Hydrogen Mobility Europe










Emerging Conclusions

4/5 Update on deployment strategies and case studies

elementenergy

Document prepared by: Element Energy

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FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

This document provides an interim summary of H2ME results

- The H2ME initiative is a **flagship European project**, deploying hundreds of fuel cell hydrogen cars, vans and trucks and the associated refuelling infrastructure, across 8 countries in Europe.
- It will **create the first truly pan-European network, and the world's largest network of hydrogen refuelling stations.**
- The project is made up of two phases, H2ME (1), which started in 2015, and H2ME-2, which will end in 2022. Over the course of these two phases, **more than 1400 vehicles and 45+ hydrogen refuelling stations** will be deployed.
- The project is being supported by the European Union through the Fuel Cells and Hydrogen Joint Undertaking (FCH 2 JU) but is driven by the **continuous engagement of the industry.**
- This documents provides a **summary of the project status, highlights key achievements and also suggests some of the emerging issues** which need to be tackled by the fuel cell vehicle sector as it moves towards a commercially viable mass market proposition.
- This is a living document that will be updated as the project progresses. It is intended to:
  - Give first hand information to stakeholders, policy-makers etc.;
  - Align H2ME partners on the common themes emerging from the early demonstration results;
  - Serve as a basis for additional dissemination materials.

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1. Introduction

- **Why is hydrogen mobility important?**
  - Perspectives for society and policy makers
  - Perspectives for early adopters (private customers, fleet manager and local authorities)
  - Perspectives for energy providers
  - Perspectives for car OEMs
- **Societal challenge for transport sector**
  - Transport is the only sector with rising CO2 emissions
  - How does hydrogen fit into today's green mobility efforts
- **How it works ?**
  - What is a Fuel Cell Electric Vehicle (FCEV)?
  - What is a Hydrogen Refuelling Station (HRS)?
- **Commercialisation**
  - Status
  - Technical advancements
  - Remaining barriers

2. **Project Overview**

- **Hydrogen Mobility Europe**
  - Project partners
  - Overview H2ME (1) & H2ME 2
  - Overarching objectives
- **Deployment overview & targets**
  - Vehicles deployment overview
  - Refuelling infrastructure deployment strategy
  - Deployment timeline
- **National strategies – H2ME & broader context**
  - Germany
  - UK
  - France
  - Scandinavia
  - Netherlands

3. Demonstration activities

- **Deployment to date**
  - Total HRS deployed
  - Total vehicles deployed
  - Countries of deployment
- **HRS in the project**
  - Technical Specifications
  - Project snapshot
  - Performance case study
- **Vehicles in the project**
  - Technical Specifications
  - Project snapshot
  - Performance case study

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4. **Update on deployment strategies and case studies**

- **Overview strategies**
  - Ownership models and characteristics for refuelling stations
  - Characteristics of vehicle deployments
- **National, regional and local case studies**
  - Country level infrastructure network – H2Mobility Deutschland (Germany)
  - Regional planning - Zero Emission Valley in the Auvergne Rhône Alpes region (France)
  - City scale approaches

5. Project achievements and Emerging conclusions

- **Project Achievements**
  - Update on sector and European effort
  - Advancements on the state-of-the-art
- **Emerging conclusions HRS**
  - Technical advancements (HRS)
  - Commercial strategies for HRS
- **Emerging conclusions vehicles**
  - Technical advancements vehicles
  - Commercial strategies for vehicles
- **Recommendations for policy makers**
  - Recommendations for hydrogen mobility initiatives
  - Recommendations for maturing the supply chain
  - Recommendations for policy and funding
- **Summary conclusions**

Public Resources

- This document provides an overarching summary of the activities undertaken in the project. However, more detailed reports are available on the H2ME website (https://h2me.eu/reports/).
- Key reports available are :
  - Hydrogen Refuelling Stations Safety, Regulations, Codes and Standards. Lessons Learned: Interim Report 3, H2ME2 Deliverable 5.20, Cenex
  - Well to Wheels environmental impact assessment, H2ME (1) Deliverable 4.19, Cenex
  - Hydrogen fuel retailing Interim Report, H2ME (1) Deliverable 2.4, H2ME 2 Deliverable 6.7, Element Energy
  - Yearly Vehicle and Infrastructure Performance Report 3 (2015-2019), H2ME (1) Deliverable 4.12, H2ME 2 Deliverable 5.3, Cenex
- The website will be updated with the most recent project reports as, and when, finalized and accepted by the consortium.

Contents

4. Update on deployment strategies and case studies

Section overview

Overview strategies

- Ownership models and characteristics for refuelling stations
- Characteristics of vehicle deployments

National, regional and local case studies

- Country level infrastructure network – H2Mobility Deutschland (Germany)
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Different deployment strategies have resulted in various ownership models and characteristics for refuelling stations

Region	Strategy for HRS network development	Level of risk of low utilisation	Ownership models	Total number of public HRS[1]	HRS pressures (for light vehicles)
Germany	Extensive national coverage + major cities	**High:** first 100 HRS are 'unconditional'. However, letters of intent to deploy vehicles increasingly sought to minimise risk of low utilisation	Joint venture between industry partners from hydrogen production and retail, as well as some automotive involvement: demonstrates commitment and shares the risk. Significant Government support also helps.	71	• Mainly 700 bar
France	Local/regional clusters linked to demand (captive fleet approach)	**Low:** demand is secured in advance of investment decision	Individual investments, with coordination by Mobilité Hydrogène France	12	• Mainly 350 bar • Dual pressure (350 bar + 700 bar)
UK	Mainly regional (south-east) focus to build 'H2 hubs'	**Moderate:** stations built with a mix of public and private investment in projects which group vehicles and stations	Individual investments with government support	12	• Mainly dual pressure (350 bar + 700 bar)
Nordic region	Develop network to allow long distance mobility across the region	**High:** network coverage achieved in advance of significant vehicle deployment	Predominantly individual investments, with a joint venture structure in Denmark. Case is based on expected increases in vehicle deployment	17	• Mainly 700 bar

[1] As of July 2019

The characteristics of vehicle deployments also reflect the different strategies

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Region	Initial light vehicle types	Total FCEVs on the road (approx. in summer 2019)	Diversity of vehicles deployed	Light duty vehicle applications	Implications for overall hydrogen demand and HRS utilization
Germany		>500	Mainly cars	Car clubs; B2B leasing; Ride Pooling; local authorities	Demand is **distributed across several cities**; few HRS are seeing high levels of utilization
France		>300	Initially range-extended vans; now cars as taxis	Utility fleets; delivery vans; local & national agencies; taxis	Recent adoption of taxis in **Paris** has led to significant increases to the hydrogen demand on the local network
UK		>150	Passenger cars, vans and buses	Taxis; police vehicles; local authorities	Recent adoption of taxis in **London** has led to significant increases to the hydrogen demand on the local network
Nordic region		>300	Passenger cars and buses	Local & national government agency fleets; taxis; private customers	Demand is **distributed across several cities**; few HRS are seeing high levels of utilization. Programs now being established to promote taxi use.

Experiences and lessons learnt from a national HRS network implementation in Germany (H_2 Mobility Deutschland)

Hydrogen refuelling station installation process

- Since its inception in 2015, H_2 Mobility Deutschland has decreased the total period of time to deliver an HRS from 24 down to 16 months, with an end target of 12 months

- A number of challenges makes reducing lead time difficult:
  - **Location**: various criteria for network planning ; the number of different stakeholders involved; constructional constraints (space, noise, etc.)
  - **Permitting**: lack of standardised permitting process with authorities - regional differences in Germany lead to unpredictable lead times
  - **Delivery time of HRS**: immaturity in the supply chain results in delivery time of 9-10 months from HRS suppliers as well as limited capacities
  - **Resource bottlenecks**: Requirement for OEM approval and vehicle testing at each station can delay commissioning process

Lessons learnt have been recorded and guidance documents (DE)| (EN)| (FR) developed to help new-comers to the HRS installation process. Work is on-going in addressing the challenges identified.
Sources: H_2 Mobility Deutschland, Element Energy, AFHYPAC

Source: Summary and lessons learnt from the hydrogen mobility strategies tested in this project interim 2020, H2ME (1) Deliverable 5.12, CONFIDENTIAL, Element Energy

Preparing for a national infrastructure network (Germany)

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- A 2017 Study by Shell found that the **number of FCEVs in selected markets could exceed 100 million by 2050** and would reach the **20 million threshold in the 2030s**.
- As the market for vehicles increases, this will justify commercial deployment of hydrogen stations to expand the network.
- Despite high initial rollout costs due to low utilisation which harms their economics, **analysis suggests that an hydrogen infrastructure scales better than competing zero emission technologies**, both in terms of infrastructure costs and logistics (e.g. additional load on the grid).

2018 study from Jülich - Infrastructure costs comparison for battery and hydrogen vehicles

- It found that the **hydrogen infrastructure works out cheaper as of 1 million vehicles** and that a battery charging network is more cost intensive than hydrogen in the long term.

Infrastructure cost / national fleet size	up to 100,000 vehicles	From 1 million vehicles	From 20 million vehicles
For Battery vehicles	~ EUR 310 million	~ EUR 2.8 billion	~ EUR 51 billion
For Hydrogen vehicles	~ EUR 450 million	~ EUR 1.9 billion	~ EUR 40 billion

Sources: Shell, Jülich.
https://www.shell.de/medien/shell-publikationen/shell-hydrogen-study.html#vanity-aHR0cHM6Ly93d3cuc2hlbGwuZGUvaDJzdHVkaWUuaHRtbA
http://h2-mobility.de/wp-content/uploads/2018/01/Energie-und-Umwelt_408_Robinius-final.pdf

Zero Emission Valley is an ambitious initiative for hydrogen mobility at the regional level in the Auvergne Rhône Alpes region (France)

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Zero Emission Valley case study

- Auvergne Rhône Alpes is set to become the first hydrogen territory in Europe, with a commitment to 1000 FCEVs and 20 HRS in the valley.
- A public-private partnership with stakeholders spanning the entire hydrogen value chain will fund the project, with an expected budget of €70M to be spent over 10 years.

Source: fuelcellworks.com

Challenges of deployment at scale

- The need for multiple HRS in one location and high cost of FCEVs results in prohibitively high capital investment to kick-start large projects

Policy context

- Regional support for the project in the form of €15M in grants or direct investment

Collaboration between local governments and private investors brings the following benefits:

- The engagement of a variety of stakeholders enables commitment to a hydrogen project across the entire value chain in a region.
- Stakeholders have greater economic security, leading to higher levels of investment and larger scale infrastructure and vehicle deployment.
- The increased scale of infrastructure deployment benefits FCEV end users by offering more convenient and further ranging refuelling.
- The demonstration of hydrogen projects of scale will draw further investment to a region.

- The project is currently in its early stages, with a key next step being engaging with the public on the importance and benefits of the project. Due to the large number of stakeholders, the management of this project will be challenging for the regional government.

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Source: Summary and lessons learnt from the hydrogen mobility strategies tested in this project interim 2020, H2ME (1) Deliverable 5.12, CONFIDENTIAL, Element Energy

The localised benefits of implementing hydrogen as a green mobility solution

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- Local authorities are implementing solutions to secure quality of life, economic development, sustainability and climate protection for their citizens.
- Hydrogen can be part of the solution as a step in the transition towards a cleaner future.

London (UK)

Motivation:

Large Metropolitan area with local pollution issues and ambitious targets for emissions and noise reduction

Demonstration: Fleet of FCEVs buses and FCEVs in taxi operation and emergency response services

Sarreguemines (France)

Motivation:

- Local Authority with a large fleet of vehicles preparing for a transition towards a low carbon economy and aim to reduce primary energy consumption & promote energy efficiency
- Keen to create opportunities for employment and promoting their territory

Demonstration: Fleet of FC RE-EV Renault Kangoo vans supported by an HRS with electrolyser testing grid balancing services.

Sandviken (Sweden)

Motivation:

- Foster industrial innovation & development and supporting HFC technologies as a supply chain supplier.
- Keen to create opportunities for employment and promoting their territory

Demonstration: Fleet of FCEVs supported by a HRS using H2 produced via electrolysis (using electricity from a nearby wind farm) and transported via H2 grid.

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Attractive business models for these applications are emerging, and hundreds of vehicles have already been deployed in various fleets

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- Hydrogen vehicles are now being used at scale by fleet operators in several of the applications mentioned above, including:
  - **Hype: >100 fuel cell taxis in Paris**, with plans for a total of 600 taxis to be in operation by the end of 2020
  - **Green Tomato Cars: 50 fuel cell taxis in London**
  - **CleverShuttle: 45 FCEVs in ride-sharing fleets in Germany;** >1 million km covered
  - **Delivery & utility vans**: DHL, La Poste, City Logistics, water & energy companies: >150 Kangoo ZE H2 vans in France

- Currently, specific market conditions (which apply in the cases above) make fuel cell vehicles particularly attractive for these applications:
  - Fleets have high daily mileages and/or a need for fast refueling to enable flexible operations
  - Strong regional incentives for zero emission vehicles make the purchase or lease price more attractive and/or increase the financial burden associated with operating fossil fuel vehicles
  - Operational area aligns with locations of refueling infrastructure

hype

greentomatocars

CleverShuttle

LA POSTE

DHL

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