Brief Report

Adapting International Green Hydrogen Regulations and Standards to the MENA and Jordanian Context

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Adapting International Green Hydrogen Regulations and Standards to the MENA and Jordanian Context

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Abstract

International green hydrogen regulations, standards, and guidelines are reviewed to assess their applicability to the Jordanian context. The analysis covers European Union directives, ISO and IEC standards, and best practices drawn from Germany, Japan, and Saudi Arabia. A gap analysis is conducted against Jordan's Draft National Hydrogen Strategy (2023) and the World Bank's 2025 policy note. Five regulatory gaps are identified: the absence of a dedicated hydrogen code, missing certification and quality standards, incomplete safety and technical codes, undefined infrastructure regulations, and weak policy integration. A two-phase adaptation roadmap is proposed, covering 2025 to 2030 and 2030 to 2050. Legislative reform, institutional capacity building, and regional cooperation are recommended to position Jordan as a green hydrogen production and export hub.

Keywords: green hydrogen; regulatory framework; Jordan; MENA; RFNBO certification; renewable energy policy

1. Introduction

Green hydrogen is recognized as a critical element in the global energy transition, particularly for hard-to-decarbonize sectors. Global hydrogen demand reached approximately 100 million tonnes in 2024, yet over 99% was supplied by fossil-derived (gray) hydrogen, while low-emission hydrogen (blue and green) remained below 1% of total supply [1]. According to the International Energy Agency (IEA), the share of low-emissions hydrogen must be expanded to approximately 4% by 2030 to meet climate objectives [1]. National hydrogen strategies, subsidies, and regulatory frameworks have already been established by the European Union and other major economies [2].

Jordan is strategically positioned to contribute to this emerging global market. Solar irradiance exceeding 3,000 full-load hours per year is received in the southern deserts, and strong wind resources are available in the Tafila governorate. Renewable electricity targets of 1.8 GW by 2025 and 8 GW by 2030 have been established, with the long-term objective of developing a green hydrogen export economy [3]. Multiple international agreements and memoranda of understanding have been signed to support this sector. A National Hydrogen Committee was formed in 2023, led by the Ministry of Energy and Mineral Resources (MEMR). The Draft National Hydrogen Strategy (2023) outlines a production target of 0.6 MMTPA by 2030 and up to 3.4 MMTPA by 2050, requiring approximately 47 GW of renewable energy capacity [4]. These targets are projected to create approximately 11,000 direct jobs and to avoid 4.2 Mt of CO_2 emissions per year by 2050 [4].

Despite favorable natural resources, several technical and economic barriers remain, including outdated infrastructure, constrained water supply, and relatively high hydrogen production costs [3]. International standards including ISO, IEC, and NFPA, alongside EU requirements, must be adopted into Jordan's regulatory framework [5]. The present study examines Jordan's green hydrogen strategy through a review of current legislation, identification of regulatory gaps, and formulation of recommendations to support the country's positioning as a regional hub.

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Authoritative sources including IEA reports, ISO/IEC publications, and EU regulations are drawn upon to identify priority areas for reform.

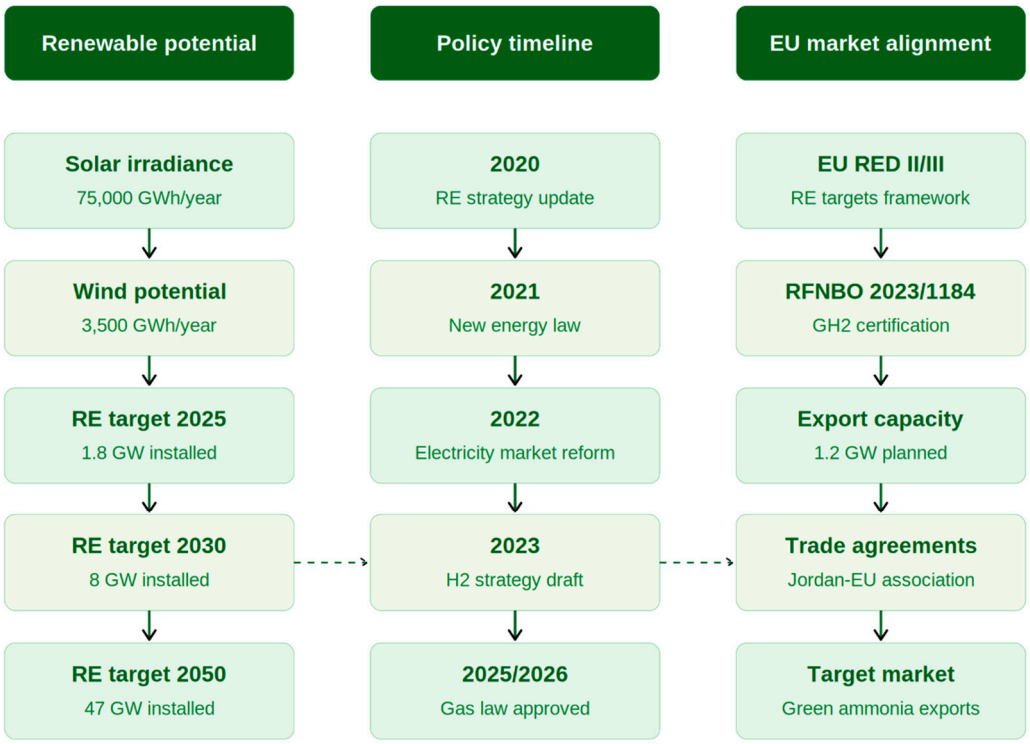

Figure 1. Jordan's Renewable Energy Potential and EU Alignment [4].

The figure presents three parallel tracks: (1) renewable potential (solar irradiance 75,000 GWh/year, wind potential 3,500 GWh/year, RE targets of 1.8 GW by 2025, 8 GW by 2030, and 47 GW by 2050); (2) policy timeline (2020 RE strategy update, 2021 new energy law, 2022 electricity market reform, 2023 H_2 strategy draft, 2025/2026 gas law approval); and (3) EU market alignment (EU RED II/III framework, RFNBO 2023/1184 certification, 1.2 GW planned export capacity, Jordan–EU trade agreements, green ammonia target markets). Source: adapted from [4].

2. Regulatory Framework Analysis

2.1. National Legal Context

The governance of hydrogen as a fuel has been initiated through the new 2025 Gas Law, approved by the Jordanian Parliament in February 2026, in which hydrogen is classified as a regulated gas. Licensing for the import, transportation, storage, and distribution of gases and hydrogen derivatives is administered by the regulator under the provisions of this law [6]. Implementing regulations are to be issued by the Council of Ministers, with compliance oversight assigned to the regulator. A framework comparable to that applied to natural gas is being extended to hydrogen, representing a foundational step in hydrogen-specific legislation.

2.2. International Standards

Several international standards are available for hydrogen technologies. Safety and performance requirements for electrolyzer systems are defined in ISO 22734. Hydrogen fuel purity specifications are established in ISO 14687. Safety requirements for hydrogen refueling stations are provided in ISO 19880-1 [7–9]. These standards have not been incorporated into Jordanian law. Limited national provisions may be drafted through the Jordan Standards and Metrology Organization (JSMO), requiring alignment with ISO/IEC norms [10].

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A certification system for green hydrogen has been developed at the EU level through Delegated Regulation 2023/1184 (the Renewable Fuels of Non-Biological Origin, RFNBO). Strict criteria are imposed, including a life-cycle emissions threshold of ≤3.4 kg CO_2 per kg H_2 [11].

2.3. Regional Context

A significant role in ammonia production and export is being planned by Jordan to serve European demand. A national certification scheme aligned with the EU framework has been proposed, indexed to the carbon intensity required for compliance [4]. Alignment with regional frameworks applicable to MENA countries is also necessary. National hydrogen strategies have been adopted by Saudi Arabia and Oman, while regulatory work on hydrogen production, transportation, and storage is being advanced in Egypt and Morocco [12–15]. Hydrogen-related guidelines have been adopted by member countries of the Gulf Cooperation Council (GCC) [16].

The inclusion of hydrogen within the new gas law represents a major step. However, provisions addressing environment, health, safety, formal certification mechanisms, and laboratory standards remain outstanding.

3. Methodology and Gap Analysis

3.1. Analytical Approach

The gap analysis is conducted through comparison of Jordan's current legal and institutional framework against international benchmarks, specifically EU directives, ISO/IEC standards, and NFPA codes. The Draft National Hydrogen Strategy (2023) and the World Bank's 2025 policy note are used as reference documents. Gaps are identified across five regulatory domains.

3.2. Identified Regulatory Gaps

Gap 1: Absence of a Dedicated Hydrogen Regulatory Code. With the exception of the new gas law, no regulatory code specifically devoted to hydrogen is maintained in Jordan. Existing sectoral legislation, including the electricity law, oil law, and environment law, does not address hydrogen production or distribution. Regulatory ambiguity is created by the absence of defined provisions for each stage of the hydrogen value chain.

Gap 2: Missing Certification and Quality Standards. Hydrogen certification and quality standards are not currently established. Hydrogen certification is required by European markets under the EU RFNBO framework, which applies a detailed emissions calculation methodology. No domestic entity has been designated to administer emission verification. Additionally, no local laboratory has been accredited to perform testing in accordance with ISO 14687 requirements for hydrogen purity. Limited testing capacity and a shortage of technical expertise among inspectors and researchers are also observed.

Gap 3: Absent Safety and Technical Codes. National electrical, building, and transportation regulations are being updated internationally to address hydrogen safety, including high-pressure containment, flame arrestors, and leak detection. Jordan's construction regulation is based on an earlier edition and does not yet incorporate the current NFPA 2 standard governing hydrogen systems in buildings. Hydrogen refueling stations and fuel cell vehicles are also not addressed by existing vehicle and fuel regulations. Delays for new hydrogen-related infrastructure and applications are consequently anticipated.

Gap 4: Infrastructure and Investment Regulations. Rules for common-use infrastructure (CUI) are not in place. Dedicated regulations for hydrogen pipelines, comparable to those applied to gas and oil, must be introduced. Without such rules, legal grounds for pipeline construction are absent. Port and ammonia terminal regulations will also require revision to accommodate liquefied and gaseous hydrogen.

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Gap 5: Policy Integration. Hydrogen is referenced within Jordan's Energy Strategy and Policy but has not been translated into a formal national hydrogen strategy. Risks of misalignment are created by unresolved questions concerning renewable energy purchase obligations, water allocation for electrolysis, and grid planning modifications. Cross-sectoral coordination has been initiated through the MEMR hydrogen committee, yet formal integration of hydrogen into energy sector policy is still pending.

3.3. Summary of Gaps and Adaptation Measures

The identified gaps and proposed adaptation measures are summarized in Table 1.

Table 1. Key gaps and proposed adaptation measures for the green hydrogen roadmap in Jordan.

Document	Relevance	Current Status	Gap	Recommended Action	Priority	Responsible Agency	Suggested Timeline
EU RFNBO Rules	Export criteria	Not adopted	No local verification	Develop RFNBO verification procedures	High	MEMR / Industry	2025 Q4
RED II	Sustainability targets	Not integrated	No national target	Align Jordanian policy with RED II	High	MEMR	2025 Q4
ISO 22734	Electrolyzer safety	Partial adoption	Limited training	Adopt ISO 22734, engineer training	High	JSMO / MEMR	2025 Q3
ISO 14687	Fuel quality	Not adopted	No certified labs	Establish hydrogen quality labs	High	JSMO / MEMR / Universities	2025 Q4
IEC 60079	Explosion protection	Partial adoption	Limited inspector capacity	Train inspectors to enforce IEC 60079	High	JSMO / Civil Defense	2025 Q3
Hydrogen Regulation	Transport and derivatives	Absent	No legal framework	Amend the Petroleum Products Law or issue a hydrogen-specific bylaw	High	MEMR	2026 Q1
Certification	Export markets	Absent	No independent certifiers	Establish accredited certification bodies aligned with EU RFNBO	High	JSMO / MEMR	2026 Q2

Without targeted reform, international criteria for a green hydrogen hub will not be met. Existing laws must be adapted, and new standards must be created for safety (based on IEC/ISO/NFPA), certification (based on EU RFNBO and domestic regimes), and infrastructure use (pipeline and storage licensing).

4. Strategy Integration

Jordan's hydrogen ambitions are embedded within broader energy and economic development plans. Alignment has been established between the draft hydrogen strategy, the Economic Modernization Vision 2033, and the National Energy Strategy 2030 [17]. Excess solar and wind generation is intended to be absorbed by green hydrogen production, supporting the development of clean industrial sectors including green ammonia and fertilizers. The target of 47 GW of renewable capacity by 2050 represents a substantial transformation of the energy sector, requiring grid capacity upgrades, demand response mechanisms, and load management frameworks capable of accommodating both power generation and fuel cell backup.

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Hydrogen development must be linked to national energy policy targets. The National Renewable Energy Strategy objective of achieving 31% renewable electricity by 2030 must be adjusted to account for electrolyzer demand [3]. Renewable energy incentives should be complemented by take-or-pay obligations on hydrogen off-takers or by the integration of Power-to-X (P2X) projects into auction mechanisms. The hydrogen strategy should be codified into legislation, with explicit production and export targets that enable the development of downstream sectors, international trade, and associated research and development.

Sectoral applications of hydrogen are envisaged in ammonia, cement, steel, and transport. Coordinated support from the Ministries of Industry and Transport will be required, including tax reductions for green ammonia and procurement frameworks for fuel cell buses. Demand-side policies must be matched to supply-side investments, as advocated by the IEA [18]. Capital expenditure requirements for the planned hydrogen production are estimated at $175 billion by 2050 [4]. All available financing alternatives will need to be mobilized, with public-private partnerships occupying a central role.

Hydrogen goals must be integrated across industrial, environmental, and energy policies. Electricity planning, water resource management (including desalination for electrolysis), vocational training, and water law will all be affected. Jordan's renewable energy commitments are expected to generate new industrial opportunities through hydrogen development. Long-term success depends on the integration of the renewables buildout, emissions targets, economic diversification, and international trade objectives.

5. Implementation Roadmap

A two-phase roadmap has been developed to implement Jordan's green hydrogen strategy, covering short-to-medium term actions (2025–2030) and long-term actions (2030–2050).

5.1. Short-to-Medium Term (2025–2030)

1. Certification and safety standards should be adopted through the rapid issuance of national RFNBO verification procedures aligned with EU Regulation 1184/2023, the designation of accredited hydrogen quality laboratories, and the publication of hydrogen-specific Environmental Impact Assessment (EIA) and grid code guidelines.
2. Institutional capacity should be strengthened through the formal establishment of an inter-ministerial steering committee and a dedicated MEMR hydrogen unit. The mandate of the Energy and Minerals Regulatory Commission (EMRC) should be extended to cover hydrogen plants.
3. Pilot projects should be promoted through tenders and public-private partnerships for initial green hydrogen facilities, targeting up to 0.6 Mt per year, alongside announced export projects.
4. Infrastructure should be developed through the construction of common-use facilities in Aqaba, a dedicated hydrogen and electrolyzer zone, pipeline spurs to the port, and an ammonia terminal. Network upgrades should be implemented where electrolysis plants are interconnected.
5. Capacity building should be initiated through regulator training, certification of the first cohort of engineers, and public outreach on hydrogen safety.

These measures support the 2030 targets of 8 GW of renewable capacity, 0.6 Mt of green hydrogen, and 0.5 Mt of exports, while aligning with World Bank policy recommendations.

5.2. Long Term (2030–2050)

1. Pipeline and storage development should be advanced through the enactment of hydrogen pipeline regulations and the construction of cross-border pipelines, including potential repurposing of the Arab Gas Pipeline (AGP) for hydrogen by 2040.

 doi:10.20944/preprints202509.2248.v2

2. Large-scale hydrogen storage should be developed, and hydrogen-compatible gas networks should be expanded.
3. Regional market integration should be pursued through the harmonization of Jordanian standards with GCC and North African partners and through participation in international hydrogen certification bodies.
4. Advanced industries should be supported through the promotion of local manufacturing of electrolyzers, fuel cells, and hydrogen materials to capture domestic value, drawing on the German model [21].
5. Downstream industries including green ammonia, e-methanol, and green steel should be encouraged to localize.
6. Adaptive policy should be maintained through continuous updates to regulations reflecting new international norms and technologies.

If the roadmap is implemented across both phases, Jordan's production targets are expected to be achieved, and integration into regional hydrogen supply chains is anticipated through operational export pipelines and shipping networks.

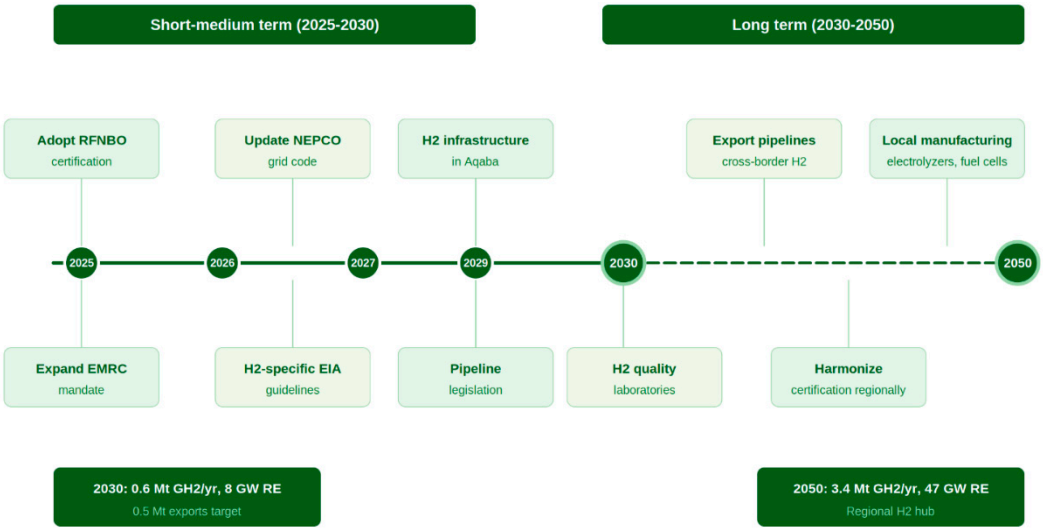

Figure 2. Jordan's Hydrogen Roadmap 2025–2050.

The figure depicts a timeline divided into short-to-medium term (2025–2030) and long term (2030–2050) phases. Short-to-medium term milestones include: adopt RFNBO certification (2025), expand EMRC mandate (2025), update NEPCO grid code (2026), H_2-specific EIA guidelines (2026), H_2 infrastructure in Aqaba (2027), pipeline legislation (2029), and H_2 quality laboratories (2029), with 2030 targets of 0.6 Mt GH_2/yr, 8 GW RE, and 0.5 Mt exports. Long-term milestones include: export pipelines (cross-border H_2), local manufacturing (electrolyzers, fuel cells), and regional certification harmonization, with 2050 targets of 3.4 Mt GH_2/yr, 47 GW RE, and operation as a regional H_2 hub.

6. Discussion

6.1. International Best Practices

Comparative analysis of leading hydrogen economies provides reference points for Jordan's regulatory development.

Germany. A national green hydrogen strategy was launched in 2023, establishing a significant framework for integrating hydrogen into existing energy policy. A target electrolyzer capacity of 10 GW has been set, supported by a €7 billion budget [21]. Construction of an 1,800 km hydrogen pipeline by 2030 has been planned, together with participation in the EU hydrogen backbone

 doi:10.20944/preprints202509.2248.v2

initiative. A joint standards and certification system has been established in collaboration with other EU member states.

Japan. A hydrogen society framework has been established, emphasizing project legislation and demonstration. In 2024, the commercial scale of the hydrogen supply chain by 2030 was set through the Hydrogen Society Promotion Act [20]. Projects supported by the government include the world's first large-scale liquefied hydrogen shipment (Suiso Frontier) and trials of organic hydrogen carriers (methylcyclohexane, MCH). Investments have been directed toward gas turbines capable of hydrogen blending at 10% or higher. Demonstration hubs, such as the proposed Aqaba hub, should be prioritized by Jordan, and supportive frameworks should be enacted prior to full-scale project implementation.

Saudi Arabia. Green hydrogen has been included within Saudi Arabia's Vision 2030 economic transformation plan, with both blue and green hydrogen initiatives being investigated. The NEOM green hydrogen plant, developed in collaboration with NEOM, ACWA Power, and Air Products, is considered the largest globally, with an announced 2.2 GW electrolyzer capacity by 2030 and a production target of 650 tonnes per day by 2026 [22]. International cooperation is being enhanced, and Aramco's connections to ammonia and other industrial markets are being leveraged. Green hydrogen costs in Saudi Arabia are estimated at approximately $2.16/kg, with blue hydrogen at $1.13/kg. Strategic collaborations and partnerships should be formed by Jordan to leverage its comparative advantages and to attract large-scale projects.

6.2. Key Recommendations

The following practical measures are proposed to address Jordan's regulatory gaps:

- The Hydrogen Strategy should be finalized and legislated, with its objectives integrated into the national energy strategy and economic vision. A cross-sectoral steering committee and a formally mandated MEMR Hydrogen Unit should be established.
- International standards should be adopted into national regulations, including ISO 22734, ISO 14687, ISO 19880, IEC 60079, and NFPA 2. References to hydrogen safety should be incorporated into building, electrical, and gas codes.
- A certification framework should be established in line with EU Regulation 2023/1184, with auditors trained for implementation. National bodies, potentially within JSMO or a newly created agency, should be designated to verify hydrogen origin and emissions.
- Testing and laboratory capacity should be built through investment in hydrogen testing facilities for purity and trace analysis. Accreditation for ISO-standard testing should be pursued in collaboration with universities and research laboratories, supporting both domestic quality control (ISO 14687 compliance) and export certification.
- Infrastructure rules should be updated through the issuance of hydrogen-specific regulations for pipelines and storage, modification of the grid code to accommodate larger electrolyzer loads and bi-directional energy flow, and the development of regulations for hydrogen-powered vehicles and refueling stations.
- Capacity building and outreach should be supported through funded training programs for regulators, operators, and safety inspectors. Public information campaigns on hydrogen benefits and safety should be launched, and hydrogen curricula and research should be incorporated into university programs, following the Japanese educational alliance model.
- Private investment should be incentivized through finalized financial instruments, including subsidies and tax breaks for green hydrogen production and offtake, with consideration given to instruments such as Germany's H_2 Global to mitigate offtake risk. Public funding sources including USAID, EBRD, and donor contributions should be deployed to co-finance pilot projects.
- Regional and international cooperation should be strengthened through active engagement in hydrogen forums and standardization bodies, the pursuit of bilateral hydrogen trade

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agreements, and the leveraging of existing frameworks such as the Jordan–EU Association Agreement and GCC dialogues for regulatory harmonization.

Coordination among MEMR, EMRC, JSMO, the Ministry of Planning, and international partners will be required for implementation. Clear responsibilities and timelines must be assigned across short-term and long-term horizons.

7. Conclusion

Abundant renewable energy resources are available to Jordan for the development of green hydrogen production and export infrastructure. However, the current regulatory framework remains in an early stage of development. Five regulatory gaps have been identified in this study to support the country's efforts in establishing green hydrogen roles and regulations. Comparative analysis of green hydrogen deployment in Germany, Japan, and Saudi Arabia indicates that early regulatory reform, institutional coordination, and public-private partnerships accelerate deployment.

Short-term focus should be placed on the 2030 production targets through pilot projects and regulatory updates. Long-term focus toward 2050 should be directed at cross-border pipelines, regional standards alignment, and industrial growth in Aqaba. Through the implementation of the proposed recommendations, Jordan's economic position and energy security can be strengthened, cooperation with EU partners can be expanded, and additional investment in the hydrogen industry can be attracted.

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