HyLAW

Production, Storage, and Hydrogen Refuelling Stations

Status: Final, January 2019

Main Author(s): Alexandru Floristean

Contributors : Sabrine Skiker

Acknowledgments:

The HyLAW project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 737977. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research.

Table of contents

1. Introduction and Summary

According to market studies, by 2050, hydrogen will represent 18% of the total worldwide energy consumption. This would decrease the amount of CO_2 released in the atmosphere by 6 gigatons per year and, at the same time, create 30 million of jobs within an industry worth 2.5 trillion dollars annually[1]

Given the systemic role that Hydrogen can fulfil in integrating all energy sectors (production, transmission, distribution and consumption) and the central role it can play in decarbonising our societies, the need for producing, storing and distributing hydrogen in high quantities and in new locations is growing rapidly.

Hydrogen has been produced, stored and used (often in large quantities) safely for decades. New products such as Fuel Cell Electric Vehicles (e.g. cars, vans, trucks, buses, trains, utility vehicles, forklifts and heavy machinery) are already operating around the world. Rapid advancements in vessels and aircrafts powered by hydrogen or hydrogen-based fuels are being developed and tested. Residential and commercial fuel cells (e.g. combined heat and power units) are increasingly gaining market share for heating and power of buildings

These applications require hydrogen to no longer be seen as an "industrial gas" for the chemical industry but to be produced, stored and used in locations convenient for users and consumers in a wide range of sectors.

This paradigm shift requires hydrogen refuelling stations (co-located alongside conventional fuels) in commercial and residential areas, in ports, airports, warehouses and hydrogen storage units in commercial and residential buildings or even homes.

While centralised production of hydrogen at large scale can generate large amounts of hydrogen at low costs, in some cases, the production of hydrogen on-site (e.g. at a hydrogen refuelling station), in sufficient quantities to meet the demand of the site or to reduce the need of frequent distribution by truck and tube trailers, represents the better (or only option).

Existing legislation covering production, storage and distribution of hydrogen was not designed to regulate this new context. Authorities responsible for zoning and permitting for new hydrogen installations struggle to implement the rules when faced with novel projects and new settings for hydrogen.

As a result of this, unintended regulatory and administrative burdens caused by unadapted rules (or lack thereof) and insufficient experience creates barriers to large scale deployment of hydrogen infrastructure, increasing the costs for project developers and authorities alike and delaying market uptake of clean, decarbonised hydrogen.

This document looks at the existing rules and regulations applicable in the 17 EU countries covered by the HyLaw project and in Norway in order to identify the root causes of the problems and identify potential solutions based on existing good practices.

Although based on a horizontal analysis of the rules and regulations in various countries, the recommendations proposed by this paper focus on actions which can be taken at local or national level[2]

2. Overview of the legal framework

The production of hydrogen is subject to a significant number of requirements. Although enshrined in national legislation following transposition, the source of most of these requirements can be traced to EU Directives in various fields. Nevertheless, while the overall requirements are similar across all partner countries, significant differences in interpretation and implementation exist.

At EU level, the most relevant legislative acts for hydrogen production plants are: the SEVESO Directive (2012/18/EU)[3], the ATEX Directive (2014/34/EU)[4] and Directive 2010/75/EU on industrial emissions[5]. These acts apply specifically to the production of Hydrogen and generate important obligations on operators involved in the production of Hydrogen as well as on manufacturers of equipment used in the process.

The obligations prescribed in the SEA[6] and EIA[7] Directives could also apply, subject to national conditions[8].

[1] Hydrogen Council, 2017

[2] Actions which can be taken at EU level are presented in HyLaw's "EU Policy paper" available at www.hylaw.eu/info-centre . For a more in-depth analysis, please consult deliverable D4.1 "Analysis of commonalities and differences between countries", available at www.hylaw.eu/info-centre

[3] 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

[4] Directive 2014/34/EU - covering equipment and protective systems intended for use in potentially explosive atmospheres

[5] Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) (IED)

[6] Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (SEA Directive)

[7] Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (EIA Directive)

As a result of these Directives, hydrogen production units (irrespective of the methods of production) and, to a certain extent, storage sites, will be subject to:

- Risk Assessments as per the general obligations laid down in the SEVESO Directive. Such requirements will always apply to production facilities which store more than 5 tonnes of Hydrogen. Additional requirements ("upper tier") will apply to those facilities storing more than 50 tonnes
- Health and Safety requirements and conformity assessment procedures, as envisioned by the ATEX Directive. As this directive applies to zones where potentially explosive atmospheres may occur, these obligations result from the nature of hydrogen as a flammable gas
- Integrated Environmental obligations, as required by the IED. This requirement applies to hydrogen production, irrespective of method. The threshold of applications depends on the interpretation of "industrial scale".
- Environmental Impact Assessment procedures, as envisioned by the SEA and EIA Directives. As Member States may choose to impose this obligation to hydrogen production plants or not, in certain countries, the production of hydrogen below certain thresholds is not subject to this requirement[9]

In addition, from a land use perspective, the production of hydrogen is, in almost all partner countries, regarded as an industrial activity, irrespective of the production method (even when produced from non-emitting methods such as water electrolysis), hence such activity would only be permitted in an area designated as an industrial zone or, in under specific conditions in commercial areas

3. Challenges and way forward

The production and storage of hydrogen is tightly regulated and significant obligations exist to ensure that it is handled safely and with due concern to environmental risks. However, existing legislation in almost all Member States has been designed in a time where hydrogen was being regarded as, mainly, an industrial gas for the use as an industrial feedstock in the chemical industry and therefore produced, stored and used on site on industrial platforms.

The increased use of hydrogen as a fuel has put existing rules to the test in countries where hydrogen refuelling stations have been deployed. By studying the legal and administrative rules across the partner countries and the experiences of project developers which have deployed HRS in a number of jurisdictions, a pattern of legal and administrative challenges emerges:

Challenge 1: Lack of administrative experience and guidance
The process that a project developer wishing to open a hydrogen refuelling station or expand a current station to include hydrogen is unclear, the steps to follow and the regulations that would apply are (initially) insufficiently known both to the developers as well as to the competent authorities. In this case, authorities and operators would have to "learn the process together" significantly increasing the effort required on both sides and the length of time for completion. Countries which have already commissioned a sizable network of HRSs (e.g. DE, UK, NL) have recognised this and have published official guidance on both the process as well as the applicable rules. In these countries, this need has also resulted in the development of specific normative rules for HRS, a step which significantly improves the efficiency of the administrative process.

Challenge 2: Zoning and Land use plans
From a land use perspective, the production of hydrogen is, in many partner countries, regarded as an industrial activity, irrespective of the production method (even when produced from non-emitting methods such as water electrolysis), hence such activity would only be permitted in an area designated as an industrial zone or, in under specific conditions in commercial areas. The consequence of this being that HRSs with on-site production would be relegated to industrial zones, thereby hampering the market take-off/limiting the commercialization of FCEVs and decreasing the convenience factor expected by consumers. While it cannot be excluded that it is the explicit wish of competent authorities to only allow hydrogen production (irrespective of quantity and method) in industrial areas, we believe that this situation may also be the unintended outcome of the misunderstanding of the processes involved and/or the lack of clarity on the scope of application of legislation and the applicable NACE code which does not distinguish between the various production methods for hydrogen.

[8] Production and Storage of Hydrogen falls within the projects listed in Annex II (*6a and 6c -production of chemicals; and storage facilities for chemical product*), for which Member States shall determine whether the project shall be made subject to an assessment or not, they may result in the obligation to prepare an Environmental Impact Assessment (EIA),

[9] For example, in Germany, for hydrogen storage on–site >3t <30t – an environmental impact assessment could be required due to specific local circumstances; ≥ 30t < 200t – an environmental impact assessment is required, if the project as such can have considerable negative impact on the environment at the discretion of the approval authority by an overall preliminary assessment and for hydrogen storage on–site ≥ 200t – an environmental impact assessment is always required

Challenge 3: Safety distances
In order to utilise existing refuelling infrastructure (avoiding stranded assets and reducing the costs for developing a sizeable hydrogen refuelling network) or to decrease the overall space needed for refuelling (e.g. at bus depots), Hydrogen should be located alongside conventional fuels in adapted multi-fuel refuelling stations. However, the lack of normative rules has resulted in a greater reliance on the risk-based approach to project approval, in turn, the lack of experience of authorities with hydrogen as a fuel has meant that a cautionary approach has been taken which has imposed high safety distances for hydrogen storage and dispensing. This had two consequences: (i) it has limited the ability of existing conventional fuel infrastructure to be adapted to include Hydrogen dispensing and (ii) has created uncertainty for operators and increased costs for (re)design.

Challenge 4: Lack of ambitious policies and supportive funding
While not a regulatory challenge *per se*, a number of countries lack the policy framework in place and associated funding support to develop a meaningful hydrogen refuelling infrastructure and associated fleets within a reasonable timeframe. Only 14 countries included hydrogen into their National policy frameworks develops under the AFID and even some of these set themselves un-ambitious goals or failed to provide sufficient incentives and policy support to realise their plans.

4. Recommendations

Some of the challenges presented above have been mitigated or even overcome in countries which have begun deploying HRS infrastructure. Analysing good practices across different countries (DE, UK, NL, DK, FR, BE), a number of recommendations emerge:

Recommendation 1: Develop and publish permitting guidelines for HRS at national level
The process which should be followed by project developers, alongside the rules which should be observed and complied with should be clearly described in a clear and comprehensive document. This document should be prepared by public authorities or in close collaboration with them. This process, which would build on existing rules will highlight the need to adapt existing rules or create specific ones applying to Hydrogen Refuelling Stations. (see recommendation 2). In countries where such guidelines have been published (e.g. DE, UK and partly NL) the permitting process is no longer regarded as a major barrier against deployment.

Recommendation 2: Develop and publish specific rules for the permitting and operation of HRS
The process of developing and publishing permitting guidelines (and/or the continued process of HRS development through demonstration projects) will highlight the need for specific rules covering the obligations surrounding HRS permitting (including safety distances). Such rules should aim to streamline the permitting process, provide more clarity and certainty to HRS operators while ensuring the development of safe and secure infrastructure. Normative rules relative to safety distances should take into account mitigation measures and take into account the need to allow hydrogen refuelling to co-exist with conventional fuels in existing locations. The German National Organization Hydrogen and Fuel Cell Technology (NOW) has developed approval guidelines for HRS, these have been made publicly available[10] The Netherlands[11] and the UK[12] have since then developed and published similar guidelines, thus providing more support to project developers seeking to build and operate HRSs.

Recommendation 3: Allow placing HRS in all areas where conventional refuelling stations are allowed
From a land use perspective, an HRS should be allowed in the same zones as conventional refuelling stations in order to incentivise the use of existing stations, adapted to provide hydrogen refuelling and continue their relevance in a decarbonised transport system. To the extent possible (i.e. subject to conditions) HRS with on-site production should also not be treated differently from a land-use perspective.

Recommendation 4: Develop more ambitious national targets for hydrogen refuelling infrastructure and associated incentives
National authorities should commit to oversee the deployment of sufficient number of HRS spanning their core transport network and key urban nodes, with gap filling investment support provided and a governance structure to see this happen. In this respect the German example of a public private partnerships (NOW and H2 Mobility) should be seen as a clear best practice. In order to ensure sustainability of the network, national authorities should also provide clean vehicle

[10] See https://www.h2-genehmigung.de/Index/Index?lang=1 for approval guidelines for Hydrogen refuelling stations, prepared by the national organization for Hydrogen and Fuel Cell Technology.

[11] See: Guidance on hydrogen delivery stations for refuelling of motor vehicles, co-located with petrol fuelling stations (APEA, BC GA, EI guidance) available at: https://publishing.energyinst.org/topics/petroleum-product-storage-and-distribution/filling-stations/guidance-on-hydrogen-delivery-systems-for-refuelling-of-motor-vehicles

[12] See PGS 35 (Hazardous Substances Publication Series 35, Hydrogen: Installations for delivery of hydrogen to road vehicles available at: http://www.publicatiereeksgevaarlijkestoffen.nl/publicaties/PGS35.html

support for the rollout of fuel cell electric vehicles (FCEVs) - particularly through geographically clustered fleet programmes. In this respect, the Deployment of Alternative Fuels Infrastructure Directive, 2014/94/EU (DAFI) should be linked to the Clean Vehicle Directive review and must be updated as to reflect the necessary changes with regard to the hydrogen uptake. At the very least, hydrogen infrastructure development should be made mandatory and the distance between Hydrogen Refuelling Stations should be reduced from 300km to 150km[13].

[13] This would be equal to the current km between compressed natural gas (CNG) stations.