

The first edition of the International Zero Emission Bus Conference took place on 30 November 2016 in City Hall, London, followed by the 10th edition of the International Fuel Cell Bus Workshop on 1st December 2016. Over 250 high level stakeholders from 22 countries attended the event! Representatives from local authorities, transit operators, industry, and national and financial regulatory and funding agencies held lively discussions around zero emission bus (ZEB) technologies' readiness levels and commercialisation paths. It was agreed unanimously that ZEB technologies are ready to be deployed globally today.

All presentations and the full program are available here: http://www.cte.tv/zebc_presentations/

KEY TAKEAWAYS:

- ❖ **Over 100 fuel cell electric buses (FCEBs) are currently in commercial operation worldwide with over 11million km of service**
- ❖ **200 additional FCEB will be deployed in Europe and US in next 2 to 3 years**
- ❖ **FCEBs have demonstrated availability ranging from 75% to 95% in US and EU**
- ❖ **FCB costs have decreased by 75% since 1990s**
- ❖ **Transit agencies/bus operators currently operating FCEBs today are looking at expanding their fleet in the near future**
- ❖ **FCEBs are used today by operators like direct replacement of conventional buses offering the same flexibility**
- ❖ **Hydrogen infrastructure solutions are scalable - up to 100 buses exist todayStakeholders agreed that there is a need to continue global cooperation in order to drive down costs and share experience and best practises.**
- ❖ **Regulations and Incentives are needed to promote the uptake of FCEBs**
- ❖ **Areas for improvement – bus and infrastructure cost, aftersales support (spare part cost and availability, trouble shooting), servicing by bus operators (training programs), support funding and regulations**

US FCEB status and improvements *(see presentations Sunita Satyapal and Leslie Eudy)*

- The capacity of fuel cells shipped worldwide doubled from 2014 – 2015 (300 MW in 2015) – The US Department of Energy has 2020 targets of €40/kW.
- California is leading the way in FCEB deployments with 19 FCEBs already and >30 planned. Almost two thirds of US have clocked up over 15,000 hours and have an average availability at 77%, with fuel cell system issues accounting for 40% of the problems.
- NREL presented the 2016 Fuel Cell Buses in U.S. Transit Status Report¹

EU FCEB deployments *(see presentations Kerstin Mueller and Amy Perry)*

- The FCEB project CHIC deployed 54 FCEBs in Europe and at one site in Canada. The overall project successfully demonstrated the flexibility in operation that hydrogen offers compared

¹ https://energy.gov/sites/prod/files/2016/12/f34/fcto_2016_fuel_cell_bus_report.pdf

with diesel, with >9.6 million km driven, >380 tonnes of hydrogen dispensed. Information, including challenges and lessons learnt, is contained in the CHIC final report “fuel cell electric buses: a proven zero emission solution. Key facts, results, recommendations”².

- Aberdeen (UK) has the largest FCEB fleet in Europe with 10 buses. Bus availability is currently >75%, with over 640,000 km driven in the first 18 months of operation. The station has dispensed >75 tonnes of hydrogen with an availability >99.9%. Lessons learnt: Infrastructure construction and bus delivery need to be aligned, with clear roles and responsibilities assigned contractually. Supply chain for spare parts is currently in a very early phase and has caused unnecessary availability issues.

Infrastructure for large scale bus depots (see presentation Michael Faltenbacher)

The NewBusFuel project is looking at large scale hydrogen stations for up to 100 buses to be refuelled. Preliminary conclusions: Ramp up of fleet size and infrastructure must be coordinated and requirements for redundancy thought through. Infrastructure redundancy increases CAPEX, though other options like strategic spares stock, contractual response time and modularity of design can all improve availability for a lower capital cost. Public conclusions of the project will be available by spring 2017³.

Operators of FCEBs (see presentations “Pioneers in the Industry” sessions)

- Tower Transit operates 8 FCEBs in London on the RV1 route. Lessons learnt: New technology introduces new hazards. It is important to use a comprehensive risk register as unexpected costs will occur and there will be issues with technology teething, supply chain, etc. It is the strength of the project group and supporting stakeholders that leads to success e.g. operators need to work with the bus manufacturers.
- Sunline Transit operates 5 FCEBs in California, an additional fleet of 10 FCEBs is due by 2019. Sunline has adopted a policy of purchasing alternative fuelled vehicles back in 1993 and is developing a Centre of Excellence. Community engagement with local children designing the bus graphics has helped increase public awareness and local support
- RVK in the Cologne region has committed to procuring only zero emission vehicles by 2030. RVK has access to large quantities of low cost by-product hydrogen from local industrial processes. RVK has built a strong partnership with regional stakeholders to enable them to realise ambitious FCEB deployment plans.
- AC Transit, in California, has been active in trialling FCEBs since 2003. The company now has 13 FCEBs in operation and has a strong focus on developing technical experience for maintenance staff. AC Transit will get 10 new FCEBs in 2018.
- The Orange County Transportation Authority (California) currently has one bus but plans to start the operation of 10 FCEBs and a refuelling station in December 2018. When considering Zero Emission buses there is a need to consider range, cost and reliability. Current challenges are the capital cost of the FCEB vs. CNG, expensive fuel locally and parts availability. The expected benefits are better fuel economy and lower maintenance, and of course zero emission!

² <http://chic-project.eu/newsevents/news/fuel-cell-electric-bus-project-chic-launches-final-project-report-as-tool-for-cities-and-bus-operators>

³ <http://newbusfuel.eu/publications/>

Workshop Slides & Summaries

❖ **Workshop A: Bus Operation:**

<http://www.cte.tv/wp-content/uploads/2016/12/Workshop-A-Bus-Operation.pdf>

❖ **Workshop B: Hydrogen Infrastructure:**

<http://www.cte.tv/wp-content/uploads/2016/12/Workshop-B-H2-Infrastructure.pdf>

❖ **Workshop C: Commercialisation Strategy:**

<http://www.cte.tv/wp-content/uploads/2016/12/Workshop-C-Commercialisation-Strategy.pdf>