

SSA E-MOBILITY (ELECTRIC VEHICLES) TOOLKIT



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1. Introduction

With the world's biggest car maker (Toyota) announcing its intentions to invest billions in developing battery-powered electric vehicles between 2022 and 2030 at the start of the year 2022, it is becoming more glaring that the transportation sector which accounts for about 20% of Greenhouse Gas (GHG) emissions with road transportation accounting for more than three-quarters of this share is gaining centre stage in global decarbonisation efforts. Beyond decarbonisation, the adoption of electric mobility enhances energy efficiency in the renewable energy space and environmental sustainability within Sub-Saharan Africa (SSA) by avoiding the emission of tonnes of greenhouse gases. This toolkit provides an overview of the adoption of electric mobility for productive use of energy in SSA. It achieves this by considering an overview of Electric Mobility (E-Mobility) including their various forms and components. It further considers some of the factors driving the adoption of E-mobility in SSA and factors supporting the drive. In addition, it compares the proportionate adoption of electric mobility in SSA to the global adoption. Finally, it dives into the policies and

legislation on E-mobility and country by country analysis of E-mobility adoption in all 49 SSA countries. It concludes by highlighting some of the challenges to large-scale adoption of E-mobility across SSA and recommends some areas for improvement to scale up adoption.

2. Electric Mobility (E-Mobility)

2.1 What is E-Mobility?

Electric mobility involves the use of electric vehicles as a means of transportation. It uses one or more electric vehicles (EV) to transport people and goods thereby minimising the GHG emitted into the atmosphere. With the global concern around environmental and climate change issues, it is considered that large-scale adoption of electric vehicles serve as an effective way of decarbonizing the transport sector particularly where the electricity is generated from a renewable source.

2.2 E-mobility and Productive use of energy

E-mobility is considered a productive use of energy because it involves the utilization of energy including electric and non-electric energy in the form of heat, or mechanical energy – for activities than enhance income and welfare.

2.3 What are Electric Vehicles?

EVs are vehicles powered partially or entirely by electric power stored in a rechargeable battery which provides power to an electric motor or engine. The vehicles can be recharged by simply

plugging into an electricity grid or charging station. They do not emit tailpipe emissions and are considered a cleaner and sustainable means of transportation because, amongst other advantages, they convert energy into power more efficiently and they only consume power while in motion. The cleaner the source of the electricity, the cleaner the environment because the use of electric vehicles that consume clean energy prevents toxic gases from being released into the atmosphere.



I. Key components of an electric vehicle include:

S/N	Component	Function
1	Battery	The battery provides electric power to the accessories and other components of the electric vehicle.
2	Charge port	The charge port enables the electric vehicle to connect to an external power supply to charge the traction battery pack.
3	DC/DC converter	Converts high voltage DC power from the traction battery pack to low voltage DC power needed to run the accessories of the electric vehicle and to recharge the battery.
4	Electric traction motor	Electric traction motor uses power from the traction battery pack to drive the wheels of the electric vehicle.
5	Onboard charger	Converts the incoming AC electricity that is supplied by the charge port to DC power for charging the traction battery.
6	Power electronics controller	Manages the flow of electrical energy delivered by the traction battery thereby controlling the speed of the electric traction motor.
7	Thermal system (cooling)	The thermal system maintains a proper operating temperature range of the engine, electric motor, power electronics, and other components.
8	Traction battery pack	Battery pack stores electric power to be used by the electric traction motor.
9	Transmission (electric)	Transfers mechanical power from the electric traction motor to drive the wheels of the electric vehicle.



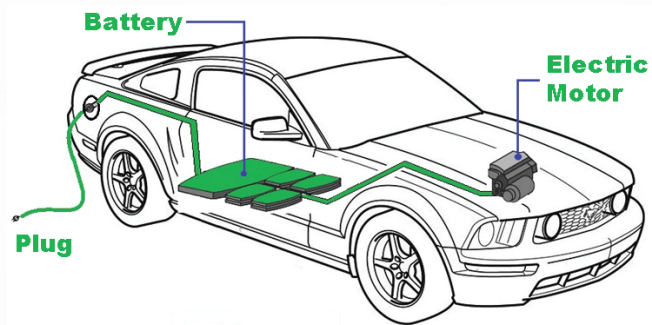
2.4 Types of Electric Mobility

E-mobility encompasses all the different types of e-mobility including cars, motorcycles, bicycles, 2 and 3 wheelers, buses, boats, and electrified rail.

2.4.1 Electric Cars

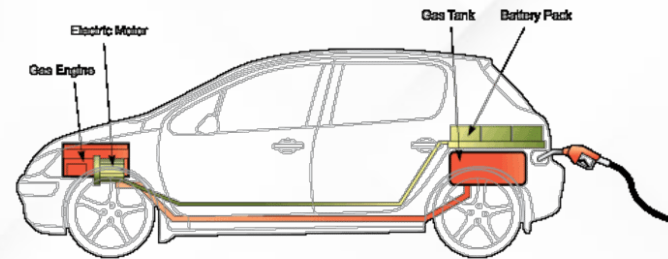
The three major types of electric cars are identified below

Battery Electric Vehicles (BEVs)



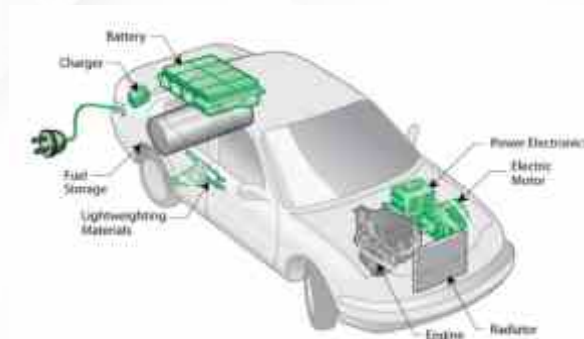
BEVs are electric vehicles that use rechargeable batteries rather than a gasoline engine. The battery pack, which is recharged from the grid, provides all the energy the vehicle requires for motion. BEVs are low emitters because they produce no hazardous emissions or air pollution while in motion unlike typical gasoline-powered vehicles. They equally create minimal noise and do not burn fossil fuels while in motion.

Hybrid Electric Vehicles (HEVs)



HEVs are propelled by both a gasoline engine and an electric motor. The battery receives all its energy from regenerative braking, which recoups otherwise wasted energy in braking to aid the gasoline engine during acceleration. This braking energy is generally wasted as heat in the brake pads and rotors of a standard internal combustion engine car. Regular hybrids cannot recharge by plugging into the grid and cannot charge at an EV charging station.

Plug-in Hybrid Electric Vehicles (PHEVs)



To power the vehicle, PHEVs use both an engine and an electric motor. PHEVs, like ordinary hybrids, can recharge their batteries via regenerative braking but also vary from normal hybrids in that they have a considerably bigger battery and can recharge by plugging into the grid.

2.4.2 Electric Bicycles

Electric Bicycles are motorized bicycles that have in-built electric motors used to assist propulsion. These bicycles also use rechargeable batteries and typically travel up to 25 to 32 km/h (16 to 20 mph). Usage of electric bicycles has experienced rapid growth worldwide since 1998.

2.4.3 2 and 3 Wheelers



Research shows that 90% of electric vehicles currently operating around the world are 2 and 3 wheelers. A 3-wheeler is a vehicle with three wheels while a 2-wheeler is a vehicle with 2 wheels. Electric two and three wheelers are beginning to cover the landscape of e-mobility in middle income and developing countries because unlike regular cars, they are cheaper to purchase, and they are already largely consecrated in low income countries. As such, the United Nations Environment Programme regards 2 and 3 wheelers are the first priority in moving to electric mobility in SSA. Scenario calculations using the UN Environment eMob calculator show that assuming a steep and global shift to battery electric motorcycles by 2030, could result in CO2 emissions reductions of about 11 billion tons between now and 2050.

2.4.4 Electric Buses

An electric bus is a bus that is driven using electric motor as opposed to Internal Combustion Engine (ICE). About 17% of the world's buses today are electric but electric buses are expected to cover over 67% of the global bus fleet in 2040. These buses have lower operating costs over the

long term compared to ICE buses and are easier to maintain with their streamlined electric engines. In addition, electric buses are regarded as ideal for electrification because they can convey a decent amount of people with about the same energy consumption as they would with one passenger in an electric car.

2.4.5 Electric Boats

Electric boat refers to any boat or ship whose primary propulsion technology is an electric drive system. There are several types of electric boats: full battery electric, hydrogen fuel cell electric, or electric hybrid boats or ships. Most electric boats take a hybrid approach with sails or diesel engines as the primary source(s) and electric motors as auxiliary power. This set of vehicles do not cause pollution in the rivers, streams, or lakes with spilled fuel or toxic residue. Electric boats allow owners to have greater independence in terms of owning their own power because electricity for shore power charging can be generated in several ways including solar panels and other renewable sources.

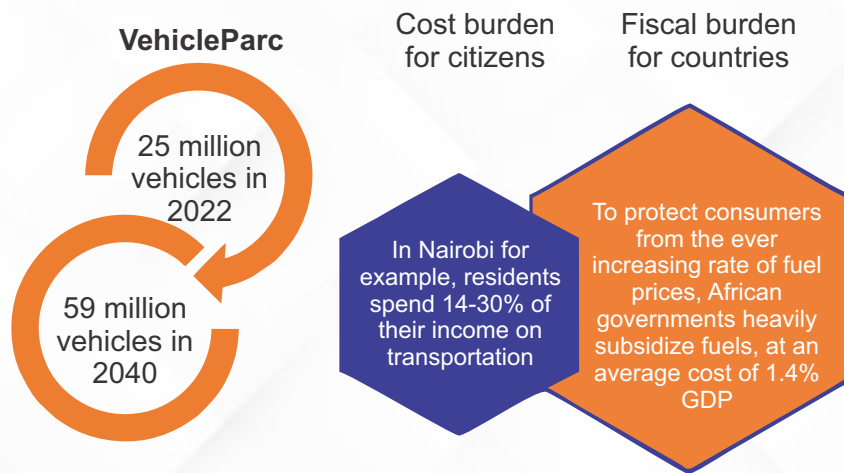
2.4.6 Electrified Rail

An electrified rail supplies electric power to railway trains without an on-board prime mover or local fuel supply. Electricity is typically generated in generating stations, transmitted to the railway network, and distributed to the trains. The railway usually provides its own distribution lines, switches, and transformers. Globally, electrified rail comprised 296,000 kilometres of track in 2018. If that increases significantly by 2050 and encourages much more freight on electrified tracks, emissions from fuel use can be reduced by 0.1–0.7 gigatons of carbon dioxide.

2.5 EV and the Transportation Sector in SSA

Transportation in SSA is heavily reliant on internal combustion engine (ICE) vehicles which have negative environmental impacts including pollution of the air with antecedent health implications. It is recorded that transport currently makes up 10% of the total GHG emissions in Africa. In the six countries that make up around 70% of SSA's annual vehicle sales and 45% of the region's population, the

vehicle parc is expected to grow from 25 million vehicles today to an estimated 59 million by 2040. Maintaining the status quo of fuel powered vehicles with this projected increment carries several implications for SSA and the world at large. It also carries with it a cost burden for citizens and a fiscal burden for countries. As such, EVs present an opportunity to meet the growing transportation demand without jeopardising climate ambitions and creating health risks.



3. Factors driving E-Mobility adoption in SSA

3.1 Climate Change

Climate change effects have become a well-recognized threat to humanity's sustenance on earth. Countries of the world have adopted mechanisms in terms of Nationally Determined Contributions (NDCs) and other local mechanisms to mitigate its effects. SSA has not been left out in this process with countries pledging ambitious targets to reduce GHG emissions from energy use by stipulated percentages. Transportation takes the stage as the second largest energy consumption emitter after Industry. Electric mobility simply creates an avenue for meeting those targets.

3.2 Global Energy Transition

The ongoing global shift to low carbon sources of energy also spurred by climate change regulations means looking to fewer emitting sources of fuel. Renewables happen to be one of such sources, but its usefulness is limited to electricity generation. Up to 90% of Africa's transportation occurs by road which leads to a

huge dependence on fossil fuel. EVs allows for the utilisation of renewable sources of energy through strategic approach to vehicle electrification, thus harnessing electricity supply for mobility.

3.3 Policy/Government support

As stated, policy support for renewable energy adoption shown by governments of SSA countries following pledged Nationally Determined Contributions (NDCs) in the form of provision for investments into E-mobility building, deployment of fiscal measures promoting e-mobility, etc., have also supported the drive towards E-Mobility adoption. Countries across SSA such as Nigeria, Rwanda, Kenya, South Africa, etc., have incorporated into their legislative frameworks, climate change regulations aimed at reducing carbon emissions by promoting the use of renewable energy across all fields of operation within the economy. Such regulations also include incentives for investments into renewable energy use and have resultantly, promoted the adoption of EVs as a better and more reliable mode of transportation in these countries albeit at differing scales.

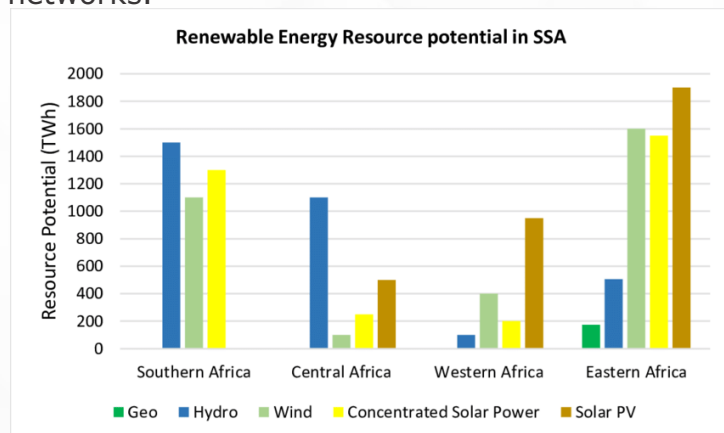
3.4 Technological Advancement

The recent technological advancement that has taken over the world in providing electric mobility is also a driving factor for the adoption of e-mobility in SSA. The continent does not want to be left behind in the technological progression the world is experiencing, and as such, is considering ways to adapt to these new changes. These include technology for renewable energy use, EV build up, and increased grid reliability through EV batteries which can be used as an energy storage asset.

4. Factors Supporting EV adoption in SSA

4.1 Large Renewable Energy base

Sub-Sahara Africa has a vast, diverse, and geographically distributed renewable energy resource base as represented in Fig. 1 below. The existence of such wide renewable energy base supports the creation of standalone mini grids designated specifically for EV charging. It also eliminates the cost burden associated with fuel subsidisation for 44 of 46 SSA countries that rely on fossil fuel imports to power their transportation networks.



Source: Research Gate

4.2 Green Climate Fund

The Green Climate Fund(GCF) is a unique global platform to respond to climate change by investing in

emission and climate resilient development. Recognising that climate change mitigation efforts cannot be achieved by state finance alone, the GCF has set up a Private Sector Facility that promotes private sector investments through concessional instruments, including low interest and long-tenor project loans, lines of credits to banks and other financial institutions, equity investments and risk mitigators such as guarantees, first loss protection, and grant-based capacity building programmes which potential investors can utilise for investments targeted at upscaling E-vehicles.

4.3 Green Fund Initiative

Specific to South Africa is the Green Fund Initiative(GFI) run by the South African Government through the Department of Environmental Affairs. The GFI is aimed at supporting the transition to a low carbon, resource efficient and a climate resilient development path. Prior discussions leading to the creation of the GFI brought to light the low energy consuming nature of electric vehicles and its contribution to low carbon emissions. As such, the fund was created to provide opportunities for EV manufacturing and related ventures which support EV adoption in SSA.

4.4 Carbon Market/Mechanisms

The carbon market is based on a system that regulates the GHG emissions that certain countries can emit. Entities governed by the scheme are generally allowed to trade their allowances, to enable other entities account for emissions beyond the assigned cap. In the same vein, project-based systems have been created allowing entities governed by the scheme to institute GHG carbon abatement projects within developing countries in return for carbon offset. This scheme supports EV adoption in SSA as it has the potential to encourage small to large scale e-mobility development in SSA across the e-mobility value chain.

4.5 Global Green Growth Institute (GGGI)

GGGI is a treaty-based international, intergovernmental organization dedicated to supporting and promoting strong, inclusive and sustainable economic growth in developing countries and emerging economies with a mission of global transition toward a model of green growth. Some of the support offered to developing countries includes; delivering policy advice to projects and programs in countries, conducting sector assessments, assessing technology options where relevant, identifying and conceptualizing sustainable project models. The

Business team of GGGI also plays a strategic role in ensuring agile, transparent and fair procurement of goods, work and services, at the best value for money in compliance with GGGI's procurement standards.

It was recently re-affirmed by GGGI Ethiopia, that sustainable transport is one of the focus areas of intervention for GGGI; which justifies GGGI's plans to support Ethiopia in the transition of its transport sector to sustainable modes of transportation including low carbon-based mobility and non-motorized transportation.

5. EV adoption statistics in SSA vs Globally

The transportation sector currently makes up 10 percent of the total greenhouse gas (GHG) emissions across SSA; and in the six countries that constitute 70% of SSA's annual vehicle sales and 45% of the region's population (South Africa, Kenya, Rwanda, Uganda, Ethiopia, and Nigeria), the quantity of ICE vehicles in the market is expected to grow from 25 million in 2022 to an estimated 58 million by 2040, due to increased urbanization and rising incomes. Notably, a growing number of start-ups are investing in the region's nascent electric two-wheeler space to design vehicles at a cost and durability suitable for the local market; and due to this, "two-wheelers will likely be the first segment of e-mobility to be electrified, with electric two-wheeler sales expected to rise to 50-70% of all sales by 2040." Vans and minibuses would likely be next, followed by passenger cars.

These statistics show that while SSA faces some unique challenges in its electric mobility transition – including unreliable electricity access, low EV affordability, and the dominance of used ICE vehicles – a growing ecosystem, focusing particularly on electric two-wheelers, is emerging in the region.

Globally however, the majority electric mobility option remains EVs; from the affordable Nissan Leaf to high-

end EVs like Tesla's Model S and Mercedes-AMGs all-electric SLS. EVs are recognized as having a central role in the ambitious objective of zero emissions target for 2050, and the global transportation industry appears prepared for it. China and the USA constitute the largest markets for EVs and by 2035, both countries along with countries forming part of the European Union, are expected to sell only electric vehicles (EVs), and by 2050, 80 percent of the world's vehicle sales are expected to be electric. The biggest concentration of privately owned electric two/three wheelers is in Asia, specifically in China, accounting for 99% of registrations. Globally, there are currently around 290 million two/three wheelers. The market is also growing in Europe, having risen by 30% in 2020.

The adoption of EVs across the globe has also birthed the vehicle-to-grid (V2G) trend which makes it possible to transfer the electricity stored in electric vehicle batteries back to the grid, the same way stationary storages are connected to the grid. V2G services are already commercially available, and several charger manufacturers can supply V2G chargers. The V2G market is also projected to grow to over \$5 billion by 2024.

In 2022, there are around 16 million electric cars on the road worldwide, consuming roughly 30 terawatt-hours (TWh) of electricity per year, the equivalent of all the electricity generated in Ireland.



6. Policies and Legislations that promote Electric Mobility across SSA

S/N	Country	Policies/Legislation/Projects/Programs
1	Angola	• No legal framework available.
2	Benin	• No legal framework available.
3	Botswana	• No legal framework available.
4	Burkina Faso	• No legal framework available.
5	Burundi	• No legal framework available.
6	Cameroon	• No legal framework available.
7	Cape Verde	• Electric Mobility Policy Charter (CPME), Resolution No.13/2019: The strategic vision of the Government's policy for Electric Mobility in Cabo Verde is to achieve the gradual replacement of the current fleet of vehicles equipped with internal combustion engine (gasoline or diesel based) by clean electric vehicles, without GHG emission, by 2050, in alignment with the country's energy transition and according to the Electricity Sector Master Plan (2018-2040).
8	Central African Republic	• No legal framework available.
9	Chad	• No legal framework available.
10	Comoros	• No legal framework available.
11	Djibouti	• No legal framework available.
12	DRC	• No legal framework available
13	Equatorial Guinea	• No legal framework available.
14	Eritrea	• No legal framework available.
15	Ethiopia	• .No legal framework available.

S/N	Country	Policies/Legislation/Projects/Programs
16	Gabon	<ul style="list-style-type: none"> No legal framework available.
17	Gambia	<ul style="list-style-type: none"> No legal framework available.
18	Ghana	<ul style="list-style-type: none"> Drive Electric Initiative, 2019: This was developed to promote the use of electric vehicles on Ghana's roads. The initiative seeks to promote and create demand for electric vehicles with a target of having over 100 electric vehicles and at least 10 public charging stations.
19	Guinea	<ul style="list-style-type: none"> No legal framework available.
20	Guinea-Bissau	<ul style="list-style-type: none"> No legal framework available.
21	Ivory Coast	<ul style="list-style-type: none"> Strategic 2013-2020 plan for the development of the electricity sector in Ivory Coast: This aims to expand electricity production capacity, upgrade transmission infrastructure, and increase the generation of renewable energy, which will allow the deployment of renewables into implementing electric mobility.
22	Kenya	<ul style="list-style-type: none"> National Climate Change Action Plan (NCCAP) 2018/2022: This is a five-year plan that seeks to allow Kenya adapt to climate change and reduce greenhouse gas emissions. One of the goals of the Plan is to pilot projects on electric vehicles in the country. Finance Bill of 2019: This action plan proposed reduction on the excise duty for all vehicles with only electric motor for propulsion (BEVs) from 20% to 10%.
23	Lesotho	<ul style="list-style-type: none"> No legal framework available.
24	Liberia	<ul style="list-style-type: none"> No legal framework available.
25	Madagascar	<ul style="list-style-type: none"> No legal framework available.
26	Malawi	<ul style="list-style-type: none"> No legal framework available.

S/N	Country	Policies/Legislation/Projects/Programs
27	Mali	<ul style="list-style-type: none"> • No legal framework available
28	Mauritania	<ul style="list-style-type: none"> • No legal framework available
29	Mauritius	<ul style="list-style-type: none"> • No legal framework available.
30	Mozambique	<ul style="list-style-type: none"> • No legal framework available.
31	Namibia	<ul style="list-style-type: none"> • No legal framework available.
32	Niger	<ul style="list-style-type: none"> • No legal framework available.
33	Nigeria	<ul style="list-style-type: none"> • The Nigerian Energy Transition Plan 2022 - the ETP seeks to decrease emissions significantly by the uptake of electric vehicles (EVs) and use of clean energy in Nigeria
34	Republic of Congo	<ul style="list-style-type: none"> • No legal framework available.
35	Rwanda	<ul style="list-style-type: none"> • Strategic Paper on Electric Mobility Adaptation in Rwanda, 2021: The goal of this strategic paper is to accelerate the adaptation of electric vehicles through the provision of incentives to both electric vehicles and their charging infrastructure and providing awareness to the public about the benefits associated with the usage of electric vehicles.
36	Sao Tome and Principe	<ul style="list-style-type: none"> • No legal framework available.
37	Senegal	<ul style="list-style-type: none"> • No legal framework available.
38	Seychelles	<ul style="list-style-type: none"> • The Government of Seychelles directed the scrapping of duty on all fully electric vehicles with effect from 15th July 2015. Duty on hybrid vehicles was also reduced to five percent. As of April 2018, excise tax rates for plug-in hybrid vehicles were significantly reduced as a way of encouraging the purchase of these vehicles. • A Global Environment Facility (GEF) project is currently underway to support the establishment of a coordinated institutional framework and a gender sensitive strategy for the promotion of low carbon electric mobility in Seychelles.

S/N	Country	Policies/Legislation/Projects/Programs
39	Sierra Leone	<ul style="list-style-type: none"> No legal framework available
40	Somalia	<ul style="list-style-type: none"> No legal framework available.
41	South Africa	<ul style="list-style-type: none"> Green Paper, 2021: This Draft Green Paper is a government policy discussion paper that seeks to develop a framework for a comprehensive and long-term automotive industry transformation plan on new energy vehicles with a focus on seven (7) areas which include: local market optimization; regional market development; localization; automotive infrastructure development; industry transformation; technology and associated skills development; and institutionalizing the SAAutomotive Masterplan.
42	South Sudan	<ul style="list-style-type: none"> No legal framework available.
43	Sudan	<ul style="list-style-type: none"> No legal framework available.
44	Swaziland	<ul style="list-style-type: none"> No legal framework available.
45	Tanzania	<ul style="list-style-type: none"> No legal framework available.
46	Togo	<ul style="list-style-type: none"> While there is no legal framework available for Evs in Togo, the 2022 Finance Bill implements a 100% abatement on import duties for EVs.
47	Uganda	<ul style="list-style-type: none"> While no legal framework is currently available, the second Transport Master Plan is being prepared which will provide guidance on how the country's infrastructure should develop from 2021 to 2040. It has been submitted that Sustainability measures will be high on the agenda of the new Transport Master Plan in line with the UN SDG Goals.
48	Zambia	<ul style="list-style-type: none"> No legal framework available.
49	Zimbabwe	<ul style="list-style-type: none"> Zimbabwe is in the process of developing an e-mobility framework which shall outline the facets that will create a conducive environment for the growth of the industry.

7. Country by Country Analysis

S/N	Country	Analysis
1	Angola	<ul style="list-style-type: none"> There are currently three recorded charging stations in Angola and there have been investments made into the growth of e-mobility within the country. For instance, the national individual transport platform T'Leva invested \$22 million in the purchase of 1000 electric cars in January 2020 and planned to move on to other urban mobility solutions such as electric two-wheelers later in the year. However, the production of electric cars in Angola has been criticized based on the fact that the country is still unable to feed, educate, provide adequate sanitation, water and electricity (43% electricity access rate) to the majority of its citizens and is going through a prolonged and profound economic crisis. Angola also depends on oil for economic sustenance, hence, the idea of switching their energy base of transportation from fossil fuels to renewable energy will require the design and implementation of a national and regional plan ensuring that within a specified period, EVs are the basis for mobility amongst the people.
2	Benin	<ul style="list-style-type: none"> In September 2021, the partnership between the Beninese government and Arise Integrated Industrial Platforms (Arise IIP), a pan-African developer of special economic zones consecrated the installation of the first processing unit within the Industrial Zone of Glo-Djigbé (GDIZ) to be operated from 2021 to 2026. There has also been an investment of \$20 million made by M-Auto electric mobility towards creating a production line of 1,000 motorcycles and 30 electric tricycles per day, which will eventually employ more than 1,500 Beninese.
3	Botswana	<ul style="list-style-type: none"> The Botswana Electric Mobility (e-mobility) Programme was launched by the government of Botswana in 2021 with the primary purpose of accelerating Botswana's readiness to transit from petroleum-based transport to electric mobility. The Botswana Institute for Technology Research and Innovation (BITRI) has been mandated with capacity building for the e-mobility ecosystem, in collaboration with key strategic partners namely Business Botswana (BB), University of Botswana (UB), Botswana International University of Science and Technology (BIUST) and Technical and Vocational Education and Training institutions (TVETs). Botswana has also joined the Energy Resource Governance Initiative (ERGI), an initiative to support the discovery and development of mineral reserves of strategic metals used to make batteries for electric vehicles.

S/N	Country	Analysis
4	Burkina Faso	<ul style="list-style-type: none"> Two and three wheelers account for three out of four vehicles in Burkina Faso and these vehicles that run on an ICE contribute from 60 to 75% of harmful air pollutants within the country. Renewable energy sources also account for only 17% of total electricity production in Burkina Faso and the country has a low 14% electricity access rate. There is no record of a framework in place for e-mobility in Burkina Faso.
5	Burundi	<ul style="list-style-type: none"> The United Nations Environment Programme (UNEP) is currently active in Burundi, working on the introduction of electric two and three wheelers. The country has a 11% electricity access rate but about 80% of its electricity is generated with renewable energy resources. The country also has direct fiscal incentives in place for renewable electricity. The Government of Burundi has initiated an "Urban Transport Development Project" with an annual budget of \$28,000. In the context of renewable energy, the Ministry of Energy has also initiated an "Energy Efficiency Project" which comprises planned investments for renewable energy projects, that will provide the electricity required and some of the infrastructure for charging the electric vehicles.
6	Cabo Verde	<ul style="list-style-type: none"> The government of Cabo Verde plans to replace the country's entire vehicle fleet with electric vehicles utilizing locally generated electricity from renewable energy resources by 2050. However, the achievement of this target is hindered by the fact that electric vehicles cost more than ICE vehicles, and the country also lacks the needed expertise for promoting and using electric vehicles. To effectively implement its strategy to promote e-mobility, the Government of Cabo Verde partnered with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and successfully applied for funding from the NAMA Facility to promote the use of electric vehicles. This strategy which is to run from 2020 to 2025 includes offering financial incentives to encourage the acquisition of electric vehicles (rebates on purchases of electric vehicles), developing a public charging infrastructure, improving the legal framework for e-mobility, raising awareness of electric mobility, and strengthening the relevant stakeholders.

S/N	Country	Analysis
7	Cameroon	<ul style="list-style-type: none"> Cameroon has a 63% access rate to electricity and offers direct fiscal incentives for renewable electricity. The country also has one of the highest rates of urbanization in sub-Saharan Africa, with 56% of the population living in urban areas. It is estimated that, by 2050, 70% of Cameroonians will live in urban areas. Although there is no policy for e-mobility promotion or records of e-mobility within the country, there have been forecasts for the imminent arrival of electric vehicles, warranting an increased access to energy rate organized for the people by the government of Cameroon.
8	Central African Republic (CAR)	<ul style="list-style-type: none"> CAR has a 32% electricity access rate and direct fiscal incentives for renewable electricity in place, but no framework for energy efficiency in its transport sector. The country does not have a recorded strategy or milestone in e-mobility promotion.
9	Chad	<ul style="list-style-type: none"> Chad has a low electricity access rate of 12% and no framework for energy efficiency in its transport sector. The country does not have a recorded strategy or milestone in e-mobility promotion.
10	Comoros	<ul style="list-style-type: none"> Access to electricity remains relatively limited in Comoros, with only 8% of the population being serviced in the three islands (Grande Comore, Moheli and Anjouan) and electrification is highly dependent on fossil fuels. Comoros has no data on e-mobility promotion.
11	Democratic Republic of Congo (DRC)	<ul style="list-style-type: none"> DRC is a well-recognized supplier of one of the raw materials used in building electric vehicles, cobalt which is used to power EVs and store energy in solar and wind energy systems. The country does not have a framework for energy efficiency in its transport sector and does not have a recorded strategy or milestone in e-mobility promotion.

S/N	Country	Analysis
12	Republic of Cote d'Ivoire	<ul style="list-style-type: none"> Being West Africa's leading electricity producing country, Cote d'Ivoire has remained in the spotlight in relation to revolutionizing the daily life for its inhabitants seeking environmentally friendly means of transportation. In particular, the Ivorian resort of Jacquelineville just outside Abidjan is looking to replace noisy and dirty bush taxis with solar powered electric three wheelers. The country also has support for the provision of zero and low emission buses through the Global Electric Mobility Programme of the UNEP and the Soot-free Urban Bus Fleet project of the Climate and Clean Air Coalition. Also, with support from the Global Environment Facility, the country seeks to develop an institutional framework, endorse a gender sensitive national strategy for the promotion of electric mobility in public transport to implement its Draft Road Map for sustainable mobility, enable public and private sector stakeholders to plan for the scale-up of low-carbon electric mobility in Côte d'Ivoire, and adopt financial incentives and technical standards to promote investments in low carbon electric mobility in public transport.
13	Equatorial Guinea	<ul style="list-style-type: none"> Equatorial Guinea is an upper middle-income country with an electricity access rate of 67%; however much of this access is highly dependent on fossil fuels. The transport sector is also dependent on fossil fuels and contributes 16% of the country's Co2 emissions. Equatorial Guinea has no data on e-mobility promotion.
14	Eritrea	<ul style="list-style-type: none"> Eritrea has frameworks in place for renewable energy promotion such as partnerships with extant agencies such as the UK solar developer Solarcentury which completed a 1MW minigrid in Maidma in Eritrea. These developments have aided the quicker adoption of electric mobility in the country. There has also been an uprise in car owners seeking hybrid (where the combustion engine is replaced with electric batteries) and electric cars.
15	Eswatini	<ul style="list-style-type: none"> The Eswatini Energy Efficiency and Conservation Policy of 2019 mandates that the government periodically reviews trends on the research and development activities of fuel-efficient technologies, including hybrid, electric vehicles, and emerging alternative energy efficient technologies and publicize significant developments. Equatorial Guinea has no data on e-mobility promotion.

S/N	Country	Analysis
16	Ethiopia	<ul style="list-style-type: none"> Ethiopia has a Climate Resilient Transport Sector Strategy by the Ministry of Transport of Ethiopia which includes the promotion of hybrid and electric vehicles and the construction of electric rail networks powered by renewable energy and an introduction of urban electric rail and bus rapid transit. ALYI 3 Wheel Electric Vehicles have been integrated into Ethiopia's transport system.
17	Gabon	<ul style="list-style-type: none"> Gabon has a high electricity access rate due to its high potential for hydroelectricity, and the presence of oil companies that have contributed to the electrification for their industrial needs. Tesla set up its first outlet south of the Sahara in Libreville, Gabon in 2018. Resultantly, there has been an increase in demand for hybrid and electric cars throughout the country.
18	Gambia	<ul style="list-style-type: none"> The first EV in the Gambia came in 2018; however, 55% of the overall population does not have access to electricity and this has hindered a faster adoption of Evs.
19	Ghana	<ul style="list-style-type: none"> The Government of Ghana has developed a Drive Electric Initiative in 2019 to promote electric vehicles on Ghana roads. The Government of Ghana is currently looking at ways to adopt EVs from a policy perspective. An EV policy is currently being drafted.
20	Guinea Bissau	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Guinea-Bissau.
21	Kenya	<ul style="list-style-type: none"> There are about 350 registered EVs in Kenya. The government in partnership with development partners is developing knowledge products on electric mobility with a view on building public interest on the subject (E-mobility). Proactive engagement of stakeholders from both the public and private sectors is taking place on a continuous basis. The objective of the consultation is to identify barriers that hinder the uptake of electric mobility in Kenya and provide corrective measures. The Finance Bill of 2019 has proposed a reduction on the excise duty for all vehicles with only electric motor for propulsion (BEVs) from 20% to 10%.

S/N	Country	Analysis
22	Lesotho	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Lesotho.
23	Liberia	<ul style="list-style-type: none"> Emergi, a Dutch start-up, has plans underway to introduce electric vehicles in Liberia.
24	Madagascar	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Madagascar.
25	Malawi	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Malawi.
26	Mali	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Mali. However, it has been forecasted that 2&3Wheelers will take the front stage in EV adoption in Mali.
27	Mauritania	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Mauritania.
28	Mauritius	<ul style="list-style-type: none"> The Government of Mauritius has provided several incentives to promote the uptake of electric vehicles. In addition to the existing tax relief and custom duty waiver, the Development Bank of Mauritius will provide a loan at a low rate of 2% for solar kits for domestic purposes. The Central Electricity Board (CEB) of Mauritius has also worked out a tariff whereby customers would benefit from charging their electric vehicles at specific times of the day and night during off-peak times. The time-of-use tariff will allow the person to charge their electric car at night at a rate that is 60% less than the peak (evening) rate.
29	Mozambique	<ul style="list-style-type: none"> Electric mobility in Mozambique is a favourable option as over 94% of electricity produced in the country is generated from renewable energy sources. The Government of Mozambique is in support of the shift to electric mobility and deliberations are underway to approve the National Draft electric mobility strategy. This strategy promotes the import of cleaner, low carbon vehicles including electric vehicles.

S/N	Country	Analysis
30	Namibia	<ul style="list-style-type: none"> The concerns surrounding EVs in Namibia include: a lack of charging infrastructure and a lack of electricity connections in certain remote areas. In 2019, however, the United Nations Development Programme (UNDP) in Namibia in collaboration with UNICEF Namibia, officially launched the Vehicle Grid Integration (VGI) and Electric Vehicle (EV) project. With this project, UNDP aims to ensure business continuity, lower the cost of EV ownership and pilot emergency response services with EV.
31	Niger	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Niger.
32	Nigeria	<ul style="list-style-type: none"> In June 2021, the first made-in-Nigeria EV was unveiled, and the first EV charging station was inaugurated by the National Automotive Design and Development Company (NADDDC) in Sokoto state in April 2021. In relation to the charging infrastructure and increasing the rate of electric mobility, Nigeria's Energy Transition Plan which was launched in August 2022, plan to decarbonise the transport sector with the adoption of EVs by 2030.
33	Rwanda	<ul style="list-style-type: none"> Rwanda launched the first electric vehicle in the whole of Africa in October 2019 as the country prioritizes the development of a climate resilient low carbon economy. The Government of Rwanda has approved a new set of incentives that will help the country catalyze the adoption of electric vehicles. Also, the incentives will play a key role to mobilize investment into the e-mobility sector. These incentives include: a preferential corporate income tax rate of 15%; reduced electricity tariff at the industrial level; and in some cases, rent free land for the installation of charging infrastructure. In addition, the country aims to have 20% of all buses transition to electric vehicles by 2030 which will result in an estimated reduction of 72,000 tCO₂eq.

S/N	Country	Analysis
34	Sao Tome and Principe	<ul style="list-style-type: none"> There is currently no information on EV mobilization in Sao Tome and Principe.
35	Senegal	<ul style="list-style-type: none"> Senegal is looking to create conditions for the shift from conventional vehicles to EVs. At the transport level, Senegal can through the program of renewing its automobile fleet start focussing on importing vehicles that meet the requirements for environmentally friendly needs such as e-buses, low-speed EVs, etc.
36	Seychelles	<ul style="list-style-type: none"> There's a UN GEF financed Seychelles mobility project currently underway to deploy electric mobility within Seychelles. Seychelles announced its intentions to pilot two electric buses in Seychelles Public Transport Corporation aimed at analysing the efficiency of E-mobility in Seychelle roads.
37	Sierra Leone	<ul style="list-style-type: none"> UN GEF fund is currently underway to promote innovation and technology transfer of sustainable energy breakthroughs for electric drive technology and electric mobility in Sierra Leone. There's an adoption of 3-wheeled electric vehicles in Sierra Leone and a battery technology rental in place.
38	Somalia	<ul style="list-style-type: none"> Somalia has a low electricity access rate of 16% of its population with access; however, 0.14% of its annual importation goes to importing electric motors. There are also independent organizations that participate in creating electric vehicles for farmers in rural areas.
39	South Africa	<ul style="list-style-type: none"> South Africa has undoubtedly already embraced the electric revolution. The infrastructure to completely support electric cars is still far away, but three fully electric cars are presently available on the market, in addition to a variety of hybrid alternatives, especially the BMW i3 and i8 and the Nissan LEAF. Electric car charging facilities are available at four BMW dealerships and nine Nissan dealerships (seven of the Nissan dealerships sell the Nissan LEAF). BMW and Nissan have also agreed to share their charging networks to promote the sale and use of electric vehicles in general. Cape Town is also planning to construct several charging stations in the near future, and Johannesburg already has a few. With the present level of interest, South Africans should expect a significant increase in infrastructure to support electric vehicles.

S/N	Country	Analysis
40	South Sudan	<ul style="list-style-type: none"> There is currently no information on E-mobility adoption in South Sudan. With the nation building its electric grid virtually from scratch, it is difficult to see how full-scale e-mobility can be incorporated at this time.
41	Sudan	<ul style="list-style-type: none"> Due to the political and economic crisis in the country that has affected oil prices, making farmers unable to afford to run their three-wheeler vehicles - tuk-tuk rickshaws for passengers, and motorbike tricycles with a trailer attached for carrying goods, electric mobility has been adopted as an alternative by farmers in rural areas. However, e-mobility is also affected by the frequent power cuts in Sudan.
42	Tanzania	<ul style="list-style-type: none"> National academic institutions are advancing research into E-mobility and EV prototypes in Tanzania.
43	Togo	<ul style="list-style-type: none"> Le monde de l'énergie launched the first solar electric vehicle in Lomé in 2016. In September 2021, a Togo company (M. Auto Electric) began assembling motorbikes and three-wheelers at Plateforme industrielle d'Adétikopé. The company has also expressed intentions to install recharging solutions in the capital of Lomé and subsequently in the West-African region.
44	Uganda	<ul style="list-style-type: none"> Zembo Motorcycles SMC Ltd in collaboration with InfraCo Africa introduced e-motorcycles to Uganda's boda-boda sector in 2019 and has since sold over 200 electric boda-boda with projections to see over 2,000 available to buy and access by mid-2023 and established 20 charging stations projected to go up to 60 by Q1 2023. Lease to own agreements are being negotiated in local currency to reduce exchange rate risk for drivers. The need to own or recharge batteries for the motorbikes are eliminated by creating a system where drivers simply swap a discharged battery for a fully charged one at any Zembo's battery swap station.
45	Zambia	<ul style="list-style-type: none"> Zambia is the second world largest Copper producer in Africa and Copper is a major component of EVs. Zambia Copper can drive a global shift to EVs, and this could lead the adoption of EVs within Zambia.

S/N	Country	Analysis
46	Zimbabwe	<ul style="list-style-type: none"> At present, there are three EV assembling plants which have been set up in Harare and private sector participants are working closely with the Government of Zimbabwe and key ministries to set up EV plants in Harare. Agilitee, a Zimbabwe based car maker has set up an electric vehicle assembly plant in Zimbabwe and announced its first electric self-charging car. 30EVs have been reported sold by the company at the time of developing this toolkit.

8. Challenges to large scale EV Adoption in SSA

8.1 High Upfront Cost

Most vehicles acquired in SSA are bought pre-owned or second-hand, either from the global north or between user to user within SSA. An analysis by the UN Environment revealed that about 60% of annual EV registrations globally, are of pre-owned vehicles. The statistics go even higher for specific countries within SSA like Nigeria that has 90% of its annual EV registrations comprising pre-owned vehicles. The rate of purchase of pre-used vehicles is largely associated with the high cost of owning a new vehicle. The Instalment payment plans readily accessible in the global south make it easier for the burden of payment for new electric vehicles to be met. Even though available, the non-accessibility of such payment plans across SSA countries, creates a roadblock to the large-scale adoption of EVs across SSA countries because most potential users are unable to afford the cost of new EVs or electric three-wheelers, due to the general high upfront costs.

8.2 Lack of Technical Expertise for EV adoption in SSA countries

Electric mobility is a recent development. There is a need for new engineering skill set and capabilities are needed for new automotive product introduction. EV involves the transformation of cars into computers powered by batteries. This creates a demand for a parallel transformation of the automotive engineering force both in terms of manufacturing and maintenance of these vehicles. There is a need for investment into capacity building and knowledge transfer to SSA states to aid a smooth large-scale adoption of e-vehicles in SSA countries in the nearest future.

8.3 Gap in Energy Access

Sierra Leone was recorded to have 53 unprecedented blackouts in a day in 2017. Nigeria has also recently experienced blackouts through the first quarter of 2022. These coupled with the 600million plus persons without access to the grid in SSA, raises to question the reliability of a mobility system that is equally dependent on electricity supply within SSA.

Furthermore, a large-scale transition to EV raises the question of conflict of interest between the need to access electricity for communities who currently lack electricity access for basic needs, and the use of already insufficient grid electricity to power vehicles that have alternative options such as traditional sources of fuel and natural gas.

8.4 Lack of Charging Infrastructure

The development of charging infrastructure is as important as the adoption of e-mobility itself. Public charging infrastructure necessary to support the use of e-vehicles must be made available beforehand. Charging of e-vehicles involves simply plugging the onboard charger/cable into the socket and observing charging times. To get the maximum charging experience, Direct Current (DC) fastchargers which provide high-power DC up to 120KW directly to the battery must be available. Getting these fast chargers will require highly specialised and high-powered equipment designated at charging stations.

9. Recommendations for EV/E-Mobility adoption across SSA

9.1 E-Mobility Regulation

Regulatory mechanisms can be a significant driver for EV adoption across SSA; countries across the world such as China, Norway, and India, amongst others, have adopted a range of regulatory approaches to promoting E-mobility adoption, such as:

- Banning sales of ICE vehicles within certain time frames.
- Setting carbon emission limits or fiscal incentives such as: (i) tax exemptions for EV sales or subsidies for public charging infrastructure (ii) reduced registration times for EVs (iii) allowing free parking for EV drivers, etc.

9.2 Increased Energy Access

SSA countries should look towards providing reliable electricity supply considering that this is a requirement for a successful electric mobility transition, particularly in urban areas. Stable electricity supply and charging infrastructure will need to be built ahead of demand to mitigate the

'range anxiety' that may hinder consumers from adopting EVs. In increasing electricity access, there should be plans made by countries to manage increased domestic consumption at off-peak times, since vehicles are likely to be charging overnight. In the case of electric two-wheelers, charging can be made possible through mini-grids, making these vehicles a core solution in areas with poor grid access or reliability.

9.3 Policy Support/Incentives

To avoid becoming the dumping ground for the world's unwanted used ICE vehicles setting back the continent's carbon-emission-reduction goals in the decades ahead, SSA countries should individually seek to promulgate policies that promote sustainable mobility. Such policies should contain electrification targets for vehicles and incentives promoting investments into e-mobility and EV adoption; Rwanda for instance has tax exemptions in place for EV sales. Incentives are necessary because EVs have high upfront costs that make them unaffordable by the average car owner in SSA countries; and it would take until the mid or late 2030s before

used EVs are made available at scale in SSA countries and at similar prices to low-cost used ICE vehicles.

9.4 Capacity Building

Policies and initiatives set by SSA countries towards promoting e-mobility will help these countries develop the manpower and strengthen the skills, processes and resources required for them to survive, adapt and thrive in a fast-paced global e-mobility adoption scheme. To ensure adequate capacity building, countries must pattern their policies and initiatives in accordance with long-term solutions stemming from consultation with stakeholders.

9.5 EV Education/Awareness

There are many myths about EVs that will have to be addressed by SSA countries through EV education and awareness to increase the potential for electric mobility adoption in the territories of these countries. Such education can take place in the form of television and online advertisements, workshops, and general awareness campaigns. These ventures should

establish in the minds of citizens, the safeties and benefits that exist with electric mobility such as:

Cheaper and more convenient charging for an EV

Increased vehicle range of an EV over that of an ICE vehicle

Long-lasting nature of an EV's battery over that of an ICE vehicle

9.6 Investment in Infrastructure

Many vehicle owners across SSA have heard of EVs and recognize that the technology is sound and better for the environment; however, 'range anxiety' is often quoted as a barrier to its adoption. Range anxiety is "the fear of driving an electric vehicle and running out of power, without being able to find a charging station on time to replenish the battery." Such fears can be reduced by investments made into fast-charging stations to facilitate on-the-go charging and accommodate business fleets such as transportation, delivery, and heavy-duty distribution companies. Such public charging stations can be set up by partnerships between the state or private companies and large retail actors. Currently, the amount of public charging stations globally is enough for electric cars, but

more will need to be constructed to meet future demands; in 2020, the number of public charging stations installed globally was about 1.3 million, by 2030, this number is estimated to be over 16 million.

Public or private investments into commercial e-mobility such as electric buses, mini-buses, vans, and bikes will also be more favourable for an early and gradual electric mobility transition rather than leaving such transition to individual car owners who may be unable to afford the upfront costs of EVs. Such investments should be tailored towards homegrown-product innovation needed to meet local conditions across SSA countries. For example, developing an electric two-wheeler that is both durable and capable of carrying a spare battery may be required to meet the needs of the sub-Saharan African two-wheeler driver. Stakeholders can also invest in retrofitting existing ICE vehicles with electric power trains. Uganda-based Kiira Motors which launched Africa's first hybrid electric vehicle in 2014 reportedly received a \$40 million investment from the Government of Uganda, through which the company hopes to produce up to 300 EVs per year.

9.7 Vocational training

As stated, the deployment of commercial e-mobility will be a better way to kick start the adoption of EVs across SSA. As such, governments of SSA countries should ensure that proper training on the use of EVs or electric two-wheelers is provided by public transportation agencies to commercial transport workers. Partnerships can also be initiated by the government with private companies to facilitate such training programmes for citizens interested in learning how electric vehicles operate and are maintained. Furthermore, the local assembling or manufacturing of electric cars will do a lot for economic development across SSA countries, hence, training programmes in this regard should also be provided to local car manufacturers by the government.

9.8 Innovation

SSA will need to be innovative in its manufacturing of EVs. The possibility of e-mobility Vehicles with solar panels embedded in the body work and inverters incorporated into the vehicles to allow for self-charging from direct

sunlight is a good start which could unburden the electric grid of excessive burden. It could also address the earlier mentioned issue of conflicting interest between the need for electricity access for basic needs and electricity access to power vehicles for mobility. However, such initiative will need to be balanced against the need to keep the car as light as possible because the heavier the car, the higher the level of energy consumption.



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