Interreg Baltic Sea Region

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SMART GREEN MOBILITY
BSR HyAirport

Inception Report on National Frameworks

Content

Glossary

ADR	-	European Agreement concerning the International Carriage of Dangerous Goods by Road.
AFIR	-	Alternative Fuels Infrastructure Regulation or Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure.
ATEX directives	-	Two interlinked directives. Comprise of ATEX Equipment Directive or Directive (EU) 2014/34 covers equipment and protective systems intended for use in potentially explosive atmospheres and ATEX Workplace Directive or Directive 99/92/EC refers to minimum requirements for improving the health and safety protection of workers at risk from an explosive atmosphere.
BSR	-	Baltic Sea Region (consists of such states: Latvia, Lithuania, Estonia, Poland, Denmark, Sweden, Finland, and Germany).
BSR HyAirport	-	BSR Hydrogen Air Transport - Preparation of Baltic Sea Region Airports for Green Hydrogen. A project within the BSR framework, with Work Package 1.1 focusing on assessing the legal framework for integrating hydrogen into airport operations, covering production, storage, fuelling infrastructure, and transportation.
Chicago Convention	-	The Convention on International Civil Aviation, established the International Civil Aviation Organization and rules of airspace, aircraft registration and safety, security, and sustainability, and details the rights of the signatories in relation to air travel.
CLP	-	Classification, Labelling and Packaging Regulation (EC) No 1272/2008 lays down uniform requirements for the classification, labelling, and packaging of chemical substances and mixtures according to the UN globally harmonised system, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.
Denmark	-	Kingdom of Denmark.
EASA	-	European Union Aviation Safety Agency established in 2002 under Regulation (EC) No 1592/2002 (replaced by Regulation (EU) 2018/1139), oversees aviation safety and environmental protection across the EU.
EIA	-	Environmental impact assessment.
EIR	-	Environmental impact report.
Estonia	-	Republic of Estonia.
EU	-	The European Union.
EUROCONTROL	-	The European Organisation for the Safety of Air Navigation, a pan-European, civil-military intergovernmental organisation dedicated to supporting European aviation.
EV	-	Electric vehicle.
Finland	-	Republic of Finland.
Germany	-	Federal Republic of Germany.
GH2	-	Gaseous Green Hydrogen.
GH2 storage facilities	-	A facility used for the stocking of GH2 of a high grade of purity, including large, in particular underground, hydrogen storage, excluding terminals used for storing liquid GH2 and smaller, easily replicable hydrogen storage installations.
Green Hydrogen	-	Hydrogen produced from renewable energy sources, such as through electrolysis, identified as critical for decarbonizing aviation under the European Commission's EU Hydrogen Strategy (2020) and supported by Directive (EU) 2018/2001.
GSE	-	Ground support equipment, equipment used at airports to service aircraft between flights. Services include refuelling, towing airplanes or luggage/freight carts,

		loading luggage/freight, transporting passengers, loading potable water, removing sewage, loading food, de-icing airplanes, and firefightingGround support equipment, equipment used at airports to service aircraft between flights. Services include refuelling, towing airplanes or luggage/freight carts, loading luggage/freight, transporting passengers, loading potable water, removing sewage, loading food, de-icing airplanes, and firefighting.
ICAO	-	International Civil Aviation Organization, a United Nations specialized agency established in 1944 under the Chicago Convention, with 193 member states, responsible for setting global aviation standards, including guidelines for hydrogen use through CAEP and CORSIA.
IEC standards	-	The International Electrotechnical Commission standards designed to ensure that products and services are safe, reliable, and of high quality, and that they are compatible with each other.
Latvia	-	Republic of Latvia.
Lithuania	-	Republic of Lithuania.
NECP	-	National Energy and Climate Plan.
Northern-Baltic Hydrogen Corridor	-	A cross-border hydrogen infrastructure project, that enables hydrogen transmission in Finland, Estonia, Latvia, Lithuania, Poland, and Germany.
Poland	-	Republic of Poland.
REACH	-	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC) No 1907/2006 lays down a comprehensive legislative framework for chemicals that are manufactured and used in Europe.
SAF	-	Sustainable Aviation Fuel is fuel, including hydrogen-derived synthetic aviation fuel, mandated under Regulation (EU) 2023/2405. This includes GH2, if it qualifies as a synthetic aviation fuel.
Seveso III Directive	-	Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC.
Sweden	-	Kingdom of Sweden.
TEN-T network	-	Trans-European Transport Network, a planned network of roads, railways, airports and water infrastructure in the European Union.
VOC installations	-	Volatile organic compounds installations.

1.Report Summary

1.1. BSR HyAirport Project Summary

The BSR HyAirport project is a strategic initiative to establish the BSR as a leader in sustainable aviation by adopting GH2 as a future energy source. Recognizing the geo-economic importance of efficient air transport for mobility and connectivity in the BSR, an environmentally sensitive region with numerous short-haul flights, the project aims to prepare airports for the safe storage, handling, and delivery of GH2. This aligns with the anticipated market entry of hydrogen-powered aircraft, offering a transformative opportunity to decarbonize aviation in a region where peripheral access and cross-border connectivity are critical for economic and social cohesion.

The project unites a diverse partnership of airports, technology providers, airlines, and research institutions across Latvia, Lithuania, Estonia, Poland, Denmark, Sweden, Finland, and Germany. This collaboration provides a platform to address shared challenges, including developing regional GH2 supply chains tailored to local demand, ensuring compliance with legal and safety standards, and testing innovative refuelling and handling solutions. By leveraging collective expertise, the BSR HyAirport project seeks to deliver practical, scalable solutions that meet the needs of BSR airports and set a global benchmark for hydrogen-powered aviation.

1.2. Objectives for Report on National Frameworks

The inception report maps the national regulatory frameworks of the eight BSR countries (Latvia, Lithuania, Estonia, Denmark, Germany, Finland, Sweden and Poland), identifying key institutions, policies, and legislative acts relevant to GH2 adoption in aviation. It evaluates their applicability to four critical operational areas: 1) production, 2) storage, 3) fuelling infrastructure, and 4) transportation of GH2. The analysis identifies regulatory gaps, operational challenges, and barriers that hinder the safe, efficient, and scalable deployment of GH2 in airport operations.

This assessment supports the EU's decarbonization objectives, particularly the European Green Deal's goal of climate neutrality by 2050, and aligns with international commitments, such as the ICAO's net-zero CO_2 emissions target by 2050 and CORSIA. The report provides recommendations to address national regulatory deficiencies in BSR countries, enhance safety and environmental compliance, and facilitate the transition to hydrogen-based aviation systems.

Specifically, the report objectives include:

Mapping the Regulatory Ecosystem

To outline the roles of key regulatory bodies and frameworks governing GH2 use at airports.

Identifying Gaps and Challenges

To pinpoint deficiencies in current regulations, such as absent hydrogen-specific safety standards, inadequate environmental assessment frameworks, or insufficient infrastructure integration provisions across production, storage, fuelling, and transportation.

Proposing Solutions

To recommend targeted policy adjustments, institutional enhancements, and strategic initiatives that address identified barriers, ensuring alignment with EU strategies, including the Hydrogen Strategy (2020), REPowerEU Plan (2022), and the Hydrogen and Decarbonised Gas Market Package (2024).

Supporting Project Goals

To provide a robust legal foundation for BSR HyAirport project partners, enabling stakeholders to prioritize infrastructure investments, refine operational protocols, and contribute to regional and global decarbonization efforts in aviation.

By achieving these objectives, the report serves as a vital resource for policymakers, airport operators, and industry stakeholders, offering a clear roadmap to overcome national regulatory hurdles and accelerate GH2 adoption for sustainable aviation.

1.3. Scope of Analysis

The scope of analysis for Group Activity 1.1 provides a comprehensive evaluation of the legal frameworks governing GH2 use in aviation across the eight BSR countries, contextualized within EU and international regulations. This transnational approach ensures relevance to the diverse regulatory environments of the BSR while promoting interoperability and consistency.

The analysis examines national regulations related to GH2 deployment in airport infrastructure, aircraft operations, and ancillary equipment, covering production, transportation, storage, refuelling procedures, and handling of hydrogen-powered aircraft, as well as environmental, safety, and building authorization requirements. A comparative analysis identifies disparities and commonalities among jurisdictions, highlighting challenges to uniform application and opportunities for harmonized best practices. The scope includes strategic planning documents and technical standards to provide a holistic view of the regulatory landscape. The findings

inform recommendations to address gaps, enhance safety and sustainability, and support the seamless integration of GH2 into the BSR's aviation ecosystem.

1.4. Implementation Method

The implementation method for Group Activity 1.1 employs a rigorous, evidence-based, and collaborative approach to analyse and refine the legal framework for GH2-powered aviation in the BSR. The methodology integrates qualitative and legal research techniques, using primary and secondary sources to deliver actionable outcomes. It comprises three key components: data collection, legal analysis, and stakeholder engagement, executed in a structured sequence to meet the project's objective.

1.4.1. Data Collection

The research involves a thorough review of national legislation and legal texts from the eight BSR countries, supplemented by strategic planning documents, technical standards and others. Interviews with partner airports across the BSR provide insights into operational realities, legal challenges, and perspectives on GH2 adoption, ensuring a robust evidentiary base.

1.4.2. Legal Analysis

The collected data is subjected to a detailed legal analysis to assess the national regulatory landscape. This involves identifying provisions relevant to GH2 production, storage, transportation, refuelling, and handling, and pinpointing gaps, such as missing hydrogen-specific safety standards or inconsistent authorization processes. A comparative analysis across the BSR countries evaluates variations in national regulations, focusing on safety, environmental protection, and infrastructure integration, to propose harmonized standards and best practices.

1.4.3. Stakeholder Engagement

To validate findings and refine recommendations, the method includes continuous consultation with project partners, including airports. Bilateral workshops with representatives from, industry foster dialogue and ensure the practical applicability of the final deliverables.

1.5. Summary of Key Findings

This comparative summary examines the regulatory landscape for green hydrogen (GH2) production, storage, transportation, and refuelling infrastructure – particularly within or near airport environments – across BSR countries. It covers key legal and planning dimensions, including zoning, protection zones, environmental and safety regulations, construction requirements, and liability issues.

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.

No.	Aspect of research	Estonia	Latvia	Lithuania	Poland
1.	Territorial Planning Aspects related to GH2 Production and Storage				
		No dedicated GH2 zoning or permitting framework exists; updates to spatial and municipal plans are needed to align with sectoral regulations. *See more here*	GH2 facilities are not explicitly permitted under current land use rules; municipal spatial plan amendments are needed for deployment at Riga Airport. *See more here*	No clear land-use or zoning provisions for GH2 infrastructure within or near airports, complicating project approvals. *See more here*	No clear zoning definitions for hydrogen facilities; current municipal plans often exclude GH2 from permitted airport-area uses. *See more here*
2.	Protection Zones Aspects related to GH2 Production within the Airport				

		Hydrogen's hazardous status requires strict safety permits and explosion protection standards near critical infrastructure like airports. See more here	Air navigation safety zones limit development; regulations should be updated to accommodate GH2 storage within these areas. See more here	Lack of defined land-use rules for GH2 in airport protection zones creates planning barriers. See more here	Multiple legal restrictions limit GH2 facility placement within airport areas, stemming from aviation, planning, and risk laws. See more here
3.	Environmental and Safety Regulations regarding Hydrogen Production and Storage				
3.1.	*Safety Regulations*	Estonia lacks GH2-specific aviation safety rules; current compliance relies on general safety and chemicals legislation. See more here	Oversight exists across multiple domains, but airport-specific GH2 safety guidelines are lacking. See more here	No GH2-specific aviation safety rules exist; current system relies on general fire and civil protection laws. See more here	No hydrogen-specific aviation safety rules; reliance on general safety frameworks causes regulatory uncertainty. See more here
3.2.	*EIA Procedure*	EIAs are required under the Planning Act but add complexity and delay due to intersecting environmental regulations. See more here	EIA is legally required but specifics for GH2 projects are undeveloped. See more here	EIA is required, but criteria are not tailored to hydrogen's specific risks. See more here	EIA is required but not yet tailored to hydrogen-specific hazards. See more here
3.3.	*Pollution Permits*	GH2 is not clearly defined as a pollutant, creating uncertainty in the pollution permitting process. See more here	GH2's pollution classification is unclear, complicating environmental permit requirements. See more here	GH2 is not classified as a pollutant, creating uncertainty in the permitting process. See more here	Hydrogen is not classified as a pollutant, creating unclear emission compliance standards. See more here
3.4.	*Requirements for Chemical Substances*	GH2 is treated as a general chemical under the Chemicals Act, implying standard safety, registration, and risk controls apply. See more here	GH2 falls under chemical safety laws, potentially classifying large sites as high-risk facilities. See more here	GH2 is treated as a dangerous substance under EU-aligned chemical safety law, requiring strict handling measures. See more here	GH2 is treated as a dangerous substance; large storage requires risk assessments and safety documentation. See more here
3.5.	*Construction Regulations regarding Hydrogen Production and Storage*	Governed by the Building Code, but there is a need for hydrogen-specific construction and safety standards. See more here	No dedicated GH2 building standards exist; current rules rely on general construction and hazardous material regulations. See more here	No hydrogen-specific construction rules exist; oversight is fragmented among authorities. See more here	Construction laws lack GH2-specific guidance, especially for integrating infrastructure in airport zones. See more here
3.6.	*Liability in Environmental Protection*	Environmental risks from GH2 fall under the Environmental Liability Act. See more here	Not explicitly addressed in current documentation. See more here	Operators are liable for GH2-related environmental damage, but GH2-specific rules on hazard prevention and liability are unclear. See more here	Operators face strict liability for environmental harm, with mandatory preventive and monitoring measures. See more here
4.	Hydrogen Transportation				
		Infrastructure for GH2 transport is underdeveloped; current rules default to ADR and natural gas pipeline standards. See more here	EU Directive 2024/1788 requires a national hydrogen roadmap, but practical transport infrastructure remains underdeveloped. See more here	No dedicated legal framework for GH2 transport in aviation; general laws apply with regulatory gaps. See more here	No specific rules for GH2 transport or pipeline retrofitting, leading to legal and technical uncertainty. See more here
5.	Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems				
		Estonia lacks specific rules for hydrogen vehicles and fuelling; current regulations refer	Hydrogen refuelling equipment (stations) is regulated, lacks specific regulations for hydrogen	Lithuania lacks specific rules for hydrogen vehicles and fuelling stations, especially in	No comprehensive hydrogen refuelling framework; existing rules cover alternative fuels

		to EU standards but miss local provisions. See more here	fuelled vehicles. See more here	airport contexts. See more here	and general safety only. See more here

No.	Aspect of research	Denmark	Sweden	Finland	Germany
1.	Territorial Planning Aspects related to GH2 Production and Storage				
		No clear zoning rules or legal basis for GH2 facilities at airports; land use remains ambiguous. See more here	No national regulations or land use definitions for GH2 at airports; municipalities lack guidance, causing regulatory ambiguity. See more here	GH2 facilities not explicitly defined in zoning laws; existing categories can apply, but regulation is fragmented. See more here	Clear legal pathways exist under the National Hydrogen Strategy and Hydrogen Acceleration Act. See more here
2.	Protection Zones Aspects related to GH2 Production within the Airport				
		GH2 facilities face strict safety and environmental rules; proximity to airports complicates classification and siting.	Emergency standards and zoning rules are unclear; Seveso Act applies if thresholds are exceeded, triggering strict controls. See more here	Airport protection zones and chemical safety zones are regulated by aviation and chemical laws, with siting based on risk assessments. See more here	Not specifically addressed, but environmental review and mitigation are required for projects in sensitive areas. See more here
3.	Environmental and Safety Regulations regarding Hydrogen Production and Storage				
3.1.	*Safety Regulations*	No hydrogen-specific airside safety protocols exist; general laws do not fully address GH2 risks. See more here	No hydrogen-specific aviation safety laws; current framework relies on general safety and environmental laws. See more here	Safety laws require permits and risk assessments but lack clear guidance for airport integration and risk categorization. See more here	Comprehensive safety rules exist under the Hazardous Substances Ordinance and Technical Rules for Hazardous Substances. See more here
3.2.	*EIA Procedure*	EIA is mandatory for hydrogen production and storage projects. See more here	EIA is mandatory, but hydrogen-specific project classification and risk assessment guidelines are lacking. See more here	EIAs apply but hydrogen projects are not clearly listed, causing inconsistency and delays. See more here	Hydrogen projects are subject to full environmental impact assessment under national law. See more here
3.3.	*Pollution Permits*	Not specifically addressed. See more here	No GH2-specific guidance in pollution permit laws, leading to uncertainty. See more here	Required under the Environmental Protection Act for GH2-related emissions. See more here	Emissions are regulated under the Federal Emission Control Act, covering production and fuelling stations. See more here
3.4.	*Requirements for Chemical Substances*	GH2 is a hazardous substance under Danish and EU law, triggering strict safety controls. See more here	Hydrogen is highly flammable and tightly regulated under explosive goods laws. See more here	GH2 regulated under chemical safety laws, requiring permits and emergency planning. See more here	Strictly governed by the Hazardous Substances Ordinance and related technical rules. See more here
3.5.	*Construction Regulations regarding Hydrogen Production and Storage*	Safety standards apply, but general laws may not adequately reflect GH2-specific technical challenges. See more here	No zoning or construction standards specific to GH2 in airport zones; current laws hinder deployment. See more here	No hydrogen-specific standards; permits governed by general construction laws, causing local interpretation issues. See more here	Not specifically detailed in the provided material. See more here
3.6.	*Liability in Environmental Protection*	Not explicitly covered in the available information. See more here	Strict liability applies under the Environmental Code, with operators responsible for damage	Not specifically addressed in the provided information. See more here	Covered by a broad environmental protection framework, though

			regardless of fault. See more here		liability details were not specified. See more here
4.	Hydrogen Transportation				
		Has established a legal foundation for transporting hydrogen via natural gas pipelines and regulated by road transport too. See more here	Regulatory framework incomplete; transport governed by general dangerous goods laws pending EU directive implementation. See more here	No specific rules for hydrogen pipelines; legislation for hydrogen networks remains undeveloped. See more here	Strong legal framework under the Energy Industry Act supports regulated hydrogen transport infrastructure. See more here
5.	Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems				
		No specific legal framework for GH2 aircraft or fuelling systems; regulatory basis is lacking. See more here	No comprehensive hydrogen infrastructure rules: siting, permitting, and technical standards are underdeveloped. See more here	Governed by general vehicle and safety laws; lacks targeted technical standards and clear regulatory guidance. See more here	A complete regulatory framework is in place, ensuring safety and standards for hydrogen vehicles and refuelling. See more here

1.6. Summary of Key Regulatory Gaps, Challenges and Roadblocks

This section summarizes the common regulatory gaps, challenges, and roadblocks identified across all BSR countries assessed in the report. While each country presents unique national-level challenges and legal intricacies, which are elaborated in the respective country chapters, this summary highlights cross-cutting issues that represent regional bottlenecks to the integration of green hydrogen (GH2) into airport infrastructure.

Common Regulatory Gaps and Challenges across the BSR

Absence of Hydrogen-Specific Legal Frameworks

Most BSR countries lack comprehensive, hydrogen-specific legislation. Instead, hydrogen-related activities are often governed under general frameworks for chemicals, energy, or construction. This results in regulatory ambiguity, particularly regarding safety classifications, permitting standards, emission thresholds, and environmental obligations tailored to GH2.

Fragmented Institutional Oversight

Regulatory responsibilities are often divided among multiple authorities — including aviation, environmental, transport, safety, and municipal planning agencies — without a unified coordination mechanism. This fragmentation leads to overlapping mandates, procedural inefficiencies, and extended permitting timelines for hydrogen infrastructure projects at or near airports.

Unclear Zoning and Land Use Classifications

Hydrogen production and storage are typically not defined or explicitly permitted within airport zoning or land use plans. In several cases, airports are designated as transport zones that do not accommodate industrial production or energy generation, requiring complex amendments or legal reinterpretation to enable GH2 deployment.

Ambiguity in Safety and Construction Standards

Existing building and safety codes rarely reflect the unique properties of hydrogen, such as high flammability and high-pressure containment. The absence of harmonized safety distances, construction protocols, and operational standards specifically adapted for GH2 in aviation contexts results in technical uncertainty and increased liability risks for developers.

Gaps in Environmental Assessment and Pollution Regulation

While most countries require Environmental Impact Assessments (EIAs) for hydrogen-related infrastructure, the criteria are often not tailored to hydrogen-specific risks such as leakage or explosion potential. Similarly, hydrogen is inconsistently defined in pollution control frameworks, creating uncertainty in permitting and monitoring obligations.

Underdeveloped Hydrogen Transport Regulations

Transport regulations for GH2, whether by pipeline or road, are in many cases incomplete or based on general frameworks for natural gas or dangerous goods. With the transposition of EU Directive 2024/1788 still pending in several countries, national legislation does not yet fully support dedicated hydrogen transmission infrastructure, limiting logistical feasibility for airport-based supply.

Lack of Clear Standards for Hydrogen Vehicles and Refuelling Systems

The legal frameworks governing hydrogen-fuelled ground support equipment (GSE), aircraft, and fuelling stations are either missing or underdeveloped. This leaves project developers reliant on general alternative fuels regulations, with limited national guidance on siting, technical requirements, or certification for hydrogen systems in aviation environments.

Operational Restrictions from Airport Protection Zones

Existing airport protection and air navigation safety zones restrict the siting of industrial infrastructure near runways and critical systems. In the absence of updated risk models specific to GH2, these spatial restrictions can prohibit the optimal placement of hydrogen production or storage units within airport grounds.

Roadblocks to Harmonized Implementation

Lack of Coordinated Policy Direction

The disparity in national regulatory maturity, with some countries (e.g. Germany) possessing advanced hydrogen frameworks while others remain in early developmental stages, complicates cross-border collaboration and harmonization.

Limited Technical Capacity and Awareness

Regulatory authorities, particularly at municipal levels, may lack expertise in hydrogen technologies, further delaying decision-making and introducing risk aversion into approval processes.

High Compliance Costs and Investment Risks

The lack of clear legal certainty and predictable permitting pathways increases development risks, deters private sector investment, and raises the cost of infrastructure deployment across the region.

1.7. Summary of Key Recommendations

This section outlines the key regulatory and strategic recommendations that are common across all BSR countries analysed in this report – Estonia, Latvia, Lithuania, Poland, Denmark, Sweden, Finland, and Germany. These cross-cutting recommendations address the primary challenges identified in the comparative assessment of national legal and regulatory frameworks relevant to the adoption of green hydrogen (GH2) in aviation contexts, particularly within or near airport environments.

While each BSR country also faces unique legal, institutional, and infrastructural barriers, detailed country-specific recommendations are provided within the respective national chapters of this report.

The following recommendations are broadly applicable across the BSR and aim to foster regulatory clarity, ensure safety, and accelerate the development of hydrogen infrastructure necessary for decarbonising the aviation sector.

Establish Hydrogen-Specific Legal Frameworks

Across the BSR, national legislation typically lacks targeted provisions tailored to hydrogen's unique properties and use cases in aviation. Countries should develop comprehensive hydrogen legislation that defines GH2 infrastructure, clarifies its legal treatment across permitting regimes, and aligns with EU directives and ISO standards.

Modernize Land-Use and Zoning Regulations

Zoning laws and municipal spatial plans often do not accommodate hydrogen production or storage within airport zones. Member states should revise land-use frameworks to include GH2 facilities as permissible or encouraged developments in transport infrastructure zones.

Simplify Multi-Authority Permitting and Approval Processes

The complexity of permitting—often requiring coordination among environmental, aviation, fire safety, and municipal planning authorities—delays implementation. Countries are advised to designate lead or coordinating authorities and develop standardized, streamlined approval procedures.

Define and Implement Aviation-Specific Safety Standards

Hydrogen infrastructure in airports presents unique safety challenges, including risks related to explosion hazards and electromagnetic interference. Dedicated safety codes, buffer zone guidelines, and emergency response protocols should be developed and integrated into aviation regulatory systems.

Strengthen Environmental and EIA Frameworks for Hydrogen

Environmental impact assessment (EIA) and pollution permitting regimes should be updated to explicitly address hydrogen's flammability and environmental risks. Clear thresholds, classification standards, and BAT-based requirements are essential to ensure consistency and legal certainty.

Support Infrastructure Development Through Public Funding and PPPs

The deployment of GH2 infrastructure, including fuelling stations and storage systems, is capital-intensive. National governments should provide co-financing instruments, technical assistance, and incentives for public-private partnerships to reduce investment risks and stimulate deployment.

Integrate Hydrogen into National and Regional Transport Strategies

Hydrogen should be reflected in long-term transport and energy planning documents, particularly in alignment with the TEN-T network. Strategic integration ensures funding prioritisation, regulatory coordination, and alignment with broader EU climate goals.

Enable Regulatory Flexibility for Emerging Technologies

Countries should establish adaptive regulatory frameworks that can accommodate technological innovation, such as liquid hydrogen and hybrid propulsion systems, through sandbox mechanisms or pilot-friendly provisions that allow testing under controlled conditions.

These recommendations provide a common roadmap for BSR countries seeking to harmonize their approach to GH2 aviation infrastructure, reduce deployment barriers, and contribute to a climate-resilient air transport system. Country-specific nuances and legislative details should be reviewed within the respective national chapters.

2.Republic of Estonia

2.1. Executive Summary on Estonia National Legal and Regulatory Framework

Estonia stands at a pivotal moment in its pursuit of sustainable aviation through the integration of GH2, as outlined in this analysis of the national legal and regulatory framework. With ambitious goals set by the Hydrogen Roadmap for Estonia 2030+ and the National Energy and Climate Plan, the country aims to decarbonize its transport sector and achieve carbon neutrality by 2050. The focus of this report is the potential for GH2 production, storage, transportation, and refuelling infrastructure at Tallinn Airport, a critical hub for advancing Estonia's energy transition. However, the absence of hydrogen-specific legislation presents significant hurdles to realizing these objectives.

The current regulatory framework relies on adapting existing laws, including the Planning Act, Aviation Act, Chemicals Act, and Building Code, none of which explicitly address GH2-related activities. Regulatory oversight by bodies such as the Transport Administration, Technical Regulatory Authority, and Environmental Board ensures compliance with safety, environmental, and infrastructure standards. Yet, the lack of clear zoning classifications for GH2 facilities within airport transport zones creates uncertainty, particularly for production infrastructure. Complex, multi-layered approval processes involving multiple authorities further delay project timelines, posing challenges for stakeholders seeking to navigate this evolving landscape.

Hydrogen's classification as a hazardous substance adds another layer of complexity, requiring stringent safety measures and mandatory EIAs under the Environmental Impact Assessment and Environmental Management System Act. These requirements, while essential for safety, increase costs and extend permitting timelines for production and large-scale storage facilities. Transportation regulations also face gaps, with road transport adhering to international ADR standards but lacking fully developed infrastructure for hydrogen logistics within airport zones. The not yet completed transposition of EU Directive 2024/1788, which governs hydrogen pipeline infrastructure, underscores the need for legislative updates to align with EU mandates.

The absence of specific regulations for hydrogen-powered vehicles and aircraft further complicates operational clarity, though Estonia adheres to EU-wide standards like ISO 19880-1:2020 for refuelling infrastructure safety. To address these challenges, Estonia should develop dedicated hydrogen legislation, amending key laws such as the Natural Gas Act, Building Code, and Planning Act to provide clear permitting pathways and emission standards. Revising municipal spatial plans to permit GH2 facilities in airport zones would resolve land-use ambiguities, while a centralized task force could streamline approvals across regulatory bodies.

Investing in specialized infrastructure, such as explosion-proof equipment and high-pressure storage systems, is critical to meeting safety requirements. Public-private partnerships could accelerate the development of refuelling stations and maintenance facilities, supported by expanded training programs for ADR-certified personnel. Tailored emergency response plans, incorporating advanced leak detection and regular risk assessments, will mitigate aviation-specific risks, particularly electromagnetic interference with navigation systems. By implementing these measures, Estonia can overcome regulatory barriers, positioning itself as a regional leader in GH2 aviation and advancing both national climate goals and the broader EU energy transition.

2.2. Introduction

Estonia stands at a critical juncture in the development of its GH2 aviation infrastructure. The national regulatory framework governing this emerging sector reflects a complex interplay between EU directives, domestic legislation, and industry-specific regulations. While Estonia has made notable progress in aligning with broader energy transition goals – particularly through initiatives like the Hydrogen Roadmap for Estonia 2030+

and the National Energy and Climate Plan – significant regulatory gaps remain unaddressed, especially in the domains of hydrogen production, storage, and transportation.

The current regulatory approach largely relies on applying analogous existing legislation rather than implementing hydrogen-specific provisions. This creates uncertainty in critical areas such as permitting processes and zoning requirements. The situation is further complicated by the intersection of aviation safety protocols, environmental assessment requirements, and hazardous material handling regulations, all of which impact project approval timelines and feasibility.

This report provides a comprehensive analysis of Estonia's regulatory landscape for GH2 integration in aviation, with particular focus on key legislative instruments including the Planning Act, Aviation Act, Chemicals Act, and Building Code. The analysis also examines the roles of principal regulatory bodies – notably the Transport Administration and Technical Regulatory Authority – that shape the development of the GH2 ecosystem in Estonia.

By identifying challenges in land-use classification, inter-agency coordination, and safety standards harmonization, this assessment offers insights into streamlining hydrogen adoption pathways while maintaining alignment with the EU's broader energy transition objectives. The findings presented herein are based on currently enforced laws and applicable regulations, providing stakeholders with actionable intelligence for navigating this evolving regulatory environment.

2.3. Key National Regulatory Bodies

The production, usage, transportation, and storage of GH2 involve complex processes that require stringent safety, environmental, and technical oversight due to hydrogen's highly flammable nature and potential environmental impacts. Regulatory bodies play a critical role in ensuring compliance with safety standards, environmental protection, and operational efficiency.

This section outlines the relevant authorities overseeing these activities, focusing on their roles in enforcing regulations specific to hydrogen-related operations, including occupational safety, transportation safety, fire and explosion prevention, environmental compliance, and infrastructure standards. Authorities that do not have direct relevance to hydrogen-specific regulations are identified for exclusion to streamline the focus on pertinent oversight bodies.

2.3.1. Ministry of Climate[1]

The Ministry is responsible for authorising the Transport Administration or a non-profit association to issue licences, as well as to issue transport permits and verify carriers' compliance with operational requirements. It exercises administrative supervision over the performance of any administrative agreement it makes for these purposes. The Ministry of Climate is also identified as the contact point for the exchange of information related to road transport undertakings. It exercises state supervision over compliance with road transport requirements within its competence and decides on applications for activity licenses to organise training of transport managers of the carriage of dangerous goods.[2]

2.3.2. Transport Administration[3]

The Estonian Transport Administration was created on 1 January 2021 by merging the Civil Aviation Administration, the Road Administration and the Maritime Administration, this becoming their legal successor.

[1] Ministry of Climate. Available at: https://kliimaministeerium.ee/en/ministry-news-and-contact/about-ministry . [accessed: 02.04.2025.]
[2] Road Transport Act, Article 19-21, 46-48[1]. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516012024003/consolide [accessed: 02.04.2025.]
[3] About the Estonian Transport Administration. Available at: https://www.transpordiamet.ee/en/administration-news-and-contact/administration [accessed: 01.04.2025.]

The Transport Administration plays a crucial role in overseeing and regulating various aspects of road transport, including roadworthiness testing, vehicle registration, driver training, traffic management.[4] It ensures that all vehicles, including trucks transporting hazardous materials like hydrogen, meet strict standards. The authority is also responsible for vehicle type-approval, registration, and monitoring compliance with safety and technical requirements, which is especially relevant for hydrogen transport, given the specific design and operational requirements for hydrogen-powered or hydrogen-carrying trucks.

Drivers may need specific training and certification, as regulated by the authority. In addition, regulatory enforcement and state supervision ensure that transport operators adhere to safety protocols, including proper vehicle maintenance, secure loading procedures, and compliance with electronic toll systems.

The Transport Administration organises and inspects the roadworthiness testing of ADR vehicles makes decisions on the compliance of vehicles with ADR requirements. The Transport Administration also reviews applications for driver training licenses and organises examinations for drivers carrying dangerous goods and issues ADR training certificates.[5]

It also executes states supervision in civil aviation over the fulfilment of the requirements established in Fire Safety Act and legislation established on the basis. Fire safety regulations for civil aviation may be established by a regulation of the minister in charge of the policy sector.[6]

Aviation Act however imposes additional tasks on the Transport Administration in the aviation sector such as carrying out inspections of conformity of various aviation entities such as civil aircraft, air operators, production organisations, maintenance organisations, training organisations, aerodrome operators.[7] It also has the authority to approve persons to perform these inspections and also is the controller of the aircraft register and is responsible for issuing and recognising aviation personnel licences. In the field of aviation security, the Transport Administration is identified as the appropriate authority within the meaning of relevant EU regulations and coordinates activities to adhere to EU legislation and ICAO standards.[8]

2.3.3. Rescue Board[9]

Key authority exercising state supervision on the rules laid out in Fire Safety Act and legislation established on the basis thereof throughout the national territory. Only in urgent cases it also exercises state supervision over the fire safety requirements in areas that are under other authorities supervision, for example in the area of civil aviation and watercraft, including floating docks that is normally supervised by the Transport Administration. The Rescue Board also plays a role in coordinating building design documentation with local governments regarding fire safety requirements before a building permit or authorisation for use can be granted. It is also the competent authority for the recognition of foreign professional qualifications for certain fire safety services.

2.3.4. Consumer Protection and Technical Regulatory Authority[10]

This authority exercises state supervision in the area of fire safety requirements for rail transport, underground constructions and requirements established for explosion hazard zones. More in depth requirements than those which are laid down in Fire Safety Act shall be established by a regulation of the minister in charge of the policy sector.[11] This authority is also responsible of issuing frequency authorisations and notifies Transport

[4] Road Traffic Act, Articles 73, 78, chapter 1 and 4, subchapter 4. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/527032025001/consolide [accessed 01.04.2025.]
[5] Road Transport Act, Articles 35, 40, 43, 46. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516012024003/consolide [accessed: 02.04.2025.]
[6] Fire Safety Act, Article 28 and 38. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/529122024004/consolide [accessed: 01.04.2025.]
[7] Aviation Act, Article 7^1. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024012/consolide [accessed: 01.04.2025.]
[8] Aviation Act, Article 7, section 6. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024012/consolide [accessed: 01.04.2025.]
[9] Fire Safety Act, Articles 38 and 4^1. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/529122024004/consolide [accessed: 01.04.2025.]. Estonian Rescue Board. Available at: https://www.rescue.ee/ [accessed: 22.04.2025.]
[10] Consumer Protection and Technical Regulatory Authority. Available at: https://ttja.ee/en/business-client/about-us/information-and-contacts/introduction-and-structure [accessed: 02.04.2025.]
[11] Fire Safety Act, Article $29.^1$ Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/529122024004/consolide [accessed: 01.04.2025.]

Administration of any amendments, suspension, revocation, or expiry of frequency authorisations for aeronautical equipment. It has the right to issue compliance notices to airport operators for violations of relevant EU regulations.[12]

It also maintains information system that electronically stores, organizes, and facilitates the exchange of data essential to its multifaceted responsibilities, including legislative oversight, report generation, permit issuance, certification, and ensuring the safety of equipment and associated processes. As the designated entity for recognizing foreign professional qualifications pertinent to the Act's competency standards, it also mandates economic operators involved in equipment work to submit notices of economic activities—detailing competent personnel—directly to the Authority for registration, if the notice is not previously submitted through the Estonian information gateway or through a notary. Entrusted with enforcing the Act and related legislation it can suspend equipment use or deploying technical barriers to mitigate immediate risks, while also investigating technical causes of accidents linked to equipment or related processes.[13]

It is responsible for enforcing Building Code regulations across various technical and construction domains. Its tasks include verifying the conformity of pressurized equipment, electrical and communication installations, and specific construction works—such as those for national defence, security. It ensures compliance with national spatial plans, protection zone requirements, energy performance standards for buildings, including certificates, audits. The Body also oversees wind turbine safety, small-area wireless access points, and undertakes random sampling to validate energy performance certificates, checking input data, results, and building conditions. In the context of hydrogen implementation at airports, rigorous oversight of safety, energy performance, and infrastructure compliance could significantly influence production and operational standards, ensuring safe integration into airport facilities.[14]

2.3.5. Environmental Board[15]

Its task is to implement state policies on environmental use, nature conservation and radiation safety and to monitor the fulfilment of the laws and norms established for the protection of the natural environment. Certain activities within special and protected areas require its express consent. It does not approve activities that may interfere with protection objectives or cause damage but may set written requirements for approval. Regarding construction, the Board has the authority to remove unauthorized works in protected areas and zones after notifying the local authority. This can impact construction, transportation, and hydrogen production projects that require compliance with nature conservation regulations.[16] If there has been caused damage, the Board has the right to demand, by its precept, that the person who caused damage take preventive and remedial measures and give mandatory instructions for taking them.[17]

The Environmental Board is the authority that issues air pollution[18] and also integrated permits. Permit authorises the operation of all or any part of an installation in a manner which guarantees that the activities carried out in the installation have minimum possible impact on the environment, human health etc.[19] Airports producing and using hydrogen must obtain an integrated permit from the Environmental Board, comply with BAT-based emission limits, monitor activities, and report incidents. The Board ensures compliance through inspections and can amend permit conditions as needed.

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[12] Aviation Act, Articles 37^1 and 60^3. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024012/consolide [accessed: 02.04.2025.]
[13] Equipment Safety Act, Articles 10, 12, 13 and 15. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/514052024002/consolide [accessed:02.04.2025.]
[14] Building Code, Article 130. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024005/consolide [accessed: 02.04.2025.]
[15] Environmental Board. Available at: https://www.keskkonnaamet.ee/en/organization-contacts/organization/introduction [accessed: 02.04.2025.]
[16] Nature Conservation Act, Article 70^4. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024003/consolide [accessed: 02.04.2025.]
[17] Environmental Liability Act^1, Article 14. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/502102023003/consolide [accessed: 02.04.2025.]
[18] Atmospheric Air Protection Act, Article 80. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/510062024001/consolide#para19 [accessed: 02.04.2025.]
[19] Industrial Emissions Act, Article 7 and 27. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523012024003/consolide [accessed 02.04.2025.]

2.3.6. Tax and Customs Board[20]

The Tax and Customs Board exercises state supervision over compliance with specific documents related to carriage, cargo safety requirements, and requirements for the carriage of dangerous good. It can also take special measures of state supervision as outlined in the Law Enforcement Act.[21]

2.4. National Planning Documents and Strategies

The development of hydrogen use in Estonia's transport sector is a key pillar in the country's strategy to meet its climate and energy objectives. Estonia's National Energy and Climate Plan[22] which update was approved by the Estonian Government in 2023[23] lays out a comprehensive vision for achieving carbon neutrality by 2050, focusing on integrating renewable energy sources, improving energy efficiency, and transitioning to cleaner fuels, including hydrogen. A major component of this plan is reducing greenhouse gas emissions in the transport sector, which is one of the largest contributors to emissions in Estonia.

In line with this, the National Energy and Climate Plan[24] and its update sets out the country's strategic actions for integrating hydrogen into its energy system by 2030. This plan envisions Estonia as a key player in the development and deployment of GH2 as a sustainable energy source. It also aligns with the EU's green energy targets and underscores Estonia's role in broader regional initiatives, such as the Baltic Hydrogen Corridor project[25]. This cross-border hydrogen transmission infrastructure aims to connect the Baltic States to Finland and Germany, facilitating the transport of GH2 from Estonia to central and western Europe. This collaboration will not only integrate Estonia into the EU hydrogen economy but also enhance decarbonization in both the industrial and transport sectors.

Estonia's National Energy and Climate Plan and its update highlights the importance of hydrogen in decarbonizing the transport sector, including the development of hydrogen-powered vehicles and refuelling infrastructure. Additionally, the Energy Sector Development Plan[26] emphasizes the role of renewable energy in supporting GH2 production. Further, the Strategic Development Plan for Transport 2021-2035[27] identifies hydrogen as a key alternative fuel in the transition to a low-carbon transport system.

Estonia's Sustainable Estonia 21[28] strategy also indirectly supports the development of hydrogen, as one of its main goals is to promote ecological balance and energy efficiency. By producing GH2 from renewable energy sources, Estonia can significantly reduce emissions across multiple sectors, including transport, industry, and heating. This aligns with the country's broader objective of decarbonizing its energy system and fostering more sustainable practices.

[20] Estonian Tax and Customs Board. Available at: https://www.emta.ee/en/private-client/board-news-and-contacts/estonian-tax-and-customs-board/introduction-and-structure [accessed: 02.04.2025.]
[21] Road Transport Act, Article 49 and 50. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516012024003/consolide [accessed: 02.04.2025.]. Law Enforcement Act. Available at: https://www.riigiteataja.ee/en/eli/528072023002/consolide [accessed: 22.04.2025.]
[22] Estonia's 2030 National Energy and Climate Plan. Available at: https://energy.ec.europa.eu/system/files/2022-08/ee_final_necp_main_en.pdf [accessed: 02.04.2025.]
[23] Draft update of Estonia's' National Energy and Climate plan for 2030. Available at: https://commission.europa.eu/publications/estonia-draft-updated-necp-2021-2030_en [accessed: 16.04.2025.]
[24] Estonia's 2030 National Energy and Climate Plan. Available at: https://energy.ec.europa.eu/system/files/2022-08/ee_final_necp_main_en.pdf [accessed: 02.04.2025.]
[25] Please see: https://elering.ee/ [accessed: 02.04.2025.]
[26] Please see: https://kliimaministeerium.ee/en/energy-sector-development-plan [accessed: 02.04.2025.]
[27] Please see: https://kliimaministeerium.ee/sites/default/files/documents/2023-09/Transpordi%20ja%20liikuvuse%20arengukava%202021-2035_EN%20%281%29.pdf [accessed: 02.04.2025.]
[28] Please see: https://www.fao.org/faolex/results/details/en/c/LEX-FAOC181070/ [accessed: 02.04.2025.]

2.5. Territorial Planning Aspects related to GH2 Production and Storage

In Estonia, territorial planning for GH2 production and storage is governed by the Planning Act[29], which establishes the legal framework for land use and infrastructure development. While there is no specific designation for hydrogen-related projects as sites of national importance, strategic energy infrastructure may be integrated into national and municipal spatial plans under the framework of Estonia's energy policy and climate goals. The development of GH2 facilities must comply with zoning regulations, EIAs under the Environmental Impact Assessment and Environmental Management System Act[30], and safety restrictions outlined in the Building Code[31] and Nature Conservation Act.[32]

Given the absence of a dedicated regulatory framework for GH2 infrastructure within airport territories, this analysis will examine broader planning principles, identify key legal challenges, and highlight existing regulatory gaps that may require further legislative clarification to support hydrogen adoption in the aviation sector.

2.5.1. GH2 Production and Storage within the Airport

Tallinn Airport is situated within a designated transport infrastructure zone, regulated under Estonia's Planning Act[33] and the comprehensive spatial plans of Tallinn and Rae Municipality. According to the Building Code[34] and national spatial planning regulations, primary permitted uses within such zones include:

- transport infrastructure and related facilities;
- engineering networks and utilities;
- logistics and warehousing;
- commercial and service activities linked to airport operations.

Additional permitted uses may include commercial buildings, storage facilities, and fuel stations. While conventional fuel stations are allowed within the airport's infrastructure plan, GH2 production facilities are not explicitly listed as a permitted or additional use. This regulatory gap may pose challenges for establishing hydrogen production within airport premises.

The aerodrome protection zone, established under the Aviation Act[35], imposes strict safety and land-use limitations, particularly concerning industrial installations and energy infrastructure. Notably, the use of wind turbines—an essential renewable energy source for GH2 production—may be restricted within airport-controlled zones due to aviation safety concerns.

GH2 storage, however, may have more flexibility. If classified as part of airport refuelling or energy supply infrastructure, storage facilities could align with existing permitted uses under the Planning Act.

To enable GH2 production within the airport, Estonia may need to amend current land-use regulations, introduce clearer classifications for hydrogen infrastructure within airport zones, and align territorial planning with national and EU energy policies. GH2 storage, on the other hand, appears more viable under existing regulations, provided compliance with safety and operational guidelines.

2.5.2. GH2 Production and Storage near the Airport

The development of GH2 production and storage facilities near Tallinn Airport is governed by a multi-layered regulatory framework that combines national legislation, municipal planning instruments, and sector-specific

[29] Planning Act. Available at: https://www.riigiteataja.ee/en/eli/527062016001/consolide [accessed: 02.04.2025.]
[30] Environmental Impact Assessment and Environmental Management System Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/518102024017/consolide [accessed: 02.04.2025.]
[31] Building Code. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024005/consolide [accessed: 02.04.2025.]
[32] Nature Conservation Act. Available at: https://www.riigiteataja.ee/en/eli/515112018002/consolide [accessed: 02.04.2025.]
[33] Planning Act. Available at: https://www.riigiteataja.ee/en/eli/527062016001/consolide [accessed: 02.04.2025.]
[34] Building Code. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024005/consolide [accessed: 02.04.2025.]
[35] Aviation Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024012/consolide [accessed: 02.04.2025.]

restrictions. While Estonia's Planning Act[36] establishes the foundation for land-use classification, the specific zoning designations and permitted uses are determined through municipal spatial plans and supplemented by sectoral regulations.

Under Estonia's planning system, the areas surrounding Tallinn Airport are typically divided into several functional zones:

- transport and Infrastructure zone;
- industrial and Logistics zones;
- protected and Green zones.

The regulatory status of hydrogen infrastructure varies significantly between these zones. GH2 storage may qualify as permitted infrastructure in transport zones when classified as airport refuelling systems whilst production facilities face stricter regulatory challenges, as hydrogen remains classified as a hazardous substance.

Current gaps in the framework include the absence of explicit hydrogen infrastructure classifications in zoning categories and unclear permitting pathways for electrolysis facilities. To facilitate development, amendments to municipal plans and harmonization between spatial planning and sectoral regulations will be essential, alongside case-by-case evaluations for projects in restricted zones.

The feasibility of GH2 infrastructure will ultimately depend on evolving national hydrogen policies, EU directives like AFIR, and local governments' flexibility in interpreting existing zoning rules for emerging energy technologies.

2.6. Protection Zones Aspects related to GH2 Production within the Airport

Estonian legislation establishes a comprehensive regulatory framework for industrial activities near critical infrastructure like Tallinn Airport, with particular relevance for GH2 projects. The Aviation Act[37] forms the primary legal basis, prohibiting storage of hazardous materials including hydrogen within designated aerodrome protection zones while requiring special permits for any construction potentially affecting navigation systems.

These restrictions are further reinforced by the Building Code[38], which mandates specific safety distances for gas installations and pressure equipment, along with requirements for advance notification of maintenance work. The Nature Conservation Act[39] complements these regulations by governing broader land use restrictions in protected areas and establishing clear financial responsibilities for necessary infrastructure modifications.

For hydrogen facilities specifically, the regulatory environment presents additional challenges due to the substance's hazardous classification. Operators must obtain specialized safety permits demonstrating compliance with stringent explosion protection standards, while facing operational limitations on production volumes based on proximity to airport operations. The technical requirements are particularly rigorous, mandating the exclusive use of explosion-proof equipment in all storage and processing areas. These measures reflect the elevated risk profile associated with hydrogen and the need to maintain absolute aviation safety near critical airport infrastructure.

The approval process for any hydrogen project near Tallinn Airport involves multiple regulatory bodies and stages of review. Initial assessments focus on verifying the proposed location against official protection zone maps and conducting preliminary risk evaluations. The technical review phase requires close coordination with the Tallinn Airport operator and formal approvals from both the Transport Administration and Technical

[36] Planning Act. Available at: https://www.riigiteataja.ee/en/eli/527062016001/consolide [accessed: 02.04.2025.]
[37] Aviation Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024012/consolide [accessed: 01.04.2025.]
[38] Building Code. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024005/consolide [accessed: 01.04.2025.]
[39] Nature Conservation Act. Available at: https://www.riigiteataja.ee/en/eli/515112018002/consolide [accessed: 01.04.2025.]

Regulatory Authority. Final authorization depends on successful completion of EIAs, fire safety certifications, and operational permit approvals, creating a multi-layered oversight process.

Projects located within close proximity to the airport, typically within a five-kilometre radius, face enhanced scrutiny across several dimensions and herein the closest Natura 2000 site is the Pirita River Valley Landscape Conservation Area, which is located 3.4km from the airport boundary. Aviation safety considerations require detailed analysis of potential electromagnetic interference with navigation systems, while emergency response plans must account for the unique challenges of hydrogen-related incidents near airport operations. The Civil Aviation Authority maintains particular interest in these cases, often requiring additional risk mitigation measures and more frequent safety inspections.

2.7. Environmental and Safety Regulations regarding Hydrogen Production and Storage

2.7.1. Safety Regulations

Safety regulations for hydrogen production and storage within airport territory must comply with national and international aviation, environmental, and hazardous substance laws. Given hydrogen's flammability, high-pressure storage risks, and environmental impact, strict measures are required to ensure compliance with ICAO and EASA regulations, preventing risks to air traffic and airport operations.

Under Estonia's Occupational Health and Safety Act[40] and Chemicals Act[41], employers must implement protective measures, employee training, and regular equipment maintenance to prevent hydrogen-related hazards. Any person handling GH2 must maintain records for at least 10 years to ensure accountability. All reasonable measures shall also be complied with under the Equipment Safety Act.[42]

Risk assessments must identify hazards, establish safety protocols, and restrict access to untrained personnel. Employees in high-risk areas require specialized training, especially for hydrogen fuelling operations, following ISO 19880-1:2020 standards. Emergency preparedness includes evacuation plans, trained response personnel, leak detection systems, and access to emergency communication (112 emergency call system).

While EU and national Aviation Act[43] primarily emphasize aircraft safety, strict security measures apply to all infrastructure within the airport territory to prevent disruptions to operations. Safety requirements are also assessed as part of the EIA process, the identification of high-risk facilities, and the registration and monitoring of hazardous equipment and substances. This multi-layered approach ensures a thorough risk assessment of production and storage, aligning with regulatory compliance, environmental protection, and safety standards.

While tailored regulations may be developed in the future to optimize hydrogen implementation, the current regulatory framework is sufficient to support safe and functional hydrogen integration within airport operations.

2.7.2. EIA Procedure

On a national level when planning the construction and placement of infrastructure for hydrogen production and storage in Estonia, it is essential to consider that the Environmental Impact Assessment and Environmental Management System Act[44] outlines specific projects requiring an EIA. This assessment evaluates potential environmental effects and establishes measures to prevent or mitigate adverse impacts. If a project fails to meet

[40] Occupation Health and Safety Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/518032025012/consolide [accessed: 01.04.2025.]
[41] Chemicals Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/512062023001/consolide [accessed: 01.04.2025.]
While GH2 is not explicitly named in the Chemicals Act, it falls under the broader definition of a chemical substance (Regulation No. 1907/2006), particularly as a gaseous fuel. As such, its production, storage, and handling are likely subject to the Act's general safety, registration, and risk management requirements if it meets the criteria for a hazardous chemical, therefore also included under the assessment of this legislative act herein and further.
[42] Equipment Safety Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/514052024002/consolide [accessed: 01.04.2025.]
[43] Aviation Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024012/consolide [accessed: 01.04.2025.]
[44] Environmental Impact Assessment and Environmental Management System Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/518102024017/consolide [accessed: 01.04.2025.]

legal requirements or poses significant risks, the assessment may lead to restrictions or the prohibition of the proposed activity.

Projects subject to EIA requirements include facilities for industrial production of organic and inorganic chemical substances involving multiple sequential chemical conversion processes. Since hydrogen is classified as an inorganic chemical substance, hydrogen production facilities must undergo an EIA to ensure compliance with regulatory standards.

Regarding storage, it should be noted that hazardous product storage facilities, including fuel could also be subject to an EIA procedure. The issuer of development consent makes a preliminary estimate as to whether the activities (of fuel storage) have significant environmental impact. If it is found that the proposed activity will not result in significant environmental impact, an EIA is not necessary, although the justification behind this conclusion must be appended to the decision. If it is determined that the proposed activity may result in significant environmental impact, a decision to initiate the EIA must be made. This requirement ensures that large-scale storage operations adhere to safety and environmental protection measures.

Therefore, both hydrogen production and storage will likely require compliance with EIA regulations to ensure adherence to legal standards and risk mitigation.

2.7.3. Pollution Permits

To obtain an air pollution permit for activities involving GH2, operators must submit a detailed application under the Atmospheric Air Protection Act.[45] This includes information on emission sources, pollutant types, and dispersion modelling to assess potential environmental and health impacts. If hydrogen-related activities lead to emissions exceeding air quality limits or involve hazardous pollutants, a permit is mandatory. The permit sets strict emission allowances and requires adherence to the best available techniques to minimize environmental risks.

A key challenge is that hydrogen itself is not explicitly classified as a pollutant, creating uncertainty in permit requirements. While its combustion may release regulated pollutants like nitrogen oxides, the lack of specific legal thresholds for hydrogen emissions complicates regulatory enforcement. Additionally, safety concerns related to fire and explosion risks may result in heightened scrutiny, potentially leading to stricter permit conditions or even refusal if risks are deemed too high. The absence of clear regulations on GH2 production and storage adds further uncertainty, highlighting the need for regulatory refinement to ensure clarity for businesses and safe integration into Estonia's environmental framework.

2.7.4. Requirements for Chemical Substances

Considering that hydrogen is included in the European Chemicals Agency's database[46] as a hazardous chemical substance, its production must also comply with the requirements of the Chemicals Act[47] and Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances[48], in conjunction with EU regulatory legal acts. These regulations mandate the registration of chemical substances, provision of information and labelling, adherence to safety requirements, and limitations on activities involving hazardous substances.

Facilities engaged in the production, handling, storage, or use of hazardous substances, including hydrogen, may be classified as major accident hazard sites under the Chemicals Act. These sites are categorized based on the quantity of hazardous substances present and the potential risks they pose to human health and the environment. In accordance with these regulations, facilities handling significant quantities of hydrogen must implement strict safety management systems, conduct risk assessments, and develop on-site emergency

[45] Atmospheric Air Protection Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/510062024001/consolide [accessed: 01.04.2025.]
[46] Please see: https://echa.europa.eu/lv/substance-information/-/substanceinfo/100.014.187
[47] Chemicals Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/512062023001/consolide [accessed: 01.04.2025.]
[48] Please see: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0018

response plans. Additionally, controlled access measures must be enforced to prevent unauthorized entry into hazardous substance storage areas.

Furthermore, storage must be designed and constructed to meet pressure and safety requirements, ensuring they can withstand designated usage conditions and prevent leakage or uncontrolled release of hydrogen.[49]

Consequently, hydrogen production must comply with the requirement for hazardous substances, ensuring proper registration, labelling, and safety measures. Depending on the potential risks, facilities handling hazardous substances may be classified as high-risk sites and must adhere to strict safety requirements.

2.7.5. Construction Regulations regarding Hydrogen Production and Storage

The construction and placement of hydrogen production and storage infrastructure in Estonia are regulated under various legal frameworks, primarily the Building Code[50] and relevant provisions in the Energy Sector Organisation Act[51]. These regulations establish requirements for building permits, safety standards, and environmental considerations.

Hydrogen storage, particularly in pressurized tanks or other containment systems, may be classified under gas installations and pressure equipment, which are subject to protection zones established by law. Within these zones, activities that could endanger the infrastructure, obstruct maintenance, or interfere with safety measures are restricted. The facility owner is required to disclose the exact location and technical specifications of the installation, ensuring that it meets all regulatory requirements.

Furthermore, fire safety regulations and hazardous materials handling laws impose additional constraints on hydrogen facilities. Since hydrogen is highly flammable, storage and processing sites will likely need to comply with technical supervision laws for hazardous installations, which regulate registration, inspection, and operational oversight. Facilities exceeding specific storage volume thresholds may also fall under separate industrial risk assessment requirements, ensuring that safety measures align with national and EU standards.

From an urban planning and environmental standpoint, the Energy Sector Organisation Act introduces additional permitting considerations if the hydrogen facility is classified as a renewable energy project. While such projects are generally considered to be of overriding public interest, their placement is restricted in Natura 2000 areas or other protected zones to prevent negative environmental impacts. In cases where a project qualifies as a priority renewable energy infrastructure, the permitting process may be streamlined under national energy policy directives.

Given the increasing importance of hydrogen in energy transition, transport, and industrial applications, Estonia may need to develop dedicated hydrogen construction and safety standards. A comprehensive review of existing building laws and technical guidelines would help establish clear regulatory pathways for hydrogen infrastructure, ensuring alignment with international safety norms while facilitating the country's shift towards sustainable energy solutions.

2.7.6. Liability in Environmental Protection

Liability in scope of the environmental protection is governed by the Environmental Liability Act[52] and the General Part of the Environmental Code Act[53], based on the polluter pays principle. Liability applies to those whose actions or omissions cause environmental damage, with strict liability imposed for high-risk activities such as industrial emissions, hazardous chemical handling, and waste transport.

[49] Building Code. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024005/consolide [accessed: 01.04.2025.]
[50] Building Code. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024005/consolide [accessed: 01.04.2025.]
[51] Energy Sector Organisation Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/517112024001/consolide [accessed: 01.04.2025.] Please note that the current version in force until the 31.05.2025.
[52] Environmental Liability Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/502102023003/consolide [accessed: 01.04.2025.]
[53] General Part of the Environmental Code Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024010/consolide [accessed: 01.04.2025.]

Liable parties must take preventive and remedial measures at their own expense, including damage assessment, mitigation, and monitoring. The Environmental Board identifies responsible parties and enforces compliance. Costs can be recovered from polluters, though exemptions apply if damage resulted from third-party actions or compliance with legal orders.

Challenges include proving causal links in cases of diffuse pollution, potential gaps in remediation requirements due to cost considerations, and broad conditions for liability exemptions, which may complicate enforcement and complete environmental restoration.

2.7.7. Summary and Conclusions on Estonian Regulations on Hydrogen Production

Regulatory uncertainty presents a significant challenge, as hydrogen lacks explicit classification in pollution permit frameworks. While it falls under the European Chemicals Agency's hazardous substances database and requires compliance with the Chemicals Act and Directive 2012/18/EU, the absence of hydrogen-specific legal thresholds complicates regulatory enforcement. This creates a grey area regarding exactly which permits are needed and what emission standards apply, potentially causing delays in project approval.

Safety and infrastructure requirements pose additional barriers due to hydrogen's flammability and high-pressure storage risks. Facilities must implement strict safety management systems, conduct thorough risk assessments, and develop emergency response plans in accordance with the Chemicals Act. Construction and placement must adhere to the Building Code and Energy Sector Organisation Act regulations, including protection zones for gas installations. These comprehensive requirements demand significant investment in specialized infrastructure, training, and safety systems that may not be readily available in the current airport environment.

2.8. Estonian Regulations on Hydrogen Transportation

2.8.1. Hydrogen Transportation via Natural Gas Pipelines

Article 55 of the EU Directive 2024/1788 on common rules for the internal market in renewable gas, natural gas, and hydrogen[54] (the Directive) mandates that hydrogen transmission system operators establish a 10-year hydrogen roadmap. This roadmap must provide detailed information on infrastructure that can be repurposed or planned for hydrogen transportation, particularly to supply hydrogen to hard-to-decarbonize sectors.

Currently, Estonia has not yet fully transposed this Directive into national legislation as the Directive has to be transposed into national law by 5 August 2026. However, the Estonian government is in the process of drafting hydrogen-related regulatory measures to align with EU requirements. The Natural Gas Act[55] already governs gas transmission and distribution infrastructure, and it is expected that Estonia will update this act to explicitly incorporate hydrogen-related provisions.

Despite the 2026 deadline for transposition, Estonia has already taken steps to evaluate the feasibility of repurposing existing natural gas infrastructure for hydrogen transport. The Hydrogen Roadmap for Estonia 2030+,[56] developed under the Ministry of Economic Affairs and Communications and Ministry of Climate, suggests that a blending approach (mixing hydrogen with natural gas in existing pipelines) could serve as an interim solution before dedicated hydrogen pipelines are constructed.

Under the Building Code[57], any modifications or repurposing of natural gas pipelines for hydrogen transport must comply with safety regulations for pressure equipment and ensure that storage, transmission, and

[54] Please see: https://eur-lex.europa.eu/eli/dir/2024/1788/oj/eng
[55] Natural Gas Act. Available at: https://www.riigiteataja.ee/en/eli/524072017015/consolide [accessed: 02.04.2025.]
[56] Republic of Estonia Ministry of Climate, Republic of Estonia Ministry of Economic Affairs and Communications, "Estonian Hydrogen Roadmap". Available at: https://kliimaministeerium.ee/sites/default/files/documents/2023-07/Estonian%20hydrogen%20roadmap%20ENG.pdf [accessed: 02.04.2025.]
[57] Building Code. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/516122024005/consolide [accessed: 02.04.2025.]

distribution infrastructure meet explosion prevention and material compatibility requirements. In addition, operators must obtain approvals from the Technical Regulatory Authority and comply with EIA requirements under the Nature Conservation Act[58] if pipeline modifications impact protected areas.

In case of a decision to connect to the national gas transmission system, operators must enter into agreements with Elering AS, Estonia's unified gas transmission system operator. The same requirement applies to distribution system operators if they intend to integrate hydrogen storage into the existing gas network.

Since hydrogen transportation via natural gas infrastructure is permitted under EU law, the existing safety, technical, and operational regulations for natural gas pipelines in Estonia will apply by analogy to hydrogen transportation until specific hydrogen transport regulations are enacted. However, hydrogen has different properties (e.g., higher permeability, embrittlement risks), so additional assessments may be necessary beyond standard gas rules.

2.8.2. Hydrogen Transportation via Road Transport

In Estonia, road transport serves as a viable alternative for hydrogen delivery, subject to strict regulations governing the movement of dangerous goods. The Road Transport Act[59] and the Road Traffic Act[60] establish the primary legal framework, ensuring that hydrogen transport complies with ADR regulations and international safety standards. These regulations govern vehicle requirements, operator certifications, and liability measures to mitigate risks associated with transporting highly flammable gases.

Hydrogen transport vehicles must meet ADR certification standards, including specialized pressure-resistant tanks and leak prevention systems. Additionally, drivers require ADR certification, ensuring proper handling and emergency response capabilities. However, gaps remain in training enforcement and infrastructure readiness, particularly in securing designated refuelling and maintenance facilities for hydrogen-powered transport fleets.

Within airport zones, additional restrictions apply under the Aviation Act and Tallinn Airport's internal safety protocols, requiring prior coordination with airport authorities to prevent risks to air traffic and critical infrastructure. The Nature Conservation Act further regulates transport near high-risk areas, imposing restrictions that may complicate hydrogen logistics, particularly in densely populated or environmentally sensitive regions.

While Estonia's regulatory framework aligns with international best practices, further policy adjustments may be needed to streamline hydrogen transport corridors, improve refuelling station accessibility, and enhance emergency response coordination. Developing clearer operational guidelines will be essential to ensuring the safe and efficient integration of hydrogen transport into Estonia's evolving energy and mobility landscape.

2.8.3. Summary and Conclusions on Estonian Regulations on Hydrogen Transportation and Safety Regulation

Article 55 of the EU Directive 2024/1788 mandates that hydrogen transmission system operators establish a 10-year hydrogen roadmap detailing infrastructure for hydrogen transportation to hard-to-decarbonize sectors. Estonia has not yet fully transposed this Directive into national legislation as the Directive has to be transposed into national law by 5 August 2026, though the government is drafting hydrogen-related regulatory measures to align with EU requirements. The existing Natural Gas Act is expected to be updated to explicitly incorporate hydrogen provisions. Despite the 2026 transposition deadline, Estonia is already evaluating the feasibility of repurposing natural gas infrastructure for hydrogen transport, with the Hydrogen Roadmap for Estonia 2030+ suggesting a blending approach as an interim solution.

[58] Nature Conservation Act. Available at: https://www.riigiteataja.ee/en/eli/515112018002/consolide [accessed: 02.04.2025.]
[59] Road Transport Act. Available at: https://www.riigiteataja.ee/en/eli/518012019007/consolide [accessed: 02.04.2025.]
[60] Road Traffic Act. Available at: https://www.riigiteataja.ee/en/eli/516022016004/consolide [accessed: 02.04.2025.]

Alternative hydrogen transportation methods, such as road transport, must comply with strict regulations governing dangerous goods movement under the Road Traffic Act and Traffic Act. These align with ADR regulations and international safety standards governing vehicle requirements, operator certifications, and liability measures. Hydrogen transport vehicles must meet ADR certification standards with specialized pressure-resistant tanks and leak prevention systems, while drivers require ADR certification for proper handling.

Within airport zones, additional restrictions apply under the Aviation Act[61] and Tallinn Airport's safety protocols, requiring prior coordination with airport authorities to prevent risks to air traffic and infrastructure. Though Estonia's regulatory framework aligns with international best practices, further policy adjustments may be needed to streamline hydrogen transport corridors, improve refuelling station accessibility, and enhance emergency response coordination.

2.9. Estonian Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

Estonia currently lacks specific regulations governing hydrogen-powered vehicles and aircraft. No specific legislative provisions are available in connection with hydrogen refuelling infrastructure. The Liquid Fuel Act[62] and the Building Code outline general safety and technical requirements applicable to fuel storage and refuelling stations, and EU-wide standards for hydrogen infrastructure development exist, there is no legal framework or standards in Estonian.

Hydrogen refuelling stations must comply with international safety and performance standards, including ISO 19880-1:2020 for hydrogen refuelling station safety and ISO 14687:2019 for hydrogen fuel quality. These standards ensure secure hydrogen integration for airport GSE and potential hydrogen-powered aircraft. The Explosives Act[63] and Fire Safety Act also impose safety measures, particularly regarding storage and handling of gaseous fuels to mitigate explosion risks.

If a hydrogen refuelling station stores more than 0,5 tonne of hydrogen, it may be classified as a high-hazard facility under the Environmental Liability Act, requiring stringent risk management measures, including hazard identification, civil protection planning, and designated safety zones.

Currently, Estonia's Planning Act[64] and Nature Conservation Act regulate land use within airport territories. While existing legislation allows for conventional fuel stations at airports, there is no explicit legal framework addressing hydrogen refuelling stations for aviation use. Introducing hydrogen infrastructure at Tallinn Airport would likely require amendments to these regulations, feasibility assessments, and approvals from the Transport Administration and Civil Aviation Authority.

2.9.1. Summary and Conclusions on Estonian Regulations on Fuelling and Usage

To advance hydrogen adoption in Estonia's aviation sector, regulatory updates and incentives are needed to align hydrogen refuelling infrastructure with aviation safety standards and sustainability goals. A structured legislative framework, incorporating risk assessments and clear permitting guidelines, would facilitate the safe integration of hydrogen-powered vehicles and aircraft within Estonia's airports.

[61] Aviation Act. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/523122024012/consolide [accessed: 02.04.2025.]
[62] Liquid Fuel Act. Available at: https://www.riigiteataja.ee/en/eli/531032014004/consolide [accessed: 02.04.2025.]
[63] Explosives Act. Available at: https://www.riigiteataja.ee/en/eli/506042021003/consolide [accessed: 02.04.2025.]
[64] Planning Act. Available at: https://www.riigiteataja.ee/en/eli/527062016001/consolide [accessed: 02.04.2025.]

2.10. Key Findings of Sector-Specific Estonian Regulations

Estonian regulations present several key considerations for hydrogen implementation at airports. Tallinn Airport's designation under a transport infrastructure zone allows conventional fuel stations, but lacks explicit provisions for GH2 production facilities, creating significant regulatory uncertainty. This gap in zoning classifications represents a primary challenge for airport hydrogen infrastructure development.

The regulatory framework imposes substantial operational requirements, with operators needing to implement comprehensive protective measures, conduct specialized employee training, maintain extensive records for at least a decade, and perform regular equipment maintenance. Additionally, hydrogen production facilities must adhere to the Chemicals Act, which mandates implementation of strict safety management systems due to hydrogen's classification as a hazardous substance.

Environmental assessment requirements add another layer of complexity, as the Environmental Impact Assessment and Environmental Management System Act mandates evaluations for hydrogen production facilities due to their classification as chemical substance production. Storage facilities may face additional EIA procedures, in accordance with the results of the preliminary estimate, to verify safety and environmental protection measures, adding time and cost considerations to project development.

Transportation regulations present further challenges, as Estonia has yet to fully transpose EU Directive 2024/1788 on hydrogen transport into national legislation as the Directive has to be transposed into national law by 5 August 2026, though the existing Natural Gas Act provides some governance for gas transmission infrastructure. Road transport of hydrogen must comply with strict ADR regulations under the Road Traffic Act and Road Transport Act, with airport zones imposing additional restrictions that complicate logistics planning and operational flexibility.

2.11. Identified Regulatory Gaps, Challenges and Roadblocks

Regulatory Uncertainty

Hydrogen lacks explicit classification in pollution permit frameworks. While it falls under the European Chemicals Agency's hazardous substances database, the absence of hydrogen-specific legal thresholds complicates regulatory enforcement, creating a grey area regarding required permits and emission standards.

Infrastructure and Safety Requirements

Hydrogen's flammability and high-pressure storage risks necessitate specialized infrastructure. Facilities must implement strict safety management systems with technical requirements mandating explosion-proof equipment in all storage and processing areas, demanding significant investment that may not be readily available in airport environments.

Land Use Classification Gaps

Current zoning regulations do not explicitly account for hydrogen infrastructure. GH2 production is not listed as a permitted use in airport zones, while production facilities face stricter regulatory challenges due to hydrogen's hazardous substance classification.

Multi-Authority Approval Process

The approval process for hydrogen projects near Tallinn Airport involves multiple regulatory bodies and stages of review, creating a complex oversight system.

Transport Infrastructure Limitations

While Estonia's transportation framework aligns with international standards, gaps remain in training enforcement and infrastructure readiness, particularly for designated refuelling and maintenance facilities for hydrogen transport fleets.

Technical Standard Integration

Estonia currently lacks specific regulations governing hydrogen-powered vehicles and aircraft, though it follows EU-wide standards for hydrogen infrastructure development. A structured legislative framework incorporating risk assessments and clear permitting guidelines would facilitate safe integration of hydrogen technologies.

Aviation Safety Considerations

Projects require detailed analysis of potential electromagnetic interference with navigation systems, while emergency response plans must account for the unique challenges of hydrogen-related incidents near airport operations, often resulting in additional risk mitigation measures and more frequent safety inspections.

2.12. Recommendations

The analysis of Estonia's regulatory framework for GH2 in aviation reveals significant opportunities alongside notable challenges, including regulatory uncertainty, land-use classification gaps, and complex approval processes. To support the safe and efficient adoption of GH2 at Tallinn Airport and align with Estonia's climate goals and EU energy directives, the following recommendations address key barriers and propose actionable steps to streamline hydrogen infrastructure development.

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.

However, when creating or updating relevant legislation, Estonia should include provisions that ensure future flexibility for liquid hydrogen deployment, avoiding overly rigid frameworks that could inadvertently create barriers to liquid hydrogen infrastructure or operations in later stages of hydrogen market development.

Responsible authorities:	Time of completion:
Ministry of Climate, Ministry of Economic Affairs and Communications	2025 - 2026

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.

Responsible authorities:	Time of completion:
Ministry of Climate, local government	2026

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.

Responsible authorities:	Time of completion:

Ministry of Climate, Transport Administration, Consumer Protection and Technical Regulatory Authority	2025

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 and ensure compliance with international safety standards.

Responsible authorities:	Time of completion:
Ministry of Climate, Transport Administration, Private sector entities	2025 - 2027

Strengthen Emergency Response and Aviation Safety Protocols

Develop tailored emergency response plans for hydrogen-related incidents near airports, incorporating advanced leak detection systems and 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. These steps will enhance safety confidence, addressing aviation-specific concerns and supporting broader GH2 adoption in Estonia's transport sector.

Responsible authorities:	Time of completion:
Transport Administration, Civil Aviation Administration, Rescue Board	2026 - 2027

3.Republic of Latvia

3.1. Executive Summary on Latvian National Legal and Regulatory Framework

This analysis examines the regulatory landscape for GH2 implementation and identifies significant regulatory gaps that currently hinder development in this area. While Latvia has established overarching climate and energy goals that recognize hydrogen's importance in decarbonizing transportation, the existing regulatory framework presents several substantive barriers to implementing GH2 infrastructure at airports.

The most critical regulatory obstacle is the absence of explicit zoning provisions for hydrogen infrastructure. Current municipal spatial planning designates Riga International Airport as a "transport infrastructure zone" which does not permit industrial production facilities necessary for GH2 production. While storage facilities might potentially be allowed as "engineering infrastructure" or "warehouse-type facilities", and GH2 refuelling stations as "fuel stations", these interpretations lack regulatory certainty. Additionally, navigational safety zones covering significant portions of airport territory impose further restrictions on GH2-related construction.

Hydrogen's classification as a hazardous chemical substance triggers multiple regulatory requirements related to safety, risk management, and environmental compliance. However, the regulatory framework lacks specificity regarding how GH2 production through water electrolysis should be classified for pollution permitting and industrial activity categorization. The absence of hydrogen-specific national, supranational or international construction standards and airport integration safety guidelines creates additional technical and procedural uncertainty.

Energy supply constraints present another significant challenge, as current regulations restrict commercial-scale renewable energy installations within airport territory, limiting the viability of on-site GH2 production. While surrounding areas might theoretically accommodate hydrogen facilities, similar classification uncertainties and restrictions likely apply to these zones as well.

To advance GH2 implementation at Latvian airports, priority must be given to regulatory improvements that explicitly recognize hydrogen infrastructure within appropriate zoning frameworks. Developing scale-appropriate classifications for hydrogen facilities, establishing construction and safety standards specific to aviation contexts, and creating clear guidelines for permitting would significantly reduce barriers to development. A state-level review of territory use restrictions within transport infrastructure zones is essential to enable GH2 production at airports while maintaining appropriate safety standards.

3.2. Introduction

The aviation sector faces increasing pressure to reduce its environmental footprint and greenhouse gas emissions. GH2, produced through electrolysis powered by renewable energy sources, has emerged as a promising SAF alternative with significant potential to decarbonize airport operations and eventually air transport itself. As Latvia pursues its climate neutrality goals and aligns with EU initiatives on sustainable energy transition, developing GH2 infrastructure at airports represents a strategic opportunity to advance these objectives.

This analysis examines the regulatory framework governing the implementation of GH2 production, storage, and distribution infrastructure at Riga International Airport. It identifies key regulatory gaps, challenges, and roadblocks that currently impede the development of such infrastructure within airport territories and surrounding areas. The assessment covers multiple regulatory dimensions including spatial planning and zoning requirements, environmental permitting, safety regulations, construction standards, and energy supply considerations specific to the aviation context.

While Latvia has established national planning documents and strategies that acknowledge hydrogen's role in transport decarbonization, the translation of these high-level objectives into a coherent regulatory framework for airport-based hydrogen infrastructure remains incomplete. This creates uncertainty for potential project developers and may delay Latvia's progress toward sustainable aviation goals.

By identifying the specific regulatory barriers and recommending targeted improvements, this analysis aims to contribute to the development of a more enabling environment for GH2 implementation at Latvian airports. The findings and recommendations presented here are particularly relevant for policymakers, airport authorities, energy developers, and aviation stakeholders seeking to advance Latvia's position in the emerging hydrogen economy while supporting the sustainable transformation of its aviation sector.

3.3. Key National Regulatory Bodies

3.3.1. The Ministry of Climate and Energy

The Ministry of Climate and Energy is leading authority responsible for national energy and climate policy.[65] The Ministry of Climate and Energy plays a crucial role in formulating and implementing national policies related to climate change and energy. This includes the development of strategies for renewable energy integration, energy efficiency, and the reduction of CO2 emissions.

In the context of GH2 implementation, the Ministry of Climate and Energy is responsible for defining Latvia's GH2 strategy and aligning it with EU goals. It involves drafting regulatory framework, coordinating with other governmental bodies, and facilitating initiatives that promote the GH2 production as part of Latvia's broader energy transition goals.

[65] Paragraph 1 of the Regulations of the Ministry of Climate and Energy.

3.3.2. The Ministry of Transport

The Ministry of Transport oversees Latvia's transportation infrastructure and policy, focusing on the development of a sustainable, efficient, and safe transport system. With the transportation sector being a significant contributor to CO2 emissions, the Ministry of Transport is actively seeking solutions to decarbonize transport modes, including the integration of alternative fuels such as GH2.[66]

In relation to GH2, the Ministry of Transport may be involved in planning and supporting the establishment of GH2 refuelling stations and the adoption of GH2 powered vehicles, particularly in public transportation. In addition, the Ministry of Transport is the responsible authority overseeing the aviation sector, where one of the key priorities is the use of sustainable, low-carbon fuels in air transport.

3.3.3. The Ministry of Smart Administration and Regional Development

The Ministry of Smart Administration and Regional Development is tasked with ensuring environmental protection and promoting balanced regional development across Latvia. The Ministry's responsibilities encompass developing policies related to nature conservation, regional development, municipality governance control, and spatial planning.[67]

Additionally, the Ministry of Environmental Protection and Regional Development collaborates with local governments and it could potentially facilitate integration of GH2 infrastructure into regional development plans, ensuring that such initiatives contribute positively to environmental sustainability and regional growth.

3.3.4. The Civil Aviation Agency

The Civil Aviation Agency or the State Agency "Civil Aviation Agency" Republic of Latvia is responsible for implementing national policy and governance in the use of the airspace of the Republic of Latvia and in the field of civil aviation. This includes overseeing the safety of civil aircraft operations, ensuring aviation security, and monitoring aircraft emissions to ensure compliance with environmental protection standards.

In recent years, the Civil Aviation Agency, within the scope of its competence, has actively contributed to the development of legislation at the EU level, including the introduction of requirements for SAF. Additionally, the Agency will be responsible for overseeing the use of alternative fuels to support the sustainable development of air transport, as well as conducting administrative proceedings in cases of non-compliance.

3.3.5. The Energy and Environmental Agency

The Energy and Environmental Agency was established on 1 February 2025 through the reorganization of the State Environmental Monitoring Bureau and the energy division of the State Construction Control Bureau. Operating under the supervision of the Ministry of Climate and Energy, EVA aims to streamline the implementation of renewable energy projects in Latvia, thereby creating a more attractive environment for investors.[68]

While specific details regarding the Energy and Environmental Agency's role in GH2 implementation are not explicitly outlined in the regulatory enactments, the agency's mandate to support renewable energy projects suggests that it may play a facilitative role in advancing GH2-related initiatives within the country.

3.3.6. The Ministry of Economics

The Ministry of Economics is responsible for fostering sustainable economic development and creating favourable conditions for innovation and investment in Latvia. Its core functions include developing policies related to industrial growth, energy transition, and regulatory oversight to support emerging technologies.

[66] Cabinet of Ministers Decree No 710 "On Transport Development Guidelines 2021-2027", adopted 21.10.2021.
[67] Paragraphs 1 and 3 of the Regulations of the Ministry of Smart Administration and Regional Development.
[68] Publicly available information about the Energy and Environmental Agency. Please see: https://www.eva.gov.lv/lv/par-mums.

The Ministry coordinates policy and regulatory frameworks to enable the development of GH2 production and storage facilities for aviation use. The Department of Construction Policy ensures that all projects comply with spatial planning and construction regulations, upholding necessary safety, environmental, and technical standards throughout implementation. Moreover, The State Construction Control Bureau, which is a public administration body under the supervision of the Ministry of Economics, is the national regulatory authority responsible for overseeing construction standards, safety, and compliance in infrastructure projects as well as administering energy policy. It ensures that construction activities adhere to legal, technical, and environmental requirements.

In conclusion, the absence of a clearly designated authority at the national policy-making level for overseeing GH2 development may create a gap in Latvia's energy transition framework. Nevertheless, in the context of hydrogen use in aviation, the Civil Aviation Agency serves as the responsible institution, ensuring a coordinated and effective approach to the implementation of SAF.

3.4. National Planning Documents and Strategies

The development of hydrogen use in the transport sector has been identified as one of Latvia's strategic objectives. A key goal of Latvia's Sustainable Development Strategy until 2030[69] is to ensure the country's energy independence by increasing self-sufficiency in energy resources and integrating into the EU energy networks. Achieving this goal includes promoting the use of renewable energy sources in the transport sector, including hydrogen-powered engines. Latvia's strategy for achieving climate neutrality by 2050[70] highlights the increasing role of hydrogen as an energy carrier, produced using electricity generated from renewable energy sources. Therefore, the focus is on strengthening the use of hydrogen specifically in the transport sector.

It should be noted that transport sector is one of the largest contributors to GHG emissions. To address this, the National Energy and Climate Plan[71] has set specific targets for reducing GHG emissions in the transport sector by 2030. As part of these efforts, support is planned for municipalities to acquire 20 hydrogen-powered public transport buses and install publicly accessible hydrogen refuelling points at two refuelling stations. Additionally, support programs are expected to be implemented to facilitate the purchase of medium- and heavy-duty vehicles for businesses, direct and indirect public administration institutions, promoting the transition to alternative fuels, including hydrogen. Moreover, draft Energy Strategy 2050[72] recognises a hydrogen as alternative to fossil fuels.

The establishment of the "Norsaf" SAF plant in Liepāja aligns with Latvia's national goals for energy independence and climate neutrality. This project supports the EU's strategy for increasing the use of SAF, with targets set for 2050. The development of SAF technology, which includes the use of GH2 and CO2 capture, complements Latvia's efforts to integrate hydrogen into its transport sector, contributing to the country's climate objectives and the broader EU Green Deal goals.

Furthermore, the National Energy and Climate Plan assigns the Ministry of Climate and Energy, the Ministry of Economics, and AS "Augstsprieguma tīkls" the task of developing an action plan for hydrogen infrastructure and market regulations by 2025. The objective is to complete Latvia's segment of the Northern-Baltic Hydrogen Corridor by 2035, as part of a collaborative effort involving six transmission system operators from Finland, Estonia, Latvia, Lithuania, Poland, and Germany. This initiative seeks to develop a cross-border, 100% hydrogen gas corridor, connecting Finland to Germany through the Baltic States and Poland.

With increasing investments in renewable electricity in Latvia, the near future may present opportunities for the export of GH2. This would involve projects such as the development of wind farms, electrolyser facilities, and hydrogen supply chains for various industries, including public transport, heating, and manufacturing. Additionally, within the renewable energy ecosystem, it is crucial to highlight potential investments and services

[69] Latvia's Sustainable Development Strategy until 2030. Available at: https://www.mk.gov.lv/lv/media/15129/download?attachment
[70] Latvia's strategy for achieving climate neutrality by 2050. Available at: https://likumi.lv/ta/id/342214
[71] National Energy and Climate Plan. Available at: https://likumi.lv/ta/id/353615
[72] Draft Energy Strategy 2050. Available at: https://ppdb.mk.gov.lv/wp-content/uploads/2025/02/projekts_kem-energetikas-strategija-2024.10.24.pdf

that Latvian ports can offer for the ELWIND offshore wind project and future offshore wind parks. The development of GH2 marks a significant step in global efforts to combat climate change, emphasizing Latvia's commitment to a cleaner, more sustainable future while creating new economic, environmental, and social opportunities.

However, achieving these goals will require developing expertise in net-zero emission technologies. Therefore, the National Energy and Climate Plan envisions the establishment of a Hydrogen Excellence Centre, which will focus on skills development, research, and the promotion of new competencies in line with net-zero emission technology regulations and academic frameworks.

In the light of above, Latvia's national planning documents and strategies include goals for implementing GH2, with a strong emphasis on its use in the transport sector. However, the potential GH2 use in airport operations is not addressed in these strategies. Thus, the establishment of a comprehensive hydrogen strategy appears necessary to ensure that all sectors, including aviation, are adequately addressed—specifically with regard to ground operations and the prospective use of hydrogen-powered aircraft.

3.5. Territorial Planning Aspects related to GH2 Production and Storage

Cabinet of Ministers Regulation No. 240 "General Regulations for Spatial Planning, Use, and Construction" sets out the general requirements for local-level spatial development planning and defines the permitted land use categories.

It should be noted that, at the level of Cabinet of Ministers regulations, neither the GH2 production facilities, nor the GH2 storage facilities are not directly included in any functional zoning as a permitted land use activity. This creates a regulatory challenge for establishing GH2 production at the airport, as it is not explicitly allowed.

Addressing this regulatory gap may involve, among other measures, a collaborative review within a working group involving the Ministry of Climate and Energy, the Ministry of Smart Administration and Regional Development, and municipalities to consider aligning the permitted land-use categories in industrial zones, as defined in Regulation No. 240, with the list of polluting activities. This alignment would meaningfully reflect the ongoing changes at the EU level, particularly in light of the amendments introduced by Directive 2024/1785, which expanded the list of regulated polluting activities to include hydrogen production via water electrolysis with a production capacity exceeding 50 tonnes per day.

Pending formal regulatory updates, following section will examine the spatial planning aspects related to the development of GH2 production and storage infrastructure in and around the Riga International Airport area.

3.5.1. GH2 Production and Storage within the airport

At the municipal level, the Mārupe Municipality Spatial Plan for 2014-2026 designates the area of Riga International Airport as a "transport infrastructure zone". Permitted uses within this area cover airport operations, including its infrastructure, airfield facilities, aircraft maintenance, navigation structures, freight terminals, and passenger stations for all transport modes. Additionally, roads, railways, and major transport connections such as bridges, tunnels, and viaducts fall within the allowed scope.

Beyond these core functions, Territorial Use and Construction Regulations of Mārupe Municipality allows for additional uses such as commercial and service facilities, office buildings, logistics hubs, defence and security institutions, parking areas, public outdoor spaces, and fuel stations. However, ancillary uses include engineering networks and infrastructure necessary for servicing the area.

Currently, industrial production or manufacturing facilities — such as those required for GH2 production — are not listed among the permitted uses in airport zones under the regulatory enactments, nor are they included in the municipality's spatial planning documents. This presents a regulatory obstacle to establishing GH2 production facilities at the airport, as such activity is not explicitly authorized at municipal level.

It should be emphasised that the new Mārupe Municipality Spatial Plan for 2024-2036 is still being developed, although the process of public consultation for the first version has concluded.[73] However, the newly proposed Mārupe Municipality Spatial Plan for 2024-2036 also restricts production or manufacturing activities within the territory of Riga International Airport.

Moreover, for GH2 production to be viable, access to nearby alternative electricity generation is essential. However, Territorial Use and Construction Regulations of Mārupe Municipality restricts the installation of wind turbines within the take-off and landing protection zone of Riga International Airport, limiting one of the key renewable energy sources. At the same time, the Mārupe Municipality Spatial Plan for 2024–2036 permits the installation of solar panels within the territory of Riga International Airport, but only for individual, non-commercial energy needs. As a result, the challenge lies not only in locating suitable sites for GH2 production facilities but also in securing a consistent and sufficient supply of alternative energy within the airport area.

Regarding the GH2 storage infrastructure, it may potentially be interpreted as permissible, provided it falls under the category of "engineering infrastructure" or "warehouse-type facilities", which are allowed within the transport infrastructure zone. Still, the regulations do not specify permissible storage volumes, leaving this aspect unaddressed.

The approach to regulating and supporting GH2-related activities should be tailored according to the scale of operations. In terms of production, there is a distinction between small-scale facilities that serve a single object or operator, and industrial-scale operations intended for commercial purposes. Similarly, storage activities vary by scale, ranging from small-scale installations such as GH2 refuelling stations to large-scale hydrogen storage facilities. Recognizing and addressing the differing technical, regulatory, and infrastructural needs of each category is essential for effective spatial planning implementation.

In the light of above, it is essential that Cabinet of Ministers regulations explicitly designate GH2 production and storage facilities as permitted land use activities within relevant functional zones. Additionally, amendments to the Mārupe Municipality Spatial Plan 2024-2036 are necessary to clearly allow GH2 storage facilities within Riga International Airport territory, with specific provisions based on the scale of operations.

3.5.2. GH2 Production and Storage near the airport

The territory of Riga International Airport is bordered by areas that, according to both the current Mārupe Municipality Spatial Plan for 2014–2026 and the newly proposed plan for 2024–2036, are designated as forest zones, mixed-use central development zones, and industrial building zones.

Pursuant to Cabinet of Ministers Regulation No. 240 "General Regulations for Spatial Planning, Use, and Construction" within these zones, municipalities may permit additional land uses, including public development and commercial facilities, such as fuel stations. Regulatory enactments should clearly define that fuel stations encompass alternative fuel refuelling stations, including those for GH2.

If alternative fuel stations would also be recognized under this category by analogy, it could open the possibility of hydrogen storage infrastructure being established near the airport territory.

Furthermore, in mixed-use central development area and industrial development zones, municipalities may permit the construction of light industry enterprises, including textile, apparel, leather goods, food production, furniture manufacturing, printing, industrial and technology parks, woodworking, and other light industries, provided they do not cause significant pollution.

To assess the feasibility of GH2 production near the airport territory, it is crucial to determine whether such production would be classified as significantly polluting, especially given its sustainable nature. If GH2 production is deemed to have minimal environmental impact, it could potentially be categorized as light industry.

[73] Teritorijas plānojums. Available at: https://marupe.lv/lv/marupes-novada-pasvaldiba/attistiba-un-planosana/teritorijas-planojums [accessed: 02.05.2025.]

However, this classification remains uncertain at this stage, as hydrogen is still considered a hazardous chemical substance, which may impose additional regulatory constraints.

Therefore, GH2 production's classification as "light industry" remains unclear due to hydrogen's hazardous substance status. This highlights the need for clear regulatory guidelines to define suitable locations for GH2 production facilities while ensuring compliance with safety and environmental standards.

To ensure legal clarity, regulatory acts should explicitly define fuel stations as including alternative fuel refuelling stations, such as those for GH2. In addition, the classification of GH2 production as "light industry" should be assessed within the regulatory framework. This would provide the basis for either amending the Mārupe Municipality Spatial Plan 2024–2036 or issuing a Detailed Plan to modify the permitted land use, thereby enabling GH2 production near Riga International Airport

3.6. Protection Zones Aspects related to GH2 Production within the Airport

Aeronautical navigation equipment is located within the territory of Riga International Airport. Consequently, there are designated near impact zones and far impact zones that define navigation equipment operational influence. The Civil Aviation Agency is responsible for ensuring compliance with the protection zone requirements surrounding these facilities.

First, Section 35 of the Protection Zones Law outlines the general restrictions applicable within designated protection zones. If a protection zone is established for the object, landowner or legal possessor has the right to undertake activities essential for its operation, maintenance, renovation, or reconstruction. Upon completion of the operation, maintenance, renovation, or reconstruction works, the landowner or legal possessor is responsible for restoring the land to a condition suitable for its intended purpose and compensating the landowner or legal possessor for any damages incurred.

Legal entities or individuals carrying out work within protection zones that require infrastructure safeguarding, modification, or relocation must coordinate these actions with the landowner or legal possessor. The financial responsibility for such activities lies with the responsible entity, unless otherwise agreed upon with the asset owner or operator.

Second, Section 50 of the Protection Zones Law establishes additional restrictions within protection zones surrounding navigational technical equipment. These include:

1) Prohibition on material storage, including animal feed, fertilizers, plant protection products, chemicals, chemical products, timber, and other substances, unless specifically designated for such use in territorial or local planning documents.
2) The establishment of waste disposal sites is not permitted.
3) Restrictions on construction and equipment installation that could interfere with the operation of navigational technical equipment.

In addition, Cabinet of Ministers Regulations No. 415 "Regulations on the methodology for establishing operational protection zones around civil aviation safety-related navigational technical equipment" specifies that work within the near impact zone of aeronautical equipment is permitted as long as it is not prohibited by the Protection Zones Law and has received approval from the owner or legal possessor of the equipment. If necessary, the owner, legal possessor, or an authorized representative may supervise the work.

An exception to this requirement applies in cases of rescue operations, emergency prevention, or mitigation activities, which may be conducted anywhere within the protection zone without prior approval. Additionally, Civil Aviation Agency inspectors are granted unrestricted access to the protection zone for inspection purposes. The owner or legal possessor of the aeronautical equipment must notify the Civil Aviation Agency of any emergency-related work performed within the zone.

Significant parts of airport territory are designated as short-range (up to 5 km) or long-range (5 – 15 km) impact zone for navigational technical equipment, which is crucial for ensuring aircraft operational safety. As a result, the construction of GH2 production and storage facilities within short-range impact zones may face significant restrictions.

Moreover, Section 30 and Section 32.2 of the Protection Zones Law must be consulted when a GH2 facility will be put in use or erected. For example, according to the Protection Zones Law 32.2, for gas pipelines constructed or rebuilt after 1 September 2002 with a pressure exceeding 1.6 megapascals, specific protection zones must be established based on the construction design calculations. However, these protection zones must not be less than 25 metres from the axis of such gas pipelines. A similar minimum protection zone of 25 metres also applies to areas surrounding filling stations and motor vehicle fuel dispensers, measured from both the tanks and the dispensers. It should be noted that operational structures and equipment related to the functioning of the filling station may be located within this area. Although this requirement primarily pertains to the transfer of oil products such as petrol and diesel fuel, it may serve as a useful point of reference and could be applied analogously to hydrogen-related infrastructure. Nonetheless, it does not carry binding legal authority in that context. Additionally, gas regulation and metering stations built or rebuilt after this date require a minimum protection zone of 100 metres surrounding the facilities to ensure safety and minimize risks associated with high-pressure gas infrastructure.

Therefore, when planning the construction and placement of GH2 production or storage facilities, it is important to take into account the short-range impact zones, where significant restrictions would apply. It is advisable to amend the relevant regulations to allow GH2 storage facilities to be situated within these.

3.7. Environmental and Safety Regulations regarding Hydrogen Production and Storage

3.7.1. Safety regulations

Safety regulations for hydrogen production or storage within the Riga International Airport territory must comply with both national and international aviation, environmental, and hazardous substance regulations.

Given the airport's strategic importance, strict safety measures are essential to prevent risks related to hydrogen's flammability and potential environmental impact. Compliance with ICAO safety standards and EASA regulations is required to mitigate risks to air traffic and airport operations.

Although EU and national aviation regulations mainly focus on ensuring aircraft safety, stringent security measures are enforced across all airport infrastructure to avoid operational disruptions. Nevertheless, there are currently no established guidelines for the safe integration of GH2 into airport operations.

Notably, Cabinet of Ministers Regulation of 19 September 2017 No. 563 "Procedures for Identifying and Determining Objects of Increased Danger, as well as for the Planning and Implementation of Civil Protection and Disaster Management" classifies hydrogen quantities above 1 tonne as hazardous substances, requiring storage sites to be designated as local objects of increased danger, with corresponding civil protection measures.

The Law On Technical Supervision of Dangerous Equipment lays down the rules for safe use and maintenance of dangerous equipment. Cabinet of Ministers Regulation of 7 November 2000 No. 384 "Regulations regarding Dangerous Equipment" defines dangerous equipment as equipment and stationary reservoirs holding over 2.5 m^3 of highly flammable gases, including hydrogen. However, the Cabinet on Ministers Regulation No. 384 has become invalid as of 2 June 2025, with no normative act replacing it. However, the Law On Technical Supervision of Dangerous Equipment has imposed a duty on the Cabinet of ministers to create new binding regulations regarding classification of dangerous equipment by 30 September 2027. Until new regulations are implemented, Cabinet of Ministers Regulation of 28 August 2001 No. 384 "Procedures for Technical Supervision of Reservoirs for Storage of Dangerous Substances" should be consulted regarding technical supervision.

These regulations highlight the essential requirement for comprehensive risk management when deploying GH2 infrastructure at the airport. Tailored guidelines to safely integrate GH2 activities while maintaining airport security and operational integrity would be necessary.

3.7.2. EIA procedure

When planning the construction and placement of infrastructure for hydrogen production and storage, it is essential to consider that Annex 1 of the Law on Environmental Impact Assessment lists specific projects that require an EIA. This process evaluates the potential environmental impact of a proposed activity or planning document and develops measures to prevent or mitigate negative effects. In cases where a project violates legal requirements, the assessment may result in the prohibition of the proposed activity.

Projects subject to EIA requirements include facilities for industrial production of organic and inorganic chemical substances involving multiple sequential chemical conversion processes. Since hydrogen (H_2) is classified as an inorganic chemical substance, hydrogen production facilities must undergo an EIA to ensure compliance with regulatory standards.

Regarding large-scale GH2 storage facilities, it should be noted that chemical product storage facilities with a total capacity of 20 000 tons or more are also subject to an EIA procedure. This requirement ensures that large-scale storage operations adhere to safety and environmental protection measures.

However, it would be necessary to amend the regulatory framework to specify that smaller-scale GH2 storage facilities may be subject to an initial EIA screening.

Therefore, both hydrogen production and storage will likely require compliance with EIA regulations to ensure adherence to legal standards and risk mitigation. It is recommended to clarify that smaller-scale GH2 storage facilities may be subject to an initial EIA screening.

3.7.3. Pollution permits

Pursuant to Paragraph 4(2)a) of the Law on Pollution, facilities for the production of inorganic substances (such as hydrogen) are required to obtain an A-category permit for polluting activities. It should be noted that the term “production” in the context of the Law on Pollution is understood as the chemical or biological processing of inorganic substances or groups of substances.

Additionally, if an A-category activity involves the use, production, or emission of hazardous chemicals that may contaminate soil and groundwater, the operator must prepare a baseline report. This report, along with the permit application and a summary of relevant information, must be submitted to the State Environmental Service.

The Law on Pollution currently does not specify permit requirements for GH2 production and storage. Given that GH2 production using renewable energy sources for water electrolysis does not generate significant pollution, there is a possibility that such a process may not be classified as a polluting activity. However, the current regulatory framework in Latvia lacks clarity regarding the classification of hydrogen production and storage.

To promote the development of hydrogen technologies and provide regulatory clarity for businesses, it is essential to review and refine the legal framework, particularly concerning the classification of GH2 production and storage and the procedure for issuing pollution permits.

3.7.4. Requirements for chemical substances

Considering that hydrogen is included in the European Chemicals Agency’s database[74] as a hazardous chemical substance, its production must also comply with the requirements of the Chemical Substances Law, in conjunction with EU regulatory legal acts. These regulations mandate the registration of chemical substances,

[74] Please see: https://echa.europa.eu/lv/substance-information/-/substanceinfo/100.014.187

provision of information and labelling, adherence to safety requirements, and limitations on activities involving hazardous substances.

Facilities involved in the production, use, management, or storage of hazardous substances could be classified as Category A or Category B (depending on the scale of the potential negative impact) high-risk sites. In accordance with Cabinet of Ministers Regulation No. 563 “Procedures for Identifying and Determining High-Risk Sites, as well as for Planning and Implementing Civil Protection and Disaster Management”, these sites must comply with strict safety requirements, including but not limited to controlled access to prevent unauthorized entry into hazardous substance storage areas. Additionally, storage equipment and packaging materials must be chemically compatible with the stored substances and resistant to degradation. Storage containers must be designed and constructed to withstand the specified usage and storage conditions, ensuring no leakage or loss of contents.

Consequently, hydrogen production must comply with the requirement for hazardous substances, ensuring proper registration, labelling, and safety measures. Depending on the potential risks, facilities handling hazardous substances may be classified as high-risk sites and must adhere to strict safety requirements.

3.7.5. Construction Regulations regarding Hydrogen Production and Storage

According to Annex 1 of the Cabinet of Ministers Regulation No. 500 "General Construction Regulations", industrial engineering structures (including chemical engineering structures) and tanks used for the storage, handling, or processing of gaseous substances with a construction volume exceeding 5000 m^3 are classified as third-group engineering structures. This represents the highest building category, indicating complexity in design, scale, or function, and therefore requiring a more stringent planning, documentation, and approval process.

Therefore, the construction of infrastructure related to hydrogen production and storage should comply with the requirements set out in the Construction Law and the General Construction Regulation.

Additionally, hydrogen production and storage infrastructure will likely fall under hazardous installations, particularly in cases where stationary tanks are used to store hazardous substances. According to fire safety regulations, any storage facility that holds easily flammable, explosive, or highly flammable liquids, gases, and their mixtures in quantities exceeding 2.5 m^3 qualifies as a hazardous installation. Given that hydrogen is classified as an extremely flammable gas, facilities involved in its production and storage will likely need to comply with the Law "On Technical Supervision of Dangerous Installations." This law governs the registration, inspection, supervision, and control of hazardous equipment, ensuring compliance with safety and technical requirements.

It should be noted that two Latvian construction standards have been developed for the construction of natural gas pipeline systems: Latvian Construction Standard LBN 241-15 "Internal Natural Gas Pipeline System" and the Regulations on Latvian Construction Standard LBN 242-15 "External Natural Gas Pipeline System." In contrast, there are currently no specific construction standards developed for GH2. Therefore, before implementing GH2 production or storage systems, it is important to establish construction standards that define the technical requirements for design, construction works, and commissioning. In addition, fire safety requirements should also be established, taking into account the explosion risks associated with GH2.

Given the increasing role of hydrogen in aviation, transport, and energy sectors, there is an evident need for Latvia to develop hydrogen-specific construction standards. A comprehensive review of existing construction laws and technical regulations is necessary to establish clear, hydrogen-adapted safety and engineering guidelines.

3.7.6. Liability in environmental protection

In accordance with Section 25(4) of the Environmental Protection Law, an operator is liable for environmental damage or the imminent threat thereof, regardless of fault, if such damage or threat arises from:

1) carrying out Category A or B polluting activities; or

2) the production, use, processing, packaging, release into the environment, or internal movement within the production facility of hazardous chemical substances or products.

This reflects the “polluter pays” principle, which is recognized in both international and national legislation. In the context of hydrogen production, an even higher standard of liability applies, meaning that the operator will be held responsible for any environmental damage, regardless of fault.

Therefore, this strict liability framework underscores the importance of preventative measures and risk management to ensure compliance with environmental protection standards.

3.7.7. Summary and conclusions on Latvian Regulations on Hydrogen Production

The regulatory landscape for hydrogen production and storage at Riga International Airport involves comprehensive oversight across safety, environmental, construction, and chemical handling domains. Due to hydrogen’s hazardous nature and flammability, its integration within airport operations must comply with both ICAO, EASA and national legal frameworks, including EIA, pollution permits, and construction regulations. Currently, there are gaps in established guidelines for integrating GH2 in airport contexts, particularly concerning small-scale storage, pollution classification, and technical construction standards, which require further clarification and development.

To support safe and efficient GH2 deployment, Latvia must update its regulatory framework to include tailored standards for hydrogen production, storage, and infrastructure construction. This includes developing hydrogen-specific safety protocols, construction norms, and fire safety rules while ensuring compliance with existing chemical substance regulations and liability laws. Clear and consistent regulation is essential for facilitating GH2 adoption, minimizing environmental risks, and maintaining operational integrity at critical infrastructure sites like airports.

3.8. Latvian Regulations on Hydrogen Transportation

3.8.1. Hydrogen Transportation via natural gas pipelines

Article 55 of the EU Directive 2024/1788 on common rules for the internal market in renewable gas, natural gas, and hydrogen mandates the development of a hydrogen roadmap. In accordance with this requirement, hydrogen transmission system operators must establish a 10-year roadmap, which must include comprehensive and detailed information on infrastructure that can be or is planned to be repurposed for hydrogen transportation, particularly for supplying hydrogen to end-users in hard-to-decarbonize sectors.

Since 2020, Latvia has maintained the position that existing natural gas distribution and management systems should be adapted for hydrogen transmission. Despite the fact that the transposition of the Directive is set until 2026, the Cabinet of Ministers of the Republic of Latvia has already approved (21.01.2025.) Cabinet of Ministers Regulation No.50 "Regulations on Requirements for the Injection of Liquefied Natural Gas, Gaseous Fuels Produced or Obtained from Renewable Energy Sources and Low-Carbon Gaseous Fuels into the Natural Gas Transmission and Distribution System". Under this regulation, specific rules have been established for injecting hydrogen into the natural gas transmission and distribution networks. Currently, the permitted concentration of hydrogen is limited to a maximum of 2 mol%. These measures enable hydrogen to be delivered to end-users through the existing natural gas infrastructure. Consequently, the Republic of Latvia has regulations in place that allow hydrogen to be supplied via natural gas infrastructure (pipelines), provided hydrogen concentration does not exceed 2 mol%.

In case of a decision to connect to the unified natural gas management and distribution system, it will be necessary to agree with the unified natural gas distribution and storage system operator on the connection. The same will also need to be done with regard to the distribution system operator and vice versa if they intend to connect to hydrogen storage.

Given that, according to the above-mentioned legislation, hydrogen can be transported using natural gas infrastructure, the safety and other regulations in force and related to natural gas pipeline infrastructure should also apply by analogy.

3.8.2. Hydrogen Transportation via road transport

Alternative methods for hydrogen delivery, such as road transport, are available. Given that hydrogen is classified as dangerous goods, compliance with the control, supervision, and liability regulations set out in the Law on the Movement of Dangerous Goods, Law on Carriage by Road, Cabinet of Ministers Regulation No.674 "Regulations on the Transport of Dangerous Goods" (Cabinet Regulation No.674) and many others are essential.

Law on the Movement of Dangerous Goods clarifies, that the movement of dangerous goods must comply with the requirements applicable to the movement of dangerous goods in international treaties (such as ADR), as well as in laws and regulations on road, rail, sea and air transport.

Besides international legislation, Cabinet Regulation No.674 specifies the procedures for international and national carriage of dangerous goods by road. Additionally, both international and national transport of dangerous goods must adhere to the European Agreement concerning the ADR, with the latest amendments having entered into force on 1 January 2023.

The aforementioned legislation stipulates specific requirements not only for vehicle operators but also for the vehicles themselves to be authorized for transporting dangerous goods, such as hydrogen. For instance, Section 7 of the Cabinet Regulation No.674 stipulates that for the transportation of dangerous goods, a driver's licence is required for vehicles intended for the transport of dangerous goods (except when the goods are transported in accordance with the provisions of subparagraph 1.1.3 of the ADR Agreement), but Section 9 of Cabinet Regulation No.674 stipulates that a certificate of conformity of the vehicle carrying the dangerous goods in accordance with the requirements of Chapter 9 of the ADR is required. These rules apply uniformly throughout the Republic of Latvia, covering all sectors, including the aviation sector, therefore vehicles transporting hydrogen in the airport area are also subject to these rules.

Despite the above, Vehicle inspection and transportation requirements within the airport area must be followed in accordance with requirements of the Aviation Security Regulation and the respective airport's internal guidelines.

3.9. Latvian Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

The current legislation in the Republic of Latvia does not establish specific regulatory requirements for hydrogen-powered vehicles or aircrafts. However, regulations governing hydrogen fuelling equipment are in force. Cabinet of Ministers Regulation No 78 “Requirements for electric vehicle charging, natural gas refuelling, hydrogen refuelling and shore-side electrical supply installations” lays down uniform requirements for electric vehicle charging, natural gas refuelling and hydrogen refuelling facilities. Inherently, all hydrogen refuelling equipment must comply with international standards such as - LVS ISO/TS 19880-1:2018; LVS ISO 14687-2:2018 and LVS EN ISO 17268:2012.

ISO 14687:2019 sets hydrogen fuel quality standards for PEM fuel cells in vehicles and stationary applications, ensuring high purity to prevent degradation and support reliability, particularly in airport operations for GSE and emerging hydrogen-powered aircraft. ISO 19880-1:2020 establishes safety and performance requirements for

GH2 refuelling stations, enabling standardized, secure infrastructure at airports for both GSE and aircraft, ensuring regulatory compliance, scalability, and safe hydrogen integration.

Besides aforementioned, hydrogen refuelling stations storing more than one tonne of hydrogen are classified as high-hazard facilities under Cabinet of Ministers Regulation No. 563 "Requirements for Electric Vehicle Charging, Natural Gas Filling, Hydrogen Filling, and Shore Power Supply Facilities." This regulation sets out essential safety requirements for such installations.

Moreover, while GH2 refuelling stations are not subject to the Protection Zone Law rules, the analogous rules of filling station protection zones could be applied to GH2 refuelling installations. In the Protection Zone Law, it is stated that the minimum width of the protection zone around filling stations and motor vehicle fuel dispensers should be at least 25 meters. However, a filling station is explicitly defined as only a refuelling installation for oil products (petrol and diesel fuel). A 25-meter minimum protection zone from tanks and filling installations is established also for motor vehicle gas filling stations. However, this also does not apply to GH2 refuelling stations. However, by analogy, a protection zone of no less than 25 meters should be required around a GH2 refuelling station. It would be recommended to also include fuelling points of GH2 and possibly other renewable fuels in the Protection Zone Law to remedy shortcomings in the law.

The owner of a high-hazard facility is required to take a number of measures as part of civil protection and disaster management planning, including, for example, identifying prevention, preparedness, response and recovery measures; developing a Civil Protection Plan; identifying the characteristics of hazardous substances and their safe location; marking the location of hazardous substances; designating responsible persons; and many others.

As already mentioned before, Section 6.7 of the TIAN stipulates that a petrol filling station may be provided as an additional use in the airport area. However, the above-mentioned regulation does not yet provide anything in relation to a hydrogen refuelling station, which would be required for airport vehicles and/or aircraft. Therefore, as it was mentioned before, to facilitate the implementation of GH2, it would be necessary to review the Cabinet of Ministers' regulations and assess the feasibility of GH2 storage within the airport territory. This could require conducting a comprehensive impact assessment and obtaining approval from the Civil Aviation Agency. In addition, it would also be necessary to develop clear regulatory guidelines and create infrastructure development incentives that align with aviation safety standards and sustainable energy goals.

3.9.1. Summary and conclusions on Latvian Regulations on Fuelling and Usage

The Republic of Latvia currently lacks specific regulatory requirements for hydrogen-powered vehicles and aircraft. However, hydrogen refuelling equipment is regulated under Cabinet of Ministers Regulation No. 78, which sets uniform requirements for refuelling stations. All hydrogen refuelling equipment must comply with international standards such as ISO 14687 and ISO 19880-1, ensuring fuel quality, safety, and infrastructure reliability, particularly in airport operations.

Hydrogen refuelling stations storing over one tonne of hydrogen are classified as high-hazard facilities under Cabinet of Ministers Regulation No. 563, requiring stringent safety measures and civil protection planning. While regulations allow petrol stations in airport areas, they do not yet address hydrogen refuelling stations for airport vehicles or aircraft. To implement GH2 fuelling stations in airport area, it is necessary to review existing regulations, conduct impact assessments, obtain Civil Aviation Agency approval, and establish clear regulatory guidelines and infrastructure incentives.

3.10. Key Findings of Sector-Specific Latvian Regulations

The regulatory framework for establishing GH2 production and storage at Riga International Airport faces several challenges due to existing zoning restrictions and unclear classifications. Currently, hydrogen production facilities are not explicitly permitted within airport zones under national or municipal territorial planning, complicating their legal establishment. While GH2 storage infrastructure may fall under permitted categories

such as engineering infrastructure or warehousing, there are no specific provisions for allowed storage volumes. GH2 refuelling stations appear to be permitted within the airport's transport infrastructure zone, yet broader renewable energy development—critical for GH2 production—is restricted, with Mārupe Municipality Spatial Plan for 2024–2036 (current draft version) only allowing solar panel use for personal, not commercial, energy supply.

Adjacent areas around the airport may offer more flexibility for GH2-related uses, but classification uncertainties—such as whether GH2 production qualifies as "light industry"—pose additional regulatory ambiguity. Hydrogen's classification as a hazardous chemical introduces strict compliance obligations related to safety, labelling, and civil protection, and depending on storage volumes, sites may be categorized as high-risk and subject to industrial risk management regulations. Moreover, both the production and storage of GH2 require the implementation of an Environmental Impact Assessment procedure and the receipt of approval for the intended activity. It should be noted that the Environmental Impact Assessment process is prolonged and complex, and may significantly extend the overall timeline for the implementation of the project.

Airport territory also includes navigational safety zones, which limit construction, and Latvia currently lacks specific construction standards for GH2 infrastructure, unlike natural gas systems. To enable GH2 development, regulatory reforms are needed, including a review of zoning restrictions, introduction of scale-based classifications for GH2 projects, and creation of clear, safety-aligned guidelines to streamline project approvals and support sustainable hydrogen integration in aviation infrastructure.

3.11. Identified Regulatory Gaps, Challenges and Roadblocks

Lack of explicit zoning provisions for hydrogen infrastructure

Neither GH2 production nor storage facilities are explicitly mentioned as permitted land uses in Cabinet of Ministers Regulation No. 240 "General Regulations for Spatial Planning, Use, and Construction". This creates a regulatory challenge for establishing GH2 production at the airport, as it is not explicitly allowed.

However, when creating or updating relevant zoning laws, Latvia should keep in mind future liquid hydrogen deployment, avoiding overly rigid frameworks that could inadvertently create barriers to liquid hydrogen infrastructure or operations in later stages of hydrogen market development.

Regulatory barriers in airport territory

The Mārupe Municipality Spatial Plan designates most of the territory of Riga International Airport as a "transport infrastructure zone" which does not explicitly permit industrial production or manufacturing facilities required for GH2 production, presenting a significant obstacle for establishing hydrogen infrastructure on-site.

Navigational safety zone restrictions

Significant parts of airport territory are designated as near impact zones and far impact zones for navigational technical equipment, which impose additional restrictions on construction activities, including potential GH2 facilities. Work within the near impact zone of aeronautical equipment is permitted as long as it is not prohibited by the Protection Zones Law and has received approval from the owner or legal possessor of the equipment

Energy source limitations for GH2 production

Current regulations restrict wind turbine installation within airport take-off and landing protection zones, while solar panels will be only permitted for individual, non-commercial energy needs, limiting renewable energy options for GH2 production.

Unclear classification of GH2 production activities

GH2 production's classification as "light industry" remains unclear due to hydrogen's hazardous substance status, affecting functional zones where such facilities can be located near airport territories.

Ambiguous regulatory framework for pollution permits

The Law on Pollution does not specify permit requirements for GH2 production and storage, creating uncertainty about whether water electrolysis for GH2 production would be classified as a polluting activity.

Absence of specific construction standards for hydrogen

Unlike natural gas pipeline systems which have established Latvian Construction Standards, there are no specific construction standards developed for GH2 infrastructure, creating technical regulatory gaps.

Lack of safety guidelines for hydrogen integration

There are currently no established guidelines for the safe integration of GH2 into airport operations, despite the need to comply with both aviation safety regulations and hazardous substance handling requirements. Moreover, delegated Cabinet of Ministers regulations regarding classification of dangerous equipment and safety rules will be adopted by 30 September 2027, most likely not much earlier.

3.12. Recommendations

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.

Responsible authorities:	Time of completion:
Mārupe Municipality	2026

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.

Responsible authorities:	Time of completion:
Civil Aviation Agency	2027

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.

The suggestion of the Ministry of Climate and Energy for further collaborative review in a working group involving the Ministry of Smart Administration and Regional Development and municipalities regarding the potential alignment of the permitted land-use categories in industrial zones should be pursued. It would be particularly important to ensure that polluted activities are aligned with EU level legal acts, such as Directive 2024/1785.

Responsible authorities:	Time of completion:
Ministry of Smart Administration and Regional Development, Ministry of Climate and Energy, municipalities	2027

Include GH2 refuelling stations in the protection zone law

Amend the Protection Zone Law to explicitly include GH2 refuelling stations, along with possibly other renewable fuel installations, within its scope. A minimum protection zone of no less than 25 meters should be

mandated around GH2 refuelling stations, analogous to the existing requirements for petrol, diesel, and natural gas filling stations.

Responsible authorities:	Time of completion:
Ministry of Smart Administration and Regional Development, Ministry of Economics	2027

Clarify GH2 production classification

Formally classify GH2 production through water electrolysis as a light industrial activity under Cabinet of Ministers Regulation No. 240 with minimal environmental impacts, despite hydrogen's status as a hazardous substance, enabling clearer zoning decisions.

Responsible authorities:	Time of completion:
Ministry of Climate and Energy	2026 - 2027

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. Align such changes with the requirements set out in Directive 2024/1785, which must be transposed in Latvian laws by 1 July 2026.

Responsible authorities:	Time of completion:
Ministry of Climate and Energy	2026 - 2027

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.

Responsible authorities:	Time of completion:
Ministry of Climate and Energy, Ministry of Economics	2026 - 2027

Expand renewable energy options in airport zones

Amend Mārupe Municipality Spatial Plan 2024-2036 to permit commercial-scale renewable energy installations within airport territories specifically for powering GH2 production.

Moreover, a connection to a renewable electricity grid in accordance with Article 3 or 4 of EU Regulation 2023/1184, can be pursued. That is, ensuring that the installation producing GH2 is located in an energy exchange bidding zone where the average proportion of renewable electricity has exceeded 90% in the previous calendar year or a connection to a renewable electricity source can be proven with direct connection to the renewable electricity source.

Responsible authorities:	Time of completion:
Ministry of Climate and Energy, Ministry of Smart Administration and Regional Development, Civil Aviation Agency	2026 - 2027

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.

Responsible authorities:	Time of completion:
Civil Aviation Agency, Ministry of Transport	2027

4.Republic of Lithuania

4.1. Executive Summary on Lithuanian National Legal and Regulatory Framework

The Republic of Lithuania stands at a pivotal moment in its pursuit of a carbon-neutral economy by 2050, with GH2 emerging as a critical enabler for decarbonizing its aviation sector. This report provides a comprehensive analysis of Lithuania's regulatory and institutional framework for integrating GH2 into aviation, with a particular focus on Vilnius Airport as a prospective hub for hydrogen infrastructure. Strategic initiatives, including the National Energy and Climate Plan 2021-2030, the Hydrogen Roadmap, and Lithuania's participation in the Baltic Hydrogen Corridor, demonstrate a strong national commitment to advancing hydrogen technologies within the broader energy transition. These efforts position Lithuania as an active participant in regional and EU decarbonization goals, yet the absence of a tailored regulatory framework for GH2 in aviation presents significant hurdles.

The current regulatory landscape in Lithuania relies on a patchwork of existing laws, such as the Law on Aviation, Law on Territorial Planning, Law on Environmental Protection, and various safety and energy regulations. While these, inter alia, provide a general foundation for managing energy and aviation activities, they lack specific provisions addressing the unique characteristics of hydrogen, including its flammability, storage requirements, and environmental implications. This regulatory gap creates uncertainty for stakeholders, particularly in areas like safety protocols, permitting processes, and territorial planning for hydrogen production and storage within or near airport boundaries. The complexity is further compounded by overlapping jurisdictions among multiple authorities, including the Ministry of Transport and Communications, Transport Competence Agency, Lithuanian Transport Safety Administration, and environmental regulators, leading to coordination challenges and potential delays in project approvals.

Key challenges identified in the report include the absence of hydrogen-specific safety standards for aviation applications, unclear EIA criteria tailored to GH2 projects, and a lack of funding mechanisms to incentivize airports to invest in costly hydrogen infrastructure. Territorial planning regulations pose additional obstacles, as there are no clear land-use classifications for hydrogen facilities within airport protection zones or adjacent municipal areas.

Despite these challenges, Lithuania's strategic alignment with EU decarbonization objectives and its proactive role in regional hydrogen initiatives provide a strong foundation for progress. To overcome the identified gaps, the report recommends the development of dedicated hydrogen legislation for aviation, the centralization of regulatory oversight under a single lead authority, and the enhancement of environmental and safety assessment frameworks to address hydrogen's unique risks. Introducing financial incentives, such as grants or public-private partnerships, is critical to encouraging investment in GH2 infrastructure at airports like Vilnius. Additionally, conducting technical evaluations of infrastructure compatibility will be essential to ensure safe and efficient deployment.

4.2. Introduction

Lithuania faces significant regulatory challenges in establishing a comprehensive framework for GH2 integration within its aviation sector. The current regulatory landscape represents a mixture of EU regulations, national legislation, and sectoral requirements that provide partial coverage but lack hydrogen-specific provisions essential for full-scale implementation. While Lithuania has demonstrated commitment to energy transition through key strategic initiatives – including the National Energy and Climate Plan 2021-2030, the Hydrogen

Roadmap, and participation in the Baltic Hydrogen Corridor – the regulatory framework remains incomplete for aviation applications.

Lithuania's approach primarily applies existing regulatory structures to hydrogen technologies without targeted provisions addressing their unique characteristics. This creates considerable uncertainty for stakeholders, particularly in areas such as territorial planning, safety protocols, and permitting processes. The complexity is heightened by the overlapping jurisdictions of multiple authorities, including the Ministry of Transport and Communications, Transport Competence Agency, Lithuanian Transport Safety Administration, and environmental regulators, all of which influence different aspects of hydrogen deployment in aviation contexts.

This report examines Lithuania's regulatory landscape for GH2 integration in aviation, focusing on key legislative instruments such as the Law on Aviation, Law on Territorial Planning, Law on Environmental Protection, and various safety regulations. The analysis explores the roles of principal statutory regulatory bodies that will shape hydrogen ecosystem development within Lithuanian airports, with particular attention to Vilnius Airport as a potential implementation site.

By identifying regulatory gaps in areas including hydrogen production within airport territories, transportation infrastructure, safety standards, and environmental assessment requirements, this assessment provides strategic insights for stakeholders navigating Lithuania's evolving regulatory environment. The findings reveal both opportunities for advancement within existing frameworks and critical areas requiring regulatory development to enable safe, efficient integration of hydrogen technologies in Lithuanian aviation.

4.3. Key National Regulatory Bodies

The development and integration of alternative fuels in Lithuania's transport sector, particularly in aviation, involve a complex interplay of institutional responsibilities. Various ministries, regulatory bodies, and agencies play critical roles in shaping policies, ensuring compliance, and overseeing safety and environmental standards.

This section outlines the key institutions involved, detailing their mandates and functions, among others, in fostering the adoption of alternative fuels, such as hydrogen, and supporting sustainable transport infrastructure. From strategic planning and regulatory oversight to safety enforcement and environmental protection, these entities collectively drive Lithuania’s transition toward a greener and more innovative energy landscape.

4.3.1. Ministry of Energy[75]

It is the main institution responsible for shaping and coordinating national policy in the field of alternative fuels used in transport. It prepares and coordinates the implementation of key strategic documents, such as the National Energy Independence Strategy, which sets goals for the development and integration of alternative fuels. The Ministry also submits proposals to the Lithuania’s Government regarding national targets for alternative fuel usage and performs other legally assigned functions in this field. Its regulatory role and strategic planning have a direct influence on the conditions for the development and application of alternative fuels.[76]

4.3.2. Ministry of Transport and Communications[77]

Ministry is responsible for shaping national policy for the development of alternative fuel infrastructure in the transport sector and coordinates its implementation. Ministry with the Ministry of Energy develops and approves the policy for the Development of Alternative Fuels Infrastructure, which sets strategic directions for projects such as hydrogen production and refuelling facilities. Furthermore, it establishes procedures for the

[75]Lithuanian Republic Ministry of Energy. Available at: https://enmin.lrv.lt/en/ [accessed: 03.04.2025.]
[76] Republic of Lithuania Alternative Fuels Law. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/0409c522915c11eb998483d0ae31615c/KUfLTlGINN [accessed: 09.04.2025.]
[77] Ministry Of Transport and Communications. Available at: https://sumin.lrv.lt/en/ [accessed: 03.04.2025.]

deployment of publicly accessible alternative fuel infrastructure. In addition, it coordinates the efforts made by state, municipal institutions and other stakeholders, to ensure consistent development.[78]

The Ministry also exercises aviation state governance according to its competence. It appoints the legal person that provides air traffic services, announces the airport where work is facilitated by scheduling or which is coordinated, sets the conditions and procedure for coordinating aircraft arrival and departure times at airports, and appoints the airport schedule coordinator or slot coordinator. Upon a proposal from the Lithuanian Transport Safety Administration, the Minister of Transport approves the state aviation safety programme and the national air transport facilitation programme. The Minister also establishes the procedure for the provision of ground handling services at airports and the approval of ground handling service providers and self-handlers.[79]

In addition, it is set to be the supervisory institution which oversees the use of transportation infrastructure and related engineering structures. It also involved assessing the design proposals for transport-related infrastructure, particularly those in protected or designated zones such as airports.[80] Also has competence in thew energy sector stated by Energy Law, without further clarifying specific aspects.[81]

4.3.3. Ministry of the Environment[82]

It is responsible for setting the rules related to the calculation of greenhouse gas emissions, including those from the production and use of various fuels such as biofuels, bioliquids, and fossil fuel comparators. It also defines environmental protection conditions for the use of biofuels and liquid bioproducts. These functions may influence regulatory frameworks applicable to fuel alternatives used at airports, as similar methodologies or environmental standards could be extended or adapted to emerging fuel types.[83] Also has a competence in the energy sector stated by Energy Law, without further clarifying specific aspects.[84]

4.3.4. National Energy Regulatory Council[85]

It is an independent national regulatory authority regulating activities of entities in the field of energy and carrying out the supervision of state energy sector.

Plays a key role in energy regulation, including potential hydrogen-related initiatives at airports. It has main functions in attesting energy workers, which could be relevant for certifying personnel handling hydrogen production or fuel systems. While the exact scope of responsibilities is not detailed, its regulatory authority in energy suggests it may oversee safety, compliance, or workforce standards.[86]

Council supervises and controls whether fuel and natural gas suppliers meet the obligations set out in “energy” legislation, including through physical inspections. In addition, it establishes procedures for evaluating the fulfilment of these regulatory requirements and has the authority to impose fines for non-compliance. These regulatory functions are relevant in the context of introducing new fuel types at airports, as the Council's oversight may extend to the supply, inspection, and compliance assessment of such energy carriers.[87]

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[78] Republic of Lithuania Alternative Fuels Law, Article 6. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/0409c522915c11eb998483d0ae31615c/KUfLTlGINN [accessed: 09.04.2025.]
[79] Aviation Law, Article 4. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.112075/asr?positionInSearchResults=20&searchModelUUID=3fa67fc8-4489-4f0f-a3e9-a2032f20d0b8 [accessed: 03.04.2025.]
[80] Construction Law of the Republic of Lithuania, Article 27^1. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.26250/asr [accessed: 09.04.2025.]
[81] Energy Law of the Republic of Lithuania, Article 4. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.167899/asr [accessed: 09.04.2025.]
[82] Ministry of environment of the republic of Lithuania. Available at: https://am.lrv.lt/en/ [accessed: 09.04.2025.]
[83] Republic of Lithuania Alternative Fuels Law, Article 7. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/0409c522915c11eb998483d0ae31615c/KUfLTlGINN [accessed: 09.04.2025.]
[84] Energy Law of the Republic of Lithuania, Article 4. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.167899/asr [accessed: 09.04.2025.]
[85] National Energy Regulatory Council. Available at: https://www.vert.lt/en/Pages/about-us/about-ncc.aspx [accessed: 03.04.2025.]
[86] Energy Law of the Republic of Lithuania, Article 28. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.167899/asr [accessed: 09.04.2025.]
[87] Republic of Lithuania Alternative Fuels Law, Article 11. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/0409c522915c11eb998483d0ae31615c/KUfLTlGINN [accessed: 09.04.2025.]

Also, by executing its functions and duties within Lithuania's natural gas sector, the Council in cooperation with the Competition Council and other institutions and agencies strive to ensure a competitive, secure, and sustainable market. It oversees licensing, pricing, infrastructure reliability, and renewable energy integration while enforcing transparency and consumer protection. Its regulatory framework - covering technical standards, market access, and compliance - could facilitate the adoption of new energy technologies by ensuring efficient and safe integration into existing systems.[88]

Under the Law on Construction of the Republic of Lithuania it is assigned supervision the use of energy - related structures, particularly ensuring their compliance with energy safety and technical standards. It reviews design proposals for new or reconstructed energy infrastructure to ensure conformity with applicable regulations. It also plays a role in overseeing the maintenance of these structures.[89]

4.3.5. Environmental Protection Agency[90]

The Agency, through its departments assesses emissions of greenhouse gases, air and water pollutants, and waste management, alongside evaluating the impact of policies and economic activities on the environment. Additionally, the Agency's broader scope involves advising institutions, businesses, and the public through data-driven recommendations and interactive tools to visualize environmental trends. It also works by addressing environmental economics and policy, such as EU directive implementation, funding strategies, and cross-border projects in water and marine sectors.[91]

4.3.6. Environmental Protection Department

This department operates under the Ministry of Environment conducts state environmental control functions under the Law on State Control of Environmental Protection. It identifies violations of IPPC and pollution permit conditions, such as exceeding pollution standards, improper waste handling, or illegal resource use. If three violations occur within 12 months, or a violation persists beyond six months (unless a longer correction period is specified), it can trigger permit revocation, except when revocation would harm public interests like water, heat, or waste management services. For VOC installations, it monitors compliance and can initiate deregistration for repeated or unresolved violations.[92]

4.3.7. Transport Competence Agency[93]

To create a professional, innovative, business-oriented aviation surveillance system, the Civil Aviation Administration was restructured by transferring its functions to two other sector bodies – Lithuanian Transport Safety Administration and Transport Competence Agency. The activities of Transport Competence Agency cover the following areas: licensing of specialists and supervision of their activities; the oversight, accreditation and licensing of aviation sector; planning of transport communications; transport monitoring and research. The purpose of the activity of Competence Agency is to contribute to the development of the public transport system in Lithuania and the supervision and development of the use of state resources allocated to it, ensuring the highest standards of quality, safety and security.

It oversees aviation safety, including ground equipment and services, which would cover hydrogen storage, handling, and refuelling systems at airports. The Agency sets technical requirements and procedures, so it could establish safety standards for hydrogen use, ensuring they align with EU regulations and the Chicago Convention. It also issues certificates and permits, meaning it could possibly be the one to certify hydrogen production facilities or equipment and approve specialists trained to work with hydrogen. Agency works with airport-managing companies to designate restricted zones, which could include areas for hydrogen production

[88] Republic of Lithuania Natural Gas Law, Article 6-8. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.111558/asr [accessed: 09.04.2025.]
[89] Construction Law of the Republic of Lithuania. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.26250/asr [accessed: 09.04.2025.]
[90] Environmental Protection Agency. Available at: https://aaa.lrv.lt/lt/ [accessed: 03.04.2025.]
[91] Environmental Protection Agency. Available at: https://aaa.lrv.lt/lt/ [accessed: 03.04.2025.]
[92] Environmental Protection Law of the Republic of Lithuania. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.2493/asr [14.04.2025.]
[93] About Transport Competence Agency. Available at: https://tka.lt/en/about-transport-competence-agency/ [accessed:03.04.2025.]

or storage to keep them secure. With its power to inspect premises and equipment, the Agency could regularly check hydrogen-related operations to ensure they are safe and compliant.[94]

4.3.8. Lithuanian Transport Safety Administration[95]

It is the national safety agency of railway, road, civil aviation and water transport. LTSA is working to achieve high quality, secure and environmentally aware transport system within Lithuania.

4.3.9. The Fire and Rescue Department

Besides organizing firefighting and rescue operations, overseeing state fire supervision, and adopting legal acts on fire safety, it also sets minimum requirements for fire safety training programs, approves training procedures for responsible personnel, and establishes inspection processes to ensure facilities comply with fire safety laws.[96]

4.3.10. State Labour Inspectorate[97]

The State Labour Inspectorate oversees occupational safety, health, and labour relations, ensuring compliance with legal requirements in workplaces, including risk assessments and accident investigations. It enforces work safety standards, conducting inspections, and issuing fines for violations. The Inspectorate also reviews workplace hazards, investigates incidents, and evaluates safety training programs, which may apply to GH2 infrastructure service staff. Additionally, it coordinates with other institutions and social partners, facilitating regulatory alignment for new technologies. Its authority to halt unsafe operations or impose penalties in the cases prescribed by law ensures adherence to labour and safety laws. Law on Safety and Health at Work of the Republic of Lithuania also mentions establishment of territorial and sectoral labour safety and health commissions for the purpose of the investigation of the issues related to prevention of violations of safety and health at work requirements in undertakings.

In enterprises operating in sectors with potential occupational risks, such as those involving new energy technologies, employers are required to ensure structured employee participation in occupational safety and health matters. This includes establishing safety and health committees where employee representatives take part in assessing risks, selecting safety measures, and investigating incidents. These representatives are elected by the workforce and have the right to propose and monitor preventive actions, as well as to receive necessary training and information.[98]

4.4. National Planning Documents and Strategies

The development of hydrogen use in Lithuania's transport sector is a critical component of the country's strategy to achieve its climate and energy goals.

The Guidelines for Hydrogen Development in Lithuania 2024–2050 approved by the order of the Minister of Energy of the Republic of Lithuania of 26 April 2024 establish the directions for the creation of GH2 ecosystem and infrastructure development within Lithuania. The Guidelines delineate two phases: up to 2030 and up to 2050 – measures for establishing Lithuania's GH2 ecosystem and infrastructure are planned until 2030, while development directions are set until 2050. The Guidelines outline a vision for hydrogen development until 2050, aiming for Lithuania to become a leader in the Baltic Sea region in the production and export of GH2.

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[94] Aviation Law of the Republic of Lithuania, Article 2. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.112075/asr?positionInSearchResults=20&searchModelUUID=3fa67fc8-4489-4f0f-a3e9-a2032f20d0b8 [accessed: 03.04.2025.]

[95] Lithuanian Transport Safety Administration. Available at: https://ltsa.lrv.lt/en/about-ltsa/ [accessed: 03.04.2025.]

[96] Fire Safety Law of the Republic of Lithuania. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.197461/asr [accessed: 09.04.2025.]

[97] State Labour Inspectorate of the Republic of Lithuania. Available at: https://vdi.lrv.lt/en/about-state-labour-inspectorate/ [accessed: 09.04.2025.]

[98] Republic of Lithuania Worker Safety and Health Law, Article 12, 13. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.215253/asr [accessed: 09.04.2025.]

The Guidelines primarily regulate the energy, transport, and industry sectors by promoting GH2 as a means to reduce fossil fuel dependence, stabilize energy systems, and decarbonize industrial processes. They envision a supportive legal framework governing hydrogen production, transportation, storage, and utilization, including safety standards. The Guidelines also encompass the development of necessary infrastructure, such as expanded production capacities, transportation networks (pipelines and refuelling stations), hydrogen storage solutions, and the establishment of hydrogen valleys. Furthermore, they anticipate fostering innovative hydrogen technology development and cultivating expertise throughout the hydrogen value chain.

Lithuania's strategy for hydrogen and carbon dioxide infrastructure development focuses on establishing transportation routes, primarily via a planned Finland-Germany pipeline, and exploring the near-term blending of hydrogen into existing natural gas networks. Adaptations of current gas infrastructure for hydrogen are under assessment, alongside participation in a broader European hydrogen corridor initiative. Storage solutions under consideration include geological repositories and synthetic methane conversion.

Regarding aviation sector, the Guidelines foresee that a broader demand for synthetic green fuels in air transport is anticipated from 2030 onwards, coinciding with the implementation of EU requirements. Regulation (EU) 2023/2405 mandates that aviation fuel suppliers ensure a minimum mandatory proportion of SAF is blended into all fuels supplied to aircraft operators at EU airports from 2025, with a minimum mandatory proportion of synthetic aviation fuels to be introduced from 2030, these proportions increasing incrementally until 2050. This obligatory utilization of synthetic green fuels will establish an initial demand and create the preconditions for investment in their production. By fostering favourable conditions for the production of synthetic green fuels, Lithuania possesses the potential to manufacture the entirety of synthetic green fuel requirements for the aviation sector across the Baltic States.

Overall, the Guidelines stipulate specific objectives to be achieved by 2030 and provide forecasts regarding the demand for GH2 and the electricity requirements for its production until 2050. The document underscores the priority of GH2 produced from domestic renewable energy sources.

Lithuania's NECP 2021-2030[99] outlines the country's commitment to a carbon-neutral economy by 2050. The plan emphasizes the transition to renewable energy sources, energy efficiency improvements, and the adoption of cleaner fuels, such as hydrogen. The transport sector, a significant source of greenhouse gas emissions, is a primary focus in the NECP, which includes strategies for decarbonizing transport through the use of alternative fuels like hydrogen.

Aligned with this, Lithuania's Hydrogen Roadmap[100] sets out the framework for integrating hydrogen into the national energy system by 2030. The roadmap positions Lithuania as an active participant in the EU-wide hydrogen transition, identifying GH2 as a key enabler of decarbonization. It also highlights Lithuania's role in regional initiatives such as the Baltic Hydrogen Corridor[101], a cross-border project aimed at connecting the Baltic States with Finland and Germany. This hydrogen infrastructure will enable the efficient transportation of GH2, linking Lithuania to broader European markets and contributing to the decarbonization of both the industrial and transport sectors.

Lithuania's National Climate Change Management Agenda[102] also emphasizes the importance of hydrogen in the country's long-term climate strategy. By 2050, Lithuania aims to achieve carbon neutrality, and hydrogen is seen as an essential tool for decarbonizing sectors that are difficult to electrify, such as transport and heavy industry. The Agenda encourages the development of renewable hydrogen production, which is expected to play a major role in reducing Lithuania's carbon footprint.

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[99] National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030. Available at: https://energy.ec.europa.eu/system/files/2022-08/lt_final_necp_main_en.pdf [accessed: 07.04.2025.]

[100] Lithuanian Hydrogen Sector Development Roadmap and the Action Plan for its implementation. Available at: https://enmin.lrv.lt/uploads/enmin/documents/files/AmberGrid_Lithuania_Hydrogen_Strategy_v2_0_110522.pdf [accessed: 07.04.2025.]

[101] Please see: https://ambergrid.lt/en/green-gas/hydrogen/nordic-baltic-hydrogen-corridor-project/967 [accessed: 07.04.2025.]

[102] Republic of Lithuania. Lithuania's National Climate Change Management Agenda approved by the Parliament of the Republic of Lithuania (Seimas), by Resolution No. XIV-490 of 30 June 2021. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/219a2632a6b311ecaf79c2120caf5094?jfwid=-56ckr0gcc [accessed 24.04.2025.]

Lithuania's Law on Energy from Renewable Sources[103] provides a legal framework that promotes the use of renewable energy, including hydrogen. The law encourages investments in renewable energy production, which is vital for producing GH2 in Lithuania. In addition, the National Energy Independence Strategy[104] aligns with these goals, positioning hydrogen as a key element of Lithuania's energy transition, which is designed to reduce the country's dependence on fossil fuels and enhance energy security.

4.5. Territorial Planning Aspects related to GH2 Production and Storage

In Lithuania, territorial planning for GH2 production and storage is primarily governed by the Law on Territorial Planning,[105] which provides the legal framework for land use, urban development, and infrastructure planning across the country. Although there is no specific designation for hydrogen-related projects as nationally significant, such infrastructure may be incorporated into national, county, or municipal planning documents, aligning with Lithuania's strategic energy and climate policy objectives.

The development of GH2 facilities must also adhere to land use provisions under the Law on Land[106], which governs the classification, use, and protection of land resources, and emphasizes sustainable development and environmental stewardship.

However, given the absence of a dedicated regulatory framework for GH_2 infrastructure within airport territories or similar high-restriction zones, this analysis will explore general planning principles, identify key legal uncertainties, and highlight regulatory gaps that may necessitate future legislative clarification to support hydrogen deployment, particularly in the aviation and transport sectors.

4.5.1. GH2 Production and Storage within the Airport

Integrating GH2 production and storage within airport boundaries in Lithuania requires compliance with a range of laws ensuring safety, security, and environmental protection.

At the core of airport operations is the Law on Aviation,[107] which sets the groundwork for any development within airport zones. This law ensures that any infrastructure, including energy facilities like hydrogen production, adheres to strict safety standards and does not interfere with aviation activities. For GH_2 facilities, this means complying with regulations that prioritize the safety of flight operations, airspace management, and the safe handling of potentially hazardous materials like hydrogen.

Beyond aviation, the broader energy context is addressed through the Law on Energy[108] and the Law on Renewable Energy Sources[109]. These laws create a supportive framework for hydrogen as a renewable energy source, promoting its development in line with national energy goals. Under these laws, hydrogen production facilities are provided with a legal basis for licensing, operational standards, and integration into the country's energy grid, positioning hydrogen as part of Lithuania's clean energy future.

Environmental risks are addressed under the Law on Environmental Impact Assessment of the Proposed Economic Activity,[110] which may require an impact assessment for hydrogen projects, particularly in sensitive

[103] Republic of Lithuania Law on Energy from Renewable Sources. Available at: XI-1375 Lietuvos Respublikos atsinaujinančių išteklių energetikos įstatymas [accessed: 07.04.2025.]
[104] Republic of Lithuania, National Energy Independence Strategy. Available at: NENS-EM-leidinys.pdf [accessed: 07.04.2025.]
[105] Republic of Lithuania Law on Territorial Planning. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/dde75b13095011e78dacb175b73de379?jfwid [accessed: 07.04.2025.]
[106] Republic of Lithuania Law on Land. Available at: https://e-seimas.lrs.lt/portal/legalActPrint/lt?jfwid=-kyrux7oi1&documentId=TAIS.170701&category=TAD [accessed: 07.04.2025.]
[107] Republic of Lithuania Law on Aviation. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.226273?jfwid= [accessed: 07.04.2025.]
[108] Republic of Lithuania Law on Energy. Available at: https://faolex.fao.org/docs/pdf/lit72280E.pdf [accessed: 07.04.2025.]
[109] Republic of Lithuania Law on Energy from Renewable Sources. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/648259603c3b11e68f278e2f1841c088 [accessed: 07.04.2025.]
[110] Republic of Lithuania Law on Environmental Impact Assessment of the Proposed Economic Activity. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/97e1a98200d711ecb4af84e751d2e0c9?jfwid=11wjp6hpi4 [accessed: 07.04.2025.]

airport environments. The Law on Land[111] as well as Law on Special Land Use Conditions[112] governs land use, including special conditions for airport zones, ensuring that any energy infrastructure, including hydrogen facilities, is appropriately sited and does not conflict with other airport operations.

However, the current legal framework lacks specific guidelines for hydrogen infrastructure within airports. This gap creates uncertainty and complicates the approval process, requiring more targeted regulations.

4.5.2. GH2 Production and Storage near the airport

When considering the development of hydrogen production and storage facilities near Vilnius Airport, several key regulatory factors come into play, shaped by the proximity to the airport and its surrounding environment. The framework governing this development is influenced by territorial planning, aviation safety, energy regulations, and land ownership considerations.

The surrounding areas of Vilnius Airport are regulated by municipal spatial plans, which designate land for various purposes such as:

- transport infrastructure;
- logistics;
- industrial; and
- potentially protected zones.

Land-use regulations[113] emphasize the proper designation of areas for specific activities. GH2 storage might be permissible within designated logistics or industrial zones, especially if aligned with airport-related infrastructure like refuelling systems. However, GH2 production, particularly when it involves electrolysis or other energy-intensive processes, could face regulatory challenges since it may not be explicitly listed as a permitted use in these zones. In this case, amendments to zoning regulations or clearer classifications for hydrogen infrastructure would likely be necessary.

The proximity of the proposed facilities to the airport also introduces aviation safety concerns. Aviation regulations[114] impose strict limitations on certain types of infrastructure within the airport's protection zone to ensure that they do not interfere with aviation operations. This includes considerations such as flight paths, aircraft movement areas, and general airport safety zones. Given the potential hazards associated with hydrogen storage and production, any GH2 facility near the airport must undergo thorough safety evaluations, with close coordination with the Transport Safety Administration to assess and mitigate any risks to aviation safety.

Another important consideration is the environmental impact of locating GH2 production and storage facilities near Vilnius Airport. The EIA would evaluate the potential effects of the facility on the surrounding environment, including risks related to hydrogen storage, noise pollution, air quality, and traffic. Given the proximity to both an urban environment and an airport, the EIA would need to assess not only the direct impact on the airport's operations but also on surrounding residential and commercial areas, ensuring that any development aligns with environmental protection standards.

Energy regulations[115] also play a crucial role in the development of GH2 facilities near Vilnius Airport. These regulations govern energy infrastructure development and the integration of renewable energy sources, such as wind or solar, for hydrogen production. If the GH2 production facility utilizes renewable energy, compliance with these laws is essential, especially regarding technical safety standards, energy supply security, and grid

[111] Republic of Lithuania Law on Land. Available at: https://e-seimas.lrs.lt/portal/legalActPrint/lt?jfwid=-kyrux7oi1&documentId=TAIS.170701&category=TAD [accessed: 07.04.2025.]
[112] The Law on Special Land Use Conditions. Available at: XIII-2166 Lietuvos Respublikos specialiųjų žemės naudojimo sąlygų įstatymas
[113] Republic of Lithuania Law on Land. Available at: https://e-seimas.lrs.lt/portal/legalActPrint/lt?jfwid=-kyrux7oi1&documentId=TAIS.170701&category=TAD [accessed: 07.04.2025.]
[114] Republic of Lithuania Law on Aviation. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.226273?jfwid= [accessed: 07.04.2025.]
[115] Republic of Lithuania Law on Energy from Renewable Sources. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/648259603c3b11e68f278e2f1841c088 [accessed: 07.04.2025.]; Republic of Lithuania Law on Energy. Available at: https://faolex.fao.org/docs/pdf/lit72280E.pdf [accessed: 07.04.2025.]

integration. Furthermore, the regulation of energy efficiency would be crucial, especially when connecting the facility to the national energy grid.

Finally, land ownership and rights present a significant aspect of developing GH_2 infrastructure near the airport. Land transactions and usage would be essential for acquiring or leasing land for the project. If the land is privately owned, the development would require negotiations for purchase or lease agreements, while if it is state-owned, the regulations for state land allotment would apply. Additionally, land servitudes or easements might be necessary if infrastructure such as pipelines needs to be installed to connect the GH2 facility to the airport. The process of acquiring land or establishing necessary legal rights could be complex, particularly in a strategically important location near an airport.

The development of GH_2 production and storage near Vilnius Airport requires careful navigation of land-use regulations, aviation safety standards, environmental assessments, energy laws, and land ownership rights. The proximity to the airport introduces unique challenges, but with appropriate coordination between national, regional, and local authorities, as well as adherence to safety and environmental guidelines, the development of such facilities could be successfully realized.

4.6. Protection Zones Aspects related to GH2 Production within the Airport

When Planning the Construction of a Hydrogen Refuelling Station or Hydrogen Storage Facility within an Airport Area, it is necessary to Consider the provisions set forth in the Law on Special Land Use Conditions of the Republic of Lithuania. These provisions apply within aerodrome protection zones and aerodrome noise protection zones.

According to the aforementioned law, aerodrome protection zones are established for both civil and military aerodromes. These zones are determined based on the distance from the runway, taking into account the technical characteristics of the aerodrome. Special territorial planning and construction restrictions apply within these zones.

In accordance with the law, it is prohibited to construct or reconstruct buildings and installations regardless of height or purpose within aerodrome protection zones without prior coordination with the Transport Competence Agency (for civil aerodromes) or the Commander of the Lithuanian Armed Forces (for military aerodromes). Additionally, building height is restricted depending on the location within the protection zone. The competent authority may withhold consent for planned activities if they pose a threat to flight safety or may negatively affect the functioning of communication, navigation, or surveillance systems.

Furthermore, specific restrictions apply in aerodrome protection zones with regard to building purposes and land use. Within these zones, it is prohibited to construct buildings designated for residential, recreational, healthcare, educational, training, or other similar purposes. It is also prohibited to install premises of such purposes within reconstructed or repurposed buildings of other designations, to change the purpose of existing buildings or premises to the aforementioned uses, or to designate areas for recreational facilities, except where such facilities are directly related to the functions of the aerodrome operator or the operation of the airport.

Accordingly, any economic activity within aerodrome protection and/or noise protection zones, including the construction of hydrogen refuelling stations or storage facilities, may only be carried out with the approval of the relevant authority (the Transport Competence Agency or the Commander of the Lithuanian Armed Forces) and in compliance with applicable regulations. These areas are classified as aerodrome protection zones; therefore, prior to initiating the design phase, all applicable restrictions must be carefully assessed.

4.7. Environmental and Safety Regulations regarding Hydrogen Production and Storage

4.7.1. Safety Regulations

The implementation of GH2 in Lithuanian airports for aviation purposes must navigate a complex and currently incomplete safety regulatory landscape. Although hydrogen is not yet explicitly regulated in national aviation laws, several general safety frameworks provide partial coverage. Key among these are the Law on Fire Safety116, the Law on Crisis Management and Civil Protection[117], the Aviation Law[118] of the Republic of Lithuania, and regulations on industrial accidents involving dangerous substances. These legal acts, together with international and EU-level aviation safety standards—such as EASA requirements, ICAO provisions, ADR, and Regulation (EU) No 139/2014—form the baseline for risk management related to GH2.

Hydrogen's classification as a highly flammable and potentially explosive gas places it under strict fire safety and accident prevention scrutiny. The Law on Fire Safety requires fire prevention systems and procedures to be in place wherever flammable substances are used or stored. Accordingly, the storage and refuelling of GH2 at airports would trigger a need for extensive fire safety infrastructure and emergency response planning.

A significant challenge arises from the lack of GH2-specific rules in the Lithuanian Aviation Law. Current provisions do not clearly address the use, transport, or storage of hydrogen within airport infrastructure or onboard aircraft. Moreover, Article 36 prohibits the carriage of dangerous goods unless specific exemptions apply, potentially complicating any attempts to integrate hydrogen as a fuel source. While Regulation (EU) No 139/2014 lays out certification and operational requirements for aerodromes, it does not yet fully reflect the integration of hydrogen-based technologies, leaving regulatory gaps at both the national and EU levels.

In summary, while there is a foundational legal framework to build upon, Lithuania currently lacks specific safety regulations tailored to GH2 in the aviation sector. This regulatory gap, particularly in aviation-specific hydrogen handling and accident prevention measures, represents a roadblock that may delay or complicate deployment.

4.7.2. EIA Procedure

According to the Law on Environmental Impact Assessment of Proposed Economic Activity of the Republic of Lithuania, EIA must be carried out when the proposed activity is likely to have a significant impact on the environment. The purpose of the EIA is to determine the potential environmental impact of the proposed activity, assess it, and propose measures to reduce or avoid the impact. It is important to note that if hydrogen production is planned, an EIA is mandatory regardless of the scale of production.

In cases where the activity is not included in the list of activities subject to mandatory EIA, a screening procedure applies. The purpose of this procedure is to determine whether, under specific circumstances, the proposed activity may nonetheless have a significant environmental impact. For hydrogen refuelling stations and storage facilities, the decision on whether an EIA or screening is required depends on the planned quantities, the scale of activity, and the environmental sensitivity of the site. If certain thresholds are exceeded (as established under the provisions of the Seveso III Directive, transposed into Lithuanian law through the regulation of chemical accident prevention), the facility may be classified as a lower-tier or upper-tier establishment, resulting in stricter regulatory requirements.

[116] Republic of Lithuania Law on Fire Safety. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.403202?jfwid=32wf9xll [accessed: 03.04.2025.]
[117] Republic of Lithuania Law on Crisis Management and Civil Protection. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.69957/asr [accessed: 03.04.2025.]
[118] Aviation Law of the Republic of Lithuania. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.112075/asr?positionInSearchResults=20&searchModelUUID=3fa67fc8-4489-4f0f-a3e9-a2032f20d0b8 [accessed: 03.04.2025.]

Meanwhile, the Strategic Environmental Assessment applies not to individual projects, but to territorial planning documents, such as special or detailed plans that foresee economic activities likely to have significant environmental or public health impacts, such as, in this case, the development of hydrogen refuelling stations or storage facilities.

The purpose of the SEA, in accordance with the Procedure for Strategic Environmental Assessment of Plans and Programmes approved by Resolution No. 967 of the Government of the Republic of Lithuania of 18 August 2004, is to assess the environmental consequences of implementing a plan or programme and to ensure that environmental protection considerations are taken into account in territorial development decisions.

If the activity is planned based on an already approved planning document for which an SEA has been conducted, a new SEA is not required. However, when preparing a new document, a screening must be carried out to determine the need for an SEA.

4.7.3. Pollution Permits

The Law on Environmental Protection[119] establishes a comprehensive regulatory framework for pollution permits, which are essential for controlling emissions from industrial and economic activities. The permitting system is structured around two main categories of permits, designed to address different levels of potential environmental impact.

Operators of large-scale industrial activities facilities must implement the best available techniques to minimize emissions and other environmental effects. These permits impose strict limits on pollutants, require regular environmental monitoring, and mandate corrective action when violations occur.

The law regulates the construction and operation of facilities that could impact the environment, requiring operators to secure permits before commencing new projects or expanding existing ones. This requirement extends to infrastructure for hydrogen production, storage, and transportation systems. These regulations ensure that such facilities are designed and operated with appropriate environmental safeguards, and that any resulting pollution is carefully controlled.

However, the current legal framework presents certain challenges when applied to hydrogen technologies. A key obstacle is the absence of explicit regulation regarding hydrogen itself as a potential pollutant. Although hydrogen is not classified as a pollutant under the law, its production or use may generate regulated pollutants such as nitrogen oxides. This regulatory gap creates uncertainty for operators, as there are no clear legal thresholds for hydrogen-related emissions, which complicates both the permit application process and enforcement mechanisms.

Additionally, the law primarily addresses environmental pollution concerns without fully accounting for the specific safety risks associated with hydrogen's highly flammable and explosive properties. These safety considerations may lead to more stringent scrutiny during the permitting process, potentially resulting in stricter permit conditions or procedural delays if safety concerns are not adequately addressed.

Given the emerging importance of hydrogen in Lithuania's energy transition, the current pollution permit framework may require further refinement to provide regulatory clarity while ensuring effective environmental protection in this developing sector.

[119] Republic of Lithuania Law on Environmental Protection. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/6378f2b0023211e6bf4ee4a6d3cdb874 [accessed: 03.04.2025.]

4.7.4. Requirements for Chemical Substances

Lithuanian regulation of chemical substances like GH2 is governed by the Law on Chemical Substances and Preparations[120], aligned with EU regulations. This framework ensures chemicals are managed safely for human health and the environment.

GH2 would be classified as a dangerous chemical substance due to its extremely flammable nature, requiring strict compliance with safety requirements for storage, handling, and use in aviation and airport sectors. Entities involved with hydrogen must conduct risk assessments to evaluate potential hazards and implement safety measures to minimize risks.

In accordance with EU law, including the Major Accident Hazards Directive[121], facilities handling significant quantities of hydrogen must implement strict safety management systems. These include risk assessments, continuous monitoring, emergency response plans, and controlled access to hazardous areas.

Hydrogen must be properly packaged and labelled with appropriate safety symbols and hazard warnings. Suppliers and users must maintain accurate records of quantities, properties, and safety measures, making these available to state authorities. Storage and transport must comply with stringent requirements to prevent leaks or uncontrolled releases, including pressure-rated containers and specially designed facilities.

Lithuanian authorities, including the Ministry of Environment and Ministry of Health Care, exercise state control through inspections, compliance checks, and enforcement of safety standards. Non-compliance can result in sanctions including fines or operational restrictions.

While the regulatory framework for GH2 in Lithuanian aviation is comprehensive, its classification as a dangerous substance subjects it to rigorous safety measures. As the hydrogen economy evolves, additional regulations may be needed to address unique challenges in aviation applications.

4.7.5. Construction Regulations regarding Hydrogen Production and Storage

The Lithuanian Law on Aviation[122] provides that the construction, reconstruction, or installation of buildings and facilities that exceed 100 meters in height above ground level within the territory of the Republic of Lithuania except within the protection zones of aerodromes, radar and meteorological radar installations must be coordinated with the Civil Aviation Agency and the Commander of the Armed Forces, in accordance with the procedure established by the Government.

Legal Basis for Hydrogen Facilities

Additionally, the Law on Aviation sets out that the construction, reconstruction, and maintenance of buildings located within a civil aerodrome and its protection zone must comply with the Republic of Lithuania's Construction Law and other relevant legislation regulating such constructions. All projects must also be coordinated with the Civil Aviation Agency.

Absent separate legislation governing construction at airports or the storage of hydrogen. general construction regulations must be applied. The installation of GH2 dispensers or/and storage facilities at Vilnius Airport (VNO) would likely qualify as a "special structure" under Lithuanian laws[123].

Definition of Special Structures

According to the Law on Construction of the Republic of Lithuania, a special structure is defined as:

- A building where hazardous substances are used or stored (subject to threshold limits);
- A structure that includes potentially dangerous equipment;

[120] Republic of Lithuania Law on Chemical Substances and Preparations. Available at: https://e-seimas.lrs.lt/rs/legalact/TAD/TAIS.128147/ [accessed: 03.04.2025.]
[121] Please see: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0018 [accessed: 03.04.2025.]
[122] Republic of Lithuania Law on Aviation. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.112075/asr [accessed: 22.04.2025.]
[123] Construction Law of the Republic of Lithuania. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.26250/asr [accessed: 22.04.2025.]

- A building with complex construction and advanced technological systems (as determined by applicable technical regulations).

Although the exact parameters of the planned construction have to be considered, it can be concluded that any facility intended for the storage or use of hydrogen would fall under the category of special structures.

In accordance with STR 1.01.03:2017 'Classification of Buildings' of the Republic of Lithuania (STR), special structures include[124]:

- Facilities for the storage and supply of oil, liquefied petroleum gas, compressed natural gas, and hydrogen, including refuelling stations and other structures involving hazardous materials;
- Buildings whose function may pose a threat to human safety or the environment (e.g., in the event of an explosion or fire);
- Technologically complex facilities involving pressure systems, gases, or flammable substances.

Practical Implications of Special Structures under Lithuanian Law are as follows[125]:

- A special structure project must be prepared by a certified designer;
- Construction can only be carried out by a contractor with the appropriate qualifications;
- A construction permit must be issued by the municipal administration, and the project must be coordinated with various authorities (e.g., fire services, National Public Health Centre);
- Construction and operation will be subject to strict supervision by the State Territorial Planning and Construction Inspectorate, the Environmental Protection Agency, the Fire and Rescue Department, and others.

Land Use and Zoning Compliance

Hydrogen refuelling or storage facility at an airport would fall under the special structure category. Therefore, it must follow all procedures established for such structures. Furthermore, in order to construct such a facility, the land use designation and purpose must be compatible with the type of structure being planned. This is governed by the Description of Land Use Purposes and STR on Structure Classification.

It should also be noted that the developer must have legal rights to the land, such as ownership or a lease of state-owned land or other legal entitlement.

If the land use designation of the selected plot is not suitable, it must be changed according to the Territorial Planning Law of the Republic of Lithuania[126], which involves preparation of a Detailed Plan in accordance with the Vilnius City Master Plan and any applicable Special Plans.

The purpose of territorial planning is to ensure sustainable development of the national territory by rational use, protection and restoration of natural resources, the creation of favourable conditions for living, work and recreation, environmental and public health protection, heritage preservation, and balanced development of economic, social, and infrastructure systems.

The land use type or purpose of a land plot shall be established or changed by preparing and approving territorial planning documents. The change of purpose shall be carried out in accordance with the procedure laid down by this Law and other legal acts.

A detailed plan is prepared in order to:

1) Establish or change land use type or building intensity and usage regulations for specific plots;
2) Determine the conditions for construction, infrastructure development, and environmental protection;

[124] Minister of Environment of the Republic of Lithuania Order Regarding the Approval of the Construction Technical Regulation STR 1.01.03:2017 "Classification of Buildings and Premises" Available at: https://eseimas.lrs.lt/portal/legalAct/lt/TAD/998f6af39c3d11e68adcda1bb2f432d1/asr [accessed: 22.04.2025.]
[125] Construction Law of the Republic of Lithuania. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.26250/asr [accessed: 22.04.2025.]
[126] Law on Territorial Planning of Republic of Lithuania Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.23069/asr [accessed: 22.04.2025.]

3) Ensure the coherence of development goals with the city's general plan and other higher-level planning documents.

To build a hydrogen refuelling or storage facility, the land must have an appropriate use designation allowing for such development. If it does not, the land use must be changed through the preparation of a Detailed Plan, as outlined in Articles 20 and 27 of the Law on Territorial Planning. This ensures the construction is legal, sustainable, and aligned with the public and private interests defined in territorial policy.

Operational Regulations for Hazardous Sites

Operation of the facility that qualifies as a hazardous site shall be subject to the requirements of the Law on Crisis Management and Civil Protection of the Republic of Lithuania.[127]

A hazardous site refers to the entire territory controlled by an operator, in which at least one installation along with its associated infrastructure, is involved in routine or related activities that include the presence of hazardous substances.

A hazardous substance is defined as a chemical substance or mixture listed in the government-approved list of hazardous substances and mixtures, or one that meets the criteria established by the government. These substances may include raw materials, products, by-products, residues, or intermediate products.

A hazardous site installation refers to a technical unit located at or below ground level within the hazardous site, where hazardous substances are produced, used, handled, or stored. This includes all necessary equipment, structures, pipelines, machinery, tools, railway branches, docks, loading quays, dams, warehouses and other structures either on land or in water required for the operation of the hazardous installation.

Further to the above, under the Law on Chemical Substances and Chemical Mixtures of the Republic of Lithuania[128], a hazardous chemical substance is defined as any substance classified as dangerous under Regulation (EC) No. 1272/2008[129]. Hydrogen is classified as a hazardous substance according to the above-named regulation.

4.7.6. Liability in Environmental Protection

Lithuanian law[130] holds operators accountable for environmental damage caused by GH2 use in aviation and airports. Any harm to air, water, or soil requires immediate remediation, with costs borne by the polluter. Preventive measures such as risk assessments and emergency plans are mandatory to minimize risks.

Companies must cover all environmental damage costs, including clean-up, restoration, and state intervention expenses. Affected parties can seek compensation if GH2-related activities harm health, property, or ecosystems. Authorities enforce compliance through fines, operational suspensions, or legal action.

While the framework ensures accountability, GH2-specific regulations remain unclear, particularly regarding hazard classification, accident prevention, and financial liability.

4.7.7. Summary and Conclusions on Lithuanian Regulations on Hydrogen Production

Lithuania lacks specific safety regulations for GH2 in aviation, creating regulatory uncertainty despite existing general frameworks covering fire safety, civil protection, and aviation. Environmental regulations require impact assessments, but the framework is not fully adapted to hydrogen's unique characteristics. While pollution permits control emissions, hydrogen itself is not explicitly regulated as a pollutant, creating compliance

[127] Law on Crisis Management and Civil Protection of the Republic of Lithuania. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.69957/asr [accessed: 22.04.2025.]
[128] Republic of Lithuania Law on Chemical Substances and Preparations. Available at: https://e-seimas.lrs.lt/rs/legalact/TAD/TAIS.128147/ [accessed: 22.04.2025.]
[129] Regulation (EC) No. 1272/2008 Available at: https://eur-lex.europa.eu/eli/reg/2008/1272/oj/eng [accessed: 22.04.2025.]
[130] Republic of Lithuania Law on Environmental Protection. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/6378f2b0023211e6bf4ee4a6d3cdb874 [accessed: 03.04.2025.]

ambiguity. As a dangerous chemical substance, it also requires strict safety protocols for storage, handling, and transport.

Construction of hydrogen facilities at airports faces challenges due to fragmented oversight across multiple authorities and lack of specific technical standards. Liability laws hold operators accountable for environmental damage from hydrogen operations, mandating remediation and preventive measures, though GH2-specific liability regulations remain underdeveloped.

Overall, Lithuania's current regulatory landscape provides a foundation but requires significant adaptation to properly address the unique safety, environmental, and technical aspects to facilitate environment suitable for its deployment.

4.8. Lithuanian Regulations on Hydrogen Transportation

4.8.1. Hydrogen Transportation via Natural Gas Pipelines

There are currently no applicable laws intended specifically for the transportation of GH2 via natural gas pipelines, especially in the context of airports and aviation applications such as Vilnius Airport. However, the evolving European regulatory landscape, particularly Directive (EU) 2024/1788[131], provides a new framework for integrating renewable gases – including hydrogen – into existing gas systems, which could be relevant for future planning.

Under the Lithuanian Law on Natural Gas[132], the definition of natural gas extends to "biogas, gas from biomass, and other types of gas that can technically and safely be injected into and transported through the natural gas system." While this definition is broad enough to potentially include hydrogen, there is no explicit clarification on whether GH2 falls within this scope, nor on the technical or safety thresholds required for such integration. This presents a regulatory ambiguity that may act as a barrier to progress, especially for infrastructure planning related to aviation hubs like Vilnius Airport.

Furthermore, Lithuania's natural gas infrastructure – including high-pressure transmission lines and lower-pressure distribution networks – forms the physical backbone that could, in theory, be repurposed or adapted for hydrogen blending or dedicated hydrogen transport. However, no current evaluation has been conducted on the suitability or readiness of these pipelines for hydrogen use. Noteworthy, that evaluation on possibilities and economic feasibility of adapting the natural gas infrastructure to transport a mixture of hydrogen and methane is planned to be conducted until 2026.

Key technical challenges such as material compatibility, hydrogen embrittlement, and the need for retrofitting compression stations and valves remain unaddressed. The absence of such assessments poses a significant practical roadblock to integrating hydrogen into these systems.

From a governance standpoint, Lithuania's legal provisions require system operators to establish rules for third-party access and usage of the gas network. If hydrogen is to be incorporated, these rules would need to be significantly revised to account for the different physical and chemical properties of hydrogen, as well as its energy density and behaviour in pipeline systems. Furthermore, Directive (EU) 2024/1788 calls for non-discriminatory access and infrastructure planning for renewable gases, but national implementation mechanisms are still under development.

A major challenge for Vilnius Airport lies in the lack of specific hydrogen infrastructure planning at the airport level. No pilot programs, feasibility studies, or stakeholder consultations have been identified that would suggest imminent integration of hydrogen delivery via pipelines. Additionally, the absence of coordinated regulatory

[131] Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC. Available at: https://eur-lex.europa.eu/eli/dir/2024/1788/oj/eng [accessed: 04.04.2025.]
[132] Republic of Lithuania Law on Natural Gas. Available at: https://e-seimas.lrs.lt/rs/legalact/TAD/a071f720c78511e682539852a4b72dd4/ [accessed: 04.04.2025.]

alignment between the aviation sector and gas infrastructure stakeholders further complicates the pathway for GH2 adoption.

In conclusion, while Directive (EU) 2024/1788 opens the door for hydrogen integration into national and transnational gas systems, several gaps remain in the Lithuanian context that may affect the feasibility of GH2 transportation to Vilnius Airport. These include regulatory clarity, technical assessments of existing infrastructure, sectoral coordination, and investment planning.

4.8.2. Hydrogen Transportation via Road Transport

The transportation of hydrogen via road, particularly for use in airports and aviation, is governed by several key legal frameworks, although specific provisions addressing hydrogen transport are limited. The Law on Carriage of Dangerous Goods by Road, Rail, and Inland Waterway[133] provides a general regulatory foundation for the transportation of hazardous materials. While it does not specifically mention hydrogen, it sets forth safety standards and environmental protections that must be followed when transporting dangerous goods. This would include the transportation of hydrogen in its various forms, particularly compressed or liquefied hydrogen, to and from airports.

Additionally, the Law on Crisis Management and Civil Protection[134] emphasizes emergency response protocols in the event of accidents involving hazardous materials, including hydrogen. This law mandates preparedness for incidents such as spills or leaks, and the decontamination and emergency treatment of affected individuals or areas. In practice, any road transportation of hydrogen to airports must adhere to these emergency procedures, ensuring that both the transporters and the airport authorities are equipped to handle potential accidents.

The Law on Energy[135] provides further context by stressing environmental protections in energy-related activities, including energy transport. While it does not directly address hydrogen, it implies that any transport of energy carriers like hydrogen must minimize environmental harm, ensuring the safety of both the immediate area and the broader environment during transport operations.

However, despite the existence of these general regulations, challenges may arise. A key gap is that there is no specific legal framework in Lithuania that explicitly addresses the nuances of hydrogen transport, especially in the context of aviation. For example, while the European Agreement concerning the ADR is applied in airports, which provides international standards for the transport of dangerous goods, the lack of hydrogen-specific provisions in national law may create uncertainty for operators. This could lead to difficulties in ensuring compliance with both national and international standards, and in determining the exact requirements for hydrogen transport vehicles, storage, and handling.

4.8.3. Summary and Conclusions on Lithuanian Regulations on Hydrogen Transportation and Safety Regulation

The transportation of GH2 to airports in Lithuania, whether via natural gas pipelines or road transport, faces several regulatory and technical challenges. While EU Directive (EU) 2024/1788 provides a framework for integrating renewable gases, including hydrogen, into gas systems, Lithuania lacks specific regulations for hydrogen integration in the national gas infrastructure. The existing laws on natural gas do not clarify the technical or safety thresholds required for hydrogen use, creating regulatory uncertainty. Additionally, there has been no assessment of Lithuania's pipeline infrastructure for hydrogen, which poses significant technical challenges like hydrogen embrittlement and the need for retrofitting equipment.

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[133] Republic of Lithuania Law on the Carriage of Dangerous Goods by Road, Rail, and Inland Waterway. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.157189/ZzLKynBpeE [accessed: 04.04.2025.]
[134] Republic of Lithuania Law on Crisis Management and Civil Protection. Available at: https://www.e-tar.lt/portal/lt/legalAct/TAR.C15592B096FA/asr [accessed: 04.04.2025.]
[135] Republic of Lithuania Law on Energy. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.167899/asr [accessed: 04.04.2025.]

Regarding road transport, while hydrogen is regulated under general laws for dangerous goods, including the Law on the Carriage of Dangerous Goods and the Law on Crisis Management and Civil Protection, there are no hydrogen-specific provisions. This leaves ambiguity in compliance and operational standards, especially for aviation-related hydrogen transport.

In conclusion, while EU regulations provide a starting point, Lithuania faces gaps in its regulatory and technical frameworks for hydrogen transportation. These include unclear legal provisions for hydrogen in natural gas systems, lack of infrastructure assessments, and insufficient sectoral coordination, which need to be addressed to ensure safe and effective GH2 transport for aviation.

4.9. Lithuanian Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

Currently, Lithuanian national law does not provide explicit regulations specifically tailored to hydrogen-fuelled vehicles and their fuelling. However, relevant provisions may be found in several overarching legal frameworks that touch on the use of alternative fuels, fire and civil safety, environmental protection, and road traffic.

The most relevant legislation is the Law on Alternative Fuels[136], which aims to support the use of alternative energy sources in transport. In accordance with Article 27 (4) of the Law on Alternative Fuels the Minister of Transport and Communications on 10 March 2023 adopted the Guidelines[137], that set out the main measures (for the period from 2023 to 2030) to promote the use of hydrogen powered road vehicles and the objectives for the development of hydrogen refuelling infrastructure.

Complementary laws provide general safety and environmental requirements that would apply to hydrogen technologies. The Law on Fire Safety[138] and the Law on Crisis Management and Civil Protection[139] outline general responsibilities related to hazardous materials and emergency preparedness, both of which are relevant due to hydrogen's high flammability. Facilities such as hydrogen fuelling stations may fall under the definition of "hazardous establishments," which would trigger specific safety and preparedness obligations.

In addition, the Law on Environmental Protection[140] would likely govern any hydrogen-related infrastructure from an environmental risk perspective, ensuring that activities like fuelling system installation and operation adhere to pollution prevention and environmental impact mitigation standards.

The Law on Road Traffic Safety[141] may also apply to hydrogen-fuelled vehicles if they operate within airport grounds or access public roads, although it is unlikely to address fuelling systems or aviation-specific vehicles like GSE or aircraft.

Despite these general laws, there is currently a regulatory gap in Lithuania concerning detailed technical and safety standards for hydrogen fuelling stations and hydrogen-powered vehicles—especially in the aviation context. International standards, such as ISO 19880-1:2020 for hydrogen refuelling station safety and ISO 14687:2019 for hydrogen fuel quality, are critical in filling this gap. These standards set global benchmarks for station design, operation, safety distances, and hydrogen purity, which are essential for the safe deployment of hydrogen vehicles and aircraft support systems.

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[136] Republic of Lithuania Law on Alternative Fuels. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/0409c522915c11eb998483d0ae31615c/asr [accessed: 04.04.2025.]
[137] Available at: https://e-tar.lt/portal/lt/legalAct/c3b5bdb0bf5011ed97b2975f7dad7488
[138] Republic of Lithuania Law on Fire Safety. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.403202?jfwid=32wf9xll [accessed: 04.04.2025.]
[139] Republic of Lithuania Law on Crisis Management and Civil Protection. Available at: https://www.e-tar.lt/portal/lt/legalAct/TAR.C15592B096FA/asr [accessed: 04.04.2025.]
[140] Republic of Lithuania Law on Environmental Protection. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/6378f2b0023211e6bf4ee4a6d3cdb874 [accessed: 04.04.2025.]
[141] Republic of Lithuania Law on Road Traffic Safety. Available at: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/823575a0ec1811e5820eec7ea316d20a?jfwid=j4afzs93 [accessed: 04.04.2025.]

4.9.1. Summary and Conclusions on Lithuanian Regulations on Fuelling and Usage

Lithuania currently lacks hydrogen-specific regulations for hydrogen-fuelled vehicles and fuelling infrastructure. Instead, general laws on alternative fuels, fire safety, civil protection, environmental protection, and road traffic provide a basic legal framework. While these laws establish broad safety and environmental obligations, they do not set technical standards or procedures tailored to hydrogen technologies, particularly in sensitive areas like airports.

This creates a regulatory gap, especially for the deployment of hydrogen fuelling systems and vehicles in the aviation sector. In the absence of national guidance, international standards such as ISO 19880-1 (refuelling station safety) and ISO 14687 (fuel quality) are essential reference points. To support safe and scalable hydrogen use, Lithuania will need to align its legal framework with these standards and introduce more targeted hydrogen regulations.

4.10. Key Findings of Sector-Specific Lithuanian Regulations

Lithuania's regulatory landscape presents several key considerations for hydrogen implementation at airports. The current framework relies on multiple regulatory bodies with overlapping jurisdictions, including the Transport Competence Agency and Lithuanian Transport Safety Administration, but lacks clear leadership for hydrogen projects in aviation contexts. This fragmented authority structure creates coordination challenges and potential approval delays for airport hydrogen infrastructure.

The strategic foundation for hydrogen implementation exists through national planning documents including the Guidelines, Hydrogen Roadmap and participation in the Baltic Hydrogen Corridor initiative, positioning Lithuania within regional hydrogen networks. However, territorial planning regulations create significant obstacles, as existing legislation lacks specific provisions for hydrogen facilities within airport territories, and no clear designation exists for hydrogen-related projects as nationally significant infrastructure.

Environmental and safety regulations add substantial complexity, with significant gaps in hydrogen-specific safety protocols for aviation applications. While hydrogen is classified as a dangerous chemical substance requiring stringent safety measures, these regulations lack aviation-specific provisions that account for unique airport operational constraints. The EIA framework, while comprehensive for conventional projects, requires adaptation to effectively address hydrogen technologies' distinctive environmental considerations.

The economic landscape creates perhaps the most significant barrier, as airports lack dedicated funding mechanisms or incentives to develop GH2 production and storage. Without additional financial support or clear cost-recovery models, airports have little motivation to undertake the substantial investments required for hydrogen infrastructure development, despite strategic alignment with national decarbonization goals.

4.11. Identified Regulatory Gaps, Challenges and Roadblocks

Absence of Hydrogen-Specific Legislation

While the Guidelines establish the directions for the creation of GH2 ecosystem and infrastructure development within Lithuania. Lithuania lacks dedicated binding laws or regulations specifically addressing hydrogen production, storage, and use in aviation contexts. While existing frameworks for energy, chemicals, and aviation provide general coverage, the absence of hydrogen-specific provisions creates significant uncertainty for project developers and investors regarding compliance requirements.

Fragmented Regulatory Authority

Overlapping jurisdictions across multiple regulatory bodies without clear delineation of responsibilities for hydrogen oversight creates inefficient approval processes. The Transport Competence Agency, Lithuanian

Transport Safety Administration, and environmental authorities all claim partial jurisdiction, but no single entity has clear leadership for hydrogen projects in aviation.

Protection Zone Uncertainties

Undefined safety distances and risk assessment parameters for hydrogen facilities within airport protection zones prevent effective planning. The current legal framework fails to establish minimum separation requirements between hydrogen storage and critical aviation infrastructure, creating ambiguity for spatial planning.

Planning and building hydrogen infrastructure in airport zones is very dependent on the opinion of the responsible authority, either the Transport Competence Agency (for civil airports) or the Commander of the Lithuanian Armed Forces (for military airports). Their judgment can heavily influence what is allowed or not, which makes the process uncertain and potentially slow.

Inadequate Environmental Assessment Framework

The EIA procedure lacks specific criteria for evaluating hydrogen project impacts in aviation settings. Without tailored assessment guidelines, environmental evaluations may fail to address hydrogen's unique risk profile and potential ecological implications, leading to inconsistent review practices.

Funding Mechanism Gaps

According to market stakeholders in Lithuania, with no additional sources of funding, airports have no incentives to develop GH2 production and storage infrastructure. The absence of dedicated financial support mechanisms or cost-recovery models significantly impedes investment decisions, as airports must bear high initial costs without clear pathways to recoup expenditures.

Infrastructure Assessment Deficiencies

No evaluation of existing aviation infrastructure compatibility with hydrogen technologies has been conducted. The absence of technical assessments regarding material compatibility, potential hydrogen embrittlement, and retrofitting requirements creates uncertainty about implementation feasibility and safety.

Unclear Liability Framework

Underdeveloped provisions for environmental liability specific to hydrogen operations at airports create risk uncertainty. While general environmental liability principles apply, the unique characteristics of hydrogen incidents are not explicitly addressed, creating potential exposure for operators and investors.

Zoning Ambiguity

Lack of clear land-use classifications for hydrogen infrastructure in municipal spatial plans surrounding airports complicates development. Current zoning regulations do not explicitly recognize hydrogen production as a permitted use in industrial or logistics zones adjacent to airports, potentially requiring case-by-case amendments.

4.12. Recommendations

To address the identified regulatory gaps and facilitate the safe and efficient integration of GH2 into Lithuania's aviation sector, the following recommendations are proposed:

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.

Responsible authorities:	Time of completion:

Ministry of Transport and Communications	2027 - 2029

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).

However, when creating or updating relevant legislation, Lithuania should include provisions that ensure future flexibility for liquid hydrogen deployment, avoiding overly rigid frameworks that could inadvertently create barriers to liquid hydrogen infrastructure or operations in later stages of hydrogen market development.

Responsible authorities:	Time of completion:
Ministry of Transport and Communications; please note herein also the role of International Air Transport Association and Regulation (EU) No 139/2014	2030

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.

Responsible authorities:	Time of completion:
Ministry of Transport and Communications	2027 - 2028

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.

Responsible authorities:	Time of completion:
Transport Competence Agency	2027 - 2030

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.

Responsible authorities:	Time of completion:
National Energy Regulatory Council, Ministry of Energy	2030

5.Republic of Poland

5.1. Executive Summary on Polish National Legal and Regulatory Framework

Poland's regulatory framework for integrating GH2 into aviation, as analysed in this report, provides a foundation for supporting the nation's energy transition, but is marked by significant gaps and complexities that hinder seamless adoption. Anchored by strategic documents like the Hydrogen Strategy until 2030 with an Outlook to 2040 and the National Energy and Climate Plan 2021-2030, Poland recognizes hydrogen as a cornerstone for decarbonizing transport and industry. However, the absence of aviation-specific regulations and the reliance on adapted, non-specialized laws create uncertainty for stakeholders aiming to develop GH2 infrastructure at airports. The report evaluates key legislative instruments, including the Environmental Protection Law, Aviation Law, and Chemical Substances and Preparations Act, highlighting their application to hydrogen production, storage, transportation, and refuelling systems within aviation contexts.

The regulatory landscape is characterized by dispersed oversight, with multiple authorities such as the Civil Aviation Authority, Office of Technical Inspection, Transport Technical Inspection, and various ministries holding overlapping jurisdictions. This fragmentation leads to coordination challenges, inconsistent interpretations, and prolonged permitting processes, particularly for complex projects like hydrogen production facilities or refuelling stations at airports. Territorial planning further complicates deployment, as municipal zoning plans typically designate airport-adjacent areas for transport or aviation functions, excluding industrial activities like GH2 production. Safety and environmental regulations, while robust, lack hydrogen-specific protocols, resulting in ambiguous EIA procedures and unclear emission thresholds for hydrogen-related activities, given its classification as a hazardous, flammable substance under the Seveso III Directive and Polish law.

Transportation of GH2 presents additional hurdles, particularly for pipeline integration. The Energy Law recognizes hydrogen as a gaseous fuel, but no technical standards exist for blending or retrofitting natural gas pipelines, leaving aviation supply chains uncertain. In contrast, road transport is well-regulated under the Act on the Transport of Dangerous Goods and the ADR Agreement, with clear safety, vehicle, and driver requirements, though airport-specific protocols are needed. Refuelling infrastructure, supported by the Act on Electromobility and Alternative Fuels, is in early development, with Poland aiming to establish hydrogen stations by 2030. However, these lack aviation-tailored standards, and high-hazard classifications for stations storing over one tonne of hydrogen trigger stringent fire and technical oversight, increasing project complexity.

Key challenges include the absence of a dedicated hydrogen legal code, high initial investment costs, workforce skill gaps, and limited funding mechanisms beyond the National Recovery and Resilience Plan. Poland's participation in the Northern-Baltic Hydrogen Corridor underscores the need for cross-border regulatory harmonization, yet domestic frameworks lag in accommodating evolving technologies. The report proposes actionable recommendations: establishing a hydrogen-specific legal framework, creating a national Hydrogen Coordination Agency, revising zoning to permit hydrogen facilities, enhancing EIA and safety protocols, expanding funding for airport pilot projects, and aligning with EU directives like 2024/1788 and international standards from ICAO and EASA. These steps aim to streamline GH2 integration, ensuring Poland's aviation sector aligns with national decarbonization goals and global sustainability objectives.

5.2. Introduction

Poland stands at a critical juncture in the development of its GH2 aviation infrastructure. The national regulatory framework governing this emerging sector reflects a complex interplay between EU directives, domestic legislation, and industry-specific regulations. While Poland has made notable progress in aligning with broader energy transition goals—particularly through initiatives like the Hydrogen Strategy until 2030 with an Outlook

to 2040 and the National Energy and Climate Plan 2021-2030—significant regulatory gaps remain unaddressed, especially in the domains of hydrogen production, storage, and transportation.

The current regulatory approach largely relies on applying analogous existing legislation rather than implementing hydrogen-specific provisions. This creates substantial uncertainty in critical areas such as permitting processes and zoning requirements. The situation is further complicated by the intersection of aviation safety protocols, environmental assessment requirements, and hazardous material handling regulations, all of which impact project approval timelines and feasibility.

This report provides a comprehensive analysis of Poland's regulatory landscape for GH2 integration in aviation, with particular focus on key legislative instruments including the Environmental Protection Law, Aviation Law, Chemical Substances and Preparations Act, and Construction Law. The analysis also examines the roles of principal regulatory bodies—notably the Civil Aviation Authority and Office of Technical Inspection—that shape the development of the GH2 ecosystem in Poland.

By identifying challenges in land-use classification, inter-agency coordination, and safety standards harmonization, this assessment offers strategic insights into streamlining hydrogen adoption pathways while maintaining alignment with the EU's broader energy transition objectives. The findings presented herein are based on currently enforced laws and applicable regulations, providing stakeholders with actionable intelligence for navigating this evolving regulatory environment.

5.3. Key National Regulatory Bodies

Poland is divided into 16 voivodships, which serve as the main administrative units. In this system, many regulatory functions are initially exercised at regional level through local government bodies such as voivodeship boards. However, the adoption and implementation of these local decisions is supervised by national-level bodies, who are government-appointed representatives in the regions.

5.3.1. The Office of Technical Inspection[142]

A state legal entity operating in the area of safety of technical devices. Its scope of activity includes supervision and control of compliance with technical supervision regulations and safety regulations concerning technical devices and fuel vapour recovery devices. Office of Technical Inspection performs technical supervision over technical devices and fuel vapour recovery devices, except for those under the jurisdiction of specialised technical supervision units. Office of Technical Inspection issues decisions related to technical supervision, maintains records of operated technical devices. It also initiates standardisation activities, participates in or develops draft technical supervision conditions and safety standards for technical devices, analyses causes and effects of technical device failures, and assesses the degree of hazard they pose. It cooperates with national and international bodies to harmonise technical supervision regulations with EU requirements.[143]

Office of Technical Inspection also performs essential regulatory tasks relevant to alternative fuel infrastructure. It conducts mandatory tests and periodic or ad hoc inspections to ensure compliance with technical standards. The Office of Technical Inspection maintains a public register detailing the location and availability of such infrastructure, enhancing transparency. Operators can also request Office of Technical Inspection's assessment of technical documentation to verify compliance with requirements before implementation.[144]

The competent authority in proceedings before the organs of technical supervision units. The President prepares an annual report on Office of Technical Inspection 's activities and submits it to the minister competent for economic affairs for approval. They also select the audit firm for Office of Technical Inspection. The President

[142] About Office of Technical Inspection. Available at: https://www.udt.gov.pl/o-udt [accessed: 09.04.2025.]
[143] Republic of Poland Act on Technical Supervision. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20001221321/U/D20001321Lj.pdf [accessed:14.04.2025.]
[144] Republic of Poland Act on Electromobility and Alternative Fuels. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000317 [accessed: 15.04.2025.]

of Office of Technical Inspection also determines the template for the application for authorisations for manufacturing, repairing, or modernising technical devices.[145] Operators of alternative fuels infrastructure must apply to the President of Office of Technical Inspection for an individual identification code or recognition of an EU member state code. The President may impose monetary penalties for violations or issue decisions to suspend operations of alternative fuels infrastructure if standards are not met, based on inspection findings.[146]

By the way of regulation, there are determined the technical conditions of technical supervision regarding the design, materials, manufacture, operation, repair, and modernisation of technical devices. In these regulations, the minister considers requirements for construction, strength calculations, execution, equipment, markings, materials, the scope and timing of technical inspections, necessary documentation, welding, plastic processing, heat treatment, non-destructive testing, operation, and maintenance. If specific technical conditions are not defined, these conditions are agreed upon with the relevant unit of technical supervision.[147]

5.3.2. Transport Technical Inspection[148]

A state legal person, subordinate to the minister responsible for transport. It performs a series of activities aimed at "ensuring the safe operation of technical devices and fuel vapour recovery devices and activities aimed at ensuring public safety in these areas" as well as technical supervision in general. These activities include, for example, periodic, ad hoc and post-failure inspections of technical devices and issuing decisions permitting or suspending their operation, checking the qualifications of persons operating, maintaining and repairing technical devices, as well as granting domestic and foreign companies authorisations to manufacture, repair and modernise technical devices.[149]

The competent authority in proceedings before the organs of technical supervision units regarding matters within the scope of Transport Technical Inspection is the Director of Transport Technical Inspection. The Director prepares an annual report on Transport Technical Inspection's activities and submits it to the minister competent for transport for approval. The Director of Transport Technical Inspection also determines the template for the application for authorisations for manufacturing, repairing, or modernising technical devices within Transport Technical Inspection's scope.[150] Also responsible for the technical conditions and testing of transport equipment intended for the carriage of dangerous goods by road, rail, and inland waterway and uses and extends the validity of ADR vehicle approval certificates.[151]

5.3.3. Civil Aviation Authority

The Civil Aviation Authority in Poland supervises civil aviation, ensuring safety and compliance. It grants operating authorizations to air carriers and aircraft operators, issues certifications for airports and landing sites, and maintains the aircraft register. The Authority also oversees air transport and airport infrastructure through its departments and regional branches. By collaborating with international bodies like ICAO, EASA, and EUROCONTROL, it aligns with global standards, supporting efficient and safe aviation operations.[152]

Supervised by the Minister responsible for transport, the Civil Aviation President holds key to responsibilities in civil aviation. The President certifies airports, maintain registers for aircraft, aerodromes, and aviation personnel,

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[145] Republic of Poland Act on Technical Supervision, Article 23 paragraph 5 point 5. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20001221321/U/D20001321Lj.pdf [accessed: 14.04.2025.]
[146] Republic of Poland Act on Electromobility and Alternative Fuels. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000317 [accessed: 15.04.2025.]
[147] Republic of Poland Act on Technical Supervision, Article 8 paragraph 5a. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20001221321/U/D20001321Lj.pdf [accessed: 14.04.2025.]
[148] Transport Technical Supervision, About us. Available at: https://www.tdt.gov.pl/o-tdt/o-nas/ [accessed: 14.04.2025.]
[149] Republic of Poland Act on Technical Supervision. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20001221321/U/D20001321Lj.pdf [accessed: 14.04.2025.]
[150] Republic of Poland Act on Technical Supervision. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20001221321/U/D20001321Lj.pdf [accessed: 14.04.2025.]
[151] Republic of Poland Act on the transport of dangerous goods, Article 9. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20112271367 [accessed: 14.04.2025.]
[152] About Civil Aviation Authority. Available at: https://ulc.gov.pl/en/authority [accessed: 15.04.2025.]

and approve operational instructions for aerodromes, issues permits for ground handling services, certifies air navigation service providers, and approves terminal charging zones. They also ensure compliance with environmental protection requirements, issue noise restriction exemptions, and can detain non-compliant aircraft.

5.3.4. The Energy Regulatory Office

The office manages various registers, such as those of energy enterprises and importers, which may be relevant for new entrants in energy production. It also has authority to conduct inspections, request cooperation from other control bodies, and access company records.[153]

Additionally, it oversees tenders for selling publicly accessible charging stations, approving transparent conditions and monitoring outcomes. It conducts market consultations every five years to gauge interest, mandating tenders if needed, and publishes infrastructure plans from local authorities. The President of Energy Regulatory Office also imposes penalties for violations. As for now it regulates electricity charging stations, this authority could potentially extend its competencies to oversee hydrogen infrastructure in the future, ensuring consistent regulatory standards.[154]

Plays a key role in overseeing and shaping the energy market in accordance with national and EU regulations. This includes monitoring gas and electricity system operators, approving technical and operational guidelines, and ensuring compliance with market obligations. Additionally, the President can approve exemptions, certify system operators, and impose financial penalties for non-compliance. Their functions support market transparency and competitiveness, which can influence the regulatory environment for introducing new energy solutions at strategic infrastructure points like airports.[155]

5.3.5. Polish Air Navigation Services Agency

The Polish Air Navigation Services Agency is the national body responsible for managing and overseeing the safe and efficient movement of air traffic in Polish airspace. Operating under the supervision of the Ministry of Infrastructure, the agency ensures the coordination and control of aircraft throughout all stages of flight, from takeoff and en-route navigation to landing. Its main activities include providing air traffic control services, managing the use of airspace, delivering aeronautical information to pilots and airlines, and overseeing the overall flow and capacity of air traffic across Poland. The agency also contributes to the modernization of aviation infrastructure and the implementation of advanced technologies aimed at improving safety, environmental performance, and operational efficiency.

In recent years, the Polish Air Navigation Services Agency has also become involved in efforts to reduce the environmental impact of aviation, particularly through the support of hydrogen fuel technologies at airports. While the agency does not build or manage fuel infrastructure itself, it plays a vital role in the planning and coordination necessary to safely integrate hydrogen-powered aircraft into existing air traffic systems. This includes participating in national and European research initiatives, working alongside airport operators, energy providers, and aviation manufacturers to assess how hydrogen technology will affect flight operations and airspace usage. The agency is helping to shape procedures, safety protocols, and regulatory frameworks that will enable the future use of hydrogen fuel in aviation, ensuring that these developments are safely and efficiently incorporated into the broader air traffic management system.

[153] Republic of Poland Law on Energy. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970540348/U/D19970348Lj.pdf [accessed: 15.04.2025.]
[154] Transport Technical Supervision, About us. Available at: https://www.tdt.gov.pl/o-tdt/o-nas/ [accessed: 14.04.2025.]
[155] Republic of Poland Law on Energy. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970540348/U/D19970348Lj.pdf [accessed: 15.04.2025.]

5.3.6. Minister Responsible for Transport

Minister exercises broad authority over civil aviation, relevant to airport operations. This minister supervises the Civil Aviation Authority, sets technical and operational standards for aerodromes, and regulates airport charges through consultations. They establish requirements for ground handling services, including permits, and designate air navigation service providers. Additionally, the minister determines aircraft classifications, airworthiness regulations, and noise restriction exemptions by regulation. These functions create a regulatory framework that ensures safety, technical compliance, and operational efficiency at airports.[156]

Minister also has general responsibility for matters related to the transport of dangerous goods not specifically assigned to other authorities. They oversee the tasks performed regarding ADR driver training and certification and the Chief Inspector of Road Transport. Issues regulations concerning various aspects of dangerous goods transport, including examination procedures, ADR certificates, and vehicle approval. They also handle the notification of conformity assessment bodies related to road and rail transport to the European Commission.[157]

5.3.7. Minister Responsible for Internal Affairs

Exercises supervision over the functioning of the national rescue and firefighting system. Fire protection inspectors issue regulations concerning ways and conditions of fire protection for buildings, other structures, and land; requirements for water supply and fire roads; detailed organisation of the national rescue and firefighting system; detailed qualification requirements for employees in fire protection units; and other duties. Furthermore, they designate research institutes of the State Fire Service that issue approvals for products used in fire protection and specify these products, their technical and operational requirements, and the procedure for granting, amending, and withdrawing approvals.[158]

5.3.8. Minister Responsible for Climate Affairs

Minister establishes detailed regulations on air quality assessments, permissible electromagnetic field levels, and noise monitoring, ensuring that infrastructure projects adhere to stringent environmental standards. They oversee the National Register of Pollutant Release and Transfer, although maintaining the register is the role of the Chief Environmental Protection Inspector. They manage the application and issuance process for integrated permits, setting operational conditions for facilities and intervening in cases of irregularities by coordinating with regional authorities like the starost and marshal of the voivodeship.

Additionally, they collaborate with other ministers to regulate product labelling, incorporating environmentally significant information, and set guidelines for emission charge payments. By enforcing compliance through penalties and monitoring facility operations, this authority provides a robust regulatory framework that could guide the safe and sustainable implementation of new fuel technologies.[159]

5.3.9. Minister Responsible for Construction, Spatial Planning and Housing

This minister is responsible for three departments of government administration construction, spatial planning and development and housing and economy. The Minister Responsible for Construction, Spatial Planning and Housing oversees national policies and regulations related to land development, building standards, and spatial management. This minister plays a key role in shaping the legal and procedural framework for construction activities, including the approval of development plans, technical conditions for buildings, and integration of

[156] Republic of Poland Law on Aviation. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20021301112/U/D20021112Lj.pdf [accessed: 15.04.2025.]

[157] Republic of Poland Act on the transport of dangerous goods, Article 9. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20112271367 [accessed: 14.04.2025.]; Republic of Poland Law of Public Roads. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20042042086/U/D20042086Lj.pdf [accessed: 24.04.2025.]

[158] Republic of Poland Act on fire protection. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU19910810351 [accessed: 14.04.2025.]

[159] Republic of Poland Law on Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 15.04.2025.]

infrastructure into spatial planning strategies. In the context of hydrogen fuel implementation at airports, the minister's responsibilities are particularly relevant. The development of hydrogen facilities, such as refuelling stations, storage infrastructure, and associated utility systems, must comply with construction and spatial planning regulations under the minister's purview.

5.3.10. Minister Responsible for the economy of energy resources

The minister sets technical standards for safe operation and modernization of alternative fuel infrastructure, defining test procedures, fees, and personnel training requirements for Office of Technical Inspection or Transport Technical Inspection oversight. They regulate refuelling point markings, issue identification code fees, and handle appeals against Office of Technical Inspection or Transport Technical Inspection suspension decisions. Currently managing standards for natural gas and LNG, this authority could extend its regulatory oversight to hydrogen infrastructure, as the plan in EU legislative framework is to implement hydrogen usage and transportation through similar technical solutions.[160]

5.3.11. State Fire Service

The State Fire Service receives safety reports from high-risk establishments and provides opinions on safety in increased-risk establishments. They prepare external operational and rescue plans for high-risk establishments. They take operational and rescue actions in the event of industrial accidents but also conduct inspections regarding compliance with industrial accident prevention regulations.[161]

5.3.12. Chief Environmental Protection Inspector

They conduct comprehensive national air quality assessments and classify air quality zones at least every five years, incorporating data from voivodeship inspectors and accounting for natural pollution sources. The inspector maintains the National Register of Pollutant Release and Transfer, systematically collecting and forwarding emissions data to the European Commission, fostering transparency in environmental impact monitoring. They also manage noise-related data, receiving identifying information from infrastructure managers, including airports, and compile summary sheets for submission to the European Environment Agency. Strategic noise maps and environmental data are disseminated, with non-compliant entities reported to regional authorities.[162]

5.3.13. Regional Director for Environmental Protection

Director is consulted on draft general plans, draft local plans, and draft resolutions concerning the rules for placing fences if a strategic EIA has been waived. They also provide opinions on draft landscape audits and can refuse to agree to decisions on the location of public purpose investments if an environmental decision is missing.[163] They also manage historical soil contamination, maintaining a register and ordering or conducting contamination tests. They approve remediation plans, assess their completion, and may implement remediation when needed. The Director receives contamination reports and research results from facilities requiring integrated permits and provides input on industrial zone planning, ensuring environmental safety for infrastructure development.[164]

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[160] Republic of Poland Act on Electromobility and Alternative Fuels. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000317 [accessed: 15.04.2025.]

[161] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 15.04.2025.]

[162] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 15.04.2025.]

[163] Republic of Poland Act on Spatial Planning and Development. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20030800717 [accessed: 15.04.2025.]

[164] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 15.04.2025.]

5.3.14. Voivodeship Environmental Protection Inspector

Conducts environmental oversight, receiving data on emissions, noise, and electromagnetic fields from permit-issuing bodies. They review strategic noise maps, monitor compliance with noise and waste regulations, and impose penalties for violations, including exceeding emission limits or failing to submit required data. The inspector can halt non-compliant facility operations and forward violation reports to authorities, ensuring a regulatory framework that supports compliant infrastructure development.[165]

5.4. National Planning Documents and Strategies

The development of hydrogen as an energy carrier has been recognized as one of Poland's strategic priorities, particularly within the transport and industrial sectors. Poland's Hydrogen Strategy until 2030 with an Outlook to 2040[166] outlines a vision for building a national hydrogen economy based on low- and zero-emission hydrogen production. One of the key goals is to decarbonize the transport sector through the introduction of hydrogen-powered vehicles and the establishment of a national network of refuelling infrastructure, especially for public transport and heavy-duty vehicles.

As transport remains one of the largest contributors to greenhouse gas emissions in Poland, the National Energy and Climate Plan 2021–2030[167] sets clear emission reduction targets for the sector. To meet these targets, Poland plans to introduce financial support mechanisms for the deployment of hydrogen buses in public transport, construction of hydrogen refuelling stations, and development of low-emission vehicle fleets. Additionally, regulatory and investment incentives are being considered to enable hydrogen use in rail and freight transport.

In line with the EU's climate objectives, Poland's Long-Term Strategy for Climate Neutrality 2050[168] emphasizes the growing role of hydrogen in decarbonizing key sectors such as industry, energy, and transport. Hydrogen is identified as a critical technology for achieving climate neutrality, especially when produced using renewable electricity. The Energy Policy of Poland until 2040 (EPP2040)[169] also prioritizes the integration of renewable energy sources into hydrogen production and highlights hydrogen as a strategic fuel for the future energy system.

To support the implementation of these goals, the National Recovery and Resilience Plan[170] allocates funding for hydrogen-related projects, including the development of hydrogen valleys, construction of electrolysers, and deployment of hydrogen-powered buses and industrial solutions. Furthermore, the National Plan for the Development of Alternative Fuels Infrastructure[171] sets the framework for hydrogen refuelling station rollout across Poland's TEN-T network, ensuring cross-border connectivity with neighbouring countries.

Poland is also an active participant in the Northern-Baltic Hydrogen Corridor initiative[172], aiming to establish a fully integrated, cross-border hydrogen infrastructure from Finland to Germany via the Baltic States and Poland. This initiative supports the creation of an internal hydrogen market and the future export of GH2.

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[165] Republic of Poland Law on Energy. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970540348/U/D19970348Lj.pdf [accessed: 15.04.2025.]
[166] Ministry of Climate and Environnement. Poland's Hydrogen Strategy until 2030 with an Outlook to 2040. Available at: https://www.gov.pl/attachment/06213bb3-64d3-4ca8-afbe-2e50dadfa2dc [accessed: 09.04.2025.]
[167] Republic of Poland, National Energy and Climate Plan for the years 2021-2030. Available at: https://www.gov.pl/web/climate/national-energy-and-climate-plan [accessed: 09.04.2025.]
[168] Poland's climate action strategy. Available at: https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767168/EPRS_BRI(2024)767168_EN.pdf [accessed: 09.04.2025.]
[169] Energy Policy of Poland until 2040 (EPP2040). Available at: https://www.gov.pl/web/climate/energy-policy-of-poland-until-2040-epp2040 [accessed: 09.04.2025.]
[170] Poland's recovery and resilience plan. Available at: https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/polands-recovery-and-resilience-plan_en [accessed: 09.04.2025.]
[171] Poland's national plan for the Development of Alternative Fuel Infrastructure. Available at: https://transport.ec.europa.eu/document/download/505456a5-872a-4b03-8bca-cde90dfcd1b5_en [accessed: 09.04.2025.]
[172] Nordic-Baltic Hydrogen Corridor. Available at: https://www.gaz-system.pl/en/hydrogen-market/projects/nordic-baltic-hydrogen-corridor.html [accessed: 09.04.2025.]

To build institutional and technical capacity, the Hydrogen Strategy foresees the creation of a national Hydrogen Competence Center, focusing on workforce development, research, and innovation in net-zero technologies. The centre will play a key role in supporting the Polish hydrogen economy and ensuring alignment with academic and industrial advancements.

In light of the above, Poland's national planning documents and strategies provide a solid foundation for implementing GH2, particularly in the transport sector. However, while the development of GH2 is well-integrated into national decarbonization strategies, its potential use within airport operations has not yet been directly addressed, highlighting a regulatory and planning gap that may require further consideration.

5.5. Territorial Planning Aspects related to GH2 Production and Storage

The Regulation of the Minister of Development and Technology on the Detailed Scope of the Draft Local Spatial Development Plan[173] sets out the general framework for local spatial planning, land use zoning, and construction. Within this framework, functional zoning categories determine what types of infrastructure and activities are permitted in specific areas. Currently, GH2 production and storage facilities are not explicitly listed as permissible uses in standard zoning classifications, particularly within airport-designated areas.

Airport territories such as those surrounding Warsaw Chopin Airport or Gdańsk Lech Wałęsa Airport are commonly zoned under "transport infrastructure" or "airport services" categories within local spatial development plans. These zones typically prioritize aviation operations, transport logistics, utility networks, and limited commercial or service-related construction. As such, industrial-scale hydrogen production plants are not currently included among the allowed functions within airport-adjacent land, presenting a regulatory limitation for GH2 deployment.

However, hydrogen storage facilities may be more flexibly interpreted under existing zoning rules—particularly if they are classified as technical or engineering infrastructure, such as utility or fuel storage components essential to airport operations. Yet, Polish planning regulations do not define clear thresholds for permissible hydrogen storage volumes, nor do they address the unique risk profile of hydrogen within urban or aviation-sensitive zones.

Importantly, Polish law allows for the designation of investments of strategic national importance under specific legislative acts. If GH2 infrastructure is framed as essential for national energy transition or aviation decarbonization goals, such status may enable exceptions from standard zoning limitations. These projects could then benefit from fast-track permitting and adjusted land-use rules, provided they comply with safety and environmental requirements.

In the absence of dedicated hydrogen zoning or national guidance for GH2 deployment in airport areas, future regulatory efforts in Poland should aim to clarify permissible land uses, define technical thresholds for storage and production facilities, and develop coordinated spatial planning strategies that align with both aviation safety and clean energy objectives.

5.5.1. GH2 Production and Storage within the Airport

The establishment of infrastructure related to the production and storage of GH2 within airport premises is subject to national and local legislation concerning spatial planning, construction law, and both industrial and aviation safety regulations.

Infrastructure development within airport boundaries requires formal coordination with, and approvals from, the airport managing body. This process ensures that all proposed works align with airport safety, security, and

[173] Republic of Poland Regulation of the Minister of Development and Technology on the Detailed Scope of the Draft Local Spatial Development Plan. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20210002404 [accessed: 09.04.2025.]

operational requirements. The airport managing body is responsible for verifying compliance with the airport's master plan and internal spatial planning guidelines, developing safety protocols specific to hydrogen handling, and coordinating with relevant authorities to facilitate a streamlined and coherent approval process.

According to the Act on Spatial Planning and Development[174], any investment must comply with the local zoning plan. For major airports such as Warsaw Chopin Airport, the territory is typically designated as a "transport infrastructure zone," which generally permits uses such as engineering infrastructure, terminals, fuel stations, and technical support facilities. However, industrial production—such as GH2 generation—is not usually listed as a permitted or complementary use. This presents a regulatory challenge that would require either amending the zoning plan or obtaining a separate land development decision.

Under the Construction Law[175], projects involving hydrogen production or storage must obtain a building permit and comply with detailed technical and fire safety requirements. Moreover, the Act on Electromobility and Alternative Fuels[176] classifies hydrogen as an alternative fuel, which could allow hydrogen storage facilities to be interpreted as part of the airport's fuelling infrastructure—similar to hydrogen refuelling stations—and thus be permitted on airport grounds.

Safety requirements related to such facilities require a risk assessment and safety report for any facility where dangerous substances like hydrogen are stored above threshold quantities.[177]

If the hydrogen production facility is intended to be powered by renewable energy, additional constraints may apply. For example, Aviation Law[178] prohibits the construction of wind turbines within certain airport protection zones, particularly near runways and approach paths, limiting access to renewable electricity sources within the airport perimeter.

5.5.2. GH2 Production and Storage near the Airport

Areas surrounding airports are typically governed by local zoning plans, which define land use categories such as industrial, commercial, agricultural, forested, or mixed-use development zones. The feasibility of locating GH_2 production or storage infrastructure near airports is therefore contingent on the local land designation and broader compliance with national regulations.

Infrastructure developments in the vicinity of airports, such as storage tanks or facilities that emit substances, typically require assessment by the Polish Air Navigation Services Agency. This evaluation is necessary to ensure compliance with obstacle limitation surfaces, to prevent potential interference with navigational aids, and to support the overall management of airspace safety.

According to the Act on Spatial Planning and Development[179], municipalities are responsible for defining land-use categories and permitted functions. In the vicinity of many airports, surrounding zones often include:

- forest areas;
- mixed-use central development areas;
- industrial and service development zones.

[174] Republic of Poland Regulation of the Minister of Development and Technology on the Detailed Scope of the Draft Local Spatial Development Plan. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20210002404 [accessed: 09.04.2025.]
[175] Republic of Poland Law on Construction. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19940890414/U/D19940414Lj.pdf [accessed: 09.04.2025.]
[176] Republic of Poland Act on Electromobility and Alternative Fuels. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000317 [accessed: 09.04.2025.]
[177] Please see: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012L0018 [accessed: 09.04.2025.]
[178] Republic of Poland Law on Aviation. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20021301112/U/D20021112Lj.pdf [accessed: 09.04.2025.]
[179] Republic of Poland Act of 27 March 2003 on spatial planning and development. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20030800717 [accessed: 09.04.2025.]

In forest zones, GH2 infrastructure would face significant constraints. The Act on Forests[180] strictly limits the transformation of forest land for industrial or infrastructure purposes unless reclassified via administrative decision. However, if hydrogen storage infrastructure could be interpreted as energy-related engineering infrastructure—analogous to fuel or EV charging stations—it might be conditionally permissible through detailed planning amendments.

In industrial and service areas, municipalities can allow the development of light industrial facilities, including logistics centres, technology parks, or energy-related infrastructure. GH2 production, if powered by renewable sources and operating with minimal emissions, could potentially fall under the category of "light industry", as long as it does not meet the thresholds for "installation likely to significantly affect the environment" under the Environmental Protection Law[181] and related EIA regulations.

However, hydrogen remains a hazardous substance as defined by the Chemical Substances and Preparations Act[182] and the Seveso III Directive (2012/18/EU) on Major Accident Hazards[183]. Thus, any GH2 storage facility near an airport would require detailed safety planning and risk assessment.

Furthermore, the installation of GH2 infrastructure would also have to respect the aviation safety regulations specified in the Aviation Law[184], particularly if located within the protection zones of navigation aids or flight paths.

From an EU perspective, Directive 2024/1788[185], which introduces legal requirements for hydrogen infrastructure operators, mandates the functional independence of hydrogen storage operators and introduces compliance obligations how GH2 infrastructure is planned, owned, and operated near key transport hubs like airports.

5.6. Protection Zones Aspects related to GH2 Production within the Airport

The siting of hydrogen production facilities within airport areas - such as those in the vicinity of Warsaw Chopin, Gdańsk, or Katowice airports - is subject to multiple restrictions arising from national legislation on aviation safety, spatial planning, environmental protection, and industrial risk management. Key protections are in place to safeguard the operational reliability of aeronautical navigation equipment, airport infrastructure, and public safety.

First, under the Aviation Law[186], airport territories are surrounded by protection and obstacle limitation zones designed to preserve the safe operation of air navigation systems and flight paths. Within these zones, construction activities—particularly involving hazardous or flammable substances like hydrogen - are subject to prior approval by the Civil Aviation Authority. Restrictions often apply to building heights, electromagnetic interference, and land use within set distances from navigational aids and runways.

[180] Republic of Poland Act on Forests. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19911010444/U/D19910444Lj.pdf [accessed: 09.04.2025.]
[181] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 09.04.2025.]
[182] Republic of Poland Act on Chemical Substances and Preparations. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20110630322 [accessed: 08.04.2025.]
[183] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC. Available at: https://eur-lex.europa.eu/eli/dir/2012/18/oj/eng [accessed: 08.04.2025.]
[184] Republic of Poland Law on Aviation. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20021301112/U/D20021112Lj.pdf [accessed: 09.04.2025.]
[185] Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC. Available at: https://eur-lex.europa.eu/eli/dir/2024/1788/oj/eng [accessed: 09.04.2025.]
[186] Republic of Poland Law on Aviation. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20021301112/U/D20021112Lj.pdf [accessed: 09.04.2025.]

Second, in accordance with the Environmental Protection Law[187], hydrogen production infrastructure may be classified as a high-risk installation if it exceeds certain thresholds. In such cases, safety zones must be established around the facility. These zones restrict activities such as material storage, construction, or public access. Operators are required to prepare and coordinate risk assessments, emergency plans, and safety documentation with local authorities and airport managers.

Furthermore, the Construction Law[188] and the Spatial Planning and Development Act[189] govern land use decisions. Local zoning plans must reflect the presence of hazardous installations and aviation-specific constraints, potentially limiting the feasibility of locating hydrogen production units within airport boundaries. Any such facility would also need to undergo an EIA and obtain approvals related to fire safety and land restoration duties post-installation work.

Given that hydrogen is classified as extremely flammable, additional precautions are required under the Fire Protection Act[190]. These include regulated distances between hydrogen facilities and other airport functions, as well as provisions for fire access, emergency response planning, and fuel containment.

5.7. Environmental and Safety Regulations regarding Hydrogen Production and Storage

5.7.1. Safety Regulations

Safety regulations for hydrogen production or storage within the territory of Polish airports must comply with both national and international aviation, environmental, and hazardous substance laws, ensuring robust safeguards against the risks posed by hydrogen's flammability and potential environmental impact.

Given the critical role of airports in Poland's transportation infrastructure, it is essential to implement stringent safety measures to mitigate risks related to hydrogen use. Compliance with relevant international standards, such as those set by the ICAO and EASA, is mandatory to ensure the safe integration of hydrogen in aviation activities. These regulations aim to address safety risks associated with air traffic, airport operations, and the infrastructure that supports them, including hydrogen production and refuelling systems.

In Poland, national aviation laws, particularly the Aviation Law,[191] focus on ensuring the safety of aviation operations, and although they primarily address aircraft safety, they also impose safety requirements for infrastructure within airport territories. This includes the management of hydrogen-related activities to ensure that potential disruptions to airport operations are prevented. The Fire Protection Act[192] and the Chemical Substances and Preparations Act[193] impose additional safety obligations, particularly for hydrogen storage and handling.

In relation to fire safety regulations, it is essential to emphasize the specific requirements set forth under Polish Fire Protection regulations, particularly in connection to hydrogen facilities located within or near airport premises. A critical component of the permitting process involves obtaining design approvals and commissioning

[187] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 09.04.2025.]
[188] Republic of Poland Law on Construction. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19940890414/U/D19940414Lj.pdf [accessed: 09.04.2025.]
[189] Republic of Poland Act of 27 March 2003 on spatial planning and development. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20030800717 [accessed: 09.04.2025.]
[190] Republic of Poland Act on Fire Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU19910810351 [accessed: 08.04.2025.]
[191] Republic of Poland Law on Aviation. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20021301112/U/D20021112Lj.pdf [accessed: 08.04.2025.]
[192] Republic of Poland Act on Fire Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU19910810351 [accessed: 08.04.2025.]
[193] Republic of Poland Act on Chemical Substances and Preparations. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20110630322 [accessed: 08.04.2025.]

acceptance from the State Fire Service. This regulatory pathway is distinct and mandatory, and it has a direct impact on both the technical design of the facility and the overall project timeline.

Furthermore, safety requirements are also integrated into the EIA process, which evaluates the potential risks of hydrogen production and storage within airport premises. As part of this process, the Environmental Protection Law[194] requires an assessment of the environmental impact, including the identification of high-risk facilities and activities, ensuring that environmental hazards are effectively managed.

A multi-layered approach that combines aviation safety regulations, chemical safety, fire prevention measures, and environmental assessments ensures a comprehensive risk evaluation for hydrogen-related activities. However, the absence of specific guidelines for hydrogen production and storage within the airport context underscores the need for more tailored safety regulations. These regulations should be designed to ensure the safe integration of hydrogen activities within the airport infrastructure without compromising airport security, functionality, or operational continuity.

5.7.2. EIA Procedure

The EIA procedure constitutes a fundamental component of Poland's environmental protection legal framework, serving as a critical mechanism to ensure that economic activities align with environmental preservation objectives. The Environmental Protection Law[195] explicitly requires the application of the EIA procedure for projects that may have significant environmental impacts.

The law stipulates that an EIA is mandatory for activities likely to cause substantial adverse environmental consequences, particularly in sectors such as energy production, infrastructure development, and industrial operations. This requirement is not limited to large-scale traditional projects but also extends to any activity that may result in significant emissions or other harmful environmental effects, including the production of GH2 and the development of aviation infrastructure.

The EIA procedure in Poland commences with a screening process to determine whether a proposed project exceeds specific environmental impact thresholds. Projects that meet these criteria are obligated to prepare a comprehensive Environmental Impact Report (EIR), which must assess potential impacts on air and water quality, noise levels, land use, biodiversity, and public safety, alongside proposed mitigation measures. Public participation is a mandatory aspect of the process, affording stakeholders the opportunity to review and provide comments on the proposed project, thereby ensuring that the decision-making process is inclusive and considers a broad spectrum of viewpoints.

The application of the EIA procedure to emerging technologies, such as hydrogen production, storage, and aviation infrastructure, presents unique challenges. Existing regulations do not fully address the environmental impacts associated with these technologies, creating potential gaps in assessing risks, such as hydrogen leakage and the safety concerns related to its flammability. As these sectors evolve, the EIA procedure will require adaptation to address these emerging risks, ensuring that it continues to fulfil its essential role in protecting environmental integrity while facilitating technological advancement.

5.7.3. Pollution Permits

To obtain an air pollution permit for activities involving GH2 in Poland, operators must submit a detailed application under the Environmental Protection Law[196]. The application must provide comprehensive details on emission sources, the types of pollutants produced, and dispersion modelling to assess the potential

[194] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 08.04.2025.]
[195] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 08.04.2025.]
[196] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 08.04.2025.]

environmental and health impacts. If the hydrogen-related activities result in emissions that could exceed air quality standards or involve hazardous pollutants, obtaining a permit is mandatory.

The air pollution permit will establish specific emission limits and may require operators to implement the best available techniques to minimize environmental risks. Although hydrogen itself is not classified as a pollutant under Polish law, its use—such as in combustion—can lead to the release of regulated pollutants, like nitrogen oxides. The emissions from such activities must comply with air quality standards.

A significant challenge is the lack of clear regulatory thresholds for hydrogen emissions, creating ambiguity in the permit process. While the combustion of hydrogen might generate pollutants that are subject to regulation, the absence of specific legal parameters for hydrogen complicates both the permit application and enforcement of emissions standards.

5.7.4. Requirements for Chemical Substances

GH2 is classified as a hazardous chemical substance due to its highly flammable nature, necessitating stringent safety measures for its storage, handling, and use, especially in aviation and airport sectors. Entities involved in hydrogen-related activities must carry out comprehensive risk assessments to identify potential hazards and implement appropriate safety measures to minimize risks associated with its use.

In line with EU legislation, including the Seveso III Directive (2012/18/EU) on Major Accident Hazards[197], facilities that store or use significant quantities of hydrogen are required to implement robust safety management systems. These systems must include risk assessments, continuous monitoring, emergency response plans, and access control to hazardous areas to ensure safe operations.

Hydrogen must be properly packaged and labelled according to safety standards, with clear hazard warnings and appropriate symbols to indicate its flammability and other risks. Suppliers and users are obligated to maintain detailed records of the quantities, properties, and safety measures associated with hydrogen, which must be made available to relevant state authorities for inspection and compliance checks.

The storage and transport of hydrogen must comply with strict safety regulations designed to prevent leaks or uncontrolled releases. This includes the use of pressure-rated containers and specially designed storage facilities to safely handle hydrogen under varying conditions.

Polish authorities, including the Ministry of Climate and Environment and the State Labour Inspectorate, oversee the enforcement of these regulations through inspections, compliance checks, and sanctions for non-compliance. Entities failing to meet safety standards may face penalties, including fines or operational restrictions.

While Poland's regulatory framework for GH2 is comprehensive, its classification as a dangerous substance means it is subject to rigorous safety controls. As the hydrogen economy continues to evolve, it is expected that additional regulations may be developed to address emerging challenges, particularly in sectors like aviation, to ensure the safe integration of hydrogen technologies.

5.7.5. Construction Regulations regarding Hydrogen Production and Storage

According to the Construction Law[198] and the implementing regulation on the technical conditions to be met by buildings and their location, industrial structures used for the production, processing, or storage of flammable gases—such as hydrogen—are subject to heightened regulatory oversight due to their classification as complex, hazardous installations. Facilities involving high-pressure hydrogen storage tanks or chemical processing units

[197] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC. Available at: https://eur-lex.europa.eu/eli/dir/2012/18/oj/eng [accessed: 08.04.2025.]

[198] Republic of Poland Law on Construction. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19940890414/U/D19940414Lj.pdf [accessed: 08.04.2025.]

are typically treated as special purpose engineering structures, requiring full building design documentation, fire protection assessments, and specialist technical expertise during the permitting process.

In addition, if stationary tanks or pipelines are used for hydrogen storage in quantities exceeding 2.5 m^3, the installation is classified as a hazardous facility under the Fire Protection Act[199]. This classification triggers a set of strict safety requirements, including:

- compliance with explosion and fire zone classifications (ATEX);
- consultation with the State Fire Service during the design and permitting stages;
- and implementation of advanced fire suppression and detection systems.

Moreover, hydrogen infrastructure typically falls under the supervision of the UDT, pursuant to the Act on Technical Inspection[200]. This law governs the registration, certification, and periodic inspection of pressure vessels, pipelines, and storage systems used for hazardous substances, ensuring technical compliance and operational safety. All hydrogen-related installations must be reported to Office of Technical Inspection and are subject to mandatory technical supervision throughout their lifecycle.

For hydrogen infrastructure located within or near airport zones, additional spatial restrictions apply under the Aviation Law[201]. Construction within designated airport protection zones—particularly near runways—requires compliance with airfield safety criteria, including height limits, reflectivity controls, and clearance zones for flight operations. Structures exceeding 50 meters above ground level, or any construction within a defined airport obstacle limitation surface, require prior notification to the minister responsible for transport.

5.7.6. Liability in Environmental Protection

Pursuant to the Environmental Protection Law[202] and in accordance with the Act of 13 April 2007 on the Prevention and Remediation of Environmental Damage[203], the operator of an installation is held liable for environmental damage or the imminent threat thereof, regardless of fault, when the damage results from:

- Conducting activities considered particularly hazardous to the environment, including operations covered by integrated permits or involving the use of dangerous substances; and
- The production, processing, storage, transport, or use of hazardous chemical substances, such as hydrogen, which—due to its physical and chemical properties—poses a high risk of fire, explosion, or contamination in the event of an uncontrolled release.

This regime reflects the strict liability principle embedded in Polish and EU environmental law, consistent with the broader "polluter pays" principle. In the case of hydrogen production, storage, or handling—especially within sensitive locations like airports—the operator bears full legal responsibility for preventing environmental harm, irrespective of negligence or intent.

Consequently, entities involved in hydrogen-related operations are required to undertake comprehensive risk assessments, implement effective safety and environmental management systems, and maintain emergency response plans. Failure to do so not only trigger administrative liability (e.g., environmental restoration orders,

[199] Republic of Poland Act on Fire Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU19910810351 [accessed: 08.04.2025.]
[200] Republic of Poland Act on Technical Inspection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20001221321/U/D20001321Lj.pdf [accessed: 08.04.2025.]
[201] Republic of Poland Law on Aviation. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20021301112/U/D20021112Lj.pdf [accessed: 08.04.2025.]
[202] Republic of Poland Law on the Environmental Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20010620627/U/D20010627Lj.pdf [accessed: 08.04.2025.]
[203] Republic of Poland Act of 13 April 2007 on the Prevention and Remediation of Environmental Damage. Available at: https://www.fao.org/faolex/results/details/en/c/LEX-FAOC087261/ [accessed: 08.04.2025.]

fines) but may also result in civil or criminal liability under applicable provisions of the Criminal Code[204] and Water Law[205], if damage to natural resources or human health occurs.

This strict liability framework reinforces the importance of preventative action and ongoing environmental monitoring as a legal obligation—not merely as a best practice—to ensure full compliance with Poland's environmental protection regime.

5.7.7. Summary and Conclusions on Polish Regulations on Hydrogen Production

Poland lacks hydrogen-specific safety regulations for use in aviation, leading to regulatory uncertainty despite the existence of general legal frameworks addressing fire protection, environmental protection, and aviation infrastructure. Environmental regulations, including those under the Environmental Protection Law, require EIA, but these procedures are not yet fully adapted to account for the specific risks posed by hydrogen, such as flammability and explosion hazards. While pollution permits regulate certain emissions, hydrogen itself is not explicitly classified as a pollutant, creating ambiguity in terms of emission thresholds and compliance standards.

As an extremely flammable gas, hydrogen falls under the legal category of a hazardous chemical substance, requiring compliance with strict safety and technical requirements for storage, handling, and transport. However, the lack of hydrogen-specific technical guidelines contributes to administrative complexity.

The construction of hydrogen-related infrastructure at or near airports faces additional challenges due to dispersed oversight among authorities, such as the Civil Aviation Authority, fire services, and the UDT. The absence of unified technical and spatial planning standards tailored to hydrogen facilities leads to delays and inconsistent interpretations during the permitting process. While liability for environmental damage caused by hydrogen operations is clearly defined under strict liability principles in Polish law, there are no dedicated GH2-specific liability mechanisms or protocols.

Overall, Poland's regulatory system offers a functional base for the oversight of hydrogen technologies, but it requires targeted updates and harmonization to effectively address the unique environmental, safety, and infrastructure demands associated with GH2 deployment, particularly in aviation contexts.

5.8. Polish Regulations on Hydrogen Transportation

5.8.1. Hydrogen Transportation via Natural Gas Pipelines

At present, Polish legislation does not explicitly regulate the transportation of GH2 via natural gas pipelines, including in contexts such as airport infrastructure or aviation applications. However, Poland's evolving energy framework—particularly in line with Directive (EU) 2024/1778[206] - is gradually opening up avenues for integrating renewable gases, including hydrogen, into the national gas system.

Under the Polish Energy Law[207], recent amendments have introduced legal recognition of hydrogen as a gaseous fuel that may be distributed using existing gas infrastructure, although specific operational guidelines remain under development. The law does not yet clarify the technical or safety thresholds required for hydrogen injection or blending into the natural gas network, nor does it distinguish between grey, blue, or GH2. This

[204] Republic of Poland Criminal Code. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970880553/U/D19970553Lj.pdf [accessed: 08.04.2025.]
[205] Republic of Poland Law on Water. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20170001566/U/D20171566Lj.pdf [accessed: 08.04.2025.]
[206] Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC. Available at: https://eur-lex.europa.eu/eli/dir/2024/1788/oj/eng [accessed: 08.04.2025.]
[207] Republic of Poland Law on Energy. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970540348/U/D19970348Lj.pdf [accessed: 08.04.2025.]

creates a level of regulatory uncertainty that poses challenges for infrastructure planning—especially in critical zones such as airport areas.

Poland's Hydrogen Strategy until 2030[208] with a perspective until 2040 anticipates the future use of the gas system for transporting hydrogen blends of up to 10% by volume by the end of the decade. Despite this strategic vision, no binding regulations or technical standards currently exist regarding the retrofitting of existing gas pipelines or the material compatibility assessments necessary to safely accommodate hydrogen. Technical issues such as hydrogen embrittlement, leak detection, and pressure management remain largely unaddressed in national legislation.

The Act on Electromobility and Alternative Fuels[209] classifies hydrogen as an alternative fuel but focuses primarily on end-use (e.g., fuel stations and vehicles), with limited reference to upstream infrastructure like pipeline transport. Moreover, the physical structure of Poland's gas transmission and distribution network—managed by operators such as GAZ-SYSTEM—has yet to undergo public evaluation concerning its readiness to handle hydrogen, whether through blending or dedicated infrastructure.

From a governance and market access perspective, current gas market rules in Poland, including third-party access provisions, would need to be revised to allow hydrogen network use. The requirements under Directive (EU) 2024/1778—such as ensuring non-discriminatory access, infrastructure planning for renewable gases, and blending limits—have yet to be fully transposed into national law or operationalized by transmission system operators.

In the specific context of airports, such as Warsaw Chopin Airport or regional facilities like Gdańsk or Katowice, no known pilot programs or regulatory mechanisms are in place to facilitate the delivery of hydrogen via pipelines. This highlights a significant coordination gap between aviation infrastructure planning and national gas strategy implementation.

5.8.2. Hydrogen Transportation via Road Transport

Alternative methods for hydrogen delivery, such as road transport, are governed by a set of laws and regulations designed to ensure safety, particularly because hydrogen is classified as a dangerous good. The transportation of hydrogen via road must comply with several key pieces of legislation, including the Act on the Transport of Dangerous Goods[210] and the ADR[211].

The Act on the Transport of Dangerous Goods establishes the fundamental framework for the safe transportation of hazardous substances, including hydrogen, within Poland. It mandates compliance with international treaties, such as the ADR, as well as national regulations governing road, rail, sea, and air transport. This act emphasizes the need for safety measures in the handling, packaging, and transportation of hazardous materials to prevent accidents and mitigate risks.

Hydrogen transport also falls under the scope of the ADR Agreement, which sets out uniform international standards for the safe road transportation of dangerous goods. The latest amendments to the ADR entered into force in 2023, and they further clarify the safety protocols necessary for transporting hydrogen. The ADR stipulates that vehicles used for transporting dangerous goods must meet specific construction and safety standards, and drivers must be trained to handle emergency situations involving hazardous materials.

Moreover, vehicles used for the transportation of hydrogen must undergo regular inspections to ensure compliance with the safety standards outlined in the ADR. This includes obtaining certificates of conformity for

[208] Ministry of Climate and Environment. 2030 Polish Hydrogen Strategy. Available at: https://energy.ec.europa.eu/document/download/e63cb8ff-2a56-4f0b-98f6-59b4e15cf3f7_en?filename=8_-_polish_hydrogen_strategy_draft_presentation.pdf [accessed: 08.04.2025.]
[209] Republic of Poland Act on Electromobility and Alternative Fuels. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180000317 [accessed: 08.04.2025.]
[210] Republic of Poland the Act on the Transport of Dangerous Goods. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20112271367 [accessed: 08.04.2025.]
[211] The Agreement concerning the International Carriage of Dangerous Goods by Road. Available at: https://unece.org/transport/road-transport/about-adr [accessed: 09.04.2025.]

the vehicles, which confirm that they meet the technical and safety requirements for transporting dangerous goods, as specified in Chapter 9 of the ADR.

In the context of hydrogen transportation within specific zones, such as airports, additional regulations apply. While the general requirements of the transport of dangerous goods are applicable, the Aviation Security Regulation and the respective airport's internal safety guidelines must also be followed. These regulations provide further safety measures for the transportation of hazardous materials within the airport area, ensuring that hydrogen is transported safely without compromising aviation security.

5.8.3. Summary and Conclusions on Polish Regulations on Hydrogen Transportation and Safety Regulation

Poland currently lacks explicit regulations for transporting GH2 via natural gas pipelines. While the Energy Law and Directive (EU) 2024/1778 lay a foundation by recognizing hydrogen as a gaseous fuel, technical standards for safe integration—such as blending thresholds, material compatibility, and pressure management—are still under development. Poland's Hydrogen Strategy envisions limited hydrogen blending by 2030, but no clear framework exists for infrastructure retrofitting or aviation-related pipeline delivery, leaving significant regulatory and operational gaps, especially in airport contexts.

In contrast, road transport of hydrogen is well-regulated under the Act on the Transport of Dangerous Goods and the ADR Agreement, which set comprehensive safety, packaging, vehicle, and driver requirements. Vehicles must be certified and equipped according to ADR standards, and operators must follow strict procedures to mitigate risks. Additional airport-specific safety protocols apply within aviation zones, making road transport the more immediately viable option for hydrogen delivery in Poland.

5.9. Polish Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

While there are no specific regulations currently addressing hydrogen-powered vehicles or aircrafts, the legal framework does cover the refuelling infrastructure for hydrogen vehicles. Key regulations, such as the Act on Electromobility and Alternative Fuels[212] and the Road Traffic Law[213], lay the foundation for the development of hydrogen-powered vehicles and infrastructure, although they mainly focus on the integration of hydrogen as an alternative fuel rather than detailing specific hydrogen refuelling station requirements. However, operators are required to adhere to evolving international safety and engineering standards, such as ISO 14687, ISO 19880-1, and IEC standards for purity and refuelling safety.

For refuelling infrastructure, Poland's Hydrogen Strategy until 2030 aims for the establishment of hydrogen fuelling stations, including those for vehicles. These stations must comply with general technical standards, including safety regulations concerning the storage and handling of hydrogen. As for safety, ISO 19880-1:2020 provides key guidelines for hydrogen refuelling stations, setting standards for infrastructure safety and performance. The stations must ensure the hydrogen purity levels, as outlined in ISO 14687, to prevent fuel cell degradation in vehicles, particularly in high-demand sectors like airport operations for GSE and potential hydrogen-powered aircraft. These standards support the safe integration of hydrogen in airport environments, ensuring scalability and compliance with safety protocols.

Additionally, refuelling stations with hydrogen storage exceeding one tonne are considered high-hazard installations under Polish regulations. As such, they must comply with fire protection regulations[214] and the

[212] Republic of Poland Act on Electromobility and Alternative Fuels. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20240001853 [accessed: 09.04.2025.]
[213] Republic of Poland Law on Road Traffic. Available at: https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970980602/U/D19970602Lj.pdf [accessed: 09.04.2025.]
[214] Republic of Poland Act on Fire Protection. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU19910810351 [accessed: 09.04.2025.]

technical supervision law[215], which includes conducting regular safety assessments, implementing risk management strategies, and ensuring that all facilities adhere to national fire safety standards[216]. The airport's operational and aviation safety regulations would further require that hydrogen refuelling stations be subject to oversight and compliance with the Aviation Security Regulation and other relevant safety codes.

5.9.1. Summary and Conclusions on Polish Regulations on Fuelling and Usage

Given these existing frameworks, the integration of hydrogen refuelling infrastructure within airports will require careful planning, including infrastructure assessments, feasibility studies, and the development of specific regulations addressing the unique needs of hydrogen refuelling stations in aviation. To ensure safe and efficient integration, further coordination between energy regulators, aviation authorities, and airport operators will be necessary, along with the adaptation of national standards to support hydrogen infrastructure development aligned with Poland's energy transition goals and sustainable aviation objectives.

5.10. Key Findings of Sector-Specific Polish Regulations

Poland's regulatory landscape presents several key considerations for hydrogen implementation at airports. The national framework involves multiple authorities with overlapping jurisdictions, including the Civil Aviation Authority, Transport Regulatory Authority, and Office of Technical Inspection, creating coordination challenges for hydrogen infrastructure development in aviation contexts. This distributed oversight structure contributes to administrative complexity and inconsistent interpretations during the permitting process.

The strategic foundation for hydrogen development is established through national planning documents, particularly Poland's Hydrogen Strategy until 2030 with an Outlook to 2040 and the National Energy and Climate Plan 2021-2030, which identify hydrogen as a critical technology for achieving climate neutrality. Poland's participation in the Northern-Baltic Hydrogen Corridor initiative further strengthens its position within regional hydrogen networks. However, territorial planning regulations present significant barriers, as existing municipal zoning plans typically designate airport-adjacent areas under categories that do not explicitly permit hydrogen production facilities.

Environmental and safety regulations add substantial complexity, with notable gaps in hydrogen-specific protocols for aviation applications. While the Environmental Protection Law provides a comprehensive framework for EIA, these procedures are not fully adapted to address the unique risks associated with hydrogen, such as flammability and explosion hazards. Similarly, though hydrogen is classified as a hazardous chemical substance under the Chemical Substances and Preparations Act, requiring stringent safety measures, the regulations lack aviation-specific provisions that account for the operational constraints of airports.

Transportation infrastructure presents additional challenges, as Poland has no explicit regulations for hydrogen transportation via natural gas pipelines, despite recent amendments to the Energy Law recognizing hydrogen as a gaseous fuel. While Poland's Hydrogen Strategy anticipates hydrogen blending of up to 10% by volume by 2030, no binding regulations or technical standards currently exist regarding pipeline retrofitting or material compatibility assessments. Road transport of hydrogen is better regulated under the Act on Transport of Dangerous Goods and ADR Agreement, but additional safety protocols are required within aviation zones.

The construction and technical regulatory environment create further obstacles, as hydrogen facilities are classified as complex, hazardous installations under the Construction Law and Fire Protection Act, triggering heightened regulatory oversight and strict safety requirements. These include compliance with explosion and fire zone classifications, consultation with the State Fire Service, and implementation of advanced safety systems, all of which increase project complexity and costs.

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[215] Republic of Poland Act on Technical Supervision. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20001221321 [accessed: 09.04.2025.]

[216] Republic of Poland Regulation of the Minister of Infrastructure of 9 October 2020 on the control of compliance with regulations and decisions in the field of civil aviation. Available at: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20200001843 [accessed: 09.04.2025.]

For operational aspects such as hydrogen refuelling and vehicle use, Poland has established a foundation through the Act on Electromobility and Alternative Fuels, which recognizes hydrogen as an alternative fuel. However, the regulatory framework primarily focuses on general adoption rather than providing detailed requirements for hydrogen refuelling stations in aviation contexts. This gap creates uncertainty for airports seeking to develop hydrogen infrastructure to support GSE or future aircraft applications.

5.11. Identified Regulatory Gaps, Challenges and Roadblocks

Lack of Hydrogen-Specific Legislation and Standards

Poland lacks dedicated legal frameworks and technical standards for hydrogen technologies in aviation, relying on ill-suited existing laws. This creates regulatory uncertainty and inconsistent safety requirements for GH2 infrastructure at airports.

Overlapping Jurisdictions and Prolonged Approvals

Multiple regulatory bodies (e.g., Civil Aviation Authority, Technical Regulatory Authority, local fire services) with overlapping oversight cause coordination challenges, inconsistent interpretations, and extended project approval timelines, delaying GH2 infrastructure deployment.

Zoning and Safety Zone Ambiguity

Unclear land-use classifications and undefined safety zones for hydrogen infrastructure in municipal plans near airports complicate development. Developers often adopt conservative approaches, locating facilities outside restricted zones (e.g. as seen in Poznań's strategy).

Fuel Handling and Pipeline Integration Gaps

Unlike established protocols for traditional aviation fuels (e.g., Poznań-Ławica's kerosene guidelines), GH2 lacks structured instructions for storage, transport, and safety. Additionally, Poland's Energy Law lacks clear thresholds for hydrogen injection into gas networks, creating planning uncertainty.

Environmental and Emission Assessment Challenges

Current EIA procedures are not tailored for hydrogen's unique risks (e.g., flammability, explosion hazards), and unclear emission thresholds complicate pollution permits and enforcement.

Investment and Funding Barriers

High initial costs for GH2 production and storage, combined with a lack of dedicated funding mechanisms beyond general allocations in the National Recovery and Resilience Plan, hinder infrastructure development at airports.

Workforce and Liability Preparedness Gaps

A skills gap in hydrogen technology operation requires workforce development programs tailored to aviation. Additionally, while strict liability for environmental damage exists, GH2-specific liability mechanisms and insurance frameworks for airport environments are absent.

A lack of liability mechanisms is a very important roadblock, as even where the airport managing body is supportive of a hydrogen-related development, it remains legally obligated to adhere to established procedures and regulatory frameworks. This includes compliance with applicable safety, environmental, and operational standards. The formal responsibilities and procedural limitations imposed on the airport managing body constitute a significant component of the overall permitting. This can create long permitting and implementation processes for new technologies.

GH2 Certification and Scalability Issues

Poland lacks robust mechanisms to certify renewable-produced hydrogen, complicating supply chain traceability. Current regulations also fail to streamline administrative processes for scaling GH2 storage from demonstration projects to commercial implementation.

Cross-Border and Technological Adaptability Challenges

Regulatory harmonization issues in initiatives like the Northern-Baltic Hydrogen Corridor limit cross-border hydrogen connectivity. The regulatory framework also lacks flexibility to accommodate rapidly evolving hydrogen technologies, stifling innovation in aviation.

5.12. Recommendations

Poland's regulatory framework for GH2 in aviation, while robust in its general environmental and safety provisions, requires targeted enhancements to fully support the integration of this emerging technology in airport operations. The following recommendations, each with a specific focus, build on the existing foundation to address critical gaps in legislation, coordination, infrastructure, environmental compliance, transportation, and international alignment, ensuring a cohesive and scalable approach to GH2 adoption.

Establish a Hydrogen-Specific Legal Framework

Current laws adapt existing provisions for hazardous substances and alternative fuels, creating ambiguity for aviation applications. A dedicated legal code, developed by the Ministry of Climate Affairs in collaboration with the Civil Aviation Authority, is needed to define precise safety, storage, and operational standards for hydrogen production and refuelling infrastructure at airports. This framework should integrate international benchmarks, such as ISO standards for hydrogen purity and refuelling safety, to align with global aviation practices.

However, when creating or updating relevant legislation, Poland should include provisions that ensure future flexibility for liquid hydrogen deployment, avoiding overly rigid frameworks that could inadvertently create barriers to liquid hydrogen infrastructure or operations in later stages of hydrogen market development.

Responsible authorities:	Time of completion:
Government	2027 - 2028

Strengthen Hydrogen Transportation Regulations

The absence of clear rules for injecting hydrogen into natural gas pipelines creates uncertainty for aviation supply chains. The Ministry of Energy should accelerate the adoption of technical standards for pipeline retrofitting, addressing issues like hydrogen embrittlement and leak detection. For road transport, existing regulations under the Act on the Transport of Dangerous Goods and ADR Agreement should be supplemented with airport-specific protocols to ensure safe delivery within aviation zones. A clear transportation framework would support reliable hydrogen supply to airports, aligning with Poland's Hydrogen Strategy goals.

Responsible authorities:	Time of completion:
Ministry of Climate and Environment	2027 - 2028

Align with International and EU Standards

Poland's participation in initiatives like the Northern-Baltic Hydrogen Corridor requires regulatory harmonization to enable cross-border connectivity. The Ministry of Climate Affairs should continue to transpose EU directives, such as Directive 2024/1788, into national law to ensure compliance with hydrogen infrastructure standards. Adopting flexible regulations that accommodate evolving hydrogen technologies will support innovation and scalability in aviation. Collaboration with international bodies like ICAO and EASA will ensure Poland's framework aligns with global aviation safety and sustainability objectives, enhancing its position in the regional hydrogen economy.

Responsible authorities:	Time of completion:
Ministry of Climate and Environment	2027 - 2028

Enhance Environmental and Safety Regulations

EIA procedures do not fully account for hydrogen-specific risks, such as leakage or flammability. The Ministry of Climate Affairs could explore updating these guidelines to include tailored risk assessments and mitigation strategies for aviation contexts. Fire safety protocols under the Fire Protection Act should mandate advanced detection and suppression systems for hydrogen facilities, developed with the State Fire Service. Establishing precise emission thresholds for hydrogen-related activities, such as combustion byproducts, would clarify air pollution permit requirements, ensuring robust environmental and safety management.

Responsible authorities:	Time of completion:
Ministry of the Interior and Administration	2027 - 2028

Boost Infrastructure and Workforce Development

High upfront costs and limited funding deter hydrogen projects at airports. The Ministry of Energy could explore expanding allocations within the National Recovery and Resilience Plan to prioritize hydrogen electrolysers, storage systems, and refuelling stations at key aviation hubs. The proposed Hydrogen Competence Center should develop specialized training programs for airport personnel, focusing on safe handling and maintenance of hydrogen technologies. Pilot projects at regional airports, supported by public-private partnerships, could test scalability and inform national standards, addressing investment and skill gaps.

Responsible authorities:	Time of completion:
Relevant non-governmental organizations	2026 - 2027

Streamline Regulatory Coordination

The involvement of multiple authorities, including local fire services, technical inspection bodies, and aviation regulators, can lead to inefficiencies and inconsistent interpretations. Establishing a national Hydrogen Coordination Agency, overseen by the Minister Responsible for Transport, would centralize decision-making and harmonize permitting processes. This agency could act as a single point of contact for developers, ensuring cohesive addressing of environmental, safety, and aviation requirements. Regular stakeholder forums involving airport operators and energy regulators would further align priorities, minimizing delays and enhancing efficiency in infrastructure deployment.

Responsible authorities:	Time of completion:
Government	2028 - 2030

Territorial Planning and Zoning

Municipal zoning plans currently prioritize aviation and transport functions, excluding industrial activities like hydrogen production. The Ministry of Construction, Spatial Planning and Housing should revise these plans to designate hydrogen facilities as permissible uses in technical or industrial zones near airports. Utilizing the legal mechanism for projects of strategic national importance could fast-track hydrogen initiatives by granting exemptions from restrictive zoning rules. Defining safety zones around hydrogen installations, integrated with aviation protection areas, would enhance planning certainty and ensure safety compliance.

Responsible authorities:	Time of completion:
Co-operation between local non-governmental organization work groups and Government	2028 - 2030

6.Kingdom of Denmark

6.1. Executive Summary on Danish National Legal and Regulatory Framework

Denmark is advancing towards its goal of climate neutrality by 2050, with GH2 seen as a key enabler for decarbonizing its aviation sector. This report analyses Denmark's regulatory and institutional framework for integrating GH2 into aviation, highlighting both progress and key gaps. National strategies—such as the Climate Transition Towards 2050, the NECP, and the Power-to-X Strategy— as well as national political agreements - such as the agreement on the Development and Promotion of Hydrogen and Green Fuels and agreements on the framework for the establishment of hydrogen pipeline infrastructure - reinforce Denmark's ambition to scale hydrogen technologies, including their potential role at airports. Local airports have also begun to take part in different Power-to-X collaborations with the hope of finding a sturdy solution for the production of sustainable aviation fuel.

The Danish Energy Agency has set up a dedicated Power-to-X secretariat which is supposed to work as a general contact point for questions on Power-to-X-projects and which can help navigate the many different permits etc. necessary for different projects.

While Denmark has aligned core legislation like the Gas Supply Act with EU directives and taken other steps to promote the possibilities of different Power-to-X projects and solutions, there is currently no dedicated regulatory framework for GH2 in aviation. Current municipality and district plans do not clearly allow for hydrogen production or storage at airports, creating uncertainty in land use and zoning until current plans may be amended. Hydrogen's classification as a hazardous substance adds further complexity under safety and environmental rules.

Key challenges may include a lack of investments in hydrogen projects, hydrogen-specific safety standards for aviation, unclear permitting pathways, and overlapping authority among national and municipal regulators. Denmark has taken some steps towards minimizing the potential overlapping regulatory authorities and lack of coordination between the authorities by setting up a dedicated Power-to-X-secretariat under the Energy Agency, and further steps could be taken in this regard.

6.2. Introduction

Denmark finds itself at a pivotal moment in advancing GH2 aviation infrastructure. The regulatory landscape shaping this nascent sector comprises a sophisticated mesh of EU regulation, national legislation, and sector-specific protocols. While Denmark has demonstrated considerable commitment to energy transition through flagship initiatives - including the Climate Transition Towards 2050, National Energy and Climate Plan (NECP), and an innovative Power-to-X Strategy - some practical vacuums persist in hydrogen production, storage, and distribution domains.

Current regulatory mechanisms predominantly extrapolate from conventional legislation rather than establishing hydrogen-dedicated frameworks. This approach may engender some uncertainty regarding authorization procedures and planning requirements. Complexities multiply at the convergence of aviation security protocols, environmental scrutiny obligations, and hazardous substance management rules and procedures, collectively affecting project viability and implementation timelines.

This examination offers an overall assessment of Denmark's regulatory ecosystem for aviation GH2 integration, highlighting instrumental legislative vehicles such as the Environmental Protection Act, Aviation Act, Planning Act, Gas Supply Act etc. as well as supplementing executive orders. The analysis further illuminates the functional roles of key regulatory entities—particularly the Danish Transport Authority, Danish Energy Agency,

Danish Environmental Protection Agency, Danish Working Environment Authority and others — that collectively orchestrate Denmark's emergent GH2 framework.

Through identification of challenges in cross-agency synchronization, and technical standards integration, this evaluation delivers strategic perspectives for expediting hydrogen adoption channels while preserving consonance with the European Union's comprehensive energy transformation agenda. The insights presented derive from currently operational statutes, furnishing stakeholders with practical intelligence to navigate this dynamic regulatory terrain.

6.3. Key National Regulatory Bodies

6.3.1. Ministry of Climate, Energy and Utilities

The Ministry ultimately holds extensive authority in regulating renewable energy projects by issuing permits and by establishing rules for deployment. The Minister collaborates with other authorities to adapt rules to support renewable energy initiatives. The Ministry administers compensation and subsidy schemes, sets safety and technical standards for infrastructure, and can delegate compliance oversight to authorized entities.[217]

The Minister sets national climate targets every five years with a 10-year perspective, ensuring they remain ambitious, and publishes a corresponding climate action plan. They prepare an annual climate programme for the Danish Parliament, detailing progress on climate goals, planned initiatives, and responses to recommendations from the Council of Climate Change. The Minister assesses whether climate goals are achievable and, if not, proposes new initiatives.[218] These functions enable the Minister to drive strategic climate policies and support innovative energy solutions.

6.3.2. Ministry for Transport

The Ministry exercises broad regulatory authority with implications for transport, transport infrastructure and operations. The Ministry has delegated authority to the Danish Civil Aviation and Railway Authority.

The Minister wields broad regulatory authority over Denmark's aviation sector, with powers relevant to the development and oversight of airport infrastructure. The Minister can issue legislation to implement EU directives and enforce aviation-related EU regulations. They ultimately set requirements and grant permissions for establishing and operating aerodromes and aviation facilities, while also issuing instructions for their maintenance and supervision to ensure safety and compliance. The minister ultimately establishes security measures, emergency preparedness protocols, and rules for aerodrome access and operations. They also oversee compliance with aviation laws, issue permits for specialized aviation activities and may delegate powers to Transport Authority to streamline regulatory processes, facilitating efficient management of airport related projects. The Minister of Transport has established the Accident Investigation Board to investigate aircraft accidents and incidents with the aim of preventing them and Working Environment Council for Aviation. [219]

6.3.3. Minister for the Environment and Gender Equality

The Minister is ultimately responsible for issuing rules on pollution control, waste handling, emissions, and the environmental impact of various substances and activities etc. These rules may apply to both stationary and mobile sources of pollution, such as facilities, transport equipment, and machinery. The minister can ultimately issue regulations on the safe handling, storage, and treatment of specific waste types, including certification for personnel managing such materials, setting environmental quality standards for air, water, and soil, and can ultimately impose coercive fines for non-compliance with reporting or monitoring obligations.[220] The Minister

[217] Kingdom of Denmark, Act on the Promotion of Renewable Energy. Available at: https://www.retsinformation.dk/eli/lta/2024/1031 [accessed: 16.04.2025.]
[218] Kingdom of Denmark, Climate Act. Available at: https://www.retsinformation.dk/eli/lta/2021/2580 [accessed: 29.04.2025.]
[219] Kingdom of Denmark, Aviation Act. Available at: https://www.retsinformation.dk/eli/lta/2024/118 [accessed: 16.04.2025.]
[220] Kingdom of Denmark, Environmental Protection Act. Available at: https://www.retsinformation.dk/eli/lta/2024/1093 [accessed: 16.04.2025.]

also oversees environmental regulations impacting energy infrastructure projects in energy parks. The minister can assume municipal powers under multiple acts for initiatives involving wind turbines, solar cell plants, or associated facilities.[221]

It also establishes coordinated procedures for environmental assessments and sets detailed rules for monitoring programs, including responsibilities for oversight and reporting. The Ministry ensures compliance with international environmental agreements and EU legal acts, conducts cross-border consultations for projects with potential transboundary impacts, and manages information sharing for environmental protection. It may delegate powers to state authorities, define appeal procedures, and amend regulations, except for projects under the Minister for Climate, Energy and Utilities, ensuring comprehensive environmental governance for relevant initiatives.[222]

6.3.4. Council on Climate Change

It is an independent expert body tasked with advising on Denmark's transition to a low-carbon, resource-efficient society by 2050, as mandated by the Climate Act. Comprising eight members and a chairman with expertise in energy, transport, and environmental fields, the Council evaluates Denmark's progress towards national and international climate goals, analyses measures to reduce greenhouse gas emissions, and provides recommendations to shape climate policy. It engages with stakeholders, including businesses and civil society, to ensure its analyses reflect practical realities and technological developments. The Council also contributes to public debate, promoting transparency in climate policy. These functions enable it to influence strategic frameworks for sustainable energy and transport solutions within Denmark.[223]

6.3.5. Danish Civil Aviation and Railway Authority

The Authority oversees critical functions relevant to airport infrastructure development and safety. It maintains the national aircraft register, issues certificates of airworthiness, and approves technical equipment for security checks. It conducts inspections, supervises compliance with aviation regulations, and can delegate inspection powers to aerodrome operators. It issues attestations for approach plans and high-altitude projects, ensuring they do not compromise air traffic safety, and refers complex cases to the Minister of Transport. The Authority enforces aviation safety by setting rules for reporting safety-related events, prohibiting non-compliant aircraft operations, and collaborating with the Accident Investigation Board on accident investigations. It also handles applications and complaints, ensuring adherence to EU regulations, which supports the regulatory framework for aviation facility enhancements.[224]

6.3.6. Danish Energy Agency

The Danish Energy Agency is part of the Ministry of Climate, Energy and Utilities. The Danish Energy Agency is responsible for an ambitious green energy transition with a high share of renewable energy, an efficient energy consumption, a high security of supply and affordable energy prices.[225] The Danish Energy Agency has set up a dedicated Power-to-X secretariat which is supposed to work as a general contact point for questions on Power-to-X-projects and which can help navigate the many different permits etc. necessary for different projects[226].

6.3.7. Danish Environmental Protection Agency

The Agency, under the Ministry for Environment and Gender Equality, oversees environmental regulation.

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[221] Kingdom of Denmark, Act on State-Designated Energy Parks. Available at: https://www.retsinformation.dk/eli/lta/2024/614 [accessed: 16.04.2025.]
[222] Kingdom of Denmark, Executive Order on the Act on Environmental Assessment of Plans and Programmes and of Specific Projects (EIA). Available at: https://www.retsinformation.dk/eli/lta/2023/4 [accessed: 17.04.2025.]
[223] Kingdom of Denmark, Climate Act. Available at: https://www.retsinformation.dk/eli/lta/2021/2580 [accessed: 16.04.2025.]
[224] Kingdom of Denmark, Aviation Act. Available at: https://www.retsinformation.dk/eli/lta/2024/118 [accessed: 16.04.2025.]
[225] Danish Energy Agency: About us. Available at: https://ens.dk/en/about-us/about-danish-energy-agency [accessed: 16.04.2025.]
[226] See https://ens.dk/forsyning-og-forbrug/godkendelser-og-tilladelser-til-ptx-anlaeg [accessed: 28.04.2025.]

6.3.8. Working Environment Authority

Operates under the Ministry of Employment, regulates workplace safety and health, issuing guidance to companies and assisting in drafting regulations and guidelines to enhance working conditions. It can order immediate rectification of unsafe conditions, halt equipment use, ensuring swift action against imminent risks.[227]

6.4. National Planning Documents and Strategies

Denmark's Climate Transition Towards 2050[228] and National Energy and Climate Plan[229] (NECP) outline the country's goal to achieve climate neutrality by 2050, with green hydrogen as a key element in reducing emissions, especially in transport and heavy industries.

The former Government's Power-to-X Strategy[230] as well as other political agreements between different political parties on Power-to-X and hydrogen infrastructure pipelines play a central role in this transition by converting surplus renewable electricity into hydrogen and other energy carriers. This strategy aims to scale up green hydrogen production, expand hydrogen infrastructure, and support export. It also aligns with Denmark's participation in the European Hydrogen Backbone project[231], creating a cross-border hydrogen network.

The NECP sets a target of reducing transport sector emissions by 70% by 2030, with hydrogen fuelling infrastructure and hydrogen-powered vehicles playing a key role. The Danish Energy Agency oversees the development of hydrogen infrastructure through a dedicated Power-to-X-secretariat, while the Danish Green Investment Fund supports financing for hydrogen projects. Hydrogen hubs are planned for industrial zones, ports, and potentially airports, though specific policies for hydrogen at airports are still under development.

6.5. Territorial Planning Aspects related to GH2 Production and Storage

The general framework for local spatial planning and permitted land uses is established under the Planning Act[232], supplemented by detailed municipal planning documents such as municipal plans and district plans. These documents define functional zoning categories and set out which types of development/projects etc. are permitted within each zone.

As of now, neither GH2 production nor GH2 storage facilities are explicitly mentioned as permitted land uses in the standard functional zoning categories established under municipal plans. This presents a regulatory ambiguity, as hydrogen production—although closely related to energy infrastructure—does not currently fall under any designated industrial or energy use category by default in many local planning documents.

For instance, areas surrounding Danish airports, such as Copenhagen Airport in Tårnby Municipality, are commonly designated as transport infrastructure zones within local plans. These zones typically permit uses related to aviation infrastructure, passenger and cargo services, and auxiliary buildings. While service-related or technical infrastructure may be allowed, it will require further scrutiny whether industrial production facilities, such as large-scale electrolysers for GH2, can be permitted under current municipality and district plans.

There is, however, a potential pathway for GH2 storage infrastructure to be interpreted as a permissible use under the category of technical installations or engineering infrastructure, particularly if integrated into aviation-

[227] Kingdom of Denmark, Working Environment Act. Available at: https://www.retsinformation.dk/eli/lta/2021/2062 [accessed: 16.04.2025.]
[228] Danish Council on Climate Change, Denmark's Climate Transition Towards 2050. Available at: https://klimaraadet.dk/sites/default/files/node/field_files/Denmark%27s%20Climate%20Transition%20Towards%202050.pdf [accessed: 14.04.2025.]
[229] Denmark's Integrated National Energy and Climate Plan. Available at: https://climate-laws.org/document/denmarks-integrated-national-energy-and-climate-plan_9ed8 [accessed: 14.04.2025.]
[230] Danish Ministry of Climate, Energy and Utilities, The former Government's strategy for Power-to-X. Available at: https://www.en.kefm.dk/Media/637788859015138974/PtX%20strategi_ENG3.pdf [accessed: 14.04.2025.]
[231] European Hydrogen Backbone. Available at: https://ehb.eu/ [accessed: 14.04.2025.] Denmark and Germany have for instance agreed on a Danish-German hydrogen infrastructure cooperation. Available at: https://www.kefm.dk/Media/638151855536501080/Joint%20Declaration%20Hydrogen%20DNK-DEU%20.pdf [accessed: 25.04.2025].
[232] Kingdom of Denmark, Planning Act. Available at: https://www.retsinformation.dk/eli/lta/2024/572 [accessed: 14.04.2025.]

related operations or designated utility corridors. More realistically, it would however be required to amend municipality plans and/or district plans to allow for a specific mentioning of GH2 storage infrastructure or similar. This will require a political willingness to amend the plans as well as a public consultation process along with potential strategic environmental assessments and a potential environmental approval[233]. The establishment of a GH2 Storage or Production facilities might also require a building permit.

6.5.1. GH2 Production and Storage within the airport

Under the Planning Act[234], all land use within airport zones must comply with municipal and local plans. Most airports in Denmark, such as Copenhagen Airport, are zoned as transport infrastructure areas, primarily intended for aviation-related services and technical infrastructure.[235] Industrial facilities like electrolysis plants for GH2 production typically fall outside the list of permitted primary or secondary uses within such zones. Consequently, establishing a GH2 facility would likely require amendments, cf. section 1.4 above. Specific legislation also exists for the area planning for some airports in Denmark, for instance the Act on the Framework for Land Use at Copenhagen Airport, Kastrup.

Even if zoning is achieved, GH2 infrastructure is subject to stringent environmental and safety requirements. According to the Executive Order on Environmental Assessment of Plans and Programmes and of Specific Projects (EIA)[236], both production and storage installations must undergo EIA, especially within high-sensitivity areas like airports. These assessments evaluate, i.e. the potential risks related to emissions, land use, and safety.

In parallel, the Executive Order on the Control of Major-Accident Hazards Involving Dangerous Substances and the Executive Order on Land-Use Planning Around Risk Establishments which implement parts of the Seveso III Directive[237] - applies to facilities storing or handling hydrogen above defined thresholds. Hydrogen is classified as a hazardous substance, and its storage within airport areas triggers obligations for risk zoning, accident prevention measures, and emergency planning. In such cases, the operator must coordinate with the Danish Environmental Protection Agency and the local fire and rescue services.

From an aviation safety perspective, the Aviation Act[238] introduces additional constraints. Any facility proposed within the airport must comply with obstacle limitation surfaces, electromagnetic interference regulations, and aeronautical protection zones related to navigation systems and flight paths. GH2 plants, which may involve tall structures, high-voltage equipment, or pressure vessels, must be approved by all the relevant authorities in coordination with the airport operator. This ensures that aviation safety and operational continuity are not compromised.

6.5.2. GH2 Production and Storage near the airport

Areas surrounding Danish airports, including those designated for transport and logistics purposes, are often subject to diverse spatial planning categories defined in accordance i.a. with the Planning Act[239] and governed by each municipality's municipal plan and local plan. Depending on the zoning, these areas may be designated for uses such as technical installations, light industrial activity, transport-related infrastructure, or even commercial development.

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[233] More general information on the planning process in relation to Power-to-X-projects is available at: https://veprojekter.dk/sites/default/files/2023-12/Establishing%20Power-to-X%20plants%20-%20a%20regulatory%20guide_finalversion.pdf [accessed: 25.04.2025.]
[234]Kingdom of Denmark, Aviation Act. Available at: https://www.retsinformation.dk/eli/lta/2024/118 [accessed: 16.04.2025.]
Kingdom of Denmark, Planning Act. Available at: https://www.retsinformation.dk/eli/lta/2024/572 [accessed: 14.04.2025.]
[235] Kindly note that special planning legislation exists for Copenhagen Airport.
[236] Kingdom of Denmark, Act on Environmental Assessment of Plans and Programmes and of Specific Projects (EIA). Available at: https://www.retsinformation.dk/eli/lta/2023/4 [accessed: 14.04.2025.]
[237] Kingdom of Denmark, Executive Order on the Control of Major-Accident Hazards Involving Dangerous Substances. Available at: https://www.retsinformation.dk/eli/lta/2016/372 [accessed 28.04.2025], and Executive Order on Land-Use Planning Around Risk Establishments. Available at: https://www.retsinformation.dk/eli/lta/2016/371 [accessed 28.04.2025]. Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC. Available at: https://eur-lex.europa.eu/eli/dir/2012/18/oj/eng [accessed: 14.04.2025.]
[238] Kingdom of Denmark, Aviation Act. Available at: https://www.retsinformation.dk/eli/lta/2024/118 [accessed: 14.04.2025.]
[239] Kingdom of Denmark, Planning Act. Available at: https://www.retsinformation.dk/eli/lta/2024/572 [accessed: 14.04.2025.]

In municipalities with major airports—such as Copenhagen Municipality, Tårnby, or Billund Municipality—the land adjacent to airport boundaries is often zoned as technical installations, industrial areas, or mixed commercial use, which may already allow or be amended to permit energy-related installations. Within these categories, municipal councils can allow infrastructure such as filling stations, vehicle maintenance centres, or power supply facilities, which could serve as an analogical foundation for permitting GH2 storage or fuelling infrastructure.

Hydrogen is classified as a hazardous substance under Danish and EU law, and some requirements are likely to be fulfilled before it can be concluded with certainty whether it is possible to establish hydrogen storage or similar facilities near the specific airports. As some of the Danish airports have already started to explore different collaborations on Power-to-X-solutions in the aviation sector, and given the strong political will supporting the green transition, we are not overly concerned about the possibility of obtaining the necessary permits, provided that the storage facilities are operated safely and responsibly.

The classification of GH2 production near the airport is less straightforward, as such production facility will require a broad range of different assessments and permits to be obtained. A GH2 production facility will possibly also be subject to protection zones as set out in the local planning documents, including around any hydrogen pipe infrastructure, meaning that it is possible that such production facility cannot be made at a near vacancy to the airport.

To enable GH2 integration near or at Danish airports, it may be necessary to revise existing zoning plans, issue sector-specific guidelines, and foster inter-agency coordination. This would include assessing the legal and technical feasibility of establishing hydrogen protection zones in alignment with airport security frameworks and Denmark's broader Power-to-X objectives, and it would require initiation of in-depth risk assessments.

6.6. Environmental and Safety Regulations regarding Hydrogen Production and Storage

6.6.1. Safety regulations

Safety regulations derive primarily from general obligations embedded in the Working Environment Act[240], the Executive Order on control of the risk of major accidents involving hazardous substances[241], and the Executive Order on Technical Regulations for gasses, all of which may affect the procedural, operational, and technical design of facilities dealing with GH2.

These statutes impose mandatory risk assessments, safety documentation, and accident prevention measures before commissioning any hydrogen-related infrastructure. This directly impacts the procedural framework—operators must demonstrate compliance with safety obligations to obtain the necessary permits, triggering involvement from multiple authorities, which may i.a. include the relevant municipality, the Ministry of the Environment local fire and emergency services, the Danish Working Environment Authority etc. Rights and obligations of operators are thereby conditioned by extensive planning, coordination, and notification requirements, especially where hydrogen is classified under high-risk chemical categories.

In practice, the integration of hydrogen raises systemic challenges due to its explosive properties and the lack of sector-specific safety protocols. Current legislation, while comprehensive in principle, may not be fully tailored to the unique technical risks associated with hydrogen use in airside environments, resulting in potential administrative uncertainty and reliance on discretionary authority interpretations.

Hydrogen production may furthermore require registration with the Danish Safety and Technology Authority.

[240] Kingdom of Denmark, Working Environment Act. Available at: https://www.retsinformation.dk/eli/lta/2021/2062 [accessed: 10.04.2025.]
[241] Kingdom of Denmark, Order on control of the risk of major accidents involving hazardous substances. Available at: https://www.retsinformation.dk/eli/lta/2016/372 [accessed: 10.04.2025.]

6.6.2. EIA procedure

The general legal framework governing EIA and Environmental Approvals creates a robust system for environmental oversight but also presents certain challenges. The requirement for an EIA and/or and Environmental Approval arises from a combination of national laws, ensuring that projects with significant environmental impacts, such as GH2 production facilities or aviation infrastructure, undergo thorough assessments. This obligation seeks to evaluate potential environmental risks, including emissions, noise, and air quality degradation, before projects are approved.[242]

However, a key challenge lies in the application of these laws to emerging technologies like GH2. While existing frameworks are well-suited to traditional industries, the evolving nature of GH2 as a clean fuel introduces complexities in assessing its long-term environmental impact, particularly as hydrogen infrastructure is still developing. The current practices may not fully address the specific nuances of GH2 production, storage, and distribution, leading to potential gaps in environmental oversight, and assistance from experts would be needed in the process of carrying out the EIA assessment prior to obtaining an approval.

6.6.3. Pollution permits

National legal framework for pollution permits in aviation and GH2 is built on key environmental laws supplemented by a number of Executive Orders. The Danish Environmental Protection Act[243] regulates pollution across industries, and the relevant minister may decide that pollution permits should be applicable to specific sectors. The Aviation Sector is subject to EU's Emission Trading System and Power-to-X projects may also be subject to the EU's Emission Trading System depending on its production levels.

Although there is no specific GH2 law, Denmark's energy policies support the development of hydrogen infrastructure, including refuelling stations for aviation, all subject to environmental oversight. Local municipalities also issue pollution permits for airport operations and hydrogen facilities, ensuring compliance with air quality and noise regulations, yet in terms of a large-scale project, the decision-making remains in hands of national agencies.

6.6.4. Requirements for chemical substances

The handling, use, and regulation of chemical substances and gasses, including those involved in GH2 production and storage, are primarily governed by obligations arising from the Environmental Protection Act[244], the Emergency Management Act, Chemical Act, the REACH regulation, Executive Order on technical requirements for gasses, and different rules on working environment[245]. These laws impose strict requirements on operators regarding the classification, labelling, storage, and documentation of chemical substances used or generated during hydrogen production processes.

Under these legal obligations, all chemical substances must be assessed for their environmental and health impacts prior to use and in order to ensure a safe handling. Facilities involved in hydrogen production must also implement monitoring systems and safety protocols for any chemical by-products or intermediates that may pose environmental or occupational risks.

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[242] Kingdom of Denmark, Act on environmental assessment of plans and programmes and of specific projects. Available at: https://www.retsinformation.dk/eli/lta/2024/1608 [accessed: 10.04.2025.], and Environmental Protection Act. Available at: https://www.retsinformation.dk/eli/lta/2024/1093 [accessed: 10.04.2025.]

[243] Kingdom of Denmark, Environmental Protection Act. Available at: https://www.retsinformation.dk/eli/lta/2024/1093 [accessed: 10.04.2025.]

[244] Kingdom of Denmark, Environmental Protection Act. Available at: https://www.retsinformation.dk/eli/lta/2024/1093 [accessed: 10.04.2025.]

[245] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1907-20221217 [accessed: 10.04.2025.]

6.6.5. Construction Regulations regarding Hydrogen Production and Storage

The Building Act[246] provides a set of technical and procedural standards for many construction activities, especially in larger scale projects. Before a building permit can be obtained by the relevant municipality, the municipality must ensure that all other applicable rules are followed, which means that the municipality will double-check whether the other necessary permits, such as EIA approval, are obtained.

Operators seeking to establish hydrogen production plants or storage facilities must obtain construction permits through municipal authorities, who assess whether the project complies with applicable technical and environmental standards as well as applicable law. This includes verifying that the facility meets zoning rules and that it aligns with broader urban planning objectives under the Planning Act[247].

However, due to hydrogen's classification as a hazardous substance, additional obligations arise under sector-specific regulations. Construction plans must also satisfy safety requirements under the Danish legislation on hazardous substances and installations, particularly regarding explosion risks, fire safety, and containment systems. This increases procedural complexity, as multiple regulatory interfaces must be navigated simultaneously—especially where hydrogen infrastructure is integrated into aviation or industrial settings.

Challenges stem from the legal system's generality: while the framework anticipates industrial developments, its application may yet fully reflect the specific risks and technical demands posed by emerging hydrogen technologies. This creates interpretive gaps, placing significant discretion with local authorities and increasing uncertainty for investors and developers in the hydrogen sector.

6.6.6. Liability in environmental protection

In Denmark, environmental liability is primarily governed by the Danish Environmental Protection Act and the Environmental Damage Act[248], which establishes the overall framework for assigning responsibility for environmental damage. This Act embodies the "polluter pays" principle, holding that the party responsible for causing pollution is liable for its remediation. Typically, this liability extends for up to 30 years, ensuring that polluters remain accountable for long-term environmental impacts. Denmark has recently set up a taskforce to review whether the liability rules can be improved and whether some current gaps can be minimized[249]. Depending on the circumstances of the specific case, the management of the polluter company may also be held liable.

6.6.7. Summary and conclusions on Swedish Regulations on Hydrogen Production

Assessed regulatory framework requires operators to navigate complex safety and risk assessments, environmental impact evaluations, and permitting processes across multiple authorities. A key obstacle may be the lack of hydrogen-specific protocols, regulatory uncertainty for new technologies, and gaps in oversight that create the risk of inconsistent interpretations by local authorities. This ambiguity increases investment risk and complicates infrastructure development. While some ambiguity may exist, Denmark has created a Power-to-X-secretariat at the Energy Agency which serves as the central contact point for Power-to-X-projects, and which can help with guidance on the applicable rules (both for companies and public authorities). This secretariat has created a step-by-step guide for the approvals etc. that may be necessary to obtain and has also created a task group for the relevant authorities[250].

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[246] Kingdom of Denmark, Building Act. Available at: https://www.retsinformation.dk/eli/lta/2016/1178 [accessed: 10.04.2025.]
[247] Kingdom of Denmark, Planning Act. Available at: https://www.retsinformation.dk/eli/lta/2024/572 [accessed: 10.04.2025.]
[248] Kingdom of Denmark, Environmental Protection Act. Available at: https://www.retsinformation.dk/eli/lta/2024/1093 [accessed: 10.04.2025.], and the Environmental Damage Act. Available at: https://www.retsinformation.dk/eli/lta/2022/482 [accessed: 28.04.2025.]
[249] Please see: https://mim.dk/media/5yemahvv/kommisorium-for-udvalg-om-revision-af-miljoeskadereglerne_webtilgaengeligt-1.pdf [accessed 28.04.2025.]
[250] Please see: https://ens.dk/forsyning-og-forbrug/godkendelser-og-tilladelser-til-ptx-anlaeg [accessed 28.04.2025.]

6.7. Danish Regulations on Hydrogen Transportation

6.7.1. Hydrogen Transportation via natural gas pipelines

In Denmark, the legal foundation for transporting hydrogen via natural gas pipelines was established through the 2022-amendment of the Gas Supply Act[251], which entered into force on 1 January 2023. This amendment formally brought hydrogen infrastructure—whether dedicated or repurposed—under the same regulatory framework that governs methane-based gas systems. Denmark has recently adopted further legislative measures to prepare for hydrogen infrastructure[252].

In April 2025, Denmark has adopted two new Executive Orders on Hydrogen Infrastructure which aim to set out further rules for the organization of the hydrogen market and access to hydrogen transmission and distribution systems. The aim is to ensure stable framework conditions for the hydrogen sector in Denmark, including ensuring that the players in Denmark are made early aware of the frameworks for the use of hydrogen infrastructure[253]. Energinet is set out to play a central role in establishing and operating Denmark's future hydrogen infrastructure, ensuring a strong interaction between the production of green hydrogen and the rest of the energy system.

Denmark's approach is aligned with the European Union Directive 2024/1788 on common rules for the internal market in renewable gas, natural gas, and hydrogen.

Although full transposition of the Directive is due by 2026, Denmark has already laid groundwork through coordinated planning and infrastructure assessments under the Power-to-X strategy. In this context, hydrogen injection into the existing gas network will be subject to both technical standards and operator agreements. Infrastructure owners must ensure compatibility with hydrogen in terms of pipeline materials, pressure capacity, and system monitoring. Coordination with the gas system operator is required to secure connection rights, blending permissions, and access to transmission or storage systems.

As hydrogen is now classified within the regulated gas category, all relevant natural gas safety and maintenance standards apply by analogy unless other rules are adopted. This includes obligations concerning leak detection, pressure testing, and emergency response. Any repurposing or new development must also conform with environmental regulations under the Environmental Protection Act and Act on Environmental Assessment of Plans and Programmes and of Specific Projects etc.[254]

In 2021 the Energy Agency conducted a report on the transportation of gaseous products in new and existing gas infrastructure, which sets out a forecast for hydrogen transition in the period from 2020-2050[255].

6.7.2. Hydrogen Transportation via road transport

The transportation of hydrogen by road is legally classified under the framework governing dangerous goods. Hydrogen is considered a Class 2.1 flammable gas under the ADR Agreement, which Denmark has ratified and implemented through national legislation. The legal basis for such transport is established in the Danish Act on the Transport of Dangerous Goods[256], which integrates ADR requirements into Danish law and applies to all transport of hazardous substances, including hydrogen, on public roads.

Operators transporting hydrogen must adhere to strict requirements concerning vehicle design, driver certification, route planning, and emergency preparedness. Only vehicles that meet ADR certification standards

[251] Kingdom of Denmark, Gas Supply Act. Available at: https://www.retsinformation.dk/eli/lta/2023/1100 [accessed: 14.04.2025.]
[252] See for instance Act no. 341 of 3 April 2025, available at: https://www.retsinformation.dk/eli/lta/2025/341 [accessed: 28.04.2025.]
[253] Please see: https://www.retsinformation.dk/eli/lta/2025/349 and https://www.retsinformation.dk/eli/lta/2025/348 [accessed 28.04.2025.]
[254] Kingdom of Denmark, Environmental Protection Act. Available at: https://www.retsinformation.dk/eli/lta/2024/1093 [accessed: 14.04.2025.] Act on environmental assessment of plans and programmes and of specific projects. Available at: https://www.retsinformation.dk/eli/lta/2024/1608 [accessed: 10.04.2025.]
[255] The report can be found here: https://ens.dk/forsyning-og-forbrug/ptx-strategi-og-politiske-aftaler [accessed: 29.04.2025.]
[256] Kingdom of Denmark, Executive Order on the Road Transport of Dangerous Goods. Available at: https://www.retsinformation.dk/eli/lta/2023/596 [accessed: 14.04.2025.]

for pressurized gas transport are permitted. Drivers must hold a valid ADR certificate specifically covering Class 2 gases, and vehicles must be equipped with the necessary safety features, signage, and documentation, as prescribed by the ADR and enforced nationally by the Danish Road Traffic Authority and the Emergency Management Agency.

The transport of hydrogen by road is also subject to provisions in the Road Traffic Act[257], which governs the movement of vehicles on Danish roads. This includes limitations on vehicle weight, height, and routing for hazardous cargo. In certain cases, special permits and escort services may be required for oversized tankers or for passage through densely populated or environmentally sensitive areas.

Additionally, all hydrogen road transport operations must comply with the Environmental Protection Act[258]. This includes obligations related to preventing environmental damage in the event of a leak or accident, as well as requirements for proper containment and emissions control during loading, unloading, and transit. Operators are responsible for ensuring that transport procedures align with both safety and environmental standards and must notify authorities in the event of any incident involving hydrogen release.

6.8. Danish Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

The Danish foundation for the regulation of hydrogen fuelled vehicles and fuelling systems lies in the EU's Alternative Fuels Infrastructure Regulation (EU 2023/1804) and a supporting technical Executive Order on requirements for publicly accessible infrastructure for alternative fuels that provides the legal basis for establishing public hydrogen refuelling stations etc.[259] Denmark does currently not have any hydrogen refuelling stations, but this is likely to change in the future.

Denmark does not currently have any vehicle-specific technical regulations or requirements for hydrogen propulsion aside from general requirements for vehicles in the Road Traffic Act[260].

In terms of safety and system performance, Denmark relies heavily on international standards. Refuelling stations are therefore expected to comply with standards such as:

- ISO 19880-1:2020 – covering the design, operation, and maintenance of hydrogen refuelling stations;
- ISO 14687 – ensuring hydrogen purity suitable for fuel cell vehicles; and

Hydrogen-fuelled aircraft are not yet addressed under specific Danish regulations, but any hydrogen-based ground support or airside mobility solutions deployed at airports must align with general aviation safety standards, fire codes, and applicable EU aviation safety frameworks.

6.8.1. Summary and conclusions on Polish Regulations on Fuelling and Usage

On paper, Denmark supports hydrogen mobility through legislation focused on refuelling infrastructure, but Denmark has yet to implement many of the necessary infrastructure etc.

In summary, regulatory framework, though still evolving, provides a clear legal foundation for the growth of hydrogen as an alternative fuel. It ensures the safe rollout of refuelling systems and positions the country to scale up its hydrogen mobility sector in alignment with European decarbonization goals.

[257] Kingdom of Denmark, Act on Road Traffic. Available at: https://www.retsinformation.dk/eli/lta/2024/1312 [accessed: 14.04.2024.]
[258] Kingdom of Denmark, Executive Order on the Act on Environmental Assessment of Plans and Programmes and of Specific Projects (EIA). Available at: https://www.retsinformation.dk/eli/lta/2023/4 [accessed: 14.04.2025.]
[259] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R1804 [accessed: 10.04.2025.] Kingdom of Denmark, Executive Order on requirements for publicly accessible infrastructure for alternative fuels, etc. Available at: https://www.retsinformation.dk/eli/lta/2025/381 [accessed: 10.04.2025.]
[260] Kingdom of Denmark, Act on Road Traffic. Available at: https://www.retsinformation.dk/eli/lta/2024/1312 [accessed: 10.04.2024.]

6.9. Key Findings of Sector-Specific Danish Regulations

The strategic foundation for hydrogen development is established through national political agreements, international cooperation and national plans, particularly Denmark's Climate Transition Towards 2050 and NECP, which identify hydrogen as a critical technology for achieving climate neutrality by 2050. Denmark's Power-to-X Strategy plays a central role in this transition by supporting the conversion of surplus renewable electricity into hydrogen, while participation in the European Hydrogen Backbone project strengthens its position within regional hydrogen networks. Although overall legal framework for the most parts is available, some uncertainties still exist regarding Power-to-X-projects, including hydrogen projects and production. It is in particular a challenge to navigate amongst the different needed approvals, protocols and authorisations and finding out which authorities to contact, and it can be burdensome to live up to all the required safety and risk measurements. The authorities might also not be fully ready to address the unique risks associated with hydrogen projects which may create regulatory uncertainty for such new technologies.

6.10. Identified Regulatory Gaps, Challenges and Roadblocks

Lack of explicit zoning provisions for hydrogen infrastructure

Neither GH2 production nor storage facilities are currently explicitly mentioned as permitted land uses in standard functional zoning categories established under municipal plans, districts plans etc., but this can possibly be amended.

Absence of hydrogen-specific safety protocols

Current safety legislation, while comprehensive in principle, is not fully tailored to the unique technical risks associated with hydrogen use in airside environments, resulting in administrative uncertainty and reliance on discretionary authority interpretations.

Regulatory uncertainty for new technologies

The evolving nature of GH2 as a clean fuel introduces complexities in assessing its long-term environmental impact, particularly as hydrogen infrastructure is still developing.

Complex multi-agency approval process

Operators must navigate multiple authorities for permissions, creating procedural complexity as different regulatory interfaces must be navigated simultaneously—especially where hydrogen infrastructure is integrated into aviation or industrial settings. Although, the Energy Agency has taken some steps to minimize these inconveniences, deliberations with multiple authorities will still be necessary.

Inadequate chemical substance classification

The novelty of GH2 technologies may result in regulatory uncertainty, especially in determining whether certain by-products fall under hazardous classifications, and what mitigation strategies are legally required.

Absence of hydrogen-specific aviation regulations

While hydrogen transport and refuelling have some regulatory coverage, hydrogen-powered aircraft are not yet explicitly regulated under Danish aviation law, creating potentially uncertainty for future development.

Interpretive gaps in construction regulations

While the construction framework anticipates industrial developments, it does not yet fully reflect the specific risks and technical demands posed by emerging hydrogen technologies, placing significant discretion with local authorities and increasing uncertainty for investors.

Inconsistent local authority interpretations

The lack of national-level clarification on hydrogen infrastructure leads to potential inconsistencies in how local authorities interpret and apply existing regulations to hydrogen projects.

6.11. Recommendations

An examination of Denmark's regulatory landscape for GH2 use in aviation highlights both promising opportunities and some obstacles, such as existing zoning plans and intricate approval procedures. To facilitate the safe and effective integration of GH2 at Danish airports – while supporting national climate targets and EU energy policies – this report offers recommendations that tackle critical barriers and outline practical measures for advancing hydrogen infrastructure.

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. This would simplify the current fragmented approval landscape where operators must navigate multiple regulatory interfaces simultaneously. 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. Setting clear timelines and procedural pathways would significantly reduce administrative uncertainty and expedite project development.

Responsible authorities:	Time of completion:
Danish Energy Agency	2026 - 2027

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. This would protect both public interests and provide certainty for investors by clarifying liability boundaries, particularly important for novel technologies like hydrogen where risk assessment methodologies are still evolving.

Responsible authorities:	Time of completion:
Danish Environmental Protection Agency	2026 - 2027

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. Collaboration between the Danish Working Environment Authority, Danish Civil Aviation and Railway Authority, and airport operators would ensure comprehensive coverage of both occupational safety and aviation-specific considerations.

However, when creating or updating relevant safety protocols, future flexibility for liquid hydrogen deployment should be ensured, avoiding overly rigid frameworks that could inadvertently create barriers to liquid hydrogen infrastructure or operations in later stages of hydrogen market development.

Responsible authorities:	Time of completion:
Danish Working Environment Authority, Danish Civil Aviation and Railway Authority, Danish Safety Technology Authority	2027 - 2028

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. Establish uniform standards for hydrogen refuelling stations at airports that align with international specifications like ISO 19880-1:2020 and ISO 14687, while accounting for aviation-specific operational needs. These measures would provide technical clarity and investment certainty for airport operators and hydrogen infrastructure developers.

Responsible authorities:	Time of completion:
Danish Energy Agency, Energinet, Danish Utility Regulator	2027 - 2028

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.

Responsible authorities:	Time of completion:
Danish Energy Agency, Ministry of Climate, Energy and Utilities, Municipalities	2027 - 2028

7.Kingdom of Sweden

7.1. Executive Summary on Swedish National Legal and Regulatory Framework

Sweden is at a pivotal stage in its pursuit of a carbon-neutral economy, underpinned by the legally binding Climate Act, which mandates net-zero greenhouse gas emissions by 2045. Within this context, GH2 has been identified as a critical enabler for decarbonizing sectors that are difficult to electrify, including aviation. This section examines the Swedish regulatory framework as it pertains to the deployment of GH2 in aviation infrastructure, highlighting legislative overlaps and identifying key regulatory challenges.

The current legal landscape consists of several statutory instruments—namely, the Environmental Code, Planning and Building Act, Act on Flammable and Explosive Goods, and the Civil Protection Act. While these collectively provide general oversight on issues relating to energy, safety, and infrastructure, they lack provisions specifically tailored to the unique requirements of GH2 production, storage, and usage within airport environments. The absence of hydrogen-specific regulations has introduced legal ambiguities, particularly concerning land use designation, permitting pathways, and safety compliance.

One of the primary regulatory challenges is the lack of a national framework that classifies hydrogen production and storage as distinct land use categories. In the absence of such definitions, municipalities are left to interpret whether GH2 facilities are permissible under existing airport zoning rules, resulting in fragmented and inconsistent applications across jurisdictions. Additionally, environmental permitting processes remain unclear, as hydrogen facilities—although considered environmentally hazardous under the Environmental Code—are not explicitly categorized, complicating the assessment and approval procedures.

Safety regulations further compound these challenges. Due to hydrogen's flammable nature, compliance with ATEX directives and the Act on Flammable and Explosive Goods is required. However, current frameworks do not stipulate hydrogen-specific safety distances or emergency response standards applicable to airport settings, creating uncertainty around protective zoning and risk management. Moreover, transport regulation is currently

incomplete, pending Sweden's full implementation of EU Directive 2024/1778, which will govern hydrogen pipeline transportation more comprehensively.

The cumulative effect of these legislative gaps is a highly complex regulatory environment characterized by overlapping mandates and limited coordination among responsible authorities. This fragmentation is exacerbated by Sweden's strict liability regime under the Environmental Code, which places significant legal and operational risk on developers pursuing GH2 infrastructure projects in aviation contexts.

To address these barriers, there is a pressing need to establish hydrogen-specific legislation that includes standardized land use classifications, harmonized safety requirements tailored to airport operations and clarified environmental permitting processes. Implementing these measures would enhance regulatory certainty, facilitate the development of hydrogen infrastructure, and support Sweden's broader climate objectives while upholding safety and environmental integrity.

7.2. Introduction

Sweden is presently at a critical juncture in the advancement of its GH2 infrastructure for the aviation sector. The regulatory framework applicable to this nascent area reflects a nuanced interaction between EU mandates, national legislative instruments, and sector-specific regulatory provisions. Although Sweden has laid the groundwork through strategic initiatives such as the Climate Act and the National Hydrogen Strategy, there remain substantial regulatory deficiencies—most notably concerning the production, storage, and conveyance of hydrogen within the context of airport operations.

At present, the regulatory framework is predominantly characterized by the application of pre-existing general legislation rather than the enactment of measures specifically tailored to hydrogen technologies. This reliance has resulted in legal ambiguity, particularly with respect to permitting protocols and land-use planning requirements. The complexity is compounded by the overlap among aviation safety regulations, environmental impact assessments, and the legal regime governing the handling of hazardous substances, all of which collectively influence project viability and procedural timelines.

This analysis offers a detailed legal examination of the regulatory environment governing GH2 deployment in Swedish aviation. It places particular emphasis on principal legislative enactments including the Planning and Building Act, the Environmental Code, the Act on Flammable and Explosive Goods, and the Civil Protection Act. In addition, the review delineates the institutional roles of key regulatory authorities instrumental in the oversight and implementation of GH2-related developments within the jurisdiction.

By addressing legal impediments such as ambiguities in land-use categorization, the absence of hydrogen-specific regulatory guidance, and the need for harmonized safety standards, this assessment aims to contribute to the development of a coherent regulatory pathway. Such alignment is critical to facilitating the integration of hydrogen solutions in a manner consistent with the EU's overarching energy transition goals. The conclusions drawn herein are based on the current statutory framework and extant regulatory instruments, providing stakeholders with pragmatic legal insights as Sweden advances toward its binding objective of net-zero greenhouse gas emissions by the year 2045.

7.3. Key National Regulatory Bodies

Some legal acts refer to regulatory bodies in general terms, such as a "supervisory authority" or simply "authority," but they also specify which particular bodies or institutions are to be understood as fulfilling these roles under the respective act. Certain bodies share supervision, regulatory, and compliance functions, which necessitates the use of generalized terms for authorities in legal acts. The Swedish Civil Contingencies Agency

and the County Administrative Board, as supervisory authorities, ensure compliance with laws and regulations governing flammable and explosive goods.[261]

7.3.1. Ministry of Climate and Enterprise

The Swedish Government, through the Ministry, oversees and conducts climate policy work to reduce greenhouse gas emissions and promote environmental functions that mitigate climate change, guided by scientific and technical considerations as delegated in the Climate Act. The Ministry shapes and administers policies to foster sustainable practices and ensure compliance with national climate legislation while the Government together sets emission reduction targets aligned with parliamentary long-term goals, integrates climate and budget policies and prepares a climate policy action plan every four years outlining Sweden's EU and international commitments to achieve national and global climate goals.[262]

7.3.2. Swedish Chemical Agency

The agency has the authority to issue regulations on chemical product handling, including knowledge requirements, precautionary measures, and permit conditions for import, export, and storage. It can grant dispensations from registration and notification obligations, as well as from requirements for safety data sheets and labelling under specific conditions. The agency also enforces compliance with EU regulations, consults with transport authorities on chemical transport regulations, and provides information to the Swedish Environmental Protection Agency to fulfil EU obligations.[263]

7.3.3. County Administrative Board

The Board, as a regional environmental authority, facilitates consultations on plans with significant environmental impacts and assesses permit applications for environmentally hazardous activities and land drainage, as designated by the Government.[264] It oversees permit applications for the professional transfer and non-professional handling of particularly hazardous chemical products. It processes applications for professional transfers within eight weeks, extendable by four weeks if needed for investigation, with applicants notified of any extension.[265] It also had been granted authority to follow and maintain measures to prevent and limit consequences of serious chemical accidents.[266]

Board is the responsible authority that must receive notification from operator at least six weeks before activities and assess whether an activity or measure is likely to have a significant environmental impact.[267] Similarly with activities involving flammable or explosive goods, alongside action programs to prevent serious chemical accidents. For such activities, operators must submit safety reports and internal rescue plans. The Board establishes supervision plans and programs for these activities, ensuring compliance with relevant laws as a supervisory authority, alongside the Swedish Civil Contingencies Agency. It has access to activity sites, can

[261] Kingdom of Sweden, Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-1999381-om-atgarder-for-att-forebygga-och_sfs-1999-381/ [accessed: 17.04.2025.]
[262] Kingdom of Sweden, Climate Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/klimatlag-2017720_sfs-2017-720/ [accessed: 17.04.2025.]
[263] Kingdom of Sweden, Act on Chemical Products and Biotechnical Organisms. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-2008245-om-kemiska-produkter-och_sfs-2008-245/ [accessed: 17.04.2025.]
[264] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 17.04.2025.]
[265] Kingdom of Sweden, Act on Chemical Products and Biotechnical Organisms. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-2008245-om-kemiska-produkter-och_sfs-2008-245/ [accessed: 17.04.2025.]
[266] Kingdom of Sweden, Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-1999381-om-atgarder-for-att-forebygga-och_sfs-1999-381/ [accessed: 17.04.2025.]
[267] Kingdom of Sweden, Environmental Assessment Ordinance. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobedomningsforordning-2017966_sfs-2017-966/ [accessed: 17.04.2025.]

request information, conduct investigations, and take samples. The Board may issue injunctions or prohibitions to enforce compliance.[268]

7.3.4. Swedish Environmental Protection Agency

Agency serves as a supervisory authority, ensuring compliance with environmental regulations as stipulated by the Government. It has the authority to bring court actions to safeguard environmental and public interests. Additionally, when the Land and Environment Court identifies a case of significant public interest, the Agency can request its referral to the Government for further review, facilitating robust oversight and regulatory alignment in environmentally sensitive operations.[269] The agency must consult with other authorities for national-level plans ensuring compliance and coordination state-wide.[270]

The Agency also issues regulations on knowledge requirements, precautionary measures, product choices, product information, and permit conditions to protect the external environment regarding chemical goods. It consults with the Swedish Chemicals Agency and relevant transport authorities when regulations impact transport. It also reviews action plans proposed by the Swedish Chemicals Agency under specific EU regulations, ensuring environmentally safe chemical management in regulated settings.[271]

7.3.5. Swedish Work Environment Authority

The Swedish Work Environment Authority supervises compliance with work environment legislation by accessing workplaces, demanding information, and conducting investigations. It issues injunctions, prohibitions, or fines to enforce safety and REACH regulation compliance, potentially ordering facility shutdowns or product recalls. The Authority assigns work environment responsibilities, mandates safety investigations. It issues regulations on technical devices, substances, and work processes to prevent health risks and accidents. It sets permit requirements for hazardous facilities or substances, mandates safety plans, and regulates employee health monitoring, such as medical examinations and exposure registers.[272]

7.3.6. Swedish Civil Contingencies Agency

The Swedish Civil Contingencies Agency ensures national compliance with the Accident Prevention Act, coordinating and advising municipalities while supervising their adherence. It oversees state authorities, provides regional data to County Administrative Boards, and reviews rescue operation reports. It allocates resources during major rescue operations, mandates participation, and orders corrective actions for non-compliant municipalities.[273]

Agency regulates the transport of chemical products and goods by issuing regulations on knowledge requirements, precautionary measures, and product choices. They must consult the Swedish Chemicals Agency, other transport authorities and the Swedish Environmental Protection Agency when their regulations impact transport, ensuring safe and compliant chemical transport in regulated environments.[274] Regulates permits and general oversight for handling flammable and explosive goods, overseeing related activities to ensure compliance with safety and design standards. It supervises the properties and market release of these goods,

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[268] Kingdom of Sweden, Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-1999381-om-atgarder-for-att-forebygga-och_sfs-1999-381/ [accessed: 17.04.2025.]

[269] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 17.04.2025.]

[270] Kingdom of Sweden, Ordinance on Environmental Impact Assessments. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-1998905-om_sfs-1998-905/ [accessed: 17.04.2025.]

[271] Kingdom of Sweden, Act on Chemical Products and Biotechnical Organisms. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-2008245-om-kemiska-produkter-och_sfs-2008-245/ [accessed: 17.04.2025.]

[272] Kingdom of Sweden, Work Environment Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/arbetsmiljolag-19771160_sfs-1977-1160/ [accessed: 17.06.2025.]

[273] Kingdom of Sweden, Act on Protection Against Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 17.04.2025.]

[274] Kingdom of Sweden, Act on Chemical Products and Biotechnical Organisms. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-2008245-om-kemiska-produkter-och_sfs-2008-245/ [accessed: 17.04.2025.]

coordinates supervisory authorities, and supports their oversight efforts. It also regulates flammable goods transported via pipelines and can issue government-designated regulations, ensuring safe handling and infrastructure compliance.[275]

7.3.7. Municipality

The Municipality manages environmental responsibilities by establishing or modifying plans, investigating their potential significant environmental impacts, and consulting with authorities to determine the need for strategic environmental assessments. It assesses permits for low-impact environmentally hazardous activities and requires permits or notifications for groundwater extraction in water-scarce areas.[276] They determine the accessibility of environmental impact statements in coordination with affected municipalities and evaluate detailed or local plans, including minor changes, using specific criteria.[277]

The municipality oversees permits for handling flammable and explosive goods in cases not managed by the Swedish Civil Contingencies Agency, including storage in movable depots across multiple municipalities. It registers information in the national permit register for explosive goods, ensuring accurate documentation and compliance. 278 It ensures accident prevention, including fire safety, by conducting cleaning and inspections of combustion appliances and ventilation systems, and performing fire safety checks on related infrastructure. It maintains action programs for preventive measures and rescue services, detailing risks, goals, and resource capabilities. The municipality supervises compliance by accessing facilities, issuing injunctions with fines, and taking corrective measures at non-compliant parties' expense. It also informs the public about rescue capacities, investigates accidents, and reports to MSB, while participating in planning and exercises for hazardous substance releases, ensuring safety and regulatory adherence.[279]

Under municipality operates several committees. The Environmental Committee oversees municipal environment and health protection tasks, handling applications for measures reported under the Environmental Code. It coordinates with the Building Committee to streamline case processing, ensuring relevant authorities, organizations, and individuals can provide input simultaneously. Decisions are aligned and announced together, unless special circumstances justify separate handling after consultation. This coordinated approach supports efficient environmental regulation and stakeholder engagement. The Building Committee on the other hand regulates planning and building activities by handling applications for building, demolition, and land permits. It promotes sustainable building practices, monitors development, and collaborates with relevant authorities and organizations. As a supervisory authority, it issues injunctions for unpermitted actions, enforces maintenance investigations, and ensures compliance with regulations.[280]

7.3.8. Land and Environment Court

The Court, as a first-instance court, assesses permit applications for environmentally hazardous activities and water operations not handled by the County Administrative Board or the Municipality, and reviews land drainage cases referred by the County Administrative Board or land surveying authorities. It adjudicates compensation for environmental damage, public intervention, or joint liability, and handles actions for prohibitions, precautionary measures, and group actions. The court refers cases to the Government if activities require specific conditions or involve significant public interest, issues summonses, and bases judgments on inspections,

[275] Kingdom of Sweden, Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 17.04.2025.

[276] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 17.04.2025.]

[277] Kingdom of Sweden, Ordinance (1998:905) on Environmental Impact Assessments. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-1998905-om_sfs-1998-905/ [accessed: 17.04.2025.]

[278] Kingdom of Sweden, Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 17.04.2025.]

[279] Kingdom of Sweden, Act on protection against accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 17.04.2025.]

[280] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 17.04.2025.]

hearings, and case documents. It may also grant rights for installations on others' property for water activities and decide on supervisory authority prohibitions, ensuring compliance with environmental regulations.

7.3.9. Swedish Transport Agency

While the Swedish Aviation Act mentions generally Swedish Government or Government designated authority as the responsible body for overseeing aviation in Sweden, the Agency is the referred body, while in some cases cooperation with Swedish Military Forces is necessary.[281] The Swedish Transport Agency works both nationally and internationally with aviation regulations. Nationally, it is the authority's responsibility to implement regulations that have been developed internationally and to follow up on the consequences of the regulations and design them according to Swedish needs.[282] As mentioned in the Aviation Act authority regulates aviation by issuing standards for aircraft airworthiness, environmental compliance, and flight safety. It grants permits for airport establishment and operations, sets conditions for their use, and enforces compliance through inspections and certificate management. The authority issues regulations on aviation equipment, flight paths, and airport facility access, while also approving air traffic services and ensuring safety requirements are met.[283]

The Agency regulates aviation by overseeing aircraft registration, issuing certificates, and ensuring compliance with safety and operational standards. It supervises air carriers and operators, enforcing different national and EU regulations. The agency has the authority to inspect airports, facilities, and premises, conducting random or necessary checks to verify adherence to aviation laws. It can prohibit flights or prevent aircraft departures if safety conditions are unmet and enforces compliance through measures like public prosecution in specific cases.[284]

7.3.10. Swedish Energy Agency

Similarly, how the Swedish Aviation Act mentions generally Swedish Government or Government designated authority as the responsible body for overseeing aviation in Sweden, the Natural Gas Act does the same for market and system-related oversight. The Swedish Energy Agency oversees energy supply and use, driving Sweden's transition to a sustainable energy system. It administers the Electricity Certificate System and EU Emission Trading System, provides energy efficiency data to households and industries, and coordinates national energy supply security. The Agency funds research on renewable energy technologies, smart grids, and future fuels, while supporting business development for climate tech innovations.[285] The Swedish Government oversees the Agency managing energy supply systems by appointing the system balance entity and defining its tasks to ensure reliable infrastructure. It grants concessions for natural gas pipelines, storage, and gasification plants, regulates exemptions and revocations, and mandates information sharing by transmission operators to maintain system stability, supporting secure and efficient energy supply.[286]

7.3.11. Energy Markets Inspectorate

The Energy Markets Inspectorate is the supervisory authority responsible for overseeing the natural gas market. The Government oversees it to ensure fair, transparent operations. It appoints the supervisory authority under natural gas law, sets market regulations, including cost and return guidelines for gas companies, and mandates transparency through published market data, monitoring plans, and consumer notifications for supply issues. It

[281] Swedish Transport Agency: Airspace. Available at: https://www.transportstyrelsen.se/en/aviation/airport-air-navigation-service-and-airspace/airspace/ [accessed: 17.04.2025.]
[282] Swedish Transport Agency: Laws and regulations. Available at: https://www.transportstyrelsen.se/sv/om-oss/dina-rattigheter-lagar-och-regler/lagar-och-regler/regler-for-luftfart/ [accessed: 17.04.2025.]
[283] Kingdom of Sweden, Aviation Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/luftfartslag-2010500_sfs-2010-500/ [accessed: 17.04.2025.]
[284] Kingdom of Sweden, Aviation Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/luftfartslag-2010500_sfs-2010-500/ [accessed: 17.04.2025.]
[285] Swedish Energy Agency: About us. Available at: https://www.energimyndigheten.se/en/about-us/ [accessed: 17.04.2025.]
[286] Kingdom of Sweden, Natural Gas Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/naturgaslag-2005403_sfs-2005-403/ [accessed: 17.04.2025.]

also establishes appeal processes, fees, and documentation to promote a competitive, compliant energy market.[287]

Inspectorate monitors and analyses electricity, natural gas, and district heating markets, proposing regulatory changes to enhance market functionality. It supervises compliance with the relevant legislation, reviewing permits for electricity and gas pipelines under the Environmental Code. It processes concession applications, conducts legal assessments, and prepares natural gas pipeline cases for Government decisions. It promotes consumer engagement through information and different tools, supports demand flexibility, and participates in Nordic and EU regulatory development, ensuring robust oversight for energy infrastructure projects.[288]

7.4. National Planning Documents and Strategies

The integration of GH2 into Sweden's aviation and airport infrastructure is emerging as a strategic priority aligned with the country's long-term climate and energy goals. Central to this vision is Sweden's Climate Act[289], which establishes a legally binding framework for achieving net-zero greenhouse gas emissions by 2045. This national commitment mandates that public authorities develop and implement measures consistent with the target, thereby providing an overarching legal foundation for the promotion of alternative fuels such as GH2 in hard-to-abate sectors, including aviation.

Sweden's Hydrogen Strategy[290] further reinforces this objective, outlining how hydrogen will contribute to the decarbonisation of heavy industry and transport. Although the strategy does not yet provide detailed regulatory or infrastructural guidance for aviation-specific use cases, it recognises hydrogen as a critical energy carrier. As such, the document leaves scope for future inclusion of airport-based GH2 applications such as aircraft refuelling, hydrogen-powered ground service vehicles, and integration into synthetic aviation fuel production.

On the transport policy front, the National Transport Infrastructure Plan 2022–2033[291] encourages a shift towards fossil-free fuels and underlines the importance of investing in infrastructure to support alternative energy carriers. Although airport infrastructure is not the primary focus, the plan creates legal and financial space for future investment in hydrogen-compatible systems, including potential distribution and refuelling facilities within airport zones.

Sweden is also legally bound by the EU's ReFuelEU Aviation Regulation (EU Regulation 2023/2405)[292], which mandates the gradual inclusion of SAFs at EU airports. This regulation establishes minimum SAF blending thresholds beginning in 2025, with a progressive increase through 2050. Hydrogen-based synthetic fuels are explicitly included under the definition of SAFs, positioning GH2 as a crucial component of Sweden's compliance strategy with EU aviation decarbonisation laws.

Furthermore, Sweden's Integrated NECP[293], as required by the EU Governance Regulation, outlines national energy and climate targets through 2030. The plan references hydrogen as a future vector in the energy transition and highlights aviation as a priority sector for emissions reductions. The NECP complements national and EU-level ambitions to position hydrogen technologies within core energy and mobility systems.

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[287] Kingdom of Sweden, Natural Gas Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/naturgaslag-2005403_sfs-2005-403/ [accessed: 17.04.2025.]
[288] Energy Markets Inspectorate: Our business. Available at: https://ei.se/om-oss/var-verksamhet [accessed: 17.04.2025.]
[289] Kingdom of Sweden, Climate Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/klimatlag-2017720_sfs-2017-720/ [accessed: 16.04.2025.]
[290] Hydrogen Strategy for fossil-free competitiveness. Available at: https://fossilfrittsverige.se/2021/01/21/vatgasstrategi-for-fossilfri-konkurrenskraft/ [accessed: 16.04.2025.]
[291] National Transport Infrastructure Plan. Available at: https://www.regeringen.se/regeringens-politik/nationell-infrastrukturplan/ [accessed: 16.04.2025.]
[292] Regulation (EU) 2023/2405 of the European Parliament and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32023R2405 [accessed: 16.04.2025.]
[293] Sweden's Integrated National Energy and Climate Plan. Available at: https://energy.ec.europa.eu/system/files/2020-03/se_final_necp_main_en_0.pdf [accessed: 16.04.2025.]

7.5. Territorial Planning Aspects related to GH2 Production and Storage

In Sweden, territorial planning is governed primarily by the Planning and Building Act[294], which outlines the framework for land use decisions at the municipal level. Each municipality is responsible for drafting and implementing a Comprehensive Plan and Detailed Development Plans that designate permissible land uses across different zones.

Currently, there is no national-level regulation that explicitly defines GH2 production or storage facilities as a distinct category of land use. This creates a regulatory ambiguity for municipalities that may wish to accommodate hydrogen infrastructure within their planning documents. The absence of express reference to GH2 production or storage in zoning classifications presents a challenge when interpreting whether such facilities fall under existing permitted uses.

Within airport-adjacent or airport-integrated zones—often designated as technical infrastructure, transport facilities, or industrial use areas—some flexibility may exist. Municipalities like Sigtuna (home to Arlanda Airport) or Härryda (Göteborg Landvetter) may, through local development plans, allow installations such as service and logistics infrastructure, warehousing, or fuel stations. If hydrogen infrastructure is analogized to these functions—particularly in its role as part of alternative aviation fuel supply—it may be permitted, especially for storage facilities.

However, GH2 production facilities—especially those involving electrolysis—are generally more industrial in nature and may not be covered by existing permitted uses within airport zoning areas. This is especially relevant if the activity is considered potentially hazardous or polluting, which would likely require specific zoning for industrial or energy production uses. Such classifications are often excluded from airport-specific detailed plans, meaning amendments to zoning plans or special exemptions would be needed before construction could begin.

Another planning layer is the designation of areas of national interest under the Environmental Code[295], which includes transport infrastructure and energy supply. Hydrogen infrastructure that supports national or regional transport strategies—such as the development of fossil-free aviation—could be aligned with these national interests. However, explicit recognition of GH2 infrastructure within the scope of national interests exemption (in Swedish - riksintressen) is not currently established in Swedish law or practice.

Furthermore, no national guidance documents currently support municipalities in zoning or planning for hydrogen infrastructure specifically. This planning gap leaves municipalities individually responsible for interpreting whether and how to allow GH2-related facilities, which leads to uncertainty and potential inconsistencies across the country.

In summary, while Sweden's territorial planning system provides mechanisms to regulate GH2 infrastructure, there is a lack of explicit inclusion of hydrogen production or storage in current zoning categories—particularly within airport territories. This regulatory gap underscores the need for national-level clarification and integration of hydrogen-related infrastructure into spatial planning frameworks to ensure safe, lawful, and strategic development in line with Sweden's decarbonization goals.

7.5.1. GH2 Production and Storage within the airport

Although airports such as Stockholm Arlanda or Göteborg Landvetter are designated as national infrastructure, land use within their perimeters is still subject to the Planning and Building Act[296]. Development projects inside

[294] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 16.04.2025.]
[295] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 16.04.2025.]
[296] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 16.04.2025.]

airport areas typically require a valid detailed development plan approved by the relevant municipality, unless the land is owned by the state and exempt through special planning arrangements.

Additionally, the Aviation Act[297] imposes aviation safety constraints that may limit where industrial or energy-related structures can be located in relation to runways, navigation equipment, and other critical infrastructure.

GH2 is classified as a flammable and potentially explosive gas, and any handling of it falls under the Act on Flammable and Explosive Goods[298]. In this context, ATEX regulations—transposed into Swedish law via the Swedish Work Environment Authority's regulations (AFS 2003:3)—require explosion risk assessments and safety measures for all hydrogen-related installations within potentially explosive atmospheres.

Moreover, hydrogen infrastructure must be incorporated into airport-wide fire safety and emergency response plans, as required by the Civil Protection Act[299].

Depending on the scale and purpose of GH2 production and storage, such projects may trigger the need for an EIA under the Environmental Assessment Ordinance[300] and possibly an environmental permit under the Environmental Code[301]. These processes are overseen by the County Administrative Board, which evaluates environmental risks and potential pollution.

While GH2 infrastructure within airports could support climate neutrality in aviation, regulatory clarity is lacking. There is no specific land use designation for hydrogen facilities in existing airport development plans, and hydrogen's classification as a hazardous substance raises additional approval hurdles.

As hydrogen production is not currently listed as a standard permissible land use within airport areas, its acceptance depends on case-by-case interpretations by both municipal authorities and national agencies like the Swedish Transport Agency. This creates uncertainty around site suitability, safety zones, and long-term operational compatibility with aviation infrastructure.

7.5.2. GH2 Production and Storage near the airport

At the core of spatial regulation is the Planning and Building Act[302]. This act ensures that all land use and construction projects are aligned with municipal planning. Any GH2 facility near an airport must comply with the local detailed development plan, which specifies permitted land uses. If the facility is not explicitly allowed within a designated zone—such as industrial, commercial, or technical infrastructure—municipalities may require a zoning amendment before construction can proceed. Building permits must also be secured, following consultation with stakeholders including aviation and safety authorities, to assess risks such as airspace interference or explosion hazards.

In parallel, the Swedish Environmental Code[303] provides the environmental framework. GH2 facilities are typically classified as environmentally hazardous activities under Chapter 9, triggering permit requirements and compliance with operational safety, emissions control, and noise management. Chapter 6 mandates EIA for larger-scale projects or those sited near sensitive areas, such as airports, where potential impacts on public health, groundwater, or ecosystems must be evaluated and mitigated.

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[297] Kingdom of Sweden, Aviation Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/luftfartslag-2010500_sfs-2010-500/ [accessed: 16.04.2025.]
[298] Kingdom of Sweden, Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 16.04.2025.]
[299] Kingdom of Sweden, Civil Protection Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 16.04.2025.]
[300] Kingdom of Sweden, Environmental Assessment Ordinance. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobedomningsforordning-2017966_sfs-2017-966/ [accessed: 16.04.2025.]
[301] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 16.04.2025.]
[302] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 16.04.2025.]
[303] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 16.04.2025.]

Supporting this, the Ordinance on Environmentally Hazardous Activities and Health Protection[304] outlines the types of operations that require either a permit or prior notification. Hydrogen production, given its chemical risks and energy intensity, often falls under these provisions. When sited near airports, authorities may impose stricter conditions on facility design, emergency planning, and operational limits due to the overlapping safety zones and risk of incidents.

7.6. Protection Zones Aspects related to GH2 Production within the Airport

The Act on Flammable and Explosive Goods[305] requires that any GH2 production facility obtain a permit and adhere to strict technical and organizational safety measures. Given the high flammability of hydrogen, protective distances must be established between the facility and airport-critical zones, including runways, terminals, and air traffic control infrastructure.

Additionally, the Seveso Act[306] applies if GH_2 storage or production volumes exceed specific thresholds. This triggers requirements for comprehensive safety reports and land-use planning restrictions, such as the establishment of buffer or consultation zones around the facility.

GH2 facilities must also comply with the ATEX regulations (based on EU Directives 99/92/EC[307] and 2014/34/EU[308], transposed into Swedish law). These regulations govern workplaces and equipment in explosive atmospheres. Designated ATEX zones must be clearly defined within the facility layout, and equipment used in these areas must be certified and maintained accordingly. Within an airport, the presence of ignition sources and high-traffic zones requires careful coordination between ATEX zoning and aerodrome safety protocols.

Under the Act on Protection Against Accidents[309], operators are obligated to implement fire safety systems and ensure effective emergency preparedness. This includes the provision of firefighting infrastructure suited to hydrogen fires, which differ from traditional fuel fires in behaviour and suppression needs. Coordination with airport rescue and fire services is essential, and local fire authorities must be consulted during permitting and operational planning.

The Environmental Code[310] mandates that GH2 facilities undergo environmental assessments, evaluating risks to human health, the natural environment, and land use compatibility. In addition, any installation within the airport perimeter must comply with zoning rules under the Planning and Building Act[311]. GH2 production may necessitate amendments to local development plans, especially if existing airport land is not zoned for industrial or hazardous energy activities.

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[304] Kingdom of Sweden, Ordinance on Environmentally Hazardous Activities and Health Protection. Available at: https://www-riksdagen-se.translate.goog/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-1998899-om-miljofarlig-verksamhet_sfs-1998-899/?_x_tr_sl=sv&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc&_x_tr_hist=true [accessed: 16.04.2025.]

[305] Kingdom of Sweden, the Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 15.05.2025.]

[306] Kingdom of Sweden, the Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-1999381-om-atgarder-for-att-forebygga-och_sfs-1999-381/ [accessed: 15.04.2025.]

[307] Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC). Available at: https://eur-lex.europa.eu/eli/dir/1999/92/oj/eng [accessed: 15.04.2025.]

[308] Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres. Available at: https://eur-lex.europa.eu/eli/dir/2014/34/oj/eng [accessed: 15.04.2025.]

[309] Kingdom of Sweden, Act on Protection Against Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 15.04.2025.]

[310] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 15.04.2025.]

[311] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 15.04.2025.]

While Sweden provides a robust framework for fire safety, environmental protection, and explosion prevention, there is currently no unified national regulation specifically addressing hydrogen production in airport zones. This regulatory gap leads to inconsistencies in how municipalities and airport operators interpret zoning, safety, and operational limits. National guidance, or integration of hydrogen-specific rules into existing aviation and infrastructure law, would improve clarity and facilitate the deployment of GH2 infrastructure in support of decarbonizing the aviation sector.

7.7. Environmental and Safety Regulations regarding Hydrogen Production and Storage

7.7.1. Safety regulations

The safe production, storage, and use of GH2 within or near airport environments in Sweden is governed by a robust national legal framework. Central to this are the provisions of the Civil Protection Act[312], which mandates risk-reducing measures and emergency preparedness for operations involving hazardous substances like hydrogen. Facilities handling GH2 must implement fire protection systems, evacuation planning, and coordinate closely with local rescue services.

Hydrogen's classification as a highly flammable gas places it under the Act on Flammable and Explosive Goods[313], which requires a formal permit for its handling, issued by municipal authorities. This applies to both storage tanks and production equipment (e.g., electrolysers) sited in or near airport zones. Authorities assess the technical design, distance to sensitive infrastructure, and emergency response plans as part of the permit process.

When GH2 is handled under pressure, the Pressure Equipment Act[314] becomes applicable. It imposes requirements for the mechanical safety of hydrogen-containing vessels, pipelines, and compressors, ensuring integrity under both operational and emergency conditions.

The Work Environment Act[315] and ATEX regulations (AFS 2003:3 – Explosive Atmospheres) govern occupational safety where explosive hydrogen-air mixtures may form. These require site-specific risk assessments, zoning of explosive atmospheres, explosion-proof equipment, and ongoing technical maintenance. In particular, hydrogen production facilities must be designed and operated to minimize ignition risks, particularly in proximity to aircraft or aviation fuel systems.

In addition to technical regulations, specific training is a key legal and practical requirement. Employers must ensure that personnel working with hydrogen systems are trained in ATEX compliance, emergency procedures, and the handling of flammable gases under pressure. This includes operators, safety officers, and maintenance teams. Training must be documented and updated regularly, particularly when equipment or processes change.

Furthermore, under the Chemical Products and Biotechnical Organisms Act[316], GH2 must be correctly classified, labelled, and stored according to chemical safety standards. This applies across the hydrogen supply chain—from on-site production at an airport to regional distribution.

[312] Kingdom of Sweden, Civil Protection Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 15.04.2025.]
[313] Kingdom of Sweden, Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 15.05.2025.]
[314] Kingdom of Sweden, Pressure Equipment Act. Available at: https://www.av.se/globalassets/filer/publikationer/foreskrifter/tryckbarande-anordningar-foreskrifter-afs2016-1.pdf [accessed: 15.04.2025.]
[315] Kingdom of Sweden, Work Environment Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/arbetsmiljolag-19771160_sfs-1977-1160/ [accessed: 15.04.2025.]
[316] Kingdom of Sweden, Chemical Products and Biotechnical Organisms Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-2008245-om-kemiska-produkter-och_sfs-2008-245/ [15.04.2025.]

Finally, construction of GH2 infrastructure must meet the safety standards outlined in the Planning and Building Act[317], which includes building technical requirements to prevent gas accumulation, fire spread, and equipment failure.

7.7.2. EIA procedure

EIA are regulated primarily under the Environmental Code[318], which provides the overarching framework for environmental protection. Chapter 6 of the Code outlines the requirement for EIAs in connection with plans, programs, and specific projects that may have significant environmental effects. It establishes the obligation to prepare an environmental impact statement and conduct consultations with authorities and the public before any decision can be made.

The Ordinance on Environmental Impact Assessments[319] complements the Environmental Code by detailing the scope of EIAs, including the content of the environmental impact statement, and defining which types of projects are automatically subject to assessment. This includes certain categories of industrial activities such as hydrogen production and storage, depending on their scale and environmental risk.

Further categorization of activities is provided by the Environmental Assessment Ordinance, which classifies activities under categories A, B, or C depending on their potential environmental impact. Category A and B projects require full environmental permits and usually a mandatory EIA. Hydrogen production, if it falls under large-scale or hazardous chemical handling, would typically fall into these categories.

Additionally, the Ordinance on Environmentally Hazardous Activities and Health Protection[320] applies to operations involving potentially dangerous substances or emissions, such as hydrogen. This regulation ensures that appropriate protective measures are considered and implemented during the EIA process to mitigate health and environmental risks.

While the legislative framework for EIAs in Sweden is well-established, the growing role of GH2 introduces new challenges. Specifically, determining whether hydrogen-related projects fall under existing categories or require updated classification is a current regulatory gap. Furthermore, there is a need for clearer guidance on assessing risks associated with hydrogen's explosive nature, especially when proposed near sensitive zones such as airports.

7.7.3. Pollution permits

The establishment of GH2 production and storage facilities—particularly in or near airport environments—requires pollution permits under the national environmental regulatory framework. The primary legal basis for such permits is the Environmental Code[321], which governs environmentally hazardous activities through its Chapter 9. Hydrogen production, due to its potential emissions and handling risks, qualifies as such and is therefore subject to permit requirements.

The Environmental Assessment Ordinance[322] classifies these activities based on scale and environmental impact. Larger GH2 production facilities and high-volume storage near sensitive areas like airports generally fall under Category A or B, meaning they require both a pollution permit and a comprehensive environmental impact

[317] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 15.04.2025.]
[318] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 15.04.2025.]
[319] Kingdom of Sweden, Environmental Assessment Ordinance. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-1998905-om_sfs-1998-905/ [accessed: 15.04.2025.]
[320] Kingdom of Sweden, Ordinance on Environmentally Hazardous Activities and Health Protection. Available at: https://www-riksdagen-se.translate.goog/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-1998899-om-miljofarlig-verksamhet_sfs-1998-899/?_x_tr_sl=sv&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc&_x_tr_hist=true [accessed: 15.04.2025.]
[321] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 15.04.2025.]
[322] Kingdom of Sweden, Environmental Assessment Ordinance. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-1998905-om_sfs-1998-905/ [accessed: 15.04.2025.]

assessment. Smaller-scale operations may fall under Category C, which only requires a notification to the municipality.

Further procedural rules are found in the Ordinance on Environmentally Hazardous Activities and Health Protection[323], which supports risk categorization and outlines necessary permit conditions for emissions control and health protection.

Additionally, while the Planning and Building Act[324] does not itself regulate pollution, it ensures that building permits for hydrogen-related infrastructure adhere to environmental protection standards set in the Environmental Code.

However, a significant regulatory gap remains. Despite hydrogen's increasing strategic relevance, Sweden's existing permitting laws do not yet offer hydrogen-specific guidance. This creates uncertainty for operators and authorities alike—particularly regarding safety protocols near critical infrastructure such as airports. The unique properties of hydrogen, including its high flammability and storage pressure, are not explicitly addressed, which may result in inconsistent permit practices or project delays.

7.7.4. Requirements for chemical substances

At the national level, the Act on Chemical Products and Biotechnical Organisms[325] forms the legal backbone for the regulation of chemical substances. This act mandates that companies handling chemicals such as hydrogen implement safety measures and report to the competent authority, the Swedish Chemicals Agency. The act is closely aligned with EU legislation, particularly the REACH Regulation[326], which governs the registration and safe use of chemical substances within the EU.

The Swedish Work Environment Act[327] introduces obligations for employers to assess risks and ensure a safe working environment when dealing with hazardous substances. In the context of GH2 production and storage, this includes proper ventilation systems, staff training, protective equipment, and emergency procedures.

Environmental protection aspects are covered by the Environmental Code[328], which mandates that activities involving hazardous substances must prevent harm to people and nature. Hydrogen production facilities must comply with relevant chapters, particularly Chapter 9 and Chapter 10.

Finally, specific technical and safety measures related to hydrogen handling are outlined in regulations issued by the Swedish Civil Contingencies Agency. These cover requirements for safe storage, risk analysis, and incident prevention for flammable gases like hydrogen.

7.7.5. Construction Regulations regarding Hydrogen Production and Storage

The foundation of all construction activities lies in the Planning and Building Act.[329] This legislation governs land use and sets the rules for building permits. Any proposed GH_2 infrastructure must conform to municipal zoning

[323] Kingdom of Sweden, Ordinance on Environmentally Hazardous Activities and Health Protection. Available at: https://www-riksdagen-se.translate.goog/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-1998899-om-miljofarlig-verksamhet_sfs-1998-899/?_x_tr_sl=sv&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc&_x_tr_hist=true [accessed: 15.04.2025.]

[324] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 15.04.2025.]

[325] Kingdom of Sweden, Act on Chemical Products and Biotechnical Organisms. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-2008245-om-kemiska-produkter-och_sfs-2008-245/ [accessed: 16.04.2025.]

[326] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1907-20241218 [accessed: 16.04.2025.]

[327] Kingdom of Sweden, Work Environment Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/arbetsmiljolag-19771160_sfs-1977-1160/ [accessed: 16.04.2025.]

[328] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 16.04.2025.]

[329] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 16.04.2025.]

plans and local development regulations. The corresponding Planning and Building Ordinance[330] outlines specific construction standards — from fire safety and structural integrity to technical functionality — that must be met.

Alongside this, the Environmental Code[331] plays a crucial role. Since GH2 production can be classified as an environmentally hazardous activity, it often requires an environmental permit. Projects above certain thresholds may also trigger an EIA, ensuring a thorough review of risks related to emissions, safety, land use conflicts, and long-term sustainability.

To manage fire and explosion risks, the Act on Flammable and Explosive Goods[332] requires a separate permit for the handling and storage of hydrogen. Regulations from the Swedish Civil Contingencies Agency specify technical safety requirements, including risk assessment procedures, fire suppression systems, and compliance with ATEX directives on explosion protection. These measures are critical when dealing with pressurized hydrogen and high-voltage electrolysers.

On the workplace side, the Work Environment Act[333] mandates that any hydrogen-related construction or operation must provide a safe environment for workers. This includes designated explosion zones, appropriate signage, emergency protocols, and compulsory training for employees dealing with hydrogen systems.

Despite the comprehensive nature of Sweden's construction-related legislation, the frameworks do not yet provide hydrogen-specific zoning classifications or unified guidelines for integrating GH_2 infrastructure in complex areas—such as airports or mixed-use zones. This lack of clarity can hinder the smooth deployment of hydrogen projects, creating uncertainty at both national and local level.

7.7.6. Liability in environmental protection

At the centre of this responsibility is the Environmental Code[334], which adopts a strict liability approach. This means operators can be held accountable for environmental damage even if no negligence is proven. Chapters 10 and 32 are particularly relevant: the former addresses contaminated land and mandates remediation, while the latter allows individuals or companies affected by environmental harm to seek compensation.

Supporting this, the Ordinance on the Remediation of Contaminated Sites[335] outlines how responsibilities are assigned, and costs are shared in cases of pollution or land degradation. This is critical when considering GH2 facilities, which may involve high-pressure systems and potentially hazardous substances.

When people or property are affected, the Tort Liability Act[336] provides another layer of accountability. Whether through pollution incidents, explosions, or water contamination, compensation can be pursued if GH2 operations cause measurable damage.

Furthermore, the Planning and Building Act[337] integrates environmental and construction law, reinforcing the need for compliance during development and operation phases. Ignoring local planning requirements or building without proper safeguards could trigger both administrative and financial consequences.

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[330] Kingdom of Sweden, Planning and Building Ordinance. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-byggforordning-2011338_sfs-2011-338/ [accessed: 16.04.2025.]
[331] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 16.04.2025.]
[332] Kingdom of Sweden, Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 16.05.2025.]
[333] Kingdom of Sweden, Work Environment Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/arbetsmiljolag-19771160_sfs-1977-1160/ [accessed: 16.04.2025.]
[334] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 15.04.2025.]
[335] Kingdom of Sweden, Ordinance on the Remediation of Contaminated Sites. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/forordning-2012259-om-miljosanktionsavgifter_sfs-2012-259/ [accessed: 15.04.2025.]
[336] Kingdom of Sweden, Tort Liability Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/skadestandslag-1972207_sfs-1972-207/ [accessed: 15.04.2025.]
[337] Kingdom of Sweden, Planning and Building Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/ [accessed: 15.04.2025.]

7.7.7. Summary and conclusions on Swedish Regulations on Hydrogen Production

Sweden regulates hydrogen production through multiple legislative frameworks, with key oversight from the Civil Protection Act, the Act on Flammable and Explosive Goods, and the Environmental Code. Production facilities require formal permits and environmental impact assessments, with classification under categories A, B, or C determining scrutiny levels.

The primary regulatory gap is the absence of hydrogen-specific guidance, creating uncertainty for operators and authorities. The unique properties of hydrogen—high flammability and specialized storage requirements—lack explicit regulatory treatment. The strict liability approach holds operators accountable for environmental damages regardless of negligence.

Future regulatory development should focus on creating hydrogen-specific classifications and clearer risk assessment guidelines, particularly for complex settings like airports.

7.8. Swedish Regulations on Hydrogen Transportation

7.8.1. Hydrogen Transportation via natural gas pipelines

The Natural Gas Act[338] sets the framework for the organization, access, and operation of Sweden's natural gas transmission and distribution systems. While it does not explicitly address hydrogen, the act provides a regulatory basis that could be expanded to include hydrogen, especially in line with Sweden's obligations under EU Directive 2024/1778 on renewable gases and hydrogen markets.

The Utilities Easement Act[339] governs the establishment of rights to lay and operate pipelines on public or private land. This law supports the physical deployment or repurposing of infrastructure and applies to hydrogen pipelines

Environmental considerations are governed by the Environmental Code[340], which requires environmental permits and impact assessments for activities involving hazardous or potentially polluting substances, including hydrogen.

Given hydrogen's classification as a hazardous and flammable substance, safety requirements are additionally regulated by the Act on Flammable and Explosive Goods[341]. This law requires permits and safety measures for the handling, storage, and transportation of hydrogen in pipeline systems.

Accident prevention and emergency preparedness are covered under the Act on Protection Against Accidents[342] and the Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents[343], which impose obligations on operators to conduct risk assessments and coordinate with authorities on contingency planning.

While current Swedish legislation allows for some degree of hydrogen integration into natural gas systems—particularly for blending or pilot projects—there is no comprehensive regulatory pathway for hydrogen-only pipelines. This is expected to change as Sweden transposes Directive 2024/1778 into national law by 2026, including the requirement to develop a hydrogen network development plan. Until then, the use of natural gas

[338] Kingdom of Sweden, Natural Gas Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/naturgaslag-2005403_sfs-2005-403/ [accessed: 15.04.2025.]
[339] Kingdom of Sweden, Utilities Easement Act. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/ledningsrattslag-19731144_sfs-1973-1144/ [accessed: 15.04.2025.]
[340] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 15.04.2025.]
[341] Kingdom of Sweden, Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 15.05.2025.]
[342] Kingdom of Sweden, Act on Protection Against Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 15.04.2025.]
[343] Kingdom of Sweden, Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-1999381-om-atgarder-for-att-forebygga-och_sfs-1999-381/ [accessed: 15.04.2025.]

infrastructure for hydrogen transport remains possible but subject to strict permitting and safety obligations under the existing legal framework.

7.8.2. Hydrogen Transportation via road transport

The core legislation governing road transport of hydrogen is the Act on the Transport of Dangerous Goods[344]. This law incorporates the provisions of the ADR into Swedish law. It sets requirements for vehicle types, driver training, safety measures, and documentation during transport.

Complementing this, the Act on Flammable and Explosive Goods[345] ensures that flammable substances like hydrogen are transported with appropriate safety protocols, including protective equipment, proper packaging, and leak detection systems. It also governs the issuance of permits for transport operators.

Furthermore, the Act on Protection Against Accidents[346] establishes the responsibility of transporters to prevent and mitigate accidents. In the case of a hydrogen-related incident, this law ensures that emergency response measures are coordinated and effective.

Additionally, the Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents[347] – also known as the Seveso Act – may apply if hydrogen is transported in large volumes or in areas near sensitive infrastructure.

Technical requirements for vehicles and containers used in hydrogen transport are defined through national standards aligned with international norms, such as SS-ISO 19881:2022 and SS-ISO 19887-1:2024. These outline safety and design specifications for fuel containers and hydrogen system components in land vehicles.

7.9. Swedish Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

At the national level, Sweden regulates hydrogen-fuelled vehicles primarily through the Vehicle Ordinance[348], which implements EU standards for vehicle safety and approval. Hydrogen vehicles must comply with technical requirements under Regulation (EU) 2019/2144 and the UNECE framework, particularly UN Regulation No. 134 on hydrogen safety.

Hydrogen as a fuel is classified as a hazardous substance under the Act on Flammable and Explosive Goods[349], placing stringent requirements on handling, storage, and distribution. These are enforced by the Swedish Civil Contingencies Agency (MSB). Permits for hydrogen refuelling stations fall under the Environmental Code[350], requiring environmental assessment and safety documentation, and the Act on Protection Against Accidents[351] ensures broader safety planning.

Energigas Sverige has developed H2-TSA 2023, which is a comprehensive set of guidelines for the design, construction, and operation of hydrogen refuelling stations in Sweden. Published in June 2023, this first edition aims to consolidate best practices and safety requirements to ensure that hydrogen infrastructure meets

[344] Kingdom of Sweden, Act on the Transport of Dangerous Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2006263-om-transport-av-farligt-gods_sfs-2006-263/ [accessed: 15.04.2025.]
[345] Kingdom of Sweden, the Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 15.05.2025.]
[346] Kingdom of Sweden, Act on Protection Against Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 15.04.2025.]
[347] Kingdom of Sweden, the Act on Measures to Prevent and Limit the Consequences of Major Chemical Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-1999381-om-atgarder-for-att-forebygga-och_sfs-1999-381/ [accessed: 15.04.2025.]
[348] Kingdom of Sweden, Vehicle Ordinance. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/fordonsforordning-2009211_sfs-2009-211/ [accessed: 15.04.2025.]
[349] Kingdom of Sweden, the Act on Flammable and Explosive Goods. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-20101011-om-brandfarliga-och-explosiva_sfs-2010-1011/ [accessed: 15.05.2025.]
[350] Kingdom of Sweden, Environmental Code. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/miljobalk-1998808_sfs-1998-808/ [accessed: 15.04.2025.]
[351] Kingdom of Sweden, Act on Protection Against Accidents. Available at: https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003778-om-skydd-mot-olyckor_sfs-2003-778/ [accessed: 15.04.2025.]

Swedish regulatory standards. The guidelines are adapted from the international standard SS-ISO 19880-1, which addresses the design, installation, commissioning, operation, inspection, and maintenance of hydrogen refuelling stations. While these guidelines apply to road transport fuelling, they can be used as a source of inspiration for fuelling infrastructure in the airport.

7.9.1. Summary and conclusions on Swedish Regulations on Fuelling and Usage

There is currently no hydrogen-specific national framework that comprehensively governs the rollout of refuelling infrastructure. Regulatory gaps exist in areas such as siting criteria, standardized permitting, and harmonized technical guidelines for refuelling systems. The absence of a dedicated hydrogen roadmap for transport applications at the national level limits long-term planning and investment certainty.

Challenges include slow and complex permitting processes, strict safety classifications that increase costs, and the lack of economic incentives following the phase-out of national subsidy schemes. Without targeted regulatory development, the uptake of hydrogen-fuelled vehicles and supporting infrastructure may remain limited in Sweden. A national strategy, with clear regulatory pathways and infrastructure targets, is needed to accelerate deployment in line with Sweden's broader decarbonization goals.

7.10. Key Findings of Sector-Specific Swedish Regulations

Swedish regulations present several key considerations for hydrogen implementation at airports. While Sweden's Climate Act and Hydrogen Strategy provide a broad foundation for promoting alternative fuels, they lack detailed guidance for aviation-specific applications. This regulatory gap creates uncertainty for project developers seeking to establish GH2 infrastructure at airports.

The Planning and Building Act governs land use decisions, but there is no national-level regulation that explicitly defines hydrogen production or storage as a distinct category of land use. This creates significant challenges when interpreting whether such facilities are permitted under existing airport zoning classifications. While some flexibility may exist in areas designated as technical infrastructure or industrial use zones, GH2 production facilities—especially those involving electrolysis—may require specific amendments to zoning plans or special exemptions.

The regulatory framework imposes substantial operational requirements through multiple laws. The Act on Flammable and Explosive Goods requires formal permits for hydrogen handling, while ATEX regulations mandate specific risk assessments and explosion-proof equipment. Operators must implement comprehensive safety measures, conduct specialized employee training, and ensure proper emergency response planning. The Work Environment Act further requires ongoing technical maintenance and documented training programs, particularly when equipment or processes change.

Environmental assessment requirements add another layer of complexity. The Environmental Code classifies hydrogen production as an environmentally hazardous activity, triggering permit requirements and environmental impact assessments. Larger facilities typically fall under Category A or B, requiring comprehensive environmental review. However, there is a notable absence of hydrogen-specific guidance in current EIA procedures, creating uncertainty in risk assessment practices.

Transportation regulations present further challenges. While the Natural Gas Act provides some regulatory basis for pipeline transportation of hydrogen, Sweden awaits full transposition of EU Directive 2024/1778 before comprehensive regulation is established. Road transport is governed by the Act on Transport of Dangerous Goods, which incorporates international ADR standards and imposes strict requirements on vehicle types, driver training, and safety documentation.

Throughout these frameworks, Sweden applies a strict liability approach under the Environmental Code, holding operators accountable for environmental damage even without proven negligence. This creates significant responsibility for hydrogen facility operators, particularly in sensitive environments like airports where multiple regulatory regimes intersect.

7.11. Identified Regulatory Gaps, Challenges and Roadblocks

Need for a Dedicated Hydrogen Regulatory Framework

Sweden could benefit from a more tailored regulatory framework for GH2 production, storage, transportation, and use, especially in aviation and airport settings. Current regulations do not fully address hydrogen's unique characteristics, which can create uncertainty for operators and authorities working to integrate hydrogen into these contexts.

Clarification Needed for Land Use and Safety Zoning

Existing zoning and land use classifications in Sweden do not explicitly include GH2 production or storage facilities, which can make it challenging to determine where such infrastructure is permitted. Similarly, the absence of clear national guidelines for safety zones around hydrogen facilities in sensitive areas like airports creates uncertainty about appropriate protective distances, complicating project planning.

Opportunities for Streamlined Regulatory Oversight

The oversight of hydrogen projects involves multiple Swedish authorities and legal frameworks, covering aspects like safety, environmental impact, and construction. Without clear coordination or national guidance, local authorities may interpret regulations differently, creating a complex landscape for operators. Streamlining these processes could help simplify compliance and support smoother project development.

Enhanced Environmental and Safety Guidance for Hydrogen

EIAs in Sweden would benefit from specific guidance tailored to hydrogen's unique properties, particularly in high-sensitivity areas like airports. Current safety regulations could also be expanded to better address hydrogen-specific needs, such as leak prevention, specialized monitoring with sensors, and requirements for supporting systems like nitrogen storage, to provide clearer direction for operators.

Support for Consistent Local Implementation

The lack of unified national standards for hydrogen infrastructure can lead to variations in how local authorities apply regulations to projects, particularly in aviation contexts. Providing additional national-level clarification and support could help ensure more consistent and predictable implementation, making it easier for stakeholders to plan and develop hydrogen facilities.

7.12. Recommendations

The assessment of Sweden's regulatory framework governing GH2 use in the aviation sector highlights both substantial potential and a range of pressing challenges. These include legal uncertainties, ambiguities in land-use classification, and intricate permitting procedures. To facilitate the secure and effective integration of GH2 within Swedish airport environments – while remaining consistent with the objectives of Sweden's Climate Act and the European Union's energy transition directives – this section sets forth targeted recommendations. These are aimed at addressing the principal regulatory obstacles and offering practical measures to accelerate the development of hydrogen-related infrastructure.

Create Hydrogen-Specific Regulatory Framework

Sweden should develop dedicated hydrogen regulations that explicitly address the unique characteristics and requirements of GH2 production, storage, and usage in aviation contexts. This would resolve the current regulatory ambiguity where hydrogen facilities lack clear classification within existing frameworks. Specific amendments to the Environmental Code and the Planning and Building Act should include hydrogen-specific provisions for environmental impact assessments and permitting processes. These changes would provide clarity for operators and authorities when evaluating GH2 projects near or within airport zones.

However, when creating or updating relevant legislation, Sweden should include provisions that ensure future flexibility for liquid hydrogen deployment, avoiding overly rigid frameworks that could inadvertently create barriers to liquid hydrogen infrastructure or operations in later stages of hydrogen market development.

Responsible authorities:	Time of completion:
Environmental Protection Agency, National Board of Housing, Building and Planning	2027 - 2028

Coordinate Multi-Agency Approval Processes

Sweden should establish a coordinated approach to hydrogen project approval that addresses the current fragmentation in regulatory oversight. A specialized task force comprising representatives from municipal authorities, County Administrative Boards, and relevant national agencies would streamline the complex permitting requirements spanning environmental protection, safety, and construction regulations. This coordinated mechanism would reduce bureaucratic barriers while ensuring comprehensive safety and environmental compliance for GH2 projects in aviation settings.

Responsible authorities:	Time of completion:
Government with possible involvement of the EU	2027 - 2028

Develop National Guidance for Hydrogen Safety Zones

Sweden needs unified national regulation specifically addressing hydrogen production and storage safety zones in airport environments. The Swedish Civil Contingencies Agency should issue comprehensive guidelines on protective distances, buffer zones, and safety protocols specific to GH2 installations near aviation infrastructure. These standards would complement existing ATEX regulations and the Act on Flammable and Explosive Goods, providing clear parameters for facility design and operational limits that account for the unique properties of hydrogen.

Responsible authorities:	Time of completion:
Swedish Civil Contingencies Agency, Swedish Transport Agency, Swedish Work Environment Authority, Rescue Services	2027 - 2028

Establish Clear Land Use Classifications for Hydrogen Infrastructure

The Planning and Building Act should be updated to explicitly define GH2 production and storage as distinct categories of land use, particularly within airport-adjacent or airport-integrated zones. Municipal comprehensive plans and detailed development plans require specific provisions that accommodate hydrogen infrastructure while maintaining compliance with aviation safety requirements. This would eliminate the current situation where municipalities must individually interpret whether and how to allow GH2-related facilities, creating inconsistencies across the country.

Responsible authorities:	Time of completion:
National Board of Housing, Building and Planning, Swedish Transport Agency, Municipalities	2027 - 2028

Streamline Environmental Assessment Procedures

Current environmental impact assessment procedures lack clarity regarding the categorization of hydrogen projects. Authorities should develop hydrogen-specific guidance for environmental risk assessment, particularly addressing the explosive nature of hydrogen when proposed near sensitive zones such as airports. This would enhance the effectiveness of the existing Environmental Assessment Ordinance by providing evaluators with

clear criteria for assessing GH2 facilities under categories A, B, or C, thereby reducing uncertainty during the permitting process.

Responsible authorities:	Time of completion:
Environmental Protection Agency	2027 - 2028

Integrate Hydrogen Infrastructure into National Transport Planning

The National Transport Infrastructure Plan should be expanded to explicitly include hydrogen refuelling infrastructure development, particularly at strategic airport locations. This would create a clear financial and planning framework for investments in hydrogen distribution systems that support aviation decarbonization. Specific provisions should align with Sweden's commitments under the ReFuelEU Aviation Regulation and the national Climate Act, thereby accelerating the transition to sustainable aviation fuels.

Responsible authorities:	Time of completion:
Swedish Transport Administration, Swedavia, Swedish Energy Agency, Government Offices	2027 - 2028

8.Republic of Finland

8.1. Executive Summary on Finnish National Legal and Regulatory Framework

Finland has established a comprehensive yet evolving regulatory framework governing hydrogen production, storage, transportation, and utilization, with particular relevance to airport integration. This framework spans multiple legal domains and regulatory bodies, though it currently lacks hydrogen-specific provisions in several key areas. The country has set ambitious targets through its Hydrogen Strategy (2023), aiming to produce at least 10% of the EU's emissions-free hydrogen by 2030. This strategy is supported by Business Finland's Hydrogen and Batteries Program (2023-2028), focusing on innovation and investment in hydrogen technologies, particularly for transport and industrial applications.

Key regulatory bodies overseeing hydrogen development include the Safety and Chemicals Agency, Finnish Transport and Communications Agency, Ministry of the Environment, Ministry of Economic Affairs and Employment, and Finavia for airport operations. These authorities enforce safety standards, environmental protection, and transportation regulations applicable to hydrogen infrastructure. From a territorial planning perspective, hydrogen facilities can be accommodated under existing land use categories, though they are not explicitly designated within the national zoning framework. Safety considerations are paramount, requiring adequate distances from critical infrastructure and integration with emergency response systems.

Environmental and safety regulations apply through various acts, including the Act on Safe Handling of Dangerous Chemicals, Environmental Protection Act, and Rescue Act. These establish requirements for permits, risk assessments, and emergency preparedness, with particularly stringent controls around airports and sensitive environments. Transportation of hydrogen is regulated primarily through dangerous goods legislation for road transport, though regulations for pipeline transportation remain underdeveloped. Similarly, hydrogen-fuelled vehicles and refuelling systems are governed by the Vehicle Act and chemical safety regulations.

Despite this foundation, significant regulatory gaps remain, including a lack of hydrogen-specific construction standards, no explicit listing of hydrogen projects in EIA regulations, a fragmented legal framework across multiple domains, insufficient guidance for airport integration, limited adaptability to emerging hydrogen technologies, unclear risk categorization criteria, and the absence of hydrogen-specific pipeline regulations. Addressing these gaps will require developing dedicated technical standards, updating EIA regulations, creating

a more coordinated regulatory framework, establishing airport-specific guidelines, implementing flexible permit pathways, standardizing risk assessment methodologies, and developing comprehensive regulations for hydrogen transportation and network operations.

8.2. Introduction

The Finland stands at a pivotal moment in the evolution of its GH2 aviation infrastructure. The national regulatory framework governing this emerging sector is characterized by a complex interrelationship between EU directives, domestic laws, and industry-specific regulations. While Finland has made substantial strides in aligning with broader energy transition objectives, particularly through initiatives such as the Government's Hydrogen Strategy (2023) and Business Finland's Hydrogen and Batteries Program (2023-2028), considerable gaps in the regulatory landscape persist, particularly with respect to hydrogen production, storage, and transportation.

Currently, the regulatory approach predominantly relies on adapting existing, analogous legislation rather than introducing hydrogen-specific provisions. This reliance on existing legal structures introduces uncertainty in key areas, such as permitting processes and zoning requirements. Moreover, the intersection of aviation safety protocols, environmental assessment mandates, and hazardous materials handling regulations further complicates project approval timelines and overall project viability.

This report offers a thorough examination of Finland's regulatory environment concerning the integration of GH2 into aviation, with a particular focus on essential legislative frameworks, including the Land Use and Building Act, the Aviation Act, the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives, and the Environmental Protection Act. In addition, the report delves into the roles and responsibilities of principal regulatory bodies – such as the Safety and Chemicals Agency, the Finnish Transport and Communications Agency, the Ministry of the Environment, the Ministry of Economic Affairs and Employment, and Finavia – in shaping the development of Finland’s GH2 ecosystem.

Through an identification of challenges related to land-use classification, inter-agency coordination, and the harmonization of safety standards, this analysis provides critical insights aimed at optimizing the hydrogen adoption process, while ensuring continued alignment with the EU's broader energy transition goals. The findings contained herein are based on the currently applicable laws and regulations, offering stakeholders a well-founded basis for navigating this evolving regulatory framework.

8.3. Key National Regulatory Bodies

8.3.1. Safety and Chemicals Agency

The Safety and Chemicals Agency is responsible for ensuring the safe use of chemicals, consumer products, and industrial activities. It regulates chemical substances to protect human health and the environment, monitors product safety, and enforces compliance with relevant safety legislation. The agency also provides guidance to businesses and the public on managing chemical risks and supervises the use of hazardous materials such as pesticides and biocides.[352]

8.3.2. Finnish Transport and Communications Agency

The Finnish Transport and Communications Agency is the national authority responsible for promoting safe, secure, and efficient transport and communications systems in Finland. It oversees sectors including civil aviation, road, rail, and maritime transport, as well as telecommunications and postal services. In the field of aviation, it handles licensing, air traffic regulation, and safety oversight. The agency also ensures compliance

[352] Republic of Finland, Safety and Chemicals Agency. Available at: https://tukes.fi/en/frontpage [accessed: 23.04.2025.]

with national and EU regulations, supports sustainable development, and protects users' rights across all transport and communication services in Finland.[353]

8.3.3. Ministry of the Environment

The Ministry of the Environment of Finland is responsible for developing and implementing environmental policy to promote sustainable development and safeguard the natural environment. Its areas of focus include climate change mitigation, biodiversity conservation, water and marine protection, land use planning, and the management of the built environment. The ministry also oversees environmental legislation, coordinates with international and EU-level environmental policies, and supports research and innovation aimed at improving environmental protection in Finland.[354]

8.3.4. Ministry of Economic Affairs and Employment

The Ministry of Economic Affairs and Employment of Finland is responsible for fostering economic growth, promoting employment, and ensuring the competitiveness of Finnish industries. It oversees areas such as labour market policy, energy and climate policy (from an economic perspective), innovation, entrepreneurship, and regional development. The ministry also supports business operations, manages industrial and technology policy, and works to ensure a well-functioning labour market and sustainable economic development throughout Finland.[355]

8.3.5. Finavia

Finavia is a state-owned company in Finland responsible for maintaining and developing the country's airport network and ensuring the smooth and safe flow of air traffic. It operates Finland's major airports, including Helsinki-Vantaa Airport, and provides services related to airport infrastructure, passenger handling, and air navigation in cooperation with other aviation authorities. Finavia plays a key role in enabling domestic and international connectivity, supporting tourism and business travel, and promoting sustainable practices in airport operations.[356]

8.3.6. Ministry of Defence

The Ministry of Defence of Finland is responsible for the country's national defence policy, military preparedness, and coordination of defence-related matters across government sectors. In addition to its core defence duties, the Ministry also plays a role in real estate oversight where national security may be implicated. Specifically, real estate projects located near airports may raise security concerns and could fall under the Ministry's review. If a project involves a non-EU developer, the acquisition of such property would also require a permit under the Act on Transfers of Real Estate Requiring Special Permission. In these cases, the Ministry may apply a higher scrutiny threshold due to the sensitive location.[357]

8.4. National Planning Documents and Strategies

Government's Hydrogen Strategy (2023) sets out an ambition to produce at least 10% of the EU's emissions-free hydrogen by 2030, positioning hydrogen as essential for reducing emissions in transport and industry.[358]

[353] Republic of Finland, Finnish Transport and Communications Agency. Available at: https://www.traficom.fi/en/transport/aviation [accessed: 23.04.2025.]
[354] Republic of Finland, Ministry of the Environment. Available at: https://ym.fi/en/climate [accessed: 23.04.2025.]
[355] Republic of Finland, Ministry of Economic Affairs and Employment of Finland. Available at: https://tem.fi/en/frontpage [accessed: 23.04.2025.]
[356] Republic of Finland, Finavia. Available at: https://www.finavia.fi/en [23.04.2025.]
[357] Republic of Finland, Ministry of Defence. Available at: https://www.defmin.fi/en [accessed: 06.05.2025.]
[358] Please see: https://valtioneuvosto.fi/en/-/1410877/government-adopts-resolution-on-hydrogen-finland-could-produce-10-of-eu-s-green-hydrogen-in-2030 [accessed: 23.04.2025.]

This strategy is supported by Business Finland's Hydrogen and Batteries Program (2023–2028),[359] which promotes innovation, exports, and investment in hydrogen technologies.

Hydrogen development is especially focused on transport, with projects such as P2X Solutions' GH2 plant[360] and Fortum's pilot facility[361] aiming to supply clean hydrogen for industrial and potentially transport applications. The Industrial Hydrogen Valley project in Uusimaa further supports regional hydrogen ecosystems, while Finland's involvement in the Northern-Baltic Hydrogen Corridor underlines its commitment to cross-border hydrogen infrastructure.[362]

In the aviation sector, Finavia aims for net-zero emissions across Finnish airports by 2025 through renewable energy and efficiency measures.[363] Finnair, meanwhile, targets a 34.5% reduction in carbon intensity by 2033 using SAFs and operational improvements.[364] Though current plans do not specify hydrogen use in aviation operations, Finland's participation in hydrogen industry networks suggests future potential.

Finland's updated NECP incorporates these goals, setting a target of at least 62% renewable energy by 2030.[365] While hydrogen's role in ground transport and industry is emphasized, its use in aviation remains at a conceptual stage.

8.5. Territorial Planning Aspects related to GH2 Production and Storage

In Finland, GH2 production and storage facilities are not explicitly designated within the national zoning framework. However, they can be accommodated under existing land use categories, provided that appropriate planning and permitting procedures are followed.

The Finnish Safety and Chemicals Agency has provided guidance on suitable zoning classifications for hydrogen-related facilities. For large-scale hydrogen production or storage, the plan symbol T/kem is recommended. This symbol denotes an industrial and storage area designated for significant facilities handling dangerous chemicals. Other applicable zoning symbols include T (industrial and storage area), TT (area for industrial operations with significant environmental impacts), and EN (energy supply area). The selection of an appropriate zoning category depends on the specific characteristics of the proposed hydrogen facility and the existing municipal land use plans.

It is important to note that the mere presence of a suitable zoning designation does not automatically permit the establishment of a hydrogen facility. Comprehensive assessments, including environmental impact evaluations and safety analyses, are required to ensure that the proposed development does not adversely affect surrounding areas.

8.5.1. GH2 Production and Storage within the airport

From a zoning perspective, GH2 facilities must fall within the appropriate land use categories defined by the airport's master plan and local municipal zoning schemes. These typically designate areas for industrial or transport-related activities. Planning permission must be coordinated with municipal and regional authorities in

[359] Business Finland, Hydrogen and Batteries Dual Helix of Decarbonisation. Available at: https://www.businessfinland.fi/en/for-finnish-customers/services/programs/hydrogen-and-batteries [accessed: 23.04.2025.]
[360] Please see: https://p2x.fi/en/project/ [accessed: 23.04.2025.]
[361] Please see: https://www.fortum.com/media/2023/06/fortum-plans-pilot-hydrogen-production-finland [accessed: 23.04.2025.]
[362] Please see: https://gasgrid.fi/en/development/finland-into-the-most-attractive-hydrogen-economy-country-in-the-world/ [accessed: 23.04.2025.]
[363] Finavia's climate programme. Available at: https://www.finavia.fi/en/about-finavia/responsibility/climate-programme [accessed: 23.04.2025.]
[364] Finnair, Climate targets backed by science. Available at: https://www.finnair.com/lv-en/sustainable-travel/climate-targets-backed-up-by-science [accessed: 23.04.2025.]
[365] Finland NECP 2021-2023. Available at: https://commission.europa.eu/publications/finland-final-updated-necp-2021-2030-submitted-2024_en [accessed: 23.04.2025.]

accordance with the Land Use Act[366] and Building Act[367], ensuring that hydrogen installations are compatible with airport operations and surrounding land uses.

Safety is a central consideration in this context. The siting of hydrogen production and storage systems must comply with the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[368], which mandates adequate safety distances from key airport infrastructure such as runways, terminals, fuel depots, and public access areas. These safety zones are determined through formal risk assessments and must be factored into the territorial layout of the airport site.

Emergency preparedness is also a requirement under the Rescue Act[369], which obliges operators to integrate emergency response systems into the facility's planning. This includes dedicated access routes for emergency services, containment infrastructure for potential leaks or fires, and coordinated procedures with local rescue authorities to ensure rapid and effective response in case of an incident.

In terms of spatial integration, GH2 infrastructure must be planned to support the operational needs of the airport. This includes space for electrolysers, hydrogen compressors, and high-pressure storage tanks, as well as potential distribution pipelines or refuelling interfaces for GSE and airport vehicles. Looking ahead, territorial planning may also need to consider future expansions to accommodate emerging hydrogen-powered aircraft technologies.

Environmental considerations play an important role, particularly where airports are located in or near groundwater protection zones or other ecologically sensitive areas. In such cases, the Environmental Protection Act[370] may require an environmental permit or a full EIA before construction can proceed, depending on the scale and potential impact of the installation.

8.5.2. GH2 Production and Storage near the airport

Facilities situated near, but outside of, airport boundaries must still align with local and regional land-use plans, as defined under the Land Use Act[371] and Building Act[372]. These areas are often designated for industrial or logistics use, and GH2 installations must be compatible with the surrounding land uses and spatial development objectives. Coordination with municipal planning authorities is essential to secure zoning approval and ensure integration with broader regional infrastructure strategies.

Safety remains a core element of territorial planning, particularly due to the proximity to aviation operations. Under the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[373], hydrogen systems near airports must maintain sufficient safety distances from runways, flight paths, and other critical aviation

[366] Republic of Finland, Land Use Act. Available at: https://www.finlex.fi/en/legislation/1999/132?language=fin&highlightId=650891&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22alueidenk%C3%A4ytt%C3%B6laki%22%7D [accessed: 22.04.2025.]

[367] Republic of Finland, Building Act. Available at: https://www.finlex.fi/en/legislation/2023/751?language=fin#chp_1__sec_1__heading [accessed: 22.04.2025.]

[368] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[369] Republic of Finland, Rescue Act. Available at: https://www.finlex.fi/en/legislation/2011/379?language=fin&highlightId=611509&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22379%2F2011%22%7D [accessed: 22.04.2025.]

[370] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

[371] Republic of Finland, Land Use Act. Available at: https://www.finlex.fi/en/legislation/1999/132?language=fin&highlightId=650891&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22alueidenk%C3%A4ytt%C3%B6laki%22%7D [accessed: 22.04.2025.]

[372] Republic of Finland, Building Act. Available at: https://www.finlex.fi/en/legislation/2023/751?language=fin#chp_1__sec_1__heading [accessed: 22.04.2025.]

[373] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

infrastructure. These distances are determined through risk assessments and must be incorporated into the site's design and location strategy to minimize any potential risk to air traffic or airport operations.

Emergency preparedness is also required under the Rescue Act[374]. Facilities near airports must develop emergency response protocols and coordinate with both municipal and airport rescue services. This includes planning for incident containment, fire response, and evacuation procedures, all of which must be factored into the spatial layout and operational planning of the GH2 site.

Proximity to the airport offers significant infrastructure advantages, particularly in terms of access to transport corridors, grid connections, and potential hydrogen demand from airport ground operations or logistics hubs. Territorial planning must therefore ensure adequate connectivity to road networks and possibly to dedicated pipelines or hydrogen transport systems, supporting efficient supply chains and future scalability.

Environmental considerations also influence site selection. If the planned location is near groundwater protection zones, Natura 2000 areas, or other sensitive environments, the Environmental Protection Act[375] may trigger permitting requirements or necessitate a full EIA. The siting process must account for ecological constraints and demonstrate how environmental risks will be mitigated.

Moreover, real estate projects located in close proximity to airports may, in certain cases, raise national security concerns. As a result, such projects may be subject to review by the Ministry of Defence under the Act on the State's Right of Pre-emption in Certain Areas,[376] which allows the state to intervene in property transactions in strategically sensitive locations. Additionally, if the project developer is a non-EU entity, the acquisition of the property would require a separate permit from the Ministry of Defence pursuant to the Act on Transfers of Real Estate Requiring Special Permission.[377] In these cases, the approval threshold may be higher than usual due to the heightened security considerations associated with the site's location near an airport.

8.6. Protection Zones Aspects related to GH2 Production within the Airport

The Aviation Act[378] plays a pivotal role in defining and regulating protection zones around airports. It mandates specific safety measures for construction and operation within these zones, ensuring that facilities such as GH2 production and storage systems do not interfere with aviation safety. The Act also stipulates that any infrastructure within the proximity of airports, especially those involving hazardous substances, must be carefully assessed and approved by aviation authorities to ensure they do not pose a threat to aircraft operations.

Under the Land Use Act[379] and Building Act[380], the zoning of industrial and hazardous material storage facilities, including those for GH2, is carefully managed to prevent conflicts with sensitive infrastructures such as airports.

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[374] Republic of Finland, Rescue Act. Available at: https://www.finlex.fi/en/legislation/2011/379?language=fin&highlightId=611509&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22379%2F2011%22%7D [accessed: 22.04.2025.]

[375] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

[376] Republic of Finland, Act on the State's Right of Pre-emption in Certain Areas. Available at: https://www.finlex.fi/en/legislation/2019/469?language=fin&highlightId=599056&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%222019%2F469%22%7D [accessed: 06.05.2025.]

[377] Republic of Finland, Act on Transfers of Real Estate Requiring Special Permission. Available at: https://www.finlex.fi/en/legislation/2019/470?language=fin&highlightId=602403&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22+470%2F2019%22%7D [accessed: 06.05.2025.]

[378] Republic of Finland, Aviation Act. Available at: https://www.finlex.fi/en/legislation/2014/864?language=fin&highlightId=614572&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22864%2F2014%22%7D [accessed: 22.04.2025.]

[379] Republic of Finland, Land Use Act. Available at: https://www.finlex.fi/en/legislation/1999/132?language=fin&highlightId=650891&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22alueidenk%C3%A4ytt%C3%B6laki%22%7D [accessed: 22.04.2025.]

[380] Republic of Finland, Building Act. Available at: https://www.finlex.fi/en/legislation/2023/751?language=fin#chp_1__sec_1__heading [accessed: 22.04.2025.]

This Act sets out guidelines for defining safety zones based on risk assessments, considering factors such as the proximity of aviation routes, the size of the facility, and the nature of the hazardous substances being stored. For hydrogen production near airports, this involves establishing clear buffer zones to mitigate the risk of explosions or fires affecting the airport's operational zones.

The Environmental Protection Act[381] establishes additional restrictions and requirements for any potentially polluting activities, including the production and storage of GH2. Facilities located within or near airport zones must implement environmental safeguards and establish protection zones to minimize the impact of emissions, spills, or accidents. These zones are designed to ensure that any accidental release of hydrogen does not compromise surrounding air quality, water sources, or public health. The Act also requires the designation of specific areas for emergency preparedness and response.

The Rescue Act[382] outlines the responsibilities of operators handling hazardous substances like GH2 to create and maintain emergency response plans. These plans must take into account the protection zones surrounding hydrogen production facilities, especially when situated within critical areas such as airports. Emergency measures are required to address the specific risks posed by hydrogen, including fire and explosion hazards, and operators must coordinate with local rescue services to ensure swift and effective action in the event of an incident.

When planning the construction of GH2 production or storage facilities near airports, developers must carefully evaluate the protection zone requirements in line with the Aviation Act and the Land Use and Building Act. These regulations ensure that the facilities are sited at a safe distance from sensitive aviation infrastructure, minimizing the risks of impact on aviation safety and airport operations. Additionally, facilities must undergo thorough risk assessments and gain regulatory approval from the Civil Aviation Authority to ensure compliance with the relevant protection zone regulations.

8.7. Environmental and Safety Regulations regarding Hydrogen Production and Storage

8.7.1. Safety regulations

Hydrogen's classification as a highly flammable and explosive gas subjects its production, storage, and use in Finland to a robust legal framework focused on technical and operational safety. The primary legislation governing these activities is the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[383], which establishes the foundational requirements for facilities managing hazardous substances. It mandates safety permits, technical documentation, and comprehensive risk assessments, particularly in sensitive locations such as airports.

Complementing this act, the Government Decree on the Monitoring of the Handling and Storage of Dangerous Chemicals[384] sets out detailed obligations for fire and explosion prevention, staff training, emergency preparedness, and the physical safety of equipment used in hydrogen applications. Storage and distribution systems must meet strict technical specifications to prevent leaks and minimize ignition risks.

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[381] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

[382] Republic of Finland, Rescue Act. Available at: https://www.finlex.fi/en/legislation/2011/379?language=fin&highlightId=611509&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22379%2F2011%22%7D [accessed: 22.04.2025.]

[383] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[384] Republic of Finland, Government Decree on the Monitoring of the Handling and Storage of Dangerous Chemicals. Available at: https://www.finlex.fi/en/legislation/collection/2012/855?language=fin&highlightId=122107&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22855%2F2012%22%7D [accessed: 22.04.2025.]

In parallel, the Rescue Act[385] requires operators to collaborate with emergency services and maintain up-to-date contingency plans. These measures are particularly critical in high-traffic zones like airport facilities, where even minor incidents can have significant safety implications.

Finally, the Occupational Safety and Health Act[386] obliges employers to identify chemical hazards, provide safety training, and ensure that working conditions meet established protective standards for all personnel involved in hydrogen-related operations.

In addition, ATEX directives ensure that all equipment and systems in hydrogen environments are designed to prevent the formation of explosive atmospheres, with explosion-proof equipment and proper zoning of hazardous areas.

8.7.2. EIA procedure

The EIA procedure for hydrogen infrastructure at airports is governed by the Act on Environmental Impact Assessment Procedure[387] and the Decree on Environmental Impact Assessment[388]. These laws require that projects likely to have significant environmental effects—such as hydrogen production or storage facilities—undergo an EIA before permits are issued.

While hydrogen-specific projects are not explicitly listed, installations involving hazardous substances or located near sensitive areas like airports typically fall under the EIA scope. The procedure evaluates potential impacts on air quality, water resources, safety, and noise, and ensures public and authority input early in the planning stage.

The results of the EIA feed into permitting decisions under the Environmental Protection Act[389]. When implemented near runways or aviation-critical zones, additional coordination with aviation authorities under the Aviation Act[390] may be required to ensure safety compliance.

8.7.3. Pollution permits

The operation of hydrogen production, storage, or refuelling infrastructure - particularly in environmentally sensitive or safety-critical areas such as airports - is subject to pollution control requirements under the Environmental Protection Act[391]. This act mandates that any activity likely to cause pollution of air, water, or soil, or other environmental harm, must obtain an environmental permit prior to construction or operation.

Hydrogen facilities often fall under this regime due to their use of hazardous substances, energy-intensive processes, and the risk of emissions or accidental releases. The accompanying Environmental Protection

[385] Republic of Finland, Rescue Act. Available at: https://www.finlex.fi/en/legislation/2011/379?language=fin&highlightId=611509&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22379%2F2011%22%7D [accessed: 22.04.2025.]

[386] Republic of Finland, Occupation Safety and Health Act. Available at: https://www.finlex.fi/en/legislation/2002/738?language=swe&highlightId=638729&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22738%2F2002%22%7D [accessed: 22.04.2025.]

[387] Republic of Finland, Act on Environmental Impact Assessment Procedure. Available at: https://www.finlex.fi/en/legislation/2017/252?language=swe&highlightId=607208&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22252%2F2017%22%7D [accessed: 22.04.2025.]

[388] Republic of Finland, Government Decree on the Environmental Impact Assessment Procedure. Available at: https://www.finlex.fi/en/legislation/2017/277?language=fin&highlightId=606971&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22277%2F2017%22%7D [accessed: 22.04.2025.]

[389] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

[390] Republic of Finland, Aviation Act. Available at: https://www.finlex.fi/en/legislation/2014/864?language=fin&highlightId=614572&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22864%2F2014%22%7D [accessed: 22.04.2025.]

[391] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

Decree[392] further defines the scope of activities requiring permits, including industrial-scale chemical processing, storage of flammable gases, and operations near water bodies or residential zones.

Where hydrogen is stored or handled in significant quantities, additional chemical handling permits are required under the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[393]. This law ensures that technical and organizational safety measures are in place to prevent environmental damage from chemical accidents or leaks.

If the facility impacts surface or groundwater - through discharges, groundwater extraction, or runoff - the Water Act[394] may also apply, requiring a separate water permit in coordination with the environmental permit.

8.7.4. Requirements for chemical substances

The handling of hydrogen as a chemical substance is subject to strict regulatory oversight, reflecting its classification as an extremely flammable and potentially explosive gas. The primary legal framework is provided by the Chemicals Act[395], which incorporates key EU regulations such as the REACH and CLP regulations. Under these provisions, hydrogen must be properly classified, labelled, and handled in accordance with EU chemical safety standards. Operators are responsible for ensuring that any hydrogen used or stored at airport facilities is registered under REACH where applicable and is accompanied by appropriate safety documentation, such as safety data sheets and exposure assessments.

In parallel, the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[396] requires operators to obtain permits and implement technical safety measures for hydrogen storage and use. This includes systems for explosion prevention, gas leak detection, ventilation, and secure containment. The accompanying Government Decree[397] further mandates detailed operational safety requirements, including risk assessments, personnel training, and maintenance protocols for hazardous chemical facilities. In addition, operations involving hydrogen typically require an operating permit—or at minimum, registration—from the Finnish Safety and Chemicals Agency, underscoring the importance of early regulatory engagement in the permitting process.

8.7.5. Construction Regulations regarding Hydrogen Production and Storage

Under Finnish legislation, the construction of hydrogen production and storage infrastructure falls within the scope of the Land Use Act[398] and Building Act[399] and its associated Land Use and Building Decree[400]. These legal instruments regulate the planning, permitting, and technical implementation of all construction projects,

[392] Republic of Finland, Government Decree on Environment Protection. Available at: https://www.finlex.fi/en/legislation/2014/713?language=swe&highlightId=614914&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22713%2F2014%22%7D [accessed: 22.04.2025.]

[393] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[394] Republic of Finland, Water Act. Available at: https://www.finlex.fi/en/legislation/2011/587?language=fin&highlightId=623339&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22587%2F2011%22%7D [accessed: 22.04.2025.]

[395] Republic of Finlan, Chemicals Act. Available at: https://www.finlex.fi/en/legislation/2013/599?language=fin&highlightId=617081&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22599%2F2013%22%7D [accessed: 22.04.2025.]

[396] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[397] Republic of Finland, Government Decree on the Monitoring of the Handling and Storage of Dangerous Chemicals. Available at: https://www.finlex.fi/en/legislation/collection/2012/855?language=fin&highlightId=122107&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22855%2F2012%22%7D [accessed: 22.04.2025.]

[398] Republic of Finland, Land Use Act. Available at: https://www.finlex.fi/en/legislation/1999/132?language=fin&highlightId=650891&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22alueidenk%C3%A4ytt%C3%B6laki%22%7D [accessed: 22.04.2025.]

[399] Republic of Finland, Building Act. Available at: https://www.finlex.fi/en/legislation/2023/751?language=fin#chp_1__sec_1__heading [accessed: 22.04.2025.]

[400] Republic of Finland, Government Decree on the Land Use and Building. Available at: https://www.finlex.fi/en/legislation/1999/895?language=fin&highlightId=649630&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22895%2F1999%22%7D [accessed: 22.04.2025.]

including those involving hazardous industrial activities. Hydrogen facilities are typically classified as special industrial buildings due to their function and the associated risks, thereby subjecting them to the most rigorous planning and permitting requirements.

In practice, hydrogen-related installations—particularly those involving stationary tanks, processing equipment, or compression systems—are considered complex, high-risk engineering structures. As such, their construction requires detailed documentation, structural risk assessments, and pre-approval by local building authorities. The permitting process must take into account zoning restrictions, site suitability, and technical designs that reflect the specific hazards associated with hydrogen, including its extreme flammability and explosive potential.

Given that hydrogen is categorized as a dangerous chemical under Finnish law, such facilities also fall under the scope of the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[401]. This act requires that construction plans incorporate explosion-proof materials, controlled access zones, leak detection systems, and sufficient safety distances from residential areas and other critical infrastructure. Hydrogen installations storing more than minimal quantities of compressed or liquefied hydrogen must register as hazardous installations and comply with regular inspections under the supervision of the Finnish Safety and Chemicals Agency.

Moreover, any new hydrogen-related construction within or near airport zones is subject to specific spatial and height restrictions in accordance with the Aviation Act[402] and the Civil Aviation Authority's regulations. Structures built within designated airspace control zones—such as those around runways or navigation aids—must not exceed permitted elevation thresholds without prior approval. This includes limitations on structure height, reflective surfaces, and electromagnetic interference, all of which could pose risks to aviation operations.

Additional safety measures are governed by the Rescue Act[403], which mandates that fire prevention and emergency response infrastructure be integrated into facility design from the outset. Facilities must coordinate with regional rescue services to develop site-specific emergency plans and implement physical safety features, such as fire-resistant enclosures, gas isolation valves, and access routes for firefighting units.

8.7.6. Liability in environmental protection

Pursuant to the Environmental Protection Act[404], the operator of a hydrogen production or storage installation in Finland is held liable for any environmental damage or the imminent threat of such damage, irrespective of fault. This liability arises in the event that the damage results from:

- Activities considered particularly hazardous to the environment, including the production, storage, or transport of hazardous substances such as hydrogen, which, due to its physical and chemical properties, presents significant risks of fire, explosion, or contamination in the event of an uncontrolled release.
- Operations involving dangerous chemicals or substances, including hydrogen, which pose serious safety and environmental concerns, especially in sensitive locations such as airports or densely populated areas.

[401] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[402] Republic of Finland, Aviation Act. Available at: https://www.finlex.fi/en/legislation/2014/864?language=fin&highlightId=614572&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22864%2F2014%22%7D [accessed: 22.04.2025.]

[403] Republic of Finland, Rescue Act. Available at: https://www.finlex.fi/en/legislation/2011/379?language=fin&highlightId=611509&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22379%2F2011%22%7D [accessed: 22.04.2025.]

[404] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

This regime is aligned with the strict liability principle entrenched in Finnish and EU environmental law, reflecting the broader polluter pays principle. In the case of hydrogen production, storage, or handling, the operator is legally responsible for preventing any environmental harm, regardless of negligence or intent.

Consequently, entities engaged in hydrogen-related operations are required to conduct comprehensive risk assessments, implement effective safety protocols, and establish robust environmental management systems. Operators must also maintain emergency response plans to mitigate the consequences of any incidents involving hydrogen. Failure to comply with these obligations can trigger administrative sanctions, such as environmental restoration orders or fines. Furthermore, non-compliance may lead to civil or criminal liability under the Criminal Code[405] or Water Act[406] if damage to natural resources or human health occurs.

This strict liability framework reinforces the need for operators to take preventative measures and conduct ongoing environmental monitoring. It is not merely a best practice but a legal obligation to ensure full compliance with Finland's environmental protection laws and safeguard against potential environmental damage arising from hydrogen-related activities.

8.7.7. Summary and conclusions on Finish Regulations on Hydrogen Production

There are several regulatory gaps and challenges in Finland's hydrogen infrastructure framework, particularly for airport integration. First, while hydrogen infrastructure is regulated under general laws, there are no hydrogen-specific construction standards, creating uncertainty in permitting and local authority interpretation. Additionally, hydrogen projects are not explicitly listed in the EIA regulations, which may lead to inconsistent application and delays in permitting, especially for pilot projects. The legal framework is fragmented across various laws, such as environmental protection, chemical safety, building regulations, and aviation control, creating coordination challenges between agencies. Furthermore, there is a lack of specific guidance for integrating hydrogen production or storage within airport planning, leaving regulatory ambiguities around zoning and safety distances. The current regulations are also not fully adaptable to emerging hydrogen applications, such as mobile refuelling units or small-scale electrolysers, which do not fit neatly into existing permit categories. There are also unclear risk categorization criteria for hydrogen facilities, complicating safety planning and civil protection. Finally, Finland's ongoing process of transposing EU Directive (EU) 2024/1778 adds legal uncertainty until the new regulations are fully integrated, particularly regarding hydrogen network access and infrastructure development rights. These gaps highlight the need for streamlined regulations, specific technical standards, and improved coordination to facilitate the safe and efficient deployment of hydrogen infrastructure, especially in sensitive areas like airports.

8.8. Finnish Regulations on Hydrogen Transportation

8.8.1. Hydrogen Transportation via natural gas pipelines

At present, Finnish legislation does not explicitly regulate the transport of pure hydrogen via natural gas pipelines, including in emerging contexts such as industrial clusters, ports, or future airport infrastructure. However, Finland's regulatory landscape is progressively evolving in line with Directive (EU) 2024/1778[407],

[405] Republic of Finland, Criminal Code. Available at: https://www.finlex.fi/en/legislation/1889/39-001?language=swe&highlightId=726257&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22Strafflag%22%7D [22.04.2025.]

[406] Republic of Finland, Water Act. Available at: https://www.finlex.fi/en/legislation/2011/587?language=fin&highlightId=623339&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22587%2F2011%22%7D [22.04.2025.]

[407] Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC. Available at: https://eur-lex.europa.eu/eli/dir/2024/1788/oj/eng [accessed: 22.04.2025.]

which requires the development of rules for renewable gas and hydrogen markets, including network planning, access rights, and technical standards.

The Natural Gas Market Act[408] provides the general framework for organizing the gas market in Finland, including access to transmission and distribution systems. While hydrogen is not yet directly covered under the act, its market-oriented structure and provisions on third-party access could be extended to renewable gases in the coming years. As of now, the act does not address hydrogen injection limits, blending conditions, or pipeline retrofitting, creating legal ambiguity for operators considering the transport of hydrogen in existing natural gas infrastructure.

The Land Use Act[409] and Building Act[410] and the Real Estate Formation Act[411] govern the establishment of pipeline routes and utility corridors. These laws apply equally to hydrogen infrastructure and provide a basis for permitting both new pipelines and the repurposing of existing ones. However, procedural clarity for hydrogen-specific infrastructure - such as rights-of-way, safety buffers, and integration with other land uses - is still lacking at the national level.

Hydrogen is classified as a hazardous chemical under the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[412]. This means that hydrogen pipeline projects fall under the supervision of the Finnish Safety and Chemicals Agency and are subject to strict safety requirements, including facility-specific permits, leak detection systems, emergency planning, and risk assessments. Additionally, the Pressure Equipment Act[413] applies to all pipeline systems operating under pressure but does not yet contain hydrogen-specific technical standards, leaving issues such as material compatibility and hydrogen embrittlement open to interpretation.

From a market regulation standpoint, Finland has not yet introduced a comprehensive legal framework for hydrogen network operation. Key provisions of Directive (EU) 2024/1778, such as unbundling of hydrogen network operators, non-discriminatory access rules, and the obligation to create a hydrogen network development plan, have not yet been transposed into national law. As a result, there is currently no formal mechanism to determine who may build or operate hydrogen pipelines, how access rights are granted, or how infrastructure planning is coordinated with national energy goals.

While pilot projects - such as the planned hydrogen transmission line between Joutseno and Imatra[414] - demonstrate the technical feasibility and industrial interest in hydrogen transport, the overall legal environment remains fragmented. There is no binding national standard for retrofitting pipelines, and no regulatory coordination between different sectors (e.g., industry, transport, energy) that may rely on hydrogen infrastructure in the near future.

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[408] Republic of Finland, Natural Gas Marker Act. Available at: https://www.finlex.fi/en/legislation/2017/587?language=fin&highlightId=605596&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22587%2F2017%22%7D [accessed: 22.04.2025.]

[409] Republic of Finland, Land Use Act. Available at: https://www.finlex.fi/en/legislation/1999/132?language=fin&highlightId=650891&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22alueidenk%C3%A4ytt%C3%B6laki%22%7 [accessed: 22.04.2025.]

[410] Republic of Finland, Building Act. Available at: https://www.finlex.fi/en/legislation/2023/751?language=fin#chp_1__sec_1__heading [accessed: 22.04.2025.]

[411] Republic of Finland, Real Estate Formation Act. Available at: https://www.finlex.fi/en/legislation/1995/554?language=fin&highlightId=650728&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22554%2F1995%22%7D [accessed: 22.04.2025.]

[412] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[413] Republic of Finland, Pressure Equipment Act. Available at: https://www.finlex.fi/en/legislation/2016/1144?language=fin [accessed: 22.04.2025.]

[414] Please see: https://gasgrid.fi/en/2023/05/02/the-first-hydrogen-transmission-network-project-in-finland-proceeds-to-basic-design-stage/.

8.8.2. Hydrogen Transportation via road transport

The core legal basis for road transport of hydrogen lies in the Act on the Transport of Dangerous Goods[415], which implements the ADR agreement. This act sets out detailed requirements for the packaging, labelling, documentation, and vehicle standards required for transporting Class 2 gases, including hydrogen. It also mandates that drivers hold ADR certifications and that operators follow safety management procedures throughout the transport chain.

Complementing this framework, the Decree on the Transport of Dangerous Goods by Road[416] provides technical specifications for transport vehicles, including hydrogen tank trailers, as well as detailed rules on loading procedures, vehicle markings, equipment standards, and transport restrictions in sensitive areas such as tunnels or urban zones.

Hydrogen's classification as a hazardous and flammable chemical also brings it under the scope of the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[417]. While this act is primarily focused on stationary facilities, it applies to road transport in situations involving the temporary storage, transfer, or handling of hydrogen during loading and unloading operations. Companies involved in hydrogen logistics must secure appropriate safety permits and comply with risk assessment and control measures enforced by the Finnish Safety and Chemicals Agency.

From a vehicle regulation perspective, the Vehicle Act[418] governs the roadworthiness, safety inspections, and technical compliance of transport vehicles used to carry hydrogen. This includes requirements for tank pressure systems, braking functions, and fire protection equipment specific to vehicles transporting hazardous gases.

General traffic conditions and route management are regulated by the Road Traffic Act[419], which includes provisions for hazard signage, speed limits, and restrictions related to the transportation of dangerous goods. The act also outlines coordination protocols with emergency services and road authorities in the event of incidents during transport.

In terms of accident prevention and emergency planning, the Rescue Act[420] imposes obligations on transport operators to carry out risk assessments and prepare emergency response plans in collaboration with local rescue services. This is particularly important for high-risk transport routes or operations near population centres.

Lastly, environmental risks associated with hydrogen transport—such as emissions, noise, or spill potential—are covered under the Environmental Protection Act[421]. Though hydrogen itself produces no direct emissions when used, its storage and transfer may still pose environmental concerns, especially near ecologically sensitive areas or groundwater protection zones.

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[415] Republic of Finland, Transport of Dangerous Goods Act. Available at: https://www.finlex.fi/en/legislation/2023/541?language=fin&highlightId=595821&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22541%2F2023%22%7D [accessed: 22.04.2025.]

[416] Republic of Finland, Decree on the Transport of Dangerous Goods by Road. Available at: https://www.finlex.fi/en/legislation/2002/194?language=fin&highlightId=643925&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22194%2F2002%22%7D [accessed: 22.04.2025.]

[417] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[418] Republic of Finland, Vehicle Act. Available at: https://www.finlex.fi/en/legislation/2021/82?language=swe&highlightId=599234&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%2282%2F2021%22%7D [accessed: 22.04.2025.]

[419] Republic of Finland, Road Traffic Act. Available at: https://www.finlex.fi/en/legislation/2018/729?language=swe&highlightId=603267&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22729%2F2018%22%7D [accessed: 22.04.2025.]

[420] Republic of Finland, Rescue Act. Available at: https://www.finlex.fi/en/legislation/2011/379?language=fin&highlightId=611509&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22379%2F2011%22%7D [accessed: 22.04.2025.]

[421] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

8.9. Finnish Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

The Vehicle Act[422] forms the foundation for the type approval and use of hydrogen-powered vehicles in Finland. It transposes EU regulations on alternative fuel vehicles and sets technical requirements for roadworthiness, emissions, and fuel systems. Hydrogen vehicles are subject to specific safety standards, including those related to fuel cell integrity, high-pressure hydrogen storage, and crash safety. The act also applies to both passenger vehicles and heavy-duty transport.

Technical requirements for vehicle approval are further detailed through the national implementation of Regulation (EU) 2018/858[423], which standardizes vehicle type-approval procedures across member states. This includes provisions for the testing and certification of hydrogen tanks, valve systems, and leak prevention in fuel cell vehicles.

On the infrastructure side, the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives[424] is the primary piece of legislation governing hydrogen refuelling stations. Administered by the Finnish Safety and Chemicals Agency, this act mandates that all hydrogen storage, compression, and dispensing systems be registered and permitted. Operators must conduct hazard and risk analyses, implement safety distances, and install emergency systems in line with national safety guidelines.

Hydrogen station developers and fleet operators must also comply with the Rescue Act[425], which requires emergency preparedness planning and coordination with local rescue services. This includes risk assessments, emergency response plans, and safety training for station personnel.

Environmental oversight is provided by the Environmental Protection Act[426], which may require permitting for hydrogen installations located in groundwater protection zones or areas with high ecological sensitivity. Refuelling stations with significant environmental impact may also be subject to environmental impact assessment procedures.

From a market development and infrastructure deployment perspective, hydrogen stations are supported under Finland's transposition of the AFIR, which mandates the buildout of alternative fuel refuelling infrastructure, including hydrogen, along major transport corridors such as the TEN-T network. This regulatory push is coordinated with the Act on Transport Services[427], which supports the integration of digital access and open data services for refuelling networks.

8.9.1. Summary and conclusions on Finish Regulations on Fuelling and Usage

While hydrogen vehicle deployment in Finland is still in its early stages, the current legislative framework provides a structured pathway for the development of vehicles and refuelling infrastructure.

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[422] Republic of Finland, Vehicle Act. Available at: https://www.finlex.fi/en/legislation/2021/82?language=swe&highlightId=599234&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%2282%2F2021%22%7D [accessed: 22.04.2025.]

[423] Regulation (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, amending Regulations (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC. Available at: https://eur-lex.europa.eu/eli/reg/2018/858/oj/eng [accessed: 22.04.2025.]

[424] Republic of Finland, Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives. Available at: https://www.finlex.fi/en/legislation/2005/390?language=fin&highlightId=635394&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22390%2F2005%22%7D [accessed: 22.04.2025.]

[425] Republic of Finland, Rescue Act. Available at: https://www.finlex.fi/en/legislation/2011/379?language=fin&highlightId=611509&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22379%2F2011%22%7D [accessed: 22.04.2025.]

[426] Republic of Finland, Environmental Protection Act. Available at: https://www.finlex.fi/en/legislation/2014/527?language=fin&highlightId=615139&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22527%2F2014%22%7D [accessed: 22.04.2025.]

[427] Republic of Finland, Act on Transportation Services. Available at: https://www.finlex.fi/en/legislation/2017/320?language=fin&highlightId=605963&highlightParams=%7B%22type%22%3A%22BASIC%22%2C%22search%22%3A%22320%2F2017%22%7D [accessed: 22.04.2025.]

Hydrogen-powered vehicles are regulated under the Vehicle Act, which aligns with EU regulations on alternative fuel vehicles. The Act sets technical requirements for roadworthiness, emissions, and fuel systems, with specific safety standards for hydrogen fuel cell vehicles, including integrity, high-pressure storage, and crash safety. It applies to both passenger and heavy-duty vehicles, with detailed approval procedures under EU Regulation (EU) 2018/858.

Hydrogen refuelling stations are governed by the Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives, which mandates safety measures for hydrogen storage, compression, and dispensing systems. These stations must be registered, conduct risk analyses, and implement safety protocols. Compliance with the Rescue Act requires emergency preparedness planning, and the Environmental Protection Act may require permits for installations in sensitive ecological areas.

Additionally, Finland's transposition of the AFIR supports the development of hydrogen infrastructure along major transport corridors, coordinated with the Act on Transport Services, which integrates digital access and open data for refuelling networks.

However, targeted updates—especially on harmonised technical standards, liability allocation, and infrastructure incentives—will be necessary to support the broader hydrogen transition in the coming years.

8.10. Key Findings of Sector-Specific Finnish Regulations

In Finland, hydrogen facilities are not explicitly zoned but can be accommodated under existing categories like industrial areas for dangerous chemicals, general industrial zones, and energy supply areas, requiring safety and environmental assessments. Hydrogen facilities at airports must align with airport master plans, ensure safety distances from critical infrastructure, and integrate emergency response systems under the Rescue Act. Transport of hydrogen is regulated by the Act on Transport of Dangerous Goods, though hydrogen pipeline transport lacks clear regulation, creating uncertainty. Hydrogen is subject to strict safety regulations under the Act on Safe Handling and Storage of Dangerous Chemicals, requiring permits and risk assessments, with ATEX directives for equipment in explosive environments.

Environmental regulations under the Environmental Protection Act apply to hydrogen facilities, particularly near sensitive areas like airports, though EIAs are typically required due to the hazardous nature of the substances involved. Vehicle and refuelling infrastructure must meet EU safety standards, with refuelling stations governed by chemical safety laws requiring risk analysis and emergency systems. Hydrogen facility operators are strictly liable for environmental damage, underscoring the importance of risk management. Construction of hydrogen facilities follows the Land Use and Building Act, with additional requirements for airport proximity, such as height restrictions and electromagnetic interference controls under the Aviation Act.

8.11. Identified Regulatory Gaps, Challenges and Roadblocks

Lack of hydrogen-specific construction standards

Finland lacks dedicated construction standards for hydrogen facilities, relying instead on general regulatory frameworks. This creates uncertainty in permitting processes and inconsistent interpretations by local authorities.

No explicit listing of hydrogen projects in EIA regulations

Hydrogen projects are not explicitly listed in Environmental Impact Assessment regulations, leading to inconsistent application of assessment requirements and potential permitting delays, especially for pilot or demonstration projects.

Fragmented legal framework

Regulations governing hydrogen infrastructure are scattered across multiple legal domains including environmental protection, chemical safety, building regulations, and aviation control, creating coordination challenges between different regulatory authorities.

Insufficient integration guidance for airport contexts

There is a lack of specific regulatory guidance for integrating hydrogen production or storage within airport planning, creating ambiguities around appropriate zoning classifications and safety distances in these specialized environments.

Limited adaptability to emerging hydrogen applications

Current regulations do not adequately address emerging hydrogen technologies such as mobile refuelling units or small-scale electrolysers, which do not align neatly with existing permit categories or safety classifications.

Unclear risk categorization criteria

The document highlights ambiguity in how hydrogen facilities are categorized for risk assessment purposes, complicating safety planning requirements and civil protection measures.

Absence of hydrogen-specific pipeline regulations

The current regulatory framework does not explicitly address hydrogen transport via pipelines, creating ambiguity for operators considering hydrogen transport in existing natural gas infrastructure or developing new hydrogen-specific pipelines.

Limited market regulation for hydrogen networks

Finland has not yet established comprehensive market regulations for hydrogen network operations, leaving questions about who may build or operate hydrogen pipelines, how access rights are granted, and how infrastructure planning should be coordinated.

Lack of coordinated approach across sectors

There is insufficient regulatory coordination between different sectors (industrial, transportation, energy) that may utilize hydrogen infrastructure, potentially leading to inefficient development and fragmented standards.

8.12. Recommendations

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.

However, when creating or updating relevant legislation, Finland should include provisions that ensure future flexibility for liquid hydrogen deployment, avoiding overly rigid frameworks that could inadvertently create barriers to liquid hydrogen infrastructure or operations in later stages of hydrogen market development.

Responsible authorities:	Time of completion:
Ministry of Economic Affairs and Employment	2027

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 electrolysers, potentially including regulatory sandboxes for pilot projects and phased approval processes that scale with project development.

Responsible authorities:	Time of completion:

Centres for Economic Development, Transport and the Environment	2027

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.

Responsible authorities:	Time of completion:
Ministry of the Environment, Centres for Economic Development, Transport and the Environment	2028

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.

Responsible authorities:	Time of completion:
Finnish Transport and Communications Agency	2027

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.

Responsible authorities:	Time of completion:
Safety and Chemicals Agency	2028

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.

Responsible authorities:	Time of completion:
Safety and Chemicals Agency, Ministry of the Environment	2029

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.

Responsible authorities:	Time of completion:
Safety and Chemicals Agency	2029

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.

Responsible authorities:	Time of completion:
Ministry of Economic Affairs and Employment	2030

Develop cross-sectoral hydrogen coordination mechanisms

Create formal coordination platforms between industrial, transportation, and energy sectors to harmonize hydrogen infrastructure development, including standardized interfaces, shared safety protocols, and integrated planning approaches to maximize efficiency and reduce redundancy.

Responsible authorities:	Time of completion:
Finnish Transport Infrastructure Agency, Finavia	2027 - 2028

9.Federal Republic of Germany

9.1. Executive Summary on German National Legal and Regulatory Framework

Germany has established a comprehensive and well-structured regulatory framework to support the implementation of hydrogen technologies in the aviation sector. The National Hydrogen Strategy explicitly prioritizes aviation applications, while the Hydrogen Acceleration Act grants hydrogen projects "overriding public interest" status, significantly streamlining approvals and strengthening their legal position.

The regulatory structure features clearly defined permitting pathways based on production and storage capacities, with detailed safety and environmental standards addressing hydrogen's unique properties. Recent administrative improvements include digital submission requirements, fixed decision deadlines, and expedited legal reviews, directly addressing historical bureaucratic challenges.

However, significant implementation challenges persist. Airport operators must navigate a complex multi-agency approval process with potential for conflicting requirements between aviation authorities and environmental agencies. The unique properties of hydrogen necessitate specialized safety protocols that are still evolving, while risk assessments remain complicated by limited operational data. Technical and economic hurdles also exist in establishing cost-effective storage solutions, specialized training, and transportation systems requiring high compression or cryogenic cooling.

To address these challenges, Germany should consider establishing a centralized hydrogen aviation authority to streamline approvals and resolve regulatory conflicts. Development of aviation-specific hydrogen safety standards, standardized risk assessment methodologies, and specialized training programs would provide much-needed clarity. Infrastructure support programs specifically targeting airport hydrogen applications would help overcome the high initial investment barriers.

With these enhancements to its already robust framework, Germany can fully realize hydrogen's potential for decarbonizing airport operations and aviation, positioning its airports as leaders in sustainable aviation while providing a model for other countries developing similar regulatory frameworks.

9.2. Introduction

Germany is at the forefront of advancing hydrogen technologies, establishing a robust regulatory framework to support the growth of this emerging sector. The country's approach combines EU directives, national legislation,

and industry-specific regulations, positioning Germany as a leader in the energy transition. While significant progress has been made, particularly through initiatives like the National Hydrogen Strategy and the Hydrogen Acceleration Act, challenges remain in key areas such as hydrogen production, storage, and transportation, especially within the aviation sector.

The current regulatory landscape often applies existing legal frameworks to hydrogen technologies, with fewer hydrogen-specific provisions. This approach creates uncertainty in critical areas such as permitting, safety standards, and infrastructure development. The integration of hydrogen into aviation is further complicated by the intersection of aviation safety protocols, environmental regulations, and hazardous material handling requirements, which can affect approval timelines and project feasibility.

This report offers a comprehensive analysis of Germany's regulatory environment for integrating GH2 in aviation, focusing on key legislative instruments, including the Building Code and the Aviation Act. It also examines the roles of critical regulatory bodies such as the Federal Ministry for Digital and Transport Affairs, the Federal Environment Agency, and the Federal Aviation Office in shaping the GH2 ecosystem.

By identifying challenges related to permitting processes, inter-agency coordination, and safety standards harmonization, this assessment provides valuable insights into streamlining hydrogen adoption pathways. It also ensures alignment with Germany's broader energy transition objectives, offering stakeholders practical guidance for navigating the evolving regulatory landscape.

9.3. Key National Regulatory Bodies

In Germany, several key national regulatory bodies oversee and support the implementation of hydrogen fuel in airport operations. These bodies are responsible for setting standards, approving infrastructure projects, ensuring safety, and coordinating funding and policy alignment with national and EU objectives.

9.3.1. Federal Ministry for Digital and Transport[428]

The Federal Ministry for Digital and Transport is the primary policymaker for transport-related initiatives in Germany, including aviation and airport operations. It develops strategies, funds research, and coordinates the deployment of hydrogen infrastructure.

The Federal Ministry for Digital and Transport Affairs oversees the National Hydrogen Strategy, and funds projects like the BALIS 2.0 Project with a funding of EUR 9.3 million for aviation fuel cells and the Clean Intralogistics Net for fuel cell-powered ground vehicles at airports. It also supports the GOLIAT project for liquid hydrogen operations at airports like Stuttgart. The ministry ensures alignment with aviation safety and decarbonization goals. The Federal Ministry for Digital and Transport also supports the development of hydrogen refuelling stations and storage facilities at airports, streamlined through the Hydrogen Acceleration Act, which simplifies permitting for such infrastructure.

Key activities of the Federal Ministry for Digital and Transport Affairs include developing policies and roadmaps for hydrogen in aviation, allocating federal funding for hydrogen research and infrastructure, coordinating with the Federal Aviation Office to ensure safety compliance for hydrogen use in airports, engaging with EU bodies like the EASA to harmonize regulations.

9.3.2. Federal Ministry for Economic Affairs and Climate Action[429]

The Federal Ministry for Economic Affairs and Climate Action is responsible for shaping Germany's economic, industrial, and energy policies. It plays a central role in implementing the country's climate policy, energy transition, and industrial decarbonization strategies. The ministry coordinates the National Hydrogen Strategy,

[428] Federal Republic of Germany. Federal Ministry for Digital and Transport. Available at: https://www.bmvi.de/EN/Home/home.html?https=1 [accessed 22.04.2025.]
[429] Federal Republic of Germany. Federal Ministry for Economic Affairs and Climate Action. Available at: https://www.bmwk.de/Navigation/EN/Home/home.html [accessed 22.04.2025.]

fosters energy market regulation, and manages funding instruments for innovation and infrastructure development.

The Federal Ministry for Economic Affairs and Climate Action holds a central position in the national hydrogen economy, particularly through its coordination of the National Hydrogen Strategy. The Federal Ministry for Economic Affairs and Climate Action is responsible for energy and industrial policy and is tasked with ensuring the market conditions and regulatory environment necessary for the production, distribution, and utilization of hydrogen fuel. It supports infrastructure planning, including pipeline development that could serve airport zones, and oversees funding instruments such as H2Global, which aims to secure large-scale imports of GH2, potentially contributing to SAF supply.

9.3.3. Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection[430]

The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection is responsible for environmental protection, climate action, conservation, and consumer safety. It develops and enforces legislation related to pollution control, emissions reduction, nature conservation, and sustainable resource use. The ministry ensures compliance with environmental impact laws and the integration of environmental considerations into all sectors of policy, including energy and transport.

The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection ensures that hydrogen-related activities at airports comply with Germany's environmental legislation, especially the Act on the prevention of harmful effects on the environment caused by air pollution, noise, vibration and similar phenomena – Federal Immission Control Act[431] (Bundes-Immissionsschutzgesetz). This includes regulating emissions from hydrogen production and use, approving hydrogen refuelling stations, and evaluating potential environmental risks associated with hydrogen storage and handling near airport grounds. The ministry also helps transpose EU directives such as RED II and III, which define sustainability criteria for renewable fuels, which is critical for certifying green hydrogen in aviation applications.

9.3.4. Federal Network Agency[432]

The Federal Network Agency is Germany's national regulator for electricity, gas, telecommunications, postal services, and railway networks. It ensures competition, non-discriminatory access to infrastructure, and fair pricing. With the expansion of Germany's hydrogen economy, Federal Network Agency has taken on a new regulatory role in overseeing hydrogen pipeline networks.

The Federal Network Agency regulates access to and the pricing of Germany's upcoming hydrogen core network, which is expected to supply major industrial and potentially airport regions. This oversight includes converting natural gas pipelines for hydrogen use and ensuring that airport operators or their fuel suppliers can access hydrogen in a fair and regulated manner. Its role is essential for creating a reliable supply infrastructure that airports can connect to for their hydrogen needs.

9.3.5. Federal Environment Agency[433]

The Federal Environment Agency is Germany's main scientific and technical authority for environmental protection. It conducts research, develops environmental standards, and advises federal ministries and

[430] Federal Republic of Germany. Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection. Available at: https://www.bmuv.de/en/ [accessed 22.04.2025.]
[431] Law on the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Immission Control Act - BImSchG). Available at: https://www.gesetze-im-internet.de/bimschg/BJNR007210974.html [accessed: 25.04.2025.]
[432] Federal Republic of Germany. Federal Network Agency. Available at: https://www.bundesnetzagentur.de/EN/Home/home_node.html [accessed 22.04.2025.]
[433] Federal Republic of Germany. Federal Environment Agency. Available at: https://www.umweltbundesamt.de/ [accessed 22.04.2025.]

legislators on climate, air quality, water protection, and sustainable technologies. Its assessments are often used to guide legislation and policy implementation.

The Federal Environment Agency contributes expert assessments on the environmental sustainability of hydrogen production and use, including full life-cycle analyses of greenhouse gas emissions. It also helps establish the criteria for the environmental certification of hydrogen, which is crucial for airports aiming to meet climate neutrality targets. Moreover, the German Environment Agency advises on safety protocols for hydrogen infrastructure at sensitive sites, ensuring that hydrogen use at airports minimizes environmental risks.

9.3.6. Federal Aviation Office[434]

The Federal Aviation Office is subordinate to the Federal Ministry for Digital and Transport Affairs. The Federal Aviation Office is the national civil aviation authority responsible for aircraft certification, operational licensing, airport supervision, and enforcement of aviation safety regulations in accordance with both national and European law. It ensures that civil aviation in Germany operates in accordance with safety, security, and environmental protection standards.

The Federal Aviation Office will play an increasingly important role in the approval and oversight of hydrogen-powered aircraft and related airport infrastructure. This includes certifying new aircraft types, ground support vehicles using hydrogen fuel, and approving hydrogen refuelling and storage systems. The Federal Aviation Office coordinates with the EASA on developing common safety protocols for the use of hydrogen in civil aviation.

9.3.7. Federal Bureau of Aircraft Accident Investigation[435]

The Federal Bureau of Aircraft Accident Investigation is Germany's independent federal authority for investigating civil aviation accidents and serious incidents. Operating under the Aviation Accident Investigation Act, its objective is to improve air safety by identifying root causes and issuing safety recommendations. The Federal Bureau of Aircraft Accident Investigation maintains technical and investigative expertise in aircraft systems, materials, operations, and human factors.

As hydrogen-fuelled aircraft and airport systems (e.g., hydrogen refuelling infrastructure or hydrogen-powered ground vehicles) become operational, the Federal Bureau of Aircraft Accident Investigation will be responsible for investigating any incidents involving such technologies. Its role will be vital in assessing the safety performance of hydrogen systems, understanding potential new failure modes (e.g., hydrogen leaks, cryogenic hazards, ignition risks), and issuing technical guidance or safety improvements. The investigations will contribute to the development of risk-informed regulations for hydrogen use in aviation and airport environments.

9.3.8. National Organization for Hydrogen and Fuel Cell Technology[436]

The National Organization for Hydrogen and Fuel Cell Technology is a federally owned coordination and management organization established to support the market introduction of hydrogen and fuel cell technologies. Operating under the supervision of the Federal Ministry for Digital and Transport and the Federal Ministry for Economic Affairs and Climate Action, it manages funding programs, builds public-private partnerships, and fosters technical innovation in hydrogen across sectors including transport, energy, and industry.

The National Organization for Hydrogen and Fuel Cell Technology serves as a key facilitator for hydrogen pilot projects in airport environments. It administers funding from programs such as the National Innovation Programme for Hydrogen and Fuel Cell Technology and HyLand, and has supported feasibility studies,

[434] Federal Republic of Germany. Federal Aviation Office. Available at: https://www.lba.de/EN/Home/home_node.html [accessed 22.04.2025.]
[435] Federal Republic of Germany. Federal Bureau of Aircraft Accident Investigation. Available at: https://www.bfu-web.de/EN/Home/home_node.html [accessed 22.04.2025.]
[436] Federal Republic of Germany. National Organization for Hydrogen and Fuel Cell Technology. Available at: https://www.now-gmbh.de/en/ [accessed 22.04.2025.]

technology demonstrations, and deployment of hydrogen-powered vehicles and infrastructure at or near airports. By bridging the gap between government policy, research, and private sector execution, the National Organization for Hydrogen and Fuel Cell Technology accelerates practical hydrogen implementation at German airports.

9.3.9. German Space Agency[437]

The German Space Agency is Germany's national research centre for aeronautics, space, energy, transport and security. It functions as both a scientific institution and a space agency that undertakes statutory tasks in the space sector on behalf of the German Federal Government. The German Space Agency conducts fundamental and applied research in aerodynamics, aircraft design, propulsion systems, sustainable fuels, and mobility innovation. It advises federal ministries and represents Germany in international research and aerospace collaborations.

The German Space Agency is at the forefront of hydrogen aviation research and development in Germany. It operates several major projects related to hydrogen-powered aircraft, fuel cells, and hybrid-electric propulsion systems. It also develops simulation tools and demonstrators for hydrogen refuelling and storage systems at airports. The German Space Agency's research provides the scientific and technical foundation for integrating hydrogen safely and efficiently into airport operations. Through cooperation with the National Organization for Hydrogen and Fuel Cell Technology, the Federal Ministry for Digital and Transport, and EASA, the German Space Agency supports the regulatory development process with empirical data and technical standards.

9.3.10. Federal Office for Economic Affairs and Export Control[438]

The Federal Office for Economic Affairs and Export Control is a federal agency operating under the authority of the Federal Ministry for Economic Affairs and Climate Action. It is responsible for administering programs in foreign trade, energy efficiency, security export controls, and economic promotion. In the energy sector, the Federal Office for Economic Affairs and Export Control oversees market surveillance, grant distribution, and compliance monitoring of funded projects, particularly in relation to renewable energy and fuel infrastructure.

In the context of energy and climate protection, the Federal Office for Economic Affairs and Export Control manages several funding programs that could apply to hydrogen production and refuelling at airports. It administers subsidies for decarbonization and may support hydrogen storage, mobile fuel-cell units, or power-to-liquid synthetic fuel installations relevant to airport operations. The Federal Office for Economic Affairs and Export Control also plays a monitoring role in ensuring that hydrogen projects receiving public funding meet efficiency and environmental criteria. Its role becomes increasingly important as hydrogen becomes part of regulated trade and transport commodities.

9.3.11. German Institute for Standardization[439]

The German Institute for Standardization is the national standards organization responsible for developing technical norms across all sectors of the economy. It operates in cooperation with governmental agencies, the private industry, and research institutions to establish voluntary standards that enhance quality, safety, and interoperability. The institute also represents Germany in European and international standardization bodies, contributing to the global harmonization of technical norms.

The German Institute for Standardization plays a crucial role in developing and maintaining standards related to hydrogen fuel production, transport, storage, and application. These standards are essential for the design and certification of hydrogen refuelling stations, high-pressure tanks, and pipelines installed in or around airports. By establishing clear and internationally compatible technical specifications, the institute ensures that hydrogen

[437] Federal Republic of Germany. German Space Agency. Available at: https://www.dlr.de/en [accessed 22.04.2025.]
[438] Federal Republic of Germany. Federal Office for Economic Affairs and Export Control. Available at: https://www.bafa.de/EN/Home/home_node.html [accessed 22.04.2025.]
[439] Federal Republic of Germany. German Institute for Standardization. Available at: https://www.din.de/en [accessed 22.04.2025.]

infrastructure in airports meets high safety and performance requirements, while also facilitating the market entry for new technologies and services.[440]

9.4. National Planning Documents and Strategies

9.4.1. National Hydrogen Strategy

The National Hydrogen Strategy[441] identifies aviation as a priority sector for hydrogen adoption. The strategy emphasizes hydrogen use in airport ground operations (e.g., fuel cell-powered vehicles) and as a future aviation fuel.

Germany's National Hydrogen Strategy, initially adopted in 2020, represents a central element of the country's energy transition and its broader goal to achieve climate neutrality by 2045. The strategy prioritizes the production and use of green hydrogen as a key solution for decarbonizing sectors that are difficult to electrify, such as heavy industry, chemicals, and heavy transport. The original 2020 strategy set an ambitious target of installing 5 gigawatts of offshore and onshore green hydrogen production capacity by 2030, supported by the development of necessary infrastructure and international cooperation for hydrogen imports. Based on the strategy, the hydrogen market shall be developed further through an incremental expansion of the areas where hydrogen is used as a fuel, i.e. in certain areas of the transport and industrial sectors. In the transport sector, the minimum share of renewable energy within the final consumption of energy in 2030 shall be increased significantly beyond the EU requirement of at least 14% contained in RED II. In addition, a minimum requirement of at least 2% kerosene from renewable energy in 2030 will be considered for the aviation sector. Stakeholders from the aviation and other industrial sectors shall be involved in the development of sector-specific long-term decarbonisation strategies based on hydrogen.[442]

In July 2023, the Federal Government adopted an updated version of the strategy,[443] significantly raising its ambitions. The revised strategy doubles the 2030 electrolysis capacity target to at least 10 gigawatts and anticipates a national hydrogen demand of between 95 and 130 terawatt-hours by 2030. The update also includes a broader scope of hydrogen sources, allowing for temporary use of low-carbon hydrogen (e.g., blue hydrogen) during the market ramp-up phase, while maintaining the long-term objective of transitioning entirely to green hydrogen. In the transport sector, the German Government wants to implement minimum quotas for the use of hydrogen and e-fuels at national level.[444]

9.4.2. Hydrogen Acceleration Act

The Hydrogen Acceleration Act[445], adopted by the German federal cabinet in May 2024, establishes a legal framework to expedite the development of hydrogen infrastructure, aligning it with the National Hydrogen Strategy and its climate neutrality objectives for 2045.

The Hydrogen Acceleration Act designates hydrogen infrastructure projects, including electrolysers, pipelines, import terminals, aboveground and underground storage facilities, as being of "overriding public interest". This classification prioritizes such projects in planning and approval processes, facilitating faster implementation.

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[440] The Standardization roadmap for hydrogen technologies. Available at: https://www.din.de/resource/blob/1140546/bfe3e27f3211008924c3c27b7b9efc8c/standardization-roadmap-for-hydrogen-technologies-2024-data.pdf [accessed: 06.05.2025.]

[441] Federal Republic of Germany. The National Hydrogen Strategy. Available at: https://www.bmuv.de/themen/verkehr/wasserstoff-und-power-to-x/nationale-wasserstoffstrategie [accessed: 25.04.2025.]

[442] Eversheds Sutherland. German Government issues National Hydrogen Strategy. Available at: https://www.eversheds-sutherland.com/en/united-kingdom/insights/german-government-issues-national-hydrogen-strategy-with-10-gw-production-capacity-target-by-2040-an [accessed: 06.05.2025.]

[443] Federal Republic of Germany. Update of the National Hydrogen Strategy. Available at: https://www.bmuv.de/themen/verkehr/wasserstoff-und-power-to-x/nationale-wasserstoffstrategie [accessed: 25.04.2025.]

[444] Eversheds Sutherland. German: Updates to National Hydrogen Strategy to double green hydrogen production capacity targeted for 2030. Available at: https://www.eversheds-sutherland.com/de/global/insights/germany-updates-national-hydrogen-strategy-to-double-green-hydrogen-production-capacity-targeted-fo [accessed: 06.05.2025.]

[445] Federal Republic of Germany. Hydrogen Acceleration Act. Available at: https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/05/20240529-bundesregierung-stellt-weichen-fuer-den-beschleunigten-ausbau-von-wasserstoffprojekten.html [accessed: 25.04.2025.]

Specifically, electrolysers are granted this status if they are directly connected to renewable energy sources or commit to sourcing at least 80% renewable electricity by the end of 2029. From 2030 onward, this requirement is expected to be met by the general increase in renewable energy within the grid.

To streamline procedures, the Hydrogen Acceleration Act introduces measures such as digitalization of approval processes, simplified procurement rules, and reduced environmental impact assessments. Notably, electrolysers with a capacity of up to 5 megawatts are exempted from certain approval requirements. These changes aim to reduce bureaucratic hurdles and accelerate project timelines.

Environmental safeguards are integrated into the Hydrogen Acceleration Act. The "overriding public interest" designation does not apply in areas where water extraction for electrolysis could significantly impact public water supplies or sensitive ecosystems, such as floodplains and wetlands.

The Hydrogen Acceleration Act is a pivotal component of Germany's strategy to foster a robust hydrogen economy, facilitating decarbonization and enhancing energy security through diversification.

9.4.3. Energy Industry Act

The Energy Industry Act[446] serves as the cornerstone of Germany's energy legislation, establishing the legal framework for the generation, transmission, and distribution of electricity and gas. Its primary objectives include ensuring a secure, cost-effective, consumer-friendly, efficient, and environmentally sustainable energy supply. The Act also facilitates the integration of renewable energy sources and the development of new energy infrastructures, such as hydrogen, in alignment with Germany's climate neutrality goals.

In the context of hydrogen fuel implementation at airports, the Energy Industry Act provides the regulatory basis for developing and operating hydrogen infrastructure necessary for aviation applications. This encompasses the production, storage, and distribution systems required to supply hydrogen as a SAF. By classifying hydrogen infrastructure projects as being of "overriding public interest," the Energy Industry Act prioritizes these projects in planning and approval processes, thereby streamlining their development. This designation is particularly pertinent for airport-related hydrogen projects, which often involve complex logistical and regulatory considerations.

Furthermore, the Energy Industry Act's provisions support the integration of hydrogen technologies into existing energy systems, facilitating the establishment of hydrogen refuelling stations and other necessary infrastructure within airport environments. This integration is crucial for enabling the adoption of hydrogen-powered aircraft and GSE, contributing to the decarbonization of the aviation sector. By providing a clear legal framework and prioritizing hydrogen infrastructure, the Energy Industry Act plays a vital role in advancing hydrogen fuel implementation at airports across Germany.

9.4.4. Renewable Energy Act

The Renewable Energy Act[447] serves as the legislative foundation for Germany's energy transition. Its primary objective is to promote the expansion of renewable energy sources into the national electricity grid. Key mechanisms under the Renewable Energy Act include guaranteed grid access for renewable energy producers, financial incentives through feed-in tariffs or market premiums, and the prioritization of renewable energy in grid dispatch.

The Renewable Energy Act plays an indirect but crucial role in facilitating GH2 production by enabling the deployment of low-cost renewable electricity. Since GH2 is produced through electrolysis using renewable

[446] Federal Republic of Germany. Energy Industry Act. Available at: https://dejure.org/gesetze/EnWG [accessed: 25.04.2025.]
[447] Federal Republic of Germany. Renewable Energy Act. Available at: https://www.gesetze-im-internet.de/eeg_2014/BJNR106610014.html [accessed: 25.04.2025.]

energy, the Renewable Energy Act's mechanisms for renewable energy expansion directly support the economic viability of electrolysers.

9.4.5. National Innovation Programme for Hydrogen and Fuel Cell Technology

The National Innovation Programme for Hydrogen and Fuel Cell Technology[448] represents a strategic initiative to accelerate the development and market integration of hydrogen and fuel cell technologies. Implemented as a public-private partnership, the programme is coordinated by National Organisation for Hydrogen and Fuel Cell Technology.

Within the aviation sector, the National Innovation Programme for Hydrogen and Fuel Cell Technology has played a pivotal role in advancing hydrogen fuel cell technologies through targeted funding of research and demonstration projects. The National Innovation Programme for Hydrogen and Fuel Cell Technology's support for hydrogen aviation technologies complements broader national and European decarbonization efforts, including Germany's National Hydrogen Strategy and the EU's ReFuelEU Aviation initiative.

9.4.6. Climate Protection Act

The Climate Protection Act[449] serves as Germany's primary legislative instrument for achieving its national and international climate commitments. This framework legislation establishes binding annual emission reduction targets across six key sectors: energy, industry, transport, buildings, agriculture, and waste management. The Act codifies Germany's ambitious climate goals, including a 65% reduction in greenhouse gas emissions by 2030 and climate neutrality by 2045, using 1990 as the baseline year.

The Climate Protection Act implements a rigorous accountability framework, assigning specific emission budgets to each sector and mandating corresponding federal ministries to ensure compliance. Should any sector exceed its annual emissions budget, the responsible ministry must implement immediate corrective measures through an "emergency program".

While the Climate Protection Act does not explicitly mention hydrogen technologies, its stringent sectoral targets, particularly for hard-to-abate sectors like heavy industry and transport, create essential regulatory pressure that favours low-carbon solutions. The Act's provisions work in conjunction with Germany's National Hydrogen Strategy to facilitate the adoption of green hydrogen.

9.4.7. Act on the Further Development of the Greenhouse Gas Reduction Quota

The Act on the Further Development of the Greenhouse Gas Reduction Quota[450] transposes RED II into national law for the transport sector. This act significantly exceeds EU requirements by setting a greenhouse gas reduction quota of 25 per cent by 2030. Specifically for aviation, a national quota for blending electricity-based, sustainable paraffin (power-to-liquid) with conventional paraffin has been introduced, aiming for a 2% blend by 2030. This national quota is more ambitious than the initial proposal in the ReFuelEU Regulation.

9.5. Territorial Planning Aspects related to GH2 Production and Storage

German spatial planning and development are governed by a multi-layered system involving federal, state, regional, and municipal levels.

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[448] Please see: https://www.ptj.de/nip [accessed: 25.04.2025.]
[449] Federal Republic of Germany. Climate Protection Act. Available at: https://www.gesetze-im-internet.de/englisch_ksg/englisch_ksg.html [accessed: 25.04.2025.]
[450] Federal Republic of Germany. Act on the Further Development of the Greenhouse Gas Reduction Quota. Available at: https://www.bundestag.de/dokumente/textarchiv/2021/kw20-de-treibhausgasminderungsquote-840248#:~:text=Zu%20diesem%20Zweck%20soll%20die,Quoten%20an%20erneuerbaren%20Energien%20einzuhalten. [accessed: 25.04.2025.]

a) Planning Approval Procedure

In accordance with the Administrative Procedure Act, for large-scale or significant infrastructure projects, such as potentially the construction of extensive hydrogen storage or refuelling facilities or major modifications to airport infrastructure to accommodate hydrogen, a planning approval procedure may be required by specific laws governing that type of project. Sec. 43l para. 2 of the Energy Industry Act stipulates that the construction, operation and modification of hydrogen pipelines, including the connecting pipelines of landing terminals for hydrogen with a diameter of more than 300 millimetres, require planning approval.

The planning approval is procedure is a comprehensive process where the project developer submits a detailed plan. Affected authorities are formally requested to submit comments.

A central part is the hearing procedure, where the plan is made available for public inspection, and those whose interests are affected can raise objections. Associations authorized to lodge legal remedies can also submit statements. After expiry of the objection period, discussion is held where objections and statements from authorities, affected parties, and associations are discussed with the project developer.

The procedure concludes with a planning approval decision issued by the planning approval authority. This decision adopts the plan and resolves objections.

The planning approval decision has significant legal effects, consolidating necessary permits and making other official decisions unnecessary. It legally regulates all public-law relationships between the project developer and those affected.

Deficiencies in the balancing of public and private interests or procedural/formal errors only lead to annulment if they are obvious, influenced the outcome, and cannot be remedied.

For planning projects with more than insignificant effects on a large number of third parties, early public participation should occur before an application is submitted, allowing the public to be informed and express views.

b) Spatial Planning System

In accordance with the Spatial Planning Act,[451] at the federal level, spatial planning can include spatially significant development plans for location concepts for ports and airports. The creation of such federal spatial development plans must be necessary for the spatial development and organization of the federal territory from a national or European perspective.

These federal spatial development plans set goals and principles for spatial planning. Spatial planning in Germany follows a "countercurrent principle," where regional and municipal plans must conform to higher-level plans, while higher-level plans must consider the conditions of lower levels, which can be implicitly concluded from Spatial Planning Act principles.

Drawing up spatial development plans requires an environmental assessment.[452] This involves identifying, describing, and evaluating at an early stage the likely significant effects on various protected assets: people (including health), animals, plants, biodiversity, area, soil, water, air, climate, landscape, cultural goods, material goods, and their interrelationships. This assessment is documented in an environmental report. The scope and detail of the assessment are determined with input from public bodies whose environmental responsibilities might be affected. For minor amendments, a preliminary assessment can determine if significant environmental impacts are unlikely, potentially allowing for the environmental assessment to be dispensed with. The

[451] Federal Republic of Germany. Spatial Planning Act. Available at: https://www.gesetze-im-internet.de/rog_2008/BJNR298610008.html [accessed: 25.04.2025.]
[452] Federal Republic of Germany. Spatial Planning Act, Article 8. Available at: https://www.gesetze-im-internet.de/rog_2008/BJNR298610008.html [accessed: 25.04.2025.]

environmental assessment should, where possible, be limited to additional impacts if a previous assessment for the same area exists. Monitoring measures are also required to identify unforeseen adverse impacts during implementation.

The public and public bodies whose interests are affected must be involved in the preparation of spatial development plans, providing opportunities to submit opinions. A summary statement on how environmental concerns and participation results were considered must accompany the plan. Furthermore, there are mechanisms for flexibility and deviation. The binding effect of spatial planning objectives on certain public bodies can be limited, for example, if they were not properly involved in the plan preparation or had valid objections. An objection can be based on an incorrect assessment underlying the spatial planning objective or if the objective prevents the body from carrying out its functions in suitable areas. Furthermore, the competent spatial planning authority can grant an application for a deviation from a spatial planning objective if it is justifiable from a spatial planning perspective and does not affect the basic principles of the plan.

For major airports, the competent authorities must prepare noise maps and noise action plans. These plans aim to address environmental noise, particularly in built-up areas, quiet areas, and near noise-sensitive buildings.

Spatially significant planning and measures, which would include development related to or around airports, must allocate areas in such a way as to avoid or minimize harmful environmental impacts.[453]

Moreover, for certain spatially significant projects, a spatial impact assessment may be conducted to examine spatial compatibility.[454] This procedure involves examining location or route alternatives and a preliminary assessment of environmental impacts. The spatial planning authority provides an expert opinion detailing the results of its assessment. This process involves the project developer submitting necessary documents, including information on potential environmental impacts. The public and affected authorities are involved at an early stage, with documents published for inspection. The expert opinion from the spatial impact assessment should be considered in subsequent approval procedures for the project.

Spatially significant planning must ensure that the effects of major accidents from operational areas, such as large hydrogen facilities, on areas requiring protection (like residential areas, transport routes, or natural reserves) are avoided as far as possible.[455]

c) Interplay of Planning and Hydrogen at Airports

Implementing hydrogen fuel infrastructure at a German airport requires navigating both spatial planning regulations and installation approval processes.

The location concept for the airport itself falls under high-level spatial planning. Developments within or near the airport area, including hydrogen facilities, must conform to relevant local land use plans (if applicable, potentially influenced by Article 249a of the Building Code[456] for production/storage from renewables in outdoor areas) and higher-level spatial planning requirements.

Integration with noise reduction plans is also relevant, as any new facilities or increased activity must be compatible with noise limits established for major airports.[457]

[453] Law on the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Immission Control Act - BImSchG), Article 50. Available at: https://www.gesetze-im-internet.de/bimschg/BJNR007210974.html [accessed: 25.04.2025.]
[454] Federal Republic of Germany. Spatial Planning Act, Article 15. Available at: https://www.gesetze-im-internet.de/rog_2008/BJNR298610008.html [accessed: 25.04.2025.]
[455] Federal Republic of Germany. Law on the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Immission Control Act - BImSchG), Article 50. Available at: https://www.gesetze-im-internet.de/bimschg/BJNR007210974.html [accessed: 25.04.2025.]
[456] Federal Republic of Germany. Building Code, available at: https://www.gesetze-im-internet.de/bbaug/BJNR003410960.html [accessed: 25.04.2025.]
[457] Federal Republic of Germany. Law on the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Immission Control Act - BImSchG), Part Six. Available at: https://www.gesetze-im-internet.de/bimschg/BJNR007210974.html [accessed: 25.04.2025.]

In summary, while the location of major airports is subject to federal spatial planning and they require noise management plans, the introduction of hydrogen fuel infrastructure involves obtaining specific permits under the Federal Immission Control Act for production and storage facilities. The Building Code provides a potential pathway for siting renewable hydrogen facilities in outdoor areas. Planning decisions, both for the installation permits and wider spatial planning, must consider environmental impacts, safety distances related to major accident hazards, and potentially noise effects.

9.5.1. GH2 Production and Storage within the airport

The construction or modification of airports requires a permit or plan approval. Public and private interests affected by the project, including environmental impact, must be taken into account.[458] While the current environmental focus in these sections appears to be primarily on noise, the requirement for environmental impact assessment is broad and could potentially cover the environmental effects (e.g., safety, emissions, infrastructure changes) associated with implementing new fuel types like hydrogen. Airport operators are also subject to various operational regulations and requirements.

9.5.2. GH2 Production and Storage near the airport

The Building Code ensures that hydrogen facilities are appropriately located to avoid interference with airport operations, such as flight paths and safety zones. The Aviation Act[459] ensures that GH2 facilities do not obstruct critical airport functions or air traffic control zones. Environmental protection is addressed by the Ordinance on Facilities Handling Substances Hazardous to Water[460] and the Water Act,[461] which ensure that hydrogen production and storage do not contaminate water resources, requiring stringent safety measures for spills and leaks.

To control emissions and noise, the Federal Immission Control Act and Technical Instructions for Noise Protection[462] (TA Lärm) regulate emissions and noise from hydrogen facilities to prevent disturbances to the airport environment. Given hydrogen's flammability, the Explosion Protection Regulation[463] and the Industrial Safety Ordinance[464] require facilities to implement explosion protection zones, proper equipment, and regular inspections to ensure safe operation. Lastly, the Workplace Ordinance[465] and accident prevention regulations ensure that workers are protected with adequate safety measures and training.

In conclusion, these laws provide a comprehensive framework to ensure that hydrogen production and storage near airports operate safely and without compromising aviation operations or environmental safety.

9.6. Protection Zones Aspects related to GH2 Production within the Airport

From an environmental and water protection perspective, the Water Act[466] applies if GH2 production takes place near water protection areas, regulating activities that may pose risks to groundwater or surface waters.

[458] Federal Republic of Germany. Aviation Act, Subsection 2. Available at: https://www.gesetze-im-internet.de/luftvg/BJNR006810922.html [accessed: 25.04.2025.]
[459] Federal Republic of Germany, Aviation Act. Available at: https://www.gesetze-im-internet.de/englisch_luftvg/index.html [accessed: 25.04.2025.]
[460] Federal Republic of Germany, Ordinance on Facilities for Handling Substances Hazardous to Water. Available at: https://www.gesetze-im-internet.de/awsv/ [accessed: 25.04.2025.]
[461] Federal Republic of Germany, Water Act. Available at: https://www.gesetze-im-internet.de/whg_2009/ [accessed: 25.04.2025.]
[462] Federal Republic of Germany, Technical Instructions for Noise Protection. Available at: https://www.verwaltungsvorschriften-im-internet.de/bsvwvbund_26081998_IG19980826.htm [accessed: 05.05.2025.]
[463] Federal Republic of Germany, Explosion Protection Regulation. Available at: https://www.gesetze-im-internet.de/gsgv_11_2016/BJNR003900016.html [accessed: 25.04.2025.]
[464] Federal Republic of Germany, Industrial Safety Ordinance. Available at: https://www.gesetze-im-internet.de/betrsichv_2015/BJNR004910015.html [accessed: 25.04.2025.]
[465] Federal Republic of Germany, Workplace Ordinance. Available at: https://www.gesetze-im-internet.de/arbst_ttv_2004/BJNR217910004.html [accessed: 25.04.2025.]
[466] Federal Republic of Germany, Water Act. Available at: https://www.gesetze-im-internet.de/whg_2009/ [accessed: 25.04.2025.]

The Ordinance on Facilities Handling Substances Hazardous to Water[467] also becomes relevant if the production involves materials such as electrolytes or cooling fluids classified as hazardous to water.

Environmental safety and emission control fall under the Federal Immission Control Act, which requires permits for industrial facilities and defines minimum buffer distances to protect surrounding areas from emissions, noise, and other environmental impacts. Supplementary technical rules such as TA Lärm (noise) and TA Luft (air quality) provide further guidance on the size and characteristics of required protection zones.

In terms of construction and land use within airport boundaries, the Building Code[468] governs zoning and spatial planning. To add, the Industrial Safety Ordinance[469] and the Explosion Protection Regulation[470] require risk assessments, proper technical installations, and clearly defined safety distances around pressurized hydrogen equipment to prevent fire and explosion hazards.

Given the airport setting, compliance with aviation law is also crucial. The Aviation Act[471] ensures that hydrogen production facilities do not interfere with protected aviation zones, such as approach paths, radar fields, and restricted operational areas. These legal provisions help maintain flight safety while integrating new energy infrastructure.

Finally, workplace safety is regulated under the Workplace Ordinance[472] and accident prevention regulations, which set additional requirements for safe distances and emergency access in areas frequented by personnel.

9.7. Environmental and Safety Regulations regarding Hydrogen Production and Storage

9.7.1. Safety regulations

The Hazardous Substances Ordinance[473] and the Technical Rules for Hazardous Substances (Technische Regeln für Gefahrstoffe – "TRGS")[474] are the primary frameworks for regulating hydrogen safety. These laws outline safety measures for handling, storage, and transport, including the requirement for regular risk assessments and the implementation of emergency response plans. These plans must be tailored to address the unique risks posed by hydrogen, including leaks, explosions, or chemical hazards.

Specifically, TRGS 510 provides guidelines on the safe storage of hazardous substances, including hydrogen, and TRGS 407 addresses the handling and transport of gases under pressure, with an emphasis on maintaining a safe working environment. Compliance with these regulations ensures that the proper safety equipment is in place, such as personal protective equipment and explosion-proof systems, and that trained personnel are managing operations.

Additionally, the Ordinance on Industrial Safety and Health[475] mandates regular safety inspections, maintenance of equipment, and employee training to ensure the continued safety of operations involving hydrogen. Operators are also required to adhere to industry standards such as DIN EN 17124 on product specification

[467] Federal Republic of Germany, Ordinance on Facilities for Handling Substances Hazardous to Water. Available at: https://www.gesetze-im-internet.de/awsv/ [accessed: 25.04.2025.]
[468] Federal Republic of Germany, Building Code. Available at: https://www.gesetze-im-internet.de/bbaug/BJNR003410960.html [accessed: 25.04.2025.]
[469] Federal Republic of Germany, Industrial Safety Ordinance. Available at: https://www.gesetze-im-internet.de/betrsichv_2015/BJNR004910015.html [accessed: 25.04.2025.]
[470] Federal Republic of Germany, Explosion Protection Regulation. Available at: https://www.gesetze-im-internet.de/gsgv_11_2016/BJNR003900016.html [accessed: 25.04.2025.]
[471] Federal Republic of Germany, Aviation Act. Available at: https://www.gesetze-im-internet.de/englisch_luftvg/index.html [accessed: 25.04.2025.]
[472] Federal Republic of Germany, Workplace Ordinance. Available at: https://www.gesetze-im-internet.de/arbst_ttv_2004/BJNR217910004.html [accessed: 25.04.2025.]
[473] Federal Republic of Germany, Ordinance on Hazardous Substances. Available at: https://www.gesetze-im-internet.de/gefstoffv_2010/ [accessed: 25.04.2025.]
[474] Please see: https://www.baua.de/DE/Angebote/Regelwerk/TRGS/TRGS [accessed: 25.04.2025.]
[475] Federal Republic of Germany, Ordinance on Industrial Safety and Health. Available at: https://www.gesetze-im-internet.de/betrsichv_2015/ [accessed: 25.04.2025.]

and quality assurance for hydrogen refuelling points dispensing gaseous hydrogen, DIN EN 17127 on outdoor hydrogen refuelling points dispensing gaseous hydrogen and incorporating filling protocols, and DIN EN ISO 19880-1 on gaseous hydrogen fuelling stations, which provide further specifications on the safe handling and infrastructure of hydrogen systems.

The Workplace Safety Act[476] complements these laws by requiring employers to provide a safe working environment for employees handling hydrogen. This includes ensuring that risk assessments are carried out regularly, and that workers have access to the appropriate safety training and equipment to mitigate any potential hazards.

In aviation contexts, safety is further ensured through zoning regulations, which determine whether an aviation-related use permit is sufficient or if a change of use is required for hydrogen infrastructure. Authorities, including local environmental protection agencies and safety inspectors, ensure compliance through regular audits, inspections, and enforcement actions.

9.7.2. EIA procedure

Hydrogen infrastructure projects at German airports are closely regulated to ensure they align with national environmental protection and sustainability goals. First and foremost, the Environmental Impact Assessment Act[477] and the Federal Immission Control Act[478] mandate comprehensive reviews of the potential environmental consequences of projects such as hydrogen production, storage, and refuelling systems.

GH2 offers significant environmental benefits, particularly in reducing greenhouse gas emissions compared to conventional aviation fuels. However, to ensure its sustainability, the entire production process must be powered by renewable energy sources and managed with attention to environmental risks. Electrolysis, the primary method of green hydrogen production, requires substantial water input, raising concerns about water use and potential contamination. These impacts must be assessed and mitigated through measures such as water recycling and conservation systems.

Under the Environmental Impact Assessment Act, large-scale hydrogen projects, especially those involving new construction or significant modifications, are subject to formal environmental impact assessment (EIA). These assessments examine effects on local ecosystems, air and water quality, and public health. Projects falling under the Federal Immission Control Act also undergo emission-focused evaluations, including safety protocols for hydrogen handling and storage. Facilities may require permits under the 4th Ordinance to the Federal Immission Control Act, which integrates EIA obligations into the approval process.

Monitoring compliance involves multiple authorities. Local environmental protection agencies and aviation authorities oversee adherence to environmental and safety standards, often supported by third-party audits. This multilayered oversight ensures transparency and enforcement throughout the project lifecycle, reinforcing Germany's commitment to safe and sustainable aviation.

9.7.3. Pollution permits

Germany's approach to pollution permits in aviation is shaped by a set of interrelated laws aimed at reducing emissions and encouraging the use of GH2. The Federal Immission Control Act[479] requires permits for hydrogen-related facilities, with stricter criteria when classifying hydrogen as renewable, especially under the 37th Ordinance. Fuel suppliers, including those serving aviation, must meet greenhouse gas reduction targets by blending renewable fuels like GH2.

[476] Federal Republic of Germany, Workplace Safety Act. Available at: https://www.gesetze-im-internet.de/englisch_arbschg/index.html [accessed: 25.04.2025.]
[477] Federal Republic of Germany, Environmental Impact Assessment Act. Available at: https://www.gesetze-im-internet.de/uvpg/ [accessed: 25.04.2025.]
[478] Federal Republic of Germany, Federal Immission Control Act. Available at: https://www.gesetze-im-internet.de/bimschg/ [accessed: 25.04.2025.]
[479] Federal Republic of Germany, Federal Immission Control Act. Available at: https://www.gesetze-im-internet.de/bimschg/ [accessed: 25.04.2025.]

Under the Fuel Emissions Trading Act[480], aviation fuel is subject to carbon pricing, pushing operators toward low-emission alternatives. GH2, when certified, is exempt from these costs, making it economically attractive. The Hydrogen Acceleration Act[481] and changes to the Energy Industry Act[482] further simplify the approval process for hydrogen infrastructure, particularly in strategic locations such as airports.

9.7.4. Requirements for chemical substances

Chemical safety in hydrogen-related operations is primarily governed by the Chemicals Act,[483] which incorporates key EU regulations such as REACH and CLP. These frameworks ensure that all chemical substances are properly registered, classified, and labelled according to their hazards.

Hydrogen is classified under the CLP Regulation as a flammable gas (H220), requiring clear labelling and hazard communication throughout its lifecycle. The Ordinance on Hazardous Substances[484] further outlines the obligations for employers and operators in handling hazardous materials, including hydrogen. This includes conducting workplace risk assessments, implementing protective measures, maintaining safety data sheets, and ensuring staff training in accordance with occupational safety standards.

Storage and transport of hydrogen must comply with the Technical Rules for Hazardous Substances[485], particularly TRGS 510 and TRGS 400, which provide detailed requirements for container safety, ventilation, and fire prevention. Additionally, the Water Resources Act[486] applies where hydrogen infrastructure poses a potential risk to water bodies, requiring containment and preventive environmental measures.

9.7.5. Construction Regulations regarding Hydrogen Production and Storage

The Building Code[487] establishes the legal framework for land use and zoning, ensuring that hydrogen-related infrastructure is built in suitable locations. It also requires compliance with local zoning regulations to determine whether specific permits are needed for industrial or hazardous activities.

The Federal Immission Control Act488 plays a key role in construction by requiring an EIA for facilities handling hydrogen. This assessment evaluates the potential environmental effects of construction and ensures that any risks, such as emissions or contamination, are mitigated.

The Ordinance on Industrial Safety and Health[489] imposes requirements on the safe construction of industrial facilities, including those handling hydrogen. This includes the design of safety systems, explosion protection measures, and structural integrity, ensuring the facility is equipped to handle the hazards associated with hydrogen.

Additionally, the Technical Rules for Hazardous Substances[490] provide specific guidelines for the safe construction of storage systems and pipelines. TRGS 510 outlines safety standards for the design of storage tanks and transport infrastructure, while TRGS 400 provides guidance on the safe construction of systems that handle gases under pressure.

[480] Federal Republic of Germany, Fuel Emissions Trading Act. Available at: https://www.gesetze-im-internet.de/behg/ [accessed: 25.04.2025.]
[481] Please see: https://www.bundesregierung.de/breg-de/aktuelles/wasserstoffausbau-beschleunigen-2289130 [accessed:25.04.2025.]
[482] Federal Republic of Germany, Energy Industry Act. Available at: https://www.gesetze-im-internet.de/enwg_2005/ [accessed: 25.04.2025.]
[483] Federal Republic of Germany, Chemicals Act. Available at: https://www.gesetze-im-internet.de/chemg/BJNR017180980.html [accessed: 25.04.2025.]
[484] Federal Republic of Germany, Ordinance on Hazardous Substances. Available at: https://www.gesetze-im-internet.de/gefstoffv_2010/ [accessed: 25.04.2025.]
[485] Please see: https://www.baua.de/DE/Angebote/Regelwerk/TRGS/TRGS [accessed: 25.04.2025.]
[486] Federal Republic of Germany, Water Resource Act. Available at: https://www.gesetze-im-internet.de/whg_2009/ [accessed: 25.04.2025.]
[487] Federal Republic of Germany, Building Code. Available at: https://www.gesetze-im-internet.de/bbaug/ [accessed: 25.04.2025.]
[488] Federal Republic of Germany, Federal Immission Control Act. Available at: https://www.gesetze-im-internet.de/bimschg/ [accessed: 25.04.2025.]
[489] Federal Republic of Germany, Ordinance on Industrial Safety and Health. Available at: https://www.gesetze-im-internet.de/betrsichv_2015/ [accessed: 25.04.2025.]
[490] Please see: https://www.baua.de/DE/Angebote/Regelwerk/TRGS/TRGS [accessed: 25.04.2025.]

Lastly, European Standards such as DIN EN 17124 and DIN EN ISO 19880-1 set out the specific construction requirements for hydrogen refuelling stations and storage infrastructure. These standards ensure that the design, materials, and installation of hydrogen systems meet rigorous safety and operational criteria.

Implementation of Hydrogen Fuel Infrastructure at Airports

There is a strong indication of regulatory drivers and specific legal provisions related to hydrogen infrastructure that would be relevant to airport operations. The Federal Immission Control Act imposes obligations for fuel distributors to reduce greenhouse gas emissions. This includes distributors of aviation turbine fuel.

Hydrogen from biogenic sources can be credited towards these greenhouse gas reduction obligations. There are also rules for determining the eligibility and calculating the greenhouse gas emissions of such fuels. Criteria for sustainable production and greenhouse gas reduction are also relevant.

The infrastructure required for hydrogen use at an airport would include facilities for its production and storage. These facilities are regulated under the Federal Immission Control Act as installations requiring permits, under the circumstances, that the installation is to be expected to be operated at the same location for longer than the twelve months following commissioning.[491]

In accordance with the Federal Immission Control Act[492], The approval procedures involve assessing the project's impact. The full procedure requires public participation,[493] while the simplified procedure generally does not.[494] The scope of the procedure depends on the scale and type of the installation. These procedures involve consultation with affected authorities and consideration of emissions and safety aspects, including major accident prevention.

Installations for the production of hydrogen by electrolysis of water require a permit if their production capacities reach certain thresholds.[495]

a) For hydrogen production facilities by electrolysis with a production capacity of 50 tonnes of hydrogen or more per day (considered as installations within the meaning of Art. 10 in conjunction with Annex I of Directive 2010/75/EU) a simplified procedure according to Article 19 of the Federal Immission Control Act must be implemented (without public participation).
b) For hydrogen production facilities by electrolysis with a rated electrical output of 5 megawatts or more (if not covered by the previous point) the full approval procedure according to Article 10 of the Federal Immission Control Act must be done (with public participation).

Furthermore, if the hydrogen is produced by means other than electrolysis, then the installation for the production of hydrogen on an industrial scale (with the exception of installations for the production or fission of nuclear fuel or for the reprocessing of irradiated nuclear fuel), must go through the full permitting process, in accordance with Article 10 of the Federal Immission Control Act (with public participation).[496]

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[491] Federal Republic of Germany. Fourth Ordinance on the Implementation of the Federal Immission Control Act (Ordinance on Installations Requiring Approval - 4th BImSchV), Article 1, paragraph 1. Available at: https://www.gesetze-im-internet.de/bimschv_4_2013/BJNR097310013.html [accessed: 25.04.2025.]
[492] Federal Republic of Germany. Law on the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Immission Control Act - BImSchG). Available at: https://www.gesetze-im-internet.de/bimschg/BJNR007210974.html [accessed: 25.04.2025.]
[493] Federal Republic of Germany. Law on the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Immission Control Act - BImSchG), Article 10. Available at: https://www.gesetze-im-internet.de/bimschg/BJNR007210974.html [accessed: 25.04.2025.]
[494] Federal Republic of Germany. Law on the protection against harmful environmental effects caused by air pollution, noise, vibrations and similar processes (Federal Immission Control Act - BImSchG), Artic9. Available at: https://www.gesetze-im-internet.de/bimschg/BJNR007210974.html [accessed: 25.04.2025.]
[495] Federal Republic of Germany. Fourth Ordinance on the Implementation of the Federal Immission Control Act (Ordinance on Installations Requiring Approval - 4th BImSchV), Annex 1, point 10.26. Available at: https://www.gesetze-im-internet.de/bimschv_4_2013/BJNR097310013.html [accessed: 25.04.2025.]
[496] Federal Republic of Germany. Fourth Ordinance on the Implementation of the Federal Immission Control Act (Ordinance on Installations Requiring Approval - 4th BImSchV), Annex 1, point 4.1.12. Available at: https://www.gesetze-im-internet.de/bimschv_4_2013/BJNR097310013.html [accessed: 25.04.2025.]

For combustion engine systems or gas turbine systems for driving work machines for the use of hydrogen, with a rated thermal output of 50 megawatts or more, the full approval procedure according to Article 10 of the Federal Immission Control Act must be done (with public participation). If the rated thermal output is between 1 megawatt to less than 50 megawatts (excluding combustion engine systems for drilling rigs) - a simplified procedure according to Article 19 of the Federal Immission Control Act must be implemented (without public participation).[497]

Installations for the storage of GH2 require permits based on quantity.498 For hydrogen storage, there are two thresholds:

a) for facilities used for the storage of GH2 with a storage capacity of at least 3 tonnes, a simplified procedure according to Article 19 of the Federal Immission Control Act must be implemented (without public participation);
b) for facilities used for the storage of GH2 with a storage capacity of 30 tonnes or more, the full approval procedure according to Article 10 of the Federal Immission Control Act must be done (with public participation).

It must be noted that the requirements for permitting set out above are also met if several installations of the same type are in close spatial and operational proximity (joint installation) and together will reach or exceed the relevant power limits or installation sizes. A close spatial and operational proximity exists if the installations; are located on the same premises, are connected to common operating facilities and serve a comparable technical purpose.

Special regulation for projects for the production or storage of hydrogen from renewable energies

Art. 249a of the Building Code[499] includes a "Special regulation for projects for the production or storage of hydrogen from renewable energies". This regulation allows such projects in outdoor areas (outside of designated built-up areas), provided technical measures ensure the hydrogen is produced only from electricity from renewable energy sources. There are also limits on the size and storage capacity of structures allowed under this provision. This section provides a specific legal basis for siting renewable hydrogen facilities, potentially relevant near or at airports if they fall under "outdoor areas" in the planning sense.

Incentives for hydrogen projects

A central legal benefit for hydrogen related projects is laid out in the Hydrogen Acceleration Act. It is established in Article 4 of the Hydrogen Acceleration Act[500] that hydrogen infrastructure projects are of “overriding public interest” and serving “public safety”. This status significantly enhances the legal standing of such projects and allows them to be prioritized in administrative and judicial proceedings. Specifically, the Hydrogen Acceleration Act grants this status to hydrogen production and storage projects through to the year 2045, and to import and transport infrastructure until 2035. This designation can be highly advantageous for airports, as it streamlines the approval process and provides a strong legal foundation against possible objections or delays.

To further facilitate implementation, the Hydrogen Acceleration Act introduces extensive simplifications and accelerations of planning and permitting procedures. These include mandatory digital submission and communication formats, fixed deadlines for administrative bodies (e.g., 12 to 18 months for decisions), and simplified public participation processes. The law harmonizes existing requirements across various regulatory

[497] Federal Republic of Germany. Fourth Ordinance on the Implementation of the Federal Immission Control Act (Ordinance on Installations Requiring Approval - 4th BImSchV), Annex 1, point 1.4.1. Available at: https://www.gesetze-im-internet.de/bimschv_4_2013/BJNR097310013.html [accessed: 25.04.2025.]
[498] Federal Republic of Germany. Fourth Ordinance on the Implementation of the Federal Immission Control Act (Ordinance on Installations Requiring Approval - 4th BImSchV), Annex 1, point 9.3, Annex 2, point 17. Available at: https://www.gesetze-im-internet.de/bimschv_4_2013/BJNR097310013.html [accessed: 25.04.2025.]
[499] Federal Republic of Germany, Building Code. Available at: https://www.gesetze-im-internet.de/bbaug/BJNR003410960.html [accessed: 25.04.2025.]
[500] Federal Republic of Germany. Hydrogen Acceleration Act, Article 4. Available at: https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/05/20240529-bundesregierung-stellt-weichen-fuer-den-beschleunigten-ausbau-von-wasserstoffprojekten.html [accessed: 25.04.2025.]

regimes, including water law, immission control law, and environmental impact assessments. For airport authorities or operators, these measures are crucial in ensuring that hydrogen infrastructure projects can proceed without undue bureaucratic delay.

In addition to administrative streamlining, the Hydrogen Acceleration Act also modifies public procurement rules to facilitate the implementation of hydrogen projects. Public contracts related to hydrogen infrastructure can benefit from procedural accelerations.[501] Projects may combine multiple tender lots for economic or technical reasons, and legal reviews of procurement decisions are to be expedited. Courts are required to rule quickly, often within one week, and interim injunctions do not suspend project execution unless specifically ordered. This is particularly relevant for publicly operated airports or those relying on public-private partnerships, where public procurement law applies.

From a judicial perspective, the Hydrogen Acceleration Act reassigns jurisdiction for large-scale hydrogen infrastructure projects directly to the higher administrative courts or, in certain cases, the Federal Administrative Court.[502] This eliminates the need for a first instance review at the local administrative court level and significantly reduces the potential for protracted legal disputes. Furthermore, legal challenges against permits for hydrogen facilities do not have a suspensive effect by default, allowing projects to proceed unless a court specifically orders a suspension.[503]

9.7.6. Liability in environmental protection

Failing to adhere to safety or monitoring practices related to hydrogen can lead to significant consequences under German law. Non-compliance with safety regulations, such as those set forth in the Hazardous Substances Ordinance[504] and the Technical Rules for Hazardous Substances,[505] can result in substantial fines. The severity of the fine depends on the nature of the violation and the potential risk posed by the failure to comply.

In cases where non-compliance leads to serious accidents or environmental damage, individuals responsible may face criminal charges, including imprisonment, for severe breaches that harm people or the environment. Furthermore, authorities have the power to shut down operations that fail to meet safety standards, ensuring that any immediate risks are mitigated, and corrective actions are implemented before activities can resume.

Compliance with safety regulations is regularly monitored by various authorities, including the local environmental protection agencies and occupational safety authorities. These agencies conduct inspections and audits to ensure adherence to protocols and have the authority to issue fines, enforce corrective actions, and initiate legal proceedings when necessary. Through these enforcement mechanisms, Germany ensures the safe and responsible production and transport of hydrogen, protecting both public health and the environment.

9.7.7. Summary and conclusions on German Regulations on Hydrogen Production

Germany has established a comprehensive and robust regulatory framework for the production and storage of hydrogen, particularly in the aviation sector. Key laws such as the Hazardous Substances Ordinance and the Technical Rules for Hazardous Substances ensure stringent safety protocols for handling hydrogen. The Federal

[501] Federal Republic of Germany. Hydrogen Acceleration Act, Article 16. Available at: https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/05/20240529-bundesregierung-stellt-weichen-fuer-den-beschleunigten-ausbau-von-wasserstoffprojekten.html [accessed: 25.04.2025.]
[502] Federal Republic of Germany. Hydrogen Acceleration Act, Article 18. Available at: https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/05/20240529-bundesregierung-stellt-weichen-fuer-den-beschleunigten-ausbau-von-wasserstoffprojekten.html [accessed: 25.04.2025.]
[503] Federal Republic of Germany. Hydrogen Acceleration Act, Article 17. Available at: https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/05/20240529-bundesregierung-stellt-weichen-fuer-den-beschleunigten-ausbau-von-wasserstoffprojekten.html [accessed: 25.04.2025.]
[504] Federal Republic of Germany, Ordinance on Hazardous Substances. Available at: https://www.gesetze-im-internet.de/gefstoffv_2010/ [accessed: 25.04.2025.]
[505] Please see: https://www.baua.de/DE/Angebote/Regelwerk/TRGS/TRGS [accessed: 25.04.2025.]

Immission Control Act and the Environmental Impact Assessment Act ensure that the environmental effects of hydrogen infrastructure projects are thoroughly assessed and mitigated. Additionally, regulations like the Ordinance on Industrial Safety and Health and specific European Standards guarantee the safe construction and operation of hydrogen facilities.

However, challenges persist, particularly in the integration of GH2 within aviation, where complexities around zoning regulations and the need for specialized permits may create delays or regulatory hurdles. Furthermore, while environmental and safety regulations are well-structured, the evolving nature of hydrogen technology and infrastructure might require periodic updates to these frameworks to ensure continued safety and sustainability.

Moreover, as Germany is a federal state. This means that each federal state may implement and interpret the relevant laws differently, leading to inconsistencies in identifying the appropriate authority for applications as well as a unified system for implementing GH2 solutions in airports. This lack of uniformity can result in time-consuming efforts to determine the correct point of contact, posing an additional administrative burden.

Overall, the regulatory environment in Germany is highly structured, ensuring both the safety of operations and environmental protection. However, because of the highly developed attention to detail, man bureaucratic hurdles exist, such as the need to prepare a lot of documents or time delays due to the number of normative regulations. Furthermore, individual questions of interpretation within each federal state may hinder uniform application of rules. Continued vigilance in enforcement and potential adaptations to the regulatory framework will be crucial to keep pace with technological advancements in hydrogen production and its use in aviation.

9.8. German Regulations on Hydrogen Transportation

9.8.1. Hydrogen Transportation via natural gas pipelines

The integration of hydrogen into the existing natural gas infrastructure is being supported by both regulatory and technical standards. One of the key regulatory bodies in Germany is the Federal Network Agency, which oversees the gas transport network, including the potential integration of hydrogen. The German Electricity and Energy Industry Act[506] lays out the general framework for energy supply, including the transportation of gases like hydrogen.

In terms of technical standards, the German Technical and Scientific Association for Gas and Water sets out guidelines for the safe transport of hydrogen through pipelines. Their G 262 standard addresses the integration of hydrogen into natural gas pipelines, covering material compatibility, pressure levels, and safety considerations to prevent issues like hydrogen embrittlement of metals. This standard is crucial to ensure that the infrastructure can handle hydrogen safely and efficiently.

Germany's national regulations also specify the permissible blending of hydrogen with natural gas in pipelines, with a typical upper limit of 10-20%. This ensures that the blended gas mixture meets the necessary safety and performance standards while maintaining the integrity of the pipeline infrastructure. Additionally, the Federal Ministry for Economic Affairs and Climate Action plays a significant role in the development of hydrogen infrastructure, offering incentives and funding through programs such as the Hydrogen Innovation and Technology Program (HyLand), which supports regional hydrogen projects and the adaptation of pipelines for hydrogen transport.[507]

9.8.2. Hydrogen Transportation via road transport

The transport of hydrogen by road is strictly regulated to ensure safety for people, property, and the environment. Hydrogen is classified as a dangerous good under Class 2 of the Agreement concerning the

[506] Federal Republic of Germany, Electricity and Gas Supply Act. Available at: https://www.gesetze-im-internet.de/enwg_2005/ [accessed: 25.04.2025.]
[507] Please see: https://www.hy.land/en/ [accessed: 25.04.2025.]

International Carriage of Dangerous Goods by Road (ADR), which is directly applicable in Germany through national regulations.

The primary legal basis is the Dangerous Goods Transportation Act,[508] which governs the national transport of dangerous goods, including hydrogen. This law is implemented through the Regulation for Road, Rail and Inland Waterway Transport of Dangerous Goods,[509] which aligns national road transport regulations with the requirements of the ADR. These rules specify detailed conditions for vehicle markings, packaging, driver qualifications, documentation, and safety equipment for the road transport of compressed or liquefied hydrogen.

Vehicle construction and approval are subject to the Road Traffic Licencing Regulation,[510] which sets technical standards for road vehicles used in hazardous goods transport. Additionally, road operations are governed by the Road Traffic Regulation,[511] which outlines general traffic behaviour and rules for vehicles carrying dangerous goods.

For hydrogen transported in portable cylinders or bundles, the TRGS 510 applies, specifying conditions for the secure loading, handling, and temporary storage of gas containers during road transport. Furthermore, occupational safety during loading and unloading is guided by Accident Prevention Regulations issued by statutory accident insurers.

9.9. German Regulations on Hydrogen Fuelled Vehicles and Fuelling Systems

Compliance with the operation and regulation of hydrogen-fuelled vehicles and their refuelling systems in Germany is governed by a comprehensive set of national and European laws designed to ensure safety, environmental protection, and operational efficiency.

The Road Traffic Act[512] sets out the requirements for all vehicles, including hydrogen-powered ones, to ensure that they meet the necessary technical and safety standards for use on public roads. Moreover, the Vehicle Registration and Licensing Regulations[513] establish technical requirements for hydrogen-powered vehicles, including safety provisions for hydrogen storage systems and refuelling interfaces.

The Pressure Equipment Directive,[514] which is incorporated into German law, regulates the safety of pressure equipment, including hydrogen storage tanks and refuelling systems, ensuring they can safely handle hydrogen at high pressures. The Federal Immission Control Act[515] oversees emissions and pollution control, requiring that hydrogen refuelling stations adhere to environmental monitoring and emission reduction measures, even though hydrogen vehicles themselves are zero-emission.

The anticipated Hydrogen Infrastructure Regulation[516] will address the specific safety and operational standards for the construction and operation of hydrogen refuelling stations. In addition, the Occupational Health and

[508] Federal Republic of Germany, Dangerous Goods Transportation Act. Available at: https://www.gesetze-im-internet.de/gefahrgutg/ [accessed: 25.04.2025.]
[509] Federal Republic of Germany, Regulation for Road, Rail and Inland Waterway Transport of Dangerous Goods. Available at: https://www.gesetze-im-internet.de/ggvseb/ [accessed: 25.04.2025.]
[510] Federal Republic of Germany, Road Traffic Licencing Regulation. Available at: https://www.gesetze-im-internet.de/stvzo_2012/BJNR067910012.html [accessed: 25.04.2025.]
[511] Federal Republic of Germany, Road Traffic Regulation. Available at: https://www.gesetze-im-internet.de/stvo_2013/ [accessed: 25.04.2025.]
[512] Federal Republic of Germany, Road Traffic Act. Available at: https://www.gesetze-im-internet.de/englisch_stvg/index.html [accessed: 25.04.2025.]
[513] Federal Republic of Germany, Vehicle Registration and Licensing Regulations. Available at: https://www.gesetze-im-internet.de/stvzo_2012/BJNR067910012.html [accessed: 25.04.2025.]
[514] Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment. Available at: https://eur-lex.europa.eu/eli/dir/2014/68/oj/eng [accessed: 25.04.2025.]
[515] Federal Republic of Germany, Federal Immission Control Act. Available at: https://www.gesetze-im-internet.de/bimschg/ [accessed: 25.04.2025.]
[516] Federal Republic of Germany, Regulation on Hydrogen Infrastructure. Available at: https://www.gesetze-im-internet.de/wasserstoffnev/BJNR495510021.html [accessed: 25.04.2025.]

Safety Act[517] ensures that workers in hydrogen fuelling systems are protected from hazards such as fire, explosion, or asphyxiation by requiring proper training, safety equipment, and risk management processes. The EU Alternative Fuels Infrastructure Directive[518] mandates the establishment of a network of hydrogen refuelling stations across Europe, ensuring that they meet safety and technical standards for interoperability and safe operation. Finally, the Emissions Trading Act[519] incentivizes the use of low-carbon hydrogen and applies carbon pricing to hydrogen production processes, reducing emissions from the hydrogen supply chain.

In addition to national and European regulations, international standards like SAE J2601 on fuelling protocols for light duty gaseous hydrogen surface vehicles, ISO 14687 on hydrogen fuel quality, and ISO 19880-1 on gaseous hydrogen fuelling stations provide further guidelines to ensure that hydrogen refuelling stations meet global safety, operational, and fuel quality standards. These standards cover aspects such as fuelling protocols, hydrogen purity, and safety systems, ensuring that the refuelling infrastructure is reliable, safe, and capable of supporting the growing hydrogen mobility sector

9.9.1. Summary and conclusions on German Regulations on Fuelling and Usage

Germany has established a comprehensive regulatory framework for hydrogen-fuelled vehicles and refuelling systems, combining national laws, EU directives, and international standards to ensure safety, quality, and environmental protection.

Key regulations such as the Road Traffic Act and Pressure Equipment Directive, alongside the EU Alternative Fuels Infrastructure Directive, create a solid foundation for hydrogen mobility. The integration of international standards like SAE J2601 and ISO 14687 further strengthens the system.

Overall, Germany's regulations effectively support the safe and efficient deployment of hydrogen technology, positioning the country as a leader in hydrogen-powered transportation, yet some gaps and challenges remain.

The Hydrogen Infrastructure Regulation is still under development, leaving some aspects of refuelling station standards unclear. Additionally, the rapid pace of technological advancements may outstrip existing regulations, especially concerning renewable hydrogen production and its infrastructure. Scalability of the hydrogen network and ensuring cross-border interoperability across Europe also present challenges, as varying national standards may complicate integration.

Continued updates to regulations will be essential to address these gaps and ensure a cohesive, scalable hydrogen ecosystem.

9.10. Key Findings of Sector-Specific German Regulations

Germany has developed a comprehensive regulatory framework to support hydrogen technologies in aviation, laying a strong foundation for their adoption at airports. The National Hydrogen Strategy prioritizes aviation, aiming for 10 gigawatts of electrolysis capacity and a national hydrogen demand of 95-130 terawatt-hours by 2030. The Hydrogen Acceleration Act streamlines approval processes, while the Energy Industry Act supports infrastructure development. Clear permitting pathways exist for production and storage facilities, with safety and environmental standards addressed through the Hazardous Substances Ordinance and TRGS 510 and 407.

Transportation regulations, including pipeline and road transport oversight, ensure hydrogen logistics are well-managed. Germany's climate policy incentivizes GH2 with a 25% reduction target by 2030, and a 2% power-to-liquid blend for aviation. Administrative measures such as digital submissions and fixed deadlines streamline processes, though further development is needed in areas like hydrogen risk assessments and personnel

[517] Federal Republic of Germany, Occupational Health and Safety Act. Available at: https://www.gesetze-im-internet.de/englisch_arbschg/index.html [accessed: 25.04.2025.]
[518] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU. Available at: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32023R1804 [accessed: 25.04.2025.]
[519] Federal Republic of Germany, Emissions Trading Act. Available at: https://www.gesetze-im-internet.de/tehg_2025/ [accessed: 25.04.2025.]

training. Germany's approach balances innovation with safety and environmental standards, positioning its airports to lead in hydrogen adoption.

Despite the strong regulatory framework, there are still considerable challenges in implementation. Airport operators must navigate a complex coordination process among various authorities, often facing conflicting requirements. The distinct characteristics of hydrogen require specialized safety protocols that are still in development. Risk assessments are complicated by a lack of operational data and subjective evaluation methods. Moreover, practical difficulties arise in creating cost-effective storage solutions, developing maintenance protocols, and establishing specialized training programs. The technical and regulatory challenges of hydrogen transport, which involves high compression, cryogenic cooling, or chemical binding, are also not fully addressed in the current frameworks.

9.11. Identified Regulatory Gaps, Challenges and Roadblocks

Multi-Authority Approval Process

The implementation of hydrogen infrastructure at German airports requires coordination with numerous regulatory bodies including the Federal Ministry for Digital and Transport Affairs, Federal Ministry for Economic Affairs and Climate Action, the Federal Aviation Office, the Federal Network Agency, the Federal Environment Agency, and several others. There are also normative and interpretive differences between each federal state of Germany. This multi-layered approval system creates coordination challenges and potential bottlenecks.

Evolving Regulatory Framework

While Germany has established the National Hydrogen Strategy and enacted the Hydrogen Acceleration Act, the regulatory framework is still evolving. The Hydrogen Infrastructure Regulation is still under development, leaving some aspects of refuelling station standards unclear and creating uncertainty for airport operators.

Environmental Impact Assessment Complexity

The Environmental Impact Assessment Act and Federal Immission Control Act mandate comprehensive reviews that can be subjective, complex, and time-consuming, especially given the evolving nature of hydrogen technologies and limited historical data for risk assessment.

Conflicting Requirements Between Authorities

Expert feedback indicates conflicts between aviation authorities and environmental agencies, particularly regarding storage and transportation requirements, creating compliance challenges for airport operators attempting to satisfy multiple regulatory bodies.

Infrastructure Integration Challenges

Integrating hydrogen infrastructure within existing airport zoning and operational areas presents regulatory challenges, as current spatial planning frameworks may not adequately address the specific requirements of hydrogen production, storage, and refuelling systems.

Transportation and Storage Hurdles

Regulations for hydrogen transport (both pipeline and road) and storage are complex and stringent, requiring specialized equipment and safety measures. The permissible blending limits in pipelines (10-20%) and the classification of hydrogen as a dangerous good under ADR create additional logistical challenges.

Staff Training and Certification Gaps

Current regulations do not clearly specify the training and certification requirements for personnel handling hydrogen at airports, creating uncertainty in workforce development and safety management.

Limited Supply Chain and Maintenance Standards

Expert feedback indicates that mature supply chains and maintenance concepts for hydrogen infrastructure are still lacking, with inadequate regulatory guidance on quality control, maintenance intervals, and operational standards.

Scale-Up and Cross-Border Challenges

Scaling hydrogen operations across multiple airports faces regulatory obstacles, particularly with cross-border operations where varying national standards may complicate integration with the broader European hydrogen network.

Climate Impact Assessment Uncertainty

While hydrogen itself produces zero emissions when used, the regulatory framework for assessing potential indirect climate impacts from leakage (as hydrogen is extremely volatile) appears underdeveloped and inconsistent.

9.12. Recommendations

Create Dedicated Infrastructure Support Programs

Establish financial incentives and technical assistance programs specifically for airport hydrogen infrastructure. This should include grants for feasibility studies, subsidies for equipment purchases, and low-interest financing options to offset the high initial costs of hydrogen systems at airports.

Responsible authorities:	Time of completion:
National Organization for Hydrogen and Fuel Cell Technology	2026 - 2027

Establish a Centralized Hydrogen Aviation Authority

Create a dedicated regulatory body specifically tasked with coordinating hydrogen implementation at airports, serving as a single point of contact between airport operators and various government agencies. This authority would streamline approvals, resolve conflicts between different regulatory requirements, and provide clear guidance on compliance.

This authority could also ensure a unified approach for hydrogen applications in all federal states of Germany.

Responsible authorities:	Time of completion:
Federal Aviation Office	2026 - 2027

Develop Specialized Training and Certification Programs

Create standardized training programs and certification requirements for personnel involved in hydrogen operations at airports. These programs should address safety procedures, handling protocols, emergency response, and technical maintenance skills specific to aviation hydrogen applications.

Responsible authorities:	Time of completion:
European Union Aviation Safety Agency	2027 - 2028

Create Integration Guidelines for Airport Master Planning

Develop specific guidelines for incorporating hydrogen infrastructure into airport master plans, addressing zoning requirements, safety distances, and operational integration. This would help airports proactively plan for hydrogen adoption while ensuring compatibility with existing operations.

Responsible authorities:	Time of completion:
Municipalities, State Aviation Authorities, Airport Operators	2030

Establish Regular Regulatory Review Mechanisms

Implement a scheduled review process to regularly update hydrogen regulations based on operational experience, technological developments, and emerging best practices. This would ensure that the regulatory framework remains relevant and effective as hydrogen aviation technologies mature.

Responsible authorities:	Time of completion:
Federal Ministry for Economic Affairs and Climate Action	2030