EUROPEAN
ZERO EMISSION BUS
CONFERENCE 9th - 12th Oct 2023
@ Busworld Europe Brussels

European ZEB 2023: Conference Report

1. INTRODUCTION TO THE FIFTH EDITION OF THE ZERO EMISSIONS BUS (ZEB) CONFERENCE

The fifth edition of the European Zero Emission Bus Conference was organised by ERM (previously Element Energy) and Busworld Foundation and took place in Brussels alongside Busworld Europe 2023 – the world's largest B2B bus and coach trade show. The Zero Emission Bus Conference (ZEB) is an event series created by ERM (previously Element Energy) and CTE (Center for Transportation and the Environment) to accelerate the transition to zero emission bus technologies. Since launching in 2016, nine successful ZEB events have been held to date in Europe and America. Previous European editions of the conference took place in Paris (2021), online via a series of ZEBINARS (2020), in Cologne (2018) and in London (2016).

The latest (2023) edition of the Zero Emission Bus conference was the first to take place during Busworld Europe, and this brought considerable benefits to attendees as what was discussed in the conference could then be seen in the exhibition. The conference timing was particularly apt given the high concentration of zero emission buses and related infrastructure and services on display at Busworld Europe 2023.

The organizers, ERM and Busworld Foundation, are grateful to all the sponsors, speakers, partners, and participants for making this edition a success. The event was supported by the Clean Hydrogen Partnership via the JIVE projects under Grant Agreements No 735582 and 779563. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe, and Hydrogen Europe Research (visit https://www.fuelcellbuses.eu/).

ERM

BUSWORLD foundation

Co-funded by the European Union

H2 ZERO EMISSION

Clean Hydrogen Partnership

The ZEB 2023 agenda was designed to give bus and coach operators, public transport authorities and policy makers a complete overview of the considerations for deploying zero emission fleets at scale. ZEB 2023 focused on technologies capable of being deployed at scale to decarbonise public transport with zero tailpipe emission solutions; i.e. battery electric buses, fuel cell electric buses, and the associated recharging and refuelling infrastructure. The conference focused on technology and policy-related topics affecting zero emission buses and coaches, rather than wider bus sector challenges. New in this edition was the special attention for zero emission long distance and tourism coaches – a full day was dedicated to this topic.

The conference was held over four days (9th-12th October 2023) and included presentations from over 75 speakers including European politicians, bus and coach operators, key associations, and OEMs leading the transition to zero emission. The agenda covered all the considerations needed to enable full fleet transitions to battery electric / hydrogen technologies, including financing options, total cost of ownership / economics of ZEBs, technical requirements of operating and maintaining ZEB fleets, and the emerging zero emission coach market.

The complete agenda can be found in the Appendix.

This report summarises the key takeaways of the conference.

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European ZEB Conference

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2. KEY TAKEAWAYS

2.1 POLICY FOCUS, OPERATIONAL EXPERIENCE AND TECHNICAL PERFORMANCE

2.1.1 LATEST EUROPEAN DEVELOPMENTS

- Electric bus sales surpassed diesel bus sales in Europe for the first time in 2023, marking an important milestone in the shift toward sustainable transportation. One in three buses sold in Europe is now electric, with the rest of the market comprising diesel, hybrid, natural gas, and hydrogen fuel cell buses.
- The Clean Vehicle Directive has played a key role in driving this transition, but Europe is still behind China in the context of zero-emission bus deployment, where 97% of city buses sold in 2022 were zero emission (compared to 24% in the EU in the same year).
- Many capital cities in Europe have committed to phasing out the use of diesel buses, with targets to have 100% zero emission fleets by between 2025 and 2035. Bus OEMs are responding to this clear signal of intent by developing a greater range of zero emission products and in some cases committing to offer only zero emission solutions from certain dates.

2.1.2 PANEL: OVERCOMING BARRIERS TO ZEB DEPLOYMENT

- Over the years, zero emission technology has matured, but significant challenges persist, particularly around building charging infrastructure, expanding the bus fleet, and addressing infrastructure constraints (i.e. getting sufficient power to depots for charging electric buses).
- To ensure that ZEBs are operating efficiently, skills need to be shifted from traditional engine knowledge to proficiency in battery technology for both drivers and maintenance personnel.
- Current challenges in introducing innovations and piloting new technologies are tied to the inflexibility of long-term contracts and the lack of adaptability needed for emerging technologies. There is a need to amend these contracts to facilitate the deployment of new zero emission technologies.

- As zero emission technology is still expensive compared to conventional diesel buses, government support through national subsidies and financial backing is essential to motivate regions and companies to embark on these projects. In addition, measures that encourage modal shift (i.e. more fare-paying passengers) can help to make the business case for zero emission buses. The example of an innovative approach in Oxford (UK) was cited which involves the city council providing additional bus lanes.
- To ensure the successful adoption of ZEBs, long-term collaboration among stakeholders in public transport, including regions, municipalities, bus operators, manufacturers, electricity providers, and regulatory bodies, is key.

2.1.3 STATE OF PLAY OF PERFORMANCE OF FUEL CELL BUSES (FCB) AND HYDROGEN REFUELLING STATIONS (HRS) – RESULTS FROM THE JIVE PROJECTS

- As of 2023, within the JIVE projects (deploying 300 fuel cell buses and associated refuelling infrastructure), 77% of the sites have exceeded the target of 90% vehicle availability, reflecting a significant improvement in the reliability and performance of fuel cell buses compared to earlier generations.
- Fuel consumption has seen a significant drop relative to past projects. As of 2023, all buses within the JIVE projects have outperformed the objective of <9kg/100km (standard buses) with values down to 6.5kg/100km.
- However, hydrogen refuelling stations have been encountering several challenges, notably related to the rising hydrogen prices and hydrogen availability issues.

2.1.4 PANEL: PERFORMANCE OF ZERO EMISSION BUSES

- The technology for zero emission buses is mature, and zero emission buses are now a mainstream option. Indeed, some bus manufacturers are now only offering zero emission solutions. For example, the bus OEM on the panel (Van Hool) has been selling only zero emission products since 2022: battery electric, fuel cell electric, and electric trolley buses.

- There was a consensus that there is no "one size fits all" solution when it comes to zero emission buses. A range of technologies will be required for the transition to a fully zero emission public transport system.
- Battery electric buses are a good solution in many circumstances. However, with current technology BEBs struggle to replace diesel buses in certain locations / duty cycles. For example, in Barcelona, where summer temperatures are high leading to significant air conditioning demands, battery electric buses are unable to complete a full day's operation. Hence, the transit company (TMB) is investing in fuel cell electric buses.

- In terms of choice between battery electric and fuel cell electric buses from a commercial perspective, the key issue is the costs of energy for running the vehicles (electricity prices versus hydrogen prices). High hydrogen prices have been an issue in recent years, but access to sufficient amounts of power is also a challenge in many countries, an issue likely to become increasingly acute with higher electrification of the mobility sector.
- The batteries within electric buses represent a significant proportion of the value of the vehicle. Some operators with growing fleets of electric buses have invested heavily in developing capabilities to manage and optimise these assets. Battery warranties typically include conditions (e.g. limits on the level of discharge permitted), which means there is a need for systems to check compliance with any such conditions. Data relating to the use and status of the batteries is critical and the panel discussed the question of who owns the data (battery OEM / bus OEM / bus operator). The need for bus operators to own (or at least have access to) data from the vehicles was highlighted.

2.2 OPERATIONAL EXPERIENCE AND TECHNICAL PERFORMANCE

2.2.1 CASE STUDY: DEPLOYMENT OF HYDROGEN FUEL CELL BUSES IN CALIFORNIA

- A hydrogen and fuel cell program has been running in California since the turn of the century. Fuel cell electric buses are being deployed along with other heavy-duty vehicles such as Class 8 trucks.
- The acceptance of fuel cell technology has grown significantly in California, with 41 transit agencies considering it as a viable option for achieving net-zero emissions compared to three in 2018.
- Having trialled battery electric buses, Foothill Transit (the bus operator present to share lessons from California) concluded that they would not be a viable replacement for diesel vehicles, mainly due to the need to increase the fleet size by around 50% because of the operational limitations of the vehicles. Fuel cell buses are seen as an attractive zero emission alternative due to their ability to be one-for-one replacements for diesel buses.
- Resilience was also mentioned as a further motivation for selecting hydrogen buses. Given that the electricity grid in California is not 100% reliable, the option of having a fleet of public transport vehicles that does not rely directly on power from the grid is attractive.
- However, there are also challenges relating to hydrogen supplies, for example access to sufficient quantities of fuel, ensuring the hydrogen is produced from renewable energy, and fuel price. The ARCHES initiative is a program in California to accelerate renewable hydrogen projects and is seeking to implement hydrogen production, storage, and distribution infrastructure to facilitate the use of renewable hydrogen at scale in the coming years.
- The hydrogen refuelling solution adopted by Foothill Transit uses liquid hydrogen delivered to the depot. The supplier contracted to provide the fuel has access to multiple sources of hydrogen to mitigate the risk of issues with any single supply route.

2.2.2 PANEL: DATA ANALYTICS – OPTIMISING OPERATIONAL FLEET PERFORMANCE AND PLANNING FUTURE FLEET DECISIONS

- As discussed during the *performance of zero emission buses* panel, accessing and monitoring data relating to battery health and performance is important for maximising the operational life of zero emission buses. While some bus operators have invested in developing in-house expertise in this area, not all will have the capacity / desire to do so.
- Battery monitoring and data analytics solutions are available from specialist providers. These products and services can detect issues (e.g. failures at a cell level) which vehicles' battery management systems might miss.

- Battery analytics services can be relatively low cost (a figure of <€100 per year per bus was quoted) and provide high value as they can help to extend battery life and prevent costly failures and unplanned downtime.
- While some Public Transport Authorities (e.g. Transport for London) make it a requirement for operators to collect and broadcast certain data, it is not currently standard practice in the industry for bus buyers to request full access to data relating to the health of the batteries in newly acquired buses. Bus operators (and others purchasing buses) are advised to consider carefully the data requirements and include suitable provisions in tender documents.
- The panel discussed the fact that while data is very important, data alone is insufficient to optimise the operation of zero emission buses. There is a need to analyse and interpret the data (facts) to yield information (organisation and interpretation of the facts) and to integrate this information into decision making processes within businesses. In some cases, a degree of organisational change may be needed.

2.2.3 PANEL: HRS INFRASTRUCTURE: CHALLENGES AND SOLUTIONS

- While industrial gas companies such as Air Products, Linde, and Messer have experience of supplying hydrogen (and other gases) to industries that require 100% reliability, supplies of hydrogen to mobility applications have, in general, not achieved these levels.
- There are examples of hydrogen refuelling stations (HRS) operating at very high availability and reliability levels, but many sites involved in the early deployment of fuel cell buses (e.g. under the JIVE projects) have encountered issues with HRS and hydrogen supplies.
- Critical components with HRS include the compressor and chilling system (if pre-cooling the hydrogen). To maximise HRS availability, redundancy in the design is advisable, i.e. include duplicates of key components so that if / when failures occur, the HRS can still operate. The main challenge with this approach is cost: it can be expensive to build in such redundancy, especially for low capacity stations. Having spare parts available and a thorough maintenance strategy for the HRS, including availability of people with the necessary skills to maintain and repair the station, is also very important.
- Some suppliers are seeking to de-risk and simplify the prospect of adopting hydrogen fuel cell buses. For example, Messer is working with CaetanoBus and Toyota Tsusho to offer an all-inclusive package comprising the bus, fuel and maintenance support on a pay-per-kilometre driven basis. However, most tendering processes for zero emission buses are not currently designed with such commercial arrangements in mind; typically a customer will procure buses and fuel separately.

- Air Products has recently commissioned a hydrogen refuelling station in Crawley (UK) based on delivered liquid hydrogen. The site includes vaporisers to convert the liquid hydrogen into gaseous which can then refuel buses at 350 bar without the need for a compressor on site. Key advantages of this approach include low footprint (minimising space needed in the depot), relatively low cost of infrastructure (per kg/day dispensing capacity), and simplicity (fewer components at the site means lower risk of mechanical failures).

2.2.4 PANEL: CHARGING INFRASTRUCTURE, CHALLENGES AND SOLUTIONS

- During the transition to ZEBs, the Public Transport Authority (PTA) strives to maintain consistent schedules and routes to minimise passenger disruptions.
- Advances in battery electric bus technology mean that they are now seen as a one-for-one replacement for diesel buses in a growing number of areas / duty cycles. The example of Amsterdam was cited, where in the past 100 battery electric buses may be needed to replace 84 diesel buses whereas now deployment plans are based on one-for-one replacements. However, the electric bus system is still complicated, extending beyond the charging points themselves.
- The demand for a robust grid connection is essential, given the substantial electricity requirement of electric buses. Operators are encouraged to begin by understanding the available grid capacity and its distribution across their operational locations. This will help them assess the grid's impact and estimate the budget necessary for grid-related investments and optimisations across different depots.
    - There are examples of changes to the rules relating to how costs of grid upgrades triggered by applications for new power connections are levied. E.g. a recent rule change in the UK (April 2023) means that grid reinforcement costs are now socialised rather than falling on the grid upgrade applicant.
- Energy storage, particularly in conjunction with solar power could support the electricity availability at charging depots. However, the feasibility of energy storage depends on the unique business case and the regional financial benefits of feeding excess energy back to the grid.
- Digitalisation (as discussed in Section 2.2.2) emerges as a promising solution to improve the connection between OEMs, PTAs, and PTOs to enhance operational efficiency and coordination.
- Smooth and continuous communication between the buses and chargers is key, necessitating adaptable charging ports to accommodate different bus models efficiently.

2.3 ECONOMICS, FINANCING AND FUNDING

2.3.1 PANEL: BUILDING A STRONG BUSINESS MODEL FOR BEBS

To establish a robust business model for BEBs several crucial considerations come into play:

- Collaboration between operators and partners is critical for a successful transition to electric buses.
- Well-crafted policies play a significant role in supporting the uptake of electric buses, encouraging both public and private investments in zero emission transport.
- CAPEX funding has been helpful in supporting the early deployments, but there's a risk that ongoing high levels of capital funding may delay price reductions expected as the market scales up and technology develops.
- As electric buses are to become significant consumers of electrical power, their energy requirements need to be carefully managed and demands for power from the electrification of transport considered as part of electricity grid upgrade planning.
- Battery electric buses currently have a significant cost premium compared to diesel buses (up to around three times the purchase price). It is therefore important to minimise the size of the fleet.
    - In the initial phase of deployment of BEBs, operators were cautiously purchasing extra BEBs. However, with greater operational experience, there are opportunities to be leaner and PTAs should avoid specifying the number of buses required in a fleet for a given route as there is scope for operators to innovate/manage risks in ways that reduce the number of buses and therefore the overall costs of delivering the service.
- Distributing risks across the value chain involving PTA and PTO, and other stakeholders can help mitigate the concentration of risk on a single entity.
- Determining the residual value of batteries and infrastructure is essential for pricing and financing. However, establishing clear residual values is challenging, given the relatively recent adoption of the technology.

2.3.2 PANEL: FINANCING A FULL FLEET TRANSITION: PUBLIC FUNDING OPTIONS

- To develop a viable ZEB project and attract funding, it is important for the project to be presented as a low-risk endeavour. Moreover, an ideal funding portfolio should balance various mechanisms, including grants, equity, and loans.

- Key obstacles for cities include the need for more guarantees, tailored solutions for small operators, and greater investment and recognition for public transport in regions where electric mobility may not be a top priority for banks or financial institutions.

2.3.3 PANEL: BUILDING A STRONG BUSINESS MODEL FOR FUEL CELL BUSES

- It is widely accepted that hydrogen fuel cell electric buses currently have a higher total cost of ownership (TCO) than battery electric buses. However, some industry observers believe that with scale (both scale of production at an individual OEM and scale of deployment per depot) and access to low-cost renewable energy for hydrogen production, the TCO could reach parity with battery electric buses.
- Thanks to projects such as JIVE, fuel cell buses are now being deployed at greater scale in some locations. The Cologne region in Germany is one example, where 74 fuel cell buses are operating today, with plans for at least 160 units by 2025. There is also growing interest in fuel cell buses in multiple cities across Europe.
- The importance of scale was discussed. For example, the all-inclusive offer from CaetanoBus becomes increasingly attractive from a price-per-kilometre perspective for orders of 50 buses and above.
- Providing a degree of certainty over hydrogen demands for fuel suppliers is also important for minimising the costs of hydrogen supply. Given the nature of the investments needed to supply hydrogen to fuel cell bus fleets, suppliers prefer long-term fuel supply contracts. These agreements can be structured to manage risks appropriately and give certainty and confidence to both parties (i.e. bus operators access a reliable supply of fuel for a predictable price while hydrogen suppliers have a guaranteed source of demand).
- While there have been challenges in recent years accessing hydrogen for bus fleets at the scale (and prices) needed for an attractive business case, the development of large-scale renewable hydrogen production facilities in the coming years is expected to address this issue.
    - The example in Cologne was again cited, where hundreds of megawatts of electrolysis capacity is planned, along with hydrogen pipelines which can provide a cost-effective means of distributing hydrogen fuel. Linking to such schemes (and/or being part of a "hydrogen valley") is one way of minimising additional investments needed and hence accessing low-cost hydrogen fuel for bus fleets.

2.4 ZERO EMISSIONS COACHES AND LONG-DISTANCE SERVICES

2.4.1 ROLE OF FUEL CELLS IN DECARBONISING COACHES:

- BEBs, despite their many advantages, pose unique challenges, particularly when dealing with larger fleets.
    - For instance, scheduling adjustments and route planning are more complex for BEBs, impacting their overall operational efficiency (i.e. distance travelled by the bus per quarter, capacity transported and number of stops for a given number of unlinked passenger trips).
    - Additionally, these buses can be sensitive to temperature fluctuations, potentially affecting their performance and battery life.
- Fuel cell technology is seen as a better fit for zero-emission coaches due to their unique requirements, such as the need for longer ranges, fast refuelling times, and ample luggage space for passengers.
- To enable a smoother transition, the experiences and lessons learned from deploying zero-emission city buses, including training, depot renovations, fuelling infrastructure, and scheduling adjustments, can be applied to coaches.
- Funding initiatives and incentives have been more focused on city buses, leaving coaches with a funding gap.
- Stakeholders are encouraged to build upon the knowledge gained from the deployment of zero-emission city buses. This collaborative approach will save time and resources while expediting the adoption of zero-emission coaches. By sharing insights and experiences across the industry, the transition to cleaner and more sustainable coach fleets can be achieved more effectively.

2.4.2 PANEL: ZERO EMISSION COACHES: MEETING THE NEEDS OF CUSTOMERS

- The cost of owning and operating vehicles in the tourism sector needs to be reasonable as tour operators are often price-sensitive due to the competitive nature of the industry.
- Key considerations for designers of coaches include driver comfort, passenger comfort, safety, luggage space, flexibility to accommodate various customer needs, and total cost of ownership.

    - Compared to buses, flexibility is crucial in the tourism industry. Tourism businesses need to adapt to various customer needs and market conditions. This relates to the types of vehicles used, routes they operate, or services they provide. This ability to

accommodate different tour packages and schedules is key for any new technology for the tourism coach market.

- In addition, reliability is essential for coaches. Consistency in operation and the ability to meet passengers' needs were underscored as non-negotiable requirements.
- Charging methods should balance depot and on-route charging to avoid schedule disruptions.
- Retrofitting existing coaches is a promising strategy to make low-emission solutions more accessible. However, the challenges of certifying retrofitted coaches and the need for further experience in this technique need to be addressed.
- The question of battery electric or fuel cell electric powertrains for coaches was raised and the panel discussed the fact that both solutions are being developed in parallel. As in city buses, battery electric solutions are expected first but hydrogen-fuelled coaches are also on the horizon (indeed, at least two models were on display at the Busworld Exhibition). The preferred technology will depend on the specifics of the operations - i.e. decisions will be made on a case-by-case basis.
- In response to the question of what needs to change to incentivise zero emission coach uptake, the panellists raised several points, including: measures to encourage greater use of coaches (e.g. restrictions on use of private cars); investment in the coach industry to ensure that attractive, reliable services are offered; and public sector (government) support with high costs at the start of the transition.

2.4.3 PANEL: ZERO EMISSION COACH ECOSYSTEM – TECHNOLOGICAL CHALLENGES AND BUSINESS ADAPTATIONS (INFRASTRUCTURE FOCUS)

- Given the way that coaches are typically operated (i.e. often not depot-based overnight), the deployment of infrastructure to support the uptake of zero emission trucks presents an opportunity for the coach sector. I.e. there should be opportunities for zero emission coaches to use recharging / refuelling infrastructure designed for trucks. In such cases, safe, comfortable facilities need to be provided for passengers (and drivers).

- The designers of any publicly accessible recharging / refuelling infrastructure intended for trucks should consider the potential needs of coach operators.
- While there is much focus on zero emission buses / coaches, it is important to recognise that even standard buses and coaches are an environmentally friendly (and very space-efficient) way of transporting people.

- The question of funding for zero emission coaches was discussed. The panel agreed that a higher amount of targeted funding for the sector would help to accelerate the adoption of these vehicles.
- Travelling across European countries raises challenges when it comes to setting targets and standards on a national level. Therefore, consistency in hydrogen refuelling infrastructure and standards across European countries is essential to enable seamless cross-border travel for hydrogen-powered coaches.

3. APPENDIX

3.1 ZEB CONFERENCE AGENDA (AS OF 9/10/2023):

SESSION 1 | CONFERENCE OPENING | TOWARDS NET ZERO: WELCOME AND INTRODUCTION | 14:30 – 16:00

Auditorium 500, Hall 7, Brussels Expo Centre, Brussels

Landscape of ZEB (Zero Emission Buses) deployment, focus on EU position and on existing EU/national policies and political barriers yet to overcome for the deployment of large ZEB fleets

14:30– 14:40	10’	**Conference Opening (1/2) – Welcome to the 5Th EU ZEB edition** • Redgy Deschacht, President, **Busworld Foundation** • Michael Dolman, Partner, **ERM (Formally Element Energy)** • Lydia Peeters, **Flemish Minister of Mobility**
14:40– 14:50	10’	**Conference Opening (2/2) - Transitioning to zero emission: Brussels ZEB Plan** *An overview of Brussels’ transition to zero emission transport, including the transition of the STIB-MIVB fleet to zero emission* • Brieuc de Meeûs, CEO, **STIB-MIVB** • Elke Van Den Brandt, **Brussels’ Minister for Mobility**
14:50 – 15:00	10’	**Overview of the status of ZEB deployment in Europe** *State of play of the bus and coach market in the EU* • Eamonn Mulholland, Researcher Heavy-Duty Vehicles Program, **The International Council on Clean Transportation (ICCT)**
15:00 – 16:00	60’	**Panel – Overcoming barriers to ZEB deployment** *This panel discussed the successful political measures, both national and European, enabling large-scale deployment of zero emission buses (ZEBs), as well as covering the remaining barriers to address. The political measures include emission reduction targets, low emission zones, infrastructure policies amongst other policies.* **Moderator**: • Axel Volkery, Deputy Head of Unit Sustainable and Intelligent Transport, DG MOVE, **European Commission** **Panel:** • Antoine Grange, CEO Europe, **Transdev Group** • Prof. Klaus Bonhoff, Head of Department Policy Affairs**, Federal Ministry for Digital and Transport, Germany** • Kristoffer Tamsons, Vice-chairman**, Swedish Public Transport Association, Sweden** • Louis Rambaud, Strategy and Transformation Director**, Go-Ahead Group**

CONFERENCE DAY 1| TECHNICAL PERFORMANCE OF ZEBs (1/2)| 16:30 – 18:05

Landscape of performances of BEBs (Battery Electric Buses), FCBs (Fuel Cell Buses) and associated infrastructures, real world technical experience of large fleets and remaining technical challenges to address for complete full fleet transition to ZEB. Maintenance and safety topics of ZEBs were also discussed.

16:30 – 16:40	10’	**How will the EU keep its position as a leader in ZEB deployment?** Daniel Mes, Cabinet Member for **Wopke Hoekstra, EU Climate Commissioner, European Commission** *Progress and actions to take in terms of European and national policies in combination*
16:40 – 16:55	15’	**State of Play of Performance of BEBs (Battery Electric Buses) and Charging Infrastructure** *AVERE, European association specifically representing and advocating for electromobility - latest results on the performance of electric buses and charging infrastructure.* Philippe Vangeel, Secretary General, **AVERE**
16:55 – 17:10	15’	**State of Play of Performance of FCBs (Fuel Cell Buses) and HRS’ (Hydrogen Refuelling Stations)** *Results from the JIVE/JIVE 2/MEHRLIN projects deploying 298 FCBs and 18 HRSs across 16 European cities – the largest deployment attempted to date in Europe.* Klaus Stolzenburg, Managing Director, **PLANET** Vanessa Roderer, Sustainability Consultant Energy & Mobility, **Sphera**
17:10 – 18:00	50’	**Panel – Performance of Zero Emissions Buses** *This panel was composed of bus operators with large ZEB fleets, with both FCBs and BEBs, and bus OEMs and discussed the performance of zero emission buses compared to diesel buses. Safety, training, and maintenance were also covered in the panel.* **Moderator:** • David Barnett, General Manager – Engineering, **Translink** **Panel:** • Gerrit Spijksma, CEO, **Qbuzz** • Josep Maria Armengol Villa, Technical Director, **TMB** (Transporte Metropolitano de Barcelona) • Geert van Hecke, Head of Sales Public Transport, **Van Hool** • Bahar Konak, Global Bus Business Development Director, **Accelera**
18:00 – 18:05	5’	**Closing Speech** Thomas Lymes, Policy Advisor for Mobility & Air Quality, **Eurocities**

DAY 2 - OPERATIONAL EXPERIENCE AND TECHNICAL PERFORMANCE

SESSION 3 | TECHNICAL PERFORMANCE OF ZEBs (2/2) | 09:30 – 11:00

Case studies of leading cities in large ZEB deployment (EU and worldwide). Data analytics, essential to smooth and optimal ZEB operation, were also covered.

09:30 – 09:35	5’	**Conference Opening Address** Jan Deman (Managing Director) - Busworld Foundation
09:35 – 09:50	15’	**Electrifying Public Transport : RATP’s ZEB Journey in Paris and beyond** *This presentation delved into RATP’s transformative journey towards sustainable public transportation, highlighting their ambitious goals, innovative strategies, and tangible outcomes.* François Warnier de Wailly, Director of the Bus Program 2025, **RATP Group**
09:50 – 10:10	20’	**The Other Electric Bus: A California Agency Deploys 33 Fuel Cell Buses & Additional Developments from the US ZEB Market** *Roland Cordero of Foothill Transit & Jaimie Levin of the Center for Transportation and the Environment (CTE) covered the state of the United States’ ZEB market with particular attention on the state of California. Mr. Cordero presented on Foothill’s active deployment of 33 New Flyer hydrogen fuel cell buses that are operating outside of Los Angeles.* Jaimie Levin, Senior Managing Consultant, **The Center of Transportation and the Environment (CTE)** Roland Cordero, Director of Maintenance and Vehicle Technology, **Foothill Transit**
10:10 – 10:50	40’	**Data analytics – Optimising Operational Fleet Performance and Planning Future Fleet Decisions** **Moderator**: • Sanne Van Breukelen, Senior Project Manager, **Cenex Netherlands** **Panel**: • Claudius Jehle, CEO, **volytica diagnostics** • Santosh Alexander, CEO, **WideSense** • Martin West, Principal Engineer Vehicles, **TFL (Transport for London)**
10:50 – 11:00	10’	**Efficient Hydrogen Refuelling Solutions – Performance and Innovations** Susanne Goldammer, Managing Director, **Linde Hydrogen FuelTech GmBH**

SESSION 4 | THE INFRASTRUCTURE CHALLENGE: BATTERY & HYDROGEN | 11:30 – 13:15

This session focused on the performance and maintenance of refuelling/recharging infrastructures and remaining technical challenges to overcome. Grid and depot management were also discussed.

11:30 – 12:15	45’	**Panel - HRS Infrastructure; Challenges and Solutions** *The panel discussed current station performance including latest progress and remaining technical challenges, available refuelling solutions (on-site/off-site, mobile/stationary etc.), adapting depots to large FCB fleets, maintenance and safety requirements and ecosystem approach.* **Moderator:** • Lionel Boillot, Project Officer, **Clean Hydrogen Partnership** **Panel:** • Erwan Bruneau, H2fM Product Manager Europe, **Air Products** • Andreas Noky, Project Manager Hydrogen Refuelling Stations, **Messer** • Flip Konings, Sustainability Advisor, **OBGD (OV-bureau Groningen Drenthe)** • Luigi Lugaro, Chief Technology Officer, **SASA (Bolzano)**
12:15 – 12:25	10	**Challenges when scaling: How to ensure operational readiness at the lowest cost in the EV transition** Uwe Munch, Director of Bus, Europe, **ChargePoint**
12:25 – 13:10	45’	**Panel – Charging Infrastructure; Challenges and solutions** *This panel discussed the current station performance, covering the latest progress and technical challenges. Specific topics covered depot electrification, charge management and solutions, maintenance and safety, connecting assets together in an ecosystem approach, and managing the limitations of grid capacity.* **Moderator:** • Céline Cluzel, Partner, **ERM (Formally Element Energy)** **Panel**: • Markus Mildner, CEO eMobility, **Siemens Smart Infrastructure** • Pieter Vermassen, Expert Grid Development, **Fluvius** • Gerard Hellburg, Programme Manager Clean & Sustainable, **Vervoerregio (Amsterdam)** • Lidia León Talavera, Vice Director of Operational Centres, **EMT Madrid (Empresa Municipal de Transportes de Madrid)**
13:10 – 13:15	5’	**Closing Speech** Ruud Kempener, **Cabinet member, Commissioner for Energy, European Commission**

END OF DAY 2

DAY 3 – WEDNESDAY 11TH OCTOBER 2023
ECONOMICS, FINANCING AND FUNDING

SESSION 5 | ECONOMICS OF ZEBs| 09:30 – 11:00

TCO (Total Cost of Ownership) of BEBs (Battery Electric Buses) and FCBs (Fuel Cell Buses) and building a sustainable business case for large ZEB fleets. Economics of retrofitted buses and 2nd hand buses/batteries were also discussed.

09:30 – 09:35	5’	**Conference Opening** Mirela Atanasiu, Interim Executive Director, **Clean Hydrogen Partnership**
09:35 – 09:55	20’	**Total Cost of Ownership Case Study on BEBs and FCBs** Vanessa Roderer, Sustainability Consultant Energy & Mobility, **Sphera**
09:55 – 10:45	50’	**Panel – Building a strong business model for BEBs (Battery Electric Buses)** *This panel discussed the economics of BEBs and how a sustainable business model for BEBs can be achieved.* **Moderator:** Richard Riley, Senior Principal Consultant, **Element Energy** **Panel:** • Bernt Reitan Jenssen, CEO, **Ruter (Norway)** • Steven Meersman, Co-Founder and Director, **Zenobē** • Matthias Grossmann, CEO Commercial Finance, **Siemens Financial Services** • Bruno Lapeyrie, Director Center of Excellence Energy Transition Bus, **Keolis**
10:45 – 11:00	15’	**Hydrogen fuel cells as enabler for mobility decarbonization: Symbio’s solution for Buses & Coaches.** Alexandre Papillon, Product Manager, **Symbio**

SESSION 6 | THE FUTURE OF FUNDING MODELS FOR ZEBs AND ASSOCIATED INFRASTRUCTURES | 11:30 – 13:20

11:30 – 12:20	50’	**Panel - Financing a full fleet transition: Public funding options** *The panellists discussed the available public funding options, both on a European and national level, and whether they are sufficient for a full transition to zero emission bus fleets.* **Moderator:** • Richard Ferrer, Head of Alternative Fuels, **European Commission - CINEA** **Panel:** • Ian Jennings, Senior Specialist Urban Transport, **European Bank for Reconstruction and Development** • Neil Valentine, Head of Urban Mobility, **European Investment Bank** • Mathilde Petit, European Funding Manager, **RATP Group** • Thomas Maltese, ZEBRA Program Manager, **C40**
12:20-12:30	10’	**1198 BUSES POWERED BY REFIRE: A Hydrogen-Electric journey** Audrey Ma, Group Vice President, International Markets, REFIRE
12:30-13:20	50’	**Panel – Building a strong business model for FCBs (Fuel Cell Buses)** *This panel focused on the economics of fuel cell buses and how to achieve a sustainable business model.* **Moderator:** • Ben Madden, Chief Technology Officer, **HYCAP** **Panel:** • Nuno Lago de Carvalho, Chief Commercial Officer, **CaetanoBus** • Magdalena Przybyła, President of the Management Board, **Municipal Transport Company in Konin (MZK Konin)** • Carsten Krause, Founder & Project Manager, **HyCologne** • Virág Mészáros, CEO, **HUMDA Hungarian Mobility Development Agency**

END OF DAY 3

DAY 4 – THURSDAY 12TH OCTOBER 2023
ZERO EMISSION COACHES AND LONG-DISTANCE SERVICES

SESSION 7 | State of Play for ZE Coaches| 09:30 – 11:00

Landscape of ZE (Zero Emission) Coaches latest market development, focus on the client's technical requirements.

09:30 – 09:40	10'	**Conference Opening** Emmanuel Mounier, Secretary General, **EU Travel Tech**
09:40 – 10:00	20'	**Market Development and Demand for zero-emission coaches – focus on French market.** • *Antoine Herteman, President of **AVERE-France*** • *Valérie Bouillon-Delporte, 1st VP of France Hydrogène and Coordinator of the Mobility Group, **France Hydrogène***
10:00 – 10:50	50'	**Panel – Zero Emission Coaches: Meeting the needs of customers** *The panel discussed the technical requirements from operators to decarbonize their coach fleets and what vehicle OEMs are doing to develop this market.* **Moderator:** • Tim Griffen, Project Officer, **ZEMO Partnership** **Panel:** • Manoela Araujo, Energy Transition Referent, **Transdev** • Agnes Pastuszak, President, **GPN (Global Passenger Network)** • Jack Li, CEO Europe, **Yutong** • Hans Peter Michelet, Chairman of the Board, **GreenEnergy (Solarbus)**
10:50 – 11:00	10'	**Daily Drive – Exploring the Technical Experience and Challenges of Operating a Fuel Cell Bus Fleet** David Yorke, Market Development Manager, **Ballard Power Systems Europe**

SESSION 8 |ZE COACHES/LDS CHALLENGES AND OPPORTUNITIES| 11:30 – 13:00

First return of experience of prototypes and early deployments. Current regulation, target for the sector and infrastructure/technological challenges were covered.

11:30 – 11:50	20’	**Opportunities and challenges in the build up of an ecosystem for zero-emission coaches** • Maximilian Lohrer, Program Manager Hydrogen and Fuel Cells (Commercial Vehicles), **NOW GmbH** • Jascha Lackner, Program Manager Bus, **NOW GmbH**
11:50 – 12:50	50’	**Zero Emission Coach Ecosystem - Technological challenges and business adaptations (infrastructure focus)** *This panel discussed the opportunities and challenges to the emerging market of zero-emission coach infrastructure, specifically looking to cover the availability of hydrogen refuelling and recharging networks, recharge time, grid capacity, managing vehicle range and the emergence of new business models* **Moderator:** • Stasa Mrdovic, Manager for Passenger Transport, **IRU** **Panel:** • Rebecca Kite, Policy Manager, **Confederation for Passenger Transport UK** • Frederik de Vries, Senior Manager Public Private Partnerships, **Rebel Group** • Daniel Zellinger**,** Team Lead Bus Fleet Strategy, **Flixbus** • Pedro Gomes, Project Manager & Coordinator of POLIS Clean Vehicles & Air Quality Working Group, **POLIS**
12:50 – 13:00	10’	**Closing Speech** Isabelle Vandoorne, Deputy Head of Unit Research and Innovation, DG MOVE, **European Commission**

END OF DAY 4/CONFERENCE