Integration of E-Mobility into Energy System

11 April, 2024, Geneva and online

Workshop Report

The Workshop on Integration of E-Mobility into Energy System was organized jointly by UNECE Group of Experts on Cleaner Electricity Systems, UNECE Group of Experts on Energy Efficiency, and UNECE Group of Experts on Renewable Energy, in cooperation with the UNECE Working Party on Transport Trends and Economics (WP.5)

The workshop was held in Geneva (Palais des Nations) and online on 11 April 2024 from 15:00 to 18:00 CEST. The format of the event was hybrid (in-person and online). The workshop was attended by 65 experts from Albania, Armenia, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, France, Georgia, Germany, Hungary, Latvia, Lithuania, Netherlands, North Macedonia, Norway, Portugal, Republic of Moldova, Romania, Russian Federation, Spain, Sweden, Switzerland, Ukraine, United Kingdom, United States of America, Uzbekistan (total 65 participants, of which 19 women).

Introduction

UNECE Secretariat represented by Ms. Nadejda Khamrakulova, Secretary, UNECE Group of Experts on Cleaner Electricity Systems; Mr. Igor Litvinyuk, Secretary, UNECE Group of Experts on Energy Efficiency; and Mr. Gianluca Sambucini, Secretary, UNECE Group of Experts on Renewable Energy welcomed participants of the workshop and made introductory remarks. The Secretariat indicated the importance of this joint initiative by three UNECE Groups of Experts and emphasized collaboration with the UNECE Working Party on Transport Trends and Economics.

UNECE activities related to e-mobility

Mr. Jim Robb, Chair, UNECE Group of Experts on Cleaner Electricity Systems opened the floor and provided insights on the implications of Electric Vehicles (EVs) in the energy system, a primary focus area for the Group of Experts on Cleaner Electricity Systems. Mr. Robb observed that widespread EV adoption may lead to a steep increase in electricity demand, especially given the transport sector's significant energy consumption. The importance of electricity as a mechanism for energy delivery, not a source, necessitates careful consideration of the energy's origin and how it's delivered to EVs. Mr. Robb pointed out that peak hour charging presents challenges and strategies are needed to manage and shift EV charging to times with excess grid capacity. Substantial investment will be required in the infrastructure for distribution, transmission, and electricity generation. And strategic planning for the deployment and location of charging stations is critical, particularly large ones for vehicle fleets and workplace integration.

Mr. Robb indicated that EV-related grid stability challenges due to demand variability must be addressed by grid operators. There's potential for EVs to complement renewable energy by providing demand flexibility that aligns with the generation patterns. He specifically pointed out that UNECE member States are formulating policies to promote e-mobility but should pay attention to the implications for the electric grid.

Additionally, the consumer charging behavior will influence tariff design, demand response programs, and engagement initiatives. In terms of further actions, development of forecasting and management tools for integrating EVs with renewable sources is necessary. For developing vehicle-to-grid (V2G) technology, leveraging EV batteries for grid support must be considered in the same context as other resources that contribute to grid reliability. Overall, the complex interplay between e-mobility and the electricity system

demands exceptional cooperation among utilities, regulators, automakers, technology providers, and consumers for a successful and smooth transition.

Mr. Stefan Buettner, Chair, UNECE Group of Experts on Energy Efficiency greeted the participants of workshop and highlighted the significance of energy efficiency in the context of mobility as well as emphasized the need to shed light on unknown nuances in energy efficiency perspectives. Mr. Buettner pointed out that the concept of e-mobility is discussed in relation to location efficiency, emphasizing the idea that mobility is necessary when what is desired is not present at the current location. He extended the discussion linking mobility with other factors, such as buildings, industry, transport, and infrastructure, emphasizing the need for location efficiency in various urban and rural environments. He delved into the broader scope of EVs beyond just cars, recognizing various types of electric vehicles and the importance of tailoring systemic solutions for efficiency in different purposes. There is a recognition of challenges, such as grid capacity issues, but also opportunities, such as utilizing self-generated renewables and vehicle-to-grid approaches to enhance flexibility and efficiency in energy usage. In particular, Mr. Buettner indicated that collaboration between the Groups of Experts is needed to address challenges and leverage opportunities, highlighting the importance of working together to find effective solutions in energy efficiency in relation to e-mobility.

Mr. Kostiantyn Gura, Chair, UNECE Group of Experts on Renewable Energy continued the floor and expressed gratitude for cooperation with UNECE secretariat and the partner Groups of Experts. Mr. Gura stressed that the ongoing energy transition is highlighted as a means to reduce emissions and pollution, with a focus on the importance of e-mobility and the installation of new EV charging points to influence energy demand. He sees that the trend towards renewable energy is emphasized as a way to build reliable and decentralized energy systems that can meet modern energy demands. Mr. Gura pointed out on the importance of crosscutting cooperation to increase the uptake of renewable energy. He indicated that strengthening renewable energy integration into resilient energy systems is underscored, with key plans outlined for future years.

Mr. Gura informed participants on the workshop about the recent event in Georgia that covered e-mobility topic, and stressed the necessity of collaboration between Groups of Experts to facilitate the development of e-mobility. Mr. Gura confirmed his readiness to contribute to the joint work of UNECE Groups of Experts and the Informal Task Force on E-mobility as well as collaboration efforts to advance the development of e-mobility and sustainable energy systems.

Ms. Els de Wit, Chair, UNECE Working Party on Transport Trends and Economics (WP.5) greeted all participants and emphasized the unique opportunity for collaboration between the transport and energy sectors, highlighting the role of UNECE in bringing together these forces within the organization to address emerging issues. Ms. de Wit indicated that there is a trend towards electrification in various transport modes, including passenger vehicles, heavy-duty vehicles, inland waterway vessels, and rail as part of the broader decarbonization efforts across the transport sector.

She pointed out that the increasing use of electric fleets in transport poses challenges to energy grids and electricity networks, especially in urban areas like Utrecht and Amsterdam in the Netherlands, where older infrastructure may struggle to meet the demands of zero emission bus fleets.

Ms. de Wit mentioned that WP.5 has been tasked with setting up a special task force in collaboration with other relevant working parties and intergovernmental groups to align on future steps in harmonizing and standardizing vehicle and infrastructure requirements to support the electrification trend while considering the implications on policy and infrastructure development.

The focus is on facilitating integrated policymaking across sectors, including e-mobility, energy, and digitalization, to ensure effective alignment and coordination as the transport sector transitions towards electrification and sustainable practices.

Ms. de Wit expressed readiness and commitment to collaborative efforts within the UNECE framework, highlighting the importance of knowledge sharing, smart charging solutions, and policy development to address the challenges and opportunities in the evolving landscape of sustainable energy and transport.

Session I: Effective management of EV charging demand

Moderator: Mr. Stefan Buettner, Chair, UNECE Group of Experts on Energy Efficiency

Mr. Buettner mentioned that effective energy management is identified as a critical issue, especially in situations where there is a limited energy supply or when energy availability does not align with demand. He pointed out the challenge faced by energy grids when a large number of EVs need to be charged simultaneously, leading to potential capacity constraints and limitations in the grid's ability to support the increased demand.

The moderator invited three experts to share insights and perspectives on EV charging technology, provide information and possible solutions to address the challenges related to energy management and the growing demand for electric vehicle charging. He stressed out that approach of inviting experts with specialized knowledge underscores the collaborative effort to address the complexities of managing energy supply and demand in the context of EV charging, highlighting the importance of expertise and diverse perspectives in finding effective solutions.

Setting the scene:

Ms. Susanne Koblitz, Independent Expert EV Charging Technology, Germany

Ms. Koblitz highlighted the challenges faced from a standardization perspective in the interface between EVs and charging infrastructure. The interface between vehicles and charging stations is not only technically complex but also involves cultural challenges due to differing design and certification processes in the mobility and electricity industries. Ms. Koblitz discussed the challenges related to grid stabilization and industry norms, particularly in Vehicle-to-Grid (V2G) systems. Certification processes, power transfer determinations, and energy needs must be reconciled between electric vehicles and the electricity grid.

She pointed out that the focus is on the importance of load management and peak shaving[1] for successful energy transitions, emphasizing the need for efficiency in managing energy demand and response times, especially in grid-quality and peak electricity demand scenarios. To address compatibility issues and improve technology integration, collaboration between industrial and development cultures in the mobility and electricity sectors is necessary.

Ms. Koblitz stressed the importance of aligning technologies and thinking collectively to overcome challenges and enhance the effectiveness of energy management solutions.

Mr. Vladimir Budinsky, Vice-President, EURACOAL

Mr. Budinsky highlighted the importance of collaboration among experts in the UNECE for addressing energy and sustainability challenges. He shared personal experience with using an electric vehicle, emphasizing the behavioral changes and organizational planning required for efficient use, charging, and strategic decision-making.

He further focused intervention on the current global energy system, highlighting the dominance of fossil fuels such as oil, coal, and natural gas, with electricity accounting for less than 20% of global energy supply. Mr. Budinsky emphasized the need to transition to a more sustainable energy system, particularly in transportation and heating sectors, requiring a significant increase in electricity production, distribution, and transition to renewable energy sources. Such transition involves replacing fossil fuels with renewable energy sources like solar, wind, bioenergy as well as nuclear energy. He underscored the challenges and

[1] Peak shaving involves briefly reducing power consumption to prevent spikes. This is achieved by either scaling down production or sourcing additional electricity from local power sources, such as a rooftop photovoltaic (PV) system, batteries or even bidirectional electric vehicles.

investments required to scale up renewable energy production and adopt new technologies within a limited timeframe. Mr. Budinsky highlighted the substantial investments, estimated at trillions of US dollars globally, required to transition to a sustainable energy system within the next 25 years. This includes increasing renewable energy capacity, upgrading distribution systems, and transitioning to efficient energy transmission methods.

He also noted challenges in building new energy infrastructure, such as high voltage lines, due to local resistance and regulatory hurdles. Managing the construction of such infrastructure projects requires careful planning and community engagement. Mr. Budinsky stressed the magnitude of the challenges ahead in transitioning to a sustainable energy system and emphasized the importance of collaboration, shared knowledge, and mutual support among stakeholders to address these complex issues effectively.

Mr. Furugzod Usmonov, Energy Expert, Tajikistan

In his intervention, Mr. Usmonov highlighted Tajikistan's critical energy challenges, such as high oil prices, dependence on energy imports, and significant pollution from the transport sector. To address these issues, Tajikistan is focusing on e-mobility initiatives, leveraging its abundant hydroelectric potential for sustainable energy production. Tajikistan has set ambitious targets to shift towards e-mobility, aiming for 55% of transportation to be electric by 2037 and transitioning all public buses and transport to electric cars by 2028. The government has implemented legislative measures to control pricing, issue licenses, and encourage the use of EVs through tax exemptions.

The lack of common charging standards across countries poses a challenge for Tajikistan, where EV standards from China differ from the European norms, affecting the popularity and adoption of EVs. The country faces infrastructure challenges, including electricity shortages in the regions, and the limitation of electricity in winter provides additional challenge for charging systems.

Mr. Usmonov mentioned the issue of overloading the electricity grid due to the high demand for charging EVs. To address this, regulatory measures are being considered, such as bans on charging during specific peak hours and the possibility of differentiated pricing for electricity consumption.
He emphasized the importance of participating in international discussions and learning from international best practices to address these challenges effectively. Collaboration with other countries can help Tajikistan overcome obstacles in e-mobility adoption and infrastructure development.

Mr. Usmonov also touched upon the evolving nature of charging infrastructure, with considerations for mobile-oriented versus network-oriented charging solutions. To anticipate future challenges and align with international standards, he acknowledged the need for continuous learning and adaptation within Tajikistan's interministerial working group on e-mobility.

Open discussion:

The moderator, Mr. Stefan Buettner, raised several questions regarding management of EV charging in scenarios where multiple vehicles need to charge simultaneously, particularly in the context of corporate fleets. The questions address the challenge of ensuring that EVs are fully charged for their primary transportation purposes while also managing and balancing the electricity load to prevent overloading the grid.

Ms. Susanne Koblitz responded that technology already implemented in EVs allows users to communicate their charging needs and preferences. EVs can be programmed to limit charging to a specific percentage, such as 80%, to protect the battery's health. Users can set different charging levels based on their needs, ensuring the battery is optimized for longevity and performance.

Users can adjust their charging preferences based on their anticipated travel needs for the next day. For instance, they can choose to fully charge the vehicle overnight if longer trips are planned, ensuring the battery is ready for extended journeys. The average daily energy consumption for most drivers in Europe

is around 50 kilometers, equivalent to approximately 10 kilowatt-hours. Understanding these typical usage patterns helps in managing the charging process efficiently and effectively.

In cases where additional charging is needed for business travel or longer trips, fast charging stations can rapidly recharge EVs within a short stop of 10 to 15 minutes. This allows for quick top-ups of the battery to accommodate immediate travel requirements.

The advanced features and capabilities are available in current EV technology to address charging needs, optimize energy consumption, and provide flexibility for users in managing their daily and business travel requirements.

The moderator commented on the need for sophisticated charging management, especially for corporate fleets, to anticipate and plan for the next day's travel requirements effectively. Managing a corporate fleet of EVs requires a proactive approach to ensure that each vehicle is adequately charged based on the distance it needs to cover the following day. By planning ahead and understanding the expected travel distances, fleet managers can optimize charging schedules to meet operational needs efficiently.

Ms. Susanne Koblitz reiterated that many of the elements, such as advanced planning, smart load management, and strategic charging for corporate fleets, are already in place or easily implementable in the context of EV management. In scenarios where corporate fleets operate within predefined regions or travel distances, planning and managing their charging needs become more straightforward. The energy management system can leverage this information to optimize and schedule charging activities efficiently. Various software solutions exist to support the management of EV fleets, enabling the integration of different needs and optimizing energy consumption. These tools play a vital role in streamlining charging operations and ensuring that vehicles are ready for their anticipated travel requirements.

Ms. Koblitz indicated that approximately 70% of the necessary technology and solutions are already available to optimize fleet energy management. While there may be a room for further enhancements and system maturity, the existing technology landscape offers a strong foundation for achieving significant optimization in charging processes.

The moderator raised questions pertaining to the challenges associated with different standards and compatibility issues in EV charging systems across various regions and countries. EVs come from various manufacturers and regions, leading to differences in charging plug designs and standards. The lack of universal compatibility can pose challenges for EV owners, particularly when crossing borders and needing to charge their vehicles in different countries.

The presence of multiple plug types and charging standards across regions, including within countries in the UNECE region, complicates seamless charging experiences for EV users. Differences in plug designs and charger configurations can hinder accessibility and convenience for charging infrastructure users.

In addition to physical compatibility challenges, the question also addressed the issue of payment systems for EV charging. Ensuring seamless and user-friendly payment processes for electric vehicle charging across borders is crucial for promoting the adoption and usability of EVs in diverse geographical areas. This suggests that international organizations like the UN may play a role in addressing standardization and compatibility challenges in EV charging infrastructure.

Ms. Susanne Koblitz provided a response with an overview of different charging standards and systems used for EVs worldwide. The Combined Charging System (CCC) integrates both AC and DC charging capabilities and is widely adopted in Europe and the US, with slight variations in connectors for the European 230 Volt AC part and the US 110 Volt AC part. The CHAdeMO system is a DC charging standard that was previously in competition with CCS in Europe. However, most car manufacturers have now shifted towards CCS as the preferred DC charging system. The GBT standard from China also plays a role in the global EV charging landscape, with different technologies and standards competing for prominence in emerging immobility markets. Ms. Koblitz highlighted the competition between European and US

technologies with Chinese technologies in the rollout of EV charging infrastructure. The interoperability of connectors is crucial for ensuring compatibility among different charging systems.

While connector compatibility is a primary concern for charging infrastructure, payment systems represent another important aspect of the user experience. The payment solutions are more of a payment challenge rather than a technology challenge, with regulations often requiring support for credit card or banking card payments to facilitate convenient and accessible charging experiences for EV users.

Mr. Jim Robb raised concerns about cybersecurity in EVs and charging infrastructure, particularly in light of the expanding attack surface created by digital connectivity and integration in modern transportation systems. He asked a question about the levels of cyber security built into the vehicles and/or the charging infrastructure.

Ms. Susanne Koblitz shared her insights on the advancements in cybersecurity within the EV charging infrastructure industry, particularly in the context of implementing Plug and Charge technology in Europe. Plug and Charge allows for automatic authentication of the vehicle without human interaction or the exchange of payment details. This streamlined process enables automatic payment transactions, with billing handled post-transaction based on vehicle identification.

The implementation of Plug and Charge necessitates a higher level of cybersecurity to ensure secure and seamless transactions between the vehicle and charging infrastructure. This shift towards automated payment processes requires robust security measures to safeguard against potential cyber threats and vulnerabilities.

The industry is progressing towards enhancing cybersecurity measures within EV charging infrastructure. While vehicles are well protected at the charging interface level, focus is also directed towards improving cybersecurity on the charging station side to address evolving threats and challenges.

Industry stakeholders are actively working towards certifications and standards that align with the increasing cybersecurity requirements in the immobility sector. By staying abreast of emerging threats and advancements in cybersecurity technologies, the industry aims to enhance security protocols and mitigate risks associated with electric vehicle charging infrastructure.

Mr. Vladimir Budinsky provided insights on the robustness of distribution systems in Europe, emphasizing the need for adequate preparation and strategic planning to accommodate the increasing adoption of EVs. The distribution systems in Europe are designed to allocate sufficient capacity based on the appliances and electricity usage listed by consumers upon applying for an electricity contract. The analogy of a six-lane highway with most traffic concentrated on one lane illustrates the current distribution system's capabilities to handle the existing load efficiently.

As the penetration of EVs increases, there is a need for proactive measures to expand and reinforce the distribution and transmission infrastructure. While the current EV adoption rate is relatively low, long-term planning is essential to avoid potential capacity constraints when EVs become more prevalent.

The example of Geneva's bus system (presented earlier at the GECES session) highlights the implementation of smart strategies, such as utilizing smaller battery-powered buses that can be charged during downtime using renewable energy sources. This approach optimizes energy usage, reduces reliance on non-renewable resources, and demonstrates the importance of deploying sustainable and efficient charging solutions for electric vehicles.

Mr. Budinsky emphasized the significance of optimizing battery size and implementing strategic charging practices to balance factors such as weight, energy consumption, and costs in EVs. Efficient battery management and smart charging techniques play a crucial role in optimizing the performance and sustainability of electric vehicles while minimizing operational expenses.

The moderator discussed the importance of systemic efficiency in transportation logistics, highlighting the need to consider various factors such as distance, infrastructure availability, and mode of transport to

optimize energy usage and operational efficiency. The significance is in assessing the most efficient transport mode based on factors like distance, existing rail infrastructure, and load capacity. By considering modal shift options and leveraging rail transport for long-haul distances and electric trucks for last-mile delivery, companies can enhance operational efficiency and reduce energy consumption.

The transition to electric trucks for urban deliveries, as seen in Germany with companies like DHL and the Postal Service, underscores the shift towards sustainable transport solutions for short distances. The availability of charging infrastructure along transportation routes plays a crucial role in facilitating the widespread adoption of EVs for freight transport and reducing dependency on fossil fuels.

He highlighted the need for multi-modal transport solutions that combine different modes of transportation to maximize efficiency and minimize environmental impact. This approach involves integrating rail electrification, high-speed passenger rail, and dedicated freight routes to optimize logistics operations and energy usage across various transport networks.

Mr. Jim Robb raised the interconnected questions regarding lithium supply, battery capacity development, and the potential shift towards incentivizing plug-in hybrid vehicles with smaller batteries.

Ms. Britta Gross responded that automakers, including industry leaders like General Motors, Ford, and Tesla, are adept at managing complex supply chains and securing binding contracts for essential materials like lithium and cobalt to support battery production for EVs. The industry's focus is on ensuring a stable supply of critical resources which highlights the strategic approach taken by automakers to address potential challenges related to materials sourcing and battery manufacturing.

The rapid pace of innovation and technological advancements in battery technology offers opportunities for continuous improvements, including the transition towards solid-state batteries and other advanced technologies in the future. As the industry progresses, automakers can adapt to evolving battery technologies and explore right-sizing strategies to optimize battery capacity based on consumer needs and driving patterns.

The concept of right-sizing batteries aligns with consumer preferences and driving habits, as most individuals do not regularly require the full range offered by larger capacity batteries. By designing vehicles with appropriate battery capacities that align with daily commuting distances and typical usage patterns, automakers can enhance efficiency, cost-effectiveness, and sustainability in electric vehicle adoption.

Mr. Ray Pilcher, the Chair of the Group of Experts on Coal Mine Methane and Just Transition (CMMJT) and professional with a background in exploration geology and resource development, brought a perspective on the challenges and opportunities in harnessing resources like lithium for battery production. While there is a sustainable supply of resources for now, he underscored the importance of being prepared for potential disruptions caused by geopolitical pressures, which can impact the availability and access to critical materials such as rare earth metals, cobalt, and lithium.

He provided suggested that plug-in hybrids could be a viable solution for addressing transportation needs. Emphasizing the importance of diversity in transportation technologies, he pointed out the significance of developing hydrogen fuel cell-driven vehicles, particularly for heavier transport applications. This approach allows for diversified options beyond electric plug-in vehicles and presents an opportunity to address specific challenges in the transportation sector.

Mr. Pilcher advocated for integration of independent systems, such as hydrogen fuel cell technologies, to complement the transition towards electrified transport and reduce dependence on the grid for all transportation needs. Recognizing the need for a multifaceted approach to sustainable transportation, he highlighted the importance of considering alternative fuel options, system resilience, and efficient resource management to address the evolving demands of the transportation sector.

He made observation that rapid adoption of alternative technologies, such as EVs and hydrogen fuel cell systems, in heavy transport and industries like mining reflects a growing trend towards decarbonization and sustainable practices.

The Moderator commented that exploration of alternative battery technologies, such as nature-based batteries and sustainable mining practices, reflects a commitment to environmental stewardship and resource efficiency. Research into nature-based batteries offers a potential solution to mitigate environmental impacts associated with traditional battery materials like lithium. While nature-based batteries may have lower energy densities compared to lithium batteries, they hold promise in terms of sustainability and reduced environmental harm during the extraction and production processes.

Initiatives like the use of spa thermal water in the Rhine Valley for mining operations demonstrate innovative approaches to minimize environmental impact and energy consumption in resource extraction. Leveraging natural resources, such as thermal water, to power mining processes underscores the importance of sustainability and resource efficiency in the mining industry.

By exploring nature-based battery technologies and adopting sustainable mining practices, stakeholders can reduce reliance on environmentally harmful materials and mitigate geopolitical risks associated with critical resource dependencies.

Ms. Els de Wit commented that dicussion was touching upon several crucial aspects of sustainable transportation and the circular economy. She mentioned the significant efforts within her ministry to focus on recycling batteries to minimize waste, prolong their lifecycle, and reduce pressure on the overall system.This aligns with sustainability goals and aims to optimize resource utilization while addressing potential environmental impacts associated with battery disposal.

The trend among Original Equipment Manufacturers (OEMs) to seek autonomy and control over battery resources highlights a shift towards new business models, such as VDL energy systems managing bus operator needs. Unleashing new markets through innovative approaches can create opportunities for policymakers to understand and support emerging trends in the industry while mitigating challenges associated with supply chain control.

Acknowledging the evolving landscape of transportation challenges, the focus on multi-modal transport, heavy-duty, long haul, maritime, and aviation sectors underscores the need for tailored solutions beyond passenger vehicles. The integration of multi-modal transport systems presents challenges and opportunities, particularly in addressing the charging infrastructure needs for continuous operations in heavy transport sectors.

Utilizing transport data and digital solutions can optimize routing, modalities, and charging demand, enhancing efficiency and effectiveness in transportation operations. She emphasized the importance of interconnected systems and interoperability across regions and continents to streamline transport, energy systems, and to create efficient corridors for seamless mobility solutions.

Ms. Susanne Koblitz shared perspective on the considerations related to plug-in hybrid vehicles and the complexity of their dual energy storage systems. Plug-in hybrid vehicles feature dual engines, two energy storage systems, and two drive trains, comprising both an electric component and a combustion engine system. The presence of multiple components, including the battery, combustion engine, fuel tank, and associated drive train elements, contributes to the overall weight and complexity of plug-in hybrid vehicles.

While plug-in hybrids offer the flexibility of utilizing electric power for day-to-day commuting and a combustion engine for long-distance travel, the trade-off includes carrying the additional weight and components of both propulsion systems. Achieving energy savings through a lighter, smaller battery for everyday use may be offset by the weight and space requirements of the combustion engine and associated components when considering long-range driving requirements.

Reflecting on personal experience with a battery that offered sufficient range for daily commuting but presented challenges for longer trips due to frequent recharging stops, she emphasized the importance of balancing battery capacity for both regular usage and occasional longer journeys.

Ensuring a suitable buffer capacity in the battery for extended travel needs while maintaining efficiency and practicality is a key consideration in designing EVs for varying driving scenarios.

Mr. Furugzod Usmonov shared additional insights and concerns regarding the challenges and opportunities faced by countries like Tajikistan in managing battery recycling and regulating the importation of vehicles with electric components. The issue of battery recycling and management poses a significant challenge particularly in the context of adopting European directives that may not align with the local market dynamics. With the importation of cars from Europe that have varying battery capacities and lifespans, there is a need to address potential concerns related to the disposal and recycling of these batteries once they reach the end of their lifecycle.

To safeguard the domestic market and prevent becoming a repository for outdated EVs with shorter battery life, Tajikistan is exploring regulatory options, such as imposing limitations on the age of imported vehicles or revising tax incentives to encourage the importation of newer, more sustainable models.Evaluating the feasibility of repurposing used EV batteries for solar PV stations presents an innovative solution that could potentially address both environmental concerns and energy storage needs.

Seeking insights from international experiences, such as the United States, on reusing electric vehicle batteries for solar applications can provide valuable guidance on sustainable energy storage solutions and circular economy practices. By exploring alternative uses for retired EV batteries and integrating them into renewable energy infrastructure, Tajikistan can potentially leverage existing resources to enhance energy storage capabilities and support the transition towards cleaner, more sustainable energy systems.

The moderator shared information about the second life opportunities for EV batteries and the importance of responsibly managing their lifecycle to prevent environmental harm and promote sustainability. EV batteries, due to their large volume and cost per kWh optimization, present second life opportunities for applications such as buffering renewable energy storage.

Examples of innovative projects repurposing EV batteries for renewable energy storage demonstrate the potential for sustainability and resource optimization in the energy sector. Companies producing vehicles in the European Union are subject to EU taxonomy regulations, which require them to report on and manage the lifecycle impacts of their products.The cradle-to-grave approach and responsibility for sustainable management of EV batteries align with efforts to promote environmental stewardship and circular economy principles in the automotive industry.

Emphasizing the need to avoid dumping valuable raw materials and to prevent environmental pollution, stakeholders must prioritize solutions that support a closed-loop system and minimize negative impacts on the environment. Engaging in ongoing discussions, research, and collaboration to find effective strategies for the responsible management and utilization of EV batteries is essential for promoting sustainability and mitigating environmental risks.

Session II: Challenges of integration of e-mobility into electricity system

Moderator: Mr. Jim Robb, Chair, UNECE Group of Experts on Cleaner Electricity Systems

Mr. Robb transitioned the focus of discussion towards interaction of EVs with the electricity system, as well as introducing the speakers for this session. The conversation pivoted towards exploring the dynamics of EVs in relation to the electricity system. The discussion aimed to delve into how EVs interact with the electricity grid and impact energy systems, highlighting the importance of understanding this integration for efficient energy management.

Setting the scene:

Ms. Britta Gross, Director of Transportation, EPRI shared insights into the challenges and opportunities related to the electrification of the transportation sector in the United States, as well as the importance of collaboration, transparency, and strategic planning in navigating the complex landscape of EV integration.

She indicated that the United States has set ambitious goals for carbon reduction and the transition to EVs, driven by federal and state initiatives focusing on environmental sustainability and the economic viability of the auto industry. Ms. Gross included information about the competition from global manufacturers, including those from Europe and China, which underscores the urgency to adopt EV technologies and propels innovations in the market.

The existing utility grid infrastructure in the U.S. faces challenges in accommodating the rapid adoption of EVs, especially concerning the timing mismatch between the deployment of electric trucks and the grid's capacity to support them.Coordination with the diverse landscape of 3,200 utilities across the U.S. and addressing the complexities of planning and implementing grid upgrades are essential to accelerate EV adoption.

Innovative tools, such as eRoadMAP,[2] aim to provide early warning to utilities and prioritize grid upgrades based on anticipated EV loads from cars, buses, and trucks. Leveraging data analytics and telemetry information from major vehicle manufacturers and fleet operators can facilitate informed decision-making and strategic investments in grid infrastructure.

Strategies like load shaping, shifting, and shedding are critical to optimizing the charging of EVs and minimizing peak demands on the grid. There is a necessity for scaling up collaboration among automakers, fleet operators, utilities, and regulators to establish reporting standards, transparency, and coordinated efforts towards electrification goals and grid modernization.

Transparency in investment plans, available hosting capacity on the grid, and collaborative decision-making processes are vital for aligning stakeholder interests and effectively managing the electrification of fleets. By creating alignment and clarity around deployment priorities and grid upgrades, stakeholders can streamline the transition to EVs and ensure sustainable and cost-effective outcomes.

Mr. Jim Robb highlighted the significant challenge of integrating large loads, including data centers and fleet vehicles, onto the utility grid, with some reaching gigawatt levels. The scale of such operations, as exemplified by Amazon, underscores the importance of addressing grid capacity and reliability to support the growing demand for EVs and other high-energy consumers in the U.S.

Mr. Bendik Nybakk Torsæter, Research Manager, SINTEF Energy Research, Norway shared insights and experiences from Norway regarding the integration of EVs into the grid. The rapid adoption of EVs in Norway and the successful management of grid integration without significant challenges serve as a significant benchmark for other regions aiming to transition to cleaner transportation systems.

In particular, Norway has achieved significant penetration rates of EVs, with over 80% of new cars sold being fully battery electric and a projection that more than 50% of the total car fleet will be electric by the end of 2024. This success underscores Norway's leadership in EV adoption and the effective integration of EVs into the transportation system.

[2] The interactive energy map that presents the approximate amount of energy needed at a local level to electrify transportation over time for light-, medium- and heavy-duty electric vehicles.eRoadMAP seeks to support users by highlighting areas where multiple customers may be clustered around one or two feeders and can help foster discussions between a utility and customer to support proactive infrastructure planning.

Research projects such as "Charging Infrastructure of the Future" and "Mega Charge" are focused on developing cost-effective and user-friendly integration solutions for EV charging infrastructure, particularly high-power charging stations. These projects emphasize the interconnection between the transport system and the power system, highlighting the need to consider the impact of different charging infrastructure types on grid operations and planning.

Fast-charging stations are identified as a future flexible resource that can have a substantial impact on the power system. Managing these resources efficiently and considering them as potential assets for grid flexibility are crucial aspects of grid integration planning. Viewing fast-charging stations as more than just a load on the system but also as a valuable resource that can be utilized strategically for grid optimization is key to maximizing their benefits.

The "Mega Charge" project focuses on the electrification of heavy-duty transport vehicles, involving various stakeholders along the value chain to address cost-effective deployment of charging infrastructure, development of charging modules, control system integration, and the utilization of charging services to distribute loads effectively.

The presentation of Mr. Torsæter highlighted the importance of research, collaboration, and strategic planning in achieving a sustainable transition to electric transport. The focus on flexible resource management, interconnection between transport and power systems, and cost-effective solutions serves as a model for addressing similar challenges in other regions.

Mr. Frantisek Budinsky, Hungary shared experience and perspective on the usage patterns of EVs, particularly emphasizing the fact that most EV users do not deplete their entire battery capacity on a daily basis. Additionally, he highlighted the prevalent use of AC charging for regular daily charging needs, with fast-charging solutions like Ionity and other providers primarily utilized for longer trips. The insights aligned with the trend of consumers increasingly seeking bidirectional charging options and dynamic off-peak charging solutions to optimize their EV charging experience.

Mr. Budinsky mentioned the growing interest among EV users in bidirectional charging and off-peak charging solutions, showcasing examples like the offers from Octopus company in the UK, which provide green energy options at lower prices during specific timeframes. His suggestion for a centralized and standardized solution to manage high-demand devices like EVs and heat pump systems, leveraging predictive energy production data and utilizing energy stored in car batteries during non-peak times, is a strategic approach to balancing peak electricity demands and optimizing energy use efficiently.

Additionally, the connectivity of modern EVs to backend systems through services like eCall underscores the potential for establishing seamless communication channels between centralized control systems, EVs, and energy production sources. By leveraging this connectivity and establishing standardized protocols for communication and energy management, there is an opportunity to create smart solutions that can dynamically adjust energy usage based on real-time grid conditions, production forecasts, and consumer preferences.

He indicated that enhancing coordination and communication between centralized energy management systems, EVs, and energy production sources is a crucial step in addressing the increasing demand for electricity and ensuring efficient utilization of resources. By establishing standardized frameworks and interoperable systems, the potential exists to create a more reliable and sustainable energy ecosystem that optimizes energy use, reduces peak demand, and integrates renewable energy sources effectively.

Open discussion

The moderator indicated that the topic of vehicle-to-grid (V2G) opportunities is indeed intriguing, as it has the potential to revolutionize the way energy is managed and utilized within the grid. V2G technology allows EVs to not only receive energy from the grid but also to provide energy back to the grid when needed, thereby serving as mobile energy storage units. The implementation of V2G technology is still in

the early stages, with several pilot projects and research initiatives exploring its feasibility and potential benefits. Some regions have started testing V2G systems, and there are ongoing efforts to integrate EVs as grid resources in a more systematic manner.

Mr. Robb invited others to share insights or experiences with V2G implementation or pose any additional questions on this topic to further enrich the discussion.

Mr. Bendik Nybakk Torsæter shared experiences related to V2G technology and smart charging practices in Norway. V2G implementation is primarily at a pilot level, indicating that it is still in the exploratory phase rather than widespread adoption in households. Nonetheless, he highlighted the potential significance of V2G in future energy management strategies, particularly in household charging and large parking areas with multiple vehicles.

Emphasizing the importance of starting with simpler and more accessible solutions, Mr. Torsæter pointed out that smart charging algorithms and time-of-use pricing mechanisms are already effectively utilized by the majority of Norwegians who own EVs. By leveraging these smart charging practices, consumers can automatically optimize their charging schedules to take advantage of lower electricity prices and grid tariffs during off-peak hours, resulting in more cost-effective and grid-friendly charging habits.

Furthermore, he observed that a significant portion of charging in Norway is carried out using AC chargers at home or other locations underscores the potential impact of implementing smart charging strategies on a broader scale. By ensuring that consumers are charging their EVs in a smart and efficient manner, there is a substantial opportunity to enhance grid reliability, reduce peak demand, and promote the integration of renewable energy sources.

While V2G technology holds promise for providing grid support and flexibility, the focus on optimizing current charging practices through smart algorithms and automated solutions aligns with the idea of addressing the low-hanging fruit first before scaling up to more advanced technologies like V2G. By encouraging widespread adoption of smart charging practices and integrating them seamlessly into existing infrastructure, the transition to a more sustainable and grid-responsive charging ecosystem can be achieved effectively.

Mr. Frantisek Budinsky emphasized the foundational importance of hardware compatibility and standardization in the development and deployment of bidirectional charging, particularly for V2G applications. The current lack of AC wall boxes supporting bidirectional charging protocols such as ISO 15118 presents a significant barrier to widespread adoption of V2G technology and a key challenge in advancing bidirectional charging infrastructure.

While there may be some DC wall boxes available on the market that support bidirectional charging, they are often expensive and more suitable for small companies or commercial applications with additional energy systems like PV systems and energy storage solutions. This limited availability and high cost of bidirectional charging hardware can pose obstacles for individual households looking to implement V2G technology effectively.

The need to establish standards not only for vehicles but also for charging appliances and smart home solutions underscores the interconnected nature of energy systems that must work harmoniously to optimize energy usage and achieve sustainable outcomes. By promoting interoperability and standardization across various components of the energy ecosystem, including EVs, charging infrastructure, home energy management systems, and renewable energy sources like PV systems, it becomes possible to create a unified and efficient energy network.

Ms. Els de Wit updated on the successful implementation of the V2G project in Utrecht, which has transitioned from the pilot phase into its second year of operation. The positive progress and community-level initiatives are taking place in Utrecht as part of this V2G project. The fact that the project originated from a local necessity to address challenges with the Distribution System Operator (DSO) highlights the

practical application of V2G technology in solving grid-related issues at a grassroots level. The experience gained from the Utrecht project offers valuable insights and best practices that can be shared with a broader audience to facilitate learning and knowledge exchange.

Moving forward, ensuring that information and experiences from successful V2G projects like the one in Utrecht are effectively communicated and disseminated within the wider community can further advance the adoption and implementation of V2G technology in other regions.

The moderator asked a question about perspective on the broader integration between the power sector and e-mobility sector.

Mr. Bendik Nybakk Torsæter responded with observations on Norway's charging infrastructure and the challenges related to high power demand from EV chargers. Norway's strong distribution system, largely powered by electricity for heating and household needs, provides a solid foundation for EV charging infrastructure.The installation of high-power charging stations, such as those offering 22 kilowatts on three-phase systems, can strain weak distribution systems and require careful planning to avoid overload issues.

The increasing demand for power from EV chargers, both to meet current needs and future expansion plans, presents challenges for DSOs in terms of capacity planning and infrastructure development. DSOs may face difficulties in fulfilling requests for high-power charging stations due to the lead time required for building new infrastructure, such as transformers and power lines, leading to delays in accommodating the desired charging capacity. In response to the demand for rapid charging infrastructure deployment, Norway is exploring solutions that can be quickly implemented and potentially relocated to adapt to changing needs.

Ms. Britta Gross expanded on the challenges and opportunities for EV integration within the United States, particularly in the context of fleet electrification. The United States is in the early stages of EV adoption compared to countries like Norway, and the robustness of the grid may vary across regions, posing challenges for accommodating high-powered charging loads, especially from fleets. The electrification of trucks and commercial light-duty vehicle fleets, such as those at airports and logistics centers, can introduce significant power demands that may strain local distribution systems and require careful planning to avoid grid congestion.

The rapid charging demands of fleet operations, such as car rental agencies at airports, challenge traditional business models that rely on quick turnover and refueling processes, necessitating innovative solutions for EV charging infrastructure.

Collaborating with fleets to explore alternative charging options, including utilizing public charging stations and optimizing charging locations, can help address grid capacity constraints and optimize cost-effective charging solutions.

Fleet operators may initially opt for high-power DC fast charging solutions but may later realize the benefits and cost-effectiveness of utilizing level 2 AC charging for their operations. Educating fleet operators about the grid impact of their charging requirements, the shared costs of grid upgrades, and the importance of right-sizing charging infrastructure can help mitigate grid strains, minimize costs, and ensure sustainable and efficient charging solutions.

Mr. Arven Syla, PhD student from the University of Geneva, asked a question regarding the mention of fast charging stations as flexible resources. He shared some doubts because fast charging typically only takes around 30 or 20 minutes before drivers leave and requested to explain how to account for fast charging stations as flexible resources in the longer term, considering the shorter charging times.

Mr. Bendik Nybakk Torsæter responded on the potential of charging stations equipped with additional resources, such as batteries, to function as flexible assets that can provide ancillary services to the grid. He emphasized the broader role that charging infrastructure can play in grid support and the importance

of considering reactive power management, voltage support, and the integration of battery systems to enhance grid stability and resilience.

Integrating stationary batteries alongside charging stations can help reduce peak demand and provide ancillary services to the grid, such as frequency support and voltage regulation. Battery systems can respond quickly to grid events, offering flexibility to address short-term challenges and support the integration of renewable energy sources and EVs.

Charging stations typically consume reactive power, which can impact voltage levels in local power systems. By leveraging converter-based interfaces and advanced control strategies, charging stations can provide reactive power support to stabilize voltage levels and alleviate grid constraints. Establishing reactive power markets or incorporating reactive power requirements in charging station agreements can help optimize grid operation and mitigate voltage-related issues in distribution networks.

Battery systems integrated with charging stations can offer peak shaving capabilities, grid support services, and participation in the flexibility market for short-duration events. By leveraging the energy storage capacity of batteries, charging stations can enhance grid reliability, optimize energy use, and contribute to grid balancing efforts during peak demand periods or grid disturbances.

Mr. Sven-Rune Olofsson indicated that collaborating with experts and exploring the opportunities for leveraging battery resources in innovative ways can indeed lead to significant advancements in grid optimization and sustainable energy integration. He mentioned the same field of research work ongoing in Sweden and shared enthusiasm for exploring the possibilities offered by battery resources to enhance grid resilience and performance.

Ms. Britta Gross shared perspective on exploring innovative solutions to leverage special vehicle use cases, such as school buses, as community backup energy resources. The idea of repurposing parked school buses equipped with larger batteries to provide essential services, like heating or cooling in community shelters during emergencies, demonstrates a creative and practical application of EV technology for resilience and disaster response.

School buses, with their large numbers and often idle times, represent a valuable resource that can be mobilized as backup energy sources during emergencies when power outages occur.By equipping school buses with appropriately sized batteries and infrastructure, they can serve as mobile energy hubs that provide critical services to community shelters, enhancing resilience and ensuring the well-being of residents in times of crisis.

Tailoring the battery size of school buses to match the energy demands of community shelters and emergency facilities illustrates the importance of right-sizing energy storage solutions for specific applications. By optimizing battery capacity based on the anticipated needs of shelters for heating, cooling, or other essential services, school buses can effectively support community resilience efforts and enhance overall disaster preparedness.

While the focus on school buses as community backup energy resources is a compelling example, exploring similar use cases for other specialized vehicle fleets, such as transit buses or emergency response vehicles, can further expand the potential of EVs in providing essential services during emergencies. Identifying and prioritizing specific vehicle fleets with unique capabilities, operational characteristics, and idle times can unlock opportunities for maximizing their role as decentralized energy assets for community resilience.

Mr. Francois Cuenot, Mechanical Engineer, UNECE, asked a question on whether it is time to establish regulations for V2G technology, including communication standards. He requested to explain if it is premature to do so, and whether we continue piloting experiments before implementing any regulatory measures, perhaps starting with either the vehicle or grid side first, or both simultaneously

Ms. Britta Gross responded on importance of developing standardized interfaces and communication protocols for V2G technology to address existing challenges and unlock its potential benefits.

Establishing standardized interfaces and communication standards for V2G systems can reduce deployment costs, streamline integration processes, and facilitate interoperability among different stakeholders and technologies. By defining clear technical requirements and protocols, standards can minimize uncertainties, enhance market confidence, and accelerate the adoption of V2G solutions at scale.

While mandating specific V2G requirements may not be necessary at this stage, focusing on standardization efforts and industry alignment can create a foundation for future regulatory frameworks and market development. Collaborative initiatives to develop standards that address grid interface, data exchange, cybersecurity, and interoperability can pave the way for smoother V2G integration and regulatory compliance in the future.

Prioritizing the responsible scaling of V2G technologies involves understanding the potential benefits, use cases, and value propositions that these systems can offer to the grid, utilities, stakeholders, and end-users. As V2G solutions evolve, it's essential to identify specific problems that V2G can address, such as grid balancing, peak demand management, energy resilience, or emergency response, and tailor implementation strategies accordingly.

Accelerating the development of V2G standards should be a primary focus to remove barriers, enhance compatibility, and promote innovation in the EV and energy sectors. Active engagement in standardization processes, collaboration with industry partners, and alignment with international best practices can drive the establishment of robust, effective standards for V2G technology.

Mr. Sven-Rune Olofsson indicated the relevant standardization group, such as IEC TC 69, and the critical role that standardized interfaces play in unlocking the potential of V2G technologies for grid integration and community benefits. The standardization of V2G interfaces and communication protocols is essential for ensuring compatibility, reliability, and interoperability with low-voltage grids, thereby minimizing grid impacts and enhancing community resilience.By establishing standardized practices, data exchange formats, and technical requirements for V2G integration, stakeholders can harness the collective resource potential of EVs to support peak shaving, renewable energy integration, and grid stability at the local level. Leveraging the aggregated capacity of EV batteries through V2G technologies presents opportunities for grid operators, communities, and energy systems to access flexible storage resources, optimize energy management, and support renewable energy sources like wind power. By coordinating V2G capabilities with grid needs, energy demands, and market dynamics, stakeholders can unlock the full value of EVs as distributed energy assets for demand response, energy balancing, and storage applications.

Addressing the complexity of V2G interactions, including roaming agreements, inductive charging technologies, and grid integration requirements, necessitates comprehensive standardization efforts that encompass diverse stakeholders, technologies, and use cases.Developing robust standards for V2G operation, grid interaction protocols, cybersecurity measures, and interoperability criteria is crucial for fostering market maturity, innovation, and regulatory compliance in the evolving landscape of electric vehicle charging and grid support services.

Standardization plays a pivotal role in shaping the future energy landscape by defining the technical specifications, communication protocols, and operational guidelines that underpin efficient V2G deployment, grid interaction, and energy transition strategies.

Ms. Susanne Koblitz shared perspective on the ongoing efforts to develop and refine standards, especially in the context of emerging technologies like V2G, highlighting the complexity and importance of ensuring robust, interoperable frameworks before scaling up new initiatives.

The iterative nature of standard development, with subsequent rounds refining and expanding guidelines to encompass new technologies like V2G, reflects a pragmatic approach to accommodating evolving industry needs and technological advancements. By building upon existing standards and integrating new requirements for cutting-edge applications, stakeholders can enhance the interoperability, functionality, and reliability of emerging technologies within established frameworks.

Policymakers' eagerness to promote advanced technologies like V2G through mandates or public funding underscores the urgency to address pressing energy challenges and leverage innovative solutions for sustainable grid operation. However, the foundational role of standardized interfaces and protocols in enabling interoperability, scalability, and market integration emphasizes the need to prioritize standardization efforts before widescale deployment to ensure seamless operation and compatibility across diverse systems.

Future work of UNECE Groups of Experts on integration of e-mobility into energy system

Mr. Jim Robb, Chair, UNECE Group of Experts on Cleaner Electricity Systems focused on the next steps and actions to be taken in the field of e-mobility, infrastructure integration, and standardization. He indicated the launching an Informal Task Force with a focus on addressing interlinkages between charging infrastructure, the electricity grid, and e-mobility management. He emphasized the importance of collaboration, knowledge sharing, and coordination across zero-emission vehicle infrastructure to enhance policy implementation and promote best practices in the industry.

Mr. Robb highlighted the UN's role in promoting harmonization of infrastructure standards, regulatory frameworks, and grid connectivity to accelerate the adoption and scaling of e-mobility technologies. Exploring regulatory barriers, incentives, and frameworks that can drive the development and deployment of game-changing technologies while addressing climate goals and mobility challenges.

He proposed the development of a position paper based on the outcomes and discussions from the workshop to outline key issues, opportunities, and challenges in e-mobility as well as suggested ongoing engagement with UNECE Groups of Experts, reconvening discussions, and potentially organizing future workshops to delve deeper into the evolving landscape of e-mobility, technology advancements, and policy implications.

Mr. Robb also recognized the early stages of the industry and the need to continue fostering innovation, knowledge exchange, and collaborative efforts to drive progress in the adoption, integration, and standardization of e-mobility solutions. He highlighted the importance of staying agile, responsive to emerging trends, and proactive in shaping the future of e-mobility through ongoing dialogue, research, and collaborative initiatives.

Mr. Stefan Buettner, Chair, UNECE Group of Experts on Energy Efficiency emphasized location efficiency, systemic efficiency, and optimizing the demand side in various settings, from urban to rural, factory, public buildings, and beyond. This underscores the critical importance of considering infrastructure limitations and addressing load-balancing challenges in the context of evolving energy demands. The need for smart solutions, load management strategies, demand-side initiatives, and energy flexibility measures to enhance overall efficiency, reduce energy demand, and support the integration of renewable energy reflects a forward-thinking approach to advancing sustainable energy transitions and maximizing the benefits of electrification.

Mr. Kostiantyn Gura, Chair, UNECE Group of Experts on Renewable Energy highlighted the multifaceted challenges and opportunities surrounding the development of e-mobility and its integration into the energy system. He acknowledged the complex nature of integrating e-mobility within the energy system, involving technical innovation, policy alignment, and collaboration among stakeholders to address challenges and capitalize on opportunities effectively. He emphasized the importance of enhancing cross-sectoral collaboration, identifying priority areas for focused work within the Informal Task Force, such as grid integration of EVs, advancements in grid-friendly technologies, strengthening cybersecurity, and promoting knowledge dissemination through seminars and events.

Mr. Gura highlighted the importance of participation in the Sustainable Energy Week in September 2024 in Geneva, which will hold discussions of the Groups of Experts, engage with member States and industry partners, and contribute to advancing sustainable energy solutions.

Ms. Els de Wit, Chair, UNECE Working Party on Transport Trends and Economics shared her perspectives on the importance of gaining more predictable insights into market developments, particularly in other transport modes such as heavy-duty vehicles and multimodal points. Understanding economic benefits and opportunities within the e-mobility transition aligns with the broader goal of showcasing the positive impacts and potential advantages of integrating EVs into the transportation system.
She highlighted the need for more predictable insights into market developments, especially in the heavy-duty vehicle segment and other transport modes, to enhance understanding, strategic planning, and policy alignment within the electric mobility sector.

Ms. de Wit indicated the significance of addressing multimodal transport challenges and pressure points, such as network constraints and system demands, to optimize infrastructure utilization, improve operational efficiency, and advance sustainable mobility solutions.

Closing remarks

UNECE Secretariat expressed gratitude to all participants for their valuable contributions, dedication, and engagement throughout the event and outlined the upcoming first meeting of the Informal Task Force on E-Mobility on 29 May 2024 inviting for active participation, collaboration, and engagement to foster strong cooperation and collective efforts in advancing e-mobility initiatives.