ELECTRIC MOBILITY TRANSITION & LOCALISATION

Towards Unlocking the NEV Value Chain for Africa

SCOPING REPORT



AIH GROUP

IDC
Industrial Development Corporation

December 2024

TABLE OF CONTENTS

TABLE OF FIGURES **4**

LIST OF TABLES **5**

1 EXECUTIVE SUMMARY **7**

2 INTRODUCTION **7**

3 MARKET OVERVIEW **8**

3.1 Drivers of Demand for Two- and Three-Wheelers in Africa 9

3.2 The Case for Electric Motorcycles 10

3.2.1 The African Market Demand for ICE Motorcycles 11

3.2.2 The African Market Demand for Electric Motorcycles 12

3.2.3 The South African Last-Mile Delivery Market Demand 15

3.3 Market Competitiveness 15

3.4 Three-Wheeler Environment 16

3.5 Conclusion 17

4 TECHNICAL OVERVIEW **18**

4.1 Production Volumes 18

4.2 Design of plant 19

4.3 Manufacturing/assembly process 24

4.3.1 Technology options 24

4.3.2 Tools, equipment and suppliers 24

4.3.3 Material supply 25

4.3.4 Manpower and skills 25

4.4 Site selection 25

5 FINANCIAL PROJECTIONS **26**

5.1 Income Statement 26

5.2 Balance Sheet Assumptions 29

5.3 Feasibility Indicators 32

5.4 Scenario Analysis 33

5.5 Organisation Structure 35

6 CONSIDERATIONS 37

6.1 Charging Infrastructure 37

6.1.1 Battery Swapping 37

6.1.2 Components of Battery Swapping Infrastructure 38

6.1.3 How Does Battery Swapping Work? 38

6.1.4 Battery Swapping Business Model 39

6.2 Battery Manufacturing 40

7 CONCLUSION 41

7.1 Way Forward 42

8 ANNEXURES 43

8.1 Annexure A: Financial Forecast 2/3 Wheelers 43

8.2 Annexure B: The South African Last-Mile Delivery Market Demand 45

8.3 Annexure C: Three-Wheeler Pricing 46

8.4 Annexure D: Battery swap costing 47

9 PROJECT TEAM 48

9.1 Project lead 48

9.2 Contributing authors 48

9.3 Service provider contact details 48

TABLE OF FIGURES

Figure 1: Driving Forces of Demand for Motorcycles in Africa 9

Figure 2: Cost of Ownership Differential Between ICE and Electric Two-Wheelers 10

Figure 3: Projected Growth in Annual Electric Motorcycle Sales, Africa 14

Figure 4: South Africa Class A Sales by Usage 15

Figure 5: Units Produced 19

Figure 6: Assembly Facility Layout 1 20

Figure 7: Assembly Facility Layout 2 21

Figure 8: Assembly Facility Layout 3 22

Figure 9: Assembly Facility Layout 4 23

Figure 10: Income Statement for 2/3 Wheeler Plant 26

Figure 11: Source Application of Funds 32

Figure 12: Proposed Organogram 35

Figure 13: Structure Recommendation 37

Figure 16: Infrastructure Components 39

Figure 17: Battery Swapping System 39

Figure 18 Swapping Station Prices 40

Figure 19: Future Growth Forecast 46

Figure 20: Projected Cumulative Market Growth for Electric Two-Wheelers in SA 46

Figure 21: Eleksa (Left) and MellowVan (Right) 47

LIST OF TABLES

Table 1: ICE Motorcycle Demand in Africa (2022) 12

Table 2: Electric Motorcycle Demand in Africa (2022) 13

Table 3: Direct Costs 27

Table 4: Manpower Costs 28

Table 5: Fixed Assets 29

Table 6: Depreciation Rates 29

Table 7: Working Capital 30

Table 8: Peak Funding 31

Table 9: Feasibility Indicators 32

Table 10: Feasibility Indicators for Scenario 1 33

Table 11: Feasibility Indicators for Scenario 2.1 34

Table 12: Feasibility indicators for Scenario 2.2 35

Table 13: Financial Forecast 44

Table 14: Market Share 44

Table 15: Production Volumes 45

Bokamoso Asset Management (Pty) Ltd
trading as AIH Group
Registration Number: 2005/033960/07
2nd Floor, Building A, Lynnwood Bridge Office Park,
4 Daventry Street, Lynnwood Manor, Pretoria
PO Box 35501, Menlo Park, 0102,South Africa
+27 12 346 9047
info@autoih.co.za

www.autoih.co.za

SUBMITTED TO: Industrial Development Corporation (IDC)

19 Fredman Drive,
Sandton, Johannesburg,
Gauteng,
2146.

Attention: Nathan Fredericks
Senior Industry Development Planner
Industry Planning Unit (COO Office)

Dear Madam / Sir

SCOPING REPORT: ELECTRIC MOBILITY TRANSITION AND LOCALISATION TOWARDS UNLOCKING THE NEV VALUE CHAIN FOR AFRICA.

We have pleasure in submitting our Scoping Report on the project to undertake a study on electric mobility transition and localisation for unlocking the NEV value chain for Africa.

Please do not hesitate to contact us should you have any queries relating to the report. I will be the primary contact person for this project. You can also contact Johan de Jager, 079 897 5214, with email johan@autoih.co.za for any questions related to the project.

My contact details are as follows:

Mobile Number : +27 76 754 0014
Email address : owen@autoih.co.za

Yours faithfully,

MR OWEN SMITH
AIH GROUP: PROJECT LEAD

1. EXECUTIVE SUMMARY

This report concludes the final phase of the NEV (New Energy Vehicle) value chain localisation project, focusing on the investment opportunity for manufacturing and assembly of electric two- and three-wheelers. The project targets the growing market for electric two-wheelers, indicating a shift towards sustainable transportation in South Africa (SA) and sub-Saharan Africa (SSA).

The localisation initiative aims to establish a competitive manufacturing and assembly facility in South Africa for both electric and internal combustion engine (ICE) two- and three-wheelers, achieving economies of scale. Initially, the facility will operate as an assembly plant using Semi Knocked Down (SKD) kits, with plans to expand into a Complete Knock Down (CKD) facility, sourcing locally manufactured parts.

Financial projections over a twelve-year period suggest a potential positive return on investment despite requiring substantial initial funding. High level financial projections for the project indicate a positive NPV and nominal IRR of 21% for the project and 26% for the investor on cumulative investment projected at just over R1 billion in the tenth year of operation as production volumes increase. Shareholder contribution to the total funding requirement is just over R390 million at peak. The funding is primarily used to finance working capital (94%) and the remainder for fixed assets. To advance the project, it is proposed to identify a strategic investment and operating partner to develop a bankable business case.

Key recommendations include developing charging infrastructure with battery swapping capabilities and monitoring the local battery value chain. While the battery charging infrastructure and battery swapping opportunity can be implemented together with the two- and three-wheeler assembly plant, the localisation of battery value chain is not considered feasible at this juncture. Market and technology developments of the latter project need to be monitored to identify when project financial parameters become feasible.

As the mobility market transitions to electric powertrains, supporting NEV localisation projects can enhance South Africa's manufacturing capabilities, driving economic growth, technological innovation, and environmental sustainability in the sub-Saharan Africa region.

2. INTRODUCTION

This scoping report concludes the final phase of the NEV (New Energy Vehicle) value chain localisation project, focusing on the investment opportunity that is manufacturing and assembly of electric two- and three-wheelers. The report provides a market overview for electric two-wheelers, particularly their growing utilisation for last-mile delivery, reflecting a shift towards sustainable transportation solutions in the South African (SA) and sub-Saharan African (SSA) markets.

A key consideration of this project is the growing demand and the establishment of a manufacturing and assembly facility in South Africa for both electric and ICE two- and three-wheelers. It is assumed that the local assembly facility can assemble and ultimately manufacture the Electric and ICE 2- and 3-wheelers competitively and carve out a moderate market share in the SA and SSA market. By considering both internal combustion engine (ICE) and electric vehicles (EV) as units for production, the project aims to achieve economies of scale.

This report includes a technical overview to guide implementation and operation. The proposed plant is initially planned to function as an assembly facility using Semi Knocked Down (SKD) kits, with future expansion plans to transition into a Complete Knock Down (CKD) facility that will include sourcing of locally manufactured parts and components. The aim of this initiative, is that it could serve as a seed project that can position South Africa as a technical hub in the sub-Saharan African market for new energy vehicles, fostering regional industrial growth and technological advancement.

The financial projections for the proposed two- and three-wheelers manufacturing operation over a twelve-year

period, while requiring substantial investment, reveal a potential positive return in investment. This financial analysis offers insights into the economic outlook for this sector, highlighting the increasing investment opportunities and potential for returns.

The report also outlines considerations and recommendations to support other NEV localisation initiatives. This include the development of charging infrastructure with battery swapping capabilities as well as monitoring the development of a local battery value chain. These potential initiatives will ultimately support the establishment of a sustainable ecosystem for NEVs. It is however, noted that the establishment of these supporting initiatives currently face economies of scale challenges due to relatively small domestic market opportunities, that negates the development of investment scope reports.

As the mobility market transitions to electric power trains, these key components in the NEV value chain should be able to support further localisation projects that can enhance the manufacturing capabilities of South Africa and drive economic growth, technological innovation, and environmental sustainability across the region. It is therefore important that these opportunities be monitored to identify the time when the market growth can trigger the initiation of these projects.

In order to move forward, the following actions are proposed to identify a strategic investment and operating partner to develop a bankable business case. The members of the Steering Committee proposed an alternative business model for the manufacture and assembly of the proposed range of two-and three-wheelers that comprises the following key elements:

- Establish a start-up assembly plant at a selected location in South Africa;
- In a parallel process, determine potential for regional assembly hubs and supply of local manufactured components and sub-assemblies:
- Regional assembly hubs feasibility; and
- Localised component and sub-assembly manufacture.

The proposed detailed bankable feasibility study will be aimed at a more inclusive business model through industrial participation by SSA countries using the hub assembly and distribution model, and localised component and sub-assembly manufacture.

3. MARKET OVERVIEW

The market for electric two- and three-wheelers in Sub-Saharan Africa and South Africa, presents an opportunity for local assembly and component manufacture. The feasibility of achieving economies of scale was evaluated by quantifying these opportunities in the Strategy and Investment Report. An initial assessment of the demand for internal combustion engine (ICE) motorcycles and a subsequent review of imported electric two-wheelers reveal a growing market for electric two-wheelers.

Motorcycle adoption in Africa is defined by the main application of commercial motorcycle-taxi and last-mile delivery services, which have been adopted in countries with high population concentration and low income. South Africa, in particular, has the potential to become a high-technology manufacturing hub for complete component packages (CKD Kits) for export and production across Africa. Current market trends in South Africa demonstrate substantial growth in the two-wheeler market, driven predominantly by the last mile delivery segment.

Market demand modelling suggests that the electric two-wheeler market could account for approximately 50% of the total two-wheeler market in Africa by 2040, potentially surpassing 1.1 million units annually by 2040. In terms of volumes in South Africa, the new sales of electric two-wheelers for the delivery market alone are expected to grow to 2 275 units* annually by 2034. It is evident that the SA market alone will not sustain a viable localisation initiative

* Given the limited availability of publically accessible information and reliance on eNatis data. The projects for the South African market is off a very low basis. Therefore even with aggressive growth projections the annual forecasted figures still remain low.

and the African market needs to be targeted in such an initiative.

However, several challenges must be addressed to promote the electric two-wheeler market in Africa. These include the demanding African road infrastructure that leads to significant vehicle wear-and-tear, the need for reliable and extensive charging infrastructure, the availability of high-quality batteries for low-volume African buyers, and the notable lack of specialised skills in this area. By addressing these challenges in the motorcycle design, providing quality, cost effective batteries and supporting skills development, the proposed assembly plant in South Africa can achieve a market share (circa 4% of the African market for two- and three-wheelers) that should justify an assembly facility, with volumes growing to circa 60,000 units per annum in 12 years.

3.1 Drivers of Demand for Two- and Three-Wheelers in Africa

In many African countries, the economic, social, and other factors driving the increase in commercial motorcycles are robust. Factors that contribute to this trend include continued population growth, rapid urbanization, poor road conditions, inadequate infrastructure for walking and cycling, and limited employment opportunities for young people.

Motorcycles have become a popular solution to the lack of transport infrastructure in many underdeveloped regions, serving not only as a mode of transportation but also as a means of employment. The figure below presents driving forces behind the increasing demand for motorcycles.

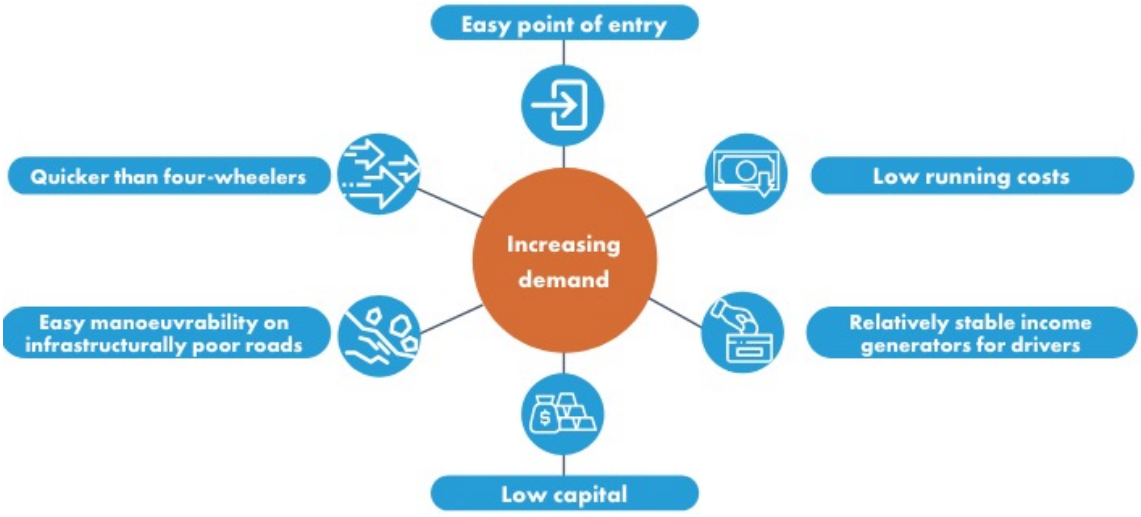


Figure 1: Driving Forces of Demand for Motorcycles in Africa

Source: PRE-E Mobility Report

Despite various challenges, the commercial market for motorcycles continues to thrive and attracts necessary investment into the sector. In some African countries, motorcycle riders benefit from government support through policy regulation and incentives such as import duty exemption, which promotes increased investment and market participation across the sector.

Policies need to support domestic development, especially industrialisation. This objective will be greatly facilitated by regional integration and the development of regional value chains as has happened within SADC and will develop further under the African Continental Free Trade Area (AfCFTA). The levers of the AfCFTA include tariff phase downs, appropriate and harmonised rules of origin, the removal of non-tariff barriers (NTB's) and enhanced trade facilitation (UNDP). In the automotive sector, the rules of origin still need to be finalised to enable free automotive trade across the continent. The deepening of regional integration creates the potential for scale and specialisation thereby greatly enhancing the possibilities for industrialisation including NEVs.

According to the United Nations Conference on Trade and Development (UNCTAD, 2021), the automotive industry is the sector which will benefit most from regional integration in Africa.

3.2 The Case for Electric Motorcycles

There are significant user benefits of riding an electric two-wheeler versus an ICE-two-wheeler motorcycle. These include faster acceleration, less noxious fumes and smoke, fewer vibrations, and less noise. Furthermore, electric motorcycles introduce maintenance and repair savings for drivers when compared to ICE two-wheelers (lower total cost of ownership). The global electric vehicle (EV) market is expected to reach 80% of sales across all segments by 2050, with the three main drivers for this transition being:

- Increased regulation in support of EVs
- Changing consumer behaviour
- EV and charging technology

Globally, OEMs are making commitments to cease production of ICE vehicles, meaning that, over time, new vehicles purchased will inevitably be NEVs. Sub-Saharan Africa remains largely reliant on ICE motorcycles for transportation and employment opportunities. This reliance on ICE motorcycles comes with relatively high running costs and long-term environmental implications from the use of fossil fuels. The electric motorcycle sector presents a viable solution to the challenges caused by high-polluting, costly ICE vehicles.

The lower operating and maintenance costs of electric motorcycles allows drivers to generate higher profit margins from the same revenue base, leading to higher earning potential and improved livelihoods. Electric motorcycles also have the potential to foster local economic development and create jobs across manufacturing and supply chain activities as they comprise fewer components and can be assembled in-country.

The cost of ownership differential between ICE and e-bikes is illustrated in a study published in Green Energy and Intelligent Transport 2 (2023), presented in the graphic below.

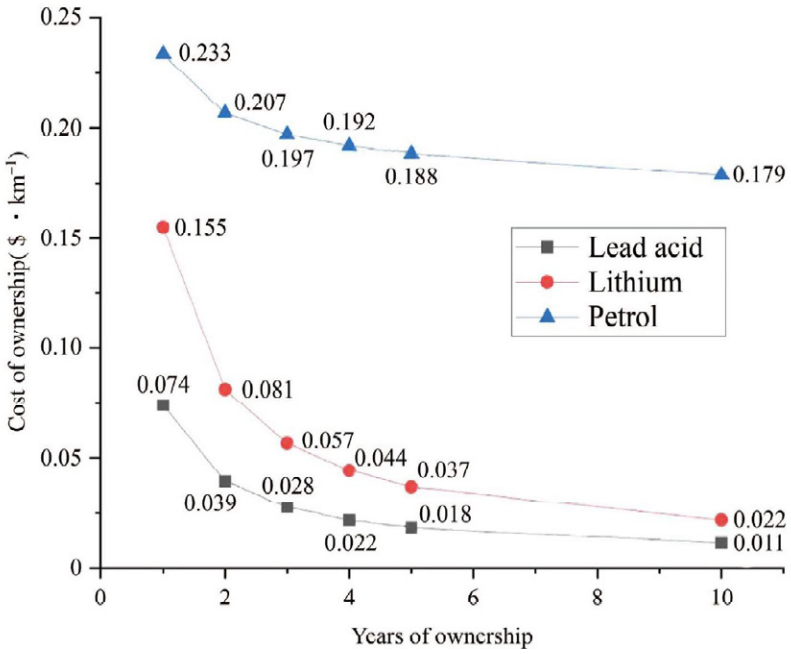


Figure 2: Cost of Ownership Differential Between ICE and Electric Two-Wheelers

Source: Green Energy and Intelligent Transport (2023)

The feasibility of owning an e-bike over an ICE motorbike illustrates the cost benefit of operational costs over time with the prices of fuel vs the price of electricity. The benefit and potential cost saving is more evident in rural areas where electricity can be provided using renewable energy sources (such as PV and wind) and where the transport and storage costs of fuel becomes prohibitively expensive.

New electric motorcycles are priced marginally more expensive than ICE motorcycles, with the battery making the electric motorcycle more expensive. Battery costs are falling significantly as manufacturers attain economies of scale and production efficiencies, along with the general shift toward lower-cost LFP batteries. Latest reports show that battery cost have halved in a space of a year, to about $53/kWh in China by 2024, making up less than 30% of the battery electric vehicle's value[1].

In sub-Saharan Africa, two-wheelers are predominantly purchased new, with more than 9 in 10 two-wheelers being purchased for commercial use as taxis or delivery services. Commercial use results in a higher average distance travelled per vehicle, which improves the TCO of the electric two-wheeler versus the ICE two-wheeler. Due to the small battery size of electric two-wheelers, they can be charged via a mini-grid, making them suitable for use in locations with low access to reliable electricity grid-infrastructure. They can also benefit from a battery-swap model, in which a depleted battery is replaced with a fully charged battery from a designated "swap station" in just a few minutes.

These factors strengthen the case for more widespread adoption of electric two-wheelers in sub-Saharan Africa, following the trend seen in Asia. Several start-ups are investing in the region's nascent electric two-wheeler space to design vehicles at a cost and durability suitable for the local market. For example, Opibus (now ROAM) in Kenya is investing in local R&D and assembly to build an electric motorcycle tailored to the needs of local *boda boda* drivers. Companies such as Ampersand in Rwanda are also developing a network of battery-swapping stations to enable two-wheeler drivers to exchange depleted batteries for fully charged batteries on the go.

Even with this emerging use case, there are still challenges to overcome. Issues include the higher up-front price point for electric two-wheelers versus ICE two-wheelers (estimated at $1,700 in mid-2021 versus $1,000 in Kenya in 2024), poor quality batteries and unknown battery lifetime data given that motorcycles in sub-Saharan Africa travel further than those in Asia, and the cost of battery swapping.

Another major issue is the financing of e-bikes and credit worthiness of drivers. The capital market for financing e-bikes is not well established. This means that even though drivers want to switch to e-bikes, they might not be able to.

Despite these challenges, the TCO for electric two-wheelers are favoured. Even with a higher up-front cost, the electric two-wheeler is 25% cheaper over a five-year life cycle compared with an ICE two-wheeler.

3.2.1 The African Market Demand for ICE Motorcycles

An assessment of the African ICE motorcycle market was conducted based on available literature and import statistics from ITC website[2], as reflected in the following table for 2022. The ICE motorcycle import demand in Africa is estimated at 1.4 million units in 2022 at a value of USD2.5 billion.

[1] https://www.bloomberg.com/news/newsletters/2024-07-09/china-s-batteries-are-now-cheap-enough-to-power-huge-shifts
[2] ITC. https://intracen.org/resources/data-and-analysis/trade-statistics

Table 1: ICE Motorcycle Demand in Africa (2022)

ICE Motorcycles	GDP US$ Billion	Per Capita GDP	2022 US$	2022 Units
Egypt	398	3,770	52,760,000	32,975
Nigeria	390	1,755	1,244,659,752	691,478
South Africa	381	6,191	109,013,000	27,253
Algeria	224	4,875	51,024,000	31,890
Ethiopia	156	1,473	55,665,000	34,791
Morocco	147	3,980	108,826,000	68,016
Kenya	113	2,188	150,100,000	93,813
Angola	94	2,550	77,100,000	48,188
Tanzania	84	1,327	154,626,000	96,641
Ghana	77	2,329	52,500,000	32,813
Uganda	52	1,163	156,613,000	97,883
Senegal	31	1,715	16,393,000	10,246
Zambia	30	1,436	9,039,000	5,649
Rest of Africa	692		706,837,501	428,864
TOTAL	2869		2,487,020,836	1,412,928

The above table reflects the concentration of ICE motorcycles in East Africa and Nigeria as opposed to South Africa and Egypt that are amongst the top 3 economies on the continent. The two-wheeler market in Nigeria is almost the same size as the estimated new vehicle sales in Nigeria (estimated at USD1.2 billion per annum), clearly indicating its economic contribution.

3.2.2 The African Market Demand for Electric Motorcycles

The current market for electric two wheelers in Africa and South Africa is limited. Total imports amounted to just $33,7 million in 2022, but this was almost double the previous year and up from $9.7 million in 2018. South Africa currently dominates electric two-wheeler imports into Africa, accounting for 37% of the total imports in 2022. Costs are a key factor in accelerating the transition.

Table 2: Electric Motorcycle Demand in Africa (2022)

ICE Motorcycles	GDP US$ Billion	Per Capita GDP	2022 US$	2022 Units
Egypt	398	3,770	574,000	319
Nigeria	390	1,755	217,000	181
South Africa	381	6,191	17,382,000	4,966
Algeria	224	4,875	34,000	24
Ethiopia	156	1,473	478,000	341
Morocco	147	3,980	6,961,000	3,867
Kenya	113	2,188	690,000	575
Angola	94	2,550	51,000	43
Tanzania	84	1,327	330,000	273
Ghana	77	2,329	80,000	44
Uganda	52	1,163	24,000	13
Senegal	31	1,715	33,000	18
Zambia	30	1,436	67,000	37
Rest of Africa	692		6,830,250	2,595
TOTAL	2869		33,751,250	13,300

**Key assumptions used in determining the African market for electric 2-wheelers, included various publications and analysis of several country import statistics from ICT database.[3] Import data for fully assembled 2-wheelers were considered for the model.*

Electric motorcycles have been a popular EV choice for retailers in Africa, making up 75% of available electric two- and three-wheel models, yet total uptake remains low. A lack of financing for e-motorcycle importers and limited charging and swapping infrastructure has dampened deployment. Currently, there are less than 20,000 electric motorcycles deployed in Africa, or less than 0.5% of the entire motorcycle fleet on the continent – but growth is accelerating due to the ease of assembly and the lower cost of ownership. The electric motorbike has a significant advantage in rural areas – the batteries can be readily recharged using a local PV installation thus negating the dependency on expensive fuel that has to be transported (imported) at high cost. Poor road infrastructure contributes to unreliable delivery of fuel and storage is costly and exposed to theft.

According to projected electric market growth trends and AIH's own modelling, the electric two-wheeler market has the potential to grow to circa 50% of the total two-wheeler market by 2040, in line with a report by McKinsey[4]. To achieve this projected market penetration, the CAGR for the sales of electric motorcycles should be in excess of 25% per annum. Based on the projected growth of electric motorcycle sales in Africa at 4% per annum in volume, the sales of electric motorcycles could exceed 1.2 million units in 2040 as seen in the graph below. This is more conservative than the projections by McKinsey (see following page).

[3] ITC. https://intracen.org/resources/data-and-analysis/trade-statistics
[4] McKinsey&Co. 2022. Power To Move. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/power-to-move-accelerating-the-electric-transport-transition-in-sub-saharan-africa

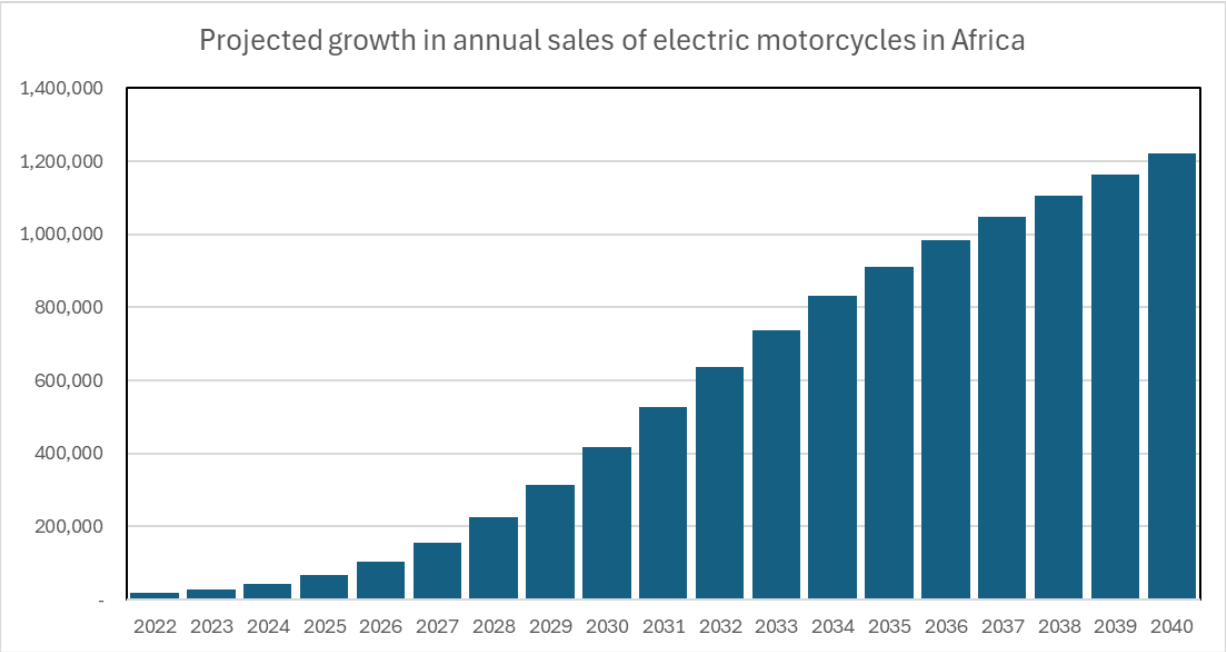


Figure 3: Projected Growth in Annual Electric Motorcycle Sales, Africa

Traditionally, the rate of electrification has been under 5% across all major two-wheeler markets with the important exception of China where it is much higher, approximately 15%. Obstacles to growth in EV adoption for African markets include higher acquisition costs, limited product options from incumbents, and the lack of finance and charging ecosystems. However, most of these issues are being addressed such as the significant improvements in battery technology (electric two-wheelers are no longer limited by range), and as scale of manufacture increases, the price differential decrease leading to the TCO of electric two-wheelers being on par with (and better than) ICE vehicles in many regions.

A recent report from McKinsey indicates that two-wheelers will electrify fastest, with electric two-wheeler sales rising to 50% - 70% of global sales by 2040. In Kenya and Nigeria alone - two of the largest two-wheeler markets in sub-Saharan Africa - would translate into 3 million to 4 million electric two-wheeler sales per year by 2040.[5] The McKinsey report states that by 2040, the demand for electric two wheelers in Africa will be over 3 million pa.[6]

Electric motorcycles lend itself to ease of assembly and imports of Complete Knock Down (CKD) kits comprising various discrete parts into Africa is a common phenomenon. Imported parts include frames, brakes (front and rear), electric harness, tyres and rims, front and rear shock absorbers, electric drive and control system, a battery management system, batteries and auxiliary systems. By manufacturing components locally, the value proposition of a Semi Knock Down (SKD) plant in SA lies in competitive prices and a quality advantage over the rest of Africa.

From McKinsey's report and the above, it is clear that growth in the electric motorcycle segment, is expected in Africa. This presents a big opportunity for South Africa to become a manufacturing base (SKD plant) of the complete package of components (SKD kit) for export and motorcycle assembly elsewhere in Africa.

To achieve economies of scale, a level of standardisation in the market will be required. This implies that the market does not support multiple motorcycle OEMs. Standardisation of battery packs and associated infrastructure for utilisation by all electric delivery two-wheelers is needed. If not, the above market will be fragmented and achieving economies of scale for each OEM may become challenging.

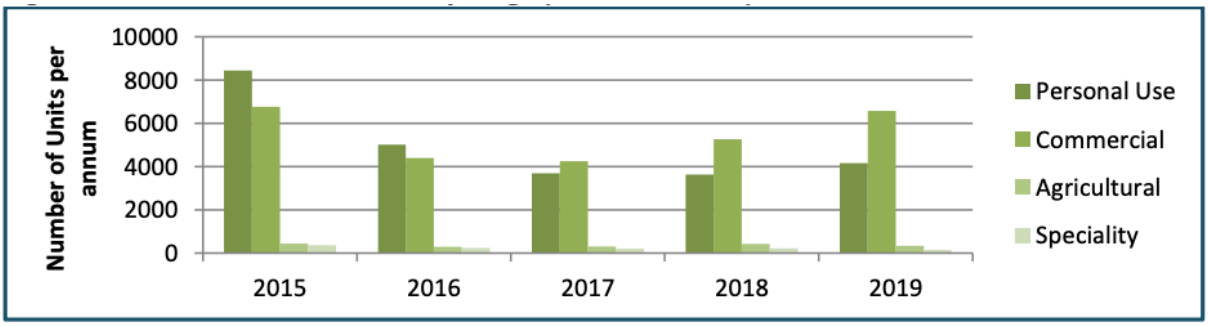
[5] McKinsey & Co. 2022. Power To Move. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/power-to-move-accelerating-the-electric-transport-transition-in-sub-saharan-africa

[6] McKinsey & Co. 2021. Green Africa. https://www.mckinsey.com/capabilities/sustainability/our-insights/green-africa-a-growth-and-resilience-agenda-for-the-continent

3.2.3 The South African Last-Mile Delivery Market Demand

Assessing the market trends in South Africa, it is clear that there is growth in the South Africa last-mile delivery two-wheeler market, albeit from a low base, as depicted below. This current growth is underpinned by the growth of the *delivery market segment*. This growth is mainly contributed to the increase of e-commerce delivery services in South Africa, such as Checkers Sixty 60, Woolies Dash, Pick n Pay asap!, and Uber Eats. Uber Eats and Mr D Food collectively account for 90% of South Africa's fast food delivery market. In terms of volumes, the new sales of electric two-wheeler delivery market are expected to grow from a level of an estimated 210 motorcycles per annum in 2023 to 2,275 per annum by 2034. Refer to Annexure B for more detailed modelling of the growing demand of electric motorcycles in the South African last-mile delivery sector.

The last mile delivery market, however, only represents a segment of the motorbike market in South Africa. South Africa has various types of motorcycles that respond to the needs of the different domestic market segments, i.e. recreational, competition, commercial, and agriculture. The graph below draws attention to the usage of Class A (up to 150cc engine) motorcycles and shows clearly that purchases for personal use have fallen while sales for commercial use have increased strongly[7].



Source: AMID, 2020

Figure 4: South Africa Class A Sales by Usage

3.3 Market Competitiveness

The following represents the horsepower, price, top speed and fuel consumption of ICE motorcycles:

- Big Boy Commercial 150cc
  - Price: R16 799,00
  - 70km/h top speed
  - Energy: 2,4L/100km
- Big Boy Commercial 200cc
  - Price: R20 999,00
  - 80km/h top speed
  - Energy: 2,5L/100km

The following represents the price, battery warranty, top speed, battery charge time and range of electric motorcycles:

- EWIZZ – Buzz electric scooter
  - R65 000 - 5 year/50 000 km battery warranty
  - 3 kw drive train with a top speed of 65 km/h

[7] https://www.tips.org.za/images/Motocycle_components_-_post_covid_industrial_development_projects.pdf

  - 72V 3.88 kWh LiNCM battery – 4-hour charge time
  - Average range is 100 km @ 50 km/h
- SKOOTA – Skoota electric scooter
  - R 65 000 – 3 year 40 000km warranty
  - 1,5kW motor with 65km/h top speed
  - 2kWh Lithium battery – 4-hour charge time
  - 65km to 95km range
  - Swappable battery pack

The current estimated cost price including a battery for an electric two-wheeler is about R65 000,00 in SA, the battery attributing to 20% - 30% of the cost price. The current average cost price for a typical ICE motorcycle used for commercial purposes in SA is R19 500,00. This shows that battery cell sourcing is the largest cost item for electric two-wheelers. If battery packs are provided on lease principle through a swapping BaaS (Battery as a System) model, and excluded from the original purchase, price parity can be achieved and TCO will be lower than for ICE two-wheelers.

The market competitiveness of a SKD plant also depends on efficient distribution channels. ICE and EV motorcycles can be distributed to local and sub-Saharan African markets through the following channels: agents, dealerships and pop-up shops. A diversity of distribution channels is recommended for Africa because it mitigates supply chain risks such as custom hold-ups, political issues and weak infrastructure across Africa. In addition to the forementioned, the development of aftermarket skills in the target markets will also support market penetration.

3.4 Three-Wheeler Environment

Africa electric three-wheeler market is anticipated to grow at a CAGR of 12.54% during the forecast period between 2023 and 2030. [8,9] Dominated by the Asia Pacific region, the global electric three-wheeler market size was valued at USD 751.94 million in 2021 and will register a CAGR of 8.23% during the forecast period till 2030.

The demand for electric three wheelers is rapidly expanding in many African countries, boosting imports and sales. The Asia-Pacific and Africa three-wheeler market was valued at $3.05 billion in 2021, and is projected to reach $5.58 billion by 2031, registering a CAGR of 6.5% from 2022 to 2031.

Three wheelers are ideal for deliveries of medium sized goods that are bigger in size and volume. A good local example of this is MellowVan, targeting a production of 30-40 vehicles per month in the near future. Refer to Annexure C for a pricing over view of three-wheelers in SA.

Three wheelers go by many different local names, including *bajaji* in Tanzania, *yellow-yellow* in Ghana, and *keke napep* in Nigeria. They are more commonly found in coastal East Africa and in Sahelian West Africa. Generally, they tend to be more present in cities and towns with flatter landscapes, partly due to their low ground clearance making them less fit for dirt roads and because of their relatively small engines (around 200cc) and heavy payloads. *Tuktuks* provide two common types of passenger service in African cities: on-demand door-to door and shared arterial routes. In some places, they have come to challenge minibuses. In some cities such as Dar es Salaam there have been attempts at pushing out motorcycle-taxis in favour of tuktuks, due to tuktuks being perceived as safer than motorcycles.

In terms of transportation services, passenger tuktuks occupy a flexible ground from a commercial door-to-door ride-hailing service to a route-based service, sometimes serving both on the same trips.

There are a wide variety of cargo tuktuks, but they are all three-wheeled vehicles that are built for not more than two passengers seated next to the driver with a cargo compartment that is either open-air or a closed box.

[8] https://www.marketsandata.com/industry-reports/africa-electric-three-wheeler-market
[9] https://www.alliedmarketresearch.com/asia-pacific-and-africa-three-wheeler-market-A31692

Delivery tuktuks engines and specifications are typically in the same range as passenger tuktuks, being around 200-250cc. Open air truck bed tuktuks are quite common in cities' trading entrepots, used for all manner of items including agricultural and hardware goods in Africa.

3.5 Conclusion

The conducted modelling confirmed the market demand and growth opportunity for electric motorcycles in Africa and South Africa. The major growth will be over the next five years and if entrance in this market is not achieved soon, the early growth opportunities will subside and achievement of economies of scale in the long term will be dependent on a flattened annual growth and replacement market.

While motorbikes are currently less popular in South Africa, the demand for motorbikes in Africa necessitates that in order to achieve economies of scale, the SSA market opportunity needs to be considered. Based on the projected growth of electric motorcycle sales in Africa at an average growth rate exceeding 25% per annum in volume (straight line growth)[10], the sales of electric motorcycles could exceed 1.1 million units in 2040.

To achieve economies of scale, 4% market penetration by 2036 into the African market is considered. This is deemed achievable due to the highly competitive African market. The South African market for two-wheelers is significantly smaller than the demand in a number of African countries, where two-wheelers provide affordable transportation solutions. The projected export volumes into Africa are assumed to contribute to 75% of the total estimated production volumes, while the local market accounts for 25% of the total production volume.

The Africa electric three-wheeler market is anticipated to grow at a CAGR of 12.54% during the forecast period between 2023 and 2030. Three wheelers are ideal for deliveries of medium sized goods that are bigger in size and volume.

The establishment of a two- and three-wheeler sector across the continent would create opportunities for the establishment of additional manufacturing/assembly hubs, as more countries participate, creating a much larger market for the export of kits.

The value proposition is represented by a large and growing national and continental market for conventional motorcycles that is transitioning to electric power. This industry will be facilitated by growing regional integration of trade made possible by the adoption of AfCFTA. The deepening of regional integration creates the potential for economies of scale and specialisation thereby greatly enhancing the possibilities for industrialisation that encompasses NEVs. It is, therefore, possible to foresee the development of a significant regional automotive value chain in which South Africa plays a key role, eventually incorporating a number of other countries across the continent

[10] The projected growth in demand for electric motorcycles (2- and 3-wheeler) is premised on the Gompertz S-curve model with two inflection points: comprising an initial slow growth followed by a rapid growth, reaching a saturation point based on market penetration, and normalised growth thereafter.

4. TECHNICAL OVERVIEW

Establishing a manufacturing and assembly facility for electric and internal combustion engine (ICE) two- and three-wheelers in South Africa involves a technical overview to guide implementation and operation. Initially, the plant will function as an assembly facility using Semi Knocked Down (SKD) kits, with plans for future expansion to a Complete Knock Down (CKD) facility that is supported by local component manufacturers.

Considerations in this technical overview include site selection, plant design, the manufacturing process, technology options, tools and equipment, suppliers of materials, and the necessary manpower and skills. This technical overview provides a roadmap for establishing a manufacturing and assembly facility, positioning South Africa as a key player in the production of electric and ICE two- and three-wheelers.

4.1 Production Volumes

To achieve economies of scale, a 4% market penetration by 2036 into the African market is considered (Table 14 in Annexure A: Financial Forecast). Based on the demand forecasts, the South African market sales initially comprise circa 30% of projected sales and as the sales into sub-Saharan Africa (SSA) increases. SSA sales contribution to revenue then increases to more than 85%.

Production volumes take into account the motorcycle market for Africa and South Africa. Due to the highly competitive African market, export volumes into Africa are assumed to contribute to 75% of the total estimated production volumes, while the local market accounts for 25% of the total production volume. Production volume detailed calculations are shown in Table 15 in Annexure A: Financial Forecast .

The first year is used for establishment and preparation of the facilities and no production is forecast for this period. The number of units and production output is phased in over the first year to establish operations.

The graph below depicts how the production volumes of ICE two- wheelers (blue) slowly decline over the 12 year period. The production volumes for EV two-wheelers (red) is projected to gradually increase during the first 5 years whereafter these volumes increase rapidly (in line with Gompertz growth model) and is projected to reach just under 45,000 units per annum, whereafter a more moderate growth would most likely be achieved. The ICE three-wheeler volumes increase marginally over the 12 year period and is projected up to a maximum of about 1 000 units per annum. The EV three-wheelers see a gradual increase and is projected up to a maximum of circa 10 000 units per annum.

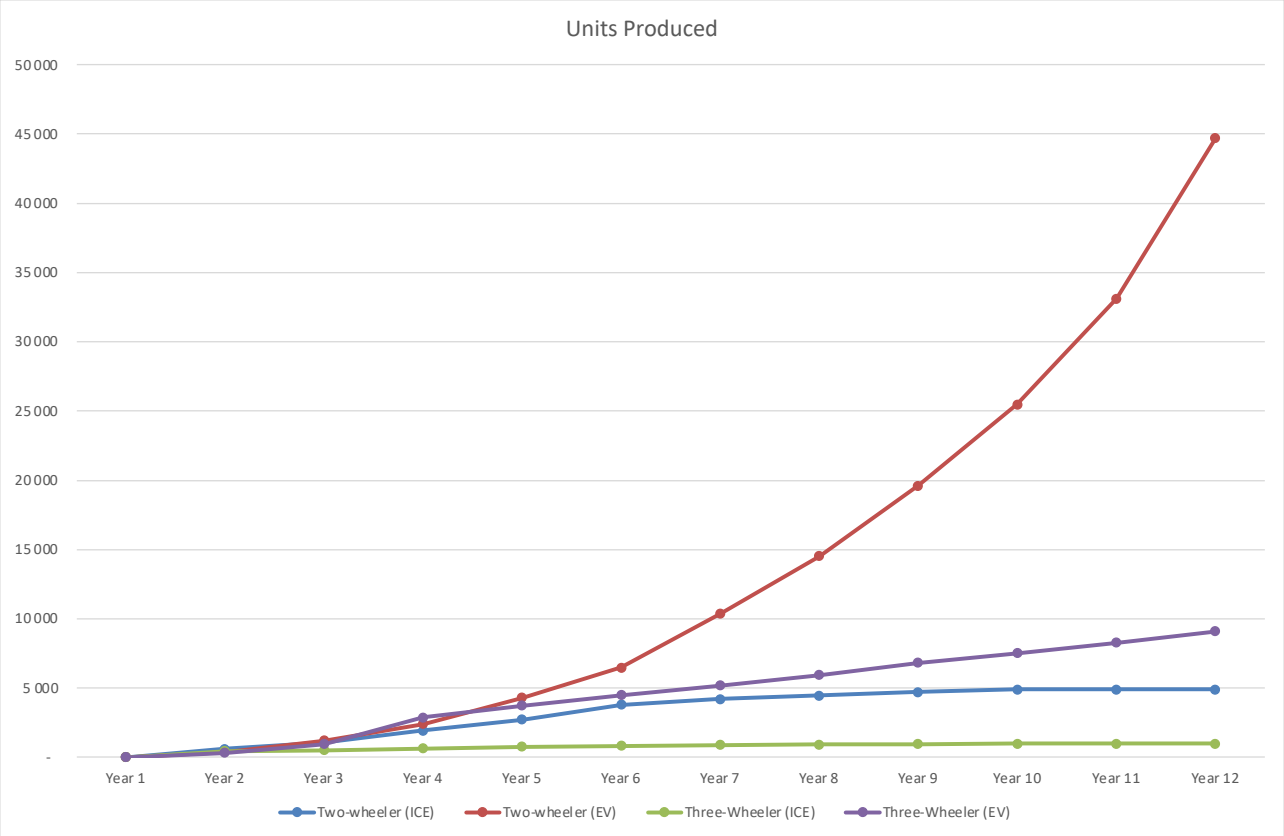


Figure 5: Units Produced

4.2 Design of plant

Refer to the facility layout in the figures below. The plant is designed to accommodate the assembly of four products, namely electric two-wheeler, ICE two-wheeler, electric three-wheeler and ICE three-wheeler. Four facility layout designs are included below to envisage the expansion of the plant as production volumes increase.

- The first facility layout in Figure 6 is designed for year 1 to year 3 of operations. This layout supports initial production volumes, starting in year 2 at 1 776 units per annum. The facility includes four assembly lines that are designed with the capacity to expand, allowing production to increase. This facility has a volume capacity of 6404 units pa.
- The layout in Figure 7 is designed for year 4 to year 7 of operations. This layout supports production volumes starting at 7 860 units per annum. This facility has a volume capacity of 10 561 units pa.
- The facility layout in Figure 8 is designed for year 7 to year 10 of operations. This layout supports production volumes starting at 21 625 units per annum. This facility has a volume capacity of 30 957 units pa.
- The layout in Figure 9 is designed for year 10 to year 12 of operations. This layout supports production volumes starting at 26 417 units per annum. This facility has a volume capacity of 60 000 units pa.

All of the facility designs include on-site warehousing, enabling products to be loaded directly onto the assembly lines from the storage area. Adequate office space is also available to support administrative functions.

As part of the plant's expansion plan, it is envisaged that the production of product frames and body panels will be supplied by local manufacturers. Battery box assembly is done as sub-assembly process on site, while the cell will be outsourced and the battery module will be delivered to the assembly line as a sub-assembly unit.

Considerations when selecting the assembly and manufacturing site might include: the facility should have a minimum internal height of 8.5 meters and be as open as possible, minimising the number of internal pillars. Essential features include a trucking yard, load-level docking stations, and drive-in access on opposite sides of the building. Additionally, ample space for future expansion would be advantageous.

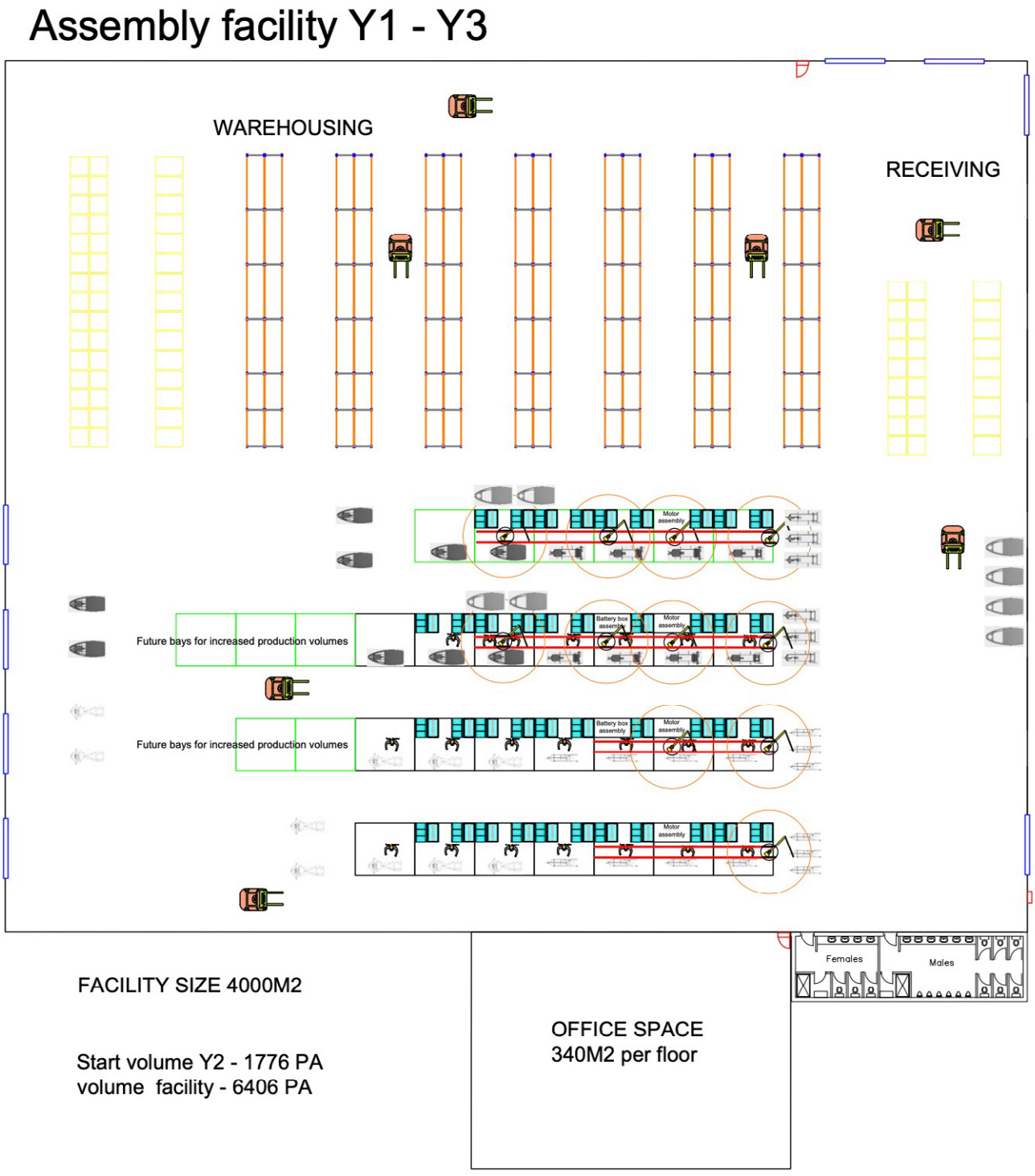


Figure 6: Assembly Facility Layout 1

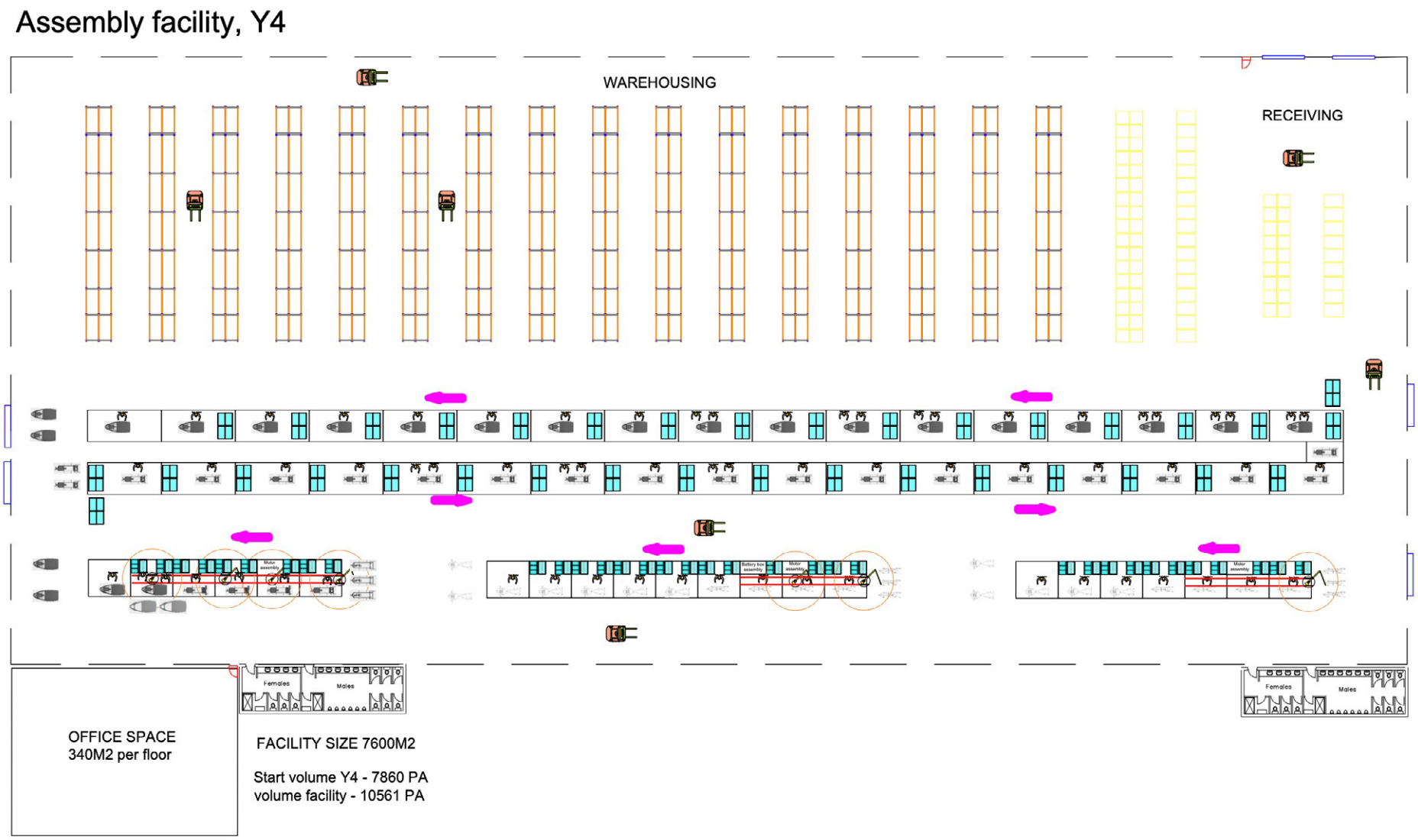


Figure 7: Assembly Facility Layout

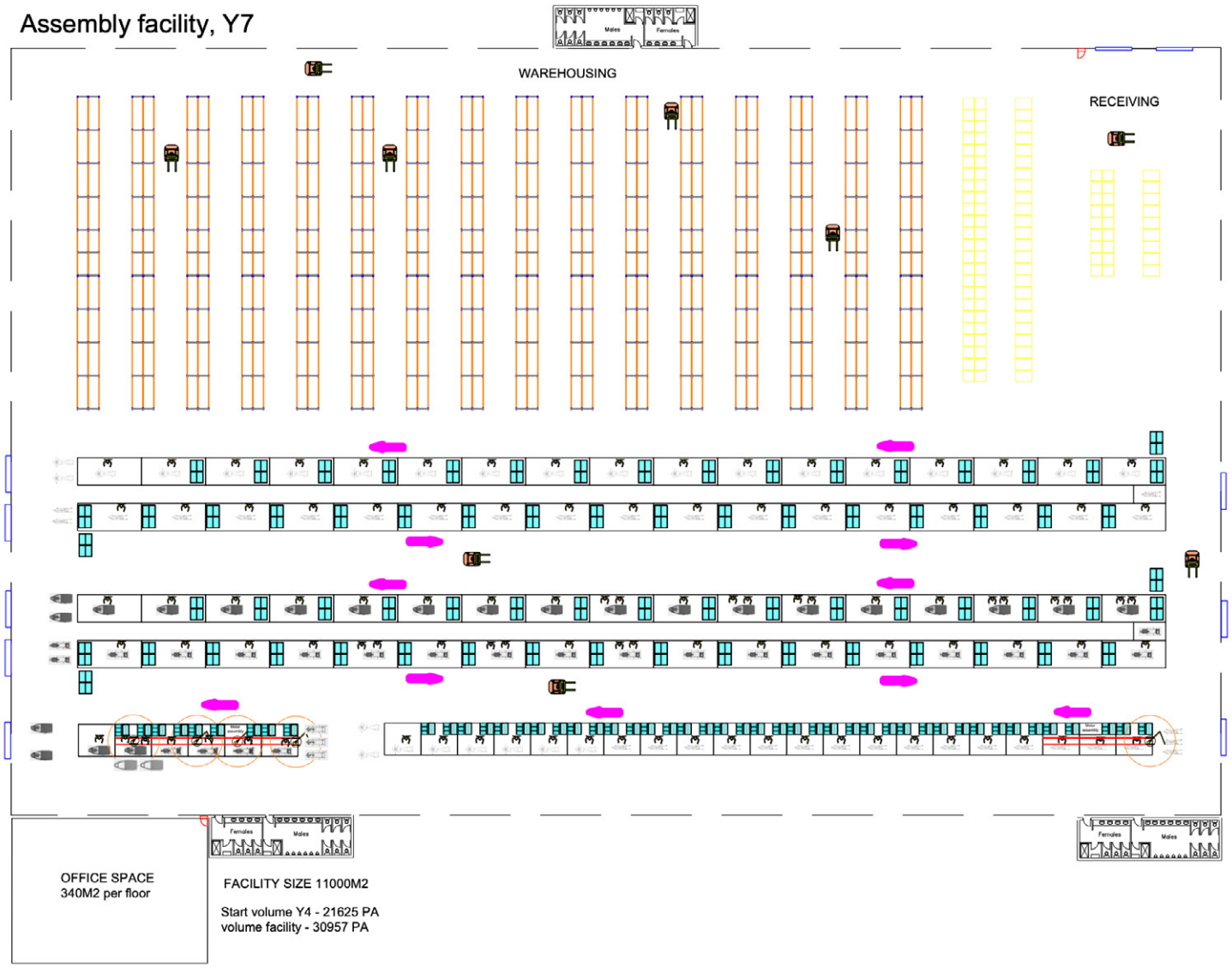


Figure 8: Assembly Facility Layout 3

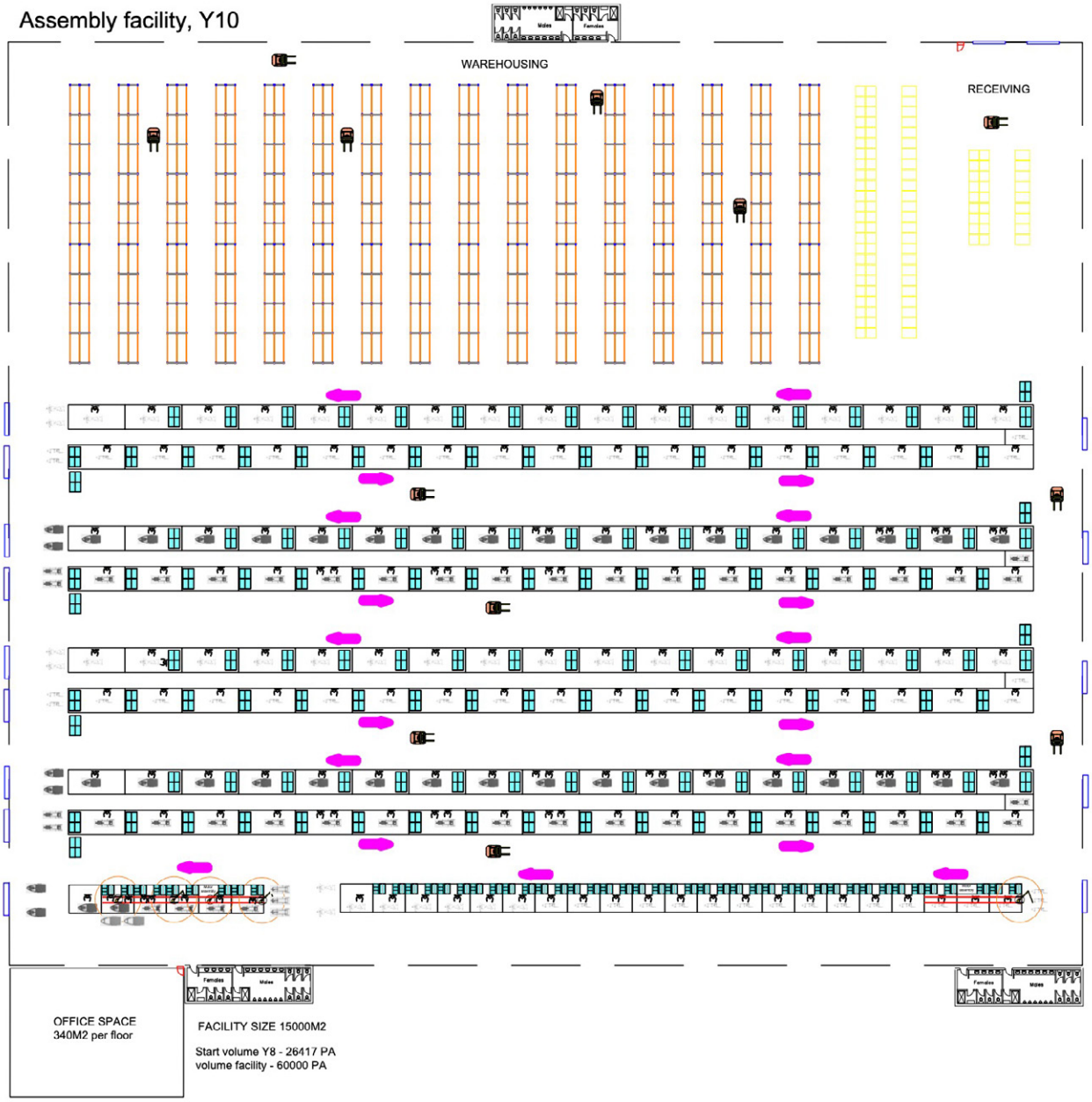


Figure 9: Assembly Facility Layout 4

4.3 Manufacturing/assembly process

The initial production will utilise full kits, with assembly lines organised into stations, each followed by a quality control and test station. Each station is dedicated to specific tasks to ensure an efficient workflow. The breakdown of tasks for the Semi Knocked Down (SKD) assembly process is as follows:

- Station 1: Loading the chassis/frame and fitting harnesses and brake lines.
- Station 2: Installing the motor and suspensions.
- Station 3: Installing the battery box and control unit, or fuel tank and fuel lines.
- Station 4: Fitting the console, steering, and controls.
- Station 5: Installing body panels.
- Station 6: Fitting seats, trim, and wheels.
- Station 7: Conducting quality control inspection and testing.

As production volumes increase, the work assigned to each station will be reduced, and the assembly line will be extended to accommodate a faster line speed, thereby enhancing overall productivity.

4.3.1 Technology options

No major technology will be required initially for this facility. The assembly process will begin with Semi Knocked Down (SKD) kits, followed by an expansion to become a Complete Knocked Down (CKD) facility. With the plant expansion, robotic welding could be considered as an option to enhance efficiency and precision.

4.3.2 Tools, equipment and suppliers

The plant design to accommodate movement of kits and components and assembled products, and support ease of manual tasks, included:

- Overhead hoists at certain stations.
- Tools will predominantly be electric smart tools.
- Ultimately, when volume production increases, in the final facility, the use of conveyors are envisaged.
- Product-specific trolleys will be needed for each assembly line. Quality control equipment for electronic testing and torque monitoring will also be required.

Suppliers of components such as frames, tyres and harnesses etc. will be selected based on their proximity to the plant, technical expertise, and capacity. Initially, components will be supplied as kits from selected industrial partners and suppliers that will be identified in a later stage of the project.

Battery box assembly is done as sub-assembly process on site, while the cell will be outsourced and the battery module will be delivered to the assembly line as a sub-assembly unit.

The design variations envisaged for the range of products, will require significant investment in a press shop/ stamping plant tools and dies. Given the current scale of production, in this project, the proposed plant and equipment therefore does not include a paint and press shop. The pressed components will be sourced from from selected industrial partners and suppliers that will be identified in the next, bankable feasibility stage of the project.

4.3.3 Material supply

Initially, components will be supplied as complete SKD kits. Where possible, local components will be sourced based on availability at the time, such as tyres, rims, and batteries. As the volume increases, the kit will be streamlined to a condensed list, transforming the plant into a CKD facility where steelwork, GRP (glass reinforced plastic) tubing, and product painting are carried out internally. Suppliers and supporting industries could also be engaged for steelwork and GRP instead of handling them in-house which is ultimately the preferred option to enhance the competitive position in the market.

4.3.4 Manpower and skills

The skill level required on the assembly line can begin with unskilled labour trained in specific assembly procedures. Skilled operators will be needed for quality control and testing. Technical staff, supply chain management, finance and administration, and production management roles will require skilled personnel.

The staff complement increases from 39 people to 198 people by the 10th year of operation as production volumes increase. The first year is used for establishment of the facilities and training of assembly staff. Production commences in the second year.

4.4 Site selection

The site selection for the facility should prioritise proximity to the supply line, ideally within an Special Economic Zone (SEZ) area. Exports are anticipated, therefore a coastal location would be more suitable to facilitate shipping logistics. Utilising a lease facility is advisable, taking advantage of existing open facilities to expedite setup.

Considering green manufacturing and SEZs in South Africa is an important element of government initiatives to support de-carbonisation and transition to sustainable manufacturing. SEZs have been developed to attract foreign and domestic investment and promote export-oriented industries. After evaluating the eleven SEZs in South Africa in the Strategy and Investment Report, the Atlantis SEZ, the Coega SEZ, the East London Industrial Development Zone (ELIDZ), and the Dube Tradeport SEZ are identified as the most suitable location for the manufacturing and assembly. These SEZs offer necessary infrastructure and incentives to support the facility's operations.

The benefits of operating within a Special Economic Zone[11]:

- **Preferential 15% Corporate Tax**
  Businesses (prescribed in section 24(4) of the SEZ Act) that are in a Special Economic Zone may be eligible for tax relief, including the reduced rate of corporate income taxation. In addition to satisfying the requirements of the SEZ Act, further criteria for some of the available tax incentives are stipulated in the Income Tax Act, 1962 (Act No. 58 of 1962).
- **Building Allowance**
  Businesses and Operators (prescribed in section 1of the SEZ Act) operating within a Special Economic Zone may be eligible for tax relief, including the building allowance, subject to requirements contained in the Income Tax Act.
- **Employment Incentive**
  Businesses and Operators operating within a Special Economic Zone may be eligible for tax relief, including the employment tax incentive subject to requirements contained in the Employment Tax Incentive Act, 2013 (Act No. 26 of 2013).

[11] The dtic. Special Economic Zones. 2024. https://www.thedtic.gov.za/sectors-and-services-2/industrial-development/special-economic-zones/

- **Customs Controlled Area**
  Businesses and Operators located within a customs-controlled area of a Special Economic Zone will be eligible for tax relief as per the Value-Added Tax Act, 1991 (Act No. 89 of 1991), the Customs and Excise Act, 1964 (Act No. 91 of 1964), the Customs Duty Act 2014 (Act No. 30 of 2014) and the Customs Control Act, 2014 (Act No.31 of 2014).
- **12I Tax Allowance**
  The 12I Tax Incentive is designed to support Greenfield investments (i.e. new industrial projects that utilise only new and unused manufacturing assets), as well as Brownfield investments (i.e. expansions or upgrades of existing industrial projects). The new incentive offers support for both capital investment and training.

5. FINANCIAL PROJECTIONS

This section of the report sets out the financial projections for a two- and three-wheeler (electric and ICE models) assembly and manufacturing facility in South Africa. The calculations were done for a SKD (semi-knock-down) assembly plant for the first 4 years, whereafter substantial capital investment in assets are considered to support the transition of the plant into a CKD (complete-knock-down) facility where components such as the steel frame and body panels will be sourced locally.

5.1 Income Statement

The graph in Figure 10 below depicts key financial indicators calculated extracted from a 12-year financial model comprising projected income statements, balance sheet and cash flow statement. The revenue for this project shows a positive, upward trend for a 12 years financial forecast. The gross profit and net profit indicates a slight negative trend from year 1 to year 4, which thereafter turns around to an upwards, positive trend due to the economies of scale being reached.

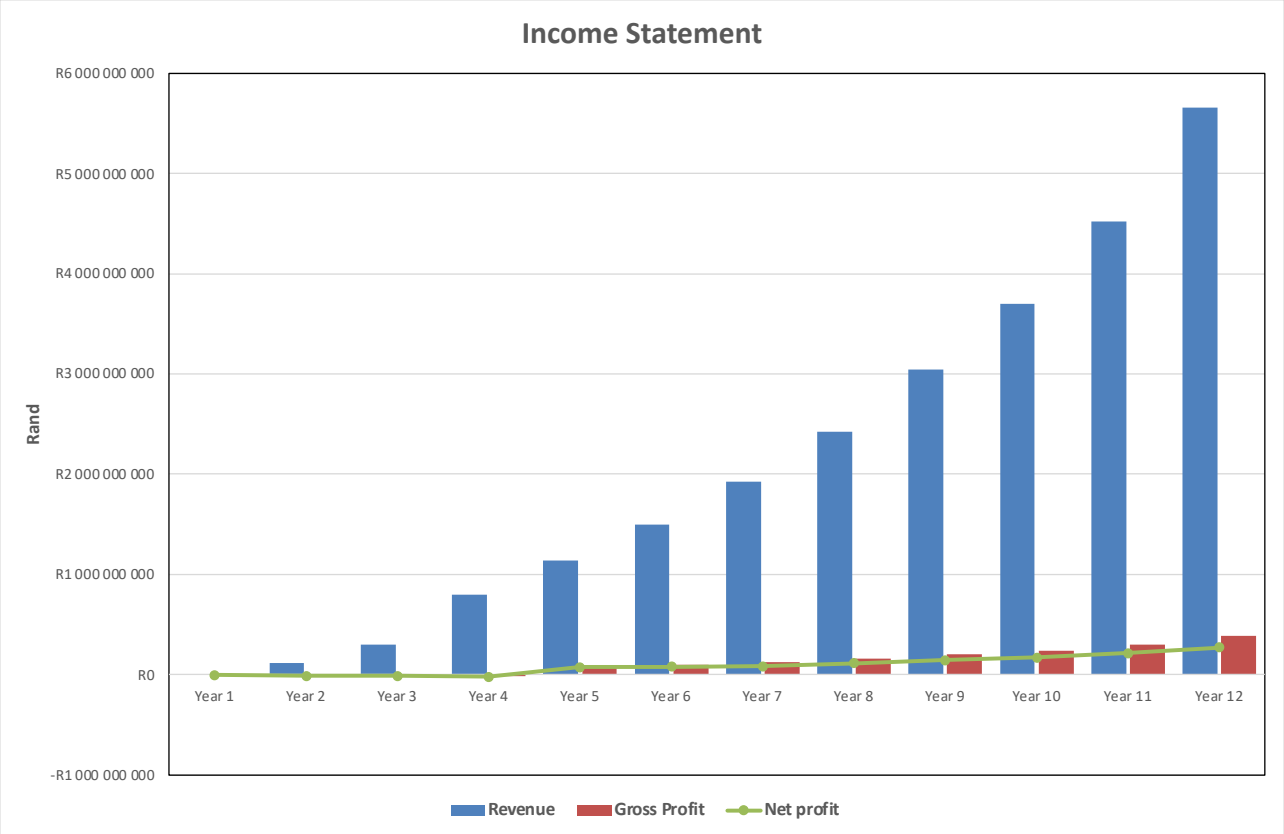


Figure 10: Income Statement for 2/3 Wheeler Plant

Key income statement assumptions include the following:

- Building is rented rather than owned;
  As production and localisation increases, the plant footprint is increased from initial 4 000m^2 to accommodate additional production lines: in year 4 (7 600m^2), year 6 (11 000m^2) and year 9 (15 000m^2);
- Equipment such as forklifts are rented;
- Direct costs comprise initially of imported kits and once localisation is introduced the direct kits costs decrease allowing for slightly higher gross profit margins.

Table 3: Direct Costs

Direct Costs	Direct Cost % Years 1-4	Direct Cost % Years 5 on
Two-wheeler (ICE)	90%	85%
Two-wheeler (EV)	95%	90%
Three-Wheeler (ICE)	90%	85%
Three-Wheeler (EV)	95%	85%

- Other key assumptions related to the income statement:
  - Inflation
    - Sales price = 4.5%
    - Salaries = 6%
    - Utilities = 10%
    - Rent = 7%
- Marketing costs: The ex-factory prices are 10% lower than the projected retail prices to provide profit margin for retailers and agents. The income statement also includes a 2% of revenue marketing costs to cover local marketing and export market development expenses.
- Manpower costs

Table 4: Manpower Costs

First year of Operation	Nr of People	Salary (TCC)	Annual
Staff structure			
General Manager	1	R80,000	R960,000
Finance and Admin manager	1	R65,000	R780,000
Quality control manager	1	R35,000	R420,000
Professional Engineer	1	R65,000	R780,000
Operations manager	1	R40,000	R480,000
Supervisors	4	R22,000	R264,000
Operators	20	R6,000	R72,000
Drivers	4	R8,000	R96,000
Admin staff	3	R8,000	R96,000
Gardener, cleaners etc	3	R3,500	R42,000

The staff complement increases from 39 to 198 by the 10th year of operation as production volumes increase.

- Start of operations: The first year is used for establishment of the facilities and training of assembly staff. Production commences in the second year
- Tax rate = 15% (rates for business established in Special Economic Zone)
- Interest rate on asset finance: 15% per annum and 2% on positive cash balance (conservative – money market rates are currently at 8% per annum or better)

Table 13 in Annexure A: Financial Forecast shows the key financials extracted from the financial model. This table depicts the following information: project turnover, gross profit and gross profit margin, net profit and net profit margin. Fixed assets, working capital, current assets, current liabilities and cash are also included. Debt/equity was calculated at 14% in year 1 (to make provision for initial loan funding for fixed assets). Initial loans are repaid by the 4th year. Return on assets and return on equity are also shown in Table 13.

5.2 Balance Sheet Assumptions

The projected balance sheet includes the following assumptions:

- Plant and Equipment:
  Battery box assembly is done as a sub-assembly process on site, while the battery cells will be procured from established suppliers. The battery module will come in assembled and delivered to the assembly line.

  The proposed plant and equipment does not include a paint and press shop. Pressed and painted parts will be sourced from selected industrial partners and suppliers that will be identified during the final feasibility phase of the project.

  The use of conveyors are envisaged once production levels justify increased automation, which contributes to an incremental increase in investment.
- Factory expansion to accommodate increased production volumes and localisation (assembly complexity) as more parts are locally manufactured:

Table 5: Fixed Assets

	Year 1	Year 4	Year 6	Year 8	Year 10
Fixed assets (Rand)					
Plant and Equipment	3,964,500	15,977,100	33,996,000	49,161,631	68,307,890
Vehicles	450,000	450,000	1,010,782	1,010,782	1,118,743
Office equipment	72,000	72,000	82,164	97,982	97,982
Computers and IT software	150,000	150,000	328,878	533,007	533,007
TOTAL FIXED ASSETS	4,636,500	16,649,100	35,417,824	50,803,402	70,057,622

- Depreciation rates:

Table 6: Depreciation Rates

Plant and Equipment	20%
Vehicles	25%
Office equipment	33%
Computers and IT software	33%

- Working capital:
  Working capital is based on extended payment for mostly export sales. Although the proposed payment terms are cash in advance, it is likely that payments from African countries are delayed due to bank delays. It is proposed that irrevocable Letters of Credit be obtained from client banks. Stock includes mostly procured materials. Long lead times for imported components would require higher stock levels.

Table 7: Working Capital

Debtors	days outstanding	60 days
Creditors	days credit	30 days
Stock (materials)	days stock	60 days

- A cash reserve of R10 million is provided for in the first 2 years of operation.
- Asset finance: 40% of asset value: 4-year term @15% with 1 year capital repayment holiday.
- Working capital is financed by shareholders' loans. 3rd party finance for debtors and stock may be considered in a detailed feasibility study.
- Other possible sources of funding working capital include: a revolving credit facility, a Medium-Term Supplier Credit Program (MSP), export financing by the Export Credit Insurance Corporation of South Africa (ECIC).

Peak funding is reflected in the following table (year 10) when the last projected plant expansion is introduced. Net working capital comprises 94% of balance sheet structure. Shareholders are required to inject just over R390 million. This investment is phased in over the years as expansions to plant are introduced and working capital requirements increase with increased volumes. The financial feasibility was concluded without any government grants or incentives, if these are approved in the future, it can be seen as an added benefit.

Table 8: Peak Funding

Source of Funds	Year 10
Share capital	R1,000
Shareholders loans	R391,639,840
Government funds	R0
Long term loans (LT loan)	R0
Asset finance	R0
Accumulated Depreciation	R41,657,950
Retained earnings	R603,437,021
TOTAL	**R1,036,735,812**

Application of Funds	Year 10	
Building and infrastructure		R0
Plant and Equipment		R68,307,890
Vehicles		R1,118,743
Office equipment		R97,982
Computers and IT software		R533,007
Working capital		**R966,678,190**
Debtors	R616,595,479	
Stock	R602,189,306	
Cash	R23,249,061	
VAT	R0	
Other / Deposits	R80,000	
Retained Loss	R0	
Creditors	-R275,435,656	
TOTAL		**R1,036,735,812**

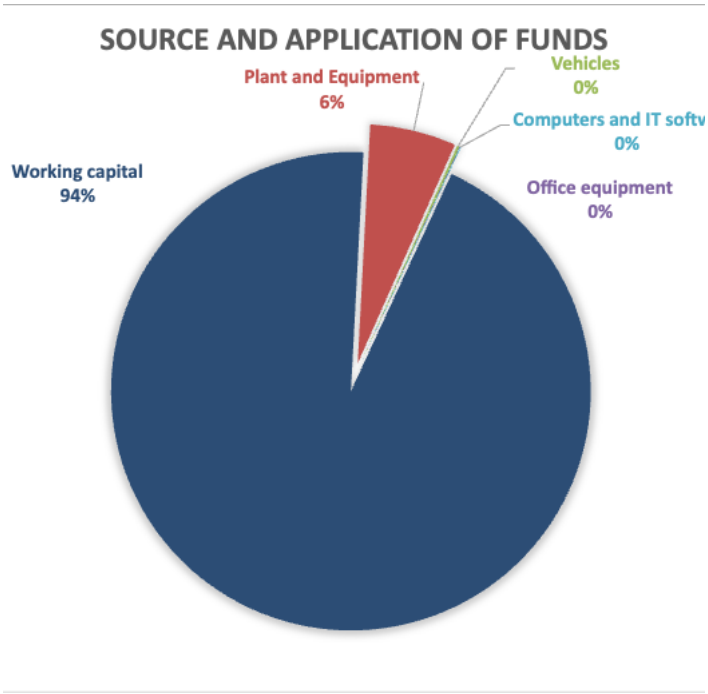


Figure 11: Source Application of Funds

5.3 Feasibility Indicators

The following table reflects the project returns based on a 12-year forecast and exit price earnings ratio of 6:

Table 9: Feasibility Indicators

WACC	
Project	**16%**
Shareholders	**22%**

IRR	Nominal	Real
Project	**21%**	**15%**
Shareholders	**26%**	**21%**

NPV	
Project	**R74,261,874**
Shareholders	**R75,245,033**

The projected returns are sensitive to production volumes and pricing and need to be confirmed once a bankable and detailed feasibility study is executed.

Project IRR takes into consideration the total investment made by shareholders and financiers, i.e. the returns (after loan repayment and taxes) on the total funding of the project. **Shareholder IRR** only uses what the shareholders invested and returns calculated after consideration of loan repayments and taxes. The shareholder returns should be higher than the project IRR due to the gearing of the balance sheet with external finance that is normally cheaper than the cost of capital invested by the shareholders.

5.4 Scenario Analysis

The robustness of the financial model (i.e. key financial outcomes) was modelled taking into consideration the following two scenarios. The feasibility indicators of Scenario 1 and Scenario 2 are then compared to the feasibility indicators from the base model.

Scenario 1:

In the first scenario, sales price and direct material cost variations were modelled to see what the overall impact is on profitability and financial feasibility. The following assumptions were made:

- Direct material cost reduces from Y1-6 at 2.5% p.a. due to the increase of volume and adding local content.
- Thereafter, direct material cost increases from Y7-12 at 2% p.a.
- Battery price (input cost) reduces from Y1-6 at 11% p.a. due to globally declining battery prices. A report by Bloomberg states that the price for lithium iron phosphate battery cells in China has dropped 51% to an average of $53 per kilowatt-hour.[12] Additionally, RMI forecasts that in 2030, top-tier density will be between 600 and 800 Wh/kg, costs will fall to $32–$54 per kWh. [13]
- Battery cost is kept constant from Y7-12.
- Sales prices in local currency (ZAR) are kept constant from Y1-12. The export sales prices in USD should therefore reduce annually due to projected ZAR devaluation of 3% pa against the USD.

Table 10: Feasibility Indicators for Scenario 1

WACC	
Project	**16%**
Shareholders	**22%**

IRR	Nominal	Real
Project	**36%**	**30%**
Shareholders	**34%**	**28%**

NPV	
Project	**R299,831,536**
Shareholders	**R180,290,558**

For scenario 1, direct material cost reduce, while sales prices are kept constant. This leads to an increase in the Gross Profit margin, which leads to a higher IRR, projected at 36% opposed to the base model's projected IRR of 21%.

[12] https://www.bloomberg.com/news/newsletters/2024-07-09/china-s-batteries-are-now-cheap-enough-to-power-huge-shifts
[13] https://rmi.org/the-rise-of-batteries-in-six-charts-and-not-too-many-numbers/#:~:text=RMI%20forecasts%20that%20in%202030,with%20BNEF's%20Net%20Zero%20scenario

Scenario 2.1:

The gradual increase in production capacity and the associated expansion of the plant in 4 phases was re-modelled in a model with two instead of four facility expansions. In this regard, the following assumptions were made:

- **Layout 1**: Start up facility (Year 1-6) to accommodate volume assembly of up to 10,600 units per annum. (Refer to facility layout 2 in Figure 7: Assembly Facility Layout 2).
- **Layout 2**: Final Expansion (Year 7-12) with 60 000 units per annum. production capacity. (Refer to facility layout 4 in Figure 9: Assembly Facility Layout 4).

This model shows that the early adoption of factory area and the associated rental costs results in a project IRR of 19% as opposed to the base model's project IRR of 21%.

Table 11: Feasibility Indicators for Scenario 2.1

WACC	
Project	**16%**
Shareholders	**22%**

IRR	Nominal	Real
Project	**19%**	**14%**
Shareholders	**28%**	**23%**

NPV	
Project	**R47 035 369**
Shareholders	**R97 939 337**

Scenario 2.2:

Using the same approach as above, but acquiring the full factory space to accommodate the ultimate planned 60,000 units capacity, instead of four facility expansions as in the base case, the following assumption was introduced into the model:

- Layout 1: Full Expansion (Year 1-12) with 60 000 units p.a. production capacity.

This model shows that renting the full facility from the project startup, results in the project IRR reducing to 17% opposed to the base model's higher project IRR of 21%.

Table 12: Feasibility indicators for Scenario 2.2

WACC	
Project	**16%**
Shareholders	**22%**

IRR	Nominal	Real
Project	**17%**	**12%**
Shareholders	**25%**	**20%**

NPV	
Project	**R16 345 068**
Shareholders	**R61 155 237**

Scenario 2.1 and 2.1 shows that renting a larger facility earlier on in the project, will result in a lower project IRR.

Wasted space and unnecessary costly rental expenses are incurred in the latter 2 models, resulting in higher risk and reduced returns for the investors. The original base model's approach of only renting the necessary space and expanding the plant at times when capacity limitations require expansion, seems the prudent approach.

5.5 Organisation Structure

The organogram presented here outlines the hierarchical structure of a company dedicated to manufacturing electric and ICE motorcycles.

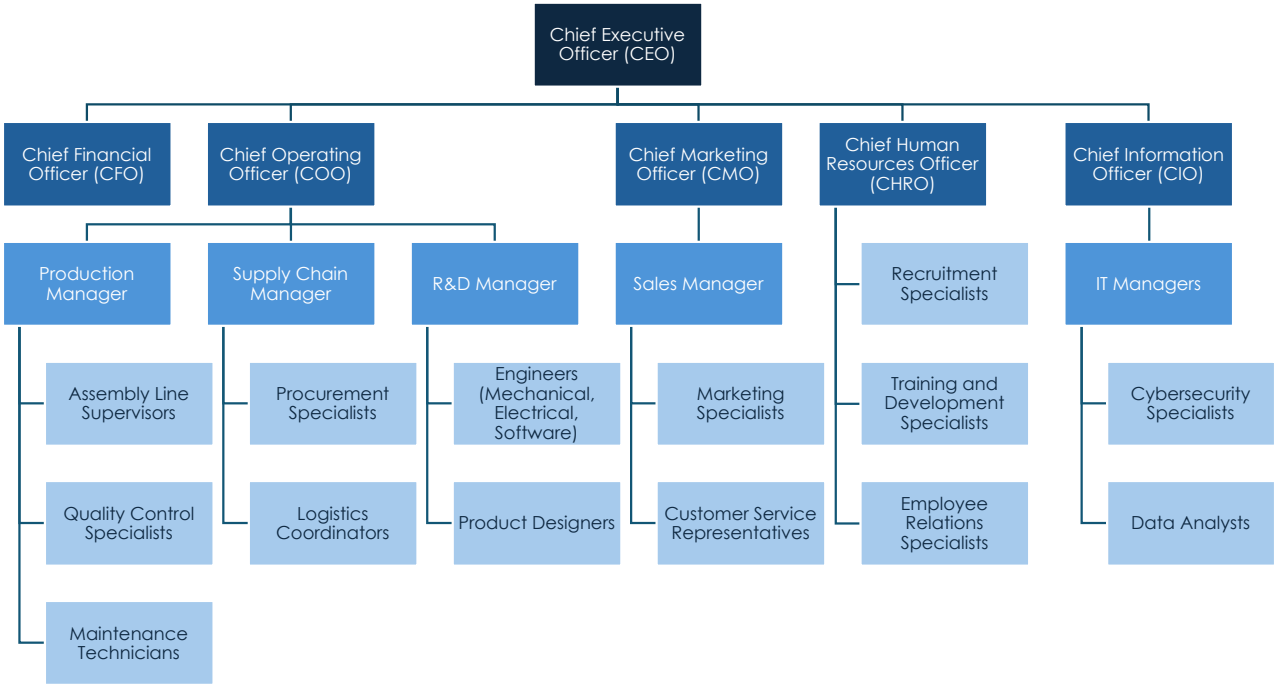


Figure 12: Proposed Organogram

At the top of the hierarchy is the Chief Executive Officer (CEO), who provides strategic direction and overall leadership. Reporting directly to the CEO are the Chief Financial Officer (CFO), Chief Operating Officer (COO), Chief Marketing Officer (CMO), Chief Human Resources Officer (CHRO), and Chief Information Officer (CIO). Each of these C-suite executives oversees critical functional areas within the organisation, ensuring that teams align with the company's broader objectives.

Under the COO, the focus is on the operational aspects of the business, encompassing production, supply chain management, and research and development (R&D). The Production Manager, Supply Chain Manager, and R&D Manager report to the COO, each leading teams responsible for manufacturing processes, logistics, and product innovation, respectively.

The Production Manager supervises Assembly Line Supervisors, Quality Control Specialists, and Maintenance Technicians, ensuring efficient production workflows, high-quality standards, and well-maintained equipment. The Supply Chain Manager oversees Procurement Specialists and Logistics Coordinators, ensuring the seamless acquisition and distribution of materials. The R&D Manager leads a team of Engineers and Product Designers, driving technological advancements and new product development.

The CMO is responsible for driving market engagement and sales, with a Sales Manager, Marketing Specialists, and Customer Service Representatives under their leadership. The Sales Manager further supervises Sales Representatives to ensure effective market penetration and customer satisfaction.

Human resources, managed by the CHRO, focus on talent acquisition, employee development, and workplace relations, Training and Development Specialists, and Employee Relations Specialists.

Lastly, the CIO oversees the IT department, ensuring robust IT infrastructure, cybersecurity, and data management through the efforts of IT Managers, Cybersecurity Specialists, and Data Analysts.

Each role within the company, demands a unique set of skills that contribute to the overall efficiency of the organisation. Each of these roles, contributes to the company's ability to manufacture high-quality EV and ICE motorcycles and compete successfully in the automotive market.

6. CONSIDERATIONS

In support of the localisation of electric two- and three-wheelers in South Africa for the African market, the following business initiative that are aligned to and supportive of the NEV industry development should be considered :

- Developing and offering charging infrastructure, and battery swapping, which can enhance the ultimate consumer/mobility operator's operational efficiency and user convenience. This will also support the sales of 2/3 wheelers in South Africa and targeted African countries.
- Monitoring the development of a local battery value chain to support a consistent and reliable supply of cost effective, reliable batteries tailored to regional needs.

By taking these opportunities into consideration, deepening and extending the localisation of NEV value chains as an industrial initiative could be achieved, driving economic growth, technological innovation, and environmental sustainability in the region.

6.1 Charging Infrastructure

The adoption of electric vehicles (EVs) is accelerating globally due to their environmental benefits and advancements in battery technology. However, one of the critical challenges remains the lengthy charging times associated with EVs. Battery swapping technology offers a solution by allowing EV drivers to quickly exchange a depleted battery for a fully charged one, thereby significantly reducing downtime which is especially time-sensitive in the e-commerce delivery sector. This section explores the feasibility and potential benefits of establishing a battery swapping infrastructure in South Africa.

6.1.1 Battery Swapping[14]

Battery swapping has as its purpose in the affordability and utility of electric vehicles and will lead to improved introduction and use of electric vehicles because:

- Reduction in EV cost. The battery constitutes 25%-35% of the overall cost of an EV. In the swapping model, the battery is not part of the cost of the vehicle, thereby addressing the issue of affordability.
- Faster turnaround. Battery swapping can be executed in less than five minutes, resulting in minimal vehicle downtime.
- Effective use of real estate for EV fuelling. A swapping station built on 25 square meters of area can serve a swap every five minutes (or 12 in an hour), while a fast-charging station can charge in the range of three to six cars per hour.

Battery swapping infrastructure has been successfully implemented in several countries, including:

- China: Leading the way with companies like NIO and BAIC establishing extensive battery swapping networks.
- India: Piloting projects in major cities, led by companies like Sun Mobility and Ola Electric.
- Taiwan: Gogoro has established a vast network of battery swapping stations for electric scooters.

South Africa's EV market is still nascent but growing. The government has shown support through policies and incentives aimed at reducing carbon emissions and encouraging green technologies. Existing infrastructure for petrol and diesel vehicles provides a basis for developing a similar network for EVs.

[14] Arthur D. Little, 2023. The relevance of EV battery swapping in emerging markets.

6.1.2 Components of Battery Swapping Infrastructure

The components that make up a Battery Swap Station are the battery, the swap station and the motorcycle. The core of this system is the battery. The battery should contain energy to provide the vehicle with enough range to complete its work. This determines the dimensions of the battery and the size of the compartment in the swapping station and battery compartment in the motorcycle. Typically, more than one battery is used as the mass of the battery should be such that it is easily handled by a person. A software application to record and manage all transactions concludes the system.



Figure 16: Infrastructure Components

6.1.3 How Does Battery Swapping Work?[15]

The driver purchases a motorcycle, and while the bike is owned by the driver, the battery is paid for over the period of use.

The cost of the battery is amortised with the swaps, meaning that the driver pays for each battery swap (cost of housing and electricity to charge the battery) and the cost of the battery is spread out over multiple swaps. Typically this is a flat rate. This could lead to battery abuse, reduced battery life and higher battery costs. Once the bike is purchased, the driver can utilise the swap stations set up by the e-bike suppliers and exchange a discharged battery for a charged battery at a small cost. The e-bike provider retains ownership over the batteries.

To use the service system, the driver needs to be registered on the system to do payments, swap batteries and track battery utilisation.

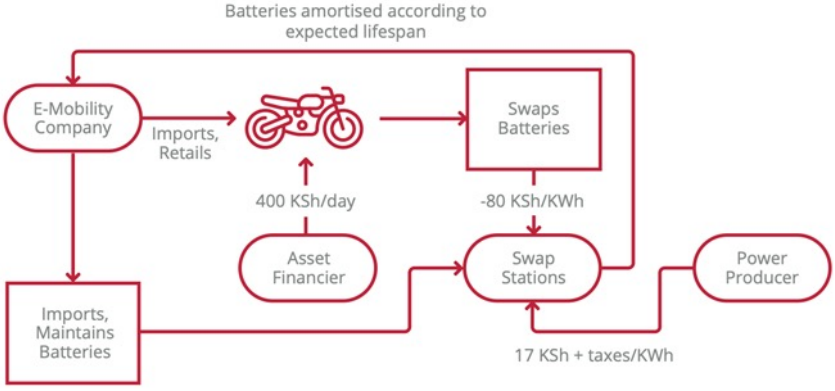


Figure 17: Battery Swapping System

[15] https://p4gpartnerships.org/sites/default/files/2023-06/Charge%20Up%20report_web.pdf

6.1.4 Battery Swapping Business Model

This business model takes battery pricing, swap station pricing and batter swap pricing, into consideration.

Battery Pricing Estimates

- Lithium battery prices have reduced by about 80% over the past decade. (Current international cost $ 90/ kWh (R 1 700/kWh) and 6 000 cycles.)
- The scooter battery can be 48V, 60V or 72V.
- The 48V 24Ah battery has a FOB price of US$ 200 (R 3 700)[16].
- The 60V 80Ah battery has a FOB price of US$ 680 to US$ 745 (R 12 600 to R 13 800).
- Battery swap stations entail a per-vehicle battery capacity of approximately 4-6 kWh, with an associated cost ranging from US$ 1 200 – US$ 1 800 (R 22 000 to R 33 000).
- Current price of a 48V 2,5kWh battery in South Africa is between R12 500 to R18 500. (Cost price is R4 000-R5 000)

It is evident from the above battery prices can vary significantly. It is suggested that an estimated price be used for a two-battery system with a combined 5kWh energy content. (Two 48V 50Ah batteries each containing 2.5kWh energy). Assume the price of a battery is R15 000. Price estimations for electric two- and where-wheelers are included in Annexure B.

The 2-wheeler will then carry two batteries at a cost of R30 000 and

- The 3-wheeler will then carry four batteries at a cost of R60 000.

Swap Station Price Estimates

- Battery swapping stations come in various sizes and configurations.
- Prices vary, but it was suggested that an average price for a module of 8-10 compartments be used in the model.
- From the below figure it seems that an estimated price of R45 000 would be a reasonable assumption for South Africa.

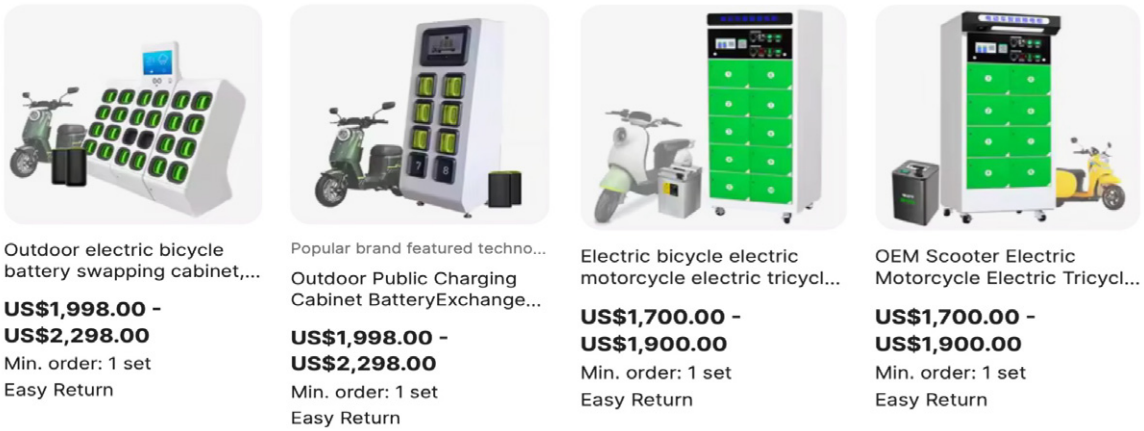


Figure 18 Swapping Station Prices

[16] https://surelithium.en.made-in-china.com/productimage/DTPUBjaVbfkO-2f1j00nSQbCilFimoO/China-Best-Price-Lightweight-Design-Power-Battery-60V80ah-Electric-Scooter-Lithium-Battery.html

Battery Swap Pricing Estimates

Assumptions for calculation of Battery Swap Pricing:

- Pricing is kept at a flat rate (pay per swap).
- The battery has a cycle life of 3000 cycles (= R5.00/cycle).
- The average charge is 60% of full capacity (= 1.5kWh = R4.50 (at R3/kWh)).
- Battery swap costing could be estimated at R13.00/swap (Annexure D: Battery swap costing).
- The scooter has a range from 100 to 200km.

The energy cost for the scooter would be between 7 to 13 cent/km. The above numbers do not include profits.

Additional revenue streams for the business include a subscription model, where users pay monthly fees for unlimited swaps, a pay-per-swap option for occasional users, and partnerships with car manufacturers and ride-sharing companies. Revenue can also be generated through advertising by leasing space on swapping stations and delivery boxes. The cost structure comprises fixed costs such as infrastructure maintenance, staff salaries, and battery procurement, along with variable costs including utilities, transportation of batteries, and station supplies.

The feasibility analysis of the battery swapping initiative identifies several key factors: market demand is driven by the increasing adoption of EVs due to rising fuel costs and environmental concerns, with urban areas with high traffic density presenting significant opportunities for battery swapping. Competitive advantages include reduced downtime for EV users compared to traditional charging and the potential to attract commercial fleets and ride-sharing companies.

The economic viability is supported by the initial investment being offset by long-term savings on fuel imports and environmental benefits, along with potential government subsidies and incentives for green technology investments. However, there are challenges such as the initial capital investment, the need for standardisation of battery technology across different EV manufacturers, and ensuring a sustainable supply chain for batteries and their components.

The implementation of the battery swapping stations and battery supply, provides an additional business opportunity for the proposed 2/3 wheel assembly and production facility. These battery swapping stations can be sold to the agents, dealers and fleet owners in the target markets and generate additional revenue.

The business case for this opportunity needs to be developed as part of the detailed feasibility study for the 2/3 wheeler venture.

6.2 Battery Manufacturing

The "Battery Value Chain Assessment Report" evaluates the 'Battery Value Chain' as an adjacent industry to the NEV ecosystem and explores opportunities to leverage and expand this market in South Africa and the broader market in Africa[17]. It highlights the significant growth in battery gigafactories globally, driven by the demand for electric vehicles and energy storage solutions, which underscores the strategic importance of battery production for national economies and sustainable energy transitions.

The battery value chain is divided into four sub-clusters: upstream materials, OEM cell manufacturing, system building blocks, and manufacturing blocks for battery plants and machinery, all of which are interconnected globally.

[17] AIH Group. 2024. IDC Battery Value Chain Assessment Report.

The report provides an overview of the battery value chain, market status, geographical distribution of industry participants, battery chemistry trends, and price trends, focusing on South African opportunities. It highlights the complexities of lithium-ion battery manufacturing, examining cost benchmarks and processes for different cell types. The role of precursor materials, particularly cobalt, manganese, nickel, and lithium, is analysed, emphasizing Africa's potential to increase mining production and value addition through beneficiation. A techno-economic model benchmarks the production cost of lithium-ion batteries, highlighting the significant investment required for battery gigafactories and the potential for raw material processing in South Africa to integrate into the global supply chain.

For South Africa a battery cell plant cost of around $125 million per GWh is considered realistic, and could be even higher based on South Africa's location. Factors that could increase the costs include:

- South Africa's ability to secure a reputable international partner with experience in the establishment and operation of such a gigafactory.
- The availability of manufacturing equipment and associated shipping, installation and commissioning costs for such a plant in South Africa, and
- Local costs structures such as energy, labour, and the like being less competitive, compared to the dominant regions.

In this context it is clear that South African and African battery manufacturing needs to be considered in a broader context due to the high capital investment requirements, which requires economies of scale to achieve financial viability. However, this is a development that needs to be monitored to identify when key drivers and volumes, reach the critical point where such a facility becomes feasible in the future.

For the purpose of the two- and three-wheeler market in South Africa and Africa considered for this study, the local assembly of battery packs is considered. As part of the next phase of the project, local battery pack assemblers' capabilities will be considered and the feasibility of local battery pack assembly will be assessed.

7. CONCLUSION

This scoping report concludes the final phase of the NEV (New Energy Vehicle) value chain localisation project, emphasising the manufacturing potential of two- and three-wheelers in South Africa and sub-Saharan Africa. By addressing both internal combustion engine (ICE) and electric vehicle (EV) segments, the project aims to capitalise on economies of scale and cater to a burgeoning African market for sustainable transportation solutions, particularly in last-mile delivery.

Market demand modelling forecasts a substantial growth trajectory for electric two-wheelers. The projections are suggesting that they could comprise half of Africa's two-wheeler market by 2034, potentially reaching over 1.2 million units annually by 2040. The new sales of electric two-wheeler delivery market in SA alone, are expected to grow to 2,275 per annum by 2034.

The demand for motorbikes in Africa necessitates that in order to achieve economies of scale, the SSA market opportunity needs to be included. The feasibility of a manufacturing facility in SA is therefore dependent on successful market penetration of locally produced products into the SSA market.

Central to this initiative is the establishment of a manufacturing and assembly facility, initially as an assembly plant using Semi Knocked Down (SKD) kits, with plans for future expansion into Complete Knock Down (CKD) that is supported by local component manufacturers. The technical overview highlighted key factors such as site selection, plant design, technology integration, and workforce skills, laying the groundwork for a robust and scalable facility that positions South Africa as a pivotal player in the production of electric and ICE two- and three-wheelers.

Financial projections underscore the promising economic outlook, indicating positive returns on investment over an eleven-year period. Overall, the financial outlook for two- and three-wheelers is positive, driven by balanced revenue streams, controlled operational and capital expenditures, and strong net investment growth.

Furthermore, the report outlined considerations and recommendations to bolster the NEV localisation environment. To establish a more robust ecosystem, battery swapping and changing infrastructure need to be developed. Adjacent industry opportunities such as battery manufacturing, which is currently not feasible in SA, need to be monitored for future feasibility.

By focusing on these key components, the NEV value chain localisation project aims not only to enhance manufacturing capabilities but also to drive innovation and contribute to the sustainable development goals of the region. As such, it represents a strategic opportunity to position South Africa as a leader in the emerging market for electric and ICE vehicles, poised to meet growing demand while advancing economic resilience and environmental stewardship in the years ahead.

7.1 Way Forward

In order to move forward, the following actions are proposed to identify a strategic investment and operating partner to develop a bankable business case. The members of the Steering Committee proposed an alternative business model for the manufacture and assembly of the proposed range of two-and three-wheelers that comprises the following key elements:

1. Establish the feasibility of a start-up assembly plant at a selected location in South Africa;

In a parallel process, determine potential for regional assembly hubs in Sub-Saharan Africa countries and supply of local manufactured components and sub-assemblies:

2. Regional assembly hubs feasibility; and
3. Localised component and sub-assembly manufacture.

The proposed detailed bankable feasibility study, aimed at a more inclusive business model through industrial participation by Sub-Saharan Africa countries using the hub assembly and distribution model, and localised component and sub-assembly manufacture, would conclude with:

- A bankable feasibility report financial requirements;
- Partner selected for the implementation of the proposed business model;
- Partner selection and feasibility assessment of regional distributed assembly hubs;
- Proposed funding model and participation of country specific financial institutions as well as regional operating (Africa and international) development finance institutions to support the funding in partnership;
- Implementation plan and cooperative funding plan, selected and screened implementation partners for the local manufacture and regional assembly hubs; and
- Proposed structure of ownership and investment instruments.

8. ANNEXURES

8.1 Annexure A: Financial Forecast 2/3 Wheelers

Table 13: Financial Forecast

Key financials	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Turnover	-	117 324 901	299 492 870	800 740 064	1 139 535 114	1 494 666 049	1 923 511 079	2 424 021 779	3 045 725 218	3 699 572 873	4 518 098 648	5 658 578 097
Gross Profit	-	2 518 691	6 043 646	18 708 538	126 060 073	159 319 493	205 030 957	258 381 410	324 650 044	394 344 995	481 593 322	603 159 345
Net Profit	(6 898 980)	(13 898 526)	(13 142 437)	(20 532 378)	72 002 160	79 057 029	83 893 798	110 988 742	143 329 333	168 638 281	211 291 321	271 451 552
	-	-	-	-	-	-	-	-	-	-	-	-
Fixed assets	4 636 500	4 636 500	4 636 500	16 649 100	16 838 142	35 417 824	35 417 824	50 803 402	50 803 402	70 057 622	70 973 142	71 641 885
Net fixed assets	4 636 500	3 657 840	2 679 180	13 512 910	10 307 888	21 862 031	14 836 491	23 196 530	16 170 991	28 399 672	22 289 653	15 932 856
Working capital:												
Current assets	10 080 000	48 768 519	260 923 085	270 062 958	484 292 064	578 718 967	700 491 692	840 383 749	1 037 024 855	1 242 113 846	1 520 454 974	1 883 172 774
Current liabilities	309 736	10 037 191	24 973 868	66 098 183	85 429 273	112 353 290	143 206 677	180 470 031	226 756 264	275 435 656	336 375 444	421 284 896
Cash	10 000 000	10 000 000	162 019 403	6 187 693	125 377 038	106 970 200	66 731 503	41 735 654	33 563 199	23 249 061	31 935 611	18 934 633
Gross Profit margin	0%	2%	2%	2%	11%	11%	11%	11%	11%	11%	11%	11%
Net profit	0%	-12%	-4%	-3%	6%	5%	4%	5%	5%	5%	5%	5%
Debt/Equity	14%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Return on assets	-48%	-25%	-6%	-7%	16%	16%	17%	19%	19%	19%	19%	20%
Return on equity	-34%	-23%	-5%	-8%	18%	20%	21%	28%	37%	43%	54%	69%

Table 14: Market Share

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Market	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
ICE 2- and 3-wheeler	1 448 358	1 535 260	1 627 375	1 725 018	1 828 519	1 938 230	2 054 524	2 177 795	2 308 463	2 446 971	2 593 789	2 749 416
Electric 2- and 3 wheeler	27 182	44 012	70 677	112 126	174 797	265 949	391 829	554 723	750 250	967 244	1 191 288	1 409 868
Projected market share												
ICE 2- and 3-wheeler	1 044	1 608	2 580	3 492	4 656	5 080	5 376	5 689	5 907	5 907	5 907	6 150
Electric 2- and 3 wheeler	732	2 160	5 280	8 064	10 980	15 543	20 466	26 439	33 003	41 398	53 816	56 507
Market share %												
ICE 2- and 3-wheeler	0.1%	0.1%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%
Electric 2- and 3 wheeler	3%	5%	7%	7%	6%	6%	5%	5%	4%	4.28%	4.52%	4.01%

Table 15: Production Volumes

Sales Budget (Units)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Two-wheeler (ICE)	-	600	1 080	1 944	2 724	3 816	4 198	4 449	4 716	4 905	4 905	4 905
Two-wheeler (EV)	-	408	1 200	2 400	4 320	6 480	10 368	14 515	19 596	25 474	33 116	44 707
Three-Wheeler (ICE)		444	528	636	768	840	882	926	972	1 002	1 002	1 002
Three-Wheeler (EV)		324	960	2 880	3 744	4 500	5 175	5 951	6 844	7 528	8 281	9 109
TOTAL		1 776	3 768	7 860	11 556	15 636	20 623	25 842	32 128	38 909	47 304	59 723

Unit Price (Rand)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Two-wheeler (ICE)		17 391	18 174	18 992	19 846	20 739	21 673	22 648	23 667	24 732	25 845	27 008
Two-wheeler (EV)		37 945	39 652	41 437	43 301	45 250	47 286	49 414	51 637	53 961	56 389	58 927
Three-Wheeler (ICE)		61 660	64 435	67 334	70 364	73 531	76 840	80 297	83 911	87 687	91 633	95 756
Three-Wheeler (EV)		197 628	206 522	215 815	225 527	235 676	246 281	257 364	268 945	281 048	293 695	306 911

Sales (Rand)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Two-wheeler (ICE)		10 434 783	19 627 826	36 919 941	54 061 505	79 141 756	90 973 449	100 771 289	111 624 357	121 313 351	126 772 452	132 477 212
Two-wheeler (EV)		15 481 423	47 582 609	99 447 652	187 061 034	293 218 170	490 260 781	717 251 522	1 011 862 585	1 374 615 322	1 867 414 915	2 634 455 591
Three-Wheeler (ICE)		27 377 075	34 021 565	42 824 645	54 039 854	61 765 865	67 772 595	74 363 480	81 595 328	87 825 132	91 777 262	95 907 239
Three-Wheeler (EV)		64 031 621	198 260 870	621 547 826	844 372 722	1 060 540 257	1 274 504 254	1 531 635 488	1 840 642 947	2 115 819 068	2 432 134 019	2 795 738 055
TOTAL		**117 324 901**	**299 492 870**	**800 740 064**	**1 139 535 114**	**1 494 666 049**	**1 923 511 079**	**2 424 021 779**	**3 045 725 218**	**3 699 572 873**	**4 518 098 648**	**5 658 578 097**

8.2 Annexure B: The South African Last-Mile Delivery Market Demand

Assessing the market trends in South Africa, it is clear that there is growth in the South Africa last-mile delivery two-wheeler market, albeit from a low base, as depicted below. This current growth is underpinned by the growth of the *delivery market segment*. This growth is mainly contributed to the increase of e-commerce delivery services in South Africa, such as Checkers Sixty 60, Woolies Dash, Pick n Pay asap!, and Uber Eats. Uber Eats and Mr D Food collectively account for 90% of South Africa's fast food delivery market.

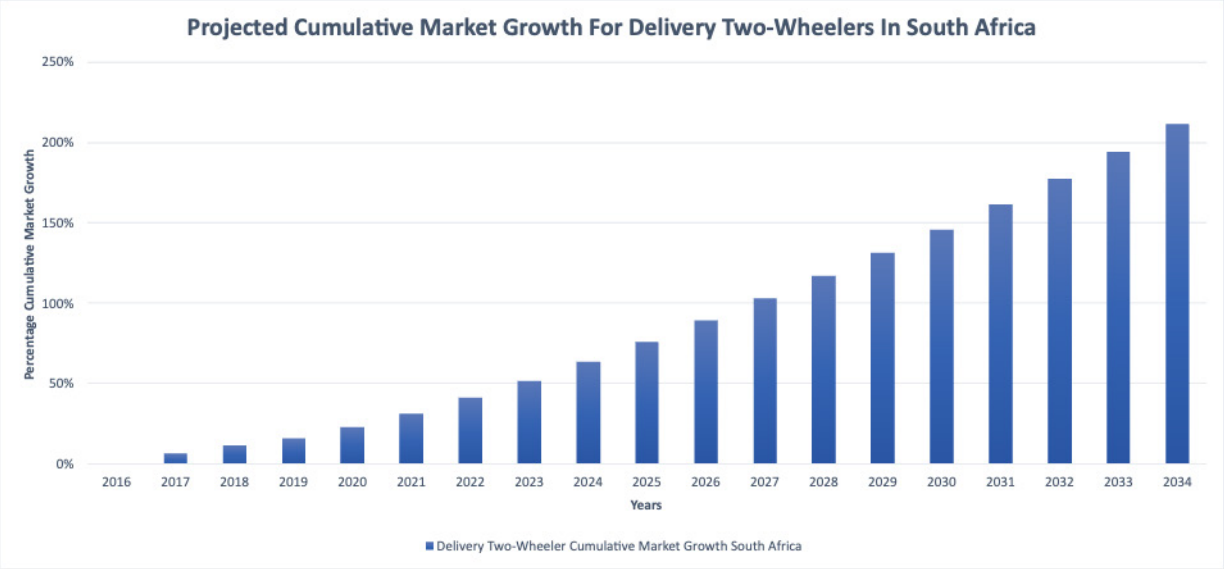


Figure 19: Future Growth Forecast

In terms of volumes, the new sales of electric two-wheeler delivery market are expected to grow from a level of an estimated 210 motorcycles per annum in 2023 to 2,275 per annum by 2034. This excludes the replacement market. Assuming a life expectancy of 7 years and a selling price decline for two-wheeler electric delivery motorcycles, the market opportunity by 2034 increase to 2,367 per annum.

A market of 2 367 per annum by 2034 is considered substantial but if this opportunity can be realised soon, the chances of achieve a higher market shares and volumes at circa 6,000 units by 2030 for electric versus ICE two-wheelers is a realistic additional opportunity.

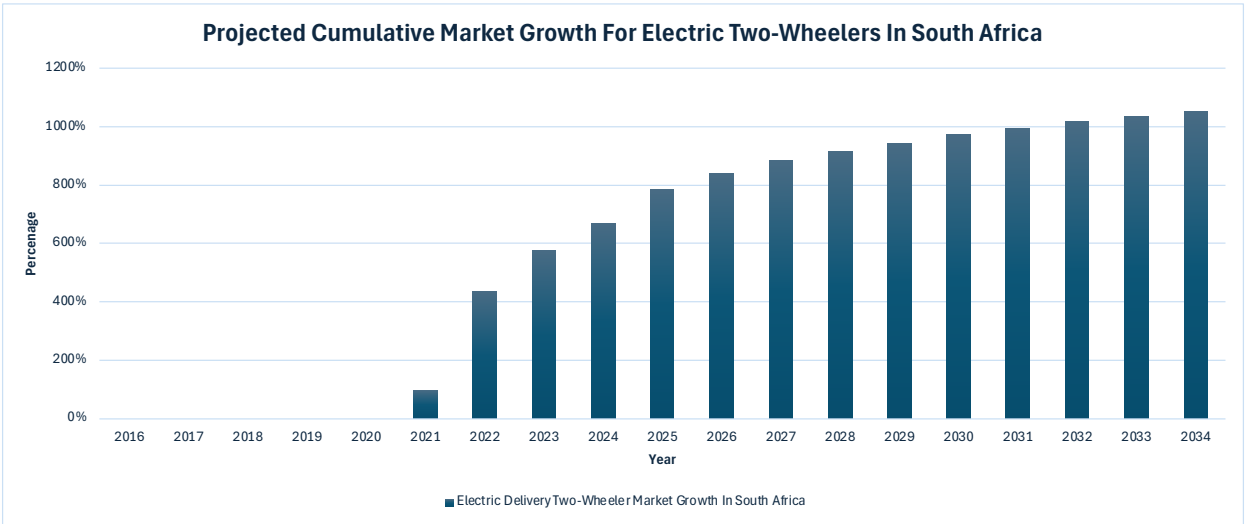


Figure 20: Projected Cumulative Market Growth for Electric Two-Wheelers in SA

From the above graph and forecast modelling, it is concluded that electric two-wheeler delivery market could be

in an exponential growth phase over the next 4 to 5 years whereafter growth levels will flatten out. Similarly, the supporting charging infrastructure and battery packs market requirement will follow the same trend.

8.3 Annexure C: Three-Wheeler Pricing

The prices for two-wheelers are:

- EWIZZ: From R40'000 to 130'000
- Vmoto: R48'500

Prices vary based on performance. For deliveries a range of at least a 100km is needed.

The prices for three-wheelers are:

- 3 Wheel Pricing Impi Rooikat from Eleksa: R43'000
- The Zbee is R155'250[18]
- MellowVan[19] is R252'000



Figure 21: Eleksa (Left) and MellowVan (Right)

All of the above are available in South Africa. Depending on the quality and specification required the price may vary significantly.

[18] https://www.greenscooterza.com/pre-order
[19] https://empowering-people-network.siemens-stiftung.org/solutions/mellowvans/

8.4 Annexure D: Battery swap costing

Assumptions for calculation of Battery Swap Pricing:

- Pricing is kept at a flat rate (pay per swap).
- The battery has a cycle life of 3000 cycles (= R5,00/cycle).
- The average charge is 60% of full capacity (= 1,5kWh = R4,50 (at R3/kWh)).
- Battery swap costing:
  - A battery can be fully charged in 3hrs.
  - Batteries are swapped in a period of 12hrs per day.
  - One compartment can be used for 4 swaps per day.
  - One swap station module has 10 compartments.
  - Can do 40 swaps/day, 14'600 swaps/year at a life expectancy or 5 years.
  - Then at a cost of (R45'000/14'600)/5 = R0,60/swap.
  - (Estimated price of R45'000 doing 14'600 swaps per year over a 5 year life, comes to cost of 60c per swap.)
  - (Add to this the cost of the battery per cycle (R5) and the cost of electricity to charge (R4,5) ==> R9,50+ 60c = R10,10. Add variation of R3. So cost of a swap can vary between 7c to 13c per km assuming an average range of 100km.)
  - Total swap cost could be then estimated as R13,00/swap.
- The scooter has a range from 100 to 200km.

The energy cost for the scooter would be between 7 to 13 cent/km. The above numbers do not include profits.

9. PROJECT TEAM

9.1 Project lead

Industrial Development Corporation of South Africa Ltd. (IDC)
Name: Nathan Fredericks
Designation: Senior Industry Development Planner
E-mail: nathanf@idc.co.za

Service Provider Project Lead – AIH Group
Name: Owen Smith
Email: owen@autoih.co.za

9.2 Contributing authors

Lehanri van der Westhuizen
Marie-Claire Steynberg
Jeané Schoeman
Tshiamo Motau
Ian Smith
Kobus Boshoff

9.3 Service provider contact details

Lynnwood Bridge
Building A, 1st Floor
4 Daventry Street
Lynwood Glen
Pretoria
0081

Tel: +27 12 346 9047 (Head Office)
Fax: +27 86 219 0100
Mobile: +27 76 754 0014
Email: owen@autoih.co.za, melt@autoih.co.za
Address: P O Box 35501, Menlo Park, 0102
Web: www.autoih.co.za