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SADC e-Mobility Outlook: A Zimbabwean Case Study

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Abstract

The current landscape in the Zimbabwean transport sector is characterised by high operating costs which in turn increases production costs for industry and commerce, thereby negatively affecting the competitiveness of Zimbabwean-made products in the region. These high transport costs combined with poor accessibility in rural areas also make it difficult for the most vulnerable urban and rural groups, including the elderly, women, children and people living with disabilities, to access safe and sustainable means of transport. Moreover, the shortage of foreign currency also negatively affects transport operators' ability to procure spare parts for their vehicles and to ensure a stable/regular supply of fuel for the Zimbabwean fleet of internal combustion engine vehicles.

This case study focuses on how e-Mobility can lower the operating costs of transport operators by reducing their downtime, the time lost in fuel queues and lowering the fuel import bill, thereby improving the country's current account position.

Moving to a multimodal mobility ecosystem by increasing the penetration of micromobility options can improve accessibility in marginalised areas. Accelerating the transition to electric mobility will improve productivity and affordability for marginalised groups through lower operational costs which can be passed on to the commuting public. Updating the current Zimbabwe Motor Industry Policy to align it with international trends on e-Mobility and setting definitive targets for electric vehicle adoption is recommended to rebuild a sustainable local vehicle assembly industry. A holistic approach considering the interface between the mining industry for electric vehicle related minerals and materials, distributed renewable energy systems and clean transportation focusing on battery electric vehicles can catalyse growth in the Zimbabwean economy that has been in a downward cycle of decline for several decades punctuated by brief periods of respite.

Introduction

This case study looks into how electric mobility (e-Mobility) can help address Zimbabwe's chronic transport challenges. Leveraging the potential of electric vehicles and micromobility[1] as part of the broader green and circular economy[2] in a just transition towards a more sustainable environmental landscape can help kick-start Zimbabwe's ailing economy. Zimbabwe's modern day urban and rural chronic transport problems date back several decades to the late 1980s. This can be attributed to several factors, according to Zimbabwe National Transport Master Plan Final Report[3], which include a lack of sustainable investment in the national transport infrastructure and associated services,

1 In this paper, when referring to micromobility, the focus is on electric micromobility, which includes electric bicycles and scooters.

2 A circular economy enables resources to remain in use for longer via reuse and repurposing for other applications, thereby reducing waste.

3 CPCS Transcom International Limited, *Zimbabwe National Transport Master Plan*, final report (2017), 6.

among others. Several mega projects such as the dualisation and rehabilitation of one of the country's busiest highways, from Beitbridge to Chirundu, have been delayed for over a decade and construction on this project has started only recently. The transport sector has also suffered from deferred maintenance resulting in some rural routes becoming unserviceable, forcing operators to withdraw their services.

Zimbabwe's transport and infrastructure landscape

As highlighted in the Zimbabwe National Transport Master Plan, the Government of Zimbabwe moved to try and reduce the burden on service delivery by introducing reforms that deregulated the transport sector. These reforms, introduced in the early 1990s and set to run until 2000, were the Economic Structural Adjustment Programme (ESAP) and the Zimbabwe Programme for Economic and Social Transformation (ZIMPREST). The most significant policy introduced was the termination of the Government-owned Zimbabwe United Passenger Company's (ZUPCO's) urban public passenger transportation monopoly in 1993. The deregulation resulted in the genesis of a new class of public transport operators. These were mainly local entrepreneurs using 11 to 15 seater minibuses commonly known as 'kombis'. The lack of investment in ZUPCO led to service disruptions and even route terminations on some rural routes due to a combination of ZUPCO's dwindling fleet and private players shunning certain routes because of the poor road infrastructure.

According to the World Bank[4], as at the end of 2019 the urban population in Zimbabwe represented 32% of the total population, slightly down from a peak of almost 35% in 2002. Zimbabwe's urban population is lower than the African average of 43%.[5]

Zimbabwe's population is approximately 14.9 million[6] with a surface area of 390 757 km^2 resulting in a population density of around 43 people/km^2. In terms of connectivity and accessibility, Zimbabwe's road network consists of 88,133 km of roads. Of these, only 17,420 km are surfaced with 9,256 km representing state roads and highways under the Ministry of Transport's Department of Roads, and 8,164 km under the urban municipalities. The bulk of the roads (63,591 km) are gravel roads and these fall under the jurisdiction of the rural district councils. A further 7,122 km are earth roads residing mostly under the rural district councils.[7]

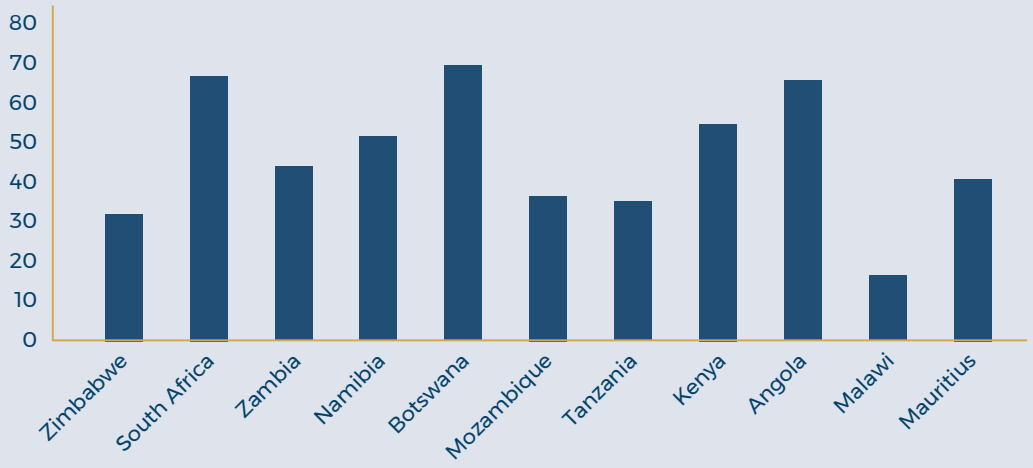
4 The World Bank, 'Urban population (% of total population) – Zimbabwe', https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=ZW.

5 UN Department of Economic and Social Affairs, *The World's Cities in 2018: Data Booklet*, 2018, https://www.un.org/en/events/citiesday/assets/pdf/the_worlds_cities_in_2018_data_booklet.pdf.

6 World Population Review, *Zimbabwe Population*, https://worldpopulationreview.com/countries/zimbabwe-population.

7 CPCS, "Zimbabwe National Transport Master Plan".

Figure 1 Urbanisation rates in the SADC region



Source: UN Department of Economic and Social Affairs, *The World's Cities in 2018: Data Booklet*, 2018, https://www.un.org/en/events/citiesday/assets/pdf/the_worlds_cities_in_2018_data_booklet.pdf

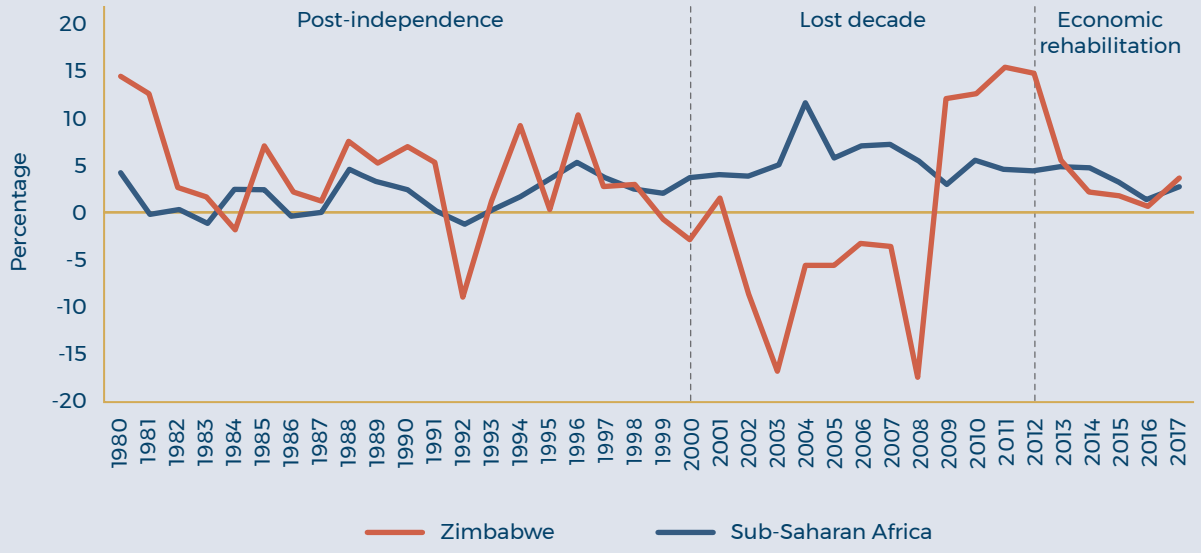
This distribution demonstrates that the majority of the population live in areas that are far from surfaced roads and rely on gravel and earth roads that are not always in the best condition to enable connectivity. With 68% of the population living in rural areas far from the main roads, walking is the primary mode of transportation. The large distances that must be covered on a daily basis are a major challenge to economic empowerment. Basic everyday activities are hindered by the time it takes and fatigue induced in making the commute, which have led to a high rate of absenteeism and drop-outs from schools, as well as a lack of access to clean water. Another major concern is post-harvest losses due to poor transport channels to get produce to the market. This highlights the need for policy makers to prioritise e-Mobility initiatives centred on the poor and vulnerable marginalised rural communities.

Zimbabwe's historical economic performance

Zimbabwe's economic performance since independence can be characterised by three distinct periods: 1980–1999, 2000–2009 and 2010–2018.[8]

8 African Development Bank (AfDB), Zimbabwe *Infrastructure Report* (AfDB, 2019), 5, https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Zimbabwe_Infrastructure_Report_2019_-_AfDB.pdf.

Figure 2 Growth rates for Zimbabwe and sub-Saharan Africa, 1980–2017



Source: African Development Bank (AfDB), Zimbabwe *Infrastructure Report* (AfDB, 2019), 5, https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Zimbabwe_Infrastructure_Report_2019_-_AfDB.pdf

The 'Lost Decade' period between 2000 and 2011 saw Zimbabwe falling significantly behind its regional peers on the transport infrastructure front due to several factors, including:[9]

- Lack of maintenance due to financial constraints;
- Accelerated deterioration through misuse;
- Capacity constraints due to migration of skilled personnel; and
- Inadequate funding for greenfield infrastructure projects.

This lost decade also led to a rapid informalisation of the Zimbabwean economy with Zimbabwe now having the second largest informal economy in the world after Bolivia[10] where 60% of Zimbabwe's population depend on informal activities for their daily income.

Although the economy recovered somewhat from 2009, capacity constraints due to migration of skilled personnel still remains a major issue and is one of the key concerns to be addressed to enable a smooth transition to electric mobility.

9 CPCS, "Zimbabwe National Transport Master Plan".

10 Leandro Medina and Friedrich Schneider, "Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?" (International Monetary Fund (IMF) Working Paper WP/18/17, IMF, 2018), https://www.imf.org/en/Publications/WP/Issues/2018/01/25/Shadow-Economies-Around-the-World-What-Did-We-Learn-Over-the-Last-20-Years-45583.

Public transport landscape

As noted earlier, the government's move to end ZUPCO's urban public passenger transportation monopoly resulted in a slow death of the organised mass transit public transport system. Informal minibus taxis make up the bulk of public passenger transport service providers in urban areas and their operations are best described as very fragmented. These operators do not observe fixed route structures or scheduled timetables, opting instead to move once they get a full load or a critical mass of passengers during off peak times. During peak times, especially on busy routes to the townships, routes are often underserved leaving commuters to queue for hours. An assessment carried out as part of the Zimbabwe National Transport Master Plan shows that accessibility in residential areas during these evening peak periods is often very poor with the kombis dropping off passengers at places that are frequently far from their actual places of residence.[11] These last mile routes from drop-off points are usually not well-lit, posing safety risks for commuters. New settlements in the large cities are characterised by poor physical planning and weak enforcement of urban by-laws and hence mobility and accessibility are a major challenge. This poor planning also means, in many cases, these new settlements can remain unconnected to the grid for several years despite being relatively close to the city centre. Residents have resorted to installing small home solar systems and digging wells or boreholes for water.

This last mile accessibility problem is ripe for disruption with micromobility solutions such as e-bikes taxis or shared micromobility platforms involving scooters and non-motorised bicycles.

Potential barriers remain, however, and need to be urgently addressed. These include inadequate facilities for micromobility transport such as neglected or poorly maintained cycle lanes and/or the lack of cycle lanes in most areas. This presents a potential opportunity for innovative infrastructure improvements based on circular economy principles. Cycle lanes could be paved with bricks made from composites containing recycled plastic, thereby removing a significant amount of plastic that would otherwise end up in landfills. Paving bricks made using plastic waste are up to $3 cheaper per square meter, significantly lowering construction costs.[12]

Another barrier is how people on the continent perceive cycling, with many regarding cycling as a 'poor man's mode of transport'.[13] Extensive nation-wide campaigns that promote cycling should be prioritised, highlighting the health and financial benefits cycling can bring.

11 CPCS, "Zimbabwe National Transport Master Plan".

12 Wilbert Mtangi (CEO and Co-Founder, Kudiwa Waste and Energy Solutions), interview by Remeredzai Kuhudzai, November 2020.

13 Kevin Mwanza, 'Africa can put bikes in the fast line. Here's how,' *World Economic Forum*, October 15, 2018, https://www.weforum.org/agenda/2018/10/on-your-bike-africa-in-a-jam-as-poor-mans-transport-ignored/.

Extensive nation-wide campaigns that promote cycling should be prioritised, highlighting the health and financial benefits cycling can bring

The death of the formal public mass transit system has resulted in an explosive growth in private car ownership, mostly in urban areas. The country's vehicle fleet grew from 522,682 in 1995 to around 1,700,000 in 2019.[14] The high volume of minibus taxi traffic, along with a large number of private cars and other commercial vehicles, result in peak time congestion in the large cities, especially in the capital city Harare. Here again, non-motorised transport such as cycling and electrified micromobility solutions should be promoted to reduce the number of cars on the road. The average commuting distance in Harare is 15km. This relatively short distance is ideal for a large cross section of micromobility solutions. Policy makers in conjunction with municipalities should prioritise the promotion of the adoption of micro mobility solutions to combat congestion in urban centres.

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Proliferation of small private cars as informal taxis

A common short hop informal taxi service popularised in the late 1980s and early 1990s by illegal private taxis or 'lifts' continue to operate on high volume city routes such as from the city centre to Avondale Shopping Centre in Harare. During this same time, the old Peugeot 404 station wagons were employed on these routes by pirate taxis, popularly known as Mshika Mshikas. Modern day drivers mostly deploy small used vehicles imported from Japan, such as the Honda Fit.

An opportunity exists to formalise the pirate taxi industry while at the same time improving the quality of service. Because of the high transport operating costs arising from the high cost of fuel (of the highest in the region), as well as the high cost of genuine spare parts, the majority of vehicle owners do not follow a strict motor vehicle service and maintenance culture. The high rate of informalisation in the economy has also seen an increase in

14 The Zimbabwe National Transport Master Plan highlights that the vehicle population rose from 522,682 in 1995 to 1,305,111 in 2014. There has since been an average of 60,000 vehicles imported per annum, bringing the estimated vehicle fleet to 1,700,000.

the number of self-taught, non-certified motor mechanics contributing to the general deterioration of the vehicles due to poor service practices.

TABLE 1 THE PRICE OF PETROL AND DIESEL IN SELECT SADC STATES

Country	Petrol Price/Litre ($)	Diesel Price/ Litre ($)
Zimbabwe	1.19	1.19
Zambia	0.90	0.85
Botswana	0.80	0.75
South Africa	0.90	0.76
Mozambique	0.90	0.87
Mauritius	1.10	0.95

Source: Zimbabwe Energy Regulatory Authority, https://www.zera.co.zw/; Zambia Energy Regulatory Board, http://www.erb.org.zm/viewpage.php?page=news; Botswana Energy Regulatory Authority, http://www.bera.co.bw/; South Africa Department of Energy, http://www.energy.gov.za/files/esources/petroleum/petroleum_fuelprices.html. Mozambique Energy Regulatory Authority; Mauritius State Trading Corporation, https://www.stcmu.com/ppm/retail-prices

For these short haul commutes, adopting and adapting a model from China's successful Low Speed Electric Vehicle (LSEV) programme could help address the high operating costs as well as improve the quality of service for commuters in Zimbabwe. Incentives should be put in place for operators of pirate taxis to regularise their operations and upgrade to a small battery electric vehicle (BEV). This could be achieved through a vehicle scrappage scheme financed via public private partnership in conjunction with non-governmental organisations and development finance institutions (DFIs), or through a reduction/removal of import duties on BEVs.

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China's LSEV market has been selling over 1.5 million vehicles per year.[15] Zimbabwe could benefit from the learnings, as well as the technology and cost improvement curves that now see better quality small BEVs reach price parity/points similar to LSEVs. For the same price range of an LSEV of approximately $4,000, small BEVs such as the Wuling Mini EV

15 Gabriel Collins, "Low-Speed Electric Vehicles: An Underappreciated Threat to Gasoline Demand in China and Global Oil Prices?" (Issue Brief 05.15.19, Rice University, Baker Institute for Public Policy, Houston, 2019), https://www.bakerinstitute.org/media/files/files/7c7fe1f9/bi-brief-051519-ces-chinalsev.pdf.

could serve this segment. Using this type of vehicle will enable taxis to cut their operating costs. The range of such vehicles is close to 120 km and would allow operators to make multiple trips which are often in the 5 km range. Equipped with battery packs that are under 14 kWh, these vehicles would only need $0.70 per full charge at the current cost of $0.05/kWh of electricity in Zimbabwe, versus close to $10 for a similar trip in traditional ICE vehicles. This model could be replicated in smaller cities and resort towns such as Nyanga, Kariba and Victoria Falls. City EVs, if adopted en masse, have the potential to put a dent in fossil fuel demand, solving one of Zimbabwe's biggest challenges – the critical shortage of petrol and diesel.

Potential barriers to adoption remain and include:

- Current lack of charging stations;
- Lack of knowledge on electric vehicles (EVs) and their capability by the general public; and
- Potential bottlenecks in regularising the informal private taxi industry as government plans to reposition ZUPCO as the main transit provider.

Strategic sectorial interventions towards electrification

Localised campus operations could represent early low hanging fruit opportunities for electrification. Fleet managers at campus centric businesses are generally in a position to afford new electric vehicle models and have a periodic fleet replacement cycle that could be taken advantage of. They offer an opportunity for high volume orders, further incentivising original equipment manufacturers and their dealerships or franchises. Campus centric industries include the mining sector, universities and colleges, airports, the tourism sector, and the farming and agricultural sector.

The mining industry

Operations around large campuses form a critical constituency of the transport landscape. The most significant of these is the mining sector. Big mines in Zimbabwe generally have dedicated lines and special arrangements with the power utility to ensure guaranteed access to power which they pay for in US dollars. The mining sector is also the largest consumer of electricity in Zimbabwe, accounting for 40% of the electricity demand. The nature of their campus operations and mobility needs is perfect for the current generation of medium range EVs. These include staff commutes from their compounds to the mines and transportation of ores to processing facilities using electrified heavy-duty mining equipment, which is now increasingly becoming an option as the technology matures.

Starting with a campus model removes one of the major concerns highlighted by people, which is range anxiety. Predetermined/set routes of known distance allow fleet operators on large campuses to easily adopt electric vehicles without disrupting their normal operations, as well as scheduling charging sessions using onsite EV charging points. Like all industries in Zimbabwe, the mining sector has been complaining that it continues to be undermined by the shortage of foreign exchange allocations and fuel which results in high production costs. Substituting fossil fuel powered vehicles with more energy efficient battery electric vehicles powered by locally generated electricity will unlock efficiencies by cutting operational costs and reducing the downtime of vehicles as EVs require less maintenance. Recent advances in technology mean that opportunities exist to also electrify heavy duty mining equipment as well as underground mining equipment, thereby improving air quality and safety at the same time.

Airport service vehicles and shuttle buses also make strong candidates for electrification. The high frequency of localised use plus the prospect of onsite charging make them perfect candidates for electrification. Other campus centric focus areas should include farms and the agricultural sector, schools, universities, colleges and establishments in the tourism sector. Many establishments in the tourism sector are located in remote off-grid areas where access to diesel is a costly and tedious exercise. In South Africa, Namibia, Botswana and Kenya, some operators and owners of resorts have started converting their old fleet of off-road and game viewing vehicles to electric vehicles. Hence, converting old ICE vehicles in the tourism sector such as game viewing vehicles could be another quick entry point towards electrification.

Regional member states should look into incentivising and regularising the vehicle conversion industry. Most member states do not have policies, standards and homologation frameworks for converting old ICE vehicles to BEVs. A successful conversion industry would promote the circular economy as well as create employment and other opportunities across downstream industries

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Zimbabwe's current motor vehicle landscape

There are over 40 registered new vehicle dealerships in Zimbabwe[16], including companies such as Croco Motors, Amtec, AMC, Royal Car Sales, Kenmac Motors, Hillside Motors, Prism Motors, Nyamidzi Motors, Mike Harris, Car Sales, Belgravia Motors, Momentum Services, Corporation for Africa & Overseas and ZIMOCO. These dealerships hold franchises for several brands including Toyota, Nissan, Mitsubishi, VW, Land Rover, Jaguar, Isuzu, Mercedes Benz, Hyundai, Ford, Great Wall, Peugeot, Renault, VW and BMW.

Motor vehicle assembly

The first motor vehicle assembly plant was set up in 1954 and was called the British Motor Corporation (BMC).[17] The BMC was established in Umtali (now Mutare) and the first cars were assembled in October 1960. A second assembly plant was set up by the Ford Motor Company in Harare in 1961. These assembly plants have changed ownership and management several times over the past 66 years but remain the only two vehicle assembly plants in the country to date. The Mutare Plant is now called Quest Motor Manufacturing and the Harare Plant is now Willowvale Motor Industries. Alongside these two passenger vehicle assembly companies, Zimbabwe also has two bus assembly firms, Deven Engineering and AVM Africa.

These local vehicle assembly plants provided the bulk of new vehicles sales in Zimbabwe per annum during the 1990s when brand new motor vehicle sales peaked at 20,000 in 1997. The economic downturn and transition to a more informal economy since the early 2000s has seen new vehicle sales fall since 1997 to below 3,000 per year and a rise in the registration of cheaper second-hand imports coming mainly from Japan and the UK. These used vehicles are sold through hundreds of informal motor vehicle sales yards or are imported directly by consumers who order vehicles from online platforms that are then shipped in directly from Japan. This shift from a majority of locally assembled vehicles to a landscape dominated by used ICE vehicle imports has had a significant impact on employment numbers in the motor vehicle industry. The sector saw a drastic drop in employment figures from a high of 20,000 workers including in the downstream industries to below 2,000 workers.[18] Without any significant legacy manufacturing or assembly operations, Zimbabwe is well positioned to make a quick transition to assembling EVs

16 Government of Zimbabwe, Ministry of Industry, Commerce and Enterprise Development, *The Zimbabwe Motor Industry Development Policy 2017–2030* (Harare: Ministry of Industry, Commerce and Enterprise Development, 2017), http://www.miced.gov.zw/index.php?option=com_phocadownload&view=category&download=71:zimbabwe-motor-industry-policy-final-00&id=3:zim-asset&Itemid=751#:~:text=The%20Zimbabwe%20Motor%20Industry%20Development%20Policy%20(2017%20%2D%202030)%20is,for%20Sustainable%20Socio%20Economic%20Transformation%20.

17 Chiedza Zharare, 'Towards a history of motoring in Zimbabwe with particular reference to the motor vehicle industry in Mutare c. 1902 to 2015' (Masters diss., Midlands State University, 2015).

18 Nyasha Nanyanye, 'Impact of second-hand vehicle imports on Willowvale Mazda Motor Industry sales' (Honours diss., University of Zimbabwe, 2014).

compared to South Africa. The South African automotive sector has significant operations and legacy firms wanting to recoup their investments in ICE vehicle production lines.

Zimbabwe motor vehicle policy and plans to resuscitate the local vehicle industry

The Zimbabwe Motor Industry Development Policy (2017-2030) aims to resuscitate and promote local assembly of brand new motor vehicles and curb the influx of used vehicles. This will eventually create a robust pool of locally produced vehicles that will feed into the second-hand vehicle market, thereby eliminating the need to import from outside the country. There is also a strong desire to increase motor vehicle exports into the region and the rest of the world by ramping up the capacity of car assemblers from the current levels of less than 10% to 100% of installed capacity. The policy sets a target of increasing the contribution of exports from the current 0% to 50% of total local production by 2030.[19]

The transition to electromobility is now well underway with over 7 million EVs now on the road worldwide.[20] Whilst the COVID-19 pandemic has been particularly devastating to global ICE passenger vehicle sales, sales of EVs have been increasing. In Norway, the world leader in terms of EV penetration[21], a massive 81.6% of new vehicle sales in September 2020 were plug-in EVs. Sixty-two percent of these were full battery EVs, with plug-in hybrid EVs making up the rest of the sales. Several countries across the world already have plans to restrict new ICE vehicle sales from as early as 2025, therefore any ambitions to export vehicles outside Africa would need to recognise this shift and ensure that the retooling of factories is geared to meet market needs. Although the policy notes the global developments in the motor sector and the transition towards EVs, it does not outline how this shift will happen and there is no roadmap to support the transition. It simply states that it expects the local industry will adapt to the new technologies by 2050. Zimbabwe's Motor Industry Development Policy also seeks to put in place measures to increase the contribution of local components in the vehicle assembling process from the current 10% to 40% by 2030.[22]

There is an urgent need to update these timelines, coordinate with domestic and regional stakeholders to draft a roadmap and develop incentives to catalyse the assembly, manufacturing of electric vehicles and adoption by consumers.

The policy advocates for employment creation, value addition of local resources and investment in the downstream component industries to increase the industry's overall

19 Government of Zimbabwe, "Zimbabwe Motor Industry Development Policy".
20 Bloomberg NEF, *Electric Vehicle Outlook 2020*, https://about.bnef.com/electric-vehicle-outlook/ (accessed June, 2020).
21 Maximillian Holland, 'September In Norway Goes Off The Charts – Record Plugin Vehicle Market Share Of 82%,' *CleanTechnica*, October 1, 2020, https://cleantechnica.com/2020/10/01/september-in-norway-goes-off-the-charts-record-ev-market-share-of-82/.
22 Government of Zimbabwe, "Zimbabwe Motor Industry Development Policy".

contribution to GDP and government revenue. Government is seeking an improved contribution to GDP and exports by the motor sector of up to 20% by 2030. However, reference is made predominantly to ICE vehicle component manufacturers in the policy.[23]

To meet these targets, it is critical that government policy looks at the interface of the local mining industry for EV related minerals and materials, distributed renewable energy systems and clean transport. A holistic approach considering the synergies of these sectors can catalyse growth in the Zimbabwean economy. Any retooling and resuscitation of component manufacturers must be forward-looking and aligned with global motor vehicle trends. This could be an opportunity for Zimbabwe and other SADC members states to transition from assembling to manufacturing a greater percentage of the vehicle's constituents, thereby increasing local beneficiation of resources and intraregional trade.

To protect the local vehicle assembly industry, the policy aims to gradually reduce the importation of second-hand vehicles through:

- Higher duties and surtax for used vehicles;
- Adoption of a pre-shipment inspection policy with standards that should be met by imported second-hand vehicles – vehicles that fail to meet the quality standards would not be allowed into the country; and
- Application of Statutory Instrument 13 of 1999 where the import duty on Completely Knocked Down kits is zero percent to encourage local assembly.[24]

Although used vehicles have a negative effect on the local vehicle assembly industry, they allow consumers to afford vehicles and improve access to mobility in a market that lacks a structured and efficient public mass transit system. In an economy with low disposable income, a dwindling middle class and absence of vehicle finance for new vehicles, used vehicles are the only potential route to car ownership for the majority of consumers. They also provide employment opportunities for vehicle import agents and used vehicle dealerships. In order to ease pressure on foreign currency and reduce emissions, used EVs should be exempted from surtaxes to encourage adoption of cleaner vehicles until the local sector is capacitated to meet demand. Import duties on used ICE vehicles can remain in place or an age cap policy could be introduced barring the importation of vehicles of a certain age. These age caps should be aligned across the region.

Impact of used vehicle imports

The second-hand motor vehicle import bill averaged $500 million per annum for the period from 2006 to 2016, with a peak in 2010 at a staggering $933 million.[25] This can be

23 Government of Zimbabwe, "Zimbabwe Motor Industry Development Policy".
24 Government of Zimbabwe, "Zimbabwe Motor Industry Development Policy".
25 Government of Zimbabwe, "Zimbabwe Motor Industry Development Policy".

attributed to another mini economic boom from 2009 to 2014 during the Government of National Unity.[26] Second-hand vehicle imports jumped almost 5-fold from just over 17,000 units per year in 2007 to over 75,000 in 2014[27], and has been averaging around 60,000 units annually since then. The surge in used vehicle imports has raised demand for petrol and diesel imports. Petrol and diesel imports account for 30% of Zimbabwe's total import bill, with $1.2 billion spent annually on fuel imports.[28] Additional foreign currency is spent on importing ICE vehicle spare parts and lubricants.

Zimbabwe has experienced crippling petrol and diesel shortages for the past three years stemming from its severe foreign currency shortages. Zimbabwe earns most of its foreign currency from domestic mining and agricultural exports. Zimbabwe's severe foreign currency shortages appear to have no end in sight and is set to worsen as COVID-19 threatens tobacco sales, its second-biggest source of foreign exchange.[29] This has resulted in the local currency losing value on the black market from 1:1 in 2017 to the current levels of $1: 100 ZWL (Zimbabwean dollar). The local currency is trading at $1: 81 ZWL at the official auction rate.

TABLE 2 SUMMARY OF USED VEHICLE IMPORT RESTRICTIONS IN AFRICA

Level of Restriction	Number of countries in Africa implementing restriction
A maximum age on imports	25
Counties having regulations ranging from banning vehicles over 10 years old to incremental taxes on vehicles older than 10 years to no regulations at all	24
Countries allow vehicles up to 9 years albeit with incremental taxes based on age	16
Countries intend to ban imports over 5 years	10
Countries have imposed a ban on vehicles older than 5 years	10
Countries intend to ban imports over 10 years	6
Countries have a complete ban	4

Source: UN Environment Programme (UNEP), *Used Vehicles and the Environment, A Global Overview of Used Light Duty Vehicles: Flow Scale and Regulation* (Nairobi: UNEP, 2020)

Zimbabwe is one of several countries on the continent that allows the import of used vehicles. Only four countries in Africa currently have bans in place for used vehicle imports, including South Africa, Sudan, Morocco and Egypt.[30] Used vehicles are popular because of

26 The Government of National Unity was a coalition government established in February 2009 between the main opposition, the MDC (Movement for Democratic Change) and the ruling Zanu PF after a disputed election in 2008.

27 Government of Zimbabwe, "Zimbabwe Motor Industry Development Policy".

28 'Zimbabwe fuel imports gobble US$1.2 billion', *The Zimbabwe Mail*, February 27, 2020, https://www.thezimbabwemail.com/economic-analysis/zimbabwe-fuel-imports-gobble-us1-2-billion/#:~:text=Zimbabwe%20spends%20over%20US%241.2,to%20endure%2C%20Business%20Times%20reported.

29 Ray Ndlovu, 'Zimbabwe's FX Shortage To Worsen as Virus Upends Tobacco Season,' *BloombergQuint*, April 7, 2020, https://www.bloombergquint.com/onweb/zimbabwe-s-fx-shortage-to-worsen-as-virus-upends-tobacco-season.

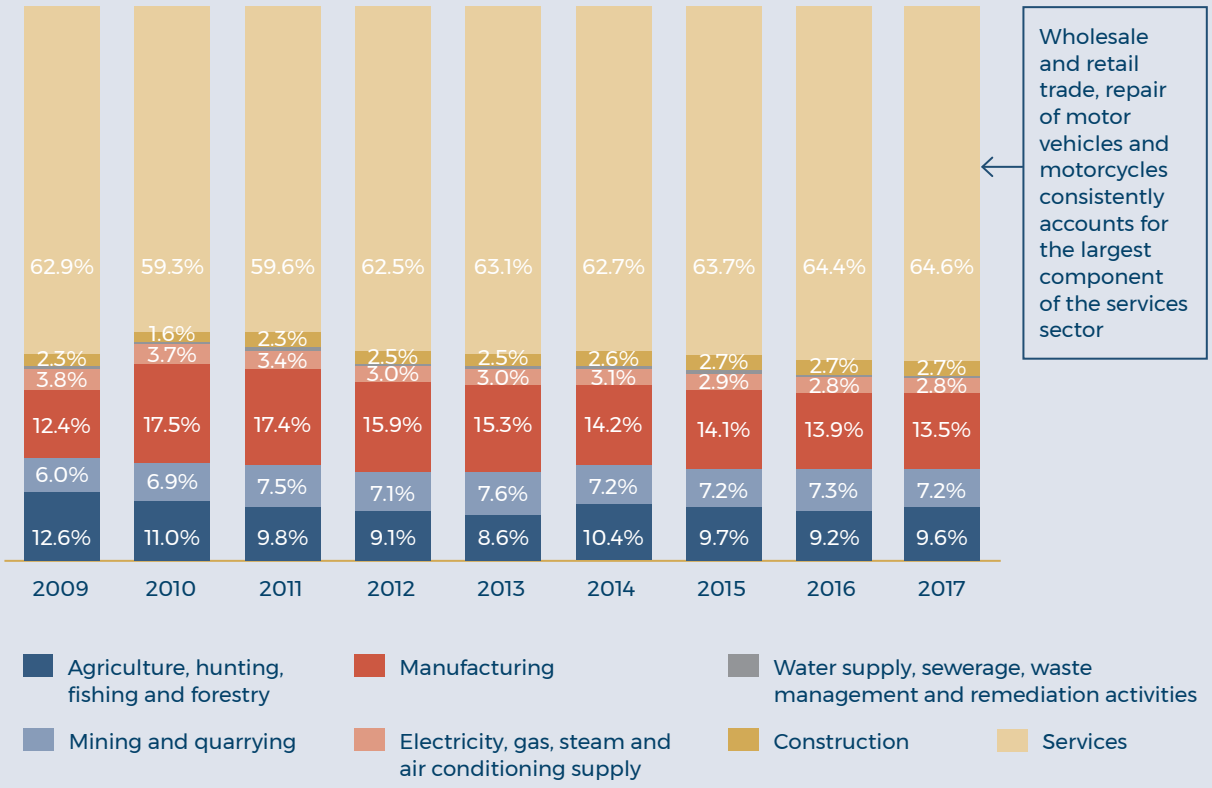
30 UN Environment Programme (UNEP), *Used Vehicles and the Environment, A Global Overview of Used Light Duty Vehicles: Flow Scale and Regulation* (Nairobi: UNEP, 2020), https://wedocs.unep.org/handle/20.500.11822/34175.

their affordability. To ensure better road safety, reduced emissions and overall cost savings, the best way forward may be to impose restrictions on used ICE vehicle imports and to shift to used EV imports.

Significance of the motor vehicle industry to the Zimbabwean economy

The services sector has consistently contributed the largest share of Zimbabwe's GDP at just over 62%. The retail, trade and repair of motor vehicles and motorcycles contribute a major portion to this sector.

Figure 3 Production share of the economic sectors in Zimbabwe, 2010–2017



Source: AfDB, "Zimbabwe Infrastructure Report"

By swiftly transitioning to electric mobility and reducing ICE vehicles, Zimbabwe can significantly improve its current account position. It would relieve pressure on the acute foreign currency situation by reducing demand for imported petrol and diesel, lubricants and spare parts associated with the ICE ecosystem.

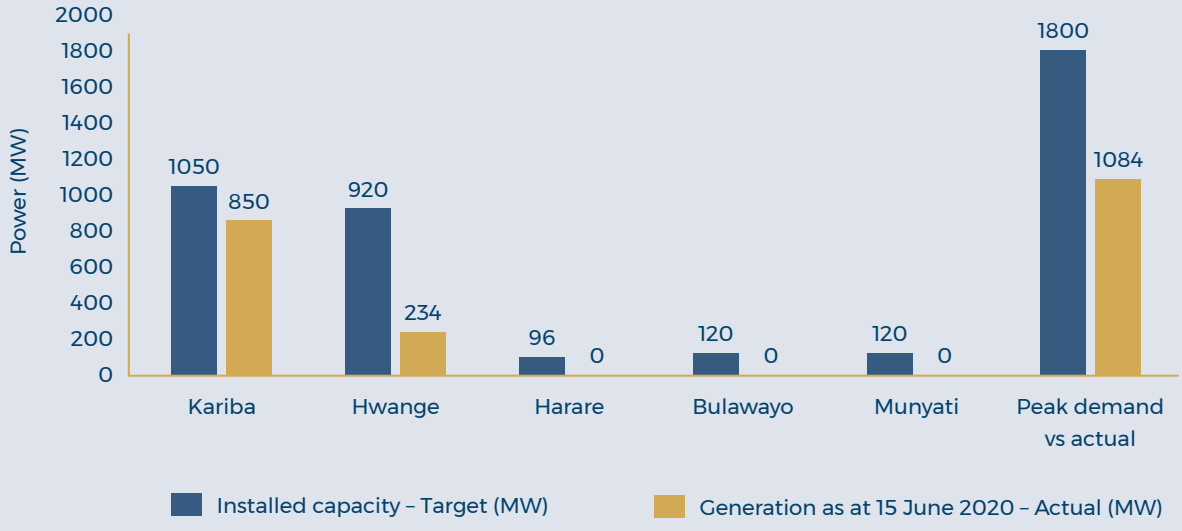
Plans to assemble EVs locally

One of the assembly plants, Willowvale Motor Industries, currently assembles models from the Chinese Original Equipment Manufacturers (OEM) BAIC under a joint venture agreement between BEIQI Zimbabwe Ltd and Willowvale Motor Industries. BEIQI Zimbabwe assembles several ICE models locally and offers after sale services. BAIC assembles the D20 Hatchback, the X25 Compact SUV and the Grand Tiger Pickup truck. BEIQI Zimbabwe plans to start assembling full electric models from the BAIC Group targeting fleet operators. One of the target groups are high utilisation sectors, such as driving schools.

Zimbabwe's electricity landscape

Zimbabwe has an installed electricity generation capacity of about 2,300 MW. Current demand peaks at around 1,800 MW in the winter months, with a slightly lower peak during the rest of the year at around 1,500 MW. During the night from 10pm to 5am, demand drops to below 900 MW. This lower demand allows for EV charging during a time when most people's vehicles would be parked anyway. International patterns show that 80% of EV charging takes place at homes overnight.[31]

Figure 4 Snapshot of the Zimbabwe Power Company power generation plants, June 2020



Source: Zimbabwe Electricity Transmission and Distribution Company (ZETDC)

31 US Department of Energy, 'Charging at Home', https://www.energy.gov/eere/electricvehicles/charging-home.

Zimbabwe's power deficit is close to 1,000 MW during peak demand periods and the national electricity utility company complements its suppressed generation with imports of up to 400 MW from its neighbours. It imports about 50 MW from HCB (Hidroelectrica de Cahora Bassa) in Mozambique and around 300 MW from Eskom in South Africa whenever finances allow. This results in periodic load shedding when demand surges.

Plans to meet demand and increase the penetration of renewable energy

According to the Zimbabwe Electricity Transmission and Distribution Company (ZETDC) System Development Plan Report of 2017, Zimbabwe's power demand is expected to increase steadily over the next 18 years.[32] Demand will rise from the current 1,500 MW to 4,400 MW in 2038. To meet this demand Zimbabwe is promoting the adoption of renewable energy underpinned by distributed solar photovoltaic (PV) generation. The recently launched National Renewable Energy Policy 2019 shows the government's desire to increase the penetration of renewables with a strong emphasis of solar PV.[33] The renewable energy policy has set a target of 2,100 MW of additional generation capacity by 2030. Grid connected solar PV is expected to represent the bulk of this contribution with a target of 1,575 MW.

Registered independent power producers

In a bid to accelerate the addition of new generation capacity, government has encouraged the establishment of independent power producer (IPPs) to bolster the capacity of the national electricity generation state owned enterprise Zimbabwe Electricity Supply Authority (ZESA). To date, 74 IPPs with a potential capacity of 7,577 MW have been registered, of which 18 are in operation.[34] Some projects have, however, failed to take off due to funding issues.

Figure 5 Registered IPPs by generation source

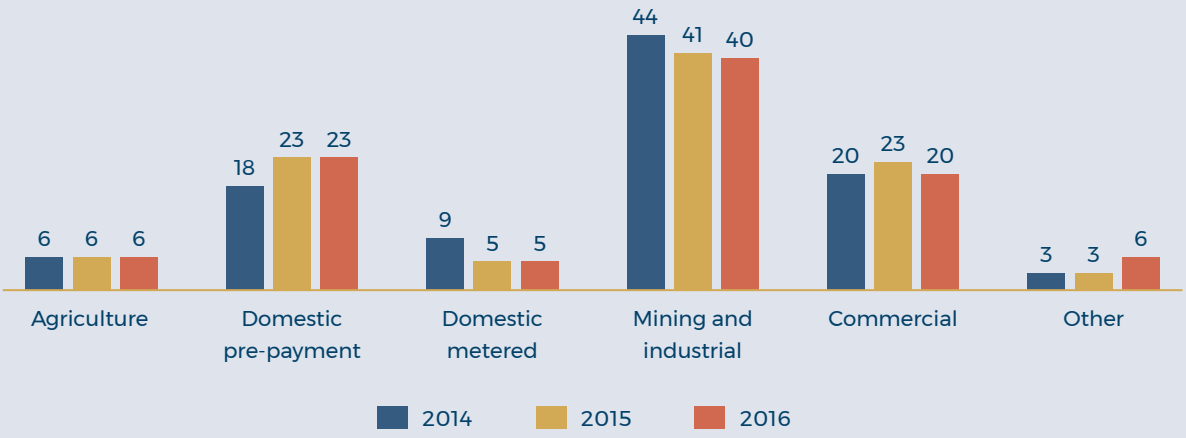
Source: ZETDC

32 ZETDC, *System Development Plan Report*, 2017, https://rise.esmap.org/data/files/library/zimbabwe/Cross%20Cutting/CC%202.pdf.
33 Republic of Zimbabwe, Ministry of Energy and Power Development, *National Renewable Energy Policy 2019* (Harare: Ministry of Energy and Power Development, 2019), https://www.zera.co.zw/National_Renewable_Energy_Policy_Final.pdf.
34 Zimbabwe Energy Regulatory Authority IPP Dashboard, https://www.zera.co.zw/electricity3/ipp/.

Zimbabwe's electricity consumption by sector

The main sector consumers of electricity in Zimbabwe have traditionally been mining and industry at approximately 40% and commercial activity at around 20%.[35] Zimbabwean firms have been following the global example as the world energy landscape moves from a centralised to a decentralised system that is mostly embedded in onsite generation for self-consumption and have installed solar PV systems to power their operations. The firms have also been forced to adopt the shift to decentralisation due to low electricity provision.

Figure 6 Electricity demand by sector



Source: AfDB, "Zimbabwe Infrastructure Report"

Large mines, such as Caledonia's Blanket Mine 20 MW PV project, are building solar plants that are capable of providing up to 30% of their 24-hour energy consumption requirements.[36] Several other firms, including Rio Zim, also plan to add 75 MW of onsite solar generation capacity to power their mining campuses in Zimbabwe. Other mines which have announced plans to install large PV plants include:[37]

- **Prospect Resources Arcadia lithium mine:** 20 MW;
- **Implats:** 200 MW of solar capacity for its Zimbabwe operations; 80 MW for Zimplats; 30 MW at Mimosa with the excess power fed into the national grid; and
- **Karo Resources (a new platinum mine in Mhondoro-Ngezi):** 300 MW solar power plant.

35 AfDB, "Zimbabwe Infrastructure Report".

36 Mathew Hall, 'Caledonia Mining secures $13m for Zimbabwe solar plant', *Mining Technology*, September 4, 2010, https://www.mining-technology.com/news/deal-news/caledonia-mining-zimbabwe-solar-plant/.

37 'RioZim licensed to build 75MW solar plants for mines,' *News Wire*, June 1, 2020, https://newzwire.live/riozim-licensed-to-build-75mw-solar-plants-for-mines/.

The mining sector is the largest consumer of electricity in Zimbabwe, therefore policymakers should continue to encourage local onsite generation by these players. With a significant fleet of vehicles for staff and operations in a campus model that is perfect for electrification, mining firms can unlock more value from their solar plants by powering EVs. This would reduce operational costs in a market experiencing high operational costs and a shortage of fuel. This approach highlights the benefits and synergies of onsite generation from solar PV and EVs. Several developers have facilitated installations in the commercial and industrial sectors using innovative financing and lease models. Firms that have installed solar power are now adding EV charging stations and have shown increased appetite for EVs to their fleet. These will be charged using onsite PV solar plants.

BOX 1 SNAPSHOT OF KENYA'S ELECTRICITY LANDSCAPE

The Kenya electricity market is generally characterised by an oversupply of generation capacity. This excess capacity is available 24 hours a day but is particularly prominent during night time where the government has had to implement a Time of Use tariff termed the 'Low Rate' to encourage heavy industrial users to shift production to the evenings and extend operating hours to boost productivity. This Low Rate call is in a bid to fully utilise their baseload capacity from geothermal instead of curtailing/ venting their geothermal power plants.

According to the Kenya National Bureau of Statistics-Economic Survey 2020, total electricity demand increased by 3.9% to 11,620.7 GWh in 2019 compared to 11,182.0 GWh in 2018. Transmission and distributive losses stood at 2,750.5 GWh and accounted for 24.1% of total local generation in 2019.[a] Electricity demand in the first half of 2020 has been curtailed by the COVID-19 induced economic slowdown.

Unlike the majority of countries in Southern Africa, Kenya has the luxury of a very a high 'effective capacity' compared to the 'installed capacity'. Installed capacity is defined as the maximum theoretical electric output a power station could produce when operating at 100%, whereas the effective capacity refers to the maximum electric output a power station is expected to achieve given current operating constraints. Kenya's installed capacity in 2019 was 2,818.9 MW whilst the effective capacity was an impressive 2,736.4 MW.[b] This achievement stands out compared to other countries in the Southern African Power Pool. For example, In Zimbabwe the installed capacity is 2,412 MW but the available capacity is at best about 1,555 MW when the Kariba Dam is fully operational. Botswana has an installed capacity of 928 MW, but the operational capacity is just around 50% of that at 459 MW.[c]

a Kenya National Bureau of Statistics (KNBS), *Economic Survey 2020* (Nairobi: KNBS, 2020), https://s3-eu-west-1.amazonaws.com/s3.sourceafrica.net/documents/119905/KNBS-Economic-Survey-2020.pdf.

b KNBS, "Economic Survey 2020".

c KNBS, "Economic Survey 2020".

Unlocking the synergies between distributed energy generation and electric vehicles will mutually support each sector. Private investments into generation as well as other public-private partnerships can bridge the current energy generation gap very quickly. Kenya is a good example of how energy generation capacity deficits can quickly swing to excess capacity.

Electricity access in the rural areas of Zimbabwe

The grid electricity access rate is 13% in rural areas and 83% in urban areas in Zimbabwe.[38] To bridge the energy divide, several firms have rolled out small solar systems targeting rural, urban and peri-urban off-grid consumers in Zimbabwe. These solar systems are offered on the popular PayGo model, where a customer pays a small percentage of the full amount as a down-payment, with the balance paid in instalments over a period of time. The solar energy systems product offerings started off with basic kits consisting of solar panels, batteries and LED (light emitting diode) lights. As battery technology improved and more energy efficient appliances became available the bouquet of appliances increased to include radios, televisions, small bar fridges and other appliances, such as hair clippers. Firms such as Zonful Energy are leading the charge of electrifying the communities as customers pay off their systems and increasingly look for more service offerings. There is now an opportunity to unlock more value from this PayGo ecosystem and extend it to mobility.

An extension to include larger storage systems is underway. As the price of lithium ion battery storage continues to come down, mobile plug and play battery storage systems are becoming economically viable to bring flexible power to off-grid communities and replace diesel generators as battery generators. The massive underinvestment in rural areas by traditional motorised transport modes and the high cost associated with delivering petrol and diesel, creates an opportunity for mobile plug and play battery generators to support rural communities by enabling/facilitating the powering of larger appliances for productive purposes.

Battery generators

The typical entry level battery generator being offered on the Zimbabwean market is a 0.6 kWh battery generator. This particular generator comes with a 150 W solar panel and an inbuilt 500 W inverter. Apart from powering home entertainment systems, other applications include water pumping and power tools. The 0.6 kWh battery is also sufficient to charge the battery packs of electric bicycles, and some bicycles have battery packs with 300 Wh capacity. These battery generators retail for $300 in Harare and this cost works well with financing models employed by firms offering the PayGo model. Several firms, such as Solar Shack, also work with local microfinance institutions such as VIRL Zimbabwe to provide loads for similar systems, lowering the barriers to entry for consumers and

38 Republic of Zimbabwe, "National Renewable Energy Policy".

small business operators. On the high end, upmarket stores are retailing premium battery generators such as the Goal Zero Yeti. The product range include the Yeti 1000 Wh Lithium for about $1,210, the Yeti 1400 Wh Lithium for $2,000 and the Yeti 3000 Wh Lithium with WIFI for $3,300.

Second life batteries to bring down the costs of battery generators and encourage local assembly and manufacturing

The transition to e-Mobility is well under way in many developed markets such as China, Europe and the US, and there are now over 7 million electric passenger vehicles on the road worldwide. There are also over 500,000 e-buses, almost 400,000 electric delivery vans/trucks and 184 million electric mopeds, scooters/motorcycles on the road globally.[39] This means there is now a critical mass of battery supply available from EVs for repurposing for other applications such as stationary storage. Some firms, such as South Africa's Revov, are one of the leaders in this space and are already exporting second life batteries to several SADC members states including Zimbabwe. Revov, along with its Chinese partners, offer stationary storage products in modular and stackable battery packs of 5.17 kWh. The modules are made of lithium iron phosphate prismatic cells repurposed from electric buses and other vehicles in China. The current lifecycle of these batteries is around 80% of their original capacity. The cells still have enough capacity in them for stationary storage applications and can have lifecycles of up to 10 years in their 'second life'. The use of second life cells in battery packs not only promotes the circular economy but also lowers the cost per kWh of these packs. A German firm, Betteries, is also working on deploying battery generators made of second life battery cells with their partners in Zimbabwe Mobility For Africa.[40]

Rural mini-grids

Rural mini-grids have for decades been touted as the best solution for electrifying marginalised off-grid communities. Mini-grid projects target rural growth points consisting of schools, clinics, business centres, surrounding households and the farming community, ensuring they have access to electricity. They also enable transformation in education, health, information and communications technology (ICT), agriculture and entrepreneurship, resulting in the improvement of living standards for members of these communities. Several pilot sites have been in operation, such as the 99 kW Mashaba Solar Mini-grid.

39 Bloomberg NEF, "Electric Vehicle Outlook 2020".

40 Remeredzai Kuhudzai, 'Mobility For Africa Shows How Electric Vehicles Can Transform Lives Where It Matters Most,' *CleanTechnica*, May 11, 2020, https://cleantechnica.com/2020/05/11/mobility-for-africa-shows-how-electric-vehicles-can-transform-lives-where-it-matters-most/.

The donor funded project is set up as a:

- 99 KW mini-grid, 2 energy centres and 2 stand-alone power units that will sell power to 3 irrigation schemes, 5 business centres, a clinic, a school and a study centre;
- An energy centre that supports economic activities such as cold rooms, agro-processing, welding and similar activities that require substantial energy;
- A resource/study centre with facilities that include ICT provision, e-learning, internet, TV, after hours study and community information; and
- Energy kiosk services for household energy requirements such as lighting, communication/mobile phone charging, entertainment (televisions and radios), and battery charging among other low energy uses.[41]

These off grid mini-grids can be used to charge electric cycles, electric motorcycles and three-wheelers unlocking further value from existing infrastructure. Several mini-grid projects are now being set up and scaled up in various in parts of the country in both public-private sector partnerships and under donor funded initiatives. To validate this model of EVs unlocking value from mini-grids, Mobility for Africa (MFA) is currently piloting electric three-wheelers in the rural Wedza district of Zimbabwe. MFA's vision is to 'bring solar powered electric transport solutions to women and their families that are affordable, efficient and adapted to peri urban and rural areas in Africa.'[42] As they execute their mission, MFA aims to 'empower rural women in Africa with transport solutions that can help them save time, sell more of their goods at the market, take their children to the clinic, to school, to collect water, as well as improve their economic opportunities within their households and local communities.' Their ultimate goal is to improve the quality of life of women and their families while at the same time 'contribute to expanding renewable energy for transport in Africa contributing to longer term sustainability and mitigating climate change.'[43]

These pilots highlight the need to scale up programmes unlocking the synergies between distributed renewable energy generation and e-Mobility. The large distances covered in rural areas remain the major challenge to economic empowerment. The primary mode of transport for goods and services is still ox drawn/donkey scotch carts. E-Mobility options covering micromobility options such as electric scooters, bicycles and three-wheelers whose battery packs are small enough to be charged using small distributed solar PV systems and mini-grids, will transform the lives of families in these communities.

41 SNV, 'Sustainable Energy for Rural Communities/Mashaba Solar Mini Grid,' https://snv.org/project/sustainable-energy-rural-communitiesmashaba-solar-mini-grid.

42 Mobility for Africa, 'About Us', https://www.mobilityforafrica.com/about.

43 Mobility for Africa, "About Us".

Energy regulations and policies impacting on the e-mobility sector

Net metering regulations 2018

Zimbabwe is one of the first countries in East and Southern Africa to introduce net metering. This will go a long way towards encouraging several innovations and applications in smarter mobility and smart cities. These regulations will open the door for applications such as vehicle-to-grid and vehicle-to-home.

Under Statutory Instrument 86 of the 2018 (Net Metering) Regulations[44], participants in residential, commercial and industrial facilities can export excess electricity generation up to 100 kW. The net export is calculated as exported units (kWh)*0.9 – imported consumer units. Although not yet scaled up, this net metering presents an opportunity for implementation of further innovations that enable smarter mobility and grids. This bidirectionality present Zimbabwe with a unique opportunity to trial and scale up vehicle-to-home and vehicle-to-grid technology. The 100 kW export limit is very restrictive. To incentivise large consumers to be more proactive in generating electricity on site, this threshold should be increase to at least 1 MW. This will stimulate generation to meet the country's daytime deficit, provide firms with cheaper power during the day, reduce operational costs and net off with cheaper night-time off peak power. It is also possible to charge their vehicle fleet with this cheaper night time power, further lowering their operational costs via diesel/fossil fuel abatement.

Several other policies focusing on sustainable development and reducing emissions in Zimbabwe have also been launched including:

Zimbabwe Renewable Energy Policy 2019:[45]

- The Zimbabwe Renewable Energy Policy 2019 seeks to provide energy access to in a sustainable way by increasing the contribution of renewables in the energy generation mix. It sets targets to increase access to clean and affordable energy through addition of: 1,100 MW by the year 2025 or 16.5% of the total generation from renewables, whichever is higher; and 2,100 MW by the year 2030 or 26.5% of total generation from renewables, whichever is higher.
- The policy also highlights the need to focus on: affordability, creating a balance between project viability and affordable energy cost to provide citizens of Zimbabwe with cleaner, greener and cheaper energy options; and accessibility, the policy framework is driven by

44 Republic of Zimbabwe, Zimbabwe Energy Regulatory Authority, *Electricity (Net Metering) Regulations, 2018* (Harare: Zimbabwe Energy Regulatory Authority, 2018), http://www.veritaszim.net/node/3732.

45 Republic of Zimbabwe, "National Renewable Energy Policy".

the UN Sustainable Energy for All (SE4ALL) program which aims to reduce the carbon intensity of energy as well as increase energy access to make it available to everyone.

National Energy Policy 2012:[46]

- Aims to promote the optimal supply and utilisation of energy, for socio-economic development in a safe, sustainable and environmentally friendly manner ensuring that the energy sector's potential to drive economic growth and reduce poverty is realised.

Zimbabwe's Intended Nationally Determined Contribution (2015):[47]

- To contribute to the global climate and to enable economic development in a sustainable manner.

Zimbabwe's National Climate Change Response Strategy:[48]

- Establishes specific provisions for dealing with climate change issues, understanding the extent of the threat and putting in place specific actions to manage potential impacts.

Zimbabwe Climate Policy (2016):[49]

- Seeks to create a pathway towards a climate resilient and low carbon development economy in which the people have enough adaptive capacity and continue to develop in harmony with the environment. The policy is expected to mainstream climate issues in all sectors of the economy including energy, agriculture, industrial processes, waste, land use, land cover and forestry.

Vision 2030:[50]

- Seeks to transform Zimbabwe into an upper middle-income economy, raise employment levels upwards, and to progressively reduce the poverty rate to levels consistent with upper middle-income economies.

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46 Republic of Zimbabwe, Ministry of Energy and Power Development, *National Energy Policy* (Harare: Ministry of Energy and Power Development, 2012), https://www4.unfccc.int/sites/PublicNAMA/_layouts/UN/FCCC/NAMA/Download.aspx?ListName=NAMA&Id=162&FileName=energy_policy.pdf.

47 Government of Zimbabwe, *Zimbabwe's Intended Nationally Determined Contribution (INDC) Submitted to the United Nations Framework Convention on Climate Change (UNFCCC)*, https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Zimbabwe%20First/Zimbabwe%20First%20NDC.pdf.

48 Government of Zimbabwe, Ministry of Environment, Water and Climate, *Zimbabwe's National Climate Response Strategy* (Harare: Ministry of Environment, Water and Climate, 2014), http://www.climatechange.org.zw/sites/default/files/National%20Climate%20Change%20Response%20Strategy.pdf.

49 Government of Zimbabwe, Ministry of Environment, Water and Climate, *Zimbabwe Climate Policy* (Harare: Ministry of Environment, Water and Climate, 2016), http://newfour.ncuwash.org/wp-content/uploads/2017/08/Zimbabwe-Climate-Policy-2016.pdf.

50 Republic of Zimbabwe, Vision 2030 (Harare: Office of the President, 2018), http://www.zim.gov.zw/index.php/en/government-documents/category/1-vision-2030?download=1:vision-2030.

Zimbabwe's mix of energy and transport policies tie into the SADC Regional Indicative Strategic Development Plan (RISDP) 2020–2030.[51] A particular focus needs to be put on aligning timelines in the RISDP with Zimbabwe's Vision 2030 which are running over the same timeframe. The RISDP highlights the importance for SADC member states to address the emerging challenges of climate change and take advantage of the opportunities arising in the green and blue economies. Zimbabwe's mix of energy and transport policy also aligns with SADC's Regional Green Economy Strategy and Action Plan for Sustainable Development.[52]

The RISDP, approved at the 40th Heads of State and Government Summit in August 2020, also ties into the region's broader Vision 2050. This vision seeks to have a peaceful, inclusive, competitive middle to high income industrialised region by 2050. Zimbabwe's Vision 2030 is also aligned with this roadmap. The goal is to have a region where all citizens enjoy sustainable economic well-being, justice and freedom. To achieve this, three pillars or priorities will underpin the RISDP, explained as follows.

1 Industrial development and market integration

Aspirations in this pillar include an industrialised regional economy that sustainably exploits its natural resources, leveraging science and technology innovations, and to enhance overall technological capabilities in member states. There is also a desire to realise the opportunities of well developed, sustainable and integrated blue and green economies. The transition to e-Mobility will tie into some of the key focus areas of this pillar such as:

- Increase labour and total factor productivity performance through innovation, research and development, technology transfer and commercialisation;
- Develop regional value chains and value addition in key priority sectors; and
- Enhance the technological capability of SADC Member States to adequately equip them for the 4th Industrial Revolution (4IR) through improved, 4IR-focused research and development.

2 Infrastructure development in support of industrialisation

The aspirations speak to increased access to affordable infrastructure and services with key action areas in:

- Supporting access to affordable renewable energy;
- Support delivery of cost effective and diversified energy;

51 SADC, *Regional Indicative Strategic Development Plan (RISDP) 2020–2030*, March 2001, (Gabarone: SADC, 2001), https://www.sadc.int/about-sadc/overview/strategic-pl/regional-indicative-strategic-development-plan/.

52 SADC, *SADC Green Economy Strategy and Action Plan*, July 2015 (SADC, 2015), https://www.sadc.int/index.php/download_file/view/7643/280/.

- Support access to affordable and clean water and sanitation;
- Develop sustainable and interconnected energy infrastructure throughout the region; and
- Develop seamless and interconnected transport routes.

3 Social and human capital development in support of industrialisation and regional integration

Aspirations in this pillar include proactive programming and monitoring measures to improve health systems and nutrition outcomes in the region and enhanced human capacities for socioeconomic development with key action areas in:

- Harmonisation of regional health policies, strategies and guidelines. EVs, battery generators and distributed solar PV systems will improve air quality contributing to improved health in local communities; and
- Promote regional skills development to boost industrialisation growth and reduce unemployment. The EV, battery generators and distributed solar PV systems will generate new employment opportunities and also provide an avenue for upskilling members of the local communities.

The SADC Industrialisation Strategy and Roadmap (2015–2063)[53] also identifies energy as a major barrier and a key enabler for the industrial competitiveness of the region. One of the cost-effective measures to overcome these barriers is for industries to utilise energy efficiently. Zoning in on the industrialisation-urbanisation-mobility interface on a regional level in a coordinated approach will also ensure sustainable urban development and reduce congestion and greenhouse gas emissions.

SADC's Green Economy Strategy and Action Plan also aims to catalyse the socio-economic transformation of the SADC region towards a resource efficient, environmentally sustainable, climate-change resilient, low-carbon development path and equitable society. Strategies on the transport side of the Action Plan include:

- Promote investments in climate-resilient transport infrastructure and relocation of infrastructure exposed to climate change impacts;
- Promote green public transport networks and multimodal transport; and
- Encourage regional trade for (energy efficient) low-emitting vehicles.[54]

53 SADC, *SADC Industrialization and Strategy Roadmap 2015–2063*, 29 April 2015 (Harare: SADC, 2015), https://www.sadc.int/files/2014/6114/9721/Repriting_Final_Strategy_for_translation_051015.pdf.

54 SADC, "SADC Green Economy Strategy".

Although Zimbabwe's overall bouquet of energy and transport policy align with SADC's mix of polices, there is a clear lack of detail and focus on e-Mobility. Clearly set quotas and targets on increasing EV penetration are absent. With the rate of the transition to e-Mobility clearly accelerating overseas, there is now an urgent need for Zimbabwe and other member states to craft a standalone EV policy

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E-mobility was mentioned, however, in the 2020 National Budget statement presented in November 2019. The budget statement noted the need to focus on promoting renewable energy projects such as solar, including the extension of incentives for solar powered vehicles, solar batteries and other related accessories.

E-mobility uptake in Zimbabwe

The first modern EV was registered in 2017 – a used Nissan Leaf vehicle import from Japan. Since then, about 50 BEVs have been registered, mostly of the same model. A strong increase is starting to be observed in the number of mild hybrids from Japan, with a few plug-in hybrids starting to be seen on the road. The early days of EV registrations have been driven by the typical early adopters independently importing their own EVs as official dealerships hesitated and adopted a 'wait-and-see' approach before embarking on EV sales. Several official dealerships when asked why they have not brought in EVs yet, cite the lack of public charging infrastructure.

Used EV imports

Used car dealers have recently started to stock used EVs in Harare. This will drive uptake as people will be able to actually see the electric cars and get a chance to test drive them. The trend that started decades ago with grey imports of ICE vehicles looks set to continue into the EV age. A survey[55] carried out at several official dealerships of legacy OEM's indicates

55 Interview with various dealerships of original equipment manufacturers in Harare, interview by Remeredzai Kuhudzai, April 2020.

that the dealerships will not start selling electric models any time soon. Reasons cited include:

- The lack of public charging infrastructure;
- Several milestones needed to get clearance from OEMs to sell EVs are yet to be met, such as training and certification of technicians on EVs and equipment to service electric vehicles;
- Low demand;
- Long lead times for several models in the traditional markets such as Europe and the US, resulting in Zimbabwe and other African states not being on the priority list; and
- Lack of incentives for EVs such as a reduction on import duties making the initial purchase cost of EVs much higher than equivalent ICE models.

Several independent dealerships are starting to take advantage of this and are starting to independently import some popular models (including the Hyundai Kona and the Peugeot 208 and 2008) from the UK, capitalising on the inertia and lethargy shown by official dealerships in bringing EVs.[56] International OEMs are not yet prioritising markets such as Zimbabwe given the demand and long wait times for new EVs in their traditional markets overseas. This strong demand has resulted in long wait times for European consumers of up to 18 months for Volkswagen's city EVs, namely the Skoda Citigo, the Seat Mii and the Volkswagen eUp, for example.

Used EVs could provide a soft-landing point for EVs as they will enter markets at prices that are more acceptable for consumers that traditionally buy used ICE vehicles. This is a great example showing how allowing used vehicle imports could catalyse the transition to e-Mobility. Used Nissan Leafs retail from about $9,000 – $13,000 (2011–2014 Year Models), making them more competitive than ICE vehicles of a similar age.

TABLE 3 AVERAGE RETAIL PRICES OF POPULAR USED VEHICLES IMPORTED FROM JAPAN

Equivalent popular ICE model (Preowned imports) 5 to 7 years old	Average retail price in East and Southern Africa
Honda Fit	$6 500
Toyota Vitz	$8 000
Mazda Verisa	$8 500
Toyota Auris	$12 000

Source: Interviews with several used car dealerships in Harare, Interview by Remeredzai Kuhudzai, October 2020

56 See: Zimtorque e-Mobility Dealership, https://emobility.zimtorque.net/.

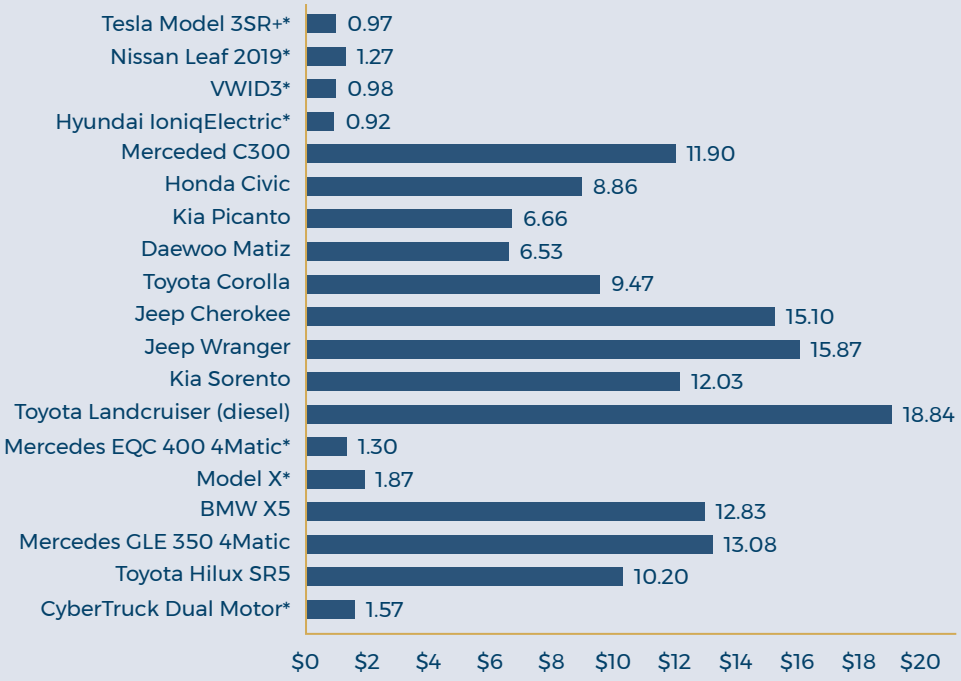
Brand new EV sales at official dealerships

New EV sales are also starting in Zimbabwe with BYD China in partnership with Tsapo Group Zimbabwe. The consortium is initiating BYD Zimbabwe, who will launch a range of electric buses, trucks, vans and passenger vehicles in Zimbabwe.

Costs of fuelling brand new ICE vehicles compared with costs of charging EVs in the same segment

In Zimbabwe, electricity is subsidised and currently ranges between $0.04–0.06/kWh making BEVs a low-cost option in term of running costs. The main driver for the switch will certainly be economical over the climate benefits in this depressed economy. Due to the chronic fuel shortages, the added advantage of not losing downtime in petrol and diesels queues will also be another major driver.

Figure 7 Cost to drive 100 km in selected brand new EVs vs equivalent ICE vehicles



Note:

* Vehicles used for illustrative purposes.

EVs listed above not yet available in Zimbabwe.

Source: AfricaNEV, Cost to drive 100 km in Zimbabwe, Private Communication

Interest from Zimbabwe business and fleet operators

Several fleet operators interviewed are at an advanced stage of procuring electric vans for their sales staff. They are also putting in orders for 4 tonne and 12 tonne electric trucks for their delivery fleet, starting with their depots in Harare with the aim of branching out once charging infrastructure is established along the highways.[57]

Hurdles faced

Some companies reported[58] that they have been looking all over the world for electric trucks, in several vehicle classes, from their traditional suppliers who used to supply them with ICE vehicles. Some of these brands are now also offering electric lorries. The suppliers in Europe say they are still either piloting or ramping up production and not yet ready to supply electric lorries to this part of the world. Local firms have expressed an interest in the Mitsubishi eCanter. Some of the Zimbabwean firms interviewed say they are keen to pilot electric trucks following on from what they have seen with SABMiller in South Africa, who is piloting the electric eCanter.[59] The large EV market appears to be even more supply constrained from a global perspective compared to passenger vehicles. Potential solutions could include converting old ICE lorries and trucks to EVs.

Incentives to catalyse EV adoption

Adopting policies incentivising EVs is strongly advised given the potential benefits of easing the burden on foreign currency. Incentive programs have been proven to strongly encourage EV adoption, such as in Norway, who leads the world in terms of penetration of EVs in new vehicle sales.

The Norwegian EV incentives include:[60]

- No purchase/import taxes (1990–);
- Exemption from 25% VAT on purchase (2001–);
- No annual road tax (1996–);
- No charges on toll roads or ferries (1997–2017);
- Maximum 50% of the total amount on ferry fares for EVs (2018–);

57 Interviews with several fleet operators in Harare, interview by Remeredzai Kuhudzai, November 2020.
58 Interviews with several fleet managers in Harare, interview by Remeredzai Kuhudzai, October 2020.
59 Remeredzai Kuhudzai, 'Anheuser-Busch InBev's South African Breweries Goes Electric with The Mitsubishi Fuso eCanter,' *CleanTechnica*, January 18, 2020, https://cleantechnica.com/2020/01/18/anheuser-busch-inbevs-south-african-breweries-goes-electric-with-the-mitsubishi-fuso-ecanter/.
60 Norwegian EV Association, 'Norwegian EV policy Norway is leading the way for a transition to zero emission in transport,' https://elbil.no/english/norwegian-ev- policy/#:~:text=The%20Norwegian%20EV%20incentives%3A&text=No%20charges%20on%20toll%20roads,municipal%20parking%20(1999%2D%202017).

- Maximum 50% of the total amount on toll roads (2019);
- Free municipal parking (1999–2017);
- Parking fee for EVs was introduced locally with an upper limit of a maximum 50% of the full price (2018–);
- Access to bus lanes (2005–);
- New rules allow local authorities to limit the access to only include EVs that carry one or more passengers (2016);
- 50% reduced company car tax (2000–2018);
- Company car tax reduction reduced to 40% (2018–);
- Exemption from 25% VAT on leasing (2015);
- Fiscal compensation for the scrapping of fossil vans when converting to a zero-emission van (2018); and
- Allowing holders of driver's license class B to drive electric vans class C1 (light lorries) up to 4250 kg (2019).

In SADC, Mauritius is leading the way in introducing incentives. To promote the use of energy-efficient transport, the excise duty on electric vehicles up to 180 kW and on hybrid cars below 1600 cc has been reduced from 55% to 25%. Excise duty on hybrid cars of 1601 cc capacity and above has been reduced from 55% to 30%.

Buy-in from policymakers and regulators/government in Zimbabwe

It is evident that key stakeholders in the Zimbabwean government are starting to focus on EVs, and several key players and stakeholders have actively started promoting EV adoptions. These include the following:

The Zimbabwe Energy Regulatory Authority (ZERA):

» ZERA issued an request for proposals for EVs in early 2019. The tender has already been awarded and the vehicle has already been delivered (see Figure 10). ZERA wants to adopt EVs to set an example and to raise awareness to drive adoption of EVs. ZERA is now moving to install charging stations at several facilities across the country.

Central Mechanical Equipment Department (CMED):

» The CMED is a parastatal, wholly owned by the government under the Ministry of Transport and Infrastructural Development. CMED sources, services and maintains vehicle fleets for government departments. CMED has a subsidiary, EASYGO, that offers vehicles for hire and driver training on a commercial basis to members of the

public, and corporate and non-governmental organisations. In July 2020, CMED issued a request for proposals for luxury EVs to add to its fleet.

Ministry of Energy Support:

» The Ministry of Energy announced in September 2019 that the government firmly supports the adoption of EVs and that the government's fuel retailing company will install charging stations at its fuel stations and along the country's major highways.[61]

Zimbabwe Electric Utility Company (ZESA):

» The ZESA board highlighted that it requires 2,600 vehicles to return to its optimal operating levels and to restore its 24-hour fault restore service. They intend to upgrade their fleet and include EVs as part of their fleet replacement programs. ZESA would like to take the lead by utilising its 90 centres across the country to roll out electric charging points.[62]

Figure 9 A ZERA 62 kWh Nissan Leaf e+ vehicle at their head office in Harare

Source: Image author's own

61 Alvine Chaparadza, 'Govt About To Introduce Electric Vehicles Incentives Soon – Energy Minister Fortune Chasi,' *TechZim*, September 9, 2019, https://www.techzim.co.zw/2019/09/govt-about-to-introduce-electric-vehicles-incentives-soon-energy-minister-fortune-chasi/.

62 Kuda Bwititi, 'I have a clear vision for Zesa: Gata,' *The Sunday Mail*, February 2, 2020, https://www.sundaymail.co.zw/i-have-a-clear-vision-for-zesa-gata.

EV charging standards for Zimbabwe and the region

Although there are now over 7 million EVs on the roads worldwide, there is yet to be a full consensus on the charging standards for direct current (DC) fast charging. The European market appears to be converging towards the Combined Charging System (CCS). Most of the EVs available in South Africa (a market where the importation of used EVs is banned) are from Europe, meaning they would be equipped for CCS. These include the BMW i3, the Jaguar I Pace, the Mini Cooper, the Porsche Taycan and soon the Mercedes EQC SUV and the Audi e-Tron.

In neighbouring Zimbabwe and Botswana, where used vehicle imports are allowed, the majority of EVs that have started to arrive are used Nissan Leafs from Japan. The Japanese are continuing to push for the Chademo charging standard[63] and as such the majority of vehicles landing in these markets would be equipped for Chademo. The UK is also a source market to some extent for used vehicles, meaning there will also be a percentage of vehicles arriving that would be equipped for CCS.

The Chinese OEMs are also starting to exert some influence in the SADC region on the ICE front and it will only be a matter of time before they extend this reach to EVs. The Chinese also insist on their own charging standard, GB/T.[64] However, they also export vehicles equipped with CCS such, as shown below.

Figure 10 A Chademo DC fast charging port on a 62 kWh Nissan Leaf e+ in Harare

Source: Image author's own

63 See: Chademo Fast Charging, https://www.chademo.com/about-us/what-is-chademo/.

64 Dalroad, 'An introduction to electric vehicle rapid charging standards,' https://www.dalroad.com/resources/an-introduction-to-electric-vehicle-rapid-charging-standards/.

Figure 11 A CCS DC fast charging port on a 48 kWh BYD T3 Van in Harare

Source: Image author's own

Implications of large-scale adoption of EVs for the mining industry

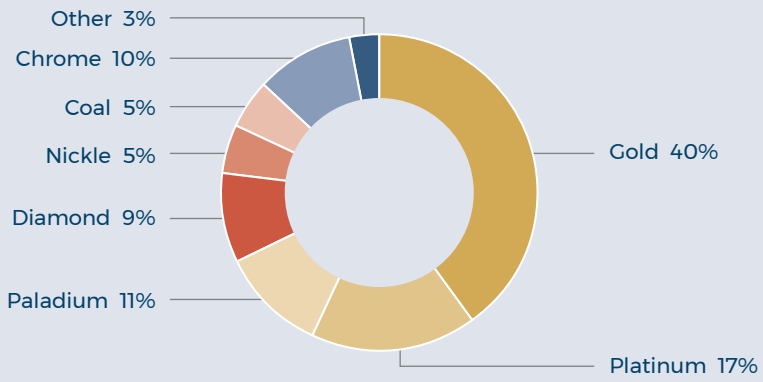
The mining sector in Zimbabwe accounts for about 60% of the country's exports.[65] The mining sector contributes significantly to government revenue and employs more than 37,000 people in formal jobs and over 200,000 artisanal and small-scale miners. Foreign currency shortages, liquidity constraints and infrastructure deficits continue to be a threat to the mining sector's growth potential. Leveraging the booming EV market could assist the mining sector to realise this potential. Worldwide battery production is predicted to reach 800 GWh in 2025, from around 210 GWh this year.[66] Already one of the important battery cathode materials, nickel, has started to experience growth in output in Zimbabwe. The average capacity utilisation across the mining industry increased from 71% in 2017 to 75% in 2018. Capacity utilisation levels in nickel increased from 60% to 70%. The mining sector continues to be affected by a large pool of factors that affect growth and efficiency, including power, transport and access to funding. This is why the distributed energy generation from renewables and introducing more energy efficient modes of transport though e-Mobility thereby reducing transport costs, will unlock efficiencies in the entire

65 The Chamber of Mines of Zimbabwe, *Annual Report 2019* (Harare, Chamber of Mines of Zimbabwe, 2019), http://chamberofmines ofzimbabwe.com/annual-reports/.

66 'The person who made tesla a gigafactory is starting again with ev battery recycling (WSJ),' *Benchmark Mineral Intelligence*, August 30, 2020, https://www.benchmarkminerals.com/membership/the-person-who-made-tesla-gigafactory-is-starting-again-with-ev-battery-recycling-wsj/.

ecosystem. Reducing operational costs while boosting revenues by taking advantage of exports of battery grade materials and minerals will bring growth to the industry.

Figure 12 Distribution of minerals revenues, 2018



Source: The Chamber of Mines of Zimbabwe, Annual Report 2019 (Harare, Chamber of Mines of Zimbabwe, 2019)

TABLE 5 PERFORMANCE OF SELECTED MINERALS 2018

	2017	2018	% Change
Gold (kgs)	26,495	35,042	32%
Platinium (kgs)	14,257	14,639	3%
Palladium (kgs)	11,822	12,035	2%
Ruthenium (kgs)	1,102	1,150	4%
Diamonds (cts)	2,507,862	3,108,919	24%
Chrome (MT)	1,673,996	1,773,826	6%
Nickel (MT)	16,617	17,844	7%
Coal (MT)	2,928,036	3,096,661	6%
Lithium (MT)	45,220	77,075	70%
Granite	161,123	223,350	39%

Source: Chamber of Mines of Zimbabwe, "Annual Report 2019"

Important battery materials to drive growth

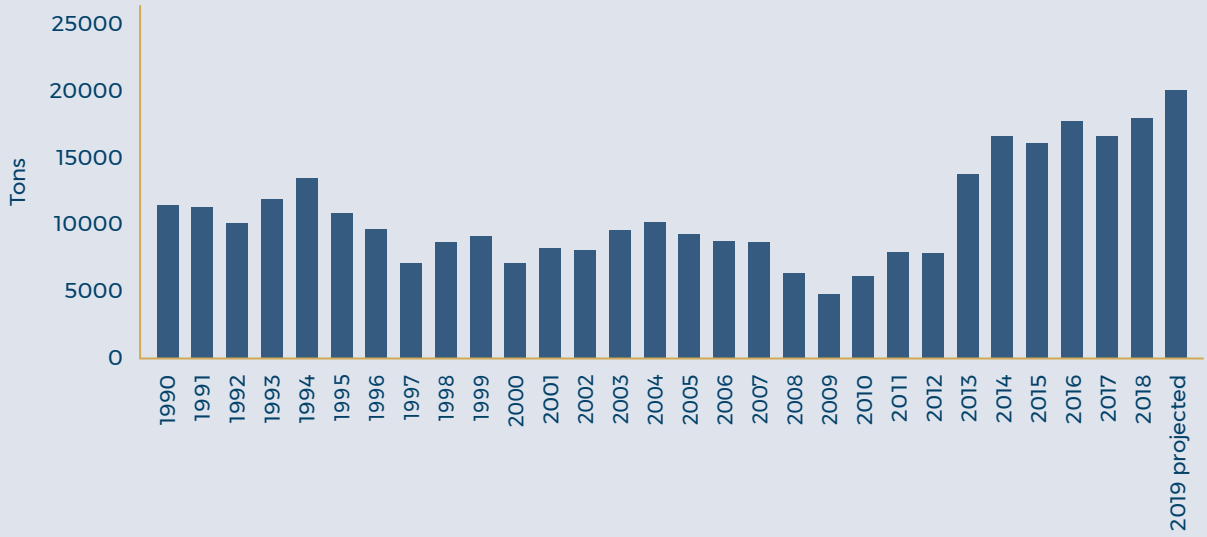
Cathode materials

Nickel

Bindura Nickel Corporation, the primary nickel producer in Zimbabwe, contributed 38% of the total production for 2018, with the rest coming from platinum producers. With OEMs moving swiftly away from cobalt to more nickel rich cathodes, there is an opportunity for

nickel production to grow even further. Elon Musk has pleaded for mining firms to ramp up their nickel output.[67]

Figure 13 Zimbabwe Nickel Output from 1990 to 2018



Source: Chamber of Mines of Zimbabwe, "Annual Report 2019"

Iron

Zimbabwe also has an opportunity to resuscitate its iron industry as the battery industry continues to shift from expensive cobalt in a bid to push down battery costs per kWh. The industry is also moving from cobalt, whose production is predominantly from the Democratic Republic of the Congo and linked at times with human rights issues such as the use of child labour in artisanal mines. Iron based cathodes are therefore again gaining significant traction. These include lithium ferro phosphate (LFP) chemistry-based cathodes whose demand could drive the resurgence of the local iron industry. Although no production was recorded for iron ore in 2018 as the major mines and iron and steel plant ZISCO has been dormant for several years and plagued by several operational issues, Zimbabwe still has significant resources of iron ore that can be exploited. The most significant high-grade ore are the Buchwa and Ripple Creek deposits. Other significant ironstone deposits are found in Mwanesi near Chivhu and Nyuni near Masvingo.

Manganese

Manganese deposits are found in Kwekwe, Gweru, Makonde, Mberengwa. Nickel rich nickel-manganese cathodes and also iron manganese phosphate cells present another opportunity for Zimbabwe to capitalise on.

67 Yilei Sun and Melanie Burton, 'Please mine more nickel, Musk urges as Tesla Boosts Production Reuters,' *Reuters*, July 23, 2020, https://www.reuters.com/article/us-tesla-nickel-idUSKCN24O0RV..

Phosphate

Significant deposits are found in Buhera with an average annual output of 60,000 tons.[68] As the lithium iron phosphate battery industry continues to grow, there is significant room for the phosphate industry to ramp up output, boosting the country's foreign exchange earnings.

Lithium

Zimbabwe is among the largest producers of lithium concentrate in the world.[69] Lithium deposits are present in Goromonzi, Mudzi, Buhera, Bikita, Chegutu, Hwange, Harare, Insiza, Rushinga, Mutoko, Mutare and the Hwange areas in Zimbabwe.[70] Lithium has traditionally been mined in Bikita and Kamativi near Hwange. As the transition to e-Mobility accelerates across the globe, lithium has emerged as a critical mineral for battery storage in both mobility and stationary storage applications. A number of new lithium projects are at various stages of implementation such as the Prospect Resources' Acacia mine near Harare that broke ground during 2018.

Another new lithium mine is planned 80 km from Bulawayo by Premier African Minerals at their Zulu Lithium and Tantalum project. The mining industry recorded a 13% growth in 2018 with lithium seeing the biggest jump at 70% year on year from 2017.[71] As the EV industry continues to grow across the globe and as new mines open up in Zimbabwe, lithium is set to be one of the most significant minerals contributing to employment creation, foreign exchange earnings growth, skills development and technology transfer, and tax revenues. An immense opportunity exists for minerals beneficiation and value addition to transition from just exporting the lithium ore but to initial battery cell production.

Anode materials

Graphite

Graphite deposits are found in Hwange, Hurungwe, Kariba, Makonde. Traditionally, graphite has been mined near Karoi at Linx mine, which has 526,828 tonnes of reserves. Zimbabwe's graphite output is estimated to be around 6,000 tons per annum.[72]

68 KPMG Zimbabwe, *Zimbabwe Mining Guide* (Harare: KPMG Zimbabwe, 2018), https://eoi.gov.in/harare/?pdf7472?000.

69 Onias Sitando and PL Crouse, 'Processing of a Zimbabwean petalite to obtain lithium carbonate,' *International Journal of Mineral Processing* 102–103 (2012): 45–50.

70 Minerals Marketing Corporation of Zimbabwe, 'Minerals found in Zimbabwe,' http://www.mmcz.co.zw/products/.

71 Chamber of Mines of Zimbabwe, "Annual Report 2019".

72 Zimbabwe Mining Development Corporation (ZMDC), 'Mining Projects and Opportunities for Investment,' brochure (2017), http://www.sera.co.zw/wp-content/uploads/2018/01/ZMDC-Investment-Opportunity-Brochure-8.pdf.

Other materials

Copper for electric motors

There over 70 known copper deposits in Zimbabwe. Operations at the largest copper mines, such as Mhangura, have been mothballed for almost 20 years. The ZMDC is working on resuscitating them and attracting investment into the copper mining sector via their call to interested investors to take advantage of the wide range of investment opportunities focusing initially on three mines namely, Mhangura, Alaska and Sanyati. As the transition to e-Mobility accelerates, and demand for electric motors grows, this should open up new markets for Zimbabwean copper.

Beneficiation of local resources and opportunity for local battery assembly and ultimately manufacturing

With Zimbabwe hosting a large cross-section of minerals and materials for lithium batteries required in the EV industry, there is a unique opportunity for the country to move from exporting minerals and other materials to manufacturing battery cells locally. Zimbabwe already has a rich history of battery manufacturing in the lead acid space.[73] There appears to be a desire to position Zimbabwe in the battery manufacturing space with lithium ion batteries.[74]

Strong focus should be placed on attracting battery cell manufacturers using the recent Zimbabwe Special Economic Zone incentives.[75] These incentives include corporate tax holidays and duty-free importation of capital equipment. Players in the mining sector should be encouraged to leverage on local and regional academic, industrial, research and development institutions to spearhead the development of beneficiation initiatives. Regional governments must set up guidelines for a phased approach of introducing quotas of minimum thresholds of the annual mining output that must contribute to the local beneficiation of resources.

Conclusion

The interface between the distributed renewable energy generations space, the mining industry for EV related minerals and materials, and clean transportation focusing on BEVs could unlock revenue, boosting efficiencies to catalyse growth in the Zimbabwean

73 See: Kariba Batteries, 'About Us,' http://www.karibabatteries.co.za/About-Us.
74 'Zimbabwe to set up battery manufacturing factories,' *Zimtech Review*, November 20, 2018.
75 Special Economic Zones in Zimbabwe, 'Incentives,' https://www.zimseza.co.zw/incentives/..

economy. E-Mobility can lower the operating costs of transport operators, reduce their downtime and the time lost in fuel queues, thereby improving the local industry's competitiveness in the region. The BEV ecosystem can also reduce the fuel import bill, improving the country's current account deficit. Moving to a multimodal mobility ecosystem by increasing the penetration of micromobility options can improve accessibility to marginalised areas. Accelerating the transition to e-Mobility will improve productivity and also improve affordability for marginalised groups. Updating the current Zimbabwe Motor Industry Policy to align it with international trends on e-Mobility and setting definitive targets for EV adoption is recommended to rebuild a sustainable local vehicle assembly industry.

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