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A road map for e-mobility transition in Rwanda



- In brief:**
- Electric vehicles (EV) are gaining popularity among both governments and the private sector globally as an energy efficient mobility technology and the Government of Rwanda (GoR) embraces the fact that their expansion is now inevitable, as they aim to scale up their nascent e-moto industry.
 - The researchers recommend e-mobility be implemented in the context of a wider vision and set of policies that increase person-carrying capacity of roads, implement complete streets and integrate different modes of transport.
 - The researchers suggest GoR identify a viable market segment of early EV adopters, and apply a combination of fiscal incentives including price subsidies, well-targeted tax breaks, and non-fiscal incentives to increase e-mobility in the early stages.
 - Also, GoR will need to work out the detail of standards, regulations and planning for charging infrastructure, recycling of batteries, parking and data, incorporating institutions in charge of urban and land use planning, budgeting, and data governance, in this process.
 - GoR should also focus on the whole ecosystem of e-mobility and take an adaptive thinking approach that will facilitate removal of barriers in each part of the ecosystem.

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Background

Electric vehicles (EV) are gaining popularity among both governments and the private sector globally as an energy efficient mobility technology and their expansion is now inevitable. This is driven by worsening health effects of urban air pollution and congestion, international commitments to cut GHG emissions, the need to reduce dependency on oil imports, and a corresponding drive to tap the benefits of EV technology.

Recognising these benefits, the Government of Rwanda (GoR) aims to rapidly transition to electric motorbikes (e-motos), and eventually to electric vehicles more broadly. President Kagame announced in August 2019 his intention to replace Internal Combustion Engine (ICE)-motos with e-motos. On 28th November 2019, the Ministry of Infrastructure (MININFRA) briefed the Rwandan Cabinet about its initiative to promote e-mobility. Subsequently, on 25th February 2020 MININFRA hosted a workshop in partnership with the IGC to learn and exchange views on how Rwanda may plan its e-mobility transition. During the workshop, relevant stakeholders representing public, private and development partners shared their views. Based on the deliberations of this workshop and on international experience of EV adoption, this policy brief develops a near-term road map for managing EV transition in Rwanda, particularly for its capital city Kigali.

E-mobility and e-moto context in Rwanda

Currently, Rwanda has 221,000 registered vehicles consisting of 52% motorcycles and 38% passenger vehicles¹, of which at least 30,000 are in Kigali². The number of vehicles is increasing rapidly (almost 12% per year) and the government is thus concerned about deteriorating air quality in Kigali and rising fuel import bills (12% of total imports)³. A recent EV study⁴ recommended that the GoR should aim to convert 30% of motorcycles, 8% of cars, 20% buses and 25% of mini and micro buses to electric power, by 2030, although senior officials and private sector firms have expressed their desire for a faster transition, especially in e-motos. Currently, Volkswagen is also exploring electric mobility solutions and Global Green Growth Institute is studying the possibility of introducing e-buses.

As of April 2020, in Kigali a few e-motos are now fully operating as taxis; their number is likely to increase because two private firms – Ampersand and Safi – have entered the market and have plans for scaling up their operations, and a third – Rwanda Electric Mobility, is due to launch soon. Ampersand has already logged over 400,000 kilometres on its taxi bikes in Kigali. These firms are likely to compete and over time they aim to rapidly replace ICE-moto taxis.

Currently, the purchase price of e-motos is higher than ICE-motos due to high battery cost, but e-motos are cheaper to operate: life-cycle costing shows that commercial e-motos operating on average 170-190 kilometres per day will be able to negate the high upfront cost of the battery with the savings in maintenance and operating costs. According to Ampersand the total cost of their battery swapping based e-moto operation is cheaper than ICE-motos despite the high electricity tariff in Rwanda, which is \$27.7 per kilowatt-hour. Ampersand claim to improve daily earnings of drivers from the current \$1.7 per day to

¹ Byiringiro, Alfred, (2020), "Electric mobility in Rwanda: policy and vision for electric mobility", [PowerPoint presentation] Presented at "Scaling up sustainable transport systems in Rwanda" joint MININFRA-IGC workshop in Kigali on 25th February 2020, Ministry of Infrastructure, Rwanda.

² Whale, Josh. (2020), "Sparkling mass market electric transport in Africa", [PowerPoint presentation] Presented at "Scaling up sustainable transport systems in Rwanda" joint MININFRA-IGC workshop on 25th February 2020, Ampersand.

³ Byiringiro, Alfred, (2020), "Electric mobility in Rwanda: policy and vision for electric mobility", [PowerPoint presentation] Presented at "Scaling up sustainable transport systems in Rwanda" joint MININFRA-IGC workshop in Kigali on 25th February 2020, Ministry of Infrastructure, Rwanda.

⁴ Sweco (2019) "Electric mobility in Rwanda: background and feasibility report" Unpublished report. Sweco, SMART Project. Commissioned for KFW-FONERWA.

\$3.6 per day, assuming that the lower costs are not passed on to customers.

Electrification of motorbikes will improve air quality and therefore health outcomes, cut carbon emissions (from about 55.1 grams per kilometre for ICE-motos to about 13.3 grams per kilometre for e-motos), reduce fuel imports, and increase wages and/or lower travel cost for users. However, the expansion of e-motos will reduce government fuel tax revenues by up to 6 billion RWF by 2025⁵. The government will also need to increase transport capacity as discussed in the next section.

GoR aims to promote and manage an EV transition in a manner that enhances overall welfare by nurturing an integrated, safe, clean and affordable multi-modal transport system. Since the future is difficult to predict, the GoR must define its near-term policy framework and supportive actions that could be monitored for results and necessary mid-course corrections. Some considerations and recommendations for managing the e-mobility transition in the near term are presented below.

Policy recommendations

1. Establish a wider vision of the future of sustainable urban mobility

GoR needs to provide policy clarity in the medium-term (the next five to seven years). If the main policy objective is to reduce GHG emissions, then the lowest cost GHG-reducing measures in both the transport and electricity sectors must be identified and prioritised. The emerging best practice is to remain “technology neutral” without prescribing e-mobility as the only solution for GHG emission reduction in the transport sector. E-mobility is not a panacea. Even a city with 100% EV and decreased emissions, can have congestion, poorly designed roads, inefficient land policy, inaccessibility to public transport, dominance of private rather than public vehicles, and sprawl, with negative economic and social consequences. Therefore, e-mobility has to fit into a wider policy context; some considerations are as follows.

First, as Kigali densifies, policy should ensure that transport routes are as high capacity as possible – which means increasing the number of passengers per vehicle and promoting multi-modal transport means. Given the fiscal and topographical constraints on road widening and expansion, government has no choice but to strike a balance between these constraints and the likely demand imposed by various mode users. Buses have the effect of hugely increasing road capacity; thus the installation of more complete streets containing bus lanes and/or Bus Rapid Transit along key transport corridors will be important. This is in the Kigali Master Plan but will require significant resources and effort to implement effectively given the performance issues with current bus services⁶. Policies and solutions that encourage shared vehicle user-ship should be considered.

Second, e-mobility scale-up is not simply about increasing the number of EVs and e-motos but requires strong collaboration between private and public sectors. It requires charging infrastructure to cater to various vehicle types, across an entire city or even country, and this requires urban and land use planning, infrastructure planning. Moreover, electrification of vehicles, smart planning of land and data sharing between government and commercial travel service providers could help to develop different forms of multi-modal mobility solutions that are connected, near-emission-free and affordable in meeting needs of different user groups. Within healthy regulatory regime agencies responsible for operating various modes such as buses, mini-buses, taxis, shared two or three wheel vehicles, could come together and generate market responsive services. Local conditions will also shape the approach and

⁵ Sudmant, A & Gouldson, A. (2020), “The social, environmental and economic impacts of e-motos in Kigali: preliminary findings”, [PowerPoint presentation] Presented at “Scaling up sustainable transport systems in Rwanda” joint MININFRA-IGC workshop in Kigali on 25th February 2020, University of Leeds.

⁶ City buses operated under private contracts leave at irregular times, their routes are poorly communicated, and they are subject to overcrowding. Limited numbers of buses and increasing road congestion, particularly during rush hours, are affecting the productivity of the current bus fleets and their performance.

actions to effectively meet the mobility needs of residents and businesses. Since infrastructure, a public good, will not be provided by the market alone, the primary role of government will be to provide and coordinate the delivery of physical and virtual connectivity infrastructure within and between cities.

Third, multi-modal journeys in which households can reliably take different forms of transport between any one point and any other in the city, are important, as is planning and funding the transfer points between them. The role of City of Kigali, the Kigali Master Plan and ongoing urban and land use planning will be critical in promoting dense land development and increasing use of public transport with first and last mile connectivity provided by shared e-mobility service providers as well as Non-Motorised Transport. To promote integrated multi-ride mobility, GoR, including the City of Kigali, have to build a strong partnership among public transport operators, private shared service providers and communities. At transfer points between multi-ride services and public transport, the city has to provide dedicated parking spaces, lanes and facilities for shared vehicles.

2. Identify viable market segments of early EV adopters

International experience has shown that it is important to understand the potential e-mobility market and to get early feedback so that any EV strategy is aligned with the needs of the market⁷. The emergence of three commercial operators of e-motos and a commercial operator of electric bikes in Kigali points to the users of two-wheelers being the early adopters of EVs in Rwanda. Given the ease of charging at home and in strategic locations of the city, this segment of the market holds the highest potential for penetration in the near-term. As mentioned earlier, commercial operators will drive the early uptake due to the low running cost of e-motos compared to ICE-motos. The critical factor that would accelerate growth will be improvement in earning ability of operators, drivers and organisational role that government may play in this market. Replacing one-third of the existing 30,000 ICE-motos in Kigali with e-motos will take time even if one assumes that the GoR will stop sales of ICE-motos.

E-buses are a worthwhile long term target because of their high passenger-to-vehicle ratio and low emissions-to-passenger ratio; they are also safer than e-motos. However, the high price of electric cars (15-30% higher than ICE-cars) and e-buses (two to three times that ICE-buses)⁸ means that these modes of transport have to wait for a better value proposition. A future decline in battery price, below US100/kwh, will significantly improve market potential of electrified cars, large buses, mini-buses and trucks. Therefore, in the near-term operating range, charging time and price will remain the major barriers to the introduction of E-buses in Rwanda. The first movers in the car segment are likely to be rental car businesses and sharing services operators like Volkswagen's Move service, or – if it eventually enters Rwanda – Uber or similar shared-service providers. Commercial electric three-wheelers and mini-buses are gaining popularity in several developing cities as observed in India and Addis Ababa of Ethiopia⁹. These vehicles have potential to fill the void left by the lack of essential public transport in Kigali. For trunk public transport services (buses or BRT) these vehicles can effectively provide last mile connections.

⁷ Rode, P. (2020), "Electric mobility services for complete streets in Addis Ababa", [PowerPoint presentation] Presented at "Scaling up sustainable transport systems in Rwanda" joint MININFRA-IGC workshop in Kigali on 25th February 2020, London School of Economics.

⁸ Ernst & Young (2017) Standing up India's EV ecosystem: who will drive the charge?

⁹ Rode, P. (2020), "Electric mobility services for complete streets in Addis Ababa", [PowerPoint presentation] Presented at "Scaling up sustainable transport systems in Rwanda" joint MININFRA-IGC workshop in Kigali on 25th February 2020, London School of Economics.

3. Apply a combination of fiscal and non-fiscal incentives to increase e-mobility in the early stage

Many countries are adopting measures in three broad areas: i) price subsidies, ii) tax breaks and iii) a range of privileges on road use, for example, EV use of bus lanes, free or reserved parking, charging and other facilities. Price subsidies – for example to vehicles and electricity tariffs – are sometimes accompanied by a more indirect mechanism to tip the price balance away from ICEs: some countries have imposed fuel efficiency standards on ICE vehicles that raise their cost – thus advantaging EVs. Tax exemptions may include exemption or reduction of fuel tax, registration fees, or import duties; these are currently offered in many countries to consumers and the auto industry during the early stage of EV adoption. These incentives reduce the acquisition cost differential between EVs and ICE vehicles, at the same time, help scale up the production and services in a nascent e-mobility industry.

GoR might thus offer a context-tailored combination of fiscal and non-fiscal incentives during the early phase of e-transition. Within the fiscal constraints, GoR should evaluate options for lowering or exempting certain taxes and tariffs for EV users, industry and commercial service providers but be prepared to gradually phase them out once the EV industry becomes self-sustaining. For instance, given the high electricity tariff in Rwanda (US\$ 27.7/kwh) government may **consider a differential time-of-use rate for electricity that would mitigate grid load effects but at the same time would lower the tariff for EV battery chargers during low demand periods** of early morning, mid-day and night. Since EVs such as e-motos will be in intense use during the peak hours their users and operators would find the new tariff structure convenient and cheaper to use. Currently, government offers a low electricity tariff to industries but this is not responsive to demand fluctuations. However, once e-transition accelerates, government should revisit the tariff structure to compensate for the increasing loss of transport fuel tax revenues.

Similarly, a well targeted tax reduction could promote use of electricity storage systems or solar cell enabled chargers by the EV industry. At the 25th February workshop, e-moto company Ampersand requested VAT exemption on EV charging stations, and also that the VAT reimbursement period is reduced from the current 9 months or more to 30 days. They argued that along with lower electricity tariffs, this package of fiscal subsidies and exemptions would strongly increase the growth rate of the e-moto industry.

An e-bike leasing firm, Gura, also stated the need for readily available loans for sustainable leasing programmes from the financial sector. Government could be a facilitator in accessing tradable carbon credits and green financing from international sources. In parallel, new regulations towards ICE-moto registration caps, emission standards and mass retrofit of ICE vehicles (if necessary) should be developed to speed up the conversion of ICE-moto fleet to e-motos.

Collaboration between EV industry players and local educational institutions should be promoted to train future workers with skills that will be required by the emerging EV sector. Safi and Gura are leading the way on this by working with Rwanda's Technical and Vocational Education and Training scheme to draw up a curriculum, and are starting to work with Kigali Employment Service Centre and the City of Kigali who will assist with providing skilled workers for the industry.

The magnitude and nature of fiscal incentives vary widely across countries depending upon each government's fiscal capacity, expected market response to policies, and the likelihood of meeting other local objectives besides emission reduction, such as auto industry development, innovations in new mobility technologies and lowering of pollution and fuel import. The costs of the above measures must

be balanced against achieving the primary objective of emission reduction and its co-benefits such as reduced noise, local air pollution and fuel import. In other words, all proposed fiscal measures must be evaluated in terms of the price that Rwanda should pay to reduce each unit of GHG emission.

4. Develop standards, regulations and planning for charging infrastructure, recycling of batteries, parking and data sharing

GoR should lead the development of standards for ease of use of charging infrastructure by various vehicle manufacturers, service providers and home based users. A policy framework should also be set up for recycling and reuse of batteries. Although over the past years (2013-2018) Rwanda has improved carbon emissions in power generation from 308 to 134 gCO₂/kwh¹⁰ by increasing hydro source, more needs to be done to clean the grid by reducing use of oil, diesel and peat.

In Kigali land and transport sector policies and planning documents need to be evaluated to provide preferential parking spaces for EVs at major transport nodes, city centre and commercial areas. The zoning and building codes designated in Kigali master plan should be reviewed to accommodate future of EV infrastructure (e.g., EV builders and parts maker sites, battery swapping stations, maintenance facilities, parking spots, lanes for buses, mini-buses and high occupancy EVs, charging stations etc.) at suitable locations with minimal impact on environment. Flexibility in regulations would be necessary to address concerns of users and various mobility operators.

In addition, to monitor progress, government should institute a protocol for data sharing between its agencies (power, transport, industry and urban development) and the new EV operators and service providers.

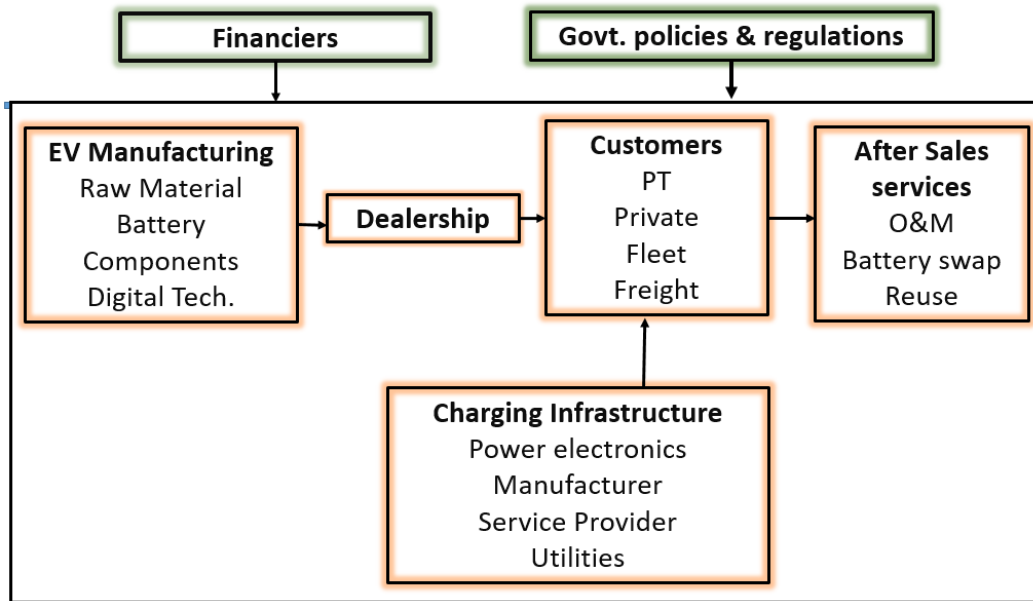
5. Adopt an ecosystem-based perspective for collaborative governance and mid-course correction

The transition from ICE-vehicles to EVs will have significant implications for the existing automotive businesses in Rwanda. The new entrants into e-moto markets are either importing their vehicles or assembling them from imported parts. Besides, new capabilities and skills electrification would require rebuilding of a supportive ecosystem consisting of EV building, charging infrastructure and various services (see *Figure 1*). By adopting an ecosystem perspective, government will be able to uncover barriers and risks that may emerge within each component of the ecosystem and affect the pace of EV transition.

Given the nascent state of EV in Rwanda, the country has to rely on imports for many vehicle components in the near future. For instance, batteries, a high cost component of EVs, is presently produced only by two or three countries (Korea, Japan, USA) in the world thus Rwanda will continue to rely on its import. Therefore, the near-term focus should be on building capacity for Operations and Management, and services to assemble EVs, charging infrastructure and battery reuse or disposal.

¹⁰ "World Bank; International Association of Public Transport. 2018. Electric Mobility and Development. ESMAP Paper;. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/30922> License: CC BY 3.0 IGO."

Figure 1: Electric vehicle ecosystem



The GoR would also benefit from embracing a path of adaptive thinking and collaborative governance, and introduce a phased program of fiscal and non-fiscal measures as discussed in recommendation 3. Such an approach will allow government agencies to work together to regularly monitor the effectiveness of adopted measures in increasing penetration of EV use and in developing supporting business activities. It will also permit opportunities for mid-course corrections. For this purpose, a robust partnership between MININFRA, Rwanda Energy Group, Rwanda Utilities Regulatory Authority, Rwanda Standards Board, Ministry of Trade, Ministry of Local Government, Rwanda National Police, possibly National Industrial Research and Development Agency, City of Kigali and relevant districts, EV industry players, consumer groups, development partners and others, should be established. Regular consultation among the partners will help to garner their views on the adopted measures and suggestions for any change. An electric mobility taskforce, as recommended by the 25th February 2020 workshop, would be helpful in this regard.