



# Hydrogen Mobility Europe

## Six Monthly Summary Technical Report Presenting Project Data to December 2022 – D5.41



Authored by	Peter Speers, Victor Lejona and Tom Price
Approved by	Steve Carroll
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Contact Details	<a href="mailto:peter.speers@cenex.co.uk">peter.speers@cenex.co.uk</a> Cenex, Holywell Building, Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3UZ, UK

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Co-funded by  
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# Abbreviations

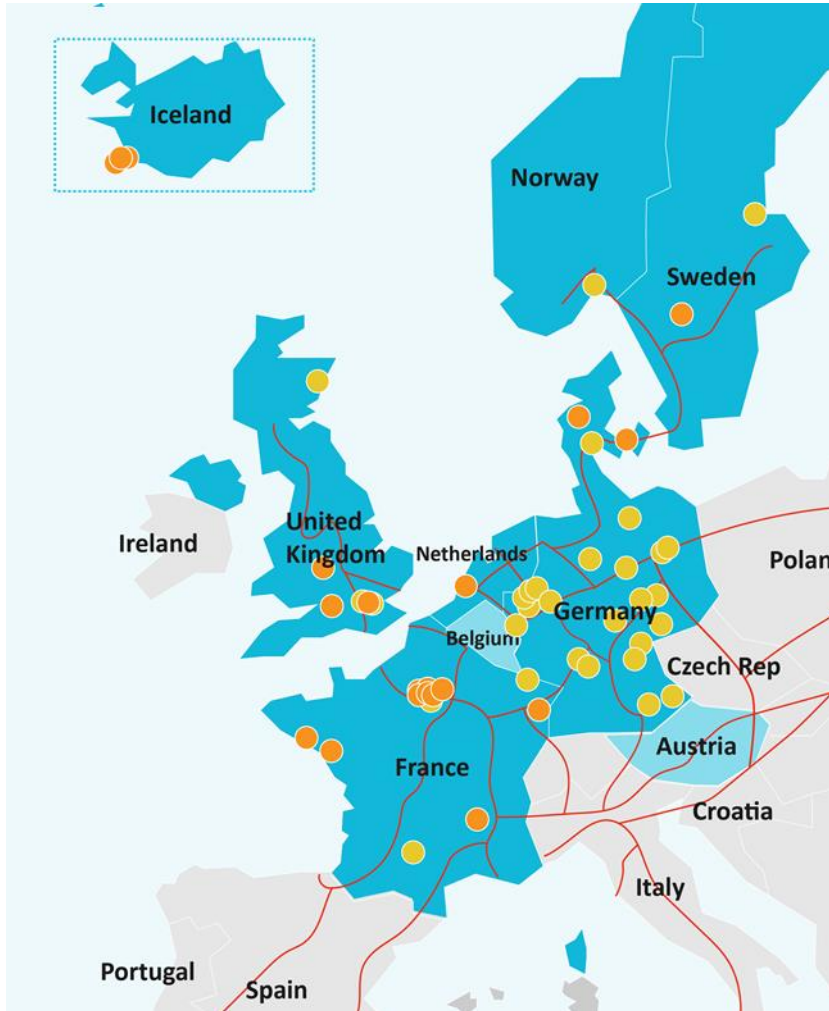
A-M		N-Z	
B2B	Back-to-Back (Refuelling)	NEDC	New European Driving Cycle
BEV	Battery Electric Vehicle	NREL	National Renewable Energy Laboratory
FCEV	Fuel Cell Electric Vehicle	OEM	Original Equipment Manufacturer
FCH2 JU	Fuel Cells and Hydrogen Joint Undertaking	PEM	Proton Exchange Membrane
FC REEV	Fuel Cell Range Extended Electric Vehicle	PHEV	Plug-in Hybrid Electric Vehicle
FE	Fuel Efficiency	SOC	State of Charge
H <sub>2</sub>	Hydrogen	TCO	Total Cost of Ownership
H2ME	Hydrogen Mobility Europe	US DOE	US Department of Energy
HRS	Hydrogen Refuelling Station	WLTP	Worldwide Harmonised Test Procedure
HyTEC	Hydrogen Transport in European Cities	WTW	Well-to-wheel
MDBRE	Mean Distance Between Refuelling Events	ZEFER	Zero-Emission Fleet vehicles for European Rollout
MPS	Metropolitan Police Service (London, UK)		

# The Purpose of this Report



- ❑ Hydrogen Mobility Europe (H2ME, <https://h2me.eu/>, 2015-2023, which comprises sub-projects H2ME-1 and H2ME-2) is the largest passenger and light duty hydrogen vehicle and hydrogen refuelling station (HRS) demonstration initiative co-funded by the Fuel Cells and Hydrogen Joint Undertaking (FCH2 JU).
- ❑ Supported by €67m of FCH2JU funding, the €170m H2ME project aims to deploy more than 1 400 vehicles and 49 HRS in eight countries by 2023.
- ❑ This is the ninth of a series of reports began in 2019 providing brief summaries of H2ME data.
- ❑ This version presents project data collected to the end of 2022.
- ❑ Metrics reported include:
  - Numbers of vehicles and hydrogen refuelling stations (HRS) deployed
  - Distance driven by the project vehicles
  - Hydrogen dispensed by the project HRS.
- ❑ Additional information on, and analysis of, the performance of H2ME vehicles and refuelling stations can be found in the *H2ME Annual Technical Performance Reports* cited as sources on each slide.
- ❑ H2ME will collect and report data until June 2023 as part of the ongoing H2ME-2 project.





## New hydrogen refuelling stations:

- ❑ 20 - 700bar HRS in Germany
- ❑ 11 - 350bar and 700bar HRS in France
- ❑ 11 - 700bar HRS in Scandinavia
- ❑ 6 – 350bar and 700bar HRS in the UK
- ❑ 1 - 700bar HRS in NL

## Fuel cell vehicles:

- ❑ 500 OEM (Original Equipment Manufacturer) FCEVs
- ❑ 900 fuel cell FC REEV vans

## Hydrogen rollout areas:

- ❑ Scandinavia, Germany, France, UK, The Netherlands








## Observer coalitions:

- ❑ Belgium, Luxembourg, and Italy

## Industry observer partners:

- ❑ Audi, BMW, Nissan, Renault, Renault Trucks, AGA, OMV

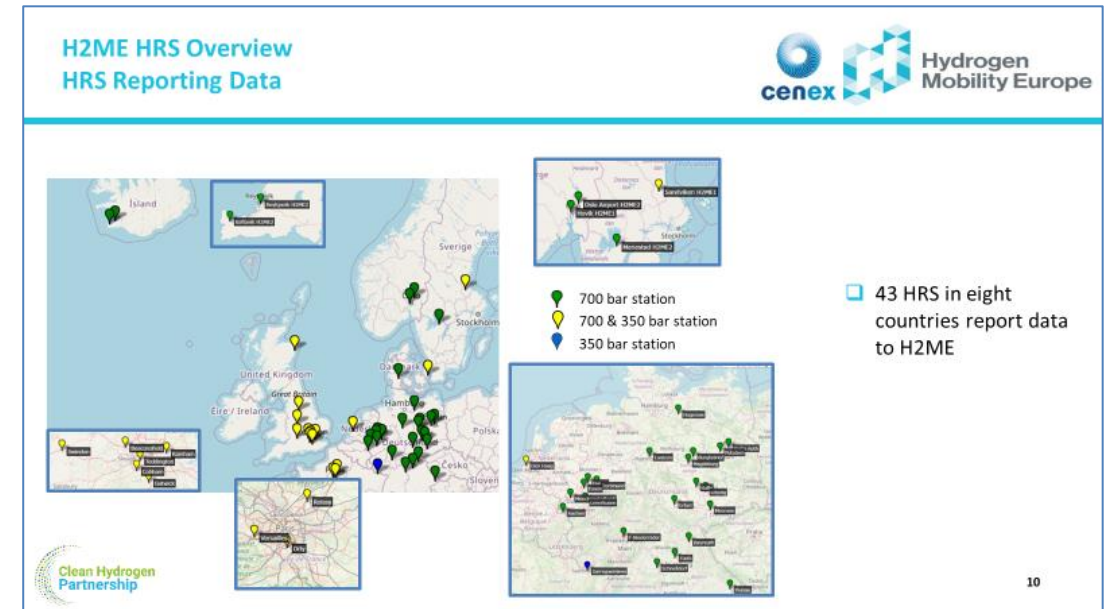
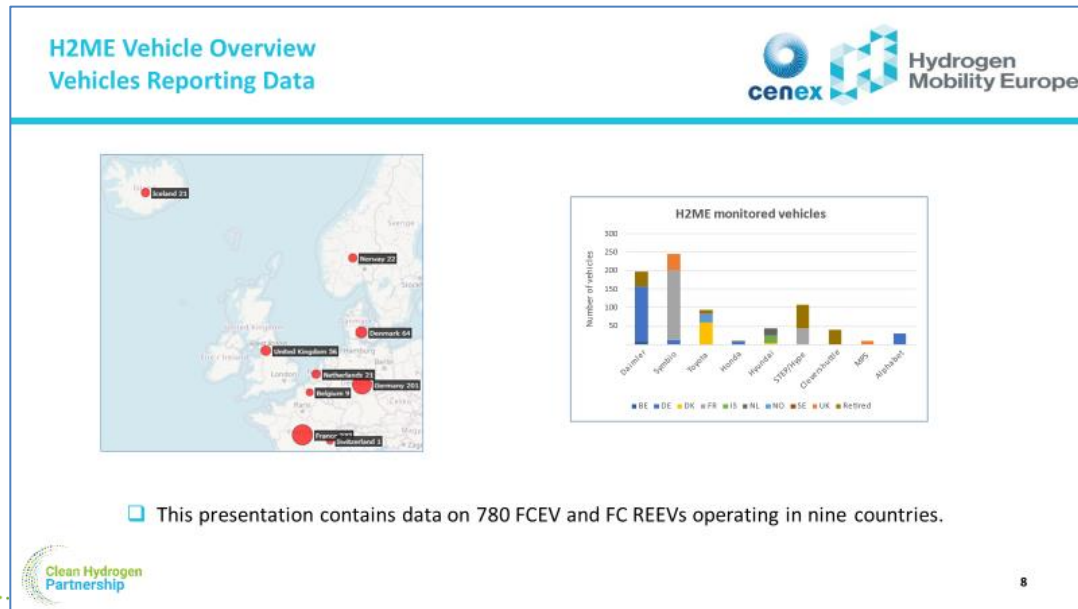
# Vehicles Reporting Data to H2ME

	Daimler B-Class F-CELL FCEV	Daimler GLC F-CELL FCEV/PHEV	Honda Clarity FCEV	Hyundai ix35 FCEV	Hyundai Nexo FCEV	Toyota Mirai FCEV	Symbio ZE H2 FC REEV
							
<b>Project and dates reporting data</b>	H2ME-1 2015-2018 (retired)	H2ME-1 & 2 2019-	H2ME-2 2017-	H2ME-2 2017-	H2ME-2 2019-	H2ME-1 & 2 2017-	H2ME-1 & 2 2015-
<b>H2ME use-cases</b>	Passenger and fleet car	Passenger and fleet car	Passenger and fleet car	Passenger and fleet car, taxi	Passenger and fleet car	Passenger and fleet car, police car, taxi	Light van in company fleets
<b>NEDC range</b>	380 km	478 km	650 km	590 km	756 km	605 km Gen1	300 km
<b>H<sub>2</sub> tank capacity and pressure</b>	3.7 kg (700 bar)	4.4 kg (700 bar)	5.5 kg (700 bar)	5.6 kg (700 bar)	6.3 kg (700 bar)	5.0 kg (Gen 1) 5.6 kg (Gen 2) (700 bar)	1.8 kg (350 bar version)
<b>Battery capacity</b>	1.4 kWh	13.5 kWh (9.3kWh usable)	1.7 kWh	0.95 kWh	1.6 kWh	1.6 kWh (Gen 1) 1.2 kWh (Gen 2)	22 kWh



# H2ME Vehicle and HRS Numbers

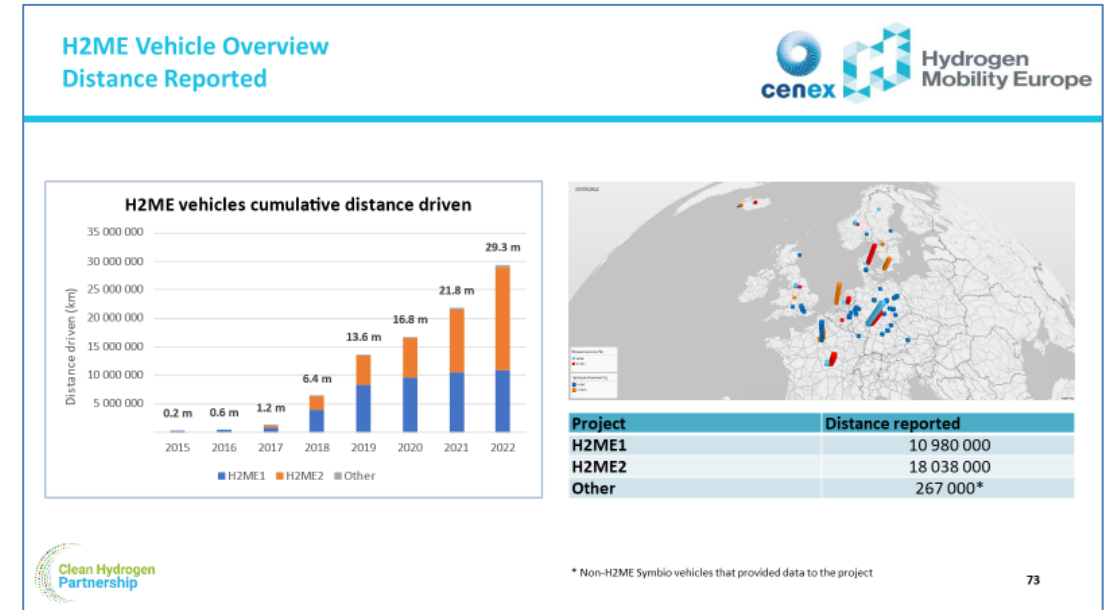
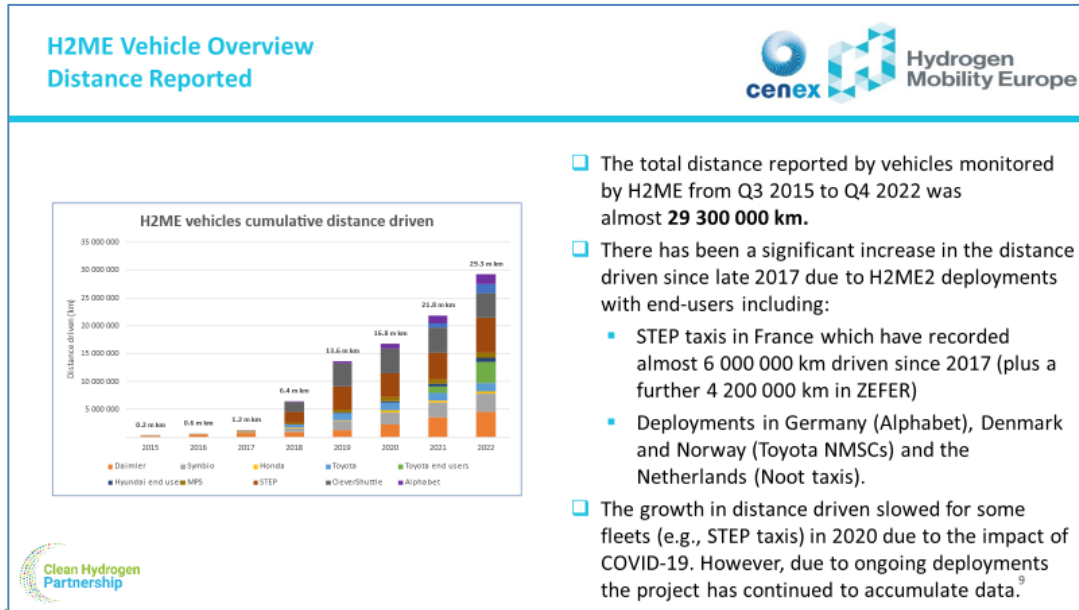
- Vehicles and stations reporting data to H2ME to the end of 2022 comprise:
  - **534 FCEVs** and **246 FC REEVs** and **43 HRS**.
  - The number of vehicles and HRS reporting is unchanged from 2022 Q2.



Source: Cenex analysis based on H2ME-2 Vehicle and Infrastructure Performance Report 4 (2015-2021)  
<https://h2me.eu/wp-content/uploads/2021/11/H2ME2-D5.17-Public-FV-Report-4-Interim-and-final-summary-%E2%80%A6-1.pdf>

□ To the end of 2022:

- H2ME FCEVs and FC REEVs reported almost **29.3 million km** driven (2022 Q2 value: 25.1m km).
- Urban deployments of high-usage vehicles such as taxis continue to dominate the H2ME vehicle dataset, as evidenced by increasing data volumes being received from taxi fleets stationed in Denmark, France and the Netherlands.



Source: Cenex analysis based on H2ME-2 Vehicle and Infrastructure Performance Report 4 (2015-2021)

<https://h2me.eu/wp-content/uploads/2021/11/H2ME2-D5.17-Public-FV-Report-4-Interim-and-final-summary-%E2%80%A6-1.pdf>

# H2ME How Vehicles are Used and Refuelled

- ❑ H2ME vehicles average between 19 km and 128 km of driving per day. In some cases they have driven over 1 000 km in a single day. The distance driven depends on the vehicle use case and deployment location.
- ❑ The average refuelling amount for each FCEV type deployed varies from 50% to 57% of the tank capacity.
- ❑ In all countries and use cases, the FCEVs have proven that they are capable of fulfilling the driver's daily and annual needs.

### H2ME: Vehicle & HRS Case Studies

#### Passenger cars in Germany: GLC F-CELL FCEV/PHEV compared to the B-Class F-CELL FCEV

**Daimler GLC F-CELL daily distance distribution**

Average daily distance : 96km  
Max. daily distance: 1 217km

**Daimler B-Class F-CELL daily distance distribution**

Average daily distance : 66km  
Max. daily distance: 620km

- ❑ The GLC F-CELLs are being driven much further on average every day than the B-Class, and also show much higher maximum daily distances, including one day of 1 200 km+ driven and five refuels.
- ❑ For comparison, the maximum daily distance driven during the H2ME B-Class trial (2015-2018) was 620 km with three refuels.
- ❑ Presumably this is a reflection of:
  - People trialling the newer vehicle's capabilities.
  - The expanded H2Mobility Deutschland refuelling network in 2020 versus 2015: in 2015, H2Mobility operated 15 HRS in Germany; by 2018 this had increased to 57 and in late 2020 had reached 88.
- ❑ As with the B-Class, the data shows that the GLC is comfortably capable of fulfilling the average German driver's needs (annual average distance travelled ~ 14 000 km, average daily distance ~ 40 km\*).

\* Motor Vehicle Use and Travel Behaviour in Germany, [http://www.dlrw.de/documents/publikationen/73/dlrw\\_01\\_c\\_44461\\_de/dp602.pdf](http://www.dlrw.de/documents/publikationen/73/dlrw_01_c_44461_de/dp602.pdf)

### H2ME Vehicle & HRS Case Studies

#### Toyota Mirai FCEV: Refuelling Behaviour Comparison

**Refuelling behaviour of Toyota Mirai FCEVs**

Tank size: 5.0 kg, avg. fill: 2.5 kg (50%)  
Distance between refuels: 217 km

**Refuelling behaviour of Daimler GLC F-Cell**

Tank size: 4.4 kg, avg. fill: 2.5 kg (57%)  
Distance between refuels: 197 km

**Refuelling behaviour of Honda Clarity FCEVs**

Tank size: 5.4 kg, avg. fill: 3.0 kg (55%)  
Distance between refuels: 230 km

**Refuelling behaviour of Hyundai Nexso FCEVs**

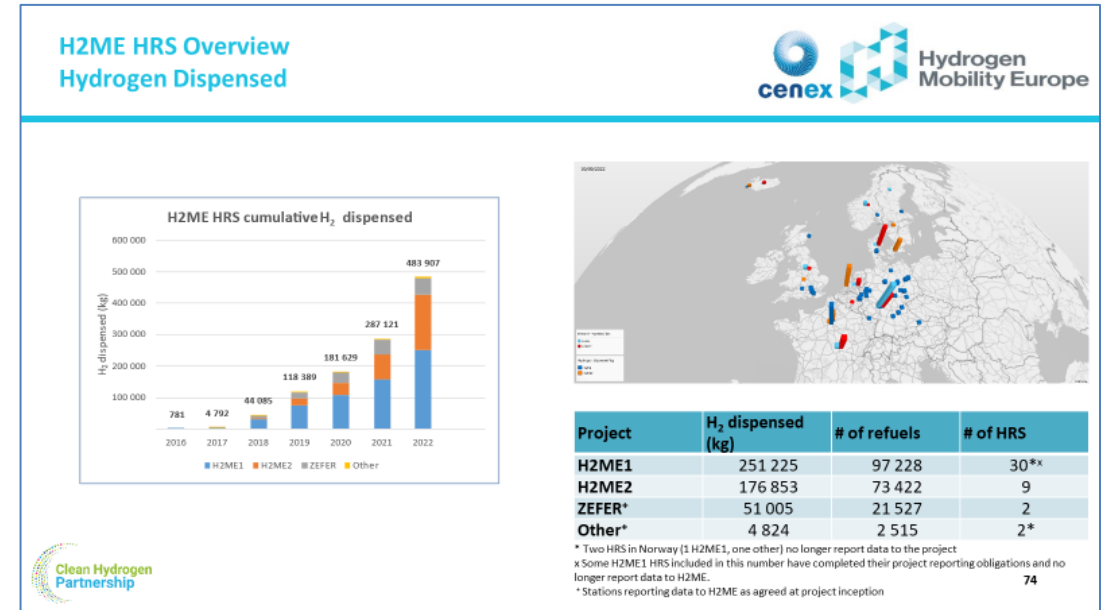
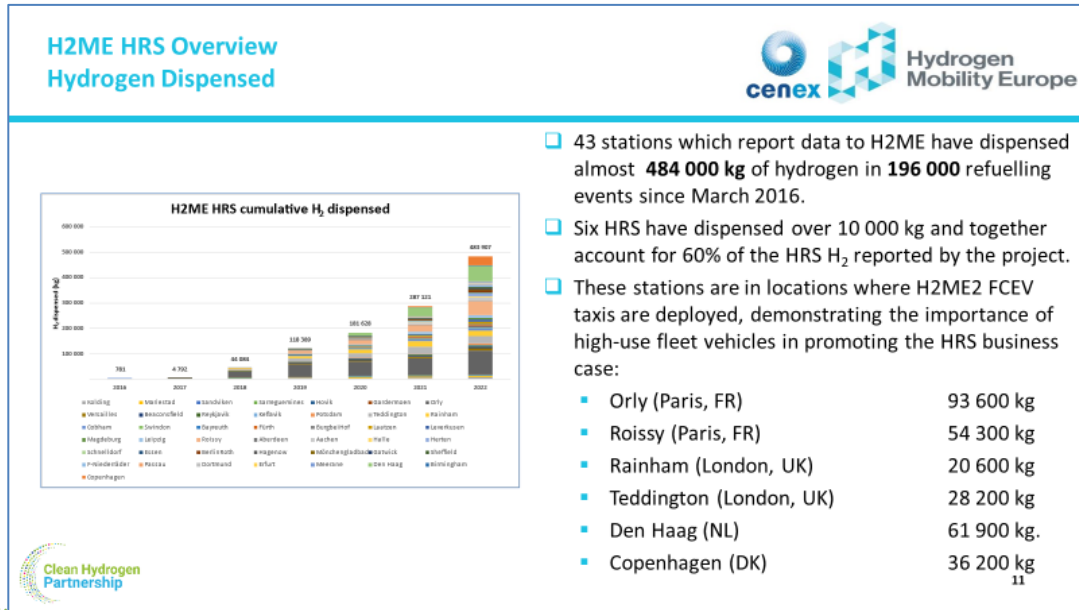
Tank size: 6.3 kg, avg. fill: 3.2 kg (50%)  
Distance between refuels: 320 km

- ❑ The graphs compare refuelling data from H2ME FCEVs: the Mirai, Honda Clarity, GLC F-Cell and Hyundai Nexso
- ❑ After an initial adjustment period, where users appear to refuel frequently with small amounts of H<sub>2</sub>, the graphs show little variation over time in refuelling behaviour in terms of average fill as a proportion of the tank capacity.
- ❑ The distance between refuels reflects the tank capacity.
- ❑ The fact that the GLC F-Cell is a range-extended vehicle with plug-in capability appears to make little difference to its hydrogen refuelling behaviour compared to the FCEVs which cannot plug-in.



□ To the end of 2022:

- The 43 HRS reporting data to H2ME dispensed almost **484 000 kg** of hydrogen in **196 000** refuelling events (2022 Q2 values: 377 000 kg of hydrogen and 148 600 refuels).
- HRS deployed in locations where taxis operate continue to provide the bulk of H2ME usage, with six of the HRS accounting for 60% of the overall refuelling amount.



Source: Cenex analysis based on H2ME-2 Vehicle and Infrastructure Performance Report 4 (2015-2021)

<https://h2me.eu/wp-content/uploads/2021/11/H2ME2-D5.17-Public-FV-Report-4-Interim-and-final-summary-%E2%80%A6-1.pdf>

- ❑ The average reported availability of H2ME HRS at the end of 2022 was 95.8% (2022 Q2 value: 94.5%).
- ❑ Almost half of project HRS exceeded the H2ME-2 availability target of 98% at the end of 2022 (2022 Q2 value: 32%).
- ❑ 13% of HRS were less than 80% available at the end of 2022, compared to the 2022 Q2 figure of 18%.

### H2ME HRS Overview Station Availability

- ❑ The definition of HRS availability is focused on the user (i.e. – can the station dispense H<sub>2</sub>?), but excludes maintenance.
- ❑ The graph is presented as recommended by the HyLights Monitoring and Assessment Framework \* – i.e., minimum-maximum/average – to maintain anonymisation of the HRS from individual project OEMs (Level 4 as per the DoA).
- ❑ The black bars show the lowest and highest HRS availability in the quarter.
- ❑ The project-average station availability is currently **95.8%** (blue line).
- ❑ The reported average excludes HRS which have exhibited unusually-low availability in a given quarter (less than 80%) as these are generally down to one-off issues or, in 2020 and 2021, COVID-19 related problems (e.g., lack of parts and available maintenance staff).

\* [https://www.fch.europa.eu/sites/default/files/HyLights\\_D3\\_3\\_MAF-Handbook-II\\_Final%20%28ID%202875010%29.pdf](https://www.fch.europa.eu/sites/default/files/HyLights_D3_3_MAF-Handbook-II_Final%20%28ID%202875010%29.pdf)

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### H2ME HRS Overview Station Availability: Non-HyLights Presentation

- ❑ The definition of HRS availability is focused on the user (i.e. – can the station dispense H<sub>2</sub>?), but excludes maintenance.
- ❑ This graph shows the availability of all HRS from 2018.
- ❑ The graph shows that **47% of the project HRS exceeded 98%** availability in 2022 Q3.
- ❑ The graph shows in part the impact on availability of the introduction of increasing numbers of new HRS from late 2018 onwards as shown by the increase in the proportion of HRS exhibiting low (<80%) availability in each quarter as new HRS are introduced (e.g., see 2022Q3 vs 2021Q3).
- ❑ The reported average excludes HRS which have exhibited unusually-low availability in a given quarter (less than 80%) as these are generally down to one-off issues.
- ❑ The project-average station availability of all HRS is currently **95.8%**.

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Source: Cenex analysis based on H2ME-2 Vehicle and Infrastructure Performance Report 4 (2015-2021)

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