



Fuel Cell Electric Vehicles as Taxis

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Fuel Cell Electric Vehicles as Taxis



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Cenex-LCV 5th September 2019



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FCEVs as Taxis



H2ME and ZEFER

- H2ME (<https://h2me.eu/>) and ZEFER (<https://zefer.eu/>) are Fuel Cell and Hydrogen Joint Undertaking (FCH JU)-supported projects that aim to demonstrate that operating zero tailpipe-emission hydrogen fuel cell electric vehicles (FCEVs) in urban vehicle applications can be viable compared to diesel alternatives.
- The FCEV use cases that are investigated by H2ME and ZEFER include:
 - **As taxis in intensive (up to 24/7) high-mileage operation**, and
 - In inner-city fleets where their zero-emission characteristics and lack of noise are of particular value (e.g., the Metropolitan Police).

FCEVs as Taxis



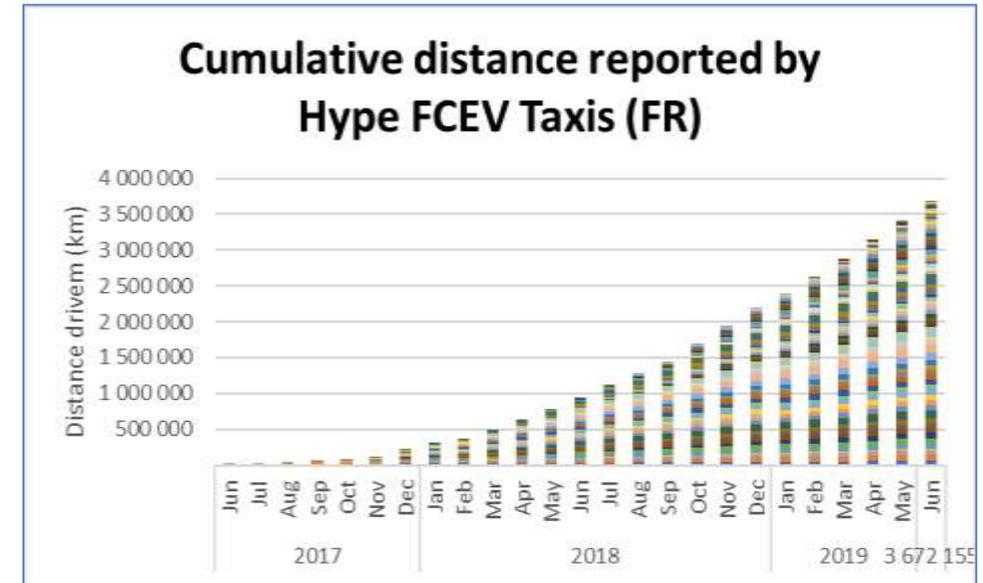
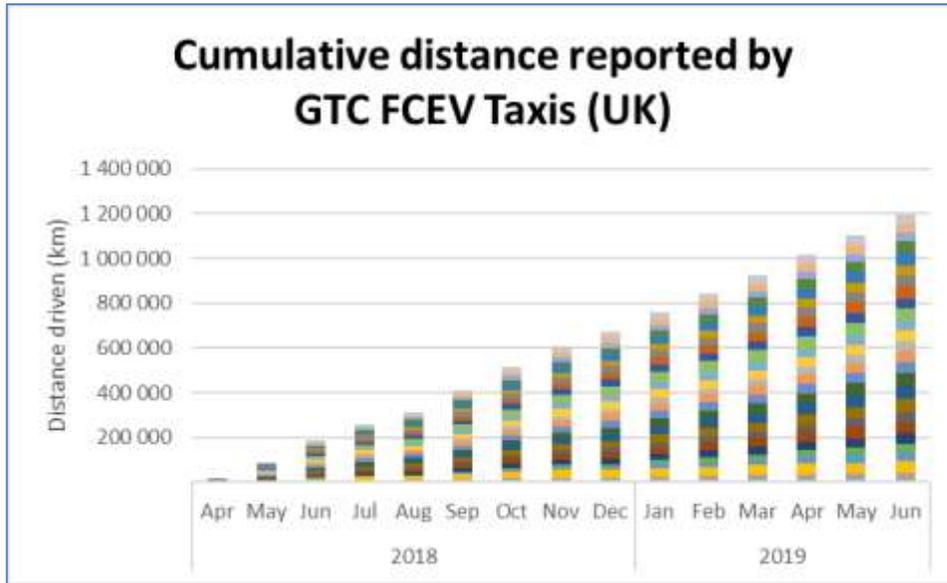
H2ME and ZEFER – vehicles deployed

- **London: Green Tomato Cars (GTC)** deployed 25 Toyota Mirai FCEVs as private-hire taxis in London starting in 2018. The vehicles joined GTC's existing fleet of 600 low emission taxis.
- 25 further Mirais are currently being deployed.
- **Paris: STEP (Société du Taxi Electrique Parisien)**, via its Hype joint venture with Air Liquide, began deploying H2ME-supported FCEV taxis in Paris in 2017.
- Over 100 of an eventual total of 600 FCEVs (the majority will be Toyota Mirais) have been deployed by Hype.



FCEVs as Taxis

How far are vehicles driving?

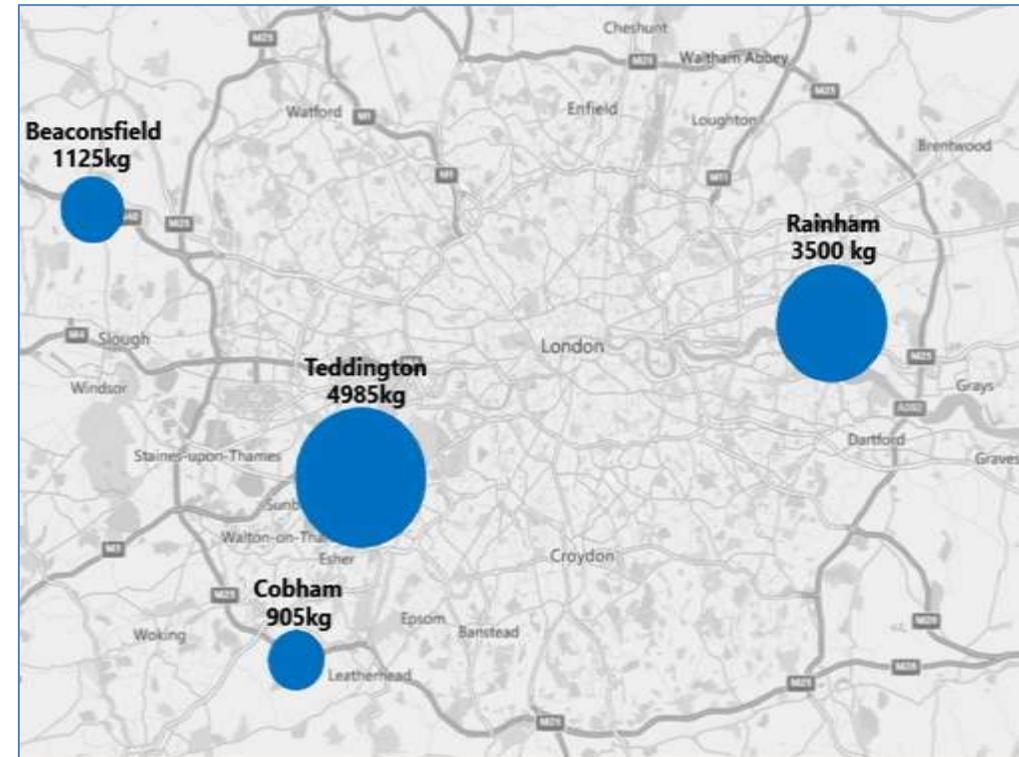


- Project FCEV taxis have reported a total of ~4.8 million km driven since 2017.
- The average distance driven per month is ~3 500 km.
- On average the London FCEVs travel 100 km per kg of hydrogen.
- This equates to a vehicle range of **500 km per 5 kg** tank.

FCEVs as Taxis

Where the FCEVs are being refuelled

- The vehicles use all five London hydrogen refuelling stations*, but 81% of fuelling is at ITM Power's more centrally-located Rainham and Teddington HRS (which are considered *destination HRS*).
- The overall average refuelling amount is ~2.2 kg (44% of the tank capacity of 5 kg).
- Refuelling time is 1 kg H₂/minute.



* ITM Power data only shown

FCEVs as Taxis

Economics

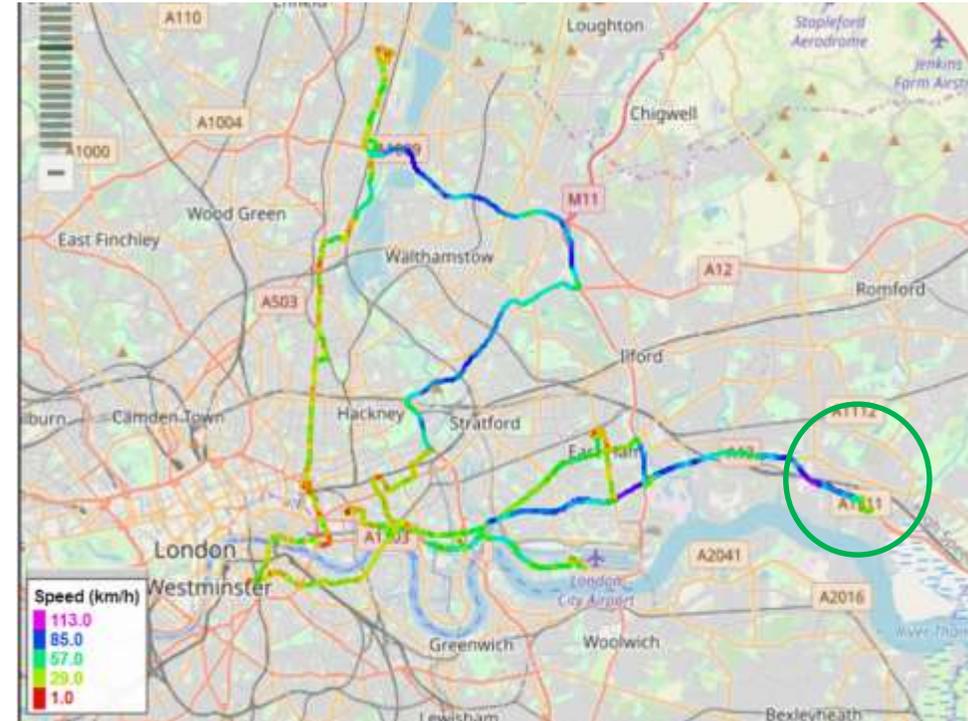
- Support from the FCH JU and OLEV lowers the taxi lease price to 'normal' levels (~£300-£350 per month).
- Vehicles leased for four years/100 000 miles.
- Vehicle serviced every 10 000 miles.
- Aim for vehicle to be 'profit neutral' – in return for lease support, GTC purchases fuel and devotes time to promoting the vehicles and integrating them into its operations.
- Passengers charged a small premium (~10%) if they specifically request a H₂ taxi.



FCEVs as Taxis

Operational adjustments

- Dispatching software limits vehicles to up to ten miles outside M25 to ensure vehicles remain within reach of the London HRS network.
- In practice, this only affects ~ 3% of GTC's journeys.
- Drivers trained to be ambassadors for the vehicles and to drive the vehicle as economically as possible.
- Over ~ 18 months, only four out of fuel incidents.



FCEVs as Taxis

Safety

- As we've shown, the 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 vehicle shown in the photograph is being repaired.

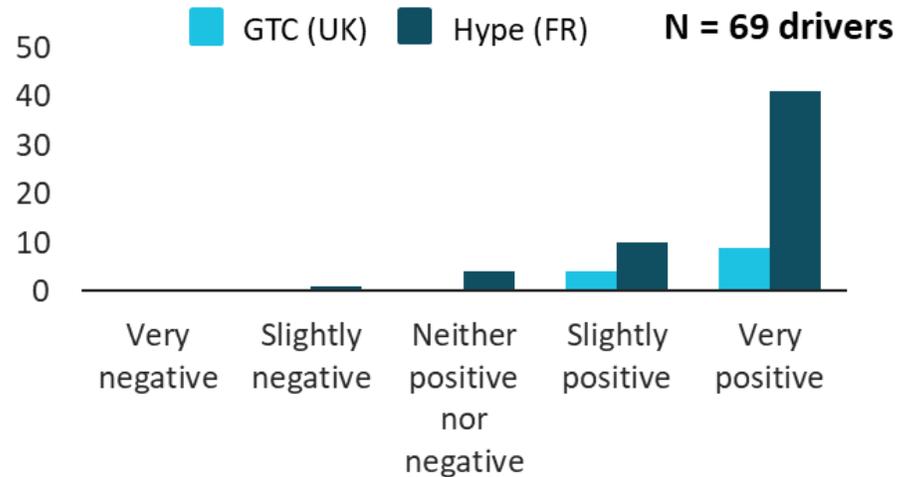


FCEVs as Taxis

What do drivers think?

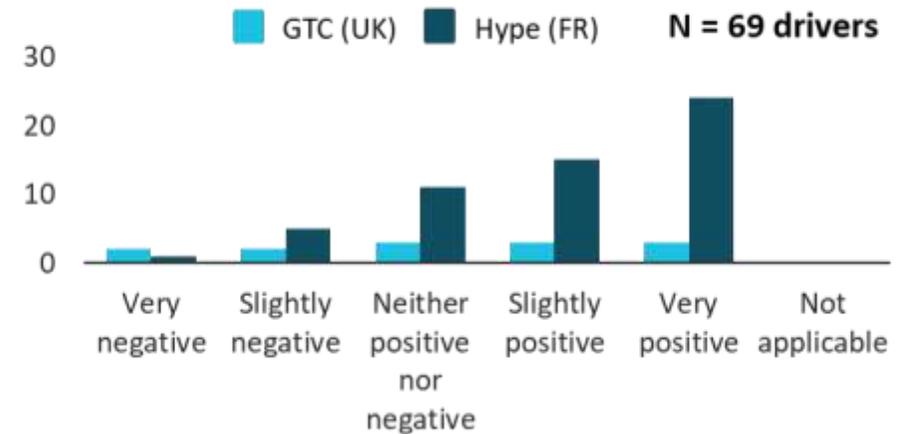
FCEV

Overall, how would you describe your experience with FCEVs?



HRS

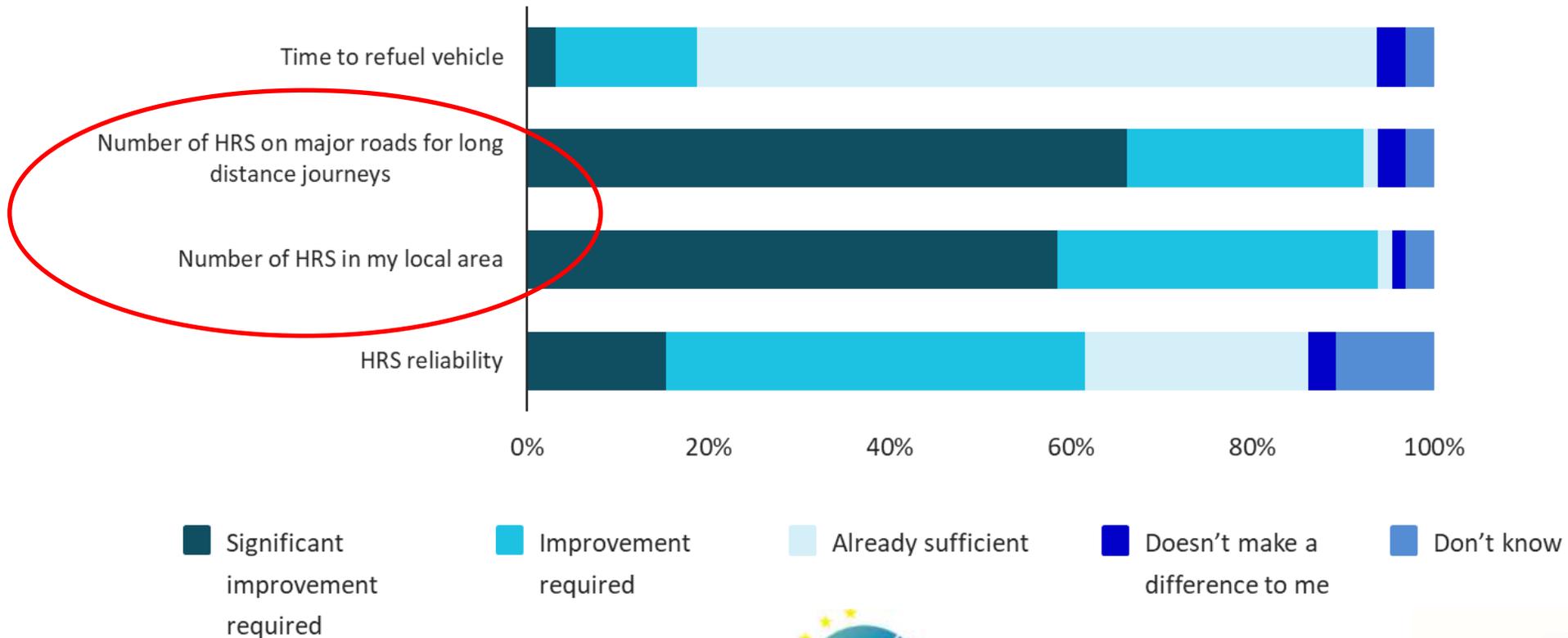
Overall, how would you describe your experience with hydrogen refuelling stations?



What do drivers think?

Based on your first experience of Hydrogen Refueling Stations (HRS), which of the following do you think have to be improved before they would be suitable for your organisation?

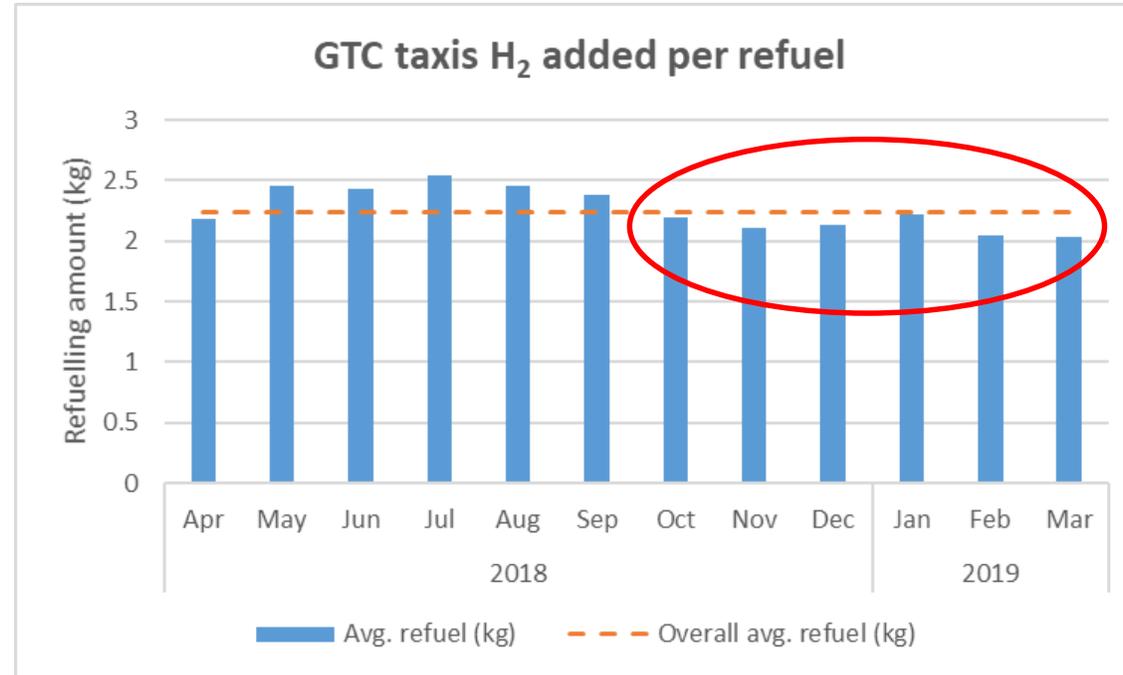
Total, N=65 drivers



FCEVs as Taxis



Working with drivers and refuelling station providers



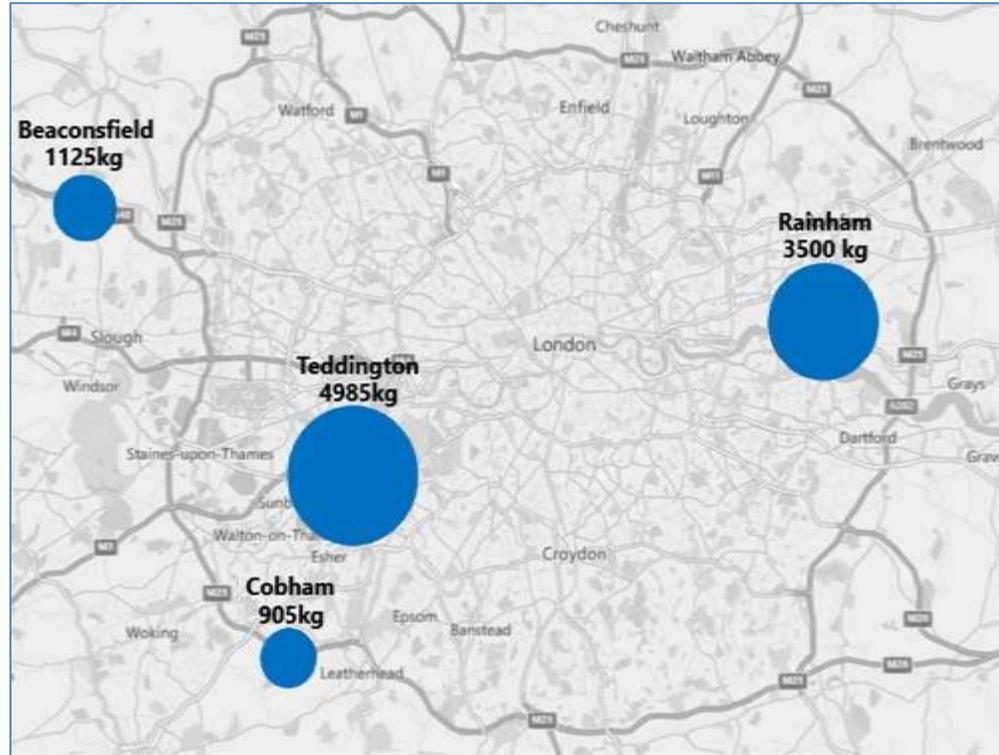
- Refuelling data above shows that drivers in late 2018/early 2019 were refuelling more (too) frequently: average refuelling amount and distance between refuelling events were down.
- Unnecessary trips to refuel reduce economic efficiency of the drivers.



FCEVs as Taxis



Where the FCEVs are being refuelled



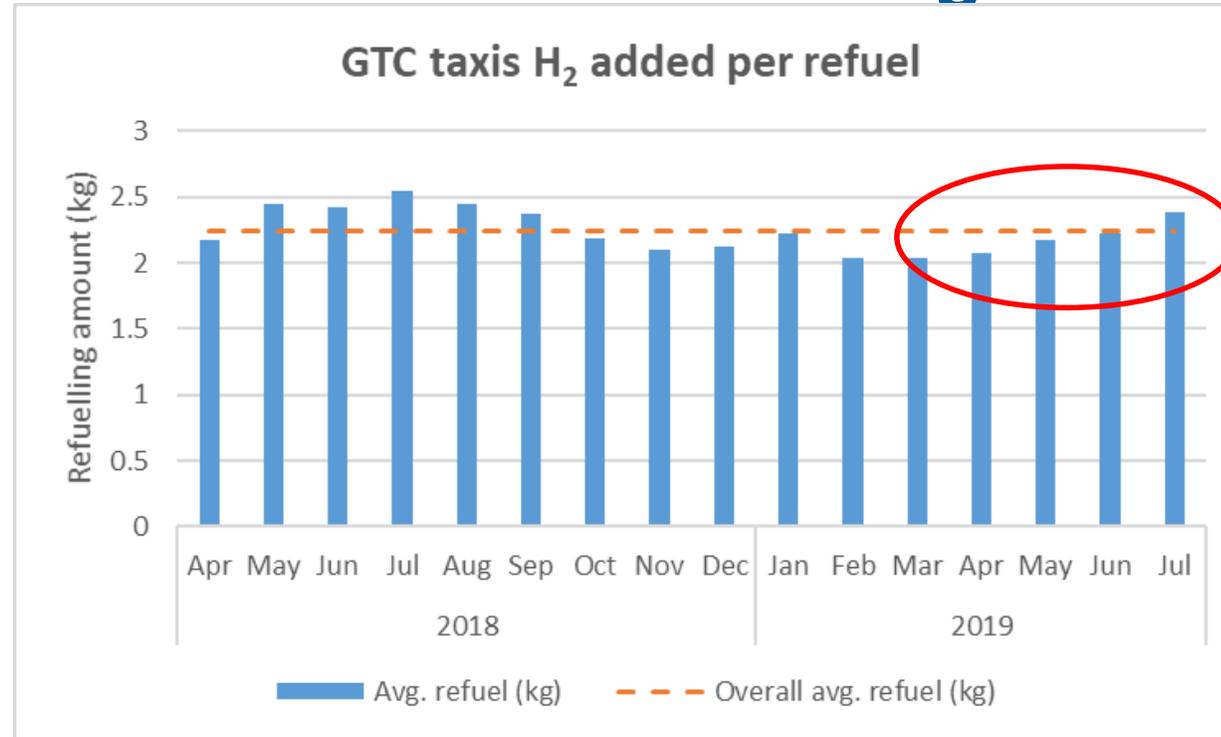
Working with drivers and refuelling station providers

- Addressed by a combination of measures:
 - 1. Working with ITM Power to provide more feedback to the drivers on the availability of the stations in the refuelling network.
 - 2. ITM Power developed and released an app which shows live data on the status of each refuelling station.
 - 3. Changing drivers from contracted to self-employed which incentivises them to increase hourly productivity and minimise unnecessary trips to refuel.

FCEVs as Taxis



Working with drivers and refuelling station providers



- Initial evidence since changes introduced indicates that drivers are improving refuelling efficiency and therefore productivity.

Conclusions

- Toyota Mirai fuel cell electric vehicles are operating effectively as zero tailpipe-emission taxis in cities including London and Paris.
- Since 2017, H2ME and ZEFER FCEV taxis have driven almost 5 million km.
- In London, the taxis drive around 100 km on each kg of hydrogen fuelled.
- Using FCEVs as taxis requires only minor operational adjustments to keep journeys within reasonable range of refuelling stations.
- The FCEVs have proven to be reliable. They are serviced every 10 000 miles.
- The vehicles have been involved in several accidents and collisions. **None of the incidents involved any release of hydrogen or problems with the fuel cell system.**
- Quantitative analysis, feedback from drivers and partnership working with vehicle/station providers is used to improve the operational efficiency of the vehicles.

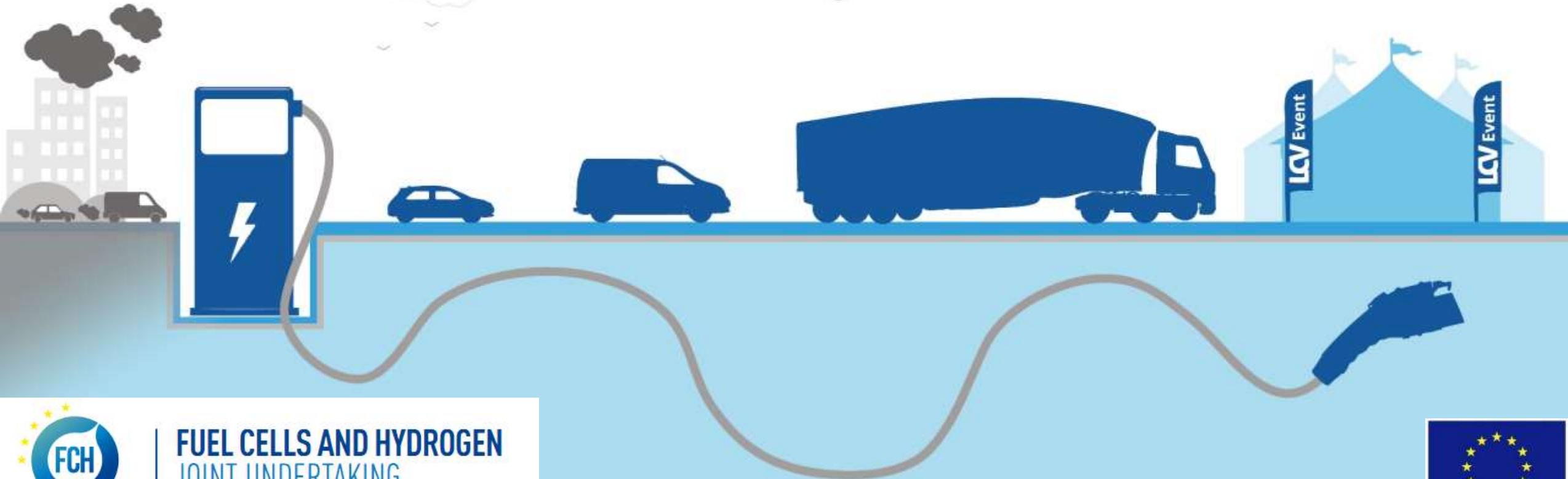
Thank you for listening

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These activities have received funding from the European Union's Horizon 2020 Programme through the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) under grant agreement numbers 671438, 700350 & 779538.



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