HyLAW London Workshop

Application Area 1: Hydrogen Production, Storage, Distribution and Refuelling

HyLAW
Hydrogen law

Grant Agreement No 737977

Hydrogen Production, Storage, Distribution and Refuelling

Introduction – this area has broad application coverage:

- **Production of hydrogen** (centralized and localised)
- **Storage of hydrogen (**as a pressurised gas / liquified / or via metal hydride)
- **Transport and distribution of hydrogen (**road transport in cylinders and tube trailers of bulk hydrogen gas / metal hydride stored hydrogen and liquified hydrogen)
- **Hydrogen as a fuel and refueling infrastructure for mobility purposes** (fuel quality, fuel measurement and HRS facilities)

There are many subcategories within each of these areas that go into considerably more detail than can be reviewed in this workshop

A high level assessment and recommendations for the main categories only will be provided, but more specific aspects covering specific issues experienced can and should be referenced in the Q&A sessions

Hydrogen Production - centralised

Assessment – centralised production

- The majority of centralized hydrogen production is typically classified as an industrial activity scaled and developed for on-site consumption (refinery, petro-chemical processing, etc) and any development is subject to formal industrial land use planning approval and designed and operated in accordance with relevant EU regulations (SEVESO, ATEX, EID) which are also applicable in the UK. There is no fundamental concern with the regulatory framework and its applicability for such production

Image of Air Liquide SMR plant Germany supplying 22,000 tonnes H2 pa or an adjacent polymer plant

Hydrogen Production - localised

Assessment – localised production

- There is however a challenge for localised H2 production and the issue that land use planning and zone prohibition does not distinguish between production methods of hydrogen, subjecting environmentally friendly (yet more marginally costly) production such as electrolysis to the same restrictions as large scale and traditional industrial pathways to hydrogen production – and thereby restricted to purely industrial zone and hazardous activity siting

Hydrogen Production - localised

Recommendations – localised production

- Zone prohibitions and administrative practice should distinguish and recognise that hydrogen production can take place in different ways. Given that some of these methods (e.g. electrolysis) have little environmental impact and generate little to no emissions they could, potentially be treated different from a land use plan than traditional industrial methods.
- While zone prohibition will continue to exist even in such situations, it is important that legal and administrative procedures recognise the differences and distinguish between the various methods, thereby allowing the potential for authorities to leverage an additional (non-financial) tool to incentivize production of hydrogen through environmentally friendly methods
- The absence of simplified processes for small quantity localized H2 production leads to a restrictive environmental procedure which may discourage investors
- Develop guidelines for mandatory permitting steps, with reference to EU directives that need to be applied when a hydrogen production unit is installed. This document should attempt to differentiate between hydrogen production methods (SMR, electrolysis, gasification, etc) in order to highlight the differences (or lack-thereof)
- This document should cover both centralized and localized production units, in order to clearly identify similarities and differences resulting from the size of the plants.

Hydrogen storage

Assessment

- In principle, hydrogen storage only takes place in conjunction with hydrogen **production** – as a temporary stage between output and delivery to a direct usage / process activity, or prior to onward distribution; or in conjunction with a user in temporary storage and intending to drawdown the hydrogen over time.
- Typically hydrogen storage, from a legal and administrative perspective, is considered as chemical storage of flammable and dangerous gases and land use plans often relegate such activities to industrial zones, in accordance with the traditional view that hydrogen is an industrial gas
- UK regulations and permitting is partly volume related (and therefore fall under Hazardous Substance regime at 2 tonnes, or under the COMAH Directive at 5 tonnes) and partly based on the type of storage – whether storage cylinders are classified as pressure vessels. From a land use perspective the site has to be within an appropriate zone (not impinging on any residential zones) and land use approval is dependent on demonstrating compliance with all design and use requirements, and safety requirements and separation distances, for potentially hazardous flammable / explosive industrial gasses

Hydrogen storage

Recommendations

- With the increased use of Hydrogen in various commercial applications (e.g. as a fuel, sold in hydrogen refuelling stations or consumed by micro-CHP's), the storage of hydrogen should be possible in all areas where the application consuming hydrogen can be located
- Subjecting hydrogen storage to risk assessments, in accordance with the SEVESO and ATEX Directive is in line with the purpose and intention of these acts
- However, the application of the EIA and SEA Directives and other environmental permitting can result in a disproportionate administrative burden on project developers and economic operators wishing to bring hydrogen applications to market. In addition, the process itself (involving several permits, provided by different authorities, and requiring much time and effort) imposes high costs on operators and further delays the commercial deployment of these applications
- The permitting processes for the storage of hydrogen should be simplified and streamlined. – Best practices such as the appointment of One-stop-shop authorities should be the standard. Whenever possible (e.g. Risk assessment, Health and Safety, etc.) assessments and the associated authorities which are competent to issue them) should be integrated with the view to minimise duplication of effort and reduce overall administrative burden while maintaining a high level of safety and environmental protection

Hydrogen transport and distribution

Assessment

- Hydrogen is legally classified as dangerous to transport and is included in the list of dangerous goods in Annex A to the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) .
- Dangerous goods are those substances and articles the transport of which by road is prohibited by, or authorized only in certain circumstances by Annexes A and B to the ADR
- Transport means any road transport operation performed by a vehicle on the territory of at least two ADR Contracting Parties, **within** or between the territories of EU Member States, including the activity of loading and unloading of dangerous goods, covered by Annexes A and B.
- Vehicle means any motor vehicle intended for use on the road, having at least four wheels and and any trailer


Hydrogen transport and distribution

Assessment

- Tunnel restrictions and parking restrictions apply (subject to quantities of compressed hydrogen (beyond 333l) per transport unit in packages (when carrying only hydrogen on board)
- Participants in the carriage of dangerous goods shall take appropriate measures according to the nature and the extent of foreseeable dangers, so as to avoid damage or injury or to minimize their effects. Persons employed by the participants, shall be trained in the requirements governing the carriage of such goods appropriate to their responsibilities and duties.
- The transport equipment shall conform to the requirements for a delivery vehicle, the cargo itself must also be clearly marked with the UN number corresponding to the dangerous goods contained. The outer packaging must clearly and legibly display the letters 'UN' followed by the relevant code for that substance or article. One or more hazard labels must be attached to indicate the type of hazard in the form of a symbol.
- Transportable Pressure Equipment Directive 2010/35/ EU (TPED) addresses the safety requirements and the conformity assessment procedure for transportable pressure equipment used exclusively for the transport of gases
- Current limitations in volume and pressure of high pressure receptacles used for hydrogen transport by road are not appropriate to deliver large quantities of hydrogen to large refuelling stations or other (industrial) end users. These limitations represent a structural barrier and therefore the current standards have to be revised and changed as to allow higher vessels capacities (pressure and volume)

Hydrogen transport and distribution

Recommendations

- The provisions for transport of dangerous goods by road are standardised in ADR and implemented in all partner countries through harmonised transposition of Directive 2008/68. The hydrogen is treated in the same way as other flammable gases and therefore no recommendations for change of the existing legal an administrative framework could be made.
- The requirements about the construction, testing, type approval and certification of the equipment for transportation of dangerous goods and in particular for hydrogen are very detailed regulated and standardised in ADR, TPED and a number of technical standards. The application and implementation of the rules is harmonised across the EU Member states and no legal or operational barriers could be identified. Therefore, no recommendations for improving of the existing legal framework conditions are provided
- Current standards for compressed hydrogen receptacles have been developed for a relatively small market volumes and short delivery distances. New materials and production technologies are now available for increasing the capacities of the cylinders and tubes, improving the payload of hydrogen trailers and allowing hydrogen delivery at larger scales. Therefore, the existing standards need to be revised and adapted. This also applies to smaller portable cylinders and supply / distribution to dispersed customers
- Changing standards is a slow process and requires continuous involvement towards building an industrial consensus for improving of existing volume and pressure limitations of hydrogen receptacles in view of the revisions of the existing ISO standards for gas pressure vessels designated as cylinders, for tubes in composite materials and for composite tubes
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Hydrogen as a fuel and refueling infrastructure

Assessment – Hydrogen as a fuel and Certification of Origin

- The Alternative Fuels Infrastructure Directive (AFID) establishes a common framework of measures for the deployment of alternative fuels infrastructure in the Union in order to minimize dependence on oil and to mitigate the environmental impact of transport and sets out minimum requirements for the building-up of alternative fuels infrastructure, including refueling points for hydrogen Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure (AFID)
- Under AFID, Member States which include hydrogen refueling points accessible to the public in their national policy frameworks shall ensure that, by 31 December 2025, an appropriate number of such points are available, to ensure the circulation of hydrogen-powered motor vehicles, including fuel cell vehicles, within networks determined by those Member States
- The AFID was transposed in the UK in October 2017. The transposition for UK hydrogen refuelling points includes only the reference to ISO 17268 for refueling nozzles
- Hydrogen was recognised in the UK as a transport fuel in 2016 – if hydrogen is for use both with a fuel cell, and for combustion in a dual fuel vehicle (although there is a difference in duty payable for hydrogen combustion fuel)
- Road Transport Fuel Obligations Order, Amended in 2007 to transpose elements of the EU Renewable Energy Directive 2009/28/EC; Amended further in 2013 to implement requirements of articles 7a-e of the Fuel Quality Directive; Motor Fuel (Road Vehicle and Mobile Machinery Greenhouse Gas Emissions Reporting Regulations 2012 Part of the UKs transposition of the Fuel Quality Directive 2009 and transposes Articles 7a to 7e, and Annex IV, of Directive 98/70/EC
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Hydrogen as a fuel and refueling infrastructure

Assessment – Hydrogen as a fuel and Certification of Origin

- The most recent version of the Fuels Quality Directive introduces a definition for renewable transport fuels which would also apply to hydrogen. However, despite national / private initiatives (DE, DK, BE) to define "green" / "renewable" hydrogen, there is currently no binding or voluntary, uniform certification of origin system at European level
- The absence of a common definition of green (or renewable) hydrogen can be a barrier that will slow down the implementation of (green) hydrogen as an alternative fuel. Divergent approaches may jeopardize the free movement of (green) hydrogen across borders.
- Moreover, the absence of Guarantee of Origin (GoO) scheme for green (renewable) hydrogen hinders the development of a green (renewable) hydrogen market which may encourage the production of hydrogen from hydrocarbons that may reduce the overall environmental benefits of hydrogen in all applications (mobility, energy, industrial feedstock)
- Directive (Eu) 2015/1513 Of The European Parliament and of The Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources
- The Fuel Quality Directive defines "renewable liquid and gaseous transport fuels of non-biological origin" as "liquid or gaseous fuels other than biofuels whose energy content comes from renewable energy sources other than biomass, and which are used in transport".
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Hydrogen as a fuel and refueling infrastructure

Recommendations – Hydrogen as a fuel and Certification of Origin

- A Guarantee of origin system for green (renewable) and low carbon hydrogen should be established at EU level (e.g. CertifHy project) as a consumer information tool.. This could be achieved, for example, in the context of the revision of the Renewable Energy Directive (RED II), it's implementing acts and national transposition acts.
- The certification of hydrogen should include the carbon intensity and other relevant parameters (e.g. renewable origin) as for electricity in order to encourage the production and use of Hydrogen from low carbon and/or renewable processes.
- The renewable origin of the hydrogen should be transferrable independently of the molecules to which it relates (subject to reasonable conditions pertaining to mass balance and avoidance of double-counting).

Hydrogen as a fuel and refueling infrastructure

Assessment – Fuel Quality

- There is currently no UK legal requirement for hydrogen fuel suppliers to provide H2 at a specific purity level and conformity to international standards for H2 as an industrial gas / high purity gas as covered in standard ISO 14687 is / can be specified by users while ISO 4687-2:2012 and SAE J2719_201511 currently specify purity standards for fuel cell applications with 99.97% overall hydrogen purity and allowable levels of key
- Most countries adhere (from a regulatory perspective) to the standards laid down within ISO 14687-2 and ISO 19880–1, however, different approaches have been adopted and the ISO norm typically forms the basis for the quality control, but that checking on all the possible contaminants is very difficult/expensive. In practice measurement is done on key contaminants which are checked continuously, however, due to the associated costs, not all contaminants named in the norm are checked.
- A new standard for hydrogen quality measurements is under development: ISO/DIS 19880–8 *Gaseous hydrogen – Fueling stations – Hydrogen quality control*. It is expected that the standard will be endorsed soon. The aim of the standard is to develop a practical implementing method for hydrogen quality control in which minimum analysis requirements of impurities are specified per hydrogen supply chain, as well as the frequency at which the analyses should be performed

Hydrogen as a fuel and refueling infrastructure

Recommendation – Fuel Quality

- Although not harmonized, in most countries where HRS are present, a procedure for fuel quality measurement is in place. A competent authority is assigned and the responsible party for the quality of the fuel is set.
- However, the technical means to verify the purity in accordance with the applicable standards are not widely available. A strict enforcement of such requirements would place disproportionate costs on certain parts of the hydrogen value chain which will further delay the deployment of hydrogen technologies.

Hydrogen as a fuel and refueling infrastructure

Assessment – measurement of dispensed Hydrogen

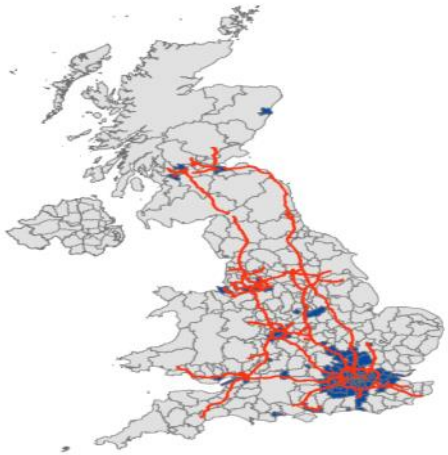
- Accurate measurement of hydrogen fuel dispensed to a vehicle (or other customers) is required for pricing / user charging purposes.
- However, refuelling stations must store hydrogen in accordance with the worldwide accepted standard SAE J2601, with nominal working pressures of 700 bar and a temperature range of -40 °C (pre-cooling) to 85 °C (maximum allowed vehicle tank temperature).
- These harsh operating conditions mean that it is difficult to provide sufficient traceability in flow metering measurements, which will need to be taken into account when developing hydrogen compliant meters. The development of flow meters for use at refuelling stations must also be compatible with OIML R 139-1, which is the regulation for the equipment used to 'deliver compressed gases (natural gas, hydrogen, biogas, etc.) as fuel into fuel cell vehicles, small boats and aircraft'. This standard currently specifies that the flow meter must provide a relative accuracy of 1% (which is not achievable with commercially-available meters). A new work item proposal (NWIP) has been issued by OIML TC8 SC7 to develop a dedicated OIML standard for flow metering at hydrogen refuelling stations.
- This is a global challenge and at this point FCEV suppliers have been offering inclusive hydrogen supply – but will need to be brought into line with the UK Weights and Measures Act (or other appropriate legislation)

UKH2Mobility HRS coverage

Full population coverage 2030

Tier 1 roads
Tier 2 roads
Tier 1 Tier 2 Tier 3

Seeding of Tier 1 regions[1] – major cities and connecting roads



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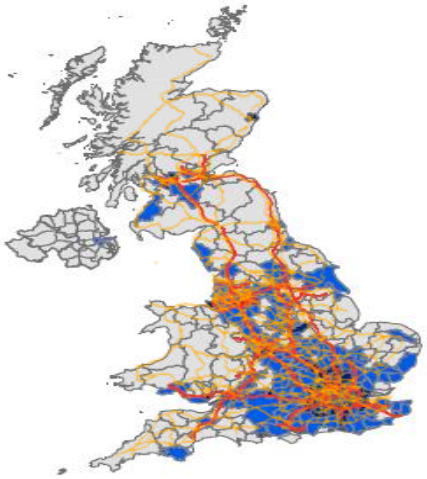
Initial seeding in **major population centres**

Coverage extended to Tier 2 regions and all major roads <2025



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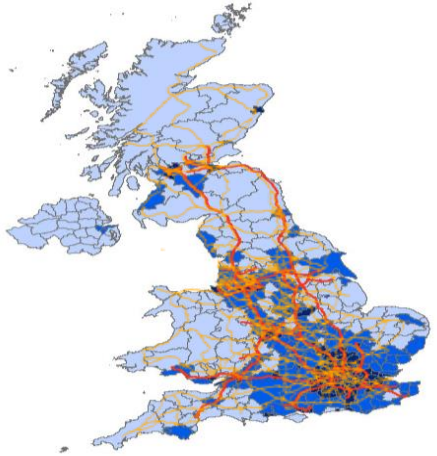
Extend coverage to enable close-to-home refuelling to **50% of the population** and long distance **travel**

Full population coverage 2030



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Extend close-to-home refuelling to the **whole of the UK,** including less populated regions

There are currently 12 operational HRS >80kg/day (of which 9 provide 700 bar) with five more expected to be deployed by end-2018 (plus 2 mobile refuelers) and 3 new bus refuelers planned for 2019

Hydrogen as a fuel and refueling infrastructure

Assessment – refueling infrastructure planning and permitting

- In most countries, on-site production of hydrogen (even when produced from non-emitting methods such as water electrolysis) would result in the HRS being classified as an industrial activity, hence such an HRS would only be permitted in an area designated as an industrial zone, significantly reducing the convenience level of users and severely limiting the business case for development of HRS's with on-site production
- When considering the process for permitting of construction and operation of an HRS, there are very few countries where the regulations specifically cover H2 HRS
- **HRS operators face uncertainty** during permitting: there is no standardized approach by the administration for the interpretation of the applicable regulation, which can lead to non–uniform interpretation by different authorities,
- **Unreasonably high requirements**: Authorities which wish to exercise a high degree of precaution in the face of limited experience with hydrogen technologies interpret general (industrial) regulations by imposing the "maximum" level prescribed
- **Duplication of efforts**, without added safety benefits: every new HRS project is treated on a case by case basis which increases the necessity of individual (case–by–case) modelling, calculation, planning, etc. Designs which have been deemed safe already could be replicated at lower administrative and economic cost, however this does not appear to be the case in most countries.
- **Disincentive HRS with on-site production:** the authorization procedure for HRS with on–site production is cumbersome and, in some cases, prohibitive

Hydrogen as a fuel and refueling infrastructure

Assessment – refueling infrastructure planning and permitting

- UK - may requires further permitting based on the extent to which there is on-site H2 production and the volume of H2 storage (if H2 storage is >2 tonnes volume then permitting under Hazardous Substances controls will apply(and full Control Of Major Accident Hazards (COMAH regulations will apply for related consent if over 5 tonnes storage on site
- Local authority permission will also take into account approval by the local Fire Brigade and for HRS construction and operational requirements by the UK HSE (Health & Safety Executive) for hazardous installations and this will take into account compliance with BCGA Blue Book requirements for co-located HRS with conventional fuel supply
- There is a significant 'overhead' for the sector and restricts the ability to rollout HRS in main urban areas – but it is inevitable in the context of refuelling facilities for a potentially hazardous substance
- The Addendum to the code of practice "Design, construction, modification, maintenance and decommissioning of filling stations" (The Blue Book) to enable co-location of hydrogen refuelling stations with petrol facilities: Energy Institute – 2017 has been of fundamental advantage to the sector

Hydrogen as a fuel and refueling infrastructure

Recommendations – refueling infrastructure planning and permitting

- Ensure that Hydrogen refuelling stations (with or without on-site production56) are **explicitly treated in the same manner** as conventional refueling stations from the perspective of land use plans and zone prohibitions
- For such a treatment to be possible, direct **emission free (e.g. via electrolysis) production** of hydrogen should be excluded from the scope of legislative acts (e.g. EU and national laws) which currently cover the production of hydrogen. At the very least, the concept of "*chemical conversion on an industrial scale*" should be defined in a manner which excludes the production of hydrogen via electrolysis in small enough quantities (i.e. those required to supply a HRSs with on-site production) from the obligations stemming from the IED, EIA and SEA Directives.
- Moreover, to support practical implementation at local and regional level, the NACE codes should be adapted to reflect the **emission free (e.g. via electrolysis) production** of hydrogen separately from the manufacture of industrial gases under which hydrogen production traditionally falls.
- Furthermore, to further reduce the risk of unequal treatment from a land-use plan perspective, HRS should unequivocally fall under the same NACE code as conventional refueling stations, i.e. 47.30 - Retail sale of automotive fuel.
- Finally, the production of H2 below a certain threshold of direct emissions should be addressed separately from massive industrial production

UKHFCA

SCOTTISH Hydrogen & Fuel Cell ASSOCIATION

HYDROGEN LONDON working towards a hydrogen economy for London and the UK

HyLAW

Hydrogen law

FCH FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

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