RTR CONFERENCE

CONFERENCE

RESULTS FROM ROAD TRANSPORT RESEARCH

Summary Report
#RTR2025

11 - 13 February 2025
Brussels

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WELCOME
TO BRUSSELS
Simon Edwards
ERTRAC Vice-Chair & RTR Conference Chair

INTRODUCTION

The 8th edition of the European Conference on the Results from Road Transport Research (#RTR2025) took place from 11th to 13th February 2025. For the first time ever, more than 1000 participants joined the conference, on-site in Brussels and online to listen to the presentations from 90 projects in 23 sessions.

The presentations gave the final outcomes from some Horizon 2020 projects, providing a glimpse into a promising future for a more sustainable, integrated and digital road mobility. Furthermore, attendees were introduced to new results from many, running Horizon Europe funded projects.

In addition to the standard programme, featuring activities related to road transport safety, logistics, urban mobility and infrastructure, projects from the co-programmed partnerships "Towards Zero Emission Road Transport Partnership" (2Zero), "Connected, Cooperative and Automated Mobility Partnership" (CCAM) and the "Batteries for Europe Partnership" (Batt4EU) were invited.
For the first time, the conference also featured projects beyond research and innovation, with a specific session dedicated to the Connecting Europe Facility (CEF) which supports deployment and demonstration.

In this Summary Report, the moderators of each session briefly introduce the key outcomes highlighted by each project's representative and provide a summary of the discussions and conclusions from their session. If you want to deep dive into the session content, we invite you to watch the recording of each session, which is easily accessible by clicking on the YouTube logo next to the session title.

We wish you a good read and hope to see you at the next edition of the Road Transport Research conference, from 10th to 12th February, 2026.

Simon Edwards
Ricardo
ERTRAC Vice-Chairman & RTR Conference Chair

PARALLEL SESSION 1:

Air quality and particles emissions

Summary from **Leonidas Ntziachristos (LAT/AUTh)**

The session air quality and particles emissions took place on February 11th, 2025 and was chaired by Alexandru Ghiurca (CINEA) and Leonidas Ntziachristos (LAT/AUTh). The session related to two topics of the Work Programme, namely:

(a) Understanding and mitigating the effects on public health of emerging non-regulated nanoparticle emissions issues and noise (2020)
(b) Prevent smog episodes in Europe: Air quality impact of engine-emitted volatile, semi volatile and secondary particles (2022).

These serve the objective of designing cost-effective policies on decreasing the pollution impacts of transport in a holistic manner, i.e. by including non-exhaust contributions and secondary atmospheric processes. The session comprised four project presentations, two from the 2020 call, nPETS and LEON-T, and two from the 2022 call, EASVOLEE and PAREMPI.

The **nPETS** project (June 2021 - November 2024), presented by Prof. Ulf Olsson from KTH, Sweden, aimed at characterising the contribution of different sources to ambient concentrations of nanoparticles and assessing their toxicity, in order to evaluate the impact of different policy scenarios. The project conducted field and laboratory measurement campaigns assessing inflammatory endpoints of exhaust particles from different transport means (rail, maritime, aviation and road), the latter specifically distinguished to exhaust and non-exhaust emissions. Based on these results, it assessed different policy scenarios. Projections related to the renewal of road fleets

and introduction of low emission zones for zero emission vehicles both exhibit very promising reductions in nanoparticle exposure for the city of Stockholm. Laboratory results varied in terms of the inflammatory potential of brake induced nanoparticles, while clutch nanoparticles were found to be at the same level as brake nanoparticles.

Juan Garcia (IDIADA) presented the results of the **LEON-T** project (June 2021 – November 2024), which aimed to improve our understanding of tyre related emissions and noise. The project conducted on-road and laboratory wear tests to identify tyre mass loss depending on tyre and road characteristics and operational conditions. Moreover, it studied the distribution of tyre particles with distance from road and the fate of these particles with atmospheric ageing. Results showed up to 30 g/m^2 microplastic coverage within 10 m from the road, up to 1 $\mu g/m^3$ atmospheric concentration and up to 20% of PM_{10} comprising of tyre wear. Tyre wear particles were found to lose material with time due to UV-degradation in the atmosphere. The project offered recommendations on how tyre particle ambient concentrations can be decreased. It concluded, however, that on-road PM/PN measurement protocols are not yet ready for regulatory consideration.

Prof. Spyros Pandis (FORTH) presented the progress of the on-going project **EASVOLEE** (February 2023 – January 2027), which aims to quantify the contributions of secondary PM formation from transport in the atmosphere and to develop health-related metrics, strategies and policies to improve exhaust aerosol-related air pollution. The project has conducted laboratory and field testing of organic exhaust species of road vehicles and has improved relevant chemical transport models (CTMs) in predicting regional concentrations of secondary organic aerosol particles due to different sources. The aim is to be able to support future relevant policy initiatives.

Dr. Päivi Aakko-Saksa (VTT) presented the approach and preliminary results of the **PAREMPI** project (January 2023 – December 2025), which shares similar objectives with EASVOLEE in better characterising the contribution of different secondary aerosols from transport sources to ambient $PM_{2.5}$ levels. PAREMPI also includes specific emissions characterisation of aviation and marine exhaust, further to road vehicles. Together with EASVOLEE the project builds a database of emission factors for particle precursors and toxicity for emissions from different transport modes. It also develops a software model aimed at assessing the total PM mass potential of exhaust, based on composition of precursor gases. This is deemed to be useful for more effective control of aerosol emissions from transport.

The discussion that followed the presentations focused, in large, on whether toxicological evidence can be used to guide regulation on controlling specific species.

However, there was pessimism in this option primarily due to the very variable results of the different toxicity tests. Instead, the presenters offered some solid recommendations for future research objectives. One line of research should focus on tyre emissions and better understanding wear and particle production mechanisms as a function of tyre and road surface properties and operational and environmental conditions, in order to have robust emission factors for the various applications within EU Member States. A specific item was raised on winter tyres and their variable operation on ice, snow and dry road surface, often encountered in Nordic countries. A second item of interest was the environmental performance of new technologies, such as plug-in vehicles, with their frequent engine starts, and new fuels expected for road/non-road vehicles (e.g. hydrogen) and zero carbon fuels for shipping. Finally, closing the gap between bottom-up (from emission factors to atmospheric concentrations) and top-down (from atmospheric concentration to emission factors) approaches in understanding pollutants and atmospheric interactions, together with streamlining definitions of different particulate species (e.g. VOC, IVOC, SVOC, OC, BC, EC, nvPM, PM, filterable, condensable, etc.) were seen as priorities.

PARALLEL SESSION 2:

Road infrastructure, maintenance and circularity

Summary from **Ciaran McNally (UCD)**

Session 2 took place immediately after the opening session and addressed the topic of infrastructure management, and how we can achieve a more circular transport system. The session began with an introduction by Claudia Ciuca from CINEA, who set the scene and outlined the Horizon calls that led to the successful projects being presented. The first three projects presented arose from the topic: MG-2-10-2020 "*Enhancing coordination between Member States' actions in the area of infrastructure research with a particular focus on biodiversity and ameliorating environmental impacts and full automated infrastructure upgrade and maintenance*". The final two projects arose from the call "HORIZON-CL5-2022-D6-02-06 *Smart and efficient ways to construct, maintain and decommission with zero emissions from transport infrastructure.*"

The first project presented was the **HERON** project and was titled "Improved Robotic Platform to Perform Maintenance and Upgrading Roadworks: the Heron Approach". Unfortunately, the coordinator was not able to attend the RTR2025 Conference, so this project was presented by Claudia Ciuca in her role as Project Officer. She presented the vision-based systems being developed by the HERON team for asset management and showed how they are also addressing worker safety.

The second project presented was **InfraROB** and this was delivered by Pedro Arias Sánchez from the University of Vigo. He gave an overview of the project and the various automated solutions that have been developed for processes such as paving, cable detection, line marking and pothole repair. The main results were presented alongside the project KPIs and a description of the long and short-term impacts.

The final presentation under the first topic was from Jose Solís Hernández from CEMOSA, who presented the **OMICRON** project. His presentation was titled "Intelligent Road Asset Management Platform" and described their approach to Digital Inspection, Predictive Maintenance and Road Maintenance. A number of applications were presented, including pavement condition prediction, structural health monitoring of bridges and planning/optimisation of maintenance activities. All were enabled using robotic systems and the impacts of these was also discussed.

The second part of the session featured two related projects, the first was **LIAISON**, which was presented by David Garcia Sanchez from Tecnalia. The title of his presentation was "Lowering Transport Environmental Impact Along the Whole Life Cycle of the Future Transport Infrastructure", it focused on developing tools, methodologies and solutions that would help the transformation to a more sustainable transport sector. David outlined the LIAISON Dynamic Multi-Infrastructure Governance Framework and showed a number of applications (e.g. modular rigid pavements; optimised 3D printed beams; bioasphalt pavements and low noise track ballast). Using the LIAISON framework, they are aiming to foster green, sustainable and innovative public procurement processes for these solutions.

The final project in the session was **CIRCUIT**, it was presented by Dr Irina Stipanovic from Infra Plan Consulting. The project aims to develop a holistic approach for circular, smart, resilient and sustainable transport and is founded on the four pillars of Digitalisation, Recycling, Reuse and Energy. The project aims to understand the barriers and enablers for the Circular Economy: these were tested on a number of pilot projects. Irina finished with a discussion of the expected impacts arising from the project.

The presentations were followed by a discussion that was moderated by Dr Ciaran McNally from UCD. There were a number of common threads that linked the presentations – the role of legislation/regulations on demonstrations; life cycle assessments; harmonised approaches for implementing circular solutions; and digitalisation as an enabler. The discussion focussed on these topics, with several questions from the audience and thoughts provoking contributions from the panellists.

PARALLEL SESSION 3:

EV charging - advanced solutions benefiting both the user and the grid

Summary from **Christof Schernus (FEV)**

The session featured four presentations dealing, in one or the other way, with the interaction of battery electric vehicles (BEV) with the energy grid through the charging infrastructure. Applications such as smart charging, vehicle-to-grid (V2G), vehicle-to-home (V2H), vehicle-to-building (V2B) and vehicle-to-load (V2L) are being investigated. While smart charging can be a monodirectional power connection from the charging infrastructure to the vehicle, the V2X applications are bidirectional and use the battery of the EV not only for storing the energy used for driving. V2G enables vehicles to provide electricity back to the grid, building or home through a suitable charger. Or they can provide electricity to power tools or other devices (V2L).

eCharge4Drivers ("Electric Vehicle Charging Infrastructure for improved User Experience") was presented by Presentation by Vasilis SOURLAS, senior researcher in ICCS-NTUA, Greece (I-SENSE group). The, already completed, project responded to the H2020 topic LC-GV-03-2019 "User-centric Charging Infrastructure", with a consortium of 30 partners from twelve countries under the coordination of ICCS. The project performed 10 demonstrations in the metropolitan areas of Zelik, Grenoble, Barcelona, Bari, Berlin and Luxembourg, and on TEN-T corridors in Austria, Greece, Turkey and Greece. Nine different use cases addressed infrastructure, e-mobility services and decision support tools. The project developed user-friendly charging stations and other technology solutions, such as battery swapping, lamp post charging etc., and demonstrated the interoperability of electromobility services for enhanced user-experience. With the large number of demonstrations, the project fostered the broad implementation of charging points in Europe.

Polls among end-users and stakeholders showed an average 50% increase in the acceptance of electric vehicles, charging comfort experience and inclination to invest in infrastructure after experiencing project solutions. Such solutions included tools for booking and routing, i.e. the ability of booking charging points to make sure they are available upon arrival, and plug & charge solutions.
Further, V2G charging stations were realised, and decision-making tools for municipalities and investors were developed that help plan the installation of charging infrastructure so it matches user demand and commercial expectations.

FLOW ("Flexible energy systems Leveraging the Optimal integration of EVs deployment Wave") was presented by Josh EICHMAN, group lead for Energy Systems Integration at the Catalonia Institute for Energy Research (IREC). Like the next two projects in this session, FLOW responds to the topic "HORIZON-CL5-2021-D5-01-03 - System approach to achieve optimised Smart EV Charging and V2G flexibility in mass-deployment conditions (2ZERO)". The project boosts and demonstrates multifaceted EV smart charging and V2X integration into the energy systems, thanks to a range of comprehensive solutions providing answers to the needs of all actors involved. FLOW also delivers multi-actor orchestration to ensure data exchange and synchronisation across actors for VGI and EV flexibility services. These solutions are deployed in five demonstrations (including two testbeds and three large-scale demonstrations) in CZ, IE, IT, DK and ES, covering a wide range of applications (e.g. V1G/V2B/V2H/V2G, public/private/semi-public, urban/rural/touristic and passenger/commercial vehicle) to validate and quantify the benefits associated with enabling and valorising EV flexibility, alleviating grid challenges, and fostering mobility and energy decarbonisation. The objectives include user-centric design, interoperability, smart charging infrastructure and microgrids, open digital tools for planning and assessment, optimisation of the integration of EVSE in the energy system, and business models to support the scalability of the approach.
A user-customisable smart charging application was developed to allow users to plan and define their mono- or bi-directional smart charging procedure, and preferences including smart routing options to charge during the journey. An integrated assessment and system platform helps assess impact and orchestrate and coordinate stakeholders of charging and energy infrastructure.

XL-CONNECT ("Large scale system approach for advanced charging solutions") was presented by Alois STEINER, Co-Team Leader for Innovative Energy Management & Comfort Systems at Virtual Vehicle Research. XL-CONNECT builds several demonstration sites for smart charging and bi-directional charging. In a survey on user behaviour and reactions to incentives, users showed a high inclination to use vehicle-to-home (V2H) and smart charging but an increased reluctance to vehicle-to-grid (V2G). Preconditions for V2G acceptance are mentioned, such as a necessary

compensation for premature battery ageing, which many users are still concerned about.
The demonstration sites investigate bottlenecks in the grid and how to mitigate them, e.g., employing sector-coupling concepts. Digital twins are created to investigate the possible upscaling of the solutions. Two of the demonstration sites deal with vehicle-to-building (V2B) use cases, connecting the employees' private cars and pool cars, respectively, to a micro-grid. The first, the "Neuman Use Case", was a virtual use case comparing a stationary battery storage for photo-voltaic (PV) energy with integrating the employees' private cars. While private car users expected a compensation, the investment costs of the V2B demonstration were still lower than the stationary battery storage that was assessed to have a payback time of 8-9 years. At the second use case, the use of the company's pool cars, demonstrates significant benefits in better exploitation of PV capacity and reduced losses of power transfer, by which the cost of premature battery degrading was limited.

DriVe2X ("Delivering Renewal and Innovation to mass Vehicle Electrification enabled by V2X technologies") was presented by Gonçalo MENDES, Postdoctoral researcher at the Laboratory of Electricity Markets and Power Systems of LUT University (Finland). The project aims to advance the deployment of V2X solutions. Specifically, it will focus on developing new knowledge, models and technologies to support the deployment of EVs. Drive2X is the first project to have eight replicable use cases employing the E-Mobility Systems Architecture (EMSA). Amongst them one in Amsterdam dealing with long-term smart charging at the airport, where the vehicle is given under the control of the facility for about a week. Another deals with a vehicle integrated in a more private situation of a microgrid. Smart charging algorithms were developed and are currently being implemented in the infrastructure. An impressive user survey was executed, with over 3300 users replying to a questionnaire about their charging preferences, inclination to participate in smart and/or bidirectional charging and the user experience. Battery degradation is explored in many details and preliminary results hint that the impact of bidirectional charging on premature ageing of batteries seems much overestimated. The project will continue until the end of 2026, so many more results are to be expected.

Q&A

In the Q&A session, airports, as an opportunity to scale-up smart and in particular bidirectional charging with large impact, were discussed because the parking operator could control a very large battery capacity to make profits from balancing the grid of the airport. Policy tools to support cities are developed by several of the projects that presented. It was also asked how smart charging could be turned into profit by Transmission System Operators (TSO) and Distribution System Operators (DSO), not only for end-users; it was countered that present incentives for end-users are so low that the high cost for a bidirectional wall box to participate in V2G leads to a pay-back

time of up to 10 years. Another resistance against upscaling V2G lies in the reservation of vehicle owners not only to have an uncertainty about the battery state of charge should they need to user their vehicle unexpectedly earlier than planned, but in the first place to give another party control about their hardware property. Lastly, when discussing possible ways to increase the efficiency of bidirectional charging, Alois Steiner mentioned that the XL-CONNECT project would investigate the potential of waste heat recovery from charging stations.

The projects presented in this session contribute significantly to the objectives of the 2Zero Partnership's Strategic Research and Innovation Agenda (SRIA), as they develop and demonstrate smart charging and bidirectional energy services solutions accepted by the users and providing services to the grid in different scenarios, such as office buildings, factories, private homes and public spaces, that can lead to increase the penetration of renewable energy in the overall energy grid.

PARALLEL SESSION 4:

Deployment and demonstration – inputs from CEF

ISM Atlante4EU

Summary from **Mats Rosenquist (Volvo Group)**

ISM ("Iberdrola Smart Mobility A reliable network of charging stations for electric vehicles to allow charging along the TEN-T Core and Comprehensive Networks") was presented by Ainhoa Garmendia, responsible for the deployment of Iberdrola's public charging network in Spain

The main objective of this project was to implement a reliable network of charging stations for electric vehicles to allow charging along the TEN-T Core and Comprehensive Networks in Spain and Portugal. This network consists of a total of 592 charging stations with 2,339 either high power (350 kW -150 kW) or fast (50 kW, 43 kW) charging points. 416 charging stations and 1,690 charging points will on the Core Network and 176 charging stations with 649 charging points on the Comprehensive Network. The project contributes to raising significantly the level of e-mobility of Spain, which is currently below the European average, and allowing Portugal to reach the top positions in e-mobility in Europe

The main challenge highlighted by the project was the long installation processes before commissioning the charge stations. This is due to the long procedures to obtain necessary permits and to the long time needed for the up-grade/connection to the grid. This process could be as long as 3 years for medium voltage installations. This was also addressed in the discussion where further actions will be needed.

Atlante4EU ("A reliable network of charging stations for electric vehicles to allow charging along the TEN-T Core and Comprehensive Networks") was presented by Francesco Causa, Atlante Head of Program Management & Viviana Russo, Atlante Global Head of Legal. The Atlante4EU project covered the installation of over 430 sites under development across Europe, in Italy, France, Spain and Portugal. More than 100

sites have been installed, and more than 50 sites equipped with battery storage, as of January 2025. Besides the financial support from CEF, financial support has been received from the institutions, Intesa San Paolo, Caisse des Dépôts and Cassa Depositi e Prestiti. The Atlante4EU project is the first CEF project for Atlante coverings more than half of Medium Voltage sites in Atlante's full pipeline. It is estimated that over 1300 tons of CO_2 have been avoided thanks to Atlante4EU stations already online, with numbers set to increase as grid connections are established.
The project also provided innovative solutions, such as local battery storage at several sites, to further strengthen the availability of charging power, together with several charging services for enhanced customer experience. Results also include experiences from providing charging solutions with battery storage, which enables more efficiency, versatile grid connections and enhanced performance. Atlante4EU is providing to the users only 100% green electricity.

InDiD ("Development of Cooperative Intelligent Transport Systems (C-ITS)" was presented by Emilie Petit, Project Manager for Automated Connected Mobilities at Cerema. The InDiD project is the continuation of the European cooperative intelligent transport systems (C-ITS) projects SCOOP@F, C-ROADS France and InterCor, in which Cerema participates. The project aims to expand coverage to new experimental sites, and to develop new use cases that address the urban environment, along with increased autonomous vehicle perception use cases. By deploying connectivity to infrastructure, InDiD improves safety and cooperative traffic management. InDiD also engages with representatives from Mobility, Digital and Telecommunication Industries, as well as major public transport and urban node authorities. Experiments have been carried out at several pilot sites covering different regions in France, to test hybridisation of short-range (e.g. ITS-G5) and long-range (e.g. cellular) technologies, on the path towards large-scale deployment.
Results include the deployment of digital infrastructure as a key step to enable enhanced perception and augmented mobility. The project also addresses several C-ITS services, such as Carpooling and Park & Ride services for modal transfer, green light services, road closures, green light phase extension for Pedestrian, facilitation and safety of specific pedestrian crossings, road closed in the event of flooding, with re-routing, pedestrian crossings warning when vehicles approaching, and negotiating a toll gate for an autonomous Vehicle. Some key challenges have been identified, such as the lack of economic balance between the actors, the war of short-range technologies, operational issues and collaboration with the C-ROADS platform, which will be addressed in the SCALE project.

MobiliData ("Connected infrastructures bringing enhanced perception to road users") was presented by Kristof Rombaut, advisor in innovation, specialised in Smart Mobility at the Flemish Agency for Roads and traffic. Within the Mobilidata project,

governments, companies and researchers worked together to bring innovative technological traffic solutions to road users. This resulted in many benefits, such as better travel directions, traffic alerts tailored to your route and lights turning green sooner at intelligent traffic lights. This was done in accordance with the applicable privacy regulations. To make traffic safer, smoother, more sustainable and more comfortable for all road users, Mobilidata developed innovative, technological traffic solutions. In consultation with various researchers and developers, Mobilidata defined five major categories comprising 31 traffic solutions. Data collection and sharing forms the basis for two-way communication between intelligent road infrastructure and road users. In the course of 2023 and 2024, road users and traffic management in Flanders were able to benefit from different services, such as intelligent traffic lights, navigation and parking management, risk and hazard notifications, traffic rules notifications and policy support.
Results from the project were presented covering fixed use case specifications, 91 intelligent and connected traffic lights deployed across Flanders, cellular communication was tested and worked fine for the selected use cases, and measured behavioural impact from end users. This resulted in that, under non-saturated conditions, connected users have less waiting time at the traffic lights.
The challenges identified related to technical issues (continuous optimisation needed), product (product fit iTLC with Flemish context), operational and organisational change, and the need for regional & international scale.

Conclusions

Results from four projects funded by the CEF programme were presented at this session – for the first time at a RTR conference! This session demonstrated the importance of strengthening the links between the research and innovation programmes and the deployment programmes.

Two projects presented the deployment of the much-needed charging networks in the south-west region of Europe, as more battery electric vehicles are available in these markets. The 2Zero Strategic Research and Innovation Agenda (SRIA) has identified one objective to further enhance and develop the charging network in Europe. Increasing charging power and charging stations density and availability is of key importance. Electrification is key to decarbonise road mobility.

Two projects presented the deployment of digital infrastructure and C-ITS services enabling better traffic management as step towards automated transport and mobility. The CCAM Strategic Research and Innovation Agenda (SRIA) highlights the importance of enhancing the interaction between vehicles and infrastructures, as an enabler for higher levels of automation, to further improve road safety, reduce congestion and make the mobility system more efficient.

During the Q&A, session results and learnings from the four projects to further understand the challenges and barriers to deploy research results solutions and infrastructures required for the green and digital transformation of the European mobility system, were discussed. In the ongoing STRENGTH_M Coordination and Support Action, one of the tasks is to identify and analyse the results from the projects at the RTR2024. Here, ten different criteria areas to better understand how to bring the results from R&I projects towards deployment of results, were used. The session covered learnings about challenges related to the need to enhance knowledge and technology. It also stressed the importance of standardisation and the need to speed-up and simplify the regulatory frameworks - particularly the permit processes. We also learned about the need to further develop the eco-system, since involving new stakeholders and users is crucial for deployment. The session also highlighted the need to develop the infrastructure, in particular the energy infrastructures and electric grids, but also the need for digital infrastructures and services. In addition, there is a need to further develop the physical infrastructure, for example as in attractive charging stations and intelligent traffic lights. Finally, the session highlighted that it is crucial to provide coordinated financial support for research and innovation, and for deployment of infrastructures and services, to strengthen European competitiveness and the green and digital transition.

PARALLEL SESSION 5:

Digital innovative solutions for sustainable urban logistics

Summary from **Yanying Li (ALICE)**

The session showcased six projects aimed at revolutionising urban logistics through sustainable and innovative solutions using cutting-edge digital technologies. Each presentation highlighted unique approaches to addressing the challenges of last-mile delivery, urban space optimisation and decarbonisation.

The **SENATOR** project "Smart Network Operator Platform enabling Shared, Integrated and more Sustainable Urban Freight Logistics", was presented by Angela Núñez, Correos, Spain. The project has developed a logistics platform that enhances urban freight management by integrating data from various stakeholders. The platform has reached technological maturity, offering real-time data analytics to optimise delivery routes and reduce congestion. Collaboration with city planners and logistics companies has been pivotal in refining the platform's functionalities. The project also developed a strategy for Dublin freight consolidation centre.

The **UNCHAIN** project "Urban logistics and plaNning: AntiCipating urban freigHt generAtion and demand including dIgitalisation of urbaN freight", was presented by Elena Garica, ETRA I+D, Spain. The project has created a decentralised framework for urban logistics, leveraging blockchain technology to enhance transparency and efficiency. The project engaged with citizens to co-create logistics solutions, in multiple

European cities, that have demonstrated reductions in administrative overhead and delivery times.

The **DISCO** project "Data-driven, Integrated, Syncromodal, Collaborative and Optimised urban freight meta model for a new generation of urban logistics and planning with data sharing at European Living Labs", was presented by Paola Astegiano, FIT Consulting, Italy. The project has developed the first version of the Meta Model Suite, which is a stepwise approach to help cities understand their current and future logistics landscape, select preferred scenarios for reshaping their urban logistics system, and implement suitable innovative solutions. The project has also developed the first version of the Urban Freight Data Space. Some examples of the measures implemented in the first group of Living Labs have been presented.

The **URBANE** project "Upscaling innovative green urban logistics solutions through multi-actor collaboration and pi-inspired last mile deliveries", was presented by Prof. Rod Franklin. The project has tackled the negative trends associated with last-mile deliveries by identifying and scaling-up novel and sustainable urban logistics solutions. The project established four Lighthouse Living Labs to demonstrate innovative last-mile delivery solutions. Those solutions have integrated digital tools, such as digital twins, blockchains and AI, to enhance solution scalability.

DECARBOMILE project "Five pillars to DECARBOnize the last MILE logistics", was presented by Clarissa Reali, Interface Transport, France. The project has developed 11 use cases to decarbonise last mile delivery and will be fully implemented in 2025. The use cases will be implemented in four Living Labs, considering technical, environmental and socio-economic factors of each city.

The **GREEN-LOG** project "Cooperative and Interconnected Green delivery solutions towards an era of optimised zero emission last-mile Logistics", was presented by Amalia Ntemou, Netcompany Intrasoft, Greece. The project has developed a Logistics-as-a-Service platform for interconnected city logistics, including automated delivery concepts and cargo-bike-based last mile delivery in five Urban Living Labs across Europe. The project also demonstrated multimodal parcel deliveries that integrate public transport and sustainable micro-consolidation using delivery robots.

Conclusion

Urban logistics plays a vital role in the functionality of European cities and is essential for achieving European climate goals. The projects presented in this session have explored a range of innovative solutions, including sustainable logistics for the on-demand economy, new delivery models and business approaches, and future-proof urban freight planning.

A common theme across all projects is the integration of digital technologies, such as Digital Twins, mobility data spaces, AI and blockchain to address the increasing demand for urban freight transport. These projects have fostered collaboration amongst key stakeholders, including cities, logistics companies and technology providers, to develop practical solutions for more efficient and sustainable urban logistics.

The outcomes of these initiatives include a suite of digital tools designed to support demand planning, transport coordination, freight and logistics optimisation and urban infrastructure development. By leveraging these innovations, European cities can enhance their logistics systems while advancing their sustainability and climate goals.

PARALLEL SESSION 6:

High-performance and safe-by-design next generation battery systems for road transport applications

Summary from **Manasa Sridhar (IVECO Group)**

Session 6 of the conference covered "High-performance and safe-by-design next generation battery systems for road transport applications". This session was held on the first day of the conference, in the second round of parallel sessions, from 16:30 to 18:45. The session introduction was given by Martha Gialampouki from CINEA and the Q&A was moderated by Manasa Sridhar from the IVECO Group. The purpose of the projects presented is to develop next generation battery system technologies, for the electrification of transport and mobile applications. These projects are pivotal in advancing the BEPA's SRIA for high-performance, safe-by-design battery systems and accelerate the electrification of multiple transport modes, including road, waterborne, airborne, rail and non-road transport. Collectively, they contribute significantly to the European Commission's objectives of fostering innovation, accelerating the shift to clean mobility, enhancing sustainability and bolstering the competitiveness of European industry. Their collaborative efforts within the EU-INGENIOuS cluster aim at a unified approach to addressing critical challenges in battery technology through synergies in digitalisation, AI-driven battery management and next-generation materials, thus leveraging the wider stakeholder group to accelerate technology transfer, standardisation and large-scale adoption.

EXTENDED

The EXTENDED project was presented by Maximilian Mellin, Project Leader in the Innovation Hub at BMZ Group. The project started in June 2023 it has an expected end date of March 2026. EXTENDED is developing efficient, lightweight and sustainable semi-solid state battery packs with reduced charging times, increased range and a longer lifespan. The project has produced improved cell modelling, a reduced scale

model for more efficient testing, as well as demonstrated effective safety features, such as heat spreading and heat shields. The project is expected to prepare module demonstrates for three different use cases, electric vehicles, heavy duty vehicles and home energy storage systems, as well as three workshops to present these developments to the public and stakeholders.

TEMPEST

The TEMPEST project was presented by Jeremy Warren, in the Multipartner projects division of Applus+/Rescoll, and chair of the EU-INGENIOUS cluster, which includes all projects of this session. The project aims to develop next generation cell technologies for multiple applications, with new architectures and designs for improved safety and performance. The project has already managed to significantly surpass its target to reduce the weight of the batteries by using lighter materials, demonstrated in the gravimetric cell-to-pack ratio. The project has managed to reduce the weight by nearly 80%, far exceeding the 15% originally targeted. The project's expected impacts include extended range and performance through volumetric and gravimetric cell-to-pack ratio changes, as well as an upskilling and training programme, and standards and policy contributions with the JRC.

VERSAPRINT

The VERSAPRINT project was presented by Lisa-Lou Gracia, Project Manager at CEA. The project is now reaching its halfway point of the 36 months' duration. At system level, the project develops versatile solutions by using 3D printing techniques to create building blocks that address safety issues, enhance performance, and decrease cost and environmental impact. These building blocks are already showing results, particularly for increased safety, with busbars eliminating the electrical shortcut risks during assembly and disassembly, and exhaust gas management venting toxic gas away from the system, reducing its temperature and reducing the risk of fire. The expected impacts include increasing the battery life and enabling remanufacturing and recycling, hence reducing environmental impact.

NEXTBAT

The NEXTBAT project was presented by Mikko Pihlatie, Research Professor on electrification of transport at VTT. The project started in June 2023, and has a duration of 42 months, until November 2026. The project objectives are to design and manufacture battery prototypes and architectures, including both hardware and software, and demonstrate and validate these prototypes for certification of next generation battery systems. The project has achieved several results related to safety and performance, demonstrated through simulation and digital twin development. These include immersion cooling demonstration, battery overcharge tests and prototypes for high energy and high power cells. Expected impacts include enhanced battery performance and system design, advancing safer battery technologies with

safety protocols, and increasing battery sustainability through recyclability and circular economy principles.

BATSS

The BATSS project was presented by Iosu Cendoya, Business Developer for European projects at CIDETEC. The project starts later than the others in its cluster as it was awarded from the reserve list, starting in January 2024 and running until December 2026. BATSS' objectives are to design a battery system for different types of electric vehicles, with reduced costs and increased safety through a safe-by-design cell-to-pack concept. The first tests of the downscaled module design will happen soon, and performance, safety, and modularity tests are currently being scaled up to 3D models. Expected impacts include the increased performance and safety of next generation battery systems for mobile applications, and reduced manufacturing, refurbishment, dismantling and recycling costs of battery system.

Conclusion

The development of high-performance, safe-by-design next-generation battery systems for road transport applications, as addressed in EXTENDED, TEMPEST, VERSAPRINT, NEXTBAT and BATSS, is instrumental in the transformative journey that the EU embarks on, fulfilling the ambitions charted out in the Clean Industrial Deal and the Automotive Action Plan. The Q&A highlighted some important challenges that need to be tackled along the way. For instance, the panel discussed the trade-offs between designing generic battery systems that can fulfil the performance and durability requirements across diverse applications, *versus* customised systems that face increased costs, complexity and manufacturing scalability issues. Not to mention that the different segments (offroad, aviation, road transport and maritime) follow varied safety, certification and performance standards, making cross-sector compatibility difficult. Amidst these, there was consensus on the opportunity of developing a modular battery architecture that can balance both approaches by standardising core components while allowing application-specific adaptations, optimising cost, performance and supply chain efficiency. This can be achieved through an open-source approach, engaging the wider community to collaboratively develop standards and frameworks, preventing fragmentation and siloed development across industries. Recognising the power of collaboration, these projects have joined forces under the EU-INGENIOuS cluster, an alliance that serves to amplify the impact of individual projects, fostering a multiplier effect that maximises synergies and ensures that the innovations reach a wider community and have substantial impact. Another unanimously agreed challenge is related to the sourcing of cells, which, in the case of the projects integrating solid-state cells, relies exclusively on Chinese manufacturers. This dependency results in long wait times and unavailability of advanced cell prototypes, delaying battery pack testing and integration, ultimately

causing disconnected and slowed-down development of battery system components due to lagging adaptation to cutting-edge cell technologies. It was highlighted that the EU-INGENIOuS cluster can support the development of a comprehensive database on diverse cell technologies by systematically listing their pros and cons for integration into high-performance, safe-by-design battery systems, thereby guiding future researchers and investors in selecting the most promising, cost-effective solutions for various applications. Disseminating results at the 'half-time' of the currently running EU-funded projects EXTENDED, TEMPEST, VERSAPRINT, NEXTBAT and BATSS is crucial in the current environment of challenges and opportunities for the European battery industry. Sharing early insights fosters collaboration, informs stakeholders of progress, and helps address evolving market needs, regulatory frameworks and technological advancements, ensuring that these projects remain aligned with the dynamic demands of the industry and contribute to Europe's competitive edge in the global battery sector.

PARALLEL SESSION 7:

Integration and large-scale demonstration of CCAM solutions

Summary from **Guido di Pasquale (PAVE Europe)**

The session explored key strategies and challenges in advancing CCAM solutions across Europe, focusing on both passenger mobility and freight transport. Discussions highlighted real-world testing, stakeholder engagement and the integration of automated mobility into transport systems. The session aligned with the CCAM Partnership's goal to accelerate CCAM technology adoption. IN2CCAM, CONDUCTOR, MODI, Move2CCAM and ULTIMO projects tackled two major issues from the CCAM Strategic Research and Innovation Agenda (SRIA):

- Insufficient demand and societal understanding of CCAM benefits (problem driver 1): Projects showed how CCAM can enhance traffic efficiency, safety, reduce emissions and optimise transport, but awareness and acceptance remain a challenge;
- Fragmentation in R&I efforts and lack of a long-term vision (problem driver 3): Each project contributed uniquely but the session stressed the need for harmonised methodologies, standardisation and coordinated policies for scalable CCAM solutions.

The discussion emphasized real-life testing, public acceptability and addressing interoperability challenges across regions and mobility systems.

IN2CCAM ("Advancing Integration and Interoperability of CCAM") - funded by €4.98 million from the EC, is a three-year project (November 2022 – October 2025) involving 21 partners from 10 countries to advance CCAM. Demonstrations in six living labs aim to accelerate CCAM adoption. The project enhances physical infrastructures such as dynamic lanes, intelligent traffic lights and road signs, and digital advancements for traffic balancing, freight transport and safety. It explores governance and business

models to integrate automated and shared vehicles with public transport. Key implementations include the IN2CCAM platform using digital twin technology for maintenance, prediction and governance evaluation. A Green Light Optimal Speed Advisory (GLOSA) service was tested in Tampere, and digital twin-based rerouting in Turin. Through real-world demonstrations, simulations and digital twin technology, IN2CCAM improves traffic efficiency, safety and sustainability for seamless CCAM integration.

CONDUCTOR ("Fleet and Traffic Management Systems for Conducting Future Cooperative Mobility"), with a €4.6 million budget, is a 36 month project (November 2022 – October 2025) involving 15 partners from seven EU Member States. It aims to enhance CCAM by integrating advanced traffic and fleet management solutions to improve efficiency, intermodality and governance. Significant results include reducing private vehicle travel time by 28.3% and passenger travel time by 17.7% in Athens, optimising CAV routing and traffic control in Madrid, and improving freight management in Almelo by prioritising truck signals. CONDUCTOR also developed an automated Demand-Responsive Transport (DRT) platform with an AI-powered routing engine and CCAM-DRT integration for last-mile delivery. Through real-world testing, simulations and multimodal synchronisation, the project aims to reduce travel times, emissions and costs, while enhancing traffic efficiency and accessibility for smarter urban transport.

MODI ("Advancing Automated Freight Transport in Europe"), running from October 2022 to March 2026, involves 36 organisations from eight countries with a budget of €28 million (€23 million from the EU). It accelerates the adoption of SAE L4 automated freight vehicles by addressing logistics deployment barriers. MODI demonstrates real-world use cases such as border crossings, confined area operations and public road transport, while developing new business models and partnerships. A key achievement is the CCAM logistics test corridor spanning Norway, Denmark, Sweden, Germany and the Netherlands. MODI fosters stakeholder collaboration through the CCAM Logistics Task Force with ALICE, leading to a Book of Recommendations for future deployment and regulation. Through demonstrations and research, MODI bridges the gap between research and market readiness, enhances traffic management tools and strengthens Europe's leadership in automated multimodal freight transport.

ULTIMO ("Advancing Sustainable User-centric Mobility with Automated Vehicles"), Europe's largest project for deploying fully automated vehicles in public transportation, runs from October 2022 to September 2026 with a €52M budget (€40M funded) and involves 23 partners from eight countries. It aims to establish a scalable, economically viable, on-demand, door-to-door shared mobility service using automated vehicles. Deployment sites include Herford (Germany), Groruddalen Valley

(Norway), and Geneva (Switzerland), with at least 15 vehicles per site operating for 12 months. The project is user-oriented, not only developing and testing fleet orchestration and automation, but also proposing and evaluating passenger services that compensate for the absence of a driver. These services address aspects such as passenger assistance, safety and accessibility to ensure a seamless and inclusive mobility experience. In addition, the project conducts a holistic cost analysis of public transport services, considering costs related to HD mapping, V2X infrastructure, IT centres, charging stations and personnel needs. ULTIMO emphasizes the need for new policies to implement on-demand services. Collaboration among PTOs, public regulators, government and technology providers is essential for large-scale deployments but securing funding and long-term planning remains a challenge.

Move2CCAM ("MethOds and tools for comprehensiVE impact Assessment of the CCAM solutions for passengers and goods") started in September 2022 and will continue until 2025. It includes eight partners, three prototypical regions and has a budget of €2.5 M. Its goal is to develop an impact assessment tool to evaluate the societal effects of CCAM solutions. The project has built a large stakeholder network, conducted eight co-creation activities, and developed 52 use cases, including business models for 15 of them. Other achievements include AV demonstrations, VR development and interactive games. The Impact Assessment Modeling Tool, launched in 2024, supports scenario creation, evaluation and comparison, enabling policymakers to make informed decisions. Training sessions will follow, further supporting the adoption of CCAM solutions. Move2CCAM has engaged over 260 organisations and 8,500 citizens, aiming to facilitate the societal introduction of CCAM technologies.

The projects presented showcased diverse applications and approaches, advancing CCAM technologies for passenger and freight transport. Each project provided valuable insights and results aimed at enhancing CCAM adoption, efficiency and impact within real-world transport systems. Large-scale demonstrations are a priority, as emphasized by each project. These projects highlight the importance of testing CCAM technologies in real-life conditions to address practical challenges, user expectations and operational requirements.

A key takeaway was the necessity of integrating business models, governance strategies and infrastructure adaptations for long-term sustainability. Future R&I recommendations advocate for coherent long-term planning, cross-sector collaboration and enhanced funding mechanisms to support seamless CCAM deployment in Europe's transport ecosystem.

The session raised critical questions about bridging the gap between CCAM research and market readiness and integrating the entire system – including vehicles, infrastructure and business models – into a cohesive framework. Discussions focused

on traffic and incident management, routing optimisation, logistics operations and public transport services, showcasing innovative approaches from the projects. Significant work remains in societal acceptance, policy adaptation and large-scale demonstrations to validate solutions.

To conclude, key factors for scaling-up CCAM demonstrations include larger vehicle fleets, public authorities planning for the future, integration and interoperability across systems, and an adequate legislative framework to support real-world deployment. Ensuring these elements will be essential for CCAM's long-term success across Europe.

PARALLEL SESSION 8:

Innovative components for more efficient EVs

Summary from **Damian Backes (ika RWTH-Aachen)**

Electric motors (EM) are a key component for powertrains in sustainable mobility. Therefore, their advancement in terms of technical properties such as efficiency and power density but also usage of critical raw materials is crucial. The projects presented in this session are contributing to the related challenges by improving the power density and efficiency while reducing the costs for the electric motors. The design approaches also take into account recyclability of the electric motors to reduce the dependency on scarce resources. Joao Duarte Carrilho Miranda (CINEA) introduced the session.

EM-TECH develops innovative electric machine technology solutions for automotive traction applications. The project focuses on passenger car and van applications to provide competitive costs and significant reduction of motor energy loss during vehicle operation, and to decrease the rare earth content, including implementing magnet recycling solutions. The solutions include innovative direct and active cooling designs, virtual sensing functionalities, enhanced machine control, electric gearing and digital twin-based optimisation. The proposed innovations can be divided into radial flux direct drive in-wheel motors characterised by high torque density (>150 Nm/litre, >50 Nm/kg), and on-board single stator double rotor type ironless axial flux machines providing power density and specific power levels in excess of 30 kW/litre and 10 kW/kg. The solutions with continuous power levels of 50 to 120 kW are aiming at competitive costs (<6 Euro/kg for a production of 100,000 units/year) while leading to significant reduction of motor energy loss during real vehicle operation (>25%), and to >60% decrease of the rare earth content, including implementation of magnet recycling solutions.

MAXIMA also works on the development of sustainable and efficient axial flux motors. Different topologies for the electric motor have been evaluated to achieve the targets of torque density 20 Nm/kg and 50 Nm/litre as well as reductions of losses by 20 % at a typical vehicle operation point and a 2 % reduction of energy demand via optimal control of the electric motor. The results show that different designs have a significant impact on the CO_2 equivalent emissions, but strongly depend on the emissions from the electricity mix during the use phase of the machine. If the electricity is mostly coming from renewables, the use phase has less impact on the emissions over lifetime than the production phase. A special focus is also put on the recovery and recycling of the magnet material. A process to recover the material from the stator has been defined and shows promising characteristics of the recycled magnet material that will be further assessed in the future. All developments are supported by the usage of a digital twin, which will also be used to improve the control and diagnosis of the electrical machine.

The **HEFT** project focuses on advancing electric motor design through innovative configurations that enhance magnet extraction and recycling capabilities. The consortium has developed various motor designs for different vehicle segments, prioritising the reduction of rare earth element usage by 58 to 60 % compared to the state of the art, and incorporating diverse magnet grades. Key innovations include the use of oil cooling systems to eliminate water jackets, thereby reducing weight, and the implementation of continuous winding techniques to improve efficiency. A plastic housing decreases the weight further and lowers the carbon footprint. Additionally, the project employs a recycling process that degrades adhesives at elevated temperatures, facilitating the mechanical removal and reuse of magnets. These developments aim to significantly enhance sustainability and efficiency in electric vehicle technology while reaching high power densities above 7 kW/kg.

VOLTCAR develops high-speed (up to 30k rpm), permanent magnet-assisted synchronous reluctance motors with a reduction in the use of rare materials by more than 60 %. The motor prototypes are engineered to ambitious performance standards, including power density (above 23 kW/litre and 7 kW/kg) and efficiency, while adhering to sustainability criteria such as recyclability and minimal use of rare resources and copper. The validity of the 50 kW and 120 kW motor prototypes is demonstrated through X-in-the-loop (XiL) experimentation environments according to automotive standards. Key developments include the use of eco-design principles and digital tools for comprehensive design tasks, collaboration among key players rather than across the entire value chain, size reduction through increased speed and direct winding cooling, elimination of welds in lamination stacks for enhanced performance, cost savings through reduced permanent magnet usage despite a slight decrease in efficiency, extraction of magnets for reuse instead of recycling materials, back-to-back

motor testing, and potential efficiency improvements by using less expensive materials if slightly lower specific power is acceptable.

CliMAFlux is developing advanced axial flux motors (AFMs) with innovative excitation and cooling techniques to reduce energy loss by over 35% and decrease rare earth material usage by 60%. Utilising high-fidelity multi-physics models and digital twins, the project aims to increase power density beyond 23 kW/litre, achieve over 70 % recyclability at end-of-life, and reduce costs by 50 % (~€5/kW) in mass production. These motors integrate with power electronics and mechanical systems, managed by AI-driven predictive controllers for enhanced vehicle functionalities. The focus includes flexible AFM designs, reduced permanent magnet use, overcoming speed limitations with thermoplastic solutions exceeding 20k rpm, and applications in high-torque active dampers. The motors will be benchmarked for performance and environmental impact across various vehicles using virtual and hardware test platforms up to TRL7.

Following the presentations, an extensive and lively discussion ensued, moderated by Damian Backes (ika - RWTH Aachen). In this session, questions regarding the usage and price of AFMs were raised, with the researchers expecting similar reductions to those that have already been achieved for RFMs. Hybrid concepts between AFM and RFM are currently not pursued by the projects. Digital twins are seen as an important tool to assess the state of the electric motor, giving also access to data that is not available via sensors in production machines. Key aspects include the determination of the remaining useful life and, e.g., to assess the state of the bearings. Especially on the development of new approaches such as digital twins, clustering can benefit to align the projects and sustain the solutions. However, the collaboration would have to respect different platforms and not infringe on confidential aspects. The usage of AI was also addressed. For several reasons, the main focus for AI is currently not the control of the EM itself but rather the development process, e.g. for a digital twin based on neural networks.

PARALLEL SESSION 9:

PHEV and retrofit systems

Summary from **Adrian Velaers (CONCAWE)**

This session took place on Day 2, 12th February, focussing on two separate areas defined by the EC in the Work Programme. The PHOENICE project studied Hybrid Light-Duty Vehicles, with a focus to optimise driveline and thermal systems for maximum energy efficiency and low emissions. The second part of the session studied Retrofit Solutions for Emissions. Both the AeroSolfd and VERA projects demonstrated solutions to address older vehicle emissions with low-cost retrofit technologies. The studies went further to tackle nanoparticle and brake emissions, with some specific practical examples for filtration systems in metro stations and brake filters for city busses.

PHOENICE – "PHev towards zerO EmissioNs and ultimate ICE efficiency". This project was presented by Dr. Toni Tahtouh from IFP Energies Nouvelles. The project aimed to demonstrate the maximum potential of a plug-in Hybrid Electric Vehicle, optimised to reduce both fuel consumption and pollutant emissions, in real driving conditions. Innovative technologies were applied to a state-of-the-art Stellantis 1.3-litre gasoline engine to demonstrate remarkable results with these optimised systems. Engine prototype testing showed highly promising results, achieving a gross efficiency of 47% and approximately 10% improvements across a wide operating range. All developed components were assembled into a vehicle demonstrator, which was successfully calibrated and will commence testing on a rolling road test bench as this project continues into the real-world vehicle demonstration phase.

AeroSolfd - "Fast track to cleaner, healthier urban Aerosols by market ready Solutions of retrofit Filtration Devices for tailpipe, brake systems and closed environments" - was

presented by Dr.-Ing. Martin J. Lehmann (MANN+HUMMEL GmbH). Addressing the call HORIZON-CL5-2021-D5-01-15 "Development and demonstration of cost affordable and adaptable retrofit solutions for tailpipe and brake polluting emissions". A retrofit gasoline particle filter (GPF) was designed, tested, validated and demonstrated successfully. Durability tests on 42 vehicles in different regions for a minimum of six months, with the type approval process commencing in Germany. A brake dust filter was also developed and tested with promising results. Laboratory tests are complete and a truck is prepared for winter testing. An air purifier was developed for use at a metro station. This was installed and tested in Lisbon, with measurements ongoing.

VERA "Vehicle Emission Retrofit Activities". Professor Zissis Samaras presented results of this project focussing on tailpipe retrofit solutions for road vehicles and brake retrofit solutions for road vehicles and metro/rail applications. Development and experimental results from a coated GPF system were presented. Brake retrofit solutions for various road vehicles were presented with brake dynamometer and road test results. Reductions in PM10 and PM2.5 were in the range of 80-90% depending on the vehicle mass. Further road tests were also conducted. The study also included filtration systems at metro stations and presented an overall impact assessment as well as a cost-benefit analysis.

A lively discussion followed with many questions from the audience concerning the feasibility of retrofitted vehicle exhaust after treatment systems. At this stage, solutions are limited to GPF systems (gasoline vehicles) as these do not create additional back pressure and will not interfere with OEM engine management systems. This area will remain challenging if the expectation is to bring old vehicles to current emissions standards, as retrofitting advanced systems is not simple. The systems presented to address brake particulate emissions appear to be more feasible, with very good solutions presented for both on-vehicle filters and those mounted in confined spaces, such as metro stations. Further testing and cost-benefit analysis is required to assess the extent to which implementation could be considered. The PHOENICE project very clearly showed the excellent results PHEV technology can achieve, to be highly energy efficient with a very much lower use of scarce battery material. The technology electrical catalyst pre-heating is a good solution to address emission concerns as a result of more frequent cold starts associated with PHEV IC engine operation. More emissions data and further research is required to explore this aspect of PHEV operation together with the use of renewable fuels.

PARALLEL SESSION 10:

Predictive safety assessment framework and safer urban environment for vulnerable road users

Summary from **Magnus Granström (CHALMERS)**

The topic of this session was predictive safety assessment frameworks and safer urban environments for vulnerable road users. The expectation in the call from 2022 were the following: to implement a Safe System approach prioritising safety for all road users and stakeholders; to develop predictive frameworks and virtual models to assess future road safety scenarios and impacts; and to enhance urban safety for vulnerable road users through infrastructure, education and innovative transport solutions.
Two projects were presented in the session, both of them approximately half-way through their duration.

The **PHOEBE** project "Predictive Approaches for Safer Urban Environment" aims to increase the road safety of vulnerable road users, especially those who use active mobility and e-scooters. This is achieved through the inter-disciplinary power of traffic simulation and road safety assessment. Three use cases/pilots are being used in the project: Athens (focus enhanced VRU space and speed management actions), Valencia (dedicated bicycle corridors) and West Midlands, UK (reallocation of road space to cycling and e-scooter use and encouragement of modal shifts). So far, the focus has been on setting the framework and performing a number of end user needs collection activities, as well as analysis and initial planning of the use cases.

The **SOTERIA** project aims to accelerate the attainment of the Vision Zero EU goal for vulnerable road users, through a holistic framework of innovative models, tools and services that enable data driven urban safety intelligence, facilitate safe travelling of VRUs, and foster the safe integration of micro-mobility services in complex environments. SOTERIA uses four cities for living labs: Oxfordshire & Wolverhampton

(Integration of micro-mobility to current mobility paradigms), Saxony (VRU safety applications for Generation Z), Madrid (Shared mobility services for improving user well-being and clean urban environment), Chania/Igoumenitsa (sensor systems aiming to identify road hazards for unprotected VRUs such as bicycles, powered two-wheelers and e-scooters). In addition, the project is also looking into leveraging novel data sources to analyse road safety.

We are continuously learning more and more in this field, the end user engagement which is really crucial in order to find suitable long-term solutions that are desirable both from an urban planning and user perspective. The two projects have a close collaboration and join forces with V4SAFETY, providing additional input on user models etc.

PARALLEL SESSION 11:

Innovative components for more efficient EVs

Summary from **Damian Backes (ika RWTH-Aachen)**

Power electronics are essential for the efficient operation of electrical powertrains in sustainable mobility. Advancements in this field focus on enhancing technical attributes, such as efficiency and power density, while reducing costs thus contributing to the affordability of electric vehicles. Projects highlighted in this session aim to address these challenges by boosting power density and efficiency, alongside cost reductions for power electronic systems. Additionally, they aim at improved control and diagnostics, better thermal management and improved system integration. Joao Duarte Carrilho Miranda from CINEA introduced the session, underscoring the importance of these innovations in achieving sustainable mobility goals.

The **SCAPE** project aims to enhance electric vehicle (EV) power conversion systems by establishing a standardisable, modular and scalable design methodology based on multilevel technology. It focuses on developing highly compact and integrated building-block implementations while applying intelligent modulation and control strategies, along with online diagnostics and digital twin technologies for predictive maintenance using machine learning. Key results from the project include a targeted efficiency of over 97.5% for inverters via a reduction of losses by more than 35 %, a significant cost reduction to below 2.5 €/kW, and an expected increase in life to over 16,000 hours or 600,000 km. These advancements are designed to reduce the costs of EV power electronics through economies of scale via the building-block approach while improving performance metrics such as reliability, efficiency and power density, ultimately enabling advanced functionalities in electric vehicles. Chip embedding enables a significant potential for increased power density, reducing the thermal resistance to the cooling system by 44 % and stray inductance by 83 %. Digital twins

are used in combination with an online monitoring system to detect faults and adjust the control.

HiEfficient focuses on the development of highly efficient and reliable electric drivetrains through the use of modular, intelligent and integrated wide bandgap power electronics modules. Key highlights include the introduction of newly developed GaN devices which leverage "System in Package" and "System on Chip" concepts. The project aims for a significant volume reduction of up to 40 % for power electronic components compared to state-of-the-art technologies. This is exemplified by an onboard charger for electric vehicles that achieves a power density of 7 kW/litre. Additionally, the integration of novel technologies allows for an increase in lifetime, with improvements reaching up to a factor of 50 due to advanced integration methods for semiconductor devices within the PCB. Microfluidic 2-phase cooling allows for heat transfer up to 250 W/cm² and reduced thermal cycling, thus improving lifetime and reliability. Overall, these advancements contribute to more sustainable mobility solutions by enhancing efficiency, reducing size and weight, and improving reliability in future electric vehicles.

Following the presentations, an extensive and engaging discussion took place, moderated by Damian Backes (ika - RWTH Aachen). The conversation highlighted the critical need for efficient thermal management solutions, which play a significant role in both projects. Chip embedding was recognised as a method to reduce thermal resistance between components and cooling mediums, while enhanced cooling solutions are essential for further increasing power density. Notably, the innovations developed in these projects have potential applications beyond the automotive sector. Although the exploitation of results from the completed HiEFFICIENT project has already commenced, it may take several years before these advancements are available to end customers, as the market introduction has to follow the vehicle development cycles. Regarding future research needs, new materials going beyond the current generation of wide band gap (WBG) materials will have to be investigated.

PARALLEL SESSION 12:

Sustainable and resilient freight transport and long-haul logistics

Summary from **Isabelle Schnell (Volvo Group)**

The freight transport and logistics sector is facing growing challenges: increasing demand, environmental pressures, supply chain disruptions and the need for increased efficiency while reducing emissions. The projects are the results of the Horizon Europe call in 2022 but the issues they address are still at the centre of our policies: competitiveness, resilience, decarbonisation, digitalisation and simplification.
The first two projects – SETO and KEYSTONE - focus on Smart Enforcement for More Efficient and Compliant Operations. Here the need is for digital tools and automated compliance checks to transform enforcement, reduce administrative burdens and ensure fair competition. The EU is investing in digital freight transport information and strengthening cross-border cooperation for seamless enforcement.
The second group of two projects – SARIL and REMUNET - addresses the Resilience of Supply Chains. Recent crises, from the pandemic to geopolitical disruptions, have shown the vulnerabilities in supply chains. The EU is working on strategies to diversify transport routes, enhance multimodal solutions and ensure critical supply continuity under stress.
Finally, the TRACE project tackles Integrating Logistics Networks for Better Resource Use
The future of logistics lies in connectivity and collaboration – integrating different transport modes and logistics operators to optimise freight movement. The EU is promoting collaborative digital platforms and innovative models such as the Physical Internet to maximize efficiency and sustainability.

SETO (June 2023 – May 2026) was presented by Beatriz Matinez-Pastor. SETO will deliver an innovative digital solution that will allow authorities to access all information required for the smart enforcement of transport and safety legislation in real-time using the "one-click" principle. SETO will utilise state-of-the-art information exchange technologies and expand the system to multimodal transport (e.g. port to the inland waterway to the road). Use cases: enforce overloaded road vehicles using weigh-in-motion (WIM) and on-board weighing solutions, enforce lane positioning and cabotage regulations, estimate the carbon footprint of the transported goods, explore different business models and build a business case for both the operators and the authorities.

KEYSTONE (June 2023 – May 2026) was presented by Mauro Dell'amico. KEYSTONE will enable authorities to access data for verifying compliance with transportation rules for both goods and passengers. KEYSTONE offers application programming interfaces that allow transport authorities and logistics operators to share data. The digital solutions consist of standardised APIs for data and information sharing between transport enforcement authorities and logistics operators. Two highly diverse pilots can prove the efficiency of the KEYSTONE's innovation. The overarching goal is reducing costs, minimising environmental impact and enhancing safety and interoperability.

SARIL (June 2023 – May 2026) was presented by Corinna Köpke. SARIL will study sustainability and resilience for infrastructure and logistics networks and aims to complement the definition of resilience with KPIs that will quantify both, the system resistance against disruptions, as well as the environmental burden of freight transport. Recommendations to improve the classic resilience will be made, e.g. synchro-modal approaches. Regional (Italy) and national (Spain and Portugal) scenarios focus on natural hazards which become more threatening due to climate change, the international scenario (Northern and Central Europe) considers the disruptions due to pandemics or wars.

ReMuNet (July 2023 – June 2026) was presented by John Von Stamm. ReMuNet identifies and signals disruptive events, and assesses their impact on multimodal transport corridors. It reacts seamlessly upon disruptive events in real-time. It supports TMS-providers to improve route planning resilience. ReMuNet communicates alternative, pre-defined, multimodal transport routes to logistics operators and, subsequently, to truck drivers, locomotive drivers and barge captains. It significantly reduces emissions and boosts freight transport corridor efficiency in case of disruptive events. Use case orchestrates route utilisation, suggests transshipment points and optimises capacity allocation, minimising damage and shortening the recovery time.

TRACE (June 2023 – May 2026) was presented by Stathes Hadjiefthymiades. TRACE offers a universal platform integrating planning, scheduling, optimisation and events management as well as the use of blockchain technology to facilitate the real-time conclusion of smart contracts and financial operations. TRACE proposes new transfer corridors, safe areas where unmanned vehicles can collect items towards the destination. TRACE will perform studies related to the barriers towards the new logistics era, the new business opportunities, the requirements for the legislation and regulatory frameworks and expose the benefits of the proposed approach in terms of the reduction for energy demand and emissions while limiting the operational costs for logistics stakeholders.

To accelerate innovation and end-users-focused solutions, the data-exchange landscape should further evolve: we should strive for purpose-driven approach with benefit / cost analysis, enhanced standardisation efforts to enable interoperability and facilitate data usage that is coming from different sources (– e.g. working on semantic standards with common definitions and vocabularies).
While Generative AI shows promise for improving decision-making accuracy, it is essential to carefully implement and verify the results until the algorithms are optimised.
Efficient data management with high quality of data is also key.
Finally, we should continue to support initiatives to "federate" the data and facilitate purpose-driven data exchange by enhancing even more cooperation between data users and holders.

PARALLEL SESSION 13:

Human centric CCAM and driver safety

AWARE2ALL i4DRIVING BERTHA Fit Drive PANACEA FITNESS TO DRIVE

Summary from **Peter Urban (ika RWTH-Aachen)**

The session on "Human centric CCAM and driver safety" held on 12th February, 14.15 – 17.15, focussed on road safety as an important element in the Clean and Digital Transport Transition, as outlined in amongst others the updated ERTRAC Vision 2050. Moving close to zero road fatalities and serious injuries by that year is an explicit target of the European Commission, which becomes more and more ambitious to achieve in view of the stagnating number of about 20,000 EU road fatalities per year. The five projects presented in this session aim at reducing the number of road crashes and at mitigating their consequences in order to contribute to this long-term road safety target. Three out of these five projects address call topics under the CCAM Partnership following its Specific Objectives SO1 (Validated safety of CCAM technologies and systems) and SO2 (Secure and trustworthy interaction between road users, CCAM and "conventional" vehicles).

Following the introduction to the session by Andrea Arcelli on behalf of the European Commission, Oihana Otaegui took the floor and presented the status of the **AWARE2ALL** project, which started in November 2022 and has entered the final year of its three-year duration. The project deals with the conceptual development of safety systems for highly automated vehicles in future scenarios of mixed traffic, including the corresponding assessment tools and methodologies. More specifically, the project is developing new restraint system concepts for the potential occupant postures and orientations expected in highly automated vehicles, taking into account the diversity of the population. Consortium members are also doing research on new occupant monitoring systems and interior HMI solutions for situations in which control of the vehicles is handed back to the driver. Complementing these interior HMI solutions,

AWARE2ALL is developing an external HMI concept for the interaction of highly automated vehicles with other human road users, based on dynamic risk assessment. All these solutions will be demonstrated by virtual, hybrid and/or physical prototypes. For the latter, the need for substantial simplifications in obtaining testing permits on public roads was highlighted in the discussion.

As another project under the CCAM Partnership, Vincenzo Punzo presented the **i4Driving** project, which started in October 2022 with a duration of 42 months. i4Driving is developing a model library of human driving behaviour, which shall serve as a baseline against which CCAM systems can be evaluated, and which shall enable virtual simulations to better reflect the heterogeneity and complexity of human driving behaviour in different traffic situations. This shall cover both safety-critical and non-critical situations. New behavioural models are developed based on experiments in four driving simulators with a common experimental design. Quantitative uncertainty management techniques support the model development to define the appropriate level of model complexity. For non-critical situations, the i4Driving consortium has already carried out test track experiments for model validation purposes. After another 13 months of project duration, the model library from i4Driving is expected to become a basis for further research activities to support the validation of CCAM systems and for the design of human-like, easily predictable behaviour of automated vehicles.

The **BERTHA** project, presented by José Solaz, addresses the same call topic as i4Driving, but the three-year project only started in November 2023. It follows the same key objectives as i4Driving but with a focus on a single probabilistic behavioural model. Within the project, this model will be designed to replicate human driving behaviour in five use cases/scenarios. It shall be made available on an open simulation platform for the automotive industry to incorporate new use cases at a later stage. So far, both personal and situational influencing factors have been identified to be considered in the model and, based on a survey among 4,700 drivers, eight driving behaviour archetypes have been defined. Moreover, the project has already achieved a pilot release of the driver behavioural model. In the discussion, José Solaz highlighted the importance of the early involvement of standardisation bodies and of Euro NCAP, so that project results will support them effectively in the design and implementation of future test protocols harnessing the virtual simulation of automated vehicles in mixed traffic.

While the first three projects in this session are carried out under the CCAM Partnership, **FITDRIVE** is answering a regular call in Horizon 2020. The project has a duration of 42 months and ended in the same month as the RTR2025 Conference was held. As a key result, Marteyn van Gasteren, the coordinator of the project, presented the FITDRIVE system, which can detect relevant deviations from a driver's usual driving

style and, in particular, the onset of fatigue. The system makes use of vehicle data as well as driver monitoring data in combination with neurophysiological models of fatigue onset. The system also features a connection for roadside controls by the police (smart tachograph) and a mobile drug-screening device. Pilot tests with professional drivers in different EU Members States reveal promising results, yet accuracy of the system needs improvement. In his presentation, Marteyn von Gasteren underlined the current limitations in obtaining relevant vehicle data via the OBD-II port. Therefore, FITDRIVE has initiated a request for amendment of the respective EU regulation. FITDRIVE has also engaged in two meetings at the European Parliament on the new driver licence directive related to reduced driver fitness and dangerous behaviour. In order to maximise the project's impact in line with the respective Horizon 2020 call topic, the FITDRIVE consortium has decided to apply an open-research approach, amongst others, enabling a spinout company to commercialise the concept of the smart tachograph.

PANACEA, the last project presented in this session, addressed the same call topic as FITDRIVE, but was completed already in October 2024. The overall objective of the project was to create a holistic driver fitness monitoring and assessment system that detects professional drivers who are not fit to drive and supports them as well as their employers by appropriate measures. Key achievements are three commercial health toolkits able to detect stress, fatigue as well as the use of alcohol and other drugs. Moreover, the project has developed coaching and supporting applications targeting drivers and operators. The "PANACEA solution" has been evaluated for usefulness, ease-of-use, user satisfaction and acceptance in pilot tests with professional drivers and courier service riders in three EU Member States. Apart from technology integration issues, lessons learnt include the high sensitivity of impairment in the context of professional driving, so that early involvement of drivers, operators and other relevant stakeholders is important for good adoption. Moreover, the need for a diverse revenue model and/or adoption incentives was highlighted for financial sustainability from the perspective of fleet operators.

Already highlighted as a need in a road safety session during last year's RTR Conference, this 2025 session offered a nice, multifaceted insight in current research on human behaviour in the context of road safety and in advances in modelling such behaviour. By addressing the diversity of the population, all projects clearly contribute to the inclusiveness of road transport, which the European Commission emphasized as an important future objective in the opening session of RTR2025. At the same time, the need for further research became apparent, as well, particularly on modelling human behaviour and on a new definition with clear criteria for the fitness to drive. Concerning the general implementation of the Framework Programmes, speakers in the discussion part of the session highlighted room for increasing the efficiency of research funding

by having more focus in call topics. At the same time, proposers should have the flexibility to select specific aspects to address in their project proposals, so that significant progress can be made in these directions. Moreover, the need to build on previous work effectively and ease the transfer of results between projects was emphasized, in order to increase the efficiency of EU research funding.

PARALLEL SESSION 14:

Solid state batteries for electromobility

Summary from **Guinevere Griffin (Fraunhofer ISC)**

Session 14, on day 2 of the conference, covered the topic "Solid State Batteries for Electromobility". The session was introduced by Alexandru Ghiurca, Project Advisor at CINEA. This session included six projects, five funded from Horizon Europe and one from Horizon2020. These projects contribute to advancing the technology and understanding of solid-state batteries, in terms of safety, performance, cost and sustainability. These projects will help advance Europe's development of batteries for e-mobility, improving competitiveness with international competition.

SUBLIME

The SUBLIME project was presented by Seyedhosein Payandeh, battery technology specialist at FEV Europe. The project has concluded in December 2024, after beginning in March of 2020. Overall, SUBLIME's objective was to increase EV adoption by taking on the challenges presented by consumer needs, such as cost reduction and increasing range and charging time. SUBLIME achieved improved thermal stability, proven through abusing testing, and simulations resulted in increased understanding of solid-state electrode (sulphide) degradation. SUBLIME was one of the first group of projects on solid-state batteries, now that it has concluded, the results and experiences of SUBLIME will be integrated into new EU projects on solid state batteries, allowing a continuation of many of the achievements and lessons learned.

HELENA

The HELENA project was presented by Pedro López-Aranguren, senior researcher at CIC EnergiGUNE, and Sara Abada, senior researcher at IFP Energies Nouvelles. The project has a duration of 48 months and began in June of 2022. HELENA responds to the need for development of safe, novel high energy efficiency and power density solid-state battery cells based on halide electrolytes for electric vehicles and aircraft. The project is establishing EV and aircraft battery requirements, optimised materials to enhance stability and cycling performance, and is developing multiscale multi-physics modelling to assess cell design and assembly. The project has already produced two patents and six publications.

PSIONIC

The PSIONIC project was presented by Margaud Lécuyer, manager of the Innovation Team and BlueSolutions. PSIONIC began in July of 2022 and has a duration of 48 months. The overall objective of PSIONIC is to design all-solid-state batteries and prototype cells based on polymer electrolytes and components produced with extrusion processes, achieving unprecedented levels of safety, along with higher energy and power density. The project experienced some difficulties with the electrolyte, due to an incompatibility between NMC and the electrolyte initially used, resulting in very quick degradation. The project uses models to understand the interactions in the interfaces, and several tests are being done on electrochemical characterisation, cycle life and safety to evaluate results. The issue with the electrolyte is being overcome through the development of a new polymer electrolyte used in the cathode.

SEATBELT

The SEATBELT project was presented by Didier Devaux, scientist at CNRS. SEATBELT has a duration of 48 months and began in July of 2022. The project intends to develop a low cost, safe-by-design solid state battery with high energy densities and long cyclability, with sustainable and recyclable materials. Early results from the project have yielded successful development of in-situ hybrid halide solid electrolyte, resulting in one patent application and three research papers. The project has also established a viable recycling process, resulting in more than 90% recycling efficiency. The expected impacts include a sustainable battery with very high recyclability, high-performance, low-cost manufacturing and increased safety.

ADVAGEN

The ADVAGEN project was presented by Rahmandhika Firdauzha Hary Hernandha, Solid-state battery team leader at Avesta Battery and Energy Engineering. ADVAGEN began in August of 2022, with a duration of 48 months. The project aims to create high-performance lithium metal battery cells through innovations with a hybrid sulphide/oxide electrolyte, anode and cathode materials with enhanced performance, stability and sustainability. ADVAGEN is not able to publicly show many of its early results as they are still under confidentiality, however conductivity has been improved, and trials for cathode layer manufacturing are being upscaled. So far, three publications and one patent have come from the project. The project has challenging objectives and, while early results are promising, extra efforts will be needed to be able to move further to the pilot line or industrial scale levels.

AM4BAT

The AM4BAT project was presented by Sneha Subhas Malunavar, scientist at Austrian Institute of Technology. AM4BAT began in June of 2022 and will conclude in 2026. The project aims to create an anode free solid-state battery, with high performance targets and fast charging capability, using sustainable additive manufacturing techniques. The project has developed an NMC cathode, hybrid-polymer electrolyte and made cycling tests of cathode films, resulting in increased understanding of the effects of curing temperatures. The expected impact is reduced cost, higher energy density, more sustainable battery, with increased safety due to no flammable solvents being used in development.

Conclusion

The challenges with solid-state battery technology were highlighted throughout the session. For example, multiple projects are encountering difficulties with materials and challenges to reach targets. Several projects indicated the need for further research on hybrid electrolyte materials, such as combinations of polymers and inorganic materials, to find the best material for use. Ultimately, the electrolyte choice will be driven by the application and the time to market. There are some specific areas where progress is needed. In particular, knowledge is needed in materials upscaling, in order to enable progress in the following steps in manufacturing. Advanced processes, such as dry processing, digital twins and AI enhanced development and automation, are needed for the battery assembly processes, to scale these up to pilot line and to enable industrial uptake. The research from these projects is important to advance industrial uptake of e-mobility solutions, for multiple transport modes. As the projects continue to generate results and overcome challenges, the understanding of solid-state technology in Europe improves and more suitable materials, processes and use cases can be discovered.

PARALLEL SESSION 15:

Zero emission systems for HDV

Summary from **Ian Faye (Robert Bosch)**

The projects presented in the session responded to calls in 2022 for Modular multi-powertrain zero-emission systems for HDV (BEV and FCEV) for efficient and economic operation, and a new generation of full electric urban and peri-urban Bus Rapid Transit systems to strengthen climate-friendly mass transport. All the projects started in 2023 and have reached the midpoint of their duration. The common denominator for the projects is the ambition to prove the operation capabilities of these vehicles in their targeted real operational settings. The three Heavy Duty Vehicle projects are members of the AEVETO (Advanced Electric Vehicles for Efficient and Economic Transport Operations) cluster, which provides an umbrella allowing exchange between the projects to maximise the collaborative synergy between them. The AEVETO cluster represents a pioneering initiative dedicated to revolutionising the landscape of heavy-duty transport through the collaborative synergy of R&D projects funded by the European Commission. Focused on Zero Emission Heavy Duty Vehicles, AEVETO creates and provides a common umbrella or vision of key EU projects, propelling the development and adoption of Battery Electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs) within the heavy-duty sector. In general, the projects are uncovering the need to better harmonise regulations to ensure seamless cross-border operations especially for innovative HD solutions that help tackle the Green Deal challenges.

ZEFES – "Zero Emission flexible vehicle platforms with modular powertrains serving the long-haul Freight Eco System". The EU-funded ZEFES project will take zero-emission long-haul goods transport in Europe to the next level. ZEFES is currently preparing real-world demonstrations of long-haul BEVs and FCEVs across Europe, using two major arteries and includes both cross-border operation as well as travel on ferries.

This will be demonstrated by modular and efficient long-haul battery-electric vehicles (ten units) and long-haul fuel-cell electric vehicles (three units) which will rely correspondingly on Megawatt Charging Systems (MCS) and Hydrogen Refuelling Stations (HRS) being in place when operation starts this year. ZEFES is also working on digital twins that are included in tools that support both buying decisions and mission planning, as well as features such predictive maintenance and selecting the most suitable vehicles. ZEFES addresses the problem of different weight and safety restrictions. It is also discovering and reporting on barriers and challenges faced from the infrastructure side. ZEFES is currently working here with partners and stakeholders to find solutions in time, as well as preparing recommendations on revised directives on weight and dimensions.

EMPOWER – "Eco-operated, Modular, highly efficient, and flexible multi-POWERtrain for long-haul heavy-duty vehicles". The EU-funded EMPOWER project involves a smaller consortium than ZEFES, it is working on two flexible, modular and scalable zero-emission HDVs belonging to the VECTO vehicle group 9 (6×2 rigid trucks). The first vehicle will be powered by a fuel cell system with a driving range of 750 km, and the second by a battery-electric powertrain with a driving range of 400 km. The project is developing a portfolio of technology bricks, beginning with a modular and scalable fuel cell system for vehicle demonstration, down to modular electrified braking systems that will have clear advantages over the classic hydraulic or pneumatic systems. The demonstrators will be sharing the fully integrated e-axle and associated controls. A particular technical challenge for the fuel cell system is the need to work at a minimum power of 180 kW to complete missions over the Brenner Pass. The design for reaching the target of 30,000 hours operation lifetime is still on-going. With regard to medium- and long-term impact, EMPOWER will achieve solutions that ensure the resulting load capacity of both demonstrators reaches at least 90 % of the baseline vehicles. The modular and scalable application makes this platform customer oriented, guaranteeing the best compromise between range needs, payload and type of mission.

ESCALATE – "Powering EU Net Zero Future by Escalating Zero Emission HDVs and Logistic Intelligence". The ESCALATE project is nearly as large as ZEFES and also aims to develop and demonstrate long-haul b-HDV (battery), f-HDV (fuel cell) and r-HDV (range extended) at a minimum GVW of 40t with 750km range between recharging under real-world operational conditions, and targeting cost-effective electric multi-powertrains for a minimum of 500 km daily with six months of operation. ESCALATE is tackling, similar to EMPOWER, improvements in specific modules/component groups but strongly emphasizes the importance of a data driven approach that includes both AI and digital twins. From this perspective they rely of physics-based models to compensate for any lack of data. The project takes a pilot approach where each of the

five vehicle manufacturers will be testing on specific routes. Finally, the project has developed a web-based TCO tool and is developing a dynamic LCA approach to emulate sustainability aspects in a precise manner.

EBRT2030 – "European Bus Rapid Transit of 2030: electrified, automated, connected". The main objective of EBRT2030 is to create a new generation of advanced full electric, urban and peri-urban European BRT enhanced with novel automation and connectivity functionalities. The project has three well-focused key objectives that include operational demonstrations in six European cities and in one South American city, the development of technology-focused key innovative solutions and, most importantly, the ability to replicate the results in further cities. Currently the project is focusing on the development of the technologies and preparing the implementation in the demonstration sites. The innovations include intelligent driver support and safety systems, advance energy and thermal management, as well as in-motion charging systems and several connectivity aspects, ranging from monitoring to smart charging and adaptive fleet scheduling. These innovations (hardware and software) aim at improving efficiency and the level of service or addressing specific issues, reducing costs etc. in the demonstration cities. Successes in Barcelona and Prague have been highlighted, as well as a simulation platform to support the implementation of eBRT. Finally, a call for potential follower/twinning cities is being prepared.

PARALLEL SESSION 16:

New mobility services in cities

MOVE 21 | SCALE-UP User-Centric & Data Driven Solutions for Connected Urban Poles | SUM SEAMLESS SHARED URBAN MOBILITY | GEMINI GREENING EUROPEAN MOBILITY through cascading innovation INITIATIVES

Summary from **Ivo Cré (POLIS)**

The session addressed new mobility services in cities. As European cities and regions strive to become climate-resilient, these services that complement mainline public transport (such as new and shared mobility services for both goods and passengers, micro mobility, bicycle and scooter sharing, demand responsive transport, car-pooling or car sharing), offer a promising solution to reduce congestion and air pollution, address road safety risks and foster social inclusion. However, to deliver "Mobility as a Service" and meet these mobility challenges, new and shared mobility services (NSMS) need to be a credible alternative to the private car, coupled with safe and integrated infrastructure that is accessible, reliable and user-centric. Cities and regions have a crucial role in the demonstration and testing solutions at scale, showcasing how to integrate NSMS with city transport operations and infrastructure to achieve long-term decarbonisation, or how to improve the efficiency and accessibility to the transport networks/systems covering the TEN-T urban nodes and corridor(s) for transport of freight and/or passengers.

The topics discussed in the session relate to decarbonisation (use of clean vehicles or active modes) and digitalisation ('digital by default' solutions, that are part of platforms, and compliant to EU legislation, using European data standards and specifications) in urban mobility, as discussed in the ERTRAC Urban Mobility Working Group. The projects are all part of the CIVITAS initiative, DG MOVE's urban mobility R&I initiative.

MOVE21 and **SCALE-UP** are Horizon 2020 projects selected under the topic "Cities as climate-resilient, connected multimodal nodes for smart and clean mobility: new approaches towards demonstrating and testing innovative solutions". These projects

were expected to demonstrate the integration of new scalable technologies and measures into city transport operations and infrastructure to achieve long-term decarbonisation impacts. Specifically, they were expected to showcase the deployment of NSMS within the TEN-T urban nodes and corridors for both freight and passenger transport. Both projects use the CIVITAS evaluation methodology.

MOVE21 was presented by Raffaele Vergnani (POLIS) and Tariq Van Rooijen (TNO). The project is ending in April 2025, after 4 years of activities. MOVE21 - Multimodal and interconnected hubs for freight and passenger transport contributing to a zero emission 21st century - helped three living labs, three replicator cities and six cascade cities to transform into climate-neutral and connected multimodal urban nodes for mobility and logistics. The project demonstrated in real life concepts such as Multimodal hubs, Park and ride, Digital integration (modes and service providers), DRT fleets for urban logistics and Multifunctional hubs. Innovations happened at all five axes of the OECD categorisation: at social, governance, business, technological and service level. The project results can be found in nineteen new collaboration schemes, four commercial business plans, and improvements to strategic planning at the local level as well as to regulations and policies a local, national and European level. The project calculated environmental impact and long-term decarbonisation effect of its measures when upscaled or mainstreamed: CO_2 reduction between 13% and 16%; NOx reduction between 12% and 14%; PM2.5 reduction between 8% and 12%; Modal shift increase of sustainable modes between 18% and 21% (i.e. cycling, walking, micromobility etc.).

SCALE-UP was presented by Michiel Penne (City of Antwerp). The project ends in May 2025, after four years of duration. The project name stands for: "Scale up user-Centric and dAta driven soLutions for connEcted Urban Poles". Three Urban nodes and seven Scale-up cities implemented in real life 28 mobility measures in five intervention fields. The overall ambition is to create well-connected, multi-usage and climate resistant urban nodes, and this at the urban, Functional Urban Area and TEN-T scale. The project addresses physical, digital and human behavioural aspects of this challenge. The project developed 12 governance typologies for vertically integrated policy deployment. Each of the measures has its own impact assessment and evaluation, e.g. 33% of the city bikes journeys in Turku replaced car trips, the Madrid Canalejas logistics hub avoided 103 tonnes of CO_2 and made operations possible with 22 fewer cars in the streets, shared bicycle trips in Antwerp almost doubled between 2022 and 2024, etc.

SUM and **GEMINI**, which were funded under the Horizon Europe topic "Accelerating the deployment of NSMS for the next decade". The projects were expected to develop and pilot test at least three different business model scenarios, with a focus on

increasing the share of NSMS in the modal distribution. Also, enabling the integration of NSMS with public transport and re-designing the transport infrastructure to accommodate new mobility modes and behaviours and ultimately, reducing the congestion and air pollution, road risk and foster social inclusion in each city. At the time of the conference, the projects were mid-way their 3-year duration.

SUM was presented by Giulia Petrarulo, INRIA. SUM - Seamless shared urban mobility – and contributes to the mobility transformation in 15 European cities by 2026 and 30 European cities by 2030, towards new shared mobility (NSM) modes integrated with public transport (PT) to reduce car dependency, GHG emissions and promote eco-friendly transport. The project follows a living lab approach at nine locations. The project aims to achieve technological breakthroughs such as the development of prediction tools for the availability of shared modes, on-demand shared mobility management tools, tools for the scheduling and ticketing integration of NSM and PT, co-creation activities to develop/modify mobility hubs and the street-space, mobility management (pricing and nudging) tools to reduce the cost of NSM. At this stage of the project, the living lab specifications and needs are defined, and the open data platform has been established. Technological tools are being prototyped and tested. The project has established a Standardised Impact Evaluation Framework. The project focuses on engagement and co-creation activities, through surveys, workshops and stakeholder involvement activities in the living labs. In the long-term, the project will deliver evidence-based guidelines, a unified ticketing system as an open data platform.

GEMINI – "Greening European Mobility through cascading innovation INItiatives" – was presented by Vera-Marie Andrieu, UEMI. The project is active in eight mobility Living Labs. The project will utilise innovation-driven scenarios to promote and deploy new mobility systems (NMS) and analyse socio-economic and behavioural factors in their uptake. The project will establish a dataspace. One main achievement of the project so far was to assess challenges for the integration of technical innovations: regulations and infrastructures were highlighted as principal issues. The project uses a framework based on the CIVITAS 2020 process and impact evaluation framework, expanded with a Common Impact Model, a Cross Impact Performance Emissions model to calculate emissions reduction, and a total ownership Tracking Economics Calculator to assess the economic viability of the new mobility services. Expected impacts are a 25% increase in the share of NMS in the modal split, a 20% reduction of congestion, a 20% reduction in both traffic related air pollution and CO_2 emissions.

All four projects aim to overcome the challenge of integrating mobility solutions at different levels and scales – as identified in SCALE-UP: different spatial scales (city, Functional Urban Area, Corridor) are addressed, as well as the digital, physical and behavioural aspects. Governance is an essential part of managing this integration. This

is highlighted in MOVE21's white paper. Working with the private sector, including Original Equipment Manufacturers (OEMs) is essential to reach the goals set in the Horizon Europe Work Programme and in the project.

The projects each focus on giving a policy purpose to the research and innovation activities they conduct: the results are reflected in long-term strategic plans such as SUMPs, and directly link to EU policies in the field of decarbonisation and digitalisation. The projects also face the challenge of overcoming barriers to scale the solutions they have demonstrated. From the discussions with the audience, we understand that procurement can play an important role in creating a market for the solutions.
Future research questions have been discussed: the overall issue of urban mobility in relation to TEN-T developments is mentioned as of high importance. A next generation of these projects should look at digital and transport network infrastructure implications of scaled implementation of NMS. The panellists also recognised that CCAM brings a new dimension to the mobility concepts they are studying. This could be a topic of future research. Finally, a coherent impact assessment framework is needed: this can help to improve the comparability of results.

PARALLEL SESSION 17:

Next generation battery packs for BEV and PHEV

LIBERTY MARBEL ALBATROSS HELIOS

Summary from **Bozorg Khanbaei (BEPA)**

Session 17 of the conference was on the topic "Next generation battery packs for BEV and PHEV", on day 3 of the conference. The introduction was given by Martha Gialampouki, project officer at CINEA, joined by co-moderator Bozorg Khanbaei, policy officer at BEPA. The projects are the enablers of achieving the Batt4EU Partnership objectives in innovating technologies that facilitate integration of battery cells into EV modules and packs, enhance the system level understanding and contribute to a highly competitive and performant Electric Vehicle production in Europe.

LIBERTY

The LIBERTY project was presented by Werner Leitgeb, Lead Researcher for battery safety at Virtual Vehicle Research. The consortium has 16 partners from seven countries, and a duration of 48 months, beginning in January 2021 and concluding recently in December 2024. LIBERTY has developed a lightweight battery system with a range of up to 500km, ultra-fast charging capabilities and a lifespan comparable to ICE vehicles. With the recent conclusion of the project, many results were shared on the pack design, cooling system, safety, BMS and LCA. Battery performance testing was carried out for several aspects, including system assembly, safety on a cell level and a system level, and integration of the battery system in the vehicle with simulation-based assessments. LIBERTY's objectives address many consumer concerns, such as range anxiety, charging time, safety and battery lifetime.

MARBEL

The MARBEL project was presented by Eduard Piqueras Jover, R&I project coordinator at EURECAT. The project is in the final months of its 4¼ year duration, concluding in March 2025. MARBEL is developing a compact, modular, lightweight and high-performance battery pack with increased energy density and reduced charging times, enhancing vehicle efficiency and user convenience. The project has achieved results particularly in its circular design, which facilitates reparability and transition to 2nd life or disassembly, and uses recycled and recyclable materials with 95% reduction in energy consumption. The impacts of the project objectives are more sustainable and efficient electric vehicles with shorter charging time and double the lifespan. The project has created a pool of skills in battery eco-design, dismantling and reconditioning strategies.

ALBATROSS

The ALBATROSS project was presented by Aysel Pilav, R&D project expert at Yeşilova Group. The project is in its final year, with a duration of 48 months plus a six months extension, and will conclude in June 2025. ALBATROSS is creating advanced battery pack designs and systems to achieve increased range, energy density and sustainability, while reducing weight and charging times. The project has achieved a 13% increase in energy density, with 31% more capacity, with a range of almost 500km. Results in BMS have made the battery systems compatible with ultra-fast charging, enhanced safety and advanced SoX functionalities, with four patent applications stemming from the BMS research. The expected impacts of ALBATROSS include better understanding of immersion cooling, advancing knowledge in BMS and sensor capabilities, improved sustainability and recycling, as well as automation and efficiency.

HELIOS

The HELIOS project was presented by Tomas Jezdinsky, market research expert and freelance consultant at International Copper Association Europe. The project began in January 2021, and has been extended to conclude in August 2025. HELIOS aims to implement a new battery pack concept that is intelligent, modular and scalable, suitable for a wide range of electric vehicles and enhancing adaptability and performance. With the current design, the project has had to compromise between energy versus power density, and is able to prove one or the other. Lightweight and high resistance modules have been manufactured, BMS and EMS components have been developed and proven. A digital twin has been developed in the project, optimising performance and process circularity. The project impacts will raise acceptance of EVs by addressing consumer concerns; several publications and two patents being considered for exploitation.

Session 17 provided valuable insights into next-generation battery pack technologies through the presentations of four key European projects: LIBERTY, MARBEL, ALBATROSS and HELBAT. These projects collectively demonstrated significant advancements aligned with the Batt4EU Partnership objectives, notably in enhancing pack modularity, integration efficiency, safety, sustainability and circularity. LIBERTY showcased critical advancements in system-level integration, particularly in cooling strategies and battery management systems (BMS), enhancing both performance and vehicle safety. MARBEL's innovative approach to modular and circular design highlighted tangible progress in enhancing reparability and promoting circular economy strategies. ALBATROSS brought forward significant achievements in battery management, fast-charging compatibility and immersion cooling, complemented by substantial intellectual property developments. Finally, HELBAT contributed valuable insights into balancing trade-offs between energy and power densities in modular battery designs.

The session underscored the importance of integrating cell-level innovations effectively into battery packs to achieve superior vehicle performance, sustainability and safety. Qualitatively, the presented findings significantly contribute towards Europe's goal of achieving more sustainable, competitive, and efficient electric vehicle battery systems. Future research is needed, especially regarding scalable and economically viable solutions for managing the trade-off between energy density and power capabilities, advancing immersion cooling technologies and enhancing circularity through innovative designs that further facilitate reparability and recyclability.

PARALLEL SESSION 18:

Improving road safety in Africa

Summary from **George Yannis (NTUA)**

The session "Improving Road Safety in Africa", moderated by Patrick Mercier-Handisyde (EC, DG RTD) and George Yannis (NTUA), explored innovative road safety solutions tailored to the specific challenges of African countries. Road crashes remain a significant public health issue in Africa, with high fatality rates attributed to inadequate infrastructure, regulatory gaps and limited public awareness. The session presented two major EU-funded projects, AfroSAFE and TRANS-SAFE, both of which started in September 2022 and will continue until August 2026, that are implementing the Safe System Approach to improve road safety in low- and middle-income African countries. These projects aim to develop scalable and replicable solutions that align with global road safety goals while addressing local challenges.

AfroSAFE ("Safe System for radical improvement of road safety in low- and middle-income African countries") was presented by Carmelo D'Agostino (LTH). The project focuses on enhancing road safety management by developing structured data collection methods, reviewing and revising national policies and identifying key constraints and opportunities for improvement. One of the major areas of intervention involves infrastructure safety, with efforts to implement Road Infrastructure Safety Management (RISM) guidelines in Zambia, Tanzania and Ghana. In the area of vehicle safety, AfroSAFE has reviewed existing regulations and proposed improvements to safety standards, taxation, vehicle registration and inspection methods. The project also emphasizes the importance of road user behaviour, mapping road safety culture in African countries and introducing pilot studies to promote a shift in mindset toward safety-conscious behaviours. A major component is post-crash response, where efforts

are being made to improve the capability of health services and coordination between emergency responders, aligning with WHO protocols. Moreover, capacity building plays a crucial role in AfroSAFE's strategy, with the establishment of the AfroSAFE Academy, which offers training programmes, knowledge-sharing platforms and expert workshops to support long-term improvements in road safety.

TRANS-SAFE ("Transforming Road Safety in Africa") was presented Oliver Lah (Urban Living Lab Center). The project is structured around five key pillars: informing stakeholders about road safety risks, integrating the Safe System Approach into national policies, enhancing assessment and management systems, implementing pilot safety projects and evaluating the overall impact on regional and global road safety goals. TRANS-SAFE has conducted extensive road safety assessments, analysing crash statistics, policy frameworks and the risks faced by different road users. A core feature of the project is the Safe System demonstration pilots, which have been implemented in four cities. These pilot projects focus on AI-powered smart traffic control systems, walkability safety assessments and infrastructure improvements near schools. The project also promotes gender-inclusive road safety measures, including initiatives to improve women's safety in public transport and ensure safer walking environments in Cape Town. Another key aspect is the development of post-licence driver training programmes, which have been introduced in Kumasi to improve driving behaviour and reduce road risk. The long-term vision of the project is to establish Living Labs that will embed road safety principles into urban planning and transportation policies, ensuring sustainable improvements in road safety practices across Africa.

The discussion session emphasized the importance of sustaining road safety efforts beyond the lifespan of the projects, with a strong focus on long-term knowledge transfer and capacity building. The European Commission's support for African Road Safety Observatory (ARSO) was seen as a critical element in maintaining structured efforts beyond the project lifecycle. The AfroSAFE Academy was also highlighted as a key initiative designed to train professionals and create a self-sustaining knowledge hub, managed by local experts. Another major theme of the discussion was the feasibility of implementing the Safe System Approach in Africa, given the challenges of weak administrations, inconsistent policy enforcement and varying levels of institutional capacity across different countries. The debate around lighter versions of global road safety tools, such as scaled-down NCAP safety ratings, simplified network-wide road safety assessments and adapted data collection protocols, generated mixed perspectives. There was broad consensus that customised, context-sensitive solutions are required to accommodate the diverse socio-economic and regulatory landscapes across Africa. Marianne Vanderschuren, Professor at the University of Cape Town also presented the demonstration pilot in the city of Cape Town (safe routes to schools, safe

walking for women, safer walking and cycling). Lastly, the discussion highlighted that as motorisation continues to increase, the gap between vulnerable road users and vehicle-dominated transport systems is widening, leading to higher pedestrian fatality rates.

PARALLEL SESSION 19:

Unleashing the innovation potential of public transport

Summary from **Françoise Guaspare (Ile-de-France Europe)**

The session focused on the potential and the innovation of public transport, designed within the CIVITAS Initiative and Climate-Neutral and Smart Cities Mission. These projects contribute to the overall goal of more efficient, inclusive and climate-neutral public transport in the future. The projects presented: UPPER and SPINE aimed at two different goals:

- increasing the use of public transport by enhancing the satisfaction of the users;
- trying to find cooperative solution to accelerate the transition towards climate neutrality by implementing a local policy framework for public transport.

To achieve all those objectives, it is essential that UPPER and SPINE collaborate effectively. The presentation was followed by an insightful discussion moderated by Françoise Guaspare who is working for a public transport company in Paris.

UPPER - "Unleashing the potential of public transport in Europe", € 23.5M co-funded by the European Commission under the Horizon Europe Programme. It is a 4-year project (2022-2026), involving 41 partners from ten countries to improve public transport attractiveness and lead the transition towards a zero-emission mobility. The project seeks to test and evaluate the resilience of public transport, use simulation tools, data and Artificial Intelligence to trigger behaviour change and enhance the integration of active modes of transport.

UPPER aims to persuade people to use public transport instead of their private car by implementing measures that will act on five innovation axes: mindset and culture, urban mobility planning, mobility services ecosystem, road network management, and democratic governance. The overall target is increasing the use of public transport by more than 30% and the user satisfaction by more than 25% in the participating cities.

The mid-term results of the project are the conduction of a diagnosis of public transport, co-creating inclusive solutions, thematic workshop, cluster meeting and continuous monitoring of the situation. Positive impacts are already showing in the cities involved, with the development of a navigation application, increasing the shared mobility, implementation of parking outside the urban area or multimodal planning services. UPPER is a pathway to improve sustainability and inclusivity of transport services and making mobility a right for everyone.

SPINE – "Smart public transport initiatives for climate-neutral cities in Europe", co-financed by the Commission, brings together 39 partners and 11 cities, €17M. SPINE aims to accelerate progress towards climate neutrality by integrating public transport systems with new mobility services, sharing schemes, active transport modes and micromobility. The SPINE consortium consists of experienced professionals who will provide a comprehensive approach to the challenges, scope and expected impacts of the project.
SPINE's vision will be attained through these six objectives:

- Analyse the urban structure within public transport;
- Test to evaluate innovative mobility solutions;
- Define and implement the digital tools that will enable the deployment of innovative mobility solutions;
- Deploy those solutions and business models in six Twinning Cities;
- Foster the dissemination of those solutions and contribute to the changing canvas of the European transport policy framework.

For the four leading cities of the project (Antwerp, Bologna, Tallin and Las Palmas), the analysis of the landscape and the digital tools is already achieved, as well as the dissemination of solutions.
In Antwerp, the implementation is more focused on multimodal journey (app and screen) and the public transport prioritisation in traffic management. In Bologna, it focuses on MaaS and Micro incentives campaign. In Talinn, the implementation showcases itself through digitalisation, the development of multimodality, environment censors and cargo bike renting services. In Las Palmas the development of multimodal hubs (information screen), e-bike stations and public transport prioritisation. The long-term results expected by this project is the development of digital solutions tailored to cities needs and interests, a better communication within the public transport eco-system to achieve a more attractive public transport system.

Q&A session moderated by Francoise Guaspare

During the Q&A session, different aspects of this topic were discussed such as the ambition of an improvement of 30% of passengers, which depends on the starting point of each city. In fact, cities that are already developed in this field are not expected to aim at such a high target. Regarding the use of public transport by tourists, it will

depend on each city, but it can be very well used, for instance during the Olympic Games where 90% of application users were tourists. Concerning the price of the service, it is not very important as long as the quality of the service is good.

Conclusion

The two projects presented showcased diverse approaches of the development of public transport, but that can work together to enhance the ecosystem of the public transport. These projects are already in line with a more sustainable and efficient mobility. A takeaway is the necessity to rethink the mobility strategies towards multimodality and the management of traffic. To achieve an inclusive mobility towards carbon neutrality, a continuous effort in research should be made to assess the mobility of tomorrow.

PARALLEL SESSION 20:

Materials for light and safe green vehicles

Summary from **Thilo Bein (Fraunhofer LBF)**

Within this session, the two projects FLAMINGo and Flexcrash were presenting their results on materials and lightweighting for electrified vehicles. FLAMINGo addressed the Horizon 2020 call on advanced lightweight materials and their production process (2020) and just finished early 2025. Flexcrash is funded under the Horizon Europe call on testing of safe lightweight vehicles (2021) and runs until August 2026. Although both projects are not directly linked to EGVI or 2Zero, both contribute to Pillar 1 "vehicles technologies" and Pillar 4 "LCA approaches and circular economy" of the recent SRIA of the 2Zero Partnership.

The **FLAMINGo** project is addressing the use of nanoparticle enhanced aluminium metal matrix composites (Al-MMnC) in the lightweighting of green vehicles. The aim was to achieve a 10% weight reduction through substitution of steel with Al-MMnC and applying SSbD principles. In doing so, the full life cycle from production until End-of-Life was considered. With respect to Al-MMnC, the project could demonstrate that the use of nanoparticles is safe and does not impact the recyclability of the aluminium. At the same time, through addition on nanoparticles the yield strength could be improved up to 30% in the laboratory, enabling significant weight reductions in selected components. Implementing these materials in a re-design of the reference vehicle (light commercial vehicle, N1 category) a 7% weight reduction on metal parts and 2% weight reduction on vehicle level could be achieved. A detailed scenario analyses reviled, that even higher substitutions using secondary Al-MMnC can be achieved resulting in weight reductions up to 24% and a CO_2 reduction of 14%.

The second project, **Flexcrash** addresses the flexible and hybrid manufacturing of green aluminium to produce tailored adaptive crash-tolerant structures. With respect

to materials, aluminium powders with a high amount of recycled aluminium and minimised content of CRMs is being developed suitable for 3D-printing. 3D-printing, in particular Laser Metal Deposition (LMD), is used as a flexible manufacturing approach to realise small scale 3D structures: adding functional values (AVFF) increase the crash performance of a component. The challenge is to optimise the LMD parameter to ensure a high quality of the printed material and to minimise the thermal input into the base material. The flexible of the 3D-printing process allows optimisation of the topology of the AVFF according to the specific crash scenario. Initial simulations clearly showed the impact of the added pattern, increasing the energy absorption up to 30%. This approach allows to reinforce critical areas of the vehicle without compromising lightweighting thus reducing injuries and fatalities.

Both projects clearly demonstrated that the use of secondary aluminium in a SSbD driven design approach is feasible and significant weight savings and increased performance can be achieved if material development manufacturing and design are considered consistently and the full life-cycle is taken into account. As such, both projects are contributing to the advancement of circularity in the automotive sector. However, further research is needed on, e.g., nanoparticles used in the Al-MMnC, on the optimisation and the industrial upscaling of the manufacturing processes (in particular 3D-printing) as well as on the designs. Furthermore, the sourcing of secondary materials and the transfer to other markets should be considered.

PARALLEL SESSION 21:

Multimodal traffic management for door-to-door transport of passengers and freight

Summary from **Vivi Michalaki (National Highways)**

Parallel session 21, which took place in the afternoon of Day 3, addressed the topic of advanced multimodal traffic management for door-to-door transport of passengers and freight, in presentations of three projects that were funded through a 2022 call. The European Commission's expectations of this call include the development of network and traffic management decision-making tools using high-performance computing, the optimisation of network demand/capacity balancing for passenger and freight flows during planned and unplanned network disruptions, the governance arrangements for multimodal transport management as well as test solutions in pilots. All three projects discussed the above objectives through different approaches, techniques, pilots and use cases.

ACUMEN ("Ai-aided decision tool for seamless mUltiModal nEtwork and traffic managemeNt", June 2023 – May 2026) was presented by Claudio Roncoli, Aalto University. ACUMEN has 17 partners from nine countries and focuses on ensuring seamless, sustainable and safe door-to-door travel for people and goods, while trying to leverage the new technologies available, such as Artificial Intelligence (AI). The project has been structured in three pillars: data framework and analytics, advanced monitoring and forecasting, and decision-making and management solutions. In the data framework topic, the focus is on how we can better organise sharing and use of data in traffic management while aligning with privacy and security requirements. With the use of AI technologies, it is possible to collect relevant information without accessing the actual data sources. Integration of multiple data sources is also applied for public transport information, as well as real-time disruption detection using AI methods. In the context of monitoring and forecasting, the project focuses on travel

activity demand for different modes of transport, including within-day as well as day-to-day variation, that can inform us on the passenger needs we need to satisfy. With the combination of different data and methodologies, we can improve resilience and prioritisation of transport services, and make informed decisions based on our enhanced knowledge. Digital twin technology is used to replicate the transport system, input data, apply models and provide solutions for the traffic managers. The project has developed four pilots; in Amsterdam, Athens (improve decisions in the traffic management centre), Helsinki (multi-modal traffic coordination) and Luxembourg (on-demand shared van services), with different use cases (from real-world to simulation, and operational/local level to strategic/city level). The main impacts of the project include the reduction in door-to-door multimodal trip delays, as well as reduction in the effort required by the traffic managers in decision-making.

SYNCHROMODE ("Advanced traffic management solutions for synchronized and resilient multimodal transport services", May 2023 – April 2026) was resented by Dimitrios Tzanis, Centre for Research and Technology Hellas (CERTH). SYNCHROMODE consists of 16 partners from six countries and focuses on the development, implementation and assessment of the SYNCHROMODE Toolbox, which is a traffic management tool that can also assist existing traffic management systems. Key objectives include the development of an advanced multi-actor cooperation model for multimodal service operations, the development of an interoperable solution for data gathering, harmonisation, fusion, quality assessment and analysis, the use of simulation models (offline and online) for traffic and specifically connected and automated vehicle (CAV) scenario assessment. The project has included three case studies (including 15 use cases) in Thessaloniki (resilient multimodal traffic management), South Holland (seasonal events and roadworks) and Madrid (combined passenger and freight transport). The use cases have been finalised and the user and system requirements for the SYNCHROMODE Toolbox have been validated using gamification approaches in co-creation workshops. A new governance model has also been developed, based on the SOCRATES 2.0 paradigm. Data gathering, fusion and analysis have been approached through new tools and methodologies. Tools utilised include: the creation of SYNCHROMODE Data Exchange Repository, the development of a travel and traffic pattern analysis framework based on vehicle trajectories, a data-driven tool for the identification of roadworks' impact as well as a data-driven tool for demand estimation. Methodologies utilised involve the data quality assessment and imputation in real-time, logistics delivery demand estimation, public transport service assessment as well as bottlenecks and disruptions. Digital twin technology has been utilised for planning/optimisation, as well as operational purposes. Real-time traffic state prediction can be applied, using a range of data sources, combining with potential disruptions. Examples of where the digital twin technology can be implemented are the synchronisation of public and

demand-responsive transport, the optimal plan of roadworks, and understanding the links with advanced C-ITS and CAV services. The development of the Toolbox's architecture, user interface and databases have progressed, while the project is in the process of developing the plans for testing and impact assessment. Main impacts are the involvement of AI and predictive analytics in the multimodal traffic management domain, the reduction of emissions and travel times and improvement of cost efficiency. Maintaining the SYNCHROMODE toolbox will also contribute to more seamless multimodal mobility and better decision-making in traffic management.

DELPHI ("FeDerated nEtwork of pLatforms for Passenger and freight Intermodality", July 2023 – June 2026) was presented by Sofia Kokonezi, Institute of Communication and Computer Systems (ICCS). DELPHI consists of 16 partners (plus one associated partner and one affiliated entity) from eight countries and focuses on the strategic dimension of integrating passenger and freight transport in a single system. The project has been structured in three pillars: governance & ecosystem specification, architecture, data, processing & optimisation, and validation activities through realistic pilot demonstrations. DELPHI's objectives include the novel governance and regulatory schemes, the multimodal passenger and freight transport Network of Platforms (NoP) framework, an AI/machine learning-powered transport network and traffic management optimisation framework, the validation through four pilots and simulation-based analysis to ensure effectiveness, as well as ensuring compatibility with existing EU standards and policies. The four pilots are set in Madrid (multimodal transport for last-mile parcel delivery), Attica (optimised freight and passenger traffic models and data sharing framework), Mykonos (integration of freight and passenger models such as using the public transport network for freight deliveries) and Cluj-Napoca (data sharing and relevant governance framework). Achievements so far include the completion of use case designs and the generation of a combined passenger and freight traffic governance framework, including 21 tailored recommendations. The governance framework was developed through data collection and analysis (working sessions and questionnaires), and the recommendations focused on the following key areas: data interoperability, development of a shared vision and collaborative business models, harmonisation of regulations across sectors, and smart contracts and dynamic data sharing protocols. The above will be validated through pilot implementations and will then constitute the concept of 'DELPHI town'. Further achievements cover the data collection through drone flights and the sensor and camera network. The main project impacts include an improved multimodal transport network, more effective and resilient network-wide data exchange, tested and validated systems for enhanced prediction and resolution of bottlenecks, high market adoption and transferability of innovations, new governance arrangements for multimodal traffic management, and tools for optimising mobility flows of passengers and goods.

All three projects in this session showed progressed towards the European Commission's initial objectives by identifying ways to improve multimodal traffic management through the development of new governance frameworks and the application of novel techniques, such as AI and Digital twins. These techniques can allow better scenario planning and testing, and ultimately more proactive traffic management within different modes, both for passengers and freight transport.

The discussion following the presentation initially focussed on the need for data and the challenges around collection and sharing. Mapping data needs for the use cases from the start is crucial, as is identifying alternative ways to gather the necessary information (e.g. through AI or data fusion) and being proactive in stakeholder engagement. The evolution of CAV technologies (as part of CCAM concept) is also expected to play a crucial part in multimodal traffic management both for road users, and operators.

In the models developed within the projects, several scenarios are explored in the various use cases for demand prediction, noting that both planned and unplanned events (such as weather conditions) and disruptions (such as roadworks) are included, which can be extremely useful for identifying ways for capacity optimisation. However, achieving a single integrated transport system is still a challenge, as different cities/regions will have different needs and existing tools to build on. A starting point to this end can be promoting a level of standardisation in the architecture and tools utilised, as well as cooperation and coordination in planning and traffic management.

In conclusion, the advancements achieved through these projects can contribute to better decision making in traffic management for all modes, reduced delays and emissions, as well as improved management of bottlenecks and disruptions.

PARALLEL SESSION 22:

CCAM enablers

Summary from **Margriet van Schijndel (TU/e)**

The session CCAM Enablers took place on Thursday, 13th February, 13:30 -15:00. The topic closely relates to Cluster 5 on Key Enabling Technologies (CCAM Partnership). This cluster aims to further develop enabling technologies, driven by digitalisation and extending the application of these enabling technologies beyond the individual vehicle, in a systems approach. The Cluster 5 activities are to contribute to enhancing trust and user adoption of CCAM solutions by facilitating safe, secure and resilient operation of the CCAM technologies and services.
The session topic directly relates to Clean and Digital Transport Transition, with an emphasis on the digital aspects. CCAM enablers offer the technologies needed to make CCAM happen on the road. They will contribute to making the transport systems more efficient, more sustainable and user-friendly, thus supporting both the goals of digitalising the transport sector and transitioning towards clean energy solutions. By integrating connectivity, cooperation and automation into transport networks, the overall transport system becomes smarter, greener and more efficient, directly contributing to cleaner, more digitalised transportation solutions. As such, the CCAM enablers have a direct contribution to the Clean and Digital Transport Transition.

SELFY ("SELF assessment, protection and healing tools for a trustworthY and resilient CCAM", June 2022 – May 2025) was presented by Fanny Breuil (EURECAT). The project contributes to be a "CCAM Enabler" by providing a security and protection layer to the CCAM systems, which is crucial for increasing the trust in CCAM, thus fostering its adoption by the society.
SELFY's main goal is to promote a safe and secure operation amongst CCAM vehicles and mobility systems and services, enhancing trust and end-user adoption of CCAM

solutions. It addresses four pillars: trust, resilience, situational awareness and data sharing. The main results include the development and validation of 21 tools, divided in three group of tools: SACP (Situational Awareness and Cooperative Perception), CRHS (Cooperative Resilience and Healing System) and TDMS (Trust and Data Management System).
Key recommendations include the need for protocols for additional protection for vulnerable users, and the need for continuous professional consultation, to ensure the involvement of experts at each phase of autonomous technology development to address the needs of all users. Expected impacts of the project results include an increase of the robustness level by over 50%, identification of over 90% of security breaches, and an increase in mitigation rate to over 75%.
In the discussion, it was stressed that for user acceptance, it is of utmost importance to ensure appropriate data protection in implementations, using anonymisation algorithms, especially for sensitive data and privacy related data.

AITHENA ("AI-based CCAM: Trustworthy, Explainable, and Accountable", November 2022 – October 2025) was presented by Oihana Otaegui (VICOMTECH).. The project serves as a CCAM enabler by establishing a harmonised methodology for the development and testing of AI-based CCAM solutions. By focusing on the trustworthy AI pillars, AITHENA ensures that AI systems used in CCAM meet the highest standards for vehicle drivers, function developers and certification/legal bodies. AITHENA is a CCAM enabler by paving the way for the safe, reliable and regulatory-compliant deployment of AI-driven CCAM solutions.
AITHENA's main objective is the definition of a common and harmonised methodology for development and testing of AI-based CCAM solutions (perception, situational awareness, decision-making and traffic management). The project uses three main AI pillars for trustworthiness: data, AI models development, and testing and validation approaches. The main results presented include the central approach, where the AITHENA methodology builds on existing documents, standards, AI Act, FAME project information and the AITHENA taxonomy. Other results include the data anonymisation pipeline, the trustworthy perception system and explainable and robust decision making.
Expected impacts of the project results include the validation of AI containing driving functions, policy recommendations for the exploitation of explainable AI in CCAM, and contributions to the open-source community.
In the discussion, it was stressed that the project aims to reveal how we can bring AI to wider implementation in the automotive domain, which will enable much more complex tasks to be done than with regular algorithms. In developing and using AI for decision making, robust approaches are needed, taking into account also limitations of the vehicle and its surroundings.

AI4CCAM ("Trustworthy AI for CCAM", January 2023 – December 2025) was presented by Loic Cantat (IRT SystemX).. The project contributes to be a "CCAM Enabler" proposing digital frameworks to link several scenarios, simulation and user acceptance. It develops trustworthy AI models for vulnerable road user and fosters collaboration to ensure ethical and socially acceptable automated mobility solutions evaluating ethical impacts.

The main objective of the project is to develop an open environment for integrating trustworthy-by-design AI models of vulnerable road user behaviour anticipation in urban traffic conditions whilst accounting for improved road safety and user acceptance. The project results presented include a methodology for the development of Trustworthy AI for CCAM applications, use case demonstrations with simulations and VR interactions, as well as an evaluation approach with a validation handbook. Static and dynamic criteria are included. A digital twin is developed for scenario definition activities, and for the creation of realistic virtual urban environments as validation tool for running scenarios.

Expected impacts of the project include guidelines on Trustworthy AI for CCAM considering ethical, social and cultural aspects to drive current and future innovations, and foster user acceptance. Furthermore, the project aims to strengthen the European AI ecosystem for CCAM.

During the discussion, it was stressed that the project partners have largely benefited from performing VR tests with test persons, to gain much better understanding of their perceived safety in different scenarios, in order for them to be able to adjust the technologies accordingly. Synthetic data is generated, with a focus on what is to be seen as real, by the system under test.

ROADVIEW ("Robust Automated Driving in Extreme Weather", September 2022 – August 2026) was presented by Eren Aksoy (Halmstad University).. The project contributes to be a "CCAM Enabler" by delivering a weather-resilient embedded in-vehicle perception and decision-making system for Connected and Automated Vehicles to accelerate the implementation of AI-based innovative CCAM technologies for passengers and goods.
The main objective of the project is to addresses weather-related challenges by developing robust and cost-efficient embedded in-vehicle perception and weather-aware decision-making systems for CCAM with enhanced performance under harsh weather conditions. The project is based on three pillars: synthetic data generation, controlled rain/fog tunnels, and real-world data. Scenarios for city driving as well as for highway driving are included. Project results aim to include more powerful and reliable in-vehicle perception systems, with improved resilience and accuracy under harsh weather conditions, noise models integrated into different test systems, as well as a

data annotation approach for data labelling of Lidar, Radar and RGB images for training machine learning models.
Expected impacts of the project include increased user acceptance of CCAM technologies, due it its advanced all-weather reliability and safety, contributions to testing and validation of CCAM solutions in all-weather conditions and recommended minimal sensor set to reliably deliver safe driving also under harsh weather conditions.
In the discussion it was stressed that ROADVIEW aims to close research gaps for several ODD's, so AD vehicles can drive not only in sunny Spain but also in the winter in Scandinavia. Data from the rain tests is available as valuable means for validation of CCAM systems.

PARALLEL SESSION 23:

Batteries – development of Generation 3b technology

Summary from **Wouter IJzermans (BEPA)**

Session 23 covered the topic "Development of generation 3b battery technology". It was held on day three of the conference. All projects contribute to advancing the goals of the BATT4EU Partnership by developing advanced materials enabling higher energy/power density thanks to operation at a higher voltage, with "Generation 3b" referring to the use of high-voltage cathodes with silicon/carbon anodes in liquid electrolyte li-ion batteries. The session was introduced by Johan Blondelle, Policy Officer at DG RTD in the European Commission, and co-moderated by Wouter IJzermans, Executive Director at BEPA. The session agenda included one project from Horizon 2020 and three from Horizon Europe. Unfortunately, the results from the SiGNE project were could not be presented in the session, due to strikes at the Brussels airport preventing the presenter from travelling.

HYDRA

The HYDRA project was presented by Simon Clark, senior research scientist at SINTEF AS. It was the only project in this session funded under Horizon2020 and, therefore, the only one to have finished. HYDRA concluded its research activities in August 2024, after having begun in September 2020. The objective of HYDRA was to create innovative electrodes that combine high energy and power capabilities, aiming to enhance the performance and efficiency of next-generation lithium-ion batteries. HYDRA has created an open data platform for the community, which included data from over 30 cells, up to 12,000 cycles, and reference and maritime profiles. The project has achieved performance comparable to commercial NMC and LFP batteries up to TRL 6, that are cheaper and reduce critical raw material (CRM) usage. The impacts of the project include a demonstrated high voltage and high-capacity electrode

materials, enhanced manufacturing processes with pilot line production, and ensure fast commercial implementation, with industrial partners already creating new and improved products. The developed open data platform has the potential to facilitate data exchange within the European battery community and contributes to the BATT4EU goal of creating a best-in-the-world battery research community in Europe, while the projects results are encouraging and are informing the next set of projects, including the Intelligent projects (with many common partners) and the other projects in this session.

HighSpin

The HighSpin project was presented by Michele De Gennaro, Head of Competence Unit, Electric Vehicle Technology at Austrian Institute of Technology. The project began in September 2022, with an expected end date in August 2026. The project aims to strengthen the European battery industry by delivering next-generation battery cells for automotive and aviation applications. The project has selected and developed and LNMO cathode with an improved rate capacity and energy density, together with a high voltage electrolyte. Significant improvements in the production processes are an improved three-dimensional electrode structure by laser ablation, and a multilayer coating process. The impact of the enhanced electrode structuring is significant for sustaining higher charging rates, enabling fast charging of the batteries. The project is expected to impact Generation 3b batteries by lowering CRM demand, improving market entry, more efficient recycling of new cell chemistries, and a transfer of developments to Generation 4 solid state batteries. The project contributes to advancing the state-of-art for high-voltage battery cells in Europe, but is also developing the necessary manufacturing knowledge necessary to scale-up the production of such cells.

NEXTCELL

The NEXTCELL project was presented by Zahra Daneshi Far, project manager at FEV France, and Neel Sanghvi, technical coordinator of the project at the ABEE group. The project began in January, 2023 and is expected to conclude in December 2026. NEXTCELL's overall objective is to provide a new Li-ion cell generation for both high capacity and high voltage applications, by developing a ground-breaking "gellified cell" concept. The project has developed different generations of anode materials, cathode active materials and a gelled membrane separator. It has found that the choice of liquid electrolyte is crucial to produce electrodes. Further, it has defined the criteria for the liquid electrolyte to be compatible with the gelled separator. The project's key impacts are advanced Li-ion batteries with improved cost, performance, safety and sustainability, along with broader user acceptance and market penetration. With its ambitious "gellified cell" The project presents and alternative pathway to achieving the KPIs set out in the Horizon Europe call.

With the Hydra project, the Horizon 2020 efforts on developing Generation 3b cells have come to a close. The results of Hydra and her sister projects are promising and are built upon by the new set of projects, which are funded under the BATT4EU Partnership. In this new set of calls, the manufacturability is a key factor: it is a significant area of focus for the projects. This focus should help the upscaling of this technology once the current R&I challenges are overcome. The session showed that there are multiple ways of trying to achieve the ambitious KPIs for this technology and that the solutions that are developed by projects have multiple potential benefits, including cost reduction and a lower use of CRM. While the results on the development and production of the high-voltage cathodes were encouraging, it was acknowledged during the discussion by the speakers that development of the silicon-rich anodes were still a major challenge and need further attention. It was also clear that the main target for this technology is still the road transport sector. The HighSpin projects aims to learn lessons for the production of cells fit for aviation use, but those will need to transposed to the next generation of battery cells (Generation 4). Lastly, the project showed the importance of creating an integrated scientific community and the open sharing of research results. The open data platform developed within the Hydra project is a good step forward in that direction.

PLENARY SESSION:

How to achieve circularity in the automotive industry?

Summary from
Simon Edwards (Ricardo, ERTRAC Vice-Chairman & RTR Conference Chair)

Introduction

With a changing geopolitical landscape and increasing demands for natural resources, critical raw materials, circularity concepts in particular, are gaining more attention. Given this, what would a circular economy mean for the automotive industry, an industry producing 85 million vehicles per year? Consequently, a plenary, panel discussion session took place on the topic of "Circularity in the Automotive Industry", with representatives from the European Commission and along the value chain of the automotive industry.

The panellists were (from left to right in the picture above):

- **Aurel Ciobanu-Dordea**, Director of Directorate B, 'Circular Economy' – Directorate General for the Environment (DG ENV);
- **Thilo Bein**, Head of Knowledge Management, Fraunhofer LBF;
- **Stefan Christiernin**, Head of Engineering Research, Volvo Cars;
- **Fabrice Stassin**, representing BEPA, (Director Government Affairs Electromobility Projects, Coordinator for Asian Affairs, UMICORE);
- **Wolfgang Nuechter**, Mobility Electronics, Operational Sustainability Officer, Robert Bosch GmbH.

The session was chaired by Simon Edwards (Ricardo and ERTRAC Vice Chairman).

Panel Discussion

The first question was posed to the EC, **Aurel Ciobanu-Dordea,** *"The political picture has condensed over the past few years, with various strategies being developed (reflected, for example, in the Critical Raw Materials Act) and a number of legislative proposals (e.g. the Eco-design for Sustainable Products Regulation; Batteries Regulation; the End-of-Life Vehicle Regulation proposal etc.). Can you guide us through these strategies, proposals and regulations, please? What might be still to come?"*. Aurel noted that "only good things are to come" but that "it is only with circularity that we can finish the job", achieve truly sustainable mobility. However, circularity is not a single bullet. Since twenty years, Europe has been putting in place policies to decarbonise, to mitigate climate change: after many years there are results but more are needed. Circularity is needed: it is an indispensable part of sustainability. The policy and regulatory landscape is complex but, looking towards automotive decarbonisation, where competitiveness is also necessary, the EC have tailored the interventions, those that have come and will come. At scale, circularity will reduce the cost of materials and strengthen the strategic autonomy of the industry. This drive has inspired the batteries regulation, supporting electrification; more measures on recycling efficiency and recycled content are to come: the EC have understood the messages from the industry to help the proper functioning of the market. Another piece of legislation in the making is the End-of-Life Vehicles directive: its objectives are the management of the end-of-life, improving the resource efficiency, changing the vehicle design to support dismantling, to recover more materials. The landscape does not end with this, the Competitive Compass, which looks at economics and sustainability, responds to the critical situations in some industry sectors, including the automotive industry, the steel and aluminium industries etc. At the end of February, another policy paper will be the Clean Industrial Deal, with more detail, so that all can prepare for the design stage measures and engage with the European Commission. Further, we have the Strategic Dialogue with the Automotive Industry, so you can come and suggest further improvements, e.g. in relation to material efficiency and circularity measurements in the industry. Yet, questions remain, "Can we come forward with the Circularity Act at the end of 2026, one that is easy to implement for the public authorities, throughout Europe?", "Can we have vehicles that meet a minimum number of requirements for circularity, so that we can support public procurement, meet the demand?".

A second question was posed to the OEM representative, **Stefan Christiernin**, *"How is the automotive industry adapting to these new requirements? What are the economic implications thereto for the industry?"*. Stefan responded by noting that there are three aspects: energy, matter and code. Energy is half of the carbon content footprint, what is left is metal, material, this is important - we have set the goal to become fully circular

by 2040. If we do this right, it will be a "gold-mine", positive for future business. For example, considering aluminium, considering mega-castings, by making this switch, we can reduce the carbon footprint by 16%. Of course, if you want to do more, it becomes more difficult, with many variables and subjects for future research (which the EC could support). The end game needs to have a sustainable business. For example, an aluminium drinks-can is good business now, with the new circularity machines: cars are more complicated, but we have a good example now to follow. Considering now steel, dismantling is expensive, but we need to do it in an intelligent way, keeping the elemental materials apart - there are ideas from the steel industry that can solve this. Then we would have a Europe source of steel, to help control the prices, the variability. These are some of the ideas: some of the good economics.

The discussion continued with a question to the RTO representative, **Thilo Bein**, "*In order to truly implement the circular economy in the automotive industry, one aspect that will need to be further investigated and created is the concept of reverse manufacturing: the EC have expressed interest to fund this area in the future. What is reverse manufacturing and what could its implementation look like? For example, in relation to batteries?*" Thilo commented that Stefan had already stressed reverse manufacturing and noted that we must manage 10 million vehicles per year in Europe, efficiently, to extract valuable components and materials. We need to assess how the components can be used, e.g. battery second life or material recovery. We need to consider the different stakeholders, the recycling industry is dispersed at the moment, covering many industries not just automotive: so there is dilution of quality. Thus, we need to invest for the automotive industry, introducing automation, e.g. for battery reuse or recycling. We need to consider the logistics of the system, e.g. we should have centralised infrastructure for recycling, shipping is a possible problem, e.g., for batteries. We could, therefore, have a flagship project to build-up infrastructure, to demonstrate the required technologies, for steel, for plastics, maintaining product quality, testing the business model viability and energy efficiency, its effectiveness. We must bring in all players including financing to realise this. R&D can support the start of this, showing the viability of the business model, the benefits for the European automotive industry. Longer term, this is a concept that we can export to other regions of the world, for more European value, e.g. related to the 4 million vehicles that leave from Europe each year.

The discussion moved on with a question to the BEPA representative, **Fabrice Stassin**, "*Achieving circularity in the automotive industry means much more than focusing on "clean vehicles". To truly embrace circularity, we need to ensure that all materials being used to produced vehicles, being used during vehicle operation, are recycled/recyclable/recoverable. Where do we stand and where do you see the critical barriers in relation to these aspects in the next 5 to 10 years?*". Fabrice noted that there

are three groups of challenges that are known: circular economy starts with the product design and manufacturing (hence EVs are working on higher energy dense battery packs, stationary applications are considering other materials, otherwise there are solid state batteries) and, considering the product design, we need to bring repairability and durability to the fore. Further, in production, particularly with the beginning of a new product, we have a lot of initial waste: we need to recover this scrap, so the design and the production process can help here. The second challenge is collection (and not loss from Europe); morally, we should ensure that exported materials are handled with the same conditions as we have within Europe. Further, we need to see digital product passports, "track and trace" brings accountability. Finally, if we want to recycle, we need CO_2, water, land-use and chemical minimised processes, ones that can be profitable so that they continue and survive. We need an industry to do this, hence we need a framework to encourage the birth of this industry, that is a job for the new Commission.

This topic was continued with a question to the Tier 1 supplier, **Wolfgang Nuechter**, "*When we discuss circular value chains for the automotive industry, the importance of batteries and electric vehicles in the future are quite obvious. What about the electronic and semiconductors devices, which being used more and more in vehicles, e.g. also in the future for connectivity and automated driving? How will the Circular Economy look like for such devices, such components?*". Wolfgang looked back to cars 50 years ago, a handful of electronic components, now there are at least ten times as many. Electronics are in about 4 or 5th place, in terms of the mass of the vehicle. One challenge is that this is not one block of material, it is distributed throughout the car, you have the connectors, you have the housings as well as the electronics themselves. The housings are not the electronics, even though they is 80% of the mass of the 'electronic components'. The silicon-chips are a lower mass but the electronics dominate the CO_2 footprint of the control unit. It is not a recycling issue - it is a value-add issue. How do we get the value back? We must use refurbishment, repair and remanufacturing, End-of-life is not the solution for electronics: via the design phase, we are reducing the number of electronics, e.g. through the use of cloud rather than on-board computing. Further we are going smaller and smaller, components, that use less energy. Hence, we must retrieve the value-add during the lifetime of the products: as a Tier 1 we offer retrieval to our OEM partners, to keep the vehicles, the components in service for longer. But this is only one part, we need a concept to design re-use into the components, to design-in recovery of the components. This is a research need that still needs to be achieved.

Aurel, coming back to what he had heard from industry, noted that he recognised the issues that we have, whilst adding that, without increasing the policy landscape complexity, the EC are considering complementary measures: how do we look at the

carbon footprint of materials, e.g. steel or aluminium, whilst including the scrap aspect. Yet, the biggest challenge is, "how do we manage the scale?": with the low prices in the markets for CRM, there is a big economic challenge to make recyclates cheaper than raw materials. The EC are looking at that as well, the wider landscape, to support the industry competitiveness: to make things more appealing for the components.

Stefan agreed directly: it has to make good business sense. Considering casting, we need to design, to manufacture differently to make recyclability a better business. More challenging are the prices of circular compared to virgin metals, yet, if we have smarter disassembly, we find new value in the entire chain, so that the recycled materials may be lower price. Further, Finance needs low risk, digitalising is comparatively easy - for materials there are four or five risks more risks. Hence, we need to step-up derisking activities along the value change, we need to do this within the research and development actions.

Thilo raised two additional points: secondary materials must be cheaper, yes, but we have also competition between sectors. Sometimes this leads to higher prices for recycled materials. Hence, we need a system-approach, also considering the vehicle lifetime of 10-12 years before the materials return into the value chain. For this we need information, digital data, the exchange of this across the value chain. This may need more investment, e.g., perhaps more than for the EV transition. He noted that shredding is not a value add!

Wolfgang noted that, considering how to know what to recycle from the car, the digital passport will help here, achieve economy as best as possible, to keep the cars in the loop. However, there is an economic constraint for the recycling of electronic components, this is resulting from the logistics of the recycling chain. We must have easily dismantle-able cars to improve this. Further, considering gold, cars are sometimes more concentrated with gold than natural sources, but for tin it is otherwise So we must design in economic recyclability through complementary materials choices.

Fabrice considered the economics and the industry, noting that we will not recycle if there is not an industry in Europe. There are three elements: firstly, profit comes from scale (tens of millions of vehicles, for many years to come). Secondly, private investors are not there unless the regulation is clear, battery regulation is a good example, but we need the secondary regulation otherwise there will not be investment (take the CO_2 footprint calculation as a difficult case in point). Thirdly, we need the logistics to fill the large factories: moving waste around Europe is very difficult. We must improve, free-up the logistics regulations. Finally, the price of electricity is too high in Europe compared to the competition.

Aurel had three comments: the Delegated Act on the Carbon Footprint has been controversial, it has been difficult, the energy mix is the issue for the calculation, but it will be finished this year. On the point of battery recycling, the EC are concerned about this - an obligation for recycled content does not solve the problem, black mass may be toxic, so we must handle it appropriately, not allow it to go to other countries without regulation. The EC are thinking about novel ideas to solve this: encourage recycling in Europe without endangering international trade, and will have a solution to this soon. Yet questions remain, "How do we promote 're-made in Europe'?", "What is the role of the closed-loop to reduce the sectorial competition, to protect individual sectors?". He agreed that without demand, without regulatory balance, the industry supply will not "get off the ground". Here the EC shares the same views as the industry.

Stefan asked: "how to make this work?". It is really complicated. One super important point is data. How things are used, if they can be reused, how they should be handled, how that data can come in real time into the recycling process? He noted that, if we get data right in Europe, the Circular Economy will have less inherent friction, enabling new design methods, managing material variability better: this would be a great competitive advantage, if Europe gets there first.

Thilo, added one further aspect, there will never be 100% circularity, there will always be some losses, so, we do always need some alternative material sources. One urgent aspect is to investigate the PFAS situation, within a Circular Economy perspective.

Simon, in closing the session, thanked all and noted that this had been a stimulating discussion, covering policy, research and industrial aspects; that Europe must carry on integrating these aspects, to maintain planning, stability, resilience and independence. He suggested that the panel get back together again in five years to see how well Europe has done by that time.

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