

Global Electric Two- and Three-Wheeler Conference
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Bangkok, Thailand

FINAL REPORT

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Background

Two-wheeler and three-wheeler vehicles are the fastest-growing transport mode in many low- and middle-income countries. By 2050, more than 400 million two- and three-wheelers will be on the road globally, which represents a 50 percent increase compared to today. As global sales of E2Ws and E3Ws are increasing by more than 14 percent annually, they are projected to continue to be the largest EV fleet among all road transport modes. Asia is at the center of this growth, which is why UNEP decided to hold its first Global Electric Two and Three-Wheeler conference at its regional headquarters in Bangkok, Thailand.

Despite the environmental benefits and cost competitiveness of E2Ws and E3Ws, there are several barriers holding back their market penetration. Many developing countries lack an enabling policy and regulatory framework that promotes these vehicles. Given the crucial role of two- and three-wheelers in their road transport sector and the limited international experience, emerging economies have a unique role to play in the design and harmonization of policies, regulations and standards for this vehicle type.

The objectives of the conference were therefore to advance the discussion around regional and global harmonization of electric 2&3 wheeler standards and regulations, establish information exchange and networking opportunities between countries, cities, companies, financiers and industry experts, and disseminate relevant knowledge products.

Day 1

Opening

Ms. Marlene Nilsson, Deputy Regional Director of UNEP Asia and the Pacific Office opened the conference by welcoming the around 70 participants from 23 countries. She expressed her appreciation to the German government, represented by Dr. Ernst Reichel for the unwavering support, both as a donor and a global leader in sustainable mobility. This support played a pivotal role in initiating UNEP's work on electric mobility, setting the stage for its expansion to now assist over 60 countries in their transition to electric mobility, including 17 countries focusing on electric two and three-wheelers. She also noted that E2/3W have risen to account for 10% of global transportation energy consumption.

Dr. Ernst Reichel, German Ambassador to Thailand thanked UNEP for the invitation to his first visit at the United Nations. He highlighted the important role of transport in preventing further growth of GHG emissions, especially in developing countries. The project titled "Integrating Electric 2&3 Wheelers into Existing Urban Transport Modes in Developing and Transitional Countries" funded by the German International Climate Initiative (IKI) and implemented by UNEP since April 2017, will be finalized by the end of this year. The project was originally active in 6 countries – 3 in East Africa (Kenya, Uganda, Ethiopia) and 3 in Southeast Asia (Thailand, the Philippines and Vietnam). Replication projects in Malaysia, Indonesia and Burundi have been integrated later on. The BMUV-IKI project was one of the first-of-its kind to support e-mobility in the Global South. It was crucial in developing UNEP's Global Electric Mobility Programme, which is now active in 60 countries and, together with partners, is implementing a total of more than USD 130 million in grants.

Ms. Gita Sabharwal, UN Resident Coordinator Thailand welcomed the participants to the UN office in Bangkok and emphasized the importance of addressing two and three wheelers as they are about 500 million on the road globally, responsible for about 10% of all transport sector energy use of non-OECD countries. She shared a vision where all these vehicles run on clean energy to combat air pollution and climate change. To achieve this, we need partnerships and successful demonstration projects to get data to improve policy. This conference serves as a platform where knowledge flows not only from the North to the South but mainly between South-South.

K Surapong Meanmitr, Deputy-Director General, Office of Transport and Traffic Policy and Planning, Thailand refers to the conference as a significant milestone as it convenes for the first time electric two and three wheeler experts from many different parts of the world. He presented Thailand as a leader in the region with a significant automotive industry, sets an inspiring example for the entire region. He also thanked UNEP for the collaboration on the successful pilot of 50 electric motorcycle taxis in Nonthaburi and Bangkok.

From Fuel Economy to E-Mobility: A decade of action in the Global South

Yeonju Jeong from UNEP summarized the evolution of UNEP's e-mobility programme from the BMUV-IKI project focusing on E2Ws and 3Ws in 6 countries to working across all modes in over 60 countries globally. Due to the high growth of the vehicle fleet in non-OECD Countries of vehicles, long vehicle life ~20 years, transport emissions are projected to grow to 25-30% of all emissions. She emphasized that while important, improvements in fuel economy for ICE vehicles will not be sufficient to meet GHG emission reduction goals. Therefore, the shift to smaller and electric vehicles is crucial. While virtually no electric mobility projects and programmes existed at national and city level in LMICs in 2018, today many LMICs have projects on electric mobility. UNEP's Global Electric Mobility Programme contributed significantly to this boost in e-mobility in LMICs and is working with partners to actively support more than 60 LMICs, implementing grants close to USD 150 million, and leveraging co-finance exceeding USD 600 million.

E2&3W Ecosystems in South East Asia

Dr Nuwong Chollacoop from the National Energy Technology Center Thailand presented the pilot project supported by UNEP. The Chinese company TAIIG donated 50 E2Ws that were used as taxis and their performance was evaluated. This provided lots of interesting data, for example on energy consumption with 1 vs. 2 passengers. He mentioned the challenges of E2W registration in Thailand as vehicles of less than 25 kph are not registered and registration requires e2Ws to be sold together with battery, for which the cost is still 30% higher than for ICE vehicles.

Dr Vu Ngoc Khiem from the University of Transport Technology in Vietnam presented the data that was collected in a similar pilot project in Hanoi. He emphasized the importance of demonstration projects as E2Ws sales and stock are still low at less than 5% of the total fleet. Sales in ICE 2Ws are still rising much faster though Vietnam has the target

of 100% EVs by 2050 and commitment to stop manufacture, assembly and import of vehicles using fossil fuels by 2040 and by 2050 100% of all road vehicles to cleaner fuels.

Dr Raymund Abad from Clean Air Asia in the Philippines mentioned that 77% of first time vehicle buyers choose 2/3Ws and that the stock increased by 200% in 11 years. New policies to promote EVs in the Philippines include the EV Industrial Development Act and a comprehensive roadmap for EVs. 75% of the registered EVs are E2/3W even though many small E2/3W are not being registered, similar to what was mentioned for Thailand.

Dr Horizon Gitano from Malaysia highlighted the efficiency of e-scooters vs cars in transporting people. E2Ws are increasingly popular with in Malaysia, especially with elderly, women (no need to kick start or shift, lower speed), disabled (E3W), and immigrants (perception the license not required). Many models are available online from 175\$ to 3000\$, but only the low end is selling because economics are unfavorable to EVs due to low petrol price in Malaysia. Over 90% of all E2/3W on the road are not legal as they haven't undergone roadworthiness testing. He highlighted the importance of keeping the vehicles affordable, so measures to improve quality must be weighed against any increase in cost.

E2&3W Ecosystems in Africa

Eduardo Nyandwi from the Ministry of Transport in Burundi presented the initial awareness raising campaign and capacity building activities on the electrification of 3Ws that are being undertaken as part of the replication activities of the IKI funded project. He pointed to the need for a survey of existing 2/3W transport and their social impact as a baseline for guiding the national e-mobility project that is starting in the country financed by the GEF.

Nyaga Kebuchi from Sustainable Transport Africa in Kenya explained that 2/3W are 48% of vehicle population and that about 300 000 new units are entering fleet per year. Currently, there are about 900 E2Ws on the road mainly used as taxis. The donation of 50 E2Ws by TailG under the UNEP supported project where one of the first in the country assembled locally and tested in different use cases such as local government, forestry department and national power company. The main recommendations from the concluded pilot were to increase robustness, reduce charging time, improve maintenance capacity, improve data tracking and develop local battery testing capability.

One key difference between motorcycle growth in East Africa compared to most Southeast Asian countries is that most of the growth in East Africa represents

'shared-use' – i.e. motorcycle taxis. This is due to the lack of mass urban transport systems, increasing congestion, growing national economies, and increased disposable income from a lower base.

National Actions to drive e-mobility

A panel discussion on national actions for e-mobility with representative from 6 countries across Asia, Africa and Latin America was moderated by **Jemimah Muli from GIZ Kenya**.

Dr Vu Ngoc Khiem, University of Transport Technology, Vietnam shared that transport is a is estimated to contributed 18% of annual GHG emissions in Vietnam. The country has however made a commitment to net zero by 2050. Vietnam has around 1.8 million electric vehicles and about 4 million electric 2 wheelers.

Andro Marcello Zetga, Ministry of Transportation, Indonesia presented Indonesia's target of having a fifth of vehicles electric by 2025. Further the country targets to have 4.5 million electric 2 wheelers by 2035. The government is providing several incentives to accelerate electrifications such as: Minimizing tax on electric cars and motorcycles, unrestricted access to cities for EVs, promoting electric bus production, requirement for government to use electric vehicles and generous subsidies.

Chutinthorn Mankhong, Office of Transport and Traffic Policy and Planning, Thailand reiterated that Thailand has placed electrification high on the national agenda providing for a national electric vehicle committee which is chaired by the deputy prime minister. The committee has sub committees on EV component development, EV infrastructure development, impact assessment of biofuels and promotion of EV uses. The country also has a 30 by 30 policy with targets to have 30% vehicle production being electric by 2030 and 100% EVs by 2035. To promote this, the country is offering: tax exemption for up to 11 years for EV manufacturers, upfront purchase subsidy of up to THB 150000 and 40% duty reduction for import of completely built units of luxury vehicles. As a result, EV sales were 6,000 in 2021, 30,000 in 2022, and already there are 50,000 units sold in the first half of 2023. The Government is also aiming to be a leader in the automotive sector within the region, and the subsidies are capped at 5 years with the hope that market mechanism will drive take over from then.

Sheikh Tunis, Environmental Protection Agency, Sierra Leone is doing the national coordination of the e-mobility efforts in the country, but private sector activity is still lacking. The 2&3 wheeler fleet is growing very fast as is the case in many other African

countries. Therefore, the national GEF funded e-mobility project is addressing the electrification of 2&3 wheelers as well as establishing a regulatory framework for e-mobility in the country. The country is looking to partner with private sector actors who could set up and provide electric vehicles and infrastructure across modes.

Bakatimbe Tchannibi, Ministry of Environment Togo highlighted that 2&3 wheelers are considered the biggest contributor to emissions in the transport sector in the country. Togo developed an electric mobility roadmap in 2020 which sets a target of 3% of newly registered vehicles to be electric by 2025. There is also a target of 100% electric vehicles registrations by 2050. The country has also recently provided incentives for EVs with 0% tax on EV purchase. This has been done through a transparent discussion with the Ministry of Economics explaining the context on cost of fuel importation versus the benefits for adoption of e-mobility. In addition, the country has provided an industrial platform to assist investor in the sector to set up in the country. Consequently, one e2w operator has set up. Through the GEF project, the Togo is working on developing an e-mobility framework to catch up and incentivize with private sector investments. The biggest challenge is the lack of awareness of the population on electric mobility. A future challenge will be the useful life of the batteries and end of life management of the EV batteries.

Maximiliano Parisi, Buenos Aires City government, Argentina shared lessons learnt from e-mobility in Latin America. Chile has for example the second largest fleet of e-buses after China. In Argentina and the larger South America, 2&3 wheelers are not very popular yet but on the rise. A good opportunity to introduce these e2&3W would be through urban cycle logistics and micro-mobility. The biggest challenge he sees is availability of financing. Though the technology and batteries are well known, they are very expensive and require significant funding for adoption.

Main Session Take aways are that all countries that have set some sort of target for e-mobility and started developing an enabling policy/regulation framework. It is important to have a national stakeholder coordination mechanism to streamline interventions towards transport electrification and address the unique set of respective local circumstances.

The role of E2&3W in mitigating climate change and how to measure it

Alvin Mejia from UEMI started the session with a presentation on Electrifying 2&3wheelers as a building block of Climate Change Mitigation. 2&3 wheelers are significant in the developing South because of their nimbleness, various use cases, lower acquisition costs etc. therefore, they are a significant piece of the puzzle towards mitigating emissions. The GHG impacts of e-2and3 wheelers may vary depending on a variety of

factors – this is why proper Monitoring, Results and Verification (MRV) is encouraged. Countries have set targets for GHG reductions across the world and there is therefore a necessity to measure advances through a MRV framework. The MRVs can be for policies/ impact, emissions and support. MRVs are essential for informing transparency, deciding on project reporting (ex-ante) and also understanding results ex post. Considerations for transport MRVs should follow the ASIF (activity, structure, intensity, factor of emissions) structure. Institutional set ups are critical to ensuring sustainability of MRVs. The electrification of 2&3 wheelers may result in impacts which may not just be about a one-is-to-one vehicle replacement. Therefore, causal chain analysis is an important step, which is also connected towards defining the data to be monitored as the action is being implemented.

Jose Bienvenido Biona from the Electric Vehicle Association of the Philippines (EVAP)/ Tojo Motors Corporation followed with a presentation on Electrification as an Opportunity to Enhance MRV. Tojo motors corporation has been supporting the electrification of local government vehicle units in the Philippines through the introduction of quadricycles. The electrification of the vehicles (e.g. e-quads – practically the same as 3 wheelers in function for the application) allows the integration of sensors (and the software systems) to aid baselining of activity and fuel consumption, SoC data collection, Charging energy consumption, Location/ speed / operations, trip purpose, Number of passenger and cargo load, vehicle and battery conditions. They complement the digital data collection with driver surveys to find about vehicle use.

The presentations were followed by a roundtable discussion on the institutional set-ups for MRV moderated by Alvin Meija with discussants from 4 countries.

Valerie Ongolo Zogo, Ministry of Transport Cameroon shared that in Cameroon, 2 wheelers are predominantly imported from India and China. However, there is no legal registration of 2&3 wheelers. It is therefore not possible to know the numbers in the country. In addition, 3 wheelers not legally used for passenger transport in Cameroon. For this reason, there is no recognition of 2&3 wheelers in the countries MRV systems. There is a need to put in place a system to generate information about technology options as well as this mode. Currently, most transport initiatives are led by the private sector without the government involvement. Through UNEP's support, the country did a vehicle baseline and provided recommendations for the inclusion of 2&3 wheelers in

Raymund Abud, Clean Air Asia, Philippines explained how electric mobility has been included in the national MRV processes. The Departments of Energy and Transport are working together to operationalize the MRV. The overall coordination is done by the national climate

change commission which also has a role in communicating the findings to UNFCCC. It is important to engage local government agencies to collect information and pass it along to the national government agency. Therefore, there is a need for capacity building at the local government level because to make data from urban areas correct and representative.

Peerawat Saisirirat, ENTEC, Thailand shared the link to Thailand's carbon markets platform <https://carbonmarket.tgo.or.th/> which shows the amount of CO2 sold. The platform also includes the electric mobility projects and information on the market price. They are haven't developed MRV guidelines for electric 2 and 3 wheelers, but we are collecting data through the UNEP supported project. Thailand has a training course to enhance the transport MRV capacity. The course is hosted by the office of Transport, but it's not a government courses but private conducted by companies (environment consultants).

Lu Thi Yen, University of Transport Technology, Vietnam highlighted the legal documents relevant to MRV, such as the NDC, the law on Environmental Protection 2020, Circular Ministry of Natural Resources and Environment about the matters for GHG inventory and MRV for GHG emission in waste management. Before 31st of December this year for 2023, the Ministry of Natural Resources and Development with other ministries and Provincial Peoples Committee must review the list of GHG emitting facilities which must conduct GHG inventories (for companies that emit 3,000 or more tons per year) from 2020-2026 and work on measures to reduce emissions. They need to report reductions by 2027. UTT plans to develop detailed guidance on MRV (e.g. electric 2 and 3 wheelers).

The takeaways were that there is necessity to measure advances in transport electrification through an MRV framework and that capacity building, vertical coordination and finding the why are crucial. For that proper institutional set ups are critical to ensuring sustainability of MRVs.

Day 2

Global E2&3W Market Overview

Thomas Courtright from the Africa E-mobility Association presented the findings of a global market overview of E2&3Ws that is being developed under UNEP's Global Working Group for Electric Two and Three Wheelers. In many LMICs, electric 2- and 3-wheelers are not registered, so official data is difficult to obtain. There are an estimated 570 million two

and three-wheelers on the road in Africa, Asia and Latin America. As of today, most of these two and three-wheelers are still using internal combustion engines and petroleum fuels. They are consuming between 15% and 20% of all liquid petroleum fuels used for transport in non-OECD countries every year. Shifting these vehicles to electric has the potential to mitigate between 500 and 600 MtCO₂eq every year. With rapidly growing two and three-wheeler markets especially in Africa and Latin America, this mitigation potential is yet to grow. There are an estimated 27 million 2&3W in Africa, of which less than 1% are electric, 490 million in Asia, of which approximately 7% were electric and 50 to 60 million 2&3W in Latin America, of which less than 1% were electric. The full report will be available on UNEP's website soon.

SOLUTIONSplus - implementing LEV pilots in Asia, Africa, Latin America and Europe

Alvin Mejia, UEMI presented the Solutions Plus project funded under Horizon 2020, total budget 20 million EU with a consortium of 46 partners. SOLUTIONSplus brings together highly committed cities, industry, research, implementing organisations and finance partners and establishes a global platform for shared, public and commercial e-mobility solutions to kick start the transition towards low-carbon urban mobility. The project encompasses city level demonstrations to test different types of innovative and integrated e-mobility solutions, complemented by a comprehensive toolbox, capacity development and replication activities. Demonstration actions are happening in Hanoi (Vietnam), Pasig (Philippines), Lalitpur/Kathmandu (Nepal), Kigali (Rwanda), Dar es Salaam (Tanzania), Quito (Ecuador), Montevideo (Uruguay), Madrid (Spain), Nanjing (China) and Hamburg (Germany). The demonstration actions in Dar es Salaam, Kigali, Quito and Kathmandu will test the development, upgrading and retrofitting of 2 or 3 wheelers in particular for the last-mile connectivity (people and freight). Go to www.solutionsplus.eu for more information.

Innovative approaches to e-mobility

A roundtable discussion including presentations on innovative projects for e-mobility was moderated by **Joachim Bergerhoff from the Sustainable Mobility in Medium-Sized Metropolitan Regions in ASEAN (SMMR) in Cambodia.**

Kanya Pranawengkapti, Wuppertal Institute Germany presented the introduction of light electric vehicles for urban logistics in Latin American cities. In Quito 10 e-cargo bikes were tested over 2 months. In Montevideo, 2 e-cargo bikes were piloted for individual deliveries for which traditional cargo bikes are too big. Both pilots showed increased

efficiency through increased numbers of packages delivered and reduced numbers of working hours. For several use cases, a potential increase for monthly income was observed.

Gerutu Gerutu, Dar es Salaam Institute of Technology Tanzania presented the pilot project for electric three-wheelers for last-mile connectivity for the Dar es Salaam BRT. In addition, they deployed 16 pedal assisted e-bikes that were locally assembled and used for the delivery of medical goods. They are also lobbying for tax exemptions with the Tanzanian Government.

Vu Ngoc Khiem, University of Transport Technology, Vietnam presented the electric two-wheeler sharing pilot project in Hanoi. Hanoi with an 8.5 million population has 8 million personal vehicles, so the switch to EVs is very important. The pilot serves to draft technical features of systems and propose policies for Hanoi authorities.

Ashima Pandey, Founder, Yatri Motorcycle Nepal shared his experiences in localizing electric 2-wheeler production in Kathmandu. 2Ws are rising in Kathmandu and EVs are very feasible despite the challenging topography. The problems they are aiming to address are 1) unoptimized 2W EV platforms for Nepal's topography leading to inefficient powertrain performance and underwhelming charging performance and 2) unavailability of networked smart Fast Chargers for seamless payments. They therefore focus on creating a connected ecosystem, so people don't need to think about the switch to electric vehicles.

Opportunities and challenges of Electric Three – Wheelers

A panel to highlight opportunities for electric three wheelers was moderated by **Naressa Saripada from Clean Air Asia**.

Souliyo Vongdala, LOCA Co.Ltd., Laos presented the project developed by E-Sarn technological college (ETC) and NSTDA. Since E4Ws are still too pricey for the average person, E3Ws could be a good alternative especially since existing tuktuks are becoming unaffordable due to increasing / volatile gas prices. The ETC and NSTDA team enhanced the design, reducing body weight and improving electric system efficiency of the vehicle to boost local acceptance and social awareness. The drivers of the e-tuktuk will be provided with a service via the LOCA platform. The platform is not just a ride-hailing app but also serves as a service meter collecting GPS data from drivers and calculating the fare.

Krisada (Mick) Kritayakirana established Muvmi in 2018, an on-demand ridesharing service, that moves in neighborhoods and connects to mass transit. They have had over 7

million passengers so far. Most trips are short, less than 5 miles (8km). Their 500+ electric three wheelers have saved 1,400tonnes CO2e so far.

Sasiranga de Silva, University of Moratuwa presented his work on the 2 and 3w ecosystem in Sri Lanka.

Edouard Nyandwi, Ministry of Transport Burundi explained that 2Ws & 3Ws are not allowed in the capital city of Bujumbura, but they are used in the periphery. They are currently revising transport & traffic laws to align with the new transport means. They are preparing a conference on e-mobility with political, banking and insurance sector as well as transport sector representatives to raise awareness on E3ws.

Beran Forster, Ministry of Transport Sierra Leone highlighted the rise of 3W registration from 0 in 2015 to 5% by end 2022. 3ws are seen as safer than 2-wheelers as they go slower, but there are still safety concerns as unregulated and going on sidewalks - interacting with pedestrian (similar to 2-wheelers). They are working on an Electric 3W demonstration project to test the system with UNEP support.

Financial mechanisms for scaling up electric two and three-wheelers

Pan Piyasil, GIZ Thailand presented a financial assessment of electric motorbike taxi services in Bangkok. The barriers for financing electric motorcycles in Thailand, include that most banks don't understand e-mobility and related due diligence requirements. Unclear government commitments and a lack of historical data for lenders to be assured of their return of capital add to that challenge. He proposed the structure of an Integrated End-to-end Financing Model. Here an Integrated end-to-end service SPV owns all assets required for motorcycle taxi electrification through a long-term contract with e-motorcycle manufacturers as well as charging infrastructure suppliers and provides an integrated end-to-end service to the motorcycle taxi operators under monthly or yearly contracts. Operators can rent electric motorcycles together with maintenance and charging services through the SPV. Operators will be charged for the integrated service on a monthly basis while the revenue comes from the fare collection.

The presentation was followed by a panel discussion on financial mechanisms for scaling up electric two and three-wheelers moderated by Pan Piyasil, GIZ Thailand.

Poonsit Wongthawatchai, Krungsri Bank Thailand presented on their Environmental, Social and Governance (ESG) policy. The bank released the first green bond of 400 million USD this year, with a significant amount been earmarked for e-mobility. They also issued the first Sustainability Bond for Transportation in Southeast Asia amounting to USD 180 million.

Sarocho Kessakorn, ADB, highlighted that ADB has mobilised private sector financing of 540 million and is investing substantially in electric mobility in Asia. She presented project examples such as the Thailand Green Loan for Electric Vehicle Charging Network, Vietnam Green Loan for Electric Mobility and the Bangkok Public Transport Electrification for Bus Fleet

Nikki Rudnick, Uber, US explained how the ride hailing company is supporting its drivers (earners) to access financing for electric vehicles across different markets. Their goal is to support drivers to join the transition and to move to all electric vehicles on the platform by 2040 across the globe.

Arnold Bufi, Tipaklong Sustainable Mobility, which is a startup that was established 3 years ago shared the challenges he faces in accessing financing due to the usual large ticket sizes required by investors.

Breakout groups

The participants were divided into four groups and rotated to have in depth discussions on the topics of 1) road and vehicle safety 2) battery swapping vs plug in charging 3) end of life of EV batteries and 4) behavior change and incentives.

Road and Vehicle Safety for E2&3W

Maximiliano Parisi, Buenos Aires City Government facilitated this group and broke down the main issues regarding road and vehicle safety into 3 groups: Human behavior, vehicle related and traffic management. Human behavior is about the driver's own safety and the interaction with other people and vehicles on the road. This is the same if the vehicle is ICE or electric. Important safety factors are helmet wearing, speed and vehicle size differences. Governments play an important role in registering drivers and vehicles, developing and enforcing safety regulations and providing safe

infrastructure. The group also discussed the characteristics of the vehicles, especially the battery since that is the major difference between ICE 2&3W and E2&3W. Battery homologation and electrical safety standards are very important to encourage the use of these vehicles. In Africa for example there aren't many local safety standards for these vehicles, most of them are industry standards from abroad because of importation. The group agreed that standards shouldn't be a limitation for further innovation on E2&3W and not push people away from these vehicles. EVs being very silent is also a problem for road safety in urban areas mainly. Capacity building for technicians and users on safety of vehicles and charging is crucial. With regards to traffic management, the challenge of enforcement was discussed, e.g. for exclusive lanes and speed limits. Special plates and labeling policies can be a solution. The group concluded that the three aspects discussed are deeply interrelated.

The most difficult topic to address is human behavior, but it's not impossible to change the mindset of future users with education and training, most important when getting their license and when buying these vehicles. Improving helmet quality, especially in Africa, is another very important matter. When safety aspects are comprehensively addressed there is no necessity to banning these mobility solutions as it is happening in some places.

Charging Infrastructure & swapping

Jose Bienvenido Biona, Electric Vehicle Association of the Philippines (EVAP) facilitated the breakout session on charging infrastructure vs battery swapping. The group started with laying out the rationale for battery swapping: Reduce charging time, lower upfront cost of vehicle, improve battery life with professionals handling the batteries and reduce the impact on the grid. Which system of charging to use highly depends on use cases. Commercial users also lean more towards battery swapping. However, the lack of standards for interoperability between battery swapping systems might limit its scale up and fast charging might take over. Grid supply and demand are other factors to consider. In situations with limited power supply, solar could be used for swapping as it will not require higher power + standby generator.

End of life of EV batteries

Dr Horizon Gitano from Focus Tech Malaysia moderated the session on the End of life (EOL) of EV batteries. The group identified the 3 main sources of EOL Batteries: 1) Crashed Cars 2) Batteries degraded from normal use and 3) EOL Vehicles. As these batteries can be hazardous (especially when punctured or short circuited) special handling is

required. Only trained technicians should remove, handle and recycle these batteries. This will require special training at scrappage centers, and certification by a government body. For leased batteries or batteries in battery swapping systems the battery owner is best positioned to deal with the management and disposal of the batteries. For individual battery/vehicle owners they will have to allow removal/disposal by a certified disposal center. For smaller removable batteries the government should set up a “used battery” disposition system (E-waste management). Comprehensive and regionally or better globally aligned guidelines for the management of EOL are needed.

Behavior Change and Incentives

Alissa Raj from C40 facilitated the discussion on incentives and behaviour change. It was highlighted that for tax incentives to work they must be developed in consultation with the private sector. Non-financial incentives are even more important. For example, to prepare the physical environment for EVs, safe infrastructure, low emission zones, charging infrastructure and integration with public transport are critical. To achieve shifts in behaviour, soft approaches such as pilot projects to raise awareness, soft loans, labelling of vehicles and targeted communication for different population groups by local influencers are needed. Packaging of information is also important as too technical at the moment – messages need to be well customised for average citizens. These can support more regulatory approaches such as government mandates to disincentivize and ban ICE vehicles, limiting vehicle permits and renewals, etc. Key remaining challenges that were discussed evolved around affordability & access, governance & coordination between different government agencies and mobilising governments to make unpopular decisions.

Day 3

Battery Swapping Regulations and Standards

Nuwong Chollacoop, ENTEC Thailand presented an upcoming UNEP funded paper on Battery Swapping Regulations and Standards in ASEAN. The government wants standards for quality assurance. For companies, standards set the direction for their business. Contrary to large electric four-wheelers such as cars and buses, and to the exception of the UN Regulation No. 136 vehicles of category L, “there are hardly any international standards governing the design of e-2Ws and e-3Ws. In addition, there are no common standard specifications for swapping batteries and their bulk charging, and most deployments are custom-designed, limiting the scale-up across EV models/ brands and swapping or Energy operators. However, they are needed to reduce expensive charging infrastructure investment due to lack of interoperability, to aggregate enough demand for industrial investment and guide e2w industry for faster development.

Thailand came up with a flexible and voluntary standard for battery swapping which allowed 48, 60, 72 voltage batteries. Internationally there is a collaboration between European and Japanese companies developing. ENTEC with the support from SolutionsPlus and UNEP has developed a battery standard prototype for Thailand. Indonesia is another big market for 2Ws with over 100 million on the roads. In March this year, Indonesia passed significant EV targets and incentives, including subsidies and goals for number of swap stations.

Robert Njoroge, Kenya Bureau of Standards presented the EV standard development in Kenya. Standardization is part of a push and pull with government wanting standards and companies often resisting as they see it as monopolization. Presently, international standardization is ongoing at the IEC regarding charging for two- and three-wheelers at a voltage of 120 V max. This is mainly focusing on electrical safety, not on standardizing dimensions of batteries of swap stations. The rapidly evolving landscape creates additional challenges for standards setting. Kenya focuses on safety specifications for EVs in manufacture and assembly. They talk to innovators and do research to keep tabs on what is changing, and to ensure standards setting is up to par with market needs. High imports of used vehicles creates different challenges – as EVs age differently, there’s a need to set standards around depth of discharge (DoD) capacity.

Localising E2&3W value chains

Amos Mwangi from WRI presented the E-mobility supply chain including the 1) battery supply chain – mining, production, use in an EV, re-use and recycling 2) Electricity supply chain according to energy supply mix and 3) Manufacturing of EV – raw materials, parts, OEMs, distributors, export, customer usage, scrap yard, recycling or disposal. This was followed by a panel discussion.

Dr Horizon Gitano, Focus Applied Technologies, Malaysia highlighted that the huge sales volumes in China leading to economies of scale in manufacturing make localizing of value chains in smaller markets such as Malaysia difficult. The supply chain can be enhanced by global component integration and harmonized, open sourced and published regional standards. Parts that can easily be produced locally include tyres, frames, seats, brakes, rims while controller, motor, wiring, chargers but are still mainly imported from China. The challenges for retrofitting include inconsistent quality of vehicles, re-registration and high investment in old vehicles. In Malaysia, domestic manufacturers are focused on producing “high end” E-motorcycles as they believe there are more profits to be made, and this is the “big” market (equating it with the conventional motorcycle market). This is a mistake currently because E-motorcycles can’t compete with the power/range of ICE bikes at a reasonable price. He proposes an Inter-ASEAN E2W program using components from ASEAN countries, harmonize standards and collectively impose tariff barrier on “Non-ASEAN” products.

Lod Huang, TAIL G China explained how the partnership with UNEP has helped disseminate technical knowledge on EVs. Tail G electric motorcycles have been used in pilot projects in Kenya, Uganda, Malaysia and Philippines. They have annual sales of up to 15 million 2Ws and 3Ws, 25,000 branded stores in China and export to over 90 countries. One significant challenge is that standards differ in ASEAN countries which results in smaller sales volume in the market than the potential.

Thirachet Lapjaturapit, Stallion Thailand has worked with UNEP on localisation project. Tracing of the production process will reduce emissions in the supply chain and manufacturing process. They aim to produce a net zero emissions electric motorcycle by 2025. The challenges to achieve this goal include the currently slow pace of transition from ICE to EVs, unclear rules for the end of life of EV and batteries, homologation and competition from China.

Sasiranga De Silva, Thermal R Sir Lanka presented his company which focuses on development and manufacture of e2Ws and e3Ws under a battery swapping system. The biggest challenges and opportunities for local manufacturing of E2&3W in Sri Lanka are local economic issues including Forex devaluation and petrol shortages and competition from large manufacturers abroad.

The overall challenges for localization of manufacturing are the lack of quality standards and their enforcement, small markets, ranges not accurately stated on online markets and lack of charging points. Tax breaks are a relatively weak incentive as manufacturers want subsidies, or feebates. The problem is subsidies are tough to get rid of. Harmonized ASEAN / African standards would help to better integrate value chains.

Role of Digital Platforms Accelerating the Transition to E2&3W

Nikki Rudnick, Uber, USA gave a presentation on the company's strategies around electrification. Since Uber doesn't own the vehicles, it's all about partnership. Uber commitments are 100% EV rides in US, Europe by 2030 and 100% EV rides globally by 2040. In the last year, Uber EVs have increased from 26,000 to 61,000 and constitute roughly 5% of US market and 7% of EU market. For many people - the first experience of an EV is with Uber. The lived experience key to adoption – drivers who try out EVs are much more likely to want to buy them and users also get exposed to EVs. They have the Uber Motorcycle option in several African markets and this segment is growing rapidly. In Kenya, Uber has recently launched 160 e-bodas (e-motorcycle taxis) with a fleet management partner. Riders earn 30 to 40% more than their ICE motorcycle counterparts.

The presentation was followed by a panel discussion on the role of digital platforms for transport electrification.

Bidtiporn Chartisathian from Robinhood, a Ride-hailing company is looking to convert its around 30,000 food delivery 2Ws to electric. For that, they must convince drivers and provide insurance and other amenities to support drivers to move to EVs. The ride hailing company can act as middlemen between manufacturers and consumers. They currently rent EVs which helps ensure there is insurance and maintenance but expect that drivers will want to own the vehicles.

Kwan-Arweemas, Swap & Go is a subsidiary of the national Thai oil company, setting up battery swapping stations for scooters at their petrol stations. They track the performance of batteries and offer monthly subscriptions for E2W delivery drivers. The drivers use their app and can opt for unlimited swaps. They aim to convert 10,000 ICE vehicles to electric.

Jose Bienvenido Biona, Electric Vehicle Association of the Philippines (EVAP) explained that the Philippines adopted EV mandates for ride-hailing companies. They are starting a pilot with 200 electric scooters. He sees rental as more viable than ownership because of the cost of the vehicle.

Joachim Berghoff from SMMR, Cambodia represented the user perspective. Users want easy access to private vehicles, book mobility services on one platform and select the type of vehicle when booking. The regulator wants to know what platforms are doing and needs their data to plan for electrification. They could set regulations around times or places when and where EVs must operate. They could also set average performance or emissions standards and require a minimum share of electric km driven.

The discussants agreed that the lower operating costs of EVs should be passed on to the end users. The ride hailing and delivery platforms should provide the option to choose EVs and provide the regulator with following data sets in an anonymized manner:

- Passenger data: Trip data, including the origin, destination, timing, fare, and route number.
- Vehicle data: GPS track, route number, average passenger load, and other relevant data for each trip.
- Safety-related data: Information on all incidents related to the operator's services, including flags for unsafe driving, traffic crashes, traffic citations, fatalities, injuries, cases of sexual harassment, and theft.

The Role of Cities in Enabling Safe E2&3W Circulation

Alissa Raj from C40 presented a report that C40 is finalizing on The Role of Cities in Enabling Safe Electric 2 and 3 Wheeler Circulation. They guidelines establish 10 pathways for cities

1. Create political will
2. Make mobility more inclusive
3. Build internal competencies
4. Identify early adoption opportunities
5. Use collaborative models
6. Facilitate infrastructure creation
7. Improve EV competitiveness
8. Complement public transport
9. Make roads friendlier to 2 and 3 wheelers
10. Factor in regional concerns

This was followed by a brief presentation from three C40 member cities representatives and a discussion.

Mariama Whitmore, City of Freetown, Sierra Leone presented the City Climate Action Plan that the city developed last year. She also highlighted the importance of political will and inspirational leadership for getting new technologies and approaches to the people.

Aini Anas, City of Jakarta, Indonesia mentioned that they are using EVs as official vehicles for Central Government and Regional Governments. They developed a comprehensive roadmap for electrification of 2ws in Jakarta.

Maximiliano Parisi, City of Buenos Aires, Argentina shared that 48% of fatal victims in Buenos Aires are 2W drivers and that the guidelines that C40 are developing are very important for cities.

Enabling policy and regulatory framework for electric 2&3 wheelers

Eng Immaculate Nyamaizi, Ministry of Works and Transport, Uganda gave an introductory presentation on the status and policy under development for Electric 2&3 Wheelers in Uganda.

This was followed by a panel discussion on the enabling framework for E2&3Ws moderated by **Raymund Abad, Clean Air Asia**.

Shritu Shrestha, Wuppertal Institute presented regional guidelines for e-2&3W in Southeast Asia that are currently being developed under the SolutionsPlus project. This guideline aims to evidence the potential of light electric vehicles (LEV) to maintain and enhance mobility of people and goods, the contribution of LEV to the decarbonisation of the transport sector and provide recommendations on how to promote the use of LEV in the regions.

Robert Njoroge, Kenya Bureau of Standards, shared trends in 2&3 wheeler policy in Africa.

Silas Sanga, Energy and Petroleum Regulatory Authority (EPRA) Kenya the findings of a market assessment of electric two and three-wheelers to identify barriers to uptake, and make recommendations on priority policy interventions to promote the adoption of electric mobility and to carry out public sensitization on electric two and three-wheelers in Kenya. EPRA also developed guidelines for charging infrastructure and battery swapping station set up in Kenya.

Horizon Gitano, Focus Applied Technologies presented the ASEAN 2&3 wheeler standards guidelines which have been published by UNEP in 2020. The standards are categorized into E2/3W policies for safety which includes helmet and license requirements, age limited and rules on road usage; e2/3w policies for registration which states what vehicles require registration, who pays road Tax and which vehicles need to be insured and how. The E2/3W policies- standards and testing recommend what vehicle type compliance testing should include (Speed, Range and Battery Life, Braking, Lighting, Hill climb, rain/Flood capabilities and basic mechanical robustness). Challenges include poor statistics on fleet size and usage

as 2ws are not currently registered properly and accident statistics are not tracked because the police doesn't have a category for "EVs" on the accident investigation form.

How to increase gender inclusion in E2W

Shritu Shrestha, Wuppertal Institute presented the findings of a pilot project on gender inclusion in the electric motorcycles business done in Rwanda under the SolutionsPlus project. The learnings from the project led to the development of a checklist for the design of gender inclusive e-mobility projects. The key principles are: Planning, Training, Retaining, Evaluating and Disseminating.

Closing

In her closing remarks June Jeong from UNEP reflected on the progress on e-mobility since the start of UNEP's global programme between 2016 - 2018 up to now. The conference shone a spotlight on the importance of technical standards, discussed innovative approaches to electrifying 2 and 3ws, and united diverse stakeholders, including start-ups, ministries, authorities, city governments, manufacturers, finance and international development institutions. The focus of the conference was on electrifying and improving two and three- wheelers due to their increasing importance in addressing pressing issues such as air pollution, climate change, and road safety in low and middle income countries. However, it was emphasized that public and non-motorized transport remain highly efficient and the most environmentally friendly mobility options. UNEP's Global Electric Mobility Programme will continue to serve as a global platform for EV pioneers, fostering connections among governments, industries, financiers, academia, and agencies for our collective progress.

Day 4

The final day was dedicated to 2 parallel site visits on Electric two and three wheelers:

The first site visit focusing on Electric 2-wheelers included a visit to the EGAT learning center, ENTEC's battery swapping stations established under the UNEP supported pilot project, Stallions service shop and the Swap&Go battery swapping stations in Bangkok.

The second site visit 2 focusing on Electric 3-wheelers included a visit to the Muvmi head office, their charging stations, depots and their electric tuk-tuk driver training academy.

Conclusion

The electrification of 2 and 3 wheelers provides significant opportunities for decarbonizing transport, reducing air pollution and improving accessibility for people especially in low and middle income countries. Despite the noteworthy benefits, a major uptake of E2Ws can have unintended consequences, such as hampering efforts to promote public transportation and active mobility due to the substitution effect. Moreover, operating two-wheelers has higher injury and fatality rates, compared to other modes of transportation. Therefore, the significant uptake of light mobility will entail risks that must be managed. There is an urgent need for governments to clearly defining vehicle types based on speed limits, power, and provide adequate measures to safely integrate 2 and 3 wheelers in road traffic. Policies that incentivize ICE 2W manufacturers to sell electric models are also required. Examples of such policies include regulating the fuel consumption (or CO₂ emissions, or fuel economy) standards, tightening vehicle emission standards, and mandating E2W production. In addition, comprehensive regulations related to e2&3Ws have to be developed, including for vehicle operation and testing, vehicle inspections and maintenance, vehicle labeling, and technical regulations on vehicle components. Additional information should also be added to the label to reflect requirements specific to e2Ws (e.g., driving range, energy consumption). This will increase the profile of e2Ws and will be useful when priority measures (e.g., parking priority, lane usage priority) for e2Ws are implemented. Regulations aiming at ensuring the safe use of light EVs should target all vehicles, especially the larger ones that pose the greatest safety risk.

On a global level, commitments that aim to phase out ICE vehicles just be expanded to include 2- and 3-wheelers. In line with that, countries are encouraged to set targets that by a certain year only E2&3Ws will be allowed to be newly registered. Additionally, policies related to E2W vehicle disposal and recycling of expired batteries are necessary. UNEP's Global E-mobility Programme will continue to provide technical and financial support to countries in managing the transition to electric two and three wheelers. Please check out the resources section for additional materials.