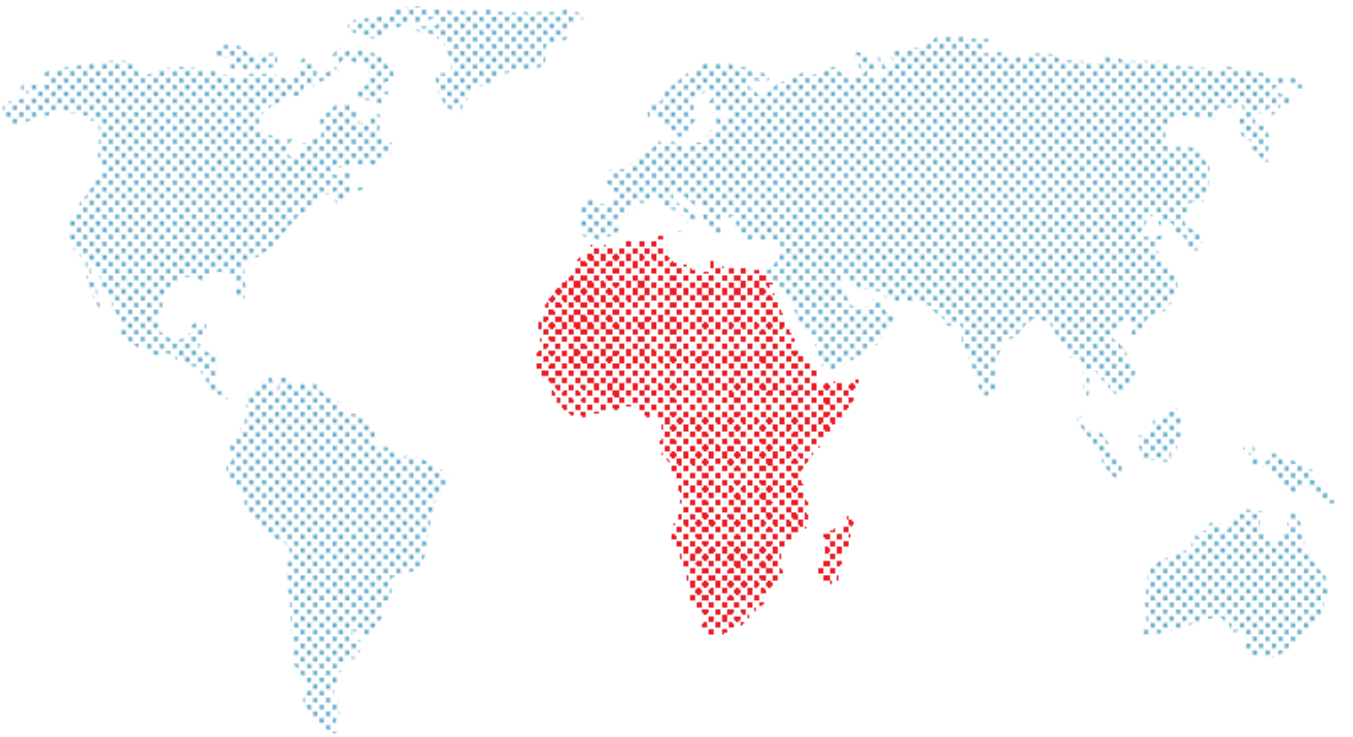
AFRICA: A NEW MARKET OPPORTUNITY

Johnson Matthey

Clean Air Division



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Executive Summary

The purpose of the report is to show Johnson Matthey a new market opportunity in Africa to offset future revenue declines in autocatalyst technologies in established markets due to electric vehicles. Africa's population and household incomes are rising rapidly, providing more and more Africans with the ability to purchase new vehicles. With Africa's automotive market having one of the highest growth prospects in the world being coupled with African nations keenness to securing a spot as a beachhead for the automotive industry, Africa has extremely high potential to insulate Johnson Matthey from the immediate effects of the electric vehicle revolution.

Currently, Nigeria has a population of 206.1 million with 6% of the population having a vehicle, Uganda has a population of 45.7 million with 3.1% having a vehicle, Ghana has a population of 31.1 million with 2.9% having a vehicle, Morocco has a population of 36.9 million with 7.6% having a vehicle, Egypt has a population of 102.3 million with 4.6% having a vehicle, and Tanzania has a population of 59.7 million with 0.6% having a vehicle. To compare, South Africa has a population of 59.3 million with 16.2% of the population having a vehicle. Africa's automotive market is largely untapped and will only continue to grow. Important to note is that Africa is heavily resistant to electric vehicles due to a lack of infrastructure to support them. South Africa, the continent's most developed country, only sold 66 EV's in 2019 and has no known public charging stations.

Innoson Vehicle Manufacturing Company is an automobile producer in Nigeria currently producing 10,000 vehicles annually with increasing demand and is the largest indigenous African vehicle manufacturer. Foreign Vehicle manufacturers Peugeot Automobile Nigeria and Dana motors also assemble in Nigeria with combined production capacities of 82,000 vehicles annually. Uganda forecasts new vehicle demand to increase from 2,500 to over 600,000 vehicles annually by 2030 in Eastern Africa. Kiira Motors Corporation is a state enterprise car manufacturer based in Uganda currently producing 5,000 vehicles annually and has ties with Cummins. Kiira Motors is also in talks with the UK's trade envoy to Uganda to discuss future funding for their assembly plants. Kantanka Automobile is an automobile producer in Ghana and has sold over 1,000 vehicles since commercial operations began from 2017 to 2020. Volkswagen and Mahindra & Mahindra Limited also recently opened assembly plants in Ghana to serve future demand in Ghana and neighboring West African countries.

Morocco's automotive sector is expected to grow by $14 billion within the next 5 years due to recent government incentives and foreign investment. Dacia, Renault, and Hyundai have the largest market share in the country and PSA Peugeot Citroen invested $615 million in a manufacturing facility in 2019 to increase their production capacity to over 700,000 cars annually. Dacia also produces over half of their total vehicles in Morocco alone. Egypt's major producers are Ghabbour (GB) Auto, General Motors, and Nissan with new vehicles sales surging above 200,000 annually. Further, due to Egypt's natural gas surplus, Egypt initiated a vehicle conversion to compressed natural gas (CNG) initiative for 1.3 million cars in March 2021 which requires methane-specific catalytic converters. Lastly, Toyota, Ford, and Nissan were the top 3 brands in Tanzania with new vehicles sales of only 3,000 annually due to easy access of

imported used vehicles. However, Tanzania has begun to prioritize the automotive segment as a key revenue generator and encourage flows of FDIs in the automotive sector. Tata is also the market leader in Tanzania's Medium Duty truck segment.

Nigeria, Uganda, Ghana, Morocco, Egypt, and Tanzania have growing economies and a high GDP growth rate, the most important indicator of economic health. Each country, with the exception of Tanzania to a lesser degree, also have a fast-growing industrial sector to further accelerate their automotive industry. Labor forces within each country are becoming increasingly educated and well-trained due to international sponsors such as the World Bank and the International Monetary Fund and have massive and fast-growing populations to support them.

Introduction

With the world beginning its transition to electric vehicles (EVs), Johnson Matthey must begin exploring new markets and opportunities to maximize the life of their autocatalyst technology business. Following the lead of California in the 1960s, automobile emission controls were progressively tightened throughout the western world.[1] In response, JM developed and produced the first catalytic converter to manage vehicle pollution in the world in 1974. Since then, JM has become the world's largest supplier of automobile catalytic converters by volume in 2013, with sales of devices that alter environmentally damaging car and truck emissions.[2]

However, EVs are beginning to replace traditional gasoline and diesel-powered vehicles making catalytic converters obsolete. In 2019, EVs accounted for 2.6% of global passenger vehicle sales and jumped to 7% in the first half of 2021.[3] The UK announced its intentions to make its transportation sector fully electric by 2040 and the US expects half of its new car sales will be electric by 2030. With many other governments following, such as when much of the western world followed the lead of California in the 1960s, JM must continue to explore new markets and opportunities.

Although much of the developed world is making the switch to EVs, there are still growth prospects in the traditional automotive market. Africa is beginning to emerge as a traditional automobile production hub. After the European car industry moved much of its production into Eastern Europe, some believe the next step is Africa, both for production and a growing consumer market.[4] Morocco is an emerging automobile manufacturing hub, South Africa has a history of car making, and multinational vehicle manufacturers are setting up production plants in Angola, Ethiopia, Ghana, Kenya, Namibia, Nigeria, and Rwanda.[4]

Africa has more than a billion people, 17% of the world's population, but accounts for only 1% of cars sold worldwide, compared with China's 30%, Europe's 22%, and North America's 17%, according to the Paris-based International Organization of Motor Vehicle Manufacturers (OICA). Africa has on average 44 vehicles per 1,000 people, compared with the global average of 180 and 800 in the United States, according to consulting firm McKinsey & Company.[4]

Further, Africa is home to some of the fastest growing economies in the world. Shown in Table 1 are the highest GDP growth rates within Africa in 2021.

Table 1: Highest GDP Growth Rates within Africa in 2021.[5]

African Country	GDP Growth Rate (%)
Kenya	7.6
Botswana	7.5
Niger	6.9
Mauritius	6.6
Uganda	6.3
Cambia	6
Ivory Coast	6
Cape Verde	5.8
Rwanda	5.7
Guinea	5.6

To compare, the GDP growth rate of China was 6.7%, the EU was 1.8%, and the US was 1.2% within the same period. The magnitude of African countries GDP compared to China, the EU, and US differ greatly, however, the GDP growth rate is the most important indicator of economic health.

Africa has often been a consumer when it comes to cars. Almost every car bought and used by Africans is imported and used.[6] However, the African automobile industry is responding by beginning to produce vehicles themselves. Africa currently has a large array of automobile producers, with all but one only producing gasoline and diesel-powered vehicles. These brands include Morocco's Laraki and Menara, Libya's Saroukh El-Jamahiriya, Kenya's Mobius, Nigeria's Innoson and Proforce, South Africa's Birkin, Penara, Paramount, Uri, Bailey, IVEMA, and Harper, Tunisia's Wallyscar, Uganda's Kiira, and Ghana's Kantanka.[7]

Also, combustion fuel pollutants from vehicles is the number one cause of urban air pollution in Africa, costing $215 billion per year per a report from the Organization of Economic Cooperation and Development (OECD).[8] Urban air pollution kills about 600,000 people per year and accounts for 5.7% of all deaths in Africa.[9] In most cases, catalytic converters are removed from used vehicles being exported to Africa for their precious metals, thereby causing or further exacerbating the urban air pollution situation within Africa. Much of Africa is still developing their countries, with some countries beginning to propose legislation to tighten automobile emissions, and JM could play an integral role in reducing urban air pollution from vehicles using their autocatalyst technologies.

Many companies have already taken notice of Africa's growing markets. Foreign investment in the North Africa region grew from $5 billion in 2011 to $12 billion in 2016, most of which was linked to automotive production.[10] Morocco's car industry has already overtaken South Africa, and is expected to soon be producing more cars than Italy.[10] Volkswagen, BMW, Toyota, Nissan, and others are also making

strides in setting up additional production plants within Africa and are working with governments to draft legislation and incentives for in-house automobile production.[17]

The purpose of the report is to show Johnson Matthey that Africa offers opportunities to offset future declines in autocatalyst sales in developed countries and maximize profits over the coming years. The scope of the report covers the global rate of electric vehicle adoption, Africa's resistance to electric vehicles, the economic growth developments within African countries, future automotive growth trends within Africa, which African countries offer the greatest future benefits in the near to medium term, and labor forces within those countries.

Methods

While creating the report, it was found that the topic was an under-researched topic. There were a wide variety of reputable sources used to answer or supplement individual questions within the overall topic. Most information relevant to the topic used qualitative data analysis and secondary sources. Secondary sources were sourced from reputable associations, authors, or governmental agencies. Primary sources were originally produced using professional standards and global best practices. Quantitative data analysis was used to a lesser degree and included preparing the data in excel files and forming graphs or tables to better illustrate findings.

As a non-executive or business-related employee at Johnson Matthey, there was no internal information available regarding any JM customers within Africa that would allow for further analysis. Therefore, research was conducted assuming JM did not have business relations with any of the countries or companies found, with the exception of having a plant in South Africa. All research was collected online using search engines to find reliable sources and authors. The origins of the information found were reputable online news agencies such as Reuters and Bloomberg, research reports from universities, professionals, and government agencies, official company websites, and data platforms such as the World Bank and Statista. When selecting material, a date range of ten years was used. Almost half of all references used were from 2021, with the oldest being from 2012. There was a single outlier of 1979 due to referencing a Nobel-prize winning economist in development economics.

Ethical considerations involved in the research included matching research conclusions with their associated objectives and verifying the collection methods used were reputable. Research was conducted with integrity and transparency, and there were no conflicts of interest while writing the report. When possible, more than one source was used to cross-examine findings to ensure reliability.

The aforementioned methods constitute the standard approach to conduct research for under-researched topics without producing primary data. Primary data could not be produced due to lack of funds and not being an official representative of JM. Not being an official representative of JM meant that official contact could not be made with companies to collect additional information that would further enhance findings. Lack of funds resulted in not having the ability to access or produce advanced African country analyses via traveling to Africa to inspect production plants and speaking with official representatives (primary data). Despite these setbacks, primary data source data was found via a collection of reputable secondary data sources, and the entirety of the data collection used was sufficiently broad to produce compelling and authentic conclusions.

Findings

1. Global Rate of Electric Vehicle Adoption

As EV prices continue to fall and more models become available, it is possible we are nearing a critical tipping point with EVs poised for exponential growth in an increasing number of countries over the next decade under the right conditions.[11] Experts agree that growth of sales of electric vehicles is likely to follow an S-Curve or market diffusion curve as shown below.[11][12]

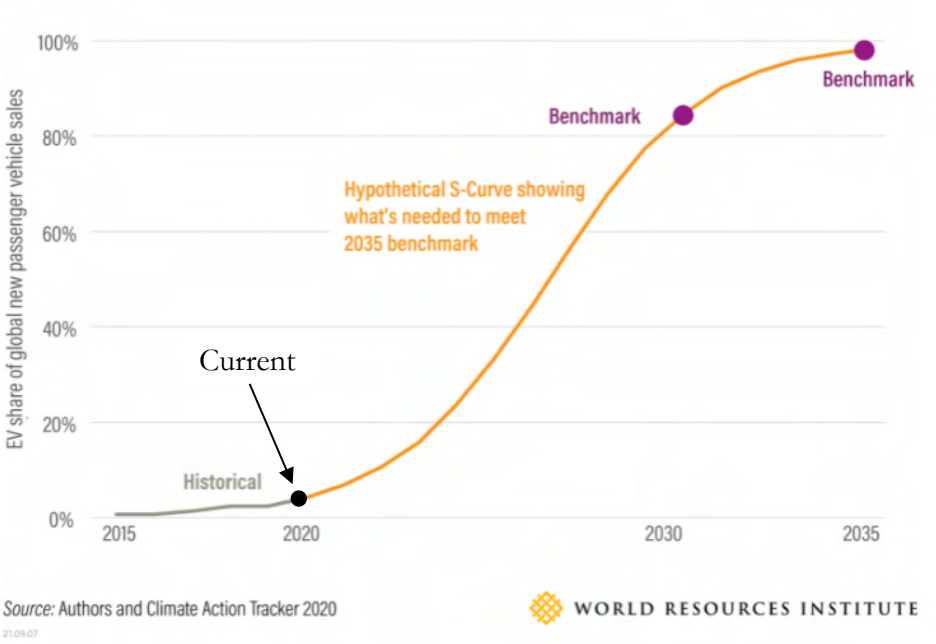


Figure 1: Potential Growth Model of EV Sales.[11]

A growth in EV sales will lead to a decrease in demand for gasoline and diesel-powered vehicles (traditional), until new vehicle sales for traditional vehicles are negligible or no longer allowed. This leaves used traditional vehicles as the last market potential for catalytic converters in much of the developed world. Catalytic converters should be replaced in a used vehicle after roughly 10 years or 161,000 kilometers. However, drivers commute roughly 7,157 kilometers per year globally on average and are unlikely to replace their catalytic converters after 10 years.[27]-[43] There remain outliers within each country that will purchase a new catalytic converter for their used vehicle, however, the impact of these additional sales are minimal, unpredictable, and do not support a sustainable business model.

Furthermore, global car sales for traditional vehicles are expected to decline from 92% in 2019 to 30% in 2040, with EVs overtaking traditional vehicles in 2037 as shown in Figure 2.[13]

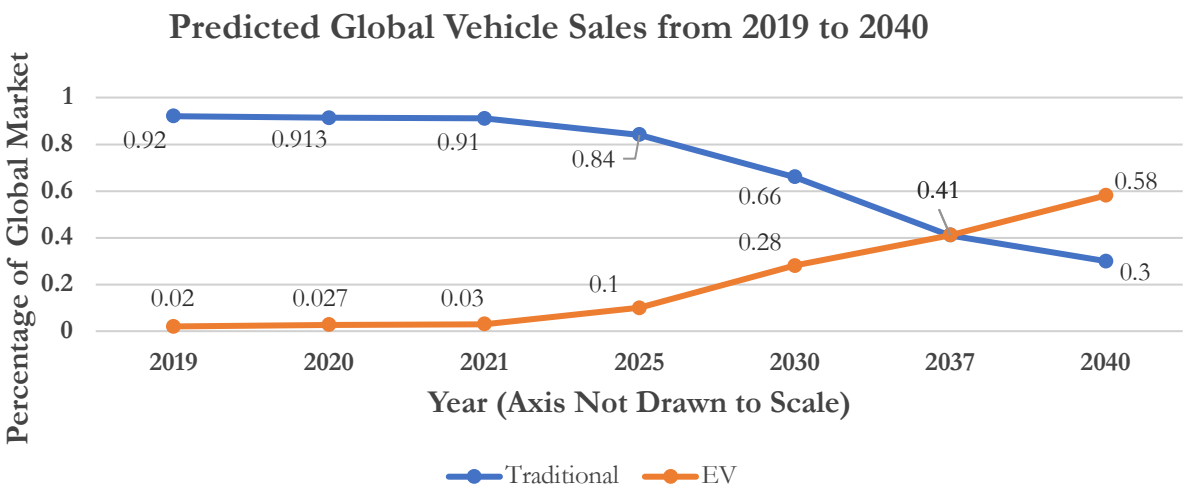


Figure 2: Predicted Global Vehicle Sales from 2019 to 2040[13] (Plug-In Hybrids Excluded).

The findings on the future decline in traditional automobile sales and increase in EV sales include Africa, but analysts have not accounted for Africa's resistance to incorporating EV's as well as a future increase in automobile production and sales within Africa.

2. Africa's Electric Vehicle Resistance

Most African countries have weak electricity grids, bad roads, and lack of public E-chargers making EV adoption very difficult.[14] Frequent blackouts in some African countries could limit consumer demand for electric cars, as it cuts off access to transport. In Nigeria, the average access to electricity is about 12 hours and there are no known public EV charging stations in the country.[14] Just 66 electric cars were sold in 2019 in South Africa – the continent's most developed economy.[17]

In contrast, Africa possesses 7.5% and 7.1% of the global oil and gas reserves, respectively.[15] To compare, the US holds 35.23 billion barrels of oil in its reserves and accounts for just 2.1% of the global oil reserves. As international energy prices recover, Africa is attracting investor interest in the oil and gas sector. For some African countries, the oil industry represents an enormous source of income; in Nigeria, oil generates almost 10% of the country's GDP and in Libya, oil rents account for over 40% of their GDP.[16] With such a large reliance on the oil and gas sector, African nations will seek to leverage their natural resources to boost industrialization and modernize their economies by increasing consumer availability to reliable automobiles.

3. Countries Economic Growth Development

Before jumping into the automotive growth trends within Africa, it is important to note where African countries currently lie in terms of overall economic growth. Using Rostow's stages of growth development model, all countries likely pass through five stages to become developed. The model asserts that all countries exist somewhere on this linear spectrum and climb upward through each stage in the development process.[96]

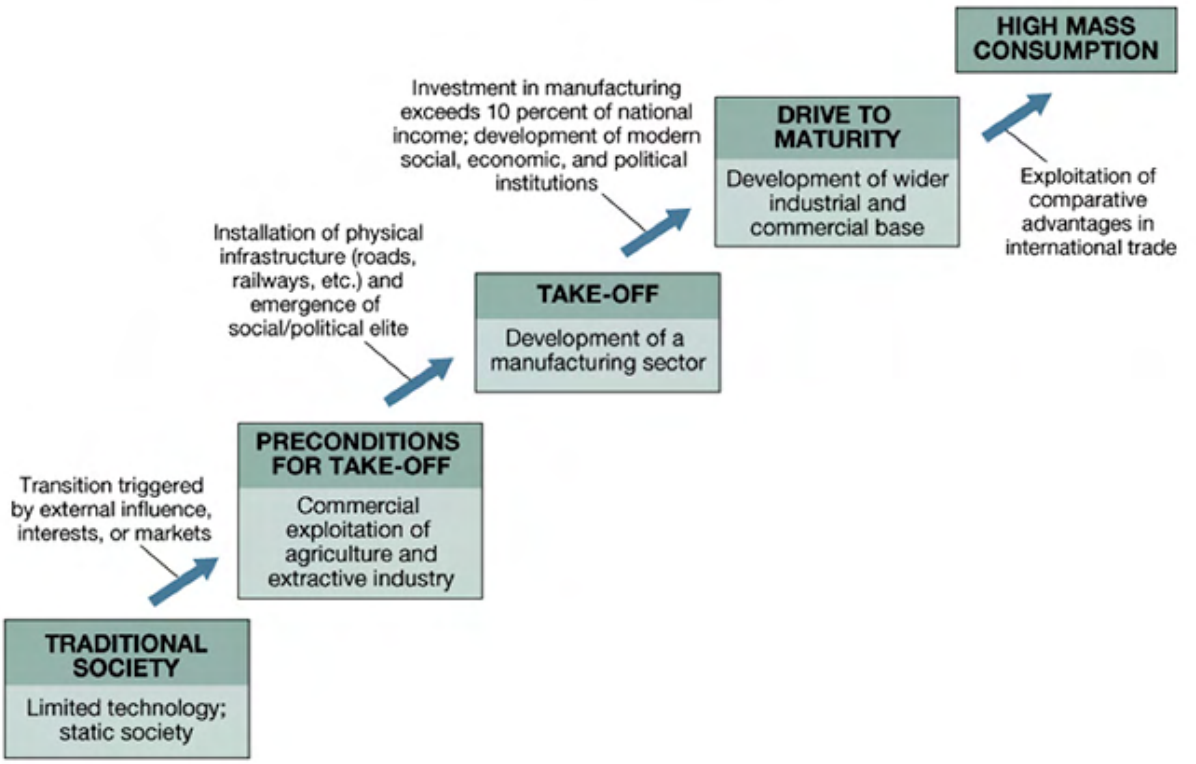


Figure 3: Rostow's Stages of Economic Growth.[96]

These stages suggest that a society moves from a traditional phase which is characterized by a lack of science or technology, a dependence on agriculture, and a high level of poverty to a modernized, industrialized, and developed economy.[96]

Stage 1: Traditional Society

A Traditional society represents an economy with limited technology and a static society. Rostow's model suggests that an economy in this stage can begin transitioning to the next stage by external influences, interests, or markets. Examples of countries still in the first stage of development include tiny island countries in the Pacific.

Stage 2: Pre-Conditions for Take-Off

Pre-conditions for take-off constitute a commercial exploitation of an economy's agriculture and extractive industries, however, the development of agriculture can also continue in this stage. The model suggests that an economy can begin moving to the next stage by the installation of physical infrastructure including roads, railways, etc., and the emergence of persons who hold dominant positions in government or major institutions. An example of a country in the second stage is Angola in sub-Saharan Africa.

Stage 3: Take-Off

The take-off stage represents an economy that has developed a manufacturing sector and industrialization begins to occur, and workers and institutions become concentrated around a new industry. The model suggests that an economy in this stage can begin its transition to the next stage by investing more than 10% of their national income in the manufacturing sector and the development of modern social, economic, and political institutions. Examples of countries in stage 3 include developing economies such as in Vietnam and Thailand.

Stage 4: Drive to Maturity

The drive to maturity includes the development of a wider industrial and commercial base, a continuous growth of investment, and improvement of the country's infrastructure. Further, the economy demonstrates the capacity to move beyond the original industries. Rostow's model suggests that an economy can begin moving to the last stage by the exploitation of their comparative advantages in international trade. An example of a country still in stage 4 is Argentina.

Stage 5: High Mass Consumption

The last stage, high mass consumption, is characterized by mass production and mass consumption. This stage represents the growth of service-based professionals, the existence of a welfare state (retirement and unemployment benefits), and population concentration in urban areas. According to Rostow's model, developed nations such as Britain, USA, Japan, Germany, and Canada are in the last stage.

Most economic models, including Rostow's, are political in nature and come with inherent biases. Rostow's model is based on western models and shows them as being the only way forward. Critics have cited that all countries do not develop in a linear fashion and may skip steps or take different paths.[96] Rostow also assumes that all countries have a desire to develop in the same way, with an end goal of high mass consumption, disregarding the diversity of priorities that each society holds and different measures of development.[96] Lastly, each stage has overlap between them as Rostow did not provide a basis that distinctly separates one stage from another.

3.1 Nigeria

The economy of Nigeria is a middle-income, mixed economy, and emerging market, with expanding manufacturing, financial, service, communications, and technology sectors.[97] Nigeria's economy has transformed from one mainly based on agriculture to manufacturing and services. The fastest growing sector in Nigeria is manufacturing.[97] A combination of the cheap and plentiful labor force along with its huge market, both within and beyond the country has led to rapid economic growth.[97]

In 2020, Nigeria's total manufacturing investment comprised over 10% of their annual national revenue and had a GDP of $432.3 billion.[98][25] To put Nigeria's growth into perspective, their GDP was only $170 billion in 2000. These benchmarks place Nigeria in the *Take-Off* stage (stage 3) of economic growth development due to Nigeria investing more than 10% of their national income in the manufacturing sector and having growing industries, as well as an accelerating economic growth rate. Nigeria would be classified as a stage 4 economy if not for their poor health, wealth, and education indicators.

3.2 Uganda

Uganda is a landlocked nation in central eastern Africa. Uganda's economy is essentially agricultural and occupies some four-fifths of the working population.[99] Economic development and modernization have been impeded by political instability. However, since the 1990's, Uganda has been acclaimed for its economic stability and high rates of growth, claiming almost 7% growth per annum.[100] It is one of the few countries praised by the World Bank, International Monetary Fund, and the international financial community for its economic policies of government divestiture and privatization and currency reform.[99] These acclamations have provided Uganda with significant levels of debt relief as rewards and allowed Uganda to focus on eradicating poverty and expanding resource exploitation, industries, and reform.[99]

In 2020, Uganda had a GDP of $37.37 billion.[25] Uganda's industry represents 25.5% of the economy, with manufacturing accounting for 82% of it.[100] Uganda is beginning to leverage its agricultural and extractive industries, and expand on its existing infrastructure, thereby placing Uganda in the *Pre-Conditions for Take-Off* stage (stage 2) of economic growth development. Infrastructure has become a key priority for the Ugandan government in recent years. Infrastructure spending currently comprises roughly 32.8% of the government's total annual expenditure.[101] The infrastructure expenditure includes road networks, railway transport, inland water transport, and energy and ICT Infrastructure.

3.3 Ghana

In 2019, Ghana had the fastest growing economy in Africa due to their steps towards good governance and sustainable development.[102] Ghana gained its independence in 1957, and the government set their focus on the economy. Ghana's focus on sustainable development has resulted in consistent growth due to meeting the needs of the present without compromising the ability of future generations to meet their own needs. Also, Ghana's focus on good governance has resulted in a reduction in inequalities and an increase in economic growth, quality education, and more sustainable cities.[102]

Sustainable development and good governance were a result of Ghana's Economic Recovery Program (ERP). The ERP eventually led to the addition on the Village Infrastructure Project (VIP) to bridge the inequality gap between the urban and rural populations. Ghana has competitive edges versus other African countries; these include political stability, location, security, and an effective legal system. Ghana's economic growth is becoming more noticeable every year and has allowed Ghana to become the second most economically developed country in West Africa.

Ghana's growth, having once been fueled by cocoa production, is now being buoyed by crude petroleum and gold. Ghana's government has begun implementing policies aimed at diversifying the economy and preventing an over-reliance on the commodity markets.[103] For example, the government introduced a policy in 2018 to provide improved regulatory guidelines in the automotive industry and boost FDI.[103] The manufacturing sector contributed 10.5% of the GDP in 2020, with their GDP being $72.35 billion.[25] Further, Ghana has been an example for other African countries in promoting resilient political institutions, transparent and peaceful transitions of power, and regional stability. Due to these reasons, Ghana is in the *Take-Off* stage (stage 3) of economic growth development. Ghana also lies along the Gulf of Guinea and the Atlantic Ocean providing near limitless trading potential both in and out of Africa.

3.4 Morocco

Morocco is situated on the north-west corner of Africa overlooking both the Mediterranean Sea and the Atlantic Ocean. Since the 1980s, the Moroccan government has undertaken a vigorous program of privatization and economic reform. Manufacturing accounts for about one-sixth of GDP and is steadily growing in importance in the economy.[104] Morocco's factory output is growing at record pace, with manufacturing production jumping 19.9% YoY in Q2 of 2021.[105] Through the creation of interlinked production clusters, both the government and private investors are setting the stage for areas such as automotive production, agro-industry and aeronautic components manufacturing to become central to the economy.[106] Logistics are being strengthened with ongoing investments in infrastructure including road extensions and port developments.[106]

Morocco's GDP was $112.9 billion in 2020 and is expected to grow to $117 billion by the end of 2021.[25] Morocco is currently in the *Take-Off* stage (stage 3) of economic growth development due to its continual focus on growing the manufacturing sector, stable government, and accelerating growth around the automotive industry. Morocco is currently in the process of expanding its existing commercial and industrial base by offering incentives such as a five-year corporate income tax exemption, with a reduced rate of 8.75% for 20 years thereafter.[107]

3.5 Egypt

Egypt is classified as a lower middle-income country and uses a free-market economy with some state control. It has a reasonably stable multiparty system and is strongly supported by the US and EU. Egypt's economy is diverse, with agriculture, manufacturing, energy, and services constituting the bulk of output. During the 20th century, manufacturing grew to be one of the largest sectors of Egypt's economy, accounting for roughly one-fourth of the GDP by the 21st century.[109] In 2017, the industry sector accounted for 33.8% of the GDP and is continuing to grow.[110] Also, Egypt has a GDP of $362 billion and is on track to increase roughly 5.5% by the end of 2021.[108]

Egypt's strategic location offers companies a platform for their commercial activities into the Middle East and Europe. Egypt is currently developing a wider industrial and commercial base and is promoting and receiving an ever-increasing level of investment due to their developed stock exchange and heavy growth in the services and industrial sectors. Further, Egypt has significant infrastructure and is continuously improving its quality and depth yearly. Due to these factors, Egypt is in the *Drive to Maturity* (stage 4) of economic growth development.

3.7 Tanzania

As of 2020, Tanzania moved from a low to a lower-middle income country and uses a mixed economy in which there is a variety of private freedom, combined with centralized economic planning and governmental regulation. Tanzania has one of Africa's fastest growing economies with an average of nearly 7 percent annual GDP growth since 2000.[114] However, widespread poverty persists with 49% of Tanzania's population living below the international extreme poverty line. Businesses in Tanzania are at the forefront of growth through job creation, innovation, generating tax revenue, and fair competition.

Tanzania had a GDP of $62.41 billion in 2020.[25] Agriculture still occupies a central role in the economy, accounting for roughly 29% of GDP and employing around two-fifths of the population.[115] Economic expansion is also being driven by mining and energy, given Tanzania's deposits of gold and natural gas. Due to these reasons, Tanzania is in the *Pre-Conditions for Take-Off* (stage 2) stage of economic growth development. Although Tanzania has a higher-than-average GDP growth rate, its effects do not reach much of the population and Tanzania still heavily relies on their agricultural and extractive industries.

4. Future Automotive Growth Trends Within Africa

Volkswagen, BMW, Toyota, Nissan, and others have joined forces to lobby African governments for steps that would reduce the imports of used vehicles and allow local production to flourish.[17] As Mike Whitfield, Nissan's top executive for Africa, told Reuters, "The question on Africa isn't, 'Is it a market of the future?' 'It's a case of when.'" Thomas Schaefer, head of Volkswagen's Africa business, said there is a potential market in sub-Saharan Africa for 3 to 4 million new cars, up from just 420,000 in 2017.[17] Africa's population and household incomes are rising rapidly, providing more and more Africans with the ability to purchase new vehicles. The Association of African Automotive Manufacturers (AAAM) identified Nigeria, and Ghana as potential manufacturing hubs and helped draft legislation setting up standards and incentives for new automobile production.[17] Details of the government's plans provided to Reuters demonstrate that African nations are keen to secure a spot as a beachhead for the automotive industry.

As EV sales continue to disrupt established markets in the America's, Europe, and Asia, carmakers are investing millions of dollars in new plants and operations within Africa. In reinforcement of these claims, Reuters reported that a pivot to Africa could also help insulate automakers from the immediate effects of the EV revolution. The continent is ill-placed to join due to the higher prices of EV's and unreliable power grids. Africa will most likely remain as the last bastion of internal combustion engines.[17] The biggest hurdle to developing a new car market in Africa is used car dumping from countries such as japan. Auto executives acknowledge the challenges but point to a famous precedent. When Volkswagen and General Motors entered China in the 1980s and 90s, vehicle ownership rates were lower than in many African markets. Today, those two companies alone sell over 3.5 million vehicles annually in China.

Currently, the African automotive market is valued at $28.45 billion in 2020 and is expected to reach $39.87 billion by 2026, registering a CAGR of 5.55% over the forecasted period.[4] However, the outbreak of the pandemic impacted the automotive market negatively, with the majority of markets in the region having yet to recover. The demand for new vehicles across the African region increased until 2018. During 2019, a slowdown in the overall African economy resulted in sales of new vehicles decreasing by a little under 4% to 1.17 million vehicles, as compared to 1.22 million in 2018. Passenger cars accounted for 73.81% of the vehicles sold, while commercial vehicles accounted for the rest.[4] Although there was a decline in the overall sales of new vehicles in 2019, commercial vehicle sales increased by 0.33% or 308,000 units. In 2020, despite the pandemic, Egypt witnessed an increase in new vehicle sales by 26.55% or 231,000 vehicles. Overall, the African automotive market has one of the highest growth prospects in the world. Many multinational vehicle manufacturers are building manufacturing plants in African countries and South Africa, Egypt, and Morocco already have sizeable automotive assembly and manufacturing sectors.

5. African Countries with the Greatest Future Benefits

While identifying African countries with the greatest future benefits, multiple factors were examined before more in-depth research was conducted: current economic development and the trajectory of near-to-medium term economic development of the country, manufacturing capacity and growth rate of the country, labor forces within the country, the country's geographic location, and current automobile production within the country. After examining these factors across a wide range of African countries, it became evident that a handful of them stood out: Nigeria, Uganda, Ghana, Morocco, Egypt, and Tanzania.

Nigeria is an emerging market with rapid growth, is situated along the Atlantic Ocean and Gulf of Guinea, has an abundant labor force to tap into, houses the largest African automotive producer, and has a blooming automotive market. Uganda is a landlocked nation but is praised for its economic stability, high rates of growth in labor force and economy, modernized infrastructure expansion, growing market demand for automobiles and has an active and growing automobile producer. Ghana has one of the fastest growing economies in Africa with sustainable development, is also situated along the Atlantic Ocean and Gulf of Guinea, implemented policies to benefit automotive production, regional stability, and has international automobile producers already setting up production plants within the country. Morocco is situated on the north-west corner of Africa overlooking the Mediterranean Sea and Atlantic Ocean, has undertaken vigorous programs of privatization and economic reform, has a large manufacturing sector with record pace factory output and accelerating growth thereby helping it to achieve the number two top automobile producer in Africa, advantageous incentives for in-house automobile production, and a growing automotive market. Egypt has a strategic location offering companies a platform for their commercial activities into the Middle East and Europe, has a large automotive market, significant infrastructure with growth every year, and boasts an immediate opportunity for catalytic converter sales due to the recent gasoline to compressed natural gas conversion switch for 1.3 million cars. Lastly, Tanzania also has one of Africa's fastest growing economies, is situated along the Indian Ocean, has abundant labor force availability, expansive R&D efforts, access to the Chinese automotive market, has a growing automotive market, and has a government that prioritizes the automotive segment as a key revenue generator and encourages flows of FDIs into the automotive sector.

Other countries that were considered include Kenya, Ethiopia, Rwanda, and Madagascar. Kenya was found to have a plummeting new automotive market and an over-reliance on used automobiles with no transition in sight. Ethiopia is also dominated by the second-hand imported vehicle market and has the lowest motorization rate globally providing no benefits in the near-to-medium term due to widespread poverty and little governmental action. Rwanda's recent Volkswagen production plant, opened in 2018, only produced and sold 55 cars after a year likely due to an under-employed population and widespread poverty. Lastly, Madagascar was considered but has experienced an unstable sales trend in recent years, as well as its population not having as much of a need for automobiles as other countries due to being on an island. Also, Madagascar lacks an effective manufacturing industry, with what little it has being dominated by textiles. South Africa is an established automobile producer in Africa but was excluded from most of

the report due to having extensive studies already being done with little to no "hidden potentials" left to explore for Johnson Matthey.

5.1 Nigeria

As of 2020, Nigeria's population was 206.1 million, with an annual growth rate of 2.5%.[25] In 2018, the Nigerian Bureau of Statistics (NBS) reported that Nigeria had 11.8 million vehicles or about 6% of the population.[44] Of this number, 39% were privately owned, 56% were commercial vehicles, 1.1% were registered as government-owned, and 0.4% were registered for diplomats.[44] From January 2020 to August 2021, new car sales increased by 25.2% YTD to 7250 units sold.[45] Volkswagen reported the best performance, with sales rising 71.6% YTD.[45]

The pandemic negatively impacted Nigeria's automotive sector as the nation attempted to curb the spread of the virus through limited human contact. Before the pandemic, Nigeria was just recovering from the effect of oil price shock in 2014, with their GDP dropping by 3% in 2019.[22] Sales of new cars also dropped by 36.1% in 2020 compared to 2019 because of the pandemic.[22] Despite these recent declines, multiple manufacturers are opening new production plants and car sales are climbing. According to Naijauto, a reputable top 10 online platform for buying or selling vehicles in Nigeria, the production capacity of indigenous car companies is expected to improve, and the Nigerian auto market in general is forecasted to bounce back in 2021.[22] As more cars are produced and new plants are opened, new car prices will decline, making it possible for more Nigerians to buy new cars thereby increasing demand.

Innoson Vehicle Manufacturing Company is also based in Nigeria and is the largest African automobile producer. Innoson currently has the capacity to produce 10,000 vehicles per year and is in the process of transitioning to a fully automated production plant, which would increase production capacity to 60,000 per year.[23] Innoson is also building a plant for the manufacture of heavy-duty vehicles and a tractor manufacturing plant.[23] Currently, Innoson produces vehicles for the Sierra Leone government and has concluded plans to establish an assembly plant in Freetown, Sierra Leone.[23] Furthermore, Innoson has signed a Memorandum of Understanding (MOU) with Congo, Mali, and Côte d'Ivoire for the establishment of assembly plants for Innoson vehicles in their respective countries.[23] Innoson is also in collaboration with the Nigerian Army for the manufacture and supply of vehicles.[23]

Peugeot Automobile Nigeria (PAN), currently targeting to assemble around 3,000 vehicles annually, has a great deal of potential for growth at its plant in Kaduna.[24] Also assembling automobiles, Dana Motors, which is part of Nigerian Dana Group, began assembling the whole Kia range of passenger cars in 2015.[24] Total vehicle production capacity in Nigeria as of 2014 was 78,000, with a truck assembly capacity of 3,000 and a car and bus assembly capacity of 75,000.[24]

5.2 Uganda

As of 2020, Uganda's population was 45.7 million, with an annual growth rate of 3.3%.[25] In 2019, Uganda had 1.4 million registered vehicles in the country, or about 3.06% of the population based on the number of vehicles with insurance policies.[26] From 2018 to 2019, annual new vehicle sales grew 31.58% from 1900 to 2500 vehicles.[18] With forecasts suggesting a market demand of over 600,000 vehicles by

2030 in the East Africa Community, Uganda is seeking to advance its automotive technology to become an active player.[111]

Kiira Motors Corporation is a State Enterprise car manufacturer based in Uganda and produces multiple vehicle models including the Kiira EV SMACK which was designed for the region, its terrain, and consumer's ability to afford the car. The vehicle is powered by a rechargeable battery, but also utilizes an internal combustion engine-based generator.[19] Kiira generated a revenue of $207.7 million in 2019 and a profit of $6.1 million and is 96% owned by the government, with the remaining 4% belonging to Makerere University located in Uganda's capitol city of Kampala. Uganda will continue to invest in, foster, and grow Kiira to contribute to the industrialization agenda to aid the transformation of Uganda into an upper middle-income economy by 2040.[112] Kiira is developing long-term technology partnerships to build core capabilities to develop, make, and sell motor vehicles in Africa.[112]

Kiira's plant was expected to be completed in 2021, with production of 5000 vehicles per year beginning during the first half of 2022.[21] However, Kiira recently announced that the plant is still being constructed due to delays in funding by the government in December of 2021.[111] Due to the delay, only 10 out of a planned 1,050 Kayoola Diesel Coach buses have been manufactured and delivered. Importantly, Kiira markets its vehicles as EV's, when in actuality they are hybrids using an ICE to power the internal batteries, meaning they still require the use of a catalytic converter. Also, Kiira has ties with Cummins who supplies diesel engines to their Kayoola Diesel Coach bus model. In November 2021, Ugandan born Lord Dolar Popat, the UK's trade envoy to Uganda, traveled to Kampala to discuss potential funding for the completion and development of Kiira's assembly plant to place Kiira in a competitive position in the growing African market.[113]

5.3 Ghana

As of 2020, Ghana's population was 31.1 million with an annual growth rate of 2.1%.[25] In 2015, there were 890,000 registered vehicles, a 4.5% increase from 2014 and about 2.9% of the population.[51] Ghana is the third largest economy in West Africa and is likely to experience growth in the automotive industry from 2020 to 2026.[46] This is due to an increase in "Made in Ghana" vehicles initiated by Kantanka Automobile since 2016 and an increasingly skilled-work force in the Ghana automotive industry.[46]

Kantanka Automobile is an automobile producer in Ghana and was established in 1994.[47] Kantanka is the largest automobile producer in Ghana and has sold over 1000 cars since commercial operations began in 2017.[48] Kantanka's sole manufacturing plant is in Gomoa Mpota in the central region of Ghana. Kantanka aims to create a niche market with diverse brands of vehicles that meet the income status of Ghanaian citizens. Prices for their vehicles range from $12,800 to $29,700 and payment plans are offered to customers who wish to pay in installments.[48] Ghana's average income is expected to continue rising once the pandemic subsides, allowing more citizens to afford and purchase new vehicles, which would in turn increase production rates of new vehicles within Ghana.

Volkswagen recently opened an assembly plant at Accra North Industrial Area in Ghana, and the first vehicle was assembled in August 2020.[52] Volkswagen's assembly plant in Ghana will initially focus

on the production of passenger cars, SUVs, and light commercial vehicles including pickup trucks and minibuses which are some of the most used gars in Ghana. Volkswagen's target is to produce 5,000 cars in their first year of production.[52] Also, Mahindra & Mahindra Limited, an Indian Multinational Corporation (MNC) manufacturing automobiles, farm equipment and automotive components, opened an assembly plant at the southern part of Accra.[52] Mahindra's assembly plant in Ghana serves demand in Ghana and neighboring countries in West Africa, but no production capacities have been published for the plant.[53]

5.4 Morocco

As of 2020, Morocco's population was 36.9 million with an annual growth rate of 1.2%.[25] With close to 2.8 million registered vehicles, or about 7.6% of the population, Morocco comes in at a distant second to Egypt in North Africa.[54] New car sales saw an 11.8% increase in the first five months of 2021, compared to the same period of time in 2019.[55] From January to June 2021, car sales reached over 74,000 units and exceeded pre-pandemic levels.[55]

Although the automotive market in Morocco was thriving, the pandemic forced the sales of new cars to drop almost 20% in 2020.[58] However, the automotive market rebounded and exceeded 2019 levels in 2021 and is expected to continue increasing YoY. According to several international experts, Morocco's auto industry is set to contribute as much as 24% to the Moroccan GDP by 2022.[59] As of October 2021, new passenger vehicle sales recorded an increase of 10.77% with 115,611 units sold.[59] With the government incentives and foreign investments' rapid implementation, financial experts anticipate the automotive sector to grow by $14 billion within the next five years.

The automotive sector is already Morocco's leading export sector and has made the kingdom the leading passenger car manufacturer in Africa, having passed South Africa at the end of 2018. In terms of market share within the automotive industry in Morocco, Dacia brand is the most popular and holds 28.9% of the market, Renault follows with 13.5%, and Hyundai is third with 8.02%.[55] Renault launched a second production line in 2019 increasing their production output to 402,000 vehicles and PSA Peugeot Citroen invested $615 million in a manufacturing facility in 2019 producing 200,000 vehicles per year with a total production capacity of 700,000 cars.[56] Dacia opened the Azurite Blue Lodgy facility in Tangier in 2012 and built its 1,000,000th vehicle in 2017.[57] The plant has an annual production capacity of 340,000 vehicles across its two lines. Dacia has one other production plant within Morocco in Casablanca. These two plants alone produce half of all Dacia's produced annually.[57] Further, with Morocco attracting both European and Asian (including Chinese) auto manufacturers, the country has become a crossroad between all three markets.

However, Morocco is mindful of the global switch to EV's and is encouraging its next vehicle manufacturer to produce a platform that allows it to manufacture both electrified vehicles and conventional models.[60] Currently, Morocco has negligible EV sales, but due to Morocco wanting domestic annual sales of EVs to rise to 70,000 to 100,000 by 2025, the window for market opportunities for JM are already beginning to shrink. Although Morocco is already attempting to lay the groundwork for EV's, there still exists a large market potential for JM into the foreseeable future.

5.5 Egypt

As of 2020, Egypt's population was 102.3 million with an annual growth rate of 1.9%.[25] Egypt contains the most vehicles in North Africa; there were 4.71 million registered vehicles or about 4.6% of the population in 2017.[61] New vehicle sales have surged to more than 200,000 units per year, with roughly half being assembled locally.[62] Major players in Egypt include Ghabbour (GB) Auto, General Motors Egypt, and Nissan, both for production and retail. Egypt's importer and distributor landscape is a fragmented tangle of small and large companies, mostly based in Cairo.[62]

GB Auto is the largest automotive player in Egypt in terms of sales, revenue, market share, and production.[63] As of 2019, GB Auto's Egypt production plant had a production capacity of 80,000 units per year.[64] GB Auto produces vehicles for over 20 brands via Completely Knocked Down (CKD) kits, as well as locally sourced components. Whether the CKD kits include catalytic converters or not could not be found.

Egypt has a natural gas surplus due to rising output in recent years. Due to this, Egypt initiated a vehicle conversion to Compressed Natural Gas (CNG) initiative in March 2021 to leverage its abundance of natural gas and to reduce the amount of imported gasoline.[65] CNG-powered vehicles require a methane-specific catalytic converter, and it is not possible to install both types of converters on a bi-fuel vehicle.[66] Therefore, with the government pushing for the conversion of 1.3 million cars, 1.3 million CNG catalytic converters will be needed for the newly converted vehicles. If JM does not have a methane-specific catalytic converter developed already, serious consideration should be made to contend for Egypt's CNG conversion business.

5.6 South Africa

South Africa's population was 59.3 million in 2020, with an annual growth rate of 1.3%.[25] In 2015, South Africa had a total of 9.6 million registered vehicles; a 2.9% increase from 2014 and roughly 16.2% of the population.[67] South Africa is the continent's largest passenger vehicle market whose car sales accounted for 40% of the continent's 660,000 new vehicle sales.[68] Major vehicle manufacturers in South Africa include BMW, Mercedes Benz, and Toyota.

With JM already having an autocatalyst plant in South Africa since 1992, specifics on South Africa's domestic new vehicle market will be omitted from this report. However, important to note is that Europe and the UK are beginning their transition to EVs and will no longer allow the importation of ICE vehicles by 2030.[69] The decline in automotive exports to the UK and Europe will drastically reduce South Africa's established demand, however, South Africa could begin to route its exports towards the rest of Africa as Africa's markets continue to grow.

5.7 Tanzania

As of 2020, Tanzania's population was 59.7 million with an annual growth rate of 2%.[25] There were 380,000 registered cars in Tanzania in 2015 or about 0.6% of the population.[70] Tanzania's vehicle market grew 47% YTD in 2021 causing sales of new vehicles to grow past pre-pandemic levels.[71] Amid strong demand for automotive vehicles, several domestic and foreign OEM manufacturers are planning to expand their production bases in Tanzania. Also, the Tanzanian government prioritizes the automotive segment as a key revenue generator and encourages flows of FDIs in the automotive sector.[72]

Tanzania is one of the most promising and fastest growing automobile markets in the region. The Tanzanian automobile industry is supported by multiple factors: labor availability, R&D efforts, geographic advantage, and government support.[72] As citizen's household incomes increase, so too will new automobile sales. In Tanzania, passenger cars and LCVs are witnessing a steady increase in demand.[72] Further, domestic competition continues to intensify year-on-year with the introduction of new models and brand availability.[72] Currently, one of JM's customers, Tata, is the market leader in Tanzania's Medium Duty truck segment.[74]

In 2019, Toyota, Ford, and Nissan were the top three brands, controlling nearly 60% of the market.[73] Toyota had 29% of the market share, Ford had 15.9%, and Nissan had 15.9%.[73] Also, annual new vehicle sales were between 2,000 and 3,000, still relatively low due to easy access of imported used vehicles to consumers.[73] In 2021, the Tanzanian market grew by a 233.3% increase in sales from May to June, with 170 units sold, leading to first half year sales of 1,060 units, a 47% increase compared to first half year sales in 2020.[71]

Lastly, Tanzania's economy with its ever-growing middle class is powering a growing and impactful regional auto industry.[74] Autobei Consulting Group (ACG) believes Tanzania is one of the future key automotive markets in the East African region. To increase the market share of new vehicle sales, OEMs are looking into options to assemble vehicle parts locally or import from assembly plants in Kenya or another neighboring country to avoid import duties on new vehicles.[74] Hatchback, Saloon, and Station Wagon vehicles are the most purchased vehicle types.[74] There are large market price differences between Western and Chinese OEMs due to their price positioning and cordial ties in Afro-Chinese political and economic relationships.[74] Due to these reasons, a few of the upcoming major automotive players in Tanzania include Chinese OEMs such as Sino Truk, Foton, and Dongfeng.[74]

6. Labor Forces within Africa

Africa has the world's fastest-growing labor force but needs job growth to catch up. From 2010 to 2015, Africa has seen the highest rate of population growth at about 2.5% annually, and by 2050 it is expected that a quarter of the world's population will be on the continent.[75] Put another way, of the 2.4 billion new people on the planet by 2050, 1.3 billion of them will come from Africa. The *World Bank* defines labor force as comprising people ages 15 and older who supply labor to produce goods and services during a specified period. Shown below is a list of relevant African countries labor forces in 2020.

Table 2: African Countries Labor Forces in 2020.[25]

Country	Labor Force (Million)
Nigeria	80.3
Uganda	11.6
Ghana	12.9
Morocco	11.5
Egypt	29.1
Tanzania	28.0

The labor force values listed in Table 2 are used for the labor force breakdowns in the following sections.

Across all of Africa, 66.8% of people in 2019 aged 15 years and above were able to read and write a simple statement and understand it.[92] To put the literacy rate in context for each country, the African country with the highest literacy rate is South Africa with a literacy rate of 95% and the African country with the lowest literacy rate is Niger with a literacy rate of only 15%. Arthur Lewis, a Nobel Prize-winning economist, noted in 1979 that "the expansion of small-scale activity in the modern sector is an important part of the development process".[93] The focus countries have reached this early stage of industrialization based on small manufacturing firms producing labor-intensive goods to expand the market. This, in turn, will lead to a larger and more robust market that will increase the need for automobiles exponentially. Further, the large amounts of low-skilled workers being released from the agricultural sector are consequently being absorbed by the manufacturing sectors which often require longer commutes for workers.[94]

6.1 Nigeria

Table 3: Nigeria's Labor Force Breakdown by Educational Status in 2020.[76]

National – 80,291,894			
By Educational Status		**By Age-Group**	
Never Attended School	**15,847,257**	15-24	**16,709,724**
Below Primary	**85,711**	25-34	**23,328,460**
Primary	**14,831,238**	35-44	**20,124,531**
Junior Secondary School	**4,984,100**	45-54	**13,089,047**
Vocational/Commercial	**281,535**	55-64	**7,040,132**
Senior Secondary School	**28,558,044**	**By Gender**	
NCE/OND/Nursing	**6,530,801**	Male	**41,664,913**
BA/BSC/Bed/HND	**6,956,600**	Female	**38,626,981**
MSC/MA/M.Adm	**521,108**	**By Place of Residence**	
Doctorate	**76,526**	Urban	**28,513,287**
Others	**1,618,973**	Rural	**51,778,606**

Nigeria's Labour Force Statistics Bureau breaks down their labor force by educational status, age, sex, and place of residence per Table 3. Nigeria has a literacy rate of 62%, up 10.9% since 2008 per *Macrotrends*. Nigeria spends up to four times more on higher education than they do on basic education, whereas the global pattern is to spend the bulk of resources on basic education.[85] This causes basic education to be the most expensive level of education in Nigeria. Table 3 reflects this, with senior secondary school and university level education being much greater than primary.

Nigeria has struggled with vocational education to train citizens for manufacturing related jobs due to inadequately qualified teachers, insufficient facilities, lack of training and incentives to staff and lack of interest from political office holders.[86] However, all it takes to begin increasing vocational exposure is for educational institutions to include vocational subjects in the curriculum. Vocational education has also become a beacon for those that dropped out of school due to the inability to pay school-related fees or struggled with academics. For these reasons, Nigeria Labour Congress (NLC) began establishing functional vocational centers in the local government areas for those who need to acquire job-specific skills.[86] Many reports have been written on how Nigeria can increase the effectiveness of their vocational programs such as the *Journal of Education and Practice* and the *Journal of Educational and Social Research*.[89][90] However, out of all vocational courses offered in Nigeria, metal/auto mechanic is the most commonly offered subject with 53 courses out of 148 in total in 2010.[90]

The average annual salary for employees in Nigeria is $13,634.[121] With the highest portion of the population in Nigeria's labor force aged 25 through 34, and with vocational education in the metal/auto mechanic field increasing, Nigeria is poised to become an effective automobile producer in western Africa. Nigeria's workforce is also well positioned to drive the Nigerian automotive market towards success by having a winning mentality and an internal drive to succeed. Lofty expectations are bestowed upon Nigerian children from an early age. They are taught to marry well, amass multiple degrees, and earn enough to take care of parents in old age. As a result, parents push their children, drive them to achieve, and the children are indoctrinated in this cultural belief.[129]

6.2 Uganda

Table 4: Uganda's Labor Force Breakdown from 2017-2019.[77]

Characteristics	2016/17			2017/18			2018/19		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Residence									
Rural	67.0	63.7	65.5	66.3	57.9	62.5	62.6	58.6	60.8
Urban	33.0	36.3	34.5	33.7	42.1	37.5	37.4	41.4	39.2
Age groups									
14-17	7.3	6.8	7.0	7.4	6.4	6.9	7.4	6.2	6.9
18-30	42.4	47.5	44.6	42.1	50.5	45.9	43.0	46.9	44.7
31-64	50.4	45.8	48.3	50.5	43.1	47.2	49.5	47.0	48.4
15-24	27.8	28.6	28.1	27.4	31.9	29.4	26.9	30.9	28.7
15-35	63.8	65.8	64.7	61.9	68.6	64.9	62.1	63.1	62.5
Education Attainment									
No education	6.2	14.4	9.9	7.9	16.6	11.9	6.5	14.4	10.0
Primary	54.6	52.2	53.6	52.1	52.2	52.1	53.1	51.5	52.4
Secondary	26.4	21.8	24.3	28.6	21.7	25.4	26.5	21.4	24.2
Post primary/secondary specialized training	8.7	8.6	8.7	8.9	7.4	8.2	10.0	9.8	9.9
Degree and above	4.1	2.9	3.5	2.4	2.1	2.3	4.0	3.0	3.5
Total (%)	**100.0**	**100.0**	**100.0**	**100**	**100**	**100**	**100.0**	**100.0**	**100.0**
Total (Number '000)	**5,505**	**4,427**	**9,932**	**6,281**	**5,165**	**11,446**	**6,392**	**5,180**	**11,572**
Percentage Share	**54.8**	**45.2**	**100**	**54.9**	**45.1**	**100**	**55.2**	**44.8**	**100**

Uganda's Bureau of Statistics breaks down their labor forces by residence, age group, and educational status per Table 4. The average share of manufacturing in Uganda's GDP has been declining, from 11% between 2000 and 2010 to 9% between 2011 and 2018.[87] Therefore, a declining percentage of the population has manufacturing experience. Uganda has a literacy rate of 76.5%, up 6.3% since 2012 per *Macrotrends*. Also, Uganda recognizes education as a basic human right, however, issues with funding, teacher training, rural populations, and inadequate facilities continue to hinder the progress of educational development.[88] Uganda's labor force with secondary and post primary/secondary specialized training degrees have increase in 2018/19 from the years prior, and those with no education have simultaneously decreased.

Around 700,000 young people reach working age every year in Uganda and is expected to rise to an average of one million in the decade of 2030 to 2040.[91] Fewer than 4% of Ugandans are employers, 52% work for themselves, and 43% are unpaid family workers.[91] Only one in five workers are in waged employment. Further, Uganda's labor force growth has been speeding up, providing no limits to an available workforce. The average employee salary in Uganda is roughly $8,708 annually.[117]

The UN has led efforts to support vocational and trade education in Uganda through the UNESCO subdivision of the International Centre for Technical and Vocational Education and Training (TVET).[88] These TVET programs range in both complexity and scope. Some provide for craftsmen or technician level training that replaces standard modes of secondary education, while some TVET programs provide graduate engineering level education to students seeking education at the tertiary or post-secondary level.[87]

6.3 Ghana

Table 5: Ghana Labor Force Breakdown by Percentage in 2015.[78]

	Employed			Unemployed			Not in labor force		
Employment aspiration	Male	Female	Total	Male	Female	Total	Male	Female	Total
Legislators/managers	4.9	3.7	4.2	4.6	2.6	3.5	6.6	1.5	3.4
Professionals	23.0	18.7	20.7	22.5	24.4	23.6	41.1	36.6	38.3
Technicians and associate professionals	3.3	0.9	2.1	4.7	1.7	3.0	6.6	1.4	3.3
Clerical support workers	0.7	1.4	1.1	2.5	1.3	1.8	0.8	1.3	1.1
Service/sales workers	12.6	45.0	30.0	16.4	48.1	34.5	16.4	38.9	30.6
Skilled agriculture/fishery workers	18.9	9.1	13.6	10.3	4.9	7.2	7.9	5.2	6.2
Craft and related trades workers	20.3	20.2	20.2	19.4	16.6	17.8	10.2	12.7	11.8
Plant machine operators and assemblers	11.6	0.1	5.4	12.5	0.0	5.4	5.0	0.3	2.0
Elementary occupations	0.9	0.7	0.8	1.2	0.3	0.7	0.7	0.7	0.7
Other Occupations	3.8	0.3	1.9	6.0	0.1	2.6	4.7	1.4	2.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Urban									
Legislators/managers	6.7	4.8	5.6	5.6	3.0	4.1	7.8	2.0	4.1
Professionals	30.8	21.7	25.7	22.9	28.9	26.2	43.1	41.3	41.9
Technicians and associate professionals	4.2	1.0	2.5	6.3	2.7	4.3	7.9	1.5	3.8
Clerical support workers	1.1	2.4	1.8	3.7	1.6	2.5	1.1	1.7	1.5
Service/sales workers	13.5	46.7	31.9	19.0	46.7	34.5	15.1	40.2	31.2
Skilled agriculture/fishery workers	8.6	2.9	5.4	2.4	1.1	1.7	4.7	3.1	3.6
Craft and related trades workers	19.6	19.3	19.4	18.3	15.9	16.9	9.8	8.4	8.9
Plant machine operators and assemblers	10.3	0.1	4.6	13.7	0.0	6.0	4.5	0.5	1.9
Elementary occupations	1.1	0.8	0.9	0.8	0.2	0.4	0.5	0.5	0.5
Other Occupations	4.2	0.4	2.1	7.3	0.0	3.2	5.5	0.8	2.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

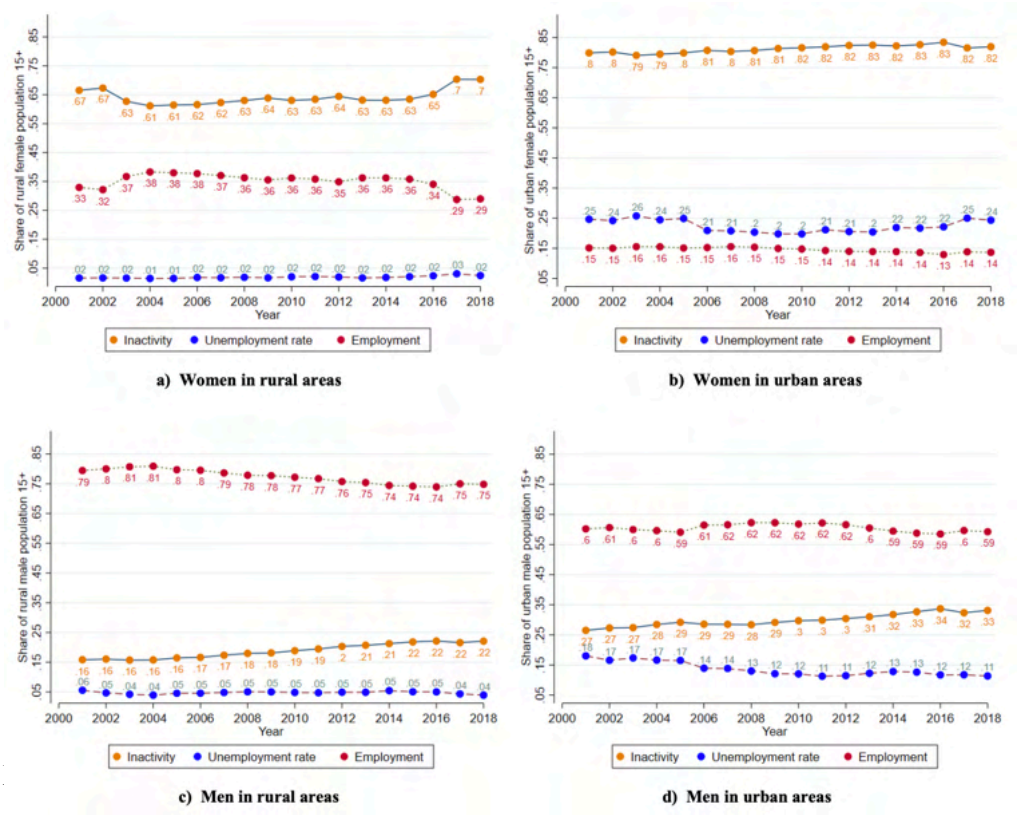
Ghana's Statistical Service breaks down their labor force by sex, occupation, and employer per Table 5. The most recent labor force report that could be found was from 2015. Ghana is a much less populous country compared to larger Sub-Saharan countries but has an annual growth rate far above the global average at around 2.5%. In other terms, Ghana is gaining another 700,000 to 800,000 people each year. With around 39% of the population under the age of 15 (in 2016), Ghana is beginning to harness its growth rate by educating the young. In 2017, Ghana announced that it was making secondary education tuition-free throughout the country, with no admission, library, or examination fees.[95] Further, Ghana will provide free textbooks, free boarding, and free meals to students.

Ghana had a literacy rate of 79% in 2018, up 21.1% since 2000 per *Macrotrends*. Ghana's youth literacy rate jumped from 71% in 2000 to 86% in 2010.[95] With more than 84% of children participating in elementary education, the workforce in roughly 12 years will be well-educated and able to perform most job functions. The *International Centre for Technical and Vocational Education and Training* reports that Ghana had around 76,800 students in vocational programs in 2019.

With 11.6% of employed and 12.5% of unemployed males aspiring to be plant machine operators and assemblers, and 20.7% of total employed and 22.5% of total unemployed people aspiring to be professional technicians and associate professionals, the labor demand for automobile production is high.

Further, the average salary that employees in Ghana earn is $15,566 annually.[116] With the lower end of new vehicles from Ghana's Kantanka Automobiles costing $12,800, Ghana's labor forces annual salaries are providing them the ability to invest in a new vehicle for reliable transportation.

6.4 Morocco



a) Women in rural areas

b) Women in urban areas

c) Men in rural areas

d) Men in urban areas

The latest labor force data that could be found for Morocco was from the *IZA Institute of Labor Economics* conducting an exploratory analysis on female labor force participation in 2021 during the COVID pandemic. Figure 3 breaks down Morocco's labor force by sex and place of residence. In 2019, Morocco had 23.1% of their total work force involved in industry compared to 21.2% in 2009.[25] Employment in industry remained stagnant in the 90's and began increasing YOY since 2005.[25] Morocco saw its highest number of students enrolled in primary education in 2020, with over 4.5 million students compared to 4.4 million in 2019 and 4 million in 2011.[25] Morocco allocates approximately one-fifth of its budget to education, with most of it going towards building schools to accommodate the rapidly growing population.[118] Slightly more than half of the children go on to secondary education, including trade and technical schools.[118] Of these, few seek higher education.

Morocco's adult literacy rate was 73.8% in 2018, a 4.3% increase from 2012 per *Macrotrends*. Poor school attendance, particularly in rural areas, has meant a lower nation-wide literacy rate when compared to urban areas. With Morocco being tied to the European Union via an association agreement and concluding Free Trade Agreements (FTAs) with the United States, Turkey, and the United Arab Emirates (UAE), Morocco has become a gateway to Europe with delivery times of one day to Spain and two days for the Rest of Europe.[119] Due to these reasons, Morocco has been bolstering its manufacturing workforce by the creation of 27 new vocational training institutions between 2015 and 2018, and by increasing the number of scholarships offered to vocational students by 177% from 2018 to 2019.[120] Morocco's population's growing educational statuses has caused higher salaries, with the average annual salary being $39,209.[130]

6.5 Egypt

Table 6: Egypt's Labor Force Breakdown (%) in 2020.[80]

Age Groups	Labor force (%)	Participation rates in economic activity(%)		
		Male	Female	Total
15-19	5.2	21.7	3.5	13
20-24	12.8	52.3	16.1	34.9
25-29	17	91.1	22.9	57.1
30-39	25.2	96.5	22.8	60.3
40-49	19.7	95.9	22.6	60.3
50-59	15.8	89.1	21.5	57.6
60-64	2.8	44.7	5.9	26.7
65+	1.5	20.3	2.5	11.8
Total	100	68.1	16.4	43.1

Egypt conducted an extensive analysis on their labor force to assess the effects of the pandemic on their workforce in 2020. Egypt's labor force is broken down in Table 6 by age group and sex. Egypt has an unemployment rate of 10.45% per *Macrotrends*, which explains why Egypt's labor force is low compared to its population size. In Egypt, the size of the youth population (ages 15-29) has been increasing from 13.3 million in 1988 to 22.2 million in 2006 and has been referred to as the "growing youth bulge".[122] The Egyptian labor market, including the private sector, is unable to keep up with the number of new job seekers. Further, Egypt's population is expected to grow by 1.6 million people annually with around 40% of Egyptians being under the age of 18.[123] Due to these factors, Egypt increased public education spending by 8% or roughly $7.4 billion.[123] The government intends to further increase funding, boost tertiary enrollment rates, and implement a range of reform projects, including the construction of eight new technical universities, aided by a $500 million loan from the World Bank. The goal of increasing

the education status of its workforce and upgrading the educational curriculum is to make Egyptians more competitive in the international job market.

Egypt's Strategic Vision for Education to 2030, adopted in 2016, seeks to expand technical and vocational education and training (TVET) and further education, develop curricula more aligned with labor market needs, and improve student-to-teacher ratios and quality assurance and accreditation mechanisms, as well as teacher training.[124] Limited data was found on Egypt's manufacturing workforce, but researchers have found that Egypt can be competitive due to having relatively cheap labor and "a fairly well qualified labor force for manufacturing".[126] However, with the average yearly salary for Egyptians being $8,318 annually and population/education rates increasing, Egypt is poised to become a cost effective location for international companies to operate and produce within.[125]

6.7 Tanzania

Table 7: Tanzania's Employed Labor Force Breakdown by Industry (%) in 2020/21.[82]

Industry	2014									2020/2021								
	URT			TZM			ZNZ			URT			TZM			ZNZ		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
Agriculture, forestry and fishing	63.2	69.4	66.2	63.9	69.9	66.9	38.3	44.0	40.8	61.8	60.4	61.1	62.6	60.9	61.8	36.8	33.8	35.5
Manufacturing industry	9.8	3.4	6.7	9.6	3.2	6.5	14.7	14.5	14.6	11.3	4.5	8.0	11.1	4.3	7.8	18.6	15.0	17.1
Services	27.0	27.2	27.1	26.4	26.9	26.7	47.0	41.6	44.6	26.8	35.2	30.9	26.3	34.8	30.5	44.6	51.3	47.4
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Tanzania's employed labor force breakdown comparing 2014 to 2020/2021 is shown in Table 9. The table breaks down data between the United Republic of Tanzania (URT), Tanzania Mainland (TZM), and Zanzibar (ZNZ). Important to note is that manufacturing employment has increased from 2014 to 2020/21 for each portion of Tanzania. Tanzania had an unemployment rate of 2.16% in 2020. Despite the effects of the COVID pandemic, Tanzania had a largely employed work force with unemployment mostly impacting the youth due to recent population increases outpacing job creation.

From 2002 through 2012, Tanzania's economy grew more rapidly than at any other time in its history. More than three-quarters of Tanzania's labor productivity growth is accounted for by structural change (major economic developments).[127] The growth attributable to structural change is almost entirely explained by a rapid decline in the agricultural employment share and an increase in non-agricultural private sector employment share.[127] Also, the World Bank has allocated $425 million to support the expansion of higher education in Tanzania.[128] The country has seen a decrease in enrollments in recent years but the annual demand for university education is expected to rise to more than half a million students by 2030. According to a senior education specialist at the World Bank, Dr. Roberta Malee Bassett, about 80% of the funding will be used to boost enrollments and to improve the quality of teaching at Tanzanian universities.[128] Annual enrollment numbers at Tanzania's higher education institutions have already grown around 112,000 in 2016-17 to more than 210,000 in 2017-18 due to improvements in infrastructure and initiatives to provide higher education loans. Tanzania's increasing education quality is

referenced as a growth driver in their economy and will likely have the largest immediate impact on their automotive industry's labor force.

Conclusions

Based on the findings of the report, I recommend that steps be taken to extend the life of Johnson Matthey's autocatalyst technology business by harnessing emerging markets within Africa and, at the very least, establishing contact with potential customers to begin a dialogue to further explore opportunities. With the world beginning its transition to electric vehicles and sales in developed countries expected to decline, the window for further opportunities is narrowing. As poverty declines and household incomes continue to rise within Africa, especially in the countries outlined in the report, governments will continue to pivot away from importing used vehicles and allow local production or importing of new traditional vehicles to further accelerate in both depth and scale. Domestic automobile manufacturers such as Innoson, Kiira Motors Corp., and Kantanka Automobile, as well as international automobile manufacturers setting up operations in Africa such as PSA Group, Renault Group, Volkswagen, and Nissan should be considered for business opportunities due to expanding market potential within Africa. Further, Egypt has a booming new vehicle market and is currently in the process of converting 1.3 million vehicles from being gasoline to compressed natural gas (CNG) powered. Making the switch to CNG will require the acquisition of 1.3 million methane-specific catalytic converters.

As shown in the report, Africa will be the last continent to take part in the electric vehicle revolution and is only now beginning to upgrade to newer model gasoline and diesel-powered automobiles due to a growing consumer market. Each country noted within the report offers geographical and economic advantages that could serve to increase Johnson Matthey's bottom line into the foreseeable future. Also, labor forces within each country are adequately equipped to support an automotive industry. Not only will labor forces sustain operating an automotive industry but help to fund it due to the large amounts of workers being released from the agricultural sector into other industries, often requiring longer commutes to work. Switching from used vehicles to newer models will also help governments tackle urban air pollution and save the lives of more than 600,000 people per year due to having a functional catalytic converter to break down hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NO_X) from exhaust gas. Oftentimes, catalytic converters are stripped from used vehicles for their precious metal content before being shipped to Africa.

Nigeria, Uganda, Ghana, Morocco, Egypt, and Tanzania represent the fastest growing consumer markets for new vehicles, aside from South Africa, for each portion of the African continent. Morocco is the largest automobile producer and has the largest new vehicle market in north-west Africa, and Egypt is the largest in the north-east. Nigeria and Ghana will contend for African business in the western and central regions. Lastly, Uganda and Tanzania will be competitive players in the eastern region, with landlocked Uganda having less restricted access to central Africa. The countries in the report will account for the lion's share of new vehicle sales, aside from South Africa, in the near to medium term.

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Appendix

Table 7: Drivers Traveling Distance used to Calculate Global Average (km/year).[27]-[43]

Country	Registered Vehicles in Country (million)	km Traveled per Capita per Year
Australia	20.1	10800
Canada	23.9	8500
Denmark	2.6	6300
France	32	6250
Germany	47.7	7000
Italy	39	6250
Japan	78.4	4000
Netherlands	8.5	6150
Norway	2.8	6500
Sweden	4.8	7000
United Kingdom	38.6	6250
United States	276	14000
China	297	1000
Russia	55.8	10200
Average:	**66.2**	**7157**