Electric Cargo Bikes “Made in Ghana”

Project Impact Report

June 2024

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

SIEMENS | Stiftung

IMPACT HUB Accra

Content

List of Tables and Figures

Supported by:
Federal Ministry for Economic Affairs and Climate Action
IKI INTERNATIONAL CLIMATE INITIATIVE
on the basis of a decision by the German Bundestag

In recent years, the International Climate Initiative has developed into a central programme for promoting climate action and biodiversity conservation. Through the IKI, Germany has been contributing to the protection of the climate and biodiversity since 2008, thereby fulfilling its international obligations within the international community. IKI relies on close cooperation with the governments of the partner countries and a diverse implementation structure to implement the 400 or so projects that are currently in progress.

The project is funded under the framework of the International Climate Initiative (IKI), which is an important part of the German government’s international climate finance commitment.

SIEMENS | Stiftung

As a nonprofit foundation, Siemens Stiftung promotes sustainable social development, which is crucially dependent on access to basic services, high-quality education and an understanding of culture. Their international project work supports people in taking the initiative to responsibly address current challenges.

The geographical focus of their work is on regions in Africa and Latin America as well as Germany and other European countries. They develop solutions and programs with partners and implement them together. Technological and social innovations play a key role in this work. Their actions are impact-oriented and conducted in a transparent manner.

https://www.siemens-stiftung.org/en/
For any queries, please contact
sebastian.gruss@siemens-stiftung.org

IMPACT HUB Accra

Impact Hub Accra is a leading social entrepreneurship and innovation centre in Ghana. The mission is to support inclusive growth in Africa through the creation of a resilient and dynamic social innovation ecosystem. Working with local and international private and public partners, it empowers local entrepreneurs, helping them fulfil their potential to become active change makers. Now with its ongoing growth project, Ako Adjei Park, Impact Hub Accra is taking its vision to the next level. The vision is to build a 20,000sqm mixed-use (live-work-play) campus of up to 20 buildings, with workspaces and growth support programs for the city’s boldest innovators.

https://accra.impacthub.net/
For any queries, please contact
bernard.adjei@impacthub.net

The project is funded under the framework of the International Climate Initiative (IKI), which is an important part of the German government’s international climate finance commitment.

The development and execution of the "Made in Ghana" e-cargo bike project relied on the collaborative efforts of numerous organizations, technical institutions, and individuals. We would like to extend our sincerest gratitude to everyone who contributed to the successful completion of this project over the past three and a half years.

We are immensely thankful to the International Climate Initiative (IKI) for their impactful funding, which laid the groundwork for advancing electric mobility solutions in Ghana and Our implementing partner, Siemens Stiftung, for their collaboration throughout this journey.

Special thanks go to Valerie Labi,Founder and CEO of Wahu, Quincy Agyapong, Ian Mbote, and the entire WAHU Mobility team for their varied collaborations and significant technical contributions throughout the program's duration.

We extend our profound thanks to representatives from the Renewable Energy Association of Ghana, Africa E-Mobility Alliance, Jumia, Solar Taxi, Kofa, Energy Quest Foundation, Ghana Climate Innovation Centre, the Design and Technology Institute, and all our local partners and contributors for providing the insights necessary to complete this report.

We also appreciate the research team—Deborah Nyarko-Mensah, Sylvester Adams, Ewurama Asare, and Desmond Abotsi—for their dedication in conducting the research and analysis needed to complete this report. Many thanks to Kirstie Kwarteng, Deborah Nyarko-Mensah, Sylvester Adams and Dennis Kotoko for their efforts in drafting and designing the final impact report.

Lastly, our endless gratitude goes to the entire e-mobility ecosystem for their support and for their ongoing efforts to increase the accessibility of e-mobility vehicles for all Ghanaians.

Acronyms

BEV	Battery Electric Vehicle
CKD	Complete Knock-Down
COP	Conference of the Parties
EV	Electric Vehicles
GHG	Greenhouse Gas
ICE	Internal Combustion Engine
NDC	Nationally Determined Contributions
OEM	Original Equipment Manufacturers
PV	Photovoltaic
SDG	Sustainable Development Goals
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change


wahu!

C40	Global network of nearly 100 mayors of the world's leading cities that are united in action to confront the climate crisis[1]
Circular economy	The circular economy is a system where materials never become waste and nature is regenerated. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting.[2]
Conference of the Parties (COP)	UN Climate Change Conference
National Determined Contributions	Countries' self-defined national climate pledges under the Paris Agreement, detailing what they will do to help meet the global goal to pursue 1.5°C, adapt to climate impacts and ensure sufficient finance to support these efforts.[3]
Paris Agreement	A legally binding international treaty on climate change. It was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016[4]
Photovoltaic (PV)	Technology or process of converting light into electricity; often associated with solar power

[1] C40, n.d.
[2] Ellen MacArthur Foundation, n.d.
[3] UNDP, 2023
[4] UNFCCC, n.d.

A word from the partners

SIEMENS | Stiftung

In an era defined by urgent climate challenges and growing inequalities, innovative and sustainable solutions are critical to ensuring a better future for all. At Siemens Stiftung, our commitment to sustainable social development drives us to support projects that address these global challenges head-on. We realigned our strategic focus to design and implement projects that address pressing challenges like Access to Essential Services, Connected Societies and Climate & Sustainability. Through collaborative partnerships, we work to build locally sustainable structures and support transformative innovations. We are proud to have partnered with Impact Hub Accra for the "Made in Ghana" E-Cargo Bike project as part of our focus on climate and sustainability. With the support of the International Climate Initiative (IKI) and local stakeholders like WAHU Mobility, the project established a solution that not only addresses environmental concerns but also enhances livelihoods through job creation and infrastructure development. Siemens Stiftung together with its partners seeks to create a sustainable local value chain for the production and operation of electric cargo bikes tailored to Ghana’s unique mobility needs. It also aimed to anchor climate-friendly mobility solutions within the country, contributing to both national climate mitigation strategies and sustainable economic growth.

Through this project, we witnessed firsthand the immense potential that lies in connecting technology, local expertise, and international support. From establishing solar-powered charging stations to developing a fleet of electric cargo bikes - the results speak for themselves: over 54,700 kilometres covered, 4.35 tonnes of CO2 emissions saved, and 31 direct jobs created. But beyond the numbers, this initiative with support from WAHU Mobility has created a scalable model for green mobility that can inspire further efforts across the region and beyond. None of this would have been possible without the dedicated collaboration of our partners.

We are especially grateful to Impact Hub Accra, whose local knowledge and unwavering dedication were essential in making this project a success. As our trusted local partner, they ensured that the project not only met its objectives but also left a lasting impact on the communities it served. WAHU Mobility, with their key technical support, played a crucial role in advancing the research, development, and scaling of the e-bikes, helping to lay the foundation for a growing e-mobility ecosystem in Ghana. Their continued engagement throughout the project was instrumental in realizing this vision.

As we look toward the future, Siemens Stiftung remains committed to supporting such transformative initiatives that foster sustainable development and climate resilience. It is through collaborations like this that we can make a real difference—creating lasting change for the environment, the economy, and society as a whole.

Dr. Nina Smidt
Managing Director (CEO) / Spokesperson of the Board

A word from the partners

Over the past decade, working alongside local and global partners to transform our city and build resilience through innovation, I have observed Accra’s evolution from the frontlines. The city continues its efforts to remake itself amid mounting pressures—youth unemployment, the challenges of climate change, and the demands of a rapidly growing urban population. These resilience-building efforts don’t always succeed for various reasons, but occasionally, an initiative captures the city’s imagination. Such moments prove that, with the right blend of partnerships, compelling narratives, deep commitment, and bold vision, we can tackle pressing challenges and create opportunities for young people to actively shape our communities' economic future. One of these moments was the emergence of the e-cargo bike initiative.
Three years ago, we partnered with Siemens Stiftung and the International Climate Initiative of the German Government to explore a vital question: Could we electrify Ghana’s last-mile delivery market with e-bikes? As our city grapples with the complexities of an energy transition across sectors, transportation emerged as the perfect testing ground for innovative business models and ideas.

At that time, quick commerce was on the rise, with global players like Glovo and Bolt gaining traction. This created an opportunity to leverage that growth and introduce a transportation transition strategy built on research and sound economics. Our project, “Made in Ghana” Electric Cargo Bikes, was designed to catalyze the electric mobility sector in Ghana, and over the past three years, it has surpassed expectations. I’ll let the report speak for itself.
As we conclude this project, we see it as the beginning of a larger mission to tackle Africa’s growing demands. We are more confident than ever, driven to pursue practical infrastructure solutions for urgent issues like housing shortages, inadequate transportation, and unreliable energy. The insights from this project have shown us that we can achieve real economic impact by improving lives while reducing carbon emissions. We are committed to being a catalyst in the search for fast, scalable solutions for those who need them most.
A heartfelt thank you to everyone who made this possible—the dedicated team behind this inspiring program, our funding partners Siemens Stiftung and the International Climate Initiative of the German Government, our local technical partners at Wahu, who brought ‘electric’ energy to every phase, and all those in the e-mobility ecosystem who dare to move this city forward. I can’t wait for the future we’re creating together!

Will Senyo
Founder & CEO, Impact Hub Accra

Executive Summary

The "Made in Ghana" e-cargo bikes project was funded by the International Climate Initiative (IKI), an essential part of the German government's international climate finance commitment. Siemens Stiftung served as the project's primary implementer, with Impact Hub Accra as the local partner. Running from July 2021 to June 2024, the project had three core objectives:

01

Establish a sustainable, local value chain for producing, operating, and maintaining electric cargo bikes tailored to the mobility needs of urban and rural areas in Ghana.

02

Build a network of charging stations with local groups and communal bodies, tested with a sustainable financing model.

03

Anchor climate-friendly mobility solutions, working with key national stakeholders to increase Ghana's capacity for climate mitigation

This ambitious project aligns with several of the Sustainable Development Goals, including Climate Action (SDG 13) , Decent Work and Economic Growth (SDG 8), Industry, innovation and infrastructure (SDG 9), Reduced inequalities (SDG 10), Sustainable cities and communities (SDG 11).

4.35 tonnes of CO2 saved

53,000 km covered

1 number of swapping stations created

E-bikes made from 73% recycled materials

Over 300 direct and indirect jobs created

The project successfully saved 4.35 tonnes of CO2, covered 54,700 KM with e-bikes, built a solar-powered battery swapping station, and created 151 direct and indirect jobs. It also maintained ongoing technical engagement with Wahu Mobility, as they grew their fleet to 160 commercial riders. Additionally, the project saw the establishment of the Net Zero e-mobility platform, a private sector community aimed at advancing the e-mobility ecosystem and adoption rates in Ghana.

Most notably, Wahu Mobility, key technical partners for the project, working closely with the Impact Hub Accra experienced significant growth, contributing to the research, development, and scaling of their commercial operations.

This report examines the project's transformative impact on Ghana's transportation sector, detailing economic, environmental, social, and policy implications. It also provides an in-depth look into the e-bikes' development process and the broader vision of revolutionizing transportation through electric mobility for last-mile delivery.

Findings

Based on the findings, the following recommendations are proposed: (See Section 7 of this report for our detailed recommendation and conclusion)

- **Develop a Unified Policy Framework:** To create a cohesive regulatory environment that supports the growth of e-mobility, a strong policy foundation is needed. Currently, the key policies influencing e-mobility lack integration which limits their effectiveness. To rectify this, the relevant Ghanaian government authorities should integrate the Electric Vehicle Policy, Ghana Automotive Development Policy, and Customs Act to eliminate inconsistencies.

- **Support Participation of Domestic Original Equipment Manufacturers (OEMs):** To promote local manufacturing and competitiveness in the automotive sector, domestic OEMs must be integrated into Ghana's automotive policy frameworks. To amend this, the Ghana Automotive Development Policy should be amended to allow domestic OEMs to join the Automotive Association without requiring international partnerships.

- **Establish Comprehensive Intellectual Property Protections:** Protecting intellectual property in our local market poses significant barriers, often making it necessary to pursue filings in other jurisdictions. To protect local innovations and facilitate domestic manufacturing, IP protections must be enacted. The Ministry of Justice should streamline the process for filing patents and trademarks in Ghana, ensuring local companies can safeguard their designs and technologies. Securing these protections will enable EV companies to retain ownership of licensing rights to their vehicles.

- **Revise Electricity Pricing Policies:** To promote greater accessibility for electric vehicle (EV) usage, the price of electricity should be affordable. EV companies and organisations in the e-mobility ecosystem can advocate with the Energy Commision and the Public Utilities Regulatory Commission for reductions in electricity tariffs, particularly for EV charging stations. This will help encourage widespread adoption by lowering operational costs for both consumers and businesses.

- **Public Awareness Campaigns:** EV companies, and other key actors in the e-mobility space such as Ghana Climate Innovation Centre and the Renewable Energy Association of Ghana should create targeted awareness campaigns and educational programs in local languages that emphasise the environmental and economic benefits of EVs, especially e-cargo bikes.

- **Implement Tax Incentives for EV Adoption:** To stimulate investment in the EV sector and support local manufacturers, it is crucial to address the current definition of two-wheelers in the automotive development policy which excludes tax concessions for EV producers and makers of two-wheel vehicles. Introducing tax exemptions for electric vehicle components, reducing VAT on EV sales, and having an automotive policy that includes two-and three-wheel vehicles are essential for fostering an environment conducive to local innovation and growth in the e-mobility sector.

Section 1 - Introduction

Climate change is increasingly becoming an issue throughout the world, with the African continent being the most impacted despite contributing the least to global greenhouse gas emissions. Intertwined with climate issues are issues of sustainability and poverty, as insufficient climate resiliency is leading to the loss of livelihoods due to impacts of climate change. To combat climate change, increase sustainability and improve job creation, a number of policies have been introduced on global, national, and local levels.

On the global level, the SDGs have provided a framework for countries to work towards by 2030. Climate change, clean environment, sustainability, and economic development are among the seventeen goals listed in the SDGs. Additionally, the Paris Agreement encourages signatory countries to set goals to reduce their greenhouse gas emissions. Signatories to the Agreement must provide an updated national climate action plan, also referred to as National Determined Contributions, every five years in accordance with the Paris Agreement regulations. The Paris Agreement aligns closely with another global climate action framework, the United Nations Framework Convention on Climate Change (UNFCCC). COP is the primary decision-making body for the UNFCCC and COP conferences are attended by countries that have agreed to adhere to the UNFCCC.

Ghana Climate Policies

In adherence with the SDGs and international policies on climate action, Ghana has created several policies to advance its climate action objectives. This includes, but is not limited to, the National Climate Change Policy, Renewable Energy Policy, National Adaptation Plan, and most recently the National Electric Vehicle Policy. Ghana also submits its Nationally Determined Contributions in accordance with the Paris Agreement and made its most recent submission in 2021. There are also several Ghanaian government institutions dedicated to addressing climate change and increasing climate resilience. This includes, but is not limited to, the Environmental Protection Agency, Ministry of Environment, Science, Technology, and Innovation, and the Energy Commission. Climate action is included in other national policies such as the National Transport Policy because of the transport sector's contribution to GHG emissions, and National Plastic Management Policy, which seeks to promote a circular economy.

In addition to the UNFCCC and the Paris agreement, Ghana is party to the Kyoto Protocol and regularly attends COP meetings. Ghana has launched its National Electric Vehicle Policy during COP 28 in December 2023. The policy's key objective is to increase the EV penetration rate to 35% by 2035 and to eliminate the selling and import of new internal combustion engine (ICE) cars by 2045.

Table 1 Ghana's climate and environmental policies and frameworks

Policy/Regulatory Framework	Purpose/Objective	Key Components
Environmental Protection Agency (EPA)	Ensures environmental protection and manages natural resources.	Conducts EIAs, enforces laws, monitors environmental quality.
Environmental Management Act (Act 490, 1994)	Establishes a comprehensive environmental management framework.	Mandates EIAs, guidelines for waste management, public participation.
Climate Change Policy (2012)	A framework for addressing climate change, focusing on adaptation, mitigation, and capacity building.	Adaptation strategies, mitigation measures, integration into development plans.

Table 1 Cont'd.

Policy/Regulatory Framework	Purpose/Objective	Key Components
Ghana's Nationally Determined Contributions (NDCs)	Outlines targets for GHG reduction and climate adaptation.	Emission reduction targets, sectoral strategies, financial needs.
Ghana's Renewable Energy Act (Act 832, 2011)	Encourages development and use of renewable energy sources	Incentives for projects, targets for renewable energy, supports R&D.
National Environmental Sanitation Policy (1999, revised 2009)	Improves sanitation and waste management practices.	Solid waste management, wastewater treatment, public education
National Environmental Policy (1995, revised 2016)	A policy focusing on environmental protection and sustainable development.	To manage and protect Ghana's natural resources and ensure environmental sustainability.
Ghana National Green Jobs Strategy (2021)	Developed with the intention to create platforms, develop capacities and institute measures that would organise and harmonise on-going green interventions through effective coordination	The framework focuses on enterprise development as the channel for the maximisation of decent green job creation potentials in the green and circular economy.
Ghana's National Adaptation Plan (NAP) (2018)	A strategy to enhance resilience and adapt to the impacts of climate change.	To integrate climate adaptation into national and sectoral planning processes.
Ghana Renewable Energy Act(2011)	Legislation aimed at promoting the use of renewable energy sources.	To increase the share of renewables in Ghana's energy mix and promote sustainable energy.

Ghana's Electric Mobility Policies

As a major sector in energy related - emissions, the Ghanaian government is actively promoting e-mobility and supporting the transition to electric vehicles across the nation.

17,660	55%	96%
Electric Vehicles (EVs)	Battery Electric Vehicles (BEV)	BEVs (Two or Three - wheeled vehicles)[5]

In December 2022, the Ministry of Transport launched the National Electric Vehicle Policy. This policy aims to ensure that the benefits of EV adoption permeate all segments of society, simultaneously fostering innovation and enhancing manufacturing competitiveness within the country. The policy measures used to promote EVs include taxation and infrastructure measures in addition to financial incentives and subsidies for purchasing and supporting imports, local assembly and retrofitting, and private sector partnerships.[6]

Ghana's Electric Vehicle (EV) policy outlines a three-stage implementation process with eight policy objectives designed to guide the development of strategies and key activities. In this impact report, it is important to reference these objectives to highlight the alignment and contributions of the "Made in Ghana" e-cargo bike project to the national EV policy framework since 2021.

Identified Objectives under the National Electric Vehicle Policy in Ghana by the Ministry of Transportation: [7]

Table 2 Objectives under the National Electric Vehicle Policy

Objective	Description
Objective 1	Promote sustainable demand for electric vehicles.
Objective 2	Support the development of the supply chain for electric vehicles.
Objective 3	Make Ghana the hub for the supply of the Lithium-ion batteries
Objective 4	Ensure reliable and adequate supply of electricity for charging electric vehicles.
Objective 5	Ensure the existence of relevant regulatory framework for the electric vehicle ecosystem and the development of charging infrastructure

Table 2 Cont'd.

Objective	Description
Objective 6	Develop human capital for the electric vehicles value chain.
Objective 7	Support research and development strategies.
Objective 8	Ensure proper management of wastes associated with the deployment of electric vehicles.

Other policies and government initiatives related to the manufacturing and purchasing of EVs in Ghana are listed in the table below.

Table 3 Policies and Government Initiatives Related to the Manufacturing and Purchasing of EVs

Policy/ Initiative	Description
Customs Act	Manages the importation of electric vehicles and components needed for EV manufacturing in Ghana
Drive Electric Initiative	A government initiative aimed at promoting the use and adoption of electric vehicles in Ghana
Ghana Automotive Development Policy	A strategic framework established to build assembly and manufacturing capacity within Ghana's automotive sector
Ghana Minerals Income Investment Fund	A sovereign minerals fund designed to maximise the value of dividends and royalties income for Ghana, ensuring sustainable monetization of mineral wealth, crucial for lithium mining for EV production.

[5] Ghana National Electric Vehicle Policy, 2022
[6] Ibid
[7] Ibid

Economic Context in Ghana(2021 - 2024): A Brief Overview

Ghana’s economic landscape during the implementation of the “Made in Ghana” e-cargo bike project (2021–2024) was shaped by a series of challenges that directly influenced both the macroeconomic environment and the growth of local industries, including the electric mobility sector.

Impact of the COVID-19 Pandemic (2021–2022)

At the onset of the project, Ghana was still grappling with the aftermath of the global COVID-19 pandemic. The economic fallout led to reduced economic activities and disrupted supply chains, which impacted manufacturing and services sectors. This created delays in industrial projects, including those reliant on imported materials. The tourism and hospitality sectors, critical to Ghana’s economy, were severely affected by lockdowns and international travel restrictions.

Russia-Ukraine War (2022 Onwards)

In 2022, the global economic disruption caused by the Russia-Ukraine war led to supply chain constraints and a spike in global fuel and commodity prices. Ghana, which imports a significant portion of its fuel and food, saw an increase in transportation costs and the cost of living. These factors contributed to inflationary pressures, which strained household incomes and increased operating costs for local businesses. The electric mobility project was indirectly affected by the rising cost of inputs and imported components needed for the manufacturing of e-bikes.

Currency Depreciation and Inflation

The Ghanaian cedi experienced rapid depreciation during this period, exacerbated by external factors and Ghana’s domestic economic vulnerabilities. Between 2022 and 2023, inflation soared, reaching over 50% at its peak, pushing up the cost of goods and services across all sectors. For the electric mobility sector, this meant higher prices for imported materials, batteries, and components, affecting production and operational costs.

Debt Crisis and IMF Bailout (2022–2023)

In 2022, Ghana’s public debt reached unsustainable levels, leading the country into debt distress. In response, the government sought a $3 billion bailout from the International Monetary Fund (IMF). This bailout came with fiscal consolidation measures aimed at stabilising the economy, which included spending cuts and debt restructuring. However, the austerity measures deepened the economic strain on households and small businesses, limiting consumer spending power, including for new technologies like electric bikes.

High Cost of Living and Fuel Prices

Rising fuel prices placed significant pressure on Ghanaian households, making traditional mobility options more expensive. While this presented an opportunity for electric mobility as a lower-cost alternative, the adoption rate was still slow due to high upfront costs and the lack of accessible financing options for the target market.

Slowing Economic Growth

During the latter half of the project, Ghana’s economic growth slowed due to a combination of domestic and international pressures. Growth projections were revised downward, and sectors such as agriculture, manufacturing, and services saw reduced output. Despite this, the renewable energy and mobility sectors remained critical for long-term economic resilience, as seen through the project’s focus on green solutions.

Outlook for the E-Mobility Sector

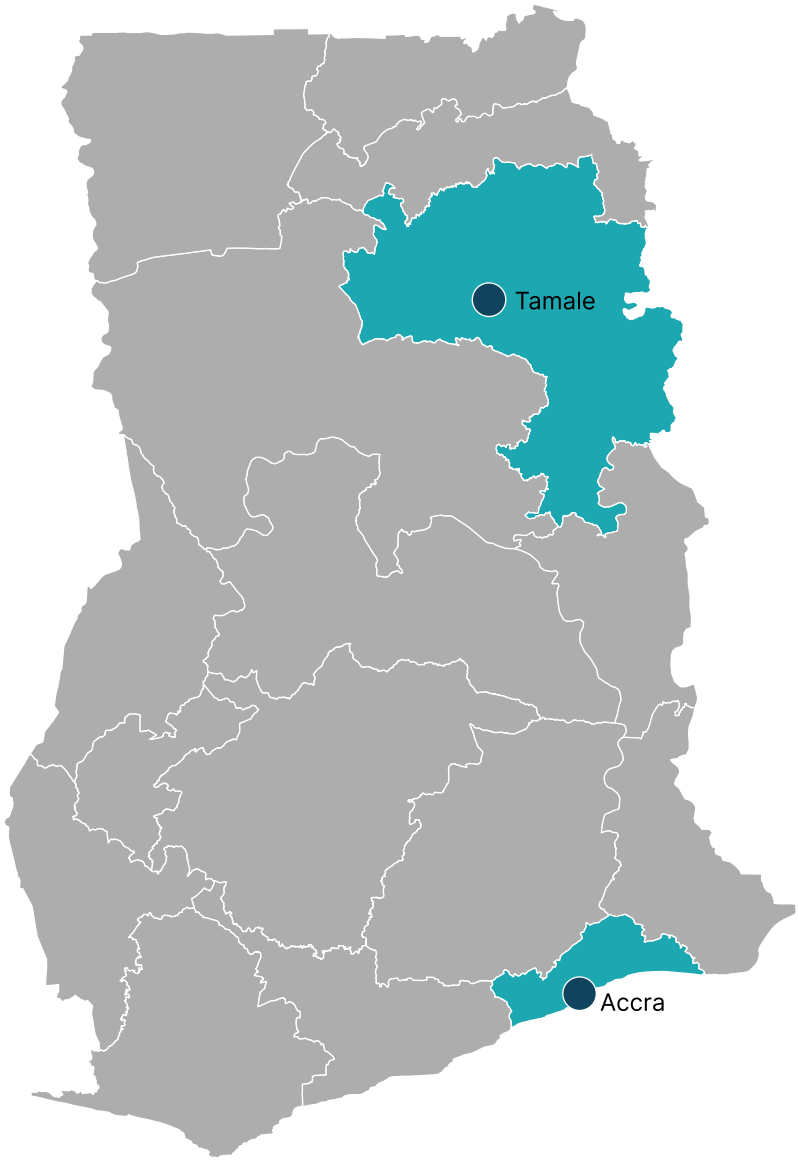
Despite the economic headwinds, Ghana’s commitment to renewable energy and climate goals provided a strong foundation for the growth of the e-mobility sector. The “Made in Ghana” project contributed to Ghana’s energy transition by providing a local solution to rising fuel costs and reducing greenhouse gas emissions, aligned with the country's long-term sustainability objectives.

Local contexts in Accra and Tamale:

The cities where the project was taking place were Accra, Ghana's capital, and partly in Tamale, the capital of Ghana's Northern Region and Ghana's fourth largest city. Accra is the most populous city in Ghana, with a population of 5,455,692 people.[8] Tamale, capital of Ghana's Northern region, is the fourth largest city in Ghana with a population of 758,000 people.[9] Tamale also serves as the primary urban centre for the five most northern regions in Ghana.

Both cities are taking action to fight climate change and trying to use climate action to create jobs to alleviate economic suffering. This is especially true in Accra as the city has the highest rate of unemployment in Ghana.[10] Accra has been a member of C40 since 2015 and is an active participant in the network's activities. The current mayor of Accra, Hon. Elizabeth Naa Kwatsoe Tawiah Sackey, attended COP28 as part of the first-ever Local Action Climate Summit where she shared Accra's plans for climate action, including Accra's five-year Climate Action Plan and highlighted the need for a circular economy to minimise waste.[11] In 2024, the mayor launched a youth climate action fund to provide young residents of Accra, aged 15–24, and youth climate organisations with the necessary resources and support needed to implement climate action projects in the city under the Accra Climate Action Plan (CAP).[12]

Tamale is also working towards climate action. Tamale is undertaking the "Building Bridges; Empowering Youth as Green Champions for Climate Resilience in Northern Region", implemented by Savannah Women Integrated Development Agency (SWIDA Ghana) with funding from the Embassy of Denmark under its Climate Action program. s The Agence Française de Développement (AFD) and the European Union (EU) are supporting the Tamale Metropolitan Assembly through the Ministry of Local Government, Decentralisation and Rural Development (MLGDRD) by proposing an urban resiliency project. The proposed project interventions would improve the living conditions of residents of Tamale through construction and rehabilitation of urban infrastructure, implementation of climate preventive strategies through a multi-stakeholder approach as well as strengthen the planning capacity of the Tamale Metropolitan Assembly by mainstreaming climate change considerations.



[8] Ghana Statistical Service, 2021
[9] Ibid
[10] Starr FM, 2024
[11] Daily Guide Network, 2024
[12] Accra Metropolitan Assembly, 2024
[13] Ministry of Local Government, Decentralisation and Rural Development, 2024

Electric Mobility in Ghana: Concept, Objectives, and Implementation of the 'Made in Ghana' E-Cargo Bikes Project

Project Background

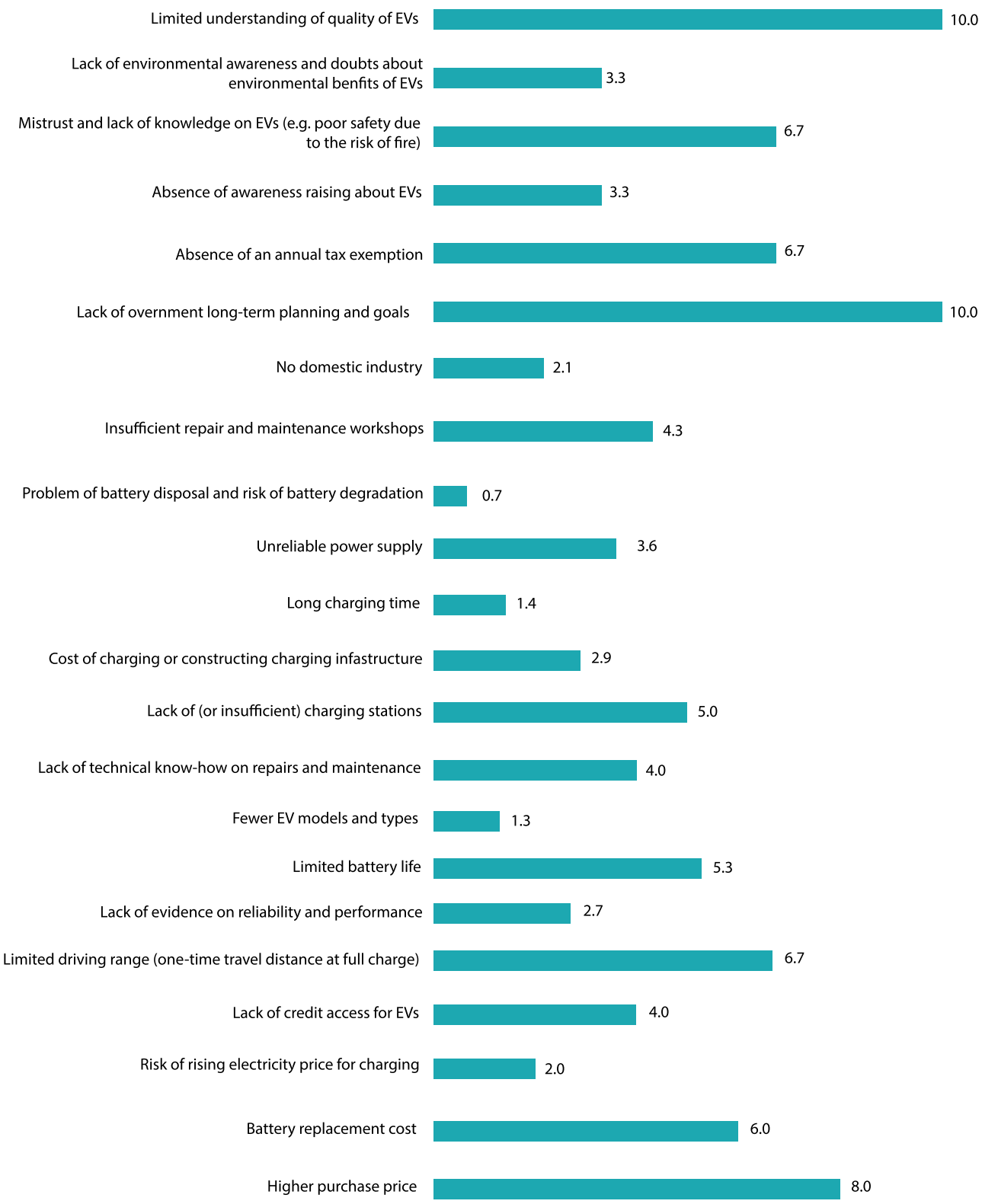
Despite its potential, electric mobility in Ghana encounters several significant barriers to widespread adoption:

- High acquisition costs: The upfront costs of electric vehicles (EVs), including electric bikes, are considerably higher compared to traditional gasoline-powered options. This is largely due to the expense of importing components and the lack of large-scale local manufacturing capabilities. For low-income groups, these costs remain prohibitive, creating a significant barrier to adoption. Without local incentives or subsidies, the initial investment required to purchase an e-cargo bike is unattainable for many who would otherwise benefit from the technology.
- Limited charging infrastructure: A critical gap exists in Ghana’s infrastructure to support electric mobility. The absence of a widespread network of charging stations makes it difficult to operate electric vehicles efficiently, especially in rural and peri-urban areas. While efforts are being made to establish solar-powered charging hubs, the current infrastructure is insufficient to support rapid growth in the electric mobility sector. The expansion of reliable and accessible charging points is essential to make EVs a practical alternative for both personal and commercial transport.
- Lack of financing mechanisms: Access to affordable financing is crucial for making electric vehicles accessible to lower-income populations. Currently, there are limited financial products tailored to this sector, such as microloans, leasing options, or government-backed programs to lower the cost burden for buyers. Without innovative financing mechanisms, many potential users, including small business owners and low-income individuals, are excluded from the benefits of electric mobility, further entrenching economic disparities and slowing the transition to sustainable transport.

[14]

[14] UNEP Copenhagen Climate Centre, 2022

Below is a snapshot as of July 2022, ranking the overall EV Barriers in Ghana [15]



Addressing these challenges requires coordinated efforts from both public and private sectors, including investment in local manufacturing, infrastructure development, and innovative financial products to create an inclusive and sustainable electric mobility ecosystem in Ghana.

[15] National Electric Mobility Roadmap, 2022

Project Rationale and Development

The proposed project—Electric Cargo Bikes "Made in Ghana"—was built on this background to provide an alternative, sustainable transportation solution that aligns with Ghana's national efforts to reduce greenhouse gas emissions. The project was scheduled to run from June 2021 to May 2024, serving as a major catalyst to the growth and development of electric mobility solutions in Ghana and all its related components.
The focus was on three work packages:

1. Build a sustainable and local value chain for producing, operating, and maintaining electric cargo bikes.Establishing and adapting to fit the mobility needs for urban and rural areas in Ghana.
2. Build a network of charging stations with local groups and communal administrative bodies and tested with a sustainable financing model.
3. Anchor systematically climate friendly mobility solutions, working with key national stakeholders in increasing mitigation capacity in Ghana.

Each work package and its success are covered in detail in this report.

The project at inception assumed that existing mobility options and patterns needed to be fundamentally transformed to lower greenhouse gas emissions, improve air quality, and reduce dependency on fossil fuels. With the long-term objective of establishing a sustainable, commercially viable, and replicable social enterprise in Ghana, the proposed approach aimed to accelerate the adoption of electric cargo bikes among low and middle-income consumers in both urban and rural areas as an alternative green transport service.

To facilitate behaviour change, the project's theory of change addressed several key barriers, including:

- Limited financial resources: Many potential users faced financial constraints that prevented them from purchasing electric cargo bikes.
- Lack of awareness: There was a general lack of knowledge about the benefits and functionalities of electric mobility options.
- Consumer interest: Generating interest and enthusiasm for new products was essential for fostering demand.

This pilot project leveraged a human-centred design framework to directly stimulate demand for new e-mobility transport technologies through the following strategies:

- Designing e-cargo bike prototype: Prototypes were developed with input from local communities to ensure they met the specific aspirations and transport needs of users, making them more appealing and functional.
- Establishing in-country manufacturing and maintenance capabilities: By building local capacity for production and maintenance, the project promoted job creation and sustainability while ensuring that the electric cargo bikes could be efficiently serviced.

- Launching a viable leasing model: A leasing model was introduced to make the electric cargo bikes financially accessible, allowing users to pay over time rather than facing the burden of a large upfront cost.
- Setting up solar PV charging infrastructure: A solar-powered charging station was developed to provide a sustainable energy source for the electric cargo bikes, reducing reliance on fossil fuels and enhancing the project's environmental benefits.
- Strengthening the enabling environment: The project shared lessons learned and best practices to influence policy and foster a supportive ecosystem for electric mobility.

Engagement with community influencers and local government was critical to raising awareness about the availability, functionality, and cost benefits of using electric cargo bikes. This engagement was bolstered by a comprehensive public marketing and information campaign through events, aimed at educating potential users and promoting the project's offerings.
At the proposal stage of the Electric Cargo Bikes "Made in Ghana" project, we identified several key stakeholder groups to engage throughout the project's delivery timelines. These stakeholders were categorised based on their level of involvement, interests, expected benefits, and implications for the project's success.

The following table provides an overview of the identified stakeholders at the project concept stage, and engaged throughout the project implementation:

Table 4

Stakeholder	Direct/ Indirect	Interest	Expected benefit from project	Implications for project
Riders **(Target group/Clients who independently lease the bikes)**	Direct	New job opportunity; Providing mobility services to community; Starting own business (entrepreneurial youth); Higher income through savings on by fuel;	Employment opportunities and higher income; Improved livelihood; Demonstration effect of being first electric cargo bike riders;	Feedback on performance, viability and acceptance of bikes by riders essential for business model and prototype adjustments; Income for social business through leasing; Visibility of electric cargo bikes on the road;
Customers (i.e. entrepreneurs, market women, farmers, etc.)	Direct	Fully functional electric cargo bike for off-road terrain and heavy loads; Alternative and more affordable, zero emission transport solutions	Benefit from lower prices and more reliable and suitable transport solutions; Improved delivery of services; First/Last Mile Connectivity;	Feedback on performance, viability and acceptance of bikes by customers; Acceptance levels and change of mobility patterns directly influence project results and end-line survey;
Technical craftsmen	Direct	New income opportunity; New customers; Extending local production pipeline;	Increase in sales and direct benefit from trainings and capacity development opportunities	Assembling bikes for users at Impact Hub Accra workshops; Continued maintenance offered to leased bikes – feedback on technical problems and adjustments to project partners;
E-Waste Upcycling Plattform (EWUP)	Direct	Use of collected waste and recycled materials for electric cargo bike production;	Advancing their project activities in regards to local value chain for e-waste recycling; Enhanced visibility through project activities;	Achieving high % of recycled and repurposed materials; Knowledge Exchange; Cooperation with existing projects focusing on e-mobility;
Existing DIY/Maker Community in Ghana	Direct	Contribute to zero emission transport solutions (development of an unique electric cargo bike first of its kind in Ghana);	Financial Awards as part of the Design Sprint Workshop (for 3 winners); Possibility to see own design deployed and scaled;	Support the Design and Patronage of E-Cargo Bikes built;
Technical Training Institutes **(For example: Design Training Institute (DTI) Tamale Technical Training Institute; Don Bosco Ashaiman)**	Direct	New Training Opportunities and Programmes;	Building on existing trainings and joint development of new modules for electric mobility vehicles; Job opportunities to relevant skills; sourcing employees in the value chain of e-cargo bikes;	Training courses for local youth on e-mobility; Knowledge exchange and maintenance ecosystem (service etc.) available; Cooperation with existing projects focusing on e-mobility;

The following table provides an overview of the identified stakeholders at the project concept stage, and engaged throughout the project implementation:

Table 4 cont'd

Stakeholder	Direct/ Indirect	Interest	Expected benefit from project	Implications for project
Women-led associations and cooperatives	Direct	Potential customers; New transport options for heavy loads in rural areas available;	Cheaper and more reliable transport option; Electric cargo bikes adopted to local context and used by women-led associations;	Supporting the inclusion of women in e-cargo bike value chain; Marketing activities for electric cargo bikes; Women directly involved as both rider and customer;
Solar PV Partners / Charging Stations Partners **Ecoligo** **EVVT (SolMate)** **PODBAD**	Direct	Improving charging station network in Ghana;	Piloting of charging stations in new areas (data); Increase their financial base; Further contributions to Green Ecosystems;	Technical input and feedback on best design for planned charging stations; Experienced and sustainable partner for charging infrastructure;
Marketing Partners	Direct	Income opportunity & increased visibility through promoting the use of electric cargo bikes "Made in Ghana";	Reach audience with relevant and new content; Additional income opportunity; High visibility both locally and nationally;	Promote the use of environmentally friendly services; Sensitize audience on recycling and e-waste; Contribute to behaviour change and sourcing of new customers;
Government Institutions & Ministries **(For example: Ministry of Energy, Tamale Metropolitan Assembly, Accra Metropolitan Assembly)**	Indirect/ Direct	Membership of E-Mobility Advocacy Group; Visibility and Promotion of Sustainability Commitments in the Transport Sector; Regulations on registration, licences, safety, insurances;	Lower CO_2 emissions from the transportation sector; Job Creation; Increased mitigation potential for Ghana; New policy recommendations;	Support the implementation of key project deliverables; Continued exchange on regulations and policy development; Support needed for initiating behaviour change in people's mobility patterns;
Community Tamale; **Community Accra;** **Community level influencers (e.g. local chiefs)**	Direct	Cooperation to build and test charging stations; find suitable locations;	Improved transport and charging solutions;	Suitable charging network in cooperation with community; Sensitised audience on recycling and e-waste and locally made goods;
UN Habitat and United Nations Environment Programme, Urban Electric Mobility Initiative (UEMI) **(and other BMU IKI projects)**	Indirect	Long-term vision of electrification of public transport sector (UEMI and bus service in Ghana); On-Going BMU IKI projects on electric mobility;	Leveraging results; Networking and Exchange; Verification of results in other contexts in Sub-Saharan Africa;	Networking and Exchange; Joint focus on policy and enabling environment Lessons learnt and recommendations on best practices

Summary on Impact and Outcomes

The intended key outcome for the Electric Cargo Bikes “Made in Ghana” project included the introduction of electric mobility solutions that would directly contribute to reducing greenhouse gas emissions and establishing climate-friendly mobility patterns. The project aimed to stimulate economic growth through increased income opportunities and enhance waste disposal practices by utilizing recycled materials. The project’s success was measured through the following indicators:

By 2024

The project was expected to save up to 135 tons of CO2 annually, thereby making a significant contribution to reducing greenhouse gas emissions in Ghana's transport sector.

By 2023

At least 40% of recycled and locally sourced materials with a low carbon footprint are anticipated to be used in the production of each electric cargo bike, reinforcing the project's commitment to sustainability.

By 2024

A total of 70 direct jobs are projected to be created through the establishment of a local value chain and production sites, contributing to economic growth and providing employment opportunities for local communities.

The development of a new electric bicycle concept in Ghana stemmed from insights gained during the initial ideation process, emphasising the local context. The design focused on understanding the specific needs, preferences, and infrastructure of the area, ensuring a commitment to innovation, sustainability, and user-centricity. Each aspect of the electric bicycle's design—ranging from the use of locally sourced materials to performance optimization for Ghana's diverse terrains—was tailored to meet the unique demands of Ghanaian riders. This approach prioritised sustainability, durability, and affordability, reflecting a commitment to empowering local communities and promoting eco-friendly transportation solutions in emerging markets. The development process resulted in several prototypes, which will be detailed in Section 3 of this report.

Overall Project Success at a Glance

4.35 tonnes of CO2 saved

53,000 km covered

1 number of swapping stations created

E-bikes made from 73% recycled materials

Over 300 direct and indirect jobs created

- In **September 2023**, the second locally produced prototype of an e-cargo bike made from 100% recycled and local materials was completed. This served as a blueprint for the production of 20 electric cargo bikes.

- As part of the Sankalp West Africa Summit **2023**, an event was organised where electric mobility actors could exhibit their products and participants could test them.

- In **October 2022**, a Design Sprint competition was held with students from local universities to develop locally adapted charging solutions for the e-cargo bikes. The eight winners of the competition will receive a scholarship to gain practical experience in the e-mobility sector for 12 months as part of the project.

- In **December 2022**, the first locally produced prototype of an e-cargo bike made of 100% recycled and local materials was completed.

- In **September 2022** an awareness raising campaign for electric mobility started demonstrating e-mobility solutions in the Ghanaian context to change the perception of Ghana's society towards e-mobility.

- In **August 2022** the Net Zero Advocacy Platform was launched with interested participants from the private sector and academia discussing current challenges of the e-mobility ecosystem in Ghana.

- A design for an e-cargo bike made of local, recycled and imported materials was finalised in **2022**.

- In collaboration with delivery services, five different e-bike models have been tested since **2022** to collect data on their local functionality and real user preferences.

Data Collection for the Impact Report

The initial baseline market research was conducted at the start of the project in Accra in 2021. A PESTLE analysis was conducted to understand the political, economic, sociological, technological, legal and environmental factors that would impact the project. The aim of the baseline research was to understand the awareness, perception and potential use of electric cargo bicycles within Accra and Tamale, to inform the development of a minimum viable market entry business model and design of vehicle. After the bikes had been designed and launched, further data collection was completed by a team of researchers by the Impact Hub Accra to assess their overall impact.

Data collection took place in June 2024. The initial data collection design included surveys to collect quantitative data and interviews to collect qualitative data. However, due to time constraints, only interviews were conducted. Survey questions were incorporated into the interview questions so quantitative data could still be collected. Interviews were conducted with representatives from 10 named stakeholder organisations and several local technicians within the e-mobility and renewable energy ecosystem. Additionally, desk research and insights from publicly available authorised publications in the sector contributed to the findings and data presented in this report.

To obtain consent for the interviews, we initially provided physical consent forms; however, many participants did not complete them prior to our scheduled meetings. As a result, we opted to secure verbal consent at the beginning of each interview, ensuring that all interviewees were aware their conversations were being recorded.

The data collection process faced several challenges and delays, primarily due to the protocols in place within government agencies. Although the research team adhered to proper procedures by sending formal requests via email and phone, they encountered difficulties in meeting with key government stakeholders. In some instances, scheduled interviews did not occur as planned, prompting the team to send interview questions via email instead, which the interviewees answered in writing.

This report is organised into seven sections. Section 2 provides a detailed technical evaluation of the “Made in Ghana” e-cargo bikes project, focusing on performance, durability, and efficiency. Section 3 discusses the EV charging infrastructure in Accra, including the PV charger developed as part of the e-cargo bikes project. Section 4 examines how public perception and awareness of EVs influence their adoption. Section 5 outlines the opportunities and challenges in Ghana’s e-mobility sector, along with the social, economic, and environmental impacts of the “Made in Ghana” e-cargo bike project. Section 6 presents case studies of companies and institutions within Accra’s e-mobility ecosystem, while Section 7 offers recommendations for the Government of Ghana and key stakeholders to enhance the integration of EVs into the transportation sector.

Electric Cargo Bikes “Made in Ghana”

This section explores the creative and technical processes that drove the development of the electric cargo bicycle concept. It outlines the journey from initial conceptualization to the refinement and optimization of prototypes, emphasising the design considerations and technological innovations that were integral to enhancing performance, efficiency, and sustainability.

The development process began with a thorough assessment of the specific mobility needs within urban environments, particularly focusing on last-mile delivery challenges in Accra. Initial brainstorming sessions involved diverse stakeholders, including local communities, technical experts, and potential users, to gather insights and preferences that would inform the design.

Through rigorous research, the team identified key features that would enhance the bicycle's functionality, such as a robust frame capable of carrying heavy loads, efficient electric drivetrains, and ergonomic designs for user comfort. The incorporation of recycled materials was prioritised to align with the project’s sustainability goals, while technological innovations were explored to improve battery life, charging efficiency, and overall energy consumption.

"The biggest issue now for Africa's transition to EVs is that we don't have vehicles that have been designed to our context"

- Valerie Labi,Founder and CEO of WAHU Mobility

The project began with a comprehensive market analysis and the purchase of 13 off-the-shelf e-bikes across 5 different models to understand the best features suited for local conditions. This strategic acquisition was designed to analyse various aspects such as ergonomics, powertrain configurations, styling, and general component choices used by manufacturers. The insights gained from this comprehensive study were instrumental in forming the initial design considerations for the electric bicycle concept, shaping foundational decisions in its prototype and development.

Table 5 Criteria for selection

Aspect	Summary
Ergonomics	Focuses on optimising design for rider comfort, safety, and efficiency. Adjustments to wheelbase, frame size, seat position, handlebars, pedals, and saddles are made to reduce strain and accommodate different body sizes. Features adjustable components and intuitive electric assist controls.
Electrical and Electronic Powertrain	Includes motors with appropriate power and torque for different loads and terrains, ensuring smooth acceleration and efficient handling. The choice between hub-mounted or mid-mounted motors affects handling and efficiency. Features a user-friendly motor controller for optimal power management.
Battery	Selection based on capacity, voltage, energy density, and chemistry, influencing the bike's operational range and longevity. Essential for determining how far the bike can travel and how long it can operate between charges.
Styling	Aesthetics were a key factor in vehicle adoption, influenced by initial market research. Designs include longtail and front-loading options to suit different uses and preferences. Features for practicality include ease of mounting/dismounting, traffic visibility, and compatibility with accessories.
General Component Selection	Emphasises the selection of robust components suitable for challenging roads. Includes high-quality frames, braking systems, and suspension systems tailored to cargo loads and rough terrains. Drivetrain components are chosen based on usage needs, with durable wheels and tyres for reliability.

Table 6 Model Breakdown

Model	Reason for Selection	Quantity Purchased
EB1 (2-Wheel)	Selected for its mid-drive, hard-tail configuration to understand comfort levels provided by the high profile fat tyre and padded seat. Additionally, a 52V battery and a 48V version were chosen to evaluate performance differences. The 1000w bottom bracket mounted mid-drive motor was selected to study this technology	3
EB3 (2-Wheel)	Chosen for its 750W rear hub motor and full suspension model. The rear spring suspension, similar to a small motorcycle and locally abundant, was of great interest for integration and performance evaluation.	2
EB3 (2-Wheel)	Selected for its 1000W rear hub motor and full suspension model, featuring a hydraulic shock similar to those used by Mapouka scooters in Northern Ghana. This selection aimed to evaluate the performance of this hydraulic shock variant.	3
ET1 (3-Wheel)	Opted for a full suspension setup with a 1000W plate-mounted mid-drive motor to study this variant commonly used by European manufacturers. The short travel rear shocks were also of technical interest.	3
ET1 (3-Wheel)	Chosen for its large capacity and compact design to explore its utility as a hyperlocal delivery vehicle for supermarkets and small shops, and to study the powertrain of an e-tricycle.	2
Total		13

Below is a component comparisons of the models, reasons for selection and quantities purchased:

Table 7 Component Comparisons

Component	EB1	EB2	EB3	EB4	ET1
Frame Material	Aluminium Alloy (AL6061)	Aluminium Alloy (AL6061)	Aluminium Alloy (AL6061)	Aluminium Alloy (AL6061)	Steel
Motor	48V 1000W Mid-drive motor	48V 750W Hub motor	48V 750W Hub motor	48V 1000W Mid-drive Motor	48V 750W Shaft motor
Battery	52v 17.5Ah	48V 16Ah	48V 17.5Ah	48V 21Ah	48V 20Ah
Brake System	Tektro hydraulic disc brakes	Tektro hydraulic disc brakes front and rear	Tektro mechanical disc brakes	Tektro hydraulic disc brakes front and rear	Tektro hydraulic disc brakes front and rear
	front and rear		front and rear		
Throttle type	Thumb	Thumb	Thumb	Thumb	Twist
Transmission	Shimano 8 Speed	Shimano 8 Speed	Shimano 8 Speed	Shimano 8 Speed	Shimano 8 Speed
Suspension	Front hydraulic suspension only	Front hydraulic suspension and rear coil spring suspension	Front hydraulic suspension and dual rear coil spring suspension	Front hydraulic suspension and dual rear coil spring suspension	No front suspension and dual rear coil spring suspension
Load limit	130kg	125kg	140kg	120kg	200kg
Range	40km (throttle only) 70km (Pedal Assist)	40km (throttle only) 70km (Pedal Assist)	40km (throttle only) 70km (Pedal Assist)	35km (throttle only) 60km (Pedal Assist)	25km (throttle only) 50km (Pedal Assist)
Max speed	45 km/h	45 km/h	45 km/h	45 km/h	32 km/h
Charging time	Approx. 6 hours	Approx. 8 hours	Approx. 9 hours	Approx. 10 hours	Approx. 9 hours
Vehicle weight	45kg	45kg	45kg	40kg	120kg
Light	Front and rear	Front and rear	Front and rear	Front and rear	Front and rear

Table 8 Advantages and Disadvantages of the Models

Model	Advantages	Disadvantages
EB1	• The mid-drive motor allowed for more efficient battery usage and good climbing performance. • Fat tyres worked well off-road. Riders reported better bike stability in comparison to their regular mountain bicycles. • Good braking performance due to the use of hydraulic disc brakes. • Large headlamps provided good night time visibility. • Integrated bicycle stand allows for easy parking.	• The frame design had a high standover height making it difficult for ladies to mount and dismount. • The lack of rear shock absorbers made plying untarred roads an uncomfortable undertaking.
EB2	• The mid-drive motor allowed for more efficient battery usage and good climbing performance. • Fat tyres worked well off-road. Riders reported better bike stability in comparison to their regular mountain bicycles. • Good braking performance due to the use of hydraulic disc brakes. • Large headlamps provided good night time visibility. • Integrated bicycle stand allows for easy parking.	• It was difficult to pedal at low speed due to the large chain ring. • Low ground clearance caused repeated pedal-ground strikes.
EB3	• The step-through design made it easier to mount and dismount. This made it easier for ladies and shorter people to ride. • The relatively large and well padded seat made all day riding comfortable. • The very high rise handlebar yielded a more comfortable upright riding position. Ideal for all day riding. • The hydraulic shocks provided a more comfortable off-road riding experience than that provided by EB2.	• The mechanical disc brakes were not as potent as the hydraulic brakes. • The large chain range made it difficult to pedal at low speed. • Long battery shape made it difficult to carry around.
EB4	• The mid-drive motor allowed for more efficient battery usage and good climbing performance. • Its compact size,(short wheelbase) made it easier to carry • Its short wheelbase resulted in a more manoeuvrable vehicle.	• The short wheel base reduced vehicle straight line stability at high speed relative to EB1. • The tyre axles did not have sufficient excess threading after mounting. • The rear cassette provided did not give a wide gear range, making pedalling relatively more intensive at lower assist levels.
ET1	• The large enclosed cargo space, shielded items from the elements. • The adaptable flatbed makes customisation a possibility. • Increased puncture resistance due to the use of motorcycle tyres.	• The lack of a digital display made troubleshooting more cumbersome due to the absence of error codes. • The use of the traditional derailleur reduced the effective ground clearance. • The lack of a front fork suspension system increased user fatigue overtime due to the lack of damping.

Prototype Development

The development of a new electric bicycle concept in Ghana was fueled by insights from the initial ideation process, which were deeply rooted in the local context. By understanding the specific needs, preferences, and infrastructure of the area, the design was crafted with a strong commitment to innovation, sustainability, and user-centricity. Each element of the electric bicycle's design—from the integration of locally sourced materials to the optimization of performance for Ghana's diverse terrains—has been tailored to meet the distinct needs and preferences of Ghanaian riders. This approach emphasises sustainability, durability, and affordability, reflecting a dedication to empowering local communities and advancing eco-friendly transportation solutions in emerging markets. The development process led to the creation of several prototypes, which are detailed in this section.

Components Selected

Table 9 Components chosen based on research from the 13 off-the-shelf e-bikes with rider data

Component	Specification
Frame Material	Galvanised Steel
Motor	48V mid-drive motor
Battery	48V 21Ah (2 per bike)
Brake System	Hydraulic disc brakes front and rear
Throttle type	Thumb
Transmission	Shimano 8 Speed
Suspension	Front hydraulic suspension and rear coil spring suspension
Load limit	170kg
Range	40km (throttle only) 70km (Pedal Assist)
Max speed	55 km/h
Charging time	Approx. 5 - 7 hours
Vehicle weight	55kg
Light	Big front light and rear lights

Why these components for the prototype?

Table 10 Justification for components

Component	Detailed Justification for Selection
Frame Material	Galvanised steel was selected for its high accessibility and cost-effectiveness, commonly used in local manufacturing, making it an economical choice for budget-conscious consumers. Mild steel, offering less corrosion resistance but cost-effective performance, provides a viable alternative for lower budgets. Aluminium alloy, though more expensive and less available, is favoured for its lightweight, corrosion-resistant properties, ideal for rugged terrain requiring durable, long-lasting materials.
Motor	Preference for mid-drive motors over hub-drives stems from their efficiency and integration with the bike's drivetrain, enhancing the vehicle's balance and performance across terrains. Mid-drives provide superior range and handling, particularly effective on inclines. Their placement lowers the centre of gravity, improving bike balance and handling. Despite causing increased wear on drivetrain components, their benefits in performance and ease of maintenance (similar to regular bikes) outweigh these drawbacks.
Battery	Lithium chemistry batteries were chosen due to their superior energy density, enabling longer range and greater payload capacity—essential for effective cargo transportation. They also offer longer lifespans and quicker charging times, boosting overall efficiency and user productivity in Ghana's varied urban environments. The higher upfront cost is offset by the battery's durability and performance advantages compared to lead acid counterparts.
Brake System	Hydraulic disc brakes were selected for their enhanced stopping power and reliability, especially suitable for heavy loads and challenging terrains. These brakes provide superior modulation and control compared to mechanical disc brakes and are more effective than regenerative braking systems in stop-and-go urban settings, where consistent and reliable stopping power is critical.
Throttle Type	Thumb throttle was chosen over twist throttle due to its simplicity and ease of use, particularly beneficial for riders with limited hand strength or dexterity. This selection enhances the user experience by making the control interface more accessible and less physically demanding.

Table 10 Cont’d

Component	Detailed Justification for Selection
Transmission	The 8-speed transmission was favoured primarily for its market availability and its capability to match the performance demands of the bikes in varied terrain conditions effectively. This choice supports smoother shifting and optimal power distribution, adapting to different riding conditions with ease.
Suspension	The suspension design was directly influenced by extensive user feedback, which highlighted the importance of ride comfort and control over diverse terrains. The selected suspension system is designed to maximise comfort and handling, absorbing shocks and improving the ride quality over rough surfaces.
Range	The bike’s range was established based on comprehensive rider feedback and test ride data, ensuring that the bikes can meet real-world expectations for distance and performance without frequent recharging.
Max Speed	Determined by evaluating the actual riding conditions in Accra, ensuring that the bikes are optimised to operate effectively at typical urban speeds, enhancing safety and efficiency.
Charge Time	Selected to offer a practical balance between battery longevity and operational efficiency, ensuring that the bikes can be used effectively throughout the day without long downtimes for charging.
Vehicle Weight	Influenced by the choice of materials, ensuring that the bike remains light enough for easy handling yet robust enough to withstand daily wear and tear and the demands of cargo transportation.
Lighting	Large headlights were incorporated to address specific safety concerns related to visibility in challenging lighting conditions, as emphasised in user feedback. This feature ensures safer navigation during early morning, late evening, or in poorly lit environments.

As technical partners, Wahu tested our bikes with their riders and provided technical equipment and expertise during the development and manufacturing of the cargo bikes. Collectively, these bikes covered 53,000 km, enabling 42,000 last-mile deliveries through strategic partnerships with delivery services like Bolt, Glovo, and Shaq Express.

Electric Bicycle Prototypes

Electric Bicycle Prototype 1 (EBP1)

Fabricated by the Design Technology Institute, a social enterprise educational institution preparing learners to develop innovative solutions for the challenges facing their community, Ghana and the continent at large, between September 2022 and December 2022.

EBP1 advantages

- The large rack was good for delivery backpacks.
- The mid-drive motor provided good climbing performance.
- The full suspension system provided good rider comfort off-road.
- The large front headlamp for improved night-time visibility.

EBP1 disadvantages

- Difficult to handle due to its heavy weight.
- Shorter estimated vehicle range due to increased vehicle weight.
- Reduced room for battery mounting activity

The Design Technology Institute unfortunately were not selected for the fabrication of Electric Bicycle Prototype 2 (EBP2) due to the following reasons:

- The price/unit was not competitive (approx GHS5000).
- The pricing was opaque. Material and labour costs were unclear.s.
- Long sample production time (4 months).

Electric Bicycle Prototype (EBP2)

With key learnings from the EBP1, two things were clear, the weight of the E-bike had to be reduced and the fabrication partner had to be changed to meet expected timeline.
The EBP2 showed massive improvements from the EBP1.

Improvements realised:

- The bicycle exhibited better manoeuvrability due to the weight reduction.
- The mid-drive motor provided good climbing performance.
- The full suspension system provided good rider comfort off-road.
- The large front headlamp for improved night-time visibility.
- The frame had much better riding ergonomics with the short handlebar and an even better riding experience with the very high rise handlebar.

Shortcoming realised:

- Weaker frame due to the thinner tubing (1.5mm tubing) used in a bid to reduce vehicle weight.

Due to their experience, they were able to provide:

- Quality welding and ability to use the MIG weld in the frame's fabrication.
- Accurate replication of the technical drawings by using a laser cut template to produce more accurate bends.

Unfortunately, it was not suitable for them to undertake the series production aspect of the project due to their slated contractual obligations for other clients. This is evident in the long sample production time (3 months).

Electric Bicycle Prototype (EBP3)

Since finding the right fabrication partner was a challenge, we had to explore other regions. Suame Magazine is an industrial area in the Ashanti Region known for metal engineering and fabrication. Among three potential partners, they found Ahmed Bio Engineering Workshop stood out for the following reasons:

- Their commitment to work to the tight project deadlines.
- Quick sample turnaround time (3 weeks)
- Acceptable submitted product sample

Unfortunately, the quality of their output dropped significantly at scale. Feedback was provided in person and well as remotely. However, this has been an extremely time-
consuming process. They delivered a total of 15 frames as of April 2024.

Improvements realised with EBP3:

- The bicycle exhibited better manoeuvrability due to the weight reduction
- The mid-drive motor provided good climbing performance
- The full suspension system provided good rider comfort off-road
- The large front headlamp for improved night-time visibility
- The frame had much better riding ergonomics with the short handlebar and an even better riding experience with the very high rise handlebar

Shortcoming realised:

- Seat position was slightly higher than desired

Local Manufacturing

Establishing local production and maintenance hubs can increase accessibility and create jobs, making e-bikes more viable for Ghanaian consumers. In 2022, a significant milestone was achieved in the electric mobility industry in sub-Saharan Africa, as we finalised the first prototype entirely made from locally sourced and recycled materials. This prototype marked a pivotal shift away from the traditional reliance on fully built or complete knock-down (CKD) import units assembled locally. The iterative development process continued through 2023, resulting in two improved prototypes, with 73% of their components being local or recycled—a slight reduction from the initial prototype's 100%.
This shift is crucial for the region, given the challenging conditions electric motorcycles face in sub-Saharan Africa. The rugged terrain, characterised by unpaved roads and extended commercial usage, exerts considerable wear and tear on these vehicles. Due to the dominance of suppliers from India, China, and Southeast Asia, these motorcycles have historically not been designed to the African context. This underscores the urgent need for vehicles specifically engineered to meet the demands of the African environment, paving the way for a more sustainable and efficient transportation future in the region.
Two of the project's objectives were 1) establish a sustainable and local value chain for producing, operating, and maintaining e-cargo bikes and 2) create green jobs and training opportunities in the e-mobility sector. By manufacturing locally, we reduced logistical costs and import dependence, which is significant in a region where import tariffs can be prohibitively high. Local production also aligns with national economic strategies that prioritise industrialisation and job creation.

"Our Ghanaian engineers really understand the context of what is needed in terms of mobility."

- Valerie, CEO of Wahu Mobility

Adoption and Usage of Electric Cargo Bikes

There are many factors that influence the adoption of EVs in Ghana. The Ghana National Baseline Survey for Electric Vehicles provides valuable insights into consumer attitudes and preferences regarding the transition from ICE vehicles to electric vehicles.[16] Findings from the survey reveal the key factors that potential EV owners and users prioritise, as well as the trends shaping EV adoption in the country.
According to the survey[17] potential Ghanaian EV owners and users consider 6 key factors when deciding to purchase an EV over an ICE vehicle. They are;

- Environmental Concerns: Many consumers are increasingly aware of the environmental benefits of EVs, which influence their purchasing decisions.
- Availability of Spare Parts: The ease of obtaining spare parts is crucial for maintaining EVs, impacting consumer confidence.
- Availability of EVs on the Market: A diverse selection of available EV models encourages adoption.
- Availability of Maintenance and Well-Equipped Workshops: Access to qualified maintenance services is vital for potential buyers.
- Initial Cost of EVs: The upfront cost remains a significant consideration for many consumers.
- Financial Savings on Fuel: The potential long-term savings on fuel costs weigh heavily in favour of EVs.

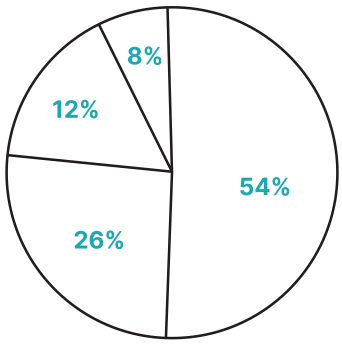
38.37% of respondents prefer Battery Electric Vehicles

Battery Electric Vehicles (BEVs) were the most popular choice among potential buyers based on the survey, with 38.37% of respondents indicating a preference for this category. Consumer preferences are further influenced by various factors, including low running costs, purchase price, reliability, diversity of fuel, and ease and convenience of charging.

Spending Willingness

The survey[18] assessed how much potential EV users were willing to invest in an electric vehicle. The results indicate:

- 54% are prepared to spend below $20,000.
- 26% are willing to spend $20,000 to $30,000.
- 12% are ready to spend $30,000 to $40,000.
- 8% would consider spending above $40,000.



This price sensitivity highlights the need for affordable options to drive higher adoption rates.
The survey[19] found a clear correlation between the availability of public charging infrastructure and EV adoption rates. Regions with more public charging stations experience higher EV purchase rates.

Consequently, ongoing programs aimed at promoting EV adoption emphasize expanding public charging infrastructure and improvement of charging speed.

Findings from the "Made In Ghana" e-cargo bikes project closely align with the data from the Baseline Survey, although we identified some noteworthy differences. A range of factors significantly influences electric vehicle (EV) adoption rates, including government policies, procurement strategies, and fiscal incentives such as tax breaks and reduced tariffs. Countries that minimise barriers to these incentives tend to see higher rates of EV adoption.

Similar to the Baseline Survey, the project found that charging infrastructure and vehicle cost are crucial elements affecting consumers' decisions to opt for EVs over internal combustion engine (ICE) vehicles. Additionally, adoption rates vary among different types of EVs, including two-wheelers, three-wheelers, four-wheeled vehicles, and buses, indicating a nuanced market with diverse consumer preferences.

The visibility of EVs in the market plays a significant role in increasing awareness and acceptance. The presence of vehicles on the road encourages more people to consider them as viable alternatives to traditional vehicles. For example, the introduction of battery manufacturing in Ghana is a promising sign for domestic EV growth. Currently, no African country possesses full capabilities for battery recycling and production, which presents a unique opportunity for Ghana to fill this gap.

The establishment of battery swap stations is another crucial factor. These stations not only provide convenience but also increase public visibility of EV technology, prompting inquiries about EVs and charging options. This heightened awareness is essential for driving adoption.

However, introducing innovative products like EVs comes with challenges, particularly in terms of consumer acceptance and market penetration. Many consumers may be hesitant to embrace new technologies, making awareness and education critical components of successful adoption strategies.

A specific example that illustrates the impact of visibility is KOFA's Jidi e-motorcycle. Its distinctive design has drawn attention in Ghana, leading to potential buyers reaching out to the company after seeing the electric motorcycle in use. This suggests that innovative and visually appealing products can significantly enhance public interest in EVs.

To achieve a more substantial impact on EV adoption, we must focus on comprehensive education initiatives aimed at the broader population. As awareness grows and more consumers begin to purchase e-bikes, we can anticipate an increase in demand, which may eventually lead to price reductions. This reduction could be facilitated by greater supply in response to rising demand, further encouraging more consumers to invest in e-bikes and supporting the overall growth of the EV market.

Conclusion

The "Made in Ghana" e-cargo bike project addresses urban mobility challenges in Accra and contributes to the evolving e-mobility sector in Ghana. By using locally sourced components, the project reduces import dependence and fosters local production, creating jobs and increasing accessibility for Ghanaian consumers. The design process, informed by stakeholder collaboration and research yields a vehicle tailored to Ghana's unique context. The project not only offers a practical solution for urban transportation, it also supports sustainability goals and job creation.

[16] Energy Commission, 2022
[17] Ibid
[18] Ibid
[19] Ibid

Electric Vehicle Charging Infrastructure in Accra

The availability and accessibility of charging stations is crucial for widespread adoption of e-bikes in Ghana. Having a limited number of charging points creates difficulties for users to keep their e-bikes charged, posing a significant barrier to widespread adoption and integration. While a robust charging infrastructure is vital for progress, Ghana encounters significant challenges, including intermittent power supply and areas with underdeveloped road networks, which need to be addressed to ensure effective implementation.

Under the project, we piloted the solar-powered swap kiosk, Wahu Mobility, along with other companies in the EV ecosystem such as Solar Taxi and Kofa, have worked on varying charging infrastructure designed to support the charging network in Ghana that are tailored to address the country's specific infrastructural challenges.

Charging Infrastructure in Accra

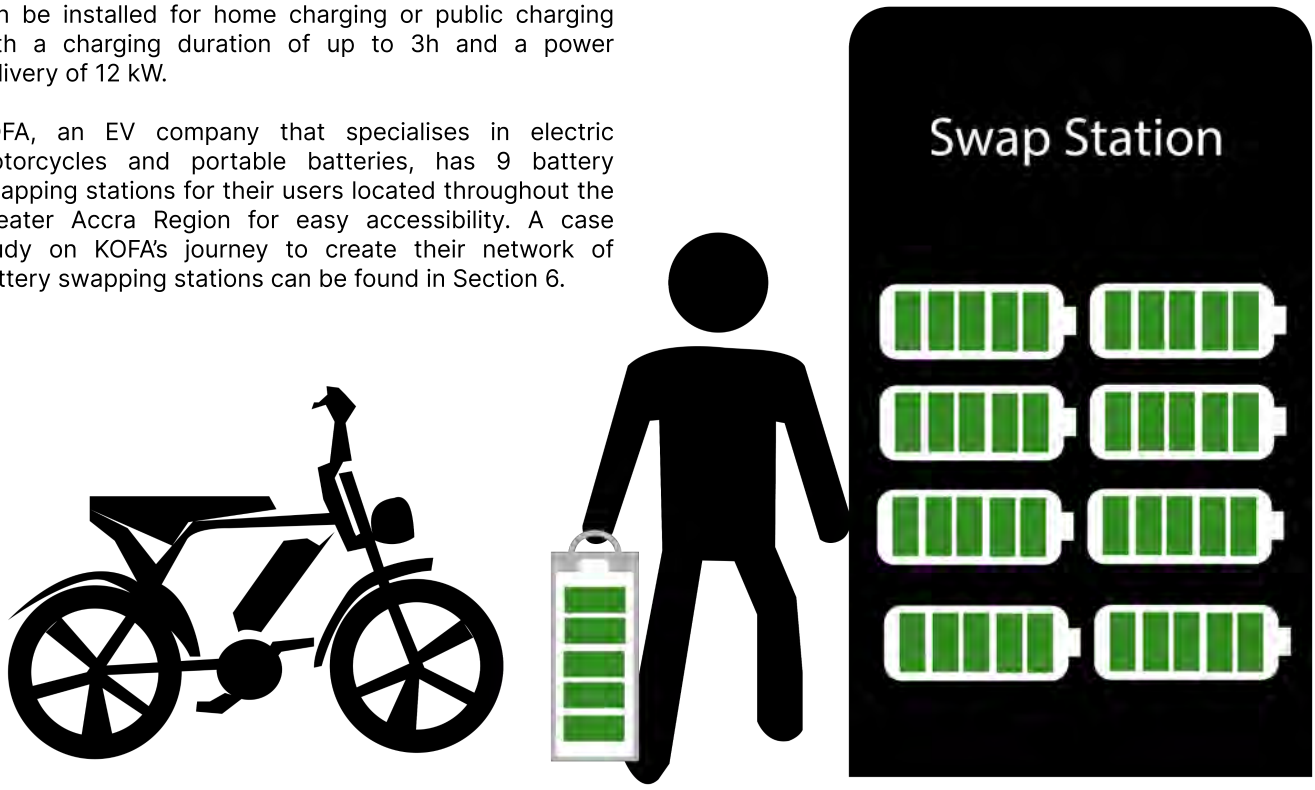
There are currently 6 public charging stations in Accra, listed below:

- IJANU DC Charger, Dizengoff Complex Industrial Area (with Tesla adapter)
- POBAD International, Charging Station, A&C Mall, East Legon
- POBAD International, Charging Station, Impact Hub Accra, Osu
- Total Energies Charging Station, Total Fuel Station, Liberation Road
- Porsche Charging Station, Palace Mall, Spintex
- Porsche Charging Station, Kempinski Hotel Parking Lot

The IJANU charger is a Level 3 charger, which is primarily DC fast charging or Tesla supercharging which can charge a vehicle from 0 to 80% in 13 to 20 minutes.[20] The remaining public chargers are Level 2 chargers that can be installed for home charging or public charging with a charging duration of up to 3h and a power delivery of 12 kW.

KOFA, an EV company that specialises in electric motorcycles and portable batteries, has 9 battery swapping stations for their users located throughout the Greater Accra Region for easy accessibility. A case study on KOFA's journey to create their network of battery swapping stations can be found in Section 6.

The design of the "Made in Ghana" e-cargo bikes has been optimized for longer range and ease of charging by equipping each bike with two batteries instead of one. This allows users to charge their batteries either at home or at charging swap stations, such as the one at the Impact Hub Accra. Valerie Larbi, speaking on the bike's design, highlighted that this approach emerged from the realization that access to charging infrastructure can be a challenge in certain areas. However, since the bikes are predominantly used for commerce during the day, riders can charge their batteries at night at home, enabling them to operate the bikes throughout the entire day without needing frequent recharges.
This strategy ensures that the bikes remain convenient for users in areas with limited charging infrastructure, while also maximizing productivity for commercial use.



[20]Ghana Electric Vehicle Baseline Survey Report, 2022

Efficiency of PV Charging Infrastructure:

The e-bike charging infrastructure harnesses solar power to efficiently charge bike batteries, significantly reducing energy consumption and emissions compared to traditional grid-powered options. Charging times average around 3-4 hours with a 4A charger and 6-7 hours with a 2A charger. By utilising green energy from solar panels, the charging station offers a more sustainable solution than conventional methods.

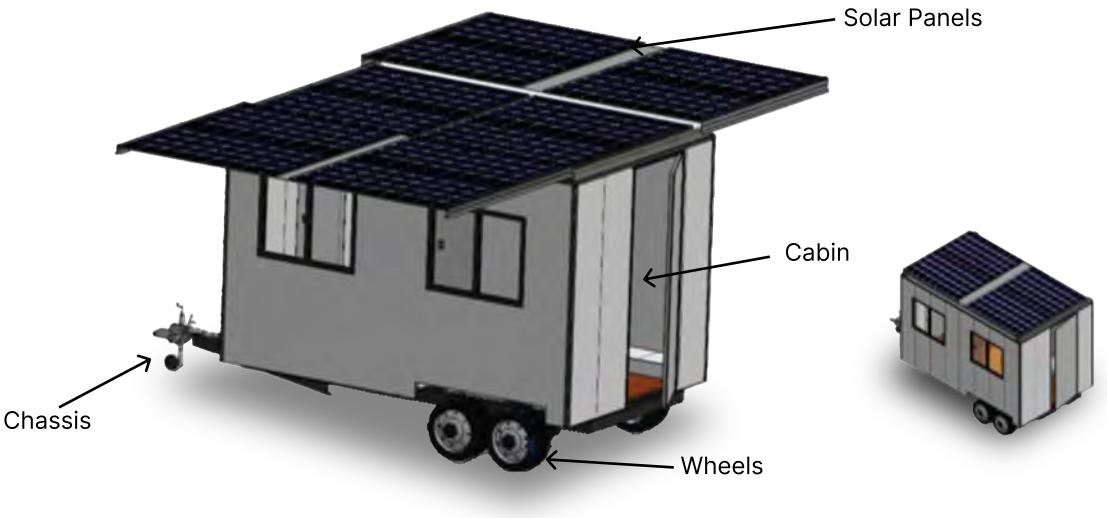
Key factors contributing to the efficiency of the PV charging infrastructure include the elimination of reliance on grid electricity and the seamless integration of the solar system with the e-bike charging and maintenance ecosystem.

This setup optimises energy management, enhancing the overall charging process and amplifying the environmental benefits of electric bikes.

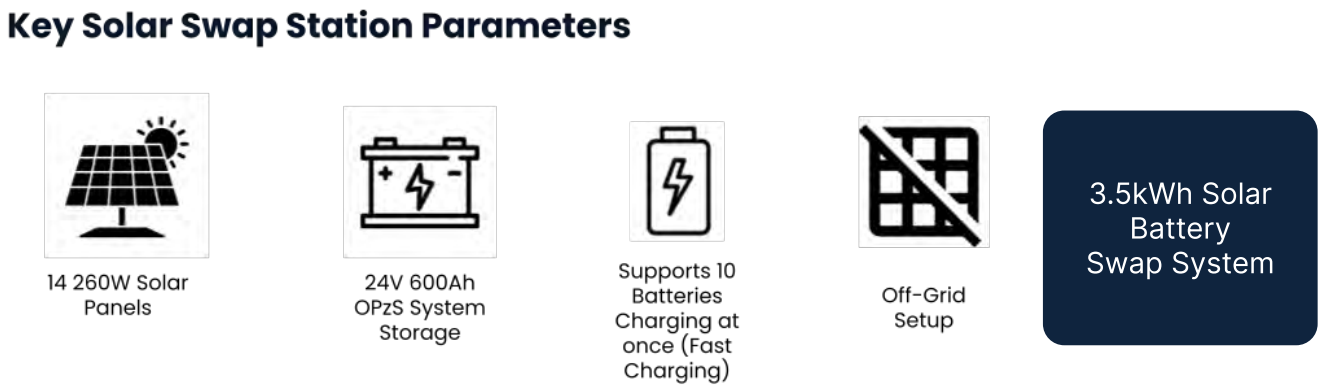
To encourage wider adoption of e-bikes, a robust charging or battery swapping infrastructure is essential to alleviate users' concerns about range anxiety. Currently, providing two batteries per bike, which can be easily charged at home, serves as a practical interim solution.

Building the Solar-Powered electric bicycle battery swap kiosk under the "Made in Ghana" Project

The solar-powered electric bicycle battery swap kiosk represents a pioneering initiative tailored to Accra's bustling streets and the increasing demand for eco-friendly transportation options. This innovative solution harnesses solar energy to enable seamless battery exchanges for electric bicycles. By integrating renewable energy technology, the kiosk provides a convenient, cost-effective, and environmentally friendly option for e-bike users, ensuring uninterrupted mobility while simultaneously reducing carbon emissions and supporting sustainable urban development. Through an examination of its design, functionality, and potential impact, we unveil a forward-thinking solution that promises to transform urban mobility and foster a greener, more resilient future for Accra's residents and communities.



As a major outcome of the 3.5 year "Made in Ghana" project, we developed and built the Solar Swap Kiosk with a 3.5kWh solar battery swap system. The Key swap station parameters were:



Charging Blueprint Location in Accra

Blue Print Map of Charging Zones

Solar Swap Station Siting Example With 5 Stations

Enclosed Service Region 45.6 km²

Swap Stations at strategic entry/exit points located along popular roads.

The zoned area includes the very busy Central Business District demonstrating the order demand.

The zone developed is based on the commercial use case as this is more demanding.

Swap stations have been located at well placed and known fuel stations and organisations with solar infrastructure.

Logic Model for Viability of Charging Station Siting

Charging Station Viability - Unit Economics

20 batteries in daily circulation

10 battery charging slots

$0.5 per swap

$10 daily revenue

$ 4500 estimated total production cost

$ 500 estimated siting & maintenance cost

1.4 years payback period

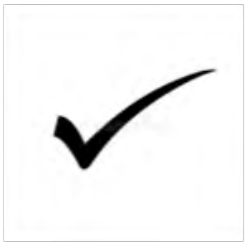
$ 3,650 annual revenue

Electric Bicycle Prototype Learnings

Logic Model for Viability of Charging Station Siting

Design Principles for Siting of 10 Charging Station Locations - Accra

To support a fleet of up 100 electric bicycles in Accra, we would require at most 10 swap stations. These sites would be determined by the following parameters:



Co- Locate where energy generation would be via existing solar infrastructure, i.e. Solar Roof/Car Park

Entrance and Exit points of Zones of high traffic routes

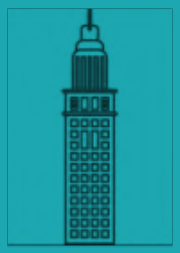
Sited in Central Business District area where there is convergence of Zones

Sited off a Main Road

Logic Model for Viability of Charging Station Siting

Design Principles for Siting of 10 Charging Station Locations - Accra

To support a fleet of up 100 electric bicycles in Accra, we would require at most 10 swap stations. These sites would be determined by the following parameters:



Siting next to tall buildings/ obstacles whose shade may obstruct sunlight to the solar panels.

Siting in flood-prone areas may present an electric shock hazard to the operators and the general public

Challenges in scaling charging infrastructure in Ghana

The development of EV charging infrastructure has encountered several challenges, despite notable progress. A significant issue is the reliance on imported components, as most charging equipment is not locally manufactured. Reducing duties and tariffs on these imports could boost local manufacturing, thereby lowering costs and accelerating the development of charging infrastructure.

Moreover, the lack of standardization in charging systems complicates the landscape, with different companies employing various battery types. Establishing a universal charging standard would streamline the infrastructure and enhance user convenience, facilitating better integration.

High taxes and capital requirements further impede the establishment of an extensive charging network. The customs department's classification of batteries as multi-purpose items results in substantial import duties, increasing overall costs. Currently, many users rely on home charging, which is not ideal for long-distance travel. According to the Ghana EV Baseline Survey, 50% of Ghanaians who own EVs charge their vehicles at home.[21] Expanding public charging stations along key routes is essential to address concerns about running out of charge during regional commutes.

Comprehensively addressing these challenges is vital for changing public perception and fostering broader EV adoption in Accra and across Ghana.

Future Charging Infrastructure Development Plans

- In spite of these challenges, the project offers a significant opportunity for expansion by piloting and providing scalable prototype options for building an extensive network of charging stations across Accra. Our technical partner, WAHU Mobility, is actively mapping charging infrastructure in Ghana for all electric vehicles.
- At the heart of this initiative is the Battery-Swap service, which leverages removable batteries to facilitate quick and convenient charging. The plan for scaling involves constructing a nationwide network of swapping stations, tailored specifically for e-bike riders. This network will be designed to meet the diverse energy needs of different regions:
- **On-Grid Swap Stations:** Positioned in urban areas with stable electricity access, these stations will ensure constant availability in high-demand zones.
- **Hybrid Swap Stations:** Located in areas with moderate power availability, these stations will combine grid power with solar energy to offer a reliable and sustainable charging solution.
- **Off-Grid Swap Stations:** Designed for rural areas with limited power infrastructure, these stations will primarily rely on alternative energy sources, such as solar power, to effectively serve remote communities.
- This strategic approach to infrastructure development ensures that all regions, whether urban or rural, will have access to efficient charging solutions, promoting broader adoption of electric vehicles across Ghana.

The user-centric approach links vehicles to an app that provides information on the vehicle. The app also guides users on how to maintain their vehicle and connects them with others in their community who can assist with vehicle support. Once the comprehensive network of charging stations is established, the innovative app will display available charging stations and ready-to-swap batteries, enhancing accessibility and convenience for EV users across Ghana.

Conclusion

The availability and accessibility of charging stations are critical to the widespread adoption of e-bikes in Ghana, where the current limited number of charging points poses significant barriers. While initiatives led by technical partners like WAHU Mobility, Solar Taxi, and KOFA aim to expand charging infrastructure, challenges such as intermittent power supply and dependence on imported components continue to hinder progress.

The integration of solar power at charging stations, coupled with a dual battery system for e-bikes, offers effective solutions to alleviate range anxiety. Additionally, the development of a nationwide network of battery-swapping stations and apps to help users locate available charging options holds great potential for overcoming existing obstacles and boosting the acceptance of electric vehicles in the country.

Addressing these issues comprehensively will be vital for reshaping public perception and driving the transition toward a more sustainable transportation ecosystem in Ghana.

[21] Energy Commission, 2022

Perceptions and Awareness of Electric Vehicles

A core component of the project delivery and setup was to increase perception and knowledge of e-mobility among key stakeholders in Ghana. Key stakeholders contribute to the integration of e-mobility and the increase of mitigation capacity in the transport sector in Ghana. To effectively deliver on this component, we designed and established the Net Zero Electric Mobility platform to lead the electric mobility charge in Ghana and beyond under the project.

We designed our work under the following components for engagement:

- Race to Zero Festivals
- Charge Design Sprint & Fellowship
- Test Drive the Future
- Net Zero Accra Podcast
- Stakeholder Events and Engagements

Race to Zero Festivals

A Race to Zero - Accelerating Clean Mobility Transitions in Ghana through stakeholder engagements.

As a leader in shaping bold conversations and actions for our city's future, Impact Hub Accra hosted the inaugural 'Race to Zero' festival in November 2022. This event, the first in a series planned throughout the project and beyond, is intended to be held annually, featuring partner-led sessions to advance the Energy Transition Agenda and promote wider adoption.
The festival celebrates the leaders driving this transition, fosters challenging discussions about what’s achievable, and holds participants accountable to high standards on the path to zero emissions. Each event in the series is co-hosted with our partners.


EVoluton


Net Zero Accra
Together.
We Are Electric.


racetoze

Building on the project's growth, successes, and expanded stakeholder base under our advocacy efforts, the 2nd ‘Race to Zero’ festival, held in May 2024, celebrated these achievements. It focused on discussing the scalability of electric vehicles (EVs) in Ghana, bringing together private and public sector leaders to contribute to the continued growth of the EV sector.



wahu!



GHANA
BOXING
FEDERATION

FIT





Technologies

Test Drive the Future

Test Drive the Future

Test Drive the Future evolved into a dedicated arm of our advocacy platform, curating the future of electric mobility by uniting our community to showcase the innovative solutions they are developing. We created an immersive experience, featuring a variety of e-mobility solutions emerging in Accra, offering participants a glimpse of the city's potential clean energy future.

We proudly highlighted the innovation, creativity, and technology that Ghanaians bring across the EV industry.. As part of this, we simulated what e-mobility could look like on a dedicated road in Ghana, showcasing trends such as electric cars, bikes, bicycles, charging stations, and other components essential to a thriving e-mobility ecosystem.
Participants had the chance to “test drive the future” and engage directly with the key players shaping this exciting transformation.

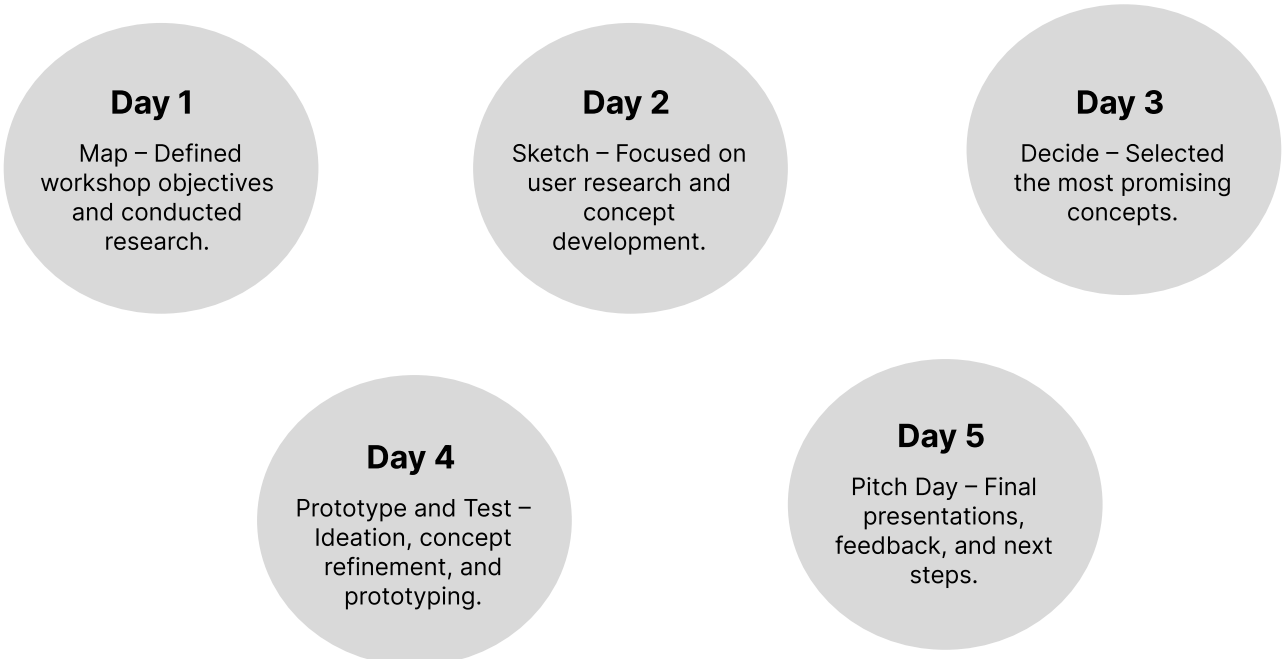
Charge Design Sprint Workshop & Fellowship

From October 10–14, 2022, we organised the Charge Design Sprint Workshop at Impact Hub Accra, bringing together a select group of students with technical backgrounds to deepen their understanding of the electric mobility space and co-design a charging and swapping infrastructure network for Ghana.

The five-day workshop employed design sprint methodology, design thinking, and human-centred design, facilitated by an expert. Participants tackled the design challenge: "How might we develop an affordable, sustainable, and reliable battery charging and swapping infrastructure network for the Ghanaian market?"

The 5 day Approach covered:

The Charge Design Sprint Workshop followed a structured five-day process:



Participant Background and Selection

Thirty (30) students and recent graduates were selected from institutions such as the Design Technology Institute, Kwame Nkrumah University of Science and Technology, Ashesi University, and others.
Participants came from diverse fields including engineering (mechanical, electrical, computer), business, agriculture, technology, graphic design, and fabrication, contributing a wide range of expertise to the workshop. We prioritised students and recent graduates who demonstrated a strong interest in electric mobility and innovative problem-solving skills, ensuring a diverse mix of expertise for effective collaboration.

Perception Change in 3 Years of the "Made in Ghana" Project

In recent years, EVs have faced scepticism from certain segments of the population, with two prominent misconceptions emerging. First, there is a belief that EVs are less robust compared to traditional transportation options. This perception leads to doubts about their reliability. The second concern is range anxiety, the fear that an EV may run out of battery power before reaching its destination. However, advancements in technology have begun to alleviate these fears. For instance, e-bikes have gained popularity by offering flexible charging options and the ability to be pedalled like traditional bicycles, thus reducing concerns about getting stranded. As people become more familiar with these vehicles, the notion that EVs might leave users in precarious situations is expected to diminish.

Another critical aspect of shifting public perception involved the development of charging infrastructure. To truly change how people view EVs, it is essential to focus not only on the vehicles themselves but also on the surrounding infrastructure. This comprehensive approach is necessary for widespread acceptance. Despite ongoing inquiries regarding the longevity of electric vehicles—such as misconceptions about their lifespan—understanding is gradually improving. For instance, concerns about the 10-year operational life of EVs are often based on outdated information. Like all vehicles, EVs may experience reduced efficiency over time, but this does not mean they become unusable.

As acceptance grows, younger, middle-income families are beginning to explore
EVs as their first vehicle options. This represents a notable shift from the past when many viewed e-vehicles with scepticism. With the increasing popularity of electric bikes and the gradual acceptance of electric cars, the market is evolving.
Now, as we enter a new phase characterised by a desire for scalability, the interest in electric mobility is stronger than ever. Many people are drawn to electric bikes, seeing them as both practical and appealing alternatives. With this momentum, the future of e-mobility in Ghana looks promising, paving the way for broader adoption and innovation in sustainable transportation solutions.

Limited Awareness and Education: Overcoming Scepticism and Embracing Electric Mobility

In Ghana, there is a pressing need for increased awareness and education about the benefits and practicalities of electric cargo bikes, especially among rural communities. Changing consumer perceptions about electric mobility is challenging, particularly given the longstanding reliance on petrol-based transport solutions. This scepticism towards new technology is not unlike the common perception that second-hand vehicles are superior to new ones due to their tried-and-tested nature. This belief, driven largely by economic constraints and a lack of access to affordable credit for new vehicles, mirrors the hesitance to adopt electric bikes.

The general populace's scepticism towards electric mobility is compounded by a lack of understanding of the significant benefits these technologies offer. Lower operational costs, reduced environmental impact, and the overall sustainability of electric bikes are advantages that are often overlooked. Without adequate information and firsthand experience, many Ghanaians remain unconvinced of the value that electric cargo bikes can bring to their daily lives and businesses.

To address these challenges, comprehensive educational initiatives are vital. These programs should aim to demonstrate the long-term benefits of electric bikes, such as their cost-effectiveness, environmental friendliness, and efficiency in urban and rural settings. By highlighting real-world examples and success stories, these initiatives can help shift public perception and foster a more favourable attitude towards electric mobility.

Engaging community leaders, leveraging local and social media, and organising hands-on demonstration events can significantly enhance the effectiveness of these educational efforts. As the benefits of electric cargo bikes become more widely recognized, particularly in terms of reduced operational costs and environmental impact, the likelihood of broader adoption will increase.
While there is a clear need for better awareness and education about electric cargo bikes in Ghana, addressing this gap requires targeted efforts to change entrenched perceptions and demonstrate the tangible advantages of embracing electric mobility. By doing so, we can pave the way for a more sustainable and economically viable transportation future.

The project's targeted outreach and awareness campaigns have significantly advanced this transformation by actively engaging the community and enhancing their understanding of e-mobility’s benefits. These campaigns have effectively communicated the urgency of climate action, outlined new employment prospects in the e-mobility sector, and introduced attractive financing packages. By providing community members with firsthand experiences of e-cargo bikes, these initiatives have demystified the technology and showcased its ease of use, thereby fostering trust and confidence in locally manufactured solutions.

As a result of these concerted efforts, there has been a notable increase in community knowledge and enthusiasm towards adopting e-mobility.

Conclusion

The project’s comprehensive approach to enhancing perception and knowledge of e-mobility in Ghana has fostered significant advancements in stakeholder engagement and public awareness. Through initiatives such as the Race to Zero Festivals, Test Drive the Future, and targeted workshops, the project has effectively bridged gaps in understand and addressed misconceptions about electric vehicles. The community’s shift from scepticism to appreciation of e-cargo bikes highlights the potential for broader adoption of e-mobility solution. As awareness grows and innovative financing options become available, the groundwork is laid for a more sustainable transportation future in Ghana.

Opportunities and Challenges of Ghana's E-Mobility Sector

Ghana's e-mobility sector is at the cusp of transformation, driven by the global push towards sustainability, urbanisation, and the increasing need for cleaner transportation options. With growing awareness around climate change and the economic benefits of reducing dependency on fossil fuels, e-mobility presents a significant opportunity for Ghana to modernise its transportation infrastructure while addressing pressing environmental concerns.

One of the most compelling opportunities within this sector lies in the development of a skilled technical workforce. The e-mobility industry requires a diverse range of technical expertise—from battery technology and charging infrastructure to vehicle manufacturing and maintenance. As Ghana embraces electric transportation, there is an urgent need to upskill its workforce, particularly in STEM-related fields. By investing in specialised training programs for engineers, technicians, and software developers, Ghana can build a robust pipeline of talent capable of supporting the growing e-mobility ecosystem.

This upskilling not only enhances the technical capacity of the nation but also offers pathways for young professionals to engage in cutting-edge industries, creating employment opportunities and driving economic growth. Developing technical institutes and partnerships with international e-mobility companies can further accelerate this growth, positioning Ghana as a regional leader in electric transportation innovation.

Setup Service and Maintenance Workshop in Tamale in February 2023

An earlier approach and focus of the project was implementation in Accra and Tamale as major pilot regions. Together with our technical partners, we provided technical training for electric bike service and maintenance. This was delivered by one of our design sprint fellows, Sylvester Abuliga.

Abuliga (Charged Fellow) to Yom Yom, Northern Ghana's first on demand delivery company.

E- Bikes technical training program under the "Made in Ghana" Project in Accra - January

In collaboration with Siemens Stiftung, Impact Hub Accra hosted a three-day technical training workshop on electric bikes in Ghana led by our technical partners, Wahu Mobility. The workshop brought together local e-mobility experts to equip e-bike technicians with the essential knowledge and skills required for effective maintenance and repair of electric bikes. This initiative was part of the larger "Made in Ghana" project, which aimed to promote and advance electric mobility solutions tailored to the Ghanaian context.

The Workshop Outcomes Included:

- Develop the capacity of technicians in Ghana who are equipped with advanced skills in e-bike maintenance, enhancing their overall expertise.
- Contribute to the growth of the local e-bike industry by fostering a skilled workforce capable of meeting the increasing demands for maintenance and repair services.
- Creation of new job opportunities for technicians, supporting economic development in Ghana.
- Improved safety awareness among technicians, reducing workplace accidents and enhancing overall safety standards in the industry.
- Enhanced customer satisfaction due to well-trained technicians capable of providing high-quality and reliable e-bicycle maintenance services.
- Encouraged local innovation in e-bicycle maintenance practices, fostering a culture of problem-solving and adaptability among technicians.
- Technicians are trained to adhere to local and international regulations, ensuring compliance with safety and operational standards.
- Establishment of a culture of continuous learning among technicians, encouraging them to stay updated on the latest technologies and industry trends.

The workshop covered several key topics, starting with an overview of the electric bicycle industry, highlighting the importance of e-bikes in promoting sustainable transportation. It then broke down the main components of an electric bicycle, including the motor, battery, controller, sensors, and display, followed by an explanation of the basics of electrical circuits, such as voltage, current, and resistance. Participants gained a working knowledge of an e-bike electrical system and learned how to identify and address common issues like motor malfunctions, battery problems, and sensor faults. The workshop also outlined the company's quality standards for maintenance and repair, along with guidelines for effective customer communication to address concerns and ensure satisfaction. In addition, technicians were instructed on the importance of accurate documentation, provided templates for service reports, and were familiarised with key performance indicators (KPIs) and the schedule for regular performance reviews to track progress and identify areas for improvement.

Workshop pictures

Financing

Many Ghanaians face significant challenges in accessing financing options to purchase e-bikes, which hampers their adoption. Traditionally, securing loans and other forms of financial support has been challenging, resulting in a reliance on older models of ICE bikes. These vehicles, while more affordable upfront, are less efficient and more harmful to the environment. The reliance on ICE bikes highlights a broader economic behaviour driven by financial necessity rather than preference. Given the general struggle to access financing, potential buyers often shy away from e-bike options.

To address these challenges, "subscribe to own" or "ride to own" financing models have been introduced to make e-bikes more accessible. This approach allows riders to gradually pay off their vehicles while using them for deliveries, transforming them from users to owners. The project has pioneered a pilot program where electric cargo bikes are made available to delivery riders at an affordable rate of 300 - 400 GHS per week over an 18-24 month period. This initiative not only facilitates access to e-bikes but also aligns payments with the earning patterns of users, making it financially manageable. Riders do not have to make a down payment or pay anything upfront. Their initial payment goes towards the bike cost.

The shift to ownership is crucial. When riders own their vehicles, they tend to adopt more responsible riding behaviours and tend to take better care of their vehicles. The financing model has increased rider safety. The project's technical partner, WAHU Mobility, has implemented a lease-to-own model, with riders collectively logging 2.5 million kilometers. This approach has resulted in minimal accidents, underscoring the positive impact of ownership on safety and performance.

Through our technical partnership with WAHU Mobility, a fleet partner was secured with major mobility players such as Bolt, Yango, and Glovo, to ensure a steady pipeline of delivery opportunities for riders. This collaboration allows riders to earn a consistent income while enhancing their bankability. By providing quality vehicles that serve as revenue-generating assets, riders are earning up to 3 times more than their previous income, increasing their economic productivity.

By structuring payments in this way, riders are able to gradually build creditworthiness, enhancing their ability to secure future financing. This approach not only makes e-bikes more accessible but also empowers riders economically, enabling them to transition to more sustainable and efficient modes of transportation.

The community aspect of the project's model is also crucial to its success. By cultivating a brand aesthetic that resonates with riders, the project was able to foster pride in their work within the courier space. Recently, the first batch of riders completed their payment plans, highlighting the effectiveness of the project's approach in promoting financial independence and enhancing the overall rider experience.
Such financing models are crucial in overcoming the economic barriers that have traditionally impeded the adoption of e-bikes in Ghana. By providing practical and manageable payment solutions, these initiatives pave the way for a broader acceptance and integration of electric mobility within the country.
Implementing comprehensive financing options and subsidies for e-bikes represents a significant opportunity for growth and expansion in the e-mobility sector, particularly in markets like Ghana where economic barriers often limit access to new technologies. This approach can make e-bikes more affordable and accessible, driving adoption among a broader demographic, including low-income individuals and small business owners who stand to benefit most from the cost efficiencies of e-bikes.

Social Impact

The "Made in Ghana" e-cargo bikes project has made significant strides in transforming the social landscape of Ghana through increasing employment opportunities, empowering riders, and creating more community cohesion. By supporting riders, mechanics, and operational staff, the project has helped address the high rates of unemployment that exist in Ghana, with 77.4% of the total unemployed persons in the first three quarters of 2023 comprising youth aged 15 to 35. Additionally, by[22] branding these roles as mobility entrepreneurs rather than mere delivery jobs, the project is changing societal perceptions of delivery riders. Delivery work, which has often been stigmatised, is being reframed as a respectable occupation, helping to elevate the status of those who engage in it.

The project together with it's technical partner WAHU mobility has developed a comprehensive training program that cover various essential skills, from navigating city streets to understanding road safety. Many riders report that the skills they acquire through the onboarding processes, including map reading, customer service, in-person and virtual training and safety videos on the app prepare them for diverse roles beyond just riding. There are also programmes for riders to be promoted to senior riders and serve as advisors for junior riders, providing opportunities for career mobility.

The result is a workforce that is not only more competent but also more self-assured. This boost in confidence can lead to improved personal and professional relationships, as riders begin to see themselves as valuable members of their communities. The commitment to enhancing skills extends beyond initial training. Through our partnership, we have actively collaborated with universities and technical institutions. An example of this was the Design Sprint Workshop discussed in Section 4. Creative partnerships with educational institutions allowed students gain practical experience, thus preparing them for successful careers in the growing e-mobility sector.

This focus on education not only benefits individuals directly involved with the project but also contributes to building a skilled workforce for Ghana's future. Some riders are university students who use their riding earnings to finance their education through their earnings, allowing them to stay in school and complete their degrees. Without this option, they would have had to cease their pursuit of higher education.

Personal stories of transformation —like that of Victor[23] who moved from homelessness to riding into Jubilee House for an e-mobility advocacy event—highlight the profound impact that project has made in the lives of people. Victor's experience serves as a powerful testament to the potential for mobility and employment to change life trajectories. Such transformations are not unique; many riders express similar sentiments about the life-changing nature of their work as delivery riders. As they increase their financial independence and deepen their sense of purpose, these individuals often become more engaged and proactive in their communities, further amplifying the positive social impact of the project's work.

Additionally, the psychological benefits of being employed and mobile for the riders are significant. Many riders report feeling a sense of pride and purpose as they transition from unemployment or underemployment to contributing members of society. This newfound identity enhances their self-esteem and mental well-being. For many, the ability to provide for their families and contribute to their households brings a profound sense of fulfilment. The community-building aspect of the project also plays a role in promoting mental health, as social connections are crucial for emotional support.

[22] Ghana Statistical Service, 2024

[23] Name has been changed

Gender

The project has had a significant impact in increasing the financial and social capacity of women. This helps ensure that the benefits of e-mobility are accessible to all segments of society. Within the project, there is notable participation from women.

The e-bikes designed through the project do not require a license to operate. This aspect significantly lowers barriers to entry for women, who often face challenges such as licensing requirements for motorcycles. By providing women with the opportunity to ride and earn, the project empowers women to take control of their economic futures. This not only boosts their income but also enhances their social status, as they become visible contributors to their families and communities.

Case Study: Wahu Mobility's Expansion into Lomé, Togo - Empowering Women in Logistics

Introduction

Wahu Mobility has marked a significant milestone by expanding its operations into Lomé, Togo. This move is part of a strategic initiative called Women Delivers, developed in partnership with the United Nations Environment Programme (UNEP) and Solutions Plus. The program is designed to empower women by integrating them into the logistics sector, providing them with Wahu Mobility eBikes tailored for delivery and errands. This case study explores the objectives, strategies, and impacts of Wahu Mobility's expansion into Lomé, focusing on the empowerment of women and the exploration of new market territories.

Background

Wahu Mobility has established itself as a forward-thinking company focused on sustainability and inclusivity. Recognizing the underrepresentation of women in the logistics sector, Wahu Mobility, alongside UNEP and Solutions Plus, launched the Women Delivers program to address this disparity and promote gender equality in the workforce.
Objectives

1. Empower Women: Equip women with the tools and opportunities to enter and excel in the logistics sector.
2. Test Francophone Markets: Evaluate the business viability and market response in Francophone regions, starting with Lomé.
3. Promote Sustainable Practices: Introduce eco-friendly eBikes to transform last-mile delivery services, reducing carbon emissions and enhancing efficiency.

Choosing Lomé

Lomé was selected as the launch city for several strategic reasons:

- Strong Riding Culture: Lomé has a prevalent riding culture, especially among women, making it a conducive environment for introducing eBike-based delivery services.
- Growth Potential: The city exhibits significant potential for the growth of sustainable courier services, with increasing demand for efficient, eco-friendly delivery options.
- Market Opportunity: As a Francophone city, Lomé offers Wahu Mobility the chance to penetrate the Francophone market, setting a precedent for further expansion in similar regions.

Implementation

The implementation of Women Delivers in Lomé involved several key steps:

- Distribution of eBikes: Wahu Mobility provided specially designed eBikes to women, enabling them to start delivery services.
- Training and Support: Participants received comprehensive training in eBike operation, maintenance, and safety, along with ongoing support to ensure their success.
- Partnerships: Collaborating with local businesses and e-commerce platforms, Wahu facilitated entry points for these women into the logistics network.

Conclusion

WAHU Mobility’s expansion into Lomé, Togo through the Women Delivers program exemplifies a significant step in empowering women in the logistics sector. By providing tailored eBikes and comprehensive training, the initiative promotes gender growth potential for eco-friendly courier services. Collaborating with UNEP and Solutions Plus enhances its impact, setting a precedent for future expansions into Francophone markets. Ultimately, this program not only empowers women but also contributes to a more inclusive and sustainable logistics ecosystem in Lomé.

Environmental Impact

This section of the report evaluates the environmental impact of the Electric Cargo Bikes "Made in Ghana" project, with a particular focus on the project's contributions to resource efficiency, waste reduction, and the implementation of sustainable practices. The analysis aims to highlight how the project supports environmental sustainability and aligns with broader climate goals. Key areas of focus include the use of recycled and locally sourced materials in bike production, the project's efforts to minimise waste, and the adoption of practices that enhance resource efficiency. Through this evaluation, the report will assess the project's overall contribution to a more sustainable and environmentally conscious transportation sector in Ghana.

Ghana is witnessing significant increases in greenhouse gas (GHG) emissions from its transportation sector, which contributed 47.7% of the country's energy-related emissions as of the last assessment. In the Business-As-Usual (BAU) scenario, these emissions are projected to reach 74 MtCO2e by 2050, up from approximately 43 MtCO2e in 2016.[24] The introduction of electric cargo bikes into Ghana’s transportation system has made a considerable impact in reducing GHG emissions. Since 2021, the electric cargo bikes have covered over 54,700 km, saving an estimated 4.3 tons of CO2 emissions.

Use of Recycled and Locally Sourced Materials

The "Made in Ghana" e-cargo bikes project has made commendable strides in integrating sustainable practices into its operations, particularly through the use of recycled and locally sourced materials in the manufacturing of electric cargo bikes. This initiative forms a core part of the project's efforts to promote environmental sustainability while simultaneously boosting the local economy and aligning with broader climate goals.

In 2022, the project completed the first locally produced prototype of an electric cargo bike made entirely from 100% recycled and local materials. This achievement highlights the project's commitment to minimising environmental impact and supporting local industries. The use of recycled materials helps in reducing waste and conserving resources that would otherwise be used in the production of new materials, significantly lowering greenhouse gas emissions. Furthermore, sourcing materials locally reduces the carbon footprint associated with long-distance transportation, enhancing the sustainability of the manufacturing process.

Additionally, the development of a photovoltaic charging station in collaboration with local stakeholders exemplifies the project's sustainable ethos. These stations provide essential infrastructure for the operation of the bikes, ensuring that their energy source is as green as the materials used to build them. The project's rigorous focus on recycling and local sourcing delivers substantial environmental benefits by significantly reducing the need for new material production, which is often energy-intensive and polluting. Furthermore, these practices encourage a circular economy where materials are kept in use for as long as possible, setting a precedent for sustainable manufacturing within the region.

Waste Reduction and Resource Efficiency

Central to the project's waste reduction initiative is its innovative approach to reusing materials and enhancing resource utilisation efficiency. An exciting development in this area is the potential collaboration with the local fashion brand, Gutta Soles. This brand is known for its creative reuse of waste products, like transforming tyres into fashionable shoes. Exploring such partnerships aligns with the project’s long-term commitment to comprehensive waste reduction by broadening the spectrum of materials that can be repurposed and recycled within the community.

The project also engaged in repurposing initiatives that contribute to the project's resource efficiency. Compared to ICE bikes, e-bikes consist of significantly fewer parts. This simplicity results in less waste; if a component fails, it is easier to dispose or recycle the part. For ICE bikes, handling waste from numerous components poses a greater challenge, while the streamlined design of e-bikes contributes to more effective waste management. Additionally, there is an ongoing effort to repurpose mechanical and electrical parts as spares, and notably, to reuse batteries from the bikes in other devices such as laptops and phones. These batteries are designed to last 24 months before their capacity falls below 80% of their original capability, thus extending their useful life and contributing significantly to the sustainability of the project. Repurposing the batteries also ensures lithium pollution is limited.

[24] UNEP Copenhagen Climate Centre, 2022

Economic Impact

Our analysis offers a comprehensive overview of the economic benefits and the challenges encountered during the project's implementation. By examining reductions in fuel and maintenance costs, increases in delivery speeds, and the job opportunities created in manufacturing and service sectors, this section aims to provide a thorough understanding of the multifaceted economic impacts. These insights highlight the significant role that electric cargo bikes play not only in reducing operational overhead but also in promoting sustainable development and enhancing the overall economic vitality of Ghana.

We focus on three key areas of economic impact: Cost Savings and Business Efficiency, Job Creation and Economic Opportunities, and Impact on Local Businesses and Suppliers.

Cost Savings and Business Efficiency

In the evolving landscape of urban delivery services, the shift from traditional delivery vehicles to electric cargo bikes represents a significant transformation. As fuel costs continue to climb, the economic viability of electric bikes becomes increasingly compelling. For example, the price of a litre of fuel escalated from GHS 4.85 in October 2020 to an astonishing GHS 15.6 by July 2024.[25] With projections indicating that these prices will continue to rise, the shift to electric mobility solutions is not just sensible but necessary for maintaining competitive operations.

Expanding on the economic impacts, there is a dramatic decrease in operational expenses that come with the adoption of electric cargo bikes. Delivery riders who previously spent approximately GHS 1,500 each month on petrol now incur merely GHS 8 weekly on electric charging. This reduction in fuel costs—translating to less than $1 a week or about $4 a month—has not only enhanced the riders' profit margins but also allowed delivery companies like Bolt and Glovo to stabilise delivery fees. In a market where fuel prices fluctuate widely, the ability to maintain consistent pricing is invaluable. It aids in retaining customers who might otherwise be deterred by frequent price adjustments.
The project focuses on delivery services primarily to maximise battery efficiency, promote profitability, and ensure rider safety. To support this focus, the e-bike was designed to be suited for delivery service work. The project also prioritised hyper local delivery, in line with delivery partner needs, which increased delivery rider availability. This increased availability has allowed these companies to streamline their operations, reducing their delivery radius to 5 KM. This adjustment has significantly quickened delivery times, a critical factor in meeting the modern consumer's expectations for speed and efficiency.

[25] Source: Statista, 2023

The result of this improved delivery performance is multifaceted: enhanced customer satisfaction boosts customer loyalty and encourages repeat business. Additionally, the positive feedback from satisfied customers serves as a powerful tool for attracting new business. Thus, electric cargo bikes are not only reducing operational overhead but also playing a crucial role in promoting sustainable development and enhancing the overall economic vitality of urban delivery services.
The adoption of electric cargo bikes is more than a mere response to economic pressures—it is a strategic decision that aligns with broader trends towards sustainability and efficiency in business operations.

Job Creation and Economic Opportunities

As consumer investment in electric vehicles grows, there will be an increased demand for charging stations and maintenance services. This transition is expected to create new job opportunities, including workers for charging stations and EV maintenance. Increased infrastructure will require personnel for operations and customer support .Skilled workers will be needed to maintain and repair electric vehicles, contributing to local employment growth.
The "Made in Ghana" Electric Cargo Bikes project has made a substantial impact on local employment, creating 31 direct jobs in diverse areas such as project management, finance, business development, technical design, bike frame fabrication, and delivery operations. Additionally, it included a temporary role for a Solar Kiosk Fabricator that concluded in early 2024. Beyond the direct jobs, the project has significantly contributed to the job market by employing over 150 individuals and recruiting 160 bike riders to manage the growing fleet of e-cargo bikes. As the demand for electric cargo bikes continues to rise, this expansion invigorates the local economy, providing a sustained boost to businesses involved in supplying necessary components and services, and reinforcing a thriving economic ecosystem. Additionally, the project has actively engaged in the ecosystem by training 10-15 mechanics specifically for the maintenance of electric bikes.
Moreover, these jobs contribute to skill development through comprehensive training and capacity-building programs that equip workers with valuable skills applicable in the expanding e-mobility industry. This focus on skill enhancement enhances the long-term employability of the workforce and ensures that the economic benefits of the project are sustained.

Impact on Local Businesses and Suppliers

The Electric Cargo Bikes "Made in Ghana" project has facilitated substantial business growth and has also strengthened supply chain capabilities and forged sustainable economic relationships within the community. Our analysis aims to highlight the transformative impact of this initiative, significantly reshaping the local economic landscape.

The integration of local businesses and suppliers into the e-cargo bike value chain has created a surge of new economic opportunities. By promoting domestic production, the project has reduced Ghana's reliance on imports, thereby nurturing a more robust and sustainable local supply chain. Suppliers of components, assembly and maintenance services, and charging infrastructure have experienced increased demand, leading to greater revenue and more secure positions in the market.

Moreover, local component suppliers, especially those producing batteries, motors, and frames, have noted a significant uptick in demand. Businesses specialising in assembly and maintenance services for e-cargo bikes have discovered new growth avenues. A pivotal achievement of the project has been its role in promoting domestic production capabilities, significantly reducing Ghana’s dependency on imported e-bike solutions. This shift has not only enhanced the resilience of the local supply chain but also integrated a broader spectrum of local suppliers into the e-cargo bike value chain. Furthermore, the project has championed capacity-building initiatives, offering training and skill enhancement programs to elevate the technical competence and market competitiveness of local suppliers.

By integrating local suppliers deeply into the e-cargo bike value chain, the project has unlocked new economic potentials, fortifying the local economy and encouraging the proliferation of startups and entrepreneurship within the e-mobility sector. This has led to a diversified economic base and has poised the Ghanaian economy for further growth and innovation in sustainable transportation solutions.

Additionally, e-bikes made through the “Made in Ghana” electric cargo bike project offer backup power solutions at prices significantly lower than those of traditional petrol generators—about 30% less. This affordability is transformative for small businesses across Accra, particularly those that rely on refrigeration or continuous power for operations. With lower overhead costs, business owners can retain more profits, which they can reinvest into their operations or use to expand their services. This model is particularly beneficial in markets where access to reliable electricity is a challenge. By reducing dependence on costly fuel sources, the e-cargo bikes enable small enterprises to operate more efficiently, contributing to local economic resilience.

Through these concerted efforts, the Electric Cargo Bikes "Made in Ghana" project has transformed the local economic landscape by enhancing supply chain efficiencies and business opportunities, setting a new standard for sustainable economic development driven by local enterprise and innovation.
Electric cargo bikes are relatively expensive for many Ghanaian consumers, making them inaccessible to those who need them most. The significant upfront cost of these bikes poses a formidable barrier to widespread adoption compared to traditional Internal Combustion Engine (ICE) bikes. However, it is essential to consider the long-term savings, which can offset the initial expense over time. The substantial reduction in ongoing operational costs—especially in fuel savings—makes a compelling economic case for adopting electric bikes over traditional ICE bikes. This perspective is crucial for potential users and investors, providing a clear view of the financial benefits that accrue from making the initial investment in electric cargo bikes.
Furthermore, these savings are not just theoretical; they translate into real, tangible benefits for users. The money previously spent on petrol can now be redirected towards other essential needs or savings, improving the overall financial stability of the riders. This shift highlights the practical advantages of electric cargo bikes and underscores the potential for a broader economic impact within the community.

Conclusion

The "Made in Ghana" e-cargo bikes project demonstrates how innovative environmental practices can be effectively integrated into industrial processes. By prioritising recycled and locally sourced materials, the project not only mitigates its environmental impact but also supports local economies and promotes inclusivity, setting a benchmark for future initiatives in the region and beyond. This section assessed the extent to which recycled and locally sourced materials are utilised in the production of electric cargo bikes as part of the "Made in Ghana" project. By examining the sourcing and integration of these materials, this analysis aims to evaluate the project's commitment to sustainable manufacturing practices and its impact on reducing the environmental footprint of production. We will explore how the use of these materials not only supports environmental goals but also bolsters the local economy by engaging local suppliers and reducing reliance on imported resources.

In terms of ecosystem development, collaborations like the "E-Cargo Bikes Made in Ghana" project illustrate the synergistic efforts of companies such as Saglev, Jumia, Solar Taxi, and Wahu Mobility. This project exemplifies how stakeholder collaboration can enhance the e-mobility ecosystem, promoting knowledge sharing and joint development.

Case Studies

Gender Case Study: The Female-Led Inception Team of Solar Taxi

Background

In a sector traditionally dominated by male leadership, Solar Taxi's inception marked a significant shift towards gender inclusiveness within the technology and transportation industries in Ghana. Founded with a vision to revolutionise transportation through sustainable e-mobility solutions, Solar Taxi differentiated itself not only through its innovative business model but also by its commitment to promoting gender equality right from its inception.

The Inception Team

The core team that launched Solar Taxi was predominantly female, a deliberate choice aimed at challenging the gender norms within the tech and automotive sectors. This team was composed of engineers, financial experts, and operational managers, all of whom brought diverse perspectives, experiences, and expertise. The decision to have a female-led team was rooted in the company's broader mission to empower women in technology and entrepreneurship, which they believed would lead to more holistic and inclusive solutions in the e-mobility space.

Challenges Faced

The team encountered several challenges, primarily related to gender biases in the industry. Scepticism from potential investors and partners, who were unaccustomed to seeing women in leadership roles in tech and engineering fields, was a significant hurdle. Additionally, the female team members often had to go the extra mile to prove their technical competencies and leadership capabilities in a male-dominated environment.

Strategies and Solutions

To overcome these challenges, Solar Taxi implemented several strategic initiatives:

1. Professional Development: The company invested in continuous training and development programs to ensure that all team members, regardless of gender, were equipped with the latest skills and knowledge in e-mobility technology.
2. Public Awareness Campaigns: Solar Taxi launched campaigns highlighting the success stories of their female team members, aiming to inspire other women and change societal perceptions about gender roles in technology.
3. Partnerships: The company formed alliances with women-led organisations and tech groups to strengthen their network and support system.

Impact

The impact of having a female-led team was profound:

- Innovation: The diverse perspectives brought about more creative and holistic approaches to product development and business strategies.
- Market Penetration: By advocating for inclusivity, Solar Taxi attracted a broader customer base, including women who felt more represented.
- Social Influence: The company became a role model for gender inclusivity in Ghana, inspiring other startups to adopt similar practices

Conclusion

The success of Solar Taxi, which has now expanded their operations to Nigeria and Togo , shows the importance of making gender inclusion a key aspect of the e-mobility ecosystem. Solar Taxi has significantly impacted the e-mobility sector by establishing an assembly plant in Accra, which has created over 100 full-time jobs. The company's electric bikes, utilised by major delivery services such as Jumia and Bolt, exemplify efficient and eco-friendly last-mile delivery solutions. Furthermore, Solar Taxi's commitment to sustainable energy is evident in their deployment of solar-powered charging stations, reducing the carbon footprint of their fleet. Solar taxi has a fleet of 500 e-vehicles including cars, bicycles, and tricycles that are available for rental and/or purchase for everyday use, in addition to use for last-mile delivery. Solar Taxi is continuing its outreach towards women through the Female Engineers Academy which trains women in the technical skills and knowledge needed to understand behind electrical vehicles. Necessary for maintaining gender parity in the e-mobility sector moving forward.

DESIGN & TECHNOLOGY INSTITUTE

Education Case Study: TVET Institutions - Spotlight on Design and Technology Institute (DTI) Mobilising Talent to Cater to the E-Bike Value Chain

Overview

Design and Technology Institute (DTI) in Ghana stands out in the Technical and Vocational Education and Training (TVET) landscape for its innovative approaches to education that align closely with industry needs. A prime example of DTI's impactful initiatives is its focus on the e-bike value chain, which is part of the broader movement towards e-mobility in Ghana. This initiative underscores DTI's commitment to mobilising talent and fostering skills that support emerging industries.

Objective

DTI aims to develop a skilled workforce capable of contributing to the growing e-bike sector in Ghana, addressing both the technical and sustainability aspects of the industry. The institution focuses on cultivating skills in design, manufacturing, maintenance, and innovation, specifically tailored to the unique needs of the e-bike market.

Educational Approach and Curriculum Integration

DTI incorporates hands-on learning experiences directly relevant to e-mobility:

- Specialised Workshops: Students participate in workshops where they learn to design, build, and test electric bikes, focusing on both mechanical and electrical components.
- Sustainability Education: Courses also cover the sustainability aspects of e-mobility, such as the use of renewable energy sources and materials, and the environmental impact of transportation solutions.
- Innovation Projects: Students engage in projects that challenge them to create viable e-bike solutions tailored to the local market's needs, encouraging innovation and entrepreneurship.

Constance Swaniker, the founder of DTI, emphasised the importance of tailoring education to the local context: "There's no way as an innovator you can design things without considering the person who's going to be using that product. It’s essential for young people to be mindful of designing something while considering what is available locally" Constance Swaniker - DTI.

Industry Partnerships

Key to DTI's success is its strong collaboration with local and international e-bike companies. These partnerships provide:

- Practical Experience: Internships and apprenticeships with e-bike manufacturers and service providers.
- Technology Transfer: Access to the latest e-bike technologies and industry practices.
- Market Insights: Enhanced understanding of market demands and customer preferences, which inform the curriculum and training programs.

For instance, DTI partnered with WAHU Mobility from September 2022 to December 2022 to develop WAHU Mobility’s first e-bike prototype. During this period, DTI students participated in a Design Sprint that involved 30 students from across Ghana’s tertiary institutions, brainstorming and designing innovative recycling ideas for the e-bike prototype. Swaniker highlighted the significance of this initiative:

"It was exciting that young people could begin to start thinking along the lines of sustainability and innovation. The participation in the Design Sprint allowed our students to be at the forefront of this emerging sector" Constance Swaniker - DTI.

Key Projects and Outcomes

- E-Trike Initiative: One of DTI's standout projects involves the development of an electric tricycle (E-TRIKE), designed for rural farming communities. This project not only provides a sustainable transport solution but also serves as a practical training tool for students.
- Community Engagement: Students work directly with local communities to understand their transportation needs, leading to designs and products that are both innovative and practical.
- Skill Development: Through these projects, students gain skills in areas such as renewable energy integration, battery management systems, and sustainable manufacturing practices.

Challenges and Solutions

- Resource Constraints: Limited access to high-tech components and materials can hinder projects. DTI mitigates this through partnerships and grants that provide necessary resources.
- Skill Gaps: The rapid evolution of technology in e-mobility requires continual curriculum updates. DTI addresses this by maintaining close ties with industry leaders to stay abreast of new developments and required skills.

Constance Swaniker pointed out the importance of adapting to local contexts:

"When you're developing e-mobility in a place like Ghana, you need to consider your local environment and meet its specific needs. This is where the beauty of partnering with local innovators comes in" Constance Swaniker - DTI.

Impact and Future Prospects

DTI's focus on the e-bike value chain has positioned it as a leader in TVET for e-mobility in Ghana. Graduates from DTI are well-equipped to enter and enhance the e-bike industry, bringing innovative solutions and sustainable practices. Looking forward, DTI plans to expand its programs to include more advanced aspects of e-mobility and to foster a broader range of international partnerships to further enrich its training capabilities.

The prospects for the e-mobility sector in Ghana are promising, driven by government support, increasing consumer demand, and the need for sustainable transportation solutions. This supportive environment suggests that the jobs and economic opportunities introduced by the e-cargo bike project will endure, further supported by efforts to develop a comprehensive e-mobility ecosystem involving various stakeholders from both the private and public sectors. Swaniker remarked,

"It's crucial that we look at the realities of our environment while also seeing the big picture of what we can achieve together through continuous collaboration and time" - Constance Swaniker - DTI.

EV Infrastructure Case Study: KOFA and the Challenge of Charging Infrastructure in Ghana's e-Mobility Sector

Parallel to the “Made in Ghana” e-cargo bike project initiatives, KOFA, an e-mobility company that specialises in battery swapping stations and electric vehicles, has also made significant strides in EV space, particularly with their electric motorcycles. KOFA’s deployment of electric motorcycles, such as the Volta and Jidi models, prevented approximately 38 tons of CO2 emissions by the end of 2023. This figure represents a substantial contribution in mitigating greenhouse gas emissions in Ghana's transportation sector. KOFA’s continuous efforts to expand their fleet and improve the efficiency of their models promise further reductions in GHG emissions.

Introduction

KOFA, a pioneering company in Ghana's e-Mobility space, has been at the forefront of introducing sustainable transportation solutions. Their commitment to providing energy-efficient alternatives to petrol has led to significant advancements, such as the launch of their electric motorbikes, the Volta and the Jidi. Despite these innovations, KOFA faces a substantial challenge: the lack of a robust charging infrastructure. This case study explores how this deficiency impacts KOFA's operations and the broader implications for scaling e-Mobility in Ghana.

Background

KOFA's journey began with extensive research in 2022 to understand the feasibility of electric mobility in Ghana. This research culminated in the 2023 launch of the Volta, an electric motorbike designed to resemble conventional ICE bikes. With an initial fleet of 50 bikes and seven swap stations, KOFA aimed to make a quick impact. By the end of 2023, they had increased their swap stations to ten and successfully avoided 38 tons of carbon emissions.
In April 2024, KOFA introduced the Jidi motorcycle, leveraging insights from their previous model to create a more advanced and user-friendly bike. Despite selling around 100 units of the Jidi, KOFA's growth is hindered by the insufficient charging infrastructure in Ghana.

Achievements in Swap Stations

Despite the challenges posed by the lack of a comprehensive charging infrastructure, KOFA has made significant strides in establishing and expanding their network of swap stations:

1. Initial Deployment: In 2023, KOFA established seven swap stations to support the launch of their Volta electric motorbikes. These stations were strategically placed to maximise accessibility and convenience for early adopters.
2. Expansion: Recognizing the importance of infrastructure in driving eMobility adoption, KOFA expanded their network to ten swap stations by the end of 2023. This growth facilitated more efficient battery swaps, enhancing the user experience and operational efficiency.
3. Carbon Emission Reduction: Through the deployment of 38 Volta motorbikes and the supporting swap station network, KOFA successfully avoided approximately one ton of carbon emissions per motorcycle, totaling 38 tons by the end of 2023. This achievement underscores the environmental impact of KOFA's initiatives.

Operational Learnings: The initial network of swap stations provided KOFA with valuable insights into the operational dynamics and user behaviour associated with electric motorbikes. These learnings have informed the design and deployment of their subsequent models, including the Jidi.

Conclusion

KOFA's achievements in establishing a network of swap stations represent a critical step towards mainstreaming eMobility in Ghana. While the lack of a robust charging infrastructure in Accra remains a significant challenge, KOFA's efforts have demonstrated the viability and benefits of electric motorbikes despite these challenges. Their continued focus on expanding and optimising their swap station network is essential for overcoming infrastructure-related barriers and driving sustainable transportation solutions in Ghana.

Conclusion

This section highlighted the diverse key players and sectors essential for fostering a robust e-mobility system in Ghana. Beyond their environmental benefits, the social impact of these companies is particularly significant, especially for women and youth. Their initiatives not only promote sustainable practices but also actively engage underrepresented groups by providing technical training and educational opportunities.

This emphasis on inclusivity empowers individuals to participate meaningfully in the e-mobility sector, helping to bridge gender gaps and enhance youth employment. By cultivating a more equitable workforce, these programs contribute to both community development and the overall growth of the e-mobility ecosystem, ensuring that a wider array of voices and talents are involved in shaping the future of transportation in Ghana.

Recommendations and Conclusion

Based on the project findings, there are a number of recommendations the Government of Ghana and key actors in the e-mobility ecosystem can enact to support integrating e-mobility options into Ghana's transportation sector. It is clear that the appetite for EVs in Ghana is growing as awareness of their benefits increases, perceptions change, and EV infrastructure develops and strengthens. The Ghanaian government and e-mobility ecosystem should be prepared to implement targeted policies and initiatives that foster collaboration among stakeholders, streamline regulatory frameworks, and promote investment in EV technologies. This will create a conducive environment for the widespread adoption of EVs.

Key Recommendations

To scale up and integrate e-mobility solutions in Ghana's transportation sector, several recommendations have emerged:

- **Develop a Unified Policy Framework:** To create a cohesive regulatory environment that supports the growth of e-mobility, a strong policy foundation is needed. Currently, the key policies influencing e-mobility—namely the Electric Vehicle Policy, Ghana Automotive Development Policy, and Customs Act—lack integration and do not effectively communicate with one another. This limits the effectiveness and their ability to provide the strong regulatory network needed for a strong e-mobility sector in Ghana.

Action Needed: To rectify this, the relevant Ghanaian government authorities-Ministry of Transport, Ministry of Trade, Ministry of Finance, and should integrate the Electric Vehicle Policy, Ghana Automotive Development Policy, and Customs Act to eliminate inconsistencies. This should encompass the inclusion of two-wheel vehicles in the definition of automotive in Ghana's automotive laws, defining "electric vehicles" in the Customs Act, and specifying tax schedules for two- and three-wheeled vehicles. Additionally, policy frameworks should include standardisation of EV regulations, to establish clear standards for electric vehicles in Ghana. This will create a more structured environment for the industry to thrive.

- **Support Participation of Domestic Original Equipment Manufacturers (OEMs):** To promote local manufacturing and competitiveness in the automotive sector, domestic OEMs must be integrated into Ghana's automotive policy frameworks. It is currently not possible for domestic OEMs to join the Automotive Association of Ghana, they must have a partnership with or are an international OEM.

Action Needed: To solve this, the Ghana Automotive Development Policy should be amended to allow domestic OEMs to join the Automotive Association without requiring international partnerships. This change would empower local manufacturers to contribute to the automotive landscape.

- **Establish Comprehensive Intellectual Property Protections:** Protecting intellectual property in our local market poses significant barriers, often making it necessary to pursue filings in other jurisdictions. To protect local innovations and facilitate domestic manufacturing, IP protections must be enacted.

Action Needed: The Ministry of Justice should streamline the process for filing patents and trademarks in Ghana, ensuring local companies can safeguard their designs and technologies. Securing these protections will enable EV companies to retain ownership of licensing rights to their vehicles.

- **Revise Electricity Pricing Policies:** To promote greater accessibility for electric vehicle (EV) usage, the price of electricity should be affordable.

Action Needed: EV companies and organisations in the e-mobility ecosystem can advocate with the Energy Commision and the Public Utilities Regulatory Commission for reductions in electricity tariffs, particularly for EV charging stations. This will help encourage widespread adoption by lowering operational costs for both consumers and businesses.

- **Public Awareness Campaigns:** EV companies, and other key actors in the e-mobility space such as Ghana Climate Innovation Centre and the Renewable Energy Association of Ghana should create targeted awareness campaigns and educational programs that emphasise the environmental and economic benefits of EVs, especially electric cargo bikes.

Action Needed: These initiatives should include mass education efforts through activations, radio interviews, and community engagement, ensuring that the information is accessible in local languages to effectively reach the masses. Additionally, develop outreach programs for children and youth to educate them about the benefits of electric vehicles, so they are motivated to use EVs when they come of age. This can be done through partnering with primary, JSS, SHS, and tertiary institutions.

- **Implement Tax Incentives for EV Adoption:** To stimulate investment in the EV sector and support local manufacturers, it is crucial to address the current definition of two-wheelers in the automotive policy which excludes tax concessions for EV producers and makers of two-wheel vehicles. EV companies, especially companies that focus on two- and three-wheel vehicles, pay high taxes on component shipments. This undermines investor confidence which can prevent EV companies from getting the needed capital to support their business.

Action Needed: Introducing tax exemptions for electric vehicle components, reducing VAT on EV sales, and having an automotive policy that includes two-and three-wheel vehicles are essential for fostering an environment conducive to local innovation and growth in the e-mobility sector.

Conclusion

The e-cargo bikes "Made in Ghana" project has demonstrated the importance of e-vehicles in Ghana. strength of the ecosystem, circular economy, and appetite for EVs in Ghana. It also shed light on the EV space on the continent as EV companies in Ghana are expanding across Africa, strengthening the e-mobility ecosystem across the continent. The project was able to scale and expand to different countries, which further shows that there is a strong market for e-mobility options across the continent.

The project has made a significant impact in the e-mobility sector and ecosystem by highlighting the challenges that make it difficult for the sector to thrive and then offering solutions, such as creating a PV swapping station to increase the swapping station network in Accra that is vital for a robust e-mobility sector. The lessons learned from developing the prototypes can provide valuable insights for other companies within the ecosystem. The project also highlighted the importance of developing strong partnerships. From creating partnerships with e-commerce, food delivery, and ride-hailing companies to partnering with academic institutions to expose students to the e-mobility space, this project demonstrated the value of using a collaborative approach to strengthen the e-mobility sector and foster innovation.

The economic impact of the project demonstrates that e-bikes are beneficial both for the environment and for the financial well-being of consumers and companies. Eliminating fuel costs benefits riders by increasing their disposable income and raises company profits. Additionally, offering innovative financing options will make e-bikes and other e-vehicles more accessible, increasing demand and contributing to lower GHG emissions in the transport sector.

The project also demonstrated the ability of the e-mobility sector to create jobs, which provides both social and economic benefits to Ghanaians. Also demonstrated the importance of increasing awareness of e-vehicles so people know they are an option. Increased awareness about EVs and their benefits, combined with affordable financing options, will also elevate demand and increase e-vehicle usage. The project also identified numerous opportunities to involve women throughout the entire e-mobility supply chain. By acquiring the necessary skills, women can secure jobs in this sector and improve their livelihoods. Government policies and initiatives at both local and national levels in Ghana demonstrate a strong commitment to climate action, the use of green energy to create jobs, and the enhancement of sustainability in the country. Since e-mobility is in its nascent stages in Ghana, there are many opportunities for growth and development. Stakeholders across all sectors have a unique opportunity to lay the foundation to solidify a sector that has the opportunity to bring immense positive change to the Ghanaian environment and economy. By establishing a supportive social, political, and economic environment for the sector, its growth and impact will be enhanced, positioning Ghana a leader in the e-mobility space on the African continent and around the world.

References

Accra Metropolitan Assembly (AMA). (2023, August 2). AMA launches Youth Climate Action Fund; calls for proposals. Retrieved from https://www.ama.gov.gh/news-details.php?n=NnNyODFuOHI2MXIyNTI5bzlubjluNHFyNDM0OTJwMHA1NjVybjExcw==

Action Net Zero. (n.d.). E-cargo bikes for businesses. Retrieved from https://www.actionnetzero.org/guides-and-tools/e-cargo-bikes-for-businessess/

Bertelsmann Stiftung. (2024). Country report 2024: Ghana. Retrieved from https://bti-project.org/fileadmin/api/content/en/downloads/reports/country_report_2024_GHA.pdf

BusinessDay. (2023, December 15). Electric vehicle assembly to start in Nigeria in January 2024. Retrieved from https://businessday.ng/energy/article/electric-vehicle-assembly-to-start-in-nigeria-in-january-2024/

Cambridge Institute for Sustainability Leadership. (n.d.). COP (Conference of the Parties). Retrieved from https://www.cisl.cam.ac.uk/cop-climate-change-conference#:~:text=COP%20stands%20for%20Conference%20of,international%20meeting%20focusing%20on%20climate.

C40 Cities Climate Leadership Group. (n.d.). About C40. Retrieved from https://www.c40.org/about-c40/

CleanTechnica. (2023). Made in Ghana: E-cargo bikes programme plans to accelerate climate-friendly mobility solutions and employment opportunities. Retrieved from https://cleantechnica.com/2023/06/24/made-in-ghana-e-cargo-bikes-programme-plans-to-accelerate-climate-friendly-mobility-solutions-employment-opportunities/

Ellen MacArthur Foundation. (n.d.). Circular economy: Introduction. Retrieved from https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

Ghana News Agency. (2023, July 25). 3.2 million vehicles registered in Ghana as at 2022 – Transport Minister. Retrieved from https://gna.org.gh/2023/07/3-2-million-vehicles-registered-in-ghana-as-at-2022-transport-minister/

Ghana Statistical Service. (n.d.). Greater Accra regional population. Retrieved September 27, 2024, from https://www.statsghana.gov.gh/regionalpopulation.php?population=MTM0NTk2MjQzOS4yMDE1&&Greater%20Accra&regid=3

Energy Commission Ghana. (2022). Ghana Electric Vehicles Baseline Survey. Retrieved from https://www.energycom.gov.gh/files/BASELINE%20SURVEY%20REPORT%20online.pdf

Ghana Statistical Service. (2023). Quarterly labour statistics bulletin. https://statsghana.gov.gh/gssmain/fileUpload/pressrelease/2023_Quarter_Labour_Statistics_Bulletin_full_report.pdf

Ghana Web. (2023, May 10). Fuel prices significantly affecting the cost of living. Retrieved from https://www.ghanaweb.com/GhanaHomePage/business/Fuel-prices-significantly-affecting-the-cost-of-living-1938920#:~:text=The%20period%20from%202016%20to,GHS%20per%20gallon%20in%202024.

Happy Eco News. (2024). Made in Ghana: Accelerate decarbonization. Retrieved from https://happyeconews.com/made-in-ghana-accelerate-decarbonization/

International Climate Initiative. (n.d.). Electric cargo bikes made in Ghana: Contributing to the transformation of Ghana's transportation. Retrieved from https://www.international-climate-initiative.com/en/project/electric-cargo-bikes-made-in-ghana-contributing-to-the-transformation-of-ghanas-transportation-img2020-i-005-gha-cargo-e-bikes-made-in-ghana/

International Monetary Fund (IMF). (n.d.). Ghana: Questions and answers. Retrieved from https://www.imf.org/en/Countries/GHA/ghana-qandas

ScienceDirect. (2022). [Title of the article]. Retrieved from https://www.sciencedirect.com/science/article/pii/S2590198222001658

Siemens Stiftung. (n.d.). Electric cargo bikes made in Ghana. Retrieved from https://www.siemens-stiftung.org/en/projects/electric-cargo-bikes-made-in-ghana/

References

Siemens Stiftung. (n.d.). eMobility in Ghana: E-cargo bikes empowering people network. Retrieved from https://empowering-people-network.siemens-stiftung.org/emobility-in-ghana-e-cargo-bikes-empowering-people-network/

Statista. (2023). Quick commerce: Grocery delivery and online food delivery in Ghana. Retrieved from https://www.statista.com/outlook/emo/online-food-delivery/grocery-delivery/quick-commerce/ghana#users

Statista. (2023). Weekly gasoline prices in Ghana. Retrieved from https://www.statista.com/statistics/1200108/weekly-gasoline-prices-in-ghana/

The Conversation. (2023, April 5). How dirty old used cars from the US and Europe carry on polluting in Africa. Retrieved from https://theconversation.com/how-dirty-old-used-cars-from-the-us-and-europe-carry-on-polluting-in-africa-podcast-204153#:~:text=%E2%80%9CBetween%202015%20and%202018%20some,to%2090%20are%20used%20vehicles.%E2%80%9D

The Conversation. (2023, May 16). Ghana is behind the curve on climate change laws: Expert suggests a way to get corporations on board. Retrieved from https://theconversation.com/ghana-is-behind-the-curve-on-climate-change-laws-expert-suggests-a-way-to-get-corporations-on-board-218612

Trade.gov. (n.d.). Ghana: Automotive sector. Retrieved from https://www.trade.gov/country-commercial-guides/ghana-automotive-sector

United Nations Development Programme (UNDP). (n.d.). Environment and Climate Change in Ghana Policy Brief. Retrieved from https://www.undp.org/sites/g/files/zskgke326/files/migration/gh/e579ff4c8c129655c9f072d935069db49b04837ad192810ad872caa27658a36b.pdf

United Nations Development Programme (UNDP). (n.d.). NDCs (Nationally Determined Contributions) for climate change: What you need to know. Retrieved from https://climatepromise.undp.org/news-and-stories/NDCs-nationally-determined-contributions-climate-change-what-you-need-to-know

United Nations Environment Programme Copenhagen Climate Centre (UNEP). (2022.). National electric mobility roadmap in Ghana. Retrieved from https://unepccc.org/publications/national-electric-mobility-roadmap-in-ghana/

United Nations Framework Convention on Climate Change (UNFCCC). (n.d.). The Paris Agreement. Retrieved from https://unfccc.int/process-and-meetings/the-paris-agreement

United Nations Framework Convention on Climate Change (UNFCCC). (2022). Greenhouse gases inventory: Ghana. Retrieved from https://unfccc.int/sites/default/files/resource/gh_nir5_15052022_final.pdf

United Nations Framework Convention on Climate Change (UNFCCC). (2024). Fourth biennial update report of Ghana. Retrieved from https://unfccc.int/sites/default/files/resource/gh_BUR4_UNFCCC_submission_02032024.pdf

World Bank. (n.d.). Ghana overview. Retrieved from https://www.worldbank.org/en/country/ghana/overview

Electric Cargo Bikes “Made in Ghana”


IMPACT HUB Accra
RECEPTION
1
IKI
INTERNATIONAL CLIMATE INITIATIVE
SPEEDSTER
SPEEDSTER TECHNOLOGIES