



**FUEL CELLS AND HYDROGEN**  
JOINT UNDERTAKING

## **H2ME / H2ME 2 Hydrogen Mobility Europe**



**Lisa Ruf**

**Element Energy**

**Project Coordinator**

<http://h2me.eu/>

[lisa.ruf@element-energy.co.uk](mailto:lisa.ruf@element-energy.co.uk)

**Programme Review Days 2018**

Brussels, 14-15 November 2018

# PROJECT OVERVIEW

The flagship projects for FCEVs in Europe



- **Call year: 2014 / 2015**
- **Call topic:**
  - FCH-01.7-2014: Large scale demonstration of refuelling infrastructure for road vehicles
  - FCH-03.1-2015: Large scale demonstration of Hydrogen Refuelling Stations and FCEV road vehicles - including buses and on site electrolysis
- **Project dates:**
  - 01.06.2015-31.05.2020
  - 01.05.2016-30.06.2022
- **% stage of implementation 01/11/2018: 30%**
- **Total project budget: 170m €**
- **FCH JU max. contribution: 67m €**

## Partners:



# PROJECT SUMMARY

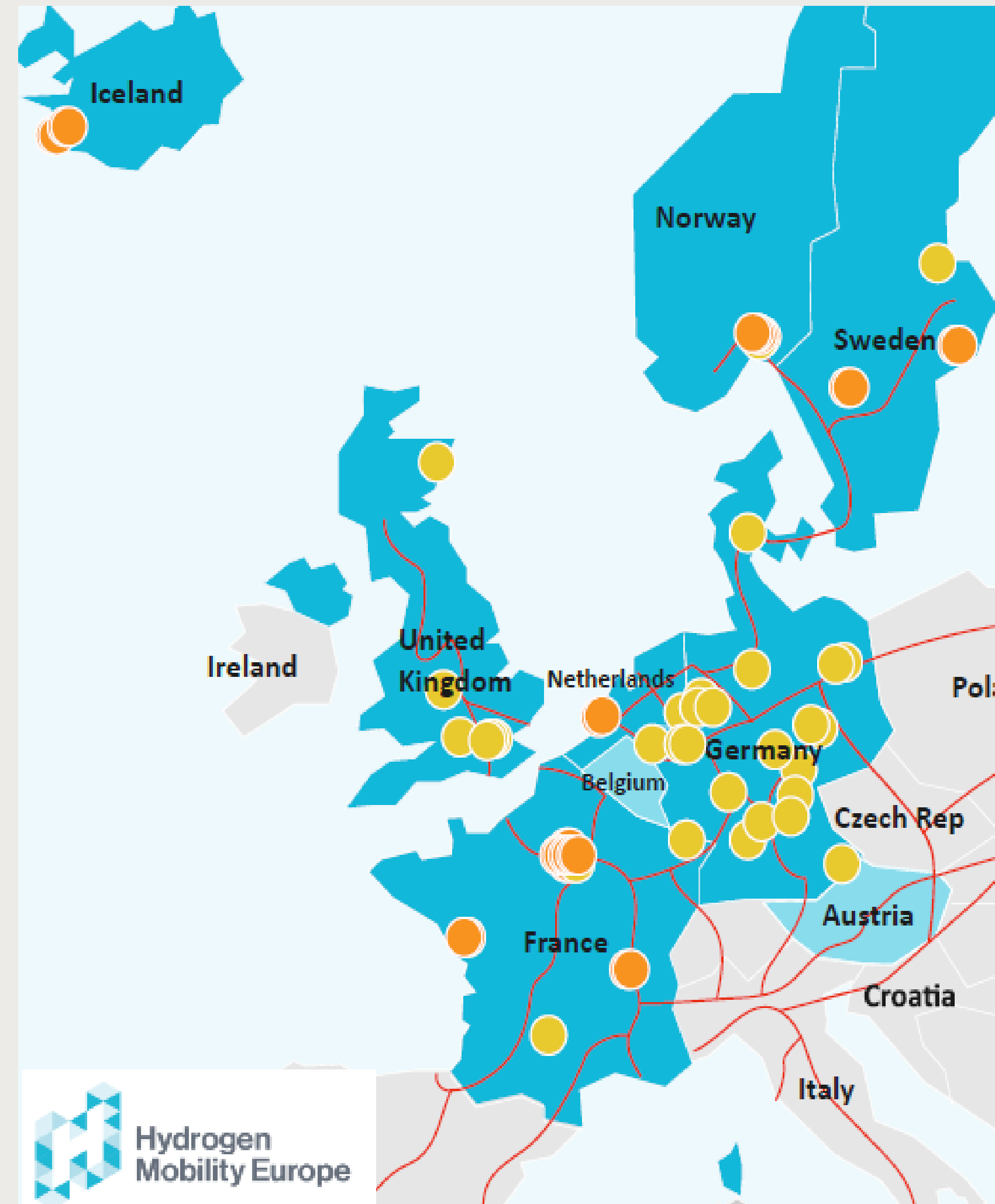
H2ME initiative (2015 – 2022)



HRS: Hydrogen Refuelling Station  
FCEV: Fuel Cell Electric Vehicle  
RE-EV : Range-Extended Electric Vehicle  
OEM : Original Equipment Manufacturer



- Flagship project for H2 mobility in European
- One ‘working framework’ the H2 mobility initiatives of 11 countries for the 1<sup>st</sup> time
- Benchmark of business case concepts in each country, providing the opportunity to
  - 1) investigate commercialisation solutions and synergies between countries
  - 2) develop a pan-European strategy
  - 3) demonstrate the system and economical benefits of electrolytic hydrogen solutions in grid operations



## 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 the **NL**
  - 11 electrolyzers

## Fuel cell vehicles:

- 500 OEM FCEVs
- 900 fuel cell RE-EV vans

## Hydrogen rollout areas:

- Scandinavia, Germany, France, UK, the NL

## Observer coalitions:

- Belgium, Luxembourg and Italy

## Industry observer partners:

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

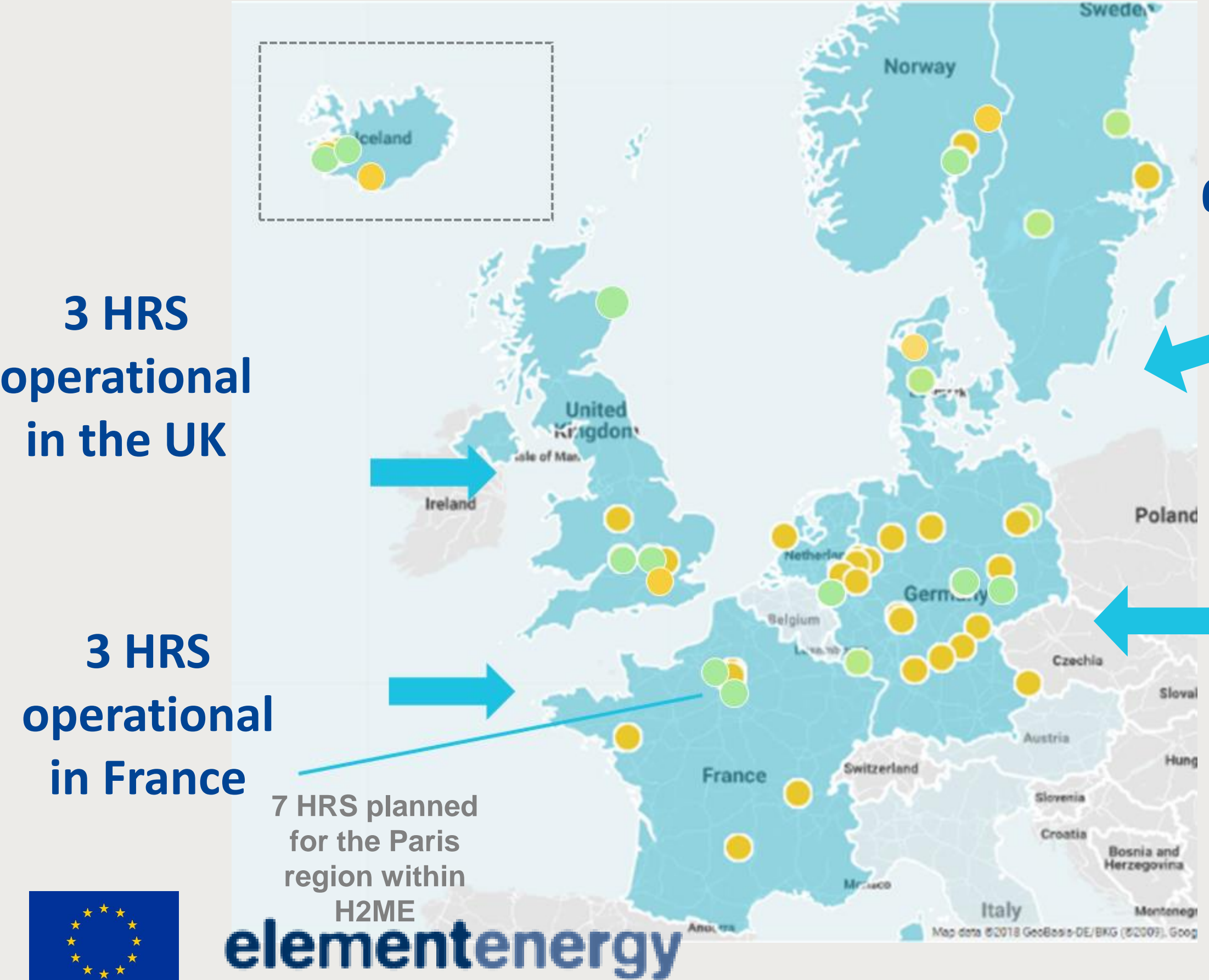


elementenergy



# PROJECT PROGRESS – DEPLOYMENT ACTIVITIES

H2ME initiative (2015 – 2018)

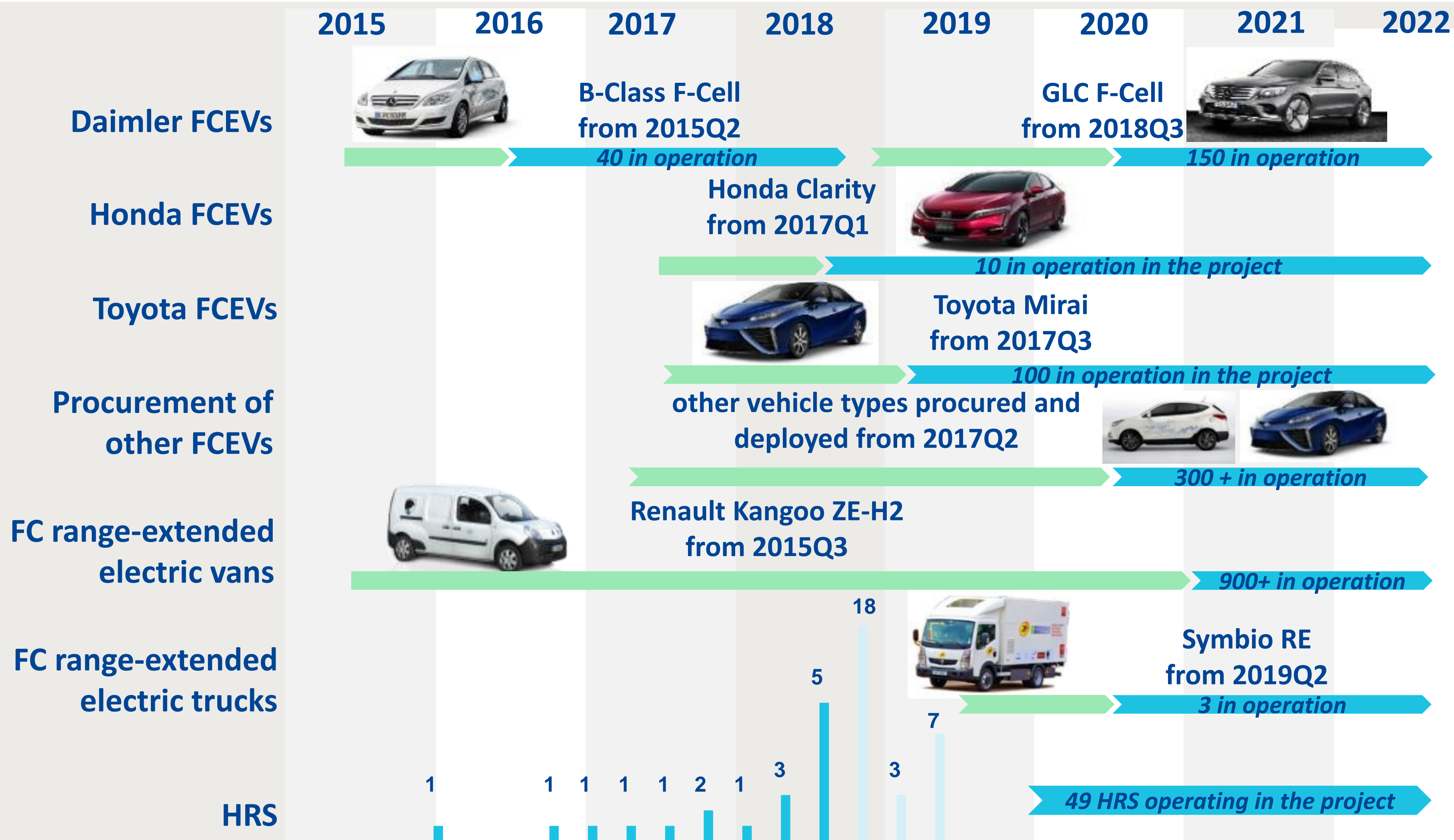


- Kolding and Mariestad (NEL),
- Reykjavik and Keflavik (H2 Iceland/Nel) ,
  - Sandviken (Linde/AGA),
- Sarreguemines (CASC/McPhy/EIFER),
  - Hovik (HYOP),
- Paris Orly and Versailles (Air Liquide),
- Leipzig, Potsdam and Aachen (H2Mobility Deutschland),
  - Beaconsfield and Swindon (ITM Power),
    - Aberdeen (Linde/BOC)
  - 170 Renault Kangoo vans
    - 40 B Class F-CELL
    - 80 Toyota Mirai
    - 10 Honda Clarity
- 60 vehicles procured by project partners



# CONTINUED DEPLOYMENT OF VEHICLES AND HRS

H2ME initiative (2015 – 2022)



Significant HRS and Vehicle deployment outside H2ME projects

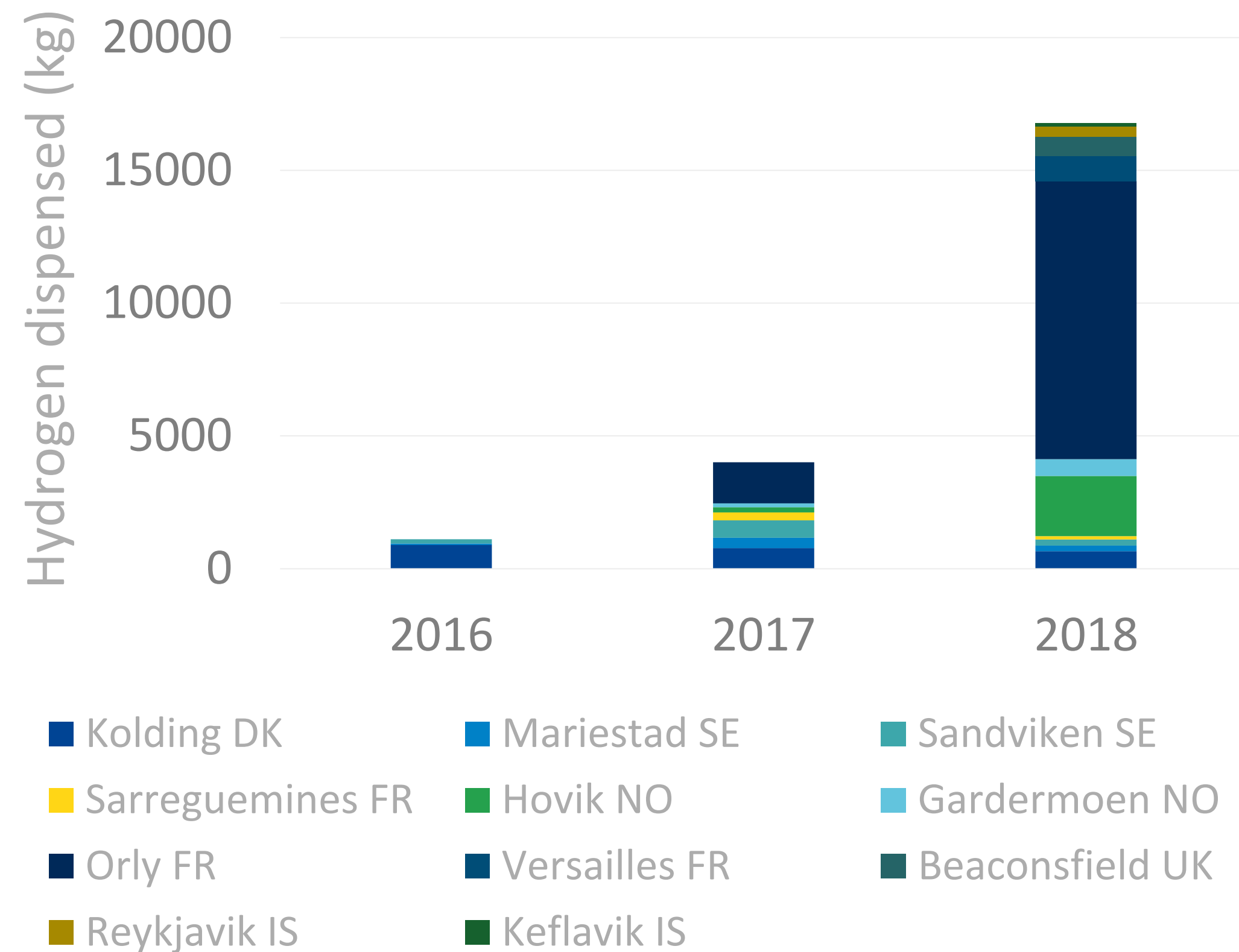


# HRS IN OPERATION

Early results on the status of the deployment and performance of HRS



### H2ME HRS hydrogen dispensed



### H2ME Project snapshot

- HRS have dispensed > **21 560 kg** of H<sub>2</sub> in **9 434** refuelling events since March 2016.
  - The Orly (France) HRS alone has dispensed > **12 000kg H<sub>2</sub>** since its opening in Q3 2017 due to usage from STEP taxis in Paris, showing the importance of the co-deployment of high-mileage fleets on HRS usage.
  - No safety incidents have been reported.

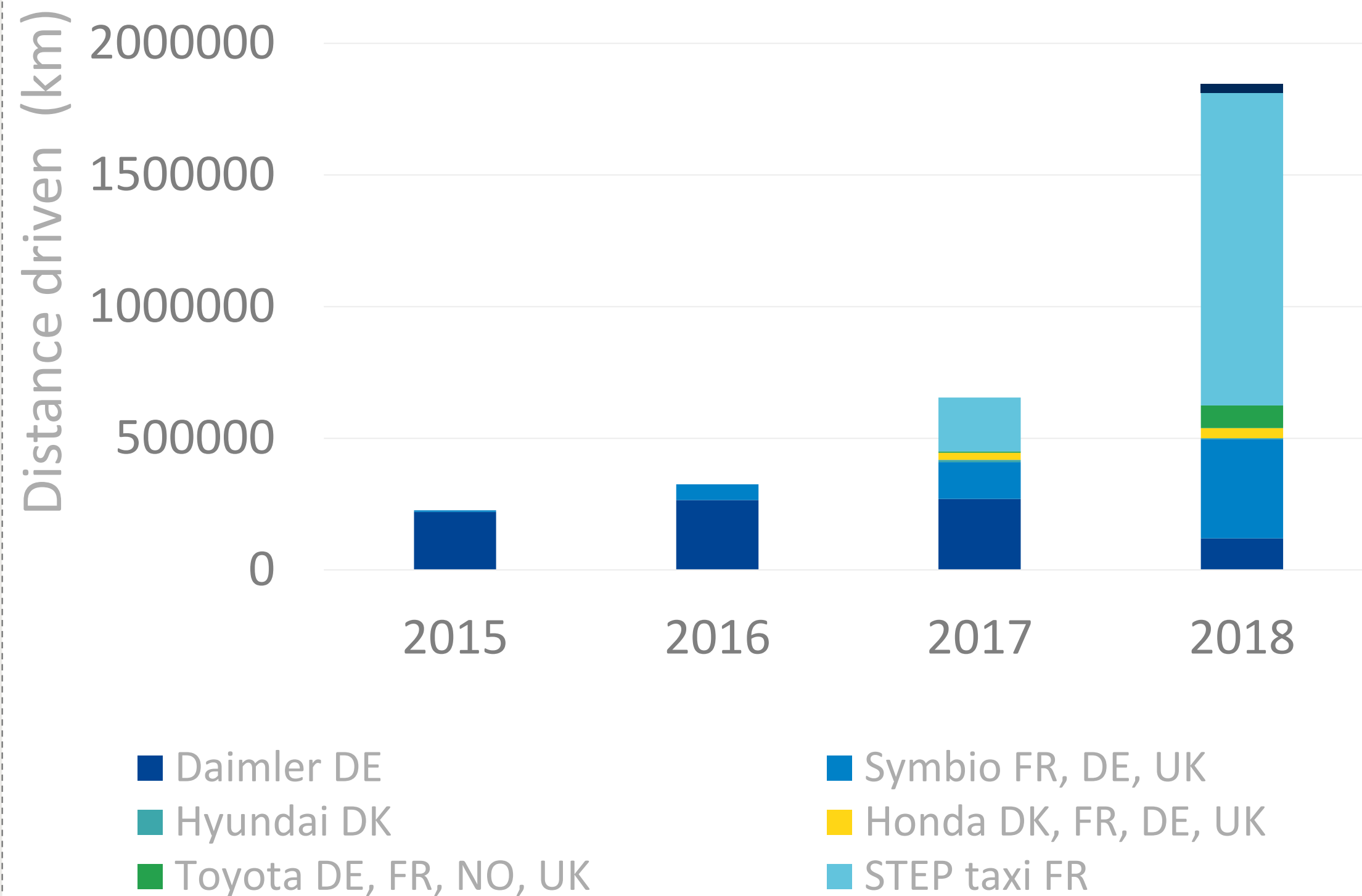


# VEHICLES IN OPERATION

Early results on the status of the deployment and performance of vehicles



## H2ME vehicle mileage reported per year



## H2ME Project snapshot

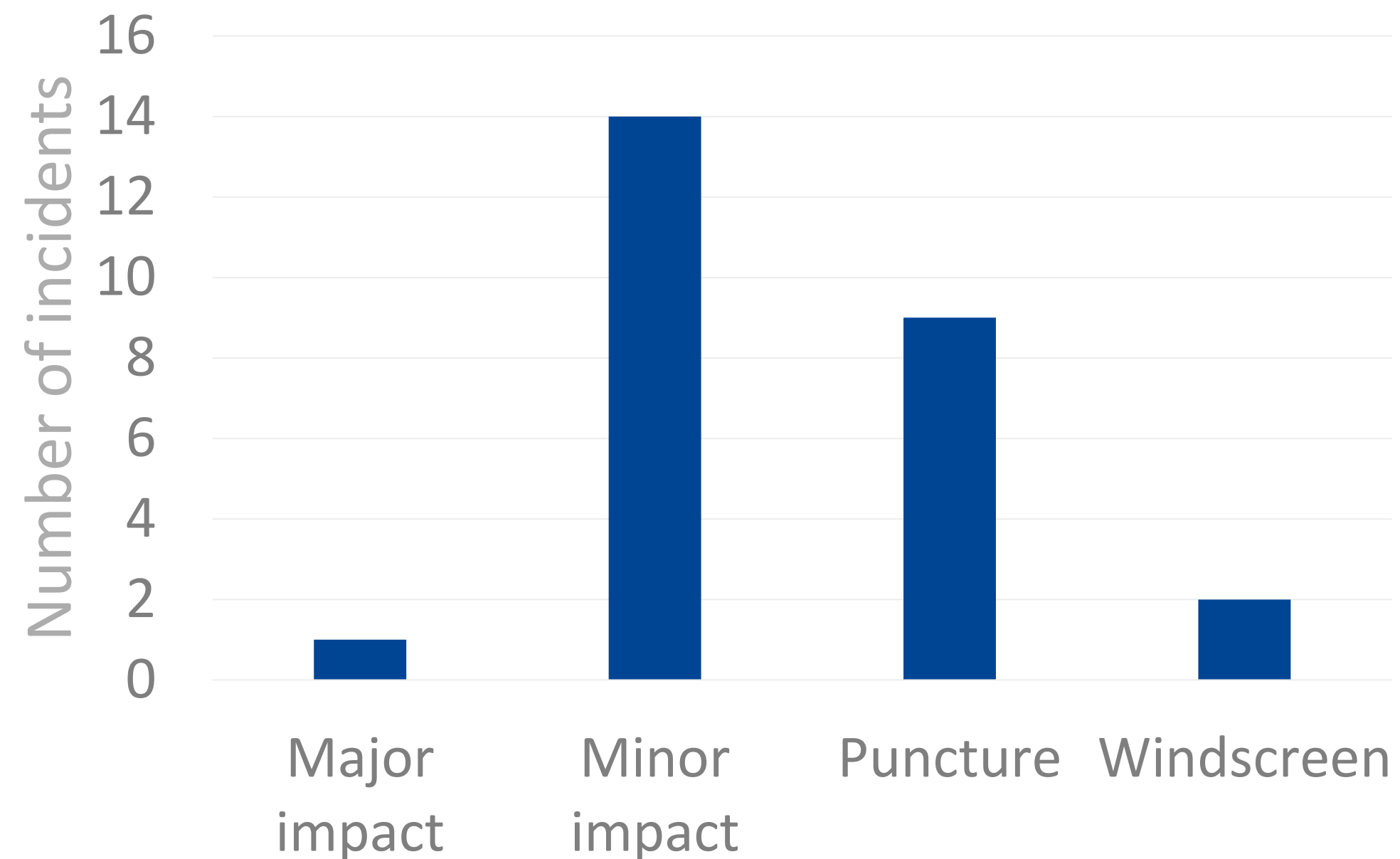
- Vehicles have reported a total of **3 051 950 km** driven since the first vehicles were deployed in Q3 2015.
- Vehicle mileage accumulation has increased significantly since the deployment of STEP FCEV taxis in Paris STEP taxis have accumulated **1 390 000 km** since August 2017.
- The furthest distance travelled by one of the STEP vehicles in the period was **72 836 km**.
- No major safety incidents involving the vehicles' hydrogen systems have been reported.



# CASE STUDY – DEMONSTRATING DURABILITY AND RELIABILITY

Taxis as test cases for FCEV usage

## STEP taxi incident reports June-Sep 2018



- STEP taxis drive a lot. Inevitably, they are involved in incidents.
- The taxis have the same frequency and types of incident as normal taxis.
- **None of the incidents involved any release of hydrogen or problems with the fuel cell system.**
- The photograph on the right shows the scale of the major impact.



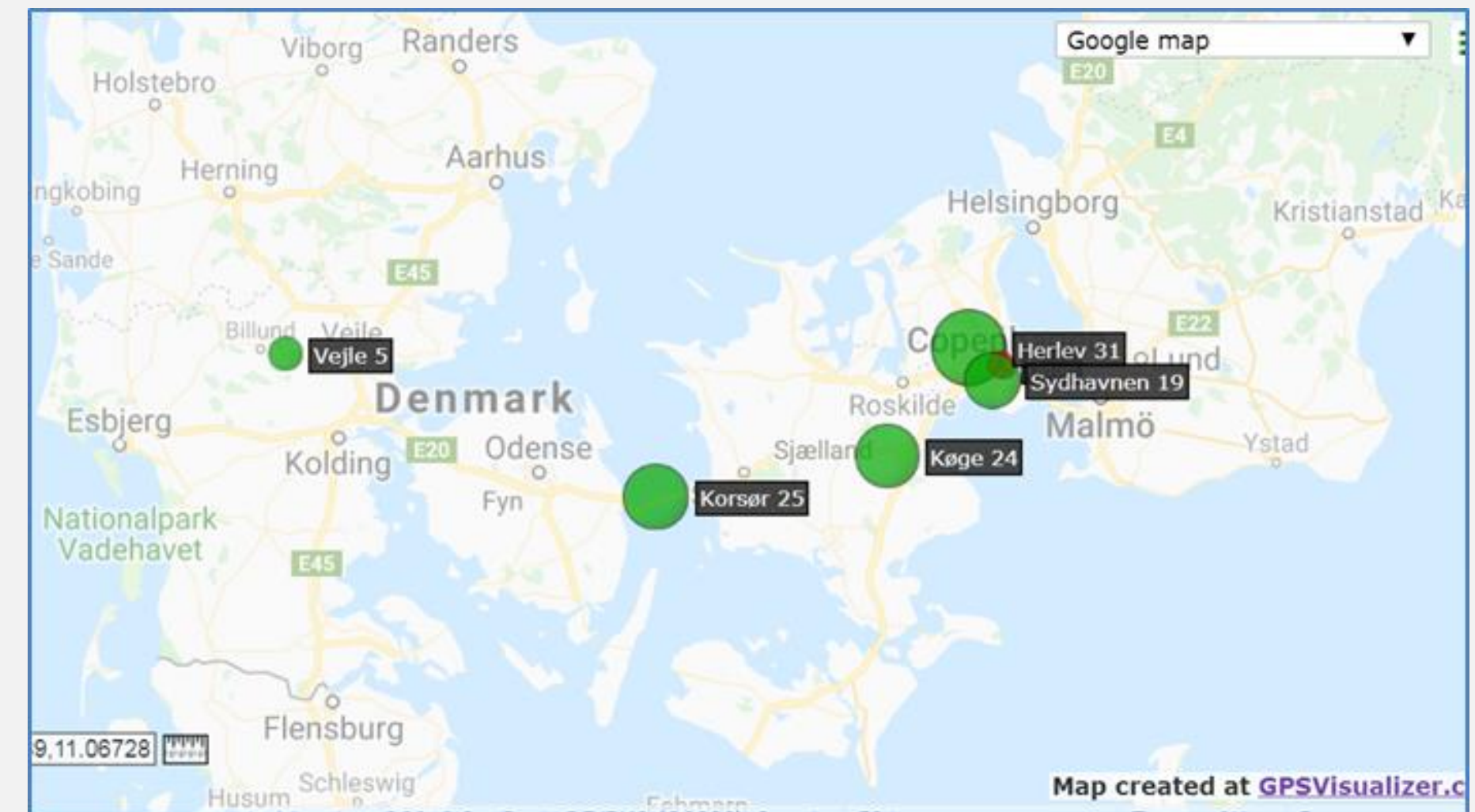
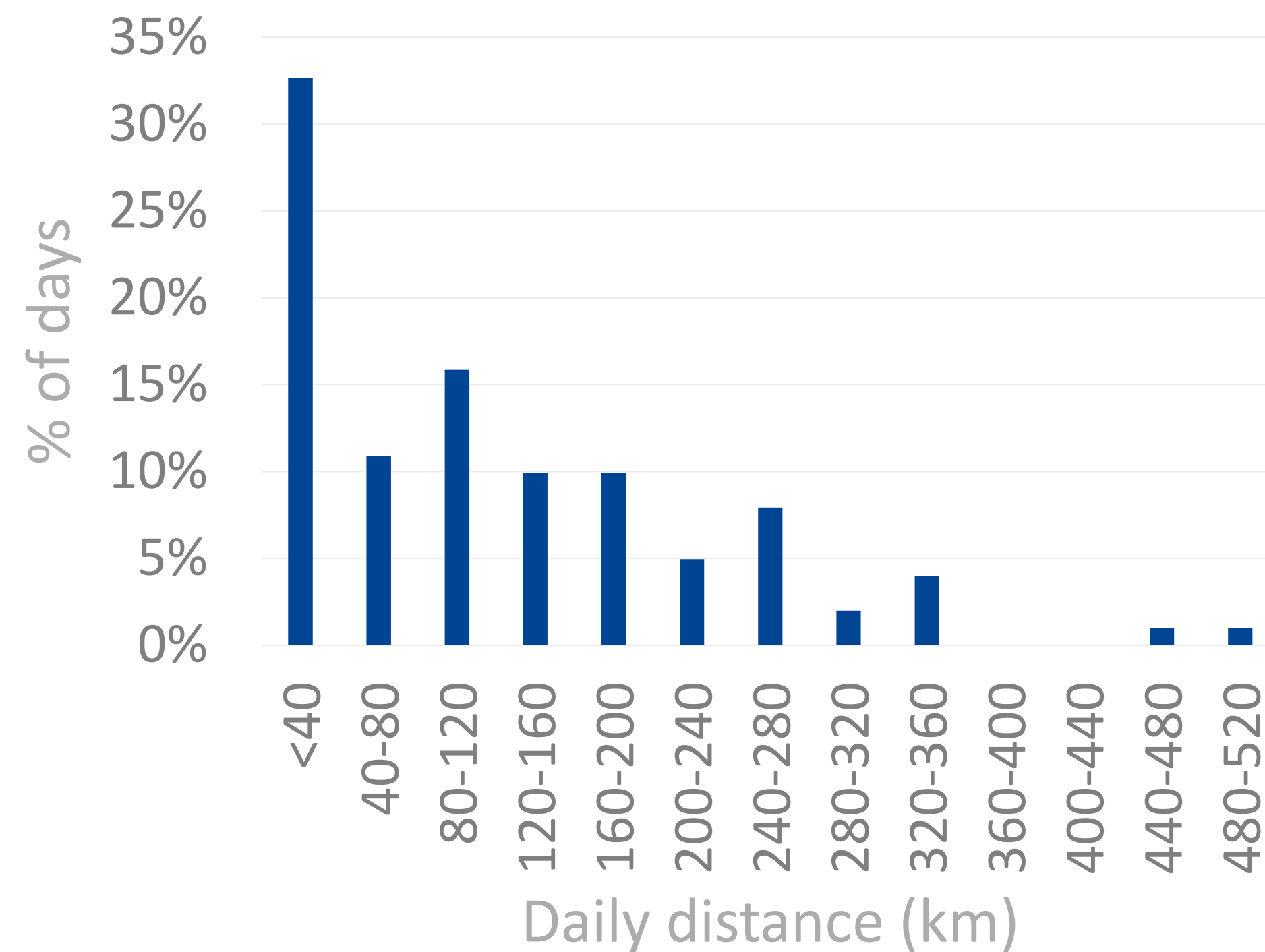


# CASE STUDY – NETWORK ENABLING LONG RANGE DRIVING

FCEV usage and HRS networks



### Copenhagen FCEV daily distance distribution



- For an FCEV in Copenhagen, around half of its H2 was refuelled at two stations. The remaining half was refuelled at three other stations in the wider Danish network.
- The vehicle **drove more than 100 km per day** on more than half the days it was used.
- Its **maximum daily distance** driven was **494 km**.

# EARLY RESULTS – COMMERCIALISATION STRATEGIES

A number of different hydrogen mobility strategies are being tested in the project



## Distinct hydrogen mobility rollout strategies are being tested in each of the coalitions involved in the project

However, best practices are becoming more apparent:

- Increasing focus on **co-location of vehicles and HRS** (e.g. adoption of demand-led approach when siting new stations via letters of intent)
- Increasing focus on **developing viable clusters of stations in key locations** (e.g. Paris, London, Hamburg) where the **redundancy and convenience of multiple stations increases the attractiveness** of fuel cell vehicles to fleet operators
- Increasing focus on **mixed vehicle types** (e.g. buses, refuse trucks) and **high demand applications** (e.g. taxis) to help sustain the early network in advance of mass passenger car roll-out

## H2ME Project lessons learnt HRS installation process

Progress in installation periods however, the installation process remains slow.

A number of challenges makes reducing lead time difficult:

- **Location**
- **Permitting**
- **Delivery time of HRS**
- **Resource bottlenecks**

Lessons learnt have been recorded and guidance documents ([DE](#)) | ([EN](#)) | ([FR](#)) developed to help newcomers to the HRS installation process. Work is on-going in addressing the challenges identified.

Sources: H<sub>2</sub> Mobility Deutschland, Element Energy, AFHYPAAC



# ELECTROLYZER IN GRID OPERATION

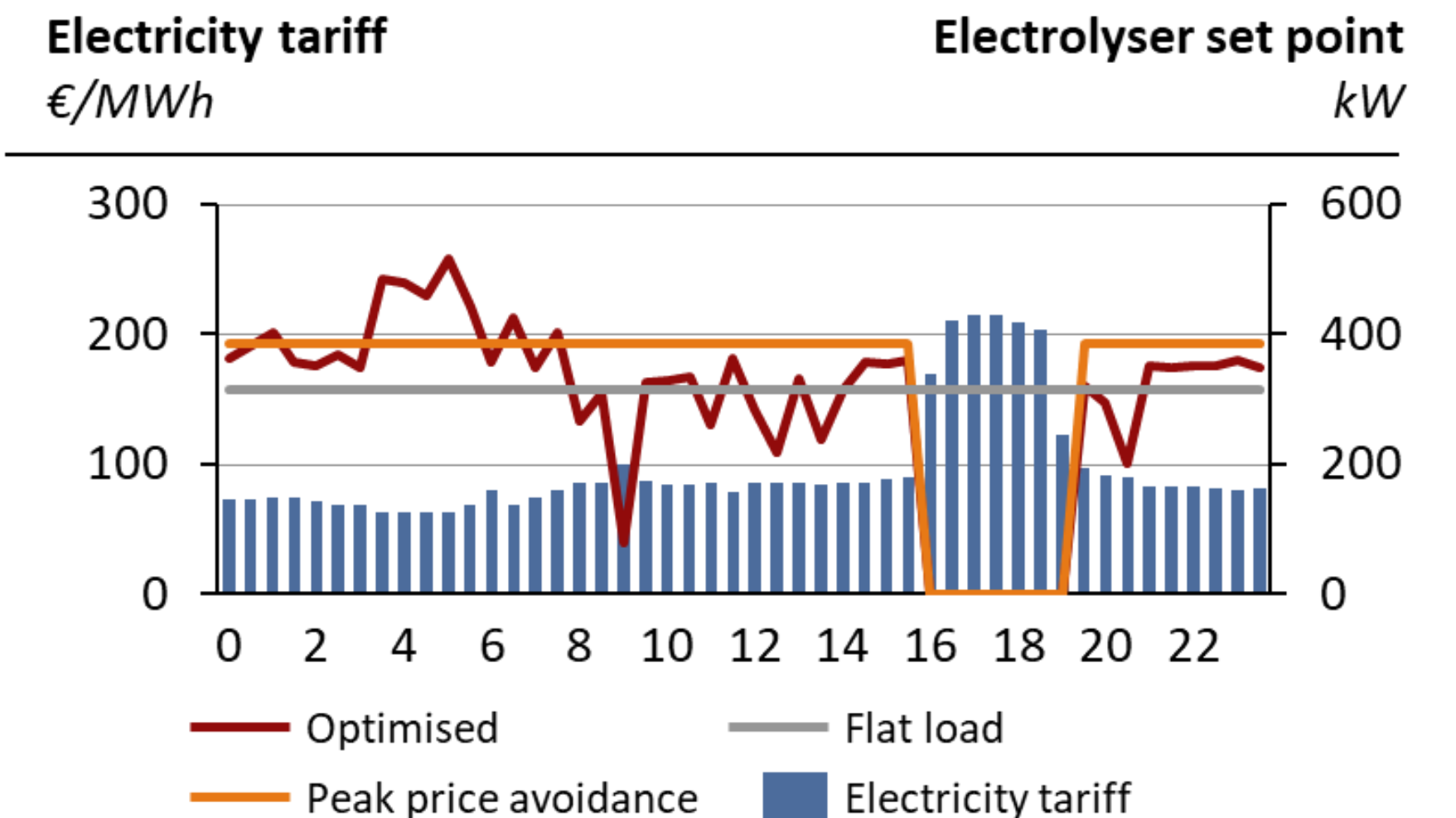
Initial findings of analysis



M1 Wind  
HRS, UK  
@ITM power

- Water electrolyzers can vary their output (and hence electricity demand) very rapidly.
- This **rapid response can be highly valuable to grid operators** who must ensure supply and demand are balanced in the market.
- This requirement for balancing becomes **increasingly important as more intermittent sources of energy generation and new electrical demands** (for heating and transport) are added to the grid.

- Initial analysis conducted as part of H2ME of electrolyzers operating under current grid conditions (i.e. in 2018) showed that **balancing revenues and electricity price optimisation could lead to a reduction in hydrogen prices to end users by ~€1.4/kg**



Scenario	Electricity costs - €/kg	Balancing revenues - €/kg	Net electricity costs - €/kg
Flat load – no balancing	4.9	0	4.9
Flat load – with balancing	4.9	0.6	4.3
Peak price avoidance – with balancing	4.2	0.5	3.7
Optimised – with balancing	4.0	0.5	3.5

# PROJECTS ACHIEVEMENTS TO DATE



## Within the project ...

- 1st H2ME HRS in Germany is 50th HRS opened
- Launch and beginning of operation for 1st Daimler GLC
- HYPE reach 100 cars in Paris - largest FCEVs taxis fleet in the world
- Closer partnership developed between Symbio and Renault
  - 10 Honda Clarity in Europe deployed under H2ME
    - 1st HRS under the canopy in the UK
  - Continue partnership between Shell and ITM power
- FCEVs in fast-response operation and demonstrating they can do it
- 2 HRS opened on the same day in Iceland and 80% of the Icelandic population will be within reach of an HRS by Dec. 18
  - Vehicles from Daimler, Honda, Hyundai, Symbio and Toyota in operation

## ... And much more

- Governments confirmed funding for HFC in several EU countries (UK, FR, NO, NL etc.)
- User cases are starting to emerge – starts of the ZEFER and increased appetite for taxi operation, emergency responses, private rental etc.)
  - Toyota announced plan for 30K vehicles per year by 2020
  - Hyundai released the Nexo and commit to 5000 vehicles for France by 2025



# Acknowledgements

Collaborators and contributors



This project has received funding from the **Fuel Cells and Hydrogen 2 Joint Undertaking** under grant agreement No 671438 and No 700350. This Joint Undertaking receives support from the **European Union's** Horizon 2020 research and innovation programme, **Hydrogen Europe Research and Hydrogen Europe.**



**FUEL CELLS AND HYDROGEN**  
JOINT UNDERTAKING

## **H2ME / H2ME 2 Hydrogen Mobility Europe**



**Lisa Ruf**

**Element Energy**

**Project Coordinator**

<http://h2me.eu/>

[lisa.ruf@element-energy.co.uk](mailto:lisa.ruf@element-energy.co.uk)

**Programme Review Days 2018**

Brussels, 14-15 November 2018