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Local Manufacturing and Commercial Viability of Electric Cargo Bicycles in Kenya

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KAZZI

Kazzi Africa is a Kenyan company dedicated to transforming last-mile transport and everyday logistics through sustainable, locally manufactured electric cargo bicycles. By fusing indigenous design and ingenuity, Kazzi Africa provides affordable, reliable transport alternatives in Kenya. The organization is committed to empowering local communities and spearheading clean mobility solutions for a resilient and sustainable future.

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Table of Contents

1. Executive Summary
2. Introduction
2.1 Study Objectives
2.2 Report Structure

3. Methodology
3.1 Stage 1: Market and Needs Assessment
3.2 Stage 2: Product Development, Testing and Pilot Deployment
3.2.1 Test Ride Protocol
3.2.2 Commercial Pilot Design
3.2.3 Data Collection
3.2.4 Performance Indicators

4. Manufacturing Approach
4.1 Local Frame and Component Manufacturing
4.2 Research on Last-Mile Cargo Solutions and Accessories
4.2.1 3D Printing
4.2.2 Plastic Injection Moulding
4.2.2.1 Post-Consumer Recyclates
4.2.2.2 Recycled HDPE and Injection Moulding Economics
4.2.3 Metal Fabrication
4.3 Local Battery Assembly and Charging Solutions

5. Bicycle Performance and User Acceptability
5.1 Performance Under Intended Operating Conditions
5.1.1 Range and Battery Performance
5.1.2 Cargo Capacity and Stability
5.1.3 Handling, Terrain and Rider Experience
5.1.4 Reliability
5.2 Design Response to Performance Findings
5.3 Field Validation

6. Business Model Findings
6.1 Asset Financing Pilot
6.2 Embedded Rider Pilot
6.3 Commercial Lease Pilot
6.4 Fleet Dispatch Partnership
6.5 Fleet Leasing Partnership Pilot
6.6 Cross-Pilot Analysis

7. Financial Analysis
- 7.1 Cost Comparison: Locally Manufactured versus Imported Frame Sets
- 7.2 Competitor Market Assessment
- 7.3 Financial Modelling Assumptions and Baseline Parameters
- 7.4 Asset Financing Model
- 7.5 Fleet Dispatch Model
- 7.6 Lease-to-Own Model

8. Summary of Findings
- 8.1 Manufacturing Strategy and Learnings
- 8.2 Business Model Pilots: Strategy and Learnings

9. Impact
- 9.1 Social Impact
- 9.2 Economic Impact
- 9.3 Environmental Impact
- 9.4 Consistency of Pilot Evidence with the Stage 1 Market Assessment
- 9.5 Summary

10. Conclusions and Recommendations

1. Executive Summary

1
Executive Summary



This study presents the findings of a study undertaken by Kazzi Africa in partnership with Siemens Stiftung to develop, optimize and test locally manufactured electric cargo bicycles for sustainable transport in Kenya. The study was conducted in two stages: a market and needs assessment, followed by product development, technical optimization and commercial business model piloting.

The market assessment identified affordability and battery range as the two primary factors influencing adoption of electric cargo bicycles. Respondents indicated a preferred purchase price of KES 50,000–65,000, while 99% supported local manufacturing, citing potential benefits including lower purchase and spare-part costs and local job creation. These findings informed the subsequent product development and commercialisation work.

The product development process resulted in 15 electric cargo bicycle prototypes across two design iterations. Field testing identified strengths in handling, braking, comfort and suitability for last-mile delivery, while also highlighting areas for improvement, particularly drivetrain reliability and battery management. These findings informed the second design iteration and demonstrated the value of iterative product development based on field use and user feedback. Twelve bicycles were subsequently deployed across five commercial pilots, covering different user groups and operating models. Across the pilots, the bicycles travelled approximately 16,254 kilometres under real-world operating conditions. Fleet-based models recorded higher utilisation compared

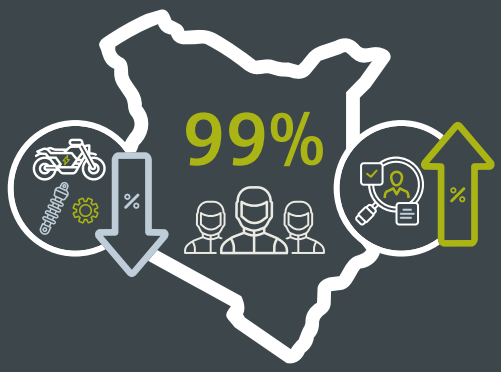
Ideal purchase price



KES 50,000 TO KES 65,000

to the embedded rider and commercial lease models.

The financial analysis indicates that local frame fabrication can be broadly cost-competitive with imported components at the production volumes assessed. The locally manufactured frame set cost approximately KES 26,680 per unit including VAT, compared with KES 28,048 for the equivalent imported frame set, a difference of approximately 5%. While this represents a modest cost difference at current volumes, local production offers potential advantages in supply-chain responsiveness, repair and servicing, and design iteration. Critical components, including motors and batteries, remain imported.



supported local manufacturing, citing potential benefits including lower purchase and spare-part costs and local job creation

The study also demonstrated the feasibility of local frame fabrication, complete bicycle assembly and local battery pack assembly. Alternative manufacturing approaches, including 3D printing, recycled plastics and injection moulding, were assessed but require different production volumes and cost structures. The findings therefore support a gradual expansion of local manufacturing capacity, with production methods selected according to component requirements and expected scale.

The evidence demonstrates the technical viability of electric cargo bicycles for last-mile delivery under the operating conditions tested. Wider deployment will depend on addressing commercial constraints, including product and cost optimisation, access to suitable financing, predictable delivery demand, appropriate fleet partnerships and the development of local manufacturing capacity.



2. Introduction

2 Introduction



Electric mobility is increasingly recognised as a key pathway towards sustainable transport in Kenya, where the transport sector contributes approximately 20% of the country's greenhouse gas (GHG) emissions. Through its Nationally Determined Contributions (NDCs), Kenya has committed to reducing GHG emissions by 32% by 2030. In recent years, Kenya's electric mobility sector has experienced significant growth, with approximately 35,000 electric vehicles registered by mid-2026, compared to fewer than 5,000 in 2024. This rapid expansion reflects growing confidence in electric mobility and creates opportunities for locally manufactured transport solutions that address Kenya's unique mobility needs.

Ridelectric Mobility Limited, operating under the brand Kazzi Africa, is a Kenyan company focused on the design, manufacture and assembly of electric cargo bicycles tailored to the Kenyan market. The Kazzi electric cargo bicycle was developed specifically for last-mile logistics, taking into account local terrain, rider requirements and the realities of operating small businesses in Kenya. The study therefore sought to evaluate the technical performance of the bicycle and to assess whether local manufacturing can improve affordability, strengthen local supply chains and support the growth of an electric cargo bicycle industry in Kenya.

The study was designed in two stages. The first stage, a market and needs assessment examined transport patterns, income dynamics, financing gaps and attitudes towards electric mobility among end users, fleet operators and financial institutions. The second stage, which forms the core of this report, focused on the development, optimization and real-world validation of a locally

manufactured electric cargo bicycle. The overall objective of the study was to evaluate the acceptability and affordability of a locally developed, tested and optimized electric cargo bicycle, while assessing the viability of local production in Kenya.

The specific objectives were to:

1. Assess the user acceptability of locally developed electric cargo bicycles.



2. Determine affordability by piloting different business models for various user and customer groups.



3. Evaluate the social and economic impacts, including changes in user income, together with the environmental impact through estimated carbon dioxide (CO_2) emissions avoided.





This study documents the iterative development of the Kazzi Africa electric cargo bicycle, presents findings from field testing, evaluates pilot deployments across five partner organizations, assesses business model viability and affordability, and discusses the opportunities and challenges associated with scaling locally manufactured electric cargo bicycles in Kenya.

3. Methodology

3.1 Stage 1: Market and Needs Assessment

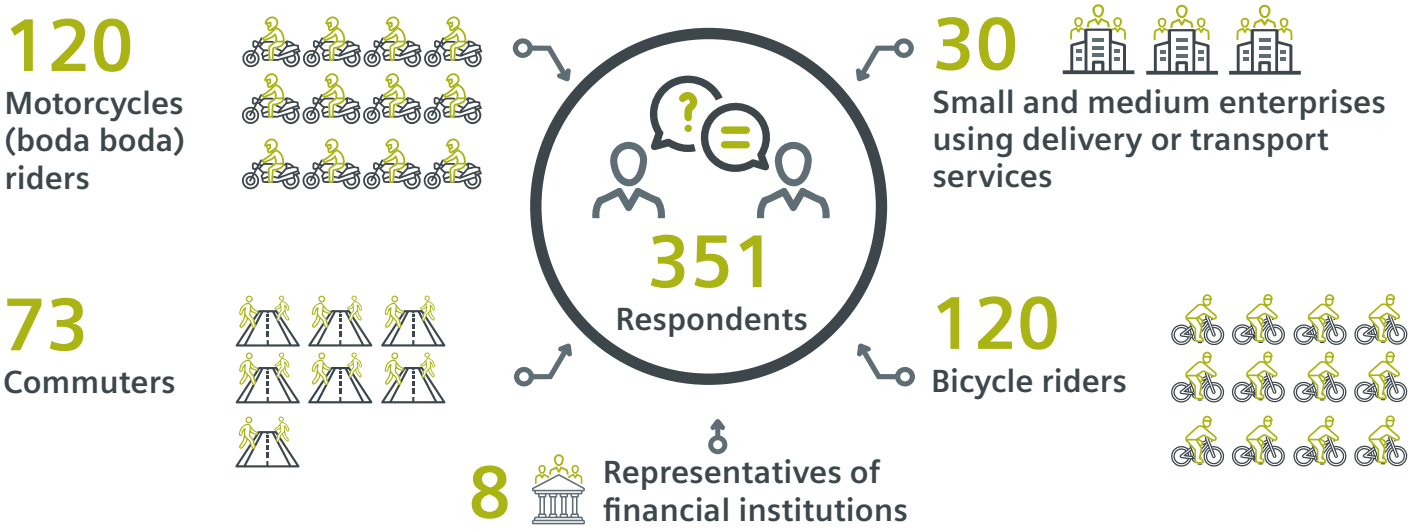
The first stage of the study assessed the market readiness of electric cargo bicycles in Kenya through three analytical lenses:

- Affordability, including the financial feasibility of ownership and associated costs such as purchase price and maintenance.
- Acceptability, including perceptions, safety confidence and willingness to use electric cargo bicycles in place of existing transport modes.
- Adoptability, including the practical conditions required to integrate electric bicycles into daily operations, such as infrastructure, usage patterns and support systems.

A total of 351 respondents were engaged: 120 motorcycle (boda boda) riders, 120 bicycle riders, 30 small and medium enterprises using delivery or transport services, 73 commuters and 8 representatives of financial institutions, including banks, microfinance institutions and credit financiers. A review of competitor offerings in the Kenyan market was conducted alongside the primary research and informs the competitor market assessment presented in Chapter 7.

Purposive sampling was used to target. individuals and organizations with direct relevance to e-mobility. The majority of responses were collected in Nairobi County, with additional participants reached in Kiambu, Ngong and Thika.

Data was collected through structured questionnaires administered in person and online, complemented by in-depth interviews with selected respondents from each target group. Interviews explored financing behaviour, user experience and barriers to adoption in greater depth. Thematic analysis was applied to qualitative responses, while descriptive statistics were used to summarise quantitative data.



3.2
Stage 2: Product Development, Testing and Pilot Deployment

The second stage covered prototype development, iterative product refinement, controlled test rides and commercial field deployment

Two versions of the bicycle were developed in sequence, with the testing and deployment of the first version (V1) generating the evidence base for the design of the second version (V2). The same testing protocol was applied to both versions, allowing performance to be compared consistently across the two design iterations.

3.2.1
Test Ride Protocol



Standardized test ride protocols were used to ensure consistent evaluation of bicycle performance throughout the study. Each test ride logged the circuit, distance travelled, battery state of charge at start and end, payload and cargo type, road and terrain conditions, motor assistance level, rider effort and comfort ratings, GPS tracks, tyre pressure and gear configuration, and the mechanical condition of the bicycle before and after the ride. Five dedicated test circuits were developed to evaluate different aspects of bicycle performance under representative operating conditions:

Test Circuit	Distance	Purpose
Kazzi Test Loop	29km	Mixed Terrain Performance Evaluation
Kazzi Hilly Loop	14km	Uphill ability and battery performance on steep gradients
Kazzi Quick Loop	4.7km	Validation following engineering modification
Kazzi Off-road Loop	7km	Performance on rough and unpaved surfaces
The commute	23km	Urban commuting and commercial delivery simulation.

The use of standardized routes ensured that bicycle performance could be compared consistently throughout the testing programme.

3.2.2 Commercial Pilot Design



Twelve bicycles were deployed with five partner organisations, with each partnership structured to test a distinct commercialisation pathway: asset financing through a financial institution, an embedded rider arrangement, a commercial lease, a fleet dispatch partnership and a fleet leasing partnership.The design enabled comparison of individual-facing and business-to-business deployment models against the affordability and financing findings from Stage 1.

3.2.3 Data Collection

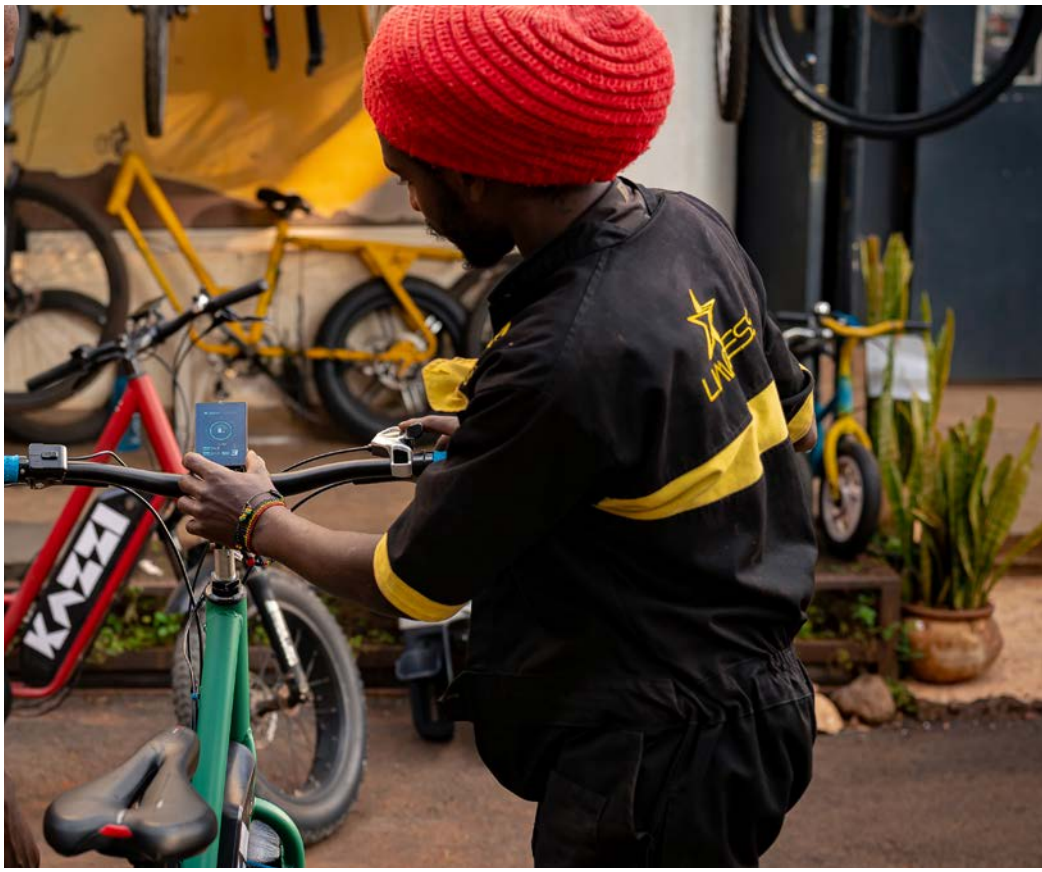
Data was collected throughout product testing and the commercial pilots using multiple complementary tools. Technical performance data were obtained from structured test ride reports documenting battery performance, distance travelled, payload, terrain, ride quality and component performance.

Operational data was collected through daily rider feedback forms, mileage tracking logs and battery charging records. Riders recorded the number of deliveries completed, distance travelled, revenue generated, charging frequency, maintenance activities and operational challenges encountered during the pilot. Loan repayment records were also monitored for bicycles deployed under financing arrangements.

Qualitative feedback was gathered through structured feedback forms, semi-structured interviews, direct communication with riders and observation during servicing and maintenance activities. These methods provided additional insight into rider experience, usability and operational challenges.

3.2.4 Performance Indicators

The study evaluated the bicycles using technical, operational and user-centred performance indicators. Technical indicators included battery efficiency, range, payload capacity, braking performance, ride comfort, terrain adaptability, component reliability and maintenance requirements. Operational indicators included distance travelled, deliveries completed, charging frequency, bicycle utilisation and operating costs. User-centred indicators focused on rider comfort, ease of use, perceived safety, overall satisfaction and suitability for commercial operations.



4. Manufucturing Approach

4.1 Developing the Bicycle Frame and Parts with a Local manufacturer



Steel components, including the frame and other structural parts, were fabricated locally through a third-party manufacturer. The locally fabricated components included the frame, controller box, fork assembly, stand, dropouts and mudguard. Motors, batteries, controllers and other mechanical components were imported, while final bicycle assembly was undertaken locally by experienced technicians.

The locally fabricated components were assessed through prototype development and subsequent field deployment. The process demonstrated the feasibility of producing the main steel structural components locally while also identifying challenges associated with production lead times, design changes and the management of intellectual property.

The experience also indicated that local fabrication can support closer integration between product development and manufacturing. However, the suitability of the manufacturing arrangement for larger-scale production would depend on factors including production volumes, supplier capacity, quality control, lead times and the ability to accommodate further design iterations.

4.2
Research of Last-Mile Cargo Solutions & Accessories

The study assessed different approaches for locally producing cargo-related components and accessories for the electric cargo bicycle. Metal fabrication, 3D printing and recycled plastics were considered for components including the controller box, mudguards, seat post sleeve, carriers and phone holder. The assessment considered the potential to increase local fabrication, reduce component weight and improve the sustainability of production.

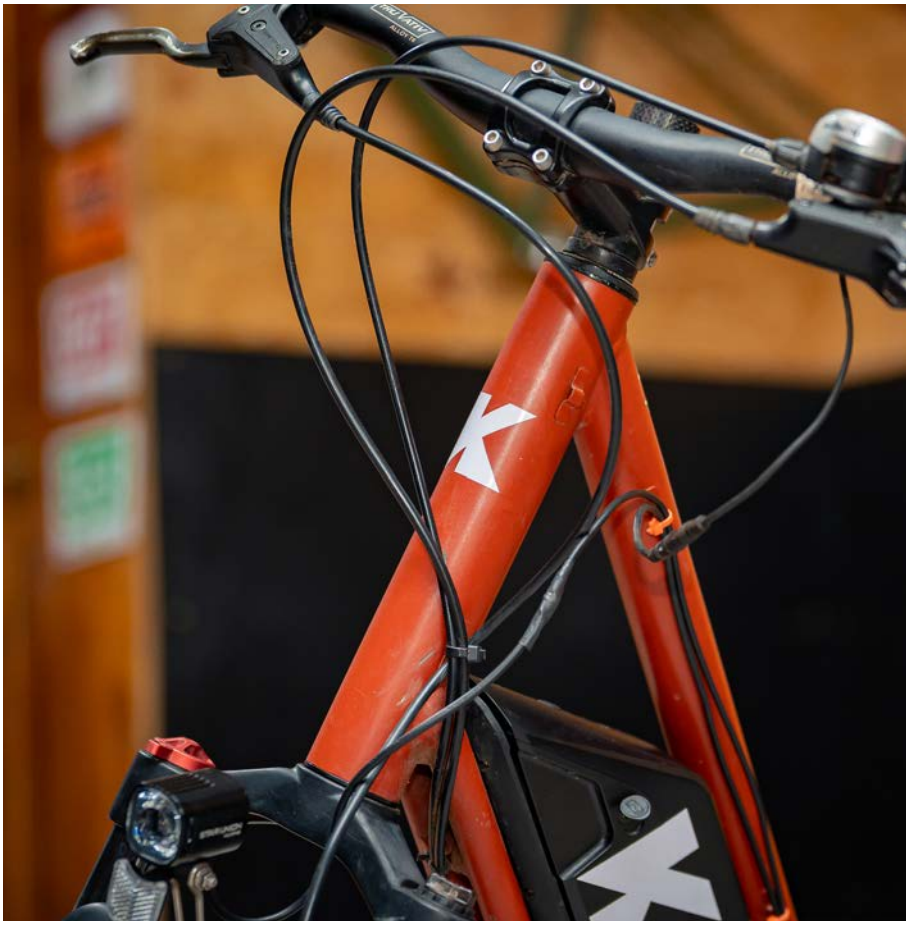
4.2.1
3D Printing

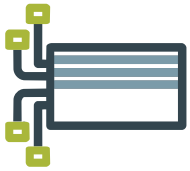
The feasibility of additive manufacturing was assessed through engagement with a local company specialising in industrial 3D printing and product prototyping. The assessment considered which bicycle components could be produced using 3D printing and whether the approach could support prototype development, product iteration and low-volume manufacturing.

Four components were identified as suitable for 3D printing during the prototype development phase: controller boxes, mudguards, seat post sleeves and phone holders.

The assessment confirmed the technical feasibility of producing these components through 3D printing. However, the relatively high unit costs limited the economic viability of the approach for commercial-scale production. Components exposed to significant structural loads, particularly cargo carriers, also presented potential mechanical-strength limitations when produced using conventional 3D-printing materials.

Alternative designs were therefore considered for selected components:





Controller box: Replace the 3D-printed enclosure with commercially available, locally manufactured plastic containers, which would improve durability while reducing production costs.



Front and rear carriers: Replace welded cage structures with a flat-sheet carrier design incorporating four to six mounting points. Durable plastic containers could then be securely attached using nylon lock nuts, simplifying manufacturing while increasing flexibility.



Side panniers: Replace cylindrical designs with rectangular or square configurations using a corrugated mild-steel base, aluminium-profile supports and perforated sheet-metal sides. This would reduce weight while maintaining structural integrity. Removable rubber inserts could be incorporated to improve cargo retention for smaller or irregularly shaped items.

4.2.2 Plastic Injection Moulding

Injection moulding was assessed as an alternative approach for producing selected plastic components at higher production volumes. The assessment considered its potential application to the mudguard, controller box, carriers and pannier boxes, particularly where repeatable production and lower unit costs could justify the required tooling investment.

The approach was considered more appropriate for higher-volume production than for the prototype and early commercial volumes assessed during the study. Its economic suitability therefore depended substantially on the expected production volume and the ability to spread tooling costs across a sufficiently large number of units.



4.2.2.1 Post-Consumer Recyclates



The study also explored the use of recycled hard plastics for components including the mudguard, controller box and carrier boxes, with the aim of reducing component weight and increasing the use of recycled materials in production.

A local plastics recycler was considered as a potential source of post-consumer recyclate. The recycler processes post-consumer plastic for use as a substitute for virgin plastic in packaging applications, including bottles and containers for fast-moving consumer goods.

The assessment found that the available packaging-grade recyclate was not suitable for the structural requirements of the cargo carrier and mudguard. The material did not provide the required combination of stiffness, strength and chemical compatibility, making HDPE a more suitable material for these components.

4.2.2.2 Recycled HDPE and Injection Moulding Economics

The availability and suitability of recycled HDPE were subsequently assessed with an established plastics manufacturer. The manufacturer confirmed that the proposed components could be produced using recycled HDPE. However, each component would require a dedicated injection mould, with an estimated cost of approximately USD 15,000 per mould.

At the production volumes considered in the study, this tooling requirement made injection moulding economically unviable. The manufacturer confirmed that the proposed components could be produced using recycled HDPE; however, each component would require a dedicated injection mould costing approximately USD 15,000, making the approach economically unviable at current production volumes. The manufacturer therefore recommended starting with metal fabrication and transitioning to injection moulding once production reaches several hundred units, at which point the mould investment could be amortised across a larger production volume.



4.2.3 Metal Fabrication



Following the assessment of alternative materials and manufacturing processes, metal fabrication was identified as the near-term approach for heavy-load cargo components. The proposed designs replace conventional heavy welded cage structures with lighter, modular configurations.

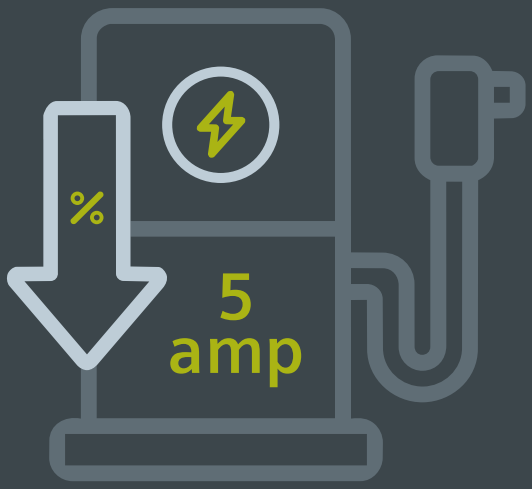
Due to the compressed project timeline, the custom metal carriers were not physically fabricated during the pilot phase. Instead, the flat-sheet, multi-point carrier and lightweight pannier designs were established as the preferred direction for the next development cycle.

This approach is intended to simplify fabrication while maintaining the structural requirements of cargo-carrying applications. Further physical testing would be required to validate the proposed designs under commercial operating conditions.

4.3 Local Battery Assembly and Charging Solutions

The feasibility of local battery assembly was assessed through the production and field testing of two battery units. These were assembled by a local battery enterprise that specialises in the repair and maintenance of electric bicycles, scooters and wheelchairs. The cells, battery management systems (BMS) and protective enclosures were sourced from local suppliers, with final assembly completed entirely within the enterprise's workshop. During field trials, these units matched the operational range of standard imported batteries, demonstrating that local battery assembly is technically viable in Kenya. The initial assembly cost was also comparable to that of imported alternatives. The assessment indicates that unit costs could decrease as production volumes increase, although the scale of this potential reduction was not established through the study. Extended observation and further testing would also be required to assess durability, reliability and quality over the full operational lifecycle.

To improve turnaround times, the team sourced 5-amp fast chargers locally, which initially reduced charging times significantly.



The study also assessed charging requirements during longer delivery days. Higher-utilisation riders reported daily distances that could approach the practical limits of a single charge. Locally sourced 5-amp fast chargers were therefore tested as a means of reducing charging time and improving operational turnaround.

The fast chargers initially reduced charging times significantly. However, charging complications subsequently occurred, which the assessment attributed to low charger quality. The experience highlights the importance of charger quality, battery–charger compatibility and appropriate quality-control procedures when introducing faster charging solutions.

The findings provide initial evidence for local battery assembly, while further testing and quality assurance would be required before assessing its suitability for larger-scale deployment.

5. Bicycle Performance and User Acceptability

5.1 Initial Design and Testing: Initial Prototype Testing



Five V1 units were manufactured and subjected to intensive testing by a standard test rider across multiple test circuits and real-world conditions. Testing included range tests, load tests, depletion tests, commute simulations and off-road evaluations. Two V1 bicycles were retained during the development period as physical reference benchmarks to maintain structural precision, alignment and quality control during manufacturing runs.

5.1.1 Range and Battery Performance

Range was measured as the distance achieved on a single full charge, segmented by motor assistance mode. Range tests carried a rider only (60 kg) with no additional cargo, to isolate the battery and drivetrain variables.

Motor-assistance mode	Range per charge (km)	Test condition
Eco	48 – 97.5 (mean 70)	Mixed-terrain testing
Mixed effort	52 – 65 (mean 59)	Uphill and battery testing
Full / high assist	48 – 59	Post-modification validation

Range testing showed that battery performance varied according to motor-assistance level and operating conditions. Under mixed-use conditions, the bicycle typically achieved 50–70 km per charge. Battery depletion increased below 25% state of charge, while the 500 W motor configuration was observed to use less energy than the 750 W configuration.

5.1.2 Load Capacity and Structural Stability

Load tests measured how the bicycle handled increasing rear-rack payloads. All figures are total system load (rider 60 kg plus cargo), since the rider is always present. The relevant outputs are handling stability and component failure mode, not range; distance is shown only to indicate exposure under load.

Total load (kg)	Cargo (kg)	Load type	Total km under load	Dominant observation
100	40	Construction stones	56	Severe vibration (rider arm numbness); pedals loosened; headset bearing wear
115	55	Water	26	Front-wheel instability — loss of single-handed control with rear-rack load
120	60	Water	16	Functional; upper limit of stable handling
125	65	Water	126	Chain breakage; display damage
135	75	Water	57	Stable handling; drivetrain stress evident
145	85	Water	53	Chain breakage (rider self-repaired in field)

The working payload ceiling was

60 Kg
of cargo



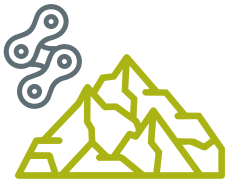
120 Kg
Total system load including rider

The working payload ceiling was 60 kg of cargo (120 kg total system load including rider). Below this, the bicycle was stable and rideable. Above it, two failure modes dominated: drivetrain failure (chain breakage under sustained load) and steering-geometry instability (front-wheel lift and loss of control as rear load increased). These were the primary structural targets addressed in the V2 update.



Commute and real-world usability

Daily commute simulations tested the bicycle as a practical last-mile vehicle under Nairobi conditions. Across 28 commute rides, riders typically covered 24–29 km in 48 to 70 minutes carrying total loads of 67–77 kg, with a mean ride comfort rating of 3.5 out of 5. The bicycle performed consistently and reliably as a daily commuter. Recurring usability observations were saddle comfort, total bicycle weight (35–40 kg, difficult to carry upstairs) and puncture frequency.



Terrain and tuning

On the off-road loop, ride comfort was initially rated 2 out of 5, with the chain dropping from the crank on rough surfaces. Tyre-pressure tuning to 15 PSI rear and 12 PSI front resolved the chain drop and lifted comfort to 5 out of 5. This was the single clearest cause-and-effect result in the test programme, eliminating the most frequent field fault at zero component cost.



Component durability — field failure frequency

Across all 82 rides, the following components generated the most recurring fault reports. This ranking is drawn directly from field notes and prioritises the engineering backlog according to real-world evidence.

Rank	Component	Incidents	Typical failure
1	Chain / drivetrain	13	Breakage under load, drop off-road, self-tensioning after gear shift
2	Headset / steerer / stem	9	Rattling, bearing wear, stem loosening
3	Crank	5	Loosening, noise
3	Brakes	5	Caliper positioning, accelerated pad wear
3	Fork / suspension	5	fork deterioration; later hydralic-suspension fork rated 5/5
6	Rear wheel / spokes	3	Wobble from uneven spoke tension under load
6	Tyres	3	Puncture cluster (bike #3)

The chain and headset together accounted for the majority of field faults and were the two highest-priority reliability targets carried into V2.

5.2.2 Key Findings from V1 Performance Testing

The V1 testing programme produced findings in three areas: the bicycle's core performance envelope, configuration and tuning insights, and design weaknesses requiring correction. Together these defined the engineering priorities for the second version.



Performance envelope

- Typical range of 50–70 km under mixed usage conditions on one full charge, with a maximum of 97.5 km achieved on one charge (6 hours 28 minutes).
- Battery depletion rate increased below 25% charge, requiring rider awareness on longer routes.
- Loads up to 60 kg of cargo demonstrated optimal performance; beyond 75 kg, stability and drivetrain stress became critical.



Configuration and tuning insights

- Tyre pressure optimization (15 PSI rear, 12 PSI front) significantly improved comfort and reduced chain drop frequency.
- The single-speed configuration (16T with 44T chainring) proved reliable on flat terrain, while the 6-speed configuration (14–28T) provided welcome adjustment for rider comfort in hilly terrain.
- The addition of a suspension fork improved ride comfort on rough roads, rated 5/5 by the test rider.
- The 500 W motor was more energy-efficient than the 750 W motor.



Design weaknesses identified

- Chain tension issues leading to broken chains under load.
- Headset bearing wear and rattling sounds from the steerer tube.
- Rear wheel wobble due to uneven spoke tension, affecting stability under load.
- Brake caliper positioning requiring adjustment for optimal performance.
- Side stand inadequate for maintaining stability with loaded cargo.
- Fork condition deterioration under sustained use.



5.2.3
V2: Iterative Improvements

Based on the V1 findings, 10 V2 units were manufactured with the following key modifications:



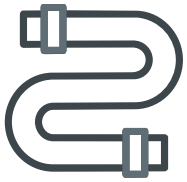
Wider 120 mm bottom bracket shell, enabling full fat-bike compatibility with the complete gear range by accommodating wider tyre configurations for improved terrain adaptability.



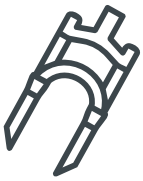
Centre stand mount, improving stability when loading and unloading.



Rear brake caliper repositioning, optimizing braking performance and reducing brake pad wear.



Motor cable protector



Introduction of front suspension



Lower frame setup for a lower centre of gravity



These modifications were implemented to enhance durability, improve load-handling stability, add rider-facing features and ensure compatibility with locally available spare parts and servicing infrastructure. One V2 unit was retained during the development period as a physical reference benchmark for future improvements and standardization.

V1 finding	V2 response
Chain break/drop under load & off-road 	Wider 120mm BB shell, motor cable protector, chain retention
Front-wheel instability >55 kg cargo 	Lower frame / lower centre of gravity
Side stand inadequate when loaded 	Centre-stand mount
Fork deterioration 	Front suspension introduced

5.3 External Field Trial

As part of the product validation process, the Kazzi electric cargo bicycle was deployed with an external organization for a one-month field trial to evaluate performance under real-world operating conditions. Overall, the bicycle received positive feedback for its handling, ride quality and energy efficiency. The test rider reported that the bicycle was comfortable and enjoyable to ride, performed well across different terrains and attracted considerable interest from other road users. The braking system performed reliably, providing confidence and control during operation.

The trial also identified several opportunities for product refinement. The chain occasionally disengaged on rough terrain, indicating the need for improved drivetrain stability. The headlight was considered insufficient for low-light conditions, and the battery management system could be enhanced to provide more accurate charge indication and reduce perceived battery drain while the bicycle is idle. Participants also recommended providing users with guidance on bicycle setup, routine maintenance, charging practices and seat adjustment to improve the overall ownership experience, and emphasized the importance of rider training, appropriate safety equipment and supportive cycling infrastructure to encourage wider adoption of electric bicycles in Kenya.

6. Business Model Findings and Performance Metrics

6
Business Model Findings and Performance Metrics

A primary objective of this study was to evaluate the commercial viability and affordability of locally manufactured electric cargo bicycles through real-world business model pilots.

Five pilots were implemented with partners representing financial services, delivery logistics, fleet management and small and medium-sized enterprises. The pilots tested different approaches to asset financing, leasing, demand access and fleet management, generating evidence on utilisation, payment capacity and the conditions required for sustained commercial deployment.

Table : Summary of Business Model Pilots

Partner	Business Model	Deployment Structure	Primary Objective
Financing partner 	Asset Financing ("Lipa Pole Pole")	Rider loan	Test affordability
Embedded rider SME 	Embedded Rider Model	Kazzi rider within an SME	Test SME logistics
Commercial lease client 	Commercial Lease Model	Company-operated deliveries	Test commercial operations
Fleet dispatch partner 	Fleet dispatch partnership	Kazzi bicycles and riders integrated into a dispatch platform	Assess utilization, rider management and operational sustainability
Fleet leasing partner 	Fleet leasing partnership/ Lease To Own	Multiple bicycles deployed within an existing e-mobility fleet	Evaluate long-term utilization, operational performance and maintenance requirements

6.1 Asset Financing Pilot (Financing Partner)

Pilot objective:

Stage 1 identified the high upfront cost of an electric cargo bicycle as a key barrier to adoption. Riders recognised the potential operational savings associated with electric mobility but faced constraints in purchasing the bicycle outright. The pilot therefore tested whether structured financing could reduce the upfront cost barrier to electric cargo bicycle ownership and enable a rider to acquire the asset through instalment payments rather than an outright purchase.

Business model structure:

A Kenyan financial institution purchased the bicycle and financed it to the rider through a lease-to-own arrangement. The rider made an initial contribution followed by daily repayments, with a higher repayment level during the early period and a lower amount thereafter. The repayment structure was designed to allow the financier to recover a larger share of the balance during the period of highest credit risk while reducing the rider's payment burden as the delivery business became established.

Pilot performance:

The rider's repayment capacity was closely linked to access to delivery demand. During the accelerated repayment period, income from a single ride-hailing platform was insufficient on some days to cover the repayment, resulting in negative take-home income. Moving to the standard repayment rate improved the rider's daily position, while joining a second delivery platform resulted in a substantially higher average daily take-home income.

The pilot therefore showed that the financing arrangement was sensitive to the volume and consistency of delivery work available to the rider. Multi-platform operation, combined with the lower repayment level after the initial period, provided materially better conditions for meeting the repayment obligation.

Key findings:

The pilot demonstrated that structured financing can reduce the upfront barrier to asset acquisition by spreading payments over time. However, financing alone did not resolve the underlying affordability challenge.

The financing partner ultimately decided not to continue financing additional bicycles, citing the competitiveness of the asset price relative to conventional imported motorcycles. The institution indicated that a substantially lower asset price would better suit the customer segment it serves, broadly consistent with the KES 50,000–65,000 preferred purchase-price range identified during Stage 1.

The pilot therefore identified two distinct dimensions of affordability: access to finance and the underlying cost of the asset. Financing can reduce the initial cash requirement, but it does not by itself address a price difference between the electric cargo bicycle and competing transport options.

6.2 Embedded Rider Pilot

Pilot objective:

The pilot assessed whether an electric cargo bicycle could be incorporated into the delivery operations of a small and medium-sized enterprise under normal commercial conditions.

Business model structure:

The arrangement provided the enterprise with access to an electric cargo bicycle and a dedicated rider without requiring it to recruit and manage the rider directly. The rider was employed and supported through the project arrangement, while the enterprise provided the delivery demand and incorporated the service into its existing logistics operations. The two parties shared the cost of the rider arrangement.

Key findings:

Pilot Performance :Over the four-week trial, the bicycle handled a substantial proportion of the enterprise's routine delivery orders. Larger and consolidated orders continued to be assigned to motorcycles, which could carry higher loads and combine multiple deliveries. The electric cargo bicycle rider completed approximately four deliveries per day, compared with roughly ten deliveries per day for motorcycle riders. Delivery requests were also dispersed across the service area, limiting the ability to concentrate the bicycle's use within a dense delivery zone.

The resulting level of utilisation was insufficient to support the arrangement under prevailing operating conditions." before"Key Findings".

Then Key Findings should read:"The pilot demonstrated that the bicycle could serve part of an established business's delivery requirements, but the available demand did not generate sufficient utilisation to support a dedicated electric cargo bicycle service. The combination of smaller loads, dispersed orders and higher utilisation of existing motorcycles for larger or consolidated deliveries limited the role that the bicycle could play within the business.

The finding is therefore less about whether the bicycle could technically perform the deliveries and more about whether the structure and volume of demand created enough productive work for the asset and rider. This distinction is important for assessing the commercial conditions under which an embedded delivery model could be sustained.

6.3 Commercial Lease Pilot (Delivery Company)

Pilot objective:

The pilot assessed whether an electric cargo bicycle could be incorporated into an established last-mile delivery operation through a lease arrangement, with sufficient utilisation to support the model

Business model structure:

The arrangement provided the operator with access to an electric cargo bicycle under a daily lease. The operator was responsible for generating and assigning delivery work, managing the rider and incorporating the bicycle into its existing logistics operations, while maintenance and product support remained part of the service arrangement.

Key findings:

The pilot demonstrated that integrating an electric cargo bicycle into an established delivery operation can improve access to delivery demand, but this does not necessarily generate sufficient utilisation for a lease model to be sustainable. The limiting factor was not the bicycle's ability to undertake the delivery work, but the volume and consistency of orders available to it.

The finding is important because it distinguishes access to an existing delivery network from access to sufficient productive demand. An established operating structure can make deployment easier, but the commercial model still depends on enough delivery activity to support the cost of the asset and rider.

6.3 Commercial Lease Pilot (Delivery Company)

Pilot Objective:

The pilot assessed whether integrating electric cargo bicycles and riders into an established dispatch network could provide more consistent access to delivery demand than the earlier operating models.

Business model structure:

The arrangement combined bicycle leasing with access to an established delivery platform. Riders were recruited and supported through the bicycle-provider arrangement, while the fleet operator was responsible for dispatching delivery requests through its existing customer network. This gave riders access to a regular flow of delivery work without requiring them to source customers independently. Rider earnings were linked to delivery distance, with the operator applying a more favourable rate structure to electric bicycles for shorter deliveries.

Key findings:

The pilot indicates that structured access to delivery demand was an important factor in increasing bicycle utilisation. Integrating the bicycles into an established dispatch network reduced the reliance on riders to generate their own work and created more predictable operating conditions.

The model also demonstrated the value of separating responsibilities within the commercial arrangement. Demand generation and dispatch were managed through the established delivery network, while the bicycle-provider arrangement focused on the asset and rider support. This division allowed each party to perform functions aligned with its existing capabilities and reduced the commercial dependence on individual riders sourcing sufficient work.

The results provide evidence that established dispatch networks can offer a more suitable operating environment for electric cargo bicycles where sufficient short-distance delivery demand is available.

6.5 Fleet Leasing Partnership Pilot

Pilot objective:

The pilot assessed whether electric cargo bicycles could be incorporated into an established electric-mobility fleet through a leasing arrangement, with sufficient and sustained utilisation to support the model. It also provided the longest period of observation under real commercial operating conditions.

Business model structure:

The arrangement provided multiple bicycles to an established fleet operator under a weekly leasing model. The fleet operator was responsible for assigning riders, managing day-to-day operations and overseeing rider performance, while maintenance and servicing remained part of the bicycle-provider arrangement.

Key findings:

Key findings: The pilot provides evidence that an established fleet operation can support sustained commercial use of electric cargo bicycles when responsibility for demand generation, rider management and day-to-day operations sits with an experienced operator.

The arrangement also created a clearer division of responsibilities. The fleet operator managed the operational side of the service, while the bicycle-provider arrangement focused on the asset, maintenance and servicing. This reduced the need for individual riders to generate their own demand and created a more predictable basis for recurring lease payments.

Following the trial, the fleet operator proposed a lease-to-own arrangement in which it would facilitate the relationship between riders, the bicycle provider and commercial financing institutions. The proposed model would use operational information on rider income and reliability to provide lenders with additional information for assessing repayment risk. This proposal emerged from the pilot but was not itself tested during the study.

6.6 Cross-Pilot Analysis

Viewed together, the five pilots reveal a clear gradient in commercial viability running from individual-facing models toward institutional fleet partnerships.

Pilot Model	Commercial Arrangement	Observed Utilisation	Pilot Outcome
Asset financing (rider loan) 	Rider acquired the bicycle through a lease-to-own financing arrangement	Depended on access to sufficient delivery work	Rider completed repayments under improved demand conditions; financing partner did not continue the model because of concerns about asset-price competitiveness
Embedded rider 	Dedicated rider and bicycle provided within an SME's existing delivery operation	~4 deliveries/day vs. ~10/day motorcycle benchmark	Not sustained because available demand did not generate sufficient utilisation
Commercial lease 	Bicycle leased to an established delivery operation	~3 deliveries/day; inconsistent demand	Discontinued because order volumes were insufficient and inconsistent
Fleet dispatch partnership 	Bicycles and riders integrated into an established dispatch network	~9.3 deliveries/day	Sustained; structured demand supported higher utilisation
Fleet leasing partnership 	Multiple bicycles leased to an established e-mobility fleet	~10.4 deliveries/day	Sustained for three months; lease-to-own extension proposed

The five pilots indicate that the conditions for sustained commercial deployment extended beyond the technical performance of the bicycle. Differences in utilisation, continuity and operating outcomes were associated with how each model generated demand, allocated operational responsibilities and addressed the cost of the asset.

Access to structured demand was an important determinant of utilisation. The models in which riders or individual businesses had more limited or dispersed access to delivery work recorded approximately three to four deliveries per day, while the two fleet-based models recorded approximately nine to ten. This pattern suggests that

established demand networks can create substantially better conditions for asset utilisation. The pilot design does not isolate demand access from the other differences between the models, however, and the observed difference should therefore not be attributed solely to the dispatch structure.

The pilots that were discontinued were constrained primarily by commercial conditions. In the embedded rider and commercial lease models, the volume and distribution of orders did not generate sufficient utilisation to support the arrangements. In the asset-financing pilot, the financing partner's concern centred on the competitiveness of the asset price relative to alternative transport options. In these cases, the bicycles were able to perform the intended delivery functions, but the surrounding commercial conditions were insufficient to sustain the models.

The allocation of responsibilities also shaped the operating conditions. The fleet-based models placed demand generation, rider management and day-to-day operations with established operators, while the bicycle-provider arrangement focused on the asset and its maintenance and support. This reduced the dependence on individual riders or small businesses to generate sufficient work and created more predictable conditions for recurring asset payments.

The evidence therefore indicates that commercial deployment depends on the relationship between the asset and the operating model around it. Demand availability, asset affordability, rider management and allocation of operational responsibilities all affect whether an electric cargo bicycle can achieve sufficient utilisation to support sustained deployment.



7. Financial Analysis

7.1
Cost Comparison: Locally Manufactured versus Imported Frame Sets

The study compared the cost of a locally manufactured frame set with an equivalent frame set imported from China. The comparison included the frame, fork and mudguard, together with freight, customs clearance, local handling, inland transport and statutory charges associated with a 15-unit shipment.

Cost Metric	Local Production (Kenya)	Imported from China (15 Units)
Base Hardware Cost 	KES 23,000	KES 21,000 (15,000 frame + 3,500 fork + 2,500 mudguard)
Freight, Clearance & Local Logistics 	N/A	KES 6,509
Import Duties & Statutory Levies 	N/A	KES 539
Subtotal (Before VAT)	KES 23,000	KES 28,048
VAT @ 16%	KES 3,680	Included in import charges
Total Cost (Including VAT)	**KES 26,680**	**KES 28,048**

At the shipment volume assessed, the locally manufactured frame set cost approximately KES 1,368 less per unit, or about 5%, than the imported equivalent. Although the imported frame set had a lower base hardware cost, freight, clearance, duties and other import-related costs increased its landed cost.

The comparison therefore indicates that local production was cost-competitive at the assessed shipment volume. It does not establish whether the difference would remain at higher production or import volumes, where logistics and other fixed costs may be distributed across more units.

Local production also provides operational advantages identified during the study, including greater proximity to fabrication and the ability to make design modifications, repairs and replacement components locally. However, the financial value of these factors was not quantified in the cost comparison. The imported frame sets, in contrast, benefit from established manufacturing processes and consistent production, but their landed cost was higher at the small shipment volume assessed.

7.2
Competitor Market Assessment



While imported electric bicycles currently dominate the Kenyan market, they typically rely on fully imported frames and proprietary components, resulting in longer supply chains, higher import costs and limited local value addition. To assess the competitiveness of the Kazzi electric cargo bicycle, a comparison was conducted against three electric cargo bicycles available in the Kenyan market, considering retail price, manufacturing approach, component sourcing and estimated total cost of ownership.

Cost Parameter	Kazzi (Local)	Competitor 1	Competitor 2	Competitor 3
Retail Price (KES)	130,000	148,000–173,600	129,999	85,000
Origin	Local frame, imported parts	Imported	Local assembly (imported parts)	Local assembly (imported parts)
Battery	960wh	720 wh	648wh	960wh
Power	500w	350w	350w	500w
Estimated TCO	KES 180,000	KES 180,000–210,000	KES 160,000–190,000	KES 135,000-140,000

The comparison shows that the Kazzi bicycle was priced broadly within the range of two of the three comparator products, while the third had a substantially lower cash price. The latter was offered at KES 85,000 for cash, with an alternative financing arrangement requiring a KES 30,000 deposit followed by instalments over 12 months, resulting in an estimated total repayment of approximately KES 135,000. The lower upfront payment reduced the initial purchase barrier, although the total financed cost was higher than the cash price.

The comparison also shows differences in battery capacity, motor power and manufacturing approach. The Kazzi bicycle had a 960 Wh battery and 500 W motor, while two of the comparator models had smaller batteries and 350 W motors. These differences are relevant when interpreting price comparisons because retail price alone does not establish equivalence between products.

The assessment therefore reinforces the affordability challenge identified elsewhere in the study: the market includes products at substantially different price points, and purchase price and financing structure can materially affect accessibility. At the same time, the available competitor data do not provide sufficient evidence to determine relative value for money or long-term cost-effectiveness across the products, particularly because specifications, operating conditions and the basis for the estimated total cost of ownership (TCO) differ.

7.3 Financial Modeling Assumptions and Baseline Parameters



Retail price:

The analysis uses the commercial retail price of KES 130,000 for the Kazzi electric cargo bicycle, derived from the bill of materials plus sales margin. While certain pilots used earlier prototype pricing, the analysis reflects the anticipated commercial pricing for future market deployment, providing a realistic assessment of rider affordability, financing requirements and business sustainability as the product moves from research and development to commercialization.



Service and maintenance:

The maintenance baseline draws on the nine-month service history of the longest-running pilot rider under real road usage. Spare parts replaced over the period comprised a pedal-assist sensor (KES 2,000), gear shifter (KES 1,500), brake pads (four at KES 1,000 each), lights (KES 2,500) and two tubes (KES 500 each), totalling KES 11,000 and averaging KES 1,222 per month. Combined with servicing costed at KES 1,000 per month, the model applies a total average maintenance cost of KES 2,222 per month.



Delivery volumes:

The operational baseline draws on the fleet pilots: the fleet dispatch partner averaged 9.3 daily deliveries and the fleet leasing partner 10.4, yielding an average of 9.85, rounded to 10 daily deliveries as the core benchmark for the financial projections.

Charging cost:

For a 960 Wh (0.96 kWh) battery at the standard KPLC rate of KES 30 per kWh, a theoretical full charge costs KES 28.80. Accounting for AC-to-DC conversion losses (85–90% charger efficiency), the model assumes an effective full-charge cost of KES 30, or approximately KES 720 per month across a six-day working week (24 charges).

Operational overhead and risk management:

Recurring monthly per-bicycle costs for asset protection are estimated at KES 416 for insurance (KES 5,000 annually, covering theft and basic liabilities), KES 388 for GPS tracking software and cellular data, and KES 518 allocated to a dedicated reserve for emergency roadside recovery.

Total monthly operating cost:

Combining maintenance (KES 2,222), charging (KES 720), insurance (KES 416), GPS/telemetry (KES 388) and roadside rescue (KES 518), the model applies a total monthly operating cost of KES 4,264 per bicycle throughout Sections 7.4–7.6.

7.4 Asset Financing Model (Financing Partner)



The asset financing model addresses the high upfront purchase cost, the primary adoption barrier identified in Stage 1, by spreading repayment into daily amounts aligned with the rider's earning pattern. The following scenario applies the repayment architecture piloted with the financing partner to the commercial retail price.



Commercial rider financing scenario.

At a sales price of KES 130,000, the rider pays a 20% deposit of KES 26,000, financing the remaining KES 104,000 over 589 daily instalments at six repayment days per week, equivalent to approximately 22.7 months: KES 508 per day for the first 90 days, then KES 267 per day for the remaining 499 days. The first 90 days total KES 45,720; the remaining 499 days total KES 133,233; together these instalments total KES 178,953. Total customer payments amount to KES 204,953 (deposit plus instalments), representing a total finance charge of KES 74,953, equivalent to 72.1% of the amount financed. The front-loaded structure accelerates capital recovery during the period of highest credit risk, mirroring lease-to-own models operating in East Africa's two-wheeler industry.

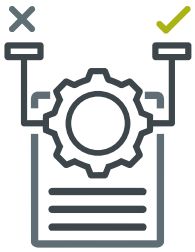


Total cost of ownership and rider economics.

Under the modelled financing structure, the rider makes an initial contribution and repays the remaining balance through scheduled instalments over the financing period. The repayment profile is front-loaded during the initial period and reduces thereafter, reflecting the structure tested in the pilot.

The pilot demonstrated that repayment capacity depended strongly on the volume of delivery work available to the rider. During the initial repayment period, operating through a single delivery platform resulted in limited take-home income after the lease payment, including several days when earnings were insufficient to cover the repayment. Income improved substantially when the rider moved to a lower repayment rate and, more importantly, when a second delivery platform was added.

The financial model therefore indicates that access to finance alone is not sufficient to make the asset affordable in practice. The rider must also have sufficient and reasonably predictable delivery income to service the repayment obligation while retaining an adequate level of disposable income.



Viability assessment.

The model illustrates the difference between reducing the upfront purchase barrier and reducing the underlying cost of the asset. Financing can spread the cost of the bicycle over a longer period and align payments with income generation, but it does not reduce the total economic cost of the asset. The financing pilot also demonstrated that the model remained sensitive to the underlying purchase price: the participating financial institution did not continue financing additional bicycles because it considered the asset price insufficiently competitive relative to conventional motorcycles.

This suggests that a commercially sustainable financing model would require both an appropriate repayment structure and a bicycle price that is acceptable to the target market and financing providers.

7.5 Fleet Dispatch Model (Fleet Dispatch Partner)

This analysis evaluates the financial viability of the which combines a fixed weekly bicycle lease with access to a structured delivery platform.





Rider economics.

At the assumed delivery rate, a rider generates approximately KES 6,600 in gross delivery revenue over a six-day working week. Weekly operating costs comprise the KES 2,100 bicycle lease and estimated charging costs of KES 180, giving total operating costs of KES 2,280.

A rider therefore needs approximately 21 deliveries per week, or about 3.5 deliveries per working day, to cover these operating costs. At the observed benchmark of approximately 10 deliveries per day, the rider reaches operating break-even within the first two working days and retains the remaining delivery income as take-home earnings, before any other personal costs not included in the model.

This demonstrates the importance of structured demand to rider economics. At the utilisation levels observed in the fleet dispatch pilot, the delivery income was sufficient to cover the bicycle-related operating costs and generate positive rider income.



Asset-owner economics.

For the asset owner, the weekly lease generates approximately KES 8,400 per bicycle per month. Against the modelled monthly costs of maintenance, charging, insurance, GPS/ telemetry and roadside rescue, the resulting net monthly cash flow is approximately KES 4,136 per bicycle.

Using a unit production cost of approximately KES 105,000, the model estimates an asset payback period of approximately 25.4 months. Against an assumed useful asset life of approximately 36 months, this leaves around 10.6 months of operation after recovery of the initial production cost.

The model therefore presents a different financial picture for the two parties. At the observed utilisation level, the arrangement generated sufficient income for riders to cover

bicycle-related operating costs, while asset recovery for the owner remained relatively long. The latter creates exposure to maintenance costs, downtime and other operating risks over the period required to recover the initial investment.

Viability assessment.

Under the modelled operating conditions, the fleet dispatch model generates positive operating cash flow for the asset owner and sufficient delivery income for riders to cover the bicycle-related operating costs. The model therefore indicates that the arrangement can support both rider income generation and recovery of the bicycle investment.

However, the estimated 25.4-month asset payback period, against an assumed useful life of approximately 36 months, indicates that the financial margin is relatively limited. The economics remain dependent on maintaining the utilisation levels observed in the fleet pilots and on controlling maintenance, downtime and other operating costs over the asset's life.

The model therefore indicates financial viability under the assumed utilisation and cost conditions, rather than demonstrating viability independent of those conditions.

7.6 Lease-to-Own Model (Fleet Leasing Partner)



The lease-to-own model builds on the fleet leasing arrangement in which the asset remained under the ownership of the provider while riders used the bicycles under a fixed weekly payment. Following the pilot, the fleet partner proposed a lease-to-own structure in which the partner would act as an intermediary between the bicycle provider, riders and financing institutions, using operational performance data from the pilot to support credit assessment.



Rider Economics

Under the piloted arrangement, weekly rider costs comprised a KES 2,000 bicycle lease and approximately KES 180 in charging costs, giving total weekly operating costs of KES 2,180. At a payment of KES 110 per delivery, riders required approximately 20 deliveries per week to cover these costs.

At the observed average of approximately 10 deliveries per day, riders recovered their weekly operating costs within the second working day. The model therefore provides sufficient operating margin at the observed utilisation level and can accommodate riders who use delivery work as a part-time income source, including the student segment observed during the pilot.

Indicator	Pre-acquisition	Post-acquisition
Total weekly cost	KES 3,000	KES 1,000
Total daily cost (6 days/week)	KES 500	KES 167
Weekly break-even orders	28	10
Daily break-even pace	4.55 orders	1.52 orders
Time to weekly break-even	~3 days	~1 day



Viability assessment

The model indicates financial viability for riders under the utilisation conditions observed during the pilot. However, the financial position of the asset owner is different because ownership is retained throughout the repayment period, leaving capital tied up in each bicycle and exposing the owner to maintenance and operational risks.

The lease-to-own structure may therefore improve access to asset ownership for riders while shifting a greater share of financing and asset risk to the owner or financing partner. Its longer-term sustainability would depend on maintaining sufficient utilisation, controlling operating costs and structuring the eventual transfer of ownership so that the repayment period is consistent with the economic life of the bicycle.

8. Summary of Findings

8.1 Manufacturing Strategy and Learnings



The manufacturing work demonstrated that a substantial share of the bicycle can be produced or assembled locally, although the most appropriate production approach depends on component type and production volume. Local steel fabrication successfully produced the frame and structural components used in prototype development and commercial deployment, while the cost comparison showed that locally manufactured frame sets were approximately 5% lower in cost than equivalent imported frame sets at the assessed 15-unit shipment volume.

The experience with third-party fabrication also identified constraints that become more significant as a product moves from prototyping towards commercial production. These included uncertainty around design ownership, production delays and limited flexibility to accommodate rapid design changes. The findings indicate that greater control over manufacturing processes would improve the ability to iterate the product and manage production schedules.

The assessment of alternative manufacturing approaches showed that different components require different production methods. 3D printing was useful for prototyping and design iteration but was not considered suitable for production at the volumes assessed because of unit costs and structural limitations. Recycled HDPE and injection moulding were technically feasible for selected components, but the estimated mould investment of approximately USD 15,000 per component made the approach uneconomic at current production volumes. Metal fabrication was therefore identified as the more appropriate near-term approach for heavy-load cargo components, with injection moulding becoming more relevant at higher production volumes.

Local battery assembly also showed initial technical feasibility. Two locally assembled battery units achieved a range comparable to the imported batteries used in the bicycles, and initial assembly costs were comparable to imported alternatives. However, longer-term testing is still required to assess durability and quality over the full operating lifecycle. The experience with locally sourced fast chargers also demonstrated the importance of component quality and battery–charger compatibility when introducing local charging solutions.

Taken together, the findings support a gradual localisation approach, combining local fabrication and assembly with continued use of imported critical components where local production is not yet economically or technically justified. Production methods should be selected according to the requirements of each component and the scale of production, rather than applying a single manufacturing approach across the bicycle.

8.2 Business Model Pilots: Strategy and Learnings

The five commercial pilots demonstrated that the conditions under which the bicycle was deployed had a significant influence on utilisation and commercial performance. Models that relied on individual riders or relatively limited sources of delivery demand recorded lower utilisation, while the fleet-based models provided access to more consistent delivery volumes and achieved substantially higher utilisation.

The asset financing pilot demonstrated that structured financing can reduce the upfront barrier to bicycle ownership, but financing does not resolve affordability where the underlying asset price remains high relative to competing vehicles. The participating financial institution did not continue financing additional bicycles because of concerns about the competitiveness of the asset price. The experience therefore indicates that financing mechanisms need to be considered alongside the underlying cost and perceived value of the asset.

The embedded rider and commercial lease pilots provided evidence of the importance of sufficient and predictable delivery demand. Both models demonstrated that the bicycle could perform the intended delivery function, but utilisation remained too low to support the associated commercial arrangements. In the embedded rider model, the enterprise's existing motorcycles were also able to consolidate larger orders, limiting the volume of work allocated to the bicycle. In the commercial lease model, inconsistent order volumes constrained utilisation despite the integration of the bicycle into an established delivery operation. SiemensStiftung_ Development.

The fleet dispatch and fleet leasing pilots achieved higher utilisation because the bicycles were integrated into established delivery networks with more consistent access to orders. Average utilisation reached 9.3 deliveries per day in the fleet dispatch model and 10.4 deliveries per day in the fleet leasing model. The fleet dispatch pilot also demonstrated that student riders could use the bicycles as a part-time income-generating asset, while the fleet leasing pilot provided evidence of sustained utilisation over three months.

Across the pilots, the evidence indicates that access to structured demand was an important determinant of commercial performance. The results also show that commercial outcomes depended on how responsibilities for demand generation, rider management, asset provision and maintenance were allocated between the parties. The models that incorporated established delivery networks placed demand generation and, in some cases, rider management with the operating partner, while the bicycle provider retained responsibility for the asset and technical support.

The pilots therefore indicate that commercial deployment is more likely to be sustained where asset costs are compatible with the target market, delivery demand is sufficiently predictable, and responsibilities and risks are appropriately allocated between the parties involved. The evidence does not establish that a single business model is universally applicable; rather, the appropriate arrangement depends on the user segment, demand profile, financing structure and operating conditions.

9. Impact

9
Social Impact

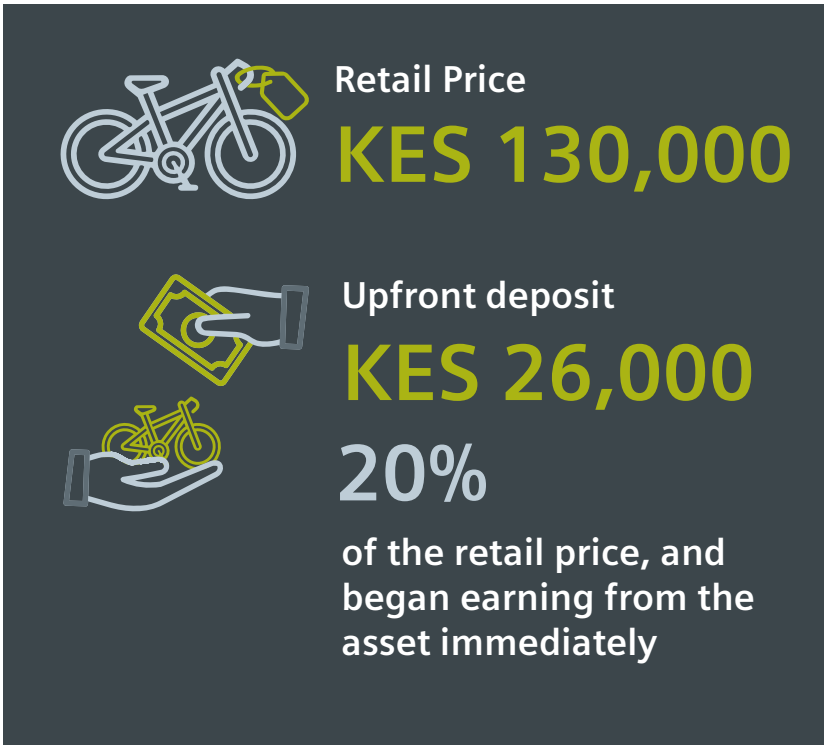
The commercial pilots provided evidence on how electric cargo bicycles could affect access to income-generating opportunities and the barriers faced by prospective users. The strongest evidence related to access to the delivery market through financing and flexible operating arrangements, particularly for riders who could combine delivery work with other commitments.

The asset financing and fleet leasing models reduced the need for riders to finance the full purchase price upfront. Under the financing model, riders could begin operating the bicycle while repaying the asset over time, addressing the upfront capital barrier identified during the market assessment. However, the pilot also showed that financing did not eliminate the underlying affordability constraint, as the participating financial institution did not continue financing additional bicycles because of concerns about the asset's price competitiveness.

The fleet dispatch pilot provided evidence of a specific opportunity for young people and university students seeking flexible income-generating work. One student rider operated part-time around an academic schedule and completed approximately 7–10 deliveries per day. The pilot therefore demonstrated that the bicycle could support part-time delivery activity rather than requiring full-time participation.

The findings also indicate that access to income-generating opportunities depended on the availability of structured delivery demand. The bicycle itself did not create demand;





riders benefited where established delivery networks provided sufficient orders to support regular utilisation. The social impact therefore depends on the wider operating model through which the asset is made available to riders.

9.2
Economic Impact



The commercial pilots provided evidence of the economic contribution that electric cargo bicycles can make through income generation, reduced operating costs and the development of local manufacturing and service capacity. The magnitude of these effects varied across the operating models and depended on utilisation, access to delivery demand and the structure of asset ownership and financing.

The strongest evidence of direct economic benefit came from the fleet-based pilots. Riders generated income through delivery work while operating costs were lower than those associated with conventional motorcycles. In the fleet dispatch pilot, riders completed an average of 9.3 deliveries per day, while the fleet leasing pilot averaged 10.4 deliveries per day, with the highest-performing rider reaching 23 deliveries in a day. These utilisation levels provided sufficient delivery income to cover bicycle-related operating costs and generate positive rider earnings under the arrangements tested.

The pilots also provided evidence of potential operating-cost savings for delivery operators. Electric bicycles avoided fuel expenditure associated with petrol motorcycles and had lower routine operating costs under the conditions observed. The study estimated that electric cargo bicycles could provide operating-cost advantages where utilisation was sufficiently high to support regular delivery activity. However, the financial benefit to users cannot be separated from utilisation: the embedded rider and commercial lease pilots showed that low or inconsistent delivery volumes could prevent these operating-cost advantages from translating into a sustainable commercial arrangement.

The study also identified potential economic benefits from local manufacturing. Local frame fabrication was approximately 5% lower in cost than the equivalent imported frame set at the assessed 15-unit shipment volume. Local production also created opportunities for local fabrication, assembly, repair and servicing, although the broader employment and local economic effects were not quantified through the study.

The evidence therefore indicates that the economic contribution of electric cargo bicycles extends beyond the operating cost of the vehicle itself. It includes income-generating opportunities for riders, potential operating-cost savings for delivery businesses, and the development of local manufacturing and servicing capacity. These benefits were strongest where the bicycles achieved sufficient utilisation and had reliable access to delivery demand."

9.3 Environmental Impact

The environmental assessment focused on the potential reduction in greenhouse gas emissions from replacing petrol-powered motorcycles with electric cargo bicycles for delivery activities. The analysis estimated emissions avoided based on the distance travelled during the commercial pilots and the corresponding emissions that would have been generated if the same distance had been travelled using petrol motorcycles.

Across the commercial pilots, the bicycles travelled approximately 16,254 kilometres. Based on the assumptions used in the study, this distance represented an estimated 3.2 tonnes of CO_2 emissions avoided compared with equivalent petrol motorcycle travel.

The pilots also demonstrated that electric cargo bicycles can operate effectively for short-distance urban and last-mile deliveries without direct tailpipe emissions. This is particularly relevant where bicycles replace petrol motorcycles for trips within dense delivery networks. The fleet dispatch pilot recorded that approximately 74.6% of deliveries were within 3 km, indicating that a substantial share of the observed delivery activity fell within distances suited to electric cargo bicycle operation.

The environmental benefits extend beyond greenhouse gas emissions. Replacing petrol motorcycles with electric bicycles eliminates direct vehicle exhaust emissions and can reduce traffic noise. However, the study did not directly measure changes in local air quality, noise levels or associated health outcomes. These should therefore be presented as potential co-benefits rather than demonstrated impacts.

The findings indicate that electric cargo bicycles can contribute to lower-emission last-mile transport, particularly where they are used at sufficient utilisation levels to replace conventional motorcycle trips. The scale of the environmental benefit will depend on the distance travelled, the extent to which electric bicycles substitute for petrol-powered vehicles, and the electricity and battery systems used to operate them.



9.4 Consistency of Pilot Evidence with the Stage 1 Market Assessment

The commercial pilots provided an opportunity to assess whether the assumptions and preferences identified during the initial market assessment were reflected in subsequent operating experience. The evidence was broadly consistent with several of the Stage 1 findings, while some expectations were only partially demonstrated during the pilots.



Stage 1 finding	Evidence from the pilots	Assessment
Riders preferred flexible financing over outright purchase	The asset financing and fleet leasing models enabled access without significant upfront capital	Validated
Young people represented a promising customer segment	University students participated successfully in the fleet dispatch pilot while balancing academic commitments	Validated
Fleet operators would be an effective market entry point	Successful deployments with both fleet partners demonstrated the practicality of fleet-based operations	Validated
Affordability would influence adoption	Flexible financing and leasing arrangements reduced financial barriers for riders	Validated
Local manufacturing would strengthen the value chain	Local companies participated in frame production; investment is required for commercial-scale production	Partially validated
Battery range and charging practicality would influence adoption	Commercial deployments demonstrated that home charging adequately supported daily delivery operations	Validated
Sustainable materials should be explored	Recycled plastics and alternative manufacturing approaches were evaluated but remain more suitable for larger production volumes	Partially validated

10. Conclusion and Recommendations

10 Conclusion

The study demonstrated that locally developed electric cargo bicycles can perform the intended last-mile delivery functions under the operating conditions tested. Across product development, field testing and commercial pilots, the bicycles demonstrated practical suitability for short-distance cargo transport, with field evidence supporting their use across different terrains and delivery environments.

The findings also show that technical performance was not the primary constraint to sustained commercial deployment. The bicycles achieved sustained utilisation in the fleet-based pilots, while the pilots that were discontinued or not continued were affected primarily by insufficient or inconsistent delivery demand, asset affordability and the conditions of the financing arrangements. This indicates that the commercial performance of electric cargo bicycles depends on the wider operating model in which the asset is deployed, rather than on the bicycle alone.



The study also demonstrated the feasibility of local manufacturing and assembly. Local frame fabrication was technically feasible and, at the assessed shipment volume, resulted in a frame-set cost approximately 5% lower than the equivalent imported frame set. Local battery assembly also showed initial feasibility. At the same time, critical components remain dependent on imports, and alternative manufacturing methods such as injection moulding require higher production volumes to become economically relevant.

The commercial pilots further demonstrated the importance of utilisation and predictable demand. Fleet-based arrangements achieved approximately 9–10 deliveries per bicycle per day, compared with approximately 3–4 deliveries per day in the lower-utilisation models. These differences had a direct effect on rider earnings and the economics of the asset. Financing could reduce the upfront barrier to ownership, but the financing pilot also showed that a financing mechanism cannot fully address an asset price that remains uncompetitive relative to alternative vehicles.

The study found that the technical feasibility of the electric cargo bicycle was not the main constraint to commercial deployment. The more significant constraints were the cost of the asset relative to competing vehicles, the availability and consistency of delivery demand, and the financing and operating arrangements through which riders accessed and used the bicycles. Local manufacturing demonstrated potential to reduce frame-set costs and strengthen local production capacity, but wider commercial deployment will depend on how these technical and commercial factors are addressed together."

10.2 Recommendations

Based ased on the findings of this study, the following recommendations are proposed to support the continued development and commercialization of electric cargo bicycles in Kenya.



1. Continue product optimization and cost reduction.



Future development should focus on reducing the overall cost of the bicycle while maintaining safety, durability and performance, through rigorous sourcing of quality components from international OEMs and the economies of scale of larger production runs, which together are estimated to reduce overall cost by 10–20%. To build resilience against low-cost imports, local manufacturers should emphasize the value propositions that off-the-shelf imports struggle to sustain: build quality, design tailored to African road conditions, responsive after-sales service and local spare parts availability.

2. Develop battery-as-a-service.



Incorporating a battery-as-a-service model, with the manufacturer retaining the battery as an asset and providing the supporting infrastructure at scale, could reduce the bicycle's sales price by up to an estimated 30%, since the battery's cost would no longer be borne upfront by the rider.

3. Develop sustainable financing models.



The study showed that the manufacturer cannot overcome high asset costs alone. Future financing programmes should be linked to reliable income-generating opportunities, and partnerships with financial institutions should incorporate realistic repayment structures informed by the rider economics documented in this study.

4. Integrate electric bicycles into daily fleet routes.



Fleet managers should actively integrate electric bicycles into short-distance delivery routes and adapt operations to support them. Replacing conventional vehicles with light electric mobility for last-mile trips significantly reduces energy consumption and operating costs for commercial partners.

5. Support rider-facing infrastructure and training.



Field trial feedback emphasized that wider adoption will require supportive riding infrastructure, rider training and appropriate safety equipment. Manufacturers, fleet operators and development partners should advocate for the integration of cycling infrastructure into urban transport planning and invest in rider onboarding covering bicycle setup, maintenance, charging practices and road safety.







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