Email:

conference@houghtonstreetreview.com

Website:

www.houghtonstreetreview.com/index.php/conference

© 2026 International Online Conference on Multidisciplinary Academic Research. All Rights Reserved.

Editor-in-Chief:

Dr. Ewelum Johnson Nnadi

Managing Editors:

1.Harold Jan R. Terano

2.Dr. Mandakini Singla

3.Massoud Kaykhaii







THE ECONOMIC IMPACT OF GREEN HYDROGEN DEVELOPMENT ON INDUSTRIAL DECARBONIZATION AND COMPETITIVENESS IN EMERGING ECONOMIES

Umida Khasanova Ikhtiyor qizi
New Uzbekistan University, Uzbekistan

Abstract

Green hydrogen is increasingly discussed as a potential instrument for reducing industrial greenhouse gas emissions and transforming energy-intensive production systems. Its economic significance extends beyond environmental benefits to include industrial innovation, investment, technological development, and international competitiveness. Nevertheless, high production costs, financing constraints, uncertain demand, and inadequate infrastructure continue to limit its commercial deployment. This paper examines the economic implications of green hydrogen development for industrial decarbonization in emerging economies through a qualitative review of recent international reports and academic literature. The analysis focuses on three dimensions: the economic feasibility of hydrogen adoption in energy-intensive industries, its potential contribution to industrial competitiveness, and the institutional and financial conditions required for successful implementation. The reviewed evidence indicates that green hydrogen is unlikely to be economically viable across all industrial applications in the short term. Its strongest near-term opportunities are associated with replacing conventional hydrogen in existing industrial uses, particularly ammonia production and refining, while selected steelmaking applications may offer additional opportunities. The paper argues that emerging economies should prioritize commercially credible projects, renewable electricity development, infrastructure readiness, and policies that stimulate reliable industrial demand. For Uzbekistan, a phased and economically targeted approach could help align industrial modernization with long-term decarbonization objectives.

Keywords: green hydrogen, industrial decarbonization, industrial economics, economic competitiveness, renewable energy, investment, emerging economies, Uzbekistan.

1. Introduction

Industrial decarbonization has become an important economic and technological challenge as countries seek to reduce greenhouse gas emissions while maintaining industrial productivity and international competitiveness. Conventional industrial production frequently depends on fossil fuels for process heat, electricity, and chemical feedstocks. Although direct electrification and energy efficiency can reduce emissions in many applications, certain industrial processes require alternative fuels or feedstocks to achieve deeper decarbonization. Green hydrogen has therefore attracted growing attention as a potential component of industrial transformation.

Green hydrogen is generally produced by splitting water through electrolysis powered by renewable electricity. Its potential industrial applications include ammonia and methanol production, selected refining processes, direct reduced iron production, and other activities in which hydrogen can serve as a feedstock or

Email:

conference@houghtonstreetreview.com

Website:

www.houghtonstreetreview.com/index.php/conference

© 2026 International Online Conference on Multidisciplinary Academic Research. All Rights Reserved.

Editor-in-Chief:

Dr. Ewelum Johnson Nnadi

Managing Editors:

1.Harold Jan R. Terano

2.Dr. Mandakini Singla

3.Massoud Kaykhaii







reducing agent. However, its environmental and economic benefits depend on the electricity source, production technology, infrastructure, and intended application.

The International Energy Agency (IEA) reported that global hydrogen demand approached 100 million tonnes in 2024, while low-emissions hydrogen accounted for less than 1% of total production [1]. This contrast illustrates the gap between the established hydrogen market and the limited current contribution of lower-emissions production technologies. The IEA also identifies high costs, uncertain demand, regulatory barriers, and infrastructure limitations as major constraints on the expansion of low-emissions hydrogen [1].

From an industrial economics perspective, hydrogen development raises several interconnected questions. Under what conditions can green hydrogen become competitive with conventional production methods? Which industrial sectors offer the strongest economic rationale for early adoption? How can emerging economies avoid investments that impose high costs without generating sufficient domestic value added?

These questions are particularly relevant to emerging economies, where renewable energy resources may be substantial but access to affordable capital, advanced technology, and industrial infrastructure can be limited. Investment decisions must therefore balance environmental objectives with productivity, fiscal sustainability, energy security, and the opportunity cost of capital.

This paper examines the economic implications of green hydrogen development for industrial decarbonization and competitiveness in emerging economies, with particular attention to the policy relevance for Uzbekistan.

2. Research Methodology

The study employs a qualitative, literature-based research design. It draws on international energy assessments and recent academic research addressing hydrogen production costs, industrial applications, financing conditions, and decarbonization strategies.

The analysis uses three complementary approaches:

1. **Thematic literature analysis:** identifying recurring economic opportunities and barriers in green hydrogen development.
2. **Comparative industrial analysis:** examining the relevance of hydrogen for existing industrial hydrogen consumption, selected steelmaking processes, and other potential applications.
3. **Policy analysis:** identifying measures that could improve the economic feasibility of hydrogen investments in emerging economies.

The principal evidence base includes the IEA's Global Hydrogen Review 2025, the Breakthrough Agenda Report 2025, and recent peer-reviewed research on hydrogen cost competitiveness [1–3].

The paper does not present original econometric estimates, primary survey data, or newly collected industrial statistics. Its conclusions represent a qualitative synthesis of existing evidence. The methodology therefore supports analytical interpretation and policy discussion but does not establish causal effects or calculate the financial viability of a specific hydrogen project in Uzbekistan.

3. Results and Discussion

3.1. Green Hydrogen and the Economics of Industrial Decarbonization

Email:

conference@houghtonstreetreview.com

Website:

www.houghtonstreetreview.com/index.php/conference

© 2026 International Online Conference on Multidisciplinary Academic Research. All Rights Reserved.

Editor-in-Chief:

Dr. Ewelum Johnson Nnadi

Managing Editors:

1.Harold Jan R. Terano

2.Dr. Mandakini Singla

3.Massoud Kaykhaii







The economic case for green hydrogen depends primarily on whether it can replace carbon-intensive fuels or feedstocks at an acceptable cost while meeting industrial requirements for reliability, quality, and production scale.

A central distinction must be made between replacing hydrogen already used in industrial processes and introducing hydrogen into applications where it is not yet widely established. Existing hydrogen consumers, including ammonia producers and refineries, may offer comparatively accessible opportunities because hydrogen is already incorporated into their production processes. In contrast, new applications may require substantial modifications to equipment, supply chains, and operating practices.

The IEA identifies existing industrial hydrogen uses, particularly refining and chemical production, as important near-term opportunities for low-emissions hydrogen adoption [1]. Such applications can potentially reduce the emissions associated with existing production without requiring an entirely new industrial end-use market.

However, green hydrogen is not automatically the least-cost decarbonization option. Direct electrification, energy efficiency, renewable heat, and other technologies may be more economical for particular industrial processes. Hydrogen should therefore be assessed against realistic alternatives rather than treated as a universal solution.

A sound economic assessment should consider the full cost of production and use, including renewable electricity, electrolyser investment, water supply where relevant, storage, transportation, conversion losses, and industrial equipment adaptation. It should also account for the reliability of electricity supply and the expected utilization rate of the hydrogen production facility.

Accordingly, the economic contribution of green hydrogen depends not simply on production capacity but on whether it can deliver reliable industrial services at a competitive total cost.

3.2. Production Costs, Investment Risks, and Market Competitiveness

The cost of green hydrogen remains a central barrier to commercial expansion. Renewable electricity prices, electrolyser capital costs, financing conditions, and plant utilization rates all influence production economics. Additional costs may arise from storage, transportation, and the need to match hydrogen supply with industrial demand.

A recent study published in the International Journal of Hydrogen Energy examined combinations of technical and financial interventions intended to improve green hydrogen cost competitiveness for industrial decarbonization. The authors identified potential contributions from using otherwise curtailed wind electricity, recovering waste heat, and applying market-based financial mechanisms [3]. These findings indicate that hydrogen economics can be influenced by the design of the wider energy and industrial system, rather than by electrolyser costs alone.

Nevertheless, the outcomes of such interventions depend on local conditions. Electricity that would otherwise be curtailed may offer an opportunity to reduce energy costs, but its availability can be intermittent. Waste heat recovery requires suitable nearby heat demand, while financial instruments cannot eliminate underlying technological or market risks.

Email:

conference@houghtonstreetreview.com

Website:

www.houghtonstreetreview.com/index.php/conference

© 2026 International Online Conference on Multidisciplinary Academic Research. All Rights Reserved.

Editor-in-Chief:

Dr. Ewelum Johnson Nnadi

Managing Editors:

1.Harold Jan R. Terano

2.Dr. Mandakini Singla

3.Massoud Kaykhaii







Emerging economies face additional challenges because financing costs may be higher than in advanced economies. A project with attractive technical characteristics may remain financially unviable if borrowing costs, currency risks, uncertain purchase agreements, or infrastructure expenses are excessive.

The IEA's Breakthrough Agenda Report 2025 highlights financing constraints, limited infrastructure readiness, and regulatory uncertainty as significant barriers to hydrogen development in emerging and developing economies [2]. These constraints suggest that public support should be designed to address clearly identified market failures rather than subsidize projects without credible demand or realistic operating plans.

For industrial competitiveness, the relevant question is therefore not whether a country can produce green hydrogen, but whether it can produce and deliver it reliably at a cost that industrial users can sustain.

3.3. Industrial Competitiveness and Domestic Value Creation

Green hydrogen may support industrial competitiveness through several channels. First, it can help lower the emissions intensity of products in sectors where hydrogen provides a technically suitable alternative to conventional production methods. Second, hydrogen-related investment may stimulate demand for engineering, equipment maintenance, renewable electricity, and specialized industrial services. Third, early investment can help develop technical expertise and new business capabilities.

However, these benefits are not guaranteed. Hydrogen production based on imported equipment and external expertise may create limited domestic value added if local suppliers, workers, and research institutions do not participate in the value chain. Similarly, an export-oriented strategy may expose projects to uncertain international demand, transport costs, and changing certification requirements.

The IEA's Global Hydrogen Review 2025 emphasizes that announced projects do not necessarily translate into operating production capacity. Investment commitments, offtake agreements, infrastructure readiness, and regulatory certainty are critical to converting project proposals into commercially viable operations [1].

For emerging economies, a selective industrial strategy is therefore preferable to an assumption that every stage of the hydrogen value chain must be localized. Potential areas of domestic participation include engineering services, equipment maintenance, renewable power integration, industrial energy management, and selected hydrogen-based products where competitive advantages can be demonstrated.

A practical assessment of competitiveness should include production costs, domestic value added, employment quality, productivity, technology transfer, and exposure to external market risks. These indicators provide a more comprehensive basis for evaluating industrial development than installed hydrogen capacity alone.

3.4. Implications for Uzbekistan

Uzbekistan's industrial modernization and renewable energy development create a relevant context for assessing future opportunities associated with green hydrogen. Nevertheless, the economic feasibility of specific projects must be established through sector-level analysis rather than inferred solely from renewable energy potential.

A phased strategy could begin by identifying industrial facilities that already consume hydrogen or could use it as a feedstock. Existing demand may provide a

Email:

conference@houghtonstreetreview.com

Website:

www.houghtonstreetreview.com/index.php/conference

© 2026 International Online Conference on Multidisciplinary Academic Research. All Rights Reserved.

Editor-in-Chief:

Dr. Ewelum Johnson Nnadi

Managing Editors:

1.Harold Jan R. Terano

2.Dr. Mandakini Singla

3.Massoud Kaykhaii







more credible foundation for early projects than applications that depend on entirely new markets.

The first policy priority is to assess the cost and reliability of renewable electricity available to potential hydrogen producers. Electricity supply must be sufficiently affordable and reliable to support competitive production while avoiding unnecessary pressure on the wider power system.

The second priority is to evaluate industrial demand and secure credible purchase arrangements before committing substantial capital. Long-term offtake agreements can help reduce revenue uncertainty, although they must be supported by realistic pricing and enforceable contractual conditions.

The third priority is to improve infrastructure and technical capacity. Depending on project requirements, this may involve electricity grid connections, hydrogen storage, transportation systems, safety standards, workforce training, and industrial research partnerships.

The fourth priority is to establish transparent investment rules and carefully targeted support mechanisms. Public finance should focus on projects with credible demand, measurable emissions benefits, realistic cost assumptions, and a plausible pathway towards commercial operation.

Finally, hydrogen development should be compared with alternative decarbonization measures. In some industrial applications, direct electrification or energy efficiency may offer greater benefits at lower cost. A technology-neutral assessment would help Uzbekistan allocate investment resources more efficiently.

These priorities suggest that the country's initial focus should be on economic feasibility, existing industrial demand, and infrastructure readiness rather than rapid expansion of hydrogen production capacity for its own sake.

4. Conclusion

Green hydrogen offers a potential pathway for reducing emissions in selected industrial sectors while supporting technological development and economic diversification. Its strongest near-term applications are likely to involve replacing conventional hydrogen in existing industrial uses, while additional opportunities may emerge in steelmaking and other processes where hydrogen has a clear technical advantage.

The analysis indicates that economic competitiveness depends on more than renewable energy availability. Production costs, financing conditions, electrolyser performance, infrastructure, reliable industrial demand, and the availability of alternative decarbonization technologies all influence investment decisions.

For emerging economies, an effective strategy should prioritize commercially credible projects, strengthen renewable electricity infrastructure, develop domestic technical capabilities, and establish predictable investment frameworks. Policies should also distinguish between projects that generate measurable industrial value and those that remain dependent on uncertain future markets.

For Uzbekistan, green hydrogen could contribute to industrial modernization if its development is guided by rigorous cost-benefit analysis, realistic demand forecasts, and coordination between energy and industrial policies. Further research should evaluate selected Uzbek industrial sectors using transparent techno-economic models and verified data on electricity prices, investment costs, hydrogen demand, and emissions intensity.

Email:

conference@houghtonstreetreview.com

Website:

www.houghtonstreetreview.com/index.php/conference

© 2026 International Online Conference on Multidisciplinary Academic Research. All Rights Reserved.

Editor-in-Chief:

Dr. Ewelum Johnson Nnadi

Managing Editors:

1.Harold Jan R. Terano

2.Dr. Mandakini Singla

3.Massoud Kaykhaii



The central conclusion is that green hydrogen should be treated as a targeted industrial decarbonization instrument rather than a universal substitute for existing energy technologies. Its long-term contribution to competitiveness will depend on the ability to combine environmental objectives with economic efficiency, technological learning, and sustainable industrial development.

References

1. International Energy Agency (IEA). (2025). Global Hydrogen Review 2025. Paris: IEA. Available at: https://www.iea.org/reports/global-hydrogen-review-2025
2. International Energy Agency (IEA). (2025). Breakthrough Agenda Report 2025: Hydrogen. Paris: IEA. Available at: https://www.iea.org/reports/breakthrough-agenda-report-2025/hydrogen
3. Blending interventions to achieve green hydrogen cost competitiveness for industrial decarbonisation. (2025). International Journal of Hydrogen Energy, 144, 1343–1357. https://doi.org/10.1016/j.ijhydene.2025.03.420