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Innovation in Transport for Sustainable Cities and Regions



## JIVE – fuel cell buses, a zero emission solution

Sabrina Skiker, Communications and EU  
Policy Manager  
Hydrogen Europe



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**JIVE and MEHRLIN projects**



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# Hydrogen Europe Membership >185 Companies, Research institutes and Associations



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Aim : Making hydrogen and fuel cells an everyday reality in Europe



Specifically on buses: lead of the dissemination activities of the JIVE project (bus deployment)

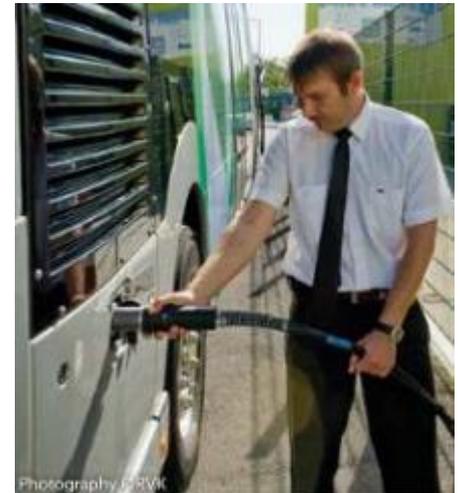
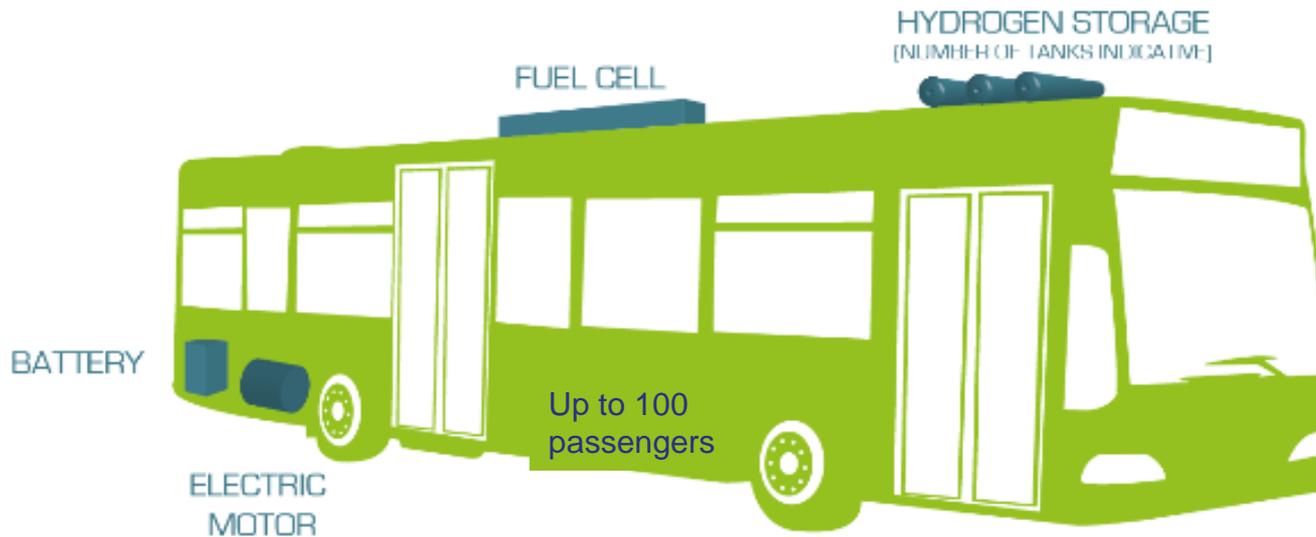
# Cities' common challenges & political solutions



- Cities across Europe and beyond are facing common challenges:
  - **Increasing urbanisation & congestion** – growing demand for transport services
  - **Environmental challenges** – air quality, GHG emissions
  - **Economic constraints** – affordable, reliable, high quality services with limited budgets
- Political answers: cities and countries plans to phase out diesel (France, Netherlands, UK) and go for low and zero emission solutions (e.g.C40 cities statement) + push with the targets in the Clean Vehicles Directive review
- Electrification as the only long term viable option for delivering zero emission buses, with two principal options:
  - 1) Battery electric buses
  - 2) Fuel cell electric buses

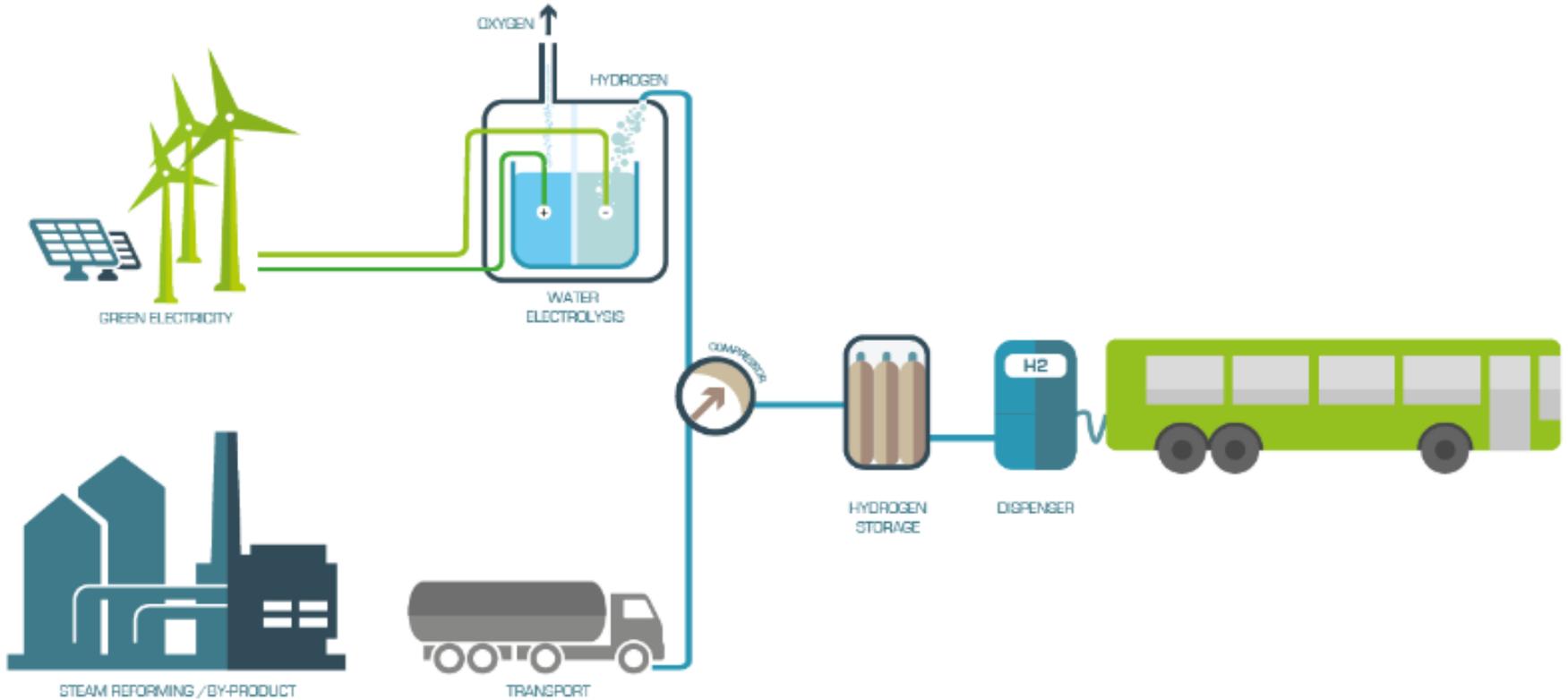


# A fuel cell bus : an electric bus



- Fuel cell: “transform” hydrogen in electrical energy
- Electric motor: converting electrical energy to mechanical energy
- Battery: balancing peaks in demand and storing regenerated braking energy

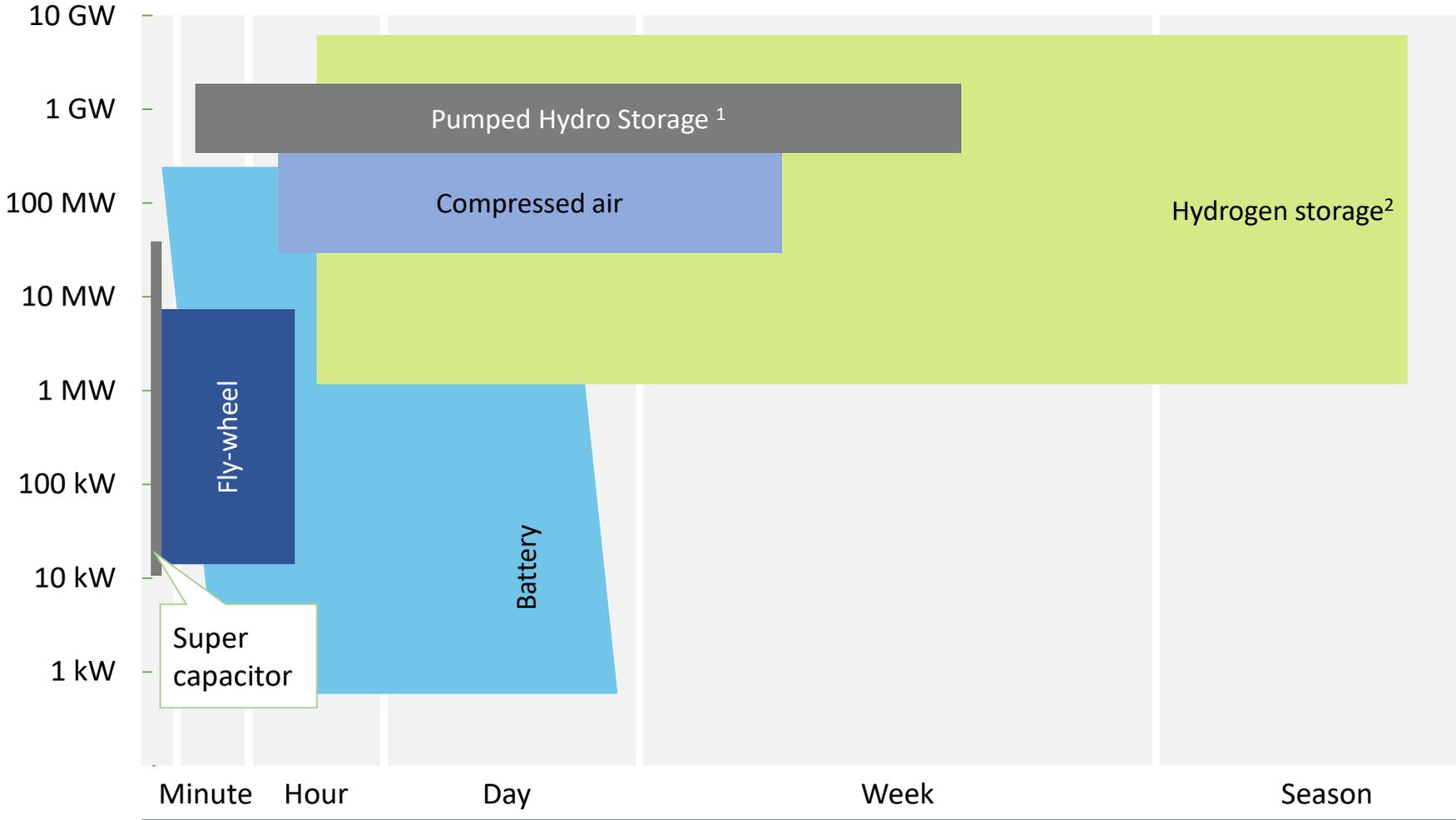
# Hydrogen production/ Refuelling Station - basics



Deploying fuel cell buses implies :

- Dedicated training
- Bus depot adaptation

# Hydrogen for long-term carbon-free energy storage



<sup>1</sup> Limited capacity (<1% of energy demand)

<sup>2</sup> As hydrogen or synthetic natural gas

Source: IEA Energy Technology Roadmap Hydrogen and Fuel Cells

# Why hydrogen is a multivector in a resilient system?



- Hydrogen can play 7 roles in the energy transition :

Enable the renewable energy system → Decarbonize end uses

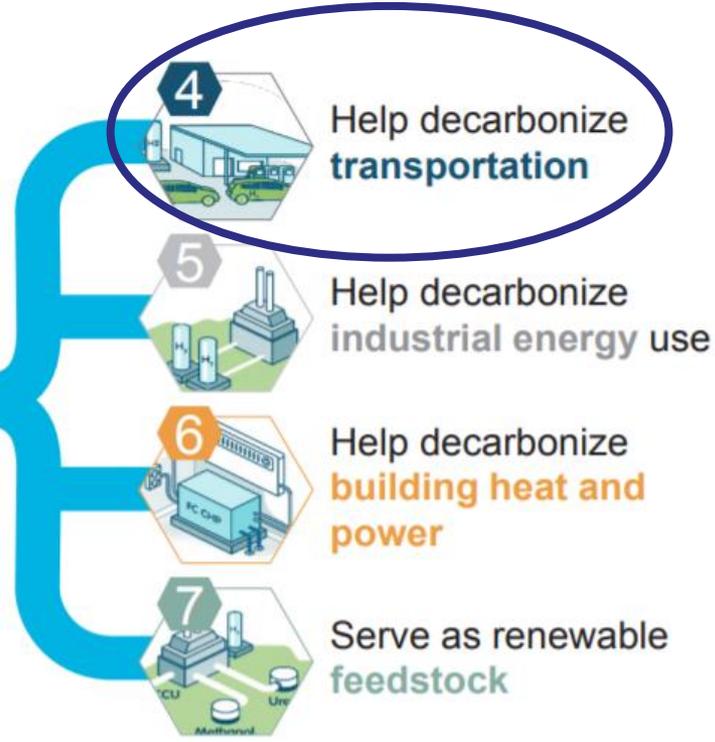
Enable **large-scale renewables integration** and **power generation**



**Distribute** energy across sectors and regions



Act as a **buffer** to increase system resilience



# Why go for fuel cell buses?



## High daily range

350+ km without refuelling



## Operational flexibility

...no need for new street infrastructure, rapid refuelling (<10 min)



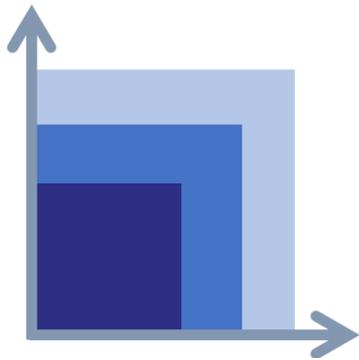
## Zero tailpipe emissions

Only water emitted and CO<sub>2</sub> emissions savings – linked to hydrogen production source



## Comfort for passengers and drivers

...due to reduced noise levels and smooth driving experience



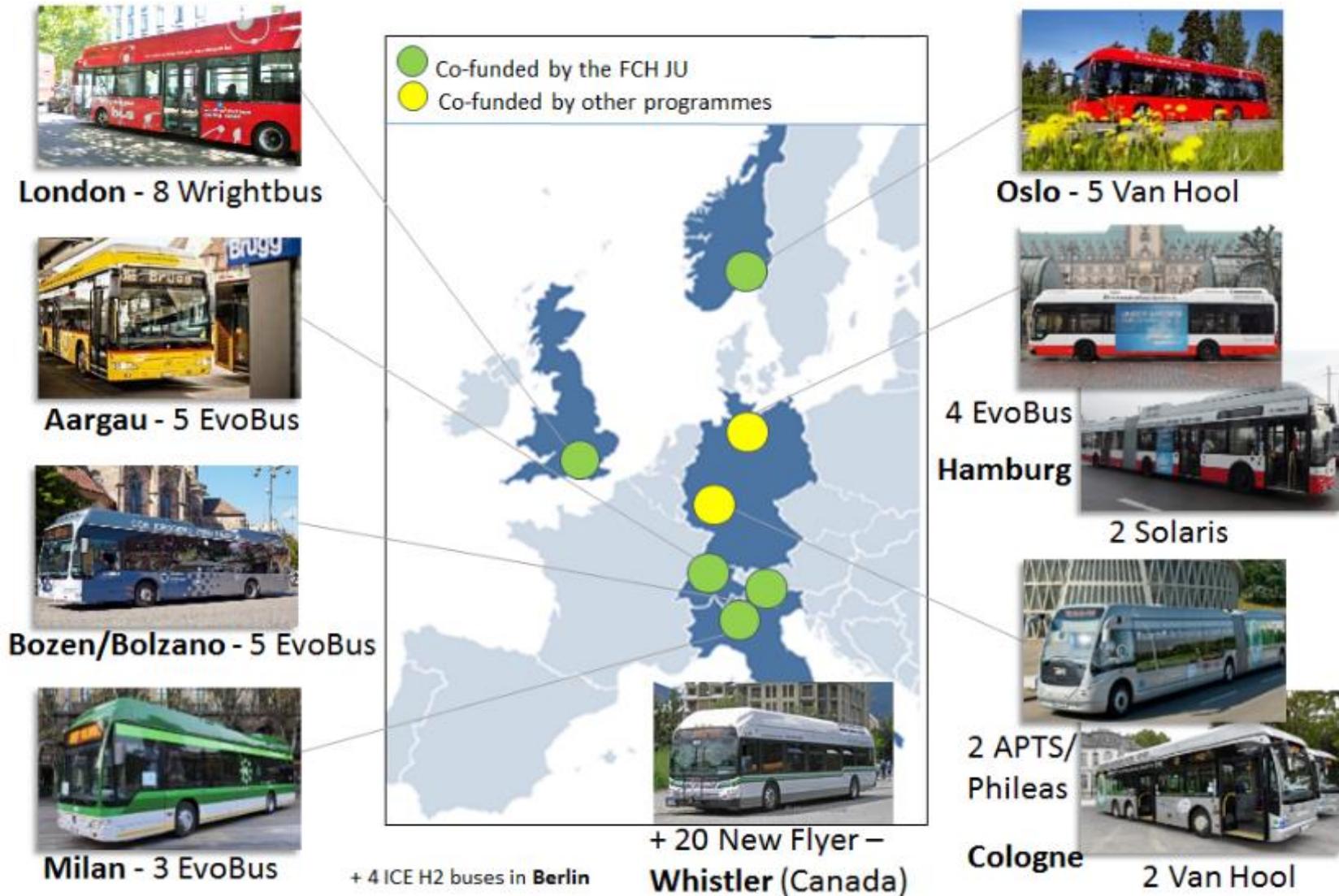
## Scalability

The refuelling infrastructure is readily scaled up to accommodate growing fleets



**A concrete answer to ambitious policy targets set for transport decarbonisation**

# CHIC delivered 56 fuel cell buses in eight cities from six different OEMs (2010-2016)



# CHIC conclusions & recommendations

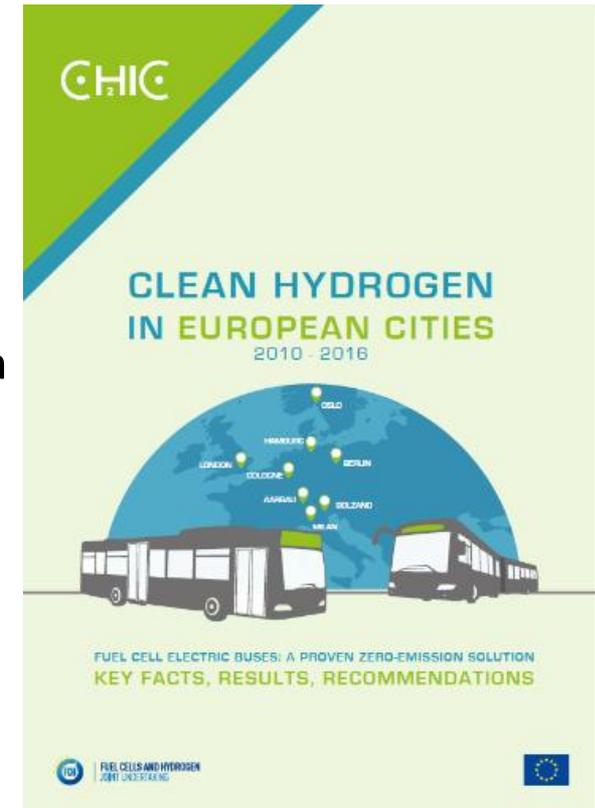


## • Fuel cell buses can offer:

- ✓ **Operational flexibility** (comparable to diesel):
  - Experience with >9 million kms driven
- ✓ **Zero local emissions**
- ✓ **Reduced CO<sub>2</sub> emissions** with a pathway to zero emission
- ✓ **Satisfaction for end users** (drivers & passengers)

## • Recommendations :

- ✓ **Improve bus availability**, especially at the beginning – by resolving teething technical issues & increasing scale
- ✓ **Reduce the technology costs – bus and hydrogen prices** – coordinated commercialisation process
- ✓ **Harmonise regulations** on hydrogen refuelling stations – work underway on international standards



Report available at:

<http://www.fuelcellbuses.eu/public-transport-hydrogen/fuel-cell-electric-buses-proven-zero-emission-solution>

# The largest fuel cell bus deployment project to date started in January 2017 for 6 years



## JIVE – bus deployment

- **139 new zero emission fuel cell buses** across 5 countries

## MEHRLIN – infrastructure

- **7 hydrogen refuelling stations** in 7 EU locations

Aim: advance the **commercialisation of fuel cell buses** and **boost the deployment of hydrogen as an alternative fuel** in the EU through large-scale deployment of vehicles and infrastructure



- Co-funded by a €32M from the **FCH JU** under the **EU Horizon 2020** programme

- Co-funded by €5.5M from the **EU Connecting Europe Facility**

# JIVE & MEHRLIN Partners and deployment sites



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Herning Kommune



**1** Scottish cluster, UK – 10 buses  
Aberdeen City Council

1b Dundee City Council

11 Oude Tonge, NL (no bus funded within JIVE)  
Stedin Diensten **STEDIN** INFRADIENSTEN

**5** Herring, DK– 10 buses  
Herring Kommune

**2** Birmingham, UK – 20 buses  
Birmingham City Council

ITM Power

**6** Riga, LV – 10 buses  
Riga Satiksme



**3** London, UK – 26 buses  
London Bus Services Ltd  
London Bus Services Ltd

**7** Wuppertal, DE – 10 buses  
WSW mobil AWG



**4** South Tyrol, IT – 15 buses  
SASA, STA, IIT

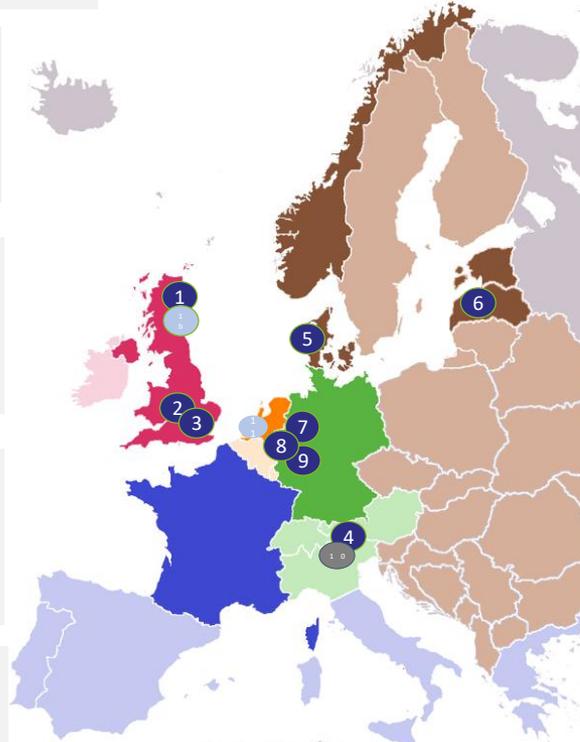
**8** Cologne region, DE– 30 buses  
Regionalverkehr Köln  
Regionalverkehr Köln  
Stadwerke Hürth



10 Rovereto, IT  
Trentino Trasporti

**9** Rhein-Main, DE – 11 buses  
VMW **VMW**

Local coordinators JIVE  
Local coordinator MERHLIN  
Bus operators Follower

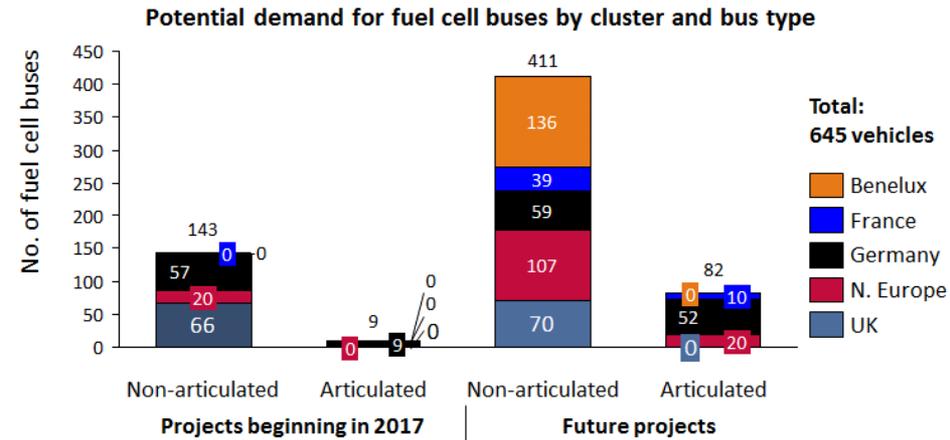


# A commercialisation strategy has identified demand for hundreds of FC buses in Europe and is leading to progress in reducing costs



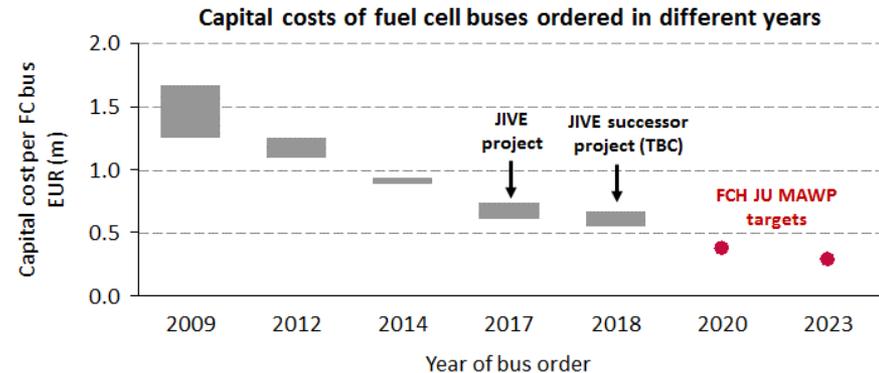
## Achievements to date

- Fuel cell bus clusters set up across Europe
- Demand for >600 buses identified
- Initiation of large-scale coordinated deployment projects (JIVE 1 and 2<sup>1</sup>)
- Procurement exercise launched in the UK and Germany
- Indications of a number of suppliers interested in delivering buses below the JIVE price target
- Demand for fuel buses in countries that had not previously engaged with the technology (Denmark, France, etc.)
- Development of innovative approaches to joint procurement (e.g. in the Netherlands)



## Potential demand for FC buses by cluster and bus type

Source: *Strategies for joint procurement of fuel cell buses*, Element Energy et al. for the FCH JU, Figure 9, p.30 (July 2016).



<sup>1</sup> The JIVE 2 project has been submitted in April 2017 and could support another 152 fuel cell buses

# Thank you for your attention

**Project coordination**  
Element Energy Limited

**Project dissemination**  
Hydrogen Europe

**Sabrine Skiker**  
Communications and EU Policy Manager  
[s.skiker@hydrogeneurope.eu](mailto:s.skiker@hydrogeneurope.eu)

[www.fuelcellbuses.eu](http://www.fuelcellbuses.eu)



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