

ELECTRIFYING MASS TRANSIT IN LAGOS

FOR A SUSTAINABLE FUTURE





Contents

Introduction	02	Policy Support and Public Engagement	17
Environmental Benefits	04	Nigeria Policy Framework	19
Cost Savings and Job Creation	07	Nigeria's Energy Transition Plan	20
Charging Infrastructure	09	Alternative Sources of Power	21
Battery Performance	11	Context and Successful Deployments	22
Technical Partnerships	14	Conclusion	26



**The global threat of climate
change requires unprecedented
ingenuity and initiative**

Introduction

The global threat of climate change requires unprecedented ingenuity and initiative. It necessitates embracing sustainable technologies and practices, particularly in sectors with significant carbon emissions such as transportation. Our white paper on Electric Vehicles (EVs) in Nigeria aims to present a compelling case for the electrification of mass transit in Lagos, Nigeria, underscoring the environmental, economic, and social advantages of this monumental and, absolutely necessary shift.

In recent years, the world has witnessed the devastating impacts of climate change, from extreme weather events to rising sea levels. As a rapidly growing city and economic hub, Lagos faces its share of environmental challenges, including air pollution, floods and traffic congestion, amongst others.

Recognizing the urgency of reducing carbon emissions and improving air quality, this OCEL initiative aims to transform Nigeria's mass transit system through the adoption of buses powered by renewable and clean energy systems such as solar and gas.



This white paper provides a comprehensive overview of the key findings and recommendations outlined in our ongoing technical and economic analysis, which we aim to culminate with a full business case for EVs in Nigeria.

It highlights the environmental benefits of electric mass transit, the potential for cost savings and job creation opportunities, the importance of charging infrastructure, battery performance considerations, the need for policy support and public engagement, alternative sources of power, as well as successful EV deployments in similar climates, thereby addressing concerns about environmental context.

By delving into each of these areas, this white paper aims to uncover the viability and significance of electrifying mass transit in Lagos, emphasizing the positive impact it can have on the city's sustainability, economy and quality of life.



Environmental Benefits

Electric mass transit holds immense promise in addressing the environmental challenges faced by Lagos and Nigeria as a whole. Our study emphasizes the urgent need to reduce greenhouse gas (GHG) emissions and combat climate change.

“Energy use accounts for 68% of total Global Greenhouse Gas (GHG) emissions, with the transport sector's heavy reliance on fossil fuels accounting for almost a quarter of Co₂ emissions.”

- Intergovernmental Panel on Climate Change (IPCC)

It's estimated that Lagos State could soon become the world's most populated city with 100 million residents by 2100. Today, Nigeria has the largest economy and population of any country in Africa and produced circa 127 million of CO₂ in 2020. The bulk of these emissions came from the use of petrol and diesel in cars, trucks and buses.

Detailed analysis of public domain and proprietary research has shown that the desegregated transportation sector contributes about 60% of total CO₂ emissions in Nigeria resulting in economic losses of between \$0.5billion - \$2.6billion (Source: World Bank) caused by air pollution.

This assertion is backed up by a University of Lagos study showing that transportation contributes ~60% of Lagos' total air pollution (more than double the global average for the sector)



With road transport energy consumption projected to increase by 2.3% year on year for diesel and 3.2% per year for gasoline from 2020 to 2050, it should be clear to all stakeholders that something must be done sooner rather than later.

By transitioning to electric buses, Lagos can significantly contribute to the reduction of greenhouse gases. Electric buses produce zero tailpipe emissions, leading to improved air quality and reduced pollution-related health risks for the city's inhabitants. Moreover, electric buses have the potential to curb noise pollution, providing a quieter and more pleasant urban environment.

Cost Savings and Job Creation

While electric buses may have higher up-front costs compared to traditional diesel buses, our research highlights the long-term cost savings they offer. Electric buses have lower operating and maintenance costs over their lifetime, which can help offset the higher initial investment.

The fact of the matter is - electric vehicles have fewer moving components; therefore, wear and tear are reduced when compared to traditional auto parts. As a result, repairs and maintenance for electric buses cost significantly less compared to internal combustion engine (ICE) vehicles with their numerous, prone-to-wear, moving parts.

Additionally, the establishment of a local assembly plant for electric buses in Nigeria presents a tremendous opportunity for job creation and economic growth. Nigeria's manufacturing sector will benefit from the demand for locally produced electric buses (and other EVs), generating employment, driving skills development and stimulating the local economy. This not only reduces reliance on foreign imports but also promotes self sufficiency and fosters technological advancements within the country.

Furthermore, electric mass transit can alleviate the financial burden on individuals and the Government. Nigeria currently experiences some of the highest fuel costs globally due to its reliance on imported petroleum products.



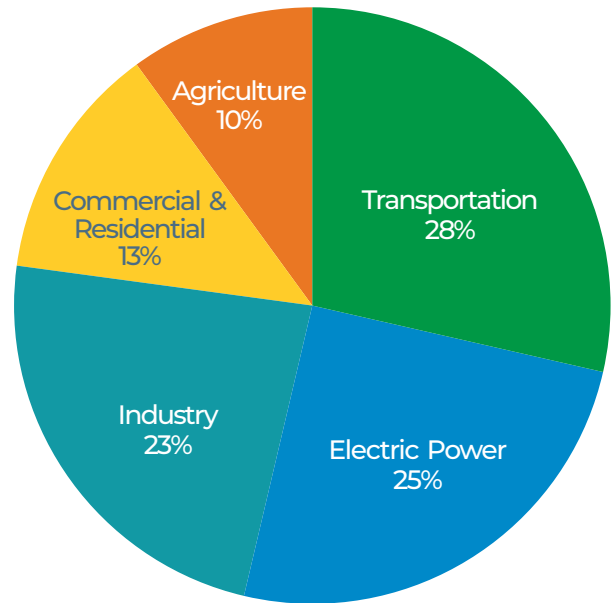
By adopting electric vehicles, Nigeria can reduce its dependence on imports, saving the country billions of dollars.

Additionally, our research strongly suggests that electricity is generally less expensive than gasoline and diesel, making electric vehicles a more cost-effective option in the long run.

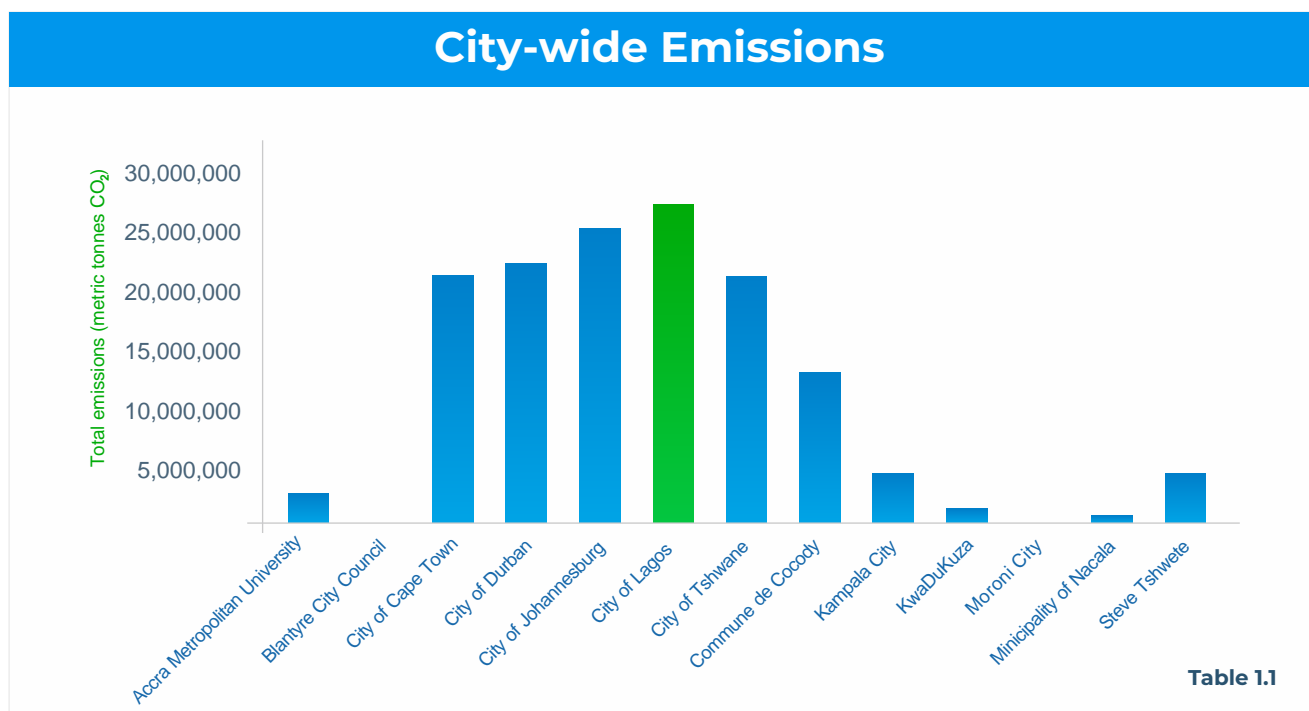
Largest Contributors to GHG by Sector (Global)

Source: Environmental Protection Agency

Figure 1.1



The environmental benefits of electric mass transit extend beyond carbon emissions reduction. They also include the conservation of natural resources, such as reduced reliance on fossil fuels, and a decreased demand for petroleum products. By embracing electric buses, Lagos can lead the way in sustainable transportation and set an example for other cities in Nigeria and beyond.



Source: CDP Africa Report Benchmarking Progress Towards Climate Safe Cities, States and Region March 2020

Charging Infrastructure



The successful implementation of electric mass transit in Lagos relies on the establishment of a robust charging infrastructure. Our ongoing study recognizes this need and proposes strategic solutions for policymakers, investors and operators to consider. As part of our own efforts to fully explore these opportunities we have entered into agreements with a host of best in class global brands across the full value chain that can support successful deployment of the initiative.

Specifically our current partnership with Yutong, the world's leading manufacturer of electric buses includes the set up of a local EV assembly plant as well as service centers with accompanying knowledge transfer, up-skilling, to name a few.



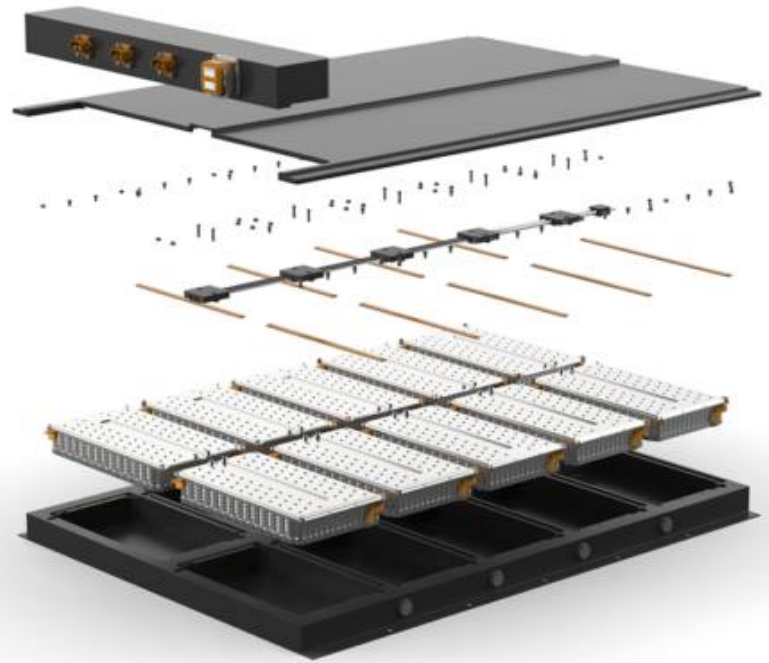
Figure 1.2 – Concept design for EV Charging stations deployed along major roads

Yutong, a top 5 EV manufacturing company globally, has extensive experience developing PoC's and delivering sustainable solutions in markets with similar environmental and social characteristics as experienced in Nigeria.

Lastly, smart charging technology plays a pivotal role in optimizing power usage. By strategically managing the charging process, smart charging systems prevent overloading the grid during peak hours and ensure efficient energy distribution. This not only benefits electric bus operators but also contributes to a more sustainable and balanced power grid.

Battery Performance

Battery performance is a critical factor in the successful deployment of electric buses. Our key learning emphasizes the importance of high-quality lithium-ion batteries, as used by leading manufacturers such as Yutong.



These batteries are renowned for their high energy density and long cycle life. Furthermore, advanced battery management systems like those used by Yutong, monitor and control crucial battery parameters, ensuring optimal performance, efficiency, and safety.

Ongoing research also supports the view that it will be essential to address concerns related to incidents involving electric vehicle batteries. While rare, such incidents can occur due to factors like manufacturing defects, damage to the battery pack, or improper handling or charging. Leading manufacturers such as Yutong, BYD and Tesla have implemented strict quality control measures and safety standards to mitigate these risks.

Additionally, all our proposed EV partners' battery management systems are designed to prevent issues such as overcharging and overheating, ensuring the safety and reliability of their electric buses.

Battery Performance

Battery Performance of one of our Technical Partners:

Type

Lithium Iron Phosphate
(LiFePO₄)

Capacity:

350-422kWh

Charge cycles

Up to 4,000 cycles

Charge hours

4-5 hours

Power

240 kW

Voltage

450 V

Energy density

150-160 Wh/kg

Operating temperature

-30°C to 55°C

Self-discharge rate

1-2% per month

Power density

1.2-1.3 kW/kg

Discharging efficiency

85-90%

Charging efficiency

90-95%

Safety features

Nitrogen protection system, thermal retardant material, fireproof enclosure. Features that prevent the batteries from catching fire or exploding.

Design features

Designed to provide long-range and reliable performance with a high energy density, which means they can store a lot of energy in a small space.

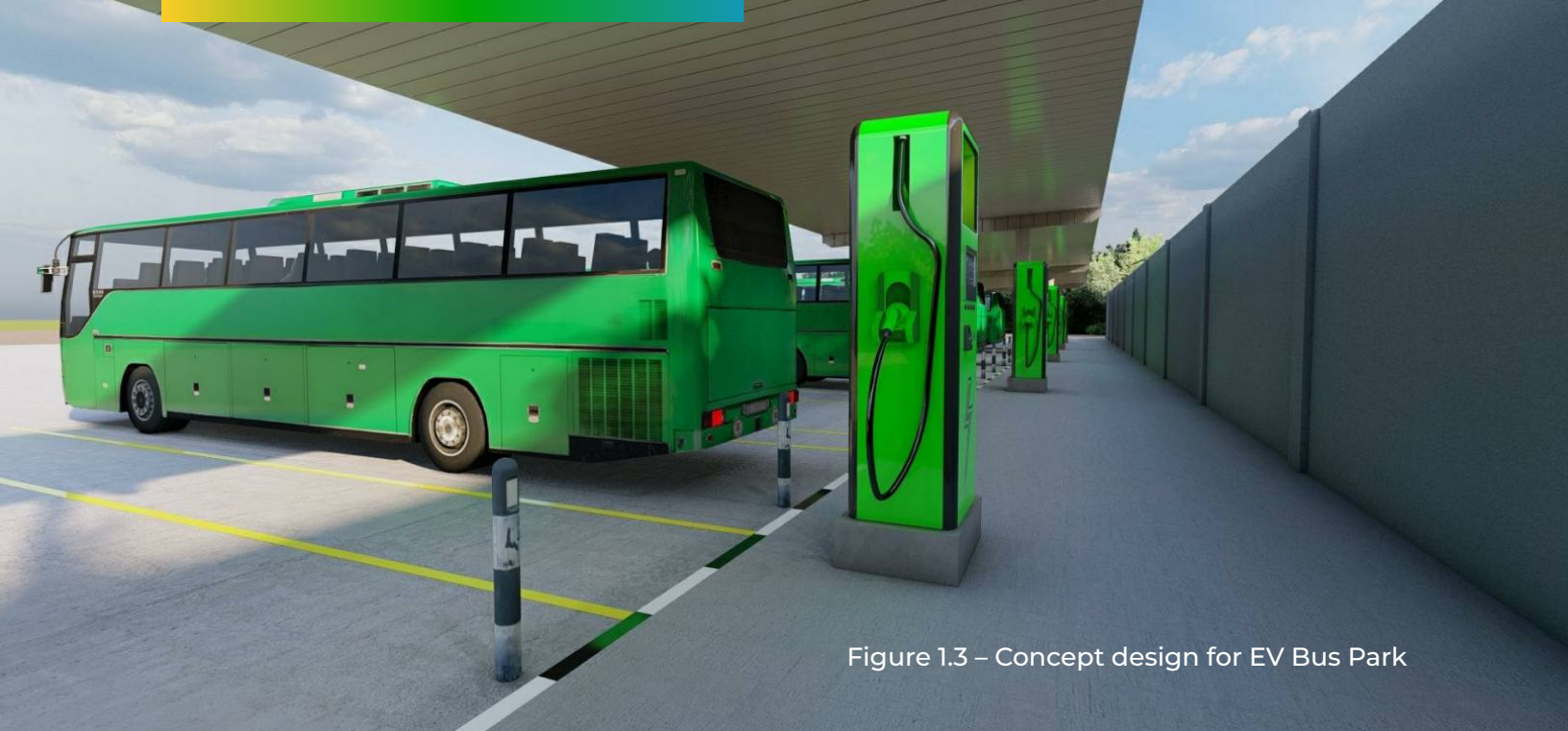


Figure 1.3 – Concept design for EV Bus Park

One crucial aspect of charging infrastructure is ensuring its resilience during power outages. To address this concern, the OCEL initiative integrates solar power solutions into charging stations. By harnessing the abundant sunlight in Lagos, charging stations can continue to operate even when the grid experiences disruptions. This approach not only ensures uninterrupted service but also reduces the strain on the existing power grid.

Furthermore, with Nigeria's energy transition policy laying emphasis on gas as a transition fuel, Nigeria's grid will see improvements in stability and supply once policy aligns with capital and new investments. Clean fuels powering the grid and charging stations augmented with solar present us with a unique opportunity to drive the sustainability agenda in the transport and logistics sector.

By leveraging advanced battery technology and stringent safety protocols, electric buses can indeed deliver reliable performance and address any potential concerns surrounding battery performance and safety.

Technical Partnerships

Oando's history is marked by a spirit of partnership. The company has consistently sought collaborations across industries and Governments, paving the way for private sector participation. Like our parent company, we strongly believe in the transformative power of partnerships especially in a sector that is still virgin territory to the country at large.

Against this backdrop our goal is to leverage the technical know-how and experience of global leaders in the sector via partnerships and collaboration.



We have painstakingly identified partners that are leaders in the electric vehicles and charging space, beyond their global ranking is their understanding of different terrains and the development of best-fit solutions as well as a commitment to planting roots beyond their home country.



In selecting our partners, the following attributes were critical:

Market Leaders: Globally renowned manufacturers and suppliers in the field of electric vehicles (EVs) and charging stations who have established themselves as leaders in the industry.

Global Spread: Partners that have a global reach, having supplied EVs and supporting infrastructure across Europe, Africa, Middle East, Latin America and Asia. In addition to establishing worldwide service stations and regional parts warehouses across the world to reduce dependency on any one market, shorten the parts supply chain as well as reinforce dealer stock levels.

Rapid Fleet Expansion: They have demonstrated the ability to deal with rapid fleet expansion especially across diverse regions by successfully supplying EVs and related solutions within a short lead time to the likes of the 2022 Beijing Olympic Games, 2022 World Cup in Qatar and COP26.

Technical Expertise: The identified companies excel in technical expertise leveraging this to manufacture a wide range of EVs that offer exceptional performance, efficiency, safety and environmental friendliness.

Research & Technology: They all have a track record of consistent investment in new technology research, specifically the research of safety, energy saving and new energy technologies for buses. Their advanced research and development capabilities ensure continuous innovation and the production of cutting-edge EV technologies.

Battery Technology: Partners that are in continuous collaboration with leaders in battery technology, positioning themselves at the forefront of EV battery technology research and development. Leaders that have made significant strides in enhancing battery performance, extending range, and improving charging efficiency, effectively addressing key challenges in the EV industry.

Finally, and in line with our commitment to local capacity building, all our partners are dedicated to supporting the success of this initiative via a willingness to set up assembly plants as well as maintenance and support facilities locally, ensuring the transfer of knowledge, job creation, and fostering economic growth within the region.

We are clear that building confidence in the local market will be fuelled by the trust people have in the Oando brand as well as the global reputation, technical expertise, research and development capabilities, and commitment to local capacity building that our partners have.



Policy Support and Public Engagement

As a pioneering corporate in Africa's energy sector, OCEL knows very well that partnering with policymakers and the general public turns the impossible into reality.

The successful adoption of electric mass transit in Lagos requires a conducive policy environment and active public engagement. Our initiative calls for supportive policies, workable financial incentives, and practical regulatory frameworks that encourage the transition to electric buses. These measures can include subsidies, tax incentives, and grants to offset the higher up-front costs associated with electric buses.

Public engagement and awareness campaigns will also be crucial in educating and garnering support for electric mass transit. By educating the public about the environmental and economic benefits of electric buses, the initiative can generate enthusiasm and foster a sense of ownership with commuters.

Public-private partnerships will also play a significant role in disseminating information and promoting the advantages of electric mass transit to the wider community.

Furthermore, this collaborative approach ensures that all stakeholders are actively involved in the decision-making process and share a common vision for a sustainable and clean transportation system, thereby creating an environment conducive to the successful implementation of electric mass transit.



Nigeria's Policy Framework

Against this backdrop and in demonstration of her commitment to achieving carbon neutrality, ending energy poverty, and driving economic growth the Nigerian Government has been proactive in the development and implementation of policies and supporting bodies as follows:

Net Neutrality Ambitions	National EV Ambition	Policies	Supporting Bodies
<p>2030 – Utilizing in-country efforts reduce GHG by 20% and 47% with international intervention in the form of financial assistance, technology transfer and capacity building.</p> <p>2060 – Achieve carbon neutrality.</p>	<p>2025 – Localization of infrastructure and capacity to support the assembling of Electric Vehicles in Nigeria</p>	<p>2021 – Passage of Climate Change Act</p> <p>2022 – Launch of Energy Transition Plan (ETP)</p>	<p>2022 – Creation of the National Council for Climate Change.</p>



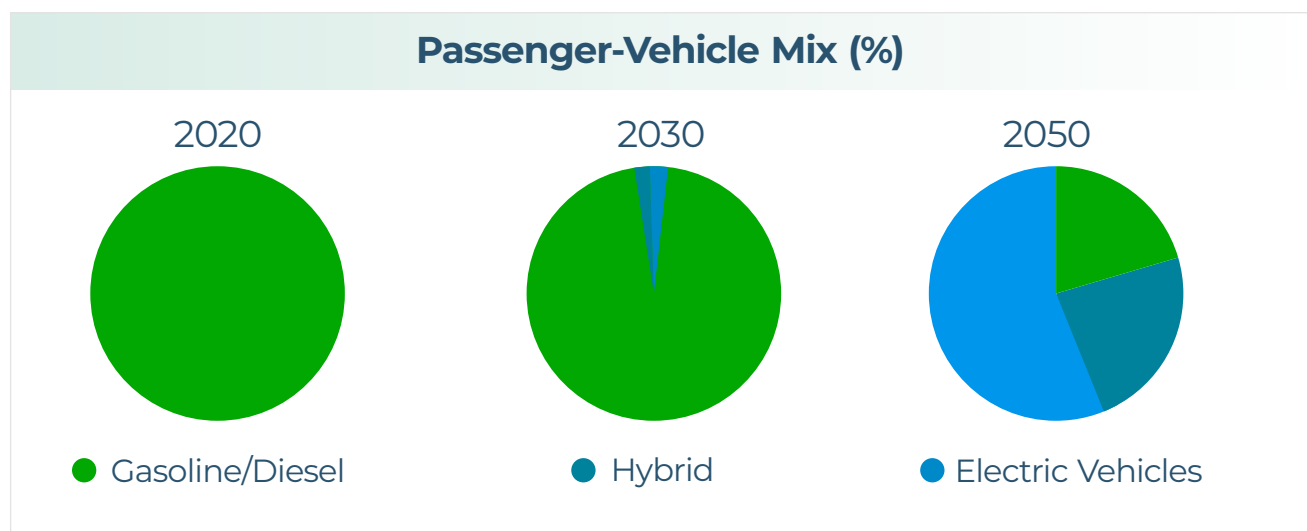
Nigeria's Energy Transition Plan

A key component of realizing the ambitions laid out in the Energy Transition Plan (ETP) is collaboration between the Public and Private sector.

According to the ETP, Nigeria's energy transition creates significant investment opportunities such as the establishment and expansion of industries related to solar energy, hydrogen, and electric vehicles.

The ETP proposes the reduction of transport emissions by switching to low-emissions transport technology and mode-shifting. The focus of the ETP analysis is on passenger vehicles which accounted for ~72% of transport emissions in 2020. Additional emissions reduction is obtainable through mode-shifting from gasoline/diesel and hybrid vehicles to electric buses/2-3 wheelers.

Furthermore, there are opportunities for biofuel blending to serve as an interim decarbonization measure in the transition to an electric-based system. Electric vehicles are considered only realistic post-2030 therefore, in the interim, biofuels can help decarbonize the sector.



Alternative Sources of Power

While the primary goal of our initiative is to eliminate fossil fuels entirely, our study acknowledges the potential role of alternative sources of power during the transition to electric mass transit. The initiative recognizes that gas can serve as an intermediate step in electricity generation for charging stations, be it at grid level or as a captive power solution for mass transit infrastructure, such as EV Charging Stations. That said – our long-term vision remains centered around renewable energy sources.

This initiative, and the associated technical design (across all phases) in Lagos State, aims to invest in renewable technologies, such as solar power, to support the charging infrastructure.

Our ongoing research and indeed case studies from other markets, such as India and Brazil, demonstrate that there is a clear opportunity for solar power solutions in the mass transit category, and that these technologies ultimately reduce carbon footprint, minimize dependency on fossil fuels, and provide an 'always available' energy source for electric buses.

Context and Successful Deployments

Our ongoing research is a greenfield area of study in Nigeria, and as such requires us to delve into case studies from other markets, where similar programmes have either been fully developed or executed.

To this end, this white paper contextualizes the proposed electrification of mass transit in Lagos by highlighting successful electric vehicle deployments in countries with similar climates, thus demonstrating the feasibility and potential for success in Nigeria.





India has a tropical climate, much like Nigeria, with high temperatures and humidity. Despite this, the country has been successful in deploying EVs with over 1.88 million registered EVs. One example is the Tata Nexon EV, which has a claimed range of 312 km on a single charge.

<https://www.autocarindia.com/car-news/tata-nexon-ev-%20certified-with-312km-range-415657>



Thailand also has a tropical climate with high temperatures and humidity, and the country has seen success in deploying EVs. In fact, Thailand is one of the largest EV markets in Southeast Asia, with a government target of having 1.2 million EVs on the road by 2036.

<https://asianinsiders.com/2023/04/11/thailand-is-looking-very-attractive-for-ev-manufacturing/>



Malaysia has a similar climate to Nigeria, with high temperatures and humidity. The country has been successful in deploying EVs, with the Nissan Leaf being one of the most popular EVs in the country.

<https://paultan.org/2021/09/04/opinion-we-now-have-premium-evs-in-malaysia-but-where-are-the-affordable-electric-cars-that-we-can-buy/>



Brazil has a tropical climate with high temperatures and humidity, and the country has been successful in deploying EVs. The Renault Zoe, for example, is a popular EV in Brazil and has a range of up to 395 km on a single charge.

<https://www.bloomberg.com/news/articles/2020-07-20/renault-s-electric-zoe-defies-virus-with-first-half-sales-jump?sref=3h53wLIP#xj4y7vzkg>



Many regions in **South Africa** have a similar climate to Nigeria, with hot, humid summers and mild winters. The country has seen significant growth in its EV market in recent years, with models such as the Nissan Leaf and BMW i3 being popular choices among South African EV drivers.

<https://cleantechnica.com/2022/02/04/the-bmw-i3-lands-with-a-bang-in-south-africas-growing-electric-vehicle-market/>

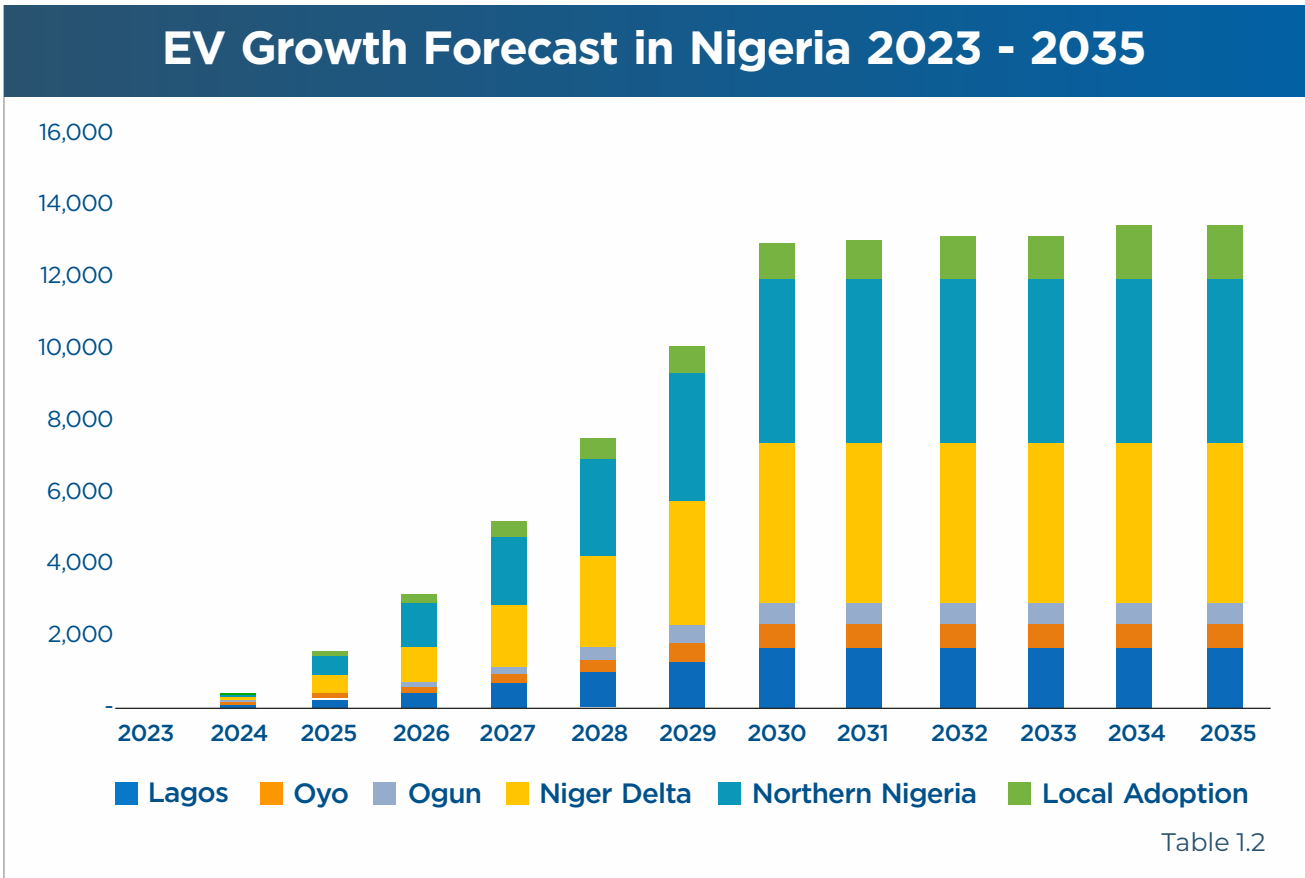


Egypt has a hot and dry climate, with temperatures that can reach up to 50°C. Despite this, the country has seen success in deploying EVs, particularly in the commercial sector, with electric buses and tuk-tuks becoming increasingly common on the streets of Cairo.

<https://enterprise.press/greeneconomys/interest-in-electric-vehicles-is-slowly-but-surely-picking-up-in-egypt/>

Although EV adoption is still relatively low in many African countries vis-à-vis other markets in Europe and Asia, there is palpable interest in the technology and their potential to support emissions reduction. As development capital comes with more stringent ESG requirements, OCEL projects regional demand will grow.

In this study - India, Thailand, Malaysia, Brazil, South Africa, and Egypt are cited as examples of countries with diverse climates that have successfully adopted electric vehicles. These examples underscore the adaptability of electric vehicles to different weather conditions and infrastructure landscapes. By drawing lessons from these successful deployments, Lagos can develop tailored solutions that suit its unique context.



Source: Generated by Oando Clean Energy using data from Global EV Adoption: The Reality in Africa may be Different (techpoint.africa) and Trends and Developments in Electric Vehicle Markets – Global EV Outlook 2021 – Analysis - IEA

Conclusion

The evidence is all around us - the world is moving away from the use of fossil fuels as a source of energy and gravitating towards more sustainable sources.

Furthermore, advances in technology coupled with innovative partnerships prove that a clean energy future is indeed within our grasp.



Figure 1.6 - A.I Generated image of an EV Bus Park in Lagos

There may be periodical setbacks, such as those currently being experienced in parts of Europe - high upfront costs, EV charge time, lack of skilled technical personnel and the absence of supportive policies, infrastructure planning and incentives to name a few.

Many of these setbacks are being actively addressed and mitigated as the EV industry continues to evolve. Advancements in battery technology, reductions in costs, increased charging infrastructure deployment, and supportive Government policies are gradually addressing these challenges and accelerating the adoption of electric buses worldwide. Whatever the case the one thing that's clear is the future is here and there will be no U-turns going forward.

Sustainable transport is one step in a long journey towards decarbonisation. Our Proof of Concept (PoC) in partnership with Lagos State aims to validate our understanding of the opportunities and challenges, with a view to developing a full business-case for a sustainable mass transit system with EVs at the core.

Furthermore, the PoC demonstrates what well meaning, development driven organisations can achieve when they work with policymakers to tackle complex challenges at the intersection of economics, policy and sustainable development.

At Oando Clean Energy, we are in the business of facilitating long-term solutions that benefit the industry and nation. We do this by prioritising the use of clean and renewable energy sources for commerce and development. We have a history of many firsts, always paving the way for private sector participation.



The success of this PoC, and the subsequent development of a full business case, will empower different players across the value chain to act in realizing a 'Smart & Sustainable' Lagos State. It is with this that we implore both the public and private sectors to provide their full support and aid us in fully exploring this opportunity to collaboratively design a more sustainable future for all.

Ultimately, the electrification of mass transit in Lagos is not just an environmental imperative but also a strategic decision that will enhance the city's livability, boost its economy, and improve the well-being of its residents. The evidence strongly indicates that it can be done here in Nigeria – we have no excuse not to be audacious and pursue this opportunity.



Together, Let's Bridge Africa's Energy Gap



For more information please contact:

Alero Balogun

Senior Vice President, Corporate Services
Oando Clean Energy

📍 The Wings Office Complex,
17a Ozumba Mbadiwe Avenue,
Victoria Island, Lagos, Nigeria.

☎ **Tel:** +234 (1) 270400, ext. 6761

✉ **albalogun@oanodplc.com**

