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# An overview of the technical and economic opportunities for biogas-based hydrogen production in Latin America

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**Abstract.** The growing need for sustainable energy solutions has intensified interest in alternative sources to reduce reliance on fossil fuels. Latin America, with its abundant biomass resources from agricultural and industrial activities, offers significant potential for renewable energy generation. Biogas, derived from the anaerobic digestion of organic waste, presents a viable energy carrier and a promising feedstock for hydrogen production, a key component in global decarbonization efforts. Despite these opportunities, the adoption of biogas-based hydrogen production in Latin America remains limited due to high capital costs, technological challenges, inadequate infrastructure, and weak policy frameworks. This study provides a comprehensive analysis of the region's potential by assessing biomass availability, technological pathways, and economic feasibility through data from research institutions and scientific literature. Technologies such as steam methane reforming and emerging biological processes are evaluated, alongside country-specific regulatory frameworks. Findings highlight those countries with strong agricultural sectors, such as Brazil, Argentina, and Colombia, hold high potential. However, economic challenges endure, with substantial investment required for technology deployment. Policy analysis reveals that progressive frameworks and financial incentives in select countries, like Chile and Uruguay, are fostering early adoption. Unlocking the potential of biogas-based hydrogen production in Latin America requires strategic investments, supportive policies, and enhanced regional collaboration. Strengthening these efforts can drive energy security, lower greenhouse gas emissions, and promote economic growth. Supporting regional initiatives with global sustainability objectives will position Latin America as a key player in the transition to renewable energy.

**Key words:** biogas-to-hydrogen conversion, economic feasibility of hydrogen, policy frameworks for bioenergy, renewable energy in Latin America, sustainable energy transition.

## INTRODUCTION

The global energy landscape is undergoing a deep shift driven by the urgent need to reduce reliance on fossil fuels and mitigate the impacts of climate change. Rising concerns over resource depletion and environmental degradation have propelled the search for cleaner, more sustainable energy sources that minimize greenhouse gas (GHG) emissions and reinforce long-term energy security (Ali & Roussel, 2021). Rapid population growth and intensified industrial activities place additional pressure on conventional energy systems, underscoring the necessity of transitioning toward renewables (Soni et al., 2024). In this context, sources such as solar, wind, and bioenergy have gained momentum as viable solutions for addressing both environmental and socio-economic challenges (Hassan et al., 2024a). Within the renewable field, hydrogen stands out as a particularly promising energy carrier, with the capacity to drive deep decarbonization across transportation, industry, and power generation (Bhandari & Adhikari, 2024). However, achieving low-carbon hydrogen centres on sustainable production methods and sufficient policy support, prompting governments and international organizations to establish ambitious targets and strategic frameworks aimed at accelerating the adoption of renewable hydrogen technologies (Alam et al., 2024; Boretti & Pollet, 2024; Hassan et al., 2024b; Oluwadayomi et al., 2024).

Unlike conventional fossil fuels, hydrogen use produces minimal direct GHG emissions, offering a potential route to decrease climate impacts and enhance energy security (Evro et al., 2024). Nonetheless, hydrogen can be generated via multiple pathways, each characterized by differing cost structures, technological complexities, and environmental implications. Steam methane reforming (SMR) from natural gas remains the dominant production method but is associated with significant carbon emissions unless coupled with carbon capture and storage (CCS). Cleaner alternatives such as water electrolysis using renewable electricity or biogas reforming are attracting attention (Materazzi et al., 2024; Onwuemezie et al., 2024; Zheng et al., 2024). These options promise a smaller carbon footprint but continue to face substantial barriers in terms of cost, scalability, and infrastructure readiness. As global interest in hydrogen intensifies, stakeholders are increasingly focused on overcoming these technical and financial barriers, recognizing that effective strategies must encompass both technology-specific innovation and supportive policy frameworks (Panchenko et al., 2023; Bade et al., 2024).

Latin America is especially well-positioned to capitalize on biogas production, given its substantial agricultural, livestock, and industrial sectors that generate large volumes of organic residues (Vega et al., 2024). These residues from crop waste and animal manure to by-products of food processing can be converted into biogas via anaerobic digestion. Beyond providing a clean and flexible energy source for heating, electricity generation, and transportation, biogas offers environmental benefits by mitigating methane emissions from unmanaged organic waste (Rodrigues et al., 2025). Its use also aligns with circular economy principles, turning waste into a resource and supporting regional sustainability goals. Despite its advantages, biogas remains underutilized in much of Latin America. Contributing factors include a lack of comprehensive regulatory frameworks, insufficient policy incentives, and limited access to financial mechanisms that could encourage investment in biogas infrastructure and technology. Enhancing adoption requires not only policies that recognize the strategic value of biogas but also collaborative efforts among public and private sectors to build robust supply chains and share best practices across borders (Gallego-Schmid et al., 2024).

Steam methane reforming of biogas, which closely resembles SMR from natural gas, remains one of the most developed pathways but demands CCS to significantly reduce emissions. Autothermal reforming, combining partial oxidation with steam reforming, has shown promise by boosting thermal efficiency and hydrogen yield, although it also requires effective carbon management. Plasma reforming is an emerging technique that uses high-energy plasma to break down methane, potentially enabling decentralized applications and faster reaction rates (Jumah, 2024). Biological processes, including dark fermentation and microbial electrolysis, convert biogas into hydrogen through microbial activity, offering low-energy alternatives but still lagging in commercialization. Improving catalyst performance, integrating waste-heat recovery, and advancing carbon capture and utilization strategies could enhance the environmental profile and economic viability of these methods. However, uncertainties related to feedstock quality, process scale-up, and capital costs remain persistent obstacles (Palone et al., 2024).

Despite considerable potential, several economic and policy barriers constrain the widespread adoption of biogas-based hydrogen in Latin America. High capital expenditures restrict from the specialized infrastructure needed for purification, reforming, and carbon capture, limiting the interest of large-scale installations for investors (Swinbourn et al., 2024). In addition, many countries in the region face fragmented or inconsistent policy environments, with varying degrees of support for bioenergy initiatives (Gallego-Schmid et al., 2024). While certain nations such as Chile, Colombia, and Uruguay have presented forward-thinking hydrogen policies, others offer limited incentives or continue to subsidize fossil fuels, creating an uneven playing field for cleaner alternatives (Ferreira et al., 2025). This mixture of regulations and financial support complicates efforts to develop cohesive value chains, delaying progress in both technology deployment and market integration. Overcoming these difficulties demands government interventions that reduce project risks through tax incentives, feed-in tariffs, or targeted subsidies, as well as public-private partnerships and collaborative ventures that blend technical expertise, financial capital, and regulatory guidance (Combariza Diaz, 2024).

A coordinated regional approach is consequently crucial for unlocking Latin America’s biogas-to-hydrogen potential. While individual countries have taken steps to incorporate biogas into their energy portfolios, the lack of uniform standards, consistent incentives, and harmonized infrastructure remains a significant challenge (Luna-delRisco et al., 2024; Martins et al., 2024). A shared strategy could foster knowledge exchange, streamline permitting processes, and clarify investment pathways, ultimately accelerating the deployment of biogas-based hydrogen technologies. Regional cooperation may also facilitate the development of cross-border hydrogen transport and distribution networks, a vital component for expanding end-use applications in sectors ranging from heavy industry to mobility. By aligning regulations and leveraging collective purchasing power, Latin American nations can attract more investment and enhance their competitiveness in the global hydrogen arena (Ferreira et al., 2025).

In this study, we address the challenge of fragmented understanding regarding the technical, economic, and policy conditions for biogas-based hydrogen (BBH) production in Latin America. Although the region possesses abundant biomass resources and a growing demand for clean energy, previous research has not comprehensively integrated technological pathways, economic feasibility, and regulatory frameworks into a consolidated analysis. This gap in the current state of knowledge limits both scientific development and strategic decision-making. Therefore, the aim of this research is to systematically assess the technical potential, conversion technologies, and economic viability of BBH in Latin America, while identifying key drivers, barriers, and regional disparities. The practical objective is to provide actionable recommendations for policymakers, industry stakeholders, and investors to support the large-scale deployment of BBH technologies, contributing to the region's energy diversification and decarbonization goals. Through a scoping review of scientific literature, institutional reports, and national roadmaps, we analyse existing and emerging technologies such as steam methane reforming, autothermal reforming, plasma reforming, and biological pathways, evaluating their feasibility and cost-effectiveness in different country contexts. Additionally, we examine policy frameworks and financial instruments, highlighting areas where clearer guidelines or stronger incentives could catalyze investment. By synthesizing best practices and case studies, this study aims to fill the identified research gap and encourage the development of BBH systems as a strategic component of Latin America's sustainable energy transition and socio-economic progress.

## LITTERATURE REVIEW

### Overview of biogas and its role in renewable energy

Biogas is a renewable energy source derived from the anaerobic digestion of organic matter, including agricultural residues, livestock manure, wastewater sludge, and municipal solid waste. This process produces a methane-rich gas that can be utilized for electricity generation, heating, and as a feedstock for advanced biofuels, including hydrogen (Luna-delRisco et al., 2011). Compared to fossil fuels, biogas offers significant environmental benefits by reducing methane emissions from decomposing organic waste, improving waste management, and promoting circular economy principles (Tjutju et al., 2024). A study conducted by Tjutju et al. (2024) have shown that biogas production not only enhances energy security but also provides economic opportunities for rural communities, particularly in regions with strong agricultural and livestock industries. In general, the integration of biogas into renewable energy systems has been widely explored, with successful implementations in Europe and North America. Fig. 1 illustrates the role of biogas across various industries, highlighting high-impact and value-added areas where these systems have been implemented. However, Latin America's biogas potential remains largely unexploited due to infrastructure limitations, policy fragmentation, and technological barriers (Gallego-Schmid et al., 2024). Recent research highlights that, despite the availability of organic feedstocks, biogas adoption in Latin America faces financial and institutional challenges that must be addressed to unlock its full potential (Luna-delRisco et al., 2025). Addressing these issues requires a combination of technological advancements, policy incentives, and investment in infrastructure to facilitate the large-scale deployment of biogas-based energy systems.

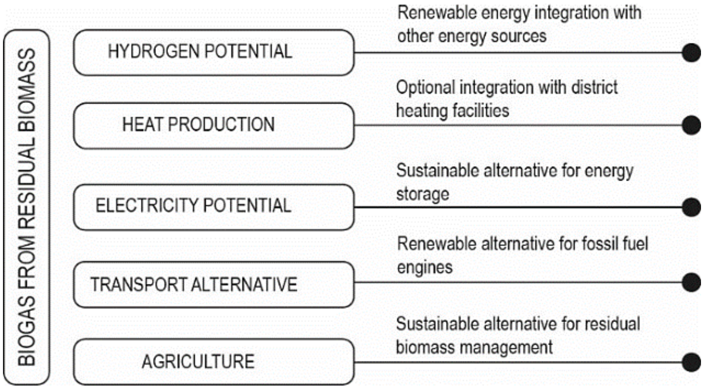


**Figure 1.** Role of biogas in a renewable energy system.

**Hydrogen production pathways from biogas**

The conversion of biogas into hydrogen involves several technological pathways, each with distinct efficiencies, costs, and environmental impacts (Fig. 2). The most widely adopted method is steam methane reforming (SMR), which reacts to methane in biogas with high-temperature steam to produce hydrogen and carbon dioxide. While SMR is commercially mature, it requires carbon capture and storage (CCS) to minimize greenhouse gas (GHG) emissions (Jeje et al., 2024). Autothermal reforming (ATR) integrates partial oxidation and SMR, improving thermal efficiency while reducing energy input requirements.

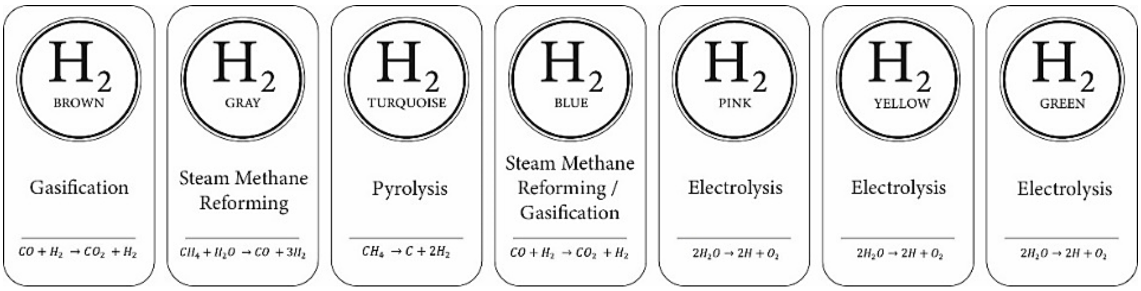


**Figure 2.** Alternative hydrogen production pathways.

Plasma reforming is an emerging technology that employs high-energy plasma to break down methane, offering rapid reaction rates and decentralized applications. Additionally, biological hydrogen production, such as dark fermentation and microbial electrolysis cells, provides alternative pathways that utilize microbial activity to generate hydrogen directly from biogas (Alhamed et al., 2024). These biological methods offer lower energy consumption but remain at early research stages due to scalability challenges. Studies suggest that optimizing these technologies through advanced catalysts, process automation, and hybrid conversion systems could enhance biogas-to-hydrogen efficiency (Kumar & Kumar, 2024). However, economic constraints and infrastructure gaps remain key barriers.

**Technological advances in Biogas-to-Hydrogen (B2H) conversion**

Recent advancements in catalysis, purification techniques, and carbon management strategies have significantly improved the efficiency of B2H conversion. Nanostructured catalysts have shown enhanced performance in reforming processes by increasing reaction rates and reducing energy input requirements (Saeed et al., 2024). In purification, membrane separation technologies, such as palladium-based membranes, have demonstrated high selectivity for hydrogen extraction, reducing impurities like carbon monoxide and residual methane (Yang et al., 2025). Additionally, pressure swing adsorption (PSA) systems have been optimized to improve hydrogen purity while minimizing energy losses (Shabbani et al., 2024). In terms of carbon management, integrated carbon capture utilization and storage (CCUS) is gaining interest in mitigating emissions associated with methane reforming. A study conducted by Cho et al. (2024) have also explored hybrid systems, combining SMR with renewable electrolysis, to enhance hydrogen yields while reducing reliance on fossil energy alternatives. Moreover, advancements in biological conversion techniques, including genetically engineered microorganisms for microbial electrolysis, show promise in improving hydrogen productivity at lower temperatures (Jain et al., 2022). While these technological innovations contribute to increased efficiency, their commercial viability remains a challenge due to high capital costs and infrastructure requirements.

**Economic feasibility of Biogas-Based Hydrogen (BBH)**

The economic viability of BBH production depends on multiple factors, including feedstock availability, process efficiency, capital investment, and market demand. Studies indicate that biogas production costs vary significantly across regions, with lower costs in countries with abundant organic waste resources (Rodrigues et al., 2025). However, hydrogen conversion technologies remain capital-intensive, particularly for advanced purification systems and carbon capture integration. Comparative cost assessments reveal that biogas-to-hydrogen pathways are currently more expensive than fossil-based hydrogen production, but with economies of scale and policy incentives, costs could decline over time (Emetere et al., 2024). Financial models suggest that government subsidies, tax credits, and carbon pricing mechanisms could improve the economic feasibility of biogas-derived hydrogen. Additionally, public-private partnerships and regional investment funds have been identified as key enablers for accelerating commercial deployment. Studies emphasize that market competitiveness can be enhanced through value chain optimization, including the development of integrated biorefineries that maximize resource utilization (Jaradat et al., 2024). Despite these opportunities, economic barriers such as high initial investments, limited financing mechanisms, and uncertain policy frameworks continue to slow down large-scale technology positioning (Emetere et al., 2024). Addressing these challenges requires targeted financial incentives and regulatory support to create a favorable investment environment for BBH technologies.

**Policy frameworks and regulatory challenges**

A well-structured policy framework is crucial for the successful deployment of B2H technologies. Currently, policy support varies significantly across Latin American countries, with some nations implementing hydrogen roadmaps while others lack clear regulations for biogas utilization. A comparative analysis reveals that Chile, Colombia

Uruguay have introduced incentive programs for green hydrogen, including tax exemptions and funding for pilot projects (Gomes et al., 2024). However, many countries in the region still prioritize fossil fuel subsidies, making renewable hydrogen less competitive. Studies highlight that regulatory uncertainty, lack of standardization, and fragmented institutional frameworks create barriers for investors and project developers (Carlson & Trencher, 2024). Furthermore, permitting processes and grid connection regulations often delay the deployment of B2H infrastructure. Data reported for international experiences suggests that long-term policy commitments, carbon pricing mechanisms, and renewable energy mandates can significantly boost investor confidence (Bade & Tomomewo, 2024). Research also underscores the importance of harmonized regional policies, allowing for cross-border collaboration and knowledge exchange. Strengthening these policy frameworks will be essential to accelerate the development of a competitive BBH sector in Latin America.

**Environmental and sustainability considerations**

BBH offers significant environmental benefits compared to fossil-based hydrogen (FBH) production. Life-cycle assessments indicate that biogas-derived hydrogen (BDH) can achieve carbon neutrality when integrated with carbon capture technologies. Additionally, biogas mitigates methane emissions, reducing its environmental impact. However, sustainability challenges remain, including land use competition, water consumption, and waste management complexities. Research highlights that circular economy approaches, such as nutrient recovery from digestate, can enhance the sustainability of biogas projects (Le et al., 2024). Integrating these sustainability measures will be essential to ensuring the long-term viability of BBH.

## METHOD

This study considers a comprehensive research approach to assess the technical and economic feasibility of biogas-based hydrogen production in Latin America. The methodology integrates quantitative and qualitative analyses, incorporating data from scientific literature, government reports, industrial case studies, and stakeholder perspectives. A systematic framework was designed to evaluate biomass availability, conversion technologies, economic viability, and policy frameworks relevant to the region. The research follows a structured methodology comprising the following key components:

**Data collection and sources**

A systematic review of scientific literature, policy documents, and technical reports was conducted to obtain relevant data on BBH production. A scoping review, following PRISMA-ScR guidelines (Tricco et al., 2018), was conducted to comprehensively map and synthesize the available evidence on biogas-based hydrogen (BBH) production in Latin America. The review included scientific literature, policy documents, technical reports, and economic datasets published in the last five years (2019–2024). Data sources included peer-reviewed publications from indexed scientific journals to assess technological advancements, efficiency data, and innovation trends, policy documents and national hydrogen roadmaps from Latin American governments and international organizations (e.g., IRENA, IDB) to understand regulatory frameworks, and economic data extracted from energy market reports, investment outlooks, and international funding databases.

The literature search strategy focused on data consultation using Scopus, Web of Science, and Google Scholar, employing key terms such as ‘biogas hydrogen production’, ‘biogas reforming’, ‘biohydrogen Latin America’, ‘hydrogen policy Latin America’, and ‘BBH techno-economic analysis’. Additionally, grey literature was incorporated by reviewing institutional repositories, governmental platforms, and international reports.

The data gathering method also considered the inclusion and exclusion of different criteria. Publications focused on biogas utilization, hydrogen production pathways, economic feasibility, and policy frameworks relevant to Latin America, as well as studies published in English and Spanish were considered as inclusion criteria, while studies focused exclusively on other hydrogen production pathways without reference to biogas, and regions outside Latin America unless presenting globally relevant technological benchmarking were excluded from this study.

The selected publications were screened for relevance based on titles and abstracts, followed by full-text reading. The sources were then categorized by topics (technical, economic, policy), geographical relevance (country-specific or regional), and publication type (peer-reviewed, report, roadmap).

A descriptive-analytical approach was applied, summarizing key technological parameters (i.e. efficiency, yields), economic indicators (i.e. investment costs), and policy instruments. The data were then cross-referenced with global benchmarks to identify gaps and opportunities.

Data validation was performed through cross-referencing multiple sources and prioritizing publications from highly ranked journals or institutional reports.

**Technological evaluation**

The technical analysis of biogas-based hydrogen production in Latin America was conducted using a multidisciplinary approach, integrating biomass resource assessment, conversion technology evaluation, hydrogen purification analysis, and global benchmarking.

Data from national agricultural agencies, industry reports, and scientific literature were analyzed to determine the availability and distribution of biomass. A comparative analysis of hydrogen production pathways was conducted. The study also approaches hydrogen purification methods and carbon capture strategies, emphasizing their role in enhancing hydrogen purity and sustainability.

**Economic feasibility analysis**

A brief approach to the cost-benefit analysis was conducted to assess the financial viability of biogas-based hydrogen production. The economic evaluation considers: i) capital expenditures (CAPEX) and operational expenditures (OPEX) for infrastructure, technology deployment, and feedstock processing, ii) levelized cost of hydrogen (LCOH) to compare production costs with conventional and renewable hydrogen sources, and iii) financial incentive scenarios, including government subsidies, carbon pricing mechanisms, and tax incentives.

**Policy and regulatory framework analysis**

An overview of existing policies, regulations, and government initiatives was conducted to assess their role in promoting or delaying biogas-to-hydrogen adoption. The analysis included a brief comparison of some national hydrogen strategies across Latin America, focusing on policy incentives for bioenergy-based hydrogen. The study also reviewed some regulatory barriers, such as lack of standardization, grid integration challenges, and permitting processes.

**Definition of analysis timeframes**

This study defines three analytical timeframes: short-term (0–5 years), mid-term (6–10 years), and long-term (> 10 years) to facilitate the assessment of policy gaps, regulatory barriers, and technological deployment challenges. The selection of these intervals was based on internationally recognized strategic planning frameworks and hydrogen development roadmaps (IRENA, 2022; IEA, 2024; European Hydrogen Backbone Initiative, 2021). The short-term period focuses on immediate regulatory actions, the initial deployment of technologies, and the investment challenges that arise in the early stages. The mid-term covers the phase where infrastructure expands, markets stabilize, and institutional frameworks become more robust. Finally, the long-term perspective looks at how systems integrate on a larger scale, how countries collaborate across borders, and how emerging technologies evolve and mature. These timeframes follow well-established models of how technologies progress toward readiness (Mankins, 2009) and how innovations spread and are adopted (Rogers, 2003). They also reflect the typical legislative, financial, and industrial cycles observed in major energy transitions. Using this structure helps organize and prioritize the key challenges and opportunities for developing BBH in Latin America.

**Limitations of the study**

While this research provides an evaluation of biogas-based hydrogen production, the authors state that certain limitations exist. The limitations found in this study are data availability, technology cost fluctuations, and policy variability. Despite these limitations, the study offers ground for decision-making and identifies key areas for future research and policy interventions.

## RESULTS AND DISCUSSION

**Technical analysis**

The technical analysis of biogas-based hydrogen production in Latin America focuses on the availability of biomass feedstocks, conversion technologies, and key performance indicators for hydrogen yield and efficiency. The findings provide insights into the feasibility of integrating biogas-to-hydrogen conversion technologies into the region’s energy landscape.

**Biomass resource potential for biogas production.** The assessment of organic feedstocks for biogas production across Latin America reveals that agricultural residues, livestock manure, and municipal solid waste are the most abundant sources. Brazil, Argentina, Colombia, and Mexico stand out as high-potential regions due to their extensive agricultural and livestock industries. Sugarcane bagasse, coffee husks, and palm oil residues present substantial opportunities for biogas generation. Data from national agricultural agencies indicate that millions of tons of organic waste per year remain underutilized, highlighting a significant untapped potential for bioenergy applications (Fig. 3).

Despite the abundance of feedstocks, logistical and infrastructural barriers affect biogas availability. In some regions, poor waste collection systems, lack of centralized biogas plants, and limited access to processing technologies constrain large-scale production. Additionally, variability in feedstock composition influences methane content, impacting hydrogen yield in conversion processes (Mignogna et al., 2024). These findings emphasize the need for improved waste management systems, efficient feedstock preprocessing, and decentralized biogas plants to enhance resource utilization for hydrogen production.

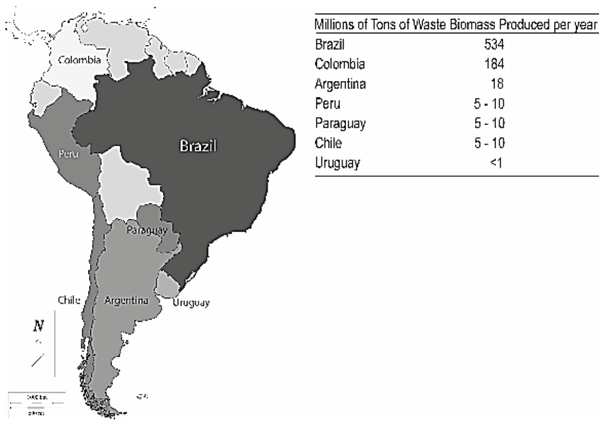


**Figure 3.** Volume of waste biomass produced per year in various countries of South America.
Source: adapted from (Sampaolesi et al., 2023).

**Performance of Biogas-to-Hydrogen (B2H) conversion technologies.** The comparative analysis of hydrogen production pathways from biogas highlights differences in efficiency, cost-effectiveness, and technological readiness levels (TRLs). Steam methane reforming (SMR) remains the most widely used method due to its high hydrogen yield (approx. 70–80%) and commercial maturity. However, its carbon dioxide emissions require integration with carbon capture and storage (CCS) to align with sustainability goals. In contrast, autothermal reforming (ATR) offers improved thermal efficiency by combining partial oxidation and steam reforming, but its operational complexity presents a challenge for large-scale adoption (Kumar & Kumar, 2024; Materazzi et al., 2024).

Emerging technologies such as plasma reforming and biological hydrogen production have demonstrated promising results in laboratory-scale experiments, yet they remain in early development stages. Plasma reforming achieves rapid methane conversion with minimal energy input, but infrastructure costs are high. Microbial electrolysis cells (MECs) and dark fermentation techniques leverage biological pathways to produce hydrogen at lower temperatures but exhibit lower yields and scalability constraints (Ahmad et al., 2024; Singh et al., 2024). These findings suggest that while conventional thermochemical pathways are currently the most viable for large-scale applications, ongoing research and innovation in catalysis, reactor design, and process optimization are essential to improve the efficiency and sustainability of biogas-to-hydrogen conversion.

**Hydrogen purification and carbon management strategies.** Hydrogen purification is critical to achieving fuel cell-grade hydrogen from biogas-derived sources. The study finds that membrane separation technologies, pressure swing adsorption (PSA), and cryogenic distillation are the most effective purification techniques (Kazmi et al., 2024; Król et al., 2024; Yang et al., 2025). Palladium-based membranes provide high selectivity but remain expensive, whereas PSA systems balance cost and efficiency, making them suitable for commercial applications. Recent advancements in metal-organic frameworks (MOFs) and hybrid separation techniques show potential for improving gas separation efficiency and reducing energy consumption.

In parallel, carbon capture and utilization (CCU) strategies are necessary to mitigate emissions from methane reforming processes. Absorption-based $CO_2$ capture using amine solvents remains the dominant approach, but novel techniques such as mineralization and bio-based $CO_2$ conversion offer sustainable alternatives. The integration of biogas upgrading technologies with carbon capture systems can enhance overall sustainability by producing both high-purity hydrogen and renewable biomethane.

**Energy efficiency and system integration challenges.** The overall energy efficiency of B2H systems depends on process integration, heat recovery mechanisms, and operational conditions. Energy efficiency assessments indicate that SMR with CCS achieves an efficiency range of 50–60%, while ATR reaches slightly higher efficiencies due to internal heat utilization. Plasma reforming and biological hydrogen production pathways exhibit lower efficiencies but offer potential advantages in decentralized applications (Zainal et al., 2024).

A key challenge identified is the integration of B2H systems into the existing energy infrastructure. The lack of dedicated hydrogen transport networks, refueling stations, and grid connections in Latin America presents barriers to widespread adoption. Hybrid biorefinery models, where hydrogen production is combined with biomethane upgrading and biofertilizer recovery, could enhance system efficiency and economic viability. A study conducted by Jaradat et al. (2024) suggests that sector coupling strategies, linking hydrogen with renewable power, industrial applications, and mobility sectors, could accelerate market development.

**Comparative analysis with global benchmarks.** A comparative analysis with leading B2H initiatives in Europe, North America, and Asia reveals key lessons for Latin America. Germany's hydrogen strategy prioritizes renewable gas integration and sector- wide collaboration, serving as a model for policy-driven deployment. Japan's investment in hydrogen infrastructure and fuel cell applications highlights the role of government funding in accelerating technology adoption. Meanwhile, Denmark's bioenergy-focused policies showcase the economic benefits of linking biogas production with hydrogen and biomethane markets (Fig. 4).

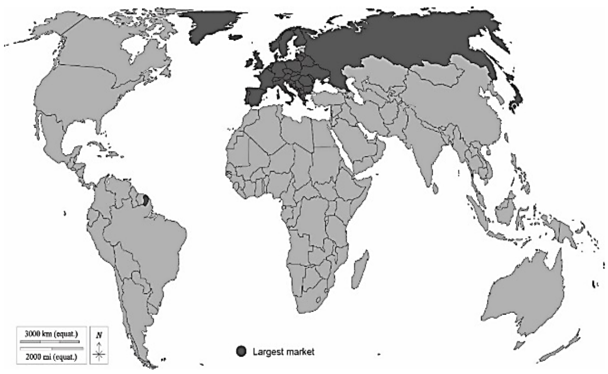


**Figure 4.** Green hydrogen market trends by region (2025–2030).

Source: Adapted from (Green Hydrogen Market Size, Share & Growth Report, 2030).

Latin America has the advantage of abundant biomass resources and growing energy demand, but it lags in infrastructure, policy incentives, and research investment. Bridging this gap requires greater government commitment, regional cooperation, and industry-driven innovation to replicate successful international models while addressing region-specific challenges.

**Economic feasibility analysis**

The economic viability of BBH production in Latin America depends on multiple cost-related, market, and policy factors that influence its competitiveness compared to other hydrogen sources. The findings in this section provide a comprehensive evaluation of capital and operational costs, financial incentives, market trends, and investment challenges for technology adoption.

**Capital and operational costs of B2H production.** The economic assessment reveals that capital expenditures (CAPEX) and operational expenditures (OPEX) for BBH production remain higher than conventional hydrogen production methods, particularly steam methane reforming (SMR) from fossil fuels (Yagüe et al., 2024; Cormos, 2025). The CAPEX of B2H systems is influenced by feedstock processing, anaerobic digestion infrastructure, gas upgrading technologies, and hydrogen purification units. Cost estimates indicate that the installation of a medium-scale biogas plant capable of hydrogen production requires an initial investment ranging between $5–15 million, depending on technology choice and plant capacity. The most expensive components are gas cleaning and reforming units, as they require advanced materials and catalytic systems to ensure high hydrogen yields (Yagüe et al., 2024).

On the other hand, OPEX is affected by feedstock costs, maintenance, and energy requirements for reforming processes. Unlike fossil-based hydrogen production, biogas-based systems require continuous biomass supply chains, which introduce logistical challenges and price variability. A study conducted by Loh et al. (2024) show that OPEX for biogas-based hydrogen plants can be reduced through economies of scale, particularly if co-products such as biomethane, electricity, and biofertilizers are integrated into the business model. These findings suggest that cost reduction strategies must focus on optimizing feedstock supply chains, improving plant efficiency, and adopting modular designs for smaller-scale distributed production.

**Levelized cost of hydrogen from biogas.** The Levelized Cost of Hydrogen (LCOH) is a critical economic indicator for assessing the feasibility of biogas-derived hydrogen compared to other production methods. In Latin America, LCOH estimates for biogas-based hydrogen range between $3.50 and $7.00 per kilogram (kg), depending on factors such as feedstock availability, technology selection, and production scale (IRENA & IDOS, 2024). This cost is higher than fossil-based hydrogen (gray hydrogen), which averages $1.50–$2.50 kg, but competitive with green hydrogen from electrolysis, which ranges from $4.00–$7.50 kg.

The economic analysis identified 3 key cost drivers for biogas-to-hydrogen LCOH. The variables are: i) feedstock costs, in which regions with abundant organic waste can achieve lower LCOH due to minimal raw material expenses, ii) plant efficiency leads to high methane conversion rates in steam methane reforming (SMR) and autothermal reforming (ATR) improve overall hydrogen output, reducing costs, and iii) existing carbon pricing incentives in countries where carbon credits incentives exist, biogas-based hydrogen can achieve cost parity with fossil-derived alternatives (Loh et al., 2024). These drivers suggest that cost reductions through process optimization, increased scale, and financial incentives are possible.

**Financial incentives and government support.** Financial incentives play a crucial role in making biogas-based hydrogen competitive in the energy market. Currently, Latin America lacks a standardized incentive framework for hydrogen production from biogas, leading to investment uncertainty and slower adoption rates. However, some countries have introduced policies that support bioenergy and hydrogen production, which could provide indirect benefits to biogas-based systems (Tunn et al., 2024).

This study approaches a few key financial mechanisms that influence project feasibility. First, subsidies for renewable hydrogen in countries like Chile and Uruguay have initiated hydrogen investment funds, although most target electrolysis-based hydrogen. Tax incentives for bioenergy projects in Brazil and Argentina provide tax reductions and investment credits for biogas plants, which could extend to hydrogen production. Carbon pricing schemes for countries implementing carbon taxes or emission reduction programs (e.g., Colombia) could create an economic advantage for low-emission hydrogen pathways. At last, international funding and grants awarded for Latin American projects from organizations such as the Inter-American Development Bank (IDB) and the Global Environment Facility (GEF), supporting renewable energy deployment (Tunn et al., 2024; Undurraga et al., 2024).

Despite these efforts, biogas-based hydrogen lacks specific financial policies that directly support its expansion. Establishing targeted subsidies, preferential financing, and carbon credit incentives could significantly reduce investment risks and improve economic feasibility.

**Market competitiveness and commercial viability.** The commercial viability of biogas-derived hydrogen depends on its ability to compete with other hydrogen production methods in the energy and industrial sectors. At present, gray hydrogen (from natural gas) dominates industrial applications due to lower costs and well-established supply chains. However, carbon-intensive hydrogen is becoming less favorable due to stricter decarbonization policies worldwide (Saha et al., 2024).

Based on the context of this study, Latin America has potential market opportunities for biogas-based hydrogen supported on the following axis: i) decarbonizing heavy industries, which focuses on sectors such as steel, cement, and chemical production that require sustainable hydrogen alternatives, providing an immediate demand for renewable hydrogen, ii) hydrogen for mobility solutions in which some countries, including Chile, Colombia and Brazil, have introduced pilot projects for hydrogen-powered vehicles such cars, buses and trucks, presenting a future market for biogas-derived hydrogen, and iii) grid integration and energy storage from hydrogen produced from biogas; this could be used to stabilize energy grids by storing surplus renewable energy and providing backup power (Gomes et al., 2024).

In the study conducted by Jaradat et al. (2024), the authors presented results in which market competitiveness was improved due to biogas-based hydrogen integration into national hydrogen roadmaps, ensuring long-term demand, pricing stability, and infrastructure development.

**Investment challenges and risk analysis.** The economic risks associated with biogas-to-hydrogen projects are related to factors such as high capital costs, regulatory uncertainty, and limited market demand. Investors and private sector stakeholders require clear financial incentives, stable policy frameworks, and access to financing mechanisms before committing to large-scale projects.

Jaradat et al. (2024) have found challenges associated to: i) lack of standardized regulations, because of the absence of clear hydrogen certification frameworks creates market uncertainty, discouraging investors, ii) limited infrastructure for hydrogen storage and transport networks. Private initiatives and government efforts are still underdeveloped, increasing logistical costs, and iii) volatile feedstock supply chains due to seasonal variations in agricultural and livestock. This volatility of available waste can affect biogas production consistency.

The findings suggest that risk mitigation strategies should focus on regional cooperation, government-backed guarantees, and Public-Private Partnerships (PPPs) to ensure long-term investment security.

**Policy and regulatory analysis**

The development of biogas-based hydrogen production in Latin America deeply depended on policy frameworks, regulatory incentives, and government support. While some countries have introduced hydrogen roadmaps and bioenergy policies, a lack of regulatory harmonization, investment security, and infrastructure planning continues to slow technology adoption and exploitation. The evaluation of the current policy landscape, existing barriers, and potential regulatory improvements to accelerate the adoption of biogas-based hydrogen in the region was evaluated.

**National hydrogen strategies and their impact on Biogas-Based Hydrogen.** This study approaches Latin American countries that have formulated hydrogen strategies to align with global decarbonization goals, in which most policies prioritize electrolysis-based hydrogen over bioenergy pathways. Chile, Uruguay, Brazil, and Colombia have developed hydrogen roadmaps that outline investment plans, market development goals, and pilot project funding (IRENA & IDOS, 2024). However, biogas-based hydrogen is rarely specified as a key component of these strategies, despite the region’s large biomass resources and existing bioenergy infrastructure. Table 1 provides a comparison of selected national hydrogen strategies and their challenges regarding biogas-based hydrogen production.

**Table 1.** Overview of selected national hydrogen policies and challenges for Biogas-Based Hydrogen in Latin America

| Country | Policy Status | Challenges |
|---|---|---|
| Chile | One of the most advanced hydrogen policies with subsidies and investment funds for green hydrogen. | Focuses primarily on solar-powered electrolysis with minimal emphasis on biogas utilization. |
| Uruguay | Integrates bioenergy within its renewable energy transition. | Lacks specific policies to incentivize hydrogen production from biogas. |
| Brazil | Strong biofuels sector with bioenergy incentives that indirectly support biogas projects. | Direct policy mechanisms for hydrogen production remain underdeveloped. |
| Colombia | Hydrogen roadmap acknowledges biohydrogen as a potential pathway. | Financial and technical incentives for biohydrogen remain unclear. |

Source: own elaboration.

**Policy gaps and regulatory barriers.** Despite growing interest in renewable hydrogen, Latin America faces significant policy gaps and regulatory challenges that delay the development of biogas-based hydrogen projects. In Table 2, the authors present a table that categorizes the urgency of policy gaps and regulatory barriers based on their impact on short-term, middle-term, and long-term projects.

**Table 2.** Outlook of policy gaps and regulatory barriers in Latin America

| Policy Gaps and Regulatory Barriers | Short-Term (0–5 years) | Middle-Term (6–10 years) | Long-Term (>10 years) |
|---|---|---|---|
| Lack of standardized hydrogen regulations | **Critical** | Moderately Critical | Not Critical |
| Limited financial incentives for bioenergy-based hydrogen | **Critical** | **Critical** | Moderately Critical |
| Complex permitting and approval processes | **Critical** | Moderately Critical | Moderately Critical |
| Absence of carbon pricing mechanisms | Moderately Critical | **Critical** | **Critical** |
| Weak integration of biogas into national hydrogen strategies | **Critical** | **Critical** | Moderately Critical |
| Limited infrastructure for hydrogen storage and transport | **Critical** | **Critical** | **Critical** |
| Fragmented regional policies and lack of coordination | Moderately Critical | **Critical** | **Critical** |
| Slow development of public-private partnerships (PPPs) | Moderately Critical | Moderately Critical | Moderately Critical |
| Unclear land-use policies for biogas facilities | **Critical** | Moderately Critical | Not Critical |
| Lack of research and development (R&D) funding for biogas-based hydrogen | Moderately Critical | **Critical** | **Critical** |

Source: own elaboration.

The table highlights key policy gaps and regulatory barriers impacting biogas-based hydrogen production in Latin America across short-term (0–5 years), middle-term (6–10 years), and long-term (> 10 years) timeframes. In the short term, critical challenges include the lack of standardized hydrogen regulations, limited financial incentives, complex permitting processes, weak policy integration of biogas, and insufficient infrastructure for hydrogen storage and transport. These barriers create investment uncertainty and delay project scalability, requiring immediate policy reforms and financial incentives. In the middle term, challenges such as the absence of carbon pricing mechanisms, fragmented regional policies, and inadequate research and development (R&D) funding become more pronounced, requiring coordinated governmental action to establish market-driven regulations, harmonize policies, and foster technology advancements. In the long term, sustaining investment in infrastructure and innovation will be essential to ensuring the competitiveness of biogas-based hydrogen. Although regulatory improvements and technological advancements may mitigate some short-term and middle-term issues, long-term challenges, including infrastructure expansion and policy stability, will require continuous managing. Addressing these policy gaps through government commitment, international collaboration, and private-sector engagement will be crucial to unlocking the full potential of biogas-based hydrogen, positioning Latin America as a key player in the global hydrogen economy.

**The role of carbon pricing and emissions regulations.** Carbon pricing mechanisms are important in determining the economic competitiveness of biogas-based hydrogen. Countries implementing carbon taxes or emissions trading systems (ETS) create stronger market incentives for low-carbon hydrogen (Ueckerdt et al., 2024; J. Yang et al., 2024). However, in Latin America, carbon pricing remains underdeveloped and inconsistently applied. Colombia has a carbon tax primarily targeting fossil fuel industries, offering limited incentives for biohydrogen production. Argentina and Brazil have regional emissions reduction programs, yet hydrogen-related credits are not widely available. Mexico previously explored carbon trading systems, but policy reversals have slowed progress. A regional carbon pricing mechanism, combined with hydrogen-specific emission reduction credits, could enhance the economic feasibility of biogas-to-hydrogen projects while promoting low-carbon energy adoption (Missbach et al., 2024).

Latin America possesses abundant renewable energy resources, positioning it to become a major producer of low-cost, low-emission hydrogen, particularly in countries like Argentina, Brazil, Colombia, and Chile. Despite this potential, the region's bioenergy capabilities have been only partially developed, with significant opportunities remaining untapped. Implementing comprehensive carbon pricing strategies and fostering regional cooperation could unlock these opportunities, advancing both economic and environmental objectives.

However, the economic viability of biogas-based hydrogen production in Latin America faces significant challenges. High capital costs associated with biogas plant construction and operation, coupled with limited access to financing, impede project development. Additionally, the absence of standardized regulations and incentives for biohydrogen creates uncertainty for investors. Technological challenges, such as the need for efficient biomass collection and processing, further complicate the technology adoption panorama. Addressing these issues requires coordinated policy frameworks, investment in research and development, and the establishment of financial mechanisms to support biogas-based hydrogen initiatives (Rodríguez-Fontalvo et al., 2024).

**Opportunities and Challenges**

The potential for biogas-based hydrogen production in Latin America is driven by abundant biomass resources, growing hydrogen markets, environmental benefits, and socio-economic advantages. Countries like Brazil, Argentina, Colombia, and Mexico possess significant agricultural and livestock industries, providing a sustainable supply of organic waste for biogas production. These feedstocks offer a low-cost alternative to fossil fuels, reducing dependency on imported energy sources. Additionally, Chile and Brazil are emerging as hydrogen market leaders, investing in infrastructure and national strategies that could integrate biogas-based hydrogen to strengthen energy security and economic growth.

From an environmental perspective, biogas-derived hydrogen significantly reduces methane emissions, aligning with climate policies and global decarbonization efforts. When coupled with carbon capture and utilization (CCU) technologies, biohydrogen can even achieve low emissions, making it attractive for industrial applications seeking low-carbon energy alternatives.

Beyond economic and environmental benefits, biogas-based hydrogen has strong socio-economic potential, particularly for rural development. Countries with strong agricultural sectors can create jobs in feedstock collection, biogas plant operation, and hydrogen distribution, while decentralized energy systems can increase energy access in remote areas.

**Table 3.** Analysis and comparison of opportunities for biogas-based hydrogen development in Latin America

| Country | Biomass availability | Hydrogen market integration | Environmental impact and decarbonization | Socio-economic potential | Challenges and limitations |
|---|---|---|---|---|---|
| Brazil | **High** Large agricultural and livestock waste (sugarcane bagasse, soy residues, manure) | **Strong** Already investing in green hydrogen; potential for biohydrogen inclusion | **High** Existing biogas infrastructure could reduce methane emissions significantly | **Strong** Biogas sector already supports rural employment; potential to expand hydrogen workforce | **Policy Gaps** Hydrogen roadmap prioritizes electrolysis; limited direct incentives for biohydrogen |
| Argentina | **High** Extensive livestock and agro-industrial waste (corn, wheat, cattle manure) | **Moderate** Emerging interest in hydrogen, but biohydrogen not yet prioritized | **Moderate** Biogas projects exist, but few large-scale hydrogen applications | **Moderate** Potential for rural job creation, but lack of investment in hydrogen production | **Economic Constraints** Limited funding mechanisms for biogas-to-hydrogen projects |
| Colombia | **Moderate** Strong agricultural output (coffee, palm oil, livestock waste), but uneven waste collection | **Moderate** Hydrogen strategy mentions biohydrogen, but lacks detailed implementation plans | **Moderate** Some biogas projects, but weak integration into hydrogen sector | **Moderate** Potential for decentralized rural energy access and economic growth | **Regulatory Uncertainty** Biohydrogen incentives remain unclear, slowing investment |
| Mexico | **High** Diverse biomass sources (corn, sugarcane, livestock waste, municipal solid waste) | **Weak** Limited hydrogen policy development; no strong biohydrogen incentives | **Moderate** Potential for emissions reduction, but few government-backed projects | **Moderate** Could create rural jobs, but requires policy support. | **Infrastructure Limitations** Lacks hydrogen transport and storage capacity |
| Chile | **Low to Moderate** Limited biomass, but potential for municipal waste utilization | **Very Strong** Regional leader in green hydrogen, strong government backing | **High** Hydrogen roadmap prioritizes decarbonization; potential CCU applications | **Low** Rural biohydrogen projects unlikely due to lower biomass availability | **Feedstock Constraints** Limited agricultural waste may restrict large-scale biogas-to-hydrogen projects |

Source: own elaboration.

The comparative analysis presented in Table 3, highlights Brazil and Argentina as the most viable candidates for biogas-based hydrogen production due to their abundant biomass resources and strong agricultural sectors, however Argentina's policy and investment barriers may delay progress. Colombia and Mexico possess moderate potential, but weak regulatory frameworks and infrastructure constraints limit their ability to scale biohydrogen projects effectively. While Chile leads in hydrogen market development, its limited biomass availability reinforces its reliance on electrolysis-based hydrogen, restricting the role of biogas-derived pathways. Despite the region's vast bioenergy potential, the predominant policy fragmentation, infrastructure deficits, and economic challenges create significant barriers to deployment, indicating that without stronger government incentives, clearer regulatory frameworks, and regional cooperation, biogas-to-hydrogen production will struggle to compete with other hydrogen pathways in Latin America's clean energy transition (IRENA & IDOS, 2024).

**Challenges Facing Biogas-Based Hydrogen Deployment.** The economic, infrastructural, policy, and technological barriers outlined in the analysis present significant barriers to the widespread deployment of biogas-based hydrogen in Latin America. A lack of hydrogen infrastructure further constrains deployment, as Latin America lacks the necessary transport, storage, and distribution networks for biogas-based hydrogen. While natural gas systems are well established, the hydrogen economy is still in its early stages, requiring substantial investment in compression, liquefaction, and pipeline development.

In addition to economic and infrastructure challenges, policy and regulatory uncertainty remains a major deterrent for private sector participation. Most hydrogen roadmaps in Latin America focus on electrolysis-based hydrogen, while biogas-derived hydrogen receives little policy support. Furthermore, complex permitting processes and fragmented regulations discourage investment in emerging biohydrogen projects.

From a technological perspective, there are limitations that present additional constraints. While commercially available conversion methods such as SMR and ATR are viable, they remain energy-intensive, increasing production costs. Emerging technologies like microbial electrolysis cells and plasma reforming could provide more efficient and cost-effective solutions, but they are still in early research stages. Addressing these technological inefficiencies will require sustained investment in R&D.

Despite these challenges, Latin America's vast biomass resources, growing renewable energy demand, and potential for emissions reductions create strong opportunities for biogas-based hydrogen if governments and industries implement targeted financial incentives, infrastructure investments, and regulatory reforms. Table 4 presents a regional analysis of barriers found in studied Latin American countries.

The comparative analysis presented in Table 4 highlights that Colombia and Mexico face severe infrastructure and regulatory gaps, requiring stronger financial incentives and policy reforms to facilitate biohydrogen development. While Chile leads in green hydrogen policies, its limited biomass availability constrains biogas-based hydrogen potential, necessitating alternative strategies for biohydrogen integration. The critical challenge across all countries lies in technological advancements that requires governments to improving reforming efficiency, purification processes, and cost reductions in biogas upgrading to succeed commercial viability. Although these challenges, opportunities exist if governments implement strategic policies, strengthen financial mechanisms, and invest in research and infrastructure. Latin American nations with strong agricultural sectors must prioritize biohydrogen within hydrogen strategies, while Colombia and Mexico need targeted regulatory improvements to attract investments. Without coordinated actions, technology improvements, and policy support, biogas-based hydrogen will have difficulties to compete with electrolysis-based hydrogen and fossil-based alternatives in the region's clean energy transition.

**Table 4.** Comparative analysis of economic, infrastructural, and policy barriers in Latin America

| Country | Economic challenges (CAPEX & OPEX) | Infrastructure gaps | Policy & regulatory uncertainty | Technological barriers |
|---|---|---|---|---|
| Brazil | **High** Significant investment needed for biogas digesters and reforming technologies. LCOH remains uncompetitive | **Moderate** Existing biogas infrastructure could support hydrogen but requires upgrades | **Moderate** Biohydrogen is not a priority in hydrogen roadmap, but biofuels sector could drive integration | **Moderate** SMR is dominant, but advancements in plasma reforming could enhance efficiency |
| Argentina | **High** Limited financing for hydrogen projects makes CAPEX-intensive biogas plants difficult to scale | **High** Weak hydrogen transport and storage infrastructure | **High** No clear national hydrogen strategy; fragmented regulatory framework | **Moderate** Need for R&D investments to improve efficiency |
| Colombia | **Moderate** Biogas sector is growing, but hydrogen conversion remains costly without subsidies | **High** Lack of hydrogen storage and distribution networks | **High** Limited policy support for biogas-based hydrogen; regulatory uncertainty | **High** Need for process optimization and improved methane reforming efficiency |
| Mexico | **High** High LCOH due to expensive reforming and purification technologies | **High** Poor hydrogen transport infrastructure; no large-scale biogas-hydrogen integration | **High** Lack of clear regulations and financial incentives for biogas-based hydrogen | **Moderate** Potential for microbial electrolysis but still in early research phase |
| Chile | **Moderate** High energy prices affect biogas-to-hydrogen economics, but investment climate is strong | **Moderate** Hydrogen roadmap prioritizes electrolysis, with limited biogas integration | **Low** Clear hydrogen policies exist, but biohydrogen receives minimal direct incentives | **High** Biomass scarcity limits technological scalability for large-scale biogas-to-hydrogen projects |

Souce: own elaboration.

**Strategic pathways to address challenges and maximize opportunities.** The strategic pathways presented in this study approaches a comprehensive yet ambitious framework for overcoming the barriers to biogas-based hydrogen deployment in Latin America, but their success depends on coordinated implementation and long-term commitment. Strengthening policy support and financial incentives is critical, as without explicit integration into national hydrogen strategies, subsidies, and carbon pricing mechanisms, biogas-based hydrogen will find it difficult to compete with electrolysis-based alternatives. Infrastructure expansion is equally essential, but the high capital costs of hydrogen transport and storage networks require regional cooperation and public-private investments to ensure cost-effective deployment. While technological advancements in reforming and microbial hydrogen production seem promising, scaling R&D initiatives and pilot projects requires stronger industry-academic partnerships and risk-sharing mechanisms. Additionally, integrating biogas-based hydrogen into rural and industrial applications presents an opportunity for economic diversification, but success centres on clear business models, stable policy frameworks, and investment security. These strategies must be implemented in parallel, as individual efforts will not be sufficient to transform biogas-based hydrogen into a commercially viable and scalable energy solution in the region.

## CONCLUSIONS

Biogas-based hydrogen presents a viable pathway for renewable energy development in Latin America, enhancing the region's abundant biomass resources and growing demand for low-carbon energy alternatives. While technological advancements in reforming processes, microbial hydrogen production, and carbon capture solutions have been made, further research is required to optimize efficiency, reduce costs, and improve hydrogen storage and grid integration. Scaling up demonstration projects and establishing economic models that support financial sustainability will be critical to accelerating commercialization. These efforts must be supported by strong research collaboration, investment in infrastructure, and innovation in purification technologies to improve the feasibility of biogas-to-hydrogen systems.

Although the significant potential of biogas-based hydrogen, economic, policy, and infrastructure challenges are still the main obstacles for large-scale deployment. High capital costs and a lack of a well-developed hydrogen distribution network limit commercial expansion, while regulatory uncertainty and insufficient financial incentives reduce private sector interest. Moreover, many national hydrogen strategies prioritize electrolysis-based hydrogen, leaving biogas-derived pathways undervalued in long-term energy planning. To overcome these challenges, governments must integrate biohydrogen into national energy policies, implement carbon pricing mechanisms, and introduce tax incentives and direct subsidies to improve investment conditions. Furthermore, regional collaboration and the development of cross-border hydrogen trade frameworks could enhance market integration, making biogas-based hydrogen more economically viable and accessible within the region.

To unlock its full potential, biogas-based hydrogen must be positioned as a strategic component of Latin America's energy transition, complementing other renewable hydrogen sources. Countries with strong agricultural sectors, such as Brazil and Argentina, should prioritize biogas utilization, while Colombia and Mexico require regulatory clarity and investment support to drive market growth. Chile's leadership in hydrogen policy must be expanded to include biomass-based pathways where feasible.

This study concludes that with a coordinated approach to policy, investment, and technological development, Latin America has the potential to become a competitive global player in sustainable hydrogen production, contributing to decarbonization efforts and long-term energy security.

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