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Report on the second global dialogue under the Sharm el-Sheikh mitigation ambition and implementation work programme

Report by the co-chairs of the work programme

Abbreviations and acronyms

CEO	chief executive officer
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CO ₂	carbon dioxide
COP	Conference of the Parties
EV	electric vehicle
EU	European Union
GHG	greenhouse gas
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
LDC	least developed country
NDC	nationally determined contribution
SB	sessions of the subsidiary bodies
SDG	Sustainable Development Goal
SIDS	small island developing State(s)
TEC	Technology Executive Committee

I. Introduction

A. Mandate

1. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, at its fourth session, decided that at least two global dialogues shall be held each year as part of the Sharm el-Sheikh *mitigation ambition and implementation* work programme,¹ with one to be held prior to the first regular sessions of the subsidiary bodies, starting at SB 58, and one prior to the second regular sessions of the subsidiary bodies, starting at SB 59, and that such dialogues should be conducted in hybrid format to allow both in-person and virtual participation.²

2. It requested the secretariat to prepare, under the guidance of the co-chairs of the work programme, a report on each of the dialogues referred to in paragraph 1 above, reflecting in a comprehensive and balanced manner the discussions held and including a summary, key findings, and opportunities and barriers relevant to the topic, and to prepare an annual report comprising a compilation of the individual dialogue reports for consideration by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement and the subsidiary bodies.³

3. This report has been prepared under the guidance of the co-chairs of the work programme, reflecting in a comprehensive and balanced manner the discussions held at the second global dialogue, including a summary of the discussions and the key findings, opportunities and barriers identified in each breakout group and world café session. This report captures and summarizes views shared during the dialogue but may not represent an exhaustive summary of all interventions.

B. Proceedings

4. The second global dialogue under the Sharm el-Sheikh mitigation ambition and implementation work programme took place in Abu Dhabi from 15 to 16 October 2023 in hybrid format, with 245 registered in-person and 208 registered virtual participants.⁴ The dialogue was hosted by the incoming COP28 Presidency, and its organization was supported by the Abu Dhabi Global Market and the International Renewable Energy Agency. In line with the topic for the dialogues in 2023, the topic of the second dialogue was accelerating the just energy transition in transport systems, including by:

(a) Implementing policies and measures with a global overview and country-specific experience;

(b) Addressing financial, technological and capacity-building needs related to this topic, such as through international cooperation, including with non-Party stakeholders, and the provision of support to developing countries;

(c) Promoting sustainable development and understanding of socioeconomic effects.

5. Following the structure of the first global dialogue, participants discussed opportunities, actionable solutions, challenges and barriers relevant to accelerating the just energy transition in the transport systems under the following subtopics:

¹ The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, at its third session, decided that the Sharm el-Sheikh mitigation ambition and implementation work programme is to be implemented in a manner that complements the global stocktake. Information relating to the global stocktake is available at <https://unfccc.int/topics/global-stocktake>.

² Decision 4/CMA.4, para. 8.

³ Decision 4/CMA.4, para. 15.

⁴ The webcast links, agenda, recordings and all presentations are available at <https://unfccc.int/event/second-global-dialogue-and-the-second-investment-focused-event-under-the-sharm-el-sheikh-mitigation>

- (a) Deploying and shifting to collective and non-motorized modes of transport (rail, urban public transit, cycling, etc.);
- (b) Energy and resource efficiency in the transport sector (design improvements, circular economy and material changes, vehicle vintage, carpooling, etc.);
- (c) Electrification of vehicles (infrastructure, batteries and minerals);
- (d) Shifting to low- or zero-carbon fuels (hydrogen, biofuels, biogas, compressed natural gas).

6. Opening remarks were made by Adnan Amin, CEO of COP 28, representing the incoming COP 28 Presidency; Francesco La Camera, Director General, IRENA; Nabeel Munir, Chair of the Subsidiary Body for Implementation; and Simon Stiell, UNFCCC Executive Secretary.

7. On the first day of the dialogue, eight technical experts made presentations on opportunities, actionable solutions and technologies relating to the subtopics in the context of the just energy transition in transport systems:

(a) Deploying and shifting to collective and non-motorized modes of transport (rail, urban public transit, cycling, etc.): Amanda Ngabirano, Professor, University of Makerere, Uganda, and former Vice President of World Cycling Alliance, and Philip Turner, Head of Sustainable Development, International Association of Public Transport;

(a) Energy and resource efficiency in the transport sector (design improvements, circular economy and material changes, vehicle vintage, carpooling, etc.): Karla Cervantes Barron, Research Associate in Climate Compatible Growth, Department of Engineering, University of Cambridge, United Kingdom, and Johan Falk, CEO, Exponential Roadmap Initiative;

(b) Electrification of vehicles (infrastructure, batteries and minerals): Anvita Arora, Program Director, Transport and Infrastructure, King Abdullah Petroleum Studies and Research Center, and Elizabeth Connelly, Lead, Global EV Outlook, IEA;

(c) Shifting to low- or zero-carbon fuels (hydrogen, biofuels, biogas, compressed natural gas): Amer Ahmad Amer, Transport Chief Technologist, Research and Development Center, Aramco, and Gurbuz Gonul, Director, Country Engagement and Partnerships, IRENA.

8. Following the expert presentations, a World Café session was held to provide the opportunity for more focused interaction between experts and smaller groups of participants. Participants joined 1 of 16 tables, which were divided into four groups of four tables, each group having a specific guiding question. After 45 minutes of discussion, participants moved to a different group. Two World Café sessions were held over the course of the global dialogue, one on each day. This way, all participants were able to contribute to the discussions on each of the four guiding questions. The table below states the guiding question for each group and names the facilitating expert for each table. The results of the discussions at the World Café tables have been integrated into the relevant sections of chapter II below with the breakout group discussions.

World Café sessions: guiding questions and facilitators

<i>Guiding question</i>	<i>Day 1 facilitators</i>	<i>Day 2 facilitators</i>
Group 1		
Governments face multiple important considerations when developing and updating transport infrastructure, including mobility demand, the transport network and freight logistics. What are the barriers, challenges, opportunities and actionable solutions to ensure optimal public policies and investment for low-carbon urban infrastructure, taking into account different transport modes such as walking, cycling, road and rail?	<p>Table 1: Philip Turner, Head of Sustainable Development, International Association of Public Transport</p> <p>Table 2: Maruxa Cardama, Secretary-General, Stichting Partnership on Sustainable, Low Carbon Transport (SLoCaT) Foundation</p> <p>Table 3: Mohamed Hegazy, Transport Lead, Climate Champions Team</p> <p>Table 4: Christopher Dekki, Senior Specialist, Energy Transition, COP 28 Partnerships</p>	<p>Table 1: Philip Turner</p> <p>Table 2: Maruxa Cardama</p> <p>Table 3: Mohamed Hegazy</p> <p>Table 4: Christopher Dekki</p>
Group 2		
Considering a product’s life cycle often guides energy and resource efficiency in international value chains, including dumping of inefficient used vehicles, emissions associated with biofuel production and critical minerals for batteries, what are the barriers, challenges, opportunities and actionable solutions to reduce life cycle emissions of internationally traded transport-related goods, including vehicles, to improve global energy and resource efficiency?	<p>Table 5: Celine Tan, Professor, University of Warwick, United Kingdom</p> <p>Table 6: Romeo Bertolini, Deputy Director and Head of the Bonn Office NDC Partnership Support Unit, NDC Partnership</p> <p>Table 7: merged with table 6</p> <p>Table 8: Stelios Pesmajoglou, Manager, Mitigation Division, UNFCCC secretariat</p>	<p>Table 5: Celine Tan</p> <p>Table 6: merged with table 7</p> <p>Table 7: Mareer Mohamed Hunsy, Climate Change Expert, TEC</p> <p>Table 8: Stelios Pesmajoglou</p>
Group 3		
While the number of EVs is rapidly increasing in certain countries, their deployment remains uneven across countries owing to such issues as affordability, charging infrastructure, electricity supply and battery supply chain. What are the barriers, challenges, opportunities and actionable solutions to accelerate adoption of EVs and public transportation and ensure their affordability with financial, technological and capacity constraints, particularly in developing countries?	<p>Table 9: Elizabeth Connelly, Lead, Global EV Outlook, IEA</p> <p>Table 10: Anvita Arora, Program Director, Transport and Infrastructure, King Abdullah Petroleum Studies and Research Center</p> <p>Table 11: Domenik Kohl, Transport Sector Associate, Climate Champions Team</p> <p>Table 12: Amjad Abdullah, Head of Partnerships, IRENA</p>	<p>Table 9: Elizabeth Connelly</p> <p>Table 10: Anvita Arora</p> <p>Table 11: Domenik Kohl</p> <p>Table 12: Amjad Abdullah</p>

<i>Guiding question</i>	<i>Day 1 facilitators</i>	<i>Day 2 facilitators</i>
Group 4		
Multiple options and technology development possibilities exist for low- or zero-carbon fuels, with various levels of potential for scale and their own set of constraints. What are the barriers, challenges, opportunities and actionable solutions to strengthen synergies and address trade-offs with sustainable development, taking into account the characteristics of a specific low- or zero-carbon fuel?	<p>Table 13: Amer Ahmad Amer, Transport Chief Technologist, Research and Development Center, Aramco</p> <p>Table 14: Gurbuz Gonul, Director, Country Engagement and Partnerships, IRENA</p> <p>Table 15: John Mark Mwanika, Global Labour Institute, and Amalgamated Transport and General Workers' Union/ International Transport Workers' Federation</p> <p>Table 16: Eman Thani Alsuwaidi, Market team lead – Negotiation, Incoming COP 28 Presidency</p>	<p>Table 13: Amer Ahmad Amer</p> <p>Table 14: Simon Benmarraze, Team Lead, Technology and Infrastructure, IRENA</p> <p>Table 15: John Mark Mwanika</p> <p>Table 16: merged with table 15</p>

9. On the first day of the dialogue, the World Café session was followed by breakout group discussions. Participants were divided into four breakout groups to discuss one of the subtopics listed in paragraph **Error! Reference source not found.** with the facilitators and technical experts assigned to the group. Over the course of the day, all participants were able to join each breakout group and thus discuss each subtopic.

10. The following guiding questions provided a framework for the discussions in each breakout group on the first day:

(a) What are opportunities, best practices and actionable solutions for the just energy transition in the transport sector to urgently scale up mitigation ambition and implementation in this critical decade in each subtopic (collective and non-motorized modes of transport, energy and resource efficiency, electrification of vehicles, low- or zero-carbon fuels)?

(b) What are effective policies and measures implemented from a global perspective and country-specific experience for each subtopic?

(c) How are financial, technological and capacity-building needs addressed for each subtopic?

(d) How are the issues of international cooperation, including with non-Party stakeholders, and the provision of support to developing countries addressed?

(e) How is sustainable development promoted and what are the socioeconomic effects under each subtopic?

11. At the beginning of the second day of the dialogue, the facilitators reported back on the first day's breakout group discussions.

12. Subsequently, seven technical experts made presentations on barriers, challenges and financing issues relating to the just energy transition, specifically in the areas of:

(a) Financing issues: Binyam Reja, Global Practice Manager, Transport Global Unit, World Bank Group, and Celine Tan, Professor, University of Warwick, United Kingdom;⁵

⁵ The presentations on financing issues were moved to the start of the expert presentations, and the presentations on the barriers and challenges around policies and measures were moved to the end of the expert presentations owing to technical issues. The summary of discussions in chapter II is presented in the original order of the breakout groups as shown in the agenda for the second global dialogue.

(b) Technology and capacity challenges: Mareer Mohamed Hunsy, Climate Change Expert, TEC, and Roland Roesch, Director, Innovation and Technology Centre, IRENA;

(c) Barriers and challenges in addressing sustainable development and socioeconomic impacts: John Mark Mwanika, Program Officer, Amalgamated Transport and General Workers' Union; Chair of the Urban Transport Committee Gig Economy Working Group and Co-Chair of the Sustainable Transport Working Group, International Transport Workers' Federation; and team member, Global Labour Institute;

(d) Barriers and challenges around policies and measures: Maruxa Cardama, Secretary-General, SLOCAT Partnership, Low Carbon Transport, and Mahua Acharya, former CEO, Convergence Energy Services Limited, India.

13. Following the expert presentations, the second World Café session was held, which had the same format as the session for day one (see paragraph 8 and the table above).

14. The World Café session was followed by breakout group discussions. Participants were divided into four breakout groups on the second day as well. Each group discussed one of the subtopics listed in paragraph 12 above with the facilitators and technical experts assigned to the group. Over the course of the day, all participants were able to join each breakout group and thus discuss each subtopic.

15. One guiding question provided the framework for the discussions in each breakout group on day two: What are the barriers and challenges for the just energy transition in the transport sector to urgently scale up mitigation ambition and implementation in this critical decade, taking into account the subtopics from day one (collective and nonmotorized modes of transport, energy and resource efficiency, electrification of vehicles, low- or zero-carbon fuels)?

16. At the closing plenary, the co-chairs of the work programme invited the facilitators of each breakout group on the second day to report back on the discussions. The co-chairs then thanked the participants, experts and facilitators, and declared the second global dialogue closed.

17. The global dialogue was followed by a one-day investment-focused event, organized under the guidance of the co-chairs of the work programme, to consider the cost of mitigation implementation with a view to unlocking finance, including for just transitions, overcoming barriers to access to finance and identifying investment opportunities and actionable solutions informed by NDCs to help public and private financiers, investors and international climate finance providers direct finance flows towards supporting areas of opportunity to enhance mitigation in this critical decade.⁶ The event, which was hosted by the incoming COP28 Presidency and organized with the support of the United Nations Conference on Trade and Development, took place in conjunction with the World Investment Forum 2023. This was followed by presentations on successful case studies of energy transition in the transport sector and then a 'Pitch Hub', where interested Parties shared project ideas with investors, financial institutions and policymakers with a view to getting these projects investment-ready. In the next session, participants discussed issues related to addressing structural barriers to clean energy investment and opportunities for mobilizing investment, and the session that followed focused on different regions. The event can be revisited via the webcast links.⁷ Owing to technical problems at the venue, virtual two-way participation was not possible.

⁶ As per decision 4/CMA.4, para. 11.

⁷ As footnote 4 above.

II. Summary of discussions and key findings, and opportunities and barriers

18. This subchapter captures views shared during the World Café sessions and breakout group discussions at the dialogue but may not represent an exhaustive summary of all comments made by participants.

A. Deploying and shifting to collective and non-motorized modes of transport

1. Summary of discussions and key findings

19. The breakout group discussions were facilitated by Philip Turner.

20. The introductory presentation by Philip Turner underscored the importance of deploying and shifting to collective and non-motorized modes of transport to achieving the overarching goal of sustainable mobility. As only half of the global population has adequate access to public transportation – and only 16 per cent use public transport – private vehicles are the predominant mode of transport around the world. A reduction in emissions from transportation of 45 per cent could be achieved by doubling public transport capacity, thus investment in public transportation is seen as an effective strategy to reduce emissions. Reflecting this, public transport is mentioned in 67 per cent of NDCs. Promoting active mobility by prioritizing non-motorized modes of transport (e.g. walking and cycling) is a viable option for highly urbanized areas such as cities. Sustainable mobility can be achieved in cities by implementing three key actions: designing cities around mass public transport and active mobility, optimizing road management and establishing innovative and efficient public transport systems.

21. The introductory presentation by Amanda Ngabirano discussed examples of how mobility options have been made more sustainable in cities, particularly in developing countries. The transportation sector accounts for a quarter of GHG emissions worldwide; a share that is expected to increase owing to growing demand for mobility. The negative impacts of increased mobility, including traffic congestion and air pollution, can be mitigated through land-use planning with a focus on non-motorized transport, particularly in city centres and central business districts. Improving the connection of walkways with public transport hubs has the potential to decongest the road network within densely populated inner-city areas. Other public transport modes can then be connected to outer areas of the city, allowing more efficient circulation of private transport. This multi-modality approach improves accessibility for all and results in spatial gains that can benefit social welfare by being used for, for example, recreational facilities.

22. During the discussions, participants emphasized the importance of tailoring transportation policy and technology solutions to the unique needs and circumstances of each country, region and city, including those related to local climatic conditions, geographical features, and socioeconomic and cultural factors. In some regions, for example, extreme temperatures discourage the use of public transport, walking and cycling, whereas in other regions the lack of alternative modes of transport often leads to a high share of non-motorized transport.

23. Some participants highlighted that an integrated, well-designed and holistic transportation infrastructure that includes sustainable transport, non-motorized transport, mixed land use and pedestrian walkways is often lacking in developing countries. Some participants stated that transportation conditions are different in developing countries compared to developed countries and therefore the effectiveness of public transport is city specific.

24. The role of subnational and local governments in identifying and implementing effective policies and measures was often highlighted by participants because transport infrastructure is closely linked to land-use planning and urban development. The need for aligning national climate change strategies with local transport policies, and challenges therein, was also highlighted. It was also mentioned that low-carbon development of

transport infrastructure requires the consideration of many aspects, such as institutional arrangements, technical and engineering standards, project design specifications, investment budget guidelines and innovation.

25. Several participants considered stakeholder engagement as crucial in developing accessible public transport policies and measures and ensuring local acceptance thereof. Local political support was seen as essential to addressing local priorities and ensuring continuity in long-term transport infrastructure investment despite possible changes in government at different levels. Public–private partnerships were often mentioned as a useful approach to developing transport infrastructure.

26. Consideration of social as well as economic factors – particularly the safety of public transport and bicycle lanes, gender disparity in the use of different modes of transport, air quality and private vehicle use as a symbol of economic status – was often mentioned as key to effective policy implementation.

27. Also often mentioned was the need for international cooperation to overcome financial challenges in transport infrastructure development and to remove technical capacity constraints in the operation of reliable and efficient public transport, particularly in countries with limited resources.

2. Opportunities (including actionable solutions) and barriers

28. Participants shared their ideas on effective policies, measures and strategies implemented at the national and local (city) level, including reducing congestion by expanding the public transport network and reallocating public spaces, along with increasing public safety for cyclists and pedestrians; expanding cycle networks, with investment in bicycle parking at train stations; developing pedestrian paths combined with public awareness-raising campaigns; developing specialized infrastructure for cycling; developing national strategies to monitor and control mobility volume and optimize infrastructure; reducing rail ticket prices to incentivize frequent travel by rail; and combining regional development with intercity railway routes for passengers and freight.

29. Participants noted areas of ongoing international cooperation, including through initiatives and partnerships, such as holistic mobility planning to improve public transport and active mobility in urban areas particularly and to develop readiness for investment opportunities in developing countries, capacity-building initiatives on active mobility aimed at training cycling experts, financial assistance for purchasing electric buses and behavioural change initiatives geared towards sustainability.

30. Opportunities resulting from shifting to the more sustainable modes of transport mentioned by participants include digitalization and remote work, which reduce daily transportation demand; the growing popularity of e-bikes among young people; a shift in attitudes towards car ownership among young people, many of whom now see it as unnecessary; and a modal shift in freight transport, from road to railway. The conversion of unused spaces into sustainable transport infrastructure, ensuring the involvement of all relevant stakeholders in the decision-making process, was indicated as an actionable solution to advance the just energy transitions in the transport sector.

31. Several barriers and challenges shared by participants were common across many countries that differ in terms of region, population and stage of economic development. These shared barriers and challenges, which offer opportunities for enhanced cooperation, include:

(a) The need for policy coordination among public institutions, both vertically (at the federal, regional and municipal level) and horizontally (ministries beyond transport and climate), to provide a more coherent set of policies and enable an integrated approach to land-use and transport infrastructure planning and management;

(b) The need for holistic solutions in developing integrated public transport, including land-use planning, behavioural change and infrastructure development (e.g. charging stations, smart meters and app-based monitoring for electric buses);

(c) Lack of financing for the development and update of transport infrastructure, including for e-mobility, and the high operational cost of public transport;

(d) Lack of connectivity and accessible transport infrastructure in rural areas;

(e) Increased reliance on personal vehicles arising from concerns about safety during the pandemic, which led to increased reliance on personal vehicles.

32. Barriers and challenges associated with specific national circumstances in relation to promoting collective and non-motorized modes of transport in many regions included an unfavourable cultural perception of public transport, which is often linked to lower socioeconomic groups; personal vehicles being seen as a symbol of status and freedom; concerns about safety and sexual harassment when using public transport, particularly for women and children; divergent standards of public transport arising from private ownership of the various modes in a public transport network; disparity in the quality of the public transport infrastructure across cities; lack of connectivity between different public transport modes (such as train stations and bus stops), leading to the increased use of cars; limited and fixed public transportation routes, which cause inconvenience and make it difficult to carry out daily tasks without a private vehicle; the possible impacts of hurricanes and severe storms on the safety of public transport systems in island nations; and the lack of political stability to ensure long-term transport infrastructure investment.

33. More specific examples include extreme temperatures and hot and humid climatic conditions as a barrier to promoting walking and cycling; geographical features, particularly limited land, as a barrier to developing dedicated infrastructure such as bicycle lanes; low population density as a barrier to the cost-effective operation of public transport; lack of government control over land use as a barrier to developing transport infrastructure; and obsolete urban design of cities as a barrier to meeting the current needs of residents.

34. Participants highlighted the need for capacity-building and technical assistance to be provided to developing countries, particularly those which lack well-developed public transport systems, including assistance for developing a legal framework and collecting data that enable an assessment of the feasibility of transport infrastructure projects. In addition, participants often alluded to challenges in aligning timelines between the preparation and the implementation of national policy strategies and NDCs.

B. Energy and resource efficiency in the transport sector

1. Summary of discussions and key findings

35. The breakout group discussions were facilitated by Ghanim Hableel, Senior Climate Negotiator, Mitigation and Response Measures, incoming COP 28 Presidency.

36. The introductory presentation by Karla Cervantes Barron highlighted the role of resource efficiency in reducing GHG emissions from the production and consumption of energy and materials in the transport sector. Several options to enhance energy and resource efficiency in the transport sector were discussed, including demand reduction, a shift to public transport and improved efficiency of each transport mode. While electrifying vehicles and decarbonizing electricity reduces emissions, the current trend of large car sizes will lead to more emissions and material use – building electric sports utility vehicles (‘SUVs’) rather than electric cars of medium size requires 57 per cent more material. Adopting the circular economy approach is an opportunity to make the design and manufacture of EVs more efficient and sustainable, including through design innovations (reduction in raw material and energy use), consideration of vehicle attributes (reduction in car size and compliance with efficiency standards) and use of low-carbon materials. Local authorities can explore alternative mobility options (e.g. car sharing and low-carbon transport networks) and realign waste management practices to focus on reuse and recycling.

37. The introductory presentation by Johan Falk highlighted ways to scale up policies and solutions in order to halve transport emissions by 2030. The point was made that success will not be found in one-size-fits-all solutions, but rather in combinations of strategies that reflect the demands of the population and socioeconomic realities. For example, EVs are highlighted as a targeted solution. Their sales have grown exponentially since 2015 and are forecasted to surpass 14 per cent of total personal car sales in 2023. If such trends continue, EVs are projected to comprise 80–90 per cent of new vehicle sales in 2030. Nevertheless, the

electrification of vehicles will not be enough to reach net zero goals – that will necessitate an overhaul of the entire value chain, following the principles of the circular economy and continued investments in greening the power grid, increasing the use of renewable energy sources, promoting car sharing and providing mobility as a service. Combining these strategies with initiatives targeting behavioural change and policies will help to ensure energy efficiency in the transport sector. Case studies of cities with best practices in integrated transport solutions – Bogotá, Oslo and Stockholm – were presented

38. Participants shared their ideas on effective policies and measures for increasing resource efficiency, one of which was a vehicle deposit system in which a payment is required as a deposit at the time of every new vehicle purchase and is reimbursed to recycling and scrapping companies on disposal of the vehicle. Other examples shared were extended producer responsibility, which would require manufacturers to take responsibility for how their vehicles are disposed of and recycled at end of life; compulsory registration of vehicles owned by local authorities as a complementary measure to manage their end of life; and efforts to regulate the export of inefficient old vehicles from developed countries to developing countries through international regulatory measures.

39. Upgrading energy efficiency standards, promoting energy-efficient driving and developing a platform for information on energy efficiency were mentioned as examples of effective policies and measures for increasing energy efficiency. Some participants highlighted the role of clear local goals, strategies and local targets in national circumstances to promote resource and energy efficiency while other participants did not agree with this view and stressed that there is no one-size-fits-all solution.

40. The importance of comprehensive life cycle assessment, particularly for EVs and biofuels, was underlined by participants with reference to the cross-border supply chain. It was noted that solving a transportation problem in one country can create a different problem in another country along the supply chain (e.g. deforestation, need for disposal of EV batteries, and mining of critical minerals).

41. Participants called for more international cooperation between technology exporters and importers because many countries that have to import all vehicles owing to the lack of domestic vehicle manufacturing capacity are required to follow technical standards set by foreign manufacturers. Global policy coordination was mentioned as a way to prevent old, inefficient vehicles from being exported to developing countries where necessary spare parts are sometimes not available locally. The need for data on and measurement of the carbon footprint of products to ensure international consistency was highlighted.

42. Some participants also highlighted that, owing to different capacities among countries, additional support and innovation are required in order to make use of available energy efficiency measures, taking into account common but differentiated responsibilities and respective capabilities in the light of different national circumstances.

2. Opportunities (including actionable solutions) and barriers

43. The opportunities around resource and energy efficiency mentioned by some participants include:

(a) The implementation of digital and smart transport systems to improve transport efficiency;

(b) A circular economy approach to transport systems and associated business innovation, including battery recycling, EV leasing schemes, smaller vehicle use, carpooling to reduce road congestion and reusing asphalt pavements for road construction;

(c) The upgrading of energy efficiency standards for various types of vehicles, including locomotives;

(d) Behavioural change by consumers;

(e) International cooperation on setting standards for sustainable fuels.

44. The barriers to resource and energy efficiency mentioned by some participants include:

- (a) Insufficient transport-related data and local capacity to develop comprehensive projects addressing energy efficiency and resource efficiency;
- (b) Lack of technical capacity and infrastructure for handling electronic waste, which often necessitates its shipping to other countries, leading to increased costs;
- (c) Limited financial returns from the retrofitting of existing vehicles;
- (d) The trade-offs associated with encouraging the use of existing internal combustion vehicles until the end of the product lifetime to reduce material consumption and promoting the adoption of EVs to reduce GHG emissions from vehicle operation would need further considerations.

C. Electrification of vehicles

1. Summary of discussions and key findings

45. The breakout group discussions were facilitated by Anvita Arora and Elizabeth Connelly.

46. The introductory presentation by Anvita Arora discussed mechanisms for accelerating the just energy transition in transport systems. The ‘avoid-shift-improve’ approach was introduced as part of a broader strategy to achieve sustainable mobility. Countries should prioritize an approach that avoids or reduces the need for motorized travel and that enables a shift to more sustainable modes of transport, which can significantly reduce emissions at a lower cost than an approach that involves improving transport modes, such as electrification, and boosting operational efficiency. Moving from internal combustion engine cars to internal combustion engine buses is estimated to lead to larger CO₂ emission reductions than moving to EVs. Analysis has shown that subsidizing EVs in some places is an expensive way to decarbonize the transport sector, including because of the intensive mining activities required to extract critical minerals. A multidimensional perspective that takes into account product life cycle and a circular economy approach is needed to develop integrated transportation decarbonization policies that look beyond exhaust pipe emissions. Vehicle technologies, including alternative fuels, should be part of a wider strategy. To recognize differences across countries, decarbonization pathways need to be context- and country-specific. A just and equitable implementation of pathways to the electrification of transport should include life cycle analysis, consider the broader context in managing competing priorities, and prioritize the electrification of mass transit and shared mobility.

47. The introductory presentation by Elizabeth Connelly provided an overview of the global EV industry. In 2022, electric car sales exceeded 10 million units, and the trend of strong sales is expected to continue as cheaper EV technologies become available. Electric car sales grew globally by 55 per cent in 2022. Sales were led by China, Europe and the United States, but a growing trend in sales was also observed in emerging economies such as India, Indonesia and Thailand. The electrification of vehicles is not confined to two- and three-wheelers and medium-sized cars, with sales of electric buses and trucks also picking up at a steady rate. Globally, public charging infrastructure is keeping up with the demand from increased EV sales. The number of available charging stations for light-duty vehicles increased by 55 per cent in 2022, with China, Greece, India and the Republic of Korea surpassing the global average. An increase in battery material prices in 2022 had an impact on EV prices, but EV prices tend to be stable owing to the introduction of alternative battery chemistries. Nonetheless, reliable battery supply chains are essential to the planned transition to EVs and their capacity could grow fourfold by 2030 if recent announcements of expected capacity increases are realized.

48. During the discussions, participants noted that, while the political momentum towards decarbonization has accelerated the uptake of EVs in some countries, barriers to wider deployment exist, especially in developing countries, such as the high upfront cost of EVs, limited EV model availability, inadequate charging infrastructure, the lack of a clean, stable electricity supply, and the current battery supply chain, coupled with the need for sustainable waste management of batteries and recycling processes. The need to ensure energy access and affordable energy for all before moving to electrification of the transport sector in

developing countries was emphasized, with references made to competing priorities to electrify households, ensure adequate power grid capacity and improve energy security.

49. Some participants mentioned the use of financial incentives, including subsidies, preferential loans, tax incentives and public procurement, as an effective policy or measure to advance the electrification of vehicles, whereas other participants considered such fiscal measures as not feasible in many developing countries owing to government budget constraints and stressed the need for further cost reductions to ensure affordability.

50. Participants underlined that a one-size-fits-all solution is not feasible for implementing the transition to EVs because of different national and regional circumstances, different economic realities and disparities in production capacities. Some participants highlighted the need to also consider the principles of equity and common but differentiate responsibilities and respective capabilities in the light of different national circumstances.

51. Several suggestions for effective policies and measures were put forward, including:

(a) Designing national-level strategies and clear road maps to enhance coordination among different government agencies, subnational and municipal governments, and the private sector;

(b) Applying holistic approaches to integrate the use of EVs into broader sustainability and energy policies, including those for renewable energy supply, power grid expansion and energy storage;

(c) Prioritizing the electrification of public transport vehicles, such as buses, over that of private vehicles to yield greater benefits;

(d) Linking EV development with clean electricity supply;

(e) Taking life cycle and circular economy perspectives to ensure sustainable EV value chains, from the extraction of raw materials to end of product life;

(f) Developing long-term plans to facilitate public and private partnerships and stakeholder engagement, including car dealers, local communities and manufacturers, to expedite EV uptake and infrastructure development, including through addressing financial and technological gaps;

(g) Implementing awareness-raising, training and capacity-building activities in parallel with evolving technologies and infrastructure.

52. The socioeconomic aspects of vehicle electrification mentioned by participants include positive impacts on public health due to improved air quality, especially in areas with a high volume of traffic; the need for reskilling to address job losses in the conventional transport vehicle industry; and the linkage between energy access, clean electricity supply and electric mobility.

53. International cooperation on information exchange, awareness-raising, and technology development and transfer was highlighted by some participants, who referred to positive experiences in some developing countries. The need for enhanced support on finance, technology cooperation and capacity-building for developing countries was also underlined by some participants. Participants raised concerns about the export of inefficient, used internal combustion engine vehicles to developing countries as EV uptake increases in high-income countries. The need for fair competition based on a non-discriminatory and predictable market environment to promote innovation, trade and investment was mentioned by some participants, given that the development and deployment of EVs is still at an early stage.

2. Opportunities (including actionable solutions) and barriers

54. The opportunities around the electrification of vehicles mentioned by some participants include:

(a) Economic growth from the mining of critical minerals, battery production and the local EV manufacturing value chain;

(b) The charging of electric two- and three-wheelers with solar power, particularly in countries with a high potential for solar energy;

(c) The electrification of public transport, combined with stakeholder engagement, to alleviate traffic congestion, improve air quality and enhance accessibility;

(d) The growing focus on innovation, research and development, including for local solutions.

55. The barriers to enhancing the electrification of vehicles highlighted by some participants include:

(a) Lack of access to financial resources to develop infrastructure, including a sufficient number of charging stations, particularly in high-density, low-income cities and many developing countries; a stable, clean electricity supply; and an adequate power grid;

(b) Lack of technical capacity to deploy charging stations and ensure the safety of EVs;

(c) Certain characteristics of EVs compared with internal combustion engine vehicles, including the higher upfront cost, need for charging time, shorter distance coverage and lack of vehicle variety to meet local geographical requirements;

(d) Job losses in the conventional transport vehicle industry;

(e) Limited information on and awareness of EVs, including the fear of battery explosion;

(f) Lack of electricity access by the population and insufficient grid capacity to accommodate EV charging.

D. Shifting to low- or zero-carbon fuels

1. Summary of discussions and key findings

56. The breakout group discussions were facilitated by Gurbuz Gonul and Amer Ahmad Amer.

57. The introductory presentation by Gurbuz Gonul provided an overview of the current global shift towards low- and zero-carbon fuels. According to the IRENA publication *World Energy Transitions Outlook 2023*, in 2020, modern biomass use accounted for only 1 per cent of global total final energy consumption, and the shares of green hydrogen and its derivatives were very small. Liquid biofuel, hydrogen, synthetic kerosene, green ammonia and green methanol are expected to contribute to emission reductions in the transport sector towards 2050, with the electrification of vehicles likely to be the largest contributor to reductions. However, only a limited number of NDCs mention biofuels and hydrogen as alternative fuels for reducing transport sector emissions. The presentation outlined the opportunity of greening heavy-duty road freight – particularly heavy-duty trucks on long-haul trips, which generate most road freight emissions – through transitioning to low- and zero-carbon fuels such as biomass-based diesel substitutes, biogas and biomethane. Policy support to improve technology readiness would accelerate the use of advanced biofuel and e-fuel²⁴ options, which will mature at different paces.

58. The introductory presentation by Amer Ahmad Amer highlighted the potential role of e-fuels in enabling a resilient mobility transition. The need to decarbonize the transport sector and reduce emissions is met with the challenge of rising transport energy demand due to population growth and increasing wealth in emerging economies. Energy-dense liquid e-fuel could facilitate the electrification of transport thanks to its ability to act as a portable renewable electricity storage medium. In order to scale up the use of e-fuels, a clear incentive scheme for the private sector to invest in renewable energy sources is needed, together with stringent yet achievable GHG intensity reduction targets. The use of hybrid e-fuels (a blend of 5 per cent e-fuels with conventional fuels), which have the potential for reducing annual emissions by 60 million t CO₂, could be an initial step towards the broader use of e-fuels. The costs of synthetic e-fuels vary in different regions; for example, e-kerosene is cheaper in

the Middle East and North Africa and in Southern Europe. The speaker noted that countries should focus on emission reductions and not on technology elimination when considering e-fuel production and use.

59. Participants discussed the potential role of low- and zero-carbon fuels in transport sector decarbonization, particularly in heavy-duty transport, aviation and maritime transport. Given the unique opportunities, challenges and strategies related to the transition to low- and zero-carbon fuels, participants underlined the importance of context-specific solutions, based on national circumstances, available infrastructure, capabilities and international cooperation.

60. While some participants considered compressed natural gas a feasible option for low-carbon fuel, other participants questioned its viability. Some participants expressed that electrification of road transport should take precedence over the use of low- and zero-carbon fuels owing to the immaturity and high cost of many of these fuels, while other participants argued that the use of low-carbon fuels is necessary, referring to GHG emission reductions achieved at a low cost in their countries, together with a sustainability co-benefit of improved air quality.

61. Raising awareness about new low- and zero-carbon fuels was considered key to facilitating their adoption, together with developing effective policies and measures around infrastructure, implementing national road maps for deploying low- and zero-carbon fuels, providing market-readiness support, promoting the use of different fuels, and considering agricultural land use and the biofuel supply chain in land-use planning. The need to adopt a full life-cycle approach to ensure holistic accounting of all GHGs was highlighted by some participants as a way to ensure an optimal combination of solutions enabling the shift low- and zero-carbon fuels and to minimize that socioeconomic and environmental impacts being shifted across sectors.

62. The need for international cooperation, including peer-to-peer exchange through regional dialogues and South-South cooperation, was underscored by participants as being crucial to addressing the challenges related to low- and zero-carbon fuels, such as high production costs, technical capacity constraints, lack of regulation and lack of awareness. The need to develop standards and certification for low- and zero-carbon fuels, including from a carbon intensity perspective based on a life cycle approach, especially for green hydrogen, was highlighted by one participant.

63. In order to reduce the cost of low- and zero-carbon fuels, several ideas and solutions were mentioned by participants, including the co-processing and co-feeding of intermediate energy carriers in existing refining assets with minimal complexity and retrofit cost, scaling up production driven by growth in demand initially coming from aviation, to improve learning and reduce the associated costs, and processing such fuels in countries with high levels of renewable energy.

64. Synergies and trade-offs related to low- and zero-carbon fuels were discussed, with participants highlighting the socioeconomic aspects, including the need for reskilling and training to address potential job losses and the need for life cycle and socioeconomic impact analysis, particularly for biofuels owing to their potential negative impacts (which may include decreased food security, land degradation and deforestation). Some participants mentioned a potential complementarity between synthetic e-fuels and biofuels, as both can be blended with conventional fuels to reduce carbon intensity while providing time for scaling up production to meet demand, considering limited feedstocks for biofuels globally and balancing competing demand for land use. Energy security due to diversified energy sources was noted as a co-benefit of the use of low- and zero-carbon fuels.

2. Opportunities (including actionable solutions) and barriers

65. Participants shared examples of opportunities for scaling up the deployment of low- and zero-carbon fuels:

(a) Advances in research and development, including those achieved through international cooperation, can lead to lower costs of low- and zero-carbon fuels and lower life cycle emissions of synthetic fuels;

(b) The use of synthetic fuels can bring down the energy transition cost since existing infrastructure is used, including through their blending with existing fuels;

(c) Countries with lower production costs could find new trade opportunities through low- and zero-carbon fuels such as green hydrogen;

(d) Under the food–waste–energy nexus, and with holistic planning approaches, organic food waste and waste from the timber industry offer the potential to scale up biofuel production without risking food security;

(e) Enhanced energy security can be realized through the development of domestic low- and zero-carbon fuel source;

(f) Strengthened engagement and partnerships with stakeholders, particularly those involving the private sector such as public–private partnerships, could make investing in low- and zero-carbon fuels and related infrastructure more attractive;

(g) Applying appropriate pricing and removing fossil fuel subsidies could promote low- and zero-carbon fuels;

(h) Taking advantage of all relevant sources, technologies and approaches to identify solutions based on national circumstances, available infrastructure and capabilities.

66. Participants often highlighted concerns about high upfront costs and general affordability, which were seen as barriers to the wider adoption of low- and zero-carbon fuels, particularly in countries with limited financial resources and those lacking production capacity for such fuels. Financing barriers mentioned by participants include limited finance available from international public finance institutions for implementing low- and zero-carbon fuel projects, lack of finance for new infrastructure development, and lack of financial instruments to de-risk private sector investments.

67. Other barriers mentioned by some participants to scaling up the use of low- and zero-carbon fuels include:

(a) Lack of legal frameworks, including regulations, standards and certification procedures, to define or qualify low- and zero-carbon fuels;

(b) Absence of political commitment from leaders and clear road maps;

(c) Limited awareness, limited technical expertise and challenges related to technology transfer.

(d) As several, low and zero fuels options are nascent technologies with own set of constraints and challenges, several participants mentioned that each low- and zero-carbon fuel has economic, technological and environment constraints and challenges, including high cost, the need for a technology breakthrough to increase safety, low energy density, a supply shortage owing to limited resources and a trade-off with biodiversity. In this context participants highlighted:

(e) Limited feedstock potential for biofuels arising from the risks biofuel production poses in terms of reduced food security and increasing food prices, land degradation, deforestation, biodiversity loss and competition for water resource;

(f) An energy-intensive production process for hydrogen, as well as storage difficulties and safety concerns. Lack of legal frameworks such as regulation.

E. Policies and measures

1. Summary of discussions and key findings

68. The breakout group discussions were facilitated by Maruxa Cardama.

69. The introductory presentation by Maruxa Cardama covered global dynamics in deploying and shifting to collective and non-motorized modes of transport. Most of the world's population lacks access to affordable, safe and sustainable transport, while demand for mobility services continues to rise, a situation that has led to increasing energy demand

and GHG emissions. Globally, two thirds of passenger journeys between 2018 and 2022 were made by private car, which highlights growing concerns about traffic congestion and related health issues (premature deaths attributed to particulate matter 2.5 from road transportation contribute to around 5 per cent of total premature deaths, with regional disparities). Despite the increasing deployment of EVs and renewable energy, EVs still have only around a 1 per cent share of the global vehicle fleet, and only a quarter of EVs are fuelled by electricity from renewable sources. Informal transport modes, despite being used for travel by millions of people in urban areas, are largely ignored by governments, generating large gaps in policy, knowledge and data. The vast majority of roads worldwide are not safe for cyclists and pedestrians. These barriers reinforce dependence on private vehicles. An integrated, inter-modal and multidimensional transport approach is one that provides opportunities for improving access while avoiding unnecessary motorized trips; shifting to modes that are less carbon and energy intensive; and improving vehicle design, energy efficiency and renewable and zero-emission energy sources.

70. The introductory presentation by Mahua Acharya focused on the challenges and opportunities faced by countries in moving from the current model of owning and operating vehicles to mobility as a service, including through electric buses. Barriers to rolling out electric buses include limited skills, capacity of and technologies used by local manufacturers, limited financial capacity of bus operators, reduced distance able to be travelled owing to road congestion, insufficient charging infrastructure and grid capacity, high capital costs for initial investment, and institutional fragmentation. Nevertheless, these barriers provide opportunities for a holistic, integrated approach in transitioning to electric buses. Firstly, particularly in new cities, all initiatives contributing to the transition should ideally be part of the broader land-use planning process to ensure that all infrastructure and related services are interconnected and function efficiently. Secondly, projects should be adapted to local conditions, including through consultative processes involving national and local authorities, the private sector, non-governmental organizations, academia and civil society. Finally, all government offices involved in the transition should be given specific tasks, which should then be centrally coordinated by a project management office, to resolve the barrier related to institutional fragmentation and to avoid the duplication of effort.

71. The importance of applying a tailored, holistic approach to the transition to sustainable transport systems, taking into account multiple policy areas, including urban development, transport and energy, was underscored by participants, as was the importance of engaging with various stakeholders, including private sector actors, local governments and individuals.

72. In this context, the needs to establish institutional arrangements for planning and implementation, as well as to mainstream climate change mitigation in other policy areas, were highlighted as crucial to addressing the fragmented landscape of policies and measures developed in isolation by national, subnational and local governments. Participants mentioned the value of policy replication, learning and efforts to support the capacity of local governments, including through city-to-city collaboration.

73. Some participants stressed that the mandate of the work programme is not to impose new targets or goals and that the approaches to develop, plan and implement policies and measures will vary across countries, as they need to align with specific national priorities and circumstances. Others highlighted that each country would need to determine its own set of policies and support measures in order to avoid unsustainable socioeconomic impacts.

74. Participants mentioned the benefit of applying a combination of policies and measures in order to align different policies and different areas of policymaking, including those relating to regulation, public procurement, infrastructure development and taxation. Raising public awareness about existing policies and measures was considered key to their successful implementation. The potential of fiscal measures, including subsidies and tax incentives, to encourage behavioural change towards emission reduction was noted.

75. The interdependence between policy implementation and financial resources, access to technology, and technical and policymaking capacity was emphasized by participants, indicating that many policies cannot be implemented without sufficient finance, appropriate technology and adequate capacity. The role of international cooperation in enabling policy implementation with adequate financial and technical support was highlighted. In this regard,

some participants mentioned the need to create a predictable and enabling international environment to enhance international cooperation.

2. Opportunities (including actionable solutions) and barriers

76. Opportunities in relation to policies and measures mentioned by some participants include:

(a) The development of national road maps and sending of clear policy signals at the national level to direct policies, measures and investment in a coordinated manner that reflect national priorities and circumstances, including those that involve long-term energy planning;

(b) The identification of suitable policies and the prevention of their premature implementation through technical assessment;

(c) The use of voluntary international initiatives to pilot and support transport decarbonization, while recognizing at the same time that any party may join an international initiative on a voluntary basis, as there is no one-size-fits-all solution;

(d) Regional-level policy cooperation, including through regional institutions and harmonized regulation;

(e) Private sector efforts to make sustainability a competitive advantage.

77. Barriers to the planning and implementation of policies and measures mentioned by some participants include:

(a) Lack of data such as proper energy balances;

(b) Political instability (cases were mentioned where policy initiatives and investments were cancelled simply because they were proposed by the previous administration);

(c) Outdated measures, particularly when new technology becomes available;

(d) Inadequate urban planning;

(e) Lack of resources, particularly finance, making long-term investment planning difficult.

F. Financing issues

1. Summary of discussions and key findings

78. The breakout group discussions were facilitated by Celine Tan.

79. The introductory presentation by Celine Tan provided an overview of the costs of a just energy transition in the transport sector. Costs can be differentiated as being specific to financing transport projects, to mitigating the impacts of transition on affected communities or to enhancing the adaptive capacity of communities. Access to and availability of financial resources is key to scaling up ambition and implementation of a just energy transition. Financial institutions should consider the disproportionately high costs of finance for developing countries, particularly for the LDCs and SIDS. The high costs of unjust, disorderly energy transition, combined with technology transfer, capacity-building and sustainable development needs, should also be taken into account. Barriers to financing just energy transitions include financing needs exceeding the capacities of national budgets; regulatory and financial risks due to reliance on debt instruments and private finance; risk of fragmented investments that are not aligned with national policy plans; limited financing and limited social and economic safeguards; and technology and capacity-building requirements. To overcome these barriers, financing the just energy transition must be part of a broader package of reforms to the current system of global economic governance and international economic law. Moreover, financial instruments and terms of financing should be aligned with national climate action plans and the SDGs to strengthen country ownership and drive mitigation ambition.

80. The introductory presentation by Binyam Reja discussed challenges and opportunities with respect to financing issues related to energy transition in the transport sector. The World Bank's approach is based on the 'avoid-shift-improve' approach, which highlights active mobility through human-centred urban planning. Electrification alone will not be enough to reach decarbonization targets. EV policies need to be embedded in a comprehensive national sustainable transport strategy. Concerning demand-side barriers, the vehicle sales market is often fragmented and does not have large enough demand to attract investment or lending. Small investments can lead to high transaction costs. Governments have limited fiscal space to support public transport investment, particularly in developing countries. Regarding the supply side, domestic financial institutions perceive investments in the transport sector as high risk owing to the largely informal and poorly regulated mobility and logistics sector. Establishing a regional facility is recommended to aggregate fragmented, small-scale investments into a sizeable programme that can be attractive to investors and financial institutions. Furthermore, such a programme would reduce transaction costs, which could increase participation by individual borrowers.

81. Given the significant gap between required finance and available funding and investments, participants highlighted the urgent need for tailored financing and investment solutions and suitable financing mechanisms to address this and other financial challenges, including debt-related barriers in developing countries. The high initial cost for transport infrastructure and facilities, long payback periods, lack of a mechanism to help ensure a suitable level of profit and low return on investment in the transport sector were mentioned as constraints for the just energy transition. Noting the high upfront costs of EV and relevant infrastructure, participants mentioned inclusivity, fairness and affordability as important considerations, and that many of the discussed solutions are not possible without adequate access to finance tailored to national circumstances.

82. Participants emphasized the important role of transport in development and the need for financing, including the need for public finance to mobilize private capital, including through blended finance and public-private partnerships, especially in regions that are not usually prioritized by private entities, together with the need for governments to provide assurance to the private sector regarding new technologies. The importance of country-level efforts was mentioned, including the establishment of a green finance entity, sustainable bonds and taxonomy, and the use of national road maps to attract investment. The need for global investment signals was also highlighted, as was the need to address debt burden in many developing countries and to consider equity and common but differentiated responsibilities and respective capabilities in the light of different national circumstances and the need for developed countries to provide adequate and predictable support to developing countries to allow for a just transition in the transport sector.

83. While some participants were in favour of a carbon tax as a revenue source for the government, other participants expressed concerns about its potential to create political challenges and trade barriers.

84. The importance of comprehensive cost-benefit analysis was highlighted by participants, including analysis of investment costs, debt levels and the costs of inaction; risk analysis; analysis of the difference between short-term gains and long-term benefits; and life cycle assessment.

2. Opportunities (including actionable solutions) and barriers

85. Opportunities related to financing issues mentioned by some participants include:

- (a) The exploration of debt forgiveness as a reset mechanism;
- (b) The creation of new market opportunities from carbon credit trading;
- (c) Repurposing of fossil fuel subsidies;
- (d) The exploration of government partnerships with international financial institutions and international initiatives to increase financial support for developing countries.

86. Several barriers and challenges to financing that are common to many countries were highlighted by participants, including:

- (a) Increased capital costs and high debt levels following the pandemic;
- (b) Budgetary constraints due to competing policy priorities.

87. Barriers and challenges to financing associated with specific national circumstances mentioned by some participants include:

- (a) Reluctance from the private sector to invest owing to the lower return on investment as a result of a sparse population and a small market size;
- (b) Currency exchange risk due to foreign currency finance;
- (c) The long time frame and prolonged efforts required to access international finance coupled with limited availability of domestic finance;
- (d) The potential for investments in certain biofuels to become obsolete owing to shifts in the market environment;
- (e) The disproportionately higher cost of finance and debt and the high level capital required for transport projects pose challenges for many developing countries and can affect the implementation of the just energy transition.

G. Technology and capacity challenges

1. Summary of discussions and key findings

88. The breakout group discussions were facilitated by Mareer Mohamed Hunsy and Simon Benmarraze.

89. The introductory presentation by Roland Roesch highlighted the fact that while many NDCs mention transport targets, few have specific long-term targets aligned with net zero goals. Systemic innovation is key to accelerating the just energy transition. The Innovation Landscape for Smart Electrification report²⁵ published by IRENA in 2023 identifies 100 innovations that can play a role in decarbonizing the energy use sector. The speaker mentioned the main barriers to energy transition as being the costs of EVs and charging infrastructure. Several potential blind spots were highlighted, including those relating to smart charging, which does not necessarily mean bidirectional charging; development of charging infrastructure, which should not mimic petrol stations or focus only on fast charging; charging infrastructure, in terms of standardization and interoperability; EV charging infrastructure deployment, in terms of inclusiveness and reflection of local circumstances; electrification strategies, in terms of taking into account mobility trends; EV charging points, in terms of co-location with solar generation to minimize their impact on grids; and maintenance of charging infrastructure by state agencies, in terms of coordination and consistency.

90. The introductory presentation by Mareer Mohamed Hunsy described the importance of climate technologies in providing solutions for sustainable road mobility. Climate technology refers to any equipment, technique, knowledge or skill needed to reduce GHG emissions. An analysis of technology needs assessments and technical assistance provided under the CTCN revealed that economic and financial challenges are the dominant technology-related challenges, and they are seen as relevant to 84 per cent of technologies.²⁶ Common capacity-related challenges include limited information and awareness, technical skills and human capacities. A TEC publication on deep decarbonization technologies for sustainable road mobility²⁷ summarizes the opportunities, barriers and policy options for plug-in EVs, fuel-cell EVs, advanced biofuels, shared mobility and fully automated vehicles. For example, barriers to plug-in EVs include the lack of supporting infrastructure such as charging stations and, in many countries, grid networks. The production process for advanced biofuels is not yet optimized owing to the lack of compatible vehicle stock and impacts on food prices and food security. The concept of shared mobility has not been fully explored owing to prevailing customer preferences for private transport modes.

91. The need for commercially viable, affordable and proven technologies was underscored by participants, particularly for countries without manufacturing capacity that

depend on imported technology. Although technologies are available, many are in the early stages of implementation.

92. The need for international cooperation, including through partnerships and support, to facilitate access to technologies and strengthen local capacities, including institutional arrangements for policy implementation and technology deployment, was also highlighted. International cooperation was also mentioned as a way to achieve economies of scale for emerging technologies, including by aggregating demand beyond a specific country. Some participants emphasized the need for international standards to ensure the universal compatibility and safety of technologies such as those involved in EV charging.

93. Participants indicated the value of raising public and policymaker awareness of clean technologies to increase their social acceptance, enable behavioural change and identify feasible, practical solutions for specific countries and regions.

94. Participants mentioned that there is no one-size-fits-all approach to developing the right technology pathway, but that combinations of different modes of transportation, technologies and policy approaches need to be pursued, based on national, regional and local circumstances. Taking a holistic view and considering cross-sector collaboration throughout the value chain for just energy transitions was highlighted by participants as being important to identifying and deploying technologies suitable for national circumstances, including technologies for manufacturing and other areas such as power grid capacity, charging infrastructure, raw material (such as minerals) availability and supply, and battery recycling.

95. Participants discussed the need for capacity-building for different stakeholder groups, including policymakers, the workforce, youth and the general public, to drive innovation and technology development and transfer.

96. Participants exchanged views on the challenges experienced with different technologies. With regard to the electrification of vehicles, issues discussed include infrastructure deficits particularly in developing countries, limited travel distance, the need for efficient EV batteries while addressing the issue of waste disposal, power grid capacity constraints, and competition for other electricity use and limited power generation capacity. Challenges relating to synthetic e-fuels include scalability, safety concerns regarding hydrogen use and lack of international standards, although participants noted the progress in the initial stages of research development on hydrogen- or ammonia-fuelled ships.

97. Some participants highlighted that existing transport infrastructure is often not adapted to the development needs of electrified transportation or to the provision of efficient transport conditions in growing cities, and noted that this provides an opportunity for, but also challenges to, accelerating the electrification of transport.

2. Opportunities (including actionable solutions) and barriers

98. Opportunities related to technology and capacity-building mentioned by some participants include:

(a) Reduced costs of new and emerging technologies, including those related to EVs, low- and zero-carbon fuels, and artificial intelligence, through continued efforts in innovation, research and development, including by start-ups;

(b) Joint pilot projects to gather data on the performance of new technologies and the sharing of experience on new technologies in different environments;

(c) A road map for the roll-out and scaling up of specific technologies, combined with a holistic finance and investment plan;

(d) The acquisition of new skills by youth through capacity-building and technical assistance;

(e) Overcoming existing structures and lock-in effects through the application of new technologies, including the start of new economic opportunities.

99. Barriers related to technology and capacity-building mentioned by some participants include:

(a) Lack of local know-how and necessary skills in the workforce, including among mechanics, for maintaining EVs and charging infrastructure and handling EV battery recycling;

(b) Supply chain constraints resulting from the concentration of specific technologies in only a few areas;

(c) Cheaper and easily accessible but unsustainable technology (e.g. inefficient used vehicles) often combined with limited consumer awareness of better options;

(d) Heavy reliance on maritime transport in SIDS with limited affordable technology options.

H. Sustainable development and socioeconomic impacts

1. Summary of discussions and key findings

100. The breakout group discussions were facilitated by John Mark Mwanika.

101. The introductory presentation by John Mark Mwanika highlighted the socioeconomic dimensions of the barriers and challenges faced by countries in transitioning to sustainable mobility. Four areas for barriers in the transport sector were described: policy and regulations, technological limitations, financial investment, and public awareness and acceptance. The lack of political will for advancing sustainable mobility and the inconsistency or inadequacy of policies, regulations and incentives at various levels often lead to the prioritization of short-term economic gains over long-term sustainability goals. Overcoming technological limitations of EVs will require significant time, resources and multi-stakeholder collaboration. There is limited public understanding of the benefits of EVs, which often results in various forms of resistance by consumers. These barriers are often accompanied by challenges related to social equity; job transition and skills gaps, as highlighted by labour impact assessment studies; economic impacts on existing industries; and access to sustainable transport in underserved areas. Social equity refers to addressing potential disparities in accessing benefits and fostering inclusivity and fairness in policy initiatives. Key transport workforce issues include poor working conditions, harassment, sexual exploitation, gender discrimination and limited access to affordable finance to purchase or upgrade vehicles. These barriers and challenges provide opportunities for formalizing workforce arrangements by including informal workers and economic activities in the scheme of benefits and rights applied for the formal economy. This inclusion can be achieved through strong, democratic and representative trade unions and associations. These associations should be included in industry-wide just transition plans that focus on collective action by governments, industries, communities and individuals.

102. The need to assess both positive and negative socioeconomic impacts of sustainable mobility was emphasized by participants, with employment being the most commonly cited issue. The importance of facilitating the reskilling of workers and providing support to disadvantaged communities was underlined, given the potential job losses in certain industries. Stakeholder engagement, including through trade unions, was considered as key to facilitating a just transition.

103. The application of a gender-based approach and access to modern energy were underlined by some participants as important to ensuring an equitable outcome of the energy transition, including in the transport sector. Linkages to other sustainable development aspects were also mentioned, including to sustainable resource management, land use, deforestation and food security.

104. Some participants underlined that the just energy transition in transport systems needs to contribute to achieving the SDGs, including those directly and indirectly linked to transport such as ensuring energy access (SDG 7) and poverty reduction (SDG 1). The multidimensional aspects of transport systems were discussed, including the empowerment of poor people and economic productivity increases through reduced travel time and better transport access for everyone. Countries need to balance different, and sometimes competing, development priorities.

105. Many participants stressed that sustainable socioeconomic development is a priority for many developing countries; therefore, affordability of EVs and low- and zero-carbon fuels was mentioned as an important factor to enabling energy transition in the transport sector.

106. Participants discussed that sustainable development in transport systems can be promoted through various means, including the implementation of policies and measures that integrate environmental, economic and social considerations and through policy coordination approaches. This can involve adopting a holistic, nationally driven approach that balances the needs of present and future generations, thereby ensuring the protection of the environment, promoting economic growth and social well-being, and addressing the need for equity, social justice and inclusivity.

107. Some participants also raised the point that accessibility to efficient transport services and not only affordability of those services should be considered. Affordable and proper access to transport systems for all needs to be ensured.

2. Opportunities (including actionable solutions) and barriers

108. Opportunities related to sustainable development and socioeconomic impacts mentioned by participants include:

- (a) Co-benefits, including improved public health owing to reduced air pollution, job creation and business development, and improved road safety;
- (b) International cooperation, including the sharing of best practices.

109. Barriers related to sustainable development and socioeconomic impacts mentioned by some participants include:

- (a) Trade-offs with economic development, particularly where transitioning away from fossil fuels leads to reduced tax revenues and in developing countries where oil reserves have recently been discovered;
 - (b) Lack of political leadership, weak institutional frameworks, corruption and competing interests;
 - (c) Private land ownership, competing land use and cultural beliefs of the local population regarding the development and use of transport infrastructure;
 - (d) Lack of available data on socioeconomic impacts and lack of modelling tools;
 - (e) Lack of international finance and technology support.
-