

Legal Framework



Executive Summary on Legal Framework Analysis



Comparison of conclusions

This legal analysis, undertaken within the BSR HyAirport project, reviews national and EU regulatory frameworks for green hydrogen (GH₂) use in aviation across eight Baltic Sea Region countries, aligning with European and international decarbonization strategies to guide the sector's safe and scalable transition.

Conducted through comprehensive review of legislation, strategic planning documents, and technical standards, supplemented by interviews with partner airports, it maps key institutions, policies, and laws relevant to GH₂ production, storage, fueling infrastructure, and transportation. **The analysis identifies regulatory gaps, operational challenges, and barriers**—such as absent hydrogen-specific safety standards and inconsistent authorization procedures—**while providing harmonized policy recommendations** to enhance safety, environmental compliance, and infrastructure integration, supporting the BSR HyAirport project's goal of accelerating the safe, efficient, and scalable deployment of hydrogen-powered aviation.

The analysis highlights significant legal fragmentation and regulatory uncertainty in most countries, with Germany standing out for its more advanced and coherent hydrogen policy framework. By identifying common gaps and country-specific challenges, the report aims to support informed decision-making for the deployment of GH₂ infrastructure in complex airport settings.

Comparison

The analysis was carried out across five main sections, addressing:

1. Territorial Planning Aspects related to GH₂ Production and Storage

Most BSR countries lack explicit territorial planning provisions for GH₂ production and storage at airports, creating regulatory ambiguity and often requiring municipal or spatial plan amendments. Estonia, Latvia, Lithuania, Poland, Denmark, Sweden, and Finland have no dedicated zoning frameworks, with land-use definitions either absent or reliant on non-specific categories. In contrast, Germany offers a clear legal pathway under the National Hydrogen Strategy and Hydrogen Acceleration Act, enabling more streamlined facility approvals.

2. Protection Zones Aspects related to GH₂ Production within the Airports

Protection zone rules for GH₂ production at airports are largely undefined or based on general safety and aviation laws, creating siting challenges across most BSR countries. Denmark, Estonia, Latvia, Lithuania, Poland, and Sweden face restrictions or regulatory ambiguity, often requiring updated standards or risk-based assessments. Finland applies clear but fragmented aviation and

chemical safety provisions, while Germany relies on environmental review without GH₂-specific rules.

3. Environmental and Safety Regulations regarding Hydrogen Production and Storage

3.1. Safety Regulations

Most BSR countries lack GH₂-specific aviation safety regulations, relying instead on general safety, fire, chemical, or environmental laws, which creates regulatory uncertainty and gaps in risk management. Estonia, Latvia, Lithuania, Poland, Denmark, Sweden, and Finland all face this challenge, with Finland applying permits and risk assessments but without clear guidance for airport integration. Germany is the exception, with comprehensive safety rules under the Hazardous Substances Ordinance and Technical Rules for Hazardous Substances.

3.2. EIA Procedure

EIA requirements for GH₂ production and storage exist across the BSR, but hydrogen-specific guidance is generally limited. Denmark, Sweden, Finland, Estonia, Latvia, Lithuania, and Poland face inconsistencies, delays, and unclear project classification due to general EIA frameworks that do not address hydrogen's particular risks. In

Germany, national law ensures a full and structured EIA process for hydrogen projects, offering clearer procedural certainty.

3.3. Pollution Permits

Across the BSR, GH₂'s status in pollution permitting remains largely undefined, creating uncertainty for emissions compliance in Estonia, Latvia, Lithuania, and Poland. Sweden and Denmark provide no hydrogen-specific guidance, leaving regulators and operators to interpret existing rules. Finland addresses GH₂ emissions under the Environmental Protection Act, offering clearer obligations, while Germany regulates both production and fuelling stations through the Federal Emission Control Act, establishing the most structured framework in the region.

3.4. Requirements for Chemical Substances

GH₂ is recognized as a hazardous or dangerous chemical across the BSR, but the level of regulation varies. Denmark and Sweden classify it under strict safety and explosive goods laws, while Finland requires permits and emergency planning under chemical safety legislation. Estonia applies general chemical controls, offering a more standard approach, and Latvia and Lithuania impose high-risk facility requirements for larger sites. Poland mandates risk assessments and safety documentation for substantial storage. Germany provides the most comprehensive framework, governed by the Hazardous Substances Ordinance

and associated technical rules.

3.5. Construction Regulations regarding Hydrogen Production and Storage

Construction regulations for GH₂ production and storage remain largely generic across the BSR, with few countries providing hydrogen-specific standards. Estonia, Latvia, Lithuania, Poland, Sweden, and Finland rely on general building codes and hazardous materials rules, resulting in fragmented oversight, local interpretation issues, and challenges for airport integration. Denmark applies general safety standards, but these may not fully address hydrogen's technical demands. Germany's construction-specific guidance for GH₂ was not detailed in the available material.

3.6. Liability in Environmental Protection

Liability for GH₂-related environmental risks varies across the BSR. Sweden and Poland apply strict liability, holding operators responsible regardless of fault, with Poland also requiring preventive and monitoring measures. Estonia and Lithuania recognize operator responsibility under general environmental liability laws, though hydrogen-

specific rules remain unclear. Germany's broad environmental framework covers liability, but details were not specified. Denmark, Finland, and Latvia provide no explicit guidance in the available documentation.

4. Hydrogen Transportation

Hydrogen transport regulation varies across the BSR. Estonia, Latvia, Lithuania, Poland, Sweden, and Finland rely on general pipeline or dangerous goods laws, leaving networks underdeveloped and creating uncertainty. Denmark has a legal basis for hydrogen transport via pipelines and road, while Germany provides the most advanced framework under the Energy Industry Act. EU Directive 2024/1788 further underscores the need for national hydrogen roadmaps.

5. Regulations on Hydrogen Fuelled Vehicles and Felling Systems

Regulations for hydrogen-fuelled aircraft and refuelling systems are largely underdeveloped across the BSR. Estonia, Latvia, Lithuania, Denmark, Finland, and Poland rely on general safety or EU standards, leaving gaps for local implementation. Sweden faces similar regulatory gaps in siting and technical standards. Germany stands out with a complete framework ensuring safety and operational standards for hydrogen vehicles and refuelling.

European Union

The European Union (EU) sees GH2 as a cornerstone of its climate goals, with aviation playing a key role. Strategies like the EU Hydrogen Strategy, REPowerEU, and ReFuelEU aim to make **hydrogen a central part of decarbonizing airports and transforming air transport** into a cleaner, more sustainable system.

However, the regulatory framework remains **fragmented and incomplete**. While no EU laws explicitly prohibit hydrogen use at airports, there are no hydrogen-specific standards for production, storage, fuelling, or transport. Existing safety and permitting rules rely on outdated or non-binding provisions, and environmental laws don't fully address hydrogen's unique impacts. Infrastructure integration is further constrained by limited airport connectivity, spatial challenges, and insufficient targeted funding. Although some voluntary technical standards exist, binding regulations and centralized oversight are still lacking.

Project Overview

The BSR HyAirport project is a transnational initiative **uniting eight Baltic Sea Region countries** - Latvia, Lithuania, Estonia, Finland, Sweden, Denmark, Germany, and Poland - to support the integration of GH2 in aviation by developing safe, scalable infrastructure at airports.

To support this transition, the project conducted a **comprehensive legal analysis** of European Union and national regulatory frameworks across the eight countries, focusing on GH2 production, storage, transport, and refuelling within the aviation context. The assessment mapped institutional responsibilities, identified relevant legislation, and highlighted key regulatory gaps to help project partners and policymakers **identify barriers to GH2 deployment and align national frameworks with EU strategies**.

Key Findings on the EU Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Construction and Aerodrome Infrastructure Standards

EU regulations mandate rigorous safety, certification, and performance standards for construction and aerodrome infrastructure, requiring detailed risk assessments and multi-agency approvals to accommodate hydrogen technologies at airports.

2. Vehicle and Equipment Safety Standards

The existing EU safety regulations for vehicles and equipment provide a comprehensive framework for

hydrogen integration. However, they also reveal critical gaps in harmonized certification processes and tailored standards for hydrogen-specific technologies, particularly in airworthiness, pressure systems, and explosive atmosphere.

3. Hydrogen Market Development and Energy Transition

The EU's comprehensive regulatory framework advances hydrogen market integration and aviation decarbonization by promoting infrastructure development, market harmonization, and consumer protection, while facing challenges in economic viability, cross-border coordination, and adapting to rapid technological change.

4. Aviation Safety and Incident Management

The regulations establish a foundational framework for aviation safety and operational management yet require updates and harmonization to effectively address hydrogen-specific risks and ensure consistent application across Member States for optimal risk mitigation and integration of emerging technologies.

5. Chemical and Environmental Safety Regulation

Establish uniform standards for chemical classification, major-accident hazard control, explosive atmosphere safety, and worker protection from chemical risks, yet require adaptation to address hydrogen's unique flammability and explosion hazards.

6. Transport Network and Infrastructure Integration

Existing regulations support hydrogen transport

infrastructure development but highlight challenges in high costs, cross-border coordination, and harmonizing safety standards.

7. Environmental Impact and Emissions Control

Environmental and emissions regulations promote sustainability and safety but face challenges in hydrogen-specific guidance, consistent implementation, and investment requirements.

8. Ground Operations and Critical Entity Resilience

Directives supporting operational efficiency and safety promote market liberalization and resilience but require updates and coordination to effectively integrate hydrogen's unique safety and infrastructure needs.

Key Challenges, Gaps and Roadblocks

- 1. Outdated Safety Standards:** Safety frameworks were designed for conventional fuels and don't adequately reflect hydrogen's high-pressure and flammability risks.
- 2. Permitting Delays and Complexity:** Hydrogen infrastructure projects face slow, fragmented permitting processes across member states.
- 3. Limited Airport Connectivity to Hydrogen Networks:** Many airports are not included in EU hydrogen backbone or TEN-T plans, limiting access to future supply.
- 4. Weak Environmental Assessment Tools:** Impact assessments often overlook hydrogen-specific factors like water use for electrolysis and land-use implications.
- 5. Lack of Hydrogen-Specific Regulations:** Existing EU aviation and safety laws don't explicitly address hydrogen, leading to uncertainty and inconsistent application.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1.

Develop Hydrogen-Specific Safety Standards for Airports: Incorporate hydrogen production and storage safety into Regulation (EU) No 139/2014, integrating ATEX and ISO standards to ensure safe airport operations.

Recommendation No. 2.

Nominate a Centralized EU Body to Harmonize Hydrogen Production Standards: Appoint a single entity under the European Commission to coordinate national approaches and eliminate inconsistencies across Member States

Recommendation No. 3.

Fund On-Site Hydrogen Production Pilots at Airports: Use IPCEI and CEF mechanisms to launch demonstration projects that test technical and economic viability of airport-based electrolysis.

Recommendation No. 4.

Promote Modular Hydrogen Storage Systems for Airports: Invest in R&D for space-efficient, scalable hydrogen storage (e.g. modular tanks), addressing airport-specific constraints.

Recommendation No. 5.

Establish Universal Hydrogen Fuelling Standards via IATA And ISO: Collaborate with IATA and ISO to develop interoperable fuelling connectors and procedures for aircraft and ground service equipment.

Recommendation No. 6.

Integrate Airport Fuelling Infrastructure Into TEN-T: Designate hydrogen refuelling infrastructure at airports as strategic nodes under the Trans-European Transport Network (Regulation EU 2024/1679).

Recommendation No. 7.

Strengthen Easa's Role in Hydrogen Safety Oversight: Support EASA in issuing technical guidance under Regulation (EU) 2018/1139 for hydrogen-related risks in aviation infrastructure and operations.

Recommendation No. 8.

Support R&D for Hydrogen Transport Solutions: Fund Horizon Europe projects targeting safe, efficient transport methods (e.g., hydrogen carriers) tailored to airport needs

Republic of Estonia

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to Gh2 Production and Storage

Current land-use and zoning regulations provide limited explicit provisions for GH₂ production within airport zones, while GH₂ storage is more readily accommodated, though both require

regulatory updates and better alignment with national and EU hydrogen policies to support development.

2. Protection Zones Aspects Related to GH2 Production within the Airports

Regulations impose stringent safety, permitting, and coordination requirements for hydrogen facilities near Tallinn Airport, with strict controls on hazardous material storage, technical standards, and multi-agency approvals to mitigate risks to aviation safety and protected areas.

3. Environmental and Safety Regulations related to GH2 Production and Storage

Hydrogen production and storage near airports must meet strict safety, environmental, and building regulations, yet the lack of clear hydrogen-specific pollution limits creates challenges for permitting and project development.

4. Regulations on Transportation

Estonia is preparing to update its regulatory framework to align with the EU Directive 2024/1788 by incorporating hydrogen provisions into the Natural Gas Act and evaluating infrastructure repurposing and road transport safety measures, while additional coordination and policy adjustments are needed for hydrogen transport near airports.

5. Hydrogen Vehicles and Fuelling Systems

Estonia currently has no specific regulations for hydrogen-powered vehicles, aircraft, or refuelling infrastructure, relying instead on general fuel safety laws and international standards.

Key Challenges, Gaps and Roadblocks

- 1. Regulatory Uncertainty:** Hydrogen lacks clear classification in pollution permit systems, creating ambiguity around compliance requirements.
- 2. Land Use Classification Gaps:** Zoning laws do not explicitly permit GH2 facilities in airport areas, complicating site approvals.
- 3. Aviation Safety Considerations:** Hydrogen use near airports raises concerns over electromagnetic interference and emergency response planning.
- 4. Multi-Authority Approval Process:** Hydrogen projects face a fragmented, multi-agency review process that delays implementation.
- 5. Infrastructure and Safety Requirements:** Strict safety standards and high investment needs for explosion-proof, high-pressure systems challenge airport implementation.

Recommendation No. 1

Develop Hydrogen-Specific Legislation and Standards: To address regulatory uncertainty, Estonia should prioritize the creation of dedicated hydrogen regulations, including explicit classifications for GH2 in pollution permit frameworks and clear emission standards. Amending the Natural Gas Act, Building Code, and Planning Act to incorporate hydrogen-specific provisions would streamline permitting processes and ensure compliance with EU Directive 2024/1788, facilitating safe and efficient GH2 production, storage, and transportation.

Recommendation No. 2

Revise Zoning and Land-Use Regulations for Airport Infrastructure: Update the Planning Act and municipal spatial plans to explicitly include GH2 production and storage as permitted uses within airport transport infrastructure zones. This would resolve current land-use classification gaps, enabling Tallinn Airport to integrate hydrogen facilities without requiring case-by-case exemptions. Harmonizing these updates with aviation safety requirements under the Aviation Act will ensure seamless adoption while maintaining operational security.

Recommendation No. 3

Streamline Multi-Authority Approval Processes: Establish a centralized coordination mechanism or task force involving the Transport Administration, Technical Regulatory Authority, Environmental Board, and other relevant bodies to simplify the multi-layered approval process for GH2 projects. This could include standardized guidelines and timelines for EIAs, safety certifications, and operational permits, reducing delays and enhancing project feasibility near critical infrastructure like Tallinn Airport.

Recommendation No. 4

Enhance Infrastructure and Safety Investments: Invest in specialized infrastructure to meet hydrogen's stringent safety requirements, such as explosion-proof equipment and high-pressure storage systems. Public-private partnerships could support the development of refuelling stations and maintenance facilities for hydrogen-powered vehicles and aircraft. Additionally, expanding training programs for ADR-certified drivers and hydrogen-handling personnel will address gaps in workforce readiness.

Recommendation No. 5

Strengthen Emergency Response and Aviation Safety Protocols: Develop tailored emergency response plans for hydrogen-related incidents near airports, incorporating advanced leak detection systems and

Following the identification of challenges, relevant recommendations were developed.

coordination with the Rescue Board and Civil Aviation Authority. Conduct regular risk assessments to evaluate potential electromagnetic interference with navigation systems, ensuring robust mitigation measures.

Republic of Latvia

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to GH2 Production and Storage

Current spatial planning regulations lack explicit permission for GH2 production at Riga International Airport and limit renewable energy installations, while GH2 storage might be allowed under certain categories, indicating a need for clearer legal definitions and adjustments to municipal plans to support hydrogen infrastructure development at and near the airport.

2. Protection Zones Aspects Related to GH2 Production within the Airports

Aeronautical navigation equipment at Riga International Airport is protected by designated impact zones with strict restrictions on activities, including storage and construction, which may limit the placement of GH2 production and storage facilities within short-range impact zones.

3. Environmental and Safety Regulations related to GH2 Production and Storage

Hydrogen production and storage at Riga International Airport are subject to multiple regulatory requirements across aviation safety, environmental impact, chemical handling, and construction, but current regulations lack specific provisions for small-scale storage, pollution classification, and hydrogen-specific construction standards.

4. Regulations on Transportation

Hydrogen can be transported in Latvia via adapted natural gas pipelines or road vehicles, both subject to existing safety and regulatory frameworks for gas infrastructure and dangerous goods, including specific airport security requirements.

5. Hydrogen Vehicles and Fuelling Systems

Latvia currently regulates hydrogen refuelling

equipment under Cabinet Regulations No. 78 and No. 563, requiring compliance with international safety and quality standards, but lacks specific rules for hydrogen-powered vehicles or aircraft, and airport hydrogen fuelling stations would need regulatory updates, impact assessments, and Civil Aviation Agency approval.

Key Challenges, Gaps and Roadblocks

- 1. No Hydrogen-Specific Construction or Safety Standards:** Existing Latvian Construction Standards do not address hydrogen infrastructure, creating uncertainty for project design and approval.
- 2. Ambiguity in Permitting and Classification:** Hydrogen is treated as a hazardous chemical, triggering strict industrial permitting requirements, but without clarity for electrolysis-based GH₂ processes.
- 3. Lack of Explicit Zoning Provisions:** GH2 infrastructure is not clearly defined in spatial planning laws, making it difficult to approve production or storage facilities, especially near sensitive sites like airports.
- 4. Restrictions in Airport Territories:** Regulations limit the use of renewable energy within airport zones, undermining the feasibility of on-site GH2 production.
- 5. Fragmented Institutional Roles:** Overlapping or unclear mandates between ministries and agencies hinder coordinated regulatory oversight and investor confidence.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1

Develop Explicit Zoning Provisions for Hydrogen Infrastructure: Cabinet of Ministers regulations should be amended to specifically designate GH2 production and storage facilities as permitted land use activities within relevant functional zones, providing clear regulatory guidance for municipal spatial planning.

Recommendation No. 2

Create Special Provisions for Airport Hydrogen Facilities: Amendments to the *Mārupe* Municipality Spatial Plan 2024-2036 should specifically allow for GH2 production and storage facilities within or near the Riga International Airport territory, with provisions tailored to aviation operations and safety requirements.

Recommendation No. 3

Establish Navigational Safety Compatibility Guidelines: Develop technical guidelines that clearly define how GH2 infrastructure can be safely installed within airport navigational safety zones, subject to Civil Aviation Agency approval and appropriate safety measures.

Recommendation No. 4

Expand Renewable Energy Options in Airport Zones: Revise territorial use regulations to permit commercial-scale renewable energy installations within airport territories specifically for powering GH₂ production, with appropriate safeguards for air traffic operations.

Recommendation No. 5

Clarify GH₂ Production Classification: Formally classify GH₂ production through water electrolysis as a light industrial activity with minimal environmental impacts, despite hydrogen's status as a hazardous substance, enabling clearer zoning decisions.

Recommendation No. 6

Develop Hydrogen-Specific Pollution Permit Framework: Create specialized pollution permit categories for GH₂ production that recognize its environmentally beneficial nature while addressing safety considerations related to hydrogen handling.

Recommendation No. 7

Establish Dedicated Construction Standards for Hydrogen: Develop Latvian Construction Standards specifically for hydrogen infrastructure, addressing design, materials, safety systems, and testing protocols for GH₂ production, storage, and distribution systems.

Recommendation No. 8

Create Comprehensive Hydrogen Safety Integration Guidelines: Develop detailed safety protocols for the integration of GH₂ infrastructure within airport operations, harmonizing aviation safety regulations with hydrogen handling requirements and emergency response procedures.

Republic of Lithuania

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to GH₂ Production and Storage

The regulatory review reveals that while Lithuania has a general legal framework for energy, land use, and environmental protection, it lacks specific provisions for integrating GH₂ production and storage within or near airport zones.

2. Protection Zones Aspects Related to GH₂ Production within the Airports

The Law on Special Land Use Conditions imposes strict construction and land-use restrictions within aerodrome protection and noise zones, requiring prior approval from relevant authorities for any hydrogen refuelling or storage facility, due to potential impacts on flight safety and airport operations.

3. Environmental and Safety Regulations related to GH₂ Production and Storage

Lithuania currently relies on general fire safety, civil protection, environmental impact assessments, pollution permits without explicit hydrogen pollutant classification, stringent chemical substance controls, and fragmented construction and operational oversight, while imposing environmental liability on operators but with unclear GH₂-specific liability provisions.

4. Regulations on Transportation

Lithuania regulates hydrogen transport under general natural gas and dangerous goods laws, with no specific hydrogen pipeline assessments completed yet, while EU Directive 2024/1788 guides renewable gas integration and a feasibility study on hydrogen pipeline adaptation is planned by 2026.

5. Hydrogen Vehicles and Fuelling Systems

Lithuania regulates hydrogen-fuelled vehicles and fuelling under general laws on alternative fuels, fire safety, civil protection, environmental protection, and road traffic, with national guidelines promoting hydrogen use since 2023 and international standards like ISO 19880-1 and ISO 14687 serving as key safety and quality references.

Key Challenges, Gaps and Roadblocks

- 1. Unclear Safety and Planning Rules:** There are no defined safety distances or risk parameters for hydrogen facilities near airports, making planning dependent on subjective authority judgments.
- 2. Fragmented Regulatory Authority:** Multiple agencies share oversight of hydrogen in aviation with unclear leadership, resulting in inefficient and uncertain approval processes.
- 3. No Hydrogen-Specific Legislation:** Lithuania lacks dedicated binding laws specifically for hydrogen production, storage, and use in aviation, causing regulatory uncertainty.
- 4. Funding and Investment Challenges:** Airports lack dedicated funding or incentives to develop hydrogen infrastructure, which hampers investment and project development.

5. Environmental and Liability Gaps:

Environmental impact assessments and liability frameworks don't specifically address hydrogen's unique risks, leading to inconsistent reviews and legal uncertainties.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1

Develop Hydrogen-Specific Legislation for Aviation: Establish dedicated national regulations that explicitly address GH2 production, storage, transportation, and use within aviation contexts. These should include technical standards, safety protocols, and permitting procedures tailored to hydrogen's unique properties, aligning with international standards (e.g., ISO 19880-1, ISO 14687) and EU frameworks (e.g., Directive (EU) 2024/1788).

Recommendation No. 2

Centralize Regulatory Oversight for Hydrogen Projects: Designate a single lead authority, such as the Ministry of Transport and Communications or the Transport Competence Agency, to coordinate hydrogen-related approvals and oversight in aviation. This would clarify jurisdictional responsibilities, reduce bureaucratic delays, and ensure consistent application of regulations across agencies, including the Lithuanian Transport Safety Administration and environmental regulators.

Recommendation No. 3

Enhance Environmental and Safety Assessment Frameworks: Update the EIA framework to include specific criteria for evaluating GH2 projects in aviation settings, addressing risks such as hydrogen leakage and flammability. Additionally, develop aviation-specific safety protocols under the Law on Aviation, incorporating hydrogen handling, storage, and refuelling guidelines to align with EASA and ICAO standards, ensuring robust risk management.

Recommendation No. 4

Introduce Funding and Incentive Mechanisms: Create dedicated financial support programs, such as grants, subsidies, or public-private partnership models, to incentivize airports to invest in GH2 infrastructure. These mechanisms should include cost-recovery models to offset high initial capital expenditures, aligning with national decarbonization goals and the Baltic Hydrogen Corridor initiative to encourage investment at sites like Vilnius Airport.

Recommendation No. 5

Conduct Infrastructure Compatibility Assessments: Initiate technical evaluations of existing aviation and gas infrastructure to assess compatibility with GH2

technologies. This should include studies on pipeline material suitability, hydrogen embrittlement risks, and retrofitting needs for both natural gas pipelines and airport facilities.

Republic of Poland

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to GH2 Production and Storage

Regulations currently do not explicitly permit industrial-scale GH2 production within airport zones, whilst coordination with airport authorities and compliance with spatial, safety, and aviation laws are embedded and mandate detailed risk assessments and adherence to national and EU directives for GH2 facilities both inside and near airports.

2. Protection Zones Aspects Related to GH2 Production within the Airports

Hydrogen production facilities within airport areas in Poland are subject to strict legal restrictions related to aviation safety, environmental protection, spatial planning, and industrial risk, requiring approvals from civil aviation authorities, compliance with zoning and high-risk installation regulations, and adherence to fire safety and emergency planning standards.

3. Environmental and Safety Regulations related to GH2 Production and Storage

Regulation of hydrogen production and storage within airport areas involves overlapping legal frameworks on aviation safety, environmental protection, fire safety, hazardous substances, and construction, yet lacks hydrogen-specific technical standards, resulting in complex permitting procedures and regulatory ambiguity, especially concerning aviation-related applications.

4. Regulations on Transportation

Polish regulations currently lack explicit provisions for transporting GH2 via natural gas pipelines—especially in airport contexts—despite legal recognition of hydrogen as a gaseous fuel under the Energy Law and Directive (EU) 2024/1778, while

hydrogen road transport is comprehensively regulated under the Act on the Transport of Dangerous Goods and ADR Agreement, including specific safety and certification requirements.

5. Hydrogen Vehicles and Fuelling Systems

Polish regulations do not yet specifically address hydrogen-powered vehicles or aircraft, but hydrogen refueling infrastructure is partially regulated under the Act on Electromobility and Alternative Fuels, with operators required to follow international safety standards such as ISO 19880-1 and ISO 14687, while high-capacity stations are classified as high-hazard installations subject to fire protection and technical supervision laws, and additional airport-specific safety regulations apply within aviation zones.

Key Challenges, Gaps and Roadblocks

- 1. Zoning and Safety Ambiguity:** Undefined land-use rules and safety zones for hydrogen infrastructure near airports hinder development and force conservative planning.
- 2. Overlapping Authorities and Delays:** Multiple regulatory bodies with unclear jurisdiction cause coordination issues and lengthy approval timelines for GH2 projects.
- 3. Lack of Hydrogen-Specific Legislation:** Poland has no dedicated legal or technical framework for hydrogen in aviation, leading to regulatory uncertainty and inconsistent safety standards.
- 4. Funding and Investment Barriers:** High upfront costs and absence of targeted financial support mechanisms discourage GH2 infrastructure investment at airports.
- 5. Workforce, Liability and Certification Gaps:** A lack of trained personnel, hydrogen-specific liability rules, and renewable hydrogen certification frameworks limit safe and scalable GH2 deployment.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1

Develop a Dedicated Hydrogen Legal Framework: Poland's current regulations treat hydrogen under broader hazardous substance laws, which creates uncertainty for its aviation applications. A specialized legal framework is needed to establish clear, aviation-specific safety, storage, and operational standards. This should align with global norms like ISO standards and include provisions for future technologies such as liquid hydrogen, avoiding overly rigid rules that could hinder future development.

Recommendation No. 2

Improve Coordination through a Central Agency: Hydrogen projects in aviation face regulatory fragmentation due to overlapping roles of local fire services, technical inspectors, and aviation bodies. A centralized Hydrogen Coordination Agency should streamline permits and unify decision-making. This body would serve as a single contact point for developers and facilitate regular dialogue between stakeholders to resolve conflicts, reduce delays, and speed up airport infrastructure deployment.

Recommendation No. 3

Enable Airport Zoning for Hydrogen Facilities: Current municipal plans exclude industrial hydrogen production near airports, limiting project feasibility. The Ministry of Construction should revise zoning laws to allow hydrogen use in technical zones and use strategic project status to bypass restrictive planning where needed. Additionally, defining integrated safety and aviation protection zones around hydrogen installations would provide clarity and enhance public and operational safety.

Recommendation No. 4

Strengthen Environmental and Safety Measures: Existing environmental and fire safety regulations lack specificity for hydrogen's unique risks like flammability and leakage. Updated EIA guidelines and fire protocols should mandate advanced safety systems and risk assessments tailored to hydrogen in aviation. Clear emission thresholds for hydrogen combustion and storage would improve environmental permitting, ensuring stronger safety and compliance in airport environments.

Recommendation No. 5

Advance Infrastructure, Transport and Skills Development: Hydrogen adoption at airports is hampered by high costs, uncertain transport rules, and a lack of trained personnel. Targeted funding via the National Recovery Plan should support hydrogen electrolyzers, storage, and refuelling infrastructure. The designation of responsible authority as a Hydrogen Competence Center can build workforce capacity, while airport pilot projects can test solutions and refine standards.

Kingdom of Denmark

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to GH2 Production and Storage

Denmark's airport zones, such as Copenhagen, currently do not explicitly permit GH2 production or storage under existing municipal zoning, requiring plan amendments and strict compliance with environmental, safety, and aviation regulations, including EIAs, hazardous substance controls, and coordination with multiple authorities, to manage risks and protect aviation operations.

2. Environmental and Safety Regulations related to GH2 Production and Storage

Regulations on hydrogen production and storage involve mandatory risk assessments and accident prevention under major hazard control laws, require Environmental Impact Assessments for projects in sensitive areas, impose pollution permits through national and municipal authorities, regulate chemical substances via REACH and related acts with strict classification and monitoring rules, enforce construction permits incorporating fire and explosion safety measures, and hold operators liable for environmental damage under a long-term "polluter pays" framework.

3. Regulations on Transportation

Hydrogen transportation via natural gas pipelines under the amended Gas Supply Act and new 2025 Executive Orders, aligning with EU Directive 2024/1788, requires infrastructure compatibility, operator coordination, and adherence to existing gas safety and environmental laws, while road transport of hydrogen is governed by the ADR Agreement and Danish laws on dangerous goods and road traffic, mandating certified vehicles and drivers, strict safety protocols, route restrictions, environmental protections, and incident reporting obligations.

4. Hydrogen Vehicles and Fuelling Systems

Regulation of hydrogen-fueled vehicles and refueling infrastructure is based on the EU Alternative Fuels Infrastructure Regulation and national technical orders, with no current hydrogen refueling stations or vehicle-specific rules beyond general road traffic laws, relying on international standards like ISO 19880-1 and ISO 14687 for station safety and hydrogen purity, while hydrogen aircraft and airport ground systems must comply with existing aviation safety and fire regulations.

Key Challenges, Gaps and Roadblocks

- 1. Inconsistent Local Authority Interpretations:** Without national-level guidance, local authorities may apply regulations inconsistently to hydrogen projects, increasing uncertainty and risk for investors.
- 2. Lack of Explicit Zoning Provisions:** Hydrogen production and storage are not currently designated as permitted land uses in municipal zoning plans, creating uncertainty for infrastructure development.
- 3. Complex Multi-Agency Approval Process:** Operators face procedural challenges navigating multiple authorities for permissions, especially when hydrogen infrastructure intersects with aviation or industrial settings.
- 4. Absence of Hydrogen-Specific Safety Protocols:** Existing safety laws don't fully address hydrogen's unique risks in airside environments, leading to administrative ambiguity and reliance on discretionary decisions.
- 5. Absence of Hydrogen-Specific Aviation Regulations:** While hydrogen transport and refueling have some oversight, hydrogen-powered aircraft lack explicit regulatory coverage, creating uncertainty for future aviation applications.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1

Modernize Spatial Planning Frameworks for Hydrogen Technologies: Municipalities should develop standardized hydrogen-specific zoning provisions that can be integrated into local plans, particularly for areas surrounding major airports like Copenhagen Airport. Additionally, establish clear guidelines for interpreting GH2 infrastructure as permissible technical installations within transport zones.

Recommendation No. 2

Develop Aviation-Specific Hydrogen Safety Protocols: Create specialized safety standards and technical guidelines tailored to hydrogen's unique properties in aviation environments. These new protocols should address the distinctive operational constraints of airports, including integration with existing safety systems, compatibility with air traffic control, and specialized risk assessment methodologies for airside hydrogen applications.

Recommendation No. 3

Establish A Coordinated Multi-Agency Approval Process : Implement a streamlined, centralized coordination mechanism for hydrogen projects at airports, involving the Danish Energy Agency, Danish Environmental Protection Agency, Danish Transport Authority, and local municipalities. A dedicated GH2 aviation task force could provide single-window clearance for project approvals, standardized application procedures, and consistent interpretation of requirements across different agencies.

Recommendation No. 4

Enhance Infrastructure Investment and Technical Standards: Accelerate the implementation of hydrogen-specific technical standards for production, storage, and refuelling infrastructure at airports, building upon Denmark's recent Gas Supply Act amendments. Develop clear guidelines for the repurposing of natural gas pipelines for hydrogen transmission to airports, addressing material compatibility, pressure capacity, and monitoring requirements.

Recommendation No. 5

Address Environmental Liability Gaps for Hydrogen Projects: Strengthen the environmental liability framework under the Danish Environmental Protection Act to clearly define responsibility allocation for potential incidents involving hydrogen infrastructure. Establish clear requirements for operators to maintain adequate insurance coverage or financial guarantees specifically calibrated to hydrogen's risk profile.

Kingdom of Sweden

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to GH2 Production and Storage

Sweden's Planning and Building Act delegates land use decisions to municipalities, which lack explicit zoning categories for green hydrogen production and storage; hydrogen facilities near airports face additional aviation safety and environmental permit requirements, with oversight from multiple agencies and case-by-case approvals due to the absence of national guidance or clear regulations.

2. Protection Zones Aspects Related to GH2

Production Within the Airports

Swedish regulations require GH2 facilities to meet strict safety, environmental, and fire protection standards, including permits under the Act on Flammable and Explosive Goods, Seveso Act thresholds, ATEX zoning, and coordination with airport rescue services, while local zoning and planning rules govern land use within airport areas, though no unified national hydrogen-specific regulation currently exists.

3. Environmental and Safety Regulations related to GH2 Production and Storage

Sweden's regulation of hydrogen production and storage involves mandatory permits under the Act on Flammable and Explosive Goods, safety and emergency preparedness requirements under the Civil Protection Act, mechanical safety standards per the Pressure Equipment Act, workplace explosion safety via ATEX and the Work Environment Act, environmental impact assessments and pollution permits under the Environmental Code, chemical classification and handling rules under the Chemical Products Act, and strict liability for environmental damage under the Environmental Code and Tort Liability Act.

4. Regulations on Transportation

Sweden's legal framework regulates hydrogen pipelines, safety, environmental permits, and road transport through existing gas, accident prevention, and dangerous goods laws, with specific standards and emergency planning required.

5. Hydrogen Vehicles and Fuelling Systems

Sweden regulates hydrogen vehicles through EU-aligned safety standards, requires environmental permits for refueling stations, and follows Energigas Sverige's H2-TSA 2023 technical guidelines for station design and operation.

Key Challenges, Gaps and Roadblocks

1. Support for Consistent Local Implementation:

The absence of unified national standards results in variable local enforcement, hindering predictable hydrogen infrastructure development.

2. Clarification Needed for Land Use and Safety Zoning:

Current zoning laws do not explicitly cover GH2 facilities or safety zones near airports, complicating infrastructure placement decisions.

3. Enhanced Environmental and Safety Guidance for Hydrogen:

Environmental and safety regulations need hydrogen-specific guidance,

especially for leak prevention and specialized monitoring near airports.

- 4. Need for a Dedicated Hydrogen Regulatory Framework:** Sweden lacks a tailored regulatory framework addressing hydrogen's unique characteristics, causing uncertainty in aviation and airport applications.
- 5. Opportunities for Streamlined Regulatory Oversight:** Multiple authorities and laws create complex oversight without clear coordination, leading to inconsistent regulatory interpretations.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1

Create a Hydrogen-Specific Regulatory Framework: Sweden should develop clear, hydrogen-focused regulations tailored to the distinct characteristics of green hydrogen (GH2) production, storage, and use in aviation. This involves updating the Environmental Code and the Planning and Building Act to include hydrogen-specific requirements for impact assessments and permitting.

Recommendation No. 2

Define Land Use for Hydrogen Infrastructure: The Planning and Building Act must explicitly categorize GH2 infrastructure, especially in and around airports, to provide consistency across municipalities. Municipal planning documents should incorporate specific hydrogen-related land use provisions that also comply with aviation safety standards. This would prevent varied local interpretations and streamline development of GH2 facilities nationwide.

Recommendation No. 3

Establish National Hydrogen Safety Guidelines: Sweden needs unified, hydrogen-specific safety regulations for airport environments, issued by the Swedish Civil Contingencies Agency. These should include standards for protective distances, buffer zones, and operational protocols tailored to GH2's properties. Such guidance would complement existing laws and ensure consistent safety measures across all hydrogen aviation projects.

Recommendation No. 4

Streamline Environmental Assessment Procedures: The environmental assessment process should be updated to clearly classify hydrogen projects and their associated risks. Introducing GH2-specific criteria would clarify categorization under the Environmental Assessment Ordinance and reduce regulatory uncertainty, especially for projects near airports where hydrogen's explosive nature requires careful evaluation.

Recommendation No. 5

Coordination Multi-Agency Approval Processes: Sweden should create a unified task force of local, regional, and national stakeholders to streamline hydrogen project approvals. This coordinated body would align environmental, safety, and construction requirements, reducing bureaucratic delays and ensuring efficient, compliant development of GH2 infrastructure in aviation contexts.

Republic of Finland

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to GH2 Production and Storage

GH2 production and storage facilities in Finland can be integrated within existing industrial or energy zoning categories both within and near airports, but require comprehensive planning, safety assessments, environmental evaluations, and, in some cases, national security clearances to ensure alignment with regulatory, operational, and spatial requirements.

2. Protection Zones Aspects Related to GH2 Production within the Airports

GH2 facilities near airports in Finland must comply with protection zone regulations under the Aviation Act, Land Use and Building Act, Environmental Protection Act, and Rescue Act, requiring risk assessments, environmental safeguards, and aviation authority approvals to prevent interference with aviation safety and ensure emergency preparedness.

3. Environmental and Safety Regulations related to GH2 Production and Storage

Hydrogen production and storage in Finland are regulated through multiple legal instruments, including the Safe Handling of Dangerous Chemicals Act, Environmental Protection Act, Aviation Act, and Building Act, each imposing specific requirements related to safety, permitting, emergency planning, environmental protection, and spatial constraints, particularly when located near airports, though without hydrogen-specific construction standards or clear EIA inclusion

criteria.

4. Regulations on Transportation

Finnish legislation does not yet explicitly regulate pure hydrogen transport via natural gas pipelines or establish hydrogen-specific technical standards, but general laws like the Natural Gas Market Act, Land Use and Building Act, and Act on the Safe Handling and Storage of Dangerous Chemicals apply, with gaps remaining in network governance, safety criteria, and infrastructure planning.

5. Hydrogen Vehicles and Fuelling Systems

Hydrogen vehicles in Finland are regulated under the Vehicle Act and EU Regulation 2018/858 for technical and safety standards, while hydrogen refueling stations must comply with chemical safety, environmental, emergency preparedness, and infrastructure deployment laws, including the Safe Handling of Dangerous Chemicals Act, Rescue Act, Environmental Protection Act, and AFIR implementation.

Key Challenges, Gaps and Roadblocks

- 1. Lack of Hydrogen-Specific Construction Standards:** Finland relies on general regulations for hydrogen facilities, causing permitting uncertainty and inconsistent local interpretations.
- 2. No Explicit Listing of Hydrogen Projects in EIA Regulations:** Hydrogen projects aren't clearly included in Environmental Impact Assessment rules, leading to inconsistent assessments and potential delays.
- 3. Fragmented Legal Framework:** Hydrogen regulations are scattered across various domains, creating coordination challenges among authorities.
- 4. Absence of Hydrogen-Specific Pipelines Regulations:** There are no clear rules for hydrogen transport via pipelines, causing ambiguity for operators and infrastructure development.
- 5. Limited Market Regulation for Hydrogen Networks:** Finland lacks comprehensive rules on who can build or operate hydrogen pipelines and how access and planning are managed.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1

Develop Hydrogen-Specific Construction Standards: Finland should establish dedicated technical construction standards for hydrogen facilities that

address the unique safety requirements, material compatibility concerns, and engineering specifications needed for hydrogen production, storage, and distribution infrastructure, particularly within airport environments.

Recommendation No. 2

Update EIA Regulations to Explicitly Include Hydrogen Projects: Environmental Impact Assessment regulations should be amended to explicitly list hydrogen production and storage projects, creating clear assessment pathways with proportionate requirements based on project scale, from small demonstration installations to large-scale production facilities.

Recommendation No. 3

Create a Coordinated Regulatory Framework: Establish an integrated regulatory framework that harmonizes requirements across environmental protection, chemical safety, building regulations, and aviation control, potentially through a dedicated hydrogen act or comprehensive amendments to existing legislation with clear jurisdictional boundaries.

Recommendation No. 4

Develop Specific Guidelines for Airport Hydrogen Integration: Create dedicated technical and regulatory guidelines for hydrogen facilities in airport contexts, addressing zoning classifications, safety distance calculations, compatibility with aviation operations, and integration with existing airport infrastructure and emergency systems.

Recommendation No. 5

Establish Flexible Permit Pathways for Emerging Hydrogen Technologies: Develop streamlined and adaptable permitting procedures for innovative hydrogen applications such as mobile refuelling units and small-scale electrolyzers, potentially including regulatory sandboxes for pilot projects and phased approval processes that scale with project development.

Recommendation No. 6

Standardize Risk Categorization for Hydrogen Facilities: Implement clear and consistent risk assessment methodologies and categorization criteria specifically for hydrogen installations, providing objective benchmarks for safety planning requirements and civil protection measures.

Recommendation No. 7

Create Hydrogen Pipeline Transportation Regulations: Develop comprehensive regulations for hydrogen transport via pipelines, addressing technical standards for new hydrogen pipelines and retrofitting of existing natural gas infrastructure, including material

specifications, safety requirements, and monitoring systems.

Recommendation No. 8

Establish Hydrogen Network Market Regulations: Implement clear market regulations for hydrogen network operations, defining roles and responsibilities for network operators, establishing non-discriminatory access rights, and creating coordinated infrastructure planning processes aligned with national energy strategies.

Federal Republic of Germany

Key Findings on the Regulatory Framework

The assessment encompassed the following areas, with findings set out below:

1. Territorial Planning Aspects Related to GH2 Production and Storage

Germany's multi-level spatial planning and approval system requires comprehensive planning approval for large hydrogen infrastructure, integrates environmental and safety assessments, enforces noise and accident prevention measures at airports, and mandates coordination across federal, state, and local authorities to ensure hydrogen facilities comply with spatial, environmental, and aviation regulations.

2. Protection Zones Aspects Related to GH2 Production within the Airports

The Water Act and Hazardous Substances Ordinance regulate groundwater and surface water protection near GH2 production, while the Federal Immission Control Act and related technical rules govern emissions and noise; the Building Code, Industrial Safety Ordinance, Explosion Protection Regulation, Aviation Act, and Workplace Ordinance set requirements for construction, safety distances, risk assessments, and aviation safety at airport hydrogen facilities.

3. Environmental and Safety Regulations related to GH2 Production and Storage

Germany regulates hydrogen production, storage, and handling through the Hazardous Substances

Ordinance and TRGS, requires permits and environmental assessments under the Federal Immission Control Act, enforces safety and construction standards via the Building Code and Industrial Safety Ordinance, applies European standards like DIN EN 17124, sets permitting thresholds based on production and storage capacity, prioritizes hydrogen projects under the Hydrogen Acceleration Act, and involves multiple authorities for compliance monitoring and enforcement.

4. Regulations on Transportation

Hydrogen transport in Germany is regulated by the Federal Network Agency and the Electricity and Energy Industry Act for pipeline blending up to 10-20%, following technical standards like G 262 to prevent pipeline damage, while road transport is governed by the Dangerous Goods Transportation Act, ADR regulations, vehicle and traffic laws, and safety rules including TRGS 510 for container handling and occupational safety during loading and unloading.

5. Hydrogen Vehicles and Fuelling Systems

Hydrogen-fuelled vehicles and refueling systems in Germany are regulated by the Road Traffic Act, Vehicle Registration Regulations, Pressure Equipment Directive, Federal Immission Control Act, Occupational Health and Safety Act, EU Alternative Fuels Infrastructure Directive, and international standards such as SAE J2601, ISO 14687, and ISO 19880-1, with the Hydrogen Infrastructure Regulation currently under development.

Key Challenges, Gaps and Roadblocks

- 1. Multi-Authority Coordination:** Implementation requires approval from numerous federal ministries and agencies, complicated by varying regulations across German states, causing potential delays and bottlenecks.
- 2. Infrastructure and Logistics Challenges:** Integrating hydrogen infrastructure within existing airport zones and managing transport, storage, and pipeline blending limits pose significant regulatory and operational hurdles.
- 3. Complex Environmental and Safety Assessments:** Stringent environmental impact assessments and conflicting requirements between aviation and environmental authorities increase compliance difficulty and project timelines.
- 4. Evolving Regulatory Framework:** The ongoing

development of the Hydrogen Infrastructure Regulation and gaps in existing laws create uncertainty for airport operators regarding hydrogen refueling station standards.

5. Workforce and Supply Chain Limitations:

Unclear training requirements and immature supply chain and maintenance standards hinder effective workforce preparation and infrastructure reliability.

integration, covering zoning, safety, and operational compatibility.

Following the identification of challenges, relevant recommendations were developed.

Recommendation No. 1

Establish a Central Hydrogen Aviation Authority: Create a dedicated regulatory body to coordinate hydrogen use at airports, unify federal-state efforts, and streamline approvals across agencies.

Recommendation No. 2

Enhance Safety Protocols for Hydrogen Use: Develop hydrogen-specific safety standards, including risk assessments, detection systems, and response procedures, based on latest research.

Recommendation No. 3

Create Hydrogen Infrastructure Support Programs: Offer grants, subsidies, and low-interest loans for airport hydrogen systems to reduce upfront costs and support feasibility studies.

Recommendation No. 4

Streamline Permitting for Hydrogen Projects: Introduce a fast-track permitting process with clear timelines and standardized documentation, leveraging the Hydrogen Acceleration Act.

Recommendation No. 5

Develop Training and Certification Programs: Standardize training and certification for airport staff handling hydrogen, covering safety, maintenance, and emergency protocols.

Recommendation No. 6

Standardize Environmental Assessment Methods: Create uniform guidelines for assessing hydrogen's environmental impact, including leakage risks and climate effects.

Recommendation No. 7

Establish Regulatory Review Mechanisms: Set up regular reviews of hydrogen regulations to reflect new technologies, practices, and operational experience.

Recommendation No. 8

Integrate Hydrogen into Airport Master Plans: Provide planning guidelines for hydrogen infrastructure

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