessment of decarbonization pathways in Colombia using open energy system optimization modelling,” *Energy Strategy Rev.*, vol. 50, p. 101226, Nov. 2023, doi: 10.1016/j.esr.2023.101226
[49] “Executive summary – An Energy Sector Roadmap to Net Zero Emissions in Colombia – Analysis,” *IEA*. Available: https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-colombia/executive-summary. [Accessed: May 12, 2026]