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E-MOBILITY IN LOW-INCOME COUNTRIES IN AFRICA

Finance, Governance, and Equity

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CONTENTS

ABBREVIATIONS

2&3W	Two- and Three-Wheeler
2W	Two-Wheeler
APR	Annual Percentage Rate
BMZ	German Federal Ministry for Economic Cooperation and Development
BRT	Bus Rapid Transit
CCG	Climate Compatible Growth
CO_2	Carbon Dioxide
COP26/COP27	26th / 27th United Nations Climate Change Conference: Conference of the Parties
DFI	Development Financial Institution
EV	Electric Vehicles
E2&3W	Electric Two- and Three-Wheeler
E3W	Electric Three-Wheeler
ESG	Environmental and Social Governance
FCDO	Foreign, Commonwealth & Development Office
FI	Financial Institution
FIA	International Automobile Federation
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GNI	Gross National Income
GRA	Global Roadmap of Action
GTF	Global Tracking Framework
HDV	Heavy-Duty Vehicle
HIC	High-Income Country
HVT	High Volume Transport Applied Research Programme
ICE	Internal Combustion Engine
ICCT	International Council on Clean Transportation
IRF	International Road Federation
ITF	International Transport Forum
IsDB	Islamic Development Bank
LDV	Light-Duty Vehicles
LIC	Low-Income Country
NDC	Nationally Determined Contribution
NMT	Non-Motorized Transport

NO_2	Nitrogen Dioxide
PM	Particulate Matter
SDG	Sustainable Development Goal
SE4ALL	Sustainable Energy for All
SLOCAT	Partnership for Sustainable, Low Carbon Transport
SSA	Sub-Saharan Africa
STEER	Loughborough Centre for Sustainable Transitions: Energy, Environment, and Resilience
SuM4All	Sustainable Mobility for All
TCO	Total Cost of Ownership
TUMI	Transformative Urban Mobility Initiative
UCL	University College London
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNCTAD	United Nations Conference on Trade and Development
VAT	Value Added Tax

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EXECUTIVE SUMMARY

In November 2022, the 27th United Nations Climate Change Conference (COP27) will be held in Sharm El-Sheikh (Egypt). COP27 will provide a unique opportunity to respond to the needs of Africa, including climate finance, adaptation, losses, and damage. These issues are important to Africa and other regions in the Global South, because they are disproportionately affected by climate change.

This paper seeks to contribute to the ongoing discussion on the just transition toward sustainable mobility in the Global South, covering decarbonization, electromobility (E-mobility), and climate finance. It builds on a discussion paper put forward for COP26 by the Sustainable Mobility for All (SuM4All) Partnership with the Climate Compatible Growth (CCG) and the High Volume Transport Applied Research Programme (HVT), which examined E-mobility from the perspective of low-income countries (LICs).[1]

Based on a review of the academic and gray literature related to E-mobility, energy, policy, and finance, and interviews and surveys of key African transport stakeholders, this paper explores the challenges and opportunities of E-mobility in 23 LICs in Africa.

Three key areas were considered: (i) the relevance of E-mobility to African LICs, (ii) fairness and governance, and (iii) cost and finance.

Relevance of E-mobility to African LICs

- African LICs contribute to less than 1 percent of global emissions and are struggling with multiple development challenges. Most countries still need to improve the accessibility, affordability, inclusivity, security, and safety of a range of mobility solutions.
- Future demand for mobility solutions in these countries, and vehicle ownership (2&3W and 4W), is expected to increase with the forecast rapid urbanization, population growth, and rising incomes. This will cause higher CO_2 emissions, greater road traffic congestion, road traffic deaths and injuries, and poor air quality. It also provides an opportunity to develop clean, inclusive transport systems, which support inclusive growth.

[1] Sustainable Mobility for All. 2021. Electromobility in the Global South: An Equitable Transition toward Road Passenger Transport Decarbonization. Washington DC. © Sustainable Mobility for All, 2021. [Online]. Available: https://www.sum4all.org/data/files/05-electromobility_in_the_global_south_an_equitable_transition_toward_road_passenger_transport_decarbonization_032322_v2_0.pdf License: CC BY 3.0 IGO

- The transition to E-mobility is gaining momentum in some African LICs, although the current market penetration of electric vehicles (EVs) in Africa is low compared with other regions in the world. There are many obstacles to overcome, including cost and governance. However, there is an opportunity to develop more sustainable transport systems that promote low emission mobility.
- A rapid transition to E-mobility may not be possible. An alternative pathway could be to allocate scarce resources in African LICs to the benefit of all and improve accessibility to the largest number by investing in public transport, with (electric) 2&3Ws to support this model. This depends on the local circumstance such as the availability of financial and technical resources.

Governance

- Where the transport system in African LICs has focused on the passenger car, it has failed to provide affordable and accessible transport for everyone. There is a need to develop transport systems and policy priorities in a way that leads to the greatest socio-economic benefits.
- While many high-income countries (HICs) have financially incentivized the acquisition of EV passenger cars, through purchase subsidies, this approach may not be suitable for African LICs.
- Countries could take step-by-step measures to shift funds generated from polluting vehicles towards clean and sustainable mobility starting with less socially sensitive ICE vehicle segments and scaling them up incrementally when other mobility choices become more available.
- Countries can use indirect incentives to support E-mobility, but these need to be in line with the national context and market developments.
- Direct and indirect incentives require continuous monitoring to determine effectiveness. Countries should plan for scaling down or phasing out financial incentives and non-financial incentives to E-mobility as soon as the market has achieved a certain level of maturity.

Finance

- Most categories of EVs have a high upfront cost compared to ICE vehicles because of the battery cost. The case for electric 2&3Ws is strong in every country studied. However, the economic case for electric passenger cars is weaker; medium-sized electric buses and larger high-capacity buses such as Bus Rapid Transit (BRT) systems have considerable upfront costs, and the assessment of their financial viability must take many factors of the local context into account.
- In some countries, it makes sense to "wait" to improve the existing vehicle fleet and focus scarce public resources on other aspects of the transport system, including the provision of public transport.
- E-mobility options will require blended finance to de-risk and innovative finance models for implementation to expand the available finance to support this model (e.g., leasing and consumer finance arrangements, aggregation of demand by the public sector in EV acquisition, and procurement).

Call to Action

While the transition toward low-carbon transport is a priority, solutions need to be developed that meet other transport goals, including access for all, efficiency, and safety. In the Global South, accessibility to transport infrastructure and services, affordability, road traffic congestion, air and noise pollution, safety, and system efficiency remain key development challenges.

To ensure a just and equitable transition to E-mobility in African LICs, the following actions could be taken:

- **Expand investment in public transport** to ensure accessibility and affordability, which is critical for the development of African LICs. Sustainable mobility goes beyond EVs and requires

better urban planning, city reorganization, and transit-oriented development. Although many Africans already use public transport, mostly through the paratransit sector, further public transport measures are needed as part of emission reduction plans.

- **Support investments in electric two- and three-wheelers (E2&3Ws)** as a first step toward E-mobility, supported by local private finance. Small vehicles such as 2&3Ws are already a dominant transport mode in African LICs. They are cheaper to purchase, appeal to low-income residents, and can be charged within a few hours via plugs at home or at a commercial site. Financing solutions could include developing subscription or rental options for vehicles and batteries.
- **Invest in the renewable energy sector** with finance from international and national public and private sector organizations to provide access to electricity for all purposes. Millions of people in Africa still do not have access to electricity. Africa has an abundance of affordable clean energy sources such as solar, hydropower, wind, and geothermal. Electrification efforts need to be open to private investment and innovations such as solar energy and battery storage. Off-grid solar systems and mini-grids have become a proven, reliable way to provide affordable modern electricity services. Achieving universal electricity access based on renewable energy will require commitment, finance, and policies and regulations that attract high-quality investments.
- **Unlock finance for E-mobility** by developing a better alignment between HICs, LICs, and funding institutions including development banks. Financing the transition to E-mobility will be possible only if enough resources are available to pay back investments and fund the cost of decarbonization policies. Market shaping activities and investments are required to improve finance for infrastructure and charging and energy capacity/coverage. Different capital will be suited to different stages of E-mobility, from the early stage (e.g., seed funding and grants), growth stage (e.g., private equity capital and development finance growth capital), and to maturity (e.g., financial and commercial investment).
- **Deliver on financial commitments from the international community** to support the adaptation and development of transport systems in African LICs, with the most appropriate and affordable technology. Levels of climate finance in Africa fall far short of needs. Africa's US$2.5 trillion of climate finance needed between 2020 and 2030 requires, on average, US$250 billion each year. More finance for African nations is therefore needed to develop and adapt to climate change, as these countries are on the frontline of impacts. Combining finance from donors and businesses and working with international development banks can direct funding into green transport projects and enable African-led climate adaptation.

1 CONTEXT

Reducing carbon from transport and meeting the Sustainable Development Goals (SDGs) will require low emission pathways to decouple economic growth from long-term development. While Africa has relatively low levels of motorization, there is a potential for high levels of vehicle ownership resulting in greater tailpipe emissions contributing to urban air pollution and climate change.

There is international pressure to decarbonize road transport systems by 2050 to meet international climate targets [1]. The Nationally Determined Contributions (NDCs) are a key instrument to the UN Paris Agreement in which countries plan their own climate targets and how they intend to achieve them. Eleven out of 23 African low-income countries (LICs) have shown their ambition to decarbonize the transport sector by setting targets in their NDCs. Six countries (Burkina Faso, Gambia, Guinea, Ethiopia, Liberia, and South Sudan) have formulated precise transport emission reduction targets to achieve by 2030. Seven countries (Burundi, Ethiopia, Guinea, Rwanda, Sierra Leone, South Sudan, and Togo) have outlined the adoption and promotion of electromobility as one measure to transform their transport sector.

Electrification of transport is a central pillar of transport sector decarbonization. In this paper we define electromobility (E-mobility) as the systems, services, and equipment that support the movement of passengers and freight by electric-powered means of transport. In this paper we focus on direct electrification of road transport vehicles, including electric scooters and pedal-assisted e-bikes, fully powered two- and three-wheelers (E2&3W), such as e-rickshaws and electric cargo bikes, as well as minibuses, buses, light four-wheelers, and cars.

The transformation toward a more sustainable and low-carbon transport needs to change more than just the energy carrier (from fossil fuels to alternative low-carbon fuels, such as electricity). A systematic approach is needed, with three complementary strategies as reflected in the Avoid-Shift-Improve (A-S-I) Framework [2]: Avoid unnecessary motorized trips (e.g., shorter distances to amenities and digitalized services); Shift to more energy efficient modes and systems: walking, cycling, and public transport, complemented by other shared modes; and Improve the energy efficiency of vehicles, infrastructure, and fuels.

In African LICs, poor transport access often translates into socio-economic development barriers and inequalities that impact livelihoods, health, and the well-being of people. It is therefore important to link transport policy, sustainable development, and climate

to deliver an inclusive and fair transport system. Adoption of E-mobility, together with cost-effective transport investments, can improve transport accessibility, efficiency, and safety. However, every country is unique with differing local contexts, and there is no single solution that will meet the needs of all LICs in Africa.

E-mobility is becoming a reality in Africa. Projects are being started across the African continent. However, current market penetration of electric vehicles (EVs) in Africa remains low compared with other world regions, and the availability of vehicles that are suitable for the African context is limited. Studies have shown that among EVs, E2&3Ws have the most potential in African countries [3–7]. In addition, several African countries are developing public transport electric buses, often with financial support from international organizations (e.g., Rwanda and Zimbabwe).

A just and equitable transition is an important principle in the global debate to decarbonize the transport sector. It requires a transformative transition in which there is a systemic shift across several areas including, governance, and finance, such that the benefits that accrue are shared, while mitigating any potential negative impacts on disadvantaged groups.

2 ABOUT THIS PAPER

This discussion paper contributes to the ongoing discussion on the just transition toward decarbonization and climate finance by focusing on E-mobility. It builds on a paper from the Sustainable Mobility for All Partnership, with the Climate Compatible Growth and High Volume Transport Programmes, launched at COP26 in 2021. That paper examined the E-mobility model from the perspective of countries in the Global South [8].

This paper focuses on a subset of countries in the Global South—African LICs[1]—and re-examines the E-mobility question, considering recent evidence, including:

- A review of the academic and gray literature related to E-mobility, energy, policy, and finance.
- Twenty-two interviews with key transport stakeholders representing African private sector operators (8), international experts and development organizations (5), representatives of financial institutions (2), and academics and others (7). The findings of these interviews informed this discussion document.
- Data from ad hoc surveys with 25 national and local representatives who attended the UNEP 'Regional Africa Forum for Action—Inclusive and Active Mobility in a Changing Climate' held on 7–9 July 2022 in Kigali, Rwanda.

While the views gathered are not necessarily representative of all African stakeholders, they provide insights into key challenges surrounding the transition to E-mobility in Africa. Issues identified in the literature review were tested with key stakeholders, and this provided an opportunity for them to share their extensive knowledge in the development of this discussion paper. In addition, a virtual roundtable of 32 parliamentarians from Africa was held to share the key messages from this paper and to gauge the views of decision makers on E-mobility.

Rather than providing a comprehensive analysis of E-mobility, this paper focuses on the challenges and opportunities for governance and finance associated with an E-mobility transition in African LICs. A brief summary of some of the key issues, including possible

[1] For the current 2023 fiscal year, low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of US$1,085 or less in 2021. The 23 African LICs include Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Sudan, Togo, and Uganda.

transport policy pathways, benefits, and barriers for E-mobility in African LICs is provided to set the scene before the chapters on governance and finance. The paper aims to add value to the ongoing debate [9] by highlighting key issues that need to be addressed for a just and sustainable transition to E-mobility in Africa.

This paper is a call to action at COP27 and beyond, challenging high-income countries (HICs) in the Global North as well as the private sector, Multilateral Development Banks, and other funders to consider their role in enabling a just and equitable transition to E-mobility for LICs in Africa.

3 KEY ISSUES

African LICs contribute to less than 1 percent of global carbon dioxide (CO_2) emissions from transport. These countries have a high dependence on paratransit[2] public transport, internal combustion engines (ICE)/pedal powered 2&3Ws, and non-motorized transport (NMT) such as walking. These countries currently contribute minimally to climate change but are the primary victims of this global problem. For example, in 2000, flooding in Mozambique destroyed road links between the capital city and the rest of the country for a year, as well as the rail connection to Zimbabwe. This led to Mozambique's per capita economic growth declining to one percent in 2000—the lowest level in two decades [10].

The transport sector is the fastest growing CO_2 emitter worldwide and globally is responsible for approximately 20 percent of energy-related emissions [11]. Transport-related CO_2 emissions range from 17 percent (Chad) to over 50 percent (Gambia). In absolute terms, this is low. In 2019, the total tons of transport-related CO_2 emissions per capita was 0.05 in Burundi and the Central African Republic, compared to 0.66 in China and 5.53 in the United States (US) (See Figure 3-1).

The level of low emissions is due to low motorization levels. For comparison, Sudan and Ethiopia have less than 5 cars per 1,000 individuals (2015), compared to 826 cars per 1,000 individuals in the US [12]. However, the current vehicle fleet is dominated by old, polluting, and unsafe cars. Most of the vehicles are secondhand ICE vehicles from the European Union, US, and Japan, which can be dirty and faulty [13]. The uptake of "clean vehicles" such as EVs has so far been a low priority [14].

Future demand for mobility solutions and vehicle ownership is expected to increase with rapid urbanization, population growth, and economic development. By 2040, it is projected that there will be about 58 million registered vehicles in the six Sub-Saharan (SSA) African countries that make up around 70 percent of SSA annual vehicle sales and 45 percent of the region's population (South Africa, Kenya, Rwanda, Uganda, Ethiopia, and Nigeria) [4].

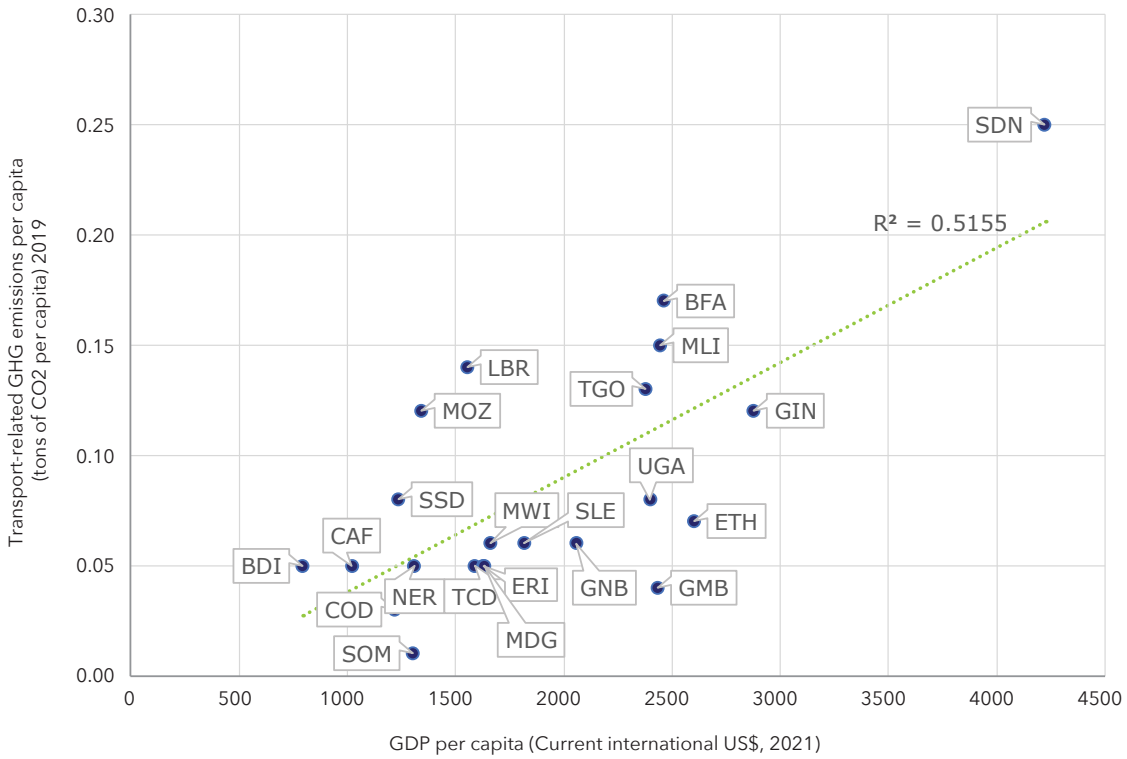
While CO_2 emissions are low today, they may rise in the future. Evidence shows that income level has a high correlation with transport-related CO_2 emissions (Figure 3-1). The challenge for African LICs will be to continue to grow economically while controlling overall CO_2 emissions. This phenomenon—known as "decoupling"—has been achieved in

[2] "Paratransit (also known as informal or community transport) provides a valuable service offering as a flexible mode of transport between formal transit and a private car. This term collectively describes transport services such as dial-a-ride, shared taxis, community transit and subscription buses." [47]

around 70 percent of HICs, because they have more financial resources and are at an advanced stage of development [15]. Over 70 percent of low- and middle-income countries have not yet achieved this [16] and would require financial and technical help to do so. The combination of young populations, rising incomes, and rapid urbanization will translate into increased demand for mobility in major cities in the Global South. Under current practices, greater motorization will result in higher CO_2 emissions, greater road traffic congestion, road traffic deaths and injuries, and poor air quality. Fine particulate emissions (PM2.5) from African road transport are expected to increase by 40 percent by 2030 compared to 2012 and are likely to contribute to poorer health outcomes [17].

African LICs face multiple development challenges; sustainable transport and mobility needs to be addressed within this context. Over half of the population does not have access to electricity. Among LICs, access varies between 7.2 percent in South Sudan to over 60 percent in Gambia [20]. These countries also lack transport infrastructure and services to support economic and social development. Lack of public transport, poor infrastructure for walking and cycling, and unsafe roads result in low mobility, along with affordability concerns. Overall, most people in African LICs cannot afford vehicle ownership. Where there is ownership, the vehicle fleet primarily relies on conventional ICEs with emissions of CO_2 and urban air pollutants.

FIGURE 3-1. TRANSPORT CO_2 EMISSIONS PER CAPITA VS INCOME



Source: Transport-related GHG emissions data accessed from [18]; GDP per capita data accessed from [19].

4 SCENARIOS FOR ROAD TRANSPORT

Countries' and cities' choices to develop transport, in particular urban mobility, can be broadly summarized in four scenarios [21]:

The first scenario is business-as-usual, in which the current development of the transport sector is continued. In most places, this implies either the absence of transport policies or a conscious car-oriented transport policy which prioritizes investments in transport infrastructure for individual motorized vehicles. In such a scenario, gaps between the wealthy and the poor would widen; cities would choke in traffic and air pollution. In the case of LICs, where few people can afford to own a car, most people will be left with poor mobility choices; in addition, the growing car fleet will continue to increase the number of unsafe and polluting secondhand vehicles, with severe impacts on human health and wellbeing. Resources would continue to be spent on fossil fuels and on road infrastructure, rather than developing inclusive and sustainable transport systems.

The second scenario puts the electrification of vehicles at the center of transport sector development, while other transport policy decisions would continue according to the business-as-usual scenario with mainly individual motorization. Benefits include better air quality in cities (limited by pollution from the particles of tires and brakes) and a reduction in CO_2 emissions. However, this comes with the same road infrastructure costs. There will be additional costs for the rapid rollout of charging infrastructure, upgrading of electric capacity, as well as private, eventually subsidized, EV investments. In this scenario, inequalities are amplified, and, particularly in LICs, disproportionate investments may come at the expense of other development needs.

The third scenario puts a focus on public transport, cycling, and walking, combined with compact urban development that makes people's trips shorter. At the same time, car use would be discouraged. Even with no electrification, this scenario would reduce CO_2 emissions given the greater energy efficiency of such transport systems. Transport would become more equitable, cities more livable, and human health and wellbeing would improve. Investments would be shifted away from cars and toward public transport [21].

A fourth scenario could be a combination of strong public transport, cycling and walking, compact urban development, and the electrification of vehicles. It implies a shift toward public transport, walking, and cycling, and the progressive electrification of remaining vehicles (2&3Ws, cars, vans, and trucks). This scenario comes with the greatest benefits for equitable access, better air quality, improved human health and wellbeing, and lower CO_2

emissions. Research suggests [21] that the only scenario that would be able to meet climate and sustainable development goals is such a combination of strong public transport and E-mobility.

The pace of the transition needs to be aligned with countries' specific prerequisites and priorities. As the scenarios suggest, the direction to take toward a sustainable transport sector is known. However, the pace and the pathways need to be determined in line with national capabilities and needs. Investing in public transport, while starting the electrification of vehicle segments that are more affordable, such as 2&3W or commercial fleet vehicles, can be a prudent approach to initiating the transition to a sustainable transport system.

5 BENEFITS AND COSTS OF E-MOBILITY

E-mobility, if developed sustainably, can offer benefits well beyond CO_2 emission reductions and decarbonization. It can reduce dependency on fossil energy (imports) and strengthen countries' balance of payments, increase energy efficiency, and reduce urban air pollution. If focused on very light vehicles, such as electric bikes, electric 2&3Ws, shared fleets, public transport, and transport as a service, it can support efficient mobility systems, reduce traffic congestion, and improve access to and affordability of transport services. By focusing on in-country value creation in the energy and transport sector, it can support industrial development and job creation. However, the adoption of EVs requires investments, and these depend on the vehicle categories and use cases.

The operation of EVs is cheaper due to lower energy costs (i.e., lower overall energy consumption; lower cost of electricity per kilometer) and lower maintenance costs (i.e., fewer moving parts create savings from lubricants; no engine or gear system maintenance needed). However, the upfront EV cost (purchasing price) is (still) higher than that for ICE vehicles. Together, these two costs define the Total Cost of Ownership (TCO). While these cost differentials fall over time, they represent a significant affordability challenge. The economic and financial viability of EVs varies across all vehicle types:

- For passenger cars in LICs, the economic case for EVs is weak. The cost differentials are still prohibitive for cars. Electric passenger cars are 20 to 50 percent more expensive than ICE counterparts depending on the market and model [22]. They also need a more costly charging infrastructure with a wider availability than, for example, E2&3Ws or commercial fleet vehicles with a shared depot for charging; this is a barrier to adoption. New EVs must compete against cheap secondhand ICE vehicles in many African markets, with lower operating standards and longer acceptable lifespans. This is the case in those countries with little or no regulation for secondhand vehicles. Used EVs are unavailable to the African markets in sufficient numbers, and this is expected to be the situation for the next decade [4].

- The case for E2&3Ws is strong in several countries.[3] Studies have shown that E2&3Ws have the most potential in African countries [3–7]. Compared to larger vehicles, they are more affordable and need less charging infrastructure. For example, in Mali and Burkina Faso, the TCO of E3Ws for freight is 40 percent lower than that of their ICE

[3] This is according to a study done by the World Bank detailed in: World Bank, Forthcoming. Flagship Report: Economics of Electrical Vehicles for Passenger Transportation. Washington DC.

counterparts. In Togo, the TCO calculations for an electric motorbike over 5 years result in savings of US$5 per week, increasing the vehicle operator's revenue by over 15 percent. Similarly, in Kenya, the TCO of EVs is a third lower than for ICE models, resulting in yearly savings of US$300.[4]

- Medium-sized electric buses can be twice the price of comparable ICE models. The cost of electric buses could be reduced if the vehicles were assembled locally and with a preferential tax regime for local assembly.
- Larger buses for high-capacity public transport—such as in Bus Rapid Transit (BRT) systems—can cost three times the price of a conventional vehicle. This is a higher upfront cost, which is even more pronounced if competing with used diesel buses with low emission standards. As with all EVs, the TCO will be determined by local energy costs. The cost of providing the needed infrastructure (depots, high-capacity charging facilities) also needs to be considered. To understand the economics of investment for larger vehicles, a closer assessment of the national and local situation is necessary.

The cost-effectiveness and overall benefit of E-mobility are determined not only by the vehicle type but also by its use. For example, an individually owned electric car that runs 15,000 kilometers a year and is parked most of the time has low cost-effectiveness—the higher upfront investment is recovered over a much longer time, through savings from operations, than is the case for vehicles with regular high mileage (e.g., light commercial fleet vehicles of different sizes, for passengers and light freight [22–23].

The required charging infrastructure for commercial vehicles is easier to quantify and often more manageable. As fleet and commercial vehicles typically run in a known perimeter and on predictable routes, the required provision of charging infrastructure is limited (e.g., in a depot or on other private grounds), and their electrification yields better cost-benefit ratios. Vehicles that offer transport services to a broader group of users and are linked to income-generating activities yield broader socio-economic benefits.

[4] Based on 20,000 kilometers annual mileage and 5 years operation.

6 BARRIERS TO E-MOBILITY

Apart from high upfront costs, several constraints exist that can prevent a swift transition to E-mobility in African LICs. These include limited financial resources to invest in EVs, an unfavorable market environment and administrative procedures, lack of knowledge and awareness in public and private stakeholder groups of E-mobility, limited environmental and safety regulation (e.g., batteries), and related electricity sector challenges (e.g., supply chain, capacity, stability, charging facilities, and tariffs). The following is a list of key barriers to E-mobility in African LICs.

Availability of Electricity in Africa: Only 48 percent of the population has access to electricity (with an urban access rate of 78 percent versus a rural access rate of 28 percent [20]), and some countries may not generate enough electricity to run EVs. Also, E-mobility comes with impacts on the grid that need to be managed.

Lack of Government Regulation and Support: Few countries have adopted E-mobility policies with support and mechanisms to adopt E-mobility sustainably and at scale.

High Cost of Electric Vehicles: To overcome the higher upfront EV costs, innovative business models are needed. Examples of new business models include separating the ownership of the vehicle from the ownership of the battery, spreading investments across several actors, and offering pay-as-you-drive payment schemes.

Transport investment choices are often long term and require significant capital investment. They have the potential to lock African LICs into high emission mobility. The long transport investment lifecycle means that choices made today on infrastructure and technology can lock in a country's development pathway for the next 15 to 30 years [24–25].[5] Once financial resources are committed to a fossil fuel-dependent development, they are unavailable for low emission investment. As a result, African LIC governments need to carefully consider the different planning options available for their transport systems.

[5] The lock-in effect results when long-term infrastructure becomes obsolete. This can be because of changes in technology, future policy, or another factor. The effect can be costly as expensive infrastructure can become obsolete before its end-of-life, people can need to be retrained, and the price of importing fuel could rise [48–49].

7 GOVERNANCE

Governance for E-mobility will need to set priorities to guide E-mobility in a just and sustainable way. This will require involving and developing the energy sector, formulating policies, adopting financial mechanisms to promote equitable E-mobility, tightening regulation on polluting secondhand vehicles, and supporting the emergence of local value chains and jobs.

The governance challenge is to ensure a just and sustainable transition to E-mobility. It is important to understand the policy options that can deliver this transition and ensure a high socio-economic return on investment. A broad-based coalition of actors is required to reduce systemic risk, enhance human capital, and strengthen societal acceptance of E-mobility. This will require aligning and coordinating the needs of different sectors and players at the national and local levels to deliver the benefits of an E-mobility transition [26].

The energy sector is a key player in the transition to E-mobility, especially in countries with underdeveloped electricity systems with access, capacity, and supply reliability challenges [8]. Given the strong interdependence of the transport and energy sectors, coordinated action across sectors and engagement of energy stakeholders is an essential part of governing the transition to E-mobility.

The new demand for electricity from transport should be balanced against the needs of other vital sectors. The electricity system of African LICs and their production capacities vary widely. Studies in Mali and Burkina Faso showed that electrifying 5 percent of the fleet of 2&3W in their capital cities would require 1.3 percent and 6.9 percent of the countries' total electricity production respectively; electrifying 70 percent of these fleets would consume 20 percent and 82 percent—a significant increase in demand. Some countries, such as Uganda and Rwanda, have sufficient supply to support E-mobility [27].

Even in less green electricity grids, E-mobility presents an opportunity to reduce emissions. As EVs are more energy efficient than ICEs, they reduce the overall energy consumption [8, 28]. However, EV electricity supply should be renewable to maximize the decarbonization benefits of E-mobility. The share of renewable electricity varies across African LICs (see Figure 7-1), and E-mobility and low-carbon electricity can be developed together.

FIGURE 7-1. SHARE OF RENEWABLE ELECTRICITY IN SELECTED AFRICAN COUNTRIES

	Over 90%	Under 10%
Renewables in Energy Sector 	Ethiopia Uganda Democratic Republic of Congo Central African Republic Mozambique	South Sudan The Gambia Chad Somalia Guinea-Bissau Niger Eritrea

Source: [29]; Icons made by Freepik from www.flaticon.com

Low-carbon public transport is needed to provide affordable and accessible transport for all in African LICs. Reducing car use and increasing public transport and active travel can reduce polluting air emissions and provide health and economic benefits. There is a need to develop transport systems and policy priorities that have the greatest socio-economic benefits.

Unforeseen consequences of policies can exacerbate inequities. Examples of policies that benefit higher income groups—such as private car owners—include preferential tariffs and taxes for four-wheelers but not lighter modes; luxury tax exemptions applied to upmarket EVs; and tax breaks or purchase premiums given as a percentage of the vehicle value (e.g., VAT) and without an upper limit. Such an approach could cause less government financial resources to be available to support equal transport access for lower-income groups and to improve the broader socio-economic development of the country, increasing social inequalities.

The policies adopted by HICs may not be suitable for African LICs. Many HICs have financially incentivized the acquisition of EVs, mostly cars, through purchase subsidies. These policies have not always been budget neutral [30], and EV investments have not always been fully recovered.

Instead, creating a more attractive environment for E-mobility through indirect incentives can play a powerful role. For example, preferential electricity tariffs for vehicle charging, eventually incentivizing charging when electricity demand is low (e.g., at night), is an effective lever (e.g., Rwanda includes this measure in its E-mobility policy). Similarly, the provision of public space for charging infrastructure is considered an effective incentive and could be applied at highly frequented destinations (e.g., markets, business districts, public buildings, etc.), at (paratransit) transport stations, and along principal routes.

A regional approach to EVs, charging, and battery regulation would be beneficial and would help countries that otherwise could not take part in the full value chain. While countries, such as South Africa and Kenya [8], are moving forward with EV standards, a regional approach—linked with economic unions and international efforts—would facilitate the creation of larger markets that enable trade, economies of scale, and cross-border transport. This would support businesses and consumers. For businesses, standards could support innovation and a more efficient market, as charging systems and battery and vehicle standards could be harmonized. This would enhance market attractiveness for investments, facilitate faster and more cost-efficient development of regional value chains, and potentially help African countries produce vehicles fit for their own market. With standards and regulations, consumers would have more confidence in the technology and would not depend on a specific provider.

Improved regulation on secondhand vehicles in both exporting and importing countries is needed. Most

African LICs have low levels of regulation regarding emission standards, quality, and age limits of imported vehicles. For example, among African LICs, only Rwanda applies Euro 4 standards. Chad, which has set an age limit of five years for light duty vehicles, and Rwanda are the only African LICs that have been classified as having good import standards [13]. Used ICEs may not even have a valid roadworthiness certificate and frequently have deficiencies in exhaust emissions, braking systems, and documentation [13].

Increasing emission standards for ICE vehicles require fuel quality improvements. Fuel quality in African LICs is often poor, containing high levels of sulfur (100 and 1,000 times the limits of petrol and diesel in Europe, respectively). Such levels would damage the emission control technologies of vehicles with higher emission standards and lead to higher particulate matter (PM) and nitrogen dioxide (NO_2) emissions than those of lower emission standard vehicles [31].

Tightening regulations should not compromise individual mobility. A combined approach of stricter regulations, the provision of attractive public transport services, and the gradual shift toward E-mobility—with a focus on 2&3W and shared fleets—has the potential to create more affordable, cleaner, and safer mobility choices for all people.

Policies to support the transition to sustainable E-mobility should be coordinated across various areas, sectors, and levels. Primarily policies[6] are required in the transport and energy sector, but industry, urban, climate, and environmental policies are also needed. Giving the market policy and price signals in advance allows companies and consumers to decide and plan to allocate resources accordingly.

Government incentives have the power to kick-start local industry activity. Typical incentives include access to land and tax breaks for young companies. These include reduced import tariffs for vehicle parts and knocked-down kits;[7] lower VAT rates for locally produced or assembled vehicles and batteries versus imports; and gradually increasing the requirements for vehicles to be produced with local parts. These levers can be used in a phased approach in developing markets. Initially, imports may be the best option. But clear signals to international suppliers and national businesses are needed so that, with increasing market development, countries can shift to a higher share of locally assembled—or produced—vehicles.

E-mobility offers several opportunities for local, national, and regional value creation in Africa. This has been shown by the growing number of private sector EV operators. As the construction of EVs is simpler than ICE vehicles, the production of components and assembly can be an opportunity for local value creation. This could reduce the cost of EVs, avoid GDP for imported EVs (and ICEs) flowing out of the country, and support a just transition by avoiding full dependence on international markets.

International EV manufacturers have not catered for the African market and its requirement for affordable and suitable vehicles. Many EVs sold on international markets may not be fit for purpose: they are unsuited for African road conditions, unable to carry sufficient weight (especially for very light vehicles that are often used to transport people and goods as a service), are overloaded with technological equipment, or do not meet customer design expectations.

It is important that the transition to E-mobility is a 'just transition' that leaves no country behind in fossil-fuel dependency. While the E-mobility transition will be possible in African LICs, pathways and timelines will depend on individual countries. There is not one solution that fits all. Accessible and affordable transport is critical for African LICs. This will require massive investments in public transport and low emission modes. International finance is needed to support this transition for E-mobility to those African LICs who have contributed the least to climate change but are now most vulnerable to its consequences.

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[6] For an extensive list of policy recommendations for national and local policy makers see pages 45–48: https://www.sum4all.org/data/files/buildingblocksandpolicyrecommendations_english.pdf [50].

[7] A collection of parts—often imported—that can be used to make a product so that it is assembled locally.

8 FINANCE

Where private financing remains difficult for EVs, blended and innovative finance models are required. At present, the credit fundamentals for these projects are difficult, and there is a need to understand how best to package these risks for the private sector.

A study on future electric 2W deployment in five African countries (Ethiopia, Kenya, Nigeria, Rwanda, and Uganda) [32] found that by 2030, the number of vehicles could range from 3 to 4.4 million, with financing needs estimated between US$3.5 and 8.9 billion. This wide estimate is not only because of the uncertainty about the number of vehicles, but reflects other parameters, such as business models, development of national value chains [33], and access to finance [32].

With limited domestic public resources, financing transport systems in African LICs will require mobilization and coordination of public and private, international development, and climate finance. Experience accessing these financial resources in SSA has been mixed. Climate financing in Africa has focused on renewable energy with few resources for transport. Development Financial Institution (DFI) financing for transport has concentrated on the basic (hard) infrastructure, rather than vehicles (and charging stations). Many SSA markets do not have the requisite demand to mobilize external capital. They also lack access to and/or a track record of commercial borrowing without DFI support.

New mechanisms to increase the amount of funding and/or reduce the risks associated with E-mobility financing are emerging. The following section summarizes some of these mechanisms.

8.1. PROMOTION OF LEASING AND CONSUMER FINANCE ARRANGEMENTS[8]

The cost of commercial bank lending rates is high in Africa [34]. For example, Madagascar has one of the highest Annual Percentage Rates (APR) at 64 percent. In 2017, Kenya had a 17 percent APR when inflation was around 8 percent, while in Uganda the APR was 20.3 percent when inflation was around 6 percent. In contrast, the rate for the UK was 4.3 percent with an inflation rate of 2 percent. These rates are only available for the most creditworthy customers, and much higher rates are charged for the average person. For car finance in Uganda, Mogo Car loans quotes APRs of between 29 percent to 98 percent, with

[8] Source: World Bank, Forthcoming. Flagship Report: Economics of Electrical Vehicles for Passenger Transportation. Washington DC.

illustrated examples of APRs ranging between 50 percent and 75 percent for a five-year loan [35].

As consumers in African LICs lack access to credit, they may not be able to access necessary finance for E-mobility. The promotion of leasing arrangements—a service compensation model in which the customer pays for continuous access to a product over an agreed period—would allow consumers to pay the capital cost of EVs over time. Unlocking credit and minimizing the financial burden on consumers can also mitigate EV ownership risks by transferring them to leasing companies. Such companies would be better positioned to mitigate key risks in operation and maintenance through economies of scale.

On the infrastructure side, a large volume of public chargers will also be needed in countries where electricity access and reliability of supply are still lagging. To close this gap, the private sector could engage in providing battery leasing and swapping services. This approach can direct investments to fewer, but larger, charging facilities and grid impact could be better managed. In addition, battery swapping models as already applied for 2&3Ws can reduce the capital cost of EVs, since the cost of the vehicle and the battery would be separated, hence transferring the cost of obsolescence and depreciation from the consumer to the private sector. However, challenges related to the required standardization of batteries and asset financing of the service providers, remain.

8.2. AGGREGATION OF DEMAND IN PUBLIC PROCUREMENT

The public sector can use demand aggregation to source EVs, charging equipment, and cost-efficient electrified transport services. Larger sourcing contracts will not only reduce the cost per unit but will also lead to favorable rates for spare parts, maintenance, and battery management. Aggregate demand can incentivize private investments into market development and reduce transaction costs for financial institutions. A national public fleet management entity could coordinate across various levels of government (e.g., ministries, local government, etc.) [36] or even multiple cities [37]. This is a complex process needing high-level coordination and technical capacities across transport and energy infrastructure. Small-scale pilots can help prepare for larger-scale projects. Models such as joint mass procurement of electric buses by regional governments, for example in East Africa, could help lower the costs.

Mozambique's Transport and Communication Development Fund can serve as a model, including for electric vehicles. The fund was implemented to support transport operators in overcoming the ICE vehicle acquisition cost [38]. By collectively purchasing vehicles or parts, funds can generate economies of scale and other benefits as discussed for public demand aggregation above. With credit, lease, or lease-to-own models, they can act as intermediaries between vehicle providers and vehicle users. For vehicle providers (who could also invest in the fund), the financial risk is reduced and income generation is sped up. For vehicle users, a fund can lower upfront costs of leasing or loan schemes that are then repaid through savings from lower operating costs. While in the past these types of funds for traditional vehicles faced challenges with repayments, E-mobility has good potential to use smart technologies to decrease risk at low additional cost.

8.3. NEW PROJECT FACILITIES

Financing is becoming available for E-mobility projects. The African Development Bank is preparing a Green Mobility Financing Facility for Africa that intends to leverage funds through the Green Climate Fund and other partners to provide finance to private sector operators. The privately managed AfricaGoGreen Fund, with funds from venture capital and focused on energy efficiency and renewable energy investments, is offering commercial loans to private operators for E-mobility in Africa. The World Bank is also working toward a Regional Transport Decarbonization Financing Facility in Sub-Saharan Africa.

The International Council on Clean Transportation (ICCT) [39] has recommended that the governments belonging to the Zero Emission Vehicles Transition Council (ZEVTC), along with other relevant international entities, support a global transition to zero emission vehicles (ZEV). They suggest this is done by helping lower ZEV technology costs and providing financial and technical help, while encouraging knowledge exchange. They also call for the creation of ZEV dedicated financing facilities via existing and new programs and initiatives to provide effective financial assistance to Emerging Markets and Developing Economies.

8.4. JOINT INVESTMENTS WITH THE ENERGY SECTOR

E-mobility could mobilize funds from the energy sector [40]. As E-mobility creates a guaranteed demand for electricity, there is a potential business case for both public and private energy investors. Over recent years, the renewable electricity sector has mobilized private shares of up to 80 percent of investments and leveraged international climate and development finance [41]. Joint investments can create synergies, and lessons learned in access to finance and business models can be transferred. This began with E-mobility pay-as-you-go schemes in African LICs, which were in use as business models for mini- and micro-grids [42].

The energy sector has the potential to be both a partner and an investor in public transport [43]. In Santiago, Chile, the electric utility's participation in the purchase and deployment of electric buses allowed the overall investment to be split between a larger number of actors and risks allocated according to each partner's capacity [44]. The utility is paid back through its core business: selling electricity. Although such approaches may not be initially accessible to African LICs (e.g., due to the need to enhance capacity in energy and transport authorities and utilities), they illustrate the potential benefits of transport and energy sector collaboration.

Adjustments to transport and energy institutional and legal frameworks may be necessary to enable private sector investment. Global investment frameworks are generally better defined for energy than for transport [25]. However, in many developing countries, the electricity sector is publicly owned and often a monopoly. Electricity market reforms may be needed to allow both private investments in renewable electricity production and to provide electricity to transport.

CONCLUSION

A growing Green Divide exists between countries in the Global North and the Global South. Historically, high-income countries (HICs) have been responsible for the bulk of global emissions and climate change: G20 countries have contributed four-fifths of global emissions. However, the poorest low-income countries (LICs) in the world—those least responsible for climate change—are often the most affected. African LICs have huge unmet development needs, with an average GNI per capita of US$668 compared to US$70,430 in the United States [45].

The push to transition to E-mobility in the Global North risks some African LICs being left behind. E-mobility is emerging as a dominant model to decarbonize road transport in the Global North, but this may not be the only pathway, particularly in the short-term, for the Global South and especially for low-income countries (LICs) in Africa.

A wide variety of socio-economic and political contexts exist in African LICs; therefore each country will be required to determine their own transport decarbonization path which best meets their needs.

Transitioning to low-carbon transport needs to be considered in light of other transport and development goals, including access for all, efficiency, and safety. In the Global South, accessibility to transport infrastructure and services, affordability, road traffic congestion, air and noise pollution, safety, and system efficiency remain key development challenges.

CALL TO ACTION

To ensure a just and equitable transition to E-mobility in African LICs, the following actions should be taken:

- Expand investment in public transport to ensure accessibility and affordability, which is critical for the development of African LICs. Sustainable mobility goes beyond EVs and requires better urban planning, city reorganization, and transit-oriented development. Although many Africans already use public transport, mostly through the paratransit sector, further public transport measures are needed as part of emission reduction plans.
- Support investments in electric two- and three-wheelers (E2&3Ws) as a first step toward E-mobility, supported by local private finance. Small vehicles such as 2&3Ws are already a dominant transport mode in African LICs. They are cheaper to purchase, appeal to low-income residents, and can be charged within a few hours via plugs at home or at a commercial site. Financing solutions could include developing subscription or rental options for vehicles and batteries.
- Invest in the renewable energy sector with finance from international and national public and private sector organizations to provide access to electricity for all purposes. Millions of people in Africa still do not have access to electricity. Africa has an abundance of

affordable clean energy sources such as solar, hydropower, wind, and geothermal. Electrification efforts need to be open to private investment and innovations such as solar energy and battery storage. Off-grid solar systems and mini-grids have become a proven, reliable way to provide affordable modern electricity services. Achieving universal electricity access based on renewable energy will require commitment, finance, and policies and regulations that attract high-quality investments.

- Unlock finance for E-mobility by developing a better alignment between HICs, LICs, and funding institutions including development banks. Financing the transition to E-mobility will be possible only if enough resources are available to pay back investments and fund the cost of decarbonization policies. Market shaping activities and investments are required to improve finance for infrastructure and charging and energy capacity/coverage. Different capital will be suited to different stages of E-mobility, from the early stage (e.g., seed funding and grants), growth stage (e.g., private equity capital and development finance growth capital), and to maturity (e.g., financial and commercial investment).
- Deliver on financial commitments from the international community to support the adaptation and development of transport systems in African LICs, with the most appropriate and affordable technology. Levels of climate finance in Africa fall far short of needs. Africa's US$2.5 trillion of climate finance needed between 2020 and 2030 requires, on average, US$250 billion each year [46]. More finance for African nations is therefore needed to develop and adapt to climate change, as these countries are on the frontline of impacts. Combining finance from donors and businesses and working with international development banks can direct funding into green transport projects and enable African-led climate adaptation.

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