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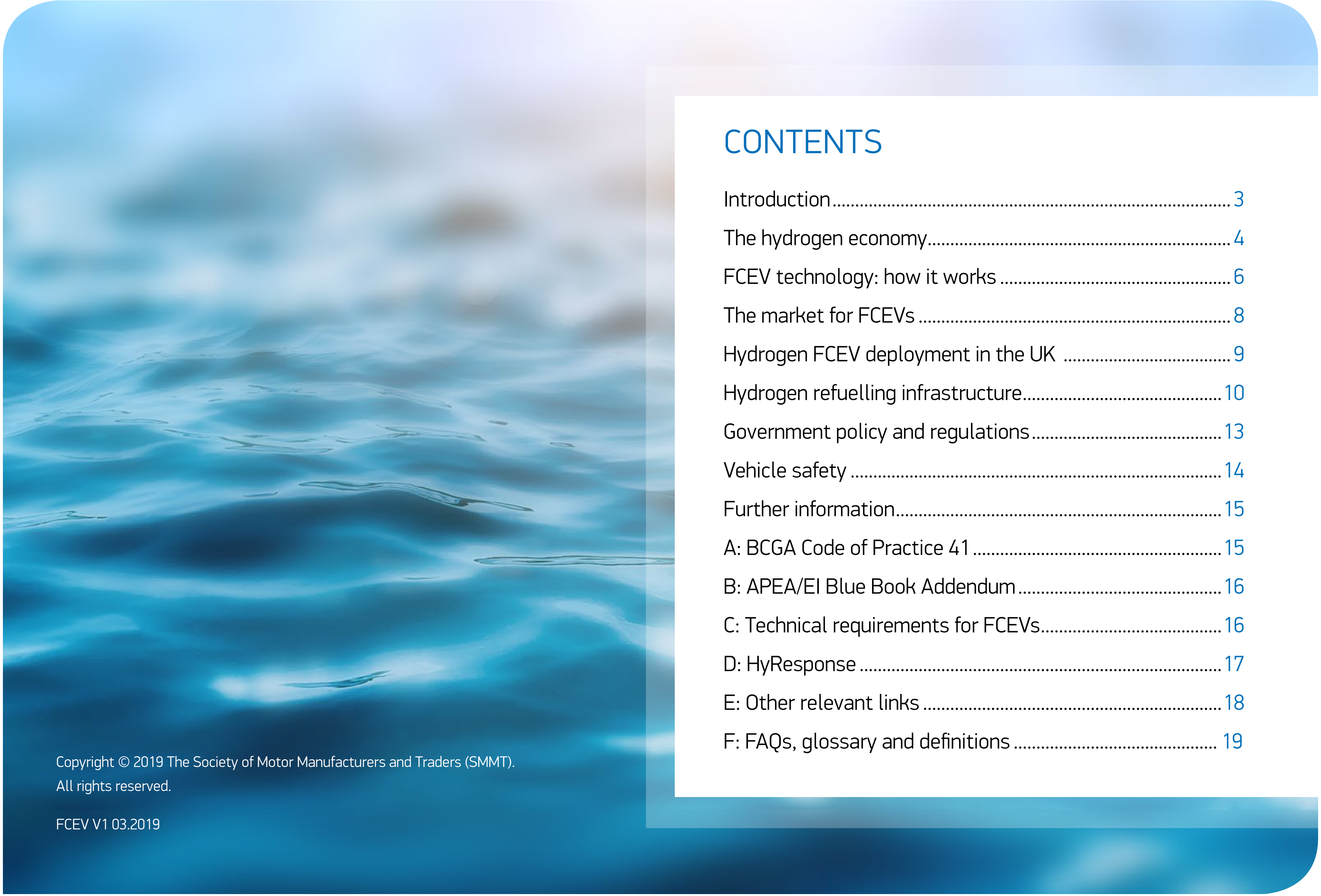
HYDROGEN FUEL CELL ELECTRIC VEHICLES

A QUICK GUIDE TO THE UK MARKET, TECHNOLOGY AND INFRASTRUCTURE



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INTRODUCTION

Over the course of the past 20 years, vehicle manufacturers have recognised the need to protect the environment and conserve natural resources. They have taken the lead by developing new powertrain technologies that are cleaner, more efficient and more accessible to consumers in global markets.

Public concerns about air quality, energy security and greenhouse gas emissions are growing. This, coupled with increasingly stringent emissions regulations and changing trends in car ownership and urbanisation, has added increasing impetus to the automotive industry's commitment to produce ultra-low emission vehicles (ULEVs). It has led to a range of different solutions, including hybrid electric vehicles, plug-in hybrid electric vehicles (PHEV), extended-range electric vehicles (E-REV), and the introduction of zero-emission tailpipe vehicles such as battery electric vehicles (BEV) and hydrogen fuel cell electric vehicles (FCEV). This changing landscape presents important opportunities for the UK, both to grow its economy and to protect the environment.

Recognising the opportunities, the automotive industry invests billions in developing, manufacturing and bringing to market vehicles that are cleaner and more fuel efficient, yet remain practical and fun to drive.

This guide introduces hydrogen fuel cell electric vehicle technology, the current UK market, hydrogen refuelling stations (HRS) and government initiatives and policy towards FCEVs.

THE HYDROGEN ECONOMY

Hydrogen is the most abundant element in the universe. It is itself renewable, and can also be produced using renewables such as wind and solar. It has been used safely and successfully in industrial processes for generations. Recently, as attention has turned to limiting global warming, the potential for hydrogen to enable the necessary energy transformation has been recognised.

Hydrogen-based energy could:

- Enable large-scale renewable energy integration for heat and power generation
- Distribute energy across sectors and regions
- Act as a buffer to increase energy system resilience
- Decarbonise industrial energy use
- Help to decarbonise building heating and power
- Provide clean feedstock for industry
- Decarbonise transportation

In all seven areas, hydrogen can offer economically viable and socially beneficial solutions. Since these solutions all complement and support each other, the hydrogen economy is attracting considerable interest and experiencing significant growth.

In the transport sector it has already been demonstrated that, in production and operation, FCEVs can produce lower whole life emissions than other vehicle powertrains, even when hydrogen is produced from natural gas without carbon capture.[1]

[1] Hydrogen Council, Hydrogen Scaling Up report 08/2017

Hydrogen fuel cell applications have been successfully deployed and shown to lower whole life costs in different applications, such as scooters, buses, forklifts, heavy weight vehicles, etc.

Hydrogen buses, medium-sized cars and forklifts are commercially available today, and the next few years are likely to see the introduction of more vehicle types including trucks, vans and trains. Additional segments such as smaller cars and minibuses would be expected to follow.

The scaling up of manufacturing capacities to produce FCEV vehicles will lead to significant cost reductions and this will create opportunities for economies that develop this technology.

Hydrogen as a fuel has distinct benefits, including fast refuelling and high energy density. Any business that values fast refuelling and/or must cover large distances may prefer hydrogen as a transport fuel. A hydrogen refuelling infrastructure could also be readily scaled up without electricity grid upgrades. FCEVs are particularly suited for applications with long-range requirements, heavier payloads and a high need for flexibility.

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FCEV TECHNOLOGY: HOW IT WORKS

FCEVs are powered by electricity that is generated on board the vehicle from hydrogen gas passing through a fuel cell stack. Very much like combustion engine vehicles, FCEVs can be refuelled quickly at a hydrogen refuelling station (HRS), and do not require to be plugged in. FCEVs produce no greenhouse gases or polluting tailpipe emissions. The only by-product of their use is a small quantity of water.

A fuel cell stack is made up of a large number of individual cells. In each cell a chemical reaction takes place between hydrogen molecules (H_2) and the oxygen (O_2) present in the ambient air. This reaction produces both water (H_2O) and an electric current. Most FCEVs use proton exchange membrane (PEM) fuel cells: hydrogen is supplied to a negative electrode (anode), where it is activated on a catalyst, causing electrons to be released. These electrons move from the negative to the positive electrode, generating electricity. At the cathode, the protons, oxygen from the air and free electrons react to form water as a by-product of the process.

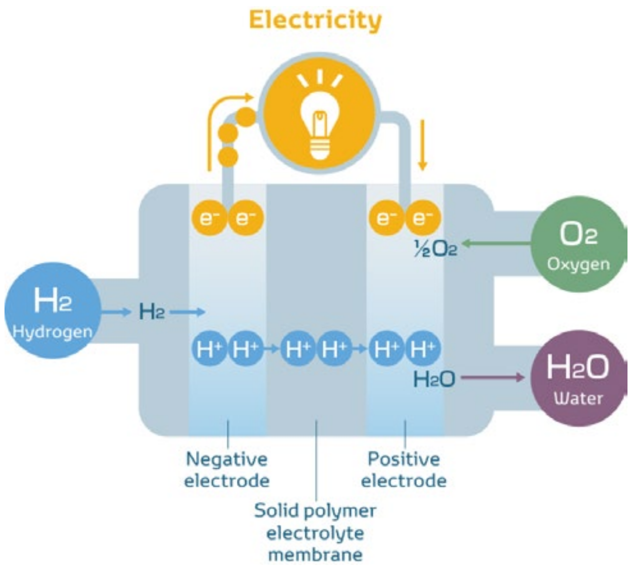


Figure 1: PEM fuel cell operating diagram (Source: Toyota Global)

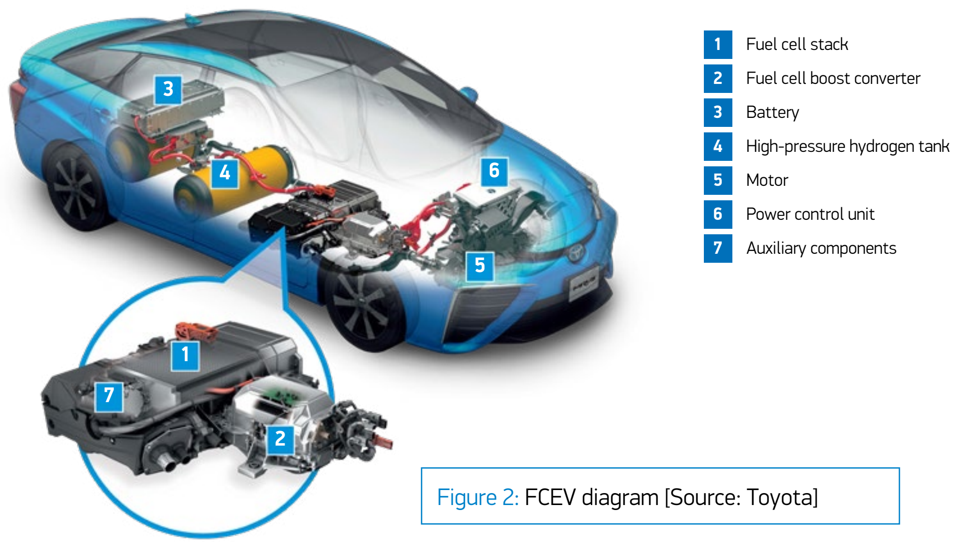


Figure 2: FCEV diagram [Source: Toyota]

The fuel cell is supplied with hydrogen from onboard high-pressure storage tanks. The on-vehicle storage pressure for FCEV cars is typically 700 bar, while for FCEVs with a larger tank size, such as vans and buses, this may be either 350 or 700 bar.

The powertrain of an FCEV is similar to that of a BEV. Electricity (as a direct current) from the fuel cell can either be sent: i) to the power inverter to create alternating current to drive the vehicle's electric motor; or ii) to the battery to charge it. A power control unit manages the flow of electricity between the components. The battery effectively acts as a buffer between the power demand placed on the electric motor and the power output from the fuel cell. This means that, unlike an internal combustion engine, maximum torque is available immediately, providing instantaneous power.

The battery also stores energy harvested from regenerative braking as electricity. A power control unit manages the flow of electricity between the components.

FCEVs have the same advantages of quick refuelling time and long range that conventional vehicles have, but with zero tailpipe emissions. Hydrogen is sold in kilograms rather than volume (litres) and refuelling a car from empty typically takes between three and five minutes. A full tank of around 5kg of hydrogen will provide a driving range of approximately 350 miles.

Hydrogen has the highest specific energy density of any element: approximately three times that of fossil fuel. This means that for a given weight it can provide more energy that can be used for power than any other fuel or energy store. A lighter vehicle can be more dynamic to drive, carry more and have a longer range than a heavier vehicle.

THE MARKET FOR FCEVs

Examples of FCEVs that are available in the UK and are fully powered by hydrogen include the Hyundai NEXO Fuel Cell, Toyota Mirai and Honda Clarity Fuel Cell. There is also Symbio Kangoo ZE-H2, which is based on a BEV with a small fuel cell to trickle-charge the battery, increasing the vehicle's driving range before recharging is necessary.

Other vehicle manufacturers also have plans to introduce FCEV models. Mercedes Benz has launched the left-hand drive GLC F-Cell, and plans a fuel cell variant of its Citaro bus. The Citaro F-CELL is an E-CELL with additional fuel cell technology and is able to travel 100km on just 8kg of hydrogen. Many others are developing the technology for deployment. For example, in 2018 Audi AG announced the collaboration with Hyundai Motor Group on hydrogen fuel cell technology.

UK bus manufacturer Alexander Dennis Ltd (ADL) announced in November 2018 that it would be adding hydrogen fuel cell buses to its product range and has already started taking orders for the new bus. The vehicle has been developed from the existing Enviro400 double-decker with support from London-based Arcola Energy.

First-generation models of these vehicles are only available in low volumes at present, as the infrastructure and customer acceptance develops. Toyota has announced plans to increase global production to 30,000 fuel cell stacks by the early 2020s and has started deploying its own hydrogen forklifts, buses and heavy trucks in other regions. By 2030, Hyundai Motor Group aims to make 700,000 fuel cell systems annually, of which 500,000 would be units for private and commercial FCEVs. That leaves 200,000 units for drones, vessels, forklifts and other uses outside transportation, such as power generation and energy storage systems. Sales volumes are likely to increase significantly in the 2020s as second-generation FCEV models are introduced to market.

Hyundai NEXO

Honda Clarity

Toyota Mirai

Symbio

HYDROGEN FCEV DEPLOYMENT IN THE UK

In the UK, hydrogen FCEVs have been deployed in commercial operation since 2011 when Transport for London (via its contractor Tower Transit) started operation of ten zero-emission hydrogen fuel cell buses. This is the longest-running hydrogen bus fleet in the world, having covered over 1 million emission-free miles. Aberdeen started operation of ten hydrogen buses in 2015 and, together with Transport for London and Birmingham City Council, received government funding from the Low Emission Bus Scheme to deploy a combined 42 hydrogen fuel cell buses by 2021.

By the end of 2018, over 120 fuel cell cars, scooters and vans were in operation with fleet owners in both the public and private sectors.

Examples of users include the Metropolitan Police, which finished its trial of seven Suzuki Burgman hydrogen fuel cell scooters in 2018. In addition, it has taken delivery of 21 Toyota Mirai, creating the world's first hydrogen-powered emergency response fleet, and there are plans to take 60 more. Green Tomato Cars operates a private hire fleet of 27 Toyota Mirai, and both Toyota Mirai and Hyundai ix35 SUVs are used by Aberdeen City Council in its car club.

Currently, the focus is on selling or leasing FCEVs to commercial operators, as production is limited and the infrastructure is still being expanded. This approach supports higher-mileage users operating in defined areas to demonstrate vehicle durability and HRS reliability.

In the early years of market introduction, the cost of FCEVs and the initial limited availability of refuelling stations have emerged as the principal consumer concerns impacting upon vehicle purchase decisions.

UK H2Mobility has undertaken research to understand how far motorists would be prepared to drive to a hydrogen refuelling station (HRS). It has also considered how sales are likely to build as vehicle costs become more competitive, with 'whole life costs' reflecting the associated operating costs of running a vehicle during its life.

HYDROGEN REFUELLING INFRASTRUCTURE

UK H2Mobility is a collaborative group evaluating the potential for hydrogen FCEVs to provide environmental and economic benefits to the UK. The group comprises industrial participants from the fuel cell technology, energy utility, industrial gases, fuel retail and global car manufacturing sectors, together with a European public-private partnership, UK government departments, the devolved administrations and the Greater London Assembly. Their objective is to develop a business case and strategic plan for the commercial roll-out of the technology.

In 2012, UK H2Mobility examined the potential of hydrogen as a fuel for transport in the UK[2]. It identified that a network of 65 publicly accessible refuelling stations would provide sufficient coverage to support the nationwide roll-out of FCEVs.

By the end of 2018, 11 publicly accessible HRS suitable for high-pressure refuelling of passenger cars, and one dedicated bus refuelling station, were operational. These stations have been built using private finance with support from funding schemes, including those from the EU-funded Hydrogen and Fuel Cell Joint Undertaking (FCHJU) and the UK's Office for Low Emission Vehicles (OLEV).

The OLEV Hydrogen for Transport Advancement Programme (HyTAP) has so far provided funding in three rounds: £11 million in 2014, £9 million in 2017 and £14 million in 2019. This funding has gone towards infrastructure developments and to support the purchase of hydrogen fuel cell vehicles.

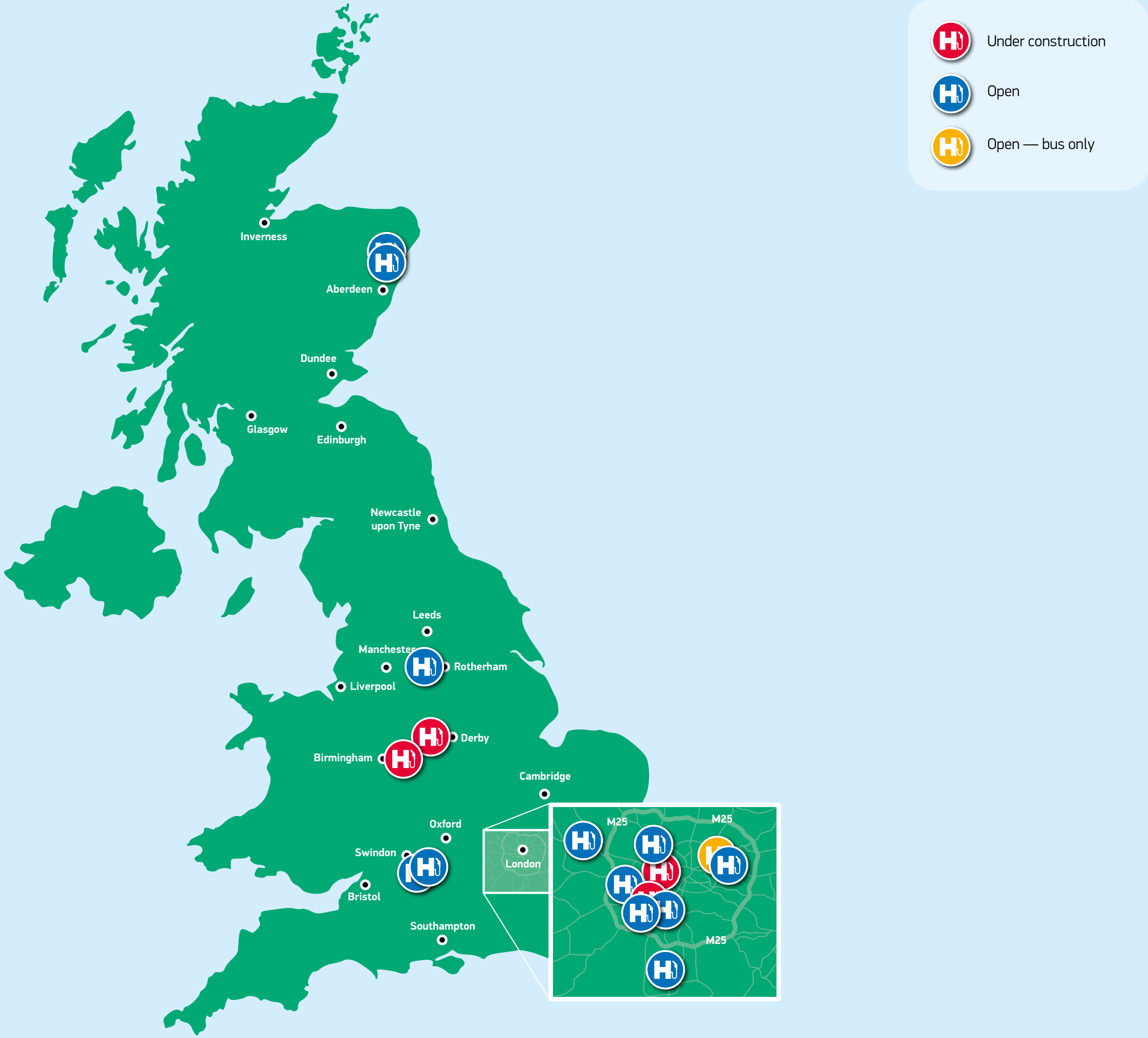
The map on the next page shows the existing and planned publicly accessible high-pressure (suitable for passenger cars) and bus HRS in the UK at 1 January 2019.

The existing stations are geographically located to support vehicle manufacturers' initial FCEV launch plans; they are a significant first step towards building the national network of 65 stations proposed by UK H2Mobility. These would cover large urban areas and major roads.

The organisation envisions the refuelling network expanding throughout the 2020s, with the aim of securing full national coverage during the 2030s.

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/192440/13-799-uk-h2-mobility-phase-1-results.pdf

Hydrogen refuelling stations



Hydrogen refuelling station safety

Hydrogen refuelling stations can be either stand-alone installations or co-located with petrol and diesel services. Safe design of hydrogen refuelling stations is covered by industry guidance and codes of practice, specifically:

a The British Compressed Gases Association (BCGA) Code of Practice 41: this covers the safe design of stand-alone hydrogen refuelling stations. See Annex A for more details.

b The Energy Institute and Association for Petroleum and Explosive Atmospheres (EI/APEA) "Blue Book": this guidance covers the safe design of petrol stations. In discussion with industry experts, EI/APEA has prepared an addendum which covers the safe design of hydrogen refuelling facilities located on petrol station forecourts. See Annex B for more details.

Industrial gas companies have developed hydrogen fuel dispensing systems that are safe and simple to use. International standards ensure compatibility between refuelling stations and vehicles, and the refuelling process typically takes around three to five minutes, offering refuelling times similar to those of conventional petrol or diesel cars.

Compatibility between vehicles and stations is facilitated by a range of SAE standards, such as J2578, J2579, J2600, J2601 and J2719. The EU Alternative Fuels Infrastructure (also known as Clean Power for Transport) Directive, 2014/94/EU, also includes requirements for hydrogen refuelling infrastructure aimed at enabling the interoperability of hydrogen refuelling stations with FCEVs across the EU.

International standards ensure compatibility between refuelling stations and vehicles.

GOVERNMENT POLICY AND REGULATIONS

Hydrogen FCEVs, alongside BEVs, have the potential to play a significant role in decarbonising road transport, aiding in the transition to vehicles that produce no harmful tailpipe emissions. The respective roles of these two technologies in the future cannot be predicted, but it is likely that both FCEVs and BEVs will coexist in the future market, fulfilling different transport needs.

Promoting the transition to ULEVs and ZEVs (zero-emission vehicles) offers opportunities for the UK, not only in tackling climate change and air pollution, but also in improving the security of energy supply and attracting inward investment by positioning the UK as one of the leading markets in which to develop, manufacture and deploy ULEV and ZEV technologies. This is why the Government is supporting PHEV, BEV and FCEV technology through the Office for Low Emission Vehicles' £1.5 billion programme of support for ULEVs. The programme includes Go Ultra Low, a joint government-industry campaign to raise consumer awareness, interest and understanding of ULEVs.

FCEV regulations

FCEVs registered in the UK are subject to EU type approval requirements. These include specific requirements for hydrogen fuel systems, defined in Regulation EC No.79/2009 and Regulation EC No 406/2010 or, alternatively, the GTR#13, via UN Regulation 134, to ensure their safety (see Annex C). These regulations require the fuel system components and installation to have undergone a number of rigorous safety tests to demonstrate their safety in fires, in crashes, against over-pressurisation, against fatigue, leakage, materials integrity, and even their integrity against gunfire. These regulations require hydrogen fuel systems to be fitted with non-return valves at the refuelling point.

FCEVs must also comply with general vehicle type approval requirements applying to conventional vehicles, including crashworthiness requirements.

Hydrogen vehicles registered in the UK need vehicle special orders (VSOs). However, since 1st October 2017, where an FCEV has EU type approval, a VSO is no longer required. For identification of FCEVs, measures in Regulation EC No. 406/2010 require FCEVs to carry green diamond labels (as shown in the picture). In the case of cars and vans, the regulations require one label in the engine compartment and one near the refuelling point. These labels do not have to be carried externally. Buses are required to carry labels at the front, the rear, on each side and at the refuelling point, while heavy vans and trucks (N2 & N3) need them on the front and back, and by the refuelling point. New label requirements are expected to come into force.

VEHICLE SAFETY

All type-approved FCEVs undergo stringent safety testing before being made commercially available, including rigorous laboratory tests and millions of miles of road testing, including in extreme hot and cold temperatures.

The high-pressure fuel tanks are designed to withstand exceptional, severe shocks so that their integrity is maintained in the event of an accident. Advanced, high-strength composite materials are used in their construction and they are lined to minimise the risk of hydrogen escaping. They are also engineered to withstand significantly higher internal pressures – typically more than 200% higher – than that at which the fuel is normally stored.

The vehicles are equipped with sensors that will detect the smallest amount of gas escaping from the tank. Should this happen, the fuel system is automatically shut down. The passenger compartment is completely separated from the hydrogen storage area and, again, sensors will immediately detect any gas entering the vehicle's cabin. As hydrogen is the lightest known substance and is made up of the smallest molecules, should any gas escape it will very quickly rise and disperse in the air.

In the event of a rapid increase in temperature, for example in a fire, safety devices will deploy to release the hydrogen in a controlled manner.

FURTHER INFORMATION

Further information on FCEV emergency response guidance can be found at:

Vehicle manufacturers’ Emergency Response Guides

- **a** Toyota Mirai: https://www.nfpa.org/-/media/Files/Training/AFV/Emergency-Response-Guides/Toyota/Toyota-Mirai-2016-2018-QRG.ashx?la=en
- **b** Hyundai NEXO and ix35: https://downloads.nfpa.org/-/media/Files/Training/AFV/Emergency-Response-Guides/Hyundai/Hyundai-Tucson-FCV-2015-2017-ERG.ashx?la=en
- **c** Honda Clarity: https://h2tools.org/sites/default/files/HondaClarityFuelCellERG.pdf

A: BCGA Code of Practice 41

Facilitating the uptake of infrastructure for the filling of alternative-fuelled vehicles, BCGA Code of Practice 41 (CP41) is a guidepost document combining the most important points from, and giving references to, a range of international standards and other industry guidance relating to the design and operation of alternative fuel vehicle filling stations.

A number of international standards, national standards and industry documents from other countries relating to the design and operation of alternative fuel vehicle filling stations have been recently published, or are currently in the process of being developed. This guidepost document combines the most important points of multiple guidance documents as referenced.

BCGA CP41 is available from the BCGA website: www.bcga.co.uk

B: APEA/EI Blue Book Addendum

This publication provides guidance for companies that provide hydrogen for the refuelling of motor vehicles and for authorities responsible for granting permits and supervising these companies when co-location with petrol filling stations (PFS) is proposed. It gives a summary of regulations, requirements, criteria and conditions based on current industry good practice as reflected in BCGA CP 41. This publication links this good practice with current industry guidance relating to PFS and as such supplements the APEA/EI industry technical guidance publication: Design, construction, modification, maintenance and decommissioning of petrol filling stations (third edition).

This guidance was prepared by a joint industry working group and is available from the Energy Institute website: https://publishing.energyinst.org/topics/petroleum-product-storage-and-distribution/filling-stations/guidance-on-hydrogen-delivery-systems-for-refuelling-of-motor-vehicles

C: Technical requirements for FCEVs

Regulation EC No. 79/2009 of the European Parliament and of the Council of 14 January 2009 on type approval of hydrogen-powered motor vehicles, and amending Directive 2007 46 EC

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:035:0032:0046:en:PDF

Regulation EC No. 406/2010 of 26 April 2010 implementing Regulation (EC) No. 79/2009 of the European Parliament and of the Council on type approval of hydrogen-powered motor vehicles

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:122:0001:0107:EN:PDF

General Technical Regulation No. 13 – Global technical regulation on hydrogen and fuel cell vehicles

https://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29glob_registry.html

UNECE Regulation No. 134 – Uniform provisions concerning the approval of motor vehicles and their components with regard to the safety-related performance of hydrogen-fuelled vehicles

https://www.unece.org/?id=39147

Technical requirements for infrastructure to ensure interoperability with type-approved FCEVs – Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure (1)

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0094

SI. 2017 No. 897 – The Alternative Fuels Infrastructure Regulations 2017

http://www.legislation.gov.uk/uksi/2017/897/made

D: HyResponse

HyResponse is a 'Coordination and Support Action (CSA)' project supported by EC Fuel Cell and Hydrogen Joint Undertaking (June 2013 to September 2016). The project aimed to establish the world's first comprehensive training programme for first responders, i.e. a European Hydrogen Safety Training Platform (EHSTP), to facilitate safer deployment of FCH systems and infrastructure.

The core training programme developed is threefold: educational training, including state-of-the-art knowledge in hydrogen safety; operational training on mock-up real-scale hydrogen and fuel cell installations; and innovative virtual reality training, reproducing in detail an entire accident scenario, including influence of first responders' intervention. Three pilot training sessions were organised during the project.

The Emergency Response Guide, explaining details of intervention strategy and tactics, was developed and included into the pilot training sessions to receive attendees' feedback, which is also available for download at the project website. The Advisory and Consultative Panel was established to engage as much as possible with European stakeholders and provide the highest outreach of project results. EHSTP was developed and made available to train first responders to deal with all safety aspects for a range of hydrogen applications, including passenger vehicles, buses, forklifts, refuelling stations, back-up power, stationary fuel cells for combined production of heat and power, etc.

http://www.hyresponse.eu/

E: Other relevant links

http://www.ukh2mobility.co.uk/

https://www.fch.europa.eu/

http://hydrogencouncil.com/

http://www.bcga.co.uk/pages/index.cfm?page_id=105

http://www.goultralow.com/

F: FAQs, glossary and definitions

What is a hydrogen fuel cell electric vehicle (FCEV)?

A fuel cell electric vehicle has a fuel cell stack that converts hydrogen gas stored on board, and oxygen from the air, into electricity in an electrochemical reaction. The hydrogen is an energy store and the electricity released is used to power an electric motor that drives the vehicle. The vehicle is silent, there is no combustion and the only by-product is water.

What is the difference between a hydrogen fuel cell electric vehicle and battery electric vehicle (BEV)?

FCEVs and plug-in BEVs are both electric vehicles. The key difference is the way that the energy is transferred to the vehicle and stored. BEVs take electrical energy, provided from an external electrical source, and store it in a battery.

Energy in FCEVs is stored in hydrogen gas and converted to electricity in a fuel cell. The hydrogen gas can be made from many sources, either at the point of consumption or remotely and shipped. Increasingly, hydrogen is being produced from renewable intermittent sources, making it a zero-emission fuel. Increasing the range of a FCEV is achieved by making the hydrogen tank bigger, which has only a small effect on the weight.

The result is that hydrogen vehicles have a much longer range and can also be easily configured for heavy-duty vehicles such as buses and haulage vehicles.

Where can I buy an FCEV?

Currently, manufacturers such as Toyota and Hyundai sell or lease this type of car. As with any new technology, the first FCEVs on the market are likely to cost more than established technology.

How can I obtain hydrogen fuel?

Hydrogen purchasing agreements can be arranged individually with the operators of the hydrogen refuelling stations (HRS). Current price for filling up is between £10 and £15 per kilogram, which would amount to £0.16 per mile.

What are the emissions of a FCEV?

The hydrogen fuel cell electric vehicle produces only water from the tailpipe.

What are the benefits of an FCEV?

There are a number of benefits including:

- The only exhaust emission is water.
- Refuelling takes just 3-5 minutes – similar to conventional refuelling.
- It has a full electric powertrain providing immediate torque for relaxed and responsive driving.
- Virtually silent operation for occupants and the outside environment.
- There is little maintenance and the fuel stack is almost 100% recyclable.
- Increasing the range only requires more storage, not a bigger fuel stack.
- Hydrogen is itself 100% renewable.
- Hydrogen can be made using excess and renewable energy with zero emissions.
- Hydrogen can be stored indefinitely and transported without loss using existing infrastructure.

How efficient are FCEVs compared to pure BEVs?

Efficiency is a measure of all the inputs that produce a given output. This can include personal time, and ability to store energy, as well as the energy itself. At every point of energy transmission and use within a system there will be some energy loss.

When looking at energy efficiency there are many variables to consider. For FCEVs there are specific considerations relating to the production and dispensing methods of the hydrogen, as well as energy use in the fuel cell conversion, that differ to BEVs.

To allow quick hydrogen fuelling (3-4 minutes) and long range, hydrogen is compressed and chilled for dispensing, which generally requires energy. However, there are efficiency benefits in lower weight, less frequent and shorter recharge/ refuelling events, and using efficient renewable energy sources for production.

BEVs use stored electricity which is generally produced on demand and distributed to the vehicle at the point of charge. The source of the energy and transmission points also need to be considered, but there are fewer transmission points than for a fuel cell vehicle so the direct energy conversion is more efficient.

Is the hydrogen fuel cell more efficient than the internal combustion engine?

When considering the conversion of energy stored in hydrogen and converted to driving energy, a fuel cell coupled with an electric motor is two to three times more efficient than an internal combustion engine running on petrol. Hydrogen can also serve as fuel for internal combustion engines.

How safe is hydrogen?

Hydrogen has been used for a wide variety of industrial applications for over a hundred years. Today, some 2,000 tonnes of hydrogen are transported annually on UK roads to customers. Hydrogen is abundant, non-toxic, colourless and odourless, and is a clean, efficient and safe energy source. It is the lightest element in the world (even lighter than air), and if released into the atmosphere it rises and dissipates quickly. Even if hydrogen does ignite, the low level of radiant heat emitted by the hydrogen flames means that nearby materials will be much less likely to ignite by heat transfer.

Hydrogen vehicles homologated for use on the public roads have been designed from scratch to the latest safety standards and have achieved some of the highest crash safety levels.

Is fuel duty payable on hydrogen sold for FCEVs?

Currently there is no fuel duty payable on hydrogen for FCEVs.

Where can FCEVs be repaired or serviced?

The fuel cell systems need limited servicing as there are no moving parts. As with all technical operations, specialist training is required to carry out any work. Please refer to the manufacturers for specific information.

Are there any incentives for FCEVs in the UK?

FCEVs are exempt from Vehicle Excise Duty (VED) in the first year, and from fuel duty. They also have enhanced capital allowances, and reduced company car tax (Benefit in Kind). Other incentives might include free or subsidised parking and exemption from congestion charges. FCEVs available in the UK market can qualify for the maximum Plug-in Car Grant, currently £3,500.

Glossary

APEA/EI – Association for Petroleum and Explosive Atmospheres and the Energy Institute

BCGA – British Compressed Gases Association

BEV – battery electric vehicle

CO_2 – carbon dioxide

EC – European Commission

E-REV – extended-range electric vehicle

EU – European Union

FCEV – fuel cell electric vehicle

Fuel Cell – a cell producing an electric current direct from a chemical reaction

HRS – hydrogen refuelling station

GTR – global technical regulations

PEM –proton exchange membrane – the cell used in the fuel cell stack

PHEV – plug-in hybrid electric vehicle

SAE – Society of Automotive Engineers

UN – United Nations

VSO – vehicle special order

Definitions

Proton – a stable subatomic particle occurring in all atomic nuclei, with a positive electric charge equal in magnitude to that of an electron.

Electron – a stable subatomic particle with a charge of negative electricity, found in all atoms and acting as the primary carrier of electricity in solids.

Anode – the negatively charged electrode by which the electrons leave an electrical device.

Cathode – the positively charged electrode by which electrons enter an electrical device.

Catalyst – a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.

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