PUBLIC TRANSPORT APPLICATION (BUS PROCUREMENT INITIATIVE) IN EUROPE

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CLIMATE CHANGE AND CLEAN AIR OBLIGATIONS

Our health
is in danger!

Our health is in danger!

SHIFTING PUBLIC AWARENESS TOWARDS SUSTAINABILITY AND ECO-FRIENDLINESS REQUIRES NEW SUSTAINABLE TRANSPORT SOLUTIONS

Europeans perceive major environmental problems…

> 50% of Europeans think that **climate change** is one of the three most important challenges our world faces

> 81% say that **air pollution** is an important problem

> 72% of citizens say that **noise pollution** is a problem in their cities

…to be caused by the transport sector…

> 63% feel that transport is a main **threat to air quality**

> 56% of Europeans think pollution can be reduced by **improving public transport**

> 71% of European citizens say that **electric cars are the most environmentally** friendly mode of transport

…and want local authorities to solve them

> 56% of Europeans think that public transport can best be improved by **city authorities**

> 72% of Europe's population believe that public authorities **aren't doing enough to improve air quality**

Source: Eurobarometer "Climate Change" (2014); Eurobarometer "Urban Mobility" (2013); Eurobarometer "Air quality"(2013)

FC BUSES ARE THE MOST FLEXIBLE ZERO EMISSION OPTION – CLEAN LIKE BATTERY ELECTRIC, THEY CAN BE OPERATED LIKE DIESEL BUSES

High daily ranges

… of 300 km on average without refuelling – Extension possible

Full route flexibility

… not bound to any required infrastructure on the route

Performance

… comparable to diesel buses, e.g. acceleration or gradeability

Fast refuelling

… down to 7 minutes possible – Also several refuelling cycles per day possible

High passenger comfort

… due to reduced noise levels and smooth driving experience

Close to technology maturity

… with more than ten years and 8 M km of operational experience

Note: For a comparison of different alternative powertrain solutions please refer to the study "Urban buses: Alternative powertrains for Europe"

Situation and Outlook in Europe
91 buses in operation or about to start

Ongoing EU-funded fuel cell bus projects

CHIC

- ✓ Aargau, CH –5 FC buses (2011)
- ✓ Bolzano, IT– 5 FC buses (2013)
- ✓ London, UK – 8 FC buses (2011)
- ✓ Milan, IT – 3 FC buses (2013)
- ✓ Oslo, NO – 5 FC buses (2013)

- ✓ Cologne, DE* – 4 FC buses (2011/14)
- ✓ Hamburg, DE* – 6 FC buses (2011/2015)

High V.LO-City

- ✓ San Remo, IT – 5 FC buses (2016)
- ✓ Antwerp, BE – 5 FC buses (2015)
- ✓ Aberdeen, UK – 4 FC buses (2015)

HyTransit

- ✓ Aberdeen, UK – 6 FC buses (2015)

Legend

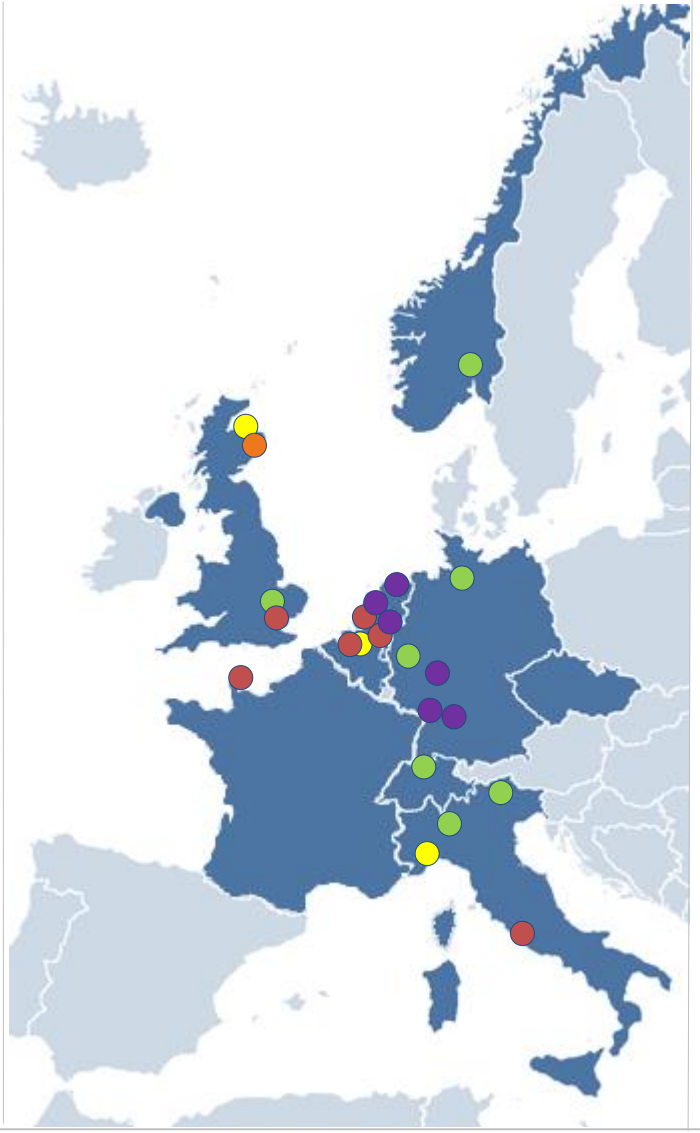
Countries with (upcoming) fuel cell buses

✓ In operation

✓ Planned operation

(2015) Operation start/planned start

* Co-financed by regional/national funding sources



Ongoing EU-funded fuel cell bus project

3Emotion

- ✓ Cherbourg, FR – 5 FC buses (2017)
- ✓ South Rotterdam, NL – 2 FC buses (2017)
- ✓ South Holland, NL – 4 FC buses (2017)
- ✓ London, UK – 2 FC buses (2017)
- ✓ Antwerp, BE – 3 FC buses (2017)
- ✓ Rome, IT – 5 FC buses (2017)

Current national/regional-funded fuel cell bus projects

- ✓ Karlsruhe, DE * – 2 FC buses (2013)
- ✓ Stuttgart, DE * – 4 FC buses (2014)
- ✓ Frankfurt, DE * - 1 FC bus (2016)
- ✓ Arnhem, NL* – 3 FC buses (2017)
- ✓ Groningen, NL* – 2 FC buses (2017)
- ✓ North Brabant, NL* – 2 FC buses (2016)

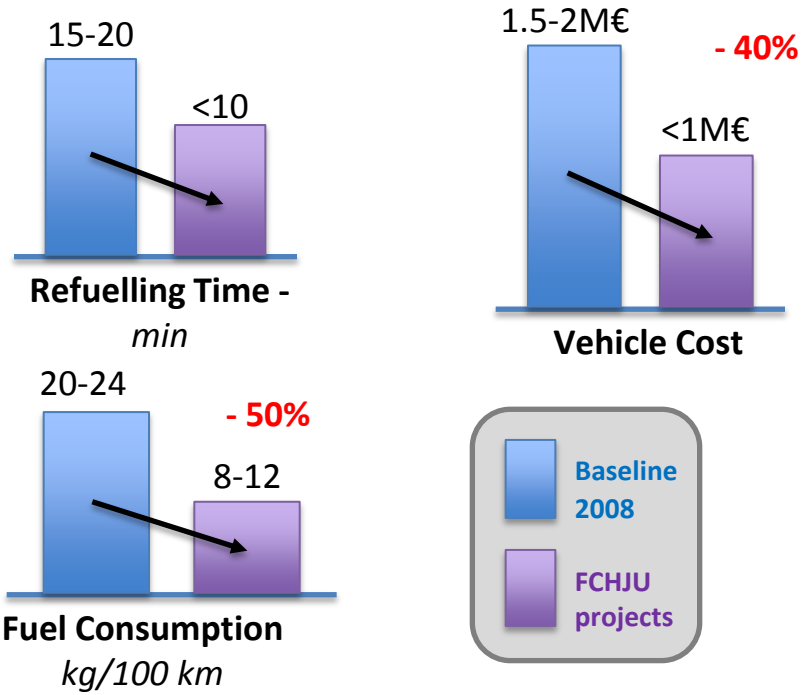
Last update: May 2016

FCH JU PROJECTS: ACHIEVEMENTS AND CHALLENGES

61M€ for 67 buses from 4 projects in 12 locations

Achievements

- As flexible as diesel buses
  - Full operations: 12-20hr daily shifts
  - Short refuelling time
- Cost reduction
- Efficient electric drivetrain
- Availability: 90% reached in certain locations over last year



Challenges

- Availability
- Spare parts
- Time to repair
- Trained staff
- Cost of FCBs, Infrastructure/H2

Volumes bring lower costs and mature supply chain

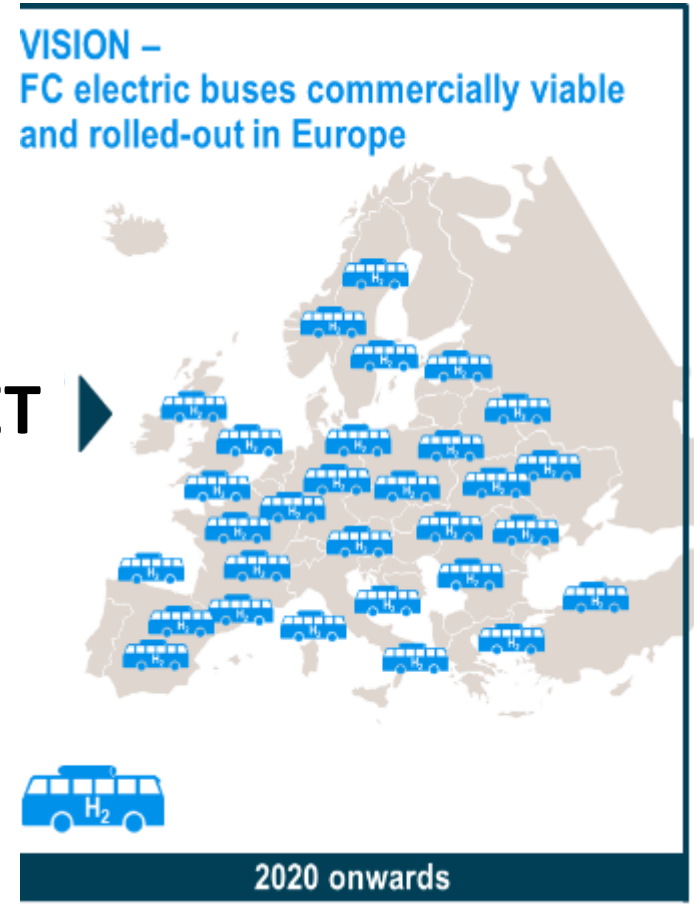
DEFINE VOLUMES THAT ENABLE COMMERCIAL MARKET AND PATHWAY TO ACHIEVE THEM

Early indications from suppliers indicate need to reach 500-1000 buses for market

How to achieve those figures within the FCH JU programme?

Must gauge purchase appetite as costs decrease to avoid valley of death and obtain commitments thereof

MARKET



Commercialisation Study

BUSES: FROM DEMO TO A 1.5 B€ MARKET APPETITE

A broad stakeholder coalition of 82 organisations established within studies
– Operators and local governments have grown now to 64 locations

Participating locations

Bus study Industry members

Bus manufacturers

VANHOOL, MAN, SOLARIS, ŠKODA, EvoBus, APTS, VDL

Infrastructure/ H_2 providers

H2 Logic, Shell, Ballast Nedam, Linde, AIR LIQUIDE, ITM POWER, AIR PRODUCTS, SIEMENS, HYDROGENICS, McPhy

Technology providers

HYDROGENICS, BALLARD, SIEMENS, PM, Intelligent Energy

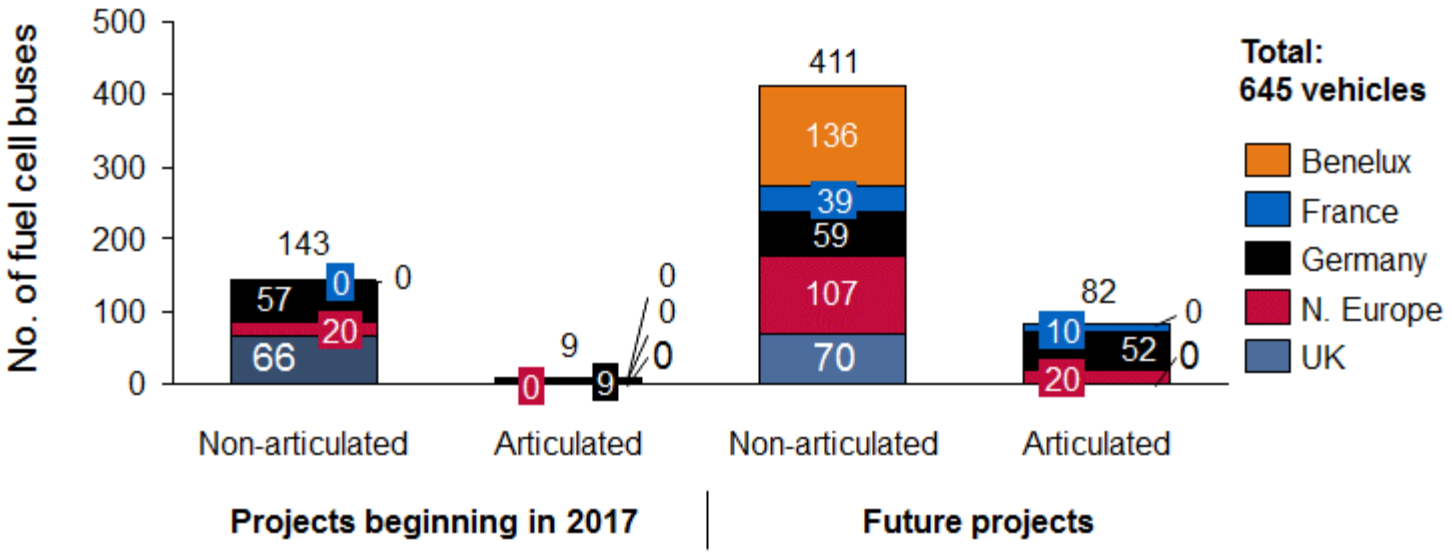
Other organisations

Government of the Netherlands, VRR, NOW, hySOLUTIONS, VDV Die Verkehrsunternehmen, EnergieRegion.NRW, iit

Secured commitments for roll-out and large scale demos

FUEL CELL BUS DEPLOYMENT PLANS – EUROPEAN LEVEL

Potential demand for FC buses by bus type (12m / 18m) and by cluster



Note that these are provisional estimates based on the work of the cluster coordinators to date. No firm commitment has been made to procure fuel cell buses by any parties involved. While the cluster coordinators have sought to provide realistic and relatively conservative deployment numbers, in practice these figures may well fall as more detailed local feasibility work is undertaken.

Comments

- Early figures indicate >600 fuel cell buses
- Overall level of investment: 1.5B€
- On-going engagement with bus industry to ensure demand can be met

Study published and available at: www.fch.europa.eu

USERS AND SUPPLIERS AGREE ON THE NEED FOR ACTION

5 leading bus suppliers and 30 cities/operators have made clear public statements of their commitment to support commercialisation of FC buses

Bus Suppliers Letter of Understanding

LoU presented to demand side representatives in an Handover-Ceremony in Brussels, 12 November 2014

Left to right: First Mayor Olaf Scholz (Hamburg), Deputy Mayor Kit Malthouse (London), Filip van Hool (CEO Van Hool), Dariusz Michalak (Deputy CEO Solaris), Rémi Henkemans (Managing Director VDL Bus & Coach), Gustav Tuschen (Head of Product Engineering Daimler Buses)

Letter of Understanding of Transport Operators and Public Authorities

LoU handed over to the EU Commissioner of Transport at the TEN-T Days in Riga on 23 June, 2015

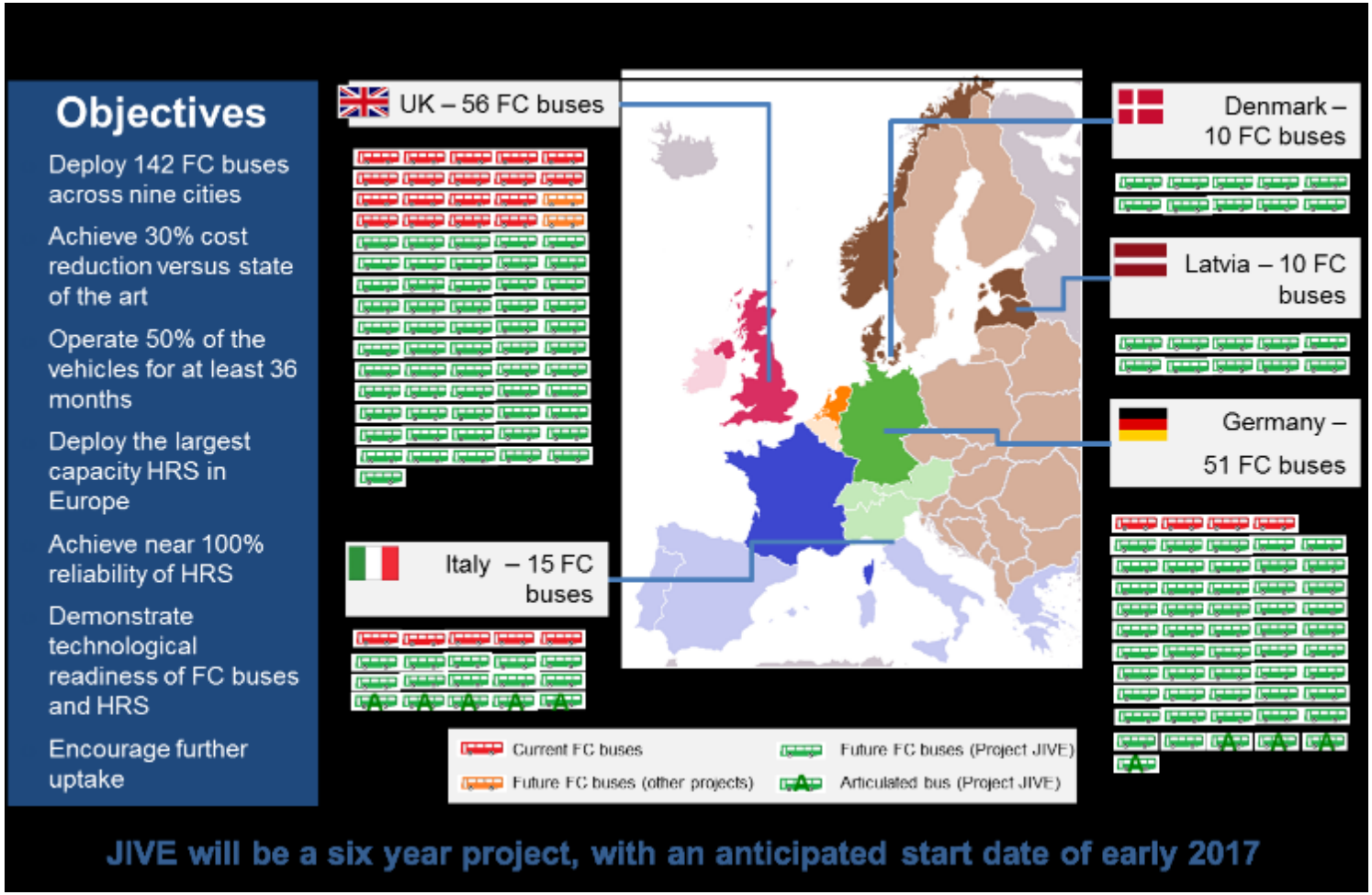
Left to right: Bert de Colvenaer (FCH JU Executive Director), Pierre-Etienne Franc (NEW-IG Chairman), Nils Usakovs (Mayor of Riga), Els de Wit (Head of Clean Fuels at the Dutch Ministry of Infrastructure and the Environment), Kirsten Holling (Ministry for Building, Housing, Urban development and Transport NRW), Violet Bulc (Commissioner for Transport), Bernard Frois (IPHE Chairman), Catherine Trautmann (European Coordinator North Sea-Baltic Corridor), Kurt Bodewig (European Coordinator Baltic-Adriatic Corridor), Florian Mussner Councillor for Mobility of South Tyrol-Bolzano)

FCH JU – CALL 2016

- Open call for proposals includes topic for large scale validation of fuel cell bus fleets – max. funding of 32M€
- Requires:
  - At least 100 buses in total
  - At least 3 cities with 20 buses
  - At least 10 buses per participating location
  - Maximum price for standard 12m bus: 650,000€
- Provides:
  - Up to 200,000€ per standard 12m bus
  - Up to 1.2M€ for large stations, up to 600,000€ for small fleets
- More info available at www.fch.europa.eu

JOINT INITIATIVE FOR HYDROGEN VEHICLES ACROSS EUROPE (JIVE)

A project to deploy 142 buses and fuelling stations in 9 European cities in 5 member states – this bid was submitted to the FCH JU in May 2016.



CONCLUSIONS

Investing in FC buses bears significant benefits

Politically

There is a push for reducing emissions in public transport

Environmentally

FC buses help to reduce noise levels, to green cities and public transport

Operationally

FC buses are the most flexible zero emission option

Economically

FC buses reduce external costs of public transport

Organisationally

The coalition and the FCH JU support operators in introducing FC buses

THANK YOU FOR YOUR ATTENTION

Thanks to Carlos NAVAS, Strategy Officer at FCH 2 JU for his kind contribution

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Further information

- **FCH2 JU** : http://www.fch.europa.eu/
- **HYDROGEN EUROPE** : www.hydrogeneurope.eu
- **N.ERGHY** : http://www.nerghy.eu