



ZERO EMISSION

JIVEs / MEHRLIN projects

JIVE Deliverable 3.20

Interim analysis of the impact on urban bus service operations and operator attitudes (D3.20)



Main author(s): Flavio Grazian
Contributor (s): Arno Kerkhof

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List of Abbreviations/Nomenclature

Abbreviation	Definition
BEB	Battery Electric Bus
CBEP	Clean Bus Europe Platform
EU	European Union
FCB	Fuel Cell Bus
FCH JU	Fuel Cells and Hydrogen Joint Undertaking, first phase of the FCH JU under the EU 7th Framework Programme
H2	Hydrogen
HRS	Hydrogen Refuelling Station
JIVE	Joint Initiative for Hydrogen Vehicles across Europe, project co-funded by the FCH 2 JU under the European Union's Horizon 2020 Framework Programme (2017 – 2024)
JIVE 2	Second Joint Initiative for Hydrogen Vehicles across Europe, project co-funded by the FCH 2 JU under the European Union's Horizon 2020 Framework Programme (2018 – 2023)
KPI	Key Performance Indicator
OEM	Original Equipment Manufacturer
PT	Public Transport
PTO	Public Transport Operator
PTA	Public Transport Authority
UG	User Group
UITP	UNION INTERNATIONALE DES TRANSPORTS PUBLICS
WP	Working Package
ZE	Zero Emissions

1. Introduction

This document is a deliverable of the JIVE project, whose full name is Joint Initiative for hydrogen Vehicles across Europe. The present report constitutes the deliverable 3.20 “Interim analysis of the impact on urban bus service operations and operator attitudes”. The following activities refer to WP3 of the JIVE project and specifically to the Task 3.2, “analysis of quality of service and stakeholders’ acceptance”, implemented by UITP since the start of the project.

The growing interest in Fuel Cell Buses (FCBs) as an emission-free solution for public transport has increased the need for understanding acceptance and the perception of this technology. The acceptance of every innovative technology by Public Transport Authorities and Operators is based on clear advantages against the present state-of-the-art. Such advantages are technical, operational, and economic and, most importantly, change with the functions performed by each actor in the bus sector. To understand the very different factors which can lead to acceptance of fuel cell buses, it is essential that the operational assessment also considers contributions of Public Transport stakeholders external to the JIVE deployment sites and cities.

This role in the project has been performed by the creation of a dedicated User Group composed by sites that have not yet included fuel cell buses in their strategy but are interested in the technology. The goal of the JIVE User Group is to exchange feedback and discuss operational assessment from the point of view of external PTO/PTAs. The User Group independence from the project consortium gives an important contribution to the user acceptance.

This report presents a summary of the activities and results related to the JIVE User Group meetings during months 1 – 70 of the JIVE project.

This document has the following structure: the first part (Section 2) describes the objectives of the User Group, its purpose, and provides an overview of the activities conducted. Section 3 presents the detailed reports of the User Group meetings. Section 4 focuses on the main findings and takeaways from the User Group meetings.

2. JIVE User Group Purpose and Overview of Activities

2.1 User Group Objective and Set-up

2.1.1 The JIVE User Group Objective

One of the objectives of Task 3.2 was the establishment of a User Group involving public transport authorities and operators external to the JIVE deployment sites. In order to understand all possible factors that can lead to acceptance of fuel cell buses, it is essential that the operational assessment also considers contributions of Public Transport stakeholders external to the JIVE cities. This role in the project was performed with the creation of the dedicated User Group composed by cities that have not yet included fuel cell buses in their strategy but are interested in the technology and its developments. Through the User Group assessments, the JIVE Consortium was able to better understand the various factors that lead to acceptance of fuel cell buses. The main objective of the JIVE User Group is to enlarge the operational assessment and validation of the JIVE concepts and results through independent expertise.

The User Group was created also with the following objectives:

- Contribute to the understanding of user acceptance of fuel cell buses.
- Follow the progress and assess the results of the project in a constructive manner.
- Contribute to the dissemination of JIVE outcomes and results through the different communication channels of the members (events, website, newsletters, etc.).

Throughout the project, the JIVE User Group became one of the most important platforms for engaging with Public Transport Operators (PTOs) and Public Transport Authorities (PTAs) external to the JIVE project, and it currently consists of 22 PTO/PTA companies across Europe and beyond. The JIVE User Group aims to mainly contribute to the tasks 3.2.3, *Assessment of Operational Improvements*, and 3.2.4 *Comparison with the state-of-art bus systems from PTO/PTA point of view through the data collected from JIVE buses*. However, it is also an integral tool of the JIVE Dissemination strategy since all of its members are interested in studying the introduction of fuel cell buses with the goal to eventually integrate them into their fleets.

The User Group follows JIVE projects' results in terms of bus performance, service quality, operations, maintenance, and other relevant aspects related to fuel cell bus technology. The group especially focuses on best practice exchanges from JIVE projects learnings and feedback on the fuel cell bus technology from PTO/PTAs point of view.

FCBs represent a zero-emission solution alternative to traditional diesel buses used in public transport, but large-scale deployment requires acceptance and commitment of PTAs and PTOs. At the same time, local and national authorities' support is a necessary condition to assist PTOs and PTAs efforts to arrive to large-scale deployment of FCBs. Through the years, the User Group meetings provided an important platform for PTOs and PTAs to discuss how to overcome technical, operational, and economic challenges

related to bus acquisition, construction of infrastructures for hydrogen production, storage and refuelling, operation and maintenance. Additionally, the User Group meetings discussed common challenges in the broader discussion on Zero Emission technologies applied to buses.

2.1.2 JIVE User Group: Selections of Experts and Group set-up process

At the beginning of the project, the JIVE User Group was created and kicked off its activities. The selection of experts was performed by UITP in the Summer 2017. During June-July 2017, UITP opened a call to recruit the members of the User Group. UITP performed this task via a news article on its website as well as through personal invitations amongst its network of members. The User Group members were selected from Public Transport Authorities and Operators based on their motivation to join the group, as well as the probability that they will deploy fuel cell buses in their fleets in the future. UITP also created a dedicated information sheet to illustrate the User Group's objectives and the members' expected contributions.

During the initial phase, the following 15 companies joined the JIVE User Group: BKK Zrt., Tower Transit, Stadtwerke Potsdam, Torres Vedras Municipality, Movia, CTP Cluj-Napoca, AMB, TMB, CUTRIC (Canadian Urban Transit Research and Innovation Consortium), OESTECIM (Caldas da Rainha Municipality), Omnibusbetrieb Winzenhöler, MPK Poznan, ARRIVA, Nexus and Keolis.

Country	City	Company	PTO/PTA
Hungary	Budapest	BKK Zrt.	PTA
UK	-	Tower Transit	PTO
Germany	Potsdam	Stadtwerke Potsdam	PTO
Portugal	Torres Vedras	Torres Vedras	PTA
Denmark	Copenhagen	Movia	PTA
Spain	Barcelona	AMB	PTA
Spain	Barcelona	TMB	PTO
Canada		CUTRIC (Canadian Urban Transit Research and Innovation Consortium)	-
Portugal	Caldas da Rainha	OESTECIM (Caldas da Rainha)	PTA
Germany	Frankfurt	Omnibusbetrieb Winzenhöler	PTO
Poland	Poznan	MPK Poznan	PTO
-	-	ARRIVA	PTO
UK	Tyne and Wear area	Nexus	PTA
	-	Keolis	PTO

Figure 1. JIVE User Group - List of initial members

The rules for participation and the administrative procedures of the User Group were set out in a contract managed by UITP that each member signed. The contract sets the

guidelines for the participation in the User Group’s meetings and activities and specifies the rights and obligations of both parties with regard to the JIVE User Group. Each member of the User Group nominates an official expert that benefits from a lump sum of 560 euros per meeting to support his/ her participation in the User Group meetings. The members may also nominate a proxy expert to act on the main expert’s behalf if she/he is not available. The experts perform the following activities:

- Active participation in JIVE User Group meetings and discussions (one/two meetings per year).
- Take part in JIVE surveys, when applicable.
- Follow the progress and assess the results of the project in a constructive manner, in line with the project's goal.
- Disseminate information about the JIVE project through the different communication channels of the contractor (events, website, newsletters, etc.).



Figure 2. JIVE User Group Information Sheet

User Group members participate in meetings, organised periodically until the end of the project in order to follow the progress and assess the results of the project in a

constructive manner, in line with the project's goal. They are also encouraged to disseminate JIVE outcomes through the different communication channels of the contractor (events, website, newsletters, etc.). In exchange, the User Group gains first-hand information on the latest research on fuel cell buses by following the results of the JIVE demonstrations. Additionally, the meetings provide a unique environment for networking and the opportunity to connect with other innovative bus stakeholders. The presentations and discussions are usually completed with site technical visits. Overall, they greatly contributed to enlarge and create a real fuel cell community.

Where possible, UITP aligned the JIVE user group meetings to other key events in the sector to maximise the knowledge and views exchange. UITP tried also to build synergies with other relevant projects on Zero Emission Technologies thus to allow a more comprehensive overview and more in-depth discussion in relation to the topic.

The User Group elected a chairperson during the first meeting of the group to act as main representative of the members. The chairperson also helps in the moderation of the meetings. Members elected the representative of TowerTransit (UK) as chairperson of the User Group.

2.1.3 JIVE User Group: evolution over the years and acceptance of Fuel Cell Technology

Throughout the project, UITP worked to further enlarge the JIVE User Group from its original composition with additional operators or authorities interested in deploying fuel cell buses. Although the User Group membership was supposed to be fixed to 15 members, UITP observed an increase in the interest of PTOs and PTAs towards the technology and the User Group meetings proved to be the right platform for sharing the projects' progresses and latest information on fuel cell buses.

In relation to the evolution of the User Group membership, one of the main success stories relates to the operator TMB (Transports Metropolitans de Barcelona), member of the User Group since the first phase of the project. TMB greatly benefited from the knowledge shared by JIVE projects in the User Group meetings in relation to fuel cell technology and its possible applications. As the conditions allowed it, and due to the support provided by UITP and Element Energy, TMB became a JIVE 2 deployment site and successfully deployed eight FCBs and a Hydrogen Refuelling Station (HRS) in the Spring 2022. This enabled the JIVE 2 project to expand to a country which was previously not represented and made Barcelona the first Spanish city to deploy FCBs. This success story proves the relevance of the JIVE User Group and its selected member cities to aggregate demand and support European cities in deploying fuel cell buses. As TMB became a fully-fledged JIVE 2 deployment site, it left the User Group to give the opportunity to other interested cities in Europe to become a member and learn from the JIVE projects results.

Additionally, UITP invited project partners that did not manage to deploy fuel cell buses and subsequently left the project to join the JIVE User Group. The membership to the group was kept dynamic meaning that if a company was interested to become a member of the User Group, UITP made it possible to join under certain conditions. It is necessary

to mention that also a few companies decided to leave the User Group due to their change of strategy in relation to Zero Emission technologies. Currently, the JIVE User Group consists of twenty-two PTO/PTA companies across Europe and beyond, a significant increase from the fifteen originally provisioned.

On a general note, UITP observed an increase over the interest on fuel cell hydrogen buses across UITP Bus Committee membership as well as European PTOs/PTAs over the years. One of the main reasons is the revised Clean Vehicles Directive that promotes clean mobility solutions in public procurement tenders, providing a solid boost to the demand and further deployment of low- and zero-emission vehicles. Adopted by the European Parliament and Council in June 2019, the Directive needed to be transposed into national law by 2nd August 2021¹. Concretely, the Clean Vehicles Directive imposes mandatory zero emission bus procurement quotas in European Member States in relation to their city bus fleets². The Directive considers fuel cell hydrogen buses, battery electric buses and in-motion charging Trolleybuses as zero emission technologies. On this topic, UITP perceived in 2020 and 2021 a gradual increase in the interest on fuel cell hydrogen buses, and this was also reflected in the number the enquiries received by UITP membership on the technology.

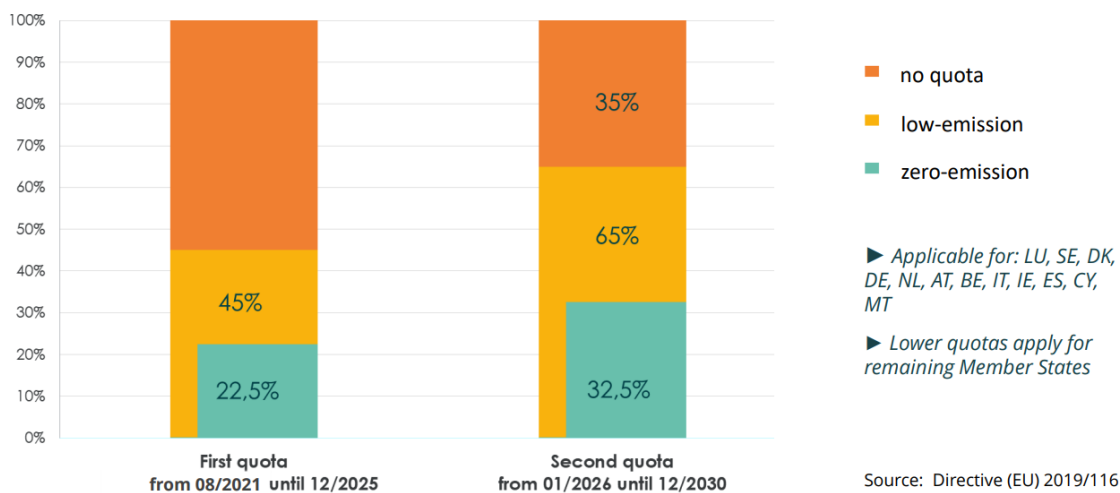


Figure 3. Clean Vehicles Directive, Procurement Quotas

Over the years, the main learnings of the JIVE projects constituted the base for UITP to be able to inform global bus operators and authorities on questions about fuel cell hydrogen buses. On this aspect, a few operators in Europe contacted UITP to be involved in the JIVE projects as their plans to procure hydrogen buses become consolidated in their respective cities. To this end, UITP suggested to some of these operators to become members of the JIVE User Group in order to be able to learn from the project outputs as well as share their plans in their cities with the other members and to contribute to the discussions.

¹ https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/clean-and-energy-efficient-vehicles/clean-vehicles-directive_en

² <https://eur-lex.europa.eu/eli/dir/2019/1161/oj>

Due to these efforts, including continuous knowledge exchange about zero emission bus technologies at the UITP Bus Committee Clean Vehicles Working Group, some major European operators such as EMT Madrid, RATP Paris, CARRIS Lisbon, STIB Brussels, and the private operator Avanza by Mobility ADO joined the JIVE User Group as new members in 2020-21. The table (Figure 4) below provides an overview of the current membership of the JIVE User Group (October 2022).

The evolution of the membership of the JIVE User Group is especially significant in demonstrating the progresses of fuel cell technology over the years and the interest of the different operators in acquiring more knowledge about it. Furthermore, this evolution shows how an increasing number of major European operators is planning to include fuel cell buses in their strategy to decarbonise their bus fleets.

Country	City	Company	PTO/PTA
Hungary	Budapest	BKK Zrt.	PTA
UK	-	Tower Transit	PTO
Germany	Potsdam	Stadtwerke Potsdam	PTO
Portugal	Torres Vedras	Torres Vedras	PTA
Denmark	Copenhagen	Movia	PTA
Spain	Barcelona	AMB	PTA
Canada		CUTRIC (Canadian Urban Transit Research and Innovation Consortium)	-
Portugal	Caldas da Rainha	OESTECIM (Caldas da Rainha)	PTA
Germany	Frankfurt	Omnibusbetrieb Winzenhöler	PTO
Poland	Poznan	MPK Poznan	PTO
-	-	ARRIVA Arriva PLC,	PTO
UK	Tyne and Wear area	Nexus	PTA
	-	Keolis	PTO
Austria	Vienna	WienerLinien	PTO
Spain	Madrid	Avanza by Mobility ADO	PTO
Spain	Madrid	EMT	PTO
France	Paris	RATP	PTO
Portugal	Lisbon	CARRIS	PTO
Belgium	Brussels	STIB	PTO
Croatia	Zagreg	ZET	PTO
South Africa	Johannesburg	Transport Authprity of Gauteng	PTA
Iceland	Reykjavik	Straeto BS	PTO

Figure 4. JIVE User Group Member Companies and Countries Represented – October 2022

The new members of the group played an active role to provide first-hand insights from the PTOs and PTAs point of view on the JIVE operational results when the data from the bus operations started to be increasingly available. This helped the analysis of the benefits of FCBs compared to conventionally fuelled vehicles.

The composition of the JIVE User group is also of strategic importance due to the geographical location of its members that are widespread in different regions across

Europe and beyond. This element increases the potential outreach of the JIVE projects to different cities interested in deploying FC buses in line with their zero emission PT strategies. At macro-level, it is also of critical importance to support the European Commission's effort to stimulate zero-emission bus deployment across Europe, including in less experienced cities. These efforts are also in line with the objectives of the JIVE 2 fuel cell trainings organised by UITP where User Group members can take part. The trainings aim to inform and train representatives from a wider range of cities on the main learnings of the JIVE projects and to develop a practical set of guidelines covering every step of the introduction of fuel cell technology. To this date, UITP organised two different fuel cell training sessions, one of them in conjunction with the fifth User Group meeting in November 2021.

In addition, the User Group contributes to the dissemination to interested cities of the project knowhow about FC buses covering distinct aspects (i.e., operations, maintenance, and procurement). Furthermore, through the work of the JIVE User group, dedicated dissemination efforts can be synchronised with other EU-funded clean bus projects. As an example, UITP organised the third JIVE User Group meeting jointly with [ASSURED project's](#) User Group in November 2019. Both User Groups share the same format and strategic objectives, and during the meeting common discussions touched upon refuelling and charging infrastructure challenges on the way to zero-emission fleets. Another example was the sixth JIVE User group meeting organised in conjunction with the [Clean Bus Europe Platform](#) study tour in Madrid in October 2022. The Clean Bus Europe Platform is an initiative under the European Commission's Clean Bus Deployment Initiative that aims to support the deployment of clean bus technologies across Europe. The Platform brings together European cities, transport authorities and operators, together with relevant stakeholders like social dialogue partners, industry, financing and funding institutions, associations, to boost and support the exchange of knowledge and expertise on clean bus deployment, including fuel cell technology.

Finally, through the knowledge gained from the JIVE User Group, some members became 'observer cities' of JIVE and expressed desire for their FC projects to become a part of JIVE should any opportunities to do so arise (e.g., TMB). As mentioned, TMB's story shows the successful effect of the JIVE User Group in promoting FC bus technology to different operators across Europe and in stimulating a large interest in the project and FC technology among PTOs/PTAs.

2.2 JIVE User Group Meetings

The table below (Figure 5) provides the JIVE User Group meeting schedule, with the selected discussion themes for each meeting. In total, UITP organised six in-depth workshops, five in physical format and one meeting held online due to COVID-19 restrictions.

	Date	Location	Focus
1	05-Oct-17	Brussels	<ul style="list-style-type: none"> •Introduction to JIVE and other FCB activities in the EU •Data collection methodology •Identification of the main challenges for the introduction of fuel cell buses
2	29-Nov-18	Cologne	<ul style="list-style-type: none"> •Operational Assessment of FC Buses •Practical experiences in operating FC Buses •Operators Feedback on JIVE Data Points Lists on FC Bus Operations
3	11-Jun-19	Stockholm	<ul style="list-style-type: none"> •Road charging/refueling infrastructure for zero-emission buses
4	21-Jun-21	Online	<ul style="list-style-type: none"> •Bus depot organisation and hydrogen refuelling station (HRS) within the bus •JIVE Bus & HRS Performance Assessment Preliminary Findings
5	18-Nov-21	Paris	<ul style="list-style-type: none"> •Fuel Cell Bus and Hydrogen Refuelling Structure Performance Evaluations - Main performance findings from the first months of operations •Operating Fuel Cell Buses: Return of Experience by Groningen and Wuppertal
6	20-Oct-22	Madrid	<ul style="list-style-type: none"> •Fuel Cell Bus and Hydrogen Refuelling Structure Performance Evaluations - Presentation of the new Best Practice Report & main performance findings from data collected •Maintenance of Fuel Cell Buses: Return of Experience by Aberdeen, Barcelona and Wiesbaden

Figure 5. JIVE User Group meetings with section of topics

Where possible, UITP organised the JIVE User Group meetings in the framework of key Public Transport events or aligned them in conjunction with other European projects related to the sector in order to maximise the knowledge and views exchange.

The meetings usually focused on a specific topic (e.g., FC buses, HRS, funding, maintenance, etc.) and included some fixed points on the agenda such as the progress of JIVE/JIVE 2 projects, the available collected data and relevant news from the FC sector. Furthermore, the meetings aimed at sharing project learnings by communicating experiences from PTO and PTAs not limited to the JIVE projects and provided knowledge on technical challenges related to bus deployments such as the setting up of HRS/FC bus project (technical, communication, etc.). When possible, UITP organised a technical visit to complement the meetings and to enlarge the knowledge acquisition.

The first User Group meeting took place in October 2017 in Brussels, Belgium. The meeting focused on the identification of the main challenges for the introduction of fuel cell buses in Europe.

The second User Group meeting was held in Cologne, Germany, in November 2018 and examined the first challenges and lessons learnt from the JIVE project as well as the first operational assessment of fuel cell busses.

The third meeting was organised in June 2019 linked to UITP Global Public Transport Summit in Stockholm, Sweden. The Summit is the main global event that gathers all public transport stakeholders with conferences and trade fairs. The User Group meeting focused on refuelling infrastructure for zero-emission buses. The meeting was held in

conjunction with the ASSURED project focusing on the shared challenges of battery electric and fuel cell buses.

The fourth meeting was supposed to take place in March 2020 in Groningen, Netherlands. However, due to the outbreak of the COVID-19 pandemic, the event was cancelled. The meeting took place instead online in June 2021 via Microsoft Teams. The User Group meeting focused on the depot organisation and the hydrogen refuelling stations (HRS) and on the preliminary findings regarding the performance assessments of fuel cell buses and Hydrogen Refuelling Stations.

The fifth User Group meeting took place in Paris, as a hybrid event, on 18 November 2021 in the framework of the Zero Emission Bus Conference. The meeting was organised in collaboration with the Clean Bus Europe Platform and the 2nd JIVE 2 fuel cell hydrogen bus training. Amongst other topics, the meeting focused on the feedback of operational experience from JIVE deployment sites on fuel cell buses.

JIVE / MEHRLIN / JIVE 2

FCB Training in Conjunction with JIVE User Group Meeting at ZEB Conference

Hybrid Meeting: Maison de la Chimie and Remote Connection
Salon 69 at Maison de la Chimie & Teams Meeting
18th November 2021
14:00 - 18:00 CET

Moderator: Arno Kerkhof, UITP Head of Bus Transport

Time:	Duration:	Session:	Presenter:	Participants:
14:00	15	Welcome & Introduction	UITP - Aida Abdulah & Efe Usanmaz	JIVE User Group Members & CBEP Cities & JIVE Project Partners
14:15	15	JIVE/JIVE 2 Projects Updates - Q&A	Element Energy - Madeline Ojakovoh	
14:30	20	JIVE/JIVE 2 Fuel Cell Bus and Hydrogen Refuelling Structure Performance Evaluations - Main performance findings from the first months of operations - Q&A	Sphera - Vanessa Roderer & PLANET - Katharina Buss	
14:50	60	Operating Fuel Cell Buses: Return of Experience by Groningen and Wuppertal - Putting buses into operations; interplay of buses and refuelling infrastructure; obstacles & solutions - Presentations & Discussion	OV Bureau Groningen Drenthe - Peter Mul & WSW Mobil - Andreas Meyer	
15:50	10	Key Takeaways & Closure	UITP - Arno Kerkhof	
16:30	90	Fuel Cell Bus Demo Tour - Caetano Fuel Cell Bus ride around Maison de la Chimie FCB ride and visit to Hydrogen Refuelling Station in Paris (Applicable only for in-person attendants) & return to Maison de la Chimie	Caetano Bus	

Figure 6. Example of agenda – JIVE User Group 5

The sixth User Group meeting was held in Madrid, Spain, as hybrid event, on 20 October 2022. The meeting was organised in conjunction with the Clean Bus Europe Platform (CBEP) study tour that took place on 19, 20 and 21 October. A first technical visit took place on 19 October in the afternoon followed by a classroom seminar and a second technical visit on 20 October. The classroom seminar focused on EMT strategy for transition to Zero Emissions Buses as well as on the return of experience on bus maintenance from JIVE deployments sites. Additionally, to create added value to the Study Tour, the CBEP organised on the third day, Friday 21 October, the first Industry Marketplace in the frame of the FIAA Bus & Coach fair at IFEMA that User Group members were invited to join.

2.3 COVID-19 Impact on the JIVE User Group activities

The COVID-19 pandemic produced major changes on a global scale and affected the JIVE project activities for most of the period of the years 2020 and 2021. Due to the COVID-19 outbreak, many physical events were cancelled, and activities stopped.

Unfortunately, the User Group activities also slowed down due to the global COVID-19 pandemic. The organisation of physical meetings and related activities was impossible (PT conferences to attract bus operators, exhibitions, technical visits), for most of the years 2020 and 2021 with a gradual return to normality from the spring of 2022.

The COVID-19 pandemic had a significant impact on the slowdown of the activities and the reason is two-fold: 1) the pandemic further affected the JIVE project bus deployments. Lockdowns all over Europe had a substantial impact on bus manufacturers and therefore some further delays occurred in bus deployments. As consequence, the interruptions in bus deployment delayed the start of the bus data performance collection and analysis; 2) PTOs/PTAs mainly focused on managing the COVID-19 outbreak in their bus networks and then, in later months, on maintaining their service continuity, gaining back passengers' trust, and focusing on their financial recovery. In this respect, the management of the impact of COVID-19 on the bus networks became the priority, and substantially delayed the analysis of the quality of JIVE bus services with the involvement of external stakeholders that are members of the JIVE User Group. UITP observed that in the first months of 2020 and for the subsequent period, the COVID-19 outbreak, and the management of the related crisis overtook the other tasks linked to innovation.

Although the management of the unforeseen circumstances of the new COVID-19 context overtook many of the activities that involved JIVE operators as well as external PTOs/PTAs, the collaboration among project partners continued effectively to progress in engaging with external operators to share learnings on the key aspects of fuel cell hydrogen bus technology. During this period, some of the operational benefits could not be properly highlighted due to continued delays in data collection and limited consolidation of operational data as well as the lack of comparative performance data against conventionally fuelled vehicles. Nonetheless, UITP successfully shared best practices and lessons learned from the projects with UITP members and other interested stakeholders in fuel cell bus technology in online meetings.

Additionally, UITP found innovative ways to engage with the future users of the fuel cell bus technology, organising online meetings (one JIVE User Group), participating in webinars and online conference as well as by publishing a [JIVE fuel cell bus knowledge brief](#), focusing on best practices and commercialisation approaches, translated in 9 European languages (English, French, Spanish, Portuguese, Italian, German, Hungarian, Polish and Danish)³.

³ Only in the period July 2021 – December 2022, the publication page has been checked 593 times, the news item 72 times, and EN publication has been downloaded via website 181 times.

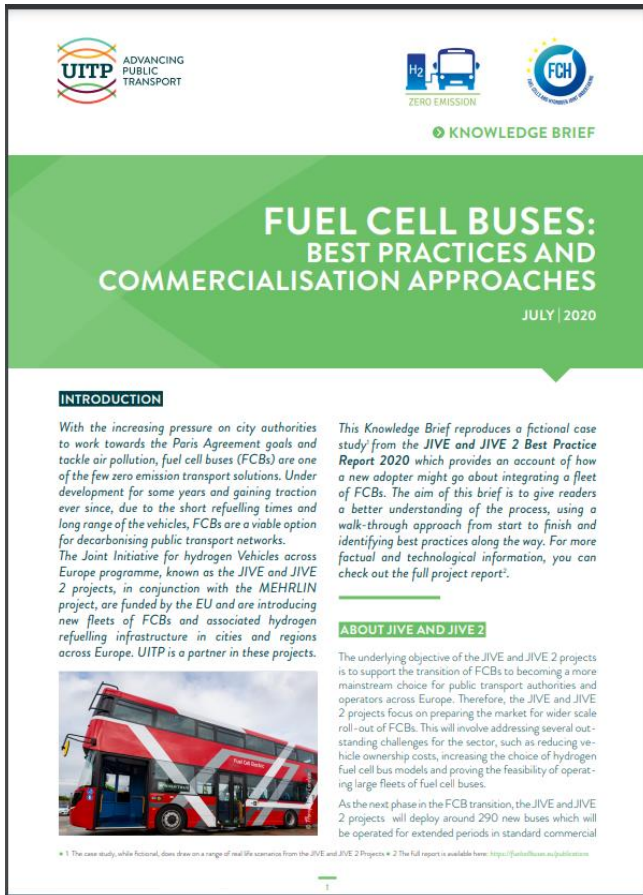


Figure 7 – JIVE Knowledge Brief

Étapes et sous-étapes d'un projet de démonstration des bus à pile à combustible et de leur infrastructure à hydrogène



Figure 8 - Knowledge Brief - French

In the autumn 2021, with the easing of the COVID-19 related restrictions and the gradual recovery of the pre-pandemic level of ridership, it became possible to progressively restart the JIVE related activities including the User Group meetings.

3. JIVE Project User Group Meetings Reports

This section presents the JIVE User Group meetings reports. These meetings' reports consist of the basis of arguments for the acceptance of fuel cell buses by the public transport sector, as in-depth discussions took place during the events. The reports are also of great value to understand the evolution and the acceptance of the technology during the years as they cover a period of 70 months of the project. The meetings are of great significance to follow the progress and assess the results of the project in a constructive manner.

3.1 JIVE User Group #1

The first JIVE User Group meeting took place on 5 November 2018 in Brussels, Belgium. Fifteen participants attended the meeting.

The full day meeting focused on the identification of the main challenges for the introduction of fuel cell bus technology in Europe. UITP provided participants with an introduction on the fuel cell bus technology, and the Fuel Cell Hydrogen Joint Undertaking (FCH JU) presented the current activities in the area of fuel cell buses alongside the objectives and the strategy for the development of a fuel cell bus market in Europe. Additionally, the project coordinator, Element Energy (EE) presented an overview of the JIVE project, its objective, and the related data collection methodology.



Figure 9. JIVE User Group #1 – Agenda

In the second part of the meeting, UITP introduced to the participants the rules for participation, the meeting schedule, and the administrative procedures of the User Group. Throughout the meeting, the participants engaged in a lively discussion with the presenters.



Figure 10. JIVE User Group #1 – UITP Presentation of the Guidelines

An exercise on the main challenges for the introduction of hydrogen buses was conducted through a survey shared before the meeting. The identified challenges were then compiled to compose a tentative list on the main topics for the future meetings. The respondents indicated the following challenges for future introduction of fuel cell buses:

- Lack of competition / choice for fuel cell buses
- Generating political support
 - o Short-term (before the buses are procured)
- Cost
 - o CAPEX
 - o Funding
- Operational
 - o Availability (bus and HRS)
 - o H₂ (especially set up of HRS, permissions)
 - o Source of hydrogen
 - o Supply chain (spare parts availability)
 - o Lifetime of key components (e.g., Fuel cell, HV battery)

During the meeting, participants engaged in further discussions, analysing various points in relation to fuel cell bus deployment:

- Refuelling time of the buses and the impact on operations.
- Different ways to produce hydrogen (green vs blue hydrogen) and efficiency as fuel.
- Bus and HRS maintenance particularly related to the availability of spare parts from OEMs.
- Commercialisations of fuel cell buses and related price targets.
- Expected time of durability of the buses.

The meeting also discussed the objectives of the project and the coordinator remarked on the importance of the testing phase that would allow to identify the major problems. The JIVE project is the first project to link demonstration activities with a commercialisation phase of fuel cell buses, combining new cities and cities that already have experience in operating FCBs. On the infrastructure side, the project coordinator explained how the MEHRLIN project covers some of the infrastructure costs. The OEM's future investments on FCBs were also discussed.

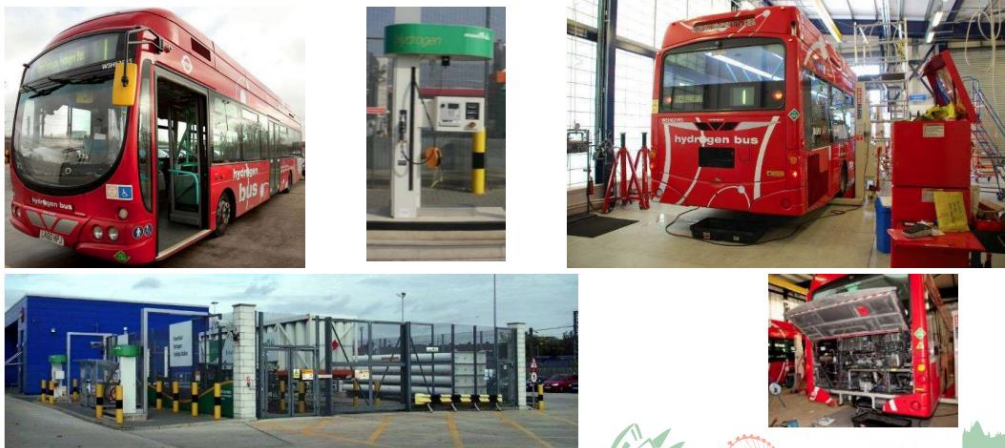
The meeting also touched upon an overview of the data collection methodology in the project and discussed in detail several Key Performance Indicators (KPIs). During the meeting, the User Group Chairperson (TowerTransit) gave a short presentation to share the experience of hydrogen buses in London in relation to deployment and operation of FCBs. He underlined the following aspects in the operation and maintenance of fuel cell buses:

- No major safety-related issues occurred since the FCEB have been put into operation.
- The challenge is to get a sufficient stock of Hydrogen to refuel the buses on time.
- The maintenance of the buses is supported by Ballard (producing the Fuel Cell), but the main responsibility stays in house.
- Administrative procedures and permit can be very tedious and time consuming.
- The supply chain is yet to be mature.
- It is a truly multi-stakeholder operation.
- There is a lack of standards and no EU regulations existing at the moment.
- There is a need for training the staff: technicians, depot management, drivers.

HYDROGEN FUEL CELL BUSES



THE BUS – THE FUELLING – THE WORKSHOP



TOWER TRANSIT GROUP

Figure 11. JIVE User Group #1 - TowerTransit presentation

The first meeting was extremely helpful to provide a first overview of the future activities and objectives of the JIVE project, as well as introducing critical elements for the deployment of fuel cell buses. The first User Group was also extremely useful to identify the barriers to deploy hydrogen buses.

3.2 JIVE User Group #2

The second User Group meeting took place in Cologne, Germany on 28 November 2019, following the Zero Emission Bus Conference. The meeting was an important opportunity to touch upon key aspects of FC buses and discuss the Key Performance Indicators (KPIs) introduced in the JIVE projects. Furthermore, the alignment with the Zero Emission Bus Conference allowed the participants to gain further up-to-date insights regarding the fuel cell bus sector. A total of nineteen participants attended the event.

At the beginning of the meeting, the Chair provided the recap of the exercise held in the first UG meeting on the main challenges identified for the introduction of fuel cell buses. JIVE project partners shared the JIVE data collection methodology updates including the JIVE Performance Assessment Handbook and Data Points Lists.



Figure 12. JIVE User Group #2 – Meeting Picture

In the afternoon, the first session focused on the operational assessment of FC buses and the feedback exercise on the JIVE Data Points Lists that UG members contributed to before the meeting. Operators were asked to provide feedback on the JIVE KPIs related to the FC bus operation. The aim was to analyse the aspects that operators, even if they do not currently operate any FC buses, deem important for the operational assessment of FC buses, and to identify potential flaws and opportunities for enhancement of the operational assessment.

The session generated lively discussions on KPIs also in comparison with other clean bus technologies. The feedback from the UG members included requests for clarifications on some data points as well as some modifications to the data points list. The compiled answers were then used for the planned revision of the Performance Assessment Handbook. The meeting continued with a presentation on JIVE / JIVE 2 Initial Expectations and Best Practice Survey. The last session, “Emerging conclusions in JIVE: Procurement of FC Buses” focused on the FC bus procurement which appeared to be a

key topic in the JIVE project. The session hosted JIVE partner RVK as guest speaker to share the company’s experiences in the FC bus procurements, since Cologne marked the largest order of FC buses in Europe with 30 buses at the end of February 2018. The session provided important insights and fruitful discussions on the practicalities of FC bus procurement.

The main points discussed during the meeting included:

- Safety of the operations.
- Cost of a bus and maintenance: The cost of a FC Bus is one of the most important parameters for the customers meaning PTA/PTOs.
- Technology ‘teething’ issues.
- Infrastructure.
- Number of Stakeholders involved.
- Regulations and standards.
- Training of the staff and drivers.
- Price of Hydrogen and its variation in different places.
- Autonomy and range of the bus.
- Supply chain for the spare parts and need for cooperation with OEMs.

JIVE User Group #2		
Thursday 29 November 2018 09 :30 – 16 :30 Hotel Mondial Am Dom Cologne Kurt-Hackenberg-Platz 1, Cologne, Germany For directions, click here		
MODERATOR: DAVID YORKE, TOWER TRANSIT		
09:30 – 10:00	Welcome coffee	
10:00 – 10:10	Opening of the meeting	David Yorke, TT
10:10 – 10:35	Tour de table	ALL
10:35 – 10:45	Brief Recap: JIVE UG Guidelines	Efe Usanmaz, UITP
10:45 – 11:00	Recap of the JIVE UG #1: Main challenges identified for the introduction of FC Buses	David Yorke, TT
11:00 – 11:45	JIVE experience <ul style="list-style-type: none"> • Key challenges and first lessons learnt • Next steps of FC Bus activities in Europe 	Madeline Ojakovoh, Element Energy
11:45 – 12:15	Data collection methodology updates <ul style="list-style-type: none"> • Performance Assessment Handbook • JIVE Data Points Lists • SoFi tool 	Stefan Eckert, Thinkstep
12:15 – 13:00	LUNCH BREAK	
13:00 – 14:15	Operational Assessment of FC Buses <ul style="list-style-type: none"> • Practical experiences in operating FC Buses • Operators Feedback on JIVE Data Points Lists on FC Bus Operations 	Efe Usanmaz, UITP Stefan Eckert, Thinkstep Klaus Stolzenburg, PLANET UG members operating FC Buses
14:15 – 15:00	Initial Expectations Survey PTO/PTA expectations on deploying and operating FC Buses	Klaus Stolzenburg, PLANET
15:00 – 15:15	COFFEE BREAK	

Figure 13. JIVE User Group #2 - Agenda

The meeting was also important to present the findings from the 1st Best Practice Questionnaire. Some evaluation results and discussion points from the meeting can be noted as follows:

- Although the high cost is still a matter of concern, PTAs/PTOs are rather optimistic that their cost expectations can be met in the future. JIVE and JIVE 2 will deploy larger amounts of buses compared with previous projects. Volume will eventually start reducing the costs of deploying FC buses.
- In relation to best practice, hydrogen and fuel cells are new technologies among many others. Therefore, the challenges in terms of project management are very similar to those in other innovative projects. It is important to set up a good team, good planning, and good organization for a successful FC bus deployment.
- Discussion on the site visits: site visits are important for PTO/PTAs to gain additional insights on FC bus technology.

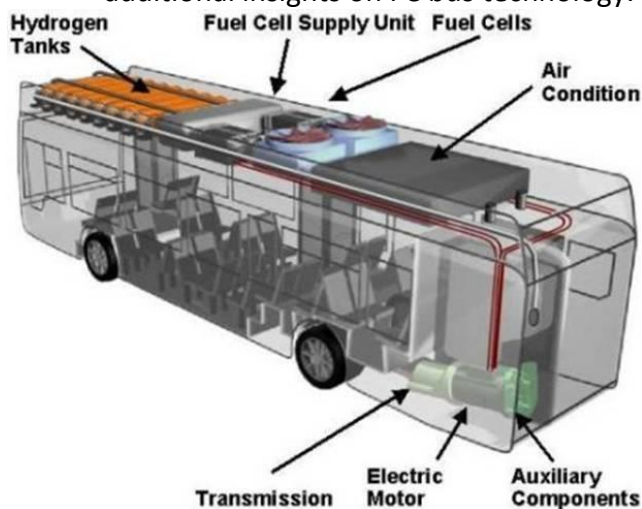


Figure 14. JIVE User Group #2 - Presentation of Fuel Cell Bus from RKV

The other sessions touched open practical experiences in operating FC Buses and Operators Feedback on JIVE Data Points Lists on FC bus operations.

The main points highlighted during the discussions included:

- Funding is still needed to reduce the financial risk of FC buses.
- Supply chain of spare parts remains a critical problem.
- Climate is an important factor affecting decision on the choice of zero emission technology since climate and geographical conditions influence operational performance.
- Lifetime of the fuel cell bus: The target in JIVE is more than 15,000 operating hours for each fuel cell, but it might be longer. The lifetime of the parts is also important to consider.

The second JIVE user group meeting enlarged the scope of the discussion around fuel cell buses as it also focused on operational experience. The lively discussion amongst the participants showed the growing interest for the technology.

3.3 JIVE User Group #3

The third JIVE User Group meeting was organised in June 2019 linked to UITP Global Public Transport Summit in Stockholm, Sweden. In this background, the User Group activity created synergies with dissemination actions to promote fuel cell buses in one of the major events in the public transport sector. The UITP Summit in Stockholm was one of the biggest events in 2019 where JIVE project outcomes were disseminated among its target groups.



ASSURED/JIVE User Groups Workshop
at UITP Global Public Transport Summit

Tue, 11th June 12.15-18.30

Meeting Room K22-23
& UITP Stand
UITP Global Public Transport Summit
Stockholmsmässan Congress Centre
Mässvägen 1, 125 30 Älvsjö, Sweden
[For the map click here](#)

Agenda

12.15 – 12.45	Visit to the Solaris Stand Stand No: A1100 <ul style="list-style-type: none"> • Presentation on Solaris zero emission bus solutions and showcase of the new Solaris Urbino 12 Hydrogen model & the latest version of the Solaris Urbino 12 Electric
13.00 – 13.55	Networking Lunch <ul style="list-style-type: none"> • For all participants and with the attendance of the invited speakers in front of the Meeting Room K22-23
13.55 – 14.00	Walk together to the UITP Stand
14.00 – 14.45	ASSURED/JIVE Talk#3 & APOLLO-EU Official Launch Event!

Figure 15. JIVE User Group #3 - first part of the agenda

The UITP Global Summit is a unique gathering for professionals from across the sector, and the 2019 Summit marked the biggest edition in UITP Global Summit history in terms of richness of the topics and the number of participations. The 2019 edition gathered 375 exhibitors from 46 countries, 53 Congress sessions featuring 300 speakers, 2,718 attendees from 81 countries and over 15,000 single-entry exhibition visitors and almost 170 press and media delegates from almost 40 countries.

The third JIVE User Group meeting was held jointly with the User Group of the Horizon 2020 EU-funded project ASSURED. The User Group consisted of PTOs/PTAs with a similar profile to the JIVE User Group format but interested in Battery Electric Buses (BEB). The main rationale was to share lessons learned in terms of planning, procurement and operations from the operators having experiences on both BEB and FCB technologies. Twenty-four representatives coming from different PTO/PTAs, associations and companies attended the workshop.

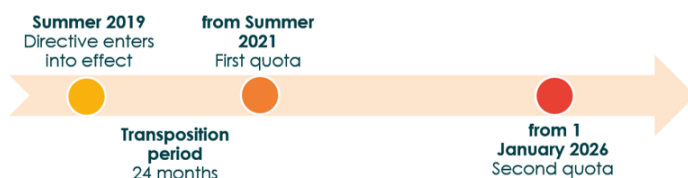
The User Groups Workshop was aligned to the JIVE/ASSURED Expert Talk #3 and took place on 11 June. The workshop started with a Solaris Bus & Coach stand visit where both BE and FC Solaris buses were displayed and presented to the User Groups participants.



Figure 16. JIVE User Group #3 - Pictures from the Solaris stand visit

This joint meeting was organised as 2019 was the year where important developments took place in the EU legislation for the promotion of clean and energy efficient road public transport vehicles. The EU legislators reached an agreement on the new rules for public procurement of clean buses by setting out minimum procurement targets for city buses for 2025 and 2030 (Revision of the Clean Vehicles Directive). The new rules triggered an increasing interest amongst the public transport companies, operators, and authorities in relation to clean bus technologies as the cities across the EU will need to procure an increasing number of clean buses by 2025 and at least a third by 2030. Fuel cell electric bus (FCEB) together with battery electric buses (BEB) were seen as the readiest and most promising zero emission technologies to decarbonise bus fleets and created an increasing attention among PTO and PTAs.

➤ ACCELERATED DEPLOYMENT OF CLEAN AND ENERGY EFFICIENT BUSES



- challenge for cities, authorities and operators
- exchange of expertise can facilitate the transition towards clean buses



Figure 17. JIVE User Group #3 - Presentation of CVD procurement quotas

The third User Group meeting aimed to having complementary exchange among zero-emission technologies and networking among invited PTOs/PTAs. The meeting focused on the common challenges faced by BEB and FCBs within the context of “Road charging/refuelling infrastructure for zero-emission buses”. Therefore, the invited speakers from PLANET, TRANSDEV, RET Rotterdam and OV Bureau Groningen Drenthe shared their insights and findings on BEB and FCEB operations and specifically on the management of the charging/refuelling infrastructure. The workshop continued with open discussions and exchange of feedback around two thematic areas:

- (1) key issues in planning and procuring charging infrastructure and hydrogen refuelling stations (HRS).
- (2) key issues in operating BEB and FCEB and their relative infrastructure.

During the meeting, the main discussion points included:

- Complementarity of different Zero Emission technological solutions (BEB or FCB) for a successful strategy for the decarbonisation of the bus fleet.
- Different characteristics of the solutions.
- The deployment of vehicles needs to be aligned with the infrastructure construction.
- Consider new safety issues (optimize workshop).
- Expect technology ‘teething’ issues.
- Importance of a good supply chain (spare parts at the sites).
- Make sure all stakeholders involved support the project (good internal communication).
- Operators need to work closely with manufacturers.
- Training for drivers, technicians, and the management is necessary.

Amongst the main challenges highlighted, in relation to fuel cell buses the main points included:

Tender Documents

- Lack of HRS standardisation.
- Implementation in bus depot with limited space and coordination with other new technologies (including battery electric buses with FC range extender).
- Drafting and agreeing contract terms and conditions.
- Evaluation criteria.

Selecting Suppliers

- Lack of feedback, poorly written proposals.
- Technology offered not meeting expectations/specifications.
- Due to quite different concepts presented, it is difficult to decide which supplier is the best choice.

Contract Development

- Ensuring that risk and responsibilities are correctly apportioned amongst the partners under the contract and that partners are fully aware of these.
- Complying with national and EU regulations (triangle PTA-PTO-HRS supplier).

Additional elements underlined in the meeting included:

- Separate tender for HRS.
- Longer distances: BEBs and FCBs are increasingly becoming interesting options.
- Bus manufacturers: step up for hydrogen and ZE coaches.



Figure 18. JIVE User Group #3 – Meeting Picture

Overall, the meeting was extremely useful to provide participants with a complete overview of the lessons learned, challenges and solutions for the deployment of both battery electric and fuel cell buses.

3.4 JIVE User Group #4

Building on the discussions of the 3rd JIVE User Group meeting in which Groningen Drenthe FCB project was presented by OV Bureau Groningen-Drenthe, the 4th JIVE User Group meeting was planned to take place in Groningen in conjunction with the JIVE General Assembly and UITP JIVE 2 specialised fuel cell bus training with site visits to Groningen bus depot, HRS, and buses.

The purpose of the 4th JIVE User Group meeting was to provide an update on the fuel cell bus deployment projects and activities that are ongoing in the JIVE User Group member cities. The meetings aimed also to share latest JIVE projects results and learnings as well as to present the second JIVE Best Practice and Commercialisation Report with a guided discussion in a workshop setting. However, due to the COVID-19 outbreak, UITP cancelled the meeting at the last minute along with the JIVE General Assembly and JIVE 2 UITP training and postponed to a later date.



JIVE / MEHRLIN / JIVE 2
JIVE User Group Update Meeting
Groningen, Netherlands
18th March 2020

Day 1 **Venue: Van Der Valk Hotel Groningen - Hoogkerk**

Time:	Duration:	Session:	Presenter:	Who:
13:00	60	<i>Arrival & Networking Lunch</i>		JIVE User Group and Project Partners Only
14:00	10	Welcome & Introduction	UITP - Efe Usanmaz	
14:10	80	Tour de Table - Updates from the JIVE User Group members about the plans on FCEBs in their cities/regions - Q&A	ALL	
15:30	30	Update on project progress (JIVE, JIVE 2 & MEHRLIN)	Element Energy - Sophie Eynon	
16:00	15	<i>Coffee</i>		
16:15	75	JIVE Best Practice and Commercialisation Report 2 & Guided Discussion	PLANET - Klaus Stolzenburg	
17:30		<i>Wrap up & Insights into 2nd Day</i>	UITP - Efe Usanmaz	

Figure 19. 4th JIVE User Group Meeting in Groningen (cancelled due to COVID-19 outbreak) Agenda

Due to the unprecedented circumstances caused by the Covid-19 outbreak, UITP organised the 4th JIVE User Group meeting online on 21 June 2021 via Microsoft Teams. Since the last official User Group meeting was held in conjunction to UITP Global Public Transport Summit in June 2019 in Stockholm, the agenda was designed to primarily get updates from the JIVE User Group members about their fuel cell bus deployment plans. In addition, the meeting was the opportunity to gain experience from Bolzano’s approach to bus depot organisation and hydrogen refuelling station. Finally, the meeting presented JIVE projects’ updates as well as the preliminary assessments from the JIVE data analysis and performance results. The meeting hosted around twenty-five participants including project partners and representatives from User Group member companies.



JIVE / MEHRLIN / JIVE 2
JIVE User Group Meeting #4
 Online, hosted by Microsoft Teams
 21st June 2021
 14:00 - 16:00 CET



Time:	Duration:	Session:	Presenter:	Participants:
14:00	5	Welcome & Introduction	UITP - Efe Usanmaz	JIVE User Group Members & JIVE Project Partners
14:05	15	JIVE/JIVE 2 Projects Updates - Q&A	Element Energy George Carew-Jones	
14:20	40	Roundtable - Update presentations from the JIVE User Group members about the plans on FCEBs in their cities/regions - Q&A Discussion	JIVE User Group Members	
15:00	30	Bolzano FCB Project: Spotlight on bus depot organisation and hydrogen refuelling station (HRS) within the bus depot - Q&A	SASA - Petra Piffer & IIT - Fabio Da Col	
15:30	25	JIVE Bus & HRS Performance Assessment Preliminary Findings - Q&A	Stefan Eckert - Sphera	
15:55	5	Quick roundtable on future learning topics & Closure	UITP - Efe Usanmaz	

Figure 20. JIVE User Group Meeting #4 Online, Meeting Agenda

In the first session, UITP shared some updates on the User Group membership, including the new members that recently joined: Avanza by Mobility ADO Spain, EMT Madrid, RATP Paris. Furthermore, as a remarkable success story, UITP communicated that TMB Barcelona, member of the User Group, became a JIVE 2 partner to deploy 8 fuel cell buses in Barcelona. UITP informed members about the JIVE online activities taking place in the new Covid-19 context and the recent publications, such as [JIVE Best Practice and Commercialisation](#) Knowledge Brief focusing on FCB projects conceptualisation, financing and planning, and procurement. The knowledge brief is available in 8 European languages and can be downloaded at www.uitp.org.

In the second session, Element Energy presented JIVE projects' progress over the past year and some key lessons learned from the PTO/PTAs point of view:

- Orders placed for 278/310 buses (90%) with 6 suppliers: both projects (JIVE and JIVE2) are on track to meet/exceed their original deployment aim.
- 91 buses operational (at the time of the meeting) with another 100+ buses due to begin operation by the end of 2021 across France, Germany, Italy, the Netherlands, Spain, and the UK.
- HRS commissioned in Pau and Groningen, with 10 more overall to be commissioned by the end of 2021.
- First reliable operational data from project buses are now being transmitted for analysis.
- Sites beginning to plan for post-JIVE further FCB deployment across various vehicle types (12m; 18m, coaches). Continued dialogue with European OEMs on this point.

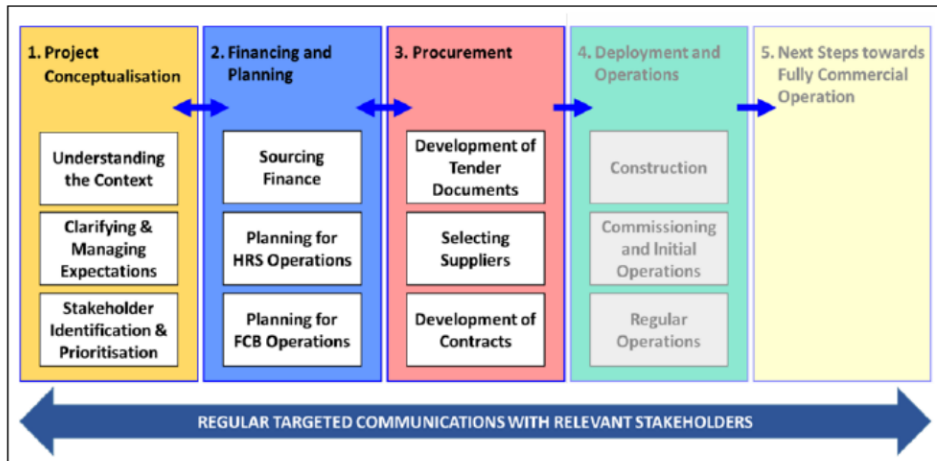


Figure 21. JIVE User Group Meeting #4 Online, Screenshot from Best Practice report presentation

The project emerging conclusions and the learnings that have been generated at multiple points of the deployment process include:

Project Set Up

- Some geographical sites (e.g., Germany, the Netherlands) are further emerging as FCB leaders; others are struggling to provide supportive funding/policies.
- EU policy is increasingly shifting towards supporting FCBs (AFID revision; RED II).
- Increasing availability of low-cost green electricity and potential for aggregated H2 supply are allowing larger projects to be established.

Procurement

- Joint procurement continues to offer a compelling cost-saving option for cities operating in similar regulatory contexts (e.g., French UGAP platform).
- An increasing number of bus supply offers are being received by sites (from European & non-European OEMs).

Operation

- Aligning bus and HRS delivery is proving difficult across sites.
- A 3-month teething period is also common across sites – few issues so far have related to fuel cell/hydrogen elements, most relate to the electric drivetrain.
- Extremely positive feedback is being received from drivers, citizens, and depot managers.
- Production of demonstrable results from operation is ongoing.

Next Steps Beyond JIVE

- FCB and HRS infrastructure prices are continuing to drop; however, model availability requires diversification (18m buses, type II intercity buses/coaches), and achieving scale still requires public funding.
- Lead times remain long amongst the existing bus OEM groups.
- The JIVE project is targeting increasingly diverse geographical locations.

In the following session, the meeting provided the opportunity for User Group members to present updates about their fuel cell bus deployment plans. The session put in evidence how some UG members are already doing test trials with FCBs (e.g., Wiener Linien Vienna, MOVIA Copenhagen, Avanza by Mobility ADO in Spain, RATP Paris) and some members are planning to procure FCBs in coming few years (e.g., EMT Madrid, Winzenhoeler in Rhein-Main). Therefore, JIVE operational results and other learnings in

good periodicity were considered very relevant to support JIVE UG cities in their plans. Some punctual support could be given to those cities in their test trials or plans for procurement.

Subsequently, SASA Bolzano presented their Hydrogen Refuelling Station project as part of JIVE and MEHRLIN projects. SASA's concept of building a hydrogen refuelling station in SASA bus depot is a relevant example for JIVE User Group members. The presentation touched upon the following elements:

- 1) The rationale for an in-depot refuelling system.
- 2) Necessary permits from authorities.
- 3) Re-organisation of the bus depot to accommodate new HRS.
- 4) Key issues for operators in planning fuel cell bus depot.

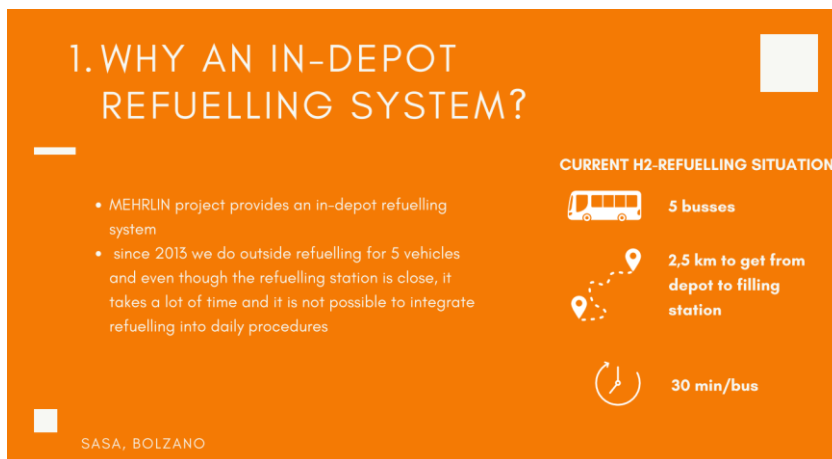


Figure 22. JIVE User Group Meeting #4 Online, SASA's presentation

On the first point, SASA remarked on the need for integration of the refuelling procedure into the daily operations of the buses to save valuable time. The presenter also shared some technical information about the necessary permits, planimetry, safety regulations, compressors and hydrogen cylinders, and the re-organisation of bus depot to accommodate new HRS in the bus depot. Some of the key suggestions included:

- Consider the number of buses that need to be refuelled.
- H₂-Refuelling process is not always as efficient as foreseen in the planning phase.
- Regulations differ from country to country.
- Importance to provide training to employees.
- The size of the refuelling station depends on the number of buses and therefore on how much Hydrogen you need to store. The bigger the quantity of hydrogen, the more infrastructure and permits you will be asked.
- At the moment, refuelling a fuel cell bus takes longer than refuelling a diesel bus. This has consequences also in the long run.

In the final session, Sphera presented the JIVE Bus Operational Data obtained in June 2021. The bus operational data was gathered from five operational sites of the JIVE projects, Bolzano, Cologne, Wuppertal, Pau, and Aberdeen. The presentation provided insights about the data and analysis on the average daily distance driven, hydrogen consumption values per site, H₂ consumption in correlation between bus and HRS data, main distance between failures, the downtime reasons, the first quarter 2021

performance assessment figures and summary of the bus data. Some examples from the presentations and data summary shared in the JIVE User Group meeting are presented in the figures below:

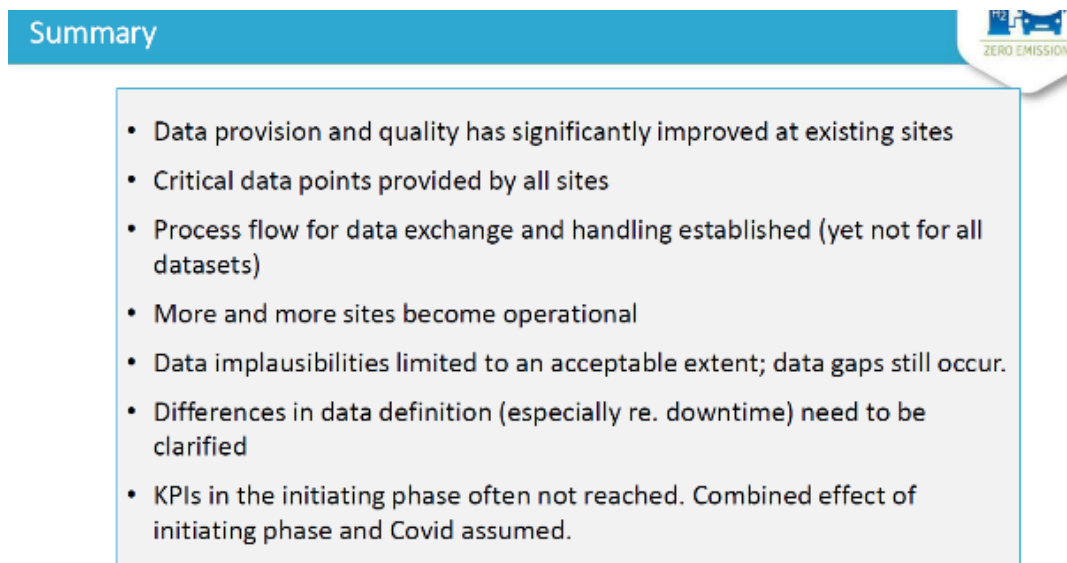
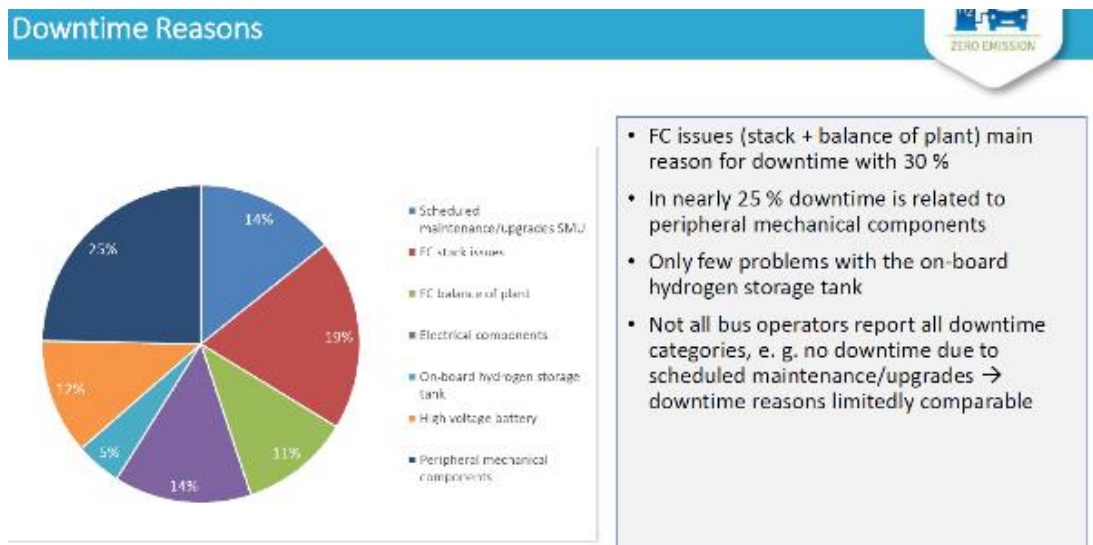


Figure 23. JIVE User Group #4 - Data performance analysis presentation

It is important to consider that, at this stage, these data results were preliminary findings, and more consolidated data and performance analysis was shared in the following User Group meetings as JIVE bus operations continued and more coherent data was collected by the sites. It is significant to underline that the User Group meeting showed the growing trend in the integration of fuel cell buses in many strategies for the transition of clean bus deployment in a number of cities outside the JIVE projects. This is relevant in the increasing acceptance of the technology and its growing importance for the bus sector.

3.5 JIVE User Group #5

UITP organised the fifth JIVE User Group meeting in collaboration with the [Clean Bus Europe Platform](#) and the 2nd JIVE 2 fuel cell hydrogen bus training on 18 November 2021 in Paris, France. The meeting was organised in a hybrid format with around twenty attendees participating on site and forty attending online. The meeting took place in the framework of the Zero Emission Bus Conference, one of the main events of the bus sector in Europe.

The training workshop on fuel cell buses updated participants on the state of fuel cell buses deployment in JIVE/JIVE 2 and presented initial lessons learned on the first months of fuel cell bus operation. At this stage, the JIVE deployment sites presented a substantial number of buses in operation and the first data from the first months of operations started to be analysed. The thematic focus of the meeting was to elaborate on the data of JIVE operational buses and hydrogen refuelling infrastructures as well as on the return of operational experience learned by Wuppertal and Groningen-Drenthe sites. Participants could learn first-hand from OV-Bureau Groningen-Drenthe and Wuppertal SW Mobil the main learnings of the interplay of fuel cell fleets with the refuelling infrastructure, its main barriers, and the solutions to address them. The User Group meeting ended with a Caetano hydrogen bus demo tour in Paris facilitated by RATP.

JIVE / MEHRLIN / JIVE 2

FCB Training in Conjunction with JIVE User Group Meeting at ZEB Conference

Hybrid Meeting: Maison de la Chimie and Remote Connection
Salon 69 at Maison de la Chimie & Teams Meeting
18th November 2021
14:00 - 18:00 CET

Moderator: Arno Kerkhof, UITP Head of Bus Transport

Time:	Duration:	Session:	Presenter:	Participants:
14:00	15	Welcome & Introduction	UITP - Aida Abdulah & Efe Usanmaz	JIVE User Group Members & CBEP Cities & JIVE Project Partners
14:15	15	JIVE/JIVE 2 Projects Updates - Q&A	Element Energy - Madeline Ojakovoh	
14:30	20	JIVE/JIVE 2 Fuel Cell Bus and Hydrogen Refuelling Structure Performance Evaluations - Main performance findings from the first months of operations - Q&A	Sphera - Vanessa Roderer & PLANET - Katharina Buss	
14:50	60	Operating Fuel Cell Buses: Return of Experience by Groningen and Wuppertal - Putting buses into operations; interplay of buses and refuelling infrastructure; obstacles & solutions - Presentations & Discussion	OV Bureau Groningen Drenthe - Peter Mul & WSW Mobil - Andreas Meyer	
15:50	10	Key Takeaways & Closure	UITP - Arno Kerkhof	
16:30	90	Fuel Cell Bus Demo Tour - Caetano Fuel Cell Bus ride around Maison de la Chimie FCB ride and visit to Hydrogen Refuelling Station in Paris (Applicable only for in-person attendants) & return to Maison de la Chimie	Caetano Bus	

Figure 24. JIVE User Group #5 and JIVE 2 #2 Hydrogen Bus Training Programme



Figure 25. Photo from the JIVE User Group Meeting #5 and JIVE 2 Fuel Cell Electric Bus Training Session #2

In the first session, Element Energy provide participants with the latest updates and results of the JIVE projects. Element Energy underlined as a pivotal result how the JIVE Projects have brought down the capital costs for fuel cell buses below the FCH JU targets. In the following session, Sphera and PLANET presented the main data and performance findings from the first months of operations of fuel cell buses and HRS. Their presentation underlined how more sites became operational, and also highlighted that even if some KPIs in the initiating phase often are not reached, after the teething phase the bus operation becomes more stable. Additionally, the demand for fuel cell buses has been steadily growing in Europe as well as the related distributed knowledge on the technology across Europe.

Why go for fuel cell buses?

High daily range

- 350+ km without refuelling
- Operating temperature does not affect range

Increased passenger capacity

- 10 - 15% more capacity than BEBs

Enhance European competitiveness

- Due to the European manufacturing base and the supply chain

A concrete answer to ambitious policy targets set for transport decarbonisation

Operational flexibility

- Similar user experience to diesel refuelling (5-10 min. fuel time)

Zero tailpipe emissions

- Only water emitted: no air pollutants or CO₂ emissions (zero CO₂ well-to-wheel when using green H₂)

Scalability

- The refuelling infrastructure is easily scaled up to accommodate growing fleets

3

Figure 26. JIVE User Group Meeting #5 - Presentation of EE

In the last session, OV-Bureau Groningen-Drenthe and Wuppertal SW Mobil presented the main learnings from their operational experience of fuel cell buses. The main highlights included:

- Hydrogen with its storage capability enables the decoupling of refuelling from energy use.
- Hydrogen can be produced “green” using many approaches and is thus the ideal contribution of the mobility sector to CO₂ neutrality.
- The comparison of mobility costs between diesel and self-produced H₂ depends strongly on the underlying infrastructure support and the state components in the electricity price.
- In terms of purely variable costs, the production of hydrogen mobility has significant cost advantages compared to diesel, but only without state electricity price components.
- In order to establish the technology, a significant cost digression of buses is necessary in the next few years, as the cost of fuel cell buses is still higher compared to diesel.
- On tendering, it is necessary to allocate risks where they best can be managed.
- In addition to the economies of scale required for OEMs, the establishment of a competitive environment is crucial.
- A key factor is the adequate training and expertise of the staff in all components (drivers, logistics, project management).

Hydrogen as a solution in public local traffic



Advantage of Hydrogen	<ul style="list-style-type: none"> • Flexible storage of energy • Available vehicles • Fast refueling • Infrastructure for hydrogen production available
Disadvantage of Batteries	<ul style="list-style-type: none"> • Restricted storage volume • In the Wuppertaler topographies are 1,7 kWh/km necessary, therefore big batteries are necessary to realize a 250 km turnaround

What did we learn?	Time	What did we learn?	operations easier than BE
Tendering and risk allocation Implementation Operation Costs (human) energy	synchronicity bus <-> HRS	Tendering and risk allocation Implementation Operation Costs (human) energy	(very) steep learning curve
	flexibility, agility, teamspirit		reliability = system reliability
	pioneering		supply management
	staff commitment		H ₂ already becoming 'normal'

Figure 27. JIVE User Group Meeting #5 – Slides from the Presentation of WSW

Some of the main learnings from the training/user group meeting included:

- The technology is mature, but still presents teething issues for proper monitoring:
 - It is necessary to be ready for a steep learning curve.
- High energy needs call for H2:
 - 1.7 kWh/km.
 - Keep an eye on the energy needed for the H2 production.
- Green H2 production plan based on different/case-based operational parameters (estimation 9kg/100km).
- Careful planning is required:
 - Good tendering and fair risk allocation for stakeholders involved.
 - Financial risks: uncertainty for the price of H2 – set fix price (and possible use subsidies) for minimum amount per year.
 - Business models: depots owned or rented by PTOs, but with ZE Technologies, the PTAs could also be the owner.
 - It is important to create stimulus for operators to deploy ZEBs.
 - TCO (CAPEX, OPEX): It is important to make it attractive for PTOs to run FCBs.
 - An appropriate funding and legal framework are necessary for making H2 competitive.
- Data is key for operational purposes – still an issue; hard to handle:
 - Streaming data from CAN bus in real time.
- Implementation:
 - Timeline: deploy in parallel HRS and vehicle purchase.
 - Create right atmosphere for staff: issues and challenges need a cooperative, coordinated approach.
- Operation:
 - Operation is less complex than BEB: 10 years could be a realistic timeframe to reach the same level of diesel.
 - HRS reliability / FCB reliability needs to be fully explored.
 - Refuelling times <15 min (cooling needs).
 - Maintenance costs might be similar to diesel buses, but more data and information is needed.
 - FCB operation is becoming increasingly normal.

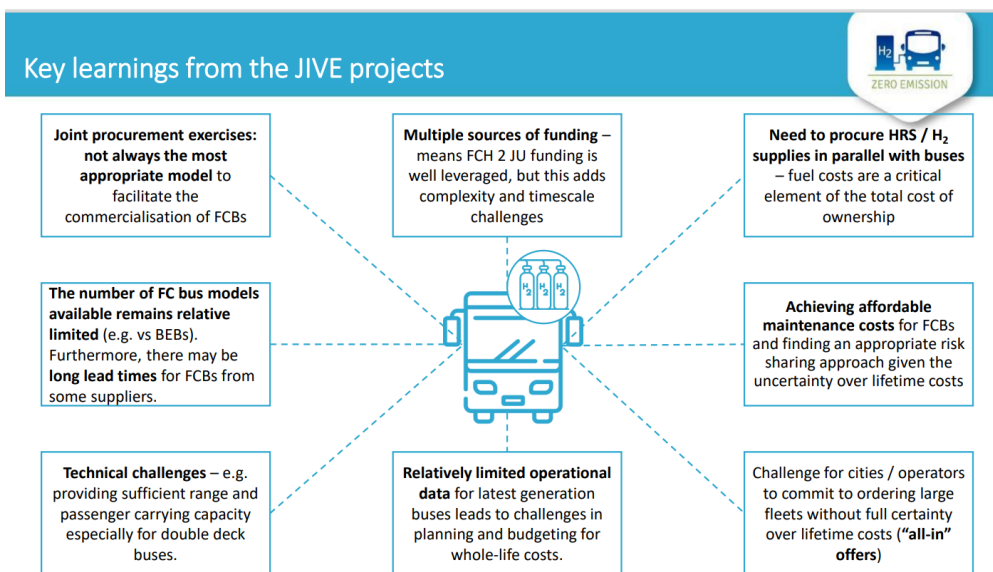


Figure 28. JIVE User Group Meeting #5 - Presentation of Key learnings

The fifth JIVE User Group provided an increasing number of learnings, solutions and insights to participants in relation to fuel cell technology. Furthermore, the increasing number of buses in operation together with the first set of reliable data on their performances was of great value for the acceptance of the technology by operators external to the JIVE projects.

3.6 JIVE User Group #6

UITP organised the sixth JIVE User Group meeting in conjunction with the Clean Bus Europe Platform study tour and took place in Madrid, Spain on 20 October 2022 in the framework of the FIAA Bus & Coach fair at IFEMA. The joint seminar session, CBEP and JIVE User Group, featured a presentation of EMT Madrid on their strategy and experience for clean bus transition. Furthermore, the session included a few presentations on operational challenges and bus maintenance of fuel cell buses from JIVE deployment sites.

The three-day programme (19-20-21 October) included two technical visits to different bus depots of EMT Madrid, providing the opportunity for participants to dive deeper into charging and fuelling infrastructure, as well as the first Industry Marketplace organised in the frame of the FIAA Bus & Coach fair at IFEMA. During the Industry Marketplace, participants attended an impulse talk on “Design & ZE buses: the opportunities of the transition to ZE emissions” capitalizing on the eBus Design Charter⁴ and a presentation on the “Concept Bus: the bus of the future for Madrid” delivered respectively by RATP Paris and EMT Madrid. As a final activity, participants experienced a bus tour to selected Bus OEMs at the FIAA Bus & Coach fair. Major bus OEMs presented their new products at FIAA 2022, such as Caetano Bus, EVOBUS Iberica, IVECO BUS, VDL B&C, Solaris, Karsan Automotive, BASCO, and welcomed the CBEP and JIVE delegation

⁴ See: <https://www.uitp.org/publications/design-charter-for-innovative-electric-buses/> (EBSF_2 EU Funded project outcome)

to their stands, offering participants the possibility of getting technical information of the latest bus products on display and updates on the latest news on the bus manufacturing market and related sectors.

JIVE / MEHRLIN / JIVE 2
JIVE User Group Meeting and CBEP Seminar
Hybrid Meeting: FIAA 2022 & Remote Connection
FIAA 2022, IFEMA, Pavilion 9, Room 9.13 & Teams Meeting
20th of October 2022
09:30 - 16:00 CET
Moderator: UITP

Time:	Duration:	Session:	Presenter:	Participants:
09:30	15	Welcome words EMT Madrid	EMT Madrid - Julieta de Mico, Institutional Affairs and CSR director	JIVE User Group Members & CBEP Cities & JIVE Project Partners
09:45	15	Welcome & Introduction to the joint session of CBEP Study Tour and JIVE UG meeting	UITP - Aida Abdulah & Flavio Grazian; Element Energy - Eva Baker	
10:00	90	EMT Madrid strategy for clean bus deployment: - Strategy & technological challenges - Tendering and system deployment - Description systems CNG, battery electric, fuel cell hydrogen - Future plans	EMT - Álvaro Rodríguez López de Guereña & Gonzalo Fernández	
11:30	10	Coffee break		
11:40	10	JIVE/JIVE 2 Projects Updates - Q&A	Element Energy - Magali Senaux	
11:50	30	JIVE/JIVE 2 Fuel Cell Bus and Hydrogen Refuelling Structure Performance Evaluations - Presentation of the new Best Practice Report & main performance findings from data collected - Q&A -	Sphera - Nicole Whitehouse & Stefan Eckert	
12:20	50	Operation and maintenance of Fuel Cell Buses: Return of Experience by Aberdeen, TMB, ESWE & 3Emotion project - Putting buses into operations; challenges encountered, current approach, bus and infrastructure maintenance - Presentations & Discussion	Aberdeen City Council - Claire Stevenson & Callum Stewart; TMB - Josep-maria Armengol; Ballard - Kristina Fløche Juelsgaard; ESWE - David Coleman	
13:10	20	Joint discussion CBEP - JIVE UG Members on challenges at their sites for ZEB deployment		
13:30	10	Key Takeaways & Closure	UITP - Aida Abdulah & Flavio Grazian	
13:40	120	Lunch and technical visit		

Figure 29. JIVE User Group Meeting #6 – Agenda

The seminar session was organised in hybrid format with a few speakers intervening online. In total, twenty-four participants attended the JIVE user group meeting on site and six joined online.

In the first part of the seminar, EMT Madrid presented a comprehensive overview of its strategy for clean bus deployment, discussing technological challenges, tendering and future plans. The presentation focused on the four following aspects:

- Technological Challenges.
- Tendering and system deployment.
- Description of different technologies: CNG, BEB, FCBs.
- Future plans.

EMT presented the various clean bus technologies currently in use, including CNG, battery electric and fuel cell hydrogen and elaborated on the main aspects of the deployment strategy and on current and future challenges. The strategic vision of EMT is of particular importance as EMT Madrid was the first public transport company using CNG (in 1994) and successfully completed the transition of its bus fleet (Fleet of 2,200 buses currently, 95.76% Green Fleet). In relation to hydrogen, EMT is planning to put in operation 10 fuel cell buses from 2023 and have a total of 20 FCBs in 2026 as a part of the Zero-Emission transition of its fleet. EMT Madrid will build up an HRS to serve 10 buses in one of its depots with a hydrogen production equipment on site with the capacity to produce up to 18 kg of H₂/h. The total investment will be around €17.2

million (including the buses) partially financed by the EU. EMT remarked on the need for finance instruments for the transition to a Zero Emission Fleet. The operator is currently receiving substantial help through the EU Next Generation Funds as there is a growing necessity to co-finance the investments.



Figure 30. JIVE User Group Meeting #6 - EMT Madrid Presentation

The second part of the day focused on fuel cell buses operational data and updates from the JIVE projects. Sphera presented the new Best Practice Report published in July 2022 with a Focus on Challenges and Solutions. The report highlights the key elements for the establishment of a successful fuel cell bus project such as:

- FC Bus projects which have been established as part of a broad energy system e.g., Pau /Groningen.
- FC Bus projects which establish and communicate realistic project expectations.
- FC Bus projects that have the 'right' people – champions for the technology, expert planners, experienced staff.

The report also pointed out some of the challenges that still remain for fuel cell buses, divided into three main categories: (1) challenges for suppliers; (2) challenges for operators; (3) challenges for authorities. The main points included:

1. Challenges for Suppliers (Buses & HRS)

- Standardising components to provide certainty of TCO for purchasers.
- Providing ready supply of parts.
- Decreasing the timeframe for production – increased involvement from major bus suppliers.

2. Challenges for Operators

- Understanding this is a major step change from running diesel buses and that finding expertise is essential.
- Working collaboratively with Suppliers and Government to make the FC Bus System viable for a commercial enterprise.

3. Challenges for Governments (Local, National & Supra-National)

- Providing certainty for Operators by providing the right frameworks: regulation and permitting.

- Providing commercial certainty for operators by de-risking their investment e.g., guaranteed demand/price for H₂; providing expertise; financial investment.
- Leveraging the FC buses to integrate Hydrogen into the regional energy system.

Additionally, Sphera presented the main performance findings from the data collected from the projects covering both buses and HRS. The aggregated data showed encouraging results coming from the operations such as:

- Fuel cell buses show an operating range similar to a diesel bus (> 350 km)
- The buses' Hydrogen consumption is very low compared to previous projects down to 6.5 kg H₂/100 km (equivalent to between 20 and 23 litres of diesel) and less than 9 kg H₂/100 km for 18 m articulated buses (equivalent to less than 30 litres of diesel).
- The demand for fuel cell buses from various operators across Europe has greatly helped stimulating the market. Today, many more models from an enlarged number of manufacturers are available.

The operators reacted in a positive way on the presentation of the data points emerging from the JIVE projects. Particularly positive reactions were noted in relation to the operational range and hydrogen consumption of fuel cell buses.



Figure 31. JIVE User Group Meeting #6 – Picture

The final session of the seminar focused on the return of experience from Aberdeen, TMB, ESWE and the 3Emotion project on the operation and maintenance of fuel cell buses. The presentations touched upon several aspects such as putting buses into operations, the challenges encountered, and bus and infrastructure maintenance. The presentations provided participants with some deep insights into the topic and an interesting discussion followed. The main takeaways included:

- The reliability of the buses was in most cases considered very good.
- The design of the adaptation of the depots for the next investments needs to be considered.
- BEB and fuel cell buses are seen as complementary technology for a Zero-Emission fleet.
- In relation to the bus maintenance, there are differences with the rest of non-FCB fleet.
- In terms of maintenance, issues arising in hydrogen buses requiring more electrical engineering input.
- One of the main requirements is the upskilling of the workforce and training more technicians.
- Servicing times are lengthier in hydrogen vehicles, influencing operational timings, staffing, etc.
- It is important to develop a sound hydrogen supply chain.
- Increasing hydrogen costs are seen as a challenge by operators.
- It is important to take into consideration the additional space on the depot.
- Increasing operational time needs to be taken into account.
- An initiation phase with small driver pool to increase acceptance among drivers and quality of feedback is advisable.



Figure 32. JIVE User Group Meeting #6 - Group Picture at FIIA

The JIVE User Group meeting was considered successful in discussing various aspects of clean bus deployment. One key aspect highlighted during the meeting was related to the financing side of clean bus deployment. Indeed, participants considered of great importance to learn more about existing business models to finance such projects to better understand the most valuable options to expand their fleet of clean buses with hydrogen technology. Finally, participants greatly valued the return of operational

experience to gain more insights in relation to opportunities and challenges of Zero Emissions technologies.

4. Assessment of acceptance of the impact on urban bus service operations and operator attitudes in the Public Transport Sector: Main Findings and Key Takeaways from the JIVE User Group

This section provides a first assessment of the acceptance of the fuel cell technology in the public transport sector by analysing the main takeaways of the discussions that took place over the six JIVE User Group meetings and workshops. As previously mentioned regarding the purpose of the JIVE User Group, these meetings were key to understand the factors which can lead to the acceptance of fuel cell buses by the public transport sectors.

The six JIVE User Group meetings covered discussions on key topics in relation to the deployment of fuel cell buses, such as challenges for their introduction, first operational assessments, bus depot organisation and refuelling infrastructure, return of operational experience, maintenance and main performance findings from data collected. However, it is necessary to underline an important consideration: due to the delays experienced in the deployment of JIVE buses and the correlated data collection from the operating sites, this interim analysis cannot be exhaustive. Although in the second part of 2022 the situation improved, there is still the need to obtain more consistent data in order to compare JIVE FCBs data with conventionally fuelled vehicles. In the upcoming meetings, the data points and JIVE FCBs performance analysis will be further presented and discussed within the JIVE User Group meetings to obtain external operators' attitudes towards fuel cell buses as requested.

At the same time, over the course of the years, and also due to the encouraging results emerging from the JIVE projects, it is possible to state that fuel cell technology for urban buses has been gradually affirming as a valuable and efficient solution for decarbonising transport networks. The increasing number of major European Public Transport Operators that decided to include fuel cell buses in their clean bus deployment strategy show the interest and the increasing acceptance of this solution for the decarbonisation of their bus fleet. This has been also reflected in the expansion of the User Group membership over the years, which highlights the importance of this platform for external operators to gain more knowledge on fuel cell buses deployment. The success story of TMB, mentioned in the previous sections, is another evidence of the recognised potential of the technology for urban bus service operations.

4.1 Key drivers and main challenges

This subsection provides a summary of key drivers and the main challenges for the acceptance of the fuel cell technology as extensively discussed in the JIVE User Group meetings.

The JIVE User Group meetings have been pivotal to enlarge the operational assessment and acceptance of the technology. The User Group meeting followed closely the

developments and learnings coming from the JIVE projects and the in-depth discussions provided an opportunity for operators to acquire more knowledge on the technology. The User Group's independence from the project consortium gives an important contribution to the user acceptance beyond the project.

1) Policies for decarbonisation

In recent years, favourable policies for decarbonisation and clean technologies are driving market and cities towards clean buses. These include the aforementioned revision of the Clean Vehicles Directive as well as strong leadership of European cities in decarbonisation strategies and commitments for zero-emissions public transport bus fleets by 2025-2030. The example of EMT Madrid, presented and discussed during the last User Group meeting, clearly shows how fuel cell buses can be part of these decarbonisation strategies and can help achieving a successful transition to clean bus fleets. On this topic, knowledge sharing during these meetings to provide User Group members with a comprehensive overview of clean bus deployment strategies has been noted as an increasingly key element for acceptance of the public transport sector.

2) Costs and financial support to de-risk the investment

One of the main objectives of the JIVE projects is to make fuel cell buses commercially viable for bus operators to be included in their fleets without subsidy. Although the drop in price is one of the main achievements of the JIVE projects, there is still the need for PTOs and PTAs interested in the technology to find financial resources of support to de-risk their investments. One of the main barriers in today's market is that fuel cell buses represent still a higher investment compared to diesel buses. Since the public transport industry operates in limited economic profitability circumstances that have been further affected by the effects of the Covid-19 pandemic (daily ridership has still not fully recovered and reached the pre-pandemic levels), the cost remains one of the most crucial elements and a possible challenge for the acceptance of the technology in the public transport sector.

3) Reliability of Supply Chain and synchronisation Bus-HRS

Since the very first meeting of the User Group, PTOs and PTAs underlined the importance of the reliability of the entire supply chain to ensure the smooth operations of fuel cell buses. Despite the different options available for Operators (on-site hydrogen productions vs off-site), it is necessary to ensure an adequate supply of hydrogen for the buses to operate. This element translates in a real need for synchronisation of the Bus and HRS processes on several levels, starting from the planning, contractual level, tendering and arriving to the operations. The deployment of vehicles needs to be aligned with the infrastructure construction. Finally, the supply chain of spare parts is essential for bus maintenance and operators need to work closely with the manufactures. On this aspect, User Group members considered particularly promising the increasing number of OEMs entering the market.

4) Planning and training of the workforce

During the discussions at the JIVE User Group meetings, members highlighted as an important factor the upskilling of the workforce and the need for adequate planning of the allocation of the resources. During the planning phase, a good project management team is an essential element for a later successful fuel cell bus deployment. Subsequently, training for drivers, technicians, and the management is necessary for the operations. The lack of an adequate planning and training of the workforce could hamper the successful deployment and operations and possibly become one of the main challenges in respect to the acceptance of the technology.

4.2 Initial Considerations on Operations

When discussing operations, User Group Members' attitude have been generally positive in respect to the technology. Operators confirmed the reliability of the buses, but a "Teething phase" has been proven common at most sites. However, operating fuel cell buses differs from diesel buses, and it has consequences on operations. Currently, fuel cell buses take longer time to refuel than diesel buses and this element has an impact also in the long term. Another important factor in relations to operations is bus maintenance, where there are differences with the rest of the non-fuel cell fleet. In fact, hydrogen buses require more electrical engineering input, and a combination of expertise covering electrical and hydrogen elements. Bus maintenance is key for operations and the cooperation with OEMs on this aspect is a necessary condition. Overall, in the JIVE User Group meetings, members highlighted how fuel cell bus deployment is a truly multi-stakeholder operation. User Group Members also remarked on the importance of the latest data points showed in the JIVE User Group meetings that are increasingly promising in terms of hydrogen consumption of the vehicles and driving range.

Although operating fuel cell buses differs from a normal diesel bus operation, throughout the years operators become increasingly acquainted with fuel cell buses operations. This has been corroborated by the growing trend on the integration of fuel cell buses in the strategies for clean bus deployment in a number of cities outside the JIVE projects. JIVE User Group members consistently perceive FCBs as a valuable option to be part of clean and zero emission strategies across Europe where the conditions allow it. In the discussions, members remarked on the complementarity of different Zero Emission technological solutions (BEB or FCB) for the implementation of a successful strategy for the decarbonisation of their bus fleet. This element is first evidence of the increasing acceptance of the technology and its growing importance for the bus sector.

4.3 Future work

With the increasing number of operational buses and more reliable data coming from the operations, the next User Group meetings will provide an important opportunity for analysing the impact of fuel cell technology on urban bus service operations and the

operator attitudes towards the technology. With the increasing level of data coming from operations, it will be possible to carry out a deeper analysis and the meetings will cover key topics to provide a better understanding of the technology and discuss operational assessment from the point of view of external PTO/PTAs. As successfully experimented, JIVE User Group meetings will seek synergies with other European projects or initiatives on Zero-Emissions technologies to provide a comprehensive overview on decarbonisation strategies for clean bus deployment that include fuel cell technology. In terms of membership, the JIVE User Group will seek to include, if the conditions allow it, new members interested in the technology to further expand the analysis over the acceptance of fuel cell buses.

Project coordination:

elementenergy

an ERM Group company

Project dissemination:



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