Clean Hydrogen Partnership

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Deliverable 4.14

Learnings from hydrogen vehicle demonstrations with delivered hydrogen

ZERO EMISSION

JIVEs / MEHRLIN projects



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1. Executive summary

As the uptake of fuel cell buses (FCEBs) has been significantly higher in Western Europe, JIVE (1) is proposing a side activity in organising a bus roadshow proposal across carefully selected cities throughout Central and Eastern Europe (CEE). The aim of the proposal is to allow for the opportunity to showcase the technology and allow for cities to familiarise themselves and test the technology, with potential for orders post roadshow. By the end of the roadshow, the **aim is for all participants (cities/operators) to announce public commitments to deploy FCEBs by 2025-2030** and develop the regional capacity to deploy FCEBs. **The proposal also aims to increase public awareness to the technology**.

The roadshows are a global proposition covering three geographically distinct regions in CEE (Central Eastern Europe). Alongside a hydrogen bus, a mobile refuelling station follows the bus roadshow to be able to refuel the bus when needed. Each city stop is expected to last less than one week, including transportation and installation/deinstallation of the infrastructure. There will be a national workshop held in each country whilst the roadshow is occurring.

The first roadshow covered Slovenia/Croatia/Czechia/Slovakia/Hungary and included a total of 13 events, including national workshops, student events, professional events and media events that were attended by over 900 participants. The 1st JIVE 2 CEE roadshow took place between the end of 2022 and beginning of 2023. It allowed to disseminate knowledge and increase public awareness about hydrogen in transport.

The second roadshows covered Poland/Lithuania/Latvia/Estonia and included a total of 19 events, including national workshops, student events, professional events and media events that were attended by over 970 participants. The 2nd JIVE 2 CEE roadshow took place between the beginning of September and mid-October 2023.

Both roadshows allowed to disseminate knowledge and increase public awareness about hydrogen in transport. Most of the citites that trialed the technology (over 90% for the 1st roadshows and 100% for the 2nd one) have annoucemed a formal interest in deploying FCEBs after the roadshows. For the countries invovled in the 1st roadshows, it has been estimated that over 150 hydrogen buses will be deployed in the region over the next years – 159 for countries of the 2nd roadshow – and some cities have developped or are in the process of developing plans related to FCEB deployment.

The 3rd Roadshow stopped in Romania, Greece, Bosnia and Herzegovina, and Bulgaria covering a total of 9 cities.

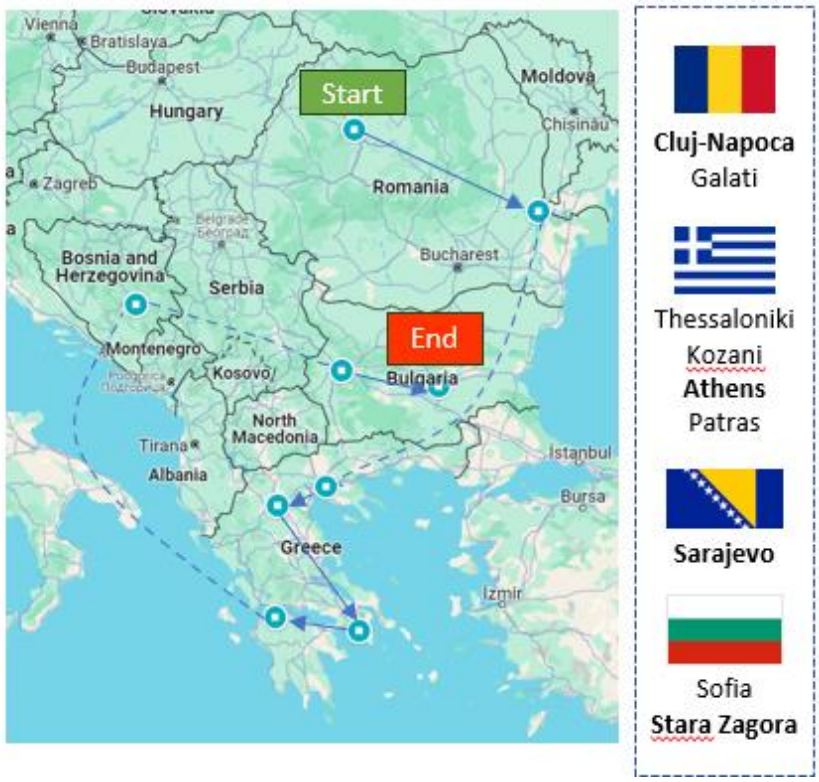


Figure 1: JIVE 3rd Roadshow stops in different countries

2. Purpose of deliverable

This deliverable "D4.14: Learnings from hydrogen vehicle demonstrations with delivered hydrogen" has been developed thanks to the inputs of the reports from the national coordinators Daria Vladikova (BGH2A, Bulgaria), Nikolaos Ntavos (CluBE, Greece), Dejan Škorić (SKODEX d.o.o., Bosnia and Herzegovina), Andreea Gheorghe and Cristina Păun (*Energy42*, Romania) describing the course of the roadshow and associated events, results of the test trials and discussions and the lessons learnt/impacts of the roadshow in their area, and inputs from Hydrogen Europe and the infrastructure providers – Caetano and Messer.

The aim of the deliverable is to:

- analyse the data collected during the roadshow with the aim of proving the relevance of the technology in the area,
- summarise the key learnings, opportunities, and barriers to the deployment of FCEBs and associated infrastructures in Greece, Romania, Bulgaria and Bosnia – Herzegovina - from the discussions, workshops and events held during the roadshow linked to the deployment of FCEBs and associated infrastructures,
- analyse the impact the 3rd JIVE Bus Roadshow had on the FCEB demand in the area but also on the wider audience,
- gather the lessons learnt from the organisation of the 3rd JIVE Bus Roadshow.

3. Key information

Public transport systems, companies, and local authorities are under a lot of pressure to reduce pollution and carbon dioxide (CO2) emissions, to achieve environmental goals set by cities, countries, the European Union, and worldwide agreements like the Paris Agreement. Hydrogen fuel cell vehicles are a promising solution because they produce no tailpipe emissions, can be refuelled quickly, and have long driving ranges without being affected by weight. Car, bus, and truck manufacturers have developed this technology and started producing these vehicles on a larger scale. Many cities have tested hydrogen vehicles to show how effective they are and to gain political support for their widespread use.

The 3rd JIVE Hydrogen Bus Roadshow was held in nine cities in Greece (Thessaloniki, Kozani, Athens and Patras), Bosnia-Herzegovina (Sarajevo), Bulgaria (Sofia and Stara Zagora) and Romania (Cluj-Napoca, Galati) to demonstrate that hydrogen buses can run as (and even more) efficiently as (than) conventional diesel or electric buses.

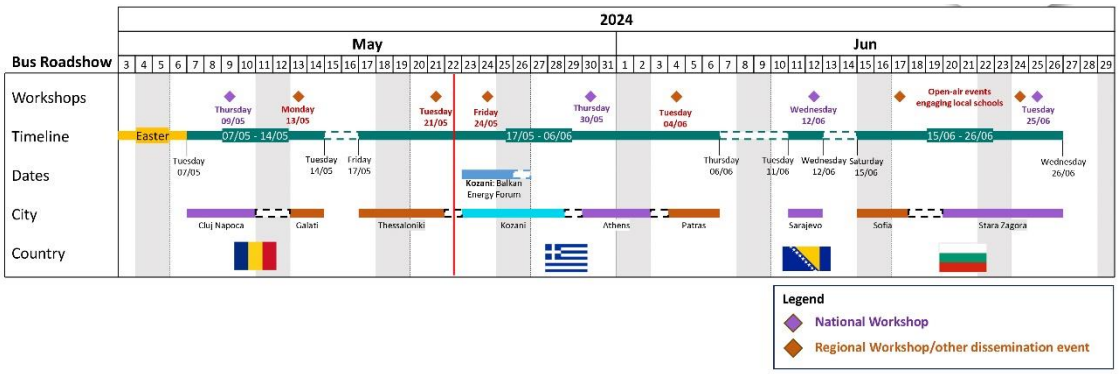


Figure 2: JIVE 3rd Roadshow timeline (with national and regional workshops/other dissemination events)

Table 1 shows the justification behind the choice of the roadshow's route and the cities of trial activities.

City	Country	Activity	Justification and comments
Cluj-Napoca	Romania	Trial/ Workshop	Cluj-Napoca is the city with the highest number of smart projects in Romania, focused on the use of smart city technology to increase the quality of life. It already owns an important fleet of electric buses, and Mayor Emil Boc officially expressed this year his interest in introducing hydrogen buses on public transport lines (part of a major framework agreement that provides for the purchase of 40 hydrogen buses). Also, the municipality is at an advanced stage of obtaining approvals for the construction of a hydrogen production capacity and refuelling station. Very high interest from all public and academic stakeholders.

Galati		Trial	Galati is one of Romania's biggest commercial traffic hubs. The local authorities have officially declared their interest in hydrogen, by building carbon-free hydrogen production capacity in the city and purchasing hydrogen buses. The City Hall has already tested a hydrogen bus in 2021. High interest from the public stakeholders.
Stara Zagora	Bulgaria	Trial	Stara Zagora city is the 6th largest city of Bulgaria located in the Southern part of the country at 230 km form the capital, Sofia. It is situated in the most carbon intensive region due to Maritza East Energy Complex which is the largest electricity producer with 3.4 GW coal thermopower plants and 8000 employers. The transition towards clean energy in the region is supported by the Just Transition Fund. Stara Zagora is the first hydrogen valley granted by the Clean Hydrogen Partnership with the project ZAHYR.
Sofia		Trial/ Workshop	Sofia is the capital and the largest city of Bulgaria with a population of 1,221,785. Joined to the Global Agreement of Mayors for Climate and Energy (GAMC) for the period 2021-2030 in 2018, Sofia Municipality has the goal to reduce greenhouse gas (GHG) emissions by 40% by 2030 compared to 2007 levels. With regards to public transport, the Municipality has successfully implemented an ecologically oriented policy of gradually reducing the number of diesel vehicles. More than 90% of the bus fleet has been replaced with environmentally friendly and energy-efficient vehicles (incl. 15% electric buses and trolleybuses). In 2021 Sofia Municipality prepared a project with a work plan for implementation of hydrogen into the public transport with the financial support received from FCH JU2 initiative: "Project Development Assistance for Cities and Regions 2020-2021". The first hydrogen refuelling station in Bulgaria is in Sofia, built as part of a scientific infrastructure in a Centre of Competence.
Thessaloniki	Greece	Trial	Thessaloniki is the second largest city in Greece and the capital city of Central Macedonia's administrative district, bearing all the structures that constitute a modern urban centre, with a population of over 878,000 residents in its Regional Unit.

			Additionally, its port being the second largest commercial port of Greece, and its location, close to the Balkans, between the East and the West, are significant factors that contribute, both to its economic growth and its cosmopolitan characteristics. Very high interest from all stakeholders, for potential decarbonization of the public transport sector.
Kozani		Trial	Kozani is a town in northern Greece, the capital of the Kozani regional unit and the Western Macedonia region. It is in the western part of Macedonia, southwest of Thessaloniki. The population of the Kozani municipality is over 70,000 people. Kozani hosts the University of Western Macedonia, which, combined with the Technological Educational Institute of Western Macedonia accumulate more than 15,000 students from all over Greece and other places. Very high interest from all stakeholders due to the energy transition and decarbonization in the region.
Athens		Trial/ Workshop	Athens is the capital of Greece, which constitutes a small administrative unit of the entire urban area and has a population of 643,452 within its official limits. Greece's capital and biggest city. The hydrogen valley preparation is ongoing, in the context of the "TRIERES" project, co-funded by the EU Horizon Europe programme and the Clean Hydrogen Partnership.
Patras		Trial	Greece's 3rd biggest city. The construction and operation of a renewable hydrogen production unit from renewable energy sources using advanced electrolysis technology, will be integrated into the industrial operations of Motor Oil's refinery in Ag. Theodoros, Corinth (a location close to Patras), in the context of the "EPHYRA" project, financed by the Clean Hydrogen Partnership.
Sarajevo	Bosnia-Herzegovina	Trial/ Workshop	Sarajevo is the capital city of Bosnia and Herzegovina, known for its rich history, cultural heritage, and stunning landscapes. With a population of approximately 395,000 citizens, Sarajevo faces challenges related to air pollution and the need to decarbonise municipal transportation. Transitioning to cleaner transportation modes such as hydrogen buses and electric vehicles is essential to improve air quality and reduce emissions in the city. Additionally, Sarajevo

			plays a pivotal role in Bosnia and Herzegovina's path towards European integration. Accelerating the country's integration process with the European Union is crucial for fostering economic development, political stability, and greater cooperation with European partners.

4. Promotion of the roadshow

The 3rd JIVE Hydrogen Bus Roadshow promotion entails using different marketing channels and strategies to create awareness about an event and get as many people as possible to attend. Event promotion incorporates direct emails, social media campaigns, flyers and direct media. In every country of the roadshow, a national workshop was held as a part of the 3rd JIVE Hydrogen Bus Roadshow activities.

ROMANIA

In Romania the communication strategy behind the 3rd JIVE Hydrogen Bus Roadshow focused on the need to increase awareness within the Romanian market about both hydrogen technology and the JIVE projects, including the use cases of hydrogen in different sectors of social and economic activities. To reach this goal, the following media tools were used:

- Special sections on *Energy42* website created,
- Press release in Romanian and English disseminated to European and national media.
- Posts on social media created using wide variety of visual material,
- Media partnerships with key publishers focused on energy and cleantech sectors (*E-nergia, Economica, InvesEnergy, NewsEnergy, Energynomics*) established,
- Video and photo content reflecting all the stages of the local roadshow created (the Entire Hydrogen Bus Roadshow in Romania was video documented),
- Promo materials – rollups created,
- Materials specially created for each municipality – Cluj-Napoca and Galați – and for each event (agenda, invitations for journalists / speakers / guests / students, newsletters),
- Draft press release prepared and delivered to the cities where events of the roadshow took place,
- Cross promotion activities (the local roadshow was mentioned in other events focused on energy and green mobility).

The 3rd JIVE Hydrogen Bus Roadshow was publicly announced through a press release and posts in social media (*LinkedIn, Facebook*).

The announcement was further taken over and promoted by municipalities and local transport companies involved in the project. Also, the roadshow was mentioned in newsletters distributed by local and regional institutions (Cluj IT Cluster, Transylvania

Coalition, etc.) and promoted by key private companies within the technical departments (E.ON, OMV Petrom).

The main goal was to promote both the roadshow – the opportunity to test the hydrogen bus by the cities and by the passengers – and the new technology based on hydrogen, and green mobility.

The press releases were distributed to the main national and local media outlets, TV stations and was picked up by journalists representing general and business publications and TV newsrooms. The announcement has been shared / reposted by many associations and experts in the field.

All local authorities and transport companies were involved in the 3rd JIVE Hydrogen Bus Roadshow, benefiting from the showcased information. They were provided with all the communication materials to promote the hydrogen bus trials and the technology itself.

The 3rd JIVE Hydrogen Bus Roadshow's communication team in Romania included professionals in public relations and digital media, in graphic design and in video and photo production.

Entities targeted by the communication campaign in Romania included but were not limited to:

- National and local institutions - from the Romanian Government to local authorities and energy regional hubs,
- Residents of the cities participating in the roadshow and regions around them,
- Private companies involved in hydrogen projects (E.ON group, OMV),
- Associations and technical experts in the hydrogen energy and mobility field (Sustainable Fuels Association, Romanian Hydrogen Association),
- Media representatives focused on energy and green mobility topics.

BOSNIA AND HERZEGOVINA

To ensure the 3rd JIVE Hydrogen Bus Roadshow's visibility in Bosnia and Herzegovina, a comprehensive communication strategy was deployed, leveraging various tools to maximise its impact:

- Press releases were distributed through the main national and local media,
- Draft press releases were prepared and delivered to spots where events of the roadshow took place,
- The media target announcement has been shared by stakeholders and experts in the field.

Special focus during the 3rd JIVE Hydrogen Bus Roadshow's events was on the public transportation companies, municipalities and state authorities (ministries) and universities of Bosnia and Herzegovina.

GREECE

The promotion of the 3rd JIVE Hydrogen Bus Roadshow aimed at introducing FCEB technology in Greece was a collaborative effort led by the Cluster of Bioeconomy and

Environment of Western Macedonia (CluBE) in collaboration with the European project TRIERES and supported by Hellenic Hydrogen and Coral Gas.

To ensure the roadshow's success, a comprehensive communication strategy was deployed, leveraging various tools to maximise its visibility and impact:

- Promotional posts: Various professionally produced promotional posts on social media showcased the hydrogen bus technology and its environmental benefits. These posts were disseminated through digital platforms, including social media channels (e.g. LinkedIn, Facebook, Instagram etc.) and the websites of the coordinating organisations.
- Official invitations: Targeted invitations were sent to a wide range of stakeholders, including government officials, public authorities, and industry leaders. These invitations provided detailed information about the events, emphasising its importance and encouraging attendance.
- Announcements and press releases: A series of press releases were issued to regional and national media outlets, highlighting the roadshow's objectives, schedule, and the innovative technology being demonstrated. Media briefings were organised to engage journalists and ensure thorough coverage.
- Social media campaign: A dynamic social media campaign was executed, featuring regular updates, event teasers, and interactive posts. The campaign used specific hashtags to generate discussions and track engagement, reaching a broad audience and fostering public interest.

At the same time, direct communications and invitations were strategically directed at specific entities to ensure participation from key stakeholders:

- Government authorities: Officials from the Ministry of Infrastructure and Transport and local municipalities were invited to provide policy insights and support for the showcased hydrogen technology.
- Public authorities and decision makers: Invitations were extended to regional transport authorities and local decision-makers to facilitate discussions on adopting hydrogen buses and the necessary refuelling infrastructure.
- Industry leaders: Key representatives from the transportation and energy sectors were targeted to explore potential partnerships and collaborations.
- Academic and research institutions: Universities and research centres specializing in sustainable energy and transportation were engaged to contribute their expertise and support the initiative.

By utilising these strategic communication efforts, the 3rd JIVE Hydrogen Bus Roadshow effectively raised awareness about hydrogen bus technology and its potential to revolutionise clean energy mobility in Greece.

BULGARIA

To ensure the 3rd JIVE Hydrogen Bus Roadshow's visibility and success in Bulgaria, a comprehensive communication strategy was deployed, leveraging various tools to maximise its impact:

- "Save the Date" letters were sent to important institutions, companies, projects (ZAHYR Hydrogen Valley, etc.), organisations, embassies, professionals interested in clean hydrogen deployment, schools from the STEM network in Bulgaria, universities etc.
- The following announcements and invitations were disseminated:
  - General announcement (in Bulgarian and English) with invitation for all the events (about 300 invitations, including 40 embassies),
  - 50 invitations for the Round Table Discussion with 42 participants,
  - 150 invitations for the Workshop in Stara Zagora with 112 registrations and 82 participants,
  - Official letters were sent to persons of special interest inviting them to take part in the opening and/or in the Workshop in Stara Zagora and all of them accepted. In case they were prevented from coming, they were replaced by their deputies.
- A series of press releases were issued to regional and national media outlets, highlighting the roadshow's objectives, schedule, and the innovative technology being demonstrated. Media briefings were organised to engage journalists and ensure thorough coverage.
- A social media campaign was executed, featuring regular updates, event teasers, and interactive posts. The campaign used specific hashtags to generate discussions and track engagement, reaching a broad audience and fostering public interest.

During the organisation of the event various organisations (Joint Innovations Centre - BAS, "Tehnokrati", "Messer" etc.) gave their practical and information support. The educational events were organised in cooperation with two Horizon Europe Projects (KICstartH2 and HyAcademy.EU) groups.

A special page entitled "Roadshow" was introduced (in Bulgarian and English) on the website of BGH2A with periodically updated information about the event.

The full agenda of the roadshow was also published in the websites of Sofia and Stara Zagora municipalities; Ministry of Transport and Communication, Bulgarian Academy of Sciences, Trakiya University and others. The social media of the national project partners were also used for promoting the roadshow.

The organisation of the event started with dedicated meetings with:

- The Vice Mayor of Sofia Municipality, who gave a full support for the event, followed by organisational meetings with the Directors of Directorate Transport and of the Metropolitan Electric Transport company which accepted to be responsible for the hydrogen bus trials in Sofia and for the bus transportation to Stara Zagora. Sofia Municipality had a successful PDA activity from the first call in 2021/2022 with the elaboration of a program for the purchase of 30 fuel cell electric buses.
- The Vice Mayor of Stara Zagora, who also fully supported the initiative and formed a team that helped the organisation, including the municipality company

Trolleybus and Bus Transport (TBT), which took the responsibility for the bus trials in Stara Zagora,

- The Minister of Transport, who welcomed the initiative for Round Table Discussion for hydrogen deployment in the city transport.
- The Rector of Trakiya University Stara Zagora who supported the proposal from the national organisers Educational Day in Trakiya University, Stara Zagora, organised with the Institute for Sustainable Transition and Development – part of the University.
- The coordinator of the national project HITMOBIL, who accepted to refuel the roadshow bus with the first hydrogen refuelling station (mobile) in Bulgaria, developed as a part of project's activities.

5. Course of the events

ROMANIA

The 3rd Hydrogen Bus Roadshow in Romania took place from the 6th to 14th of May 2024, covering two cities (Cluj-Napoca and Galati) and involving various stakeholders. The detailed schedule included driver training sessions, route trials, demonstrations, and workshops:

Cluj-Napoca (May 6th - May 10th, 2024)

- May 6th: Arrival of the bus & trailer and bus drivers training. Preparations for the next days' trials: washing the bus, putting up the stickers, replacing all the stickers from inside the bus with new ones (some of the existing ones were broken); fixing all the problems – mirrors, wheelchair ramp, etc. Several trials to set up the existing display in order to integrate the local route. Finally, the display was replaced with another one from a local bus and was further used, free of charge, during the entire roadshow by the other transport companies in Bulgaria, Greece and Bosnia and Herzegovina
- May 7th: Installation of the external bus display. As the bus did not come with a clear protocol and assistance on for the internal & external displays, the day was dedicated to finding the best solution and the local teams had to postpone by one day the start of trials in Cluj-Napoca. Unfortunately, due to this unforeseen event and the registered delay, the initially planned launch of the project by the Cluj mayor, through a live session on the city hall's social media channels, was cancelled. The risk of this happening to the next city was mitigated.
- May 8th: the 1st test day - the trials started early in the morning, covering 214 km, two routes with passengers. At the end of the day, the first refuelling was carried out, with the help of Coral Gas representatives.
- May 9th: the 2nd test day and national conference (Radisson Blu) and workshop (Technical University of Cluj-Napoca).
- May 10th: the 3rd test day. The trials started early in the morning, covering approx. 250 km, two routes with passengers. The drivers registered a record in terms of minimal fuel consumption, 3.5 kg/100 km. This was the best result obtained.

Galati (May 11th - May 14th, 2024)

- May 11th and 12th: Arrival of the bus and trailer. Bus drivers' training and preparations for the next days' trials: washing the bus, fixing the problems – doors, mirrors. First hydrogen bus trial in Galati, with the local and external staff.
- May 13th: 1st test day and media briefing. The local and national officials and journalists were introduced to the bus and hydrogen technology, the event being attended by over 30 people, including journalists from TV stations and local media. The bus was tested on line 105, one of the busiest routes in the city.
- May 14th: the 2nd test day, when the bus carried around 1200 passengers, and registered an average fuel consumption of around 5.5 kg/100km. By far the most beautiful are the reactions of passengers after a ride on the "new bus", especially of students who use route 105 to go to school. Their bus ride home from school turned into an open lesson about hydrogen, engineering, cars, and the future.

GREECE

The 3rd Hydrogen Bus Roadshow in Greece took place from May 18th to June 6th, 2024, covering four cities (Thessaloniki, Kozani, Athens and Patras) and involving various stakeholders. The detailed schedule included driver training sessions, route trials, demonstrations, and workshops:

Thessaloniki (May 18th - May 22nd, 2024)

- May 16th: The hydrogen bus arrived in Thessaloniki and was transported to the OASTH bus depot. Preliminary checks were conducted, and the bus was set up for the following day's activities.

Drivers training session at the OASTH depot

- May 19th: The bus continued the test trials online Nr. 29.
- May 20th: Another trial run online Nr. 29. In the afternoon, the bus was demonstrated at Thessaloniki International Fair (TIF). The event showcased the bus to a broad audience, emphasising its environmental benefits and operational efficiency. The bus was refuelled again in the evening at the OASTH depot.




Figure 3: Thessaloniki International Fair

- May 21st: The day started with a regional workshop; "Hydrogen Mobility Info Day" held at the Aristotle University of Thessaloniki. The workshop aimed to educate and engage local stakeholders about hydrogen technology. Later that day, the bus was tested on trial routes (Line Nr. 29).

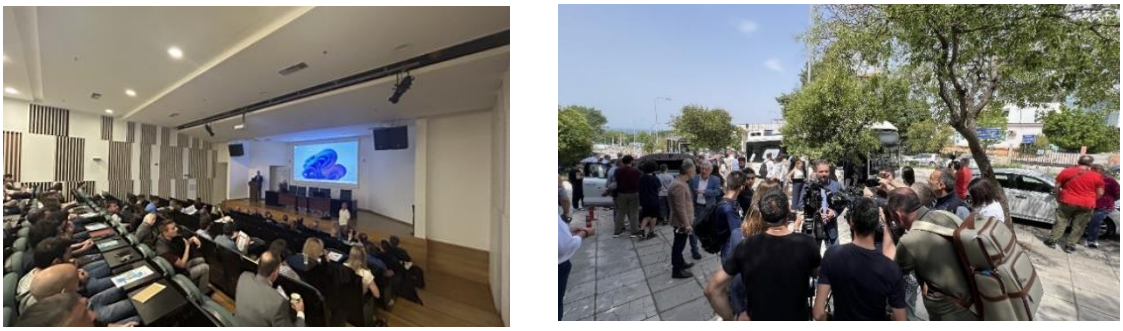


Figure 4: "Hydrogen Mobility Info Day" held at Aristotle University of Thessaloniki

- May 22nd: The final day in Thessaloniki involved another trial run on Line Nr. 29. The bus was refuelled at the OASTH depot before departing for Kozani later that afternoon. The bus travelled from Thessaloniki to Kozani on its own wheels (by the driver, Mr. Erik Kuus from Zerobus). The bus covered 126 km travelling from Thessaloniki to Kozani.

Kozani (May 22nd - May 27th, 2024)

- May 22nd: The bus arrived in Kozani and was taken to the SMA Kozani waste management yard. The depot representative facilitated the setup and installation of the refuelling equipment in the evening.
- May 23rd: Driver training and preparation for trials were conducted from 9:00 AM to 11:00 AM. In addition, the bus was refuelled at the depot. Then, the bus was displayed at the "Balkan Energy Forum" at the Exhibitions Centre of Western Macedonia.



Figure 5: The bus displayed at the "Balkan Energy Forum" at the Exhibitions Centre of Western Macedonia

- May 25th: Another demonstration at the “Balkan Energy Forum”, where the bus was available.
- May 26th: Demonstrations were conducted at the MSc “Hydrogen Science and Technology” (UoWM) and the 1st Laboratory Centre of Kozani. The bus operated

on Route 10 (INTER-CITY BUS STATION – UoWM ZEP). In addition, the bus was refuelled at the depot.



Figure 6: Demonstration at the MSc "Hydrogen Science and Technology" of UoWM & 1st Laboratory Centre

- May 27th: The bus was demonstrated at the 2nd, 5th and 6th Primary Schools of Kozani. Then, the bus operated on Route 5 (INTER-CITY BUS STATION – UoWM KOILA KOZANIS) in two shifts. Afterwards, the bus was prepared to be loaded onto a trailer to be transported to Athens.

Athens (May 28th - June 3rd, 2024)

- May 28th: The bus departed from Kozani early in the morning, loaded on a trailer, and travelled 477 km to Athens, arriving at the OSY depot.
- May 29th: Drivers training and preparation for route trials were conducted at the OSY depot in the morning.
- May 30th: The Athens National Workshop was held at the OSY depot, bringing together stakeholders and industry representatives to discuss the benefits and future of hydrogen mobility in Greece. During the national workshop, representatives from Motor Oil, which is the project coordinator of the TRIERES project, were present. There was the opportunity for creating synergies between the JIVE project and TRIERES, in the frame of the contribution of TRIERES on creating a wider hydrogen ecosystem, in which FCEBs could operate and serve thousands of passengers in a sustainable manner.



Figure 7: Athens National Workshop at the OSY depot

- May 31st and June 1st: The bus operated on Route 049 (PIRAEUS-OMONIA)

- June 2nd: Like the previous day, the bus continued its route trials on Route 049.
- June 3rd: The bus was refuelled in the morning before being loaded onto a trailer for transport to Patras. The departure from the OSY depot occurred at 10:00 AM.

Patras (June 3rd - June 6th, 2024)

- June 3rd: The bus arrived in Patras at the Astika KTEL Patras depot.
- June 4th: Drivers training and preparation for route trials were conducted at the Astika KTEL Patras depot in the morning. Then, the bus operated on a local route in Patras.
- June 5th: The bus was demonstrated at the "PATRAS ECOFORUM 2024: The Path to Climate Neutrality," held at the New Port of Patras. The event showcased the bus's capabilities and its role in sustainable urban mobility.



Figure 8: Patras ECOFORUM 2024 at the New Port of Patras

- June 6th: The bus was prepared for refuelling and to be loaded onto a trailer for departure from Patras. The refuelling was conducted early in the morning, ensuring the bus was ready for continuing its trials in Bosnia-Herzegovina.

BOSNIA AND HERZEGOVINA

The 3rd Hydrogen Bus Roadshow in Bosnia and Herzegovina took place from the 10th to 12th of June 2024, with the main events limited to the capital city of Sarajevo and The Jahorina Mountain Ski Resort. “The Jahorina Mountain Ski Resort” was chosen for the location of the main 3rd Hydrogen Bus Roadshow event in Bosnia and Herzegovina. It took place at the “Termag Hotel”, where a Forum “Hydrogen for mobility and industry” was held as part of the roadshow.

The bus was delivered to Bosnia and Herzegovina on a flat-bed truck, fully fuelled with hydrogen, but without mobile refuelling unit and without MEGC - because Bosnia and Herzegovina is not the member of the EU, importing of that equipment would have been challenging in given time frame.

The day-by-day schedule of the 3rd Hydrogen Bus Roadshow related activities in Bosnia and Herzegovina is:

- June 10th: because Sarajevo is located approximately 511 m above sea level and "The Jahorina Mountain Ski Resort" lies at 1550 m above sea level, upon the arrival of the bus in Sarajevo, the priority was to determine how the bus would handle approx. 1000 m height difference, during the step climb along 30 km of mountain roads. The first ride up the mountain was very sobering in terms of the bus's performance. While the bus is a city bus, it became quickly apparent that the specific energy management configuration was not designed for such steep climb. The last few kilometres were driven in "safe mode" at a speed of no more than 20 km/h.
- June 11th: the hydrogen bus, along with Toyota "Mirai", was displayed the city centre in front of the Council of Ministers.



Figure 9: First two H2 vehicles in Bosnia and Herzegovina on display at Sarajevo city centre

- June 12th: the day included bus trials for approximately 30 high-ranking officials, including Minister Staša Košarac, from East Sarajevo to "The Jahorina Mountain Ski Resort", rides at chosen course at the mountain with the bus and with the car, and the forum, itself.



Figure 10: Arrival of the bus at the 1984 Olympic Mountain Jahorina Ski Resort

Recognising the importance of the 3rd Hydrogen Bus Roadshow, the Minster has expressed the importance of clean technologies in the mobility and industry, underlining his full support of future hydrogen related projects in the country.

BULGARIA

The 3rd Hydrogen Bus Roadshow in Bulgaria took place from the 17th to 26th of June 2024, covering two cities (Stara Zagora and Sofia) and involving various stakeholders.

The 3rd Hydrogen Bus Roadshow's bus arrived in Sofia on the 16th of June 2024. It was fuelled with hydrogen in the HITMOBIL refuelling station. The detailed schedule included driver training sessions, route trials, demonstrations, and workshops:

- June 16th: the drivers from Sofia and Stara Zagora (6 drivers) passed a dedicated training. All of them already had experience with battery electric buses. A BTV team (one of the most popular TV channels in Bulgaria) conducted an interview with the Bulgarian organisers of the roadshow for the Sunday Morning TV block, giving detailed information about the advantages of the FCEB and the roadshow program in Bulgaria.

- June 17th: the official opening of the 3rd Hydrogen Bus Roadshow' s events in Bulgaria took place in the centre of Sofia: at Prince Alexander I Square. The opening ceremony was celebrated by the officials of several Bulgarian ministries, representatives of the European Commission in Bulgaria and other dignitaries. The opening was followed by a press conference with the officials and the organisers of the event. Numerous demonstrations attractive for both children and adults were organised. Several demonstrations of bus rides were performed with explanations and answers to questions from the passengers. Most active were the pupils from the secondary schools (National Nature and Mathematics High School, 73 Vladislav Grammatic Secondary School). Test drives were organised also with the fuel cell electric car of HITMOBIL (Hyundai NEXO), which supported also the events in Romania and Greece, being refuelled in Bulgaria. TEHNOKRATI and IEES demonstrated hydrogen mobility with scale models of hydrogen cars and other educational kits. Flyers for the electric buses and cars, as well as for the Roadshow, additionally informed the people about the benefits of clean hydrogen in the mobility sector. They were placed also inside the bus during its operation in the city transport network of Sofia and Stara Zagora, thus increasing public awareness.

- June 18th: round table discussion "Opportunities and Conditions for Introducing Hydrogen Electromobility in Bulgaria" took place. The event was organised by the Minister of Transport and Communications with the participation of 42 representatives of different organisations. It was based on the presentations of the Bulgarian organisers of the 3rd Hydrogen Bus Roadshow (BGH2A and IEES-BAS), who gave information about the SoA of the clean hydrogen projects in Bulgaria, the Bulgarian commitment to AFIR and the prospects for its implementation, the SoA of the National Hydrogen Roadmap and the needs and opportunities for its update and acceleration of its implementation with an accent on hydrogen electromobility, incentives for investments and others.

- June 19th – 21st: test trials of hydrogen bus in Sofia. The test trials were performed with passengers along trolleybus line 9 - one of the busiest lines of Sofia public transport that runs through the city centre (19 stops, 32 minutes ride in one direction). The bus operated 8 hours a day (from 12 PM till 8 PM), doing 6 courses.

- June 21st: bus drive from Sofia to Pazardjik (112 km) with a Bulgarian driver from Sofia.
    - Demonstration stops in Pazardjik: working meeting was organised by BGH2A with the Mayor, the municipality administration and local business for acquaintance with the advantages of Hydrogen bus mobility and discussions for future efforts for introduction of hydrogen buses in the city transport network. A test trial with the mayor, with municipality administration, journalists, students from school, citizens has been performed.
    - Bus drive from Pazardjik to Stara Zagora.
    - Transportation of HITMOBIL mobile refuelling station from Sofia to Stara Zagora.

- June 22nd – 23rd: Commissioning of the mobile hydrogen refuelling station and refuelling of the bus.

- June 24th: the day was devoted to education in hydrogen technologies deployment performed in Trakiya University. It was organised with the support of two Horizon Europe educational projects in which the University is participating: accelerating Sustainable Hydrogen Uptake Through Innovation and Education (KICStratH2), funded by the European Institute for Innovation and Technology (EIT) and The European Hydrogen Academy (HyAcademy.EU), funded by Clean Hydrogen Partnership. It was designed for students from the university and from two secondary schools. The students travelled to Trakiya University by the hydrogen bus, which made 2 round trips on bus line 20, connecting the town with the university. The educational day continued with open air demonstrations of hydrogen mobility with scale models of hydrogen cars and other education kits. The hydrogen bus brought back the students to the town.

- June 25th: the National Workshop “Hydrogen Electromobility in Bulgaria Forum | CEE Roadshow” took place in Stara Zagora where the Hydrogen Valley project ZAHYR, funded by Clean Hydrogen Partnership, is expected to start in the next few months.

  The event was organised in three sessions:
    - In the first one, speakers gave information about project JIVE and the Roadshow – its purpose, results, lessons learned, next steps. During the lunch break, the participants as well as the citizens and guests of Stara Zagora could make a test drive with the “Hyundai NEXO” or a short tour with the hydrogen bus and “get in touch” with the hydrogen technologies

via the demonstrations with scale models of hydrogen cars, flyers and various other presentations and experiments.

- The two afternoon sessions concerning industrial applications of clean hydrogen technologies with accent on mobility and opportunities for their accelerated deployment rose important questions related to the legislation, education and skilling, preliminary financial analyses as well as barriers and opportunities and synergy with other important sectors as waste, which can become important raw material where hydrogen is also needed.

- June 26th: test trials of the hydrogen bus were carried out in Stara Zagora. The test trials were performed with passengers along bus line 20 which connect the city with Trakiya University (17 stops, 26 minutes ride in one direction). The bus operated 8 hours a day (from 5 AM up to 1 PM), doing 5 round trips.

6. Key learnings from the test trials

ROMANIA

The 3rd Hydrogen Bus Roadshow took place in two Bulgarian cities - **Cluj-Napoca and Galati, from the 7th until the 15th of May**. The total distance driven during the tests in Romania was about 850 km: in Cluj-Napoca approx. 550 km and in Galati - approx. 300 km (for day-by-day breakdown, see table 5), with hydrogen consumption of about 100 kg (300 – 320 bars) for all the legs of journey. There were 3 filling breaks during the roadshow in Romania.

Table 2 shows a day-by-day breakdown of distance covered and hydrogen consumption in Romania

Date	Distance driven, km	H2 used, kg	Average H2 consumption, kg/100 km
8.05.2024	213.9 km	1.03 kWh/km	5.1522kg/100 km
9.05.2024	Approx. 50 km	-	5.0 kg / 100km
10.05.2024	Approx. 250 km	-	5.0 kg / 100km
13.05.2024	134 km	-	5.4 kg / 100km
14.05.2024	142 km	-	6.2 kg / 100km
Total	**Approx. 800 km**		**5.6 kg / 100km**

Both the public transport companies and the representatives of the two host cities: Cluj – Napoca and Galati – were satisfied with the results of the tests. In both cases, there were clear commitments related to the expansion of the hydrogen bus fleet, including the hydrogen valleys they plan. Cluj-Napoca plans to purchase 25 hydrogen buses by 2027 and Galati is considering a fleet of 42 buses by 2028.



Figure 11: Information flyer: the 3rd Hydrogen Bus Roadshow events in Romania

As in other countries of the 3rd Hydrogen Bus Roadshow, the main feedback for the hydrogen bus tests in Romania also was cantered around **drivers' experience**:

- It was **easier to drive** hydrogen bus than diesel and electric buses.
- It offered **increased comfort to all** - drivers and passengers.
- The **ease of refuelling** and high-power generation capacity while driving was pointed out, which gives them a **longer driving range and time saving advantages**.
- In comparison to diesel buses, the hydrogen bus was much more appreciated, both in terms of pollution (**environmental and noise**) and in terms of technology used.
- In terms of performance, the best indicator was the behaviour of the bus on streets with a large inclination. Although it was packed with passengers, there was absolutely **no problem with mixed terrains**.



Figure 12: Bus trials in Cluj-Napoca

At the same time, some issues that needed extra attention were also brought forward, namely:

- **Lack of proper hydrogen refuelling infrastructure** (Romania does not have hydrogen refuelling infrastructure, so the employment of mobile refuelling station was needed for the trials) – the hydrogen buses cannot be integrated in the public transportation fleet without a sustainable solution to this problem.

- Some of the bus **sensors were way too sensitive** and gave faulty alarms (lit up) several times.
- The trial bus had **lower loading capacity** than those in the fleets of the two operators, which **generated problems during peak hours**.
- The driver's **side door was too tight to open/close**, which created some problems during the races.
- **Difficulties with the acceleration pedal** when starting from standstill to hill.

In terms of public perception, the passengers both from Cluj Napoca and Galati were interested in this type of technology, mentioning that the rise is smoother, very silent and comfortable.

Some of them asked about the costs, refuelling options (hydrogen local generation) and realistic timeframe to have these buses permanently on the city routes.

GREECE

In Greece, the 3rd Hydrogen Bus Roadshow took place in Thessaloniki, Kozani, Athens and Patras between **the 18th of May and 6th of June,** and was carried out under the auspices of the Ministry of Infrastructure and Transport. The promotion of the 3rd JIVE Roadshow, aimed at introducing FCEB technology in Greece, was a collaborative effort led by the Cluster of Bioeconomy and Environment of Western Macedonia (CluBE) in collaboration with the European project TRIERES and supported by Hellenic Hydrogen and Coral Gas.







Figure 13: The 3rd Hydrogen Bus Roadshow' s schedule information leaflets

The Greek bus trials were carried out without passengers. This was due to legal restrictions in the country and because a special legislation for carrying passengers on board during the test trials was not granted by the Ministry of Infrastructure and Transportation.

The bus operators in the four cities in Greece were satisfied with the FCEB test trials, finding both the opportunity to carry out these test trials and the trial results themselves promising. Based on relevant discussions and comments, it can be concluded that the bus operators view the hydrogen bus as an alternative option for their bus fleet, and they would be eager to include the FCEB in their fleet in the short-term future, especially when considering environmental and ecological factors.

However, it was also outlined that conventional diesel buses or hybrid buses have an economic advantage over an FCEB, in terms of costs and economic factors, which are essential for the inclusion of hydrogen-powered buses in the bus operators' fleet. In addition, unfortunately **in Greece there is a lack of hydrogen refuelling infrastructure and equipment,** so FCEBs and their associated refuelling infrastructure are not yet deployed in the country. Therefore, FCEBs are a promising option, but cannot completely replace the existing conventional diesel and hybrid buses just yet.

The bus operators in Greece were satisfied with the average hydrogen consumption – 5.03 kg H_2/100 km (table 2), since it is lower than the range of 6.3-9 kg/100km, which is the average fuel consumption in the JIVE projects. The average hydrogen consumption during the Greek trials could be attributed to the smooth driving styles that the bus drivers followed, as the result of the successful drivers training in each city and the moderate test trials, avoiding aggressive tests. Total distance driven during the trials in Greece was 1106 km (excluding 126 km – the drive from Thessaloniki to Kozani; for day-by-day breakdown see Table 2).

Table 3 shows a day-by-day breakdown of distance covered and hydrogen consumption in Greece

Date	Distance driven, km	H2 used, kg	Average H2 consumption, kg/ 100 km
May 18	120.0	6.88	4.45
May 19	58.6	3.62	4.90
May 20	81.3	4.94	4.49
May 21	106.4	6.54	5.04
May 22*	89.9*	5.69*	6.33*
May 23	10.2	1.23	6.36
May 24	17.5	1.45	5.14
May 25	20.7	1.57	6.08
May 26	29.5	1.66	5.06
May 27	57.2	2.84	4.64
May 31	49.9	3.12	5.10
June 1	102.0	4.69	4.48
June 2	105.8	5.06	4.65
June 4	113.3	4.91	4.19
June 5	17.8	1.06	4.57
Total	**980.1**	**55.3**	**5.03**

**On 22nd May, the FCEB drove from Thessaloniki to Kozani (126 km), but this drive is excluded from the data, in order not to distort the average figures of the trial routes.*

The total amount of **hydrogen consumed during the tests in Greece was approx. 65 kg** (300 – 320 bars), with **7 refuelling rounds** during the roadshow. Each refuelling lasted around one hour, because of the natural flow refilling that took place. No problems or issues were encountered with the said process. In addition, the refuelling of two hydrogen cars also took place as part of the roadshow workshops in Greece. The bus drivers were also present during the refuelling, so they were able to learn about the refuelling process and ask questions.



Figure 14: Refuelling of the bus in Thessaloniki

- The **mobile hydrogen refuelling station operated excellently throughout the test** trials, which can be attributed to the qualified and experienced engineering team of Coral Gas, which ensured the successful and smooth operation.

- **Drivers' experience** feedback was especially appreciated during the 3rd Hydrogen Bus Roadshow events in Greece. Local drivers from the bus operators in each city participated in the training, and all of them drove the bus to get acquainted with the technology:
    - They were satisfied with the bus driving performance, emphasising very **good acceleration abilities**, which even exceeded the existing battery electric buses,
    - They agreed that the experience of **driving a hydrogen bus is better, easier and more comfortable** than driving a conventional diesel, or an electric bus,
    - They pointed out that, in comparison to electric buses, the **refuelling of the hydrogen bus is favoured**, because of the ease of refuelling and the high-power generation capacity while driving, which ensures a longer driving range, while the charging process of electric buses requires hours and they show a lower autonomy,
    - In comparison to diesel buses, the drivers showed their preference towards the hydrogen bus, since they **exhibit lower environmental and noise pollution** and because of their **advanced technology**.

- However, the drivers also pointed out some minor problems they encountered while driving the FCEB:
    - The hydraulic steering wheel didn't work properly all the time,
    - The driver's door didn't close properly sometimes,
    - There were also some difficulties with the brake pedal, when the drivers pressed on it.



Figure 15:Driver driving the bus in Kozani

The 3rd Hydrogen Bus Roadshow initiative aimed at promoting hydrogen technology and zero-emission vehicles. However, several areas can be improved to enhance the effectiveness and reach of future roadshows:

- In Greece the bus was not able to carry passengers, because a special legislation for carrying passengers on board was not granted by the Ministry of Infrastructure and Transportation (empty trial on routes, to be noted for the data). In any case, citizens were effectively informed about this technology and the benefits of hydrogen technology, the roadshow could be made more impactful by ensuring

that a larger portion of the population could engage with the new technology. This could be achieved by **organising public boarding events** where people can experience the hydrogen bus firsthand. This direct interaction would help in spreading awareness and understanding of zero-emission vehicles more effectively,

- **Extending the roadshow to more cities, especially those with universities and industrial hubs**, could significantly enhance its promotion. These areas are likely to have a higher concentration of people who are both interested in and influential regarding new technologies. Targeting such cities would not only raise awareness but also foster partnerships with academic and industrial stakeholders,
- Organising more **specialised pilot training sessions for students**, particularly those studying in relevant fields, could be beneficial. These sessions would provide knowledge exchange about hydrogen technologies in the mobility sector, preparing the next generation of engineers and scientists to contribute to the advancement of this technology. Furthermore, hosting more press conferences in different cities could amplify the roadshow's impact. Inviting a broader range of journalists and media outlets would ensure wider coverage and a more diverse dissemination of information. These events should facilitate productive discussions with relevant stakeholders, like the successful engagement in Patras,
- **Distributing questionnaires** could help to better understand the public's perception and the vehicle's performance. These questionnaires should target various social groups to gather comprehensive data on public awareness and information about the hydrogen bus.
- **A separate set of questionnaires for drivers** could collect data on vehicle behaviour, driver satisfaction, and any operational challenges faced. By implementing these suggestions, future roadshow initiatives can achieve greater impact, ensuring that more people are informed about the benefits of vehicles with zero-emissions and are encouraged to adopt this sustainable technology.

BOSNIA AND HERZEGOVINA

In Bosnia and Herzegovina, the 3rd Hydrogen Bus Roadshow took place in **Sarajevo between 11th and 13th of June**. Total distance driven during the tests was 254 km (for day-by-day breakdown, see Table 3), with average hydrogen consumption of 5.58 kg/100 km.

Table 4 shows a day-by-day breakdown of distance covered and hydrogen consumption in Bosnia and Herzegovina

Date	Distance driven, km	H2 used, kg	Average H2 consumption, kg/100 km
June 10	87.3	5.13	4.69
June 11	25.6	0.66	5.84
June 12	141.1	10.43	6.22
Total	**254**	**16.22**	**5.58**

The first trials of a hydrogen bus in Bosnia and Herzegovina can be regarded as a success, but at the same time, there is much work to be done in the country to promote hydrogen mobility of all kinds. The fact that the roadshow stopped in Sarajevo was taken as a proof

that the country is not only ready to take the first steps toward a future of green municipal and private transportation, but to start investing into the build-up of local know-how and first pilot projects around hydrogen.



Figure 16: FCEB bus during test ride in Sarajevo

The main feedback for the hydrogen bus tests in_Bosnia and Herzegovina was cantered around **drivers' experience**:

- During the test drives, the important lesson was learned that **driving a hydrogen bus on mountain roads requires additional skills**. Due to a lack of available drivers, a local project coordinator with the necessary experience took over driving duties.
- Driving hydrogen bus in various locations can be a **different and sometimes challenging experience** – especially, when mixed terrain is involved.
- Driving a hydrogen bus in mountain regions **requires different energy management** as the setup with the available bus was far from being optimal.
- Driving within permitted speed limits, even when empty, the **bus entered "safe mode"** and drove the final kilometres at a maximum speed of 20 km/h.

Overall, the following general conclusions were drawn from tests drives in Bosnia and Herzegovina:

- The hydrogen bus performed **exceptionally well in the city**, on flat roads, while **driving uphill can be a struggle**.
- Hydrogen bus producers must take notice of the **driving profile of different locations** before sending buses for testing. A bus with an energy management system configurated for flat areas will not leave a good impression if driving uphill, not even with skilled drivers.
- The available test bus was configured in a way that the **fuel cell was only charging the battery**, without any direct contribution to the electric motor. Additionally, one should **reconsider the size of the battery** itself.

BULGARIA

The 3rd Hydrogen Bus Roadshow took place in two Bulgarian cities – **Sofia and Stara Zagora, from the 15th until the 26th of June**, with trials rides carried out on the 17th, 24th and 25th of June. It operated in the city transport network of Sofia from 18th to 20th of June and in Stara Zagora – on the 26th of June. The total distance driven during the tests in Bulgaria was

898 km (for day-by-day breakdown, see Table 4), with an average hydrogen consumption of 6.188. In total, 55.57 kg of hydrogen was consumed during the test drives.

Table 5 shows a day-by-day breakdown of distance covered and hydrogen consumption in Bulgaria

Date	Distance driven, km	H2 used/kg	Average H_2 consumption, kg/100 km
June 16	24,9	1,39	4,91
June 17	27,3	3,11	4,41
June 18	129,3	9,39	7,04
June 19	119,3	9,52	7,43
June 20	119,3	9,34	7,66
June 21	254,6	13,32	4,71
June 22	-	-	-
June 23	-	-	-
June 24	No data	No data	No data
June 25	No data	No data	No data
June 26	114,8		5,94
TOTAL	**898**		

The 3rd Hydrogen Bus Roadshow's bus trials in Sofia and Stara Zagora successfully reached the goals to raise professional and public awareness and to increase the confidence and ensure security for the forthcoming implementation of the clean hydrogen technologies and hydrogen buses in the bus fleets of both municipalities. The impact of the event was much stronger than expected, as **other regions and municipalities announced an interest to include clean hydrogen in their public transportation schemes** (Pazardjik, Plovdiv).



Figure 17: Hydrogen bus and HYUNDAI NEXO being refuelled during the roadshow

The main feedback for the hydrogen bus tests in Bulgaria was cantered around drivers' experience. The representatives of public transport operators in both Sofia and Stara Zagora were satisfied with the outcomes test trials. All of them were drivers of electric buses with prior experience of working with this bus fleet of several years.



Figure 18: Bus trials in Sofia

Drivers' experience in the Bulgarian trials help to draw the following conclusions:

- **Short refuelling time** was marked as a very strong advantage of the FCEBs. However, at the same time, the blocking of the refuelling station when connected to the bus was observed in refuelling sessions of Bulgaria. A possible reason for this could be that the bus was refuelled during the previous trial without a hydrogen dispenser which automatically regulates the refuelling process and probably the refuelling station read incorrect data from the bus board computer. At the end this software related problem was solved and till the end of the roadshow there were no additional problems.
- It was recommended that the bus arrive for each trial after a system checkup, as the preparation time for the demonstrations is short, and the local staff's experience is limited. Additionally, it is difficult to find specific spare parts in a short period. In Sofia the bus came with the logos of the previous roadshow and during the weekend all the preparations needed to be performed on site. It was agreed that it would be better if all the preparation activities – including marketing-related ones, are done in advance,
- During the Bulgarian trials the bus arrived with an **insufficient quantity of freon**, and **it was hot and noisy inside during the first trials** since the fans were working on the highest power. This was mentioned not only by drivers but also by some of the passengers.

In Stara Zagora a comparison between electric buses and FCEBs was especially pointed out, as drivers of electric buses highlighted some challenging characteristics of those buses: recharging before reaching the final stop; not enough energy for the conditioning, especially in winter when heating system must operate. For Stara Zagora the battery electric buses operate only on lines in the town where there are no big slopes. Since the bus operator must ensure links with the neighbouring villages which are already part of the city transport, the battery electric buses cannot operate due to both the terrain and the greater length of the daily mileage. The FCEBs from the project ZAHYR are planned to be used on those critical lines.

Overall, the following general conclusions were drawn from tests drives in Bulgaria:

- For the first-time, **real-time data** from long term exploitation of hydrogen buses was shared. This was very engaging information for the Bulgarian companies. **Data about the first Bulgarian hydrogen refuelling station was also presented**, and very

clear signals given for the importance of the hydrogen refuelling infrastructure development in the country.

- **FCEBs are already a mature technology** with a stable market space, with sufficiently long testing and accumulated experience. For countries like Bulgaria, where these technologies are about to enter the market, these facts are extremely important.
- One of the main challenges for wider FCEB penetration in the country is the financial issue – **high prices level of FCEB and lack of hydrogen refuelling infrastructure**.

7. Key learnings from the national workshops

ROMANIA

The national workshop and conference of the 3rd Hydrogen Bus Roadshow took place in Cluj-Napoca on the 9th of May and hosted around 115 participants from Bucharest and other three important cities in Romania (Alba Iulia, Bistrita, etc.), and from abroad (Brussels, London, Riga, Athens). The national workshop was by far the largest event on hydrogen organised in Romania so far and the first dedicated to hydrogen in public transport. Starting from the main topic – the 3rd Hydrogen Bus Roadshow and its results -, broader topics of discussion were launched about hydrogen technology, the EU and national policies, application sectors and existing use cases, funding opportunities and best practices registered so far in Europe.

In addition to the national workshop and in partnership with the Technical University of Cluj-Napoca we organised a second workshop with students and professors involved in research on hydrogen.

Key conclusions from the national workshop include but are not limited to:

- The implementation of zero-emission vehicles in Romania is **related to the national hydrogen strategy**, and these activities are in line with other hydrogen implementation related initiatives. There is a working committee at the level of several ministries to finalise it and subsequently approve it by the Government.
- There are already several **projects for hydrogen production submitted by both the private sector and local authorities**. There are more and more local authorities considering the opportunity to **purchase hydrogen buses or use hydrogen in the district heating system.**
- Cluj-Napoca and Galati are determined to complete the construction of **hydrogen production plants** by 2027 and 2028, and purchase 25 and 42 hydrogen buses, respectively.
- It is possible that the first **hydrogen trains** might start running in Romania by 2027.
- **Funding opportunities for hydrogen projects are numerous**, both at the EU and national level. Interest in this technology is growing nationwide.
- In terms of barriers, the **lack of hydrogen in transport legislation frameworks** and the lack of operators prepared to make major investments in this new technology, (by building hydrogen production plants and fuelling stations for transport), are important,

The **high costs of hydrogen buses and green hydrogen itself** remain a problem. The solution considered is to develop the entire value chain (generation/ transport/distribution/charging/consumption) and the hydrogen valleys.

BOSNIA AND HERZEGOVINA

The Jahorina Mountain Ski Resort was chosen for the location of the 3rd Hydrogen Bus Roadshow national workshop in Bosnia and Herzegovina. It took place at the "Termag Hotel", where a forum "Hydrogen for mobility and industry" was held as part of the roadshow.



Figure 19: Termag Hotel

The importance of clean energy systems in the regions of winter tourist destinations, where reduced pollution is imperative, was emphasised along with necessity to decarbonise public transportation system.

Key conclusions from the national workshop include but are not limited to:

- **The implementation of zero-emission vehicles in low-income countries could be challenging.** It will be critical to find the best possible location and business model for the first pilot program, attracting both local and international funding for such a light-tower project.
- **Electric buses remain a strong competitor to FCEBs.** They have significantly more lobbyists and products on the market. The European Union should seize the opportunity to **limit imports or increase import duties on Chinese-made electric buses**, which are flooding the market with low-cost, low-quality products, endangering the future of European manufacturers.

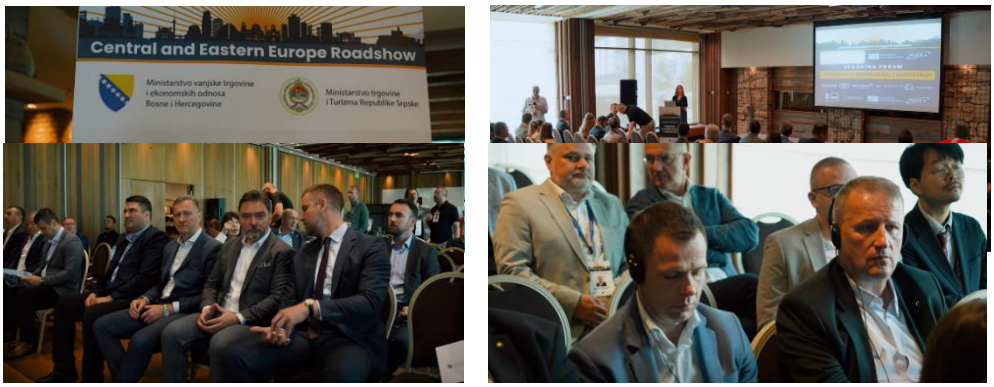


Figure 20: Forum "Hydrogen for mobility and industry"

- The interest in hydrogen mobility applications was high, but there is still a **high demand for general education on hydrogen-based technologies**.
- In the short-term perspective in Bosnia and Herzegovina, only **ski resorts might be motivated to invest in development of single FECB deployment**, hydrogen production and/or fuelling related projects.

BULGARIA

National Workshop "Hydrogen Electromobility in Bulgaria Forum | CEE Roadshow" took place in Stara Zagora on June 25th. The event had more practical orientation with the presence of the European experts in clean hydrogen mobility and an audience dominated by companies, scientific organisations (universities and institutes), regional government and agencies.

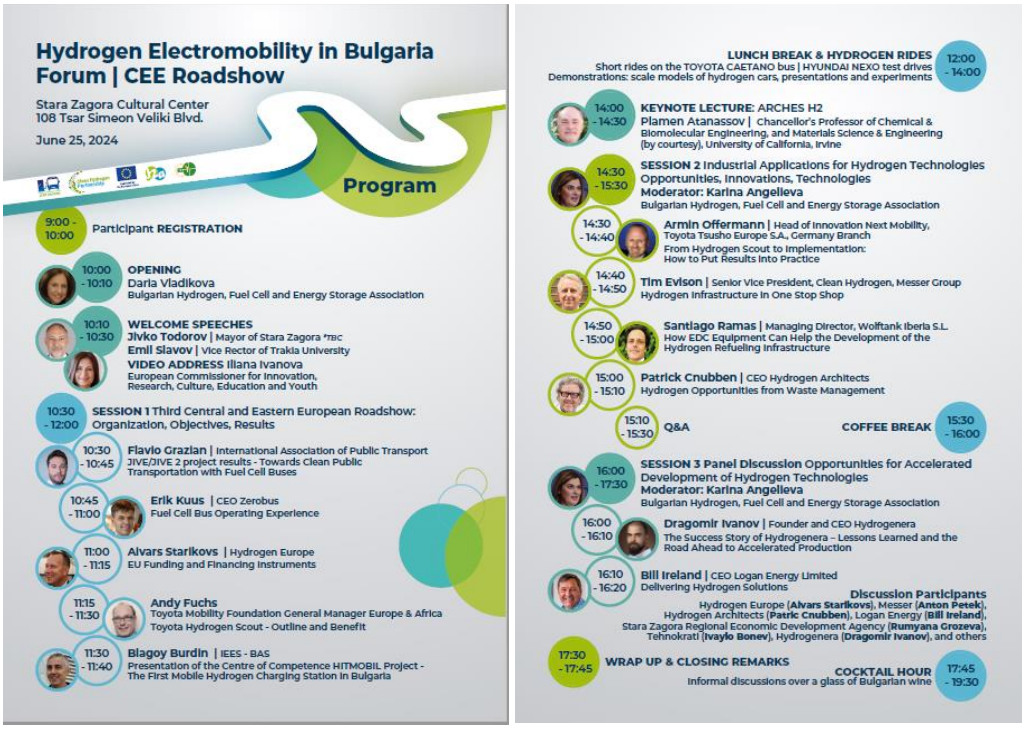


Figure 21: Agenda of the national workshop

The location of the workshop, Stara Zagora, was chosen because is one of the most carbon intensive regions in Bulgaria with excellent conditions to become the first big clean hydrogen hub starting with the realization of the first hydrogen valley funded by CH JU (ZAHYR project). The introduction of FCEBs is an important objective of the project. Thus, the bus trials were very important and useful for real testing of this new for Bulgaria transport with zero emissions.

The main goal of the workshop was to give a platform for more stakeholders from different target groups to "touch" hydrogen vehicles and to hear experts who presented information coming from real operation of FCEBs.



Figure 22: Discussions and activities of the national workshop

One of the big benefits for Bulgaria was the establishment of new contacts for joint future initiatives which mobilised Bulgarian stakeholders to initialise the preparation of new projects related to extended hydrogen infrastructure and hydrogen valleys as well as wider mobility initiatives.

Key conclusions from the national workshop include but are not limited to:

- A set of measures for **increasing the ambitions of the National Hydrogen Roadmap** must be created. It should be used as a unifying platform for coordinated and synchronised follow-up national activities for the introduction of hydrogen technologies, combining efforts in legislation, education and training as well as better coordination of the funding mechanisms.
- In terms to clean hydrogen mobility the efforts should be direct to the **implementation of the Bulgarian obligations concerning AFIR** in respect to hydrogen infrastructure (five hydrogen refuelling stations and a fleet of 120 FCEBs until 2027).
- **State incentives** should be introduced.
- **A** separate **law for electromobility promotion** should be adopted.
- The **development of local hydrogen valleys must be encouraged** based on both national and international expertise, as a part of the activities of the Hydrogen Roadmap work group under the leadership of the Ministry of Innovation and Growth.

GREECE

The workshops in Greece covered multiple cities: Thessaloniki, Kozani, Athens, and Patras. Each city hosted sessions featuring speakers from government, academia, and industry, focusing on the deployment and benefits of hydrogen fuel cell buses.

The event in **Thessaloniki** was part of the 3rd JIVE Hydrogen Bus Roadshow, featuring the hydrogen bus and a series of activities aimed at promoting hydrogen mobility and sustainable urban transport.

Key activities included:

Demonstration at Thessaloniki International Fair (TIF):

- The hydrogen bus was showcased at TIF, allowing local stakeholders, bus operators, and public authorities to experience the hydrogen bus first-hand.

Hydrogen Mobility Info Day at Aristotle University of Thessaloniki (AUTH):

- Presentations on the JIVE project and hydrogen mobility highlighted the benefits and potential of hydrogen fuel cell buses.
- The hydrogen bus and car were displayed at the Aristotle University Research Dissemination Centre (KEDEA), providing attendees, including students and academics, the opportunity to see the vehicles up close and learn about hydrogen technology.



Figure 23: Hydrogen Mobility Info Day at Aristotle University of Thessaloniki

Special Demonstrations and Public Engagement:

- **Bus demonstrations:** The hydrogen bus was demonstrated in various locations, including the Thessaloniki International Fair and the Aristotle University Research Dissemination Centre.
- **Educational activities**: The event included detailed presentations by academics and researchers from AUTH, emphasising the transition to sustainable urban mobility and green transport. Students from the 1st Primary School of Thessaloniki were given the opportunity to see the hydrogen bus and car up close, learning about environmentally friendly technologies.
- **Interactive sessions:** Participants engaged in interactive sessions and discussions on the future of hydrogen mobility, the importance of transitioning to sustainable urban transport, and the current challenges and future perspectives of hydrogen technology.

The workshop in **Kozani** was part of “The Balkan Energy Forum”, featuring the hydrogen bus, which was available at the event for demonstration to the public.



Figure 24: The bus during the "Balkan Energy Forum" at the Exhibitions Centre of Western Macedonia

Key activities included:

- **Hydrogen bus trials:** Demonstrations and trial routes were conducted from May 22-27, allowing local stakeholders and the public to experience the hydrogen bus in operation.
- **Drivers training sessions:** Conducted with the Transport Authority of Kozani to familiarise them with hydrogen bus technology and its operational aspects.
- **Public displays:** The hydrogen bus was showcased for public viewing and interaction during the Balkan Energy Forum.
- **Educational engagement:** Demonstrations at the University of Western Macedonia, the 1st Laboratory Centre of Kozani and at primary schools, where students and the public learned about hydrogen technology. A panel discussion titled "Green Mobility: Electromobility, Batteries, and Hydrogen" which included insights into the operational aspects of hydrogen buses.

These activities in Kozani were integral in promoting hydrogen mobility, providing educational opportunities, and showcasing the practical applications of hydrogen fuel cell buses to a wide audience.

The workshop in **Athens** featured a National Workshop at the OSY Bus Depot in Renti, organised by the Cluster of Bioeconomy and Environment of Western Macedonia (CluBE) in cooperation with O.SY. and with support from Coral Gas, Hellenic Hydrogen, and the European project TRIERES.

Key activities included:

- **National Workshop:** The workshop focused on sustainable urban transport and hydrogen electric buses, providing a platform for key stakeholders to discuss the integration and benefits of hydrogen mobility.
- **Presentations and discussions:** Various sessions covered topics such as the necessity for safe, qualitative, and environmentally friendly transport, and the integration of new technologies in public urban transport.

Participants had the opportunity to engage with experts on the current and future applications of hydrogen technology.

Special demonstrations:

- The hydrogen bus and a hydrogen car were demonstrated, with attendees having the opportunity to see and drive the vehicles.

- The bus continued its journey in Athens until June 2, providing ongoing demonstrations and collecting valuable data on its operation, consumption, and the refuelling process in real conditions.
- These activities in Athens were pivotal in promoting hydrogen mobility, engaging key stakeholders, and showcasing the practical applications of hydrogen fuel cell buses. The event underscored the Greek government's commitment to integrating hydrogen technology into the urban transport system and provided a comprehensive platform for discussing the future of sustainable urban mobility.

The workshop in **Patras** was part of the "PATRAS ECOFORUM 2024: The Path to Climate Neutrality," event, held at the New Port of Patras, featuring the hydrogen bus and a series of activities aimed at promoting hydrogen mobility and sustainable urban development.

Key activities included:

- The ECOFORUM event focused on sustainable development, urban mobility, and green innovation. It brought together key stakeholders from government, industry, and academia to discuss the integration and benefits of hydrogen technology. Various sessions addressed topics such as strategic planning for sustainable development, state policies, sustainable urban mobility, and energy. The discussions highlighted the role of hydrogen in the transition to cleaner and more efficient urban transport systems.

Special demonstrations and public engagement:

- **Hydrogen bus demonstrations:** The hydrogen bus was demonstrated in Patras, providing local stakeholders and the public with an opportunity to see the bus in operation and learn about its benefits.



Figure 25: PATRAS ECOFORUM 2024 at the New Port of Patras

Attendees, including students, local officials, and industry representatives, had the chance to interact with the bus, learn about hydrogen technology, and understand its potential applications in urban mobility.

- **Interactive sessions:** The event included interactive sessions and discussions on the current challenges and future opportunities for hydrogen mobility in Patras and the wider region. Key stakeholders discussed the integration of hydrogen buses into the local transport network and the steps needed to support the adoption of hydrogen technologies.

The activities in Patras played a crucial role in promoting hydrogen mobility, engaging key stakeholders, and showcasing the practical applications of hydrogen fuel cell buses. The event highlighted the potential of hydrogen as a clean energy source for transportation

and emphasised the commitment of local and regional authorities to support sustainable urban development.

Key conclusions from the national workshop include but are not limited to:

- The workshops provided a unique opportunity for participants to **gain valuable insights and knowledge in the field of hydrogen and green mobility**. The series of workshops in each city brought together a diverse group of professionals, students, public authorities, government representatives, transport companies and organisations, fostering knowledge, green innovation and skill development.
- The **practicality of hydrogen buses in public transport was highlighted**, according to test data and results of the trial routes, such as hydrogen consumption, that clearly demonstrates that **hydrogen fuel cell technology is a viable option for public transport**.
- The roadshow **received favourable feedback** from various bus operators and drivers, fleet coordinators and residents of all visited Greek cities. Their positive feedback highlights the successful demonstration and acceptance of clean technology in public transport.
- The roadshow effectively **reached out to and engaged with relevant stakeholders and policymakers**, including local government officials and government sector representatives, demonstrating significant dedication to hydrogen technology.

8. Registration/attendee analysis

ROMANIA

The analysis of the national workshop attendance in Romania shows that it was attended by approximately 100 participants and 15 speakers, while the university workshops were attended by approximately 50 participants and 5 speakers.

The national workshop organised in Cluj-Napoca was by far the largest event on hydrogen organised in Romania so far and the first dedicated to hydrogen in public transport. It brought together high-level representatives from four ministries – Energy, Transport, European Funds, Development –, and was honoured by the presence of the Ambassador of Great Britain, that of Clean Hydrogen Partnership, the mayors of two cities, the rector of the Technical University of Cluj-Napoca and top management from major energy companies in Romania, including OMV, E.ON, and Messer. The interest for the workshop was very high, more than half of those present came from hundreds of kilometres away specifically to be speakers or participate in the event. The messages delivered by the speakers during the national workshop echoed at the state level, showing that the roadshow's agenda also found its way into governmental discussions and consultations on further support for hydrogen technologies in transport and elsewhere.

The representatives of the professional associations present at the discussions drafted a white paper outlining the next steps that Romanian authorities must take to accelerate the adoption of hydrogen in the public transport.

Last but not least, the private companies present at the event conducted internal briefings and started discussions dedicated to the use of hydrogen in various sectors of the national economy.

BOSNIA AND HERZEGOVINA

The analysis of the national workshop attendance in Bosnia and Herzegovina indicates that the number of participants was at the level expected for the chosen location of the event – 70. The workshop was mainly attended by decision maker level representatives of various state authorities and ministries (Ministries of Transport, Foreign Trade, Education, and Energy). Also, the mayors and other representatives of various large municipalities (Sarajevo, Pale, East-Sarajevo) participated in the workshop.

From the private sector, representatives of several companies interested in development of green energy infrastructure, including sustainable public transport, took part in the workshop. Some of these attendees came from far away locations like Banja Luka, located a 4-hour drive from the event location. International attendees also attended the workshop, with visitors from several Austrian companies making up the largest group.

Due to the workshop's location, only representatives truly interested in hydrogen energy, economy and mobility attended the event, as there are no public transportation routes in operation to The Jahorina Mountain Ski Resort during the off-season. However, the level of interest expressed prior to, during, and after the event demonstrated the growing enthusiasm for innovative hydrogen related technologies in Bosnia and Herzegovina.

BULGARIA

The analysis of the national workshop attendance in Bulgaria indicates that it was attended by 97 participants and more than 20 speakers.

The analysis of the audience in the national workshop "Hydrogen Electromobility in Bulgaria Forum | CEE Roadshow" shows that the event was held with a strong practical orientation. It gathered European experts in clean hydrogen mobility and an audience dominated by companies, scientific organisations (universities and institutes), regional government and agencies. The introduction of FCEBs into public transport is an important objective of the ongoing project ZAHYR project as well, making the interest of municipal public transportation companies and authorities particularly noticeable. Thus, the bus trials were crucial and useful for real-world testing of this zero-emission transport technology, which is new to Bulgaria. The main goal of the workshop was to give a platform for more people from different target groups to "touch" hydrogen vehicles and to hear experts who have experience with the operation of FCEBs.

Although the national workshop was held in Stara Zagora, there were two events in Sofia with a strong impact on the future deployment of FCEBs in Bulgaria: the official opening of the Hydrogen Mobility Days in Bulgaria, and the roundtable discussion on the future of clean hydrogen mobility in Bulgaria ("Opportunities and Conditions for Introducing

Hydrogen Electromobility in Bulgaria") in the Ministry of Transport and Communications. Approximately 50 participants took part in the roundtable discussion. Both events gathered targeted operational experts from the ministries, scientific community and companies interested in hydrogen deployment. The main discussions were held at the national level, although representatives of some foreign embassies were also among the participants. The two events were more politically engaged with the purpose of involving policy makers in active cooperation, supporting processes for clean hydrogen mobility deployment.

GREECE

The 3rd JIVE Roadshow was successfully held in four cities across Greece, featuring 3 regional workshops and 1 national workshop. Those events provided a unique opportunity for participants to gain valuable insights and knowledge in the field of hydrogen and green mobility. The series of workshops in each city brought together a diverse group of professionals, students, public authorities, government representatives, transport companies and organisations, fostering knowledge, green innovation and skill development. Below, is a detailed description of each workshop, as well as information about the attendants that participated in them.

Regional Workshop in Thessaloniki (21st of May)

The workshop was held at AUTH-Aristotle University of Thessaloniki, titled ''Hydrogen Mobility Info Day'' and the duration was three hours. The session began with an overview of the JIVE project, providing a comprehensive understanding of this pioneering initiative and its significance in advancing hydrogen fuel cell technology and sustainable transportation. During the event, participants and attendees were provided with comprehensive information on the hydrogen bus and its role in promoting green mobility. Additionally, there was an in-depth presentation showcasing the hydrogen bus, highlighting its innovative features and the environmental benefits it offers. This session aimed to educate attendees on the advancements in sustainable transportation and the significant impact of hydrogen technology on the future of urban mobility. In total, there were 140 participants, of which 80 were primary school students.

The audience consisted of:

- representatives of local Transportation Companies (OASTH, OSETH),
- representatives of local authorities,
- representatives of industry (Motor Oil, Hellenic Hydrogen),
- representatives of other cities interested in the technology,
- representatives of high schools and university students, professors AUTH (Aristotle University of Thessaloniki, Institute of Electrochemistry and Energy Systems with the Bulgarian Academy of Sciences (IEES-BAS)),
- the public.

Regional Workshop in Kozani (24th of May)

The second workshop took place in the city of Kozani, specifically in the frame of the Balkan Energy Forum, held at the exhibition centre in Koila, Kozani. This significant event attracted a wide and diverse audience, keen on exploring advancements in energy and transportation. The workshop featured a series of esteemed speakers who shared their expertise and insights on various related topics of green energy.

The speakers included representatives from:

- the Ministry of Transport and Infrastructure, who provided valuable insights into national policies and strategies for sustainable transport development.
- DG-MOVE, representing MOVE.D Waterborne Transport, alongside Moumen Hamdouch from MOVE.B4 Sustainable & Intelligent Transport, who discussed European initiatives and innovations in sustainable transport.
- the Hellenic Institute of Electric Vehicles, who shared his extensive knowledge on the progress and future of electric mobility in Greece.
- MC CHARGERS, who spoke about advancements in charging infrastructure and the role of MC CHARGERS in supporting the transition to electric vehicles.
- the JIVE Roadshow, who highlighted the objectives and achievements of the roadshow in promoting hydrogen mobility and green transportation solutions.
- Motor Oil, who discussed the company's initiatives and contributions towards sustainable energy and transportation.

The participation of the hydrogen bus in the event was a pivotal part of the Balkan Energy Forum, providing attendees with a comprehensive understanding of the current trends and future directions in sustainable transport. The event fostered discussions and

collaborations among industry leaders, policymakers, and enthusiasts, all committed to advancing green mobility and energy solutions. In total, there were 1,420 participants, of which 160 were primary school students, and 60 were university students.

The audience consisted of:

- representatives of local municipal companies,
- a representative from the Ministry of Transport and Infrastructure,
- representatives of local authorities,
- representatives from high schools and university students, professors from University of Western Macedonia,
- representatives from cities interested in the technology (Kozani, Ptolemaida, Kastoria, Florina, Grevena, Amyntaio),
- the public.

National Workshop in Athens (30th of May)

The national workshop was held on May 30, 2024at the OSY Bus Depot "Renti" in Athens, lasting four and a half hours. It was a pivotal event dedicated to advancing the adoption of hydrogen-powered public transportation. This workshop brought together experts, policymakers, industry leaders, and researchers to discuss the latest developments, challenges, and opportunities in hydrogen bus technology. In total, there were 120 participants.

The audience consisted of:

- representative from the Ministry of Infrastructure & Transport,
- representatives from OSY,
- representatives from the Ministry of Environment and Energy,
- representative from the Ministry of Digital Governance,
- representative from Growthfund,
- representatives from industry & companies (Motor Oil, Hellenic Hydrogen, Toyota Hellas S.A, Coral Gas),
- representatives from municipal transport companies**,**
- journalists from local media,
- representatives from the Embassy of the People's Republic of China,
- the public.

Regional Workshop in Patras (5th of May)

The fourth workshop was held on June 5, 2024, at the ECOFORUM 2024 in Patras, coinciding with World Environment Day. This event focused exclusively on hydrogen mobility, showcasing the latest advancements and innovations in this field. It attracted a diverse audience, including industry experts, policymakers, and environmental enthusiasts, all dedicated to exploring the potential of hydrogen as a sustainable transportation solution. The workshop featured a panel discussion on sustainable urban mobility and energy, and the role of hydrogen technology in reducing carbon emissions and promoting green mobility. There was also a press conference held during the national workshop. In total, there were 75 participants.

The audience consisted of:

- a representative from the Ministry of Transport and Infrastructure,
- representatives from local and regional companies (Patra, Achaia),
- the CEO of the Patras Port Authority,
- the mayor of Patras,
- the president of the Chamber of Achaia,
- representatives from industry & companies (Helbio S.A, Motor Oil, Coral Gas, AVINOIL, Public Transport Company),
- the public.

9. Key performance indicators and impact of the roadshow on FCEB demand

ROMANIA

The key performance indicators and impact of the roadshow on FCEB demand in Romania are summarised in Tables 8 and 9, where Table 8 indicates general interest in hydrogen for mobility technologies and their possible deployment in the country, and Table 9 indicates key quantitative performance indicators of roadshow activities in Romania.

Table 6 shows general interest in hydrogen for mobility and their deployment in Romania

City	Roadshow participant	Interest in the technology	Timeline for deployment	No. of H2 buses	Comments
Cluj-Napoca	YES	YES	2026-2027	25	Local authorities expressed their intention to open the tender for the purchase of hydrogen buses. It is one of the steps envisaged in a larger project to build a hydrogen valley that includes the production plant, charging stations and hydrogen buses
Galati	YES	YES	2027-2028	42	More information was requested about the bus's performance during the tests, without response from the manufacturer. Authorities have shown interest in Caetano's offer

Table 7 shows key quantitative performance indicators of roadshow activities in Romania

Number of events organised	3
Number of participants in the stakeholder events (all events that are not media events – e.g national/technical workshop + students' event + professional events + other events + etc.)	150-180
Number of participants in the media events	150
Number of media articles, TV and radio programmes	Approx. 350
Reach of the media articles, TV and radio programmes	Approx. 2,5 mil.

Number of social media posts	Approx. 100 posts targeted the roadshow in Romania
Reach of the social media posts	Approx. 1,5 mil. According to Comm. Department from Cluj-Napoca City Hall, more than 2000 people constantly followed the TikTok and Facebook official channels during the media briefing, and approx. 20 000 read the info posted right after the event

The number of hydrogen-powered vehicles in the partner country and Central and Eastern Europe is, in general, increasing	No hydrogen vehicles yet, but high interest is visible
Stakeholders convinced that hydrogen power is the future of public transportation and ready to take practical steps to introduce it	Stakeholders highly interested in the technology and willing to learn more about it
General public is convinced that hydrogen power is safe, and it is the future of public transportation	General public is more and more aware about the technology and its benefits
Following the trial, the municipalities who tested the buses have announced a formal interest in the hydrogen-power technology	YES
Local politicians and public transport operators have made announcements regarding commitment for hydrogen-power technology procurement in the future	YES
National government or national politicians have made announcements regarding hydrogen power technology plans for the country	YES (in accordance with strategy on hydrogen)

BOSNIA AND HERZEGOVINA

The key performance indicators and impact of the roadshow on FCEB demand in Bosnia and Herzegovina are summarised in Tables 6 and 7, where Table 6 indicates general interest in hydrogen for mobility technologies and their possible deployment in the country, and Table 7 indicates key quantitative performance indicators of roadshow activities in Bosnia and Herzegovina.

Table 8 shows general interest in hydrogen for mobility and their deployment in Bosnia and Herzegovina

City	Roadshow participant	Interest in the technology	Comment	Timeline for deployment	No. of H2 buses	Comments

Sarajevo	YES	YES	Interest in the technology was evident. However, the first potential purchases will take 2-3 years	2027	2	Bosnia and Herzegovina is a low GDP country. Only the largest municipalities and resorts can afford such technologies

Table 9 shows key quantitative performance indicators of roadshow activities in Bosnia and Herzegovina

Number of events organised	1
Number of participants in the stakeholder events (all events that are not media events – e.g national/technical workshop + students' event + professional events + other events + etc.)	100
Number of participants in the media events	70
Number of media articles, TV and radio programs	10
Reach of the media articles, TV and radio programs	N/A
Number of social media posts	5
Reach of the social media posts	N/A

The number of hydrogen-powered vehicles in the country and Central and Eastern Europe is, in general, increasing	Just starting with the introduction of the technology
Stakeholders convinced that hydrogen power is the future of public transportation and ready to take practical steps to introduce it	YES
General public is convinced that hydrogen power is safe, and it is the future of public transportation	N/A
Following the trial, the municipalities who tested the buses have announced a formal interest in the hydrogen-power technology	YES
Local politicians and public transport operators have made announcements regarding commitment for hydrogen-power technology procurement in the future	YES
National government or national politicians have made announcements regarding hydrogen power technology plans for the country	YES

BULGARIA

The key performance indicators and impact of the roadshow on FCEB demand in Bulgaria are summarised in Tables 10 and 11, where Table 10 indicates general interest in hydrogen for mobility technologies and their possible deployment in the country, and Table 11 indicates key quantitative performance indicators of roadshow activities in Bulgaria.

Table 10 shows general interest in hydrogen for mobility and their deployment in Bulgaria

City	Roadshow participant	Interest in the technology	Timeline for deployment	Number of H2 buses	Comments
Sofia	YES	YES	Next 3 years	10-30	Sofia Municipality has a PDA project on deployment of FCEBs and announced an investment program for 1 billion BGN for 500 new vehicles
Stara Zagora	YES	YES	Next 3 years	10	10 FCEBs as a part of ZAHYR Hydrogen Valley project
Pazargjik	NO	YES	-	-	Manifestation of interest
Plovdiv (Economic zone)	NO	YES	-	-	Manifestation of interest

Table 11 shows key quantitative performance indicators of roadshow activities in Bulgaria

Number of events organised	3
Number of participants in the stakeholder events (all events that are not media events – e.g national/technical workshop + students' event + professional events + other events + etc.)	306-326
Number of participants in the media events	26
Number of media articles, TV and radio programmes	N/A
Reach of the media articles, TV and radio programmes	N/A
Number of social media posts	N/A
Reach of the social media posts	N/A

The number of hydrogen-powered vehicles in the partner country and Central and Eastern Europe is, in general, increasing	Bulgaria has already one vehicle (car) and mobile refuelling station
Stakeholders convinced that hydrogen power is the future of public transportation and ready to take practical steps to introduce it	Different stakeholders that participated in the events demonstrated their interest in hydrogen deployment. Two municipalities and one region are ready to start procedures and measures for hydrogen mobility
General public is convinced that hydrogen power is safe, and it is the future of public transportation	The roadshow demonstrated the safety and comfort of hydrogen mobility. The interviews with passengers, the driver's

	opinion and the results from the online survey are evidence for the positive public opinion
Following the trial, the municipalities who tested the buses have announced a formal interest in the hydrogen-power technology	YES
Local politicians and public transport operators have made announcements regarding commitment for hydrogen-power technology procurement in the future	YES
National government or national politicians have made announcements regarding hydrogen power technology plans for the country	YES

GREECE

The key performance indicators and impact of the roadshow on FCEB demand in Greece are summarised in Tables 12 and 13, where Table 12 indicates general interest in hydrogen for mobility technologies and their possible deployment in the country, and Table 13 indicates key quantitative performance indicators of roadshow activities in Greece.

Table 12 shows general interest in hydrogen for mobility and their deployment in Greece

City	Roadshow participant	Interest in the technology	Timeline for deployment	No. of H2 buses	Comments
Thessaloniki	YES	YES	N/A	N/A	Local authorities and bus operators expressed their interest for this technology, and they showed acceptance towards it
Kozani	YES	YES	N/A	N/A	Local bus operators discussed with local authorities about the leasing of FCEBs in the short-term future
Athens	YES	YES	TRIERES: Estimated 2025 – 2026 Future strategic plan: 2026 - 2028	2 50-100 (to be used in Athens and Thessaloniki	OSY, the local Road Urban Transport operator of the Metropolitan Area of Attika Region, Greece, showed great interest and participated in the co-organisation of the national workshop of JIVE 3 in Athens, offering its modern Bus Depot in Renti to host the event. OSY operates with the aim of providing public utility services under the supervision of the Ministry of Infrastructure and Transport. OSY is committed in making steps towards the decarbonization of the road urban transport by valorising EU funded projects: TRIERES project (Clean Hydrogen Partnership - GA No 101112056): OSY will study the optimal pathway to own and operate a fleet of FCEV urban buses

					according to its strategic plan, as well as test and demonstrate its capability to operate the first 2 FCEV urban buses in Greece, within the capital city, Athens. REAH3 project (CEF - Transport – under GA preparation): An HRS will be deployed inside a bus depot of OSY, which has expressed its intention to lease the land to the beneficiary AVIN, in order to refuel firstly the hydrogen buses to be acquired in the context of the TRIERES project and in the mid-term a planned fleet of 50 – 100 hydrogen buses expected to be deployed gradually from 2026 until 2028, according to official announcement of the Greek Ministry of Transport. The bus depot is located at Thriasio - Attiki, part of the urban node of Athens, Greece
Patras	YES	YES	N/A	N/A	The local authorities and the Port of Patras were very interested in assessing this technology, but they showed some concerns about the necessary measures and steps towards the implementation of this technology

Table 13 shows key quantitative performance indicators of roadshow activities in Greece

Number of events organised.	7
Number of participants in the stakeholder events *(all events that are not media events – e.g national/technical workshop + students' event + professional events + other events + etc.)*	Approx. 1750 on national/ workshop + students' event + professional events + other events + etc.)
Number of participants in the media events	41
Number of media articles, TV and radio programmes	136
Reach of the media articles, TV and radio programmes	N/A
Number of social media posts	51 (15 on Facebook, 13 on LinkedIn, 13 on Instagram, 10 on X)
Reach of the social media posts	1831

The number of hydrogen-powered vehicles in the partner country and Central and Eastern Europe is, in general, increasing	No hydrogen vehicles deployed yet, but there is high interest for them
Stakeholders convinced that hydrogen power is the future of public transportation and ready to take practical steps to introduce it	Stakeholders expressed significant interest in the technology and were eager to learn more about it
General public is convinced that hydrogen power is safe, and it is the future of public transportation	General public is becoming more aware about the FCEB technology and its environmental benefits

Following the trial, the municipalities who tested the buses have announced a formal interest in the hydrogen-power technology	YES
Local politicians and public transport operators have made announcements regarding commitment for hydrogen-power technology procurement in the future	YES
National government or national politicians have made announcements regarding hydrogen power technology plans for the country	YES

10. Lessons learned

The following **general lessons were learned** from the 3rd JIVE Hydrogen Bus Roadshow activities (bus trials and workshops/conferences/ forums):

- **Implementation of hydrogen mobility, both in private and public transportation, in low-income countries could be challenging.** It is critical to find the best possible location and business model for the first pilot programs in domain of public transportation, attracting both local and international funding.
- **Other alternative means of transportation, like electric buses remain a strong competitor to hydrogen buses.** They have significantly more lobbyists and products on the market. The EU should seize the opportunity to **limit imports or increase import duties on electric buses made in the third countries**, which can flood the market with low-cost, low-quality products, endangering the future of the European manufacturers.
- Interest in hydrogen mobility applications is high, but there is still a **high demand for general education on hydrogen-based technologies** as well.
- In the short-term, **deployment of public hydrogen mobility options might be limited to specific areas** (ski resort, recreational locations etc.) in some countries**.** They might be motivated to invest in the development of single FCEB deployment, hydrogen production and/or fuelling related projects.
- **Funding opportunities for hydrogen projects, also in the public transport sector, are numerous and diverse**, both at the EU and national level. These opportunities should be used more actively.
- **There is a lack of unified hydrogen in transport legislation framework** both on the national and the EU level.
- A comparatively small number of entrepreneurs are ready to make **major investments in hydrogen technologies in the short-term** (building hydrogen production plants, storages, fuelling stations etc.).
- **The high costs of hydrogen vehicles, including buses, and green hydrogen itself remain significant challenges**. One solution considered is to develop the entire value chain of green hydrogen (generation, transport/distribution/ charging/consumption) as a part of hydrogen valley projects throughout the EU.
- **State, municipal and other incentives** should be introduced to support and promote the development of hydrogen technologies in all the EU regions, regardless of their level of economic and/or social development.
- **Encouraging the development of local and scaled-up hydrogen valley projects** is essential for establishing hydrogen as a sustainable and long-term solution for mobility, leveraging both national and international expertise.

- **The development of hydrogen fuelling infrastructure must be encouraged** throughout the EU, sharing positive experiences and case studies from the pioneering regions of hydrogen fuelling infrastructure development with those who currently are only in beginning.

Along with the general lessons learned listed above, the following **practical lessions** were learned during the bus trials/test drives in countries of the 3rd JIVE Hydrogen Bus Roadshow:

- The satisfaction with the bus' driving performance was observed in all four countries, specifically its very **good acceleration abilities**, which even exceeded the performance of existing electric buses.
- The experience of **driving a hydrogen bus was described as better, easier and more comfortable** than driving a conventional diesel or an electric bus.
- In comparison to electric buses, the **refuelling of the hydrogen bus was much shorter, and it ensured a longer driving range**, while the charging process of electric buses requires hours, and they show a lower autonomy.
- Hydrogen buses **exhibited lower environmental and noise pollution**, which brought more comfort both to drivers and passengers.
- In some of the countries, **real-time data** from long term exploitation of hydrogen buses was shared for the very first time. For example, this was very interesting and important to the Bulgarian companies. Data on the first Bulgarian hydrogen refuelling station was presented, and the importance of the development of hydrogen refuelling infrastructure in the country was clearly signalled.
- **FCEBs were categorised as a mature technology** with a stable market niche, as well as sufficiently long testing and accumulated experience. For countries like Bosnia and Herzegovina, Bulgaria and Greece, where these technologies are about to enter the market, these facts are extremely important.
- **There is practically no standardised technical maintenance** for FCEBs or other hydrogen vehicles.
- **At the moment of the roadshow there was a lack of proper hydrogen refuelling infrastructure** - Romania and Bosnia and Herzegovina do not have a single hydrogen refuelling station, so the employment of mobile refuelling station was needed for the trials. Hydrogen buses cannot be integrated into public transportation without a sustainable solution for this problem.
- **Some transient technical problems were observed** (bus sensors were too sensitive and gave faulty alarms several times, the driver's side door was too tight to open/close, difficulties with the acceleration pedal when starting from standstill, insufficient quantity of freon, etc.), but most of them were solved during the roadshow. **Notice of these problems was taken for the next roadshows, in order to mitigate the risks preventively.**
- **Driving a hydrogen bus on mountain roads requires additional skills**. This could also result in the unavailability of experienced drivers for the trial, as was the case in Bosnia and Herzegovina. **The same pattern and duration of driver's training does not apply to all terrains.**
- The **bus should come for a system check-up after each trial leg**, since the preparation time for the trial is short and the experience of the local staff is limited.

- Driving a hydrogen bus in mixed terrains **requires different energy management**, and the system setup of the trial bus was not optimal– even driving within permitted speed limits and empty, the **bus tended to enter "safe mode"** and drive at very low speed.

11. Conclusions

The 3rd JIVE Hydrogen Bus Roadshow has positively impacted public awareness and promoted the potential deployment of hydrogen technologies and hydrogen mobility. The initiative successfully demonstrated the practicality and benefits of hydrogen technology in public transport. The roadshow highlighted the viability of hydrogen fuel cell technology as an alternative to fossil fuels, as there was significant positive feedback from bus operators, drivers, fleet coordinators, and the public. The roadshow also effectively engaged local government officials, policymakers, and students, contributing to broader acceptance and understanding of this clean technology.

In regions where the deployment of hydrogen technologies is just emerging, the 3rd JIVE Hydrogen Bus Roadshow had a very strong impact on different target groups:

- Policy makers were able to face the fact that FCEB technologies are mature and have a good potential for broader market coverage.
- Public transportation companies/operators gained firsthand experience of the benefits of FCEBs compared to diesel and electric buses.
- The public and potential passengers witnessed the benefits of FCEBs, such as the reduction of air and noise pollution and an enhanced comfort level. All stakeholders were convinced that FCEBs are secure and safe, which is a strong argument in favour of this transport technology.
- Young people (students and pupils) learned a lot about new transport technologies and will be able to share the things they saw during the demonstration with their family members and friends.
- National experts in hydrogen (mainly researchers) learned a lot of interesting and important facts about the operation and fuelling of FCEBs, providing a positive input for their future work.

The 3rd Hydrogen Bus Roadshow initiative played a catalytic role in addressing some of the key barriers to FCEB deployment, paving the way for the adoption of FC vehicles and hydrogen mobility. The engagement and interest from stakeholders, coupled with the increased public awareness, are positive indicators of the initiative's success, showing that it has served its purpose.

At the same time, the experience of the 3rd Hydrogen Bus Roadshow clearly shows that certain improvements can be made to enhance effectiveness of future roadshows. For instance, extending the roadshow to more countries and cities in the EU, especially those with universities and industrial hubs, could significantly enhance its promotion. These areas are likely to have a higher concentration of people who are both interested in and

influential regarding new technologies. Targeting such cities would not only raise awareness but also foster partnerships with academic and industrial stakeholders. Organising more specialized pilot training sessions for students, particularly those studying in relevant fields, could be beneficial as well. These sessions would provide knowledge exchange about hydrogen technologies in the mobility sector, preparing the next generation of engineers and scientists to contribute to the advancement of this technology.

Hosting more press conferences in different cities could amplify the roadshow's impact as well. Inviting a broader range of journalists and media would ensure wider coverage and a more diverse dissemination of information. These events should facilitate productive discussions with relevant stakeholders.

Finally, the distribution of target group tailored questionnaires could help better understand both the public's perception and the vehicle's performance. These questionnaires should target various social groups to gather comprehensive data on public awareness and information about the hydrogen bus. A separate set of questionnaires for drivers could collect data on vehicle behaviour, driver satisfaction, and any operational challenges faced.

By implementing these suggestions, future roadshow initiatives can achieve greater impact, ensuring that more people are informed about the benefits of vehicles with zero-emissions and are encouraged to adopt this sustainable technology