This document will explain the timetable and roadmap to fully electrify two wheelers ride hailing fleets in Greater Jakarta.

Road Map and Timetable of Two-Wheeler Electrification in Greater Jakarta

Timetable and Roadmap for Ride Hailing Fleet Electrification

30/11/2021

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1. Current Business Model Snapshot

This section would discuss the current Jakarta 2W ride-hailing sector's business model from the perspective of its main actors: 2W ride-hailing operators, 2W ride-hailing drivers, and policy maker both local and national level

1.1. Government Perspective

1.1.1. National government

2W Ride-hailing Governance

In the current ride-hailing landscape in Indonesia, there are mainly two ministries that directly regulate the operation of ride-hailing operators, which are Ministries of Transportation (MoT) and Ministries of Communication and Information (MoCI). MoT is responsible for the governance and regulation of all transportation modes in Indonesia, including the ride-hailing services while MoCI regulates the operation of online and offline applications, including the ride-hailing application. For instance, ride-hailing operators are required to be registered to be able to operate and develop their online application.

In 2019, Indonesian Government has released a legal protection for online 2W ride-hailing services through the MoT Regulation No. 12 of 2019 that mainly regulate the operational of 2W ride-hailing services, ranging from service level agreement, drivers' partnership, to fare calculation that further being regulated in MoT Decree No. 348 of 2019. As ride-hailing services are being used by the public, the primary concerns of these regulations are safety, security, convenience, accessibility and regularity. This regulation, legitimately allows motorcycles to be used for transportation mode although it is not legally considered as public transportation as regulated on the bigger regulation of Indonesian Law No. 22 of 2009. On the other side, MoCI has also regulated the online application including the ride-hailing application through MoCI Regulation No. 5 of 2021 regarding the requirements for private electronic system operators. This regulates private electronic system operators to be registered to obtain operational permits as well as the protection of users' personal data.

Although two-wheelers were not meant to be used as public transportation originally, the government has already put measures to legalise the usage of two-wheelers for online ride-hailing. While this is not necessarily showing that the government is supporting the 2W ride-hailing, this shows that the government does not have any intention to forbid them. With a high number of people who depend on 2W ride-hailing service, it is unlikely to see such manoeuvre from the Government. In fact, the government is perfecting the ride-hailing regulation.

Current ride-hailing legal protection of MoT Regulation No. 12 of 2019 lacks the penalty regulation. It is said that the Government would update the regulation to overcome the issues. Furthermore, the Government Regulation No. 22 of 2009 is already being pushed to the National Legislation

Programme agenda to be updated. This includes the legalisation of two-wheelers to be legally able to be used for public transportation mode.

Electrification Efforts or Program

The Indonesian Government, through the Presidential Regulation No. 55 of 2019 has formed a coordination team of battery-based electric vehicle (BEV) acceleration for transportation. This coordination team consists of eight ministries and one institution with the Coordinating Ministry for Maritime and Investments Affairs as the head coordinator and Coordinating Ministry for Economic Affairs as the vice coordinator. Roles of these ministries and institutions would be discussed below.

1. Coordinating Ministry for Maritime and Investment Affairs (CMMIA)
   As the head coordinator of the BEV acceleration task force, CMMIA play a role in coordinating investment-related BEV acceleration between ministries, formulating national policy to support national BEV adoption, and are also in charge of monitoring, evaluating, and reporting in the BEV industry and manufacturing sector. In December 2019, CMMIA had collaborated with Grab, one of the ride-hailing operators in Indonesia, and established an Electric Vehicle Ecosystem Roadmap until 2027. Furthermore, CMMIA has planned the preparation of the Master Plan for BEV usage which will be presented in the 2022 G20 Bali summit.

2. Coordinating Ministry for Economic Affairs (CMEA)
   CMEA plays a role in developing national economic and fiscal policy, including the transport sector, as well as providing economic policies for urban transport proposed by different ministries. Similar to CMMIA, the Deputy for Coordination of Commerce and Industry under the CMEA plans to trigger the acceleration of the BEV program in the 2022 G20 Bali summit.

3. Ministry of Finance (MoF)
   MoF plays a role in preparing state budgeting, as well as providing fiscal incentive facilities for BEV import duties and BEV registration. They also incorporate BEVs into the procurement catalogue for operational vehicles of various government agencies. Currently, through the Government Regulation No. 74 of 2021, the national government imposed 0% luxury tax (PPnBM) for electric vehicles, although motorcycles in general would not be subjected to luxury tax. As to support the 2022 G20 Bali summit agenda, MoF plans to review a number of policies and programs to accelerate BEV usage even further.

4. Ministry of Industry (MoI)
   MoI plays a role in formulation and supervision of policy implementation regarding the BEV materials and the import duty incentives for the spare parts industry. They are set to develop a national motor vehicle industry roadmap which will be in accordance with the distribution control of fossil fuel-based vehicles by the government. They have issued several policies related to BEV technical specifications such as MoI Regulation No. 27 of 2020 on Specifications, Roadmap, and Guidelines to Calculate Local Content Level (TKDN) for BEV,

and MoI Regulation No. 28 of 2020 on Completely Knocked Down and Incomplete Knocked Down BEV.

5. Ministry of Trade (MT)
   MT plays a role in ensuring the use of local domestic components based on the issued policy, MT Regulation No. 100 of 2020 on Import Requirements for Used Lithium Batteries as Raw Material for Lithium Battery Industries to Support the Acceleration of BEV Industry.

6. Ministry of Energy and Mineral Resources (MEMR)
   MEMR plays a role in developing energy planning and supply, including for the transport sector, handles charging infrastructure, pricing and business models, and also formulates national policy to support charging infrastructure provision. They have issued MEMR Regulation No. 13 of 2020 on the Provision of Electric Charging Infrastructure for BEV, which regulates charging and battery swap stations, permits and registration, safety aspect, and electricity tariffs.

7. Ministry of Transportation (MoT)
   MoT plays a role in conducting and monitoring public transport electrification, formulating BEV acceleration road map, managing public transport infrastructure operation such as charging stations and developing BEV testing facilities, as well as formulating national transport policy to support BEV adoption. The policies that have been issued include MoT Regulation No. 44 of 2020 on Physical Testing for BEV; MoT Regulation No. 45 of 2020 on Certain Vehicles with Electric Motor Drive; MoT Regulation No. 65 of 2020 on the Conversion of Motorcycle with Fuel Motor Drive into a Battery-based Electric Motorcycle; MoT Regulation No. 87 of 2020 on Physical Type Testing of BEV.

8. Ministry of Environment and Forestry (MoEF)
   MoEF plays a role in preparing the national policy for pollution control and environmental impact management of the transport sector regarding lithium battery recycling emission-quality standards. They have issued MoEF Regulation No. 12 of 2021 on Lithium Battery Recycling Emission-Quality Standards. Beside the regulation for emission standards, MoEF is also expected to issue a further regulation regarding the provision of incentives to BEV or BEV component industries that manage battery waste in accordance with the prevailing regulations.

9. Ministry of Home Affairs (MoHA)
   MoHA play a role in providing fiscal incentives for electric vehicles, such as reduction of road tax (PKB) and purchase tax (BBNKB) as stated in MoHA Regulation No. 56 of 2020 on the Basic Calculation of PKB and BBNKB, and MoHA Circular Letter No. 024/4833SJ on the BEV for Road Transportation Program Acceleration. Together with MoF, they also help determine BEV import duty incentives.

10. National Research and Innovation Agency (BRIN)
    BRIN plays a role in research on the development of electric vehicles and the development of local products as the main components used for batteries, controllers, electric motors, as well as the development of battery swap technology. They are expected to lead the assessment of various innovations and technologies to support BEV infrastructure.

11. Indonesian National Police
    POLRI plays a role in providing facilities for EV special permits, special identification plates/signs, as well as monitoring free-to-pass, odd-even lanes and car-free-day lanes as incentives to BEV users. Specifically, for electric motorcycles, they have issued a POLRI Regulation No. 5 of 2021 which requires drivers to have a C1 driver's licence as opposed to regular C driver's licence. This regulation was opposed by many electric motorcycle stakeholders. Thus, POLRI is expected to review the policy to support the growing population of electric motorcycles.

Other ministries outside the coordination team also have roles in the electrification effort and program such as:

1. Ministry of State-Owned Enterprises (MSOE)
   MSOE plays a role in managing the national transport infrastructure and operation of public transport services through several state-owned companies such as IBC (Indonesia Battery Corporation), PLN (State Utility Company), and LEN Industry by providing electricity distribution and charging infrastructure. One of the SOEs, PLN, has developed a roadmap for deployment of charging stations from 2020 to 2030. They also provide fiscal incentives such as discounts on electrical rate for home charging. Furthermore, MSOE could potentially mandate Pertamina on planning the addition of charging infrastructure to its petrol station, as well as state-owned banks on providing loans to fund BEV acceleration program and other financial support.

2. National Certification Agency (BSN)
   BSN plays a role in developing national standards BEV's supporting components, including plug-in types and batteries.

3. Bank Indonesia (BI)
   BI plays a role in providing down payment exemption for electric vehicle loans to be 0%. It was issued in BI Regulation No. 23/2/PBI/2021 on the Third Amendment of BI Regulation No. 20/8/2018 on Loan to Value (LTV) Ratio for Property Loans, Financing to Value (FTV) Ratio for Property Financing, and Down Payment for Motor Vehicle Loans or Financing.

4. Financial Services Authority (OJK)
   OJK plays a role in providing fiscal incentives such as providing funds for BEV purchase, upstream industries development (battery, charging station, and component industry), and BEV infrastructure production. They also provide credit quality assessment for BEV purchase

and upstream industries. In addition, BEV purchase credit and upstream industries credit for individuals or MSMEs may be subject to a risk weight of 75% in the calculation of Risk-Weighted Assets (ATMR).

To support battery-based vehicle electrification, the government has already taken numerous measures through some ministries. To further limit the presence of gasoline vehicles, the government has already planned to restrain the sales of gasoline motorcycles in 2040 and gasoline cars in 2050.

Fiscal Position

National Fiscal Policy

To boost the development of the Battery Electric Vehicle industry, the Indonesian government has an advancement program that is explained in Presidential Decree No. 55/2019. In this decree, it is stated that the minimum domestic component for 2-wheelers producers is targeted to be 40% up until 2023, and 60% and 80% starting from 2024 and 2026 onwards respectively. As for 4-wheelers producers, the minimum domestic components are targeted to be 35% up until 2021, and will be increased to 40%, 60%, and 80% starting from 2022, 2024, and 2030 respectively. To achieve these targets, the government will give incentives to people and institutions that are involved in researching, developing, producing as well as purchasing and utilising the battery electric vehicles. These incentives can be in terms of:

1. Import tariff for completely knock down vehicles, incompletely knock down vehicle, or primary components
2. Luxury goods tax
3. National and local government taxation
4. Relaxation for import tariff for machineries, goods and materials for investment purpose
5. Relaxation for import tariff for export purpose
6. Import tariff for raw/supporting materials for production purpose
7. Incentives for the development of the electric charging equipment
8. Incentives for export financing
9. Fiscal incentives for research, development and innovation of battery electric vehicles components technology, as well as industrial vocation.
10. Parking fee regulated by the local governments
11. Subsidies for electric charging
12. Financing support for electric charging infrastructure development
13. Certification for experts in Battery Electric Vehicle
14. Product/ technical standard Certification for Battery Electric Vehicle and its components industries

These incentives then will be elaborated in the related government and ministerial regulations.

1. Incentives for Consumers

Government Regulation No. 73/2019 explains the luxury tax regulation for electric vehicle. This regulation amended Government Regulation No. 22/2014 and its derivation in Minister of Finance Regulation No. 33/PMK.010/2017 that treat ICE vehicles and electric vehicles equally in terms of luxury goods taxation.

In the newest regulation, Electric vehicles with less than 15 passengers will be imposed a 15% luxury goods tax rate (article no.12 and no.17). Whereas Double-Cabin Electric vehicles will be imposed to a 10% luxury goods tax rate (article no. 24). However, if the vehicles are belonged to plug-in hybrid electric vehicles, battery electric vehicles, or fuel cell electric vehicles, with energy consumption equal to or more than 28 km/l or with CO2 emission level up to 100gr/km, then they will be imposed to a 15% luxury goods tax rate with a 0% basic imposition tax rate to it sale price (article no. 36). This basically means that these electric vehicles will be waived from the luxury goods tax. This regulation is effective in October 2021.

Bank of Indonesia Regulation no 22/13/PBI/2020 has amended the previous Bank of Indonesia Regulation No. 20/8/PBI/2018 regarding the financing to value for the environmentally friendly vehicles. In the Article No. 23A stated that the customer could make a 0% down payment for environmentally friendly vehicles purchase. This means that banks could fully finance the purchase of electric vehicle, this will further facilitate the ownership of electric vehicles for the customer. However, this regulation only applies to banks with a Gross Non-performing Vehicle Loan less than 5%.

Minister of Home Affairs Regulation No. 8/2020 has relaxed the vehicle tax and name transfer fee for electric vehicles. Article 10 explained that a maximum 30% vehicle tax and name transfer fee should be imposed from its original rate. And further reduction, i.e., max 20% and max 25%, will be imposed if the electric vehicles are used for public transport for passenger and goods respectively.

Minister of Energy and Natural Resources Regulation No. 13/2020 explained several schemes available for electric charging business. In the regulation, the private sector is welcomed to provide electric charging activities for private or public retail purposes. However, PT. PLN will be mandated to provide and develop the electric charging activities initially. To enhance the electric charging business, PT. PLN has planned several incentives for consumers and electric charging providers. A 30% night-use electricity discount will be given for the electric vehicle owners, from 22.00 PM to 5.00 AM. In addition, PT. PLN will impose a special price for upgrading the power, i.e., IDR 150,000 for additional power up to 11,000 VA (1-phase) and IDR 450,000 for additional power up to 16,500 VA (3-phase) (Kompas.com, Sept 24, 2021).

According to the Minister of Energy and Natural Resources Regulation No. 28/2016. The electricity tariff charged by PT. PLN to the electric charging providers will be equal to IDR

707/kWh x Q, where 0.8<Q<2. Bounded by these rules, PT. PLN will charge IDR 714/kWh to the providers (Kompas.com, Sept, 7, 2021). Whereas the maximum retail price according to the regulation should follow formula IDR 1,650/kWh x N, where N<1.5. The agreed maximum retail price for electric charging is IDR 2,647/kWh (Kompas.com, Sept, 7, 2021).

2. Incentives for Corporations

Electric vehicle producers are part of pioneer industries as explained in Minister of Finance Regulation No. 130/2020 and in Investment Coordination Board Regulation No. 7/2020. Therefore, they have the right to obtain a 50%-100% corporate tax reduction for new investments as regulated. In addition, the electric vehicle components and accessories industries could obtain additional corporate tax facilities following the Government Regulation No 9/2016 and Minister of Industrial Regulation No. 1/2018.

As for corporations who conduct research and development activities, they could obtain a corporate tax deduction at max 300% of their research and development expenses as regulated in Government Regulation No. 45/2019 and Minister of Finance Regulation No. 153/2020.

3. Budget Allocations and Research Funding

Most of the incentives mentioned above were only implemented recently. Hence budget allocations and tax expenditures for the development of electric vehicles at the national level have not been reported yet. Those regulations might further reduce the fuel subsidies that have been decreased for several years. In 2020, the fuel subsidy was only IDR 14.9 Trillion compared to IDR 38.9 Trillion in 2018. However, these might also increase the subsidy for electricity.

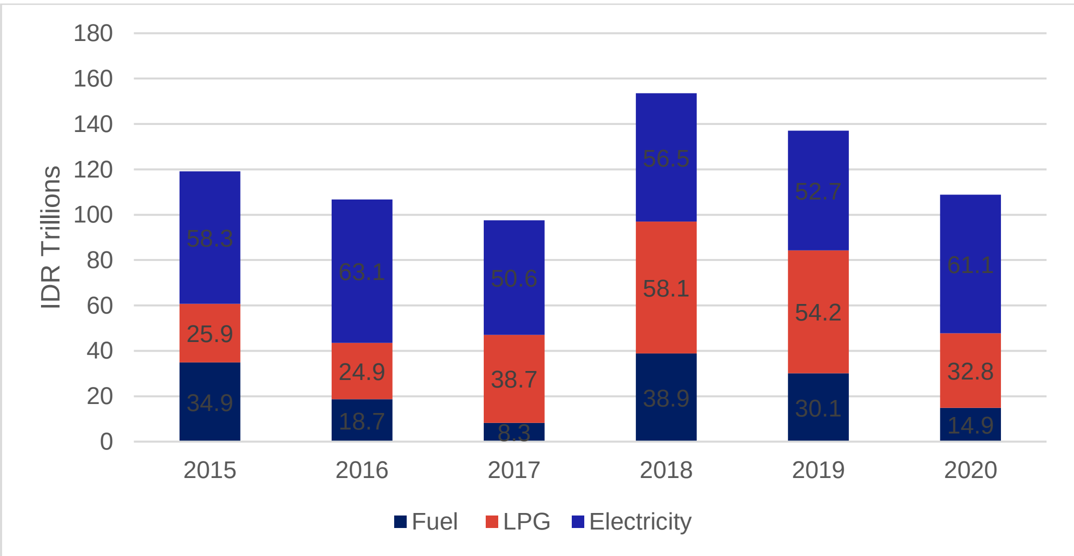
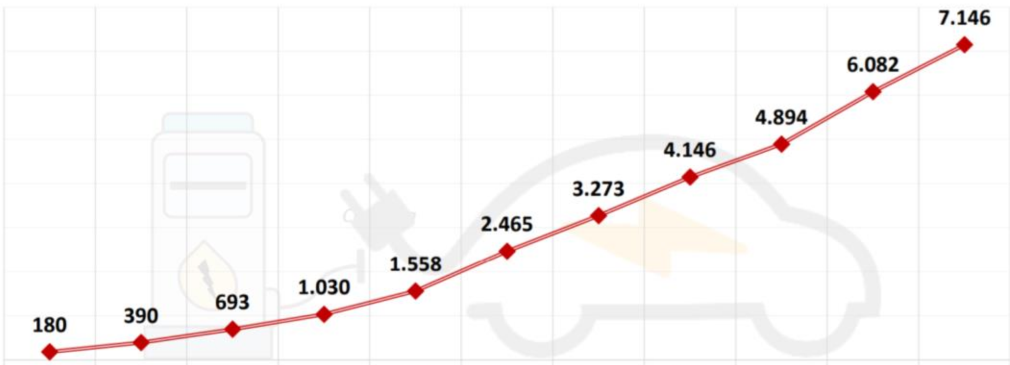


Figure 1. 1 Energy Subsidy 2015-2020 (Source: MOF)

In addition, research programs to initiate the electric vehicle development program have been conducted for several years. There are several research fundings given for the development of electric vehicles (Purwadi, 2020). In 2013-2013, the Ministry of Education and Culture allocated IDR 15 billion to 5 universities in Indonesia i.e., UI, ITB, UNS, ITS to begin the initial research for electric vehicles. In 2014-2015, the Ministry of Finance through LPDP further allocated IDR 89 billion to those five universities for the R&D of E-vehicle and its key components prototypes and developing the roadmap for electric vehicles in the next five years.

In 2016, the Ministry of Research, Technology and Higher Education established Research Centres in ITS and ITB to coordinate the multi discipline and multiple institutions involved in the roadmap. However, no further funding was allocated in 2016 and 2017. The research funding was continued in 2018 in a two-step multi-year contract where IDR 32.1 billion were allocated for the first phase in 2018-2019 and IDR 103.8 billion were allocated for 2019-2022.

In the development of the electric charging stations, PT. PLN projected to develop 7146 stations with total investment about IDR 12.3 trillion (Electrical Energy Department, Ministry of Energy and Natural Resources, 2020)[1]. Up until October 2021, there were 187 charging stations established from the targeted 669 units.



	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Investasi (Rp M)	309	669	1.188	1.766	2.672	4.227	5.613	7.110	8.393	10.431	12.255

Figure 1. 2 Development Roadmap of Electric Charging Stations in Indonesia (Source: MENR)

[1] Electrical Energy Department, Ministry of Energy and Natural Resources (2020). Penyediaan Infrastruktur Pengisian Listrik dan Tarif Tenaga Listrik untuk Kendaraan Bermotor Listrik Berbasis Baterai. Presented in an online discussion on August 6th, 2020

1.1.2. Local government (Jakarta Provincial Government)

2W Ride-hailing Governance

In terms of local government, there are mainly four agencies that are directly related to the current ride hailing landscape in Jakarta Province: Jakarta Transport Agency, Jakarta Environmental Agency, Jakarta Highways Agency, and Human Settlements, Spatial Planning, and Land Agency (DCKTRP). *The Jakarta Transport Agency* is responsible for conducting quality testing and inspection of motorised vehicles for public transport including for ride-hailing purposes. The transportation department for each administrative city in Jakarta is also responsible for controlling ride-hailing fleets that cause traffic congestion. *The Jakarta Environmental Agency* is responsible for conducting emissions tests and in November 2020, they collaborated with Gojek to hold free emissions tests for ride-hailing drivers. *Jakarta highways agency*, through Road Infrastructure and Utility Networks Planning plays a role in preparing vehicle parking rules, including ride-hailing parking, as well as providing ride-hailing pick-up point or shelter. Last, DCKTRP coordinates with private institutions and other local agencies such as Dinas Bina Marga, Transport Agency, BPKD takes part in preparing typology and schemes for providing and managing ride-hailing shelter facilities (Ruang Waktu and Urban+ Institute, 2019).

Electrification Efforts or Programs

In parallel with the Presidential Regulation No. 55 of 2019, local governments also have set their roles and initiatives in the electrification effort and program. There are six agencies that are directly related to the BEV acceleration program. The six agencies and their responsibilities are as follows.

1. Jakarta Transportation Agency
   They could potentially take part as a regulator that mandates ride-hailing electrification in DKI Jakarta, as well as formulates local-level non-fiscal incentives such as Low Emission Zone. The local government has exempted electric vehicles as well as ride-hailing vehicles from odd-even policy. They also have planned Electronic Road Pricing (congestion charging) but it has not been implemented yet.

2. Jakarta Communication and Information Agency
   They carry out public information management and communication, regional data centres, as well as electronic-based government application and information security services. They also conduct outreach on Government policies related to ride-hailing and BEV.

3. Jakarta Environmental Agency
   Despite the limited information about the current effort regarding vehicle electrification, they could potentially play a role in battery waste treatment.

4. Jakarta Planning Agency
   They play a role in formulating local-level policies which include building codes to accommodate charging infrastructure. In early 2021, the local government introduced the implementation of Low Emission Zone currently at the Old Town Area and would be expanded in the future. This policy prohibits conventional motorised vehicles, but public transportation and electric vehicles including the 2W.

5. Jakarta Financial Management Agency (BPKD)
   They play a role in formulating local-level policies which include fiscal incentives, also preparing local budgeting for road and public transport infrastructure. The local government has imposed 0% on BBN-KB for electric vehicles instead of up to 12.5% for conventional vehicles.

6. Development agency of Regional Owned Enterprise
   They play a role in supporting local governments to become pioneers in using BEVs for operational vehicles within the scope of their respective agencies. In addition, one of the ROE in Jakarta, PT Transjakarta, has conducted operational trials for electric buses and is planning to transform its fleets into battery electric bus (BEB) fleets by 2030.

Fiscal Position

The Government of DKI Jakarta has issued Governor's Instruction No. 66/2019 about Air Quality Control to address the problem of air pollution due to fossil fuel emissions. This regulation describes that Government will ensure the mitigation of air pollution problems such as:

1. Age restriction for public transportation vehicles that are over ten years old and do not pass emissions tests and to accelerate the rejuvenation of 10.047 small, medium, and large bus fleets starting in 2020.
2. Encouraging public participation in air quality control by expanding odd-even policy's areas and increasing parking rates in areas served by public mass transportation as well as implementing congestion pricing policies regarding air quality control in 2021.
3. Tightens the emission test provisions for all private vehicles starting from 2019 and placing private vehicle age restrictions that are more than ten years in the DKI Jakarta area in 2025.
4. Encouraging the transition to public transportation modes and improving pedestrian comfort by accelerating the construction of pedestrian facilities on 25 protocol roads, arteries roads, and on the access to public transportation by 2020.
5. Tightening control of immovable pollutant producing sources, especially the chimney industry which produces pollutants exceeding the emission quality standard (responsibility of the DKI Jakarta Environment Agency).
6. Optimising reforestation/vertical green-/ plant on public facilities and infrastructure by applying high pollutant absorbing plants and encouraging the adoption of green buildings principles by all buildings through incentives and disincentives which are implemented by the DKI Jakarta Environments Agency.
7. Pioneering the transition to renewable energy and reducing dependence on fossil fuels by installing rooftop solar panels in all school buildings, local government buildings, and local government health facilities

To support the vehicle electrification program in Jakarta, the DKI Jakarta government issued DKI Regional Regulation No. 3 of 2020 concerning Tax Incentives for Transfer of Motor Vehicle Title Fee on Battery-Based Motor Vehicles for road transportation whereas battery-based electric vehicle for road transportation will be free of vehicle title fee. The regulation will be valid until December 2024.

The DKI Jakarta Government targets has a goal of transitioning their denizen transportation mode into public transportation. The target percentage usage of public transportation mode by DKI Jakarta citizens is shown on Table 1.1 Based on the data in the DKI Jakarta RPJMD document (2017-2022), the DKI Jakarta government has targeted the use of public transportation to increase by around 30% in share mode. This will provide positive results to reduce the impact caused by the usage of private vehicles.

Table 1. 1 Percentage of residents travelling using public motorised vehicles

	Baseline	2018	2019	2020	2021	2022
Percentage of residents travelling using public motorised vehicles (Public Transportation Modal Share)	18%	20%	22%	25%	28%	30%

The revenues and expenditures from the DKI Jakarta Government can be seen in the 2017-2021 APBD/RAPBD, several of which is related to the electrification program by the Government such as:

1 Vehicle Tax Revenue, as shown in Figure 1.3 Based on the data presented in the 2017-2021 APBD/RAPBD, the average income from Vehicle Tax is around 8.4 trillion Rupiah per year with an average increase rate of 7.1% per year.

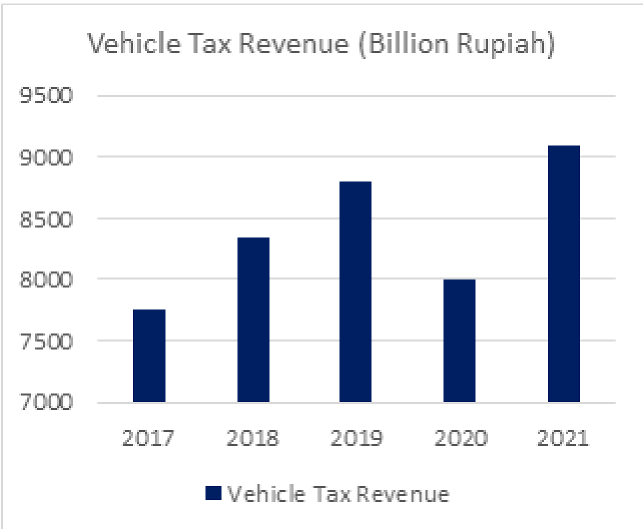


Figure 1. 3 DKI Jakarta Government Vehicle Tax Revenue

2 Fuel Tax Revenue, as shown in Figure 1.4. Based on the data presented in the 2017-2021 APBD/RAPBD, the average income from fuel tax is around 1.13 trillion Rupiah per year with an average increase rate of 0.37% per year. In 2020 there is a decrease in potential revenue

due to the Covid-19 pandemic. In addition, with the Government plans to encourage vehicle electrification, there will be a decrease in the fuel consumption by private vehicles.

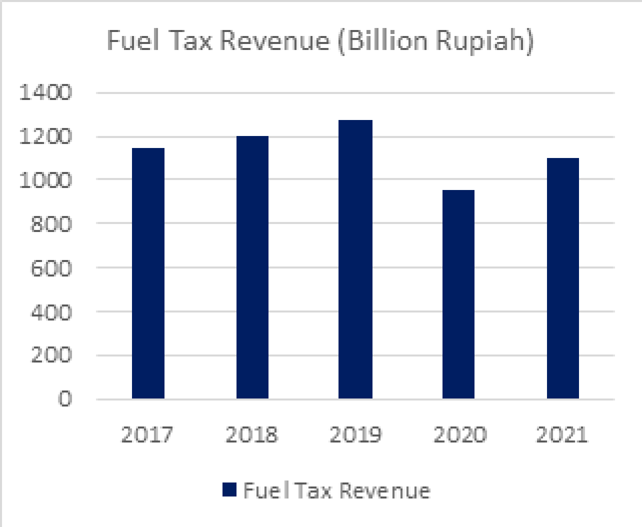


Figure 1. 4 DKI Jakarta Government Fuel Tax Revenue

3 Vehicle Title Transfer Fee Tax Revenue, as shown in Figure 1.5. Based on the data presented in the 2017-2021 APBD/RAPBD, the average income from Vehicle Title Transfer Fee Tax is around 4.87 trillion Rupiah per year with an average increase rate of 2.7% per year. With the implementation of 0% Vehicle Title Transfer Fee Tax for electric vehicles, there will be a tendency for the income from the Vehicle Title Transfer Fee Tax to be reduced.

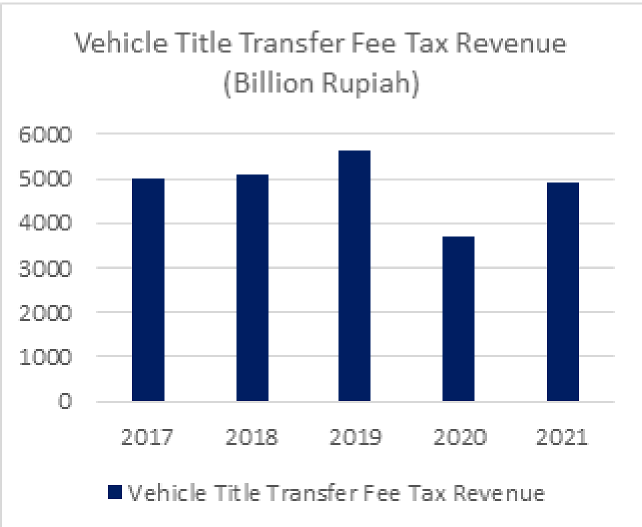


Figure 1. 5 DKI Jakarta Government Vehicle Title Transfer Fee Tax Revenue

4 Public Service Obligation Expenditure for Public Transportation Subsidies, as shown in Figure 1.6. Based on the data presented in the 2017-2021 APBD/RAPBD, the subsidy expenditure for public transport is around 3.90 trillion Rupiah per year with an average increase rate of 29% per year. The increase in expenditure is caused by the increase in public transportation usage in 2018 due to integration policies with JakLingko. The PSO expenditure is also likely

to increase due to the Government’s plan to electrify the TransJakarta fleet until 2030 as a part of the electrification program.

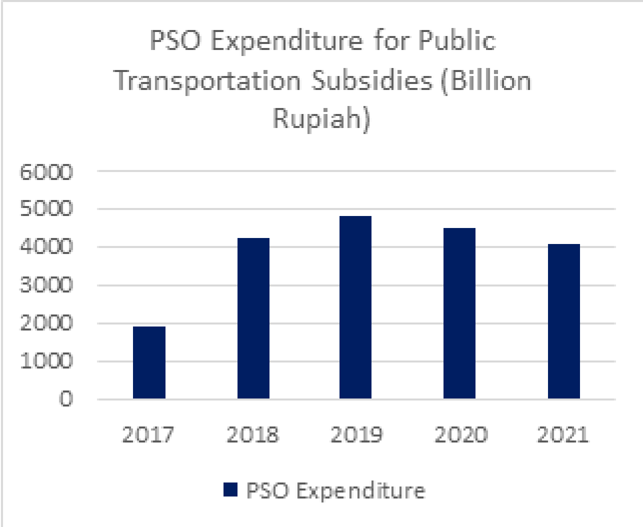


Figure 1. 6 DKI Jakarta Government PSO Expenditure for Public Transportation Subsidies

5 Electricity Cost Expenditure, as shown in Figure 1.7. Based on the data presented in the 2017-2021 APBD/RAPBD, electricity cost expenditure is around 928 billion Rupiah per year with an average increase rate in the range of -2.9%). The decrease in expenditure is due to one of the DKI Jakarta Government's policies to save electricity, especially in government buildings or other public service buildings. And with the Ministry of Energy and Mineral Resources plans to encourage vehicle electrification within the government, this will have an impact on the increasing electricity tariff costs in the future.

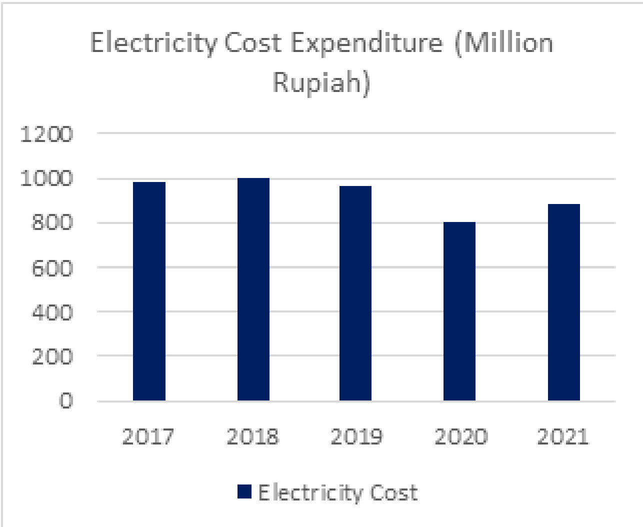


Figure 1. 7 DKI Jakarta Government Electricity Cost Expenditure

The exemption of vehicle title transfer fees by DKI Jakarta Regional Regulation No. 3/2020 will reduce the on the road selling price of electric vehicles as well, given the price is more competitive.

It is one of the supported policies provided by the DKI Provincial Government to accelerate vehicle electrification. In addition, several other policies are also encouraged by the DKI Government to provide incentives in the form of facilities (sidewalk area) provision that DKI have been built of a total area of 760,305 m^2 (within 2018-2020) and more to come with a target of 40,000 m^2 sidewalk (2021 target). There is also an incentive for buildings that implement green building in the form of building offset area.

Furthermore, there are also disincentive policies to discourage people from using private vehicles and shifting into public transportation. These policies include traffic restrictions by expanding the odd-even area, reducing on-street parking areas (causing a decrease in income from parking fees entering the Local Own-Source Revenue), and increasing parking fees in offices or shopping centres.

Currently with the DKI Jakarta policy through Governor's Instruction No. 66/2019, the foremost institution or agency to manage the transportation budget is the DKI Jakarta Transportation Agency. The spending budget of DKI Jakarta Transportation Agency is shown in Figure 1.8. The figure shows that the spending budget of the Transportation Agency in 2020 is lower than the previous years due to budget rationalisation for Covid 19 control measures. The average spending of DKI Jakarta Transportation Agency from 2017-2020 is 1.2 trillion Rupiah. In 2021 the DKI Regional Government has projected a large spending budget for Transportation Agency expenditures in the value of up to 5 trillion Rupiah. This increase in spending budget is due to the revival of the transportation sector after the pandemic and to compensate for several rationalised budgets in 2020.

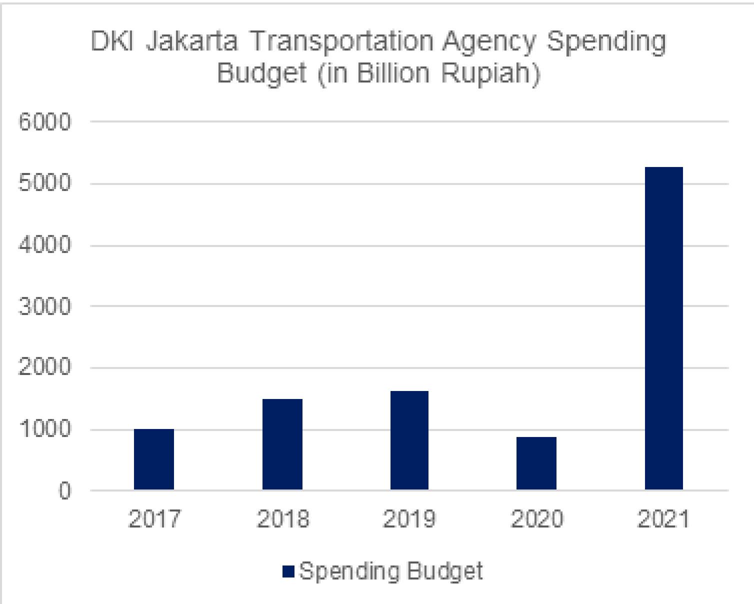


Figure 1. 8 DKI Jakarta Transportation Agency Spending Budget

1.2. Companies Perspective

1.2.1. Ride Hailing Operators

Gojek and Grab, as two of the biggest ride-hailing operators in Indonesia, currently offer similar services which mainly include passenger transport service, food delivery service, and goods delivery service. Other than these three ride-hailing main services, operators also own another business line such as groceries shopping service and digital entertainment and payment services. In this report, only these three main ride-hailing services would be discussed.

Drivers are not workers or staff of operators, but partners of the operator for ride-hailing service. This partnership does not have an expiration date once the registration but could be terminated by the operators if the drivers conduct any offence. Both Grab and Gojek do not provide the motorcycle for drivers, but provide rent for electric 2W. Drivers do not receive salary from the operators. Their income solely comes from daily operations, charged by the operators, 20% from the income.

Operators also partners with restaurants for providing food delivery service. In return, the restaurants pay commission fees to the operators. Gojek through the GoFood service charges restaurant merchants 20% + IDR 1,000 for every product sold (Iskandar, 2021). This commission fee is adjusted from the previous 12% + IDR 5,000 before March 2021. Similar to GoFood, GrabFood also charges commission fees, 30% from the price of the food, 10% higher from the previously 20% of the food price (Azzahra, 2021).

As regulated on the MoT Decree No. 348 of 2019, the lower limit of ride-hailing fare is IDR 2,000 per km while the upper limit is IDR 2,500 per km with the minimum fare of IDR 8,000 to IDR 10,000 in Jabodetabek Area. However, from March 2020, there was an adjustment for the fare. The lower limit being IDR 2,250 per km while the upper limit being IDR 2,650 per km and minimum fare of IDR 9,000 to IDR 10,500 for trips less than 4 km (Ramli & Djumena, 2020).

For food delivery service, Gojek adds other criteria to the fare which are partner or non-partner food merchants and GoPay or non-GoPay payment. In Jabodetabek, the base fare for GoFood partner food merchant using GoPay is IDR 4,000; GoFood partner using cash is IDR 9,000; non-GoFood partner and using GoPay is IDR 10,000; and GoFood partner using cash is IDR 13,000. This base fare would be added by IDR 2,000 per km.

Last but not least, for goods delivery service, Gojek applies the minimum fare of IDR 13,000 with IDR 2,815 per km for the first 10 km. After 10 km, the fare would be IDR 3,000 per km. Gojek also offers same day delivery which is cheaper than the instant one. The minimum fare is also IDR 13,000, with the first 6 km would be IDR 2,815 per km and for 6-15 km would be flat IDR 18,000. Over 15 km, the additional fee would be IDR 1,200 per km.

Grab, who has deployed the electric 2W pilot, does not let consumers choose to use electric vehicles or not, automatically assigned based on distance and area. On the contrary, Gojek on the upcoming pilot project is reported to let consumers choose the electric vehicle or not.

Scale of current operations:
The Director of Road Transportation of the Ministry of Transportation estimated the number of ride-hailing two-wheeler drivers in Greater Jakarta reach around 1.25 million drivers. However, this number came from a rough estimation and cannot exactly show the precise number of the drivers. Therefore, we conducted an estimation based on the yearly total number of hours demanded by ride-hailing customers and divided by the total number of hours worked by the driver per year. This number is estimated with the assumption that the utilisation rate of the drivers is 85%.

It is estimated that the number of ride-hailing two-wheeler drivers reach about 900,000 drivers. Unfortunately, due to COVID-19 pandemic, the number of the drivers decreased drastically with around 70%. So, the current number of the drivers are estimated around 300,000 drivers.

Electrification effort/program:
Gojek and Grab already have their fleet electrification plan. Gojek aims for their fleet to be fully electric by 2030, while Grab, in collaboration with Indonesian Government, has developed an Electric Vehicle Ecosystem Roadmap, including to provide 26 thousand electric vehicles in Indonesia by 2025 (Andi & Handoyo, 2020). According to Grab, the fleet electrification is part of the plan to reduce the pollution emitted by gasoline ride-hailing vehicles and thought that the electrification should be advantageous economically for the drivers. Similar to Grab, Gojek wants it to be a zero-emission company by 2030 and fleet electrification is one of the efforts that Gojek has been doing.

Started in mid-2019, Gojek rolled out an electric motorcycle pilot in collaboration with Astra Honda Motor with Honda Electric PCX as the model. A bit late, in December 2019, Grab announced that in early 2020, they would deploy electric vehicles, consisting of 20 units of GrabCar and 20 units of GrabBike. In this trial, Grab partnered with Hyundai, Gesits, and Astra Honda Motor as the vehicle manufacturer, as well as electric state company (PLN) and Agency for the Assessment and Application of Technology (BPPT) as the charging station provider. In August 2020, Grab continued the electrification effort by using 50 units of Viar Q1 to be operated in DKI Jakarta and in November 2020 Grab partnered with Kymco to provide 20 electric motorcycles in Tangerang, including the battery swapping station. Outside Jakarta, Grab also launched 30 electric motorcycle and battery swapping stations in Bali since late November 2020. In December, Grab rounded the electrification effort by announcing their target to operate 26 thousand electric vehicles by 2025.

Seemed outpaced by Grab, Gojek finally announced that they would start an electric motorcycle pilot with battery swapping technology in collaboration with Pertamina in 2021. Few months later, in May 2021, Gojek announced their ambition to fully electrify their fleets by 2030. Meanwhile in April, Grab said that there are already 5,000 electric fleets in Indonesia and would add another 1500 units by the end of 2021. In October, it is said Grab will continue the partnership with Viar by ordering another six thousand electric motorcycles to be deployed in the remaining 2021 in Indonesia. Not only Grab, Gojek would also deploy five thousand Gesits electric motorcycles with swap battery technology, starting with 500 units in South Jakarta. Gojek partnered with Pertamina to embed the battery swap cabinet in the fuel station.

1.2.2. Other Companies

Line of Business and Electrification Efforts or Programs

There are several companies that also have zero carbon target and initiatives other than the government, which are:

1. Indonesia Battery Corporation (IBC)
   IBC is a joint company that was established by the government which consists of four state-owned enterprises in the mining and energy sector, which are MIND ID, Antam, PLN, and Pertamina. IBC aims to develop the electric vehicle battery industry ecosystem from upstream to downstream, including the charging station infrastructure and battery recycling. MIND ID and Antam are national mining companies that will provide nickel supply of the main component of the battery. PLN (State Utility Company) is a national electricity generation and distribution company that provides the charging infrastructure, packaged battery cells, energy storage systems (ESS) batteries, ensuring grid stability, providing grid installation incentives and determining electricity tariff and incentives for charging facilities. Pertamina is a national oil and gas distribution company that will plan the addition of charging infrastructure to its petrol station, providing precursors and cathodes, battery cells for packaging, energy storage systems (ESS) battery, and charging for BEV.

2. LEN Industri
   LEN Industri is a state-owned company which is involved in technology-based business. Their business includes the defence electronics industry, transportation systems, renewable energy, Information & Communication Technology (ICT), and navigation systems. Their core strengths are in design and engineering, product development, manufacturing, testing and commissioning, construction and installation, operation and maintenance. They will play a role in developing and manufacturing electric vehicle charging stations with the help of PLN in providing electric supply.

3. State-Owned Banks
   Bank Rakyat Indonesia (BRI), Bank Mandiri, Bank Nasional Indonesia (BNI), Bank Tabungan Negara (BTN), and Bank Syariah Indonesia are the State-Owned Banks that have taken part in the ride-hailing landscape. BRI and Bank Mandiri provide small business credit services for ride-hailing drivers. Bank Mandiri provides financial support in the development of the BEV ecosystem, both in terms of investment, financing, transaction and cash management, treasury solutions, and trade solutions (Meilanova, 2021). The subsidiary of BRI, which is BRI Insurance, provides credit scheme support for electric vehicle purchase called Greensurance. Mandiri and BNI also have a subsidiary which are Mandiri Tunas Finance and BNI Multifinance, which are also involved in the BEV acceleration program by creating a zero percent down payment policy for electric vehicle purchase (Priyanto, 2020).

1.3. Drivers Perspective

Current operational pattern

There are currently three types of ride-hailing services provided by the operator: passenger transportation, food delivery and goods delivery. Some drivers are taking certain services only while the majority of drivers take multiple types of service. Combination trips are more preferable for conventional 2W drivers (336; 72%), followed by passenger transport service only (75; 16%), food delivery service only (47; 10%) and the least popular, goods delivery service (7; 2%). Out of 336 drivers who take combination types of service, 55.47% drivers take passenger transport service, while food delivery and goods delivery are 38.7% and 5.84% respectively. This indicates that passenger transport service is currently being the most popular and holds a significant role in ride-hailing service. However, the 2W electrification should be based on the characteristics of each trip that would be discussed below.

In 2W electrification, daily kilometres travelled should be considered since it would affect the battery capacity and or charging scenario. Daily kilometres travelled would be looked at from drivers who take single types of service only. On average, drivers who only take passenger transport service reach 84.2 km daily completing an average of 8.45 trips daily. Drivers who only take food delivery service travelled a shorter distance with 72.7 km and averaging 9.5 trips per day. On the other hand, drivers who only take goods delivery service travelled the longest averaging 95.5 km daily but only 6.75 trips completed per day.

Table 1. 2 Driver's working hours and distance travelled split

	Working Hours Splits (%)		Estimated Distance Travelled (km)	
	Before Break	After Break	Before Break	After Break
Total	44.1%	55.9%	33.7	42.6
Passenger Transport	42.8%	57.2%	36.0	48.2
Food Delivery	43.6%	56.4%	31.7	41.0
Goods Delivery	44.6%	55.4%	42.6	52.9
Combination	44.4%	55.6%	33.2	41.5

On an aggregate level, conventional 2W motorcycle drivers spend most of the working hours after the lunch break, almost 56% of the daily trip. This should be considered as the lunch break is one of the potential batteries charging or swapping time, so to make sure that the battery capacity of electric 2W would be sufficient for each period, before and after lunch break.

Kilometre travelled for each trip also should be considered to estimate the number of trips before charge needed. Estimating from the driver's interview's daily distance, it is estimated that passenger transport drivers average 9.96 km per trip, while food delivery and goods delivery drivers average 7.66 km and 14.15 km respectively. However, these estimations are found to be higher than the consumers' distance travelled estimation below.

Table 1. 3 Distance per Trip Based on Types of Service

	Estimated Distance per Trip		
Types of Service	Drivers Interview	Consumer Survey	Difference (ratio)
Passenger Transport	9.96	6.09	1.63
Food Delivery	7.66	3.63	2.11
Goods Delivery	14.15	10.67	1.33

These differences are reasonable since the distance travelled are based on the estimation of each respondent, some might have checked on the maps apps and some didn't. The estimation of distance travelled from drivers' interview could be used as the upper limit while the consumers estimation could be used as the lower limit.

For conventional motorcycle drivers, Honda Beat is the most popular model, followed by Honda Vario and Yamaha Mio in third place. Based on the types of service, Honda Beat is still the most dominant motorcycle model. Table 3.1 shows how dominant these three types of motorcycle are in every type of service. There's minimum to none indication that certain types of service favour a certain model of motorcycle. This indication is supported by the fact that, in general, price is the most determining factor compared to vehicle spec when drivers buy conventional motorcycles (Figure 3.1). Vehicle specs are also being considered, including the fuel economy. In general, Honda has better fuel economy compared to the other brands and this might be the reason Honda motorcycles are more popular.

Honda Beat, being the most popular motorcycle model, could be bought for a new one starting from IDR 16,665,000 in 2021. On the paper, it has an engine capacity of 100 cc, maximum power of 9.0 PS at 7,500 RPM and has the best fuel consumption up to 60.6 km/L. However, based on driver's estimation of daily distance travelled and daily fuel cost, it is found that Honda Beat has different fuel economy compared to the specification sheet, despite the difference of year manufactured. For passenger transport service only, the fuel economy would be 28.8 km/L, while for food delivery service 29 km/L and goods delivery service up to 45 km/L, generally more economical compared to other models. With its price, Honda Beat is the cheapest motorcycle model available in the market and might be the main reason for the high population for ride-hailing service.

Financial Capabilities

On average, conventional motorcycle drivers earn IDR 142,560.09 per day and vary between each type of service. Drivers who take passenger transport service earn the lowest revenue daily with IDR 140,833.33 while food delivery service drivers earn higher revenue with IDR 146,333.33. On the other hand, goods delivery service drivers earn the highest revenue daily with IDR 161,214.29, 13.09% higher than the average. However please note that the lack of samples might be the cause of this difference. With an average of 6.49 working days a week, it is estimated that the drivers could earn revenue of IDR 3,700,859.94 monthly.

Not only varied between types of service, the driver's incomes also varied between gender. Female drivers are averaging higher daily income than male drivers, more than IDR 5,000 daily. This might be due to the majority of female drivers taking the food and goods delivery service that generate more revenue.

Table 1. 4 Male and Female Drivers' Revenue

	Male	Female
Average	**142,447.37**	**148,500.00**
Differences (IDR)		6,052.63
Differences (%)		4.25%

Based on the driver interview, up to 60.1% of the drivers own the conventional motorcycle by using a credit scheme, leaving only 36.1% who paid cash and 3.9% with other methods. Drivers who acquire their vehicles in cash spent an average of IDR 14 million for their motorcycle, either new or second-hand. On the other hand, drivers who purchase the motorcycle with a credit scheme, spend an average of IDR 2 million as the down payment and IDR 825 thousand on monthly instalments for an average 30-month long credit scheme. Within this credit scheme, it is estimated that drivers average around IDR 27 million to purchase the motorcycle. Contrarily, current electric 2W drivers don't own the vehicle but rent from the operator, for IDR 30k to 50k daily. This cost already includes battery swapping or charging and maintenance cost at the operators' shelter.

Unlike the electric 2W drivers, conventional 2W drivers have to pay for fuel and maintenance costs. The latter would be counted on a daily basis although drivers do not have the maintenance daily. Drivers who take food delivery service spend less on daily expenses, both on fuel cost and maintenance cost (IDR 22,385.42 and IDR 5,687.39). Goods delivery service drivers spent the highest amount of expenses for daily fuel (IDR 32,142.86) mainly due to longer daily distance travelled but mid maintenance cost of IDR 6,734.66 daily. Passenger transport drivers, on the other hand, spend the most for daily maintenance cost (IDR 35,682.80) and mid daily fuel cost of IDR 27,560.00.

There are some options for the driver's ownership of the fleets which are to rent or to own. Ride-hailing driver's association stated that mostly, drivers would prefer to own the motorcycle, be it ICE 2W or electric 2W. It is reasonable considering that the drivers also use motorcycles not only for the ride-hailing job, but also for daily activities. However, drivers' current ownership of ICE motorcycles and higher capital cost could hinder the electric 2W adoption. The ownership scheme should also consider such factors.

Electrification Perspective

It is found from the drivers interview that only 41.3% of the drivers who are interested to shift to electric 2W despite almost 75% of the drivers know the availability of electric 2W for ride-hailing service. Over various reasons submitted, drivers are interested in electric 2W mainly due to the operational advantage including more frequent order, vehicle specification advantage, and being environmentally friendly. On the other hand, financing issues are the most discouraging issues of electric 2W adoption, followed by vehicle performance and limited infrastructure issues.

On using electric vehicles, 50% of drivers still disagree and only 32% agree if they were required to use electric vehicles for ride-hailing service. Moreover, when asked to buy an electric motorcycle for ride-hailing service, drivers' agreement significantly drops to such a policy with more than 70% disagree while only 18% who agree. To look further, the most reluctant drivers to buy electric 2W for ride-hailing service comes from goods delivery drivers, followed by passenger transportation and food delivery service respectively. Financing issues, once again become the significantly discouraging reasons for drivers to buy electric 2W. Vehicle performance issues and facilities limitation also took less significant reasons that resist drivers to buy electric 2W. Drivers' financial capabilities might hold an important role in the success of electric vehicle adoption for ride-hailing services.

Most of the current conventional motorcycle drivers suggest the electric 2W price to be less than IDR 10 million. Around 30% of the drivers suggest the price to be in the IDR 11-20 million price range and less than 5% suggest the price to be more than IDR 20 million. On the other hand, the proportion of current electric 2W drivers who suggest the price to be less than IDR 10 million is over 20% lower, rising the above IDR 11 million category.

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2. Policy Scenario Matrix

This section will cover policies that would lead to electrification of 2W ride-hailing fleets in Greater Jakarta by 2030, under the policy status quo and on a more aggressive table.

2.1. Business-As-Usual Scenario

2.1.1. Current and Projected E2W growth

With current policies, the Government of Indonesia has set a target to have 2 million of electric 2W by 2025 (Rochman & Putri, 2021). Moreover, in 2030, the government through the Ministry of Energy and Mineral Resources, has stated there would be 13-million-unit electric motorcycles in Indonesia and in 2040, all motorcycles that would be sold in Indonesia would be electric based (Umah, 2021). Accordingly, the Ministry of Industry has also determined to leverage the production of electric motorcycles up to 20% of total national motorcycle production. The capacity of current electric motorcycle production reaches up to 877,000 units annually involving 1,400 workers.

Gojek has also committed to be fully electrified, both the four-wheeler or two-wheeler-based ride-hailing. Grab, on the other hand, expected that in 2025 they would have deployed 26 thousand electric vehicles. Compared to the Government's plan, Grab's plan of 26 thousand fleet might be less significant. Gojek's plan, if followed according to plan, would be a major step, even a step further compared to the Government's plan.

2.2. Medium Ambition Scenario

Based on the current operator's target of electrification, these are the additional policies recommendation to achieve 2W ride hailing full electrification by 2030 in Greater Jakarta.

2.2.1. Policy Benchmarks

Lessons from India

Central and State governments have been promoting adoption of EVs by providing fiscal as well as non-fiscal incentives. Some of the incentives being provided on purchase of EVs are: Upfront capital subsidy under FAME India Scheme Phase II. The revision of FAME II gives an additional subsidy for electric 2wheelers. Goods & Services Tax (GST) on EVs has been reduced from 12% to 5%. States have also developed policies for special EV tariffs for buildings and charging stations and time of use tariff structure for charging EVs. While these initiatives are not linked to ride hailing specifically, they indirectly impact the ride-hailing by encouraging e-2W adoption. Upfront purchase subsidies, scrapping incentives and road tax exemptions are key drivers to encourage electric 2Wheeler adoption. Society of Manufacturers of Electric Vehicles (SMEV) reported that out of the total Electric Vehicle sales in FY 19-20, 1.52 lakh units were two-wheelers.

Specific to ride-hailing, the state government of Karnataka has issued e2w taxi policy which mandates the use of electric 2 wheelers for ride-hailing services. This has pushed ride hailing operators such as Rapido in working towards electrification more aggressively. Rapido plans to electrify 25% of its fleet by 2022.

The state government of Telangana aims to incentivize ride-hailing services for the first 5,000 four-wheeler commercial passenger vehicles registered through a 100% exemption from the road tax and registration fee, and is also incentivizing charging infrastructure.

Lessons from Other Countries

Although countries and cities across the globe have used a range of policies to support a transition away from combustion and toward electric vehicles, there are still very few policies aimed directly at ride-hailing fleet electrification. This section highlights the most common policies and strategies to encourage general EV adoption, which have both direct and indirect impacts on ride-hailing fleets.

Expand EV availability

- **Manufacturing incentives**. Incentives to support local manufacturing supports new modes to come on the market. Several countries have started by reducing the tariffs for importing parts that allow local companies to assemble their own vehicles. Additionally, subsidies to support R&D or the use of local materials can further support local manufacturing to grow and expand.

- **Vehicle standards**. Setting vehicle standards can ensure that vehicles meet certain design, safety, and emissions standards. But they are also important for providing manufacturers and operators certainty around what future requirements will be, which can encourage additional investment.

Improve cost competitiveness

- **Climate and air quality plans**. Climate and air quality policies can create the political mandate for action and help to drive demand for electric vehicles. Several countries have adopted climate or air quality targets that identify emission reduction goals in the transportation sector, which sets the stage for adoption of policies to electrify vehicles.

- **Bans on combustion vehicles**. Some countries and cities have banned combustion vehicles altogether. These bans can take a few forms. For example, Oslo, Norway, started by creating zero emission zones in the city centre, and announcing plans to gradually expand the zone over the years. At around the same time, the Norwegian federal government implemented a national policy to ban the sale of combustion cars by 2025.

- **Reduce taxes and fees.** Reducing taxes and fees for electric vehicles, including tariffs, excise tax, and value added tax can support the market to reach parity with ICE vehicles, especially when the reduction is paired with an increase in fees for combustion vehicles. These reductions of exemptions can apply to the import of the whole vehicle, or component parts.

- **Purchase subsidies**. Subsidies can be provided at the purchase point, or as a rebate to reduce the cost of purchasing an electric vehicle. The size of the subsidy should aim to bring the purchase price low enough that it is competitive with purchasing a combustion vehicle.
- **Special access allowances**. Instead of fully restricting combustion vehicles, cities can also allocate road space in ways that make it more convenient for drivers of electric modes.
- **Battery recycling and reuse.** Batteries are one of the most expensive components on an E2W. Government investment in training and facilities to support refurbishing and recycling can help to create a second life market and improve access to cheaper batteries.
- **Gas taxes**. In addition to lowering the cost of EVs, governments can raise the cost of combustion vehicles to further encourage adoption. Additional taxes on gasoline and gas-powered vehicles will make electric vehicles more appealing.

<u>**Accelerate deployment across fleets.**</u>

- **Government fleet purchase**s. Government agencies can help fledgling E2W to take root by transitioning their own fleets. If local manufacturing operations are still emerging, purchasing a fleet can help companies to get established. Even if local options are not available and vehicles need to be imported, the increased visibility can go a long way toward building awareness to electric vehicles and supporting local ancillary services to get established.
- **Supporting ancillary services.** While goods (e.g., spare parts), and services (e.g., maintenance) for combustion vehicles are readily available, the ecosystem for electric vehicles is underdeveloped. Government can support the transition to electric vehicles in part by supporting ancillary services, including maintenance, battery handling and recycling, and charging.

<u>**Develop charging infrastructure**</u>

- **Financial support for charging infrastructure.** Government investment in charging infrastructure can help to reduce the ‘range-anxiety’ that can be a barrier to purchasing electric vehicles. Public charging facilities can be a particularly useful investment for encouraging fleet transition, including ride-hailing.
- **Site allowances and prioritisation.** Government can support the expansion of public charging infrastructure by allocating space for charging in popular destinations.
- **Reducing soft costs.** Navigating laws around charging station constriction is one of the biggest expenses for EV companies. Local governments can reduce the time and cost

required to create charging stations by removing red tape associated with proposing and constructing new locations.

Raise awareness around the benefits of E2Ws

- **Business outreach**. Local businesses may not be familiar with the economic and efficiency benefits of using electric fleets. Outreach and education to businesses on the benefits of electric vehicles as well as knowledge sharing around government programs that support their use can help to drive uptake.
- **Public outreach**. Outreach to the general public can be conducted through radio, television, and internet, and public space advertising.

Table 2. 1 Electrification Strategies Benchmarking

Policy/strategy	Country Examples	Cost (govt)	Impact
Manufacturing incentives	China	Moderate	Moderate
Vehicle standards	Canada, China, USA	Low	High
Climate and air quality plans	EU, USA, China	Low	Moderate
Bans on combustion vehicles	USA, China, Canada	Low	High
Reduce taxes and fees	Japan, USA	Moderate	Moderate
Provide purchase subsidies	India, Japan, USA	High	High
Special access allowances	China, UK, Germany	Low	Moderate
Battery recycling and reuse	EU, China, USA	Moderate	Moderate
Government fleet purchases	China, Germany, UK	High	Moderate
Supporting ancillary services		Moderate	Moderate
Financial support for charging infrastructure	Canada, China, India	High	Moderate
Site allowances for charging		Moderate	Moderate

Business outreach		Low	Moderate
Public outreach		Low	Moderate

Ride-hailing Specific Policies

Policy strategies aimed specifically at ride-hailing fleet electrification are still nascent.

- **Fleet mileage standards**: One policy implemented by the California Air Resources Board in 2021 mandates that EVs must account for 90% of ride-hailing vehicle miles travelled in the state by 2030. Although aggressive, the policy aligns with the state's Zero Emission Vehicle Executive Order as well as broader state goals to reduce GHG emissions 40% below 1990 levels by 2030.

- **Fleet composition standards:** India's first ride-hailing electrification policy was recently passed as well, and orders both Ola and Uber to electrify 40% of their fleets by 2026. To show progress, both companies have to reach incremental benchmarks every year until the 40% threshold is reached.

  Other examples of ride-hailing electrification policies are not led by local governments but by private companies.

- **Utilities**: Also, in California, Peninsula Clean Energy is paying $500,000 to offset the cost of EVs for ride-hailing drivers with purchase subsidies.

- **Ride-hail operators**: In London, Uber has set a goal to have an all-electric fleet in the city by 2025. Because Uber does not own or operate their own fleet, they're encouraging EV adoption by providing financial incentives to drivers. Their Clean Air Fee will charge riders an extra $0.19 per mile, and the collected funds will be used to help drivers buy new EVs. In addition, Uber London has restricted drivers from purchasing combustion vehicles - every car added to the fleet from now on will have to be electric.

Lessons from previous policies in Indonesia

The Government of Indonesia/GoI has implemented several policies to support the electrification programs and to encourage people to transition their private transportation modes into electric based ones. The policies are as follow:

- Referring to Presidential Regulation (PR) 55/2019, the Ministry of Home Affairs has issued MoHA Regulation 8/2020 to **reduce the vehicle tax and transfer fee for BEVs as a direct incentive to customers**. Local government has also regulated on reducing transfer fees such as in DKI Jakarta with its policy issued in Governor of DKI Regulation no. 3/2020. Particularly, recently both Jakarta and Bali have adopted local transfer fee reducing schemes that encourage electric vehicle usage. However, the current tax reduction/incentive for Completely Built Up (CBU) is not clear yet, particularly in terms of the period and the amount of incentives. Also, strong monetary incentives for electrification of mass transit, such as a national level policy for vehicle registration and transfer taxes are required.

- In Presidential Regulation (PR) no. 55/2019 also established several **regulatory derivations for indirect (non-fiscal) incentives**. Non-fiscal incentives are typically managed at the local level. Particularly, in Bali, it seems to be regulating preferential parking access and mobility flexibilities for BEVs. A more robust set of non-fiscal measures is required, for instance the implementation of Low Emission Zones (LEZ).

- For BEVs infrastructure development, the Ministry of Energy has issued MEMR Regulation no. 13/2020 regarding **technical regulations for charging stations and battery swap stations**. The BEV program has already been included on the Medium-Term National Development Plan (RPJMN) 2020-2024. This document is focused on charging infrastructure development in Indonesia and its battery industry provision in Indonesia. More detailed incentives regarding installation for new connections to support charging infrastructure is needed as the current regulation from MEMR Regulation 13/2020 has not mentioned this issue.

- For the business models' policies, **innovative business models now open for electric chargers and battery swapping stations**. The Government of Indonesia (GoI) could consider adopting split business models where the asset owner and operator are independent entities.

- As part of the Energy Grand Strategy from the Ministry of Energy and Mineral Resources, the GoI has been also planning electrification of government employees' official cars with electric cars as initiated by the Ministry of Maritime Affairs and Investment. The electrification process has started since 2021 and further projected to 2024 and will be carried out in several stages (route map). Other ministries in Indonesia also have plans to use electric cars as official cars, such as the Ministry of Transportation, which has plans to order 100 fleets of electric cars to be used as their Echelon I and Echelon II official cars. In addition, the local government also has a plan to electrify their official cars into electric cars too.

- At the regional level, the West Java Government is the first provincial government to undergo an electrification program with a plan to convert all Civil Servant official vehicles within the West Java Provincial Government, starting with the Governor and Deputy Governor official cars from early 2021. The DKI Jakarta Government through the regional-owned enterprise, PT TransJakarta, has developed a route plan to electrify their entire bus fleet until 2030.

- Apart from the Government route planning, Private transportation operators in Indonesia also carry out electrification policies for their fleets. Gojek Indonesia has a plan to electrify their fleet with a target of all operating motorcycles using electric motorcycles by 2030. Grab Indonesia, the competitor of Gojek Indonesia, also has a plan to electrify their motorcycle fleets by introducing 26,000-unit electric-based vehicles, both two-wheeled and four-wheeled, from 2021 until 2025. Subsequently, the largest taxi company in Indonesia, Blue Bird Group, also has a plan to procure electric vehicles with a plan to operate 200 taxi units starting 2020 and furthermore with the target of more than 2,000 electric taxi units within the 2020-2025.

Table 2. 2 Current Indonesia Policy Inventory

Policy/strategy	Stakeholder	Cost (govt)	Impact
Vehicle Tax Reduction	MoHA, DKI Jakarta Province, West Java, and Bali	Low	High
Non-Fiscal incentives, LEZ	Bali Province	Low	Moderate
Technical regulations for charging infrastructures	Government	Moderate	Moderate
Electrification of Government's official cars	Government	Moderate	Moderate

2.2.2. Policy Recommendation

Based on the summary of identified measures, policies that suitable to be implemented so that ride-hailing fleets in Greater Jakarta could be fully electrified by 2030:

- **Purchase subsidies**: Purchase subsidies in the form of direct price reduction have a high impact on early EV adoption by defraying the total upfront cost and reducing the TCO significantly. These can be offered as IDR/kWh. For battery swapping models, the purchase subsidy can be split between the owner and the battery swap service provider to reduce the cost of deposit for the batteries. These incentives should be designed with an extended time frame to allow for the EV market to develop fully.

- **Tax exemptions**: Tax exemptions such as road tax and registration fee can also be waived for e-2Ws partially or fully.
- **Non-Fiscal incentives**: These are operational incentives which include zero emission zones, parking permits, toll fee waivers, special access etc. The impact of these is considerably significant while entailing lower resources.
- **Charging infrastructure provision**: Charging infrastructure investment policy is key driver to transition to EVs. Fixed cost subsidy can be given for developing charging stations. Policy should also enable public private partnerships and mandate density of charging networks such as a charger for every 3km based on travel demand in different zones.
- **Building regulations**: Building regulations should be modified to incorporate measures such as reserved parking for EVs and charging infrastructure provision and higher load sanction.
- **EV tariff:** The electricity tariff for charging EVs can be subsidised to reduce the operational cost of EVs

Policies specific to ride-hailing:

- **City level EV mandates**: National and city policy mandates have a high impact such as allowing only electric vehicles for ride hailing, all new registrations for commercial vehicles to be only electric and banning combustion vehicles will push ride hailing companies towards faster adoption of EVs.
- **Exemption of road tax for ride-hailing and free permits:** Ride hailing EVs can be exempted from road tax and other applicable taxes. They can also be given free parking permits. Parking incentives such as reserved EV slots and fee waiver, and equipping these spaces with charging facilities can reduce the discomfort for e-2W users in accessing public parking spaces.

National Policy Recommendation

- **Reduce vehicle tax and transfer fee**: Local government has also regulated on reducing transfer fees such as in DKI Jakarta with its policy issued in Governor of DKI Regulation no. 3/2020. However, the current tax reduction/incentive for Completely Built Up (CBU) is not clear yet, particularly in terms of the period and the amount of incentives. Also, strong monetary incentives for electrification of mass transit, such as a national level policy for vehicle registration and transfer taxes are required.
- **Incentives for charging infrastructure provision**: For BEVs infrastructure development, the Ministry of Energy has issued MEMR Regulation no. 13/2020 regarding technical regulations for charging stations and battery swap stations. More detailed incentives regarding installation for new connections to support charging infrastructure is needed as the current regulation from MEMR Regulation 13/2020 has not mentioned this issue.

- **Standardisation on the battery pack/size**: The Government of Indonesia through the Ministry of Industry have a plan to manage the size of e2w battery. They also prepared the regulation that OEMs could sell the e2w without the battery. Then, they are expecting in the future the swapping business model could attract the private sector to invest in it and it could also reduce the e2w prices.

Local Policy Recommendation

- **Non-fiscal incentives**: Non-fiscal incentives are typically managed at the local level. Particularly, in Bali, it seems to be regulating preferential parking access and mobility flexibilities for BEVs. A more robust set of non-fiscal measures is required, for instance the implementation of Low Emission Zones (LEZ). Several malls and building offices in Jakarta have allocated some parking space for the electric vehicles. Then, it could be necessary to have a parking area for ride hailing waiting near the mall or building including some areas including the charging space or battery swapping. With more area for electric vehicles, the local government could create the LEZ within the Greater Jakarta area.

3. Business Model: 2030 Fleet Electrification

This section will explain a detailed action plan of ride-hailing operators to meet the medium-ambition scenario above.

3.1. Vehicles: Securing a reliable fleet of E2W in Jakarta

3.1.1. Required Vehicles Specification

Daily distance requirement:

In 2W electrification, daily kilometres travelled should be considered since it would affect the battery capacity and or charging scenario. Daily kilometres travelled would be looked at from drivers who take single types of service only. On average, drivers who only take passenger transport service reach 84.2 km daily completing an average of 8.45 trips daily. Drivers who only take food delivery service travelled a shorter distance with 72.7 km and averaging 9.5 trips per day. On the other hand, drivers who only take goods delivery service travelled the longest averaging 95.5 km daily but only 6.75 trips completed per day. Last, combination trip drivers reach 74.7 km, completing 9.1 trips per day.

Power output requirement: Based on the specification of least capable type of vehicle yet widely used on each type of service.

Referring to the output 3.1, Honda Beat, a low-entry scooter is the most used motorcycle model in every type of service but goods delivery service. However, Honda Beat is still the second most used in that service.

Table 3. 1 Most Used Vehicle by Ride-Hailing 2W Drivers

Service Types	Most Used Vehicle	Second Most Used Vehicle	Third Most Used Vehicle
Passenger Only	Honda Beat	Honda Vario	Yamaha Mio
Food Delivery Only	Honda Beat	Honda Vario	Honda Supra
Goods Delivery Only	Yamaha Mio	Honda Beat	Honda Vario
Combination	Honda Beat	Honda Vario	Yamaha Mio

It is leading on almost every single criterion stated by the driver, especially the price. In 2021, the price of a new Honda Beat starts from IDR 16,665,000, being the cheapest from other models. By being the lightest from others (89 kg), Honda Beat has the best fuel consumption on the paper up to 60.6 km/L with maximum power of 9.0 PS at 7,500 RPM. However, based on drivers' estimation of daily distance travelled and fuel cost, it is found that Honda Beat and also other models have different fuel economy. For passenger transport service only, the fuel economy would be 28.8 km/L, while for food delivery service 29 km/L and goods delivery service up to 45 km/L, generally more economical compared to other models.

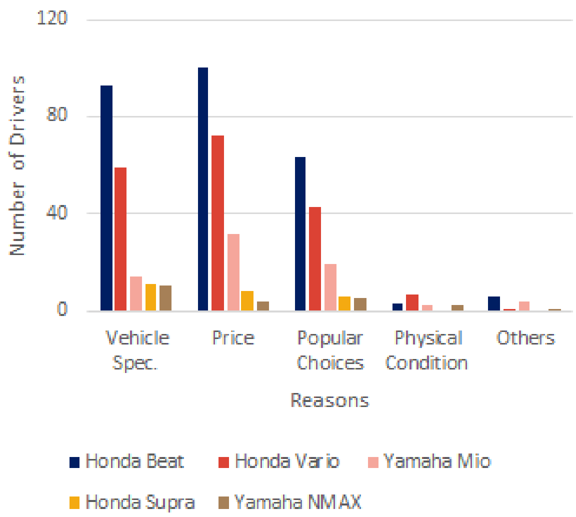


Figure 3. 1 Reason for Choosing Motorcycle's Model from Drivers' Persepctives

Despite being a low-entry motorcycle with limited specification, with its price, Honda Beat is the cheapest motorcycle model available in the market and might be the main reason for the high population for ride-hailing service. Besides, drivers were also pleased with the performance of Honda Beat for ride-hailing purposes.

When trying to replace ICE 2W, the electric 2W should be at least as good as Honda Beat in terms of performance and price. However, electric 2W has the tendency to generate less power than ICE 2W, although having much higher torque. The top speed of electric 2W would be lower but the acceleration would be higher due to higher torque. For instance, Gesits, the higher end model of electric 2W continuously would generate 2000w (+-2.72 PS and up to 5kW on maximum) compared to Honda Beat, the lower-entry ICE 2W that could generate up to 9.0 PS. However Contrarily, Gesits would generate torque up to 30 N.m while Honda Beat only generate 9.3 N.m.

Honda PCX could be used for another comparison with the model having two variants, ICE 150 cc and electric one. A standard ICE 150 cc PCX could generate output power up to 10.8 kW (14.7 PS) at 8,500 rpm and maximum torque of 13.2 N.m at 6,500 rpm. On the other hand, electric PCX which is said to have the same basis as the gasoline one, could generate power up to 4.2 kW (5.7 PS) but with higher torque of 18 N.m. These show the difference in power and torque generated for ICE and electric 2W.

The currently used electric 2W, Viar Q1 and Selis Mandalika generate 800w and 350w respectively. While Selis Mandalika is categorised as an electric bike, Viar Q1 is an electric motorcycle. Viar Q1 is currently mostly used for food delivery service and considered enough even with a low power-to-weight ratio of 5.6 and top speed of 60 km/h. This specification could be used as the basis for food delivery and higher for passenger delivery service. Prior drivers' interviews show that electric 2W drivers who used to operate conventional 2W don't necessarily see speed as a significant difficulty for electric 2W.

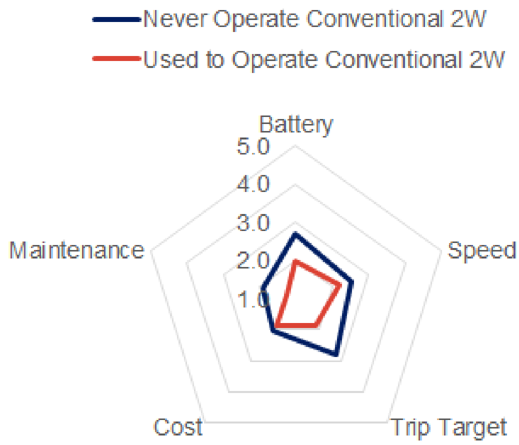


Figure 3. 2 Difficulty Factors Related to the Use of Electric 2W

Dimension requirement:

From the consumers surveys, it turns out that Honda Beat also being the most popular choice, despite majority respondents don't specifically have motorcycle model preference. Honda Beat was selected by 15% of the respondents while Honda Vario being the second most popular model with 13% votes. These models also represent similar model size from another brand such as Yamaha Mio that covered by Honda Beat. When considering the gender of the respondents, male respondents slightly more prefer Honda Vario compared to Honda Beat, while the female respondents still prefer Honda Beat. The size of motorcycle might be the main reasons since Honda Vario has bigger dimension that might feel more comfortable for male respondents which generally bigger than female respondents. Most respondents answer comfortability as the main reasons for the model they prefer and might strongly correlate with dimension. Some notable mentions from the respondents are they do not want sport motorcycle, motorcycle without rear handle, and only want automatic motorcycle which could be accommodated in electric motorcycle, even should be smoother.

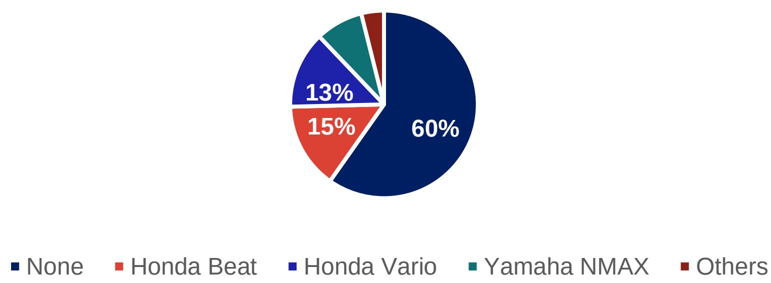


Figure 3. 3 Consumers' Conventional Motorcycles Models Preferences

Having Honda Beat as the smallest model compared to Honda Vario or Yamaha NMAX, the minimum dimension for passenger transport service should be around Honda Beat with dimensions of 1,877 x 669 x 1,074 mm. Ideally, the length to be considered should be the seat length. However, due to limited information, the overall length could be used to determine the adequacy of electric 2W models. As for width and height, some consumers highlight that Yamaha NMAX or Honda PCX model or equivalent are too wide and too high, so ideally the preferred electric 2W should be narrower and lower than the Yamaha NMAX. However, the characteristic of electric 2W models that put battery and motor under the deck, makes the overall height become taller and might be an issue for the passenger, especially women.

Figure 3. 4 Illustration of Honda Beat (left), Honda Vario (Right)

Types of Service Requirement:

Each type of service has different characteristics or requirements, depending on several factors. These requirements should be met to give drivers the right electric 2W models since a big part of drivers only take a certain type of service.

- Passenger Transport Service

  This type of service might have more significant requirements as a passenger would be the cargo. As explained earlier, maximum payload and dimension would determine if the model would be able and convenient enough for passenger transport service. Assume that the average of males' weight in Indonesia is 65 kg, so at least the electric 2W model should be able to carry weight up to 130 kg for the drivers and the passenger. For dimension, as stated above, would be based on the overall length of the fleet and using Honda Beat's length of 1,877 mm as the benchmark.

Other than maximum payload and dimension, ideally the electric 2Ws' power output should be enough to carry two persons with the assumed weight. The difference of power output between electric 2W and ICE motorcycles.

Last, as the weight of a person is significant, there would be a reduction in the distance range. In fact, the daily distance of passenger transport service is one of highest. A higher capacity battery would suit better, or if not, the ability to charge quickly or swap availability would be needed.

- Food Delivery Service
  Food delivery service might be the least demanding service as the items are relatively small and light. It also has the lowest daily distance travelled by the drivers as well as the maximum distance of a service set by the ride-hailing company. These should be the main reason why ride-hailing companies started the electrification pilot project from food delivery service. Last but not least, a special characteristic of food delivery service is waiting time for food preparation and could be utilised as an opportunity for charging/swapping.

- Goods Delivery Service
  Goods delivery service characteristics are in between passenger and food delivery service, except for the daily distance travelled where goods delivery service records the highest. Gojek ruled that the maximum weight of the goods is below 20 kg with dimensions no more than 70 x 50 x 50 cm for instant delivery. Grab, a little bit stricter, requires the goods to be less than 15 kg and less than 50 x 50 x 50 cm in size. Should this regulation be strictly applied, the total payload including the drivers should be around 80 kg. Although the dimensions should also affect the model choice, goods would be more flexible than a passenger, hence the dimension of electric 2W could be smaller. Viar Q1 is used as the benchmark as the motorcycle is already being deployed for goods delivery.

- Combination Trip
  As combination trips are dominated by passenger transport service and the service has the most considerations, the combination trip could also apply the passenger transport service requirements.

3.1.2. Suitable E2W Models

Suitable E2W models currently available in India and other Asian countries

India is seeing a major push in the electric 2W market with many existing 2W companies manufacturing EVS and new Start-ups like Ather, Ampere emerging in this space. Currently there are more than 20 e2W models that qualify for the national subsidy scheme. Table 3.2 below shows some of the most popular models.

Table 3. 2 Electric Motorcycle's Specification by Model

Company	Model	Battery size (kWh)	Range (km)	charging time (hrs)	Top speed (km/h)	Dimension L x W x H mm	Weight kg	Price IDR million	Battery type
Ather	Ather 450	2.4	75	4-5	80	1,800 x 700 x 1,250	108	21.8	Fixed
	Ather 450X	2.9	85	4-5	85	1,800 x 700 x 1,250	111	30.5	Fixed
Hero Electric	Nyx	1.3	100	4-5	42	1,970 x 745 x 1,145	73	13.42	Detachable
	Optima ER	1.3	110	4-5	42	1,970 x 745 x 1,145	73	13.23	Detachable
	Photon 48V	1.3	110	4-5	45	1,970 x 745 x 1,145	116	12.65	Detachable
	Photon 72V	1.3	45	4-5	45	1,970 x 745 x 1,145	87	11.89	Detachable
Okinawa	Ridge+	1.75	100	2-3	55	1,740 x 680 x 1,075	96	14.08	Detachable
	Praise 72V	3.0	200	6-8	70	1,970 x 745 x 1,165	96	14.36	Detachable
	Praise Pro	2	110	2-3	70	1970 x 745 x 1,165	96	15.2	Detachable
	I-Praise+	3.3	160	3-4	70	1,970 x 745 x 1,165	111	20.85	Detachable
Ampere	Zeal (Li)	1.8	65-70	5-6	55	1,720 x 660 x 1,200	78	13.02	Detachable
Revolt	RV 300	1.0	180	4.2	65	2,156 x 813 x 1,112	101	21.28	Detachable
	RV 400	1.0	150	4.5	85	2,156 x 813 x 1,112	108	24.74	Detachable
Pure EV	EPluto 7G	2.5	120	4	60	1,700 x 670 x 1,075	79	15.34	Detachable

Suitable E2W models currently available in Indonesia

Market availability data for E2w is shown at Table 3.3. The price listed in Table 3.3 is also based on Jabodetabek area price and has included tax. According to the survey, the most common e2w models used in Indonesia are Viar Q1, Kymco Nice EV 100, and Selis Mandalika. There are also other e2w models identified which are Niu Gova 03, Niu Nqi Sport, United T1800, and Smoot Tempur.

Table 3. 3 E2w Market Availability Data

Name	Brand	Battery Capacity (kWh)	Charging Time (hour) - longest time	Range - Manufacturer Data (km)	Power (watt)	Top Speed (km/h)	Dimension (L x W x H) (mm)	Curb Weight (kg)	OTR Price (IDR)	Battery Type
Selis Mandalika	Selis	0.43	6	30	350	30	1,600 x 600 x 1,080	44,4	4,500,000	Not Detachable
New Q1	Viar	1.38	7	60	800	60	1,680 x 690 x 1,220	78,5	19,940,000	Detachable

Gesits	Gesits	1.44	3	50	2,000	70	1,947 x 674 x 1,135	94,5	28,000,000	Detachable
Gova 03	Niu	2.40	7	70	1,100	60	1,740 x 705 x 1,065	84,0	24,500,000	Built In
United T1800	United	1.68	5	65	1,800	70	1,886 x 715 x 1,170	99,0	27,000,000	Detachable
Smoot Tempur*	Smoot	1.44	4	60	1,500	70	1,860 x 690 x1,050	68,0	22,000,000	Detachable
Volta 401	Volta	1.20	6	55	1,500	55	1,920 x 680 x 1,100	200,0	19,500,000	Detachable

The market research shows that there are several electric 2W manufacturers in Indonesia. The listed available electric 2Ws mostly have a detachable battery except NIU Gova 03 and Selis Mandalika, which the latter is categorised as electric bike, not electric motorcycle.

The battery capacity of electric 2Ws ranges from 0.66 to 2.4 kWh with charging time ranging from 3 to 7 hours. The range per battery of the e2w based on the manufacturer data is 40 km to 70 km per battery. Top speed of the e2w can range from 45 km per hour to 70 km per hour. The curb weight of the e2w can range from 68 kg to 200 kg. The on the road price of the bike ranged from IDR 14,000,000 to IDR 28,350,000. Please note that the Smoot Tempur model is not actually available to be bought with the battery. Currently, Smoot Tempur is only available for battery subscription but the specification is suitable for ride-hailing so it would be used for the comparison. However, the price is already including the price of a battery which is estimated from Gesits battery price.

Selected Model

In general, E2W model selection would rely on the dimensions, range (this include battery efficiency and battery slots), charging mode, and power output which could be seen from the top speed. The dimensions needed would vary between each type of service as well as the maximum range. Would be helpful for drivers if the battery charging/swapping could be kept as minimum as possible. Drivers’ major time for charging or swapping are during overnight charging at home, lunch break, and usually drivers take another break in the evening. So, including the overnight charging, the number of battery swaps or charging should be not more than 3 times a day.

The power output of the model could be reflected from the top speed although the top speed listed is speed during the peak moment that would not continuously generate and not for the longest range. However, these speeds of each model are sufficient for urban riding. In fact, the maximum speed for urban roads is 50 km/h. Selis Mandalika which only could generate a top speed of 30 km/h is fast enough to use for short trips but 5 km/h past the speed limit for using bike lanes or sidewalks in Jakarta.

* Combination and Passenger Transport Service

Table 3. 4 Model Selection for Combination and Passenger Transport Service

E2W Models	Selis Mandalika	Viar New Q1	Gesits	Niu Gova 03	United T1800	Smoot Tempur	Volta 401
Daily Distance (km)	84.2	84.2	84.2	84.2	84.2	84.2	84.2
Max Allowed Distance Per Trip (km)	30	30	30	30	30	30	30
Battery Capacity (kWh)	0.43	1.38	1.44	2.4	1.68	1.44	1.2
Estimated Practical Range - Single Battery (km)	16.67	33.35	27.79	38.91	36.13	33.35	30.57
Battery Slots	1	2	2	1	2	1	2
Number of Charging - Single Battery	**5.05**	**2.52**	**3.03**	**2.16**	**2.33**	**2.52**	**2.75**
Number of Charging - Multi Batteries *if available	**5.05**	**1.26**	**1.51**	**2.16**	**1.17**	**2.52**	**1.38**
Longest Charging Duration	6	5	3	7	5	4	6
Battery Detachability	-	✓	✓	-	✓	✓	✓
Battery Swap Availability	-	?	?	?	?	✓	✓
Output Power (watt)	350	800	2000	2000	1800	1500	1500
Top Speed (km/h)	30	60	70	60	70	60	55
Estimated Payload - Drivers and Cargo (kg)	130	130	130	130	130	130	130
Maximum Loads	150	?	150	160	150	150	200
Dimension Needs - Reference (mm)	1,877 x 669 x 1,074	1,877 x 669 x 1,074	1,877 x 669 x 1,074	1,877 x 669 x 1,074	1,877 x 669 x 1,074	1,877 x 669 x 1074	1,877 x 669 x 1,074
Dimension (mm)	1,600 x 600 x 1,080	1,680 x 690 x 1,220	1,947 x 674 x 1,135	1,740 x 705 x 1,065	1,886 x 715 x 1,170	1,860 x 690 x 1,050	1,920 x 680 x 1,100
Length Adequacy	X	X		X		X*	

For combination and passenger transport service, the electric 2W would play significant criterion. Selis Mandalika, Viar Q1, and Niu Gova 03 are too short to transport passengers based on Honda Beat as the benchmark. Smoot Tempur is also shorter but insignificant. The rest option also has a 1,500+ Watt motor that should be enough to transport passengers. Except Smoot Tempur, the other selected models have 2 battery slots that would be helpful for drivers to be less charging/swapping. Including the overnight charging at home, drivers with two batteries could only visit the battery charge/swap station once daily. When using a single battery, Gesits model might be the last model to be selected as it requires more battery charging/swapping though the extra requirement is small.

Suitable models: Gesits, United T1800, Smoot Tempur, Volta 401

* Food Delivery Service

Table 3. 5 Model Selection for Food Delivery Service

E2W Models	Selis Mandalika	Viar New Q1	Gesits	Niu Gova 03	United T1800	Smoot Tempur	Volta 401
Daily Distance (km)	72.7	72.7	72.7	72.7	72.7	72.7	72.7
Max Allowed Distance Per Trip (km)	25	25	25	25	25	25	25
Battery Capacity (kWh)	0.43	1.38	1.44	2.4	1.68	1.44	1.2
Estimated Practical Range - Single Battery (km)	17.88	35.76	29.8	41.72	38.74	35.76	32.78
Battery Slots	1	2	2	1	2	1	2
Number of Charging - Single Battery	**4.07**	**2.03**	**2.44**	**1.74**	**1.88**	**2.03**	**2.22**
Number of Charging - Multi Batteries *if available	**4.07**	**1.02**	**1.22**	**1.74**	**0.94**	**2.03**	**1.11**
Longest Charging Duration	6	5	3	7	5	4	6
Battery Detachability	-	✓	✓	-	✓	✓	✓
Battery Swap Availability	-	?	?	?	?	✓	✓

Output Power (watt)	350	800	2,000	2,000	1,800	1,500	1,500
Top Speed (km/h)	30	60	70	60	70	60	55
Estimated Payload - Drivers and Cargo (kg)	70	70	70	70	70	70	70
Maximum Loads	150	?	150	160	150	150	200
Dimension Needs - Reference (mm)	1,600 x 600 x 1,080	1,600 x 600 x 1,080	1,600 x 600 x 1,080	1,600 x 600 x 1,080	1,600 x 600 x 1,080	1,600 x 600 x 1,080	1,600 x 600 x 1,080
Dimension (mm)	1,600 x 600 x 1,080	1,680 x 690 x 1,220	1,947 x 674 x 1,135	1,740 x 705 x 1,065	1,886 x 715 x 1,170	1,860 x 690 x 1,050	1,920 x 680 x 1,100
Length Adequacy							

As explained before, the food delivery has the least requirements. All models should be enough for delivery service but adjustment on the assignment should be needed. For example, Selis Mandalika with less range and speed could have the shorter food delivery order within area with most dense charging infrastructure. Although with limited range and speed, Selis Mandalika or electric bike should also be an option for drivers as this kind of fleet are more preferred for female drivers. However, the long charging duration would be the barrier for more productive working hours and this also include NIU Gova 03. Models with non-detachable batteries, especially one with low capacity would be better to be avoided if possible or order assignment adjustment would be needed.

Suitable Model: All

- Goods Delivery Service

Table 3. 6 Model Selection for Goods Delivery Service

E2W Models	Selis Mandalika	Viar New Q1	Gesits	Niu Gova 03	United T1800	Smoot Tempur	Volta 401
Daily Distance (km)	95.5	95.5	95.5	95.5	95.5	95.5	95.5
Max Allowed Distance Per Trip (km)	50	50	50	50	50	50	50
Battery Capacity (kWh)	0.43	1.38	1.44	2.4	1.68	1.44	1.2
Estimated Practical Range - Single Battery (km)	20.79	41.58	34.65	48.51	45.05	41.58	38.12
Battery Slots	1	2	2	1	2	1	2
Number of Charging - Single Battery	**4.59**	**2.30**	**2.76**	**1.97**	**2.12**	**2.30**	**2.51**
Number of Charging - Multi Batteries *if available	**4.59**	**1.15**	**1.38**	**1.97**	**1.06**	**2.30**	**1.25**
Longest Charging Duration	6	5	3	7	5	4	6
Battery Detachability	-	✓	✓	-	✓	✓	✓
Battery Swap Availability	-	?	?	?	?	✓	✓
Output Power (watt)	350	800	2,000	2,000	1,800	1,500	1,500
Top Speed (km/h)	30	60	70	60	70	60	55
Estimated Payload - Drivers and Cargo (kg)	85	85	85	85	85	85	85
Maximum Loads	150	?	150	160	150	150	200
Dimension Needs - Reference (mm)	1,680 x 690 x 1,220	1,680 x 690 x 1,220	1,680 x 690 x 1,220	1,680 x 690 x 1,220	1,680 x 690 x 1,220	1,680 x 690 x 1,220	1,680 x 690 x 1,220
Dimension (mm)	1,600 x 600 x 1,080	1,680 x 690 x 1,220	1,947 x 674 x 1,135	1,740 x 705 x 1,065	1,886 x 715 x 1,170	1,860 x 690 x 1,050	1,920 x 680 x 1,100
Length Adequacy	X						

Good delivery service has maximum size and weight. With its structure, Selis Mandalika might be less appropriate for goods delivery service, especially for full-sized goods. Longer daily distance characteristic of goods delivery service would also not be suitable for Selis Mandalika. Although good delivery service usually generates higher battery efficiency, the

longer distance would be troublesome for some models with worse battery efficiency and less battery slot.
Suitable Model: Viar Q1, Gesits, Niu Gova 03, United T1800, Smoot Tempur, Volta 401

3.1.3. Potential Operator's Intervention

The available models might not be the most ideal for ride-hailing purposes, especially for passenger transport service. Not many models that have sufficient length for passenger transport and have a higher stance that might be troublesome for the passengers, especially female passengers. The battery capacity and or efficiency should be optimised to reduce the need of battery charging or swapping, hence the opportunity cost. One to two times charging or swapping including the overnight charging would be ideal. This also includes the faster charging duration or swap availability including the compatibility of battery swaps across many models. Operators could be involved in the electric 2W model choices.

Among the biggest variable operators must cope with is the availability (and affordability) of electric vehicle options. Indonesia is a prominent example of this EV gap -- the country's gasoline-powered 2W vehicles are largely imported, and there is not yet a local ecosystem supporting E2W production, charging, or maintenance. With few available vehicle models currently suited for ride-hailing in-country, the following are some options ride-hailing operators can pursue to build a menu of appropriate vehicle options, borrowing from the lessons of car-based ride-hailing services.

OEM Alliances

Car-based ride-hailing operators face similar barriers related to vehicle availability. Large, multinational companies like Didi Chuxing and Uber face very different vehicle supply options across the countries and regions in which they operate, even as they strive to fulfil global sustainability objectives. One way that these companies have closed that gap is through vehicle channel partnerships with automotive OEMs.

For example, as noted in greater detail below, Uber Canada has a partnership with General Motors to provide discounted electric cars to drivers on the Uber platform, and has recently announced a special program to connect drivers to the Chevrolet Bolt. Uber has a similar program in place with Nissan to encourage drivers to purchase the Nissan Leaf for use on its platform.

Uber's OEM partnerships offer preferential terms on vehicles that are already present in the US and Canada markets, seeking to accelerate uptake of EVs by increasing driver familiarity, creating economic incentives, and streamlining the purchase or leasing process. For OEMs, the partnerships trade per-unit discounts for higher greater sales volumes, jump-starting the market for their newest EV models.

Where vehicle supply does not already exist, however, some ride-hailing alliances with OEMs have gone a step further to bring new vehicle options to market. For example, early in 2020, Didi Mexico announced a plan to introduce hundreds of electric and hybrid ride-hailing vehicles to its platform, in partnership with major international OEMs like Renault and BYD. Under the Didi arrangement, some EV models were entirely new to the Latin American market and were exclusively available to Didi drivers, creating new vehicle supply specifically for the ride-hail market.

Vertical Integration

As ride-hailing continues its transition from challenger to incumbent, operators are looking for ways to build greater long-term predictability around EV supply. In a few cases, this has led operators to re-evaluate their public postures as purely technology companies as they expand 'vertically' into the direct production of ride-hailing-specific EVs.

For example, in fall 2020, Chinese ride-hail giant Didi Chuxing and Chinese automotive manufacturer BYD announced "the first purpose-built ride-hailing electric vehicle," called the D1. The car is designed to appeal to ride-hailing drivers and passengers, and has an extended driving range of 481 km. Didi intends to introduce 1 million D1s to the Chinese market by 2025.

While the D1 is produced by BYD versus Didi directly, this is another example of a ride-hailing operator introducing a new, proprietary vehicle production vertical to address the shortfall of electric vehicles. Similarly, in Spring 2021, Uber and London-based electric car and van manufacturer Arrival announced plans to build an EV specifically for ride-hail drivers.

In the 2W space, India-based ride-hail and food delivery operator Ola Cabs announced in 2020 a new internal venture, Ola Electric, to directly manufacture electric scooters. In 2021, a new entity called Ola Electric broke ground on its "Futurefactory" in the state of Tamil Nadu, to become the world's largest E2W factory, capable of producing 10M units per year -- or 15% of total global 2W output. Notably, the factory is to be staffed entirely by women.

Ola's E2W models appear primarily slated for direct consumer sales in India and abroad, versus sale or lease to drivers for use in Ola's ride-hail operation. Nonetheless, Ola Cabs' investment in the Futurefactory is a notable example of a technology-based ride-hailing company creating a new vehicle production vertical to address electric vehicles supply limitations.

Table 3. 7 OEM Alliances and Vertical Integration Comparison

	OEM Alliances	Vertical Integration
Financial commitment	Low - operators may need to guarantee some volume of purchases to entice OEMs, but do not need to invest in production capacity.	High - operators need to invest (or co-invest) in design, production, and supply chain to bring new vehicles to market.

Time to vehicle availability	Low to Medium - if suitable models are not already present in the country, the OEM will need to navigate local entry.	High - building new production capacity is time-intensive.
Control over vehicle options	Medium - operators can dictate which existing vehicle models they prefer, but do not have ultimate control over their design.	High - operators can design the exact vehicles desired, customised for ride-hailing or delivery.
Risks	Competitive risk - There may be little to stop other ride-hailing operators from creating the same OEM partnerships, or from attracting drivers away once they have purchased new EVs.	Technology risk - operators must invest significantly in new vehicle types that may or may not achieve popularity among drivers. Learning curve - operators will be producing physical assets for the first time, after previously only focusing on technology.
Policy needed	- Favourable tariff scheme for EVs	- Supportive industrial policy

Examples from other 2W companies

2W ride-hail electrification in its very early stages, but early examples point to operators incorporating vertical elements to help grow E2W supply.

For example, In Nairobi, Ecobodaa is one of several local start-ups that leases electric motorcycles to bodaboda drivers. Ecobodaa started with an OEM partnership approach, teaming with a Chinese manufacturer to customise and launch its electric vehicles. Ecobodaa's OEM partner manufactured them abroad, and the company assembled them in Kenya. Looking ahead, however, Ecobodaa reports that it is taking steps to bring the entire e-motorcycle design and manufacturing process to Kenya.

Rwanda-based Ampersand leases e-motorcycles and operates battery swap stations catering to the country's 2W taxi drivers. Like Ecobodaa, Ampersand imports motorbikes and assembles them domestically. Notably, Ampersand custom-designs and prototypes its battery packs in-country, before manufacturing them abroad.

In Spring 2021, 2W manufacturing giant Hero teamed with Gogoro to utilise the Taiwanese E2W pioneer's battery swapping technology in Hero's motorbikes. Under this strategic partnership, Hero will continue designing and manufacturing the overall vehicle, but will rely on Gogoro for the design and manufacture of its batteries and charging kiosks, compatible with any other bike models that are part of the Gogoro Network.

3.2. Vehicle Financing: Connecting drivers to E2W

3.2.1. TCO calculation

Components of cost for electric and conventional 2W

While EVs have high upfront cost in terms of the battery cost which makes up 40% of the total cost of the vehicle, they have lower operation and maintenance costs. Therefore, TCO gives a more accurate assessment of the cost effectiveness of electric 2W compared to their ICE counterparts. With falling battery prices, electric bike prices are becoming comparable to their petrol counterparts in terms of TCO. Furthermore, sensitivity analysis for the TCO gives more insight into the impact of various factors such as vehicle utilisation, maintenance cost, fuel cost etc on the total cost. Two important components of the TCO are the Capex which is the one-time purchase cost including tax, subsidies etc and the Opex which includes operational and maintenance cost, fuel cost and other miscellaneous costs. Table 3.8 gives the breakdown of the cost components for TCO calculation of electric two wheelers.

Table 3. 8 Electric 2W TCO Components

TCO components	
Capital cost	Purchase Cost
	Tax
	Insurance
	Financing Component
	Total Financial Incentive
Operational cost	Staff Cost
	Maintenance Cost

	Battery Replacement Cost
	Average Fuel Cost
Other economic factors	Discount rate
	Resale rate
	Vehicle holding period

	2W-HIGH SPEED		2W-COMMERCIAL USE	
	ATHER 450X	HONDA ACTIVA BSVI	HERO OPTIMA ER	HONDA ACTIVA BSVI
Vehicle Ex-Showroom Price	148	70	69	70
Interest Cost On Loan	-	-	-	-
Additional Battery Cost	-	-	73	-
Total Fuel Cost	13	63	30	188
Total Maintenance Cost	17	28	22	33
Salvage Value	23	18	18	14
Total Cost Of Ownership With Subsidy	187	156	191	291
Total Cost Of Ownership w/o Subsidy	220	156	212	291
Average Running/Day (Km)	20	20	60	60
Battery Pack Size (kWh)	2.9	-	2.7	-
Range* (Km)	65	45	75	45
Charging Cycles (#)	1,000	-	650	-
Subsidy Available	27	-	18	-
Additional Battery (#)	-	-	2	-

Figure 3. 5 TCO Comparison of Electric and Conventional Motorcycle (Source: Avendus, 2020)

According to a report by Avendus (EV report, 2020), for commercial use cases where the daily running kms is greater than 60kms, the TCO for electric 2Ws is lower than the ICE counterparts. Figure 3.5 shows the comparison for the same. The values shown are in the thousand INR. The maintenance cost is about 40% less for e2W when compared to the conventional 2Ws.

Adjusted suitable E2W models (or selected E2W models on each type of service) from India and other Asian countries

For the adjustable suitable model, the author selects models from India with 2 models of motorcycle which are Ampere Magnus Pro and Hero Optima HX. The model adjusted all the prices to IDR price for ease of comparison. For the comparison, the assumption is that the daily distance for the operation is 75 km per day. The adjusted suitable E2W models shows that:

a. Capital Cost

   i. The purchasing cost for vehicles including tax (import tax 7.5%, VAT 10%, and Income tax 10%) for Ampere Magnus Pro is IDR 24,422,648 and Hero Optima HC is IDR 27,911,598.

   ii. The price of buying from suppliers in Indonesia is as competitive as importing from India as shown in the table below.

Table 3. 9 Electric 2W Price

Name	Brand	OTR Price (IDR)
Selis Mandalika	Selis	4,500,000
Viar Q1	Viar	19,940,000
Gesits	Gesits	28,000,000
Gova 03	Niu	24,500,000
United T1800	United	27,000,000
Smoot Tempur*	Smoot	22,000,000
Volta 401	Volta	19,500,000

   The Selis Mandalika is Moped and Smoot Tempur actually does not sell batteries as one package of e2w. The price of buying from local suppliers is as competitive as importing from India or other places.

   iii. For charging infrastructure such as EV chargers, the price is usually included with the motorcycle. Meanwhile in India, the charging infrastructure is separated from the motorcycle price.

b. Operational and Maintenance Cost

   i. For operational cost, the electricity price in Indonesia is about IDR 2,475 per kWh and in India is IDR 1,537 per kWh (1 INR = 192 IDR). This shows that the electricity price in Indonesia is higher than India

   ii. The maintenance cost in Indonesia is IDR 402,154. Meanwhile the maintenance cost in India is IDR 229,908. The annual maintenance cost is higher in Indonesia. The higher maintenance cost in Indonesia could be attributed to the much higher price of components in Indonesia than India. The price of maintenance in Indonesia is separated for each component used for maintenance such as tires, and brake pads.

iii. The battery replacement price in Indonesia is available and can be obtained from suppliers with the supplier's given price. The price given is usually not price per kWh but the supplier's given price, albeit whether there is correlation or not from the market price of the battery itself. In this case, the battery price is not counted from how big the battery capacity (kWh) is, but from the supplier's price.

Suitable E2W models (or selected E2W models on each type of service) from Indonesia

TCO Calculation Result for E2W

Total cost of ownership (TCO) analysis is a basic costs assessment that considers all the direct and indirect costs during a product lifetime or when the system (project) is over. TCO Calculation usually consists of every possible cost, including initial, operation, maintenance costs, and salvage value (or Residual Value).[2] TCO calculation basic formula, as follows:

$$Total\ Cost\ of\ Ownership\ (TCO) = Initial\ Cost + Maintenance\ and\ Operational\ Cost - Salvage\ Value$$ [3]

Total Cost of Ownership Calculation

For this report, by adapting the TCO calculation basic level formula, the TCO formula which was used for ICE Bike and E2w:

$$Total\ Cost\ of\ Ownership = Capital\ Cost + Operational\ Cost + Maintenance\ Cost - Economic\ Benefit$$

The TCO calculation parameter for E2w includes economic input parameters, capital costs, operation costs, maintenance costs, and the economic benefit.

Economic Input Parameters

The economic input parameters that were analysed for the total cost of ownership calculation were as follows: discount rate, loan rate, Provision, EMI (equated monthly instalment), inflation rate, annual running days, concession time, and insurance. Table 3.10 shows the economic input parameters for the total cost of ownership calculation.

[2] Graco. (2021, March 30). UNDERSTANDING TOTAL COST OF OWNERSHIP (TCO). Retrieved from Graco: https://www.graco.com/us/en/in-plant-manufacturing/solutions/articles/how-to-calculate-total-cost-of-ownership.html

[3] Graco. (2021, March 30). UNDERSTANDING TOTAL COST OF OWNERSHIP (TCO). Retrieved from Graco: https://www.graco.com/us/en/in-plant-manufacturing/solutions/articles/how-to-calculate-total-cost-of-ownership.html

Table 3. 10 E2w economic input parameters for TCO calculation

Cost components	Data for TCO calculation	Assumptions
Discount Rate	10.00%	Discount Rate: (currently uses Sharada's model, will be disclosed later)
Loan Rate E2w	5.70%	EMI Years: 3 years based on the survey
Provision	0.50%	Inflation Rate: 10-year average of inflation rate in Indonesia
EMI Years	3	Annual Running Days: 313 days with assumption of drivers take one day rest very week.
Inflation rate	3.07%	Concession Time: (currently uses Sharada's model, will be disclosed later)
Annual Running Days	313	Insurance: 2.5% of the CAPEX (will be disclosed later)
Concession Time (Year)	10	Discount Rate: (currently uses Sharada's model, will be disclosed later)
Insurance	2.50%	Loan Rate and Provision: Based on average loan rate of several banks related to vehicle loan and its provision.

Capital Costs

Table 3.11 shows the capital costs component parameters for the TCO calculation which consists of E2w purchase costs, battery replacement cost, down payment, and annual tax. Please note that Smoot Tempur's price is an estimation of the 2W and one battery for illustration purposes although in the market Smoot Tempur is currently offering battery subscription only.

Table 3. 11 E2w capital cost components for TCO analysis

Cost components	Data for TCO calculation	Assumptions
E2w Purchase Cost	• Selis Mandalika : IDR 4,500,000.00 • Viar Q1 : IDR 19,940,000.00 • Gesits : IDR 28,000,000.00 • Niu Gova 03 : IDR 24,500,000.00 • United T1800 : IDR 27,000,000.00 • Smoot Tempur* : IDR 22,000,000.00 • Volta 401 : IDR 19,500,000.00	E2w: There are seven model which are Selis Mandalika, Viar Q1, Gesits, Niu Gova 03, United T1800, Smoot Tempur, and Volta 401
Battery Replacement Cost	• Selis Mandalika : IDR 1,070,000.00 • Viar Q1 : IDR 6,500,000.00 • Gesits : IDR 7,500,000.00 • Niu Gova 03 : IDR 12,500,000.00 • United T1800 : IDR 7,000,000.00 • Smoot Tempur* : IDR 7,500,000.00 • Volta 401 : IDR 6,000,000.00	Battery of e2w would be replaced at year 3 or 5. For batteries that didn't have market data, the battery price is 25% of the electric bike based on the other battery market price. Smoot Tempur has a swap battery business model thus actually didn't have battery replacement cost. According to Bloomberg, battery price is predicted to drop from 100 USD per kWh to 80 USD in 2030 but for this study, the battery price reduction is not calculated.

Cost components	Data for TCO calculation	Assumptions
Down Payment	• Selis Mandalika : IDR 657,378.48 • Viar Q1 : IDR 2,912,917.09 • Gesits : IDR 4,090,354.99 • Niu Gova 03 : IDR 3,579,060.62 • United T1800 : IDR 3,944,270.89 • Smoot Tempur* : IDR 2,118,219.55 • Volta 401 : IDR 3,652,102.67	The down payment of buying a bike is 14.61% of the bike price based on the survey result.
Annual Tax	▪ E2w tax is currently IDR 353,333 per year	Annual Tax is based on survey result

Operational Costs

Operational costs components are daily operation per day and E2w battery operational cost. Table 3.12 shows the operational cost components data analysis and assumptions of each cost component.

Table 3. 12 E2W operational cost components for TCO analysis

Cost components	Data for TCO calculation	Assumptions
Daily Operation per Day	• Combination: 74.7 km • Passenger: 84.2 km • Foods: 72.7 km • Goods: 95.5 km	The running daily distance depends on type of service and bike type. The daily distance is based on the survey result. The e2w distance is assumed to be the same as ICE bike distance to show the viability of using e2w as an alternative for operation.
E2w Battery Operational Cost	• The battery swap cost is IDR 8,000 per swap for small batteries, and IDR 10,000 per swap for bigger batteries. • For non-detachable batteries, the price of electricity is IDR 1,650 per kWh.	There are two types of charging for e2w operation, battery swap for detachable battery e2w and charging mode for non-detachable battery e2w.

Maintenance Costs

The maintenance costs component consists of brake pads replacement cost, tire replacement cost, and belt replacement. Table 3.13 shows the maintenance costs component for TCO calculation:

Table 3. 13 E2w maintenance cost components for TCO analysis

Cost components	Data for TCO calculation	Assumptions
Brake Pads Replacement Cost	• Cost of brake pads replacement is IDR 22,000 per change	• Maximum Range of each brake pads change is 10,000 km per change
Tire Replacement Cost	• Cost of each tire change is IDR 150,000 per change	• Maximum range of each tire replacement is 10,000 km per change
Belt Replacement Cost	• Currently, the only e2w that uses belt is Gesits with replacement cost is IDR 139,000 per change	• Maximum range of each belt change is 3000 km per change

Economic Benefit

The economic benefit consists of the salvage value of the E2w. Table 3.14 shows the maintenance costs component for TCO calculation:

Table 3. 14 E2w economic benefit component for TCO analysis

Cost components	Data for TCO calculation	Assumptions
Salvage Value	• E2w: 13%	Within the lifecycle of 10 years

The results of TCO calculation for E2w in different types of rides (combination, passenger only, foods only, goods only) are shown on Figure 3.6 to Figure 3.13. The detailed TCO calculation result can be seen on ANNEX A. Also, while Selis Mandalika has significantly lower TCO than the other E2ws, in reality Selis Mandalika is a type of E-scooter rather than E2w so for comparison purpose with ICE bike, Volta 401 which has the second lowest TCO will be treated as the E2w with the lowest TCO value.

Combination Service Result

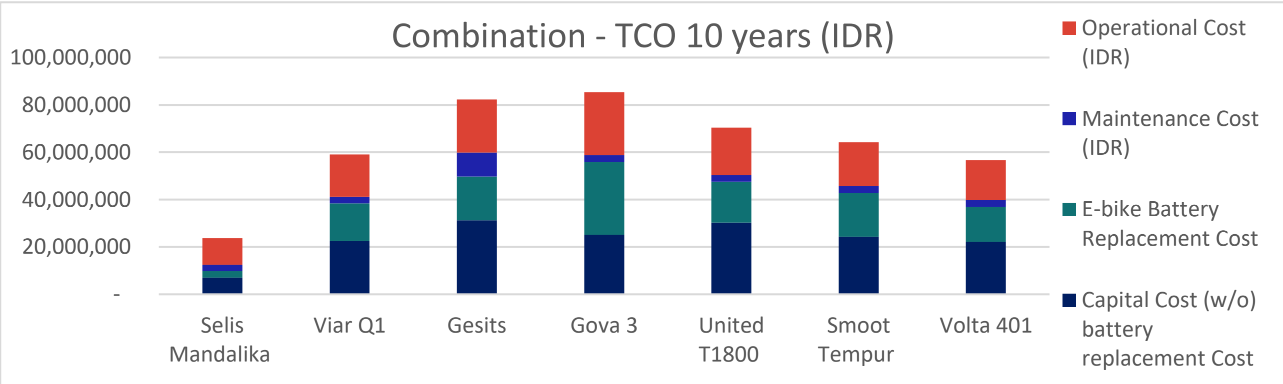


Figure 3. 6 TCO per bike calculation for E2w Combination service

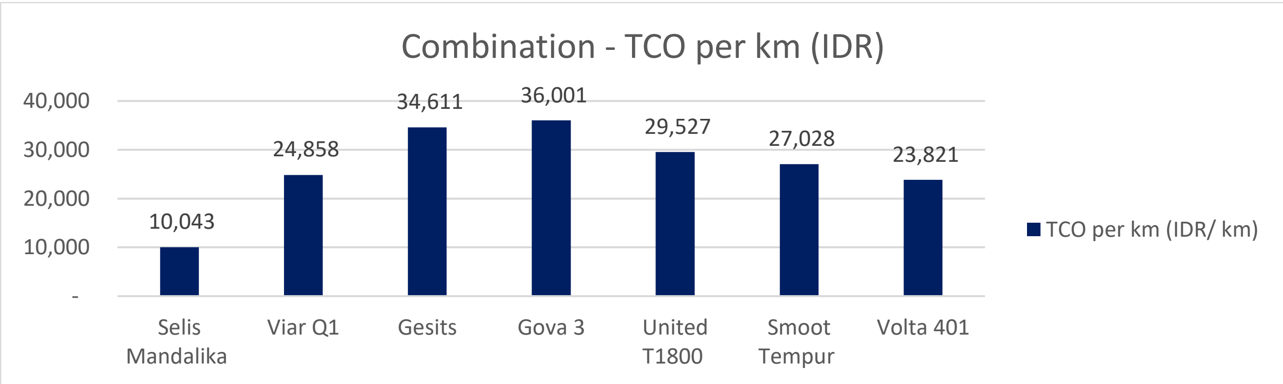


Figure 3. 7 TCO per km calculation for E2w Combination service

Figure 3.6 and Figure 3.7 shows that in the combination scenario, which the daily operation per day is 74.7 km, Volta 401 has the lowest TCO value with TCO per bike value of IDR 55,696,179 for 10 years and TCO per km value of IDR 23,821 per km.

Passenger Service Result

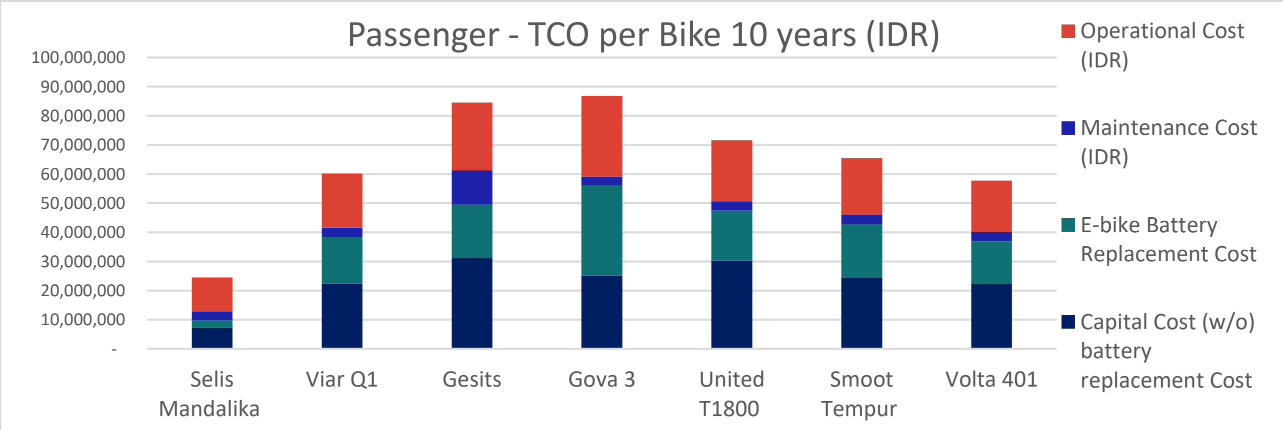


Figure 3. 8 TCO per bike calculation for E2w Passenger service

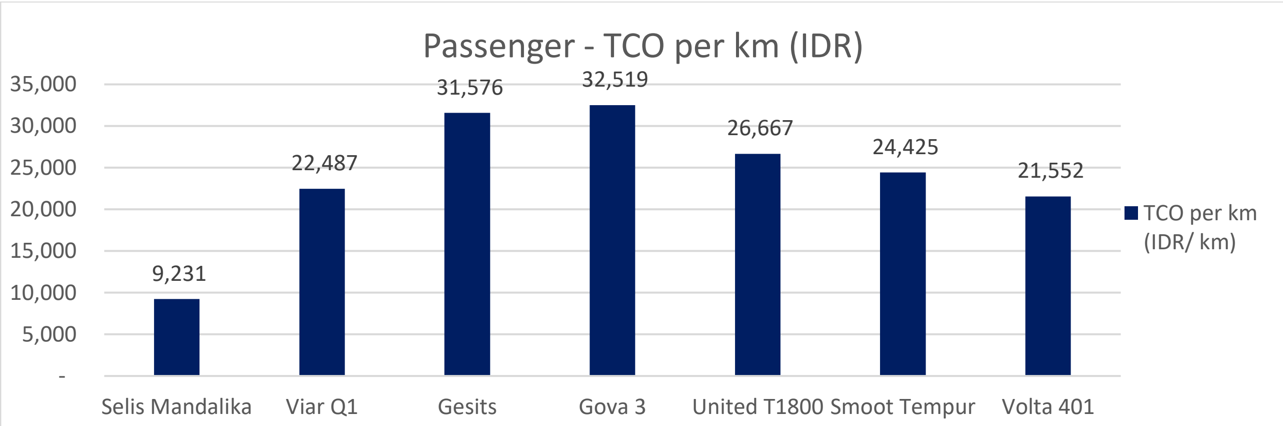


Figure 3. 9 TCO per km calculation for E2w Passenger service

Figure 3.8 and Figure 3.9 shows that in the passenger scenario, which the daily operation per day is 84.2 km, Volta 401 has the lowest TCO value with TCO per bike value of IDR 56,798,141 for 10 years and TCO per km with value of IDR 21,552 per km.

Foods Service Result

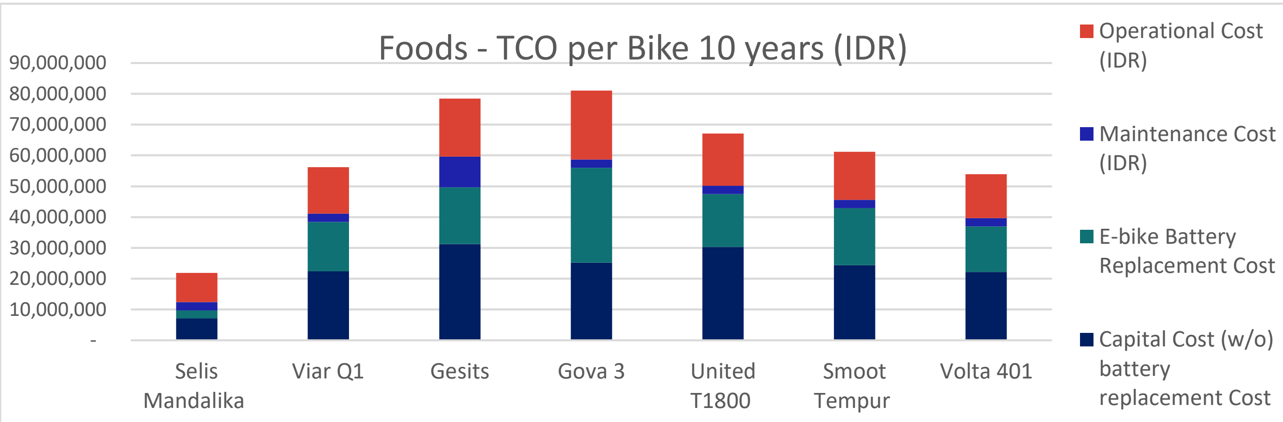


Figure 3. 10 TCO per bike calculation for E2w Foods service

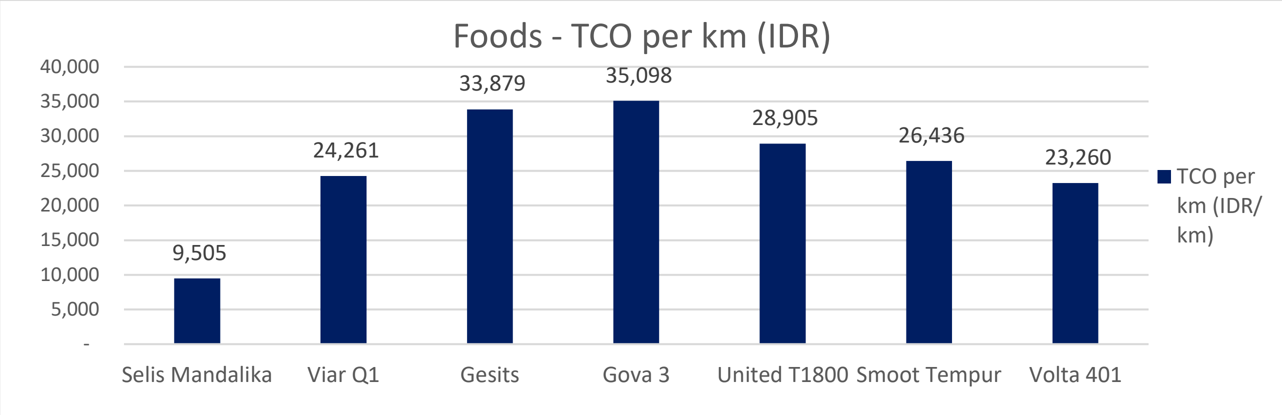


Figure 3. 11 TCO per km calculation for E2w Foods service

Figure 3.10 and Figure 3.11 shows that in the food's scenario, which the daily operation per day is 72.7 km, Volta 401 has the lowest TCO value with TCO per bike value of IDR 52,927,925 for 10 years and TCO per km with value of IDR 23,260 per km.

Goods Service Result

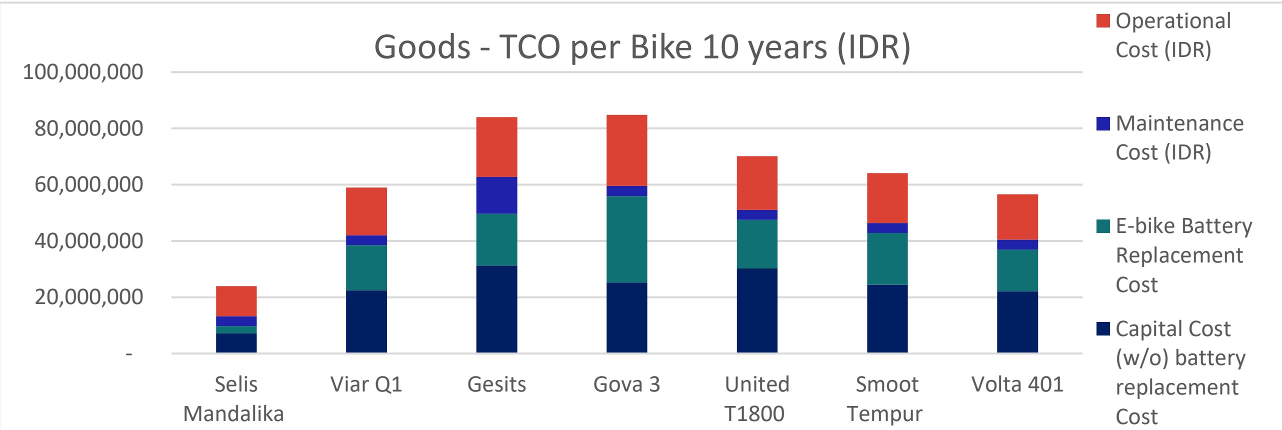


Figure 3. 12 TCO per bike calculation for E2w Goods service

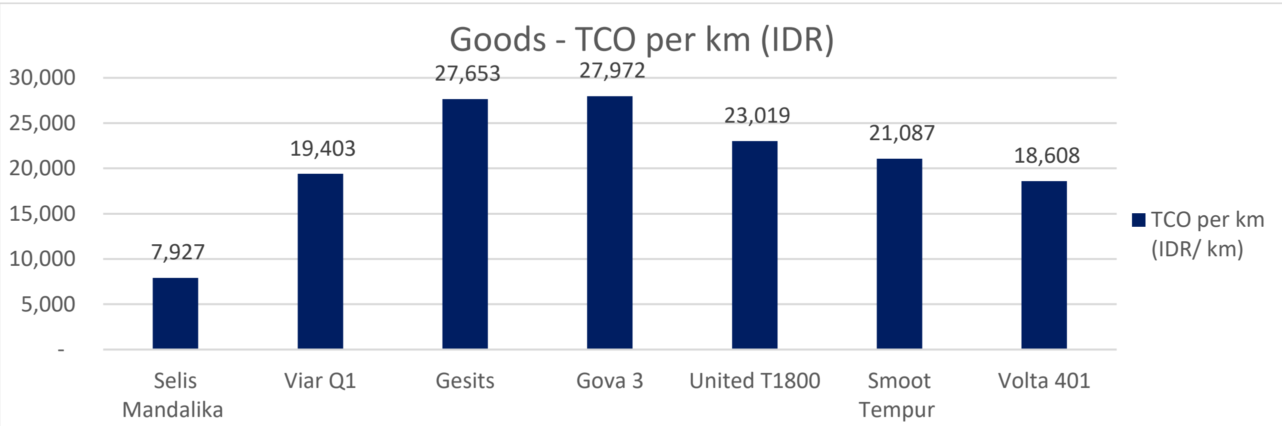


Figure 3. 13 TCO per km calculation for E2w Goods service

Figure 3.12 and Figure 3.13 shows that in the goods scenario, which the daily operation per day is 95.5 km, Volta 401 has the lowest TCO value with TCO per bike value of IDR 55,620,963 for 10 years and TCO per km with value of IDR 18,608 per km.

In summary, the TCO analysis results show that Volta 401 has the lowest TCO per bike value and TCO per km value. The reason is because Volta 401 has a lower capital and operational cost than most of the E2ws.

Another analysis shows that the higher the daily distance the higher the TCO during the ten years lifetime but the lower the TCO per km. This is caused by operation and maintenance becoming higher as the distance increases. Also, with relatively low operational and maintenance cost, increasing the daily distance per day will also decrease the TCO per km of e2w.

Currently used conventional 2W models

TCO Calculation Result for ICE 2W

The TCO calculation parameter for ICE Bike includes capital costs, operation costs, maintenance costs, and the economic benefit.

Economic Parameter Input

The economic input parameters that were analysed for the total cost of ownership calculation were as follows: discount rate, loan rate, Provision, EMI (equated monthly instalment), inflation rate, annual running days, concession time, and insurance. Table 3.15 shows the economic input parameter for the total cost of ownership calculation.

Table 3. 15 ICE Bike economic input parameters for TCO calculation

Cost components	Data for TCO calculation	Assumptions
Discount Rate	10.00%	Discount Rate: (currently uses Sharada's model, will be disclosed later)
Loan Rate ICE	5.70%	Loan Rate and Provision: Based on average loan rate of several banks related to vehicle loan and its provision.
Provision	0.50%	Inflation Rate: 10-year average of inflation rate in Indonesia
EMI Years	3	Annual Running Days: 313 days with assumption of drivers taking one day rest every week.
Inflation rate	3.07%	Concession Time: (currently uses Sharada's model, will be disclosed later)
Annual Running Days	313	Insurance: 2.5% of the CAPEX (will be disclosed later)
Concession Time (Year)	10	Discount Rate: (currently uses Sharada's model, will be disclosed later)
Insurance	2.50%	Loan Rate and Provision: Based on average loan rate of several banks related to vehicle loan and its provision.

Capital Cost

Table 3.16 shows the capital costs component parameters for the TCO calculation which consisted of ICE bike purchase costs, down payment, and annual tax.

Table 3. 16 ICE Bike capital cost components for TCO analysis

Cost components	Data for TCO calculation	Assumptions
ICE Bike Purchase Cost	• Yamaha Mio : IDR 15,880,000 • Honda Beat : IDR 16,827,000 • Honda Vario : IDR 21,050,000 • Yamaha Nmax : IDR 30,200,000	Yamaha Mio, Honda Beat, and Honda Vario are selected for TCO calculation because currently the models are the most popular ones
Down Payment	• Yamaha Mio : IDR 2,319,816 • Honda Beat : IDR 2,458,157 • Honda Vario : IDR 3,075,070 • Yamaha Nmax : IDR 4,411,740	The down payment of buying a bike is 14.61% of the bike price based on the survey result.
Annual Tax	▪ Yamaha Mio : IDR 257,599 ▪ Honda Beat : IDR 253,455 ▪ Honda Vario : IDR 257,599 ▪ Yamaha Nmax : IDR 257,601	Annual tax payment of ICE motorcycle based on the engine size ▪ 110 CC is IDR 253,455 per year ▪ 125 CC is IDR 257,599 per year

Operational Cost

Operational costs components are daily operation per day and ICE bike fuel economy. Table 3.17 shows the operational cost components data analysis and assumptions of each cost component.

Table 3. 17 ICE Bike operational cost components for TCO analysis

Cost components	Data for TCO calculation	Assumptions
ICE Bike Daily Operation per Day	• Combination: 74.7 km • Passenger: 84.2 km • Foods: 72.7 km • Goods: 95.5 km	The running daily distance depends on type of service and bike type. The daily distance is based on the survey result.
ICE Bike Fuel Economy	• Yamaha Mio ○ Combination : 24.7 km/l ○ Passenger : 27 km/l ○ Foods : 30 km/l ○ Goods : 20 km/l • Honda Beat ○ Combination : 25.7 km/l ○ Passenger : 28.8 km/l ○ Foods : 29 km/l ○ Goods : 45 km/l • Honda Vario ○ Combination : 23.9 km/l ○ Passenger : 24.4 km/l ○ Foods : 27 km/l ○ Goods : 35 km/l • Yamaha NMax ○ Combination : 24.7 km/l ○ Passenger : 26.73 km/l ○ Foods : 28.67 km/l ○ Goods : 33.33 km/l	Fuel Cost is based on the price of fuel per litre in Jakarta • Pertalite: IDR 7,650 per litre • Pertamax: IDR 9,000 per litre

Maintenance Cost

The maintenance costs component consists of brake pads replacement cost, tire replacement cost, belt replacement cost, lubricant refill cost, spark plug replacement cost and accumulator replacement cost. Table 3.18 shows the maintenance costs component for TCO calculation:

Table 3. 18 ICE Bike maintenance cost components for TCO analysis

Cost components	Data for TCO calculation	Assumptions
Brake Pads Replacement Cost	• Cost of brake pads replacement is IDR 22,000 per change	• Maximum Range of each brake pads change is 10,000 km per change
Tire Replacement Cost	• Cost of brake pads replacement is IDR 22,000 per change	• Maximum Range of each brake pads change is 10,000 km per change
Belt Replacement Cost	• Cost of belt replacement is IDR 55,000 for Yamaha Mio, IDR 75,000 for Honda Beat, and IDR 120,000 for Honda Vario.	• Maximum range of each belt change is 24,000 km per change
Lubricant Refill Cost	• Cost of changing lubricant is IDR 69,900 per lubricant change	• Maximum Range of each lubricant change is 4,000 km
Spark Plug Replacement Cost	• Cost of spark plug replacement cost is IDR 20,000 per change	• Maximum range of each spark plug change is 2 times of frequency of lubricant change
Accumulator Replacement Cost	• Accumulator replacement cost is IDR 105,000 per change	• Accumulator Maximum range is 20,000 km

Economic Benefit

The economic benefit consists of the salvage value of both ICE and electronic bikes. Table 3.19 shows the maintenance costs component for TCO calculation:

Table 3. 19 ICE Bike economic benefit component for TCO analysis

Cost components	Data for TCO calculation	Assumptions
Salvage Value	• ICE Bike: 6%	(Would need to be disclosed later, currently uses Sharada's model)

The results of TCO calculation for ICE in different types of rides (combination service, passenger service, foods service, goods service) are shown on Figure 3.14 to Figure 3.21. The detailed TCO calculation result can be seen on ANNEX A.

Combination Service Result

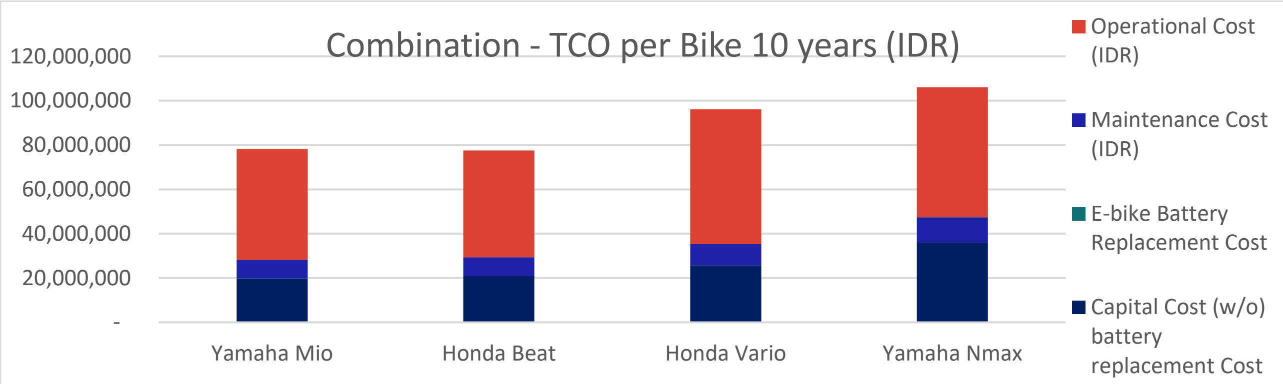


Figure 3. 14 TCO per bike Calculation for ICE Bike Combination service

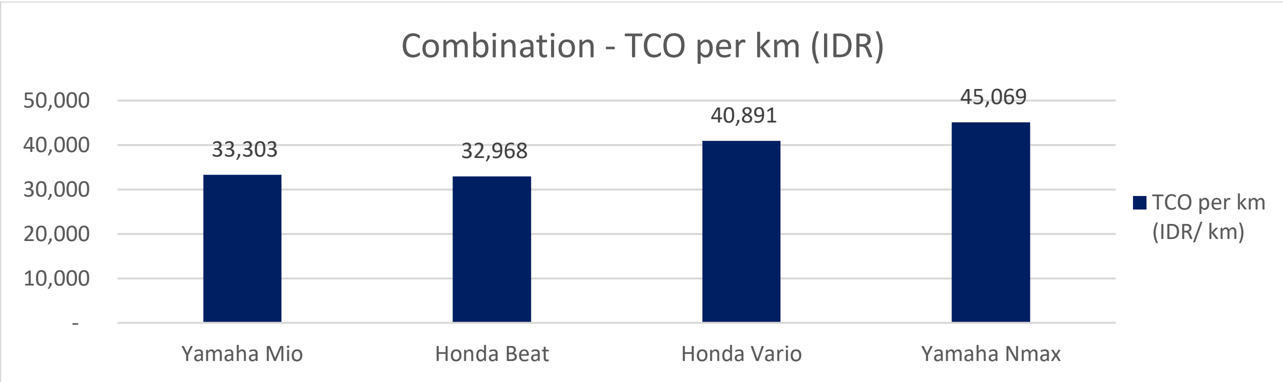


Figure 3. 15 TCO per km Calculation for ICE Bike Combination service

Figure 3.14 and Figure 3.15 shows that in the Combination scenario, which daily operation per day is 74.7 km, Honda Beat has the lowest TCO value with TCO per bike value of IDR 77,082,467 for 10 years and TCO per km with value of IDR 32,968 per km.

Passenger Service Result

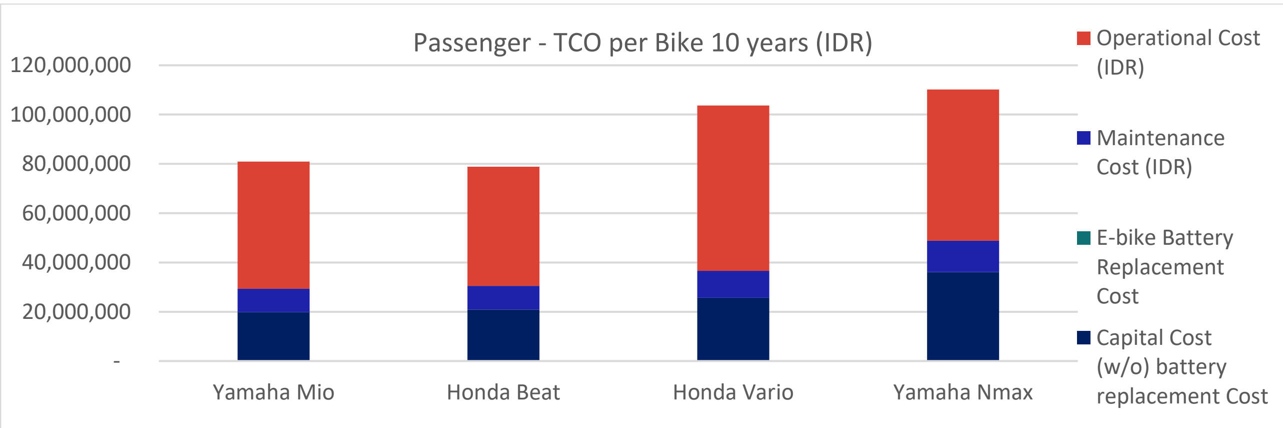


Figure 3. 16 TCO per bike calculation for ICE Bike Passenger service

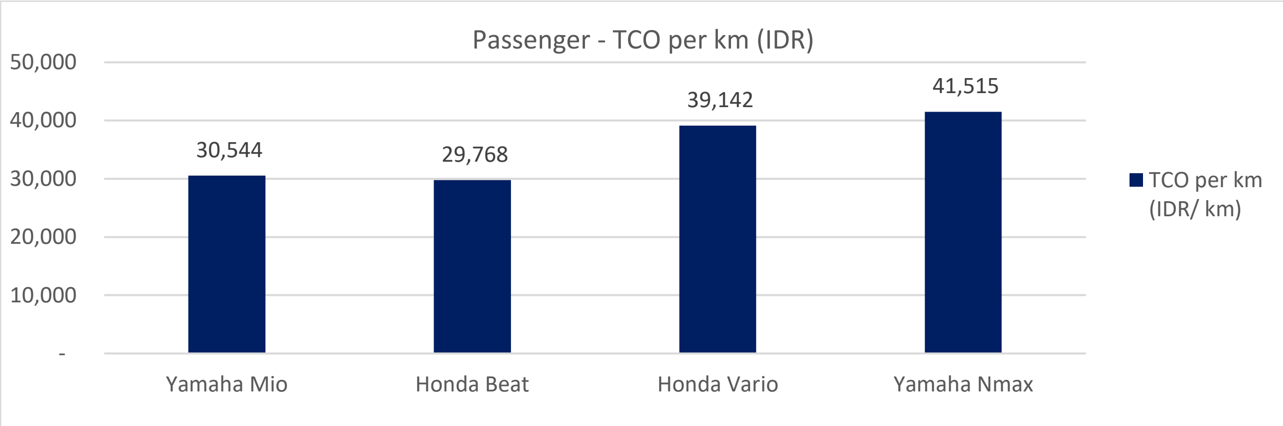


Figure 3. 17 TCO per km calculation for ICE Bike Passenger service

Figure 3.16 and Figure 3.17 shows that in the Passenger scenario, which daily operation per day is 84.2 km, Honda Beat has the lowest TCO value with TCO per bike value of IDR 78,452,168 for 10 years and TCO per km with value of IDR 29,768 per km.

Foods Service Result

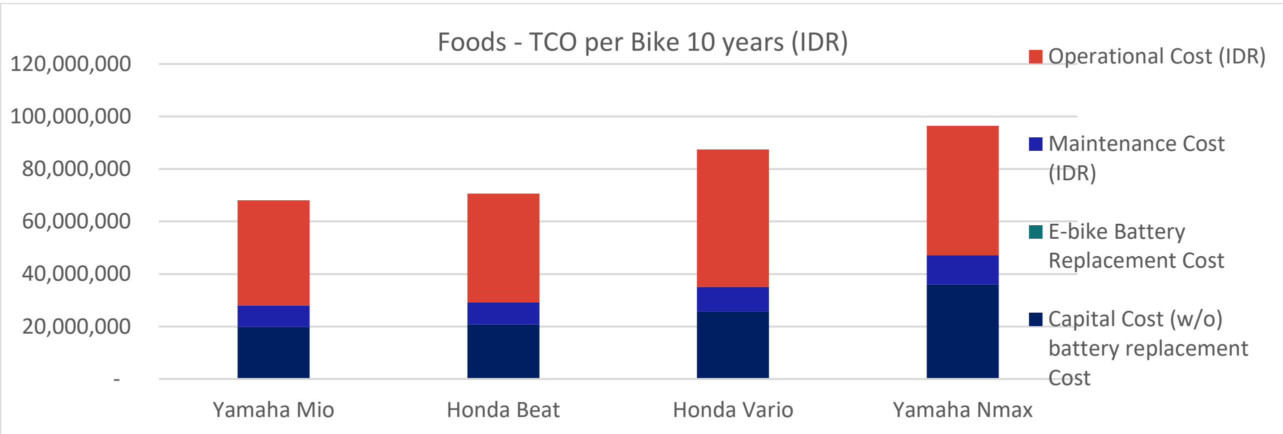


Figure 3. 18 TCO per bike calculation for ICE Bike Foods service

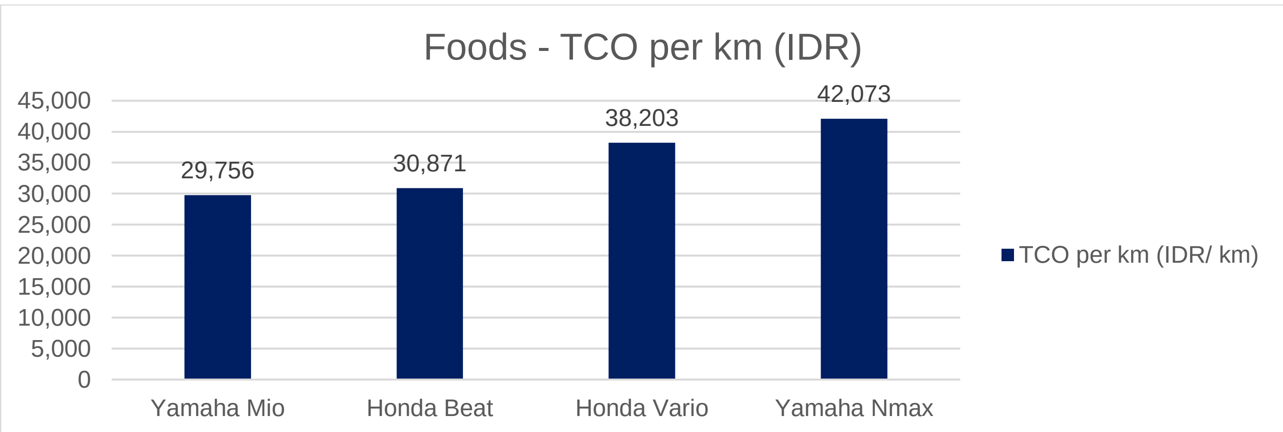


Figure 3. 19 TCO per km calculation for ICE Bike Foods service

Figure 3.18 and Figure 3.19 shows that in the Foods scenario, which daily operation per day is 72.7 km, Yamaha Mio has the lowest TCO value with TCO per bike value of IDR 67,709,372 TCO per km for 10 years and TCO per km value of IDR 29,756 per km.

Goods Service Result

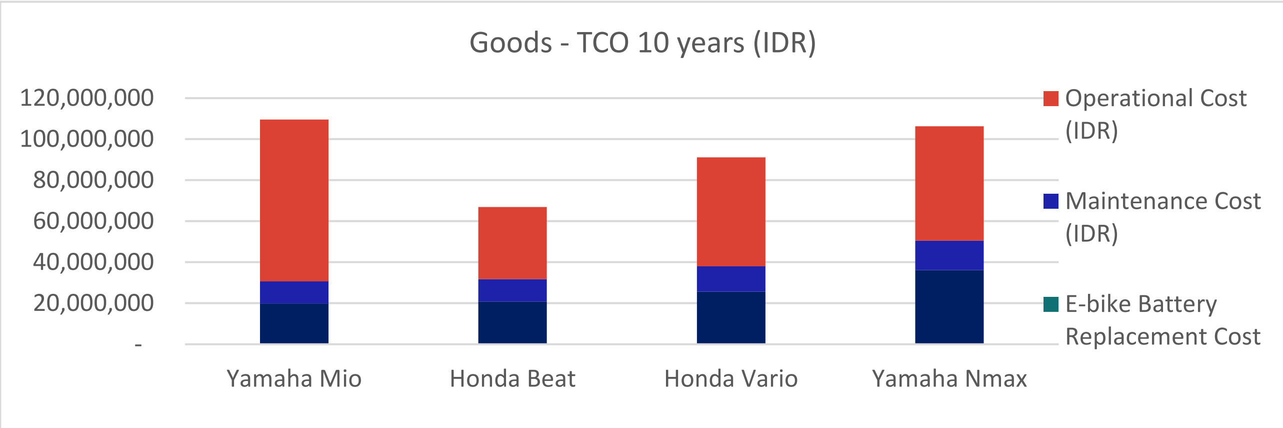


Figure 3. 20 TCO per bike calculation for ICE Bike Goods service

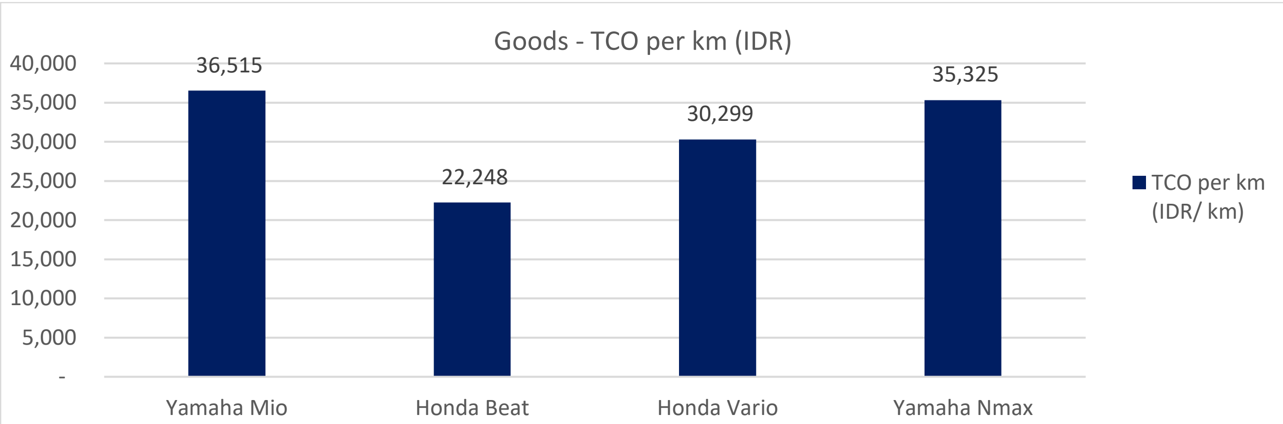


Figure 3. 21 TCO per km calculation for ICE Bike Goods service

Figure 3.20 and Figure 3.21 shows that in the Goods scenario, which daily operation per day is 95.5 km, Honda Beat has the lowest TCO value with TCO per bike value of IDR 66,502,526 for 10 years and TCO per km value of IDR 22,248 per km.

In summary, the TCO analysis results shows that overall Honda Beat has the lowest TCO per km and TCO 10 years lifetime than most of the ICE Bikes. The reason is because Honda Beat's higher efficiency in most types of service reduces the operational cost and becomes the highest factor in the results of TCO.

For Honda Beat at Goods service, it has remarkably lower TCO per km than in Combination, Passenger, and Foods's service because Honda Beat has high efficiency in the service with 45 km/L of fuel efficiency.

Another analysis shows that the higher the daily distance the higher the TCO during the ten years lifetime but the lower the TCO per km. This is caused by operation and maintenance becoming higher as the distance increases. Also, with relatively low operational and maintenance cost, increasing the daily distance per day will also decrease the TCO per km of e2w.

Differences between E2W and conventional 2W Models

2W vs E2W TCO Calculation Result and Analysis

The results of TCO calculation for ICE Bike and E2w in different types of rides (combination service, passenger service, foods service, goods service) are shown on Figure 3.22 to Figure 3.27. The detailed TCO calculation result can be seen on ANNEX A.

Combination Service Result

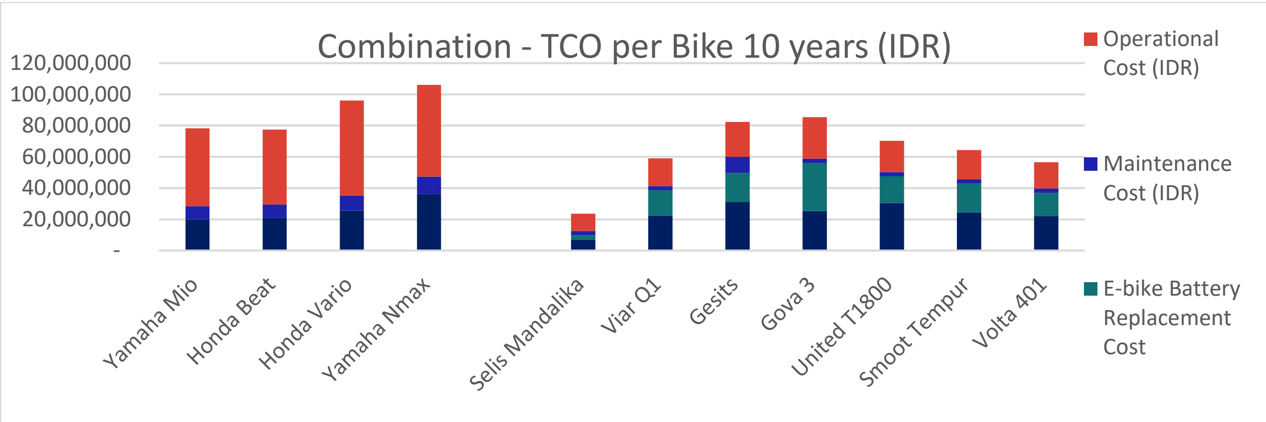


Figure 3. 22 TCO per bike calculation for ICE & E2w Combination Service

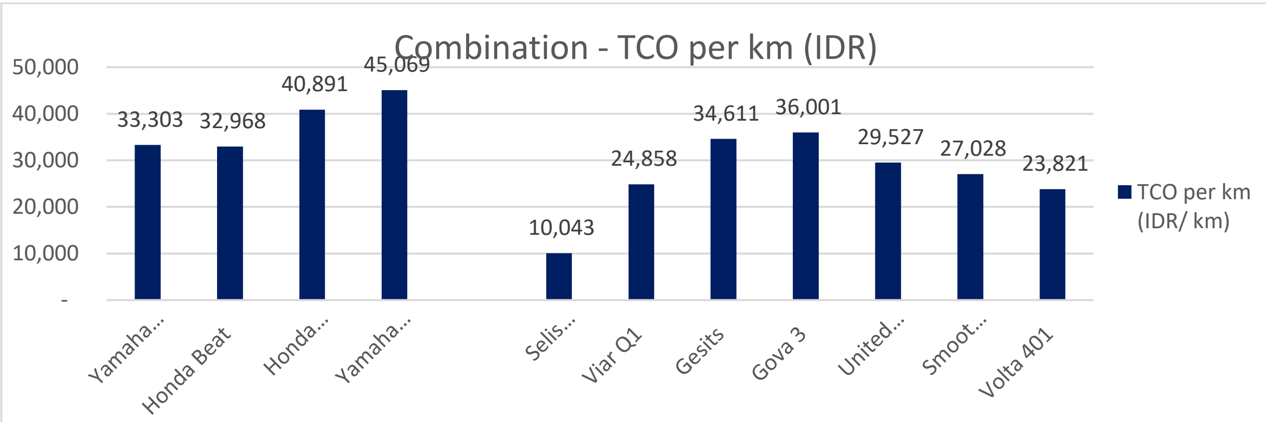


Figure 3. 23 TCO per km calculation for ICE & E2w Combination service

In the combination scenario, from Figure 3.22 and Figure 3.23 it can be seen that overall the E2ws has lower TCO per bike and TCO per km value than the ICE Bikes. The E2w which has the lowest TCO value is Volta 401 with value of IDR 55,696,179 for 10 years and TCO per km value of IDR 23,821 per km; while the ICE bike which has the lowest TCO value is Honda Beat with TCO per bike value of IDR 77,082,467 for 10 years and TCO per km value of IDR 32,968 per km. It also can be seen from the graph that the E2w with the highest TCO per bike and TCO per km value, Gova 3, still has a lower TCO value than the ICE bike with the highest TCO per km value, Yamaha Nmax.

Passenger Service Result

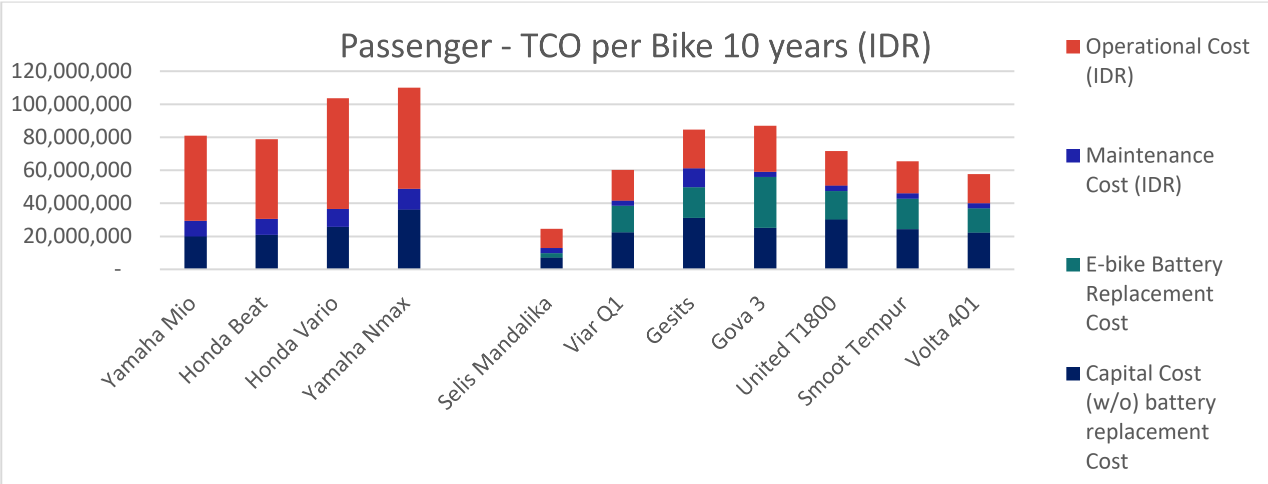


Figure 3. 24 TCO per bike calculation for ICE & E2w Passenger service

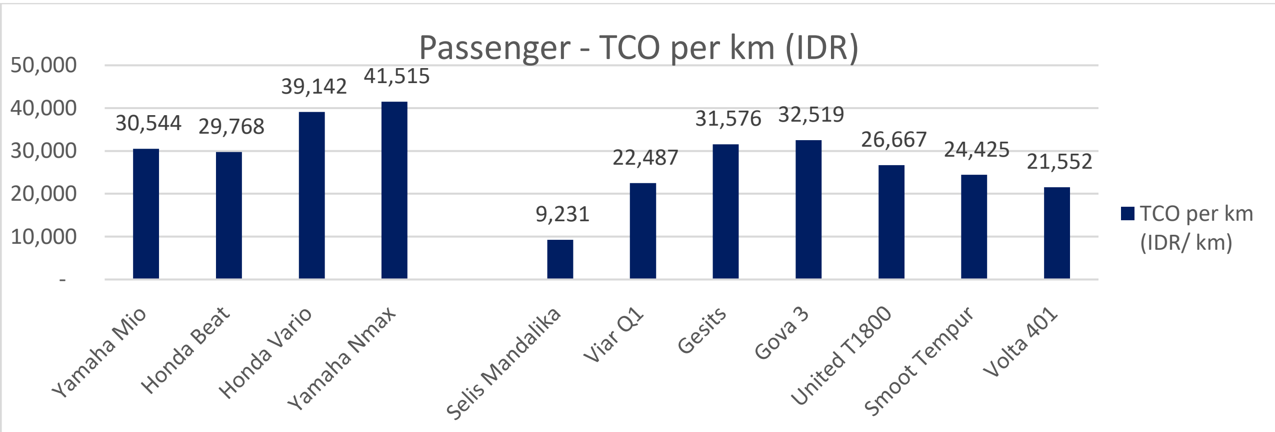


Figure 3. 25 TCO per km calculation for ICE & E2w Passenger service

In the passenger scenario, from Figure 3.24 and Figure 3.25 it can be seen that overall the E2ws has lower TCO per bike and TCO per km value than the ICE Bikes. The E2w which has the lowest TCO value is Volta 401 with TCO per bike value of IDR 56,798,141 for 10 years and TCO per km value of IDR 21,552 per km; while the ICE bike which has the lowest TCO value is Honda Beat with TCO per bike value of IDR 78,452,168 for 10 years and TCO per km value of IDR 29,768 per km. It also can be seen from the graph that the E2w with the highest TCO per bike and TCO per km value, Gova 3, still has a lower TCO value than the ICE bike with the highest TCO per bike and TCO per km value, Yamaha Nmax.

Food Delivery Service Result

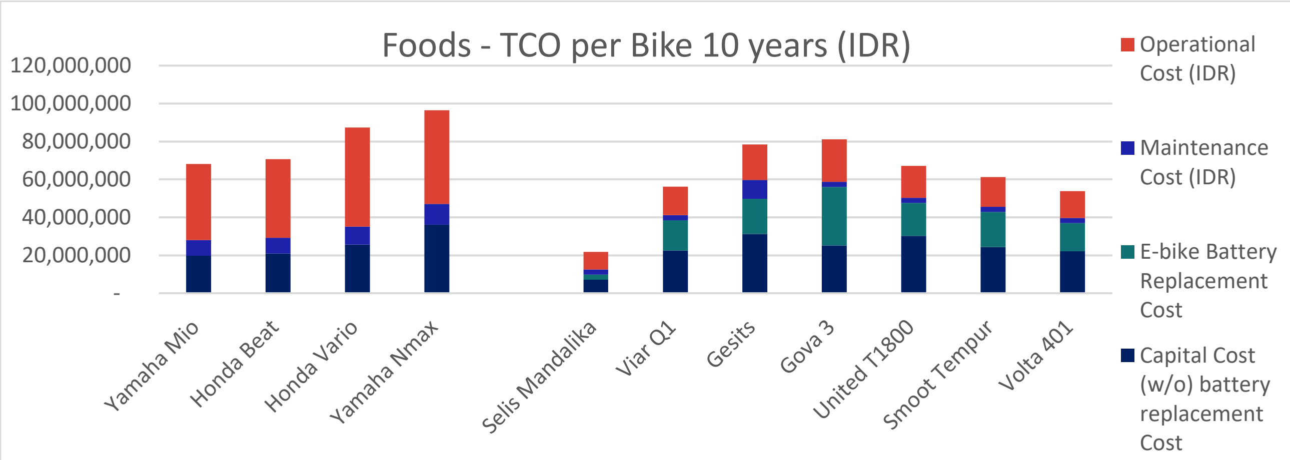


Figure 3. 26 TCO per bike calculation for ICE & E2w Foods service

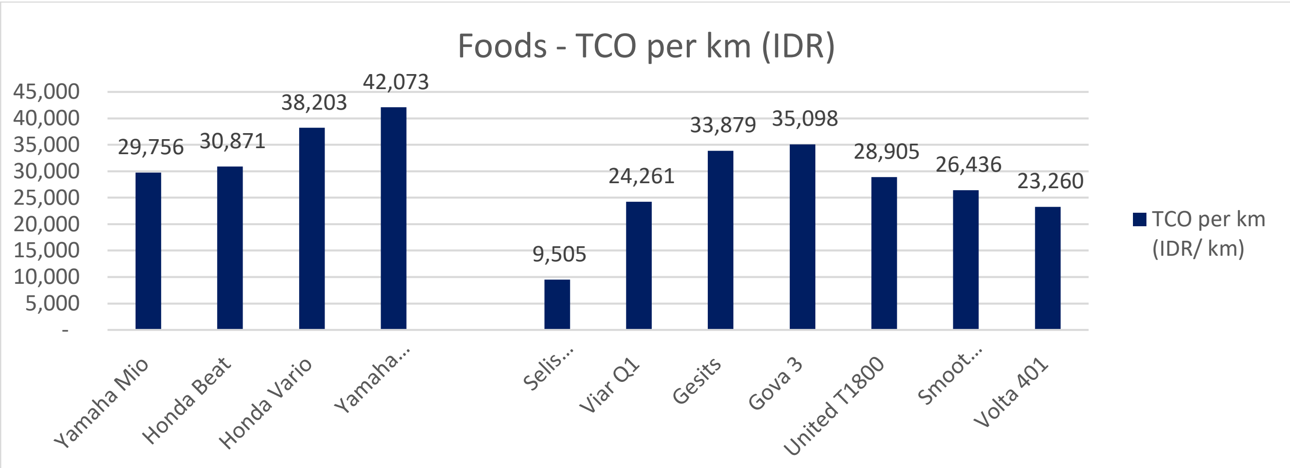


Figure 3. 27 TCO per km calculation for ICE & E2w Foods service

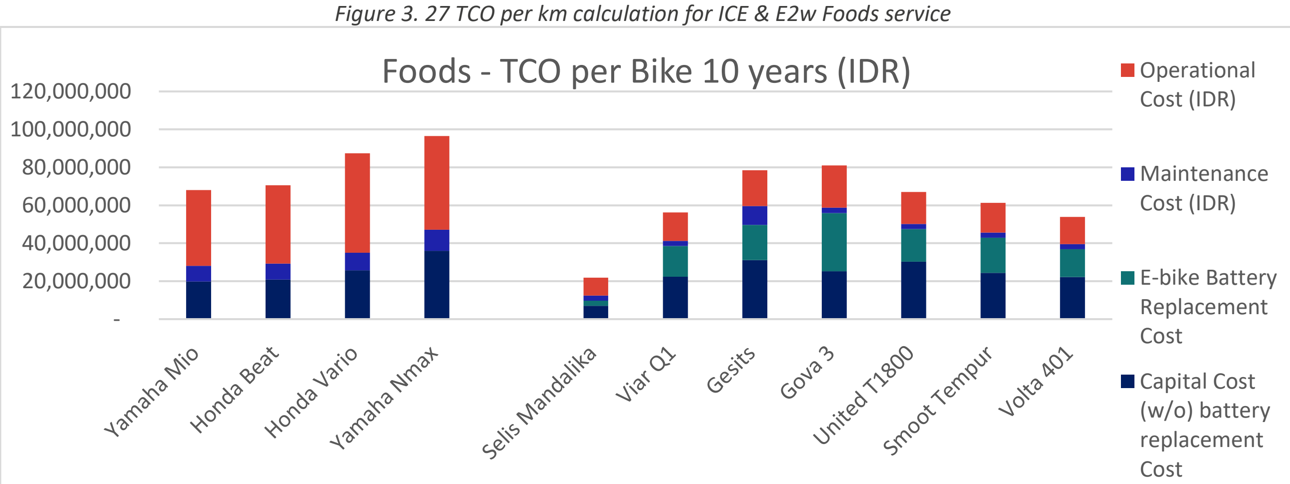


Figure 3. 26 TCO per bike calculation for ICE & E2w Foods serviceIn the food scenario, from Figure 3.26 and Figure 3.27 it can be seen that overall the E2ws has lower TCO per bike and TCO per km value than the ICE Bikes. The E2w which has the lowest TCO value is Volta 401 with TCO per bike value of IDR 52,927,925 for 10 years and TCO per km value of IDR 23,260 per km; while the ICE bike

which has the lowest TCO value is Yamaha Mio with TCO per bike value of IDR 67,709,372 TCO per km for 10 years and TCO per km value of IDR 29,756 per km. It also can be seen from the graph that the E2w with the highest TCO per bike and TCO per km value, Gova 3, still has a lower TCO value than the ICE bike with the highest TCO per bike and TCO per km value, Yamaha Nmax.

Goods Delivery Result

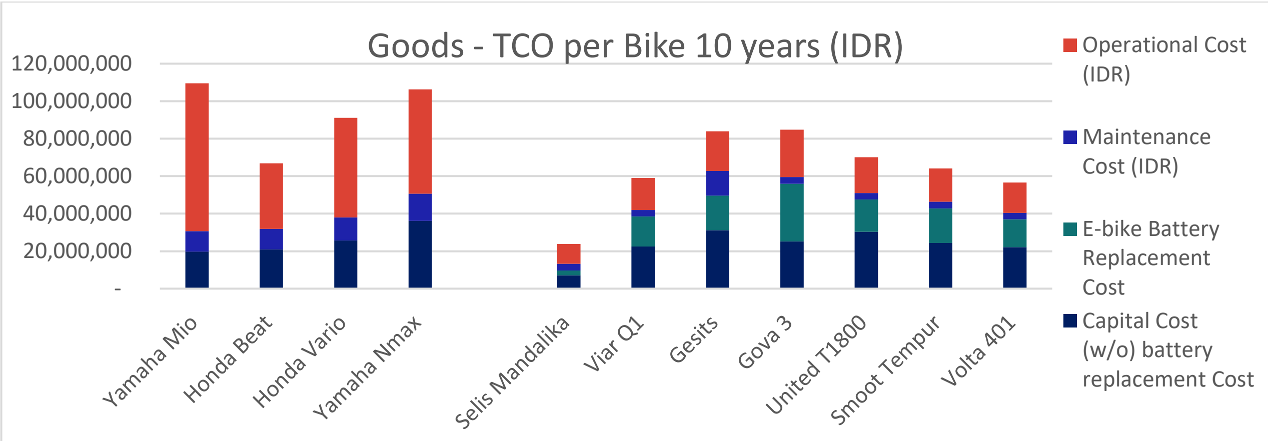


Figure 3. 28 TCO per bike calculation for ICE & E2w Goods service

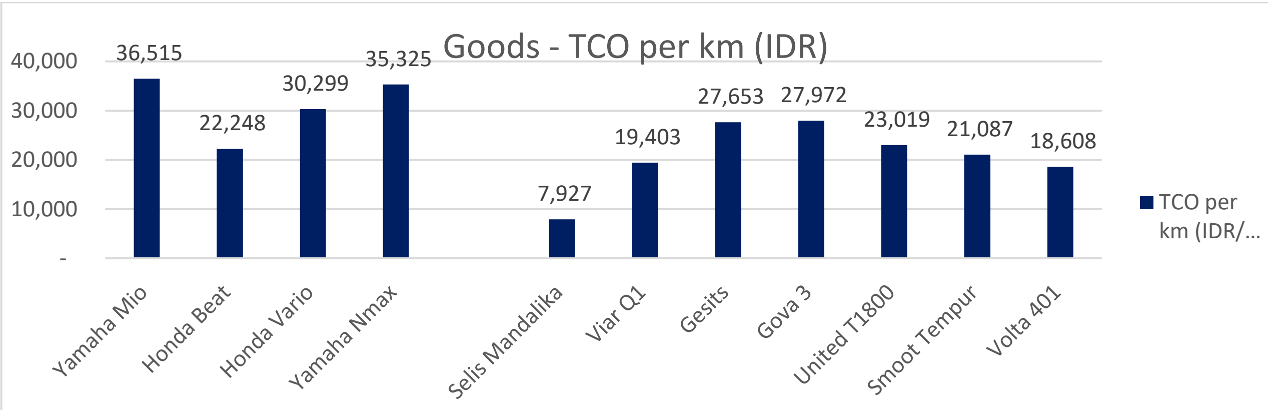


Figure 3. 29 TCO per km calculation for ICE & E2w Goods service

In the goods scenario, from Figure 3.28 and Figure 3.29 it can be seen that overall the E2ws has lower TCO per bike and TCO per km value than the ICE Bikes. The E2w which has the lowest TCO value is Volta 401 with TCO per bike value of IDR 55,620,963 for 10 years and TCO per km value of IDR 18,608 per km; while the ICE bike which has the lowest TCO value is Honda Beat with TCO per bike value of IDR 66,502,526 for 10 years and TCO per km value of IDR 22,248 per km. It can also be seen from the graph that the E2w with the highest TCO per bike and TCO per km value, Gova 3, still has a lower TCO value than the ICE bike with the highest TCO per bike and TCO per km value, Yamaha Nmax.

In summary, the E2ws has lower TCO per km and TCO per bike of 10 years lifetime than the ICE Bikes in Combination, Passenger, Foods, and Goods services. The E2ws with the lowest TCO per bike and TCO per km still has a lower TCO value than the ICE Bikes with the lowest TCO per bike and TCO per km; also, the E2ws with the highest TCO per bike and TCO per km still has a lower TCO value than the ICE Bikes with the Highest TCO per bike and TCO per km. TCO Analysis also shows that the operation of the bike contributes the highest to the TCO result.

E2w vs ICE Bike Cost Parity

For E2w vs ICE Bike cost parity, there are several assumptions that would be made and its interaction with the similar type of bike based on the correlation of engine size for ICE bike and power of E2w.

Main assumptions used for the cost parity calculation is as follows:

- A: 110 CC compared with 1500 Watt (Beat are compared with Volta)
- B: 125 CC compared with 1800 Watt+ (Vario and United T1800, Gesits)

Also, for comparison purposes, only "Combination" type of ride will be used in this section because cost parity calculation for the other types of rides (Passenger, Foods, and Goods services) produces similar results. The E2w vs ICE Bike Parity Cost result for the other types of rides (Passenger, Foods, and Goods services) can be seen on ANNEX B.

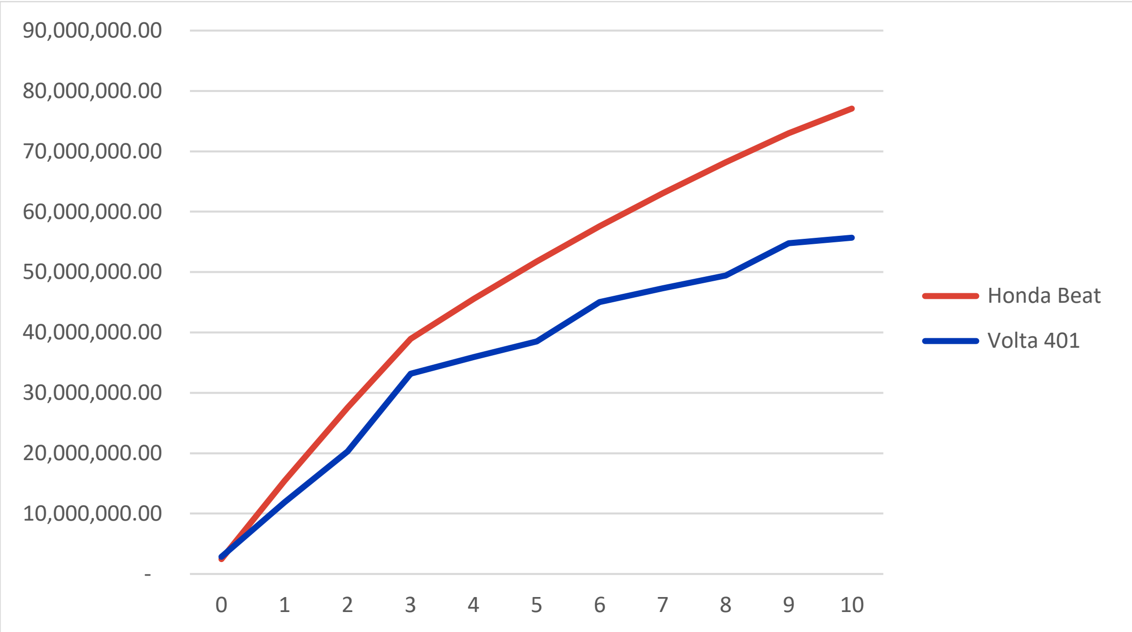


Figure 3. 30 Honda Beat vs Volta 401 TCO Comparison for 10 Years

Figure 3.30 shows that Volta 401 has lower TCO cost than Honda Beat. For Volta 401, up until the third year Volta 401 would have TCO near the TCO value of Honda Beat because of the need of changing battery, and after the third year Volta 401 would have much lower TCO than Honda Beat.

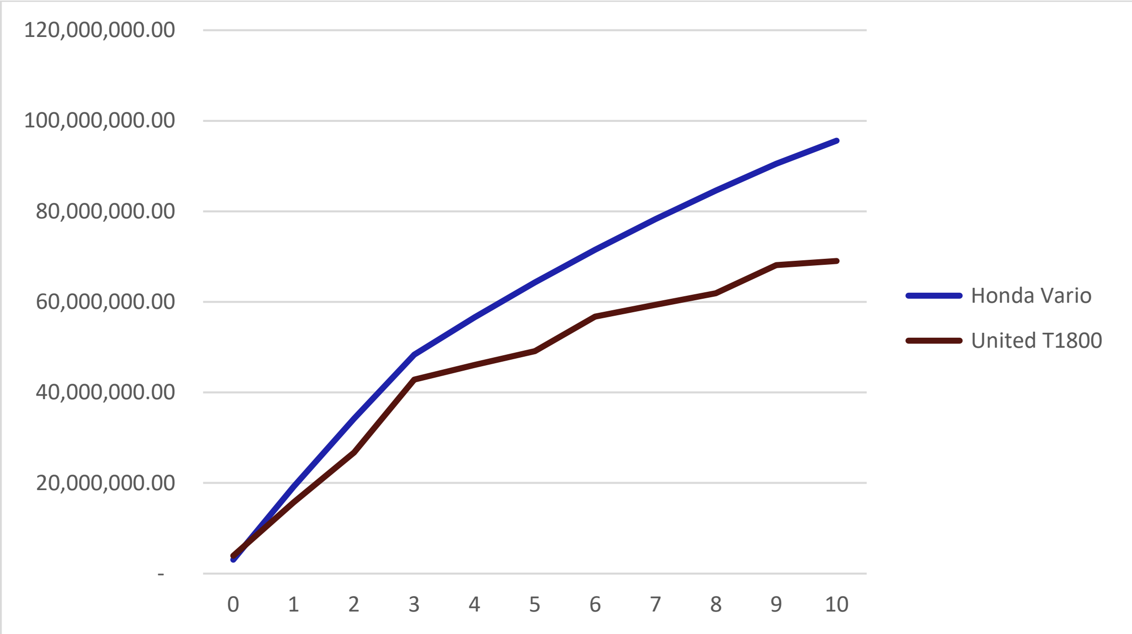


Figure 3. 31 Honda Vario vs United T1800 TCO Comparison for 10 Years

Figure 3.31 shows that the United T1800 has lower TCO than the Honda Vario. Up until the third year the United T1800 would have TCO near the TCO value of Honda Vario, but after the third year the TCO of United T1800 will be lower than Honda Vario quite significantly.

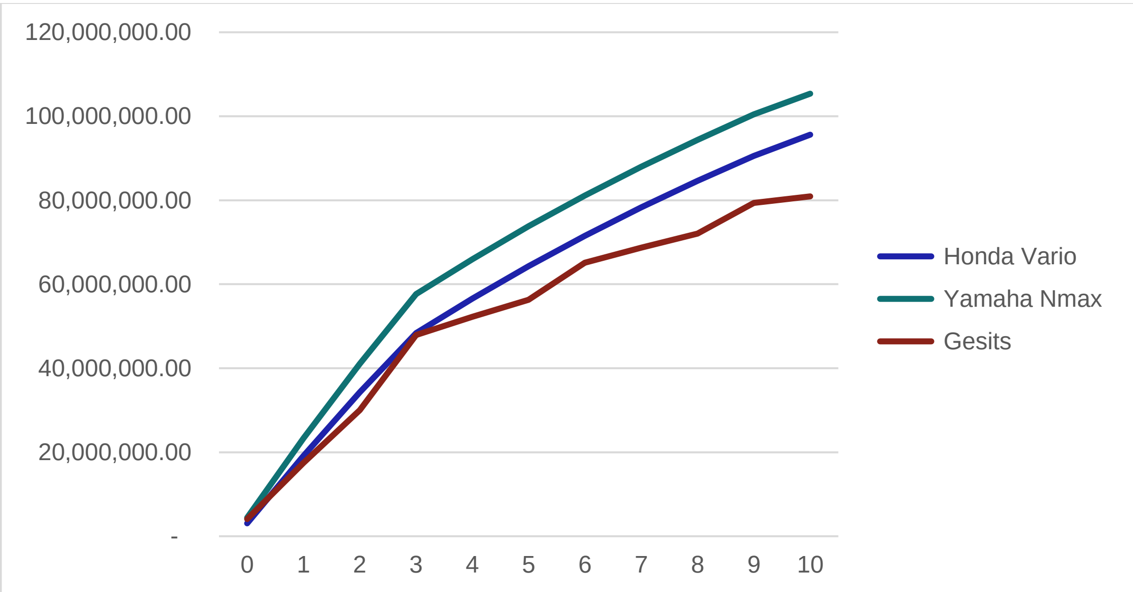


Figure 3. 32 Yamaha Nmax vs Gesits TCO Comparison for 10 Years

Figure 3.32 shows that Gesits has lower TCO than Yamaha Nmax and Honda Vario. Up until the third year the Gesits would have TCO near the TCO value of Honda Vario and lower than Yamaha NMax, but after the third year the TCO of Gesits will be lower than both Yamaha Nmax and Honda Vario quite significantly.

In summary, the E2ws has lower cost parity than the ICE Bikes in 10 years of life time. The lower cost parity makes the E2ws as the more appealing option for the driver because in the long run the E2ws has the lower TCO cost than the ICE bikes and therefore is the more profitable investment.

TCO Comparison between Different Charging Scenarios

Different charging scenarios also will be assessed in TCO calculation. The differences between charging scenarios are shown in Table 3.20. Scenario 1 is owning the battery and using plug in charging mode. Scenario 2 is to own the battery and use battery swapping mode. Scenario 3 is not owning the battery and using battery swapping mode. All of the bike models use Scenario 1 as the base scenario in the previous sections. Also, for comparison purposes, type of rides "Combination" will be used in this section because the result between the type of rides (combination, passenger, foods, and good service) has similar trends. The TCO calculation between different charging scenario results for other types of rides (Passenger, Foods, and Goods service) can be seen on ANNEX C.

Table 3. 20 Differences Between Charging Scenario

Criteria	Scenario 1 (Own the battery; plug in charging)	Scenario 2 (Own the battery; battery swapping)	Scenario 3 (Didn't own the battery; battery swapping)
Bought and own the battery	✓	✓	-
Battery swapping	-	✓	✓
The needs of battery replacement	✓	-	-
Charging fare	1.5 x IDR 1,650 per kWh	1.5 x IDR 1,650 per kWh	IDR 200.00 per km

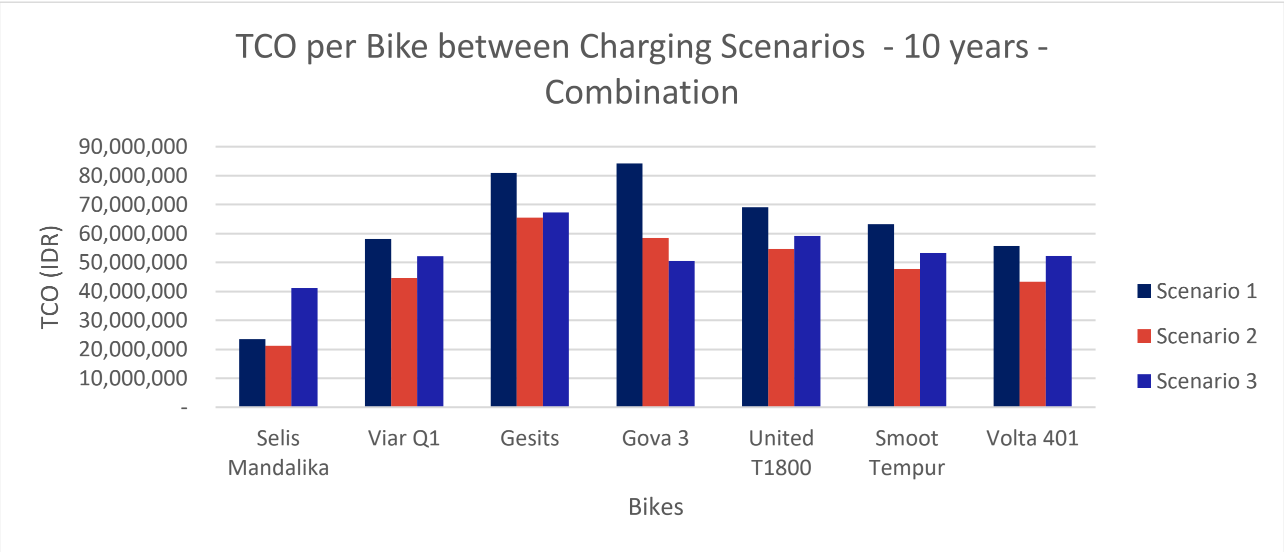


Figure 3. 33 TCO per Bike for E2w in different types of charging scenario for Combination service

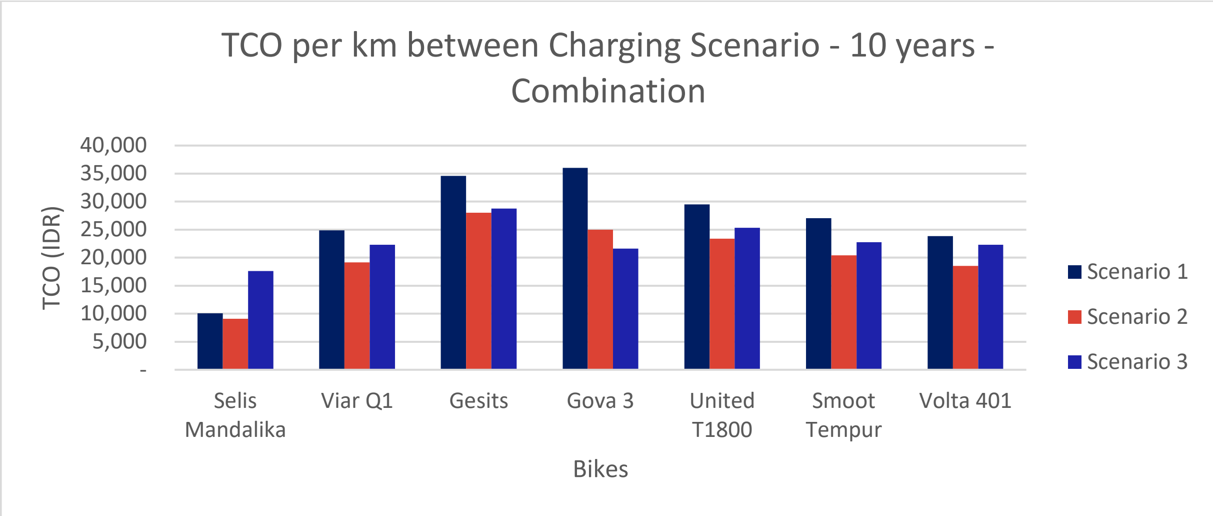


Figure 3. 34 TCO per km for E2w in different types of charging scenario for Combination service

The TCO per bike for all of the E2w models is shown on Figure 3.33 while the TCO per km for all of the E2w models is shown on **Figure 3.34.** The results show that for all of the services scenario 1 mostly has higher TCO per bike and TCO per km value than scenario 2 and 3 due to the needs of battery replacement investment. Scenario 2 mostly has lower TCO value compared to Scenario 1 because there is no battery replacement cost in Scenario 2. Scenario 2 also mostly has lower TCO value than Scenario 3 because even though there is no battery cost in Scenario 3, the high battery swap cost in Scenario 3 makes the TCO value in Scenario 3 is higher in Scenario 2. While mostly E2ws in Scenario 1 has the higher TCO per bike and TCO per km value than E2ws in scenario 2 and 3, the TCO per bike and TCO per km of Selis in scenario 1 is much lower than scenario 3 and almost the same value as Scenario 2 because Selis has higher battery efficiency than the rest of the bike and that makes the operational cost much lower. There is also the case of Gova 3 where its TCO value in Scenario 2 is higher than in Scenario 3 because the battery cost of Gova 3 is quite high; thus, it is advisable for Gova 3 drivers to use the battery swap scenario instead of buying the battery.

In summary, the charging scenario 2 (bought and own the battery; battery swapping) produce the lowest TCO per bike value and TCO per km value for almost every of the E2ws because it eliminates the driver's needs to replace the E2w battery thus reducing the TCO cost of the E2ws.

Selected E2W Models for Each Types of Service – Based on The TCO Calculation

Table 3. 21 Electric 2W Models Selection

Electric 2W Models	**Combination**	**Passenger**	**Food Delivery**	**Goods Delivery**
Selis Mandalika	IDR 23,481,634	IDR 24,328,953	IDR 21,629,318	IDR 23,694,781
Viar Q1	IDR 58,119,804	IDR 59,262,335	IDR 55,205,629	IDR 57,998,648
Gesits	IDR 80,923,530	IDR 83,216,102	IDR 77,093,017	IDR 82,658,984
Gova 3	IDR 84,173,311	IDR 85,703,244	IDR 79,865,665	IDR 83,613,449
United T1800	IDR 69,038,520	IDR 70,278,750	IDR 65,772,924	IDR 68,806,726
Smoot Tempur	IDR 63,193,413	IDR 64,370,270	IDR 60,155,765	IDR 63,033,383
Volta 401	IDR 55,696,179	IDR 56,798,141	IDR 52,927,925	IDR 55,620,963

Table 3.21 shows the summary of TCO of each model and each type of service. As mentioned before, the Selis Mandalika is categorised as an electric bike and Smoot Tempur is not available for the financial scheme. Hence those two models would be pulled out from the selection based on the TCO.

Volta 401 showed up as the lowest in TCO while on the other hand, NIU Gova 03 has the highest. With the high TCO, NIU Gova 03 does not perform better in terms of dimension, range, charging duration, and speed. Gesits and United T1800, with lower TCO would perform better in those terms, so NIU Gova 03 would be dropped from the selection.

3.2.2. Vehicle ownership scheme

Drivers' perspective

Based on the driver interview, there are around 25% of drivers who still don't know the availability of electric 2W for ride-hailing. However, less than 50% of the drivers who are interested in electric 2W for ride-hailing service.

When asked their opinion if the operator obligates the drivers to use electric vehicles, 50% disagree (or strongly disagree) while 30% of them agree (or strongly agree). However, when asked to buy themselves, only 18% of the drivers who agree to buy and operate electric 2W. This is mainly due to the financing issue including their ownership of the current motorcycle, with an average of 4.8 years old. Other reasons include the vehicle performance which is perceived to be less superior than conventional motorcycles.

Lessons learned from India

Most driver partners for ride hailing companies are hesitant to move to EVs primarily due to lower financial capabilities, lack of access to financing and lack of awareness. Early adoption of electric vehicles is happening by company owned or leased vehicles. Most of the electric ride-hailing start-up companies such as Blusmart, Smart-E, Glyd etc are deploying their own all electric fleet and captive charging hubs. This also enables them to manage their charging efficiently and improve customer experience. Partnerships with charging solution providers plays a major role in early adoption of EVs and maximising the utilisation of the chargers and accessibility.

For e2W the driver owned model is yet to evolve on a large scale is also feasible as the TCO is comparable to petrol 2Ws.

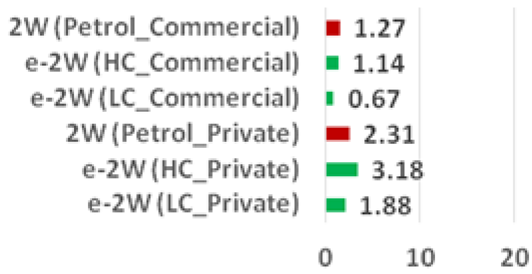


Figure 3. 35 TCO comparison for ICE 2W and Electric 2W for daily utilization of 75 km

As shown in Figure 3.35 for commercial use cases, with a daily utilisation of 75km, the TCO for a high end e2W is lower that of the ICE vehicle. e-2W (LC) represents a low- cost model with battery capacity of 1.75 kWh while the e-2W (HC) represents a high-cost model with a battery capacity of 2.4 kWh.

EV transition is being triggered by a combination of investor interests, state bike-taxi policies and interest from several states to move to EVs and B2B clients (delivery companies) focusing on reducing emissions

Lessons Learned from Other Countries

Internationally, the ride hailing operator transition to electric vehicles is still in a nascent stage. While several companies have stated their intention to transition to electric vehicles and launched programs to support EVs, there is little public information about uptake and progress to date appears limited.

Uber's Green Future Program

Uber has committed $800 million to help "thousands of drivers" switch from gasoline to electric vehicles by 2025. The program offers per-ride financial incentives as well as services to support drivers to purchase electric vehicles.

- *Program details*

  Through the *Zero Emission Incentive* program, drivers using electric vehicles receive an additional $1 per ride up to $4,000 each year, paid by Uber. The platform also allows riders to select *Uber Green*, opting in to paying an additional $0.50 to $1 per trip for an electric vehicle, and passing that fee on to the driver. In London, where the government implemented zero-emission zones, Uber began levying a $0.04 fee per mile fee on all rides

  The company is facilitating EV purchasing through negotiating fleet discounts and providing grants to be used toward the purchase of an electric vehicle. For example, Uber Canada has negotiated a deal with vehicle manufacturer General Motors to provide discounted electric cars to drivers on the Uber platform--up to $2,300 off the purchase price--as well as support accessing the federal EV subsidy of $4,000 USD. In London, Uber is providing drivers with purchase grants (“EV assistance”) that grow depending on how much the driver drives on the platform and can be used at designated retailers toward the purchase of EVs.

Uber is also connecting its drivers to EV rentals, in partnership with large car rental companies Avis and Hertz. Drivers on the platform will soon be able to rent a Tesla for $334/week, a cost that is expected to drop to under $300 once the program is underway--approximately $40-$75 more than the cost of a weekly rental for a combustion vehicle.

The company also offers discounted memberships to fast charging stations. In the UK, this is through a partnership with bp Pulse. In the US, Uber has partnered with EVGo to offer drivers a 30% discount on monthly charging memberships.

- *Program results*

While little has been published about EV uptake among Uber drivers, the company reports that in London between 2019- Fall 2020 almost 1.5 million Uber journeys (7.5 million miles) took place in EVs, and that EV penetration amongst drivers using the Uber app in London is more than 5x the UK wide average.

The notes that lack of adequate charging, lack of affordable EVs, and insufficient financial incentives to close the cost gap are the primary barriers slowing down the EV transition. As shown in Figure 3.36, a total cost of ownership (TCO) analysis of drivers in the EU found that while fuel and maintenance costs are lower for EVs, high purchase costs and potentially high opportunity cost (i.e., lost earning time due to time it takes to charge) made EVs a worse investment for most drivers.

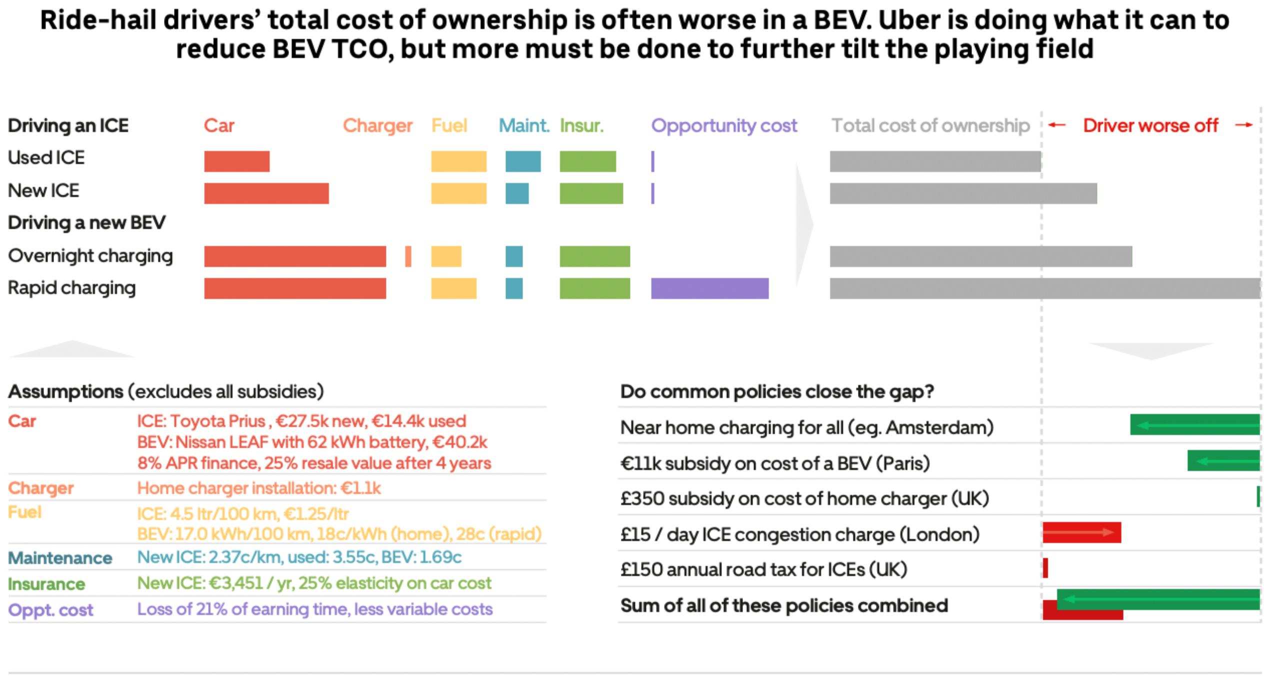


Figure 3. 36 TCO comparison of BEV Ride-hailing

Suitable vehicle ownership scheme

There are three possible ownership models for connecting drivers with electric vehicles: driver ownership, third party leasing partnerships, and company ownership.

Driver ownership is the scheme most aligned with the current business models. Under this scheme, drivers own their vehicle and are responsible for financing the purchase of the vehicle as well as vehicle maintenance, charging, and storage. To support electrification under this ownership scheme, ride hail companies can help to negotiate discounts with manufacturers and connect drivers to reduced-price vehicles.

Table 3. 22 Electric and ICE 2W Models Comparison

ICE 110 cc	Yamaha Mio	IDR 15,880,000	Electric 1500 watt	Smoot Tempur	IDR 22,000,000
	Honda Beat	IDR 16,827,000		Volta 401	IDR 19,500,000
ICE 125 cc	Honda Vario	IDR 21,050,000	Electric 1800 watt+	United T1800	IDR 27,000,000
				Niu Gova 03	IDR 24,500,000
				Gesits	IDR 28,000,000

When comparing 1500-Watt electric 2W models with 110 cc ICE motorcycles, the capital difference would be around IDR 4 to 6 million. While 1800-watt+ including the 2000-watt electric 2Ws have around IDR 3 to 7 million when being compared to 125-cc motorcycles (Honda Vario 125 cc). The 2000-watt is compared to the 125 cc ICE motorcycle since the power output would be closer to the 125-cc compared to the 150 cc. Should the operator negotiate discounts or give fiscal incentives to drivers, a capital expense reduction for up to IDR 7 million would be financially enough for drivers to adopt electric 2W. Drivers would also earn savings from the operation of electric 2W so the incentives could even be less than IDR 7 million but might not be as interesting for drivers compared to capital expense incentives.

Third party ownership allows drivers to rent vehicles at a flat weekly or monthly fee that includes maintenance and may include access to charging stations or battery swapping. To support electrification under this scheme, ride-hailing companies could partner with a third party, connecting their drivers to the rental company and committing to rent a certain number of vehicles.

Finally, ride-hailing companies could purchase a fleet of vehicles and lease them to drivers, on a month-to-month or lease-to-own basis. The benefit of this approach is that the well-capitalised ride-hailing companies could benefit from economies of scale: if they are able to purchase a large fleet of vehicles, they will be able to negotiate a better per-unit price. This model could help to streamline uptake by drivers, who have a pre-existing relationship with the ride-hailing company, unlike with new third-party vendors. However, more ride-hailing companies do not specialise in fleet management and would need to build out this internal capacity.

Whether third-party owned or company owned, vehicle rent should be an option to accommodate drivers who don't own a 2W, especially current and or future women drivers who have less priority on accessing motorcycles within a family. Rent options would open job opportunities to larger and more inclusive audiences.

Table 3. 23 Summary of Ride-hailing Operators Roles on Ownership Models

	Driver owned	**Third-party owned**	**Company owned**
Financial incentives to drivers	Providing a grant to support drivers to purchase EVs Offer per-ride bonus	Negotiate accessible rental fees for drivers Offer per-ride bonus	Offer favourable rental terms for drivers
Outreach and education	Regardless of ownership scheme, ride-hailing companies should invest in outreach and education to familiarise drivers with the benefits of EVs. Companies can develop informational websites, and organise in-person training events to connect drivers with information and resources.		
Support access to gov't incentives	Offer support to drivers to navigate and access government incentives	n/a	n/a

Negotiate fleet discounts	Partner with vehicle manufacturers to guarantee large quantity purchase, and streamline purchasing process	Support third party to negotiate fleet discounts	Purchase large fleet to reduce the per-unit cost and pass savings on to drivers
Support charging infrastructure	Provide financial incentive to support purchase of at-home charging equipment (if required) Connect drivers to existing charging facilities	Support third party to expand charging infrastructure or battery swapping capabilities, possible through TK	Invest in charging infrastructure or battery swapping across the city
Advocate for additional government incentives	Lobby federal, state, and city government to advance policies that reduce purchase costs and expand charging infrastructure		

3.3. Charging Infrastructure: Rolling out charging capacity in Jakarta

This section will define the suitable charging infrastructure type and will also determine the number of selected charging infrastructures to be built (or initiated) by the operator to enable full electrification of 2W ride hailing in Greater Jakarta by 2030

3.3.1. Required Daily Electricity

Suitable E2W models (or selected E2W models on each type of service):
Each electric two-wheeler model has its own battery consumption rate, depending on the vehicle as well as the battery itself. Table 3.24 below summarises each model's battery efficiency based on the technical specification given by the manufacturers.

Table 3. 24 Electric 2W Models' Battery Efficiency

	Selis Mandalika	Viar Q1	Gesits	Niu Gova 03	United T1800	Smoot Tempur	Volta 401
Battery Capacity (kWh)	0.43	1.38	1.44	2.4	1.68	1.44	1.2
Maximum Range – Tech Specs (km)	30	60	50	70	65	60	55
Battery Efficiency – Tech Specs (km/kWh)	69.77	43.48	34.72	29.17	38.69	41.67	45.83

Battery consumption from technical specification generally would be different from the actual usage by the drivers. From the drivers' interview, battery efficiency of Selis Mandalika is collected by dividing daily km with battery capacity times number of charging. It is, however, might not be the 100% accurate as it was the estimation by the drivers who use Selis Mandalika. The distance estimated might not calculate dead kilometre, only calculating the on-trip distance and the number of battery charging might not be the full battery charging. Due to limited data, the other model's actual battery consumption was estimated by the ratio of Selis Mandalika's technical specification and actual usage. Moreover, to estimate the difference based on the types of service, fuel consumption of ICE vehicles based on the types of service were used.

Table 3. 25 Electric 2W Model's Expected Battery Efficiency

Battery Efficiency (km/battery)	Selis Mandalika	Viar Q1	Gesits	Niu Gova 03	United T1800	Smoot Tempur	Volta 401
Combination	15.45	30.9	25.75	36.05	33.47	30.9	28.32
Passenger	16.67	33.35	27.79	38.91	36.13	33.35	30.57
Food Delivery	17.88	35.76	29.8	41.72	38.74	35.76	32.78
Goods Delivery	20.79	41.58	34.65	48.51	45.05	41.58	38.12

Table 3.25 above shows the estimation of distance travelled with one full battery, depending on its own battery capacity and battery consumption rate. The higher the value doesn't necessarily mean better battery efficiency but shows less battery charging or swapping needed.

Demand composition (or fleet composition):

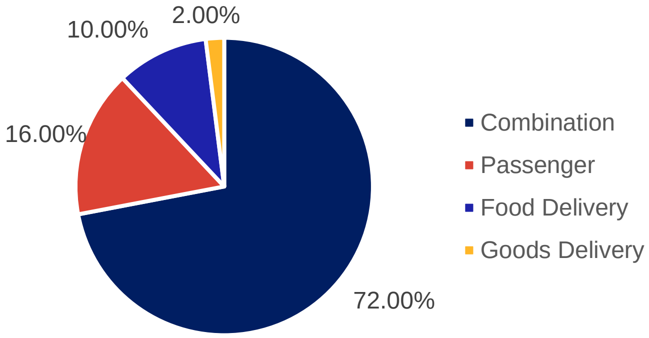


Figure 3. 37 Drivers Composition Based on Types of Services

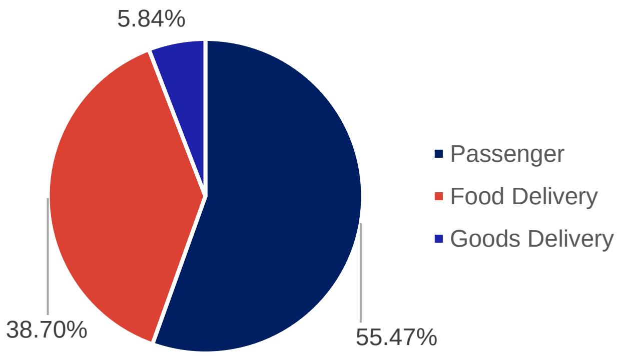


Figure 3. 38 Combination Trips Breakdown

As discussed before, the majority of drivers take combination service, followed by passenger transportation service and goods delivery service the least. When looking into combination trips, it is also dominated by passenger transport service and again, the goods delivered the least.

With the estimation of total fleet in Greater Jakarta of 900,000, the number of fleets for each type is estimated with the proportion of types of service take by the drivers:

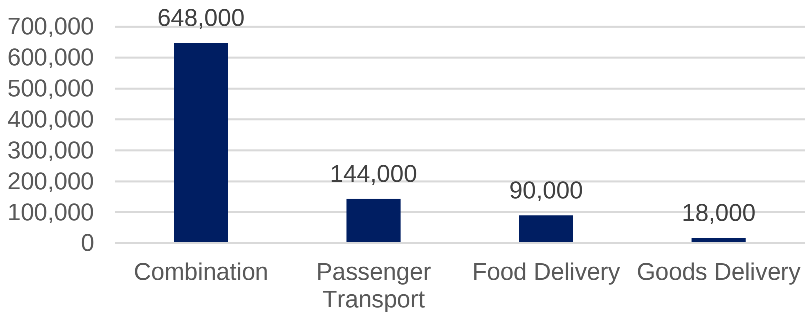


Figure 3. 39 Size of 2W Ride-Hailing Fleets Based on Types of Service

Total daily electricity demand:
By combining daily distance travelled and battery consumption rate, daily kWh needs could be estimated based on the models and types of service. Based on the table, Volta 401 is rated as the most efficient model, regardless of the battery capacity or the amount of battery charging or swapping needed.

Table 3. 26 Electric 2W Daily kWh Needs Based on Type of Services

Daily kWh needs	Viar Q1	Gesits	United T1800	Smoot Tempur	Volta 401
Combination	3.34	4.18	3.75	3.48	3.17
Passenger	3.48	4.36	3.92	3.64	3.31
Food Delivery	2.81	3.51	3.15	2.93	2.66
Goods Delivery	3.17	3.97	3.56	3.31	3.01

Combined with the number of fleets, the whole Greater Jakarta Area ride-hailing electricity needs could be estimated. This assumes that the suitable electric two-wheeler models are used evenly, so daily kWh needs from Table 3.26 are being averaged. However, the charging/swapping strategy should be split by charging on the road and charging at home. From the daily kWh needed and capacity of a single battery, we could know the number of charging/swapping needed. It should be rounded up so the and assume the battery would be 100% in the morning, due to home charging, regardless of the battery capacity left when arriving at home. The electricity needed on the road could be estimated by having the rounded-up number of charging/swapping, subtracted by one due to home charging, then multiplied with the volume of fleets.

Table 3. 27 Daily Electricity Needs

Types of Service	Percentage	Estimated Number of Fleets	Electricity Needed OTR (kWh)	Electricity Needs at Homes (kWh)	Total Electricity Needed
Combination	72.0%	648,000	1,866,240	494,638.55	2,360,878.55
Passenger	16.0%	144,000	466,560	81,324.96	547,884.96
Food Delivery	10.0%	90,000	226,800	44,282.94	271,082.94
Goods Delivery	2.0%	18,000	51,408	9,840.30	61,248.30
	100.0%	900,000.00	2,611,008	630,087	3,241,095

The electricity needed for charging at home is calculated by subtracted the 100% battery capacity with remaining battery capacity when arriving at homes. Please note that the dead kilometre is not counted here.

3.3.2. Selected Charging Infrastructures

Components of Cost for Charging Infrastructures

In India, Bharat AC 001 and Bharat DC001 standards were developed for public charging networks. The Bharat AC001 takes three phase input and gives single phase AC output and can charge 3 EVs simultaneously at an output power of 3.3kW. The Bharat DC001 gives DC output at two different power levels one of them being 3.3 kW which is suitable for charging e2Ws. The cost of the Bharat DC001 is higher than the AC chargers owing to higher output power and other ancillary equipment. The upfront cost of both Bharat Ac001 and BharatDc001 is still on the higher side, so the government is launching standards for low-cost AC chargers to reduce the initial cost. Table 3.28 shows the typical costs associated with a charging station. A typical 2 kWh e-2W battery is around 8kgs (with battery energy density of 175Wh/kg). The lower weight of these batteries enables battery swapping as another charging methodology. The costs associated with a battery swap station depend on the number of batteries. Table 3.29 shows an estimate of these costs for a 12-pack battery swapping station. A battery swap station can be both manned or unmanned and accordingly the corresponding manpower costs should be taken into consideration.

Table 3. 28 Charging Facility Component Cost

Parameter	Unit	Value
Cost of a charger		

3 kW AC charging point	IDR	671,862
Bharat AC 001	IDR	7.67 million
Other fixed-cost components		
Cost of Distribution Transformer and associated equipment per 50 kVA rated capacity	IDR	28.7 million
Cost of electric metre	IDR	479,901
Installation cost (including manpower)		10%
Electricity connection cost	IDR	4.8 million
Operation & maintenance cost (excluding energy and land)		
Annual salary of an operator	IDR	46 million
Number of operators		3
Annual maintenance cost		5% of purchase cost
Charges to be paid for energy and space use		
Rental on space	IDR/ sq. m	Based on contract
Energy charge	IDR/ kWh	Based on local power tariff
Demand charge	IDR/ kWh	Based on local power tariff
Share of revenue	%	Based on contract

Table 3. 29 Cost of battery swapping station (A conversion of 1 INR=192.95 IDR is used to calculate the value in IDR)

Parameter	Cost IDR
Single batteries cost	3.8 million
Total cost of batteries (12 nos)	46 million
Swapping station cost	103.7 million
Infrastructure cost	47.9 million
Total cost of setting up 1 BSS	251 million

Current available charging infrastructure models from India or other Asian countries

Electric 2W have battery sizes in the range of 1.5 kWh - 3kWh with a rated battery voltage between 48V and 72V. EVs can be charged using wall mounted or standalone AC charger / DC chargers based on manufacturers recommendations. The charging infrastructure for developing in a unique manner with both public and private players setting up charging stations. OEMs like Aether are also providing charging services for their own vehicles and sometimes other vehicles also. As an example, Aether partners with local businesses based on a subscription model by providing the charging equipment which can also be used to charge other vehicles. A few models of the charging infrastructure are shown in Table 3.30 along with typical specifications of chargers for e2Ws in Table 3.31.

Table 3. 30 Available Charging Infrastructures

Model	Specifications	Charger Type
PlugNgo	18 kW AC/DC (3 Industrial Sockets	AC and DC
Kazam	Wall mounted single plug 5-16 Amp charger	AC
Charzer	5A EV charger	AC
Volttic	16 A Bharat Ac-001 EV Charger, Lithium, 230V	AC
Evlion	IP55 Bharat AC 001	AC

	3 sockets	

Table 3. 31 Specification of Charging Infrastructures

Specifications of e-2W charger	
Input/ Output	AC/AC or AC/DC
Input Voltage (V)	230
Output Voltage Range (V)	48 – 72
Maximum Output Current (A)	60
Output Power Range (kW)	1 - 2.5, 6-9

Start-up firms like Sun mobility, Zuink are setting up battery swap stations in India which enable replacing low charge batteries with fully charged ones in a few minutes. In Bengaluru, Zuink has established 200 battery swap stations for electric 2Ws and plans to expand to 1000 stations in less than a year. They have partnered with small business owners(shops) and petrol bunks to set up a BSS (battery swap station). Another start-up firm Sun mobility has also set up a network of over 100 battery swap stations with a stack of 12 batteries for both e2Ws and e3Ws.

Table 3. 32 Typical Specification of Battery Swap Station

General Specifications	
IP Rating	IP20
Efficiency	95%
Battery Modules	2 / 4 / 6 / 8 / 10 / 18 / 20 (customizable)
Battery Type	Li-ion
Battery Capacity	1.2kW / 1.5kW
Cooling	Air Condition (optional)
AC Input	
Voltage	Three-Phase, 5 Wire AC System (3Ph+N+PE) 230V (+15%/-15%) Phase to Neutral
Current	< 200A per Phase
Frequency	Frequency 50Hz ± 5Hz
Operating Ambient Temperature	0°C to +55°C
Relative Humidity	Relative Humidity 5 to 95
DC Output	
Voltage	48V / 60V
Output Connector	Anderson Connectors
Max. Current	20A / 10A Battery

Adjusted available charging infrastructure models from India or other Asian countries

Based on the Ministerial of Finance Decree no. 199/PMK.010/2019, several taxes might be applied when purchasing goods from other countries (import). The taxes include import tax (7.5%), value added tax/VAT (10%) and income taxes for goods (10%-20%). The tax number or percentage will vary depending on the type of the goods. For the electronic goods or parts will approximately be with those kind percentages.

From the previous sub chapter, there is a reference number from India that might be extracted into the Indonesia context. There is a limitation in the Indonesian market regarding the market of charging infrastructure cost calculation. Then, the data from India should need to be adjusted based on the Indonesia context.

Table 3. 33 Adjusted Available Charging Infrastructures

Parameter	Unit	Value	Adjusted Value (incl. All taxes)	Remarks
Cost of a charger				
3 kW AC charging point	IDR	671862	873,924	Adjusted with Import Tax, VAT, and Income Tax
Bharat AC 001	IDR	7.67 million	9,976,753	Adjusted with Import Tax, VAT, and Income Tax
Other fixed-cost components				
Cost of Distribution Transformer and associated equipment per 50 kVA rated capacity	IDR	28.7 million	60,112,000	Refer to all-in connection cost in PLN website for 53kVA
Cost of electric metre	IDR	479901		
Installation cost (including manpower)		10%		
Electricity connection cost	IDR	4.8 million		
Operation & maintenance cost (excluding energy and land)				
Annual salary of an operator	IDR	46 million	54,000,000	Minimum Income in DKI = 4.5 million per month
Number of operators		3	3	Number of operators required (person)
Annual maintenance cost		5% of purchase cost	5% of purchase cost	-
Charges to be paid for energy and space use				
Rental on space	IDR/ sq. m	Based on contract	TBC	Based on contract and location
Energy charge	IDR/ kWh	Based on local power tariff	1,444.7	PLN Tariff in Jakarta for Residential/Business

Demand charge	IDR/ kWh	Based on local power tariff	2,466	Max PLN regulated tariff for charging
Share of revenue	%	Based on contract	TBC	Based on contract

Table 3. 34 Adjusted Battery Swap Station

Parameter	Cost IDR	Adjusted with Import Tax, VAT, and Income Tax
Single batteries cost	3.8 million	4.94 million
Total cost of batteries (12 nos)	46 million	59.8 million
Swapping station cost	103.7 million	134.9 million
Infrastructure cost	47.9 million	62.3 million
Total cost of setting up 1 BSS	251 million	262 million

Current available charging infrastructure models from Indonesia

The result of market research on charger prices is shown on Table 3.35 for the international market. On the international market, several e2w chargers were identified. The charger prices ranged from 169 USD to 2,244 USD. The model of the charger is varied such as portable charger, wall mounted charger, and charging station. The most expensive charger, priced 2,244 USD, has four charging sockets and thus can charge four bikes at once, whereas the other is only capable of charging 1 bike only.

International Market

Table 3. 35 Available Charging Infrastructures – International Market

No.	Name	Specification	Market	Price	Price per kW (IDR per kW)	Input/ Output	Input Voltage	Output Voltage Range	Output Power Range	Amperage	Other Notes
	Standard Specs					**AC/AC or AC/DC**	**230 V AC**	**48 – 72V DC**	**1 - 2.5 kW; 6 - 9 kW**		

No.	Name	Specification	Market	Price	Price per kW (IDR per kW)	Input/ Output	Input Voltage	Output Voltage Range	Output Power Range	Amperage	Other Notes
1.	PCE WL 4 Ebike charger | electric bike charging station	charging station	Germany	EUR 1,960/USD 2,244	8,854,703	AC/AC	230 V AC	230 V AC	2.3 kW – 3.7 kW	10A - 16A	4 point charging (socket only, no gun) ground mounting electric bike charging station
2.	Grin Technologies Cycle Satiator - Programmable Electric Bike Battery Charger	Portable charger	Canada	USD 340	13,788,889	AC/DC	220 V AC	24V- 52V DC	0.360 kW	up to 8A	1 charging gun (adaptor model), Programmable output V
3.	Noark Ex9EV 1 T2 10A	wall-mounted charger	Czech	EUR 516*/USD 591	3,751,565	AC/AC	230 V AC	230 V AC	2.3 kW	10A	1 charging gun, Price available is only for the input voltage 400V model
4.	Kazam EV 3.3 KW AC Smart Charging Station	wall-mounted charger	India	INR 12,600/USD 169	747,697	AC/AC	230 V AC	230 V AC	3.3 kW	16A	1 charging point (socket only, no gun)
5.	IoCharger CE Type2 mode3 IOCAW 05C	wall-mounted charger	China	USD 560	1,168,000	AC/AC	230 V AC	230 V AC	7 kW	32A	1 charging gun

No.	Name	Specification	Market	Price	Price per kW (IDR per kW)	Input/Output	Input Voltage	Output Voltage Range	Output Power Range	Amperage	Other Notes
6	Elyx Swap and Go Station	Battery Swap Station (8+1)	China	USD 3,890		AC/AC	110V AC		500W		

*The price listed is based on the market price and has not included tax.

The result of market research on charger prices is shown on Table 3.36 for the local market. There are two groups of e2w chargers in the local market, one group is the portable charger group which has price between IDR 150,000 to IDR 650,000 and the other is charging station model which has price around IDR 27,000,000.

Local Market

Table 3. 36 Available Charging Infrastructures – Local Market

No.	Name	Specification	Price	Price per kW (IDR per kW)	Input/Output	Input Voltage	Output Voltage Range	Output Power Range	Amperage	Other Notes
	Standard Specs	-	-		**AC/AC or AC/DC**	**230 V AC**	**48 – 72 V**	**1 - 2.5 kW 6 - 9 kW**	-	
1.	CHARGER 36V 12AH SELIS TYPE MANDALIKA	Portable Charger	IDR 150,000	347,222	AC/DC	220 V AC	36V DC	0.432 kW	12	1 charging gun (adaptor model)
2.	Electric Bike Smart Charger	Portable Charger	IDR 235,000	195,833	AC/DC	220 V AC	60V DC	1.2 kW	20	1 charging gun (adaptor model)
3.	Charger aki sepeda listrik 48v12ah	Portable Charger	IDR 177,000	1,843,750	AC/DC	220 V AC	48V-59.2V DC	0.096 kW	1.8 - 2	1 charging gun (adaptor model)
4.	Charger Lithium 60 volt 5 A untuk Motor listrik VIAR - viar 3pin	Portable Charger	IDR 650,000	2,166,667	AC/DC	220 V AC	60V - 71.4V DC	0.3 kW	5A	1 charging gun (adaptor model)

5.	Delta AC Mini Plus	Wall mounted charger	IDR 27,000,000	3,668,478	AC/AC	230 V AC	230 V AC	Max 7.36 kW	Up to 32A	1 charging gun, stated for car charger but specs seems fit for e2w

*The price listed is based on the market price in Indonesia and has included tax.

Drivers' perspective

Based on the discussion with the driver's association, drivers don't have a preference yet whether the charging infrastructure would-be plug-in charging or battery swapping. However, they have certain concerns, mostly about battery capacity, battery charging duration as well as charging infrastructure location. With the current conventional motorcycle, drivers are used to refuelling at night, outside the working hour. Their wish is that the electric 2W doesn't disturb the current operational pattern, mainly run out of battery during the trip as it would upset the passenger or in between trips during the productive duration.

On average, drivers work for almost 12 hours a day. With estimation of average daily kilometre travelled up to 76.3 km, it is most likely drivers need to charge the battery during the working hour, not only the overnight charging. During the working hours, drivers have some window times that could be used for battery charging or swapping: lunch breaks, idle time between orders, and waiting time at pick-up location. On average, drivers spend 75 minutes for lunch break, 30.4 minutes for idle time between trips, and 16.4 minutes for waiting at pick-up location, only for food delivery service. It is varied between different types of service. With this thin window times, a swapping battery infrastructure should be more appropriate for working hours charging compared to plug in charging.

Plug in charging could be applied if the battery capacity needed for the remaining day could be charged between the lunch break duration. However, kilometres travelled before and after lunch breaks are not known but could be estimated should the kilometres travelled distributed evenly. With the longest available free time for charging is lunch break times, the location of the charging station would be critical since drivers also have to eat, rest, etc.

Suitable charging infrastructure type

Based on the number of batteries charging or swapping estimation and the drivers' time availability, battery swapping is clearly ahead of battery charging strategy. Due to battery capacity limitation, drivers are estimated to have to charge/swap batteries more than one time a day. Charging a single battery even would take more time than drivers' lunch break duration that only occurred once daily. The opportunity cost would be too high if the charging strategy applied. Even when compared with the ICE motorcycle refuelling pattern, battery swapping is still less convenient due to limited battery range. However, still battery swapping is currently the best strategy for electric ride-hailing adoption.

Traffic counting was done in Greater Jakarta to know ride-hailing traffic in each city or regency. Road lengths of each area are also extracted from the open-source data.

Table 3. 37 Traffic Counting Results in Greater Jakarta Area

City/Regency	Areas (m2)	Roads Length (km)	Number of Survey Point	Ride Hailing 14hrs traffic	Ride Hailing 18hrs traffic
				2W/14 hrs	2W/18 hrs
Central Jakarta City	52.38	204.99	35	7868	8872
South Jakarta City	154.32	361.01	44	7303	8242
East Jakarta City	182.70	263.26	22	7844	8863
West Jakarta City	124.44	227.42	18	8601	9655
North Jakarta City	139.99	203.29	16	3986	4467
Bekasi City	206.61	232.68	4	3276	3693
Bekasi Regency	1224.88	343.09	5	2250	2544
Depok City	200.29	169.42	7	3314	3711
Bogor City	118.5	110.86	9	2266	2539
Bogor Regency	2710.62	657.07	5	1466	1635
Tangerang City	153.93	211.90	13	2629	2945
South Tangerang City	147.19	214.52	11	2604	2921
Tangerang Regency	1011.86	371.72	4	2279	2551
Total			193	55687.30	62637.24

Assume that a minimum battery swap station would consist of 12 batteries and operate starting from 6 AM to 12 PM (18 hours). To fully charge a single battery, on average it would take three to four hours. So, a single battery swap station could serve around 79 batteries daily with each battery averaging 1.45 kWh. It would serve up to 114.55 kWh of electricity daily for a single battery swap cabinet.

Table 3.38 below shows the daily kWh needed on each administrative area of Greater Jakarta based on the proportional demand with current ICE ride-hailing size. The number of battery swap cabinets needed could be estimated. For instance, to serve all ride-hailing in Central Jakarta, it would need 4,008 charging cabinets throughout Central Jakarta. The charging station should be near the main trunk and or public facilities that the drivers would use for waiting like public transport stations.

Table 3. 38 Battery Swap Station Needed in Greater Jakarta Based on Traffic Counting Data

City/Regency	Number of Survey Point	18 hrs	14 hrs	Daily kWh	Battery Swapping Station Needed
Central Jakarta City	35	14.16%	14.13%	459,066.26	4008
South Jakarta City	44	13.16%	13.11%	426,468.00	3723
East Jakarta City	22	14.15%	14.09%	458,600.57	4004
West Jakarta City	18	15.41%	15.44%	499,581.24	4362
North Jakarta City	16	7.13%	7.16%	231,137.17	2018
Bekasi City	4	5.90%	5.88%	191,087.88	1669
Bekasi Regency	5	4.06%	4.04%	131,634.87	1150
Depok City	7	5.92%	5.95%	192,019.26	1677
Bogor City	9	4.05%	4.07%	131,376.15	1147
Bogor Regency	5	2.61%	2.63%	84,600.24	739
Tangerang City	13	4.70%	4.72%	152,383.92	1331
South Tangerang City	11	4.66%	4.68%	151,142.08	1320
Tangerang Regency	4	4.07%	4.09%	131,997.07	1153
Total	193			3,241,095	28295

3.4. Marketing Strategy: Campaigns to encourage adoption

3.4.1. Outreach to drivers

Drivers' role and preferences

As the frontrunners of ride-hailing services, drivers play significant roles in the ride-hailing ecosystems. In operators' effort on electric 2W adoption, drivers are the subject of such electric 2W pilot projects. With the significant roles of the drivers, the success of any policies or business, including the electrification would depend on the involvement of the drivers. This also applied to the electrification program which should involve the drivers to succeed.

Almost 50% of the drivers are interested in electric 2W. However, when drivers are obligated to use electric 2W, for now, only 30% agree and when it comes to being obligated to own the electric 2W, less than 18% of the drivers agree. This mainly due to the financing issues and the availability of charging infrastructure, as well as the reliability of electric 2W.

Lessons learned from ride hailing operators in India (or other sectors in India)

Rapido has partnered with Zypp electric to onboard electric vehicles on their platform as part of its EV bike taxi service. In addition, it is also partnering with intermediary companies who can rent or lease electric vehicles to their driver partners by acting as demand generators.

Companies are also inviting EV owners to lease their vehicles on their platforms with innovative schemes. As an example, Zypp Electric has an EV Entrepreneur Programme of Buy, Lease & Earn. Existing EV owners can lease their vehicles on to their platform and earn monthly returns. These vehicles are then deployed with their existing driver partners.

Zypp has partnered with Hero motors and offers a customised EV ownership plan to buy Hero NYX e-bikes for potential EV buyers which can also be availed by their driver partners. The plan includes a down payment of INR 10000, monthly instalments of INR 2500 over a tenure of 24 months. They also plan to extend this to more available e2W models in India.

Lessons learned from other countries (or other sectors)

As described above, to encourage EV adoption, ride-hailing operators are employing a combination of information & education, economic incentives, and partnerships that simplify the process of purchasing or leasing an EV. Operators have not yet made information public about how these campaigns are affecting EV adoption.

These incentives are primarily packaged in web and app-based driver facing-campaigns, like Uber’s US online landing page, or a similar one dedicated to its London electrification initiative, UberGreen. These websites appeal to a wide range of driver interests, including saving on fuel and congestion zone charges, earning more on each journey, helping the city become cleaner, and upgrading their vehicle to be at the cutting edge.

Here are 8 reasons to make the switch to an EV:

1. **Clean Air Plan support**. By driving on the app in London money is collected which you can apply to use to reduce the cost of an EV. See how Uber's Clean Air Plan works.
2. **Exclusive deals**. In addition to the Government plug-in grant of up to £2,500, there are exclusive additional savings on EVs through Uber partnerships with car manufacturers and vendors. To learn more go to PartnerPoint.
3. **No Zone charges**. Electric cars don't pay to enter the Ultra Low Emission Zone (ULEZ) or the Congestion Charging Zone (CCZ). Check out regulation costs for non-EVs.
4. **Uber Green**. Fares just for EVs, all Uber Green trips benefit from a special 15% service fee on trip fares until the end of 2021. See the benefits of Uber Green.
5. **Fuel savings**. EVs enjoy reduced costs with the price of electricity compared to petrol or diesel as fuel. There are added savings available thanks to Uber partnerships with EV charging companies for both home chargers and public chargers. See making charging work for you.
6. **Boost fares**. Your trip fares get a boost once you're in an EV too. The 3p collected per mile through the Clean Air Plan is added directly to your fare once you make the switch
7. **Better for London**. Driving EVs helps reduce emissions, lower air pollution levels making London a healthier place for everyone
8. **EV technology**. EV technology makes for a great ride. Drivers who've made the switch say their new EVs are comfortable and easy to maintain and that their riders also love the quieter, smoother trips

Figure 3. 40 TCO comparison of BEV Ride-hailing

Recommended action plan

To encourage the uptake of E2W options, Jakarta ride-hail operators should borrow from the car-based ride-hailing playbook and incorporate education, substantial economic incentives, and a streamlined vehicle purchase or leasing process. Operators have a convenient messaging channel in the form of their driver-facing apps, but should reach beyond digital engagement to improve driver familiarity with this new vehicle mode.

Given the novelty of E2Ws, they should also incorporate an experiential element to their driver outreach, hosting regular vehicle demonstrations and even creating dedicated vehicle showrooms where drivers can touch, test-drive, and ask questions about available E2W models. This in-person engagement will help drivers overcome fears they may have about E2W performance, familiarise them with the refuelling (battery swap) process, and sell them on innovative vehicle features not available on conventional 2Ws.

3.4.2. Outreach to users

Users' preferences

Consumers, as the users of ride-hailing service, might respond differently to changes such as fleet electrification. This section would discuss the willingness of consumers to use electric fleets including to pay extra cost for it, if any.

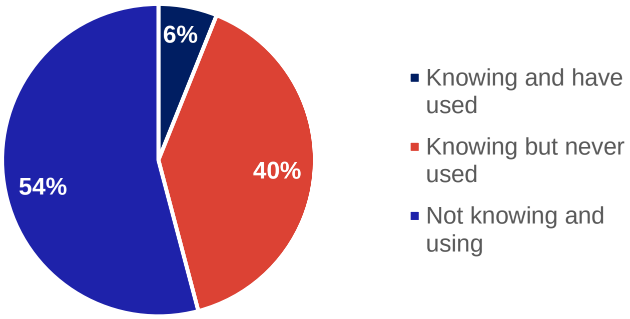


Figure 3. 41 Consumers Knowledge of Electric 2W Ride-hailing

Respondents' knowledge of current electric 2W as a ride-hailing fleet is considerably low as more than half of the total respondents neither know nor ever use the electric motorcycle for ride-hailing services. Only 6% of the respondents (34) who ever used or realised ever used electric 2W. To be supported by the users, ride-hailing electrification should be more publicly socialised.

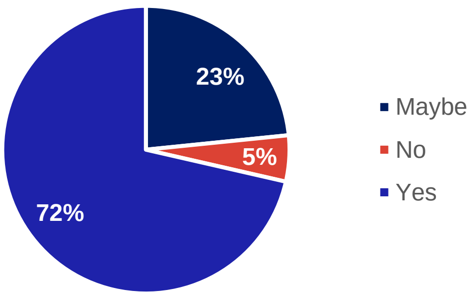


Figure 3. 42 Consumers' Support of Electric 2W for Ride-hailing

Despite the lack of information, the majority of consumers are supporting the usage of electric motorcycles as a ride-hailing fleet up to 72%, with 5% of the consumers not supporting while the rest are probable. However, when asked to choose electric motorcycle ride-hailing over the conventional one without any additional cost, 13 respondents out of 400 respondents who support the electric motorcycle for ride-hailing choose to not use the electric motorcycle.

The main reasons supporting electric ride-hailing are environmentally friendly by resulting in less emission with 265 mentions from 391 reasons submitted. More economically efficient and less fossil fuel consumption are also the reasons for electric ride-hailing support, although significantly less than the environmentally friendly (34 and 24 mentions). Other top reasons mention the support including innovation or technology advancement, less noise pollution, and alternative transportation options. Contrarily, distance limitation is the most mentioned concern by respondents who don't support electric ride-hailing as well as those who are probable. More concerns of ride-hailing fleet electrification would be discussed below.

Amongst other concerns, respondents mainly worried about low battery in the middle of the trip that might affect their trip duration, which was mentioned by 206 respondents. Related to the battery capacity, limited charging infrastructure also concerns 41 of the respondents and long charging duration that was mentioned by 12 respondents. Respondents are afraid that if the battery runs out during the trip, there's no charging station nearby and if there's any, it would take a long time to be able to start again. With quickness as one of the ride-hailing key features, the battery charging should be rapid enough to not lose the quickness aspect. The next issue that concerned respondents the most is additional cost due to fleet electrification. Short issues also be respondents concerns with the worry of battery short-circuit that could lead to the vehicle burn. This also includes the worry of electric vehicle safety during rain or when going through the flood which often happens in greater Jakarta.

Others most concerning issues include the slower speed, maintenance issues which could be new to the drivers, and limited distance reach. Another notable mention would include the current electric motorcycle dimension is not sufficient for passengers and would relate to the comfortability. Noiseless fleets are also seen as a safety hazard for some respondents as it would lower the awareness of other road users. Traffic violations have also been highlighted by the respondents that have seen a lot of traffic violations by ride-hailing drivers, including the ambiguity of road space for electric bikes. Last, it is seen that ride-hailing electrification is not the answer to the traffic jam.

The adoption of electric 2W for ride-hailing would make some changes from the ICE motorcycle. However, the core value shouldn't be missing to retain the customers to keep using ride-hailing services. Based on consumer surveys, the practicality and quickness are the main advantages of ride-hailing services. Thus, the ride-hailing with electric 2W also should be quick and practical. These are challenges for the battery capacity and charging infrastructure that should be practical for ride-hailing. Another notable mention is the economic reasons that might be cheaper than using private vehicles or similar services.

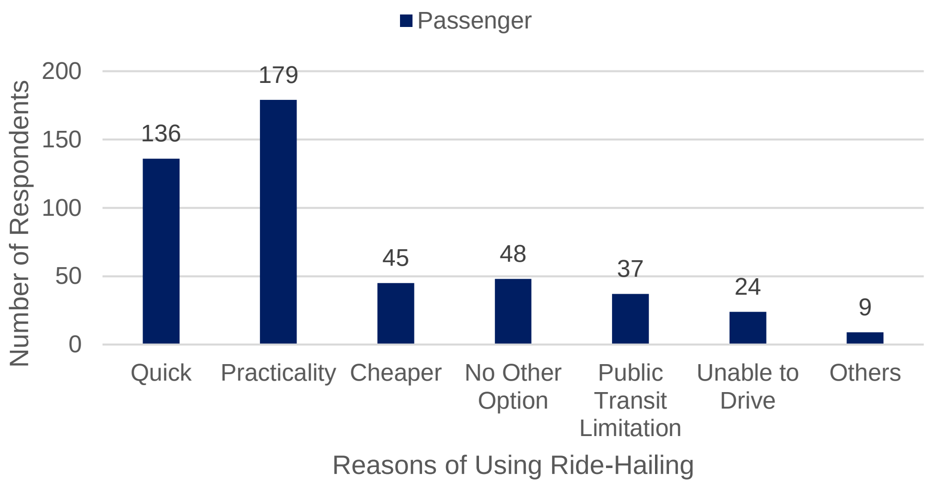


Figure 3. 43 Consumers' Reason of Using Ride-hailing – Passenger Transport

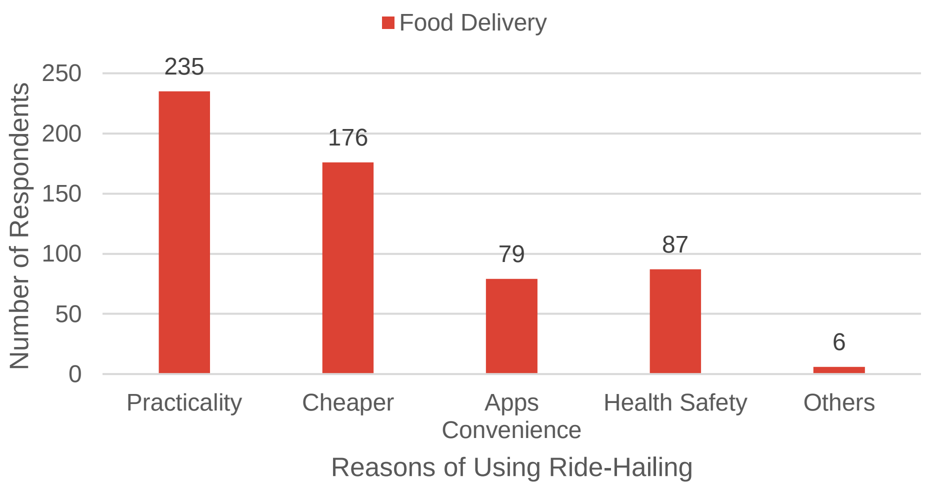


Figure 3. 44 Consumers' Reason of Using Ride-hailing – Food Delivery Service

Figure 3. 45 Consumers' Reason of Using Ride-hailing – Goods Delivery Service

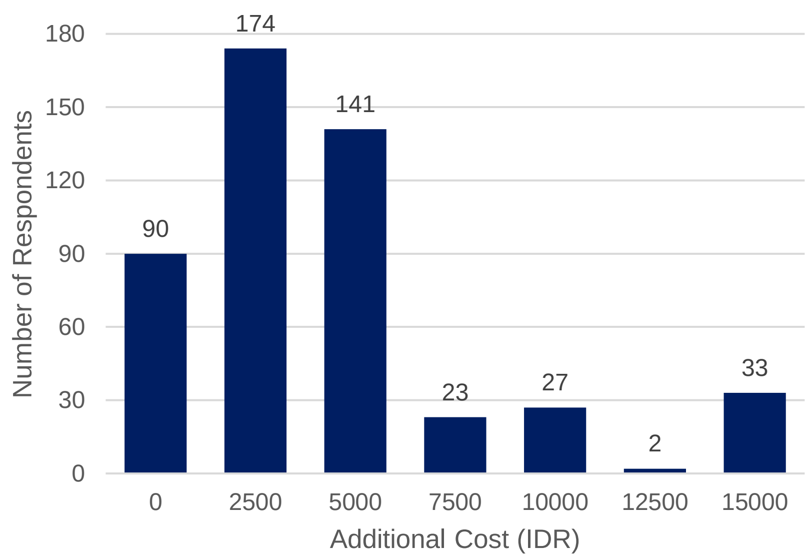


Figure 3. 46 Consumers' Willingness to Pay Additional Fare

If any additional cost applies for electric 2W, most of the respondents are willing to pay more to use the electric 2W, leaving around 18.2% who are not willing to pay more. Majority of them are willing to pay IDR 2,500 for extra cost (35.5%) and up to IDR 5,000 (28.8%). However, there are 6.7% of the respondents who are willing to pay up to IDR 15,000 for using electric 2W.

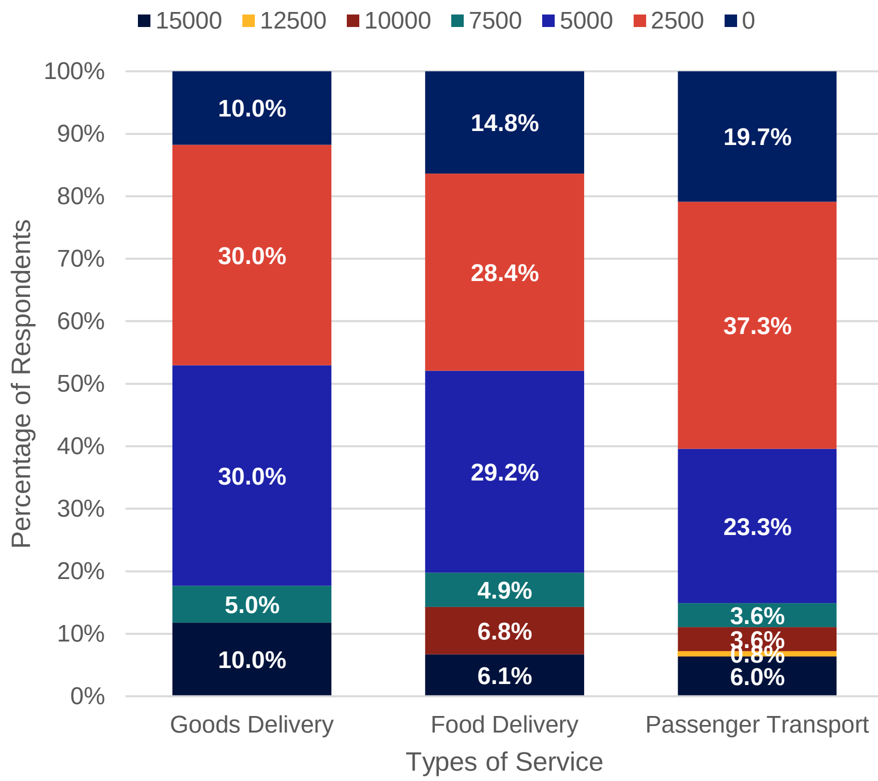
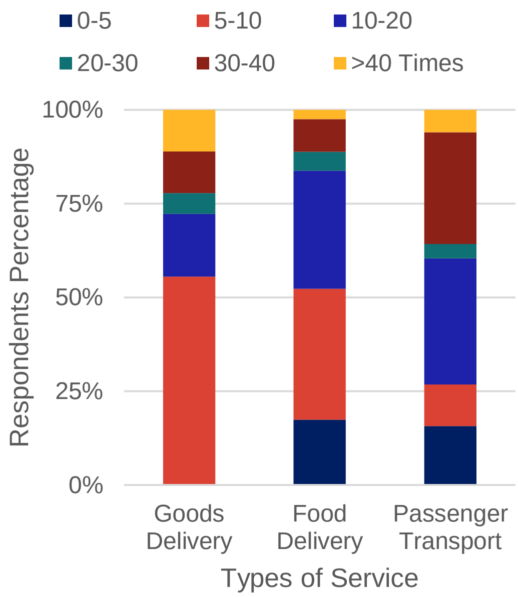


Figure 3. 47 Consumers' Willingness to Pay Additional Fare - Cumulative

Based on the types of service's respondent's percentage, passenger transport service users tend to be more reluctant to pay more than IDR 5,000 (14.1%) compared to other types of service: goods delivery (15%) and food delivery (17.8%). On average, goods delivery users are willing to pay IDR 4,852.94 for electric 2W while food delivery service user IDR 4,579.93 and passenger transport service, the lowest of IDR 3,957.45. The median of goods and food delivery service is IDR 5,000 while passenger service IDR 2,500. If the extra cost is set to be IDR 5,000, 45% of goods delivery consumers, 47% of food delivery service consumers, and 37.3% of passenger transport service would still choose the electric 2W option. This might be due to the passenger transport service being a need and used more frequently, so an extra cost for every trip would be more affecting their expenses.

Figure 3.48 below supports that consumers of passenger transport service use more frequent than other services in a month. On average, goods delivery consumers use 16.9 times a month, food delivery consumers use 13.2 times, and passenger transport use 20.3 times a month. Goods and food delivery consumers tend to spend more for fare per trip, including voucher or discount. Majority of consumers spend IDR 10,000 to 20,000 for a single trip, although passenger transport user has the widest percentage of the spending group.



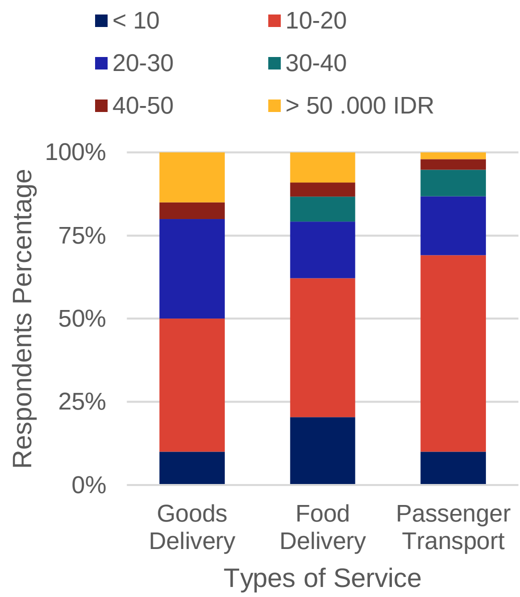


Figure 3. 48 Frequency of Use on Each Type of Services (Left) Fare Spending on Each Type of Services (Right)

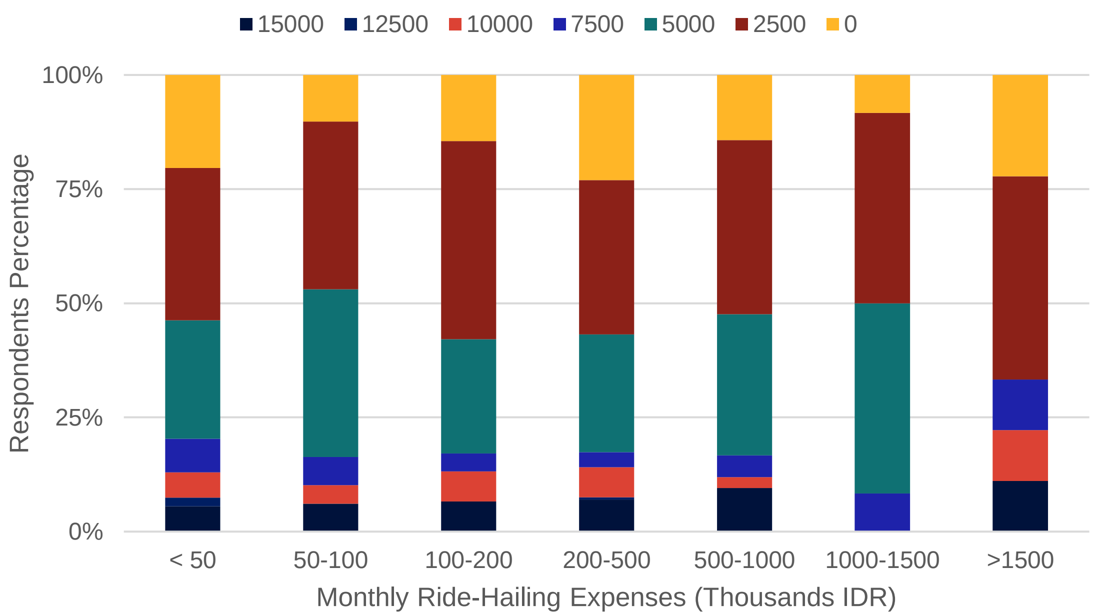


Figure 3. 49 Consumers' Willingness to Pay Additional Fare for Each Monthly Ride-Hailing Expenses Group

From frequency and fare per trip, monthly ride-hailing expenses could be estimated. However, there's no clear indication that certain monthly ride-hailing expenses have a certain preference of the extra cost. Seventy-five percent of respondents from each expense group would still choose electric 2W for ride-hailing service if the extra cost is only up to IDR 2,500. When the extra cost changed to IDR 5,000, in general less than 50% of respondents would not choose the electric 2W.

Lessons learned from other ride hailing operators in India (or other sectors)

Most electric ride-hailing companies give users statistics on the amount of CO2 saved with every trip and the total CO2 savings based on their total kms travelled in the user's profile. Some companies also give additional rewards in terms of cash back or other benefits. Ride hailing companies which are piloting electric vehicles don't yet have an option for the customer to choose between electric and ICE vehicles.

- Blusmart, an electric car ride hailing service in Delhi encourages users by giving them points for rides based on kms and participating in a challenge to earn premium gifts.
- Zypp electric, which is primarily into deliveries, gives users information on saved CO_2 for every trip and gives carbon coins which can be applied as a cash back.

Lessons learned from other countries (or other sectors)

In markets where EV options are available, ride-hailing operators are marketing them to consumers to encourage uptake and help pay for the EV incentives offered to drivers. These offerings are surfaced in customer apps, often right at the time of booking to remove barriers to making a greener choice. Operators have not yet published the cost of these programs or their impact on EV or E2W adoption.

Car-based ride-hailing

In more than 1,400 U.S. cities, 'UberGreen' gives customers the option to request an EV or hybrid electric vehicle, as local driver supply allows. Launched in 2021, UberGreen drivers receive an extra $0.50 from a $1 rider surcharge for every trip completed, helping incentivize them to drive electric (or hybrid) on the Uber platform.

Lyft has offered a similar product, 'GreenMode' in a limited number of U.S. cities, giving users the option of selecting hybrid or electric vehicles for their journey. Announced in 2019, it is unclear what the cost premium is to users, how drivers are rewarded, and the scale and status of the offering overall.

In 2021, U.S. shared e-moped operator Revel introduced an all-electric ride-hailing service in Manhattan, NYC, beginning with a fleet of 50 Tesla sedans. The service appeals to environmentally-conscious consumers, and is generally priced at a premium to yellow taxis and conventional ride-hailing services, helping the company pay the drivers as full-time employees versus independent contractors.

2W ride-hailing

Where electric options are not as widespread, 2W ride-hailing companies have offered opt-in customer programs to offset the carbon emissions of their journeys.

For instance, GoJek offers a ‘GoGreener’ carbon offset program that calculates a customer’s impact based on their ride history. When a customer opts in, GoJek invests their offset funds into tree planting projects. Grab offers a similar offering at the individual ride level, applying a flat fee to neutralise the associated carbon emissions when selected.

Recommended action plan

To encourage customers to opt for electric options, they must be as convenient as a conventional vehicle. As fleet density of E2Ws improves, we suggest surfacing these options to customers when the estimated time of arrival is similar to conventional vehicles, at a slightly higher cost (like the UberGreen program above). Choosing an EV in this manner is a quick, delightful decision -- at not too high a cost premium.

Operators should split this surcharge equally between drivers and the company, helping drivers pay for their E2W investment, and helping the operator offset their investment in charging infrastructure and other EV ecosystem elements. The customer should be clearly informed how their investment in a cleaner ride is helping create a lower-carbon transportation ecosystem, giving them a sense of satisfaction and altruism for their purchase.

Operators should make it easy for customers to track the impact of their choices in a simple-to-understand metric like number of trees planted, or gasoline-based vehicle trips avoided. These metrics should be fit for easy sharing on social media, helping people shape their public identities around greener choices.

As E2W fleet density increases, operators can create greater revenue predictability through subscription options that prefer electric vehicles each time a customer rides, as part of a monthly (or longer) plan commitment.

3.5. Timeline and Roadmap

This section will summarise all needed action plans from ride hailing operators to allow full electrification of 2W ride hailing fleets in Greater Jakarta by 2030.

3.5.1. Electrification strategy and action plan

Electrification strategy (phasing)

Most driver-partners are not yet comfortable owning EV assets, primarily due to limited understanding of EV technology and economics. Access to public charging infrastructure remains a clear barrier leading to range anxiety among drivers. High upfront cost of EVs and limited individual financing of EVs is a challenge that needs to be addressed for accelerating the adoption of EV fleets among ride hailing companies.

Electrification strategy will need to be imagined for ride hailing as a service and try to solve issues faced by traditional ride-hailing fleets and its stakeholders while using electrification as leverage for solution. Early electrification of ride hailing companies will need to include services that ride hailing companies can offer to logistics or food delivery companies in addition to passengers - such that there is sufficient scale available to help create captive charging infrastructure, access finance and optimise operations across fleet to increase utilisation. This shift in business model can be both an impediment and an opportunity. But with Covid-19 this shift has become inevitable.

Large-scale adoption of fleet EVs needs to be accompanied by system-wide changes: across customer acceptance, emergence of supporting business models and policies, manufacturing, availability of various vehicle types, awareness of technology, pricing, and set-up of both private and public charging infrastructure.

Pilot Phase- The pilot phase should focus on testing the benefits of electric vehicles for the driver partners and to the ride-hailing company. Typically, the pilot phases are short phases of anywhere between 3-6 months. During this time the ride hailing company leases or rents electric two-wheelers for a short duration of period. This could be deployed in different locations in a city or across different cities.

- This serves as a basis for understanding the driver partners comfort level with the vehicle and building confidence with drivers.
- In addition, this also helps understand if the end-users have any preference in using EVs.
- Many OEMs and start-ups manufacturing or ones who have developed prototypes are typically interested in such pilots.

Evaluation Phase- In the evaluation phase the ride hailing company needs to deploy electric two wheelers for a longer duration with different technologic options. The evaluation phase is a natural extension of the pilot phase. It involved multiple pilots happening simultaneously.

- The evaluation phase clearly involves data collection and analysis. It helps in understanding range issues, efficiency and performance of the vehicle, TCO comparison with fossil fuel-based two-wheelers and maintenance challenges
- Compare existing technologies for optimizing the operations and envisioning the EV transition. For example, evaluation phase would include understanding the operations in case of battery swapping vs a plug-in charging option
- The evaluation phase helps in discovering scale-up strategies for the ride hailing company.

Partnership Phase- A vision for the immediate short-term as well as the long-term, clearly putting forth the projected trajectories for the stakeholders, has to be determined. Successful results from pilots and test runs need to be converted to larger deployments. Prioritising the business use-cases for adoption of fleet services will help in strengthening the value proposition to the partners. In this phase, new partnerships are formed not just from creating demand for the services but also for ensuring the supply chain constraints are addressed for the driver partners. Partnerships will include with city governments and other stakeholders in the mobility ecosystem.

- The partnership phase will help in strengthening the business model. High utilisation will bring a lot of learnings to the ride hailing company including expanding the partner network. Higher potentials for utilisation will lead to ownership cost parity of EVs with ICE counterparts in each of these use-cases, making the transition easier and more viable.
- This phase would be third party-owned driven and company-owned instead of driver-owned because for the short to medium-term, until the purchase prices of ICEs are higher than EVs, investor-owned models are likely to drive adoption. Platforms will need to demonstrate promising metrics to investors/ partners across increased visibility, higher utilisation and operational savings.

There are three high-priority use cases which exhibit highest potential for adoption:

- Last-mile urban freight and deliveries – Last mile urban freight and delivery services have exponentially grown post Covid-19. Ride hailing companies can get into partnerships with e-commerce companies for delivery of goods or with local grocery and food delivery platforms and have their driver partners support them.
- Employee and customer transport – Collaboration with employers for providing transportation options for their employees including last mile connectivity from the metro rail station to the work location would be an option to consider. This would work well with small and medium sized companies and more in industrial clusters. This would be a captive audience that needs the service.
- Platform-based ride-hailing – This is the regular ride-hailing service available to any user. EV options can be shared as an additional option for customers wanting to prefer green mobility. The ride hailing company can further incentive this option to make it attractive.

Technology Phase- In this phase as the ride hailing company is forging new partnerships and discovering business models it will need to ramp-up its technology platform available to various partners. Platforms need to adapt their algorithms to enable deployment of EVs. In order to allocate rides, these algorithms need to consider charging availability, range and EV-specific cost optimization while still providing enough demand to ensure high utilisation of partner vehicles and charging assets. Data-driven solutions need to be integrated on specific applications for customers, drivers, dispatch centres, hub operations, and charging users. Deployment of EVs may lead to significant changes in how ride operations are modelled, managed, and optimised, and hence, need to be taken care of. This phase would include:

- Employing route optimization software to ensure fleet utilisation and efficiency
- Customization providing different services to various partners.
- A robust back-end of the platform taking into consideration privacy and security concerns of users.
- Discovering technology innovations with OEMs for future deployment.

Wider adoption Phase-The wider adoption phase will evolve wider roll out of e2W geographically or across specific customer segments. It will be in line with the mandates and electrification targets set through the national and local level policies. It will also include marketing strategies such as price subsidies and social fission marketing that involves leveraging existing customers as brand ambassadors, and rewarding them when they share the product with friends. It will also include attractive payment options and business models for driver partners. The following steps will be involved in this phase:

- Partnering with financiers to develop solutions for fleet
- Evaluate suitability of newer financial solutions for the drivers
- Moving towards driver-owned models

Scale-up Phase- This is the phase where most of the fleet is electric. The fleet electrification goal in the phase clearly aligns with the national government targets and mandates. Fleet electrification is leading the electrification strategy at a national level. Key steps here would include:

- Moving towards mass adoption would need to move towards driver-owned models
- Establishing long-term partnerships with public charging networks, financing institutions and OEMs

Charging infrastructures deployment

3.5.2. Timeline diagram

Two scenarios have been developed to estimate the growth of EV ride hailing vehicles in Jakarta. In the first scenario it is assumed that all the ride hailing vehicles will be electric by 2027 and in the second scenario it is assumed that all the vehicles will be electric by 2030. Currently close to 1 million driver partners are registered on the various ride hailing platforms. In the electrification future scenarios, it is assumed that all these vehicles will be converted to electric vehicles and in addition there will be an annual growth rate of vehicular growth. This methodology has been used to arrive at the total number of electric vehicles for specific scenarios. Based on experience in different Indian cities and discussing with different planning authorities it is understood that the charger requirements for electric two-wheelers could vary anywhere between the ratio of 20:1 to 30:1 (vehicles: charger). A ratio of 25:1 has been used for the purposes of calculation. The number of battery swap stations is also calculated based on the daily kWh calculation shown in the previous section.

The number of trips in specific sectors are directly proportional to the size of the market. The size of the market can be considered as a substitute for estimating the percentage share of different sectors for electrification of 2 Wheelers. For example, in India the size of the grocery market is estimated to be $0.8 billion, the size of the E-commerce logistics market is estimated to be $ 0.8 billion and while the size of the passenger ride-hailing market is estimated to be $ 2.4 billion. Taking these numbers into consideration and using the market size as a substitute for the ridership percentage for different segments, the passenger market share is roughly about 60% whereas the logistics and the groceries market together is roughly about 20% each for 100% electrification.

However, the current electrification for pilots is dominated by the B2B segment or goods delivery. This is corroborated by the survey results where out of the 59 electric 2W drivers, food and the combination service accounted for more than 90% of the services. In Indonesia, Grab and Gojek have entered into partnerships with ecommerce and logistics companies (Lazada and AnterAja) for using EV fleets. While the exact numbers are not known, an assumption is made based on the current trend for electrification in the 2W ride-hailing scenario. In the pilot and evaluation phase, the passenger service type is assumed to account for 10% while the 90% of the EVs are assumed to account for B2B, food and logistics segments. This percentage is then assumed to grow linearly to reach the distribution for 100% electrification by 2027 or 2030.

For the purpose of estimating the battery swap station density according to area, the cities or regencies are categorised into zones based on the ride-hailing demand in those regions as per the table below.

Table 3. 39 City/Regency Categorization based on the Ride-Hailing Demand

Zone	City/Regency
Zone 1	West Jakarta City, Central Jakarta City, East Jakarta City, South Jakarta City
Zone 2	North Jakarta City, Depok City, Bekasi City, Tangerang City, South Tangerang City
Zone 3	Tangerang Regency, Bekasi Regency, Bogor City, Bogor Regency

Scenario 1: Electrification by 2027

In this scenario the technology adoption curve has been used for estimating the penetration rate of electrification. The technology adoption curve is a bell curve model that describes how different people react to, adopt, and accept new innovative products and technologies. While there are many adaptions of the original model, Everett Roger's diffusion of innovations dives into the characteristics of each of the five adopter categories within the technology adoption life cycle: innovators, early adopters, early majority, late majority, and laggards.

The early and late majority adopters correspond to the technology phase, wider-adoption phase and scale-up phase. The total number of vehicles that will be electrified are approximately 1.25 Mi vehicles from a baseline number of 900,000 vehicles currently.

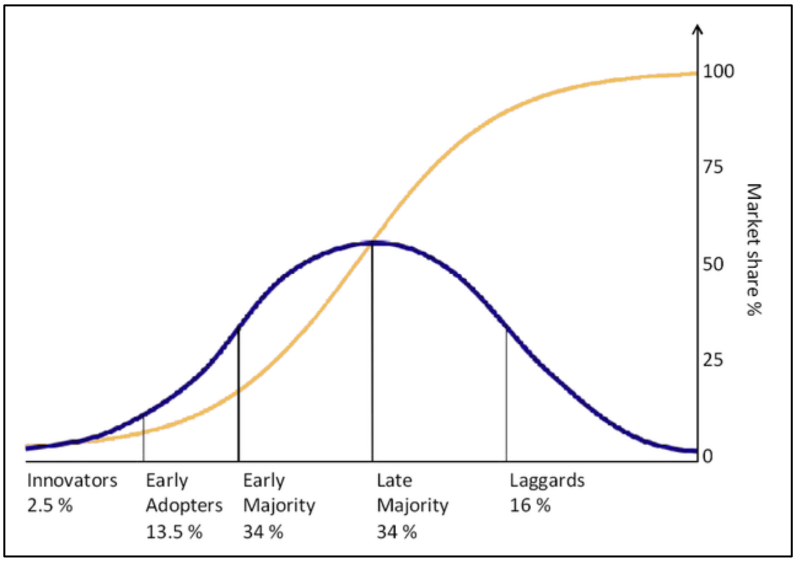


Figure 3. 50 Technology Adaption Curve for the Ride-Hailing Electrification Scenario

Table 3. 40 1st Scenario of Ride-Hailing Electrification Roadmap / Timeline Diagram

	2022		**2023**		**2024**		**2025**		**2026**		**2027**	
Support Policies	**Ride-hailing Roadmap**		**Fiscal Incentives - Charging Infrastructure & EVs**				**Interoperability standards - Battery size for swapping and connectors for charging**		**Non-Fiscal Incentives - LEZs, Building laws, parking zones**			
Marketing strategy	**Economic incentives to drivers, and partnerships**		**Strengthen partnerships, Driver facing campaigns and outreach to encourage EV adoption**				**Customer campaigns to help choose EVs, carbon offset incentives, educate on impact of EV based trips etc**				**Subscription plan to customers for choosing EVs**	
% EV Distribution	2.5%		13.5%		22.5%		23.0%		22.5%		16.0%	
# Of electric vehicles	31,201		168,484		280,807		287,048		280,807		199,685	
% Passenger services	5%	1,560	10%	16,848	15%	42,121	20%	57,410	25%	70,202	30%	59,906
% Combination	5%	1,560	10%	16,848	15%	42,121	20%	57,410	25%	70,202	30%	59,906
% Food	45%	14,040	40%	67,394	35%	98,283	30%	86,114	25%	70,202	20%	39,937
% Goods	45%	14,040	40%	67,394	35%	98,283	30%	86,114	25%	70,202	20%	39,937
# Of public chargers required	1,248		6,739		11,232		11,482		11,232		7,987	
# Home chargers required	31,201		168,484		280,807		287,048		280,807		199,685	
# Battery swap stations required	791		4,269		7,115		7,273		7,115		5,059	
	zone 1	0.75	*zone 1*	1.4	*zone 1*	3.4	*zone 1*	5.4	*zone 1*	7.4	*zone 1*	8.9

Areas and charger density # chargers/km			*zone 2*	1.4	*zone 2*	3.4	*zone 2*	5.4	*zone 2*	7.4	*zone 2*	8.9
				1.4	*zone 3*	3.4	*zone 3*	5.4	*zone 3*	7.4	*zone 3*	8.9
Phasing	Evaluation Phase		Partnership Phase		Technology Phase		Wider Adoption Phase		Scale-up Phase		Scale-up Phase	

Scenario 2: Electrification by 2030

In this scenario the technology adoption curve discussed in the previous section has been used for estimating the penetration rate of electrification. The adoption rates in the bell curve are distributed over the wider-adoption phase and scale-up phase. The total number of vehicles that will be electrified are approximately 1.47 Mi vehicles

Table 3. 41 2nd Scenario of Electric 2W Roadmap / Timeline Diagram

	2022		2023		2024		2025		2026		2027		2028		2029		2030	
Support Policies	**Ride-hailing Roadmap**				**Fiscal Incentives - Charging Infrastructure & EVs**				**Interoperability standards - Battery size for swapping and connectors for charging**				**Non-Fiscal Incentives - LEZs, Building laws, parking zones**						
Marketing Strategy	**Economic incentives to drivers, and partnerships**				**Strengthen partnerships, Driver facing campaigns and outreach to encourage EV adoption**				**Customer campaigns to help choose EVs, carbon offset incentives, educate on impact of EV based trips etc**				**Subscription plan to customers for choosing EVs**						
% EV Distribution	0.50%		1.25%		7.25%		7.00%		17.00%		17.00%		17.00%		17.00%		16.00%	
# Of electric vehicles	7,348		18,371		106,551		102,876		249,843		249,843		249,843		249,843		235,146	
% Passenger services	5%	367	5%	919	10%	10,655	15%	15,431	20%	49,969	20%	49,969	20%	49,969	30%	74,953	30%	70,544
% Combination	5%	367	5%	919	10%	10,655	15%	15,431	20%	49,969	20%	49,969	20%	49,969	20%	49,969	30%	70,544
% Food	45%	3307	45%	8,267	40%	42,620	35%	36,007	30%	74,953	30%	74,953	30%	74,953	25%	62,461	20%	47,029
% Goods	45%	3307	45%	8,267	40%	42,620	35%	36,007	30%	74,953	30%	74,953	30%	74,953	25%	62,461	20%	47,029
# of plug - in (public or company owned) chargers required in each phase	294		735		4,262		4,115		9,994		9,994		9,994		9,994		9,406	
# Home chargers required in each phase	7,348		18,371		106,551		102,876		249,843		249,843		249,843		249,843		235,146	
# Battery swap stations required	186		465		2,700		2,607		6,330		6,330		6,330		6,330		5,958	

in each phase																		
Areas and charger density # chargers/ km	*zone 1*	0.18	*zone 1*	0.2	*zone 1*	0.9	*zone 1*	1.7	*zone 1*	3.4	*zone 1*	5.2	*zone 1*	7.0	*zone 1*	8.8	*zone 1*	10.4
			zone 2	0.2	*zone 2*	0.9	*zone 2*	1.7	*zone 2*	3.4	*zone 2*	5.2	*zone 2*	7.0	*zone 2*	8.8	*zone 2*	10.4
				0.2	*zone 3*	0.9	*zone 3*	1.7	*zone 3*	3.4	*zone 3*	5.2	*zone 3*	7.0	*zone 3*	8.8	*zone 3*	10.4
Phasing	Pilot Phase		Evaluation Phase		Partnership Phase		Technology Phase		Wider Adoption Phase		Wider Adoption Phase		Wider Adoption Phase		Scale-up Phase		Scale-up Phase	

3.6. Risk Analysis

There are a number of policies, supply chain, and adoption risks that ride-hailing companies must consider when planning for a transition to electric vehicles. This section discusses these risks and what ride-hailing companies can do to mitigate.

Policy risks

- *Government does not advance policy adequate to support in-country manufacturing and/or imports*

The market for internal combustion two-wheelers is well established in Indonesia. Government policy interventions--such as reduced tariffs for imports or grants to support local manufacturing--are essential to support the electric vehicle market to grow and compete. These policies must be generous enough to bring down the purchase cost of electric vehicles, and must be adopted as soon as possible to achieve large-scale electrification by 2030.

Companies with entrenched interests in combustion vehicles have been known to stand in the way of electric vehicle incentives, preventing policy from being adequately funded or blocking this type of policy altogether. To mitigate this risk, ride-hail companies should build coalitions and actively advocate for policy that will support them in achieving ambitious electrification goals. This may include promoting international best practice and model regulations, which help government officials in drafting locally-appropriate policy proposals.

- *Government does not advance purchase incentives*

Purchase incentives, including subsidies and rebates, can help to bring the purchase cost of EVs to parity with combustion vehicles. Subsidies at the point of purchase have been shown to be particularly helpful for encouraging early adopters of new technology, since higher purchase costs tend to be one of the greatest barriers to entry. While ride-hail companies may be able to roll-out their own grant program--similar to the Uber grant program described in section TK--government support is essential to help speed uptake and bring it to scale.

As described for Risk #1, to mitigate this risk, ride-hail companies can join or build a coalition to advocate for the types of policies that would support rapid electrification.

- *Government does not pass a ban on internal combustion vehicles*

Ambitious, time-bound policies to ban combustion vehicles are particularly effective for spurring entrepreneurship in electrification, since it creates universal demand. These commitments serve as an umbrella policy that can help other supportive policies to fall into place. In countries like China, bans on combustion vehicles began as local city policy before being adopted at the federal level. When a government commits to a date by which to phase out combustion vehicles, the market will follow. As with the other policies, political advocacy can support proper shaping and adoption of these policies.

Supply chain risks

- *Risk #4: Supply chain is unreliable*

Supply chain slow-downs brought about by the COVID-19 pandemic highlight the disruption that can occur with reliance on international goods. Unreliability of global supply chains may cause delays in orders of E2W or parts for them. Ride-hailing companies should take this into account when setting targets for electrification.

- *Cost of batteries increases significantly*

Global demand for batteries is increasing dramatically. At the same time, essential battery materials such as cobalt are limited in supply. The combination of increased demand and limited supply is likely to cause prices for batteries to increase. To help mitigate this risk, ride-hail companies could support smart battery management that prolongs battery life, as well as battery recycling which can help to maximise reclamation and reuse of battery materials. While the appropriate role for ride hailing companies will differ depending on who owns the vehicle (driver, third-party, or company), at a minimum, ride-hailing companies can help to promote good battery management practices, such as not letting a battery drain fully before recharging. When it comes to recycling, ride-hail companies could partner with local recyclers to ensure drivers adequately dispose of retired batteries.

Adoption risks

- *Lack of charging infrastructure*

Ride-hail drivers must be confident in their ability to quickly and conveniently recharge their E2W. Drivers may not have access to places where they can charge vehicles overnight, and will be unlikely to switch if charging takes several hours out of their earning time. To mitigate this issue, ride-hailing companies should promote vehicles with swappable batteries, which take just a few minutes to exchange. Companies may also be able to support siting of swapping stations around a city, including by identifying high-remand areas, or TK(?).

- *Lack of maintenance expertise*

While many vehicle components are similar between combustion and electric vehicles, there are some crucial differences. Proper training of maintenance workers is essential to ensuring safe vehicle operation. As with other risks, the role of ride-hailing companies may differ depending on ownership model, but ride-hailing companies can play a role in supporting upskilling of the local labour force, potentially by supporting a free training program for maintenance workers that would cover safe battery handling and disposal, among other topics.

- *Lack of interest from ride-hailing drivers*

Even if it makes financial sense, some drivers may be reluctant to transition to an electric vehicle. Reasons for this reluctance may include uncertainty around charging, concern around how the electric vehicle will be maintained, or lack of confidence in an unfamiliar electric transmission. To help mitigate this risk, ride-hailing companies should pursue a comprehensive outreach strategy that includes information on websites, videos, and flyers as well as in-person training events. An "ambassador program" where drivers who have made the switch become spokespeople--can also be an effective way to encourage electric vehicle uptake.

- *Riders unwilling to pay more for electric vehicle*

As described in section TK, companies like Uber have implemented customer fees to increase the financial incentive provided to drivers for using electric vehicles. In some markets, such as San Francisco, these fees allow riders to opt in to paying more for the greener option, while in others, like London, the fee is automatically levied. If ride-hailing companies in Indonesia pursue an opt-in program, drivers may not receive much of a bonus for driving electric, while an automatic fee may encourage riders to choose a different ride-hailing company.

If rider fees are deemed necessary to support drivers to transition, ride-hailing companies can ensure the program is well resourced by making the fee mandatory. To ensure fair competition, any premium levied to consumers should be required across all ride-hailing companies in a given market.

4. Financial Model

This section will cover the financial model to support the recommended business model above.

Table 4. 1 Financial Model of Electric 2W Business Model

Combined Cost (IDR) / Row Labels	Column Labels 2022	2023	2024	2025	2026	2027	2028	2029	2030	Grand Total
Charging infrastructure	**IDR 36,810,440,856**	**IDR 103,441,220,592**	**IDR 573,467,756,196**	**IDR 718,030,642,968**	**IDR 1,612,055,079,648**	**IDR 1,994,000,067,924**	**IDR 2,375,609,552,604**	**IDR 2,757,356,635,284**	**IDR 3,065,482,836,252**	**IDR 13,236,254,232,324**
Battery-swap stations, hardware	IDR 25,091,400,000	IDR 62,863,400,000	IDR 364,095,100,000	IDR 351,684,300,000	IDR 853,917,000,000	IDR 854,051,900,000	IDR 853,917,000,000	IDR 853,917,000,000	IDR 803,734,200,000	IDR 5,023,271,300,000
Battery-swap stations, installation	IDR 501,828,000	IDR 1,257,268,000	IDR 7,281,902,000	IDR 7,033,686,000	IDR 17,078,340,000	IDR 17,081,038,000	IDR 17,078,340,000	IDR 17,078,340,000	IDR 16,074,684,000	IDR 100,465,426,000
Battery-swap stations, insurance	IDR 376,371,000	IDR 1,319,322,000	IDR 6,780,748,500	IDR 12,056,013,000	IDR 24,864,768,000	IDR 37,675,546,500	IDR 50,484,301,500	IDR 63,293,056,500	IDR 75,349,069,500	IDR 272,199,196,500
Battery-swap stations, power	IDR 9,724,841,856	IDR 34,089,230,592	IDR 175,204,005,696	IDR 311,508,643,968	IDR 642,466,971,648	IDR 973,477,583,424	IDR 1,304,435,911,104	IDR 1,635,394,238,784	IDR 1,946,902,882,752	IDR 7,033,204,309,824
Battery-swap stations, real estate	IDR 1,116,000,000	IDR 3,912,000,000	IDR 20,106,000,000	IDR 35,748,000,000	IDR 73,728,000,000	IDR 111,714,000,000	IDR 149,694,000,000	IDR 187,674,000,000	IDR 223,422,000,000	IDR 807,114,000,000
Driver E2W incentive	**IDR 51,426,144,000**	**IDR 128,633,750,784**	**IDR 745,803,447,460**	**IDR 720,186,361,777**	**IDR 1,748,836,032,538**	**IDR 1,748,919,117,976**	**IDR 1,748,904,483,467**	**IDR 1,748,909,353,391**	**IDR 1,646,022,607,884**	**IDR 10,287,641,299,278**
Initial vehicle purchase incentive (grant or loan)	IDR 51,426,144,000	IDR 128,633,750,784	IDR 745,803,447,460	IDR 720,186,361,777	IDR 1,748,836,032,538	IDR 1,748,919,117,976	IDR 1,748,904,483,467	IDR 1,748,909,353,391	IDR 1,646,022,607,884	IDR 10,287,641,299,278
Grand Total	**IDR 88,236,584,856**	**IDR 232,074,971,376**	**IDR 1,319,271,203,656**	**IDR 1,438,217,004,745**	**IDR 3,360,891,112,186**	**IDR 3,742,919,185,900**	**IDR 4,124,514,036,071**	**IDR 4,506,265,988,675**	**IDR 4,711,505,444,136**	**IDR 23,523,895,531,602**

In the financial model, only major infrastructures are being calculated which are battery swap stations and incentives for potential E2W drivers. These infrastructures could be implemented by the ride-hailing operators or the government while some other infrastructure such as battery recycling and maintenance centres could be provided by the OEMs. This financial model follows the timeline of electric 2W adoption at the previous section.

Initial vehicle purchase incentives are given up to IDR 7 million to make the capital of electric 2W as much as, if not cheaper than ICE motorcycle. The subsidy should be given by no operator, only the Government could also take part in it. Battery swap stations, mainly the hardware, could also be provided by the ride-hailing company, OEM, as well as government as the battery swap station generally would be also available to the public. But keep in mind the calculation of battery swap stations here only calculates the needs of ride-hailing purpose. Other's component include installation, insurance, real estate, and electricity. However, the electricity would actually be paid by the consumers, in this case the drivers would even get revenue from it. Battery swap station that was used for the benchmark priced around IDR 135 million with 12 slots of battery. Based on the estimation, it would be able to charge up to 79 batteries daily. Some assumptions are being used including the insurance of 1.5% of the hardware price, installation cost 2% of the hardware price and the price of real estate per battery station IDR 500,000 monthly.

To reach the target, in 2022 ride-hailing operators and the government would need to spend almost IDR 91 billion, with the biggest coming from incentives for drivers. Also, around 10% of the total spending are for electricity power that if not provided as subsidies, would be paid by the drivers, thus no spending for the electricity. With the planned electric 2Ws growth, the spending would be getting bigger each year but would, except for the one-time spending like vehicle incentive and battery swap station hardware. The total spending to fully electrify the 2W ride-hailing is approximately IDR 24 trillion.

In this model, the Government of Indonesia is planning to take part in the vehicle purchase incentive and also the hardware of the battery swap station with a balance split of 50-50.

Table 4. 2 Financial Model for Indonesian Government in the Vehicle Purchase Incentives and the Hardware of Battery Swap Station

	Column Labels 2022			2023			2024		
Components	Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)	Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)	Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)
Charging infrastructure	**36,810,440,856**	**24,264,740,856**	**12,545,700,000**	**103,441,220,592**	**72,009,520,592**	**31,431,700,000**	**573,467,756,196**	**391,420,206,196**	**182,047,550,000**
Capital - One Time	**25,593,228,000**	**13,047,528,000**	**12,545,700,000**	**64,120,668,000**	**32,688,968,000**	**31,431,700,000**	**371,377,002,000**	**189,329,452,000**	**182,047,550,000**
Battery-swap stations, hardware	25,091,400,000	12,545,700,000	12,545,700,000	62,863,400,000	31,431,700,000	31,431,700,000	364,095,100,000	182,047,550,000	182,047,550,000

Battery-swap stations, installation	501,828,000	501,828,000	0	1,257,268,000	1,257,268,000	0	7,281,902,000	7,281,902,000	0
Operating - Recurring	**11,217,212,856**	**11,217,212,856**	**0**	**39,320,552,592**	**39,320,552,592**	**0**	**202,090,754,196**	**202,090,754,196**	**0**
Battery-swap stations, insurance	376,371,000	376,371,000	0	1,319,322,000	1,319,322,000	0	6,780,748,500	6,780,748,500	0
Battery-swap stations, power	9,724,841,856	9,724,841,856	0	34,089,230,592	34,089,230,592	0	175,204,005,696	175,204,005,696	0
Battery-swap stations, real estate	1,116,000,000	1,116,000,000	0	3,912,000,000	3,912,000,000	0	20,106,000,000	20,106,000,000	0
Driver E2W incentive	**51,426,144,000**	**25,713,072,000**	**25,713,072,000**	**128,633,750,784**	**64,316,875,392**	**64,316,875,392**	**745,803,447,460**	**372,901,723,730**	**372,901,723,730**
Operating - One Time	**51,426,144,000**	**25,713,072,000**	**25,713,072,000**	**128,633,750,784**	**64,316,875,392**	**64,316,875,392**	**745,803,447,460**	**372,901,723,730**	**372,901,723,730**
Grand Total	**88,236,584,856**	**49,977,812,856**	**38,258,772,000**	**232,074,971,376**	**136,326,395,984**	**95,748,575,392**	**1,319,271,203,656**	**764,321,929,926**	**554,949,273,730**

2025			2026			2027		
Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)	Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)	Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)
718,030,642,968	**542,188,492,968**	**175,842,150,000**	**1,612,055,079,648**	**1,185,096,579,648**	**426,958,500,000**	**1,994,000,067,924**	**1,566,974,117,924**	**427,025,950,000**
358,717,986,000	**182,875,836,000**	**175,842,150,000**	**870,995,340,000**	**444,036,840,000**	**426,958,500,000**	**871,132,938,000**	**444,106,988,000**	**427,025,950,000**
351,684,300,000	175,842,150,000	175,842,150,000	853,917,000,000	426,958,500,000	426,958,500,000	854,051,900,000	427,025,950,000	427,025,950,000
7,033,686,000	7,033,686,000	0	17,078,340,000	17,078,340,000	0	17,081,038,000	17,081,038,000	0
359,312,656,968	**359,312,656,968**	**0**	**741,059,739,648**	**741,059,739,648**	**0**	**1,122,867,129,924**	**1,122,867,129,924**	**0**
12,056,013,000	12,056,013,000	0	24,864,768,000	24,864,768,000	0	37,675,546,500	37,675,546,500	0
311,508,643,968	311,508,643,968	0	642,466,971,648	642,466,971,648	0	973,477,583,424	973,477,583,424	0
35,748,000,000	35,748,000,000	0	73,728,000,000	73,728,000,000	0	111,714,000,000	111,714,000,000	0
720,186,361,777	**360,093,180,889**	**360,093,180,889**	**1,748,836,032,538**	**874,418,016,269**	**874,418,016,269**	**1,748,919,117,976**	**874,459,558,988**	**874,459,558,988**
720,186,361,777	**360,093,180,889**	**360,093,180,889**	**1,748,836,032,538**	**874,418,016,269**	**874,418,016,269**	**1,748,919,117,976**	**874,459,558,988**	**874,459,558,988**
1,438,217,004,745	**902,281,673,857**	**535,935,330,889**	**3,360,891,112,186**	**2,059,514,595,917**	**1,301,376,516,269**	**3,742,919,185,900**	**2,441,433,676,912**	**1,301,485,508,988**

2028			2029			2030			Total Combined Cost (IDR)	Total Company Share (IDR)	Total Govt. Share (IDR)
Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)	Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)	Combined Cost (IDR)	Company Share (IDR)	Govt. Share (IDR)			
2,375,609,552,604	**1,948,651,052,604**	**426,958,500,000**	**2,757,356,635,284**	**2,330,398,135,284**	**426,958,500,000**	**3,065,482,836,252**	**2,663,615,736,252**	**401,867,100,000**	**13,236,254,232,324**	**10,724,618,582,324**	**2,511,635,650,000**
870,995,340,000	**444,036,840,000**	**426,958,500,000**	**870,995,340,000**	**444,036,840,000**	**426,958,500,000**	**819,808,884,000**	**417,941,784,000**	**401,867,100,000**	**5,123,736,726,000**	**2,612,101,076,000**	**2,511,635,650,000**
853,917,000,000	426,958,500,000	426,958,500,000	853,917,000,000	426,958,500,000	426,958,500,000	803,734,200,000	401,867,100,000	401,867,100,000	5,023,271,300,000	2,511,635,650,000	2,511,635,650,000
17,078,340,000	17,078,340,000	0	17,078,340,000	17,078,340,000	0	16,074,684,000	16,074,684,000	0	100,465,426,000	100,465,426,000	0
1,504,614,212,604	**1,504,614,212,604**	**0**	**1,886,361,295,284**	**1,886,361,295,284**	**0**	**2,245,673,952,252**	**2,245,673,952,252**	**0**	**8,112,517,506,324**	**8,112,517,506,324**	**0**
50,484,301,500	50,484,301,500	0	63,293,056,500	63,293,056,500	0	75,349,069,500	75,349,069,500	0	272,199,196,500	272,199,196,500	0
1,304,435,911,104	1,304,435,911,104	0	1,635,394,238,784	1,635,394,238,784	0	1,946,902,882,752	1,946,902,882,752	0	7,033,204,309,824	7,033,204,309,824	0
149,694,000,000	149,694,000,000	0	187,674,000,000	187,674,000,000	0	223,422,000,000	223,422,000,000	0	807,114,000,000	807,114,000,000	0
1,748,904,483,467	**874,452,241,734**	**874,452,241,734**	**1,748,909,353,391**	**874,454,676,696**	**874,454,676,696**	**1,646,022,607,884**	**823,011,303,942**	**823,011,303,942**	**10,287,641,299,278**	**5,143,820,649,639**	**5,143,820,649,639**
1,748,904,483,467	**874,452,241,734**	**874,452,241,734**	**1,748,909,353,391**	**874,454,676,696**	**874,454,676,696**	**1,646,022,607,884**	**823,011,303,942**	**823,011,303,942**	**10,287,641,299,278**	**5,143,820,649,639**	**5,143,820,649,639**
4,124,514,036,071	**2,823,103,294,338**	**1,301,410,741,734**	**4,506,265,988,675**	**3,204,852,811,980**	**1,301,413,176,696**	**4,711,505,444,136**	**3,486,627,040,194**	**1,224,878,403,942**	**23,523,895,531,602**	**15,868,439,231,963**	**7,655,456,299,639**

As the Government in this financial model only contributes on the capital, in total the Government would spend IDR 7.6 trillion while the operators would need to spend up to IDR 15.9 trillion. With the mass adoption of electric vehicles, the price of electric vehicles including the electric 2W would certainly get cheaper. Battery price is estimated to fall with a rate of 7% yearly and electric motorcycles would also get closer to the ICE motorcycle. Hence the incentives from both Government or Operators would also get lesser.

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ANNEX A ICE Bike and E2w TCO Calculation Result

ICE Bike and E2w TCO Calculation Result

Combination Services

	Bike Model	Capital Cost (IDR)	Capital Cost (w/o) battery replacement Cost	E2w Battery Replacement Cost	Operational Cost (IDR)	Maintenance Cost (IDR)	Economical Benefit (Salvage Value) (IDR)	TCO (10 years lifetime) (IDR)	TCO per km (IDR/ km)
ICE Bike	Yamaha Mio	19,824,436	19,824,436	-	49,983,165	8,426,911	(367,346)	77,867,167	33,303
	Honda Beat	20,872,026	20,872,026	-	48,038,295	8,561,398	(389,252)	77,082,467	32,968
	Honda Vario	25,699,747	25,699,747	-	60,772,049	9,622,494	(486,941)	95,607,349	40,891
	Yamaha Nmax	36,098,038	36,098,038	-	58,645,437	11,330,470	(698,604)	105,375,340	45,069
E2w	Selis Mandalika	9,752,820	7,115,447	2,637,374	11,169,885	2,775,797	(216,868)	23,481,634	10,043
	Viar Q1	38,464,186	22,442,757	16,021,429	17,840,788	2,775,797	(960,967)	58,119,804	24,858
	Gesits	49,679,927	31,193,663	18,486,264	22,339,769	10,253,235	(1,349,402)	80,923,530	34,611
	Gova 03	55,983,277	25,172,836	30,810,440	26,594,963	2,775,797	(1,180,726)	84,173,311	36,001
	United T1800	47,515,421	30,261,574	17,253,847	20,048,511	2,775,797	(1,301,209)	69,038,520	29,527
	Smoot Tempur	42,861,385	24,375,121	18,486,264	18,616,474	2,775,797	(1,060,244)	63,193,413	27,028
	Volta 401	36,936,076	22,147,065	14,789,011	16,924,068	2,775,797	(939,762)	55,696,179	23,821

Passenger Service Only

	Bike Model	Capital Cost (IDR)	Capital Cost (w/o) battery replacement Cost	E2w Battery Replacement Cost	Operational Cost (IDR)	Maintenance Cost (IDR)	Economical Benefit (Salvage Value) (IDR)	TCO (10 years lifetime) (IDR)	TCO per km (IDR/ km)
ICE Bike	Yamaha Mio	19,824,436	19,824,436	-	51,540,477	9,498,607	(367,346)	80,496,174	30,544
	Honda Beat	20,872,026	20,872,026	-	48,319,197	9,650,196	(389,252)	78,452,168	29,768

Passenger Service Only									
	Bike Model	Capital Cost (IDR)	Capital Cost (w/o) battery replacement Cost	E2w Battery Replacement Cost	Operational Cost (IDR)	Maintenance Cost (IDR)	Economical Benefit (Salvage Value) (IDR)	TCO (10 years lifetime) (IDR)	TCO per km (IDR/km)
	Honda Vario	25,699,747	25,699,747	-	67,097,053	10,846,239	(486,941)	103,156,097	39,142
	Yamaha Nmax	36,098,038	36,098,038	-	61,240,702	12,771,427	(698,604)	109,411,562	41,515
E2w	Selis Mandalika	9,752,820	7,115,447	2,637,374	11,664,191	3,128,810	(216,868)	24,328,953	9,231
E2w	Viar Q1	38,464,186	22,442,757	16,021,429	18,630,305	3,128,810	(960,967)	59,262,335	22,487
E2w	Gesits	49,679,927	31,193,663	18,486,264	23,328,382	11,557,194	(1,349,402)	83,216,102	31,576
E2w	Gova 03	55,983,277	25,172,836	30,810,440	27,771,883	3,128,810	(1,180,726)	85,703,244	32,519
E2w	United T1800	47,515,421	30,261,574	17,253,847	20,935,727	3,128,810	(1,301,209)	70,278,750	26,667
E2w	Smoot Tempur	42,861,385	24,375,121	18,486,264	19,440,318	3,128,810	(1,060,244)	64,370,270	24,425
E2w	Volta 401	36,936,076	22,147,065	14,789,011	17,673,017	3,128,810	(939,762)	56,798,141	21,552

Foods Service Only									
	Bike Model	Capital Cost (IDR)	Capital Cost (w/o) battery replacement Cost	E2w Battery Replacement Cost	Operational Cost (IDR)	Maintenance Cost (IDR)	Economical Benefit (Salvage Value) (IDR)	TCO (10 years lifetime) (IDR)	TCO per km (IDR/km)
ICE Bike	Yamaha Mio	19,824,436	19,824,436	-	40,050,991	8,201,291	(367,346)	67,709,372	29,756
ICE Bike	Honda Beat	20,872,026	20,872,026	-	41,432,059	8,332,177	(389,252)	70,247,010	30,871
ICE Bike	Honda Vario	25,699,747	25,699,747	-	52,354,236	9,364,864	(486,941)	86,931,906	38,203
ICE Bike	Yamaha Nmax	36,098,038	36,098,038	-	49,310,385	11,027,111	(698,604)	95,736,929	42,073
E2w	Selis Mandalika	9,752,820	7,115,447	2,637,374	9,391,887	2,701,479	(216,868)	21,629,318	9,505
E2w	Viar Q1	38,464,186	22,442,757	16,021,429	15,000,931	2,701,479	(960,967)	55,205,629	24,261

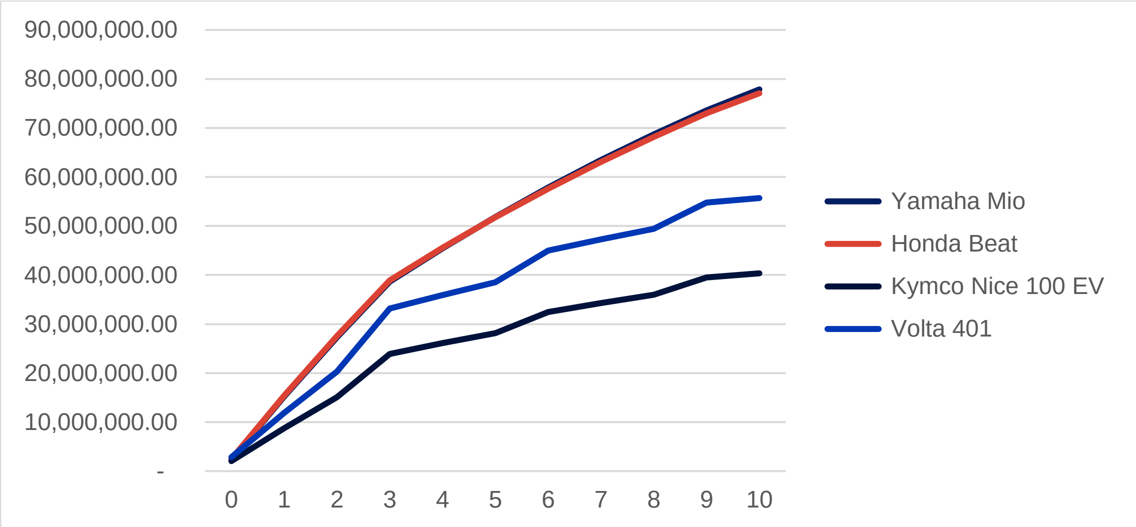
Foods Service Only									
	Bike Model	Capital Cost (IDR)	Capital Cost (w/o) battery replacement Cost	E2w Battery Replacement Cost	Operational Cost (IDR)	Maintenance Cost (IDR)	Economical Benefit (Salvage Value) (IDR)	TCO (10 years lifetime) (IDR)	TCO per km (IDR/ km)
	Gesits	49,679,927	31,193,663	18,486,264	18,783,774	9,978,717	(1,349,402)	77,093,017	33,879
	Gova 03	55,983,277	25,172,836	30,810,440	22,361,636	2,701,479	(1,180,726)	79,865,665	35,098
	United T1800	47,515,421	30,261,574	17,253,847	16,857,233	2,701,479	(1,301,209)	65,772,924	28,905
	Smoot Tempur	42,861,385	24,375,121	18,486,264	15,653,145	2,701,479	(1,060,244)	60,155,765	26,436
	Volta 401	36,936,076	22,147,065	14,789,011	14,230,132	2,701,479	(939,762)	52,927,925	23,260

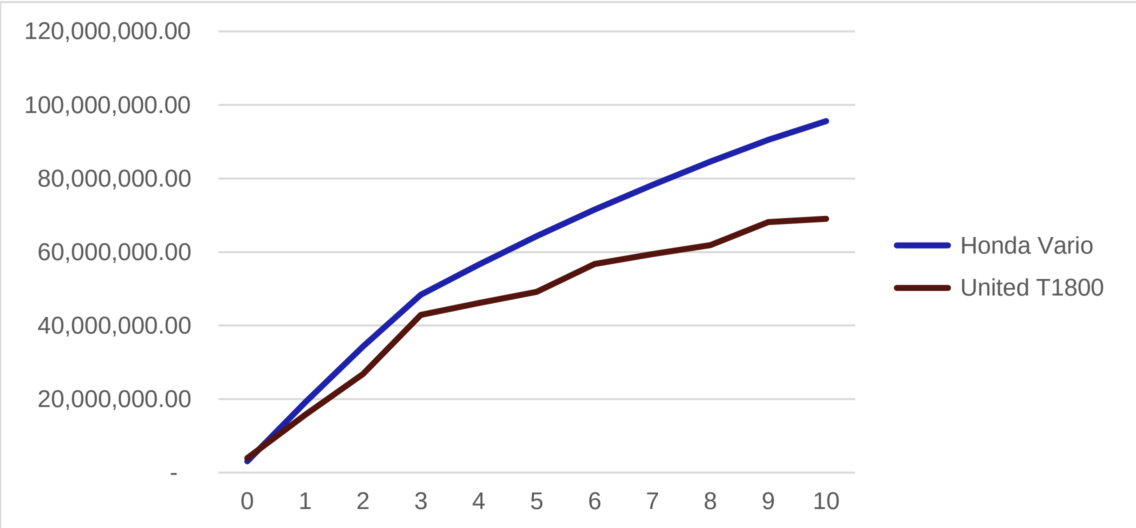
Goods Service Only									
	Bike Model	Capital Cost (IDR)	Capital Cost (w/o) battery replacement Cost	E2w Battery Replacement Cost	Operational Cost (IDR)	Maintenance Cost (IDR)	Economical Benefit (Salvage Value) (IDR)	TCO (10 years lifetime) (IDR)	TCO per km (IDR/ km)
ICE Bike	Yamaha Mio	19,824,436	19,824,436	-	78,917,530	10,773,360	(367,346)	109,147,981	36,515
	Honda Beat	20,872,026	20,872,026	-	35,074,458	10,945,294	(389,252)	66,502,526	22,248
	Honda Vario	25,699,747	25,699,747	-	53,053,802	12,301,850	(486,941)	90,568,457	30,299
	Yamaha Nmax	36,098,038	36,098,038	-	55,706,492	14,485,407	(698,604)	105,591,332	35,325
E2w	Selis Mandalika	9,752,820	7,115,447	2,637,374	10,610,119	3,548,710	(216,868)	23,694,781	7,927
	Viar Q1	38,464,186	22,442,757	16,021,429	16,946,719	3,548,710	(960,967)	57,998,648	19,403
	Gesits	49,679,927	31,193,663	18,486,264	21,220,239	13,108,219	(1,349,402)	82,658,984	27,653
	Gova 03	55,983,277	25,172,836	30,810,440	25,262,189	3,548,710	(1,180,726)	83,613,449	27,972
	United T1800	47,515,421	30,261,574	17,253,847	19,043,804	3,548,710	(1,301,209)	68,806,726	23,019
	Smoot Tempur	42,861,385	24,375,121	18,486,264	17,683,532	3,548,710	(1,060,244)	63,033,383	21,087
	Volta 401	36,936,076	22,147,065	14,789,011	16,075,938	3,548,710	(939,762)	55,620,963	18,608

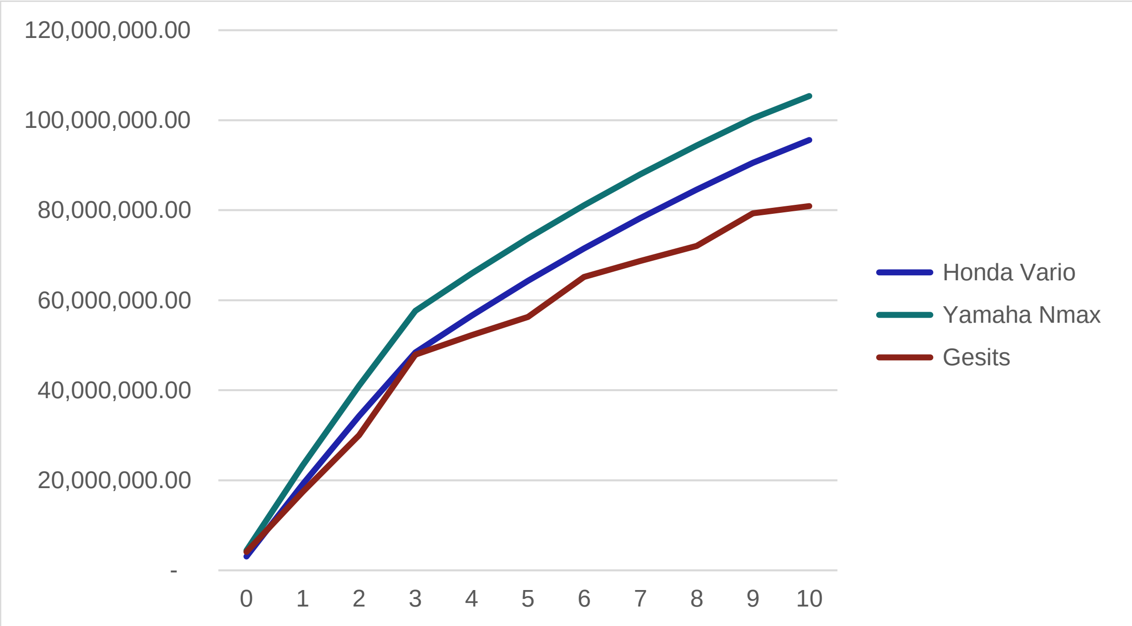
ANNEX B Parity Cost Graph for All Types of Rides

Parity Cost Graph for All Types of Rides

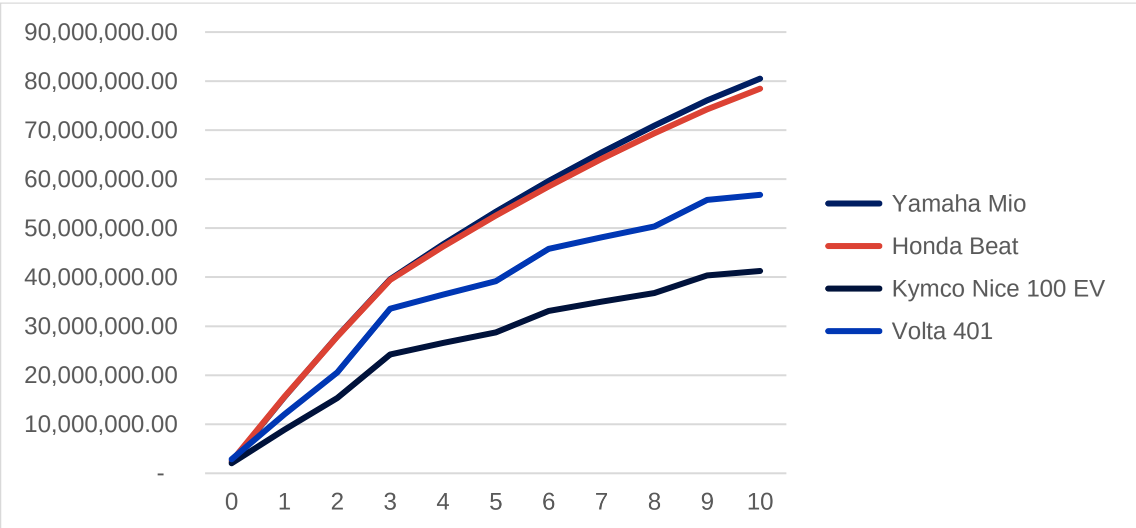
Combination Services

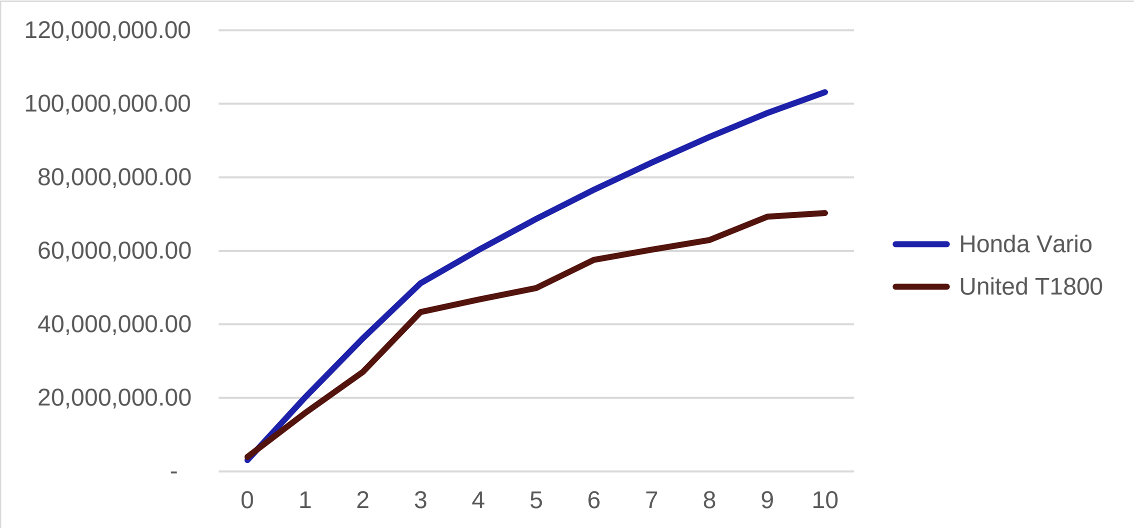


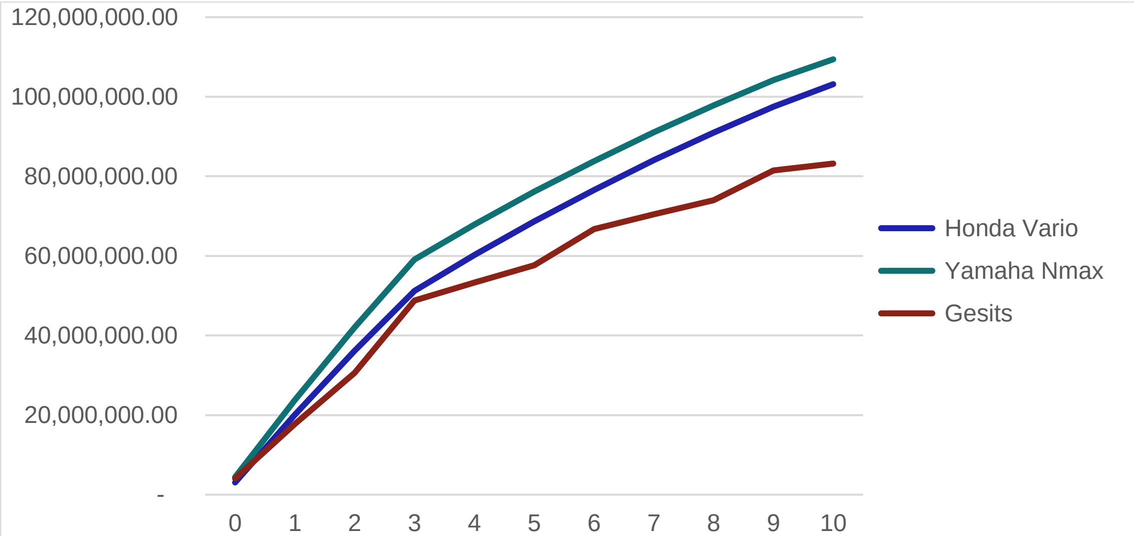




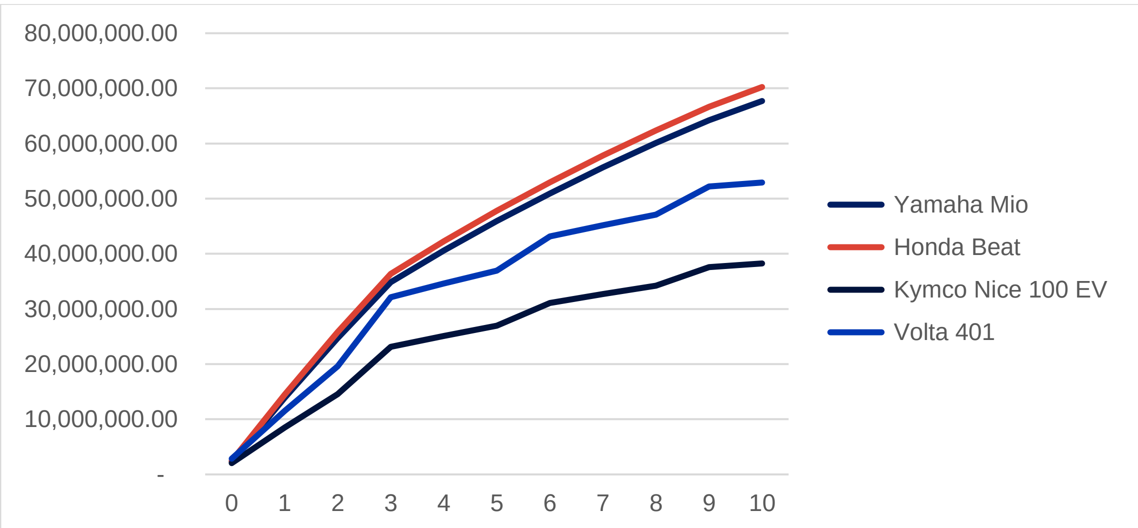
Passenger Services

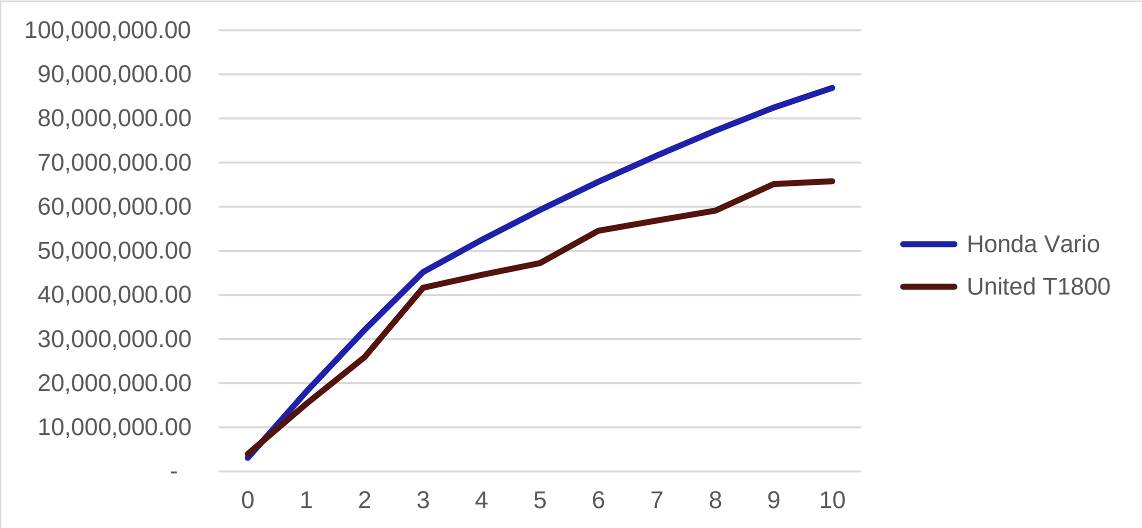


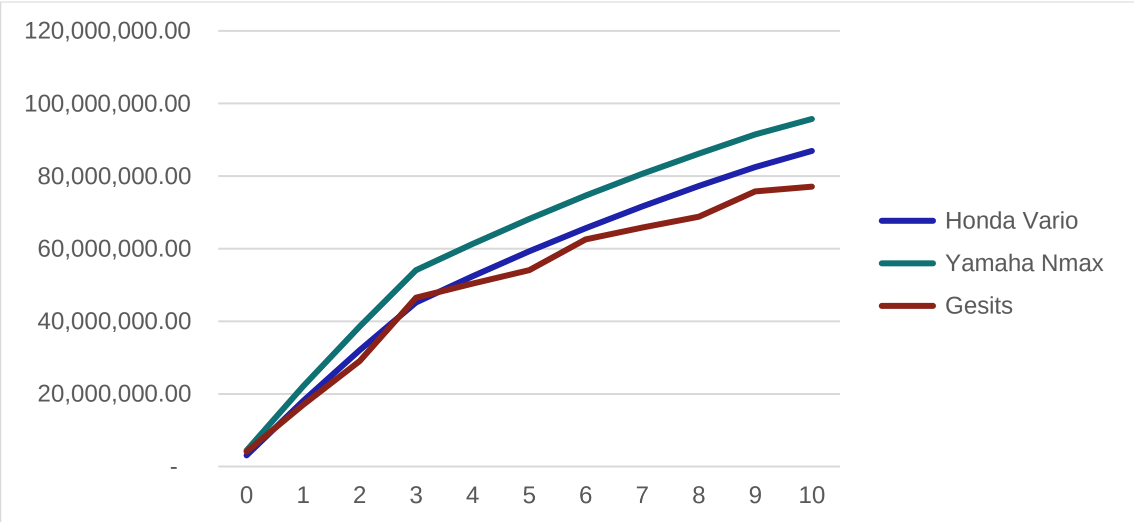




Foods Services







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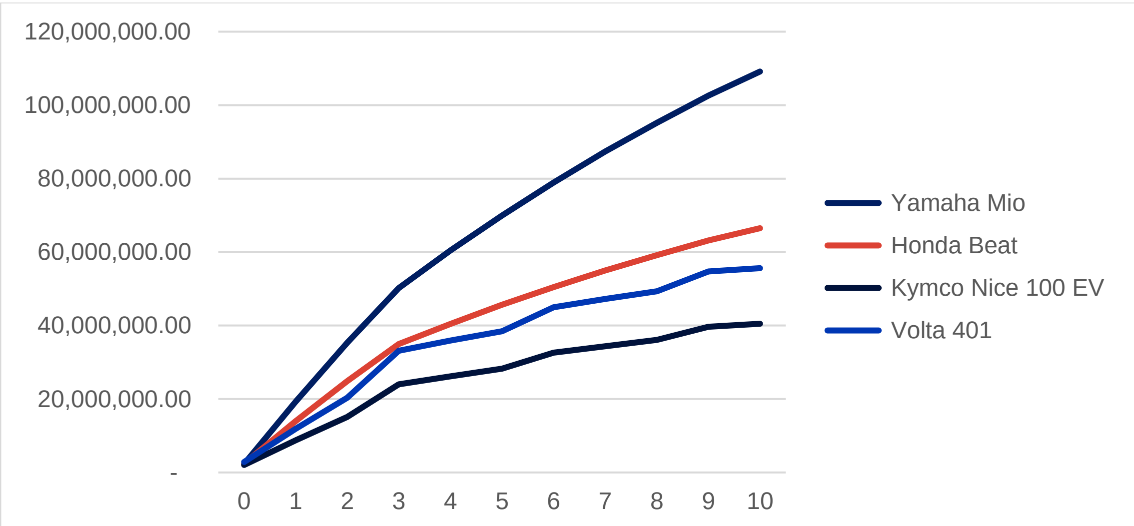

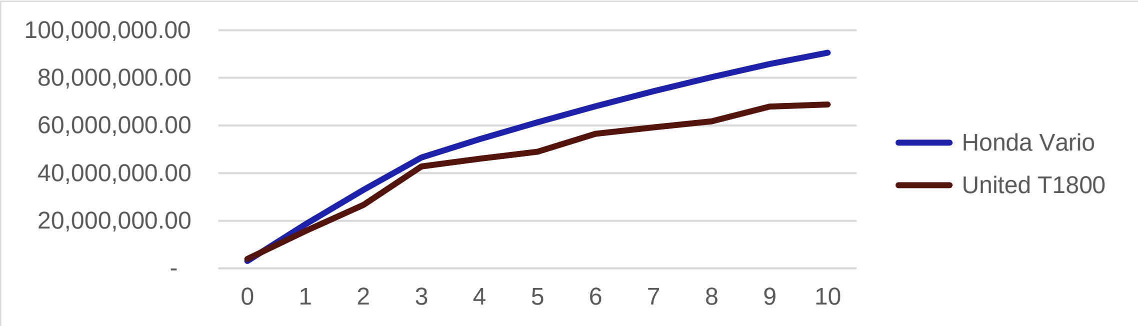
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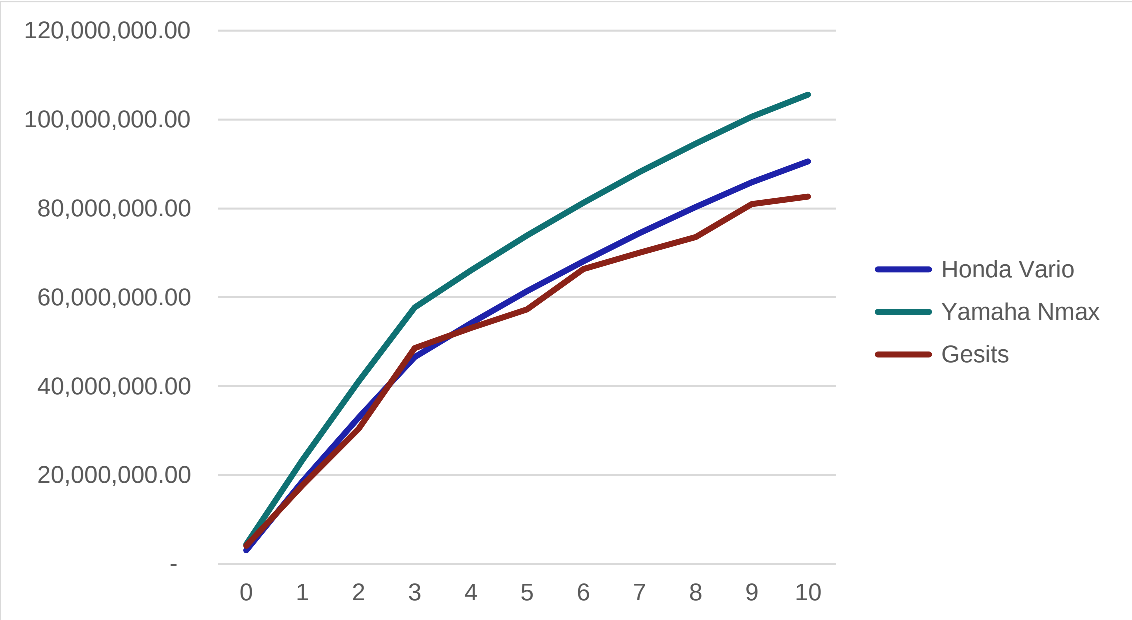
Honda Vario
United T1800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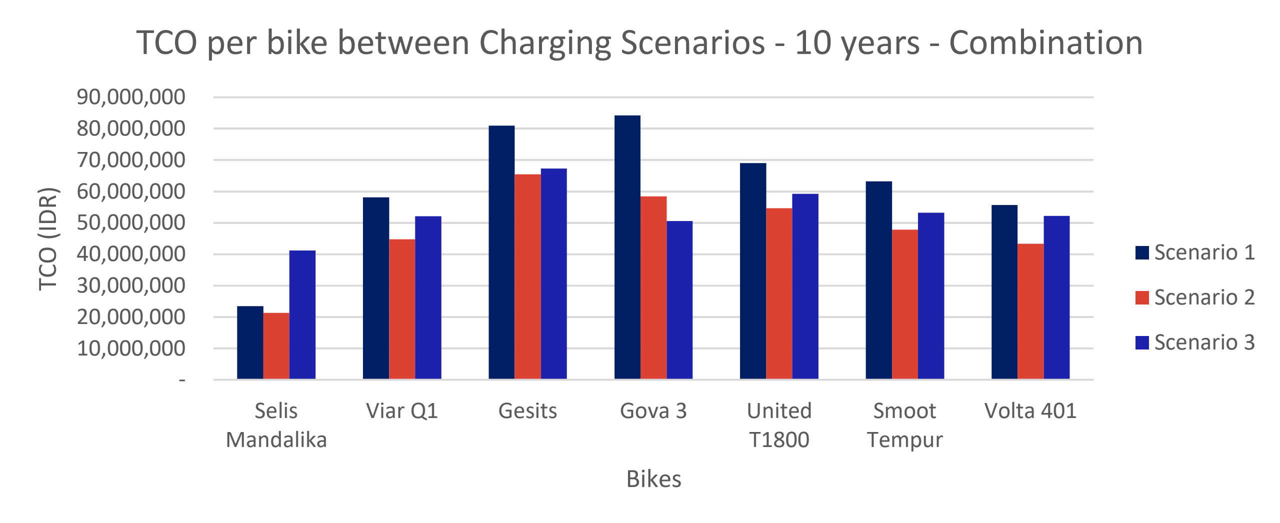
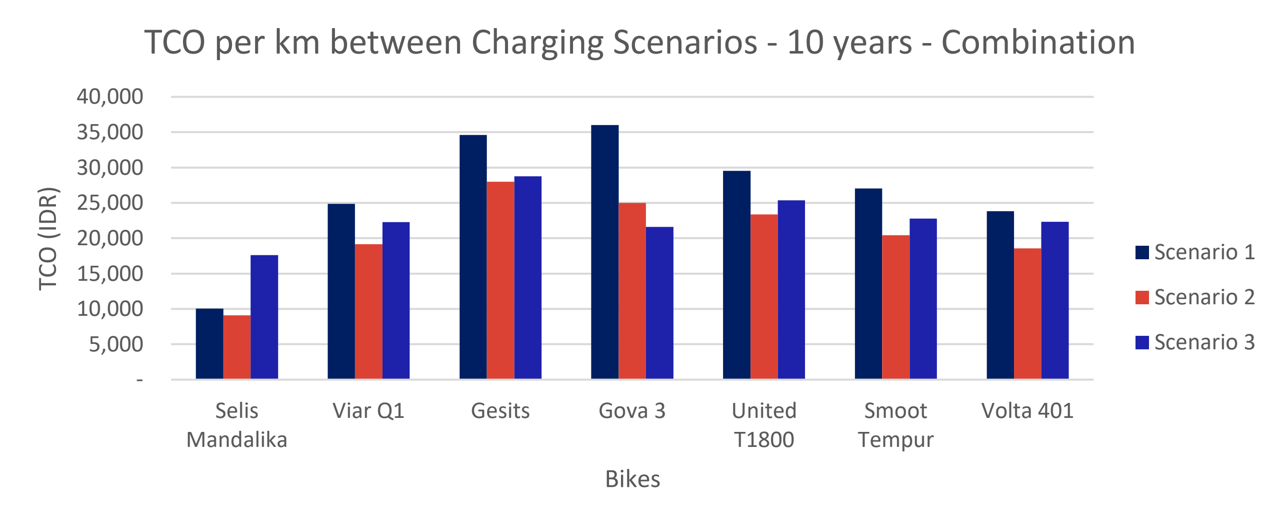
Honda Vario
Yamaha Nmax
Gesits

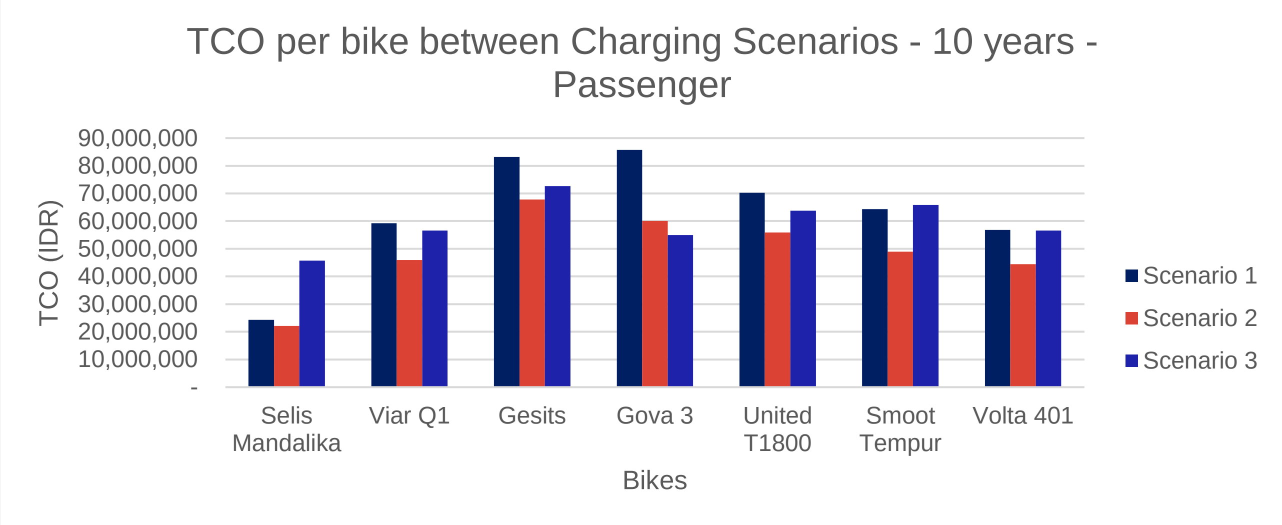
ANNEX C TCO Calculation for Different Charging Scenarios and Types of Services

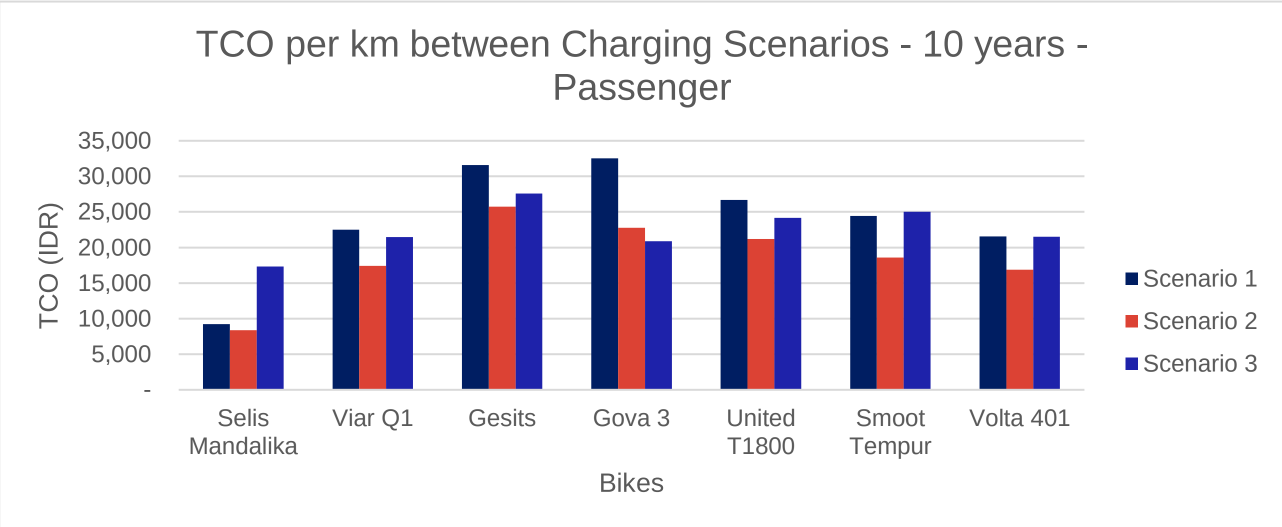
Combination Services



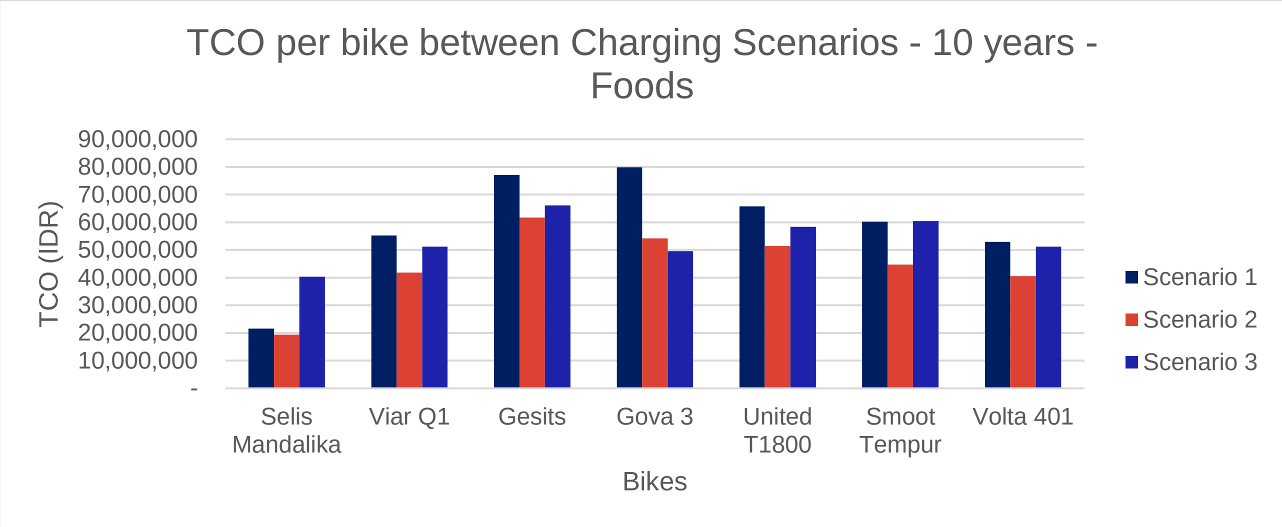


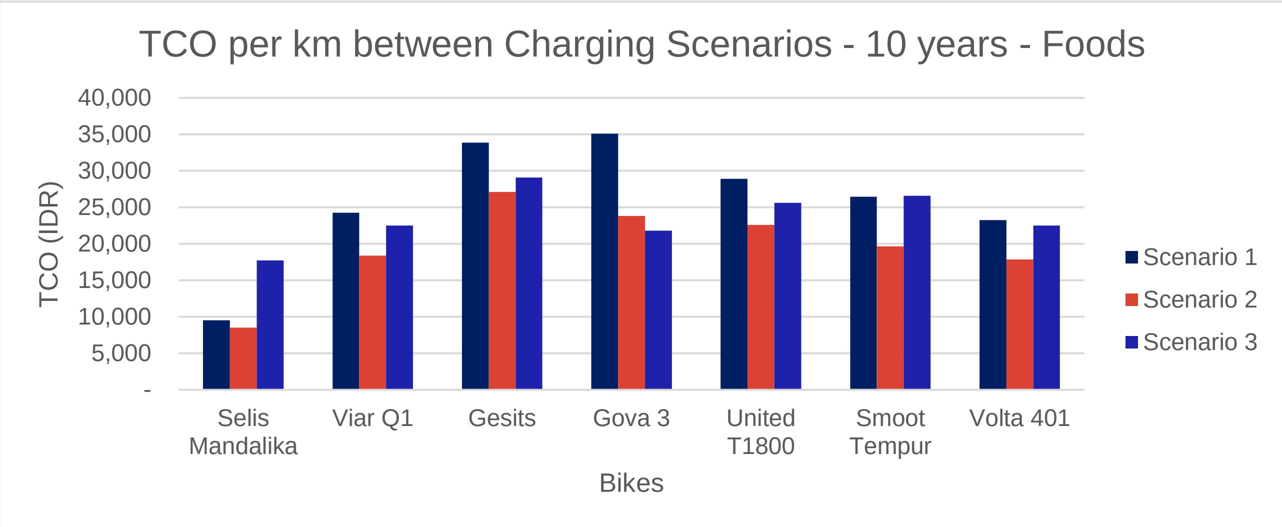
Passenger Services



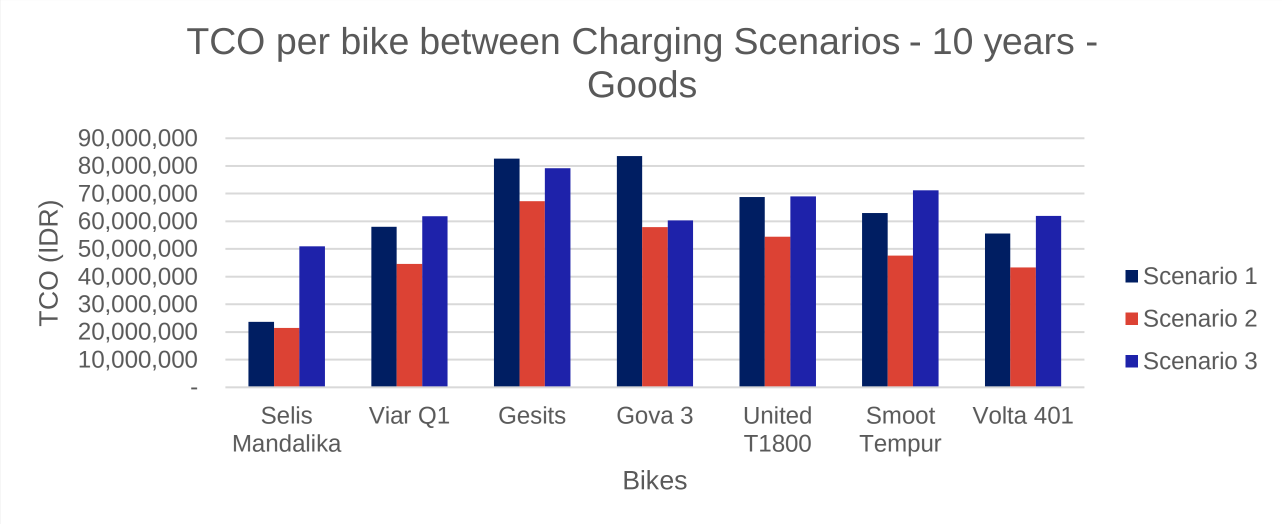


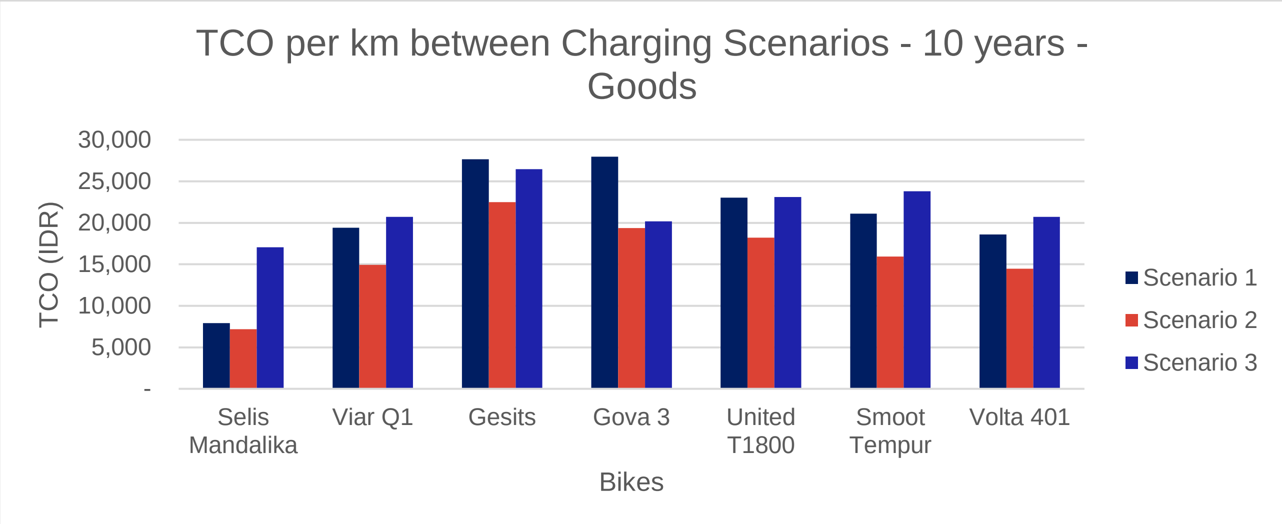
Foods Services





Goods Services





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