HyLAW

National Policy Paper - Norway

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1. Introduction and summary

1.1 HyLAW Summary and Methodology

HyLaw stands for Hydrogen Law and removal of legal barriers to the deployment of fuel cells and hydrogen applications. It is a flagship project aimed at boosting the market uptake of hydrogen and fuel cell technologies providing market developers with a clear view of the applicable regulations whilst calling the attention of policy makers on legal barriers to be removed.

The project brings together 23 partners from Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Hungary, Italy, Latvia, Norway, Poland, Romania, Spain, Sweden, Portugal, the Netherlands and United Kingdom and is coordinated by Hydrogen Europe.

Through extensive research, interviews and legal analysis, the HyLaw partners have identified the legislation and regulations relevant to fuel cell and hydrogen applications and legal barriers to their commercialization.

This National Policy Paper provides public authorities with country specific benchmarks and recommendations on how to remove these barriers.

1.2 Policy Summary at National level

Norway claims to be a pioneer in hydrogen technology. Largescale production was established as early as in 1929, and hydrogen has been an element in our industry since then. In recent years, SINTEF, IFE, and NTNU have taken lead roles in research on hydrogen as energy carrier. In 2005 the Government defined a national hydrogen strategy with a focus on coordinating research and development activities, and HyNor as a pilot "hydrogen highway" was set up in 2009.

Since then there have been ups and downs, but currently there is a strong momentum for increased hydrogen deployment. The target of reducing greenhouse gas emissions 80-95% by 2050 calls for new technology and system change. The national white paper on Energy of 2016 states explicitly that the Government wants to promote production and storage, as well as use of hydrogen.

Since transport is the sector with the largest potential for reducing national greenhouse gas emissions, vehicles are in focus. Hydrogen cars benefit from the same incentives as electric vehicles, and a national support scheme for refueling stations was established in 2017. The system of subsidies and taxes for fossil fuel transport is the focus of revision and political debate. At the same time, increased support for research and development is offered through new and existing funding schemes, such as Pilot-E, EnergiX, and Enova's support programs.

One result of this is that ASKO got Europe's first fleet of hydrogen trucks in regular operation, starting from 2018. The number of private cars is increasing, and the long-term demonstration of hydrogen buses in Oslo is scaling up. There are several pioneering projects on hydrogen for ships, and increasing interest in production and industry applications. Actors such as NEL, Statkraft and Equinor are involved in planning and exploration of different options for green and blue hydrogen production. The potential market is enormous: According to the Hydrogen Council, hydrogen will represent 18% of the global energy consumption by 2050, associated with an industry worth 2.5 trillion dollars annually.[1]

Countries such as Germany and France are in front, with ambitious, integrated strategies for sustainable hydrogen deployment. While Norway is richly endowed with competence and energy resources, the approach of the Government so far has been to follow the development. Now the transition potential associated with hydrogen is increasingly emphasized. The hopes and expectations to the Government's ongoing work to develop a new, integrated hydrogen strategy are high. To enable sustainability transition and benefit from our competitive advantages, there is the need for joint efforts, predictable framework conditions and a holistic perspective, with focus on the whole value chain for hydrogen.

[1] Hydrogen Council (2017): Hydrogen scaling up. A sustainable pathway for the global energy transition. Hydrogen Council, November 2017.

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2. Hydrogen in the maritime sector

Greenhouse gas emissions from the maritime sector in Norway were 7.4 million tons CO2e (about 14% of total national emissions) in 2015. The amount will increase to 11.5 million tons by 2040, unless action is taken soon.[2] Alternative fuels are key to realizing the ambition of a 40% cut in the emissions from domestic shipping by 2040.

With a total value creation close to 175 billion and more than 100,000 employees, the maritime industry is one of the largest and most important sectors in the Norwegian economy. The industry also accounts for a large share of Norwegian export. Almost 90 per cent of ship's equipment from Norwegian companies are exported. In 2014, Norwegian ship's equipment alone was 9 per cent of total Norwegian exports of goods and services.[3] We have also positioned ourselves as a frontrunner in sustainable maritime technology: Of the first 50 LNG propelled vessels ever built, 95 % were Norwegian. The world's first electrical car and passenger ferry powered by batteries – Ampere - entered into service in early 2015 in Sognefjorden.

Currently, there is a booming interest in hydrogen solutions. There are at least 10 pilot projects on hydrogen in ships, that is: Fuel cells installed into a boat or ship, for use as a means of propulsion through chemical reaction between hydrogen and oxygen, and with no emission except clean water. These projects include a hybrid fishing vessel and an urban water shuttle, as well as a high-speed passenger ship with the capacity for 100 persons and a speed of 28 knots (52 km/hour). The world's first larger hydrogen ferry, for longer crossing/operating timescales, is projected in Western Norway, and the aim to launch the ferry by 2020. Last but not least, one of our major shipping companies is planning an emission-free cruise-ship powered by liquid hydrogen.

The importance and potential value these initiatives have for society is underscored by figures from the International Energy Agency (IEA) and OECD: International maritime shipping currently accounts for about 800 million tons CO2e emissions per year, and this figure could almost double by 2060. Low-carbon fuels are considered as a key solution to enter on to a more sustainable course.

2.1. Overview and assessment of current legal framework

Since the white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU*, greener shipping has been a national priority area. A number of emission reduction measures, such as reduced electricity fees for ships in business activity, a lending scheme for condemnation and renewal of the local shipping fleet, a grant scheme for climate and environmentally oriented public procurement processes and increased funds for research into climate-friendly shipping have been introduced. Norway has also been working through the International Maritime Organization (IMO), to introduce energy efficiency reporting requirements and define an initial, international strategy on the reduction of greenhouse gas emissions from ships. Launched in April 2018, this initial strategy envisages a reduction of total annual GHG emissions by at least 50% by 2050.[4]

Most of these efforts are associated with a principle of technology neutrality. Hydrogen and fuel cells have been considered as a relatively immature alternative. However, now there is increasing confidence in the technology. A resolution by the Parliament in June 2016 encourages the use of development contracts for hydrogen ferries. The Norwegian Public Roads Administration has established a development project for a hydrogen-powered ferry, where the contract was awarded in 2018 and the construction is to be completed by 2021. The Government's recent ban of any kind of carbon emissions in the waters of the UNESCO World Heritage sites Nærøyfjorden and Geirangerfjorden from 2026 is another important step. Given the length and limited grid capacity in these fjords, and the economic importance of cruise-ships and tourism in Western Norway, this is strengthening the drive for hydrogen solutions.

The industry and relevant authorities are working hand in hand to address remaining challenges. However, shipping is for a large part governed through international conventions, which take very long to change. The assessment carried out in HyLaw underscores the need for international collaboration to address regulatory gaps, and for Norwegian authorities to spearhead this development, to fulfill our ambitions as a sustainable maritime nation.

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[2] DNV-GL 2016. Reduksjon av klimagassutslipp fra norsk innenriks skipsfart. [Reduction of climate gas emissions from shipping in Norway]. Report for the Ministry of Climate and Environment. Report No 2016-0150.

[3] Menon 2017: Maritim verdiskaping. Analyse av næringen i en krevende tid. [Maritime value creation. Analysis of the maritime industry in a challenging time.] Maritimt Forum.

[4] Compared to 2008.

Design/Type approval – a regulatory gap and main barrier

HyLaw has assessed five legal-administrative procedures for hydrogen in ships. Design or type approval is the most substantial requirement, whereby it is certified that a type of vessel, system, component or separate technical unit satisfies the relevant administrative provisions and technical requirements. The *International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code)* is the overarching legal framework. The national *Regulation of ships using fuel with flashpoint below 60°C* makes the IGF Code mandatory for new constructions or reconstructions in Norway. It contains detail requirements for natural gas as fuel only, and internal combustion engines, boilers and gas turbines.

Continued work has been agreed under the IGF Code working group, but the use of fuel cells is presently not regulated. Due to this regulatory gap, approval must be sought through the Alternative Design approach, as defined in *MSC.1/Circ.1455 – guidelines for the approval of alternatives and equivalents.* This is a costly and time-consuming process, including comprehensive technical, risk and environmental assessment, as well as broad stakeholder involvement. As per the IGF Code, the design team itself should include experts having the knowledge and experience in fire safety, design, and/or operation as necessary for the specific evaluation at hand.

It is estimated that the procedure takes at least one extra year, as compared to gaining final approval for conventional ships. On top of this, there is the need for technology qualification and development of standards. The EMSA Study on the use of Fuel Cells in Shipping notes, in particular, the need to address uncertainty regarding possible failure modes; to test materials ductility for the low temperatures of liquid hydrogen; to decide on the possible allowed locations of pressure tanks; and to qualify pressure tanks for maritime use.[5] The Norwegian Maritime Authority (NMA) is working to establish minimum documentation requirements, as well as additional documentation requirements for different designs. In the meantime, entrepreneurs are left uncertain, as to what the time and cost implications will be.

Ship registration – additional documentation requirements anticipated

IMO numbers are mandatory for cargo vessels of at least 300 gross tons and passenger vessels of at least 100 gross tons. Individual registration in international or national ship registers is required also for smaller ships/boats. Beside IMO requirements, a declaration of safety from an approved classification society and a set of qualification requirements are commonly required. Presently, there are no specific requirements for hydrogen-powered ships. Additional documentation requirements may come in, following the anticipated minimum requirements for alternative design, but once the design has been approved, it is not foreseen that there will be any barrier associated with ship registration.

Operations and maintenance – special safety requirements could be a hindrance

When it comes to operations and maintenance, the national *Regulation on ships using low-flashpoint fuels (flashpoint below 60°C)* includes special requirements. These are based on the *Regulation on safety management systems for Norwegian ships and maritime installations (ISM regulation)*. As per now, there are no special requirements for hydrogen-powered ships. The additional documentation requirements for alternative designs may be followed by specific operation and maintenance requirements, but due to lack of experience it is difficult to assess to what extent this will be a barrier and what the time and cost implications could be.

Approval of landing/bunkering facilities – need for guidelines

Onshore landing and bunkering installations for hydrogen fall under the same legislation as onshore landing and bunkering facilities for of other inflammable gases, that is the Norwegian *Regulation for safe handling of inflammable, explosive and pressurized substances, including relevant installations and equipment*. Small installations may be established freely, but all bunkering installations harboring more than 5 tons of hydrogen require special consent from the Directorate for Civil Protection.

Following an ongoing revision of the regulation (entering into force in the second half of 2018), all bunkering of hydrogen for passenger ships will require special consent. This is already applied in practice, through individual decisions. Applying for special consent from the Directorate for Civil Protection is a time-consuming process. The normal processing time is 3 months, including a 4-week hearing period, but the procedure may also take considerably longer, if revisions are needed. A comprehensive, quantitative risk assessment is required for approval, and this is often

[5] DNV GL (2017): European Maritime Safety Agency (EMSA) study on the use of fuel cells in shipping.

outsourced to a consultant. The costs depend on case and are difficult to specify. This adds further uncertainty to technological innovation projects, which are financially risky at the outset.

As the legislation in this area is function-based rather than providing detail regulation, new procedures specifically for hydrogen installations may not be needed. However, there is the need for close assessment and consideration of specific guidelines. Current procedures for bunkering of LNG and the experience from hydrogen filling stations for cars provide a first knowledge basis, but further risk studies and technology qualification is needed, both for liquid and compressed gaseous hydrogen. All pressurized components, such as tanks, piping and equipment, must be in compliance with EUs *Pressure Equipment Directive* (97/23).

In other words, there is a knowledge gap and need for more specific guidelines for onshore landing and bunkering installations. The lack of detail regulation is supplemented by comprehensive assessment requirements, which can be quite challenging for economic operators, at this early stage in the development.

Onboard hydrogen transport – updating will be required

Onboard transport of hydrogen is of high relevance for Norway, considering the foreseen export opportunities for green as well as "blue" hydrogen, produced from natural gas.

Generally, transportation of compressed or refrigerated hydrogen in bulk or as packed cargo, is regulated under the *International Maritime Dangerous Goods Code (IMDG Code)*. Here, the requirements for compressed and refrigerated liquid hydrogen are comparable to those for natural gas, and they have the same limitations as packed cargo. However, the *International Gas Carrier Code (IGC Code)* lacks specific requirements for hydrogen.

To address this regulatory gap, IMO adopted a set of interim recommendations for carriage of liquefied hydrogen in bulk (resolution MSC.420(97) under in November 2016. Their application is so far limited to a pilot project where Kawasaki Heavy Industries Ltd got Approval in Principle (AiP) from ClassNK. There is little available documentation of the experience from this project, and it is therefore difficult to assess the impact of the interim recommendations.

Under the IGF Code it is anticipated that initial restrictions regarding storage quantities and locations will be put in place for hydrogen (e.g. storage on top deck).

Thus, this is another area where adjustment of legal frameworks is needed, in order to provide clear and predictable conditions for technology and market development.

2.2. Conclusions

Deployment of hydrogen in ships is an important step towards a more sustainable transport and energy system. In Norway specifically, the application of hydrogen as a means of propulsion for ships is needed, to meet the ambitious emission reduction target for the maritime sector. It represents a major business opportunity for our maritime industry. Furthermore, increased use of hydrogen and fuel cells in ships will help build a market, both locally and internationally, for green and blue hydrogen produced in Norway.

While Norwegian authorities have taken important steps to facilitate development and application of hydrogen solutions in the maritime, significant barriers remain. Most critical of these is the lack of regulation for design/type approval for hydrogen and fuel cells in ships, which has severe time and cost implications.

Once the requirements for design approval become clear, individual ship registration is not likely to be associated with any barrier. The list of minimum requirements and additional requirements for different alternative designs will also be an important step towards defining any specific operations and maintenance requirements needed for ships running with hydrogen and fuel cell solutions.

Another important barrier is the lack of knowledge and specific guidelines for landing and bunkering installations for hydrogen. As the regulation in this area is function-based rather than providing detailed requirements, adjustment of the legislative framework may not be required, but there is the need for further risk studies, technology qualification and guidelines very soon. For maritime hydrogen solutions to take off, landing and bunkering infrastructure must be put in place.

For the onboard transport needed to develop a global hydrogen market, interim requirements for liquefied hydrogen have been developed. However, there are remaining regulatory gaps, both under the IGC and the IGF Code.

The use of development contracts to facilitate introduction of hydrogen and fuel solutions in the maritime sector is a promising strategy, which may strengthen public-private dialogue and increase common efforts to remove legal barriers.

2.3. Policy Recommendations

- It is important that Norwegian authorities work to strengthen international collaboration, and if possible force the pace in IMO's work to regulate hydrogen solutions and provide a procedure for type approval under the IGF Code.
- Work to define a set of minimum requirements for the approval of alternative design should be prioritized.
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- Support for further risk studies and technology qualification is needed, both for hydrogen and fuel cell propulsion systems and for landing/bunkering installations.
- Specific guidelines for landing/bunkering installations for hydrogen solutions are urgently needed.
- Further use of development contracts to facilitate introduction of hydrogen and fuel cell solutions in the maritime sector should be actively encouraged.
- The regulation of onboard hydrogen transport should be kept on the agenda.

3. Hydrogen in road transport

Road transport accounts for 17% of Norway's total CO2 emissions and around 60% of the national emissions from the Norwegian transport sector. Due to blending with biofuels and uptake of battery-electric vehicles, the total national emissions from road transport have decreased the last couple of years. On the other hand, the number of cars is growing, and emissions from freight transport have more than doubled since the 1990s. The total volume of freight transport keeps increasing, as does the share of freight transported by road, relative to sea and railways.[6]

Considering the national geography, with long distances and a sparsely spread population, the case for hydrogen fuel cell vehicles is good. In 2015 Ola Elvestuen of the Liberal Party, now Minister for Climate and Environment, envisioned 50 000 hydrogen fuel cell vehicles by 2025. However, Norway had only 144 hydrogen fuel cell vehicles by 31.01.2018.[7]

While the HyNor project resulted in four hydrogen refueling stations, the sale of battery-electric cars in Norway took off from 2010-2011, and most of the international producers prioritized other markets for the introduction of hydrogen fuel cell vehicles. The large industry actors behind HyNor pulled out in 2011, and a new company called HYOP took over ownership and operation of the stations.

HyNor left part of the population with the impression that hydrogen fuel cell cars were a hype. However, the project also brought valuable experience. The industry, key knowledge institutions and a number of public decision-makers, especially from the major cities and Akershus county administration, continued the work to explore and facilitate hydrogen solutions, both politically and through research and development.

In Oslo, Ruter currently has five hydrogen fuel cell buses in regular operation. Another ten buses have been ordered and will be ready for operation in 2020. ASKO is the first customer for hydrogen fuel cell trucks from Scania, with a range of 400 km per day. Trucks for long distance transport – the famous Nikola One - have already been preordered by three Norwegian companies, and Norwegian Hydrogen Forum has the vision to get 1000 hydrogen trucks on Norwegian roads by 2023.

At the same time, Uno-X, as a major fuel provider, have stated its readiness to establish 20 hydrogen refueling stations in Norway by 2020. A national support scheme was established in January 2017, but grants have so far only been offered for a maximum of three stations per year. This leaves us with a chicken/egg problem, without an adequate network of refueling stations, and without enough cars to provide a sound business case for station operators.

In the latter half of 2018, HYOP had to close their stations, due to financial challenges. This means that Norway currently has five hydrogen refueling stations in operation, with another two in the pipeline. Uno-X is in a different position, and several of their stations are multifuel, in more favorable locations. Still, the closing of HYOP's stations created a new wave of uncertainty. Action is therefore needed, to provide predictability and ensure business operators as well as car buyers that there will be a future market and continued fuel supply.

3.1. Overview and assessment of current legal framework

According to the national hydrogen strategy of 2005, Norway shall be an early user and as ambitious as the EU when it comes to promoting hydrogen vehicles. The strategy relates to the report from a government appointed expert committee which concludes that hydrogen produced from renewable energy or natural gas with carbon capture and storage, is to be considered as a zero-emission fuel. The need to implement new technical solutions for road transport in Norway was emphasized in a white paper on Climate policy in 2012, which also stated the intent to continue support for both battery-electric and hydrogen fuel cell vehicles.

The above-mentioned white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU*, specifies the climate impact reduction targets for the transport sector (35-40% reduction by 2030, using 2005 as reference point, and that by 2050 Norwegian transport shall be emission free/climate neutral). Furthermore, the white paper states that a national plan for infrastructure for alternative fuels will be developed. The plan shall among other address charging infrastructure for el and refueling stations for hydrogen and biogas, in consistence with the emission reduction targets for 2030.

The ambition to develop a national plan for infrastructure for alternative fuels is related to the EU *Alternative Fuels Infrastructure Directive (AFID)*, which establishes a common framework and sets out minimum requirements for building up alternative fuel infrastructure, including refueling points for hydrogen. States which decide to include hydrogen refueling points in their national policy frameworks shall ensure that, by 31 December 2025, an appropriate

[6] Norwegian Environment Agency (2018): https://www.miljostatus.no/veitrafikk-klimagassutslipp.

[7] Opplysningsrådet for Veitrafikken [Information agency for road traffic in Norway] (2018): https://ofv.no/

number of such points are available, to ensure the circulation of hydrogen-powered motor vehicles. The inclusion of hydrogen within the scope of national policy frameworks is, however, optional.

The white paper on Energy policy of 2016 further acknowledged the potential of hydrogen fuel cell vehicles, especially for long hauls and heavy loads, and prepared the ground for a national support program for hydrogen refueling stations, which was implemented 1. January 2017. The *National Transport Plan* (2018-2029) stresses the need to develop hydrogen refueling infrastructure and the role of the national support scheme Enova, which directs support to hydrogen refueling stations in strategically important locations.

In HyLAW, more than ten legal-administrative procedures to do with road transport and hydrogen refueling stations were assessed. The focus here is on those associated with specific challenges and opportunities for actors in Norway.

Type approval for vehicles – harmonize requirements and procedures

The Norwegian *Vehicle Regulation* of 17.01.2012, implements Regulation (EC) No 79/2009 on type-approval of hydrogen-powered motor vehicles. The *Regulation on approval of cars and towed vehicles (car regulation)* states that cars and towed vehicles are required to have EC type approval, unless otherwise stated in the regulation. Approval of prototypes are valid for a time period of up to 2 years and may be extended with another 1 year only.

Cars or towed vehicles produced in small series may be presented for national type approval. Furthermore, a new vehicle may be presented for individual approval, if it belongs in a group where EC type approval is not obligatory, if all parts and components are EU approved, or if it is in vehicle group M1 and N1 and produced in large series for countries outside the EC/EEA.

In Norway, EU type-approval is generally applicable for hydrogen fuel cell vehicles. However, no general type-approval for hydrogen fuel cell trucks has been made up to now, so this will be a case of individual approval. Exchange and harmonization is recommended, to share best practice and minimize uncertainty and costs for the actors.

Restrictions and incentives for hydrogen fuel cell vehicles

Restrictions for hydrogen vehicles when using public road infrastructure may be imposed in relation to the on-board storage of high pressure or liquid hydrogen and their classification as dangerous goods according to the *European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR*). In general, no substantial restrictions or barriers for hydrogen powered vehicles using the public transport network are identified.

When it comes to incentives, lack of complex, appropriate and technology neutral support measures is considered as a significant economic barrier in many EU countries. Norway, together with France and Spain, have the broadest range of incentives for hydrogen fuel cell vehicles. The size of the incentives is such that hydrogen fuel cell vehicles currently costs as much as high to medium-priced conventional cars.

Some regional authorities have added incentives to support establishment of local fleets, and also working actively to facilitate business-to-business collaboration about this.[8]

Considering the current barriers in terms of uncertainty and limited refueling infrastructure it is important to maintain the incentives for hydrogen fuel cell vehicles, even if some will be removed or reduced for battery-electric vehicles, which have reached a wider uptake.

Land use for hydrogen refueling stations

Establishing a hydrogen refueling station requires a permit from the relevant municipality, according to the Norwegian Planning and Building Act. The application will first and foremost be evaluated in light of the municipal land use plan. The municipal land use plan is developed in relation to the regional (county level) plan for transport infrastructure and regional climate and energy strategy, as well as the National Transport Plan.

The local building authority checks with the Norwegian Public Roads Administration (NPRA), if they have any objections. Neighbors shall be notified, and in certain cases, the local fire authority is asked to comment. There is no rule stating that hydrogen refueling stations with on-site production or with certain storage quantity shall be limited to certain zones or types of areas, but for areas where third-parties may enter, such as in connection with existing buildings and

[8] Hydrogen strategy for Oslo and Akershus, 2014-2025.

shops, the application is reviewed more strictly. In practice it is easier to gain permission to set up a hydrogen refueling station in an industrial zone, than in a commercial or residential zone.

If the suggested location does not suit the land use plan, a longer procedure must be undertaken to grant an exemption or change the plan. The maximum time for this is 42 weeks. According to the stakeholders consulted it may take considerably less time, but it may also take much longer, where neighbors or other parties file concerns and several rounds of feedback are required. The competence and capacity of the municipal authorities also varies considerably.

The procedure to apply for state support through Enova cannot be done in parallel but must precede and subsequently await the result of the municipal permitting process. This extends the time and costs for operators further. While one municipality has established a "fast-track" procedure, another has taken years to process the permit application.

Permitting process and requirements for hydrogen refueling stations

The permitting process is a three-stage procedure, where the municipality is in charge. First, an initial general permit is required. Subsequently, a construction permit must be obtained, and lastly an operation permit is required, before the handling and provision of hydrogen as fuel may commence.

The Directorate for Civil Protection has developed a national *Guideline for tapping of dangerous substances*. This elaborates on the implications of the *Regulation on handling of inflammable, reactive and pressurized substances*, which implements the *Seveso Directive*, as well as the *ATEX Directives* and the *Pressure Equipment Regulation*, in the case of fuel stations and refueling infrastructure.

When the tank volume for hydrogen is 0,4 m3 or more, there is a duty to notify the Directorate for Civil Protection. In case of facilities where more than 5 tons of hydrogen is stored, the *Major Accident Regulation* will come into play, and special consent from the Directorate for Civil Protection (DSB) will be required.

To obtain a construction permit the operator/applicant must document the necessary competence, and provide detailed documentation, including comprehensive risk assessment, showing that the hydrogen refueling station will be designed according to the standard *ISO/TS 20100 Gaseous hydrogen - Fuelling stations*. To get the final operation permit, it is necessary to document operator competence, control/inspection before and during installation, as well as final control carried out by an independent inspector. A separate environmental permit is not required, but there is general requirement to comply with the *Pollution Prevention Act*.

As several standards exist and requirements are function-based, there are additional initiatives in some countries to provide more clarity for hydrogen refueling station developers and local authorities. In the UK, guidance on hydrogen refueling systems co-located with petrol fueling stations prepared by the Energy Institute lays down minimum recommended separation distances, including examples of hydrogen and other fuel separation distances.[9]

National plan for alternative fuel infrastructure

As noted above, Norway has committed to developing a National plan for alternative fuel infrastructure, including hydrogen refueling stations. The latter is optional under the AFID Directive, and so far only 14 Member States address hydrogen infrastructure in their national policy frameworks. While some plans, like that of Germany, contain ambitious targets, the measures in others are insufficient to enable a suitable network.

In Norway, the National plan for alternative fuel infrastructure is to be presented in 2019. According to most stakeholders it is critical for the plan to include more speedy roll-out of a network of hydrogen refueling stations.

3.2. Conclusions

The establishment of hydrogen refueling stations started early but was set back by largescale electrification and initial lack of hydrogen fuel cell vehicles. Still, the number of cars and hydrogen refueling stations has increased in recent years. Norway boasts important pilot projects for trucks and buses, and the solutions for these segments, especially, is promising.

[9] 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

With a view to favorable developments in the energy market and expected increase in demand for hydrogen, there is increasing focus on development of integrated value chains, linking domestic production and deployment in transport with other applications, home and abroad.

In Norway, no significant barriers are associated with type approval, individual registration or handling of hydrogen fuel cell vehicles themselves. Since transport is one of the sectors with the highest potential for reducing CO2 emissions, there is a broad and strong incentive scheme for zero-emission vehicles, including battery-electric as well as hydrogen fuel cell cars. While electrification has reached far and the incentives for battery-electric vehicles will be reduced in coming years, it is important to keep those for hydrogen fuel cell vehicles until a viable threshold has been reached.

With the municipality as local "one-stop shop", the process to establish hydrogen refueling stations in Norway is not too difficult or time-consuming, compared to other countries. There is, however, considerable variation, and the level of public involvement may cause delays. Identification of best practice and a streamlining of process and requirements would ease the burden on the operators.

Considering the national climate targets and the level of uncertainty in the market, the coming plan for alternative fuel infrastructure and the new national hydrogen strategy are eagerly awaited.

3.3. Policy Recommendations

- The national plan for alternative fuel infrastructure is of critical importance. The plan should specify a number of hydrogen refueling stations by 2025, which enables transport using hydrogen fuel cell vehicles in a network covering the major cities.

- The permitting process and requirements for hydrogen refueling stations should be streamlined, with standards harmonized across the EU.

- Hydrogen refueling stations for multiple users, including cars, trucks, buses and eventually ships and trains, should be facilitated.

- Public-private collaboration to establish local fleets of hydrogen fuel cell vehicles should be facilitated and if possible encouraged with incentives.