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Strengthening Africa's Role in the Battery and Electric Vehicle Value Chain

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KEY MESSAGES

- **Africa is endowed with significant reserves of green minerals required for the energy transition but currently operates at the primary level of the battery and electric vehicle value chain**
- **Strengthening the value chain requires Africa to develop a Green Minerals Strategy to fast-track development of the continent's green mineral resources towards creating more value on the continent and expanding exports and intra-African trade leveraging the African Continental Free Trade Area (AfCFTA)**
- **The DRC, in partnership with other countries, can leverage its abundant cobalt resources and its hydroelectric power to become a low-cost and low-emissions producer of lithium-ion battery precursor materials and cells.**
- **African Champions must be invited to the table and given incentives to encourage investment on the continent.**

1 | INTRODUCTION

As the world reboots its economies from the impact of Covid-19 pandemic, it is important to adopt an economic development model that lessens environmental, climate and disaster risks and one where social and economic benefits are inclusive. At the core of the recovery and in line with commitments under the Paris Agreement, is the clean energy transition to drive economies. This involves uptake of technologies that reduce emissions such as wind and solar energy and less of fossil fuel-based technologies. Whilst clean energy and decarbonizing international investment and finance seem to be dominating the development discourse, what is less talked about is the minerals, including rare earth minerals, metals and construction materials needed for this to happen.

According to the United States Geological Survey (USGS) data on global mineral reserves, Africa hosts: Cobalt (52.4%), Bauxite for aluminium production (24.7%); Graphite (21.2%), Manganese (46%) and Vanadium (16%). This is just the tip of the iceberg because current exploration activities in Africa are delineating huge strategic mineral deposits. Specifically for cobalt, the Democratic Republic of Congo (DRC) is well positioned to take a leadership position in the energy transition industry as well as derive significant economic benefits because it accounts for 70% of the world's cobalt production and over 51% of global reserves. These minerals are needed for the energy transition as they serve as critical feedstock for battery and Electric Vehicle manufacturing vale chain.

However, despite Africa's huge battery mineral resources the continent remains a price taker and a commodity exporter largely locked at the mining stage, which is at the bottom of the global battery and electric vehicle value chain estimated to reach US$ 8.8 trillion by 2025 (Bloomberg New Energy Finance, 2021). To partake in this value chain, it is important for African countries to break the excessive dependence on the export of natural resources by creating more value on the continent through resource-driven industrialization, strengthening productive capabilities and expanding exports and intra-African trade leveraging the African Continental Free Trade Area (AfCFTA). Better integration into global value chains will not only contribute to the achievement of the Sustainable Development Goals (especially goals 8 and 9) and enlarge the share of wealth retained locally but also strengthen the competitiveness of local SMEs and enable creation of decent jobs for the youth.

This policy brief seeks to identify challenges and success factors for Africa to move up the ladder and optimise benefits from the opportunities provided by the energy transition, especially from the battery and EV value chain. This is a desk-based research with input from previous studies conducted by the African Natural Resources Management and Investment Centre of the AfDB on lithium- cobalt (African Development Bank, 2021), rare earths (African Development Bank. , 2021) and precursor production in the DRC[1] (Bloomberg New Energy Finance, 2021) as well as contributions from the Energy Policy, Regulation and Statistics unit (PESR1) of the African Development Bank.

Importance of Battery and Technology Minerals in the Energy Transition

A 2020 World Bank report has estimated the production of minerals such as graphite, lithium, nickel and cobalt, could increase by nearly 500% by 2050 to meet the growing demand for clean energy technologies (World Bank, 2020). The report estimates that over 3 billion tons of minerals and metals will be needed to deploy wind, solar and geothermal power, as well as energy storage, required for achieving a below 2°C future. The mineral intensity is such that even if the recycling rate for copper and aluminium is 100%, recycling and reuse will still not meet the expected steep demand. Aside the demand, supply constraints and disruptions are likely to be exacerbated by economic sanctions in the wake of the Russia's invasion of Ukraine and Russia's role in the metals and mining supply chain. However, it is noted that mining and processing of mineral resources gives rise to a variety of environmental and social issues that, if poorly managed, can harm local communities and disrupt supply. Emissions from mineral development can be significantly reduced by a shift in fuel sources and by using low-carbon electricity. A simulation of an indicative refined copper production project under different energy consumption profiles reveals a wide variation in emissions intensity depending on the type of fuel used and the intensity of electricity supplied by the grid. Shifting all fuels to natural gas would bring emissions down by 10%, while using renewable-based electricity reduces CO_2 intensity by about two-thirds. Further reductions could be achieved through the electrification of fuel use. When combined, electrification and renewable-based electricity have the potential to reduce emissions intensity by almost 80%. Similar trends are also visible in nickel production[2] (International Energy Agency, 2022). Fuel switching, low-carbon electricity and investment in energy efficiency can significantly reduce the emissions footprint of mineral production in the near term.

According to a study (International Council on Clean Transportation., 2022) by the International Council of Clean Transportation (ICCT) based on currently adopted policies[3] (Baseline scenario), CO_2 emissions from ICE vehicles (excluding 2&3-wheelers) in Africa will reach 909 million tonnes in 2050, 2.3 times the 2020 level. However, an accelerated transition to electric vehicles (International Energy Agency, 2019) in Africa could instead reduce CO_2 emissions to 53% below the 2020 level by 2050. The CO_2 mitigation potential is amplified by the fact that many African countries already have green power grids with high shares of low-carbon electricity generated from hydropower, geothermal, solar, and wind energy. Clearly moving from ICE vehicles to EVs is beneficial to the environment.

The global transition towards green energy and rapid decarbonization holds significant opportunities for Africa. It has spurred the demand for electric vehicles and investment in battery-powered storage systems. The Democratic Republic of the Congo (DRC) is at the heart of the dynamic battery value chain as it is endowed with strategic minerals that are components of lithium-ion batteries, used for energy storage and electric mobility. Whilst the strategic minerals are many, there are some whose importance is most high based on current battery chemistries. These are lithium, cobalt, nickel, manganese, graphite, iron and phosphate. These minerals are main components in the production of lithium-ion Batteries (LIB) used in Electric Vehicles (EV) and electricity storage. Multiple cathode chemistries remain in common use, each with different characteristics. The cathode chemistries are named based on the specific materials used in each type. Lithium iron-phosphate batteries, for example, are typically known as LFP. A nickel-manganese-cobalt oxide (NMC) battery is further identified by the proportion of those materials to each other. An NMC (811) battery

1 https://assets.bbhub.io/professional/sites/24/BNEF-The-Cost-of-Producing-Battery-Precursors-in-the-DRC_FINAL.pdf
2 https://iea.blob.core.windows.net/assets/ffd2a83b-8c30-4e9d-980a-52b6d9a86fdc/TheRoleofCriticalMineralsinCleanEnergyTransitions.pdf
3 developing charging infrastructure; providing incentives that make EVs cost-competitive with ICE vehicles; establishing EV and battery manufacturing capacity; electrifying public transportation, especially electric 2&3-wheelers; and making use of international support.

has 8 parts nickel to 1 part of manganese and 1 part cobalt. Likewise, an NMC (622) battery has 6 parts nickel to 2 parts of manganese and 2 parts cobalt.

Another group of minerals is the rare earth elements which are useful in producing strong magnets and components for wind turbines and solar equipment. With the global commitments to reduce Green House Gases (GHG) emissions and create a low carbon future, the LIB has emerged as one of the best solutions to the GHG emission challenge. It powers electric vehicles expected to replace fossil fuel-powered vehicles, and stores electricity from wind, solar and tidal power plants. In 2020, battery technology accounted for 71% of the share of lithium consumption in the manufacturing sector.

Fuelled by an increasingly renewable electrical grid, electric vehicles (EVs) offer potential to significantly reduce carbon emissions compared to internal combustion engine vehicles. Electric Vehicles account for 61% of batteries produced from 2016 to 2021, whilst 34% relates to consumer electronics and 5% for stationary storage. Currently lithium-ion batteries have life span between 15 to 20 years but this is expected to increase as technology improves. Growth in electric vehicle sales has been particularly impressive over the last three years. Electric car sales increased from 2.2 million in 2019 to 6.6 million in 2021, representing close to 9% of the global car market and more than tripling their market share from 2019. Currently the IEA estimates there are about 16 million electric cars on the road worldwide, consuming roughly 30 terawatt-hours (TWh) of electricity per year[4]. This is expected to grow rapidly due to the buoyant Chinese, European and the USA car markets. In China this is driven by national subsidies and new affordable smaller EV models. In some western countries, the surge in EV sales is partially driven by new carbon dioxide (CO_2) emission standards and subsidies, whilst consumers benefit from generous tax credits. Added to these interventions is the major policy announcements by Governments and industry players to phase out about 50% of ICEs by 2035[5]. The EV uptake in Africa is yet to gain momentum due to several factors including inadequate policy and regulatory landscape to create the needed demand. Other challenges are discussed under section 3.

Creating the demand for battery and EVs in Africa will also require the requisite skills and competencies for the burgeoning industry. Africa's often cited demographic dividend, the aspirations of its youth and the skill requirements of the economy - all hinge on well-functioning skills development programmes, which should be a key continental priority. Aside skills, funding will be needed for the entire EV value chain (exploration, mining, beneficiation, cathode and anode manufacturing, separator manufacturing, cell production, battery assembly and finally, the assembly of electric vehicles). And this is far beyond what public resources could provide. Private sector, particularly African private sector, investments will be essential to climb up the ladder in these important value chains.

2 | AFRICA'S PLACE IN THE GLOBAL BATTERY AND ELECTRIC VEHICLE VALUE CHAIN

The DRC has the largest cobalt mineral reserves of 3.6 million metric tonnes (USGS, 2021), equivalent to 51% of the global cobalt reserves. Countries producing cobalt in Africa include the DRC, Madagascar, South Africa, and Morocco, with the DRC producing 120,000 metric tonnes in 2021, equivalent to 70% of global production. It is also noteworthy that 15% of the DRC's annual production comes from local artisanal and small-scale miners. The Artisanal and Small-Scale Mining sector has been highlighted as a challenge since child labour and safety issues are not well addressed and some buyers are looking for alternative cobalt markets and/or cobalt chemistry alternatives in the battery manufacturing. Whilst Africa has rich Lithium and Cobalt resources, little to no value addition takes place. Zimbabwe only mines and exports raw lithium ore from its Bikita mine and the DRC extracts and exports raw ore or concentrate of cobalt.

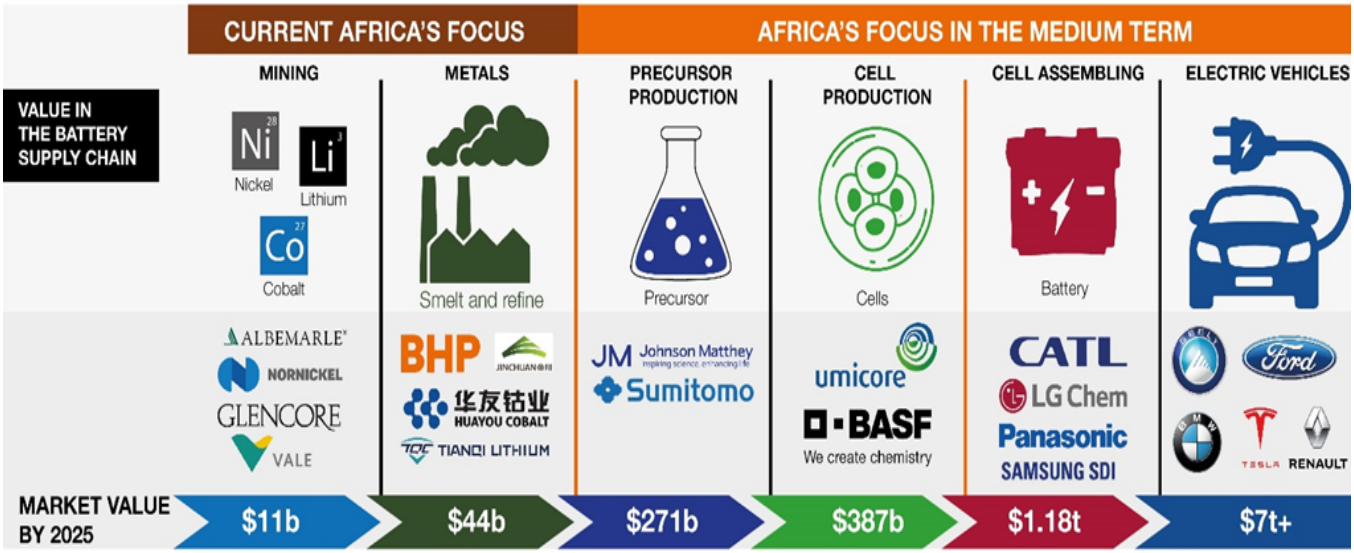
Table 1 below presents summary estimates of the percentages of world reserves of critical minerals found in African countries, along with the 2050 projected annual demand of those minerals for energy technologies as a percentage of their production in 2018. From the estimates, the demand for critical minerals for the global low-carbon energy transition in the coming decades tends to boost mining activities in resource-rich African countries. The African mining sector can anchor demand for energy infrastructure development and, at the same time, provide the mineral inputs needed for the establishment of the end-to-end EV value chain in Africa, thereby strengthening African countries' industrial base, reducing their dependence on commodities and improving their balance of payments.

From a regional geological perspective, the current confirmed mineral resources in Africa could be a tip of the iceberg. This is because similar geological formations on the continent which have the potential

4 IEA, 2022. Electric cars fend off supply challenges to more than double global sales

5 The US government announced in November 2021 an ambitious 50% electrification target for new cars by 2030, supported by the announcement of the installation of 500 000 charging points to help increase consumer confidence. At the same time, several automakers announced electrification targets. For example, VW and Ford indicated half of their sales would be electric by 2030, whilst Toyota, the largest car manufacturer in the world, announcing new investments aimed at achieving electric car sales of 3.5 million a year by 2030.

UNDERSTANDING BATTERY AND THE EV SUPPLY CHAIN



Source: BloombergNEF, Australia Government's Future Batteries Industry CRC

TABLE 1 PERCENTAGE OF WORLD PROVEN RESERVES OF CRITICAL MINERALS IN AFRICA AND THEIR PROJECTED GLOBAL DEMAND INCREASE

	Percentage of some selected world proven reserves										Projections
Mineral / Country	**DR Congo**	Gabon	Ghana	**Guinea**	Madagascar	Morocco	Mozambique	**South Africa**	Tanzania	Zambia	Zimbabwe	**2050** projected global annual demand from energy technologies as % of 2018 global annual production
Bauxite				**25**								9%
Cobalt	**51**				1.4	0.2		0.5				460%
Copper	2.2									2.4		7%
Graphite					8.1		7.8		5.3			494%
Iron ore								0.1				1%
Lithium											1	488%
Manganese		4.7	1					**40**				4%
Vanadium								**16**				189%

SOURCE World Bank data on 2050 projected annual demand for 17 critical minerals, and USGS data on global reserves.[7]

for further discoveries, are yet to be explored, and current exploration efforts continue to make discoveries (African Development Bank, 2021).

Currently Africa operates at the primary stage of the battery minerals and electric vehicle value chain which is estimated at US$8.8 trillion by 2025[6] (see figure below). The primary stage (mining and metals refining (labelled as current focus) of the value chain is also estimated at US$55 billion by 2025. However, Africa's focus in the medium term is to at least start producing battery precursors (chemicals for cell production) and cells in the medium to long term.

6 Bloomberg New Energy Finance and Australian Government Battery Future Batteries Industries, CRC

In a bid to avoid risks resulting from individual trade policies, major battery minerals consumers like China, the USA, the EU, Canada, Australia, Japan and Korea could be important allies in the developing value chains. Identifying synergies with major battery manufacturers and users such as LG, Samsung, and Tesla should be accelerated in a bid to create a clear market for the continent. It is becoming common practice for miners in the developed world to engage in joint ventures or propose agreements that facilitate the development of the full value chain.

3 | CHALLENGES IN ASCENDING THE VALUE CHAIN LADDER

For Africa, moving up the value chain remains the priority. However, this is without challenges. Key challenges to surmount include the absence of a robust strategy to take advantage of the opportunities presented by the energy transition. Aside this, other challenges include difficulty in attracting funds for exploration, lack of detailed feasibility studies towards development of discovered resources, inadequate infrastructure in terms of rail and road transport systems and port facilities and inadequate access to reliable and affordable energy. Further challenges comprise market control and lack of skills. The fact that all high-tech consumer goods using battery minerals (lithium and cobalt) as main raw materials, are manufactured outside Africa makes it a challenge but also an opportunity to localise these manufacturing segments. In 2019, 72% of the refinery production took place in China with the rest shared by Finland (9%), Japan (4%) and Canada (3%) with the rest of the world representing 12%. The market lies with China and the Western world, even though over 52% of the world's cobalt reserve is in Africa. Breaking this market stronghold is what Africa must figure out. Africa is also yet to develop regulations and policies pertaining to EV-related manufacturing, technical standards and charging infrastructure.

Many other challenges relate to inadequate demand on the African continent to justify the business case for localizing components of battery manufacturing value chains in African countries where battery minerals are mined. Added to this is the inadequate electricity supply and charging infrastructure for EVs. The continent's shift to electric mobility is lagging far behind the rest of the world. In South Africa, which is thought to be the largest EV market on the continent, only 1,000 out of more than 12 million vehicles on its roads are EVs (International Energy Agency, 2022). Specifically, South Africa sold only 92 battery electric vehicles (BEVs) in 2020, down from 154 in 2019, representing 0.02% of domestic vehicle sales (Tanderayi Mukeredzi, 2022). The low percentage of EVs on Africa's roads can be attributed to the cost of EVs and the low-income levels of most African families. Creating this demand will require a number of factors including coherent automotive policies to facilitate establishment of industries to manufacture LIBs and EVs (especially 2 & 3 wheelers and E-buses) which are seen as Africa's low hanging fruits. This will also facilitate Joint Venture arrangements with experienced global companies to invest in EV infrastructure and creating consumer awareness of the need to decarbonize, especially setting achievable targets for major companies to gradually replace their ICE fleet with BEVs.

Aside the opportunities provided by the energy transition to critical mineral rich nations, extraction of the minerals can exacerbate environmental and other risks in countries with governance challenges. At the mining stage, this calls for policies to guide gradual transformation of mining ICE fleet to EVs. On the midstream part of the value chain, the main danger associated with the LIB value chain is the disposal of waste material. Recycling is expected to alleviate some of these environmental issues but because the battery industry is still at the development stage, recycling is yet to be established in earnest primarily because of the economics of undertaking the recycling process. Currently only few battery recycling plants exist globally bringing into question how End of Life (EOL) batteries will be disposed in countries without recycling facilities

In Africa, sustainability is a major issue for artisanal and small-scale miners – the mining methods are a risk to both the environment and society, and the use of child labour is endangering children and threating the existence of the development of the mining industry. Thus, it is important to develop appropriate policies and strategies to improve sustainability across the EV battery supply chain. This will facilitate building regional infrastructure for battery recycling, transportation and creating regulatory certainty for recycling.

4 | IMPROVING AFRICA'S VALUE PROPOSITION: COMPETITIVENESS AND SUCCESS FACTORS

This section discusses competitiveness and some key success factors aimed at improving Africa's value proposition.

4.1 Competitiveness: Downstream Value Addition and Free Trade Area

A 2021 report by BloombergNEF sponsored by the African Development Bank and its Partners (UNECA, ALSF, AFC, AFREXIMBANK, BADEA) found that the DRC, in partnership with other countries[7], can leverage its abundant cobalt resources and its hydroelectric power to become a low-cost and low-emissions producer of lithi-

7 South Africa & Gabon (for Manganese), Madagascar (Nickel)

um-ion battery cathode precursor materials. It estimates that it is three times (3x) cheaper to build a cathode precursor plant in the DRC than in the USA; and similarly, much cheaper and less polluting than in China and Poland. Africa's wealth of battery minerals can be used to attract more value-add in downstream processing and manufacturing on the continent.

The African Continental Free Trade Area (AfCFTA) agreement is a significant policy instrument that can be leveraged to help Africa achieve its trade objectives. The AfCFTA has potential to create the largest free trade area in the world by participating countries. It covers 1.39 billion people with a combined gross domestic product valued at US$3.4 trillion. The AfCFTA could facilitate growth of intracontinental trade from $294 billion in 2014 (base year) to $532 billion after implementation of AfCFTA in 2035. The global electric vehicles industry will be a US$46 trillion market between 2021 and 2050, according to BloombergNEF's Long Term Electric Vehicle Outlook. This market could play a role towards the African Union's Agenda 2063, which is an African blueprint and masterplan to transform the continent. The AfCFTA can also support Africa's auto sector by improving cross-border manufacturing and sales.

In 2020, original equipment manufacturers (OEMs) sold 856,792 vehicles assembled in Africa, according to data from the Africa Automotive Data Network. Of the vehicles assembled on the continent, OEMs in South Africa sold 44% of the vehicles, followed by Egypt and Morocco with 26% and 16%, respectively. Africa can therefore leverage on its existing internal combustion engine expertise, the AfCFTA, raw materials and geographical proximity to key auto markets to become a major electric vehicle supply chain player.

4.2 Strengthening Existing Initiatives and Success factors

For Africa to go up the ladder in the battery and EV value chain, the following success factors needs to be strengthened.

The Africa Mining Vision (AMV) and the International Study Group (ISG) report on Minerals for Africa's Development have set pathways to an enhanced contribution of the extractive sector to Africa's sustainable development hinged on the aspirational objectives of transparent, optimal and equitable exploitation of mineral resources. However, these frameworks did not take into account emerging issues relating to climate change and the energy transition. At the sectoral level, the current African Commodities Strategy broadly covers agriculture, energy and minerals. However, this strategy did not give prominence to the new global trends relating to climate change and the global low carbon future. In effect, the challenges and opportunities provided by these global trends would not be efficiently addressed using the existing strategic frameworks. The missing gap therefore is the absence of a coherent and smart strategy to guide development of the critical mineral value chains. **A coherent and robust African Green Minerals Strategy** is thus needed for implementation to guide Africa's vision of leveraging its critical mineral resources for green energy and optimization of benefits for socio-economic development.

Aside development of an African Green Minerals Strategy, the following initiatives needs to be strengthened.

a) Electrification of 2&3-Wheelers: Electrification of two- and three-wheelers could be a big opportunity for Africa. Annual imports of 2&3-wheelers into Africa are estimated to be about 4 million units valued at US$2.7 billion, with a current fleet of around 15 to 20 million vehicles. Africa is set to become the second largest market for motorcycles (in unit terms) after Asia and will grow rapidly over the next decade. Currently, Uganda and Rwanda are manufacturing new electric motorcycles, retrofitting existing ICE motorcycles, and assembling electric motorcycles and battery packs. Other countries manufacturing and assembling two and three wheelers include South Africa, Ghana and Kenya. Additionally, a number of companies are currently investing in charging infrastructure for electric 2&3-wheeler charging. Startup companies have also taken advantage of these opportunity and have invested into renting the 2&3 wheelers for dispatch among others. In terms of buses, Kiira Motor Corporation of Uganda has almost completed the construction of an electric vehicle manufacturing plant. There are other existing vehicle manufacturing Plants on the continent that can be retrofitted to assemble/manufacture EVs. Africa can therefore capitalize on its growing demand for vehicles as it urbanizes, to create a critical mass for battery demand to support cell manufacturing at a macro scale. The availability of the main raw materials required to make cells within the continent makes it both a cost competitive destination and an environmentally friendly one as well as exemplified in the DRC.

b) Electric shared mobility: Due to low levels of individual car ownership, shared mobility such as buses and taxis are common in Africa. These modes could potentially accelerate the transition to electric vehicles. South Africa has introduced electric buses, 3-wheeler taxis, and taxi services for ride hailing. Ghana aims for a significant transition to electric buses by 2050. Ghana also has solar powered taxi service, used for ride hailing. In Nairobi, Kenya, a ride hailing company is operating 30 electric Nissan Leafs. Several mobility service providers are using electric motorcycles as part of their motorcycle taxi fleets.

c) Leapfrogging Manufacturing of Electric Vehicles: Africa's competitive advantage lies largely in the green minerals required for the energy transition. Africa therefore needs to use these minerals as feedstock for producing battery for the EV value chain among others. Morocco is currently working with three major international automakers to build EV manufacturing plants and aims to build EV

production capacity of 1 million vehicles by 2025[8]. South Africa has a lithium-ion battery precursor pilot plant. Other examples include Rwanda, incentivizing EV production and Tunisia building capacity for manufacturing EV components. A recent study BNEF sponsored by the AfDB and its Partners, also confirmed the viability of producing battery precursors in the DRC. Africa just needs to improve governance systems and also develop policies and incentives to attract scarce investment capital for value chain development.

d) Research, Development and Innovation: Examples on the continent include South Africa's national uYilo e-mobility programme which is developing facilities including national accredited battery and material testing, battery manufacturing, recycling, second-life usage, and vehicle-to-grid technology.

e) Developing Charging infrastructure: Availability of energy and charging infrastructure is one of the key pre-requisites for rapid EV deployment. Given that Africa is energy deficient, it will be important to improve upon its energy access. This is where stand-alone renewable energy sources comes in. Policies need to be fast tracked to attract investment into this area. Countries such as Cape Verde, Ghana and Morocco are already investing into charging infrastructure. There is also the possibility for battery swaps which will address challenges relating to charging duration among others.

5 | POLICY RECOMMENDATIONS

From the above analysis, it is clear that lithium-ion batteries are a core technology that will contribute to the energy transition, especially electrification of the transport fleet. Overall Africa's green minerals can drive the continent's strategy for a just climate and energy transition, given the sheer abundance of these critical minerals, which creates a comparative advantage, and the incipient opportunities to convert the resource potential into new investments, jobs and markets. Aside the mineral endowment, other factors needed to give Africa the impetus to climb the ladder include governance improvement, especially transparency in the business processes will be required.

Policy recommendations include the need to:

i. **Develop an African Green Minerals Strategy** to fast-track development of the continent's green mineral resources to create economic benefits from the global energy transition. This strategy should have key provisions including establishing an African Battery Alliance (ABA) with the objective of promoting battery manufacturing and recycling on the continent. This alliance will also foster international cooperation between other global battery associations as well as regional integration to address the challenge of economies of scale among others.

ii. **Improve investment climate and provide policy certainty through policy and regulatory reforms to strengthen predictability and global competitiveness**. Supportive policies could also include low-cost measures to promote domestic demand for electric two-wheelers (lower taxes, subsidies) and support for domestic production (tariffs on imports of automotive products with some exemptions for components). This will serve as basis for raising capital both externally and domestically to develop the battery and the EV value chain.

iii. **Scale up infrastructure investments (clustered around Special Economic Zones) and implement smart local content policies** with a view to fostering the emergence of globally competitive domestic firms that would supply goods and services to the Battery Electric Vehicles (BEV) value chain.

iv. **Improved knowledge of the green mineral resources** (in terms of quantifiable resources and reserves) will be required. Currently exploration capital is scarce on the continent and there is the need for development of different types of investment vehicles to support mineral exploration up to the pre-feasibility level. This will afford Governments and the private sector accurate information to negotiate deals under win-win circumstances. The identified investment vehicles can also be used to mobilise additional resources for projects along the mineral value chain from mining to product manufacturing.

v. **Improvement in the renewable energy investment landscape** will be critical for mining to serve as an anchor to provide energy for other economic activities. Africa's mining sector will be a key user of grid-based renewable power. Battery energy storage systems can be leveraged to integrate the mining sector's power demand in broader energy planning as well amend legal framework for mining to ensure that mines systematically adopt renewable energies to power their needs.

vi. **Foster the development of mineral based industrialization and regional value chains within the context of the AfCFTA** by exploring

8 According to Ryad Mezzour, the Moroccan minister for trade and industry, the country is on track to start manufacturing as many as 100,000 electric cars per year within the next two to three years. Fortunately, Morocco's existing industrial facilities alone are capable of reaching this lofty goal, although helpful international investment may also be on the table in coming years.

product complementarity, realizing economies of scale, and expanding intra-African trade in intermediate and finished goods and services. The cost of EVs can also be reduced through trade agreement and international financing to lower or waive import duties among others. Governments serving as offtakers of EV products will be very essential to boost demand.

vii. **Establish Centres of Excellence for battery development** with a view to developing local skills and competencies, as well as increasing domestic R&D, science, technology, and innovation capabilities. Additionally, there the need to explore the solar panel and wind turbine value chain in Africa.

viii. **Support Intra-African Investment.** African Champions must be invited to the table and be given incentives to encourage investment on the continent. Also special purpose vehicles (SPVs) can be created to facilitate Joint Venture (JV) partnerships with investors to help reduce regulatory red tape, de-risk projects and facilitate a well-structured knowledge transfer between multinationals and local companies.

ix. **Develop appropriate policies and strategies to improve sustainability across the EV battery supply chain.** This will facilitate building regional infrastructure for battery recycling and transportation and creating regulatory certainty for recycling.

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